This document is an automatic machine translation to English and may not precisely depict facts or figures as they were intended in the original language.

Annex 9. Equivalence report according to Article 14(3) of the EPBD

Article 14 of the current EPBD1 has been implemented in Denmark by alternative measures, cf. paragraph 3 of that article.

This note compares the expected impact of the alternative measures for the period from 15 March 2023 to 15 March 2026 with the expected effect during the same period of implementation of an inspection scheme according to paragraph 1 of the article.

Similar equivalence reports have been prepared in the past for the periods 30 June 2011 to 30 June 2014, 30 June 2014 to 30 June 2017, 30 June 2017 to 10 March 2020 and 10 March 2020 to 15 March 2023.

Summary

The expected effects are shown in the table below.

Table 1 *Expected impact of implementation under paragraph 1 or alternative measures*

	Per year [TJ/year]	Accumulated
The effect of an inspection scheme in accordance with paragraph 1;	**1,85**	**5,55**
The Business Pool	166,5	499,5
Total impact, alternative measure	**166,5**	**499,5**

The assumptions and method of calculation of the effect of implementation under paragraph 1 are set out in Section 1 below, while the corresponding effect of the alternative measure is described in Section 2.

In addition to the alternative measure mentioned in Table 1, Denmark has information and advice measures, mainly via SparEnergi.dk and the Knowledge Centre for Energy Savings in Buildings, which can be expected to have an effect that can be partly equivalent to that of an inspection scheme under paragraph 1.

1 See Article 14(3) of Directive 2010/31/EU of 19 May 2010 on the energy performance of buildings (Building Directive), as last amended by Directive (EU) 2018/844 of 30 May 2018.

However, that effect has not been attempted to quantify, given that the expected impact of that alternative measure already significantly exceeds the expected impact of a supervisory regime under paragraph 1.

Amendments relating to equivalence report for the period March 2020 to March 2023
The so-called handlers' deduction lapsed in 2022 and therefore has no effect that can be taken into account in this report.
The Business Pool became operational in 2021 and will continue to 2029. The effect of the pool is therefore taken into account, as shown above and in section 2.

1) The effect of implementation in accordance with paragraph 1;

1a)
Number of relevant installations and their energy consumption;
The rules laid down in Article 14 shall*apply to "heaters or combined space heaters and ventilation systems with an effective rated output of over 70*kW". The rules apply only to local heating systems for a building, not district heating or process heating systems, etc.

There is no data source directly indicating the number of installations of the relevant type with rated power above 70 kW or their heat output.

The estimate below in Table 2 is therefore based on data from the BBR on the size and primary heat source of buildings, as well as the following assumptions and assumptions:

- Secondary sources of heat other than solar thermal installations shall be disregarded;
- The average power demand for heating is 70 W/m^2 (i.e. only buildings larger than 1.000 m^2 have installations of a power of more than 70 kW);
- The average heat input demand is 100 kWh/m^{2}years and the installations' production and consumption correspond to this demand;
- Boilers and direct heat have an efficiency of 1
- Large heat pumps have an average seasonal energy efficiency of 3;
- The maximum power of solar heaters is 700 W/m^2 (i.e. only systems greater than 100 m^2 have a power greater than 70 kW);
- There are approximately 150 building installed solar heating systems larger than 100 m^2, their total area is 25.000 m^2 and the average heat output per year is 500 kWh/m^2 (estimates provided by DTU)

Table 2 *Estimate of the number of relevant installations and their generation (electricity consumption in the case of heat pumps)*

	Number	Heat production/ electricity
Natural gas boilers	5.667	4.944
Oil boilers	1.793	1.352
Heat pumps	675	171
Electric heat	442	307

Danish Energy Agency

Carsten Niebuhrs Gade
43 1577 Copenhagen V

T: + 45 3392 6700
E: ens@ens.dk

www.ens.dk

Solid fuel boilers	367	248
Solar-thermal installation	150	45
	12.057	**10.733**

The estimate in Table 2 is subject to some uncertainty, partly because of the above assumptions and partly because the BBR register is not always accurate. However, it is assumed that:

the register is generally more accurate for large buildings than for small ones. Overall, the estimate is estimated to be sufficiently precise to be used in this context.

1b)

Installations exempted under paragraph 2

Paragraph 2 of that article provides*that "installations which are explicitly covered by an agreed energy performance criterion or by a contractual arrangement setting* out an *agreed level of energy efficiency improvement, such as an energy performance contract, or operated by an operator or a network operator*" are exempted from the inspection requirement in paragraph 1.

Therefore, a calculation of the power when implemented in accordance with paragraph 1 shall only include installations where there is neither an operator, such as a heat ester, nor a contract with an external provider that ensures a certain level of energy efficiency in the operation of the installation.
The scope of such exemptions has been assessed below.

Boilers

On the basis of interviews with the Danish Energy Association, as mentioned in previous equivalence reports, it has been estimated that 2/3 of oil and gas-fired plants of more than 20 kW are covered by a voluntary service inspection agreement, the main objective of which is to ensure energy efficient operation and resulting financial savings. For installations larger than 70 kW, the corresponding share is estimated to be slightly higher, namely 75 %.

The inspections mentioned include both boiler, automation, pumps, drainage and hot water storage tank, and the building owner or operator will typically also be advised on options to replace a boiler or other component with a newer and more energy-efficient version.

Heat pumps

As mentioned in the latest equivalence report, the Technological Institute has assessed that 54 % of the relevant heat pump systems are located in companies where they undergo a regular inspection as described in paragraph 2, for example as part of its energy management according to ISO 50001.
Overall, electricity prices in recent years have been somewhat higher than when the above assessment was made and are not expected to fall back to the same level. Against this background, it is estimated that the proportion of heat pumps subject to regular inspections has not decreased or will not be reduced in the future. Therefore, this report also assumes that the proportion is 54 %.

Electric heat

Residential electric heating ***systems*** will typically not be inspected because, on the one hand, they are normally inside individual housing units where an operator does not have free access and, on the other hand, because electricity radiators are not slipped and lose efficiency in the same way as boilers, so there is a very limited incentive for regular use;

service and hardly any external providers.
As mentioned in the latest equivalence report, following dialogue with the industry organisation TEKNIQ Employers, which organise electricity and VVS installers, it was considered that electricity radiators in dwellings have predominantly thermostat control and that this is due to Danish electricity taxes combined with the relatively low surcharge for thermostat management. Against this background, it was estimated that in 75 % of homes with electric heating, taxes on electricity have the same effect as the measures mentioned in paragraph 2.
Overall, electricity prices in recent years have been somewhat higher than when the above assessment was made and are not expected to fall back to the same level. It is therefore estimated that not only taxes but also other components of the overall electricity price will continue to have at least the same effect as estimated in the previous report, and the mentioned 75 % have therefore been maintained.

With regard to ***public buildings***, it is estimated that 75 % are subject to a voluntary inspection as referred to in paragraph 2. The assessment is due to the fact that such inspections are included in or recommended in several actions on public buildings, including the Circular on Energy Efficiency, the State Procurement Guidance, Data Based Energy Management and Gate 21. Moreover, public buildings typically do not have the barrier to access to the installations mentioned in housing.

With regard to ***non-residential buildings***, TEKNIQ Employers considered, on the basis of the latest equivalence report, that the focus is less on replacement for thermostat-controlled electricity radiators, partly because the electricity tax is lower than for dwellings, partly because electricity costs are deductible from the tax result and partly because the main business generally has a higher priority than energy savings. However, radiators without thermostat control will usually be switched before a commercial building is sold or relet. Against this background, it was estimated that 50 % of non-residential buildings with electric heating have the same effect as the measures referred to in paragraph 2. Given the higher electricity prices already mentioned, it is considered prudent to maintain the previous estimate.

The assessments given for the different building types provide a weighted average of 60 % of buildings with electric heat, which are exempted under paragraph 2.

Solar thermal
Installations with solar collectors larger than 100 m^2 will normally be installed on larger buildings which have an operator who can inspect the facility regularly. In addition, solar heat will always be complementary to a primary heating system that can deliver regardless of weather conditions. So, if the performance of the solar system deteriorates, the primary installation will have to deliver more and this will be reflected in the cost of heating over a longer period.

Finally, according to DTU Byg, the most relevant components for inspection are also the most accessible components. These are the frost-proof fluid in the plant, expansion vessel, valves, circulators, and

hot water storage tank, which can normally all be inspected indoors in a technical room or similar. The solar collector itself is less accessible, but typically has very limited service needs and long lifespan – up to 50 years.

Against this background, it is estimated that 75 % of the relevant solar heaters are subject to measures similar to those mentioned in paragraph 2.

Total for paragraph 2
Taking into account the exceptions mentioned above, the number of relevant installations and the size of their energy consumption are reduced to that extent, as shown in Table 3 below.

Table 3 *Estimate of the number of relevant installations and their production (electricity consumption in the case of heat pumps), taking into account the exemptions provided for in Article 14 (2***)**

	Number [pieces]	Heat production/ electricity
Natural gas boilers	1.417	1.236
Oil boilers	448	338
Heat pumps	311	79
Electric heat	177	123
Solid fuel boilers	92	62
Solar-thermal installation	38	11
	2.482	**1.848**

The production volume of the relevant installations (or electricity consumption in the case of heat pumps) corresponds to 2 % of all heat production in Danish buildings. When the contribution of district heating is taken into account, the output of the installations that will be covered by a scheme under paragraph 1 represents only 0.9 % of the production for heating buildings in Denmark.

1c)
How effective would an inspection scheme under paragraph 1 be in Denmark?

Frequency
The Commission has previously stated that "*regular*" inspections mean at least one inspection during the lifetime of a heating system. If an inspection scheme were to be implemented in Denmark, experience from similar schemes with low impact and poor cost-effectiveness (see below) would encourage the minimisation of statutory inspections. The lifespan of a heating system is typically 15-20 years. In the power calculation below, it is therefore assumed that the number of inspections each year corresponds to 1/15 of the number of relevant systems.

Experience in mandatory boiler inspections;
From 1 February 2011 to 1 June 2013, owners of oil-fired boiler systems were required in Denmark to have an energy measurement carried out at least once a

year, irrespective of the size of the installation, cf. Order No 62 of 27 January 2011. The scheme came to an end because it did not function as intended.

The intention was to identify inefficient boiler plants for subsequent follow-up in the form of guidance for boiler bearings on improvement options. However, the follow-up action was never implemented because it became apparent that owners were already largely given the necessary guidance through voluntary schemes, so that in practice there were few inefficient installations. The cost-effectiveness of measurements and follow-up action would therefore have been very low.

Experience in mandatory inspections of ventilation systems;
Based on the EU EPBD, from 1 January 2008 to 31 December 2014, owners of ventilation and air conditioning systems with a capacity of more than 5 kW were required to undergo inspections at least every 5 years.

Prior to the entry into force of the scheme, it was estimated that 45.000 installations would be covered. However, by the end of 2012, when all installations covered should have been inspected, only about 6.000 inspections had been carried out, corresponding to a compliance rate of 13 %.

In addition, it was considered that the scheme had a very modest impact in terms of promoting energy efficiency and that it would be complicated and costly to redesign it for more compliance.

A number of reasons were identified which would also be relevant in relation to an inspection scheme under paragraph 1:

- Many building owners experienced that they received the same advice to a large extent through the mandatory inspection scheme and the mandatory energy labelling scheme for buildings. Therefore, they had difficulties in seeing the added value of the former.
- The recommendations of the inspection scheme were criticised as being too difficult to translate into concrete energy savings.
- Ventilation systems do not have the great attention of building owners and only very few of the inspection scheme's recommendations on increased energy efficiency were implemented in practice. The impact of the scheme was therefore very limited.

The power calculation below assumes that an inspection scheme under paragraph 1 would achieve a compliance rate of 75 %. In the light of the above experience, it can be assumed that in practice it would be significantly lower.

Experience in energy labelling schemes for buildings;
It is of course crucial to the effectiveness of an inspection scheme whether the inspected installations become more energy efficient because the recommended measures are implemented.

There are no studies showing the extent to which mandatory inspections of heating and ventilation systems lead to energy savings. However, in Denmark the impact of a parallel mandatory inspection scheme has been studied, namely the mandatory energy labelling of buildings2, where also only inspections are mandatory, while implementation of the recommended measures is voluntary. The study indicates that labelling reduces energy consumption by around 2 %, but the effect is within the

2 Vibeke Hansen Kjærbye (2008): "Do Energy Labelling on Residential Housing Cause Energy Savings?", AKF working paper, http://www.akf.dk/udgivelser/2008/pdf/energy_labelling.pdf/

statistical uncertainty. On this basis, it cannot be denied that the labelling scheme has no measurable effect on energy consumption.

This survey covers around 6.000 dwellings, some of which received energy labelling, while others did not. Consumption was measured several times in the period from 1999 to 2002, so that energy consumption before and after energy labelling could be observed and compared with developments in buildings without an energy label. The said consumption was also checked for the characteristics of the buildings and the occupants.

As mentioned above, the labelling scheme for buildings has the same basic characteristics as an inspection scheme under paragraph 1, namely compulsory inspection but voluntary implementation of the improvement proposals resulting from an inspection. In the power calculation below, it is therefore assumed that inspections according to paragraph 1 would lead to improved energy efficiency equivalent to 2 % of heat production.
In practice, improvements will be more modest because, as mentioned above, voluntary inspections are already carried out to a very large extent, which does not apply mutatis mutandis to energy labelling of buildings.

1d)

The calculated effect of an inspection scheme in accordance with paragraph 1;

With the assumptions on frequency, compliance and improvement of energy efficiency justified above, the effect of an inspection scheme under paragraph 1 will be as set out in Table 4 below.

Table 3 *Calculated power of an inspection scheme in accordance with paragraph 1*

	Energy saving [TJ/year]
Naturgaskedler	1,24
Oliekedler	0,34
Varmepumper	0,08
Elvarme	0,12
Kedler til fast brændsel	0,06
Solvarmeanlæg	0,01
	1,85

2) Impact of alternative measures

The Business Pool
The Danish Business Pool grants Danish companies for projects that save energy and/or CO_2emissions due to energy consumption, including projects relating to heating systems in non-residential buildings. Funds have been allocated to the pool in the coming years up to 2029.

In 2021 and 2022, 60 and 91 commitments were made for building heating installations with a power of more than 70 kW. According to the information reported by the companies concerned, the projects with commitments from 2021 offer a total annual saving of 166.5 TJ, while the corresponding figure for the projects with commitments from 2022 is 274.8 TJ.

It is expected that every year in the period 2023 to 2026projects will be saved at least equivalent to those awarded in 2021. Projects carried out in the first year will

therefore save at least 166.5 TJ during the second year of the period and projects carried out in the first two years will save at least 333 TJ during the third year of the period. A total saving of at least 499.5 TJ would thus be achieved during the reporting period.

The above-mentioned expected energy savings from the alternative measure are included in Table 1 above.