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Progress by Member States in reaching cost-optimal levels of minimum energy performance requirements

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1. INTRODUCTION

This report reviews progress achieved by Member States in reaching cost-optimal levels of minimum energy performance requirements for new and existing buildings, and also for building elements. It fulfils the obligation upon the Commission to report to the European Parliament and the Council on the use of the delegated powers referred to in Article 5(4) and Article 23 of Directive 2010/31/EU on the energy performance of buildings ('the Directive') [1]. This report will also inform the ongoing review of the Directive, which is an action point of the energy union framework strategy[2].

Buildings are central to the EU's energy efficiency policy. Nearly 40 %[3] of final energy consumption and 36 % of greenhouse gas emissions is due to houses, offices, shops and other buildings. Improving the energy performance of Europe's building stock is crucial for achieving the EU's 2020 emissions reduction and energy efficiency targets. It will also help to meet the longer-term objectives laid down in the policy framework for climate and energy in the period from 2020 to 2030[4], and in the low-carbon economy roadmap for 2050[5].

The Directive on the energy performance of buildings is the main legislative instrument at EU level for improving the energy efficiency of buildings. Under the previous Directive 2002/91/EC[6], Member States had to set minimum energy performance requirements for new and existing buildings. However, the setting of these requirements varied across the EU. Many Member States did not evaluate the energy-saving potential compared with the costs to determine the optimal levels of the various energy performance requirements. As cost-optimal levels were not calculated, the cost-efficient energy savings potential was not clearly known.

Furthermore, cross-border comparisons of how Member States progressed on this were difficult. This is due to diverse national and regional approaches and the use of different parameters and methodologies. Therefore, the EU legislators decided to establish under the Directive a benchmarking mechanism to calculate the cost-optimal level of energy performance requirements for new and existing buildings, both residential (single family houses and apartments) and non-residential (offices, educational buildings, hospitals, etc.) This benchmarking mechanism indicates where Member States are setting performance requirements that are below cost-optimal levels, meaning that there is an untapped cost-efficient energy-saving potential in national building stocks.

The benchmarking mechanism is drawn up based on a framework methodology that enables the comparison of energy efficiency measures, measures incorporating renewable energy sources and various combinations of these measures. The methodology is based on primary energy performance and costs, and takes into account estimated building lifetimes.

This framework enables the Commission to measure Member States' progress in reaching cost-optimal levels of minimum performance requirements. The progress of Member States in implementing the Directive's provisions on cost-optimal and minimum energy performance requirements was considered when assessing preconditions under the European Structural and

1 OJ L153 of 18.6.2010, p.13.

2 COM(2015) 80 final.

In 2010. See 'Energy, transport and environment indicators, 2012 edition', European Commission. For the purpose of this estimate, the final energy consumption for the household and services sectors has been combined. It should be noted that this includes, for example, electricity consumption for appliances but excludes energy consumption in industrial buildings.

4 COM/2014/015 final

5 COM(2011) 112. To achieve the 2050 target the residential and tertiary sectors together are to reduce their CO2 reductions by -88 to -91% (compared to 1990 levels).

6 OJ L 1, 4.1.2003, p.65.

Investment Funds for energy efficiency in infrastructure, public buildings and housing. The cost-optimal benchmarks are also used by the European Investment Bank for assessing the expected effectiveness of investments in building renovation and modernisation projects and programmes.

The following sections explain the framework methodology, legal context and requirements, and the progress made by Member States in reaching cost-optimal levels of minimum energy performance requirements.

2. WHAT IS COST-OPTIMALITY?

The cost-optimal level is defined in Article 2(14) of the Directive. It is the energy performance (measured in kWh/m^2 of primary energy[7]) that leads to the lowest cost during the estimated building life cycle (30 years for residential buildings and 20 years for non-residential buildings). The cost calculations (expressed in net present value) include investment costs in energy efficiency and renewable energy measures, maintenance and operating costs, energy costs, earnings from energy produced and disposal costs (costs for deconstruction at the end of a building's life).

The cost-optimal framework methodology is based on a conventional cost-benefit analysis framework. It does not take into account all the external factors that can affect the building-use life cycle cost calculations. Similarly, the positive impacts for society of investments in energy efficiency and integrating renewable energy in buildings are also not accounted for by the cost-optimal framework methodology. These can include job and wealth creation, increased productivity, improved health of building occupants, and value of the buildings. Because many of the benefits of energy efficiency are not accounted for in the methodology, Member States can opt for setting minimum requirements that are above the cost-optimal levels.

The cost-optimal framework methodology should be understood as a tool to support Member States in setting minimum energy performance requirements for buildings and to keep them under review, by taking into account market developments and technical progress. It lays down principles for comparing energy efficiency measures, measures incorporating renewable energy sources and combinations of such measures.

While the cost-optimal methodology sets the framework for the calculation, it allows Member States significant flexibility to select the calculation parameters (e.g. reference buildings, energy performance calculation method, energy efficiency and renewable energy measures, costs, energy prices, and discount rates). Therefore, it is not possible to directly compare cost-optimal levels across Member States. However, the cost-optimal methodology can be used to define the national benchmark for the national minimum energy performance requirements, and to assess and compare the relative ambition levels for which these requirements have been set at Member State level.

In conclusion, the use of the cost-optimal framework methodology contributes to setting minimum performance requirements for new and existing buildings and building elements (e.g. walls, roof, windows, etc.) in line with the technical and economic energy-saving potential and specific national and regional conditions. Furthermore, it enables the definition of efficiency levels that are cost-efficient for households and investors. As a result, Member States will not set requirements that are too lax, which would hinder the implementation of

[7] The calculation of primary energy includes the breakdown of energy needed for space heating, cooling, ventilation, domestic hot water and lighting systems. The resulting total primary energy demand is calculated using national primary energy conversion factors. The renewable energy produced on-site, if any, is deducted from the total primary energy demand.

energy savings. Additionally, market participants have information on the most cost-effective energy efficiency and renewable energy measures and packages for new and existing buildings, and for the replacement of individual building elements.

3. LEGAL CONTEXT

The provisions for calculating cost-optimal levels as the basis for setting and reviewing the minimum energy performance requirements at national and regional levels are a key element of the Directive on the energy performance of buildings. Article 4(1) of the Directive requires that Member States ensure that minimum energy performance requirements for buildings or building units are set according to cost-optimal levels. Article 5 sets out the framework methodology, the obligation of Member States to report the calculations to the Commission, and the Commission's obligation to report to the European Parliament and the Council on progress by Member States.

Detailed provisions on minimum performance requirements with a view to achieving cost-optimal levels are laid out in Commission Delegated Regulation (EU) No 244/2012[8] ('the Regulation'). The methodology contained in the Regulation was set in accordance with Annex III of the Directive and is complemented by guidelines[9] that are not legally binding.

The Regulation includes in its Annex III a template that Member States may use for preparing their cost-optimal calculation and reporting it to the Commission. The Regulation also specifies the main aspects that need to be addressed in the national cost-optimal reports under Annex I to the Directive. The national reports should include all input data and assumptions used, and a calculation of the difference between the national minimum energy performance requirements and the calculated cost-optimal levels. Ideally, the minimum energy performance requirements should be set as the calculated cost-optimal levels, so there is no difference, or gap, between the two. Alternatively, they should be set higher to reflect the benefits of energy efficiency that are not reflected in the cost-optimal methodology.

However, if a gap exists, with minimum energy performance requirements being higher than the calculated cost-optimal levels, Member States must justify it, or include a plan to reduce it before the next review of the cost-optimal calculations. Recital 14 of the Directive suggests that a significant gap can be considered to exist if cost-optimal levels are 15 % lower than the minimum requirements in force.

4. OVERVIEW OF THE NATIONAL COST-OPTIMAL CALCULATIONS

In total, the Commission received 30 reports from 27 Member States over the course of the second half of 2013 and 2014. The United Kingdom submitted one report for Great Britain and Northern Ireland and a separate report for Gibraltar. Belgium submitted separate reports for the regions of Brussels-Capital, Flanders and Wallonia. Greece did not submit a national cost-optimal report before the date of the present report.

Most Member States have followed the cost-optimal framework methodology for calculating and reporting the cost-optimal levels, as required by the Directive and the Regulation. The technical assessment of the details of national cost-optimal calculations was conducted by an external contractor and is available online[10]. Non-submission and incomplete submission cases are being followed up by the Commission as appropriate.

The calculation of the cost-optimal levels includes several steps:

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8 OJ L81 of 21.3.2012, p.18.
9 OJ C115 of 19.4.2012, p.1.
10 https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings.

- definition of reference buildings;
- identification of energy efficiency and renewable energy measures;
- calculation of primary energy demand;
- calculation of global costs; and
- calculation of the cost-optimal levels and the gap, if any, between the cost-optimal levels and minimum energy performance requirements.

The first step in the calculations was the definition of reference buildings for new and existing single family houses, apartment buildings, office buildings and other relevant non-residential buildings. Reference buildings should be representative of the national building stock and should be 'typical' buildings for which specific energy performance requirements exist in national legislation. However, in some Member States, the scarcity of statistical information available on building types and lack of disaggregation according to size, age, construction material, use pattern and climatic zone made it difficult to set reference buildings that fully describe national building stocks. Databases for national building energy performance certification contributed positively to the development of a robust set of reference buildings for the cost-optimal calculations in several Member States.

The second step in the calculations was the identification of energy efficiency measures (e.g. double-glazed windows with a certain U-value[11]), measures based on renewable energy (e.g. solar water heating) and relevant alternative high-efficiency systems (e.g. cogeneration, district energy supply systems, condensing boilers and heat pumps), which all have an impact on the energy performance of reference buildings. These measures are then applied to the selected reference buildings, and the resulting energy performance and global cost is calculated.

Individual energy efficiency and renewable energy measures can be combined into packages (e.g. double-glazed windows, condensing boiler and solar water heating) or variants (e.g. a set of measures to achieve a voluntary certified eco-labelled building). At least one of these packages or variants should meet the requirements for nearly zero-energy buildings for new and possibly also existing buildings as defined by Article 9 of the Directive.

It was found that some Member States could have considered more measures, in particular renewable energy measures. The consideration of more renewable energy measures might have resulted in lower cost-optimal levels, in particular for Member States with higher potential for the integration of renewable energy systems in buildings.

The third step is the calculation of the energy performance of the various measures, packages and/or variants for the selected reference buildings using CEN standards[12], or an equivalent national calculation methodology. The results of the energy performance calculation are presented in annual primary energy demand per square metre of useful floor (in kWh/m^2).

The verification of compliance of national energy performance calculation methodologies with the requirements of Annex I to the Directive and Annex A EN 15603[13] was undertaken with the support of an external contractor, under a service contract[14]. It was found that some of the national energy performance calculation methodologies do not take into account all aspects that affect directly and indirectly building energy performance. For example, measures related to new technologies (e.g. on-site wind turbines and on-site cogeneration) and

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11 U-value is a measure of the thermal insulation performance of construction materials, building elements, etc.

12 Energy Performance of Buildings — Overall Energy Use and Definition of Energy ratings, EN 15603, 2008.

13 EN 15603:2008, Energy performance of buildings — Overall energy use and definition of energy ratings, CEN, January 2008. Annex A of the standard refers to methods for collecting building data.

14 ENER/C3/2013-414.

passive solutions (e.g. natural lighting and natural ventilation) are not considered in many national methodologies. Consequently, the resulting cost-optimal levels are perhaps higher than expected, depending on the completeness of the national energy performance calculation methodologies.

The next step is the calculation of the global cost for the various measures, packages and/or variants, based on net present value using a full cost approach. This means that for each measure, package and/or variant applied to a reference building, the full cost of construction (or major renovation) and the subsequent use of the building was taken into account. The calculation periods considered were 30 years for residential and public buildings, and 20 years for non-residential buildings.

The global costs are calculated from two different perspectives: financial (i.e. building owner and investor perspective) and macroeconomic (i.e. societal perspective). For the financial perspective, the costs include the prices paid by the final consumer, including all applicable taxes, including VAT, and charges. For the macroeconomic perspective, the prices exclude all applicable taxes, VAT, charges and subsidies. However, for the latter, the cost of greenhouse gas emissions is included. In addition, one, of the at least two, discount rates to be used for the sensitivity analysis for the macroeconomic perspective is 3 % expressed in real terms. For the financial perspective, discount rates should reflect national financing environments and mortgage conditions.

Data on maintenance costs and replacement costs were not reported in detail in some Member States. A lack of data on building operation and renovation affected in particular the calculations of cost-optimal levels for major renovation and replacement of building elements. Consequently, these were more difficult to conduct than the calculations of cost-optimal levels for new buildings.

The final steps are the calculation of cost-optimal levels and appraisal of the gap in relation to the minimum energy performance requirements, for new and existing single family houses, apartment buildings, office buildings, etc., and relevant building elements.

The calculation of cost-optimal levels for each reference building is detailed in point 6 of Annex I to the Regulation. The global cost results for the various measures, packages and/or variants are compared and the lowest is selected. The cost-optimal levels are the average cost-optimal energy performance of all reference buildings in each building category (single family house, apartment buildings, office buildings, etc.), considering separately new and existing buildings. Most Member States reported the results clearly, including all the assumptions used (e.g. packages/variants, energy price developments, discount rates).

Once the cost-optimal levels are calculated, the difference with the minimum performance requirements can be determined and a decision is taken on whether the macroeconomic or the financial perspective is going to become the national benchmark. The gap between minimum energy performance requirements and cost-optimal levels is the difference between the cost-optimal levels and the performance requirements in national building codes divided by the cost-optimal level, and expressed as a percentage, as presented in point 7.2 of the Guidelines.

If the gap between cost-optimal levels and building code requirements is significant (>15%), Member States have to provide a justification, as laid down in Article 5(3) of the Directive and Article 6(2) of the Regulation, in their cost-optimal report. Where the gap cannot be justified, they must provide a plan with appropriate steps to reduce the gap.

5. PROGRESS TOWARDS COST-OPTIMALITY

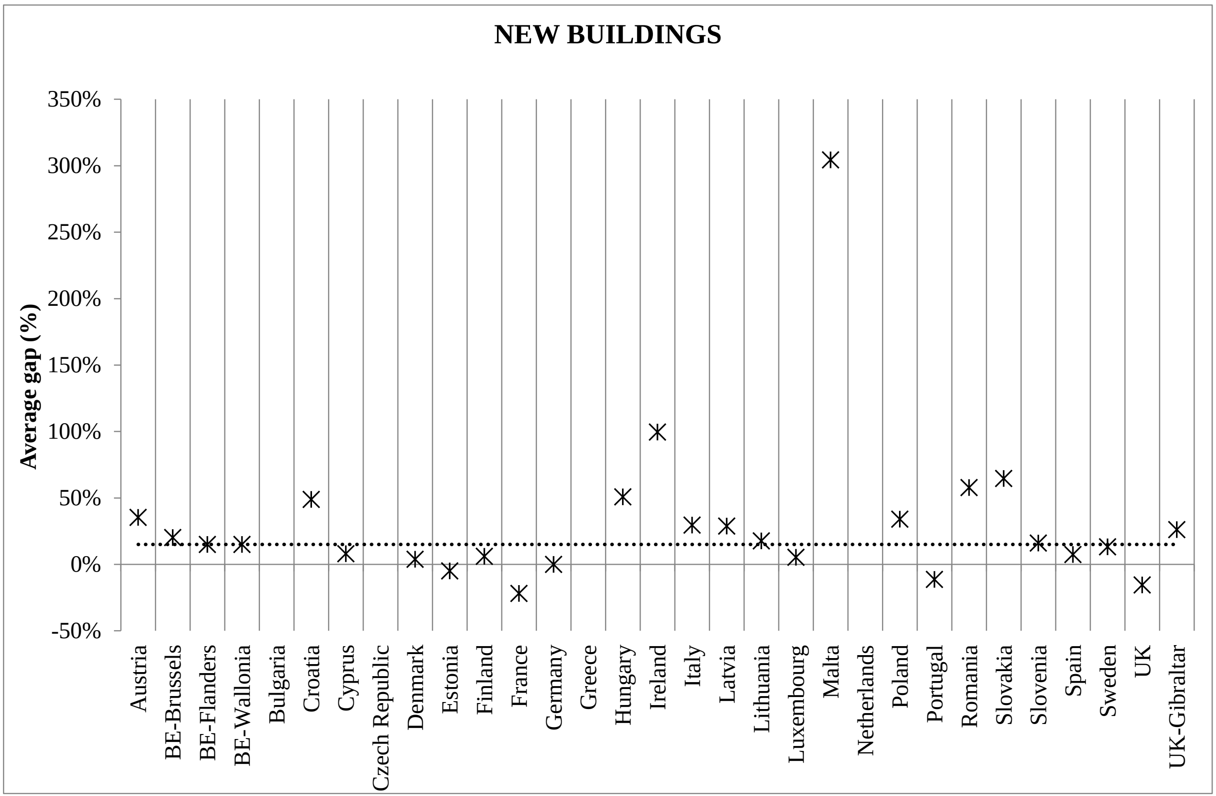
The progress of individual Member States towards setting cost-optimal levels of minimum energy performance requirements is presented in the graphs below which present the average gap. The dotted line represents the 15 % threshold above which the gap could be considered significant.

From the comparison of the reported cost-optimal levels and minimum energy performance requirements, it can be concluded that roughly half of the Member States have set minimum performance requirements that are within the 15 % threshold. For example, the average gaps between cost-optimal levels and minimum requirements for all the categories (i.e. new building, major renovations, and building elements) and building types (i.e. single family houses, apartment buildings and non-residential buildings) are below that threshold in Denmark, Finland and Spain.

5.1. New buildings

In the case of new buildings, minimum performance requirements were set no more than 15 % above the cost-optimal level in 13 cases (out of 27 calculations): Belgium-Flanders, Belgium-Wallonia, Cyprus, Denmark, Estonia, Finland, France, Germany, Luxembourg, Portugal, Spain, Sweden and UK. In Lithuania and Slovenia, the average gap was just slightly above the 15 % threshold.

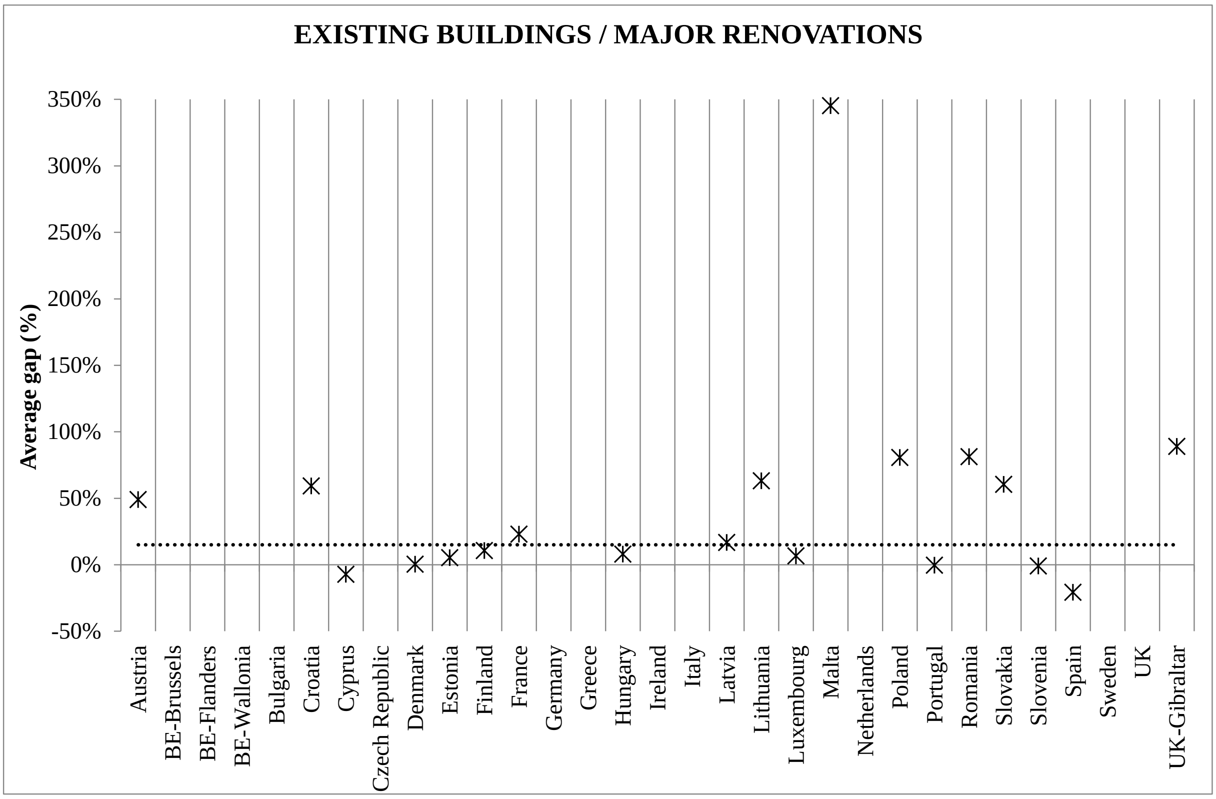
Estonia, France, Germany, Portugal and UK set minimum requirements that were more ambitious than the cost-optimal level for those countries.



Average gap between minimum energy performance requirements and cost-optimal levels: new buildings

5.2. Existing buildings / major renovations

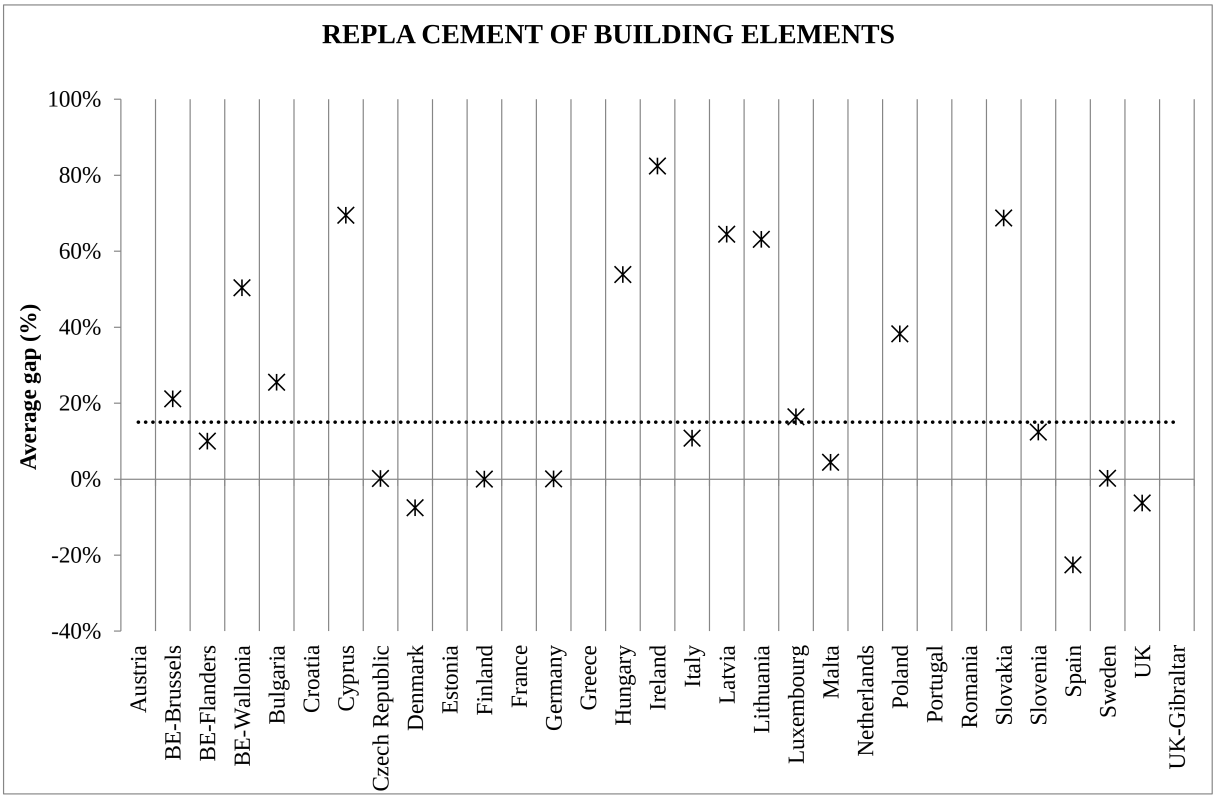
Minimum performance requirements for major renovations were set at no more than 15 % above the cost-optimal level for 9 cases (out of 19 calculations): Cyprus, Denmark, Estonia, Finland, Hungary, Luxembourg, Portugal, Slovenia and Spain. Latvia's average gap for major renovations was just slightly above the 15 % threshold. Cyprus, Portugal, Slovenia and Spain set requirements that were exactly cost-optimal or more ambitious than cost-optimal.



Average gap between minimum energy performance requirements and cost-optimal levels: major renovations

5.3. Replacement of building elements

Most Member States calculated cost-optimal levels for some building elements, but usually not for all those required by the Directive and the Regulation (wall, roof, window and floor). The minimum performance requirements were set at no more than 15 % above the cost-optimal level in 11 cases (out of 22 calculations): Belgium-Flanders, Czech Republic, Denmark, Finland, Germany, Italy, Malta, Slovenia, Spain, Sweden and UK.



Average gap between minimum energy performance requirements and cost-optimal levels: replacement of building elements

5.4. Plans to reduce the gaps

When there is a gap and Member States set minimum requirements above cost-optimal levels, they need to justify it and submit a plan explaining appropriate steps to reduce the gap. Plans to reduce gaps were presented for about two thirds of the gaps reported. Ideally, the reports should clearly indicate the concrete steps to bridge the gap within the timeframe laid down in the Directive and the Regulation, including the minimum requirements for nearly zero-energy buildings (in 2018/2020). However, the plans provided in the cost-optimal reports did not all set out convincing timelines.

Monitoring the implementation of national plans to reduce the gaps is beyond the scope of this report because Member States have until the next five-year review of the energy performance requirements to close the gap. This review is expected to happen by early 2018. On the basis of new cost-optimal calculations to be submitted by Member States in 2018, the Commission will assess how the gaps between minimum energy performance requirements and current cost-optimal levels have been closed.

6. CONCLUSIONS

All Member States, except Greece, have submitted cost-optimal calculations. In most cases, requirements were met for both the Directive on the energy performance of buildings and the Delegated Regulation on the framework methodology. The other cases are being followed up by the Commission as appropriate.

The objective of the cost-optimal framework methodology was achieved, because it informed decision-making on setting minimum energy performance requirements at national and regional levels at the 'right' (i.e. cost-effective) level.

The cost-optimal calculations have shown that there is still a significant potential for cost-effective energy savings that can be achieved by bridging the gap between the current minimum requirements and cost-optimal levels.

For the first time, a benchmarking framework based on the cost-optimal methodology proposed in the Directive and the Regulation was used. This enabled the comparison and combination of various energy efficiency and renewable energy technologies. This work supported national authorities in their task of setting realistic minimum energy performance requirements for buildings and in preparing the ground for meeting the targets for nearly zero-energy buildings[15]. This ultimately contributed to boosting overall ambition levels across the EU towards the technical and economic energy-saving potential in the buildings sector, also envisaged in the forward-looking strategies for building renovation published under Article 4 of the Energy Efficiency Directive[16]. However, the potential of different types of renewable energy could have been better explored in the calculations and better statistical information on national building stocks could be sought.

The Commission will fully use its powers under the Treaty to ensure that the Directive on the energy performance of buildings is correctly implemented. This includes achieving the cost-optimal levels of minimum energy performance requirements, within the indicated timeline, to ensure that the EU's longer-term energy and climate objectives, and the contribution of the building sector to meeting those objectives are fulfilled.

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[15] Commission Recommendation on guidelines for the promotion of nearly zero-energy buildings and best practices to ensure that, by 2020, all new buildings are nearly zero-energy buildings

[16] OJ L 315, 14.11.2012, p. 1–56