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Denmark's National Energy Efficiency Action Plan (NEEAP)

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1. Introduction

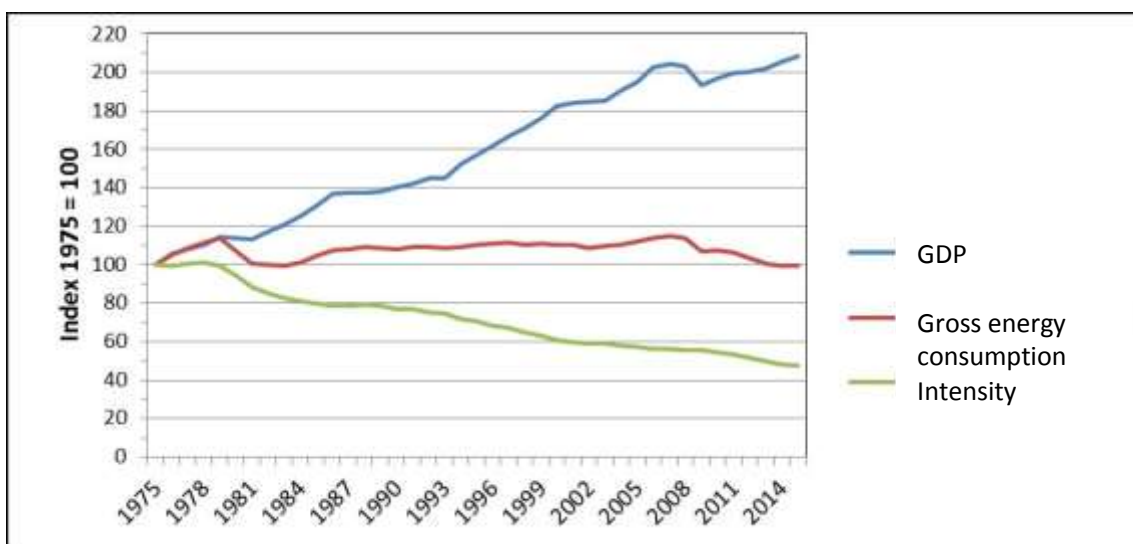
Reducing energy consumption through increased energy efficiency and energy savings has been an important part of Danish energy policy since the 1970s, when the oil crisis first led to a focus on security of supply and import dependency. Over time, climate considerations have also come to play a role in the desire to streamline and reduce energy consumption in Denmark.

Denmark has developed considerable expertise within the field of energy efficiency, which has made it possible to keep energy consumption virtually unchanged despite considerable growth over the past three decades.

On 22 March 2012, the SRSF government¹¹ entered into an energy policy agreement with the Liberals, the Danish People's Party, the Red-Green Alliance and the Conservative People's Party for the period 2012 -2020. The agreement creates a secure framework for the direction of Denmark's energy policy, and also provides a basis for making the necessary investments in renewable energy, energy efficiency and the energy system, as well as research, development and demonstration of new green energy technology. The agreement's initiatives point to a long-term objective that in 2050 energy supply will be entirely based on renewable energy, while security of supply remains high.

The energy agreement thus establishes the overall framework for energy policy in Denmark through to 2020, and is partly aimed at ensuring that energy efficiency improvements make Danish enterprises and households less vulnerable to the fluctuating and rising prices for fossil fuels triggered by the global population growth and the Earth's dwindling resources. According to the agreement, Denmark will reduce its total energy consumption by 7 % during the period 2010 to 2020.

Figure 1: Trend in gross energy consumption, GDP and energy intensity 1975-2015



As Figure 1 shows, gross energy consumption in Denmark has remained roughly unchanged since 1975. During the same period, gross domestic product (GDP) has risen by over 100 %. This sharp reduction is primarily due to substantial efficiency gains made as regards the end

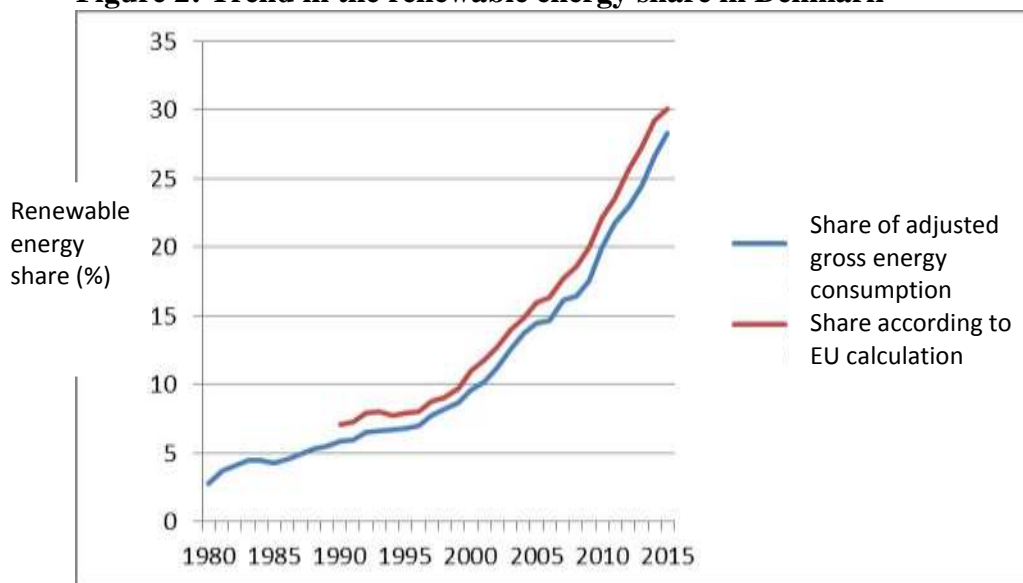
¹ The Social Democrats, the Danish Social-Liberal Party and the Socialist People's Party

use of energy and the energy supply with a transition to combined heat and power and the expansion of wind, etc.

Since 2007, gross energy consumption has been declining. In addition to the economic crisis, this is a function of further energy efficiency improvements and the resultant falling energy intensity. From 2007 to 2015, average energy intensity fell by more than 2 % per year.

As Figure 2 shows, the proportion of renewable energy has risen sharply, particularly during the past 20 years, and in 2015, renewable energy covered around 30 % of energy consumption. The growth in the renewable energy share is primarily due to the rapid expansion of wind power and a sharp increase in the use of biomass.

Figure 2: Trend in the renewable energy share in Denmark



Danish primary energy generation peaked in 2005 and has been falling since then. This is because crude oil and natural gas production rose steadily until 2004 and 2005 respectively, and production has since declined. In 2015, the production of crude oil fell by 5.4 %, while the generation of renewable energy and natural gas, etc. rose by 10.7 % and 0.1 % respectively.

Degree of self-supply was 52 % in 1990 and peaked at 155 % in 2004. In 2013, Denmark became a net importer of energy for the first time since 1996. In 2015, the degree of self-supply was 89 % compared with 90 % in 2014.

2. Overview of national energy efficiency targets and savings

2.1. National 2020 energy efficiency targets

The indicative targets for gross energy consumption (primary energy) and final energy consumption in 2020 corresponds to the energy consumption in the Danish Energy Agency's most recent baseline projection for energy consumption – Baseline projection 2017, which was published in March 2017. The baseline projection takes into account and includes the effects of all the instruments and measures included in the Danish energy policy agreement of 22 March 2012 and associated subsequent adjustments. In addition, the

baseline projection also includes previously adopted measures which are still impacting on energy consumption, e.g. the energy agreement of 2008 and the tax reform of 2009.

Gross energy consumption in 2020 in the baseline projection, and therefore Denmark's indicative target in accordance with Article 3, is a gross energy consumption excluding consumption for non energy-related purposes of 719.6 PJ (17.19 Mtoe). This entails a reduction in gross energy consumption of 14.5 % in 2020 compared with 2006.

The corresponding indicative target for final energy consumption (excluding consumption for non-energy purposes) in 2020 is 604.3 PJ (14.43 Mtoe). This represents a 7.2 % reduction compared with 2006.

The Danish Energy Agency's baseline projection is based on a number of general economic assumptions (industrial output, private consumption, fuel prices, etc.), a number of technological assumptions (what different types of plant cost, how efficient they are, etc.) and assumptions concerning what energy market actors will do based on purely commercial considerations. Some qualitative estimates, e.g. concerning planning matters, may also be included.

The projections are based on a 'frozen policy' scenario in which instruments and measures from the latest energy agreement of March 2012 are included.

The baseline projections, including the models used, the assumptions and results are described in more detail in

Baseline projection 2017:

https://ens.dk/sites/ens.dk/files/Forsyning/bf2017_hovedpublikation_13_mar_final.pdf

- Background to the Baseline project 2017:
https://ens.dk/sites/ens.dk/files/Basisfremskrivning/baggrundsrapport_til_bf_2017.pdf

Table 1: Overview of estimates of energy generation and consumption in 2020

<i>Estimated energy consumption in 2020</i>	<i>Units</i>
Total primary energy consumption in 2020 (inc. consumption for non-energy purposes)	730 PJ
Fuel input for electricity generation ² ((thermal power generation)	135 PJ
Fuel input for cogeneration ³	235
Heat generation from cogeneration – thermal ⁴	88 PJ
Electricity generation from cogeneration – electrical ⁵	44 PJ

² Includes fuels for condensing plants and CHP, for CHP the division of fuel between district heating and electricity has been calculated by using efficiency for heating of 125 % - this is to some extent an arbitrary approach.

³ Total fuel consumption for CHP for both electricity and district heat, does not include fuel for industrial CHP

⁴ Does not include district heating from industrial CHP, which is estimated to be around 3 PJ thermal output.

⁵ Does not include import/export as a consequence of the difference between production and consumption.

Energy distribution losses (all fuels) ⁶	35 PJ
Total final energy consumption ⁷	615 PJ
Final energy consumption – industry (manufacturing)	121 PJ
Final energy consumption – transport	214 PJ
Final energy consumption – households	185 PJ
Final energy consumption – services (public services + private services)	84 PJ

Source: Baseline projection 2017.

2.2. Additional energy efficiency targets

Since 2006, the grid and distribution companies in Denmark have been subject to energy efficiency obligations. The latest agreement is from 16 December 2016 and sets the overall targets up to 2020. As a result of the agreement, in 2016, 2017, 2018, 2019 and 2020 the grid and distribution companies must ensure energy savings of 10.1 PJ per year in energy end use excluding transport. Relative to the previous NEEAP, the target has therefore been reduced from 12.2 PJ/year to 10.6 PJ/year.

National intermediate target of almost energy-neutral buildings in 2015

With the introduction of a voluntary ‘lavenergiklasse 2015’ (low-energy class 2015) in the building regulations, a clear target was set regarding the requirements that new buildings must meet by 2015. Buildings constructed according to low-energy class 2015 have an energy framework that is reduced by 50 % compared with the 2006 level. Low-energy class 2015 thus lives up to the objective of the Danish energy agreement of 2008 concerning the introduction of a building class in 2015 with a 50 % reduced energy consumption compared with 2006. Low-energy class 2015 became a legal requirement in 2015.

In addition to low-energy class 2015, Denmark has also introduced ‘bygningsklasse 2020’ (building class 2020). Building class 2020 was drawn up in order to be able to satisfy the Building Directive’s requirement of almost energy neutral buildings. Building class 2020 was inserted into the current building regulations, BR10, as a voluntary building class until the time that it is introduced as a legal requirement. The building class is currently under evaluation with the aim of adopting legal requirements with final effect. Building class 2020, which reduces the energy consumption of buildings by 75 % compared with the 2006 level, was introduced as a voluntary building class at a relatively early stage in the building regulations. The Building Directive’s requirement of almost energy neutral buildings will not enter into force until 31 December 2018 for publicly owned and used buildings and 31 December 2020 for other (private) buildings.

2.3. Primary energy savings

As described in section 2.1, Denmark has an indicative national target of reducing gross energy consumption by 14.5 % in 2020 compared with 2006. The figures are based on Energistatistik 2015 (Energy Statistics 2015) and the Baseline projection from 2017.

⁶ Includes distribution loss of fuels as well as of power and district heating.

⁷ Includes consumption for non-energy purposes (11 PJ).

Table 2: Trend in gross energy consumption

	2012	2013	2014	2015	2016	2017	2018	2019	2020
<i>Energistatistik 2015</i> (Energy Statistics 2012)	783.7	765.4	753.4	756.8					
Baseline projection 2017.					753	735	732	734	730

Note: Inc. consumption for non-energy purposes

Source: *Energistatistik 2015* (Energy statistics 2015) (figures through to 2015) and Baseline projection 2017.

Table 3: Overview of estimates of primary energy consumption and final energy consumption

	<i>Primary energy consumption (PJ, GWh or ktoe)</i>	<i>Final energy consumption (PJ, GWh or ktoe)</i>
2012 - Achieved	785 PJ	616 PJ
2016 - Forecast	784 PJ	637 PJ
2020 - Forecast	757 PJ	632 PJ

Source: Figures for 2012 are based on *Energistatistik 2012* (Energy Statistics 2012), while the forecasts for 2016 and 2020 are based on *Danmarks Energifremskrivning 2012* (Denmark's Energy Projection 2012).

2.4. Final energy savings

This section contains a calculation of the final energy savings with a view to demonstrating that Denmark satisfies the requirements of the Energy Services Directive for annual energy savings of 1 % of the final energy consumption in the period from 2007 to 2016 and an accumulated saving of 9 % over the period. The calculation largely uses the same methods as in the most recent NEEAP. However, the targets and savings are calculated for the total final energy consumption, i.e. including consumption in plants covered by the CO₂ emissions trading system.

2.4.1 Final energy consumption and targets

In accordance with the Energy Services Directive, the target is calculated in relation to the average final energy consumption in 2002-2006. Consumption in the individual years and the average are shown in Table 4.

Table 4: Total final energy consumption

	2002	2003	2004	2005	2006	Mean
Final energy consumption, PJ	643.7	649.1	660.5	666.3	679.7	659.9

Note: Inc. consumption for non-energy purposes

Source: *Energistatistik 2012* (Energy Statistics 2012)

On the basis of this, the annual and accumulated targets can be calculated.

Table 5: Annual and accumulated targets

	PJ
Annual targets – 1 %	6.6
Accumulated targets 2016 – 9 %	59.4

2.4.2 Calculated energy savings

Only those calculations that are necessary to show that Denmark is meeting the targets have been established. This means that a complete calculation of the effects of all the initiatives has not been carried out.

Specifically, top-down calculations have been carried out for selected sectors and a bottom-up calculation has been carried out of the effect of energy saving by energy companies. For all other instruments, bottom-up calculations have not been made.

The calculations have been carried out on the basis of the methods in the Commission's draft guideline *'Recommendation on measurement and verification methods in the framework of Directive 2006/32/EC on energy end-use efficiency and energy services'*.

Calculations were carried out for all individual years during the period 2008-2016. The calculated energy savings for the period 2008-2015 are based on statistical figures, whereas the saving for 2016 is based on projection figures. However, the savings in 2016 in the bottom-up calculated are based on the provisional reports of the energy companies' energy savings in 2016.

Table 6: Calculated energy savings

		Savings relative to 2007								
		2008	2009	2010	2011	2012	2013	2014	2015	2016
Top-down	PJ	8.9	22.9	24.1	25.6	51.6	53.7	62.0	65.6	74.2
	%	1.4 %	3.5 %	3.6 %	3.9 %	7.8 %	8.1 %	9.4 %	9.9 %	11.2 %
Bottom-up	PJ	3.8	7.4	14.0	21.0	28.8	36.8	45.6	56.3	66.2
	%	0.6 %	1.1 %	2.1 %	3.2 %	4.4 %	5.6 %	6.9 %	8.5 %	10.0 %

2.4.3 Assumptions for the calculated energy savings

As mentioned in the previous section, the calculation of energy savings was carried out in relation to the total final energy consumption, so energy savings in enterprises and plants covered by the CO2 emissions trading system are included.

Specifically, for the period 2008-2015 top-down calculations were carried out for

- heat consumption in housing (M2)
- electricity consumption in housing (P1)
- heat consumption in trade and services buildings (M3)
- electricity consumption in trade and services (P7)
- energy consumption in manufacturing industries

The calculations used climate-adjusted energy consumptions according to *Energistatistik 2015* (Energy Statistics 2015). For housing and for trade and services buildings, data on

heated areas from Statistics Denmark were used. For manufacturing industries, data on production values from Statistics Denmark were used in the calculations.

The calculations for manufacturing industries were only carried out at main sector level, and not broken down into the individual sub-sectors. This is because consistent data on energy consumption in the individual sub-sectors are not available.

The top-down calculations do not include any energy savings in the area of transport.

For 2016, calculations were only carried out for the individual main sectors, and not broken down into heating, electricity consumption, etc. This calculation uses data from the Danish Energy Agency's baseline projection of energy consumption from 2012.

Table 7: Top-down calculations of energy savings for selected sectors

TJ		2008	2009	2010	2011	2012	2013	2014	2015	2016
Households, in total		5 204	14 079	15 040	12 612	23 747	22 394	22 930	20 624	24 209
	Heating	4 465	11 988	12 632	10 131	20 535	19 934	20 188	17 718	
	Electricity consumption, excluding electric heating	740	2 091	2 408	2 481	3 212	2 460	2 742	2 906	
Trade and services		1 231	5 342	7 584	7 313	9 955	11 322	13 719	15 449	16 589
	Heating	684	2 970	4 722	4 324	5 471	5 675	7 129	7 964	
	Electricity consumption, excluding electric heating	547	2 372	2 862	2 988	4 484	5 647	6 590	7 484	
Manufacturing, in total		2 483	3 440	1 451	5 698	17 876	20 015	25 338	29 508	33 405
	Agriculture, forestry, horticulture, fisheries	-2 964	-1 673	715	429	3 758	796	3 868	6 328	6 920
	Manufacturing	5 703	5 218	1 228	5 848	14 058	19 089	21 114	22 758	25 806
	Building and construction	-255	-105	-492	-579	61	130	356	422	679
Total		8 918	22 861	24 075	25 623	51 579	53 731	61 987	65 581	74 203

The bottom-up calculations were only carried out for energy saving by energy companies. For the period 2008-2012, the actual realised energy savings reported by the energy companies to the Danish Energy Agency are used. For 2016, the companies' provision reports were used.

An adjustment has been made for the fact that a small proportion of the reported energy savings have a lifetime of less than nine years. Specifically, it is assumed that 5 % of the energy savings have a lifetime of only one year, and that 10 % of the energy savings have a lifetime of two years or less. These adjustments are larger than the proportion of savings achieved through behaviour modification in the period up to 2009. As of 2010, the effect of behaviour modification cannot, in principle, be included. The share also takes account of the fact that there are other savings which have a lifetime of less than four years.

The results of the bottom-up calculation are shown in Table 6.

3. Policy measures implementing EED

3.1. Horizontal measures

3.1.1. Energy efficiency obligation schemes and alternative policy measures (EED Article 7 and Annex XIV, Part 2.3.2)

Denmark will meet its Article 7 obligations exclusively through the use of energy efficiency obligations. The obligations are part of the energy policy agreement of March 2012 and are laid down up to 2020 through the agreement of 16 December 2016 between the Minister for Climate, Energy and Building and the grid and distribution companies.

In accordance with Article 7(1) EED, the Danish targets are calculated as:

- Annual target – 1.5 %: 6.18 PJ
- Savings in 2020 (7 x 1.5 %): 43.23 PJ
- Accumulated savings 2014-2020 (28 x 1.5 %): 172.93 PJ

The basis for the calculations of the Danish targets pursuant to Article 7(1) are the official Danish energy statistics *Energistatistik 2012* (Energy Statistics 2012), which were published in November 2013. These data are the basis for reporting to Eurostat.

When calculating the Danish target, energy used for transport is not taken into account. Consumption for non-energy purposes is also disregarded. Otherwise, all final energy consumption is included in the calculation of the target.

The precise calculations and data sets are shown in Annex D, which also shows the breakdown of the final energy consumption by sector for 2010, 2011 and 2012.

In the energy agreement of 22 March 2012, the annual target for the Danish energy efficiency obligation was set to 10.7 PJ/year in 2013 and 2014, corresponding to 2.6 % of energy end use, and to 12.2 PJ/year for 2015-2020, corresponding to around 3.0 % of energy end use. In the PSO agreement of 17 November 2017, it was decided to reduce the target for 2016-2020 to 10.1 PJ/year

The energy savings reported for the period 2006-2016 are presented in Figure 3, which also shows the breakdown of energy savings by sector, etc.

Figure 3: Reported energy savings 2006 - 2013



Under the Danish system, obligated parties may to a certain extent take into account energy savings in transmission and distribution networks and, through until mid-2018, in connection with the establishment of new collective solar farms for district heating generation. From 2017, energy savings from the establishment of heat pumps for district heating generation can also be included. These savings, which are covered by the exemption in Article 7(2)(c), are expected, on the basis of experience, to be much less than 25 % of the total energy savings

As can be seen from Annex D, the Danish targets will entail energy savings of 83.9 PJ in 2020 and total savings of 331.1 PJ accumulated over the period 2014-2020.

In relation to the fulfilment of the obligations in Article 7 EED, the energy savings under the Danish scheme must however be adjusted to take account of a number of elements:

- The effect of the Danish prioritisation factors must be eliminated. Specifically, this means that savings which have a short lifetime, and which are therefore multiplied by a prioritisation factor of 0.5, will not entail energy savings in 2020. For savings with long lifetimes, which are therefore multiplied by a factor of 1.5, the addition must be removed when the effect in 2020 is calculated.
- Under the Danish scheme, a number of energy savings are included in areas where ecodesign requirements have been established. This particularly applies to the replacement of boilers and conversions to heat pumps, etc. These savings cannot be included in relation to the fulfilment of the obligation in Article 7.

However, as the Danish target is significantly higher than the 1.5 %, calculations show that, with these adjustments, Denmark fulfils the obligation in Article 7 EED. However, a final calculation cannot be performed until the composition of the energy savings through to 2020 is known.

The national energy efficiency obligation scheme

Denmark has had energy efficiency obligations since 2006. The obligations are enshrined in the electricity supply, natural gas supply and heat supply acts for electricity grid companies, natural gas distribution companies and district heating companies. There is therefore a legal basis for imposing an annual energy efficiency obligation on these companies, although in

practice the action is implemented through an agreement with the sectors/companies concerned. All of the companies in these sectors have signed up to this agreement. In addition to the sectors referred to, the oil sector is also a party to the agreement, and thus also has an annual energy saving target. The option of exempting small companies has not been taken up.

The companies involved are:

- around 70 electricity grid companies,
- three natural gas distributors,
- around 400 district heating grid companies,
- the oil sector, which takes care of the activities on behalf of six oil companies.

At present, four agreements have been entered into concerning the energy companies' energy efficiency obligation, the latest being from 16 December 2016. The new energy saving agreement contains principles for the distribution of the target between the individual companies and establishes the framework for the energy companies' energy saving obligation through to the end of 2020.

The obligated companies can only be credited with and report savings which the companies are involved in achieving through specific activities either themselves or on the basis of agreements with actors. There must therefore be a direct and clear link between the activity and the savings. Companies cannot report savings arising without their involvement. There must be an agreement concerning involvement before the realisation of the saving begins.

There are clear rules stipulating that the obligated parties' activities must have significantly contributed to achieving the energy savings claimed. The obligated parties' involvement may take various forms. It may take the form of advice or a grant to the final customer or, indeed, a combination thereof.

The activities that obligated grid and distribution companies can implement themselves are limited. A very large part of the action is therefore implemented by actors who have agreements with one of the obligated companies and who therefore take responsibility for implementing the action in relation to end users. These actors may be installers, tradesmen, consultant engineers, or energy trading companies. Thus, the grid and distribution companies cooperate with a large number of companies and actors who act as energy saving operators (energy service providers) in relation to households and enterprises.

In principle, energy savings in all end-use sectors and in relation to all types of energy can be taken into account. This therefore also includes energy savings in enterprises covered by the emissions trading system (ETS). However, there are a number of areas that are excluded because it is thought that the activities in question will largely be implemented without the involvement of the obligated parties.

An energy saving achieved through activities that increase efficiency and thus reduce energy consumption can be taken into account. Examples include improved insulation or the installation of more energy-efficient windows. Energy efficiency improvements in terms of the energy consumption of industry also fall within this category. Replacing old energy-efficient boilers with new high-efficiency boilers can therefore be included as an energy saving measure.

Energy savings in connection with converting from one type of energy to another can also be included if this leads to lower energy consumption. This could, for example, be conversion from an oil-fired boiler to district heating or a heat pump.

Some of the savings achieved as a result of installing new boilers or converting from one type of energy to another cannot be counted towards fulfilment of the requirements of Article 7 because the technologies are covered by ecodesign requirements. In assessing whether targets have been met, the savings achieved under the Danish system will therefore be adjusted.

Calculation methodology

Savings are calculated either using standard values (deemed savings), by means of a specific calculation of the saving resulting from the activity (scaled savings), or according to the effect of a specific market impact (surveyed savings).

Standard values

Calculation on the basis of standard values is applied in the case of smaller, standardised activities. Such savings will typically be found in homes or other buildings. If a standard value exists for a given saving, this will be applied.

The aim of establishing standard values for energy savings is to simplify the calculation of the realised energy savings. The calculation of the saving thus takes place through a simple multiplication of the standard value by the number of initiatives implemented.

In connection with the agreement on energy saving by grid and distribution companies, a technical working group was set up with representatives from the parties to the agreement. The technical working group is responsible for the work of drawing up the standard values. In practice, it is the Danish Technological Institute that performs the task of making assumptions and calculating the standard values. The values are approved by the Danish Energy Agency.

When drawing up the standard values there is a focus on, among other things, high additionality. Consideration is given to the extent to which a measure will take place independently of the involvement of the grid and distribution company.

The standard values are merely an expression of the energy savings that can be included in the grid and distribution companies' energy saving efforts. Not all measures that result in reduced energy consumption can be included as an energy saving under this scheme.

The standard values are an average of the individual energy improvement measures. Thus, the specific energy savings may be either smaller or larger than the actual energy saving. In order to ensure fair and credible standard values there is openness about the drawing up of the catalogue of standard values. Comments and suggestions for the catalogue of standard values can be sent to the Danish Energy Agency. Any suggestions and amendments should have the nature of specific and well-founded proposals for amendments of specific values.

Each year an assessment is made of whether the standard values should be adjusted and whether new ones should be added in the light of, among other things, technological development. Any amendments enter into force on 1 January, but are published not later than 1 October. Amendments only have an impact on future energy savings. Existing and previous versions of the catalogue of standard values are available at: svk.teknologisk.dk (please note that 'www' should not be included in the address).

Specific calculation

Specific calculations are used in areas where there is no standard value. These are typically large, integrated projects in commercial enterprises or public institutions. If specific calculations are used for parts of an overall project, the entire project will be assessed on a specific basis, including the effect of initiatives for which standard values exist.

Market impact

This option has been deleted from the 2016 agreement, primarily because it had not been used.

Design of rules

The rules are designed to prevent the same energy saving from being taken into account by several parties. The end user must, among other things, approve the reporting of the specific energy saving to a specific obligated company and be informed that, in so doing, the energy saving cannot be sold to another party. The new agreement contains a requirement that all agreements concerning the transfer of energy savings must be established in writing. In future, written agreements must therefore also be prepared for small projects where the saving is calculated using standard values.

The random samples and the evaluations carried out have not identified any problems with double counting.

The evaluations show that the energy savings determined are new and that they have generally been calculated correctly. During the past couple of years, numerous errors have been found in the reported analysed cases. The obligated parties are involved and have contributed to the realisation of the energy saving.

However, some of the energy savings would be implemented within a reasonable time frame without the companies' involvement (free riders). It is very difficult to calculate the proportion of free riders, but the latest evaluations show that around 50 % of energy savings in industry and around 80 % of energy savings in buildings would be implemented within three years.

A number of steps have been taken to reduce the proportion of free riders and to make adjustments for specific projects that would have been implemented in any case.

First, the annual target as of 2009 was increased by 15 % compared with the policy target. This was because some of the energy savings calculated would be implemented in any case. This increase has been continued in the current agreement.

Second, the effect of a number of initiatives which are expected to be implemented without the involvement of the energy companies cannot be taken into account. For example, the standard values are set to zero for most household appliances. The effects of behaviour modification and information campaigns cannot be taken into account either.

Finally, a number of standard values have been reduced by 10-50 % in order to compensate for the fact that some of the activities would be carried out in any case.

Lifetimes of measures

Under the Danish system, the effect in connection with the implementation of specific energy savings is calculated on the basis of the saving in the first year.

However, the saving in the first year is weighted by a simple factor that primarily reflects the lifetime of the saving, but also reflects the associated gross energy consumption and the expected CO₂ impact of the saving, particularly with regard to whether or not the saving is covered by emissions trading.

When converting from one type of energy to another, conversion factors reflecting the gross energy consumption are applied. The prioritisation and conversion factors and how they are applied in practice are set out in Annex 5 to the agreement. The agreement is available here (in English):

On the basis of the notified data, it is thought that the average lifetime of the energy savings is at least 10 years. As regards the energy savings reported in 2015, only around 1 % was multiplied by a factor of 0.5, which is the case if the lifetime is less than four years. 14 % of the notified energy savings were multiplied by a factor of 1.5, which is the case for some of the energy savings with a lifetime of more than 15 years.

Approach taken to address climatic variations within the Member States

Under the Danish energy saving scheme, energy savings are, in principle, calculated on the basis of a 'normal year'. For energy savings relating to heating consumption in buildings, standard values are generally applied which are calculated on the basis of the climate in a normal year. The scheme does not have any special rules to take account of climatic variations.

Quality standards

Obligated grid and distribution companies are responsible for ensuring that their documentation of energy savings is correct and meets the requirements laid down. To this end, companies are required to implement quality assurance. This ensures that the company's documentation and reporting, including documentation concerning savings implemented by subcontractors or third parties acting on the company's behalf, are correct and meet the requirements laid down.

As a minimum, quality assurance should focus on:

- whether the size of the energy saving has been calculated in accordance with the applicable rules, and whether specific calculations are technically sound;
- whether energy savings have been implemented in respect of the relevant consumption and can be defined as an energy saving within the meaning of the agreement;
- whether the company was involved directly, financially or via a third party before the saving was realised;
- whether the company has obtained the right to report;
- whether the energy savings have been realised and correctly documented;
- whether the energy savings have been reported correctly;

whether actors acting on the grid company's behalf are complying with the requirements of the agreement; and whether any errors linked to individual cases or the procedures of the company concerned are corrected as part of compliance with the agreement or the executive order.

In the agreement of 16 December 2016, the requirements for the companies' quality assurance, etc. were increased considerably (see below).

Monitoring and verification protocols

As part of the quality assurance, each year the obligated companies must carry out an audit to ensure and demonstrate that the reported savings have been realised and documented in accordance with the agreement and the executive order.

Every second year, the audit may be carried out internally by the company itself, with intervening audits being carried out externally by an independent auditor. The external audit must be carried out by a person/company who is independent of the grid/distribution

company and who has undergone basic auditing training and has experience of carrying out a minimum of two audits together with an experienced auditor.

The company must document that both the internal and external audits have been carried out, stating how many and which cases have been selected. This documentation must be kept for five years. In connection with the annual reports, companies must indicate whether an internal or an external audit was carried out in the year concerned.

All obligated companies must submit annual reports to the Danish Energy Agency indicating whether an internal or an external audit has been carried out.

In addition to the obligated parties' quality assurance and audits, once a year the Danish Energy Agency carries out an impartial spot check across all grid and distribution companies involved in order to verify that they meet the requirements of the agreement and of the executive order. The spot check covers all intermediaries from the reporting company down to the end user where the saving was implemented.

Audit protocols

Apart from the requirements described above, there are no special audit protocol requirements for the calculated energy savings.

Each year, all obligated companies are required to inform *Energitilsynet* (the Danish Energy Regulatory Authority) of their costs in connection with complying with their energy efficiency obligations. These costs should be subject to the general requirements applicable to the auditing of the companies' accounts.

Denmark is meeting its obligations exclusively through the use of energy efficiency obligations and will therefore not be using alternative policy measures under Article 7(9).

Material changes in the 2016 agreement

The energy saving agreement of 16 December 2016 contains numerous changes relative to the agreement dating from 2012. The most important changes are as follows:

- The target for the annual savings during the period 2016-2020 is reduced from 12.2 PJ to 10.1 PJ. Part of the reason for this reduction was that the energy companies' costs in 2015 exceeded the pledge that was established in the energy agreement of 22 March 2012.
- As of 2017, it became possible to include energy savings from the establishment of heat pumps for district heating production.
- The regulations regarding the documentation of individual projects have been tightened in many regards, e.g. better documentation of the 'before situation'.
- Stricter requirements for the obligated companies' quality assurance, including new requirements for the annual quality control of a proportion of the cases, and new requirements for audits. The results of the quality control and audits must be sent to the Danish Energy Agency every year.
- Annual coordination of all cases with a view to determining whether double counting has taken place.
- Expansion of the Danish Energy Agency's annual spot checks. In future, these spot checks will cover more companies and more cases.

As an extension of the new agreement, a new executive order concerning the energy saving obligation will include a raft of new measures to strengthen control and supervision,

including expanded controls covering the companies' costs in connection with the obligation.

3.1.2. Energy audits and management systems (EED Article 8)

Act No 345 of 8 April 2014 contains the overarching requirements for energy audits of large enterprises, which entail an obligation for large enterprises to carry out a mandatory energy audit every four years on their total energy consumption, including processes, buildings and transport. The enterprise can also satisfy the obligation by using and maintaining a certified energy or environmental management system that includes an energy audit as part of the management system.

The minimum requirements for energy audits were laid down in Executive Order 1212 of 19 November 2014 on energy audits in large enterprises, which was issued pursuant to the Act.

Enterprises covered

The requirements apply to large enterprises in all sectors, including transport activities such as shipping and aviation. Every enterprise that offers goods and services in a given market is an economic operator and is therefore covered by the requirement for mandatory energy audits.

'Large enterprises' means enterprises with at least 250 employees and an annual turnover of more than EUR 50 million or an annual balance sheet total of more than EUR 43 million. An enterprise must therefore have at least 250 employees and satisfy at least one of the two financial criteria.

In order to determine whether the criteria have been met, an assessment must be made of whether an enterprise is an independent enterprise, a partner or an affiliate. If more than 25 % of an enterprise's capital or voting rights are held by another enterprise, it is a partnership or affiliation as far as both enterprises are concerned.

Danish enterprises which do not have an annual energy consumption exceeding 100 000 KWh are exempt from the requirement for energy audits if they are able to document this to the Danish Energy Agency.

In 2014, the EU's Environment Agency believed that 500-700 enterprises in Denmark would be covered by the energy audit.

Scope of the energy audit

The energy audit must be carried out at least every fourth year, calculated from the date of the preceding energy audit. As the Executive Order indicates, the first energy audits must be completed no later than 5 December 2015. Energy audits that satisfy the minimum requirements and have been carried since 4 December 2012, which is when the Energy Efficiency Directive entered into force, count towards the enterprise's fulfilment of the requirement. This means, for example, that if a large enterprise had an energy audit carried out on 27 June 2013, the next energy audit must be carried out no later than 27 June 2017.

The scope of the energy audit will depend on the complexity of the elements to be included in a given energy audit. For energy audits in large enterprises with very complex processes, the requirements will be more extensive and different than if the large enterprise were a consultancy or office-based business or in the trade and services sector where energy consumption is simpler.

Enterprises that have a certified energy management system in accordance with the relevant international standards will be exempt from the requirement for energy audits. The existing international and European standards, such as ISO 50001 on energy management and EN 16247-1 on energy audits, are considered by the Directive to satisfy the minimum requirements. These standards were already in use in a number of enterprises on a voluntary basis. Similarly, large enterprises which use and maintain an environmental management system and which have incorporated an energy review corresponding to Article 4.4.3 in the energy management system will also be exempt from the energy audit obligation.

The Executive Order permits the enterprises covered to exempt up to 10 % of their total energy consumption in the Danish units from the energy audit. They are therefore required to carry out an energy audit on at least 90 % of their total energy consumption.

Documentation requirements

Large enterprises must submit documentation to the Danish Energy Agency to demonstrate that they have met the requirement for mandatory energy audits or show that are exempt from the requirement by submitting documentation of the fact that the enterprise has a certified energy management system or an environmental management system with an incorporated energy review.

Quality assurance

A description of the Danish scheme for the accreditation of energy audit consultants and qualifying courses, primarily in processing enterprises, can be found here: <http://energisyndskonsulent.dk/> The Danish Energy Agency participates in the registration committee, which ensures that the qualification requirements are upheld.

A description of the Danish scheme for certifying energy audit consultants to carry out energy audits of buildings is can be found here:

<http://spareenergi.dk/offentlig/bygninger/energimaerkning-af-bygninger>

Number of audits in 2017

As of 1 April 2017, the Danish Energy Agency has received a total of 560 energy audit reports and 150 energy or environmental management systems.

3.1.3. Metering and billing (EED Articles 9-11)

Metering

Article 9 of the Energy Efficiency Directive concerns the right of final customers to have individual meters installed to measure consumption. In Denmark, it is the Danish Energy Agency that lays down the rules for individual consumption metering of electricity, gas, water and heat in residential and commercial units. In connection with the implementation of Article 9, the Danish Energy Agency issued *Bekendtgørelsen om individuel måling af el, gas, vand og varme* (Executive Order No 891 of 9 October 1996 on individual metering of electricity, gas, water and heat, as amended by Executive Order No 565 of 1 January 1997) (the Meter Order). Under this Executive Order, meters for measuring heat consumption must be installed in individual residential units or commercial units in both existing buildings and new buildings. However, buildings may be exempt from this requirement on the grounds of, for example, special technical circumstances. As regards cold and hot water, meters must be installed in both new buildings and in connection with the installation of new water systems in existing buildings.

Customers of around half of the district heating plants now have smart meters. A majority of the meters installed on the market today enable consumers to read their consumption in both volume (m³) and MWh. Consequently, these consumers are able to obtain precise, regular

meter information themselves, which satisfies the Energy Efficiency Directive's aim of providing consumers with a more rational use of, among other things, district heating. The Executive Order on remote electricity meters and metering of electricity at end use, which was most recently amended by *Bekendtgørelse nr. 1358 af 3. December 2013 om fjernaflæste elmålere og måling af elektricitet i slutforbruget* (Executive Order No 1358 of 3 December 2013 on remote electricity meters and metering of electricity at end use), contains requirements for grid operators to inform and advise end users about the use of remote electricity meters and the potential for their use.

Since 2011, around 1.6 million consumers have had remote electricity meters installed. The remaining around 1.7 million consumers will have remote electricity meters with hourly metering installed by the end of 2020 at the latest. The grid operators are responsible for the installation of electricity meters. They normally outsource the task to external actors.

Bekendtgørelsen om fjernaflæste elmålere mv. (the Executive Order on remote electricity meters etc.) contains provisions that ensure fulfilment of the requirements of Article 9(2).

There are no equivalent rules on remote meters in the area of natural gas. However, the standard for natural gas meters is that consumers are able to read their consumption directly and that consumers report their consumption once a year and can freely choose whether to do so by telephone, letter or e-mail. This is considered to be a satisfactory scheme which it would not be economically viable to change by making electronic metering a requirement.

Billing

To ensure the correct implementation of Article 10 and the associated Annex VII, last year the Danish Energy Agency issued *Bekendtgørelse nr. 1395 af 25. november 2016 om energivirkomheder og bygningsejeres oplysningsforpligtelser overfor slutkunder om energiforbrug og fakturering m.v.* (Executive Order No 1395 of 25 November 2016 on energy enterprises and building owners' reporting obligations with respect to end customers concerning energy consumption and invoicing, etc.).

For electricity, gas and district heating and cooking, electricity trading companies, natural gas distribution companies, natural gas suppliers and heat distribution and district cooling enterprises shall ensure that end customers with which the enterprise has a customer relationship receive bills based on actual consumption at least once a year. In addition to this, various information shall be provided with the bill in a clear and readily comprehensible manner. The information that must be provided includes the customer's consumption over the past year and a comparison of the customer's consumption with previous years, as well as information on what energy efficiency measures are being offered to a comparable customer profile.

If a remote meter has been installed for electricity and gas, the enterprises shall, in addition to the above, ensure that end customers have easy access to supplementary information concerning previous consumption. Such information shall include energy consumption during the past three years and detailed information on consumption for any day, week, month or year.

If a remote meter has been installed for district heating and district cooling, the enterprises shall, in addition to the above, make available billing information at least three times a year. Information on the scope for energy efficiency improvements shall also be communicated to the end customer. The Executive Order contains an option to dispense from this requirement provided that the enterprise is able to document that the costs attributable to the frequent sending of billing information exceed the energy savings associated with frequent billing.

Furthermore, in the case of building owners who are registered as a customer for a meter in buildings with several apartments, the building owner's end customers with cost allocators shall receive a bill based on actual consumption at least once a year. In addition, various information shall be provided with the bill in a clear and readily comprehensible manner. The information that must be provided includes the customer's consumption over the past year and a comparison of the customer's consumption with previous years, as well as information on what energy efficiency measures are being offered to a comparable customer profile.

3.1.4. Consumer information programmes and training (EED Articles 12 and 17)

Under Articles 12 and 17 EED, Member States are obliged to focus on and strengthen consumer information, and information and training about energy efficiency. The Danish Energy Agency has drawn up an action plan and strategy for the information campaign on energy efficiency at end-user level. The aim of this information campaign is to promote energy-efficient solutions and purchasing and energy-efficient behaviour among end users. The information campaign focuses on end users, with home owners, the public sector and commercial enterprises as specific focus areas.

Improving the energy efficiency of buildings and modifying behaviour in connection with buildings is a priority in the Danish public and consumer information campaign. This involves preparing material on energy-efficient solutions, information on building regulations, and better access to information and knowledge about energy renovation. The Danish Energy Agency's website www.SparEnergi.dk is the backbone of the Agency's communications with end users concerning energy-efficient solutions both in private households and in public and private enterprises.

The objective of the campaign at www.sparenergi.dk is to:

- to be the Danes' preferred website with information and inspiration concerning energy efficiency;
- ensure a solid and effective communications platform for the efficiency campaign;
- to disseminate content and offer high-quality tools which make it easier to make the right decisions from an energy perspective;
- ensure the greatest possible access to information.

BedreBolig (Better Homes)

BedreBolig is a new scheme offering advice which was launched in autumn 2014. The aim of the scheme is to make it easier and clearer for home owners to renovate their homes by offering comprehensive, expert advice throughout the energy renovation process. In connection with the launch of *BedreBolig*, DKK 15 million has been allocated to the launch of a special information campaign.

BedreBolig focuses on, among other things, developing cooperation between home owners and financial institutions, enabling financial advisers to better advise their customers on the financing of energy improvement projects. This means that, in connection with the establishment of the scheme, a calculation program and a report format has been developed which gives the financial institutions a solid basis on which to assess the potential savings that could be made in a building and to facilitate the dialogue between home owner and bank. The scheme will be targeted at home owners until the year-end 2017. As of 1 January 2017, the scheme was expanded to also cover large buildings and apartment blocks.

Energy labelling

The Danish Energy Agency is also giving a lot of attention to energy labelling of buildings and has therefore developed a number of digital tools which are integrated at SpareEnergi.dk.

The aim is primarily to make it easier for building owners to use energy labelling and, among other things, to facilitate an analysis of energy saving opportunities for detached houses on the basis of the data gathered through energy labelling. See:

<http://sparenergi.dk/forbruger/vaerktoejer/find-dit-energimaerke>

Scrapping of oil-fired boilers/promotion of individual heat pumps

The conversion from oil-fired and natural gas boilers in existing buildings is largely concerned with improving energy efficiency. For this initiative, the Danish Energy Agency has started providing impartial advice to building owners. This will consist of free advice by telephone or post and various local activities, primarily in the form of open meetings. The initiative is an integrated part of the information obligation.

<http://sparenergi.dk/forbruger/boligen/raadgivning>

Digital tools at SparEnergi.dk

Sparenergi offers a number of digital tools which can help users to improve their energy efficiency. Examples of these are:

- *Ny Varme* (New Heating), which provides home owners with a readily accessible overview of the economics of switching from oil and natural gas to heat pumps or district heating. <http://sparenergi.dk/forbruger/varme/varmepumper>
- The digital energy label, which provides home owners with an overview of opportunities for energy improvements. <http://sparenergi.dk/forbruger/vaerktoejer/find-dit-energimaerke>
- *Tjek-dit-hus* (Check your house), which gives home owners fast access to an evaluation which determines whether or not their house has potential for energy renovation and whether it might be a good idea for ask a *BedreBolig* adviser to review the house. <http://sparenergi.dk/forbruger/vaerktoejer/bedrebolig>
- *Casebanken* (the Case Database) is a collection of illustrated examples from all around the country of home owners who have energy-renovated their own homes. The collection includes 100 cases and forms an integrated part of SparEnergi.dk. Video cases have also been developed. <http://sparenergi.dk/forbruger/vaerktoejer/casebank>
- *Offentligt Energiforbrug* (Public Sector Energy Consumption) is a digital tool which makes it possible to see the trend in electricity and heat consumption in central government buildings since 2006. <http://sparenergi.dk/offentlig/vaerktoejer/offentligt-energiforbrug>
- The energy and CO2 calculator is a new digital tool (beta version), which enables users to view the energy and CO2 accounts of Danish municipal authorities. The tool can be used to support the preparation of energy and CO2 accounts by municipal authorities. <http://sparenergi.dk/offentlig/vaerktoejer/energi-og-co2-beregneren>

Appliances/products

In addition to buildings, the Danish Energy Agency is also focusing on appliances and renewable energy technology as part of the public and consumer information campaign. The effort in the area of appliances is intended to ensure that consumers continue to have guidance and information on both purchasing and using energy-efficient appliances and solutions. For example, in the area of lighting, hard white goods and consumer electronics, a

lot of information material has been developed consisting of shop material, educational films and pamphlets.

Energy saving by energy companies

The scheme for energy saving by energy companies is discussed in detail in section 3.1.1.

In the course of 2016, as part of the marketing of the scheme, the Danish Energy Agency focused on information about the scheme for end users and on disseminating rules and requirements both to energy companies and external actors, including tradesmen, installers and advisers.

The campaign will continue in 2017, when the focus will still be on raising awareness of the scheme, including through the distribution of brochures about the scheme and holding meetings with relevant actors, as well as coordinating information with the parties to the agreement. The new energy saving agreement makes it easier for end users and actors to find information on the scheme on the companies' websites. A stronger focus has also been placed on clarifying the guidelines for the scheme, partly through the Danish Energy Agency's website, newsletters and FAQ aimed at companies and actors.

The aim of the information campaign is 1) to help spread awareness of the scheme for energy saving by energy companies among end users and actors, 2) to ensure that energy saving by energy companies is taken into consideration in the communication of other initiatives and vice versa, and finally 3) to ensure that there is coordination between the various campaigns so that the combined energy saving effort achieves the best possible synergy and impact.

Information campaign aimed at SMEs

In 2014, the Danish Energy Agency established *Energisparesekretariatet* (the Energy Saving Secretariat), which promotes the realisation of energy savings in private enterprises, particularly small and medium-sized enterprises. The secretariat supports energy efficiency initiatives within industry, which are identified and mediated, thereby boosting the competitiveness of industry. This takes place in collaboration with the industry organisations and focuses on, among other things, the increased mediation of knowledge, advice and guidance concerning energy saving measures.

Energisparesekretariatet has carried out a series of analyses of energy saving potential and behaviour amongst enterprises within the trade and service sectors with the aim of providing insight which can stimulate changes in the energy-related behaviour of non-energy intensive enterprises. The secretariat's analyses have been collated on the Danish Energy Agency's online portal sparenergi.dk/erhverv, which is regularly updated with new information concerning campaigns and business-oriented recommendations. *Energisparesekretariatet* runs network campaigns to stimulate behavioural changes in non-energy intensive enterprises, where the incentive and level of interest in energy savings is limited. Network campaigns are aimed at making the communication close and personal, or mediating it through people and organisations that are considered to be trustworthy, competent or admirable. It is very much about mediating the message directly to the end consumer face-to-face and the mediator could for example be a specialist who goes into a store, e.g. a tradesman, adviser, auditor, etc.

In *Energisparesekretariatet*'s campaign concerning lighting in the retail sector (2016), the Danish Energy Agency's LED consultants visit small and medium-sized stores and explain directly to the store owner the potential savings that could be made by switching to LED lighting. In the secretariat's campaign in the agriculture sector (2017), agriculture consultants who know and provide services to the businesses advise the business owners on modern LED lighting and ventilation in the sector. In the network strategy, there are end target groups and network target groups, where the latter are tools in relation to the campaign's objectives which

ensure a high degree of realisation in the end target group. Network campaigns have proven to be particularly effective with regard to small and medium-sized enterprises and it is recommended that the network strategy be used when the end target group does not see the relevance or needs information, which is often the case with small and medium-sized enterprises.

The Danish Energy Agency publishes *Energiledelse: Små og mellemstore virksomheder* (Energy management: Small and medium-sized enterprises), which is a guide for office enterprises on using energy more efficiently. The guide is distributed via the website spareenergi.dk. In addition, the Danish Energy Agency issues checklists which are primarily aimed at small and medium-sized enterprises that are conducting energy reviews of existing installations. In connection with the purchase of new plants and installations by enterprises, the Danish Energy Agency has drawn up requirement specifications to help draw up the correct requirements for plants or requirements in connection with tenders.

Smart meters

In connection with the installation of remote meters for end users, grid operators must inform and advise end users about the use of remote electricity meters and the potential for their use (see Article 3 of the Executive Order on remote electricity meters and metering of electricity at end use, Executive Order No 1358 of 3 December 2013) (<https://www.retsinformation.dk/Forms/R0710.aspx?id=160434>).

Training

Training and awareness-raising about energy efficiency are important elements in the Danish Energy Agency's work to improve energy efficiency. The *BedreBolig* scheme contains a large element of training. In connection with the scheme, a training course for tradesmen has been set up where tradesmen, construction engineers, engineers, architects, etc. can train to provide professional advice from the start of a renovation project through to completion (one-stop shop).

The *BedreBolig* course focuses on holistic energy renovation, including indoor climate, maintenance and comfort. *BedreBolig* advisers must have a special quality management system approved by a control body or an accredited certification body. At least one employee in an enterprise must undergo the training for the enterprise to be accredited by the Danish Energy Agency under the scheme.

Knowledge Centre for Energy Savings (Videncenter for Energibesparelser, VEB)

VEB is a service for tradesmen and educational institutions concerning energy efficiency improvements. The centre has worked with industry organisation within the area of mediating knowledge to its members, and VEB holds regular courses to support the general further education campaign run by the labour market training centres.

3.1.5. Availability of qualification, accreditation and certification schemes (EED Article 16)

Denmark currently has various schemes for conducting energy audits of buildings and production processes in enterprises; the latter under the name of 'Registration scheme for energy audit consultants'. At the same time, in connection with the setting up of the *BedreBolig* scheme (see above section), a training course has been set up with the aim of training advisers to offer comprehensive, professional advice on energy renovation of homes.

Buildings

Energy labelling of buildings must be carried out by an energy consultant employed by a certified energy labelling company. In order to obtain certification, the company must introduce a quality assurance system in accordance with ISO 9001 with certain supplementary skills requirements for energy consultants.

In order to qualify as an energy consultant, it is necessary to pass the Energikonsulent I (Energy Consultant I) course, entry to which requires a relevant basic education in construction engineering at a minimum of level 4 or higher of at least three years' duration, in accordance with the Danish qualification framework for lifelong learning. Energy consultants must also complete a refresher course every three years. The specific requirements are set out in the memo *Energistyrelsens krav til virksomheder der udfører energimærkning* (The Danish Energy Agency's requirements for companies that carry out energy labelling), which can be found at:

<https://www.retsinformation.dk/Forms/R0710.aspx?id=185076>

More information about the scheme is available at: <http://www.ens.dk/EM>

Registration scheme for energy audit consultants

The registration scheme for energy audit consultants is a combined registration and quality assurance scheme for energy audit consultants at levels A and B, technical experts and verifiers for the benefit of industry and commercial enterprises.

The registration and quality assurance scheme is aimed at ensuring that energy audit consultants registered under the scheme are qualified to:

- Perform voluntary energy audits;
- Assist enterprises that wish to enter into an energy efficiency agreement with the Danish Energy Agency in drawing up and implementing energy management systems, including carrying out energy mapping, screening and drawing up energy action plans;
- Assist enterprises in selecting and performing special audits.
- In addition, the scheme is intended to ensure that technical experts are qualified to assist with verifications in connection with the conclusion of agreements.

The organisations behind the registration scheme for energy consultants are the Confederation of Danish Industry, the Danish Energy Association, Danish Agriculture & Food Council, Maskinmestrenes forening, Tekniq, FRI, HMN and the Danish Energy Agency.

The registration concerns the individual person. Registered energy audit consultants have an engineering background, advanced marine engineer, professional bachelor degree in marine engineering or technical manager offshore, and have proven theoretical and practical experience in implementing energy efficiency improvements and energy saving measures in commercial enterprises.

The following qualifications and professional experience must be able to be documented:

- Basic training and year of graduation
- Relevant further education
- Experience of project management:
 - A level: With several cooperation partners
 - B level: With external advisers
- Mapping of energy consumption and prioritisation of action areas

- Drawn up descriptions of installations on the basis of energy saving considerations
- Carried out technical/economic assessments of energy efficiency opportunities
- Responsibility for establishing the subsequent savings-related technical changes
- Evaluation of various energy saving measures
- Design/commissioning of energy management systems
- For A level, the requirement is a total of three years' experience within the last six years (3 000 hours)
- For B level, the requirement is a total of five years' experience within the last 10 years (5 000 hours)
- B consultants are required to have knowledge of energy/environmental management or quality control.

More information about the scheme is available at: <http://energisyndskonsulent.dk/>.

Renewable energy (RE) accreditation scheme

Denmark has also set up a voluntary accreditation scheme for enterprises that install small renewable energy systems. 'Small renewable energy systems' means biomass boilers and

stoves, solar photovoltaic and solar thermal systems, and heat pumps. Enterprises can choose to be accredited for one or more of the technologies. Enterprises can opt to be accredited within one or more of the technologies. The aim of the scheme is to promote efficient energy use and consumer protection. The accreditation scheme implements Article 14(3) of Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

Enterprises can obtain accreditation from the Danish Energy Agency as either RE fitters or RE installers. Accreditation entitles the enterprise to use the designation *VE-montørvirksomhed* (RE fitters) or *VE-installatørvirksomhed* (RE installers) in its marketing and the enterprise will be included on a list of accredited enterprises on the Danish Energy Agency's website. For accreditation as RE installers, the enterprise must already be authorised as electrical or plumbing and heating installers. In order to become accredited, the enterprise must also have a quality control system approved by a supervisory body for RE fitters and RE installers. The staff of the enterprise must meet specific training requirements, see <http://www.ens.dk/forbrug-besparelser/byggeriets-energiforbrug/ve-godkendelses-ordningen/virksomhed>.

Accreditation of verifiers

The Danish accreditation body (DANAK) was selected by the Danish Safety Technology Authority to be the national accreditation body in Denmark. In connection with accreditation, DANAK assesses the skills of, for example, a certification body.

At present, there are three certification bodies accredited by DANAK to certify energy management systems as complying with DS/ISO 50001. In addition, there are at present five certification bodies accredited by DANAK to certify environmental management systems as complying with DS/EN ISO 14001.

If enterprises subject to Article 8 EED can satisfy the requirement of energy audits on the basis of a certified ISO 50001 energy management system, there are at present certification bodies which may be expected to be able to undertake such audits under ISO 50001. This similarly applies to certifications to the ISO 14001 environmental management system.

3.1.6. Energy Services (EED Article 18)

The definition of energy services is given in Article 2(7) of the Directive. On the basis of the Directive's definition, Denmark is working with a relatively broad definition of energy services. Thus, energy services include a wide range of activities promoting energy savings and energy efficiency. In Denmark, the term 'energy services (*energitjenester*)' therefore covers various activities such as advice, information, training, installation of equipment and appliances, technological development, and financing models. Energy services can also be a combination of these activities

In connection with energy saving by energy companies, there are, as described in section 3.1.1, a large number of energy saving actors offering households, public institutions and enterprises various types of energy services. These actors include various types of tradesmen and installation companies, consultant engineers, and more specialised energy saving companies. They are typically focused on the realisation of energy savings, and they offer consumers advice and other professional assistance prior to the actual realisation.

In addition, several initiatives have been taken in Denmark to promote energy services. The Danish Energy Agency's website www.spareenergi.dk has been developed to be an entry point for all final customers, including households and the public and private sectors, who want to improve energy efficiency. The website provides guidance, advice and tools aimed at the target groups. This means that www.spareenergi.dk is the entry point for various types of energy service providers and advice services. This includes the following:

- *Håndværkerlisten* (the tradesman list), <http://spareenergi.dk/forbruger/vaerktoejer/haandvaerkerlisten/> The aim of the tradesman list is to give the final customer an easy way to find energy solutions and, at the same time, to point to some tradesmen who could carry out the task. The focus is on energy savings in buildings.
- *Varmepumpelisten* (the heat pump list), <http://spareenergi.dk/forbruger/varme/varmepumper/varmepumpetyper> The aim of this list is to provide an overview of the different types of heat pump and help in choosing the right one.
- *Find rådgiver* (Find an adviser) <http://spareenergi.dk/forbruger/vaerktoejer/bedrebolig/find-en-raadgiver>, makes it easy to find a qualified adviser who can help you get started with a more comprehensive energy renovation. Via the list, users can be referred to local BedreBolig advisers, who are either accredited to provide advice to owners of detached houses or large buildings, e.g. apartment blocks.
- Advice on replacing oil-fired boilers, <http://spareenergi.dk/forbruger/boligen/raadgivning>. The Danish Energy Agency has financed an advice scheme aimed at helping and advising home owners who want to replace their oil-fired or natural gas boilers with another form of heating (see more on this below).
- *Videncenter for energibesparelser i bygninger* (Knowledge centre for energy savings in buildings), <http://www.byggeriogenergi.dk/> A scheme which was continued in the latest energy policy agreement of March 2012. The knowledge centre collects and disseminates knowledge about concrete and practical ways to reduce energy consumption in buildings. The knowledge centre does this by helping the parties in the construction industry to improve their qualifications and gain new tools to implement energy saving measures in buildings. The knowledge centre is aimed both at the construction industry and individuals seeking advice and guidance.

- *Energiselskabernes Spareindsats* (Energy saving by energy companies)
<http://www.ens.dk/forbrug-besparelser/energiselskabernes-spareindsats> This initiative is referred to in more detail in section 3.1.1. As part of the scheme, grid and distribution companies can provide advice and information on savings and enter into agreements with actors and direct contracts with consumers concerning financial involvement in and realisation of savings in their own networks.

Advice concerning the phasing-out of oil-fired boilers in particular in favour of heat pumps
Denmark has also instigated an initiative to promote the use of energy services to stimulate the replacement of oil-fired boilers in particular in favour of more energy-efficient heat pumps. According to the concept, the enterprises install and operate these for home owners, who are charged for the heat that is supplied.

The enterprises assume responsibility for:

- *Installation*

Covers the purchase of the heat pump, the provision of advice, design, installation of the heat pump and commissioning.

- *Ownership*

Covers financing and responsibility for repayment

- *Maintenance*

Covers statutory supervision, servicing, repairs, spare parts and other forms of maintenance.

- *Operation*

Covers the purchase of energy to power the heat pump and the supply of heat to the building.

An agreement between a customer and an energy service enterprise typically involves the customer paying a one-off amount in the form of a connection contribution, a regular subscription and charges for its heat consumption.

The initiative has encompassed concept development, testing and demonstration, and since autumn 2016 nationwide roll-out in collaboration with five enterprises. It is anticipated that the experiences gained with energy services for heat pumps will spread to other enterprises and that it will represent a widely available alternative to householders themselves being responsible for the investment, ownership and operation of the heat pump. The enterprises have the broadest possible scope to customise their solutions to ensure that they become as competitive as possible.

It is possible to find more information on heat pumps as an energy service. It is recommended that new enterprises visit

<https://ens.dk/ansvarsomraader/energibesparelser/varme-og-ventilation/stoette-til-nyt-forretningskoncept>

Energy saving by energy companies

In connection with energy saving by energy companies, there are, as described in article 3.1.1, a large number of energy saving actors offering households, public institutions and enterprises various types of energy services. These actors include various types of tradesmen and installation companies, consultant engineers, and more specialised energy saving companies. They are typically focused on the realisation of energy savings, and they offer consumers advice and other professional assistance prior to the actual realisation.

ESCO (Energy Service Companies)

A number of Danish enterprises offer more specific energy services in the form of various kinds of ESCO cooperation. Danish municipalities in particular have made use of various ESCO models.

In order to promote the use of energy services, the Danish Energy Agency disseminates information and best practice concern ESCO in relation to energy renovations in particular.

Other organisations

In addition to the specific initiatives started by the Danish Energy Agency to promote energy services, various other organisations are also working on promoting energy services. These include, among others:

- The energy service (www.energitjenesten.dk) provides free and impartial information on energy savings and renewable energy.
- Bolius, www.bolius.dk Bolius was established for the purpose of providing home owners with impartial, understandable and accessible knowledge on housing. Bolius is owned by Realdania, a non-profit commercial association.
- Danish Technological Institute, www.teknologisk.dk, a GTS (accredited technological service) institute, a non-profit organisation working for innovation and technological development in Danish enterprises.

The national market for energy services

In connection with the development of markets for energy services, the focus from the Government side has been on advice and information. The Danish Energy Agency's work on energy services is largely focused on gathering advice on energy services and focusing on the areas in which many people will benefit from receiving energy services. This also entails lists of available and qualified suppliers of energy services. The advice is aimed at all types of end user, including households, the public sector and enterprises. The Danish Energy Agency has also promoted the market for energy services on the transport side through strategic partnerships for the rolling out of electric vehicles.

Households, including private housing, are a large part of the Danish Energy Agency's work of promoting energy services. A large number of the above-mentioned energy services are therefore focused on households, not least the renovation of housing. The BedreBolig scheme is important in this context in order to promote a market for energy services amongst private home owners. As with energy saving by energy companies, a major element consists of promoting the market for energy services in the form of a focus on advice and support for the implementation of energy saving measures in, among others, private households.

Enterprises, both small and large, can also receive a lot of help to promote energy efficiency from the Danish Energy Agency, with www.SparEnergi.dk forming the backbone of the advice effort. Special advice tools have been developed for SMEs which can also be of benefit to large enterprises. RE for production processes is another initiative aimed at enterprises (see section 3.4.1) in which support is provided for the implementation of energy efficiency measures in production processes in connection with the conversion to renewable energy and district heating.

In the public sector, there has long been a focus on various models for energy services, and, in particular, various forms of ESCO model have been used in Danish municipalities. Many municipalities have made use of these energy services to promote energy efficiency and energy savings, primarily in connection with energy optimisation of the municipalities'

existing buildings. In December 2013⁸, a study of the use of ESCOs by Danish municipalities found that around 30 out of 98 municipalities use ESCOs. According to this study, experience of ESCOs in the municipalities is still limited, because the lifetime of the projects is relatively long. One conclusion from the study was that there are large variations in the various ESCO cooperations and projects, depending on the size of the project and the municipality's own size and resources.

Back in 2009, some trials were made of standard contracts for ESCO models. There were also various attempts to promote ESCOs through, for example, workshops. Meanwhile, the above-mentioned study of the use of ESCOs by municipalities concluded that designing standard contracts did not necessarily make any sense in the light of the many different ways of conducting ESCO projects.

There are a large number of private ESCO providers who, depending on the size of the project, help with advice, installation and operation. The vast majority of the projects are aimed at buildings, whether they concern households, enterprises or municipalities.

3.1.7. Other energy efficiency measures of a horizontal nature (EED Articles 19 and 20)

Incentives for energy improvements to rented properties

In May 2014, the Rent Act was amended through the 'Act amending the Act on rent, the Act on temporary regulation of housing conditions, the Act on urban renewal and the development of urban areas and various other acts'. One of the purposes of the Act was to make it easier and more attractive for landlords and tenants to carry out energy-saving measures.

In particular, the proposals concerning cost-effective energy improvements and agreed green urban renewal ensure that, relative to the existing legal situation, the gains from carrying out energy improvements in private rented properties will be divided differently between the landlords and tenants so that it is more attractive for landlords to make energy improvements without changing the tenants' overall housing costs.

Specifically, a landlord can demand an increase in rent for completed energy saving measures, e.g. concerning the building envelope which results in energy savings for the tenants in the property. This increase must be based on the total expenses which have reasonably been incurred in carrying out the work and may not exceed the saving that the measure entails for the tenants.

Public sector procurement

With the revision of the Danish circular on energy efficiency in state institutions No 9477 of 2 July 2014, the requirement for energy efficient public sector procurement was expanded to also encompass the procurement of services where this is profitable based on an assessment of socio-economic and environmental factors, etc.

⁸ 'ESCO i danske kommuner, en opsamling af motiver, overvejelser og foreløbige erfaringer med ESCO i kommunale bygninger' (ESCOs in Danish municipalities: a collection of themes, reflections and experiences so far with ESCOs in municipal buildings), Statens byggeforskningsinstitution (Danish Building Research Institute), Aalborg University 2013.

3.2. Energy efficiency in buildings

3.2.1. Addressing the requirements of the recast Energy Performance of Buildings Directive (EPBD) (2010/31/EU)

In connection with the reporting requirements on the energy performance of buildings, Denmark has produced calculations of cost-optimal levels of minimum energy performance requirements. These calculations can be found in the report ‘Cost-optimal levels of minimum energy performance requirements in the Danish Building Regulations’.

The report is available at:

http://ec.europa.eu/energy/efficiency/buildings/implementation_en.htm

In addition, in accordance with the requirements of Article 10(2) of Directive 2010/31/EU on the energy performance of buildings, Denmark has drawn up a list of measures and instruments aimed at promoting the objectives of the Directive. The list can be found at:

http://ec.europa.eu/energy/efficiency/buildings/doc/dk_letter.pdf

3.2.2 Strategy for the Energy Renovation of Buildings (EED Article 4)

See Annex B, Denmark’s building renovation strategy

3.2.3 Additional measures addressing energy efficiency in buildings and appliances

Energy-efficient appliances and equipment

A campaign to improve the energy efficiency of appliances and products is an important part of the Danish effort to improve energy efficiency, in which energy labelling and ecodesign requirements are the two most important schemes. In addition, there are the Energy Star programme and European industry agreements. All of these share a European dimension in which Denmark is following the EU’s targets and energy requirements for products and appliances.

At the end of 2016, there were direct requirements for over 50 product types, and the horizontal ecodesign regulation concerning standby and network standby will impose further requirements on a large number of products. Previously, the schemes mainly covered household appliances, but in future they will also cover building components (e.g. windows) and products aimed at enterprises (e.g. various types of pump, electric motor, etc.).

In 2013, the Danish Energy Agency conducted an analysis of the Danish energy saving impact as a result of ecodesign requirements and energy labelling for products. The analysis calculated the impact of the ecodesign requirements to be 5 640 GWh per year in 2020, corresponding to 5 % of energy consumption in 2011 excluding transport. The requirements are therefore making a significant contribution to reducing Danish energy consumption.

3.3. Energy efficiency in public bodies

3.3.1 Central government buildings (EED Article 5)

Denmark has notified the Commission that Article 5 of the EED has been implemented using the alternative approach involving the establishment of an energy saving target expressed in MWh. An inventory of heated and/or cooled central government buildings is not mandatory

if a Member State opts for the alternative approach in Article 5(6) and if the energy saving target is expressed in terms of values (see the Commission's guidance).

Denmark has therefore not published such an inventory. However, the calculation of the absolute energy saving target under the alternative approach, which is equivalent to the standard method's potential, is based on data which correspond to the key figures required pursuant to Article 5(5). The calculation is therefore based on relevant extracts of the area from the BBR register and the energy performance from the database over energy labels for central government buildings.

The calculation of the absolute energy saving target under the alternative approach, which is equivalent to the standard method's potential, is based on a method where the design of all central government buildings in the BBR register over 250 m² which are not protected is altered to fulfil the minimum requirements for energy performance. The total energy saving potential is obtained by multiplying the unit potential by the total population area for each energy label which is below the applicable minimum requirement. The absolute energy saving target is calculated as 3 % of the potential gradually over seven years.

In Denmark, there is a tradition of using a broad range of energy saving measures and instruments, including behaviour modification. The alternative approach is therefore closest to the methods that have previously been used for central government buildings. The energy saving obligation is regulated in a circular on energy efficiency improvements to central government institutions (2104). This is a framework management circular which gives the ministries freedom in relation to methods to fulfil the percentage energy saving potential (calculated as the ratio between the absolute energy saving target and the government's reference energy consumption).

In 2016, a midway evaluation was carried out of the energy efficiency measure. The ministries state that all types of energy improvements are carried out:

- Lighting and appliances
- Building envelope
- Installations
- Energy supply
- Water savings
- Other measures, including the relocation or reduction of activities, energy screening, behavioural campaigns and night rounds

Every year, each ministry reports its heat and electricity consumption to a database provided by the authorities. Among other things, the database is used to monitor the central government's energy consumption with a view to following target fulfilment of the EED and to raise the profile of the initiative as a tool. Finally, the energy consumption is used as underlying data for an annual calculation of the Danish Parliament and for annual reporting to the European Commission.

3.3.3 Central government buildings (EED Article 6)

With the revision of the Danish circular on energy efficiency in state institutions No 9477 of 2 July 2014, the requirement for energy efficient public sector procurement was expanded to also encompass the procurement of services where this is profitable based on an assessment of socio-economic and environmental factors, etc.

3.4. Other end use energy efficiency measures, including in industry and transport

3.4.1 Main policy measures addressing energy efficiency in industry

Voluntary agreement scheme

Since 1996, the Danish Energy Agency entered into energy efficiency agreements with large, energy-intensive enterprises in Denmark. The aims of the schemes have been to ensure that the competitiveness of energy-intensive enterprises is not weakened by energy taxes and to promote energy efficiency in energy-intensive enterprises.

With the agreement to roll-back the security of supply tax (FSA) and grant reductions in the PSO tax from July 2014 and the agreement concerning *Vækst og udvikling i hele Danmark* (Growth and development throughout Denmark) dating from February 2016, electricity-intensive enterprises can receive grants for their PSO payments in return for entering into an agreement concerning energy efficiency improvements with the Danish Energy Agency. The scheme entered into force on 10 September 2015, and in December 2016, the scheme was expanded to cover a wider circle of enterprises.

In order to take part in the scheme, the enterprises enter into a three-year agreement, which requires them to develop, implement and maintain an energy management system which is certified in accordance with the DS/EN ISO 50001 standard and the Danish Energy Agency's supplementary requirements for the energy management system. The enterprises will carry out electricity saving projects with a repayment period of less than five years and carry out special investigations concerning energy conditions with the aim of identifying potential initiative areas for energy efficiency improvements.

Energy saving by energy companies

As is apparent from article 3.1.1, a very high proportion of the energy savings made by the energy companies are achieved within enterprises. During the period 2012-2016, between 50 and 60 % of energy savings were achieved within enterprises.

International cooperation on energy efficiency in industry

In addition to the national focus on energy efficiency in industry, for a number of years Denmark has done a lot of work on spreading energy efficiency in enterprises in other countries. The aim is to spread and transfer Denmark's many positive experiences with energy efficiency, focusing on, among others, enterprises and industry.

Under *Klimapuljen 2017* (the Climate Envelope for 2017), a total of DKK 115 million is expected to be allocated to assist selected growth economies in the transition to low emissions and energy efficiency improvements are being supported in three countries. In Vietnam, aid is being given to the formulation of EE regulation in industry, in China efficient district heating is being supported and in Mexico work is under way on a voluntary agreement scheme for industry. In addition, the Danish Energy Agency has numerous minor programmes in Indonesia and Ukraine and elsewhere which support energy efficiency improvements.

3.5 Energy efficiency measures in transport

3.5.1 Main policy measures addressing energy efficiency in transport

In Denmark, a large number of initiatives have been taken to promote energy efficiency in the transport sector.

Measures which can improve energy efficiency in public transport

- Transition from diesel to electric trains on main lines. The transition is being financed by *Togfonden* (the Train Fund; see below).
- Energy efficiency requirements for taxis

Measures which can make public transport more attractive

- In 2012, the previous government entered into an agreement concerning fare reductions and investments for improvements to public transport.
- Metro expansion in Copenhagen (City Circle Line, the Nordhavn metro, the Sydhavn)
- Establishment of light railways in Aarhus, Odense and Letbane in Ring 3 (the Capital Region)

Zones

- Environmental zones in Odense, Aalborg, Copenhagen/Frederiksberg and Aarhus

Programmes to encourage eco-driving

- Mandatory refresher courses for professional drivers which include ‘green driving’. The refresher courses are mandatory under EU law, but the ‘green driving’ element is a Danish national interpretation within the framework of the Directive.

Financial support for sustainable transport measures

- Financial support for *En grøn transportpolitik* (A green transport policy). With the agreement concerning a green transport policy (from January 2009, funding was allocated for the establishment and extension of numerous funds to ensuring an ongoing, targeted initiative within a large number of prioritised focus areas, including cycling, the promotion of goods transport by rail, etc.
- In 2014, the previous government entered into an agreement concerning a modern railway implementation of *Tog-fondenDK* for rail improvements and electrification.

Tax incentives

- In 2007, vehicle taxation was changed so that the registration tax was reduced for cars with low fuel consumption.
- A green owner’s tax related to the vehicle’s fuel consumption has existed since 1997.
- Phasing of electric cars into the general tax system in 2020 and hydrogen cars in 2023 will entail lower registration fees for electric cars and hydrogen cars through until these years.

3.5.2 Savings arising from transport measures

Savings until 2016

The energy consumption of the transport sector in Denmark rose in the period between 1990 and 2007, when the energy consumption was 224 PJ. From 2007 to 2012, energy consumption in the transport sector fell, amounting to 204.8 PJ in 2012⁹. It is difficult to ascribe this fall in energy consumption to the individual measures mentioned in section 3.5.1. Ex ante and ex post analyses of the energy savings achieved or expected to be

⁹ Danish Energy Agency Baseline projection, <https://ens.dk/service/fremskrivninger-analyser-modeller/basisshyffremskrivninger>.

achieved as a result of the implementation of the above-mentioned measures have only been conducted to a limited extent.

The financial crisis which took hold in 2008 led to reduced fuel consumption in both the private sector and in industry. The change in vehicle taxation in 2007 had a major influence on what new cars are bought, especially by private individuals.

For many years, there has been a positive trend towards increasingly energy-efficient vehicles. The more energy-efficient a car is, the less CO₂ it emits per kilometre. Since 2008, average emissions from new cars in Denmark has been below the EU average, and by 2010 Denmark had already dropped below 130 grams of CO₂, which is the maximum mean emissions level which the car manufacturers' ranges must amount to in 2015. CO₂ emissions from new cars sold in Denmark have decreased from 125 g/km in 2011 to 110 g/km in 2014. This represents a reduction of over 12 % in three years.¹⁰

Expected savings up to 2020

The EU's policies within the area, combined with the measures referred to in the section above, are expected to provide a basic development with continued slackening of the transport sector's energy consumption up to 2020. In 2020, the transport sector's energy consumption is expected to amount to 214.5 PJ, which will result in almost constant emissions of CO₂ relative to the previous years. In 2020, CO₂ emissions in the transport sector are expected to amount to 13.1 million tonnes¹¹.

3.5.3 Financing of energy efficiency measures in transport

The Danish Parliament has allocated DKK 5.9 billion for the electrification of the Danish rail network.

3.6 Promotion of efficient heating and cooling

3.6.1. Comprehensive assessment

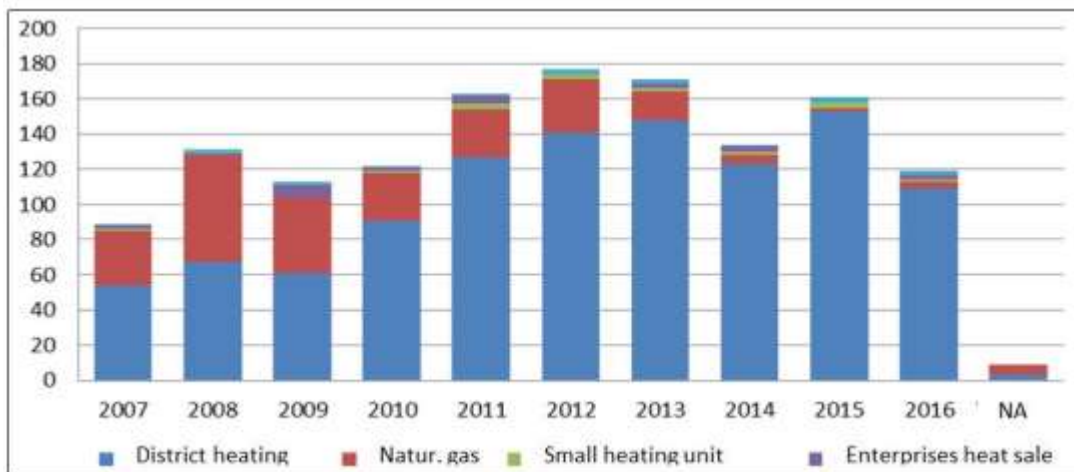
The Danish heating market almost entirely complies with the requirement for high-efficiency cogeneration and efficient heating and cooling which is referred to in Article 14(1). All combined heat and power plants with a capacity of up to 25 MW_{el} and all district heating plants can only be approved and renovated on the basis of a project proposal which documents that the plant concerned offers the best solution from a socio-economic perspective. This is assessed through a cost-benefit analysis based on a method which has been used since the early 1990s. The requirement for a socio-economic assessment applies to all material changes in collective heating systems (e.g. change in fuel, conversion from individual heating system, etc.) and the establishment of new collective heating systems. The municipalities are responsible for the processing and approval of collective heating systems. A recent survey estimates that over 1 500 projects have been subject to a socio-economic assessment during the past ten years (see Figure 1).

¹⁰ TBBST 2015,

http://www.fstyr.dk/~media/Dokumenter/04%20Krav%20til%20koretojer/Groen_transport/Forsogsordningen/2015/Publikation%20Udvikling%20i%20nye%20bilers%20br%C3%A6ndstofforbrug%202014_endelig.pdf.

¹¹ Danish Energy Agency, Baseline projection 2016.

Figure 4. Number of approved project proposals in Denmark: 2007-2016



NB: The survey covers 87 of the country's 98 municipalities (30 January 2017).

The establishment of and major renovation projects concerning power stations with a capacity exceeding 25 MW_{el} must be formally approved, but are exempt from the requirement for a cost-benefit analysis. This comprehensive assessment showed considerable unutilised potential for district cooling. In order to stimulate the utilisation of this potential, the government is proposing to change certain aspects of the current regulations. See Article 3.6.1(4).

The socio-economic potential for developing the district heating market has largely been fully utilised in Denmark. According to an extensive analysis from 2014 (*Fjernvarmens rolle i den fremtidige energiforsyning* (The role of district heating in future energy supply)), it is primarily in existing supply areas that further expansion will make socio-economic sense (densification of the existing district heating network).

The economic potential for cogeneration is similarly considered to be fully utilised and generally declining. This is primarily due to the major expansion of wind and solar energy. In 2016, the Danish government therefore proposed amendments to the regulations concerning cogeneration. These regulations are still the subject of negotiation. The proposed amendments to the regulations forms part of a collective strategy for the supply sector. The strategy therefore also contains initiatives to promote new district cooling.

The following initiatives form part of the government's strategy (*Forsyningsstrategi* (Supply Strategy), September 2016):

Combined heat and power

- Phasing out the current requirement for cogeneration in small district heating plants.

District cooling

- Allow district heating companies to finance preliminary investigations into district cooling.
- All municipal supply companies to use all district cooling technologies and intermunicipal activities within the field.

3.6.2. Individual installations: cost-benefit analysis and results

In April 2014, new regulations were introduced which ensured compliance with Article 14(5) of the Energy Efficiency Directive. The regulation specifies that cost-benefit analyses must be carried out in accordance with Part 2 of Annex IX when:

- extensive renovation is established and carried out on existing installations which primarily supply energy for purposes other than building heating and hot water supply and which have a total thermal input exceeding 20 MW
- district cooling plants with a thermal input exceeding 20 MW are constructed or subject to extensive renovation.

3.6.3. Individual installations: exemptions and exempting decisions

No new exceptions have been added since NEEAP 2014.

3.7.1. Energy efficiency criteria in network tariffs and regulations

Network tariffs

According to Article 73 of the Electricity Supply Act, grid operators must price their services according to reasonable, objective and non-discriminatory criteria relative to the costs that the individual customer categories give rise to. The starting point is therefore a requirement for cost-oriented prices and the same prices for comparable consumer categories.

Pursuant to Article 37 of the Natural Gas Supply Act, prices for services provided by distribution companies and PSO companies are set taking into account the procurement of energy, salaries, services, administration, maintenance, other operating expenses, depreciation and return on capital. The prices must be determined in accordance with reasonable, objective and non-discriminatory criteria in relation to the costs that the individual users of the grid and users give rise to.

With the aim of stimulating efficient grid utilisation and security of supply, the grid companies are now permitted to differentiate their prices to a limited extent. Price differentiation on the basis of geographic criteria is only permitted for a limited period of time. The aim of this is to give enterprises the opportunity to develop and test, for example, time-differentiated tariffs with a view to promoting better network utilisation by reducing demand on the networks at peak periods.

It is not possible to apply differentiated tariffs for the gas distribution companies for a limited period of time. However, as part of the government's supply strategy, the option of having differentiated tariffs as part of the possible consolidation of natural gas distribution is to be reviewed. This would require the Natural Gas Supply Act to be amended.

The prices for electricity and gas are set according to methods to be approved by the Danish Energy Regulatory Authority. The individual enterprises will subsequently set their prices within the framework of the approved methods.

Wholesale model

The wholesale model, which entered into force on 1 April 2016, means that electricity trading companies have become the central actor on the electricity retail market. The electricity trading companies buy grid services from the grid operators and sell a packaged product 'supplied electricity' to consumers. Thus, the grid operators no longer bill consumers directly, but bill the individual electricity trading companies for a total amount once a month. The electricity trading companies are not obliged to pass on the grid operators' tariffs to the consumers unchanged. If the grid operators want to influence consumers, their price signals will have to be strong enough for electricity trading companies to recognise that it is in their own interest to pass them on in their tariffs.

The electricity trading companies set their own tariffs. They need no approval from the authorities. This must be seen in the light of the fact that electricity consumers are free to choose their supplier and free to choose between the products on offer.

There is no wholesale model for the gas market. However, as part of the government's supply strategy, an analysis is to be carried out to determine whether a gas wholesale model should be introduced like the model that is used for the electricity market. However, before a decision is taken regarding a possible gas wholesale model, experience must be gained from the electricity wholesale model.

Fixed and consumption-related tariffs

The grid operators have a lot of freedom in their methods for setting the balance between fixed and consumption-related tariffs. Until the middle of 2013, around 50 % of the grid operators' total income consisted of subscription charges and the remaining 50 % of consumption-related tariffs. In 2013, the Danish Energy Association¹² issued a guideline on a relative reduction of the fixed charge which resulted in, among other things, the largest grid operators reducing their subscription charges by 43 %.

It is expected that the introduction of the wholesale model will create the basis for further reductions in the grid operators' subscription charges. The mere fact that a large share of the payment for network services will become consumption-related will give consumers an incentive to improve efficiency and reduce their energy use.

Connection fees

With the introduction of the wholesale model, the grid operators' contacts with customers will be reduced to being responsible for meters and ensuring connections to the grid based on connection agreements.

The grid operators may, among other things, as part of intelligent network utilisation, need to enter into agreements on interruptibility of supplies in special situations. Therefore, from the date on which the wholesale model enters into force, the grid operators will be able to take the initiative to enter into interruptibility agreements as part of their connection agreements with consumers with consumptions over 100 000 kWh.

3.7.2. Energy efficiency in demand response

Demand response

Apart from the grid operators' relatively high subscription payments, which are expected to become much lower with the introduction of the wholesale model in 2015, payments for transmission and system services, electricity taxes and VAT are consumption-dependent (øre/kWh).

However, at present there is widespread use of 'template billing' (*skabelonafregning*), which is an obstacle to demand responses from non-hourly billed consumers. Under template billing, consumption is measured once a year and the same tariff per kWh is paid regardless of when the consumption takes place. Around 50 % of Danish electricity consumption is subject to template billing.

Consumers with consumption over 100 000 kWh, who also account for around 50 % of total electricity consumption, must be billed on an hourly basis. Consumers with consumption below 100 000 kWh have the option of hourly metering and hourly billing, but the transaction costs have been so high that very few have taken up the option.

¹² Industry organisation for energy companies in Denmark.

Remote electricity meters

With **Executive Order No 1358 of 3 December 2013** on remote electricity meters and metering of electricity at end use, grid operators will be obliged to install remote electricity meters with hourly reading for all electricity end users by the end of 2020. The Executive Order lays down requirements concerning the functionality of the meters, including that it must be possible for consumers to connect external devices and continuously extract consumption-related data.

The Executive Order replaced Executive Order No 783 of 29 June 2011, which contained the same technical specifications, but required the meters to be installed on a voluntary basis.

Remote electricity meters are expected, to a certain extent, to raise consumers' awareness of their consumption and thus their interest in using energy more efficiently.

Once a cost-effective model for hourly billing of end users has been introduced, which is expected to take place in the middle of 2017, the grid operators will be obliged to report hourly data on their remotely metered consumers to Energinet.dk's datahub, from which the electricity trading companies will retrieve consumption data for billing purposes.

Natural gas consumers with a consumption of over 300 000 m³ natural gas have installed hourly meters.

Flexible billing

Flexible billing is a cost-effective model for hourly billing of end users which is being developed as part of Energinet.dk's datahub. Flexible billing is expected to come into operation in the middle of 2017.

Once flexible billing is introduced, all consumers with remote electricity meters will be able to use electricity products with time-differentiated tariffs. It will then be up to the grid operators and electricity trading companies to offer such products.

Over half of Danish electricity consumers already have remote electricity meters installed. All consumers will have installed remote meters by the end of 2020.

Nordic retail market

Since 2008, Denmark has worked, in cooperation with the other Nordic countries, on the development of a harmonised, efficient Nordic end-user market. The aim is to reduce market obstacles so that electricity customers can buy from suppliers throughout the Nordic region, and electricity traders can more easily set up business throughout the region. The work is supported by the Nordic regulators (NordREG), who have continuously drawn up recommendations for the implementation of a harmonised Nordic end-user market, including a single customer entry point to the market via the electricity supplier, combined billing, information exchange, free choice of supplier, information exchange[sic], access to consumption data, transparency, and phasing out of supply obligations.

Denmark is a long way towards implementing NordREG's recommendations. Demand-response is high on the agenda in the Nordic countries. For example, studies have been carried out which clarify the potential for demand-response in the Nordic electricity market and possible strategies for utilising this potential. Particular emphasis is being placed on the role of consumers and on how best to make use of the interplay between the electricity market and other energy markets in the Nordic region. The Nordic TSOs are heavily involved in this work.

In the gas market, it is possible for all interested transport customers to purchase capacity to/from Denmark and on to/from other European countries. In Denmark, Energinet.dk sells the entire transmission capacity on the border to Germany and Sweden at auctions via the common European platform PRISMA. As the auctions via PRISMA are synchronised, this means that the capacity of the gas pipes in most European countries is sold simultaneously. This has at least two benefits: one is that transport customers have the same possibility to purchase capacity in Denmark and across Europe. In addition, the transport customer is able to plan his entire route and obtain the various parts of the capacity simultaneously.

The trend in Denmark, as in the rest of Europe, is for transport customers to purchase their gas via exchanges to a greater extent. This means that the liquidity in the Danish gas exchange Gaspoint Nordic is rising steadily. In other words, competition in the Danish wholesale market is gradually improving. The price of gas in Denmark fluctuates with the gas price in other European countries. In addition, there are promising signs that the Danish gas market is functioning satisfactorily, as gas often flows from a high-price area to a low-price area. This means that when there is a lot of gas in Denmark, the gas flows southwards to Germany and vice versa.

Regulating power market

The increased integration of wind power, resulting in more fluctuating production, increases the need for the system operator to be able to utilise flexibility on the consumer side. The threshold for bids in the Nordic regulating power market has limited the exploitation of the potential for consumption flexibility for many operators in Denmark. System operators in Finland, Norway, Sweden and Denmark have agreed to strengthen the regulating power market and investigate the possibility of improving the conditions for including electricity consumption in the market as a resource for flexible balancing of the electricity system. The investigations will focus on the possibility of lowering the threshold for bids in the regulating power market from 10 to 5 MW and removing the requirement for online metering of consumer units below 5 MW. Pilot projects are therefore being conducted in all four countries, and the Danish project will involve a Danish company and its Norwegian balance responsible party (BRP).

3.6.4. Energy efficiency in network design and operation

On 9 July 2015, Denmark submitted the report entitled *Potentiale vurderinger for energieffektivitet i el- og gasinfrastruktur i Danmark* (Potential evaluations for energy efficiency in electricity and gas infrastructure), which was prepared with a view to fulfilling Denmark's obligations pursuant to Article 15.2 of Directive 2012/27/EU. The reporting covers transmission and distribution grids for both electricity and natural gas, as well as the natural gas stores in Denmark.

The report was prepared by the Danish Energy Agency, Energinet.dk, the Danish Energy Association and HMN Naturgas I/S.

Annex A Annual report in accordance with the Energy Efficiency Directive

A.1 National energy efficiency target for 2020

The indicative targets for gross energy consumption (primary energy) and final energy consumption in 2020 corresponds to the energy consumption in the Danish Energy Agency's most recent baseline projection for energy consumption – Baseline projection 2017, which was published in March 2017. The baseline projection takes into account and includes the effects of all the instruments and measures included in the Danish energy policy agreement of 22 March 2012 and associated subsequent adjustments. In addition, the baseline projection also includes previously adopted measures which are still impacting on energy consumption, e.g. the energy agreement of 2008 and the tax reform of 2009.

Gross energy consumption in 2020 in the baseline projection, and therefore Denmark's indicative target in accordance with Article 3, is a gross energy consumption excluding consumption for non energy-related purposes of 719.6 PJ (17.19 Mtoe). This entails a reduction in gross energy consumption of 14.5 % in 2020 compared with 2006.

The corresponding indicative target for final energy consumption (excluding consumption for non-energy purposes) in 2020 is 604.3 PJ (14.43 Mtoe). This represents a 7.2 % reduction compared with 2006.

The Danish Energy Agency's baseline projection is based on a number of general economic assumptions (industrial output, private consumption, fuel prices, etc.), a number of technological assumptions (what different types of plant cost, how efficient they are, etc.) and assumptions concerning what energy market actors will do based on purely commercial considerations. Some qualitative estimates, e.g. concerning planning matters, may also be included.

The projections are based on a 'frozen policy' scenario in which instruments and measures from the latest energy agreement of March 2012 are included.

The baseline projections, including the models used, the assumptions and results are described in more detail in

Baseline projection 2017:

https://ens.dk/sites/ens.dk/files/Forsyning/bf2017_hovedpublikation_13_mar_final.pdf

- Background to the Baseline project 2017:
https://ens.dk/sites/ens.dk/files/Basisfremskrivning/baggrundsrapport_til_bf_2017.pdf

The data reported under Annex XIV are shown in Table 8 below.

Table 8: Key statistics

a) An estimate of the following indicators in the year before last (year X-2):		2013	2014	2015
i. primary energy consumption (gross energy consumption)	Adjusted, PJ	765	753	756
ii. total final energy consumption (including Non-energy purposes)	Adjusted, PJ	613	588	606
iii. final energy consumption by sector:				
industry (manufacturing)	Adjusted, PJ	85	84	84
transport (split between passenger and freight transport, if available)	Adjusted, PJ	2050	207	210
households	Adjusted, PJ	187	188	191
services (trade and service industries)	Adjusted, PJ	82	80	80
iv. gross value added by sector:				
industry (manufacturing, excluding Refineries)	DKK billions, constant 2010 prices	221	222	227
services (trade and service industries)	DKK billions, constant 2010 prices	1192	1210	1216
v. disposable household income (gross income)	DKK 1 000, constant 2010 prices	333	333	339
vi. gross domestic product (GDP);	DKK billions, constant 2010 prices	1814	1836	1855
vii. electricity generation from thermal power	PJ	85	69	53
viii. electricity generation from combined heat and power	PJ	83	66	51
ix. heat generation from thermal power generation	PJ	135	122	128
x. heat generation from combined heat and power plants, including industrial waste heat	PJ	98	84	86
xi. fuel input for thermal power generation	PJ	250	208	175
xii. passenger kilometres (pkm), kilometres	Million passenger-if available	69 711	71 258	73 658
xiii. tonne kilometres (tkm), if available	Million tonne kilometres	16 077	16 195	15 538
combined transport kilometres (pkm + tkm), if (xii) and (xiii) are not available				
xv. population (Jan 2011)		5 602 628	5 627 235	5 659 715

Source: Energistatistik 2015 (Energy Statistics 2012) and Statistics Denmark

A.3 Analysis of energy consumption trends (ok)

Adjusted gross energy consumption was 756 PJ in 2015 (including consumption for non-energy purposes and 745 PJ excluding consumption for non-energy purposes), which is 0.3 % lower than in 2014. Compared with 1990, gross energy consumption (excluding non-energy purposes) fell by 7.5 %, while compared with 2006, consumption fell by 12.5 %. In 2015,

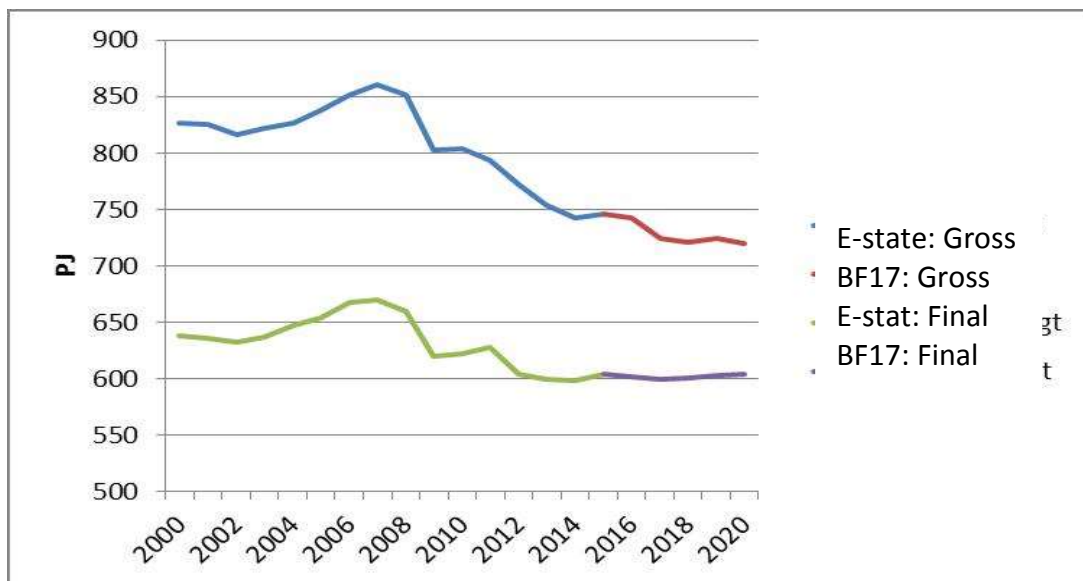
energy consumption in Denmark is at the same level as it was back in the early 1980s. At the same time, there has been an increase in economic activity as measured by gross domestic product (GDP), which means an improvement in energy efficiency in 2015 of 1.3 % compared to the previous year. Improved energy efficiency over recent decades meant that each unit of GDP required 38 % less energy in 2015 than in 1990.

In 2015, total final energy consumption (excluding consumption for non-energy purposes) is 9.4 % lower than in 2006. Final energy consumption rose by around 1 % from 2014 to 2015. This takes into account a renewed increase in consumption for transport following several years of stagnation and the fact that final energy consumption between 2014 and 2015 in manufacturing industries and the trade and services sector remained approximately constant in spite of economic growth. Final energy consumption in households has only risen by around 3 % since 2006 and by around 1.7 % from 2014 to 2015, despite an increase in the number of households and heated area.

Current developments in energy consumption are taken into account in the baseline projection of energy consumption until 2020.

Figure 5 shows the trend in gross energy consumption and final energy consumption in the energy statistics and in the projection through to 2020.

Figure 5: Trend in energy consumption excluding consumption for non-energy purposes



Source: Energistatistik 2012 (Energy Statistics 2012) and Danmarks Energifremskrivning 2012 (Denmark's Energy Projection 2012)

The table above shows the greatest change in electricity production at thermal plants and the fuel input involved. The changes from 2013 to 2014 are due primarily to changes in electricity imports: given that the level of electricity imports was higher in 2014 than in 2013, the level of electricity production in Denmark decreased accordingly.

In general, there is increased use in particular of wind power in the Danish energy system, the consequences of which include reduced energy consumption for electricity generation and district heating purposes.

A.4. Update on major measures implemented in the previous year

New agreement concerning the energy companies' savings initiatives

See the description of the new energy saving agreement of 16 December 2016 in article 3.1.1 above.

A.5 Central government buildings

Total floor area

In accordance with BBR (*Bygnings- og Boligregistret* - the Danish National Building & Dwelling Register) and information from building owners, central government has a total of 9.7 million m² of building area. Of this, it is estimated that 8.7 million m² amounts to the area in buildings which exceeds 250 m². It has also been estimated that 6.9 % of central government's building portfolio is either protected or worthy of protection. It is also estimated that 84 % of central government buildings are labelled in a class below the current standard for new-build. It follows from this that the total area of non-protected buildings over 250 m² owned and occupied by central government institutions is thus calculated to be 6.8 million m².

Denmark has notified the Commission that Article 5 using the alternative approach; see Article 6. Energy consumption by Danish ministries and underlying institutions, etc. is reported to a central database, which contains an inventory of the total energy consumption of central government. The database includes the central government's entire buildings portfolio, including buildings covered by Article 5(2) (e.g. listed buildings and buildings serving national defence purposes) which, under the Directive, may be exempted from the requirements set under (1). Furthermore, the database covers energy consumption in buildings which are covered by the national circular on energy efficiency improvements, but which do not fall within the scope of Article 5 of the Energy Efficiency Directive (e.g. rented buildings and buildings belonging to independent institutions, etc.)

From 2014-2015, energy consumption by central government fell by 76 044 MWh, corresponding to a decrease of 3.5 %. A small proportion of the consumption was calculated through the back-projection of validated data; hence the calculation is subject to a small amount of uncertainty.

The alternative approach

In Denmark, there is a tradition of using a broad range of energy saving measures and instruments, including behaviour modification. The alternative approach is therefore closest to the methods that have previously been used for central government buildings. The saving obligation for central government buildings is regulated in a circular on energy efficiency improvements to central government institutions (2104). This is a framework management circular which gives the ministries freedom in relation to methods to fulfil the percentage energy saving potential (calculated as the ratio between the absolute energy saving target and the government's reference energy consumption).

In 2016, a midway evaluation was carried out of the energy efficiency measure. The ministries state that all types of energy improvements are carried out:

- Lighting and appliances
- Building envelope
- Installations
- Energy supply
- Water savings
- Other measures, including the relocation or reduction of activities, energy screening, behavioural and night inspection rounds

Every year, each ministry reports its heat and electricity consumption to a database provided by the authorities. Among other things, the database is used to monitor the central government's energy consumption with a view to following target fulfilment of the EED and to raise the profile of the initiative as a tool. Finally, the energy consumption is used as underlying data for an annual calculation by the Danish Parliament and for annual reporting to the European Commission.

Annex B Building renovation roadmaps

See the annex regarding ‘Presentation to the Commission of a long-term strategy for mobilising investment in the renovation of residential and commercial buildings pursuant to Article 4 of the Energy Efficiency Directive’.

Annex C Status of initiatives in the ‘Strategy for the Energy Renovation of Buildings’ from 2014.

Annex D National plan for nearly zero-energy buildings

The National action plan for nearly zero-energy buildings can be found here:
http://ec.europa.eu/energy/efficiency/buildings/implementation_en.htm

Annex E Data used to calculate targets (see EED Article 7(1))

Final energy consumption

Source: Energy Statistics 2012

<http://www.ens.dk/info/tal-kort/statistik-nogletal/arlig-energistatistik>

PJ	2010	2011	2012	Avg.
Households	194.1	197.4	189.1	193.5
Commercial and Public Services	83.9	84.9	81.0	83.3
Agriculture and Industry	136.5	138.3	130.1	135.0
Total	414.5	420.6	400.1	411.7
Transport	209.7	210.2	204.8	208.2
Non-Energy use	11.0	12.4	11.5	11.6
Total	635.3	643.1	616.5	631.6

PJ

1.5% of final energy, excluding transport and non-energy	6.18
Saving in 2020	43.23
Cumulative savings 2014-2020	172.93

Cumulative savings with the Danish energy saving obligations

	2014	2015	2016	2017	2018	2019	2020	Total
2014	10.7	10.7	10.7	10.7	10.7	10.7	10.7	
2015		12.2	12.2	12.2	12.2	12.2	12.2	
2016			10.1	10.1	10.1	10.1	10.1	
2017				10.1	10.1	10.1	10.1	
2018					10.1	10.1	10.1	
2019						10.1	10.1	
2020							10.1	
Total							73.4	299.6