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## **Cost optimal levels for energy performance requirements**

### *Executive summary*

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# Cost optimal levels for energy performance requirements

## Executive summary

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## 1 Introduction

This report summarises the work done within the Concerted Action EPBD from December 2010 to April 2011 in order to feed into the European Commission's proposal for a common European procedure for a Cost-Optimal methodology under the Directive on the Energy Performance of Buildings (recast) 2010/31/EU. A full report is also available from the CA EPBD website ([www.epbd-ca.eu/outcomes/cost-optimal-levels-2011.html](http://www.epbd-ca.eu/outcomes/cost-optimal-levels-2011.html)).

The Concerted Action EPBD is an activity which aims to foster exchange of information and experience among Member States and participating countries with regards to the implementation of the specific Community legislation and policy on the energy performance of buildings. It involves the national authorities implementing the Directive, or those bodies appointed and entrusted by them to do so. The CA consortium is composed of organisations designated by all 27 Member States plus Norway and Croatia. The CA is financed by the EU's Intelligent Energy - Europe Programme.

This Working Group aimed to merge relevant knowhow and experience concerning the Comparative Methodology Framework in order to exchange the knowledge between the Member States (MS) and support the European Commission. Three major activities were performed, that are reported in this document:

- Creating common understanding and insight in the possibilities to set up a framework, based on exchange and discussion among the participants. There is hardly any sound experience in comparing requirements against cost optimal levels especially for the existing building stock.
- Managing a survey among the MS based on a questionnaire expressing the information needs of the European Commission.
- Organising a discussion session within the Concerted Action meeting in Luxembourg, April 2011 and report the results.

The recast of the EPBD requires Member States (MS) to: “*assure that minimum energy performance requirements for buildings or building units are set with a view to achieving cost-optimal levels*”. MS shall also: “*take the necessary measure to ensure that minimum energy performance requirements are set for building elements that form part of the building envelope and that have a significant impact on the energy performance of the building envelope when they are replaced or retrofitted, with a view to achieving cost-optimal levels*” (EPBD art. 4.1 and also in recital 14). According to EPBD article 5, the European Commission has to provide a Comparative Methodology Framework (by July 2011) and

accompanying Guidelines as a basis for the MS to compare their minimum Energy Performance Requirements against cost optimal levels, and report the results to the Commission.

Cost-optimal level is defined as “*the energy performance level which leads to the lowest cost during the estimated economic lifecycle*”. MS will determine this level taking into account a range of costs like investments, maintenance, operating costs, energy savings. The economic lifecycle is defined by each Member State. It refers to the estimated economic lifecycle of a building or building element. Cost-optimal solutions are by definition also cost effective (EPBD art. 2.14).

The EPBD requires MS to report on the comparison between the minimum energy performance requirements and the calculated cost-optimal levels using the Comparative Methodology Framework provided by the Commission (EPBD Art 5.2, 5.3, 5.4 and Annex III). The report shall also provide all input data and assumptions made. The comparative methodology Framework is accompanied by guidelines from the Commission to enable the MS to:

- Define reference buildings.
- Define energy efficiency measures.
- Assess the final and primary energy needs of the reference buildings and the impact of the improvement measures.
- Calculate the cost of the energy efficiency measures by applying the principles of the comparative methodology framework.

The Commission shall also provide information on the estimated long-term energy price developments.

In case the comparison shows that the requirements are significantly less than the cost optimal level, MS need to justify this to the Commission. In case the gap cannot be justified, a plan has to outline steps to significantly reduce the gap. The Commission shall publish a report on the progress of the MS.

The recast EPBD does not demand that MS set their minimum performance requirements at levels that are cost-optimal. It does however require them to report how their requirements differ from cost-optimal levels (implicitly as far as underperformance is concerned). If there are “significant” differences - exceeding 15 % (meaning that they allow energy consumptions that are 15 % higher than cost-optimal levels would be) - MS should justify them or plan steps to reduce the difference. Clearly, this first requires the calculation of a cost-optimal requirement.

The Commission is charged with producing a Comparative Methodology Framework and accompanying guidelines. In effect, MS are required to show, every five years, that their building energy requirements are reasonably close to levels that can be shown to be cost-optimal in their particular national circumstances. We know from previously gathered information (autumn 2010) that MS approach the setting of minimum performance standards from a range of different perspectives. Of the 21 questionnaire responses received, 18 countries reported that they carried out assessments of minimum energy performance requirements for buildings, and three reported that they did not do so yet. Of the 21 countries that carried out assessments, 12 of them reported that they carried out economic assessments for regulations for new buildings. Of these, 9 also included existing buildings in the assessments. As for economic assessments, rather similar numbers of countries reported carrying out financial assessments. In some cases, both types of assessment are carried out as part of the same impact appraisal. Only 8 countries reported other types of cost-benefit assessment, 2 of which were explicitly for carbon abatement. Both of these were in the context of procedures that also included economic and financial assessments. Further information from this survey is found in the report “National approaches and methods for calculating cost-effective minimum requirements” available from the CA EPBD website ([www.epbd-ca.eu/outcomes/cost-effective-minimum-2011.html](http://www.epbd-ca.eu/outcomes/cost-effective-minimum-2011.html)).

## 2 Perspectives for determination of cost-effectiveness and cost-optimality

Cost-effectiveness and cost-optimality can be considered from several different perspectives, each of which will usually provide a different result. We summarise three important perspectives:

- Of the society as a whole: the “macro” economic perspective.
- Of the individual end-users.
- Of the idealised end-users: the “micro” economic perspective.

Each of these perspectives serves a different purpose and MS will, no doubt, assign a different importance to each of them when setting requirements.

Analyses for all the perspectives share the same basic structure, but differ in their scope and the appropriate values of some parameters. All three perspectives consider costs and benefits over the assumed life of a building, including replacement costs for components or systems that have shorter life than the building. All apply discount rates to future benefits (and to costs) so that those which occur further into the future have a smaller influence than those close to the present time. In principle, all three can be evaluated in terms of “nominal” prices that include inflation, or in “real” terms that ignore it (but may include expected future price changes that are above or below average inflation). It is also important to acknowledge that there is a distinction in social acceptance between requirements for new and existing buildings. In the case of new buildings, the owner cannot really observe the cost efficiency, since there is no clear reference. For the existing buildings, this is quite different: on project level, the savings can and will be compared with the investment from the perspective of the investor/owner. Therefore, it is much more sensitive to setting minimum energy requirements in case of major renovation. Of course, societal acceptance is an important consideration for policy makers.

## 2.1 The societal “macro” economic perspective

This is a basic approach to regulatory policy-making from an economic perspective. It is used when the justification for introducing energy performance regulations is to make organisations or individuals take actions that do not reflect their own direct interests (and are therefore unattractive as investments) but that can be shown to be beneficial for the society as a whole. An alternative - or complementary - approach would be to use taxation and financial policy to better align users perceptions with societal aims.

This approach takes into account all the costs incurred by any part of society and all the benefits that result, irrespective of where they occur. There is no distinction here between costs and benefits that fall on different sections of society - it is the net balance that is important.

The macro perspective includes benefits (and costs) of “externalities”, e.g., damage from climate change associated with carbon dioxide emissions. Since there is rarely a market price for such externalities (except for industry), it is necessary to devise “shadow prices” that reflect estimates of the value of such implications. Future costs and benefits are discounted at a “social discount rate” which is typically quite low, say 3 % per year in real terms. With the macro-economic approach, taxes and subsidies are ignored, since they represent a transfer of money from one part of society to another, rather than an aggregate cost or benefit. For all perspectives (not only for the macro-economic case), there is also the risk that taxes and subsidies will not be maintained over the building lifetime.

## 2.2 The end-user perspective

This perspective is important when the objective of the regulations is to address “market barriers” that prevent owners and occupants from taking actions that are in their direct interest, but which they do not recognise as being so. It is also important as a means of assessing the risk that regulations will be seen as unfair by significant groups of those subjected to them.

End-users face a number of practical constraints when considering energy efficiency investments. These include - but are not limited to - lack of information, lack of motivation, limited access to or alternative calls on capital, uncertainty about whether an investment will increase the market value of the building, and the division of costs and benefits between landlords and tenants. Minimum building energy performance requirements can bypass some of these barriers by - in effect - demanding a certain level of investment.

This perspective only includes costs and benefits that are faced by the potential investor, which include taxes and subsidies. The cost of obtaining capital is generally significantly higher than the discount rates assumed in societal assessments.

In addition, apparently similar households or businesses in identical buildings can have very different occupation patterns and internal temperature requirements, resulting in equally varied energy demands. Since the direct costs of building energy efficiency measures do not generally depend on the occupants, a package of measures that is cost-efficient (or cost-optimal) for one set of occupants may not be so for others. The extent of objections to regulatory requirements will depend on the number of end-users who feel disadvantaged, and by what extent.

Detailed assessment of the end-user perspective is complex and difficult and it is rarely attempted when setting building energy standards.

## 2.3 The idealised end-user “micro” perspective

Because of the difficulty of assessing the detailed end-user perspective (or distilling one end user perspective out of numerous ones), it is common practice instead to use an idealised end-user perspective. This typically involves the definition of “typical” users and the assumption that the market barriers referred to above can be ignored. This makes the analysis more tractable but, in effect, it hides differences between different groups of end-users and the resulting “social equity” issues

In principle, prices for both idealised and real end-user perspectives should be those that are currently practiced (or expected) in the marketplace. However, the idealised end-user perspective is often used with a discount rate that is below the market cost of capital.

## 3 Costs efficiency approach

### 3.1 Cost efficiency vs. cost optimality

The concepts of cost-efficiency and cost optimality are related but different. Cost-optimality is a special case of cost-effectiveness. A measure or package of measures is cost-effective when the cost of implementation is lower than the value of the benefits that result, taken over the expected life of the measure. Both are based on comparing the costs and (priced) savings of a potential action - in this case, of introducing a particular level of minimum energy performance requirements for buildings. Future costs and savings are discounted, with the final result being a “net present value”. If this is positive, the action is “cost-effective” (for the particular set of assumptions used in the calculation). The “cost-optimal” result is that action or combination of actions that maximises the net present value.

Cost optimality is relatively easy to determine for single measures operating in well-defined conditions - for example, the optimal insulation thickness for pipework operating at a constant temperature in a constant-temperature environment. It is a considerably more difficult process for complete buildings, and even more so for combinations of buildings such as a national building stock.

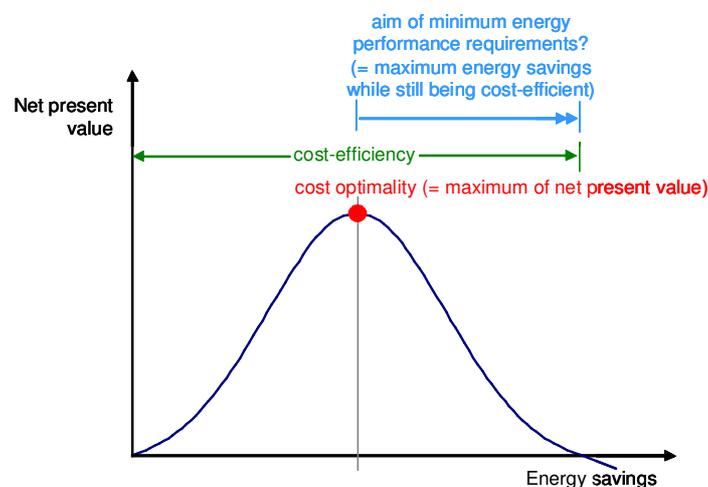


Figure 1. Scheme presenting cost-optimality and cost-efficiency.

Figure 1 illustrates the principles of cost-optimality and cost-effectiveness. In reality, the distribution may not be uni-modal (it may have several local optima). Typically, the optimal level is less clear-cut than in the illustration and may be sensitive to data uncertainties. Also, for each building type there is a cloud of curves, depending on the real building and the cost-optimal measure combination.

As the aim of the EBPD and its recast is to accelerate energy savings in buildings and not to gain as much money as possible from energy savings, the question must be whether cost-optimality by maximising the net present value is reaching far enough. The cost optimal methodology was chosen as being the best balance between investment and benefit. Higher targets imply more upfront investment costs that need to be financed. In order to realise the ambitious goals of reducing the energy use and the CO<sub>2</sub> emissions by 20 % each and increasing the renewable energy supply by 20 % by the year 2020, the focus should probably be to maximise the energy savings in buildings while still being cost-efficient. This will of course have to take into account safety margins for future changes in energy prices and interest rates.

One of the challenges for performing cost-efficiency calculations is the definition of the correct baseline. The baseline can influence the result of calculation as the perspective can change due to possible so-called “anyway costs”, such as costs for scaffolding (compared with either no insulation measures or simply a smaller insulation thickness). Possible baselines for the application in new buildings can be:

- Requirements based on health and safety.
- Currently existing requirements defined in the national regulations.

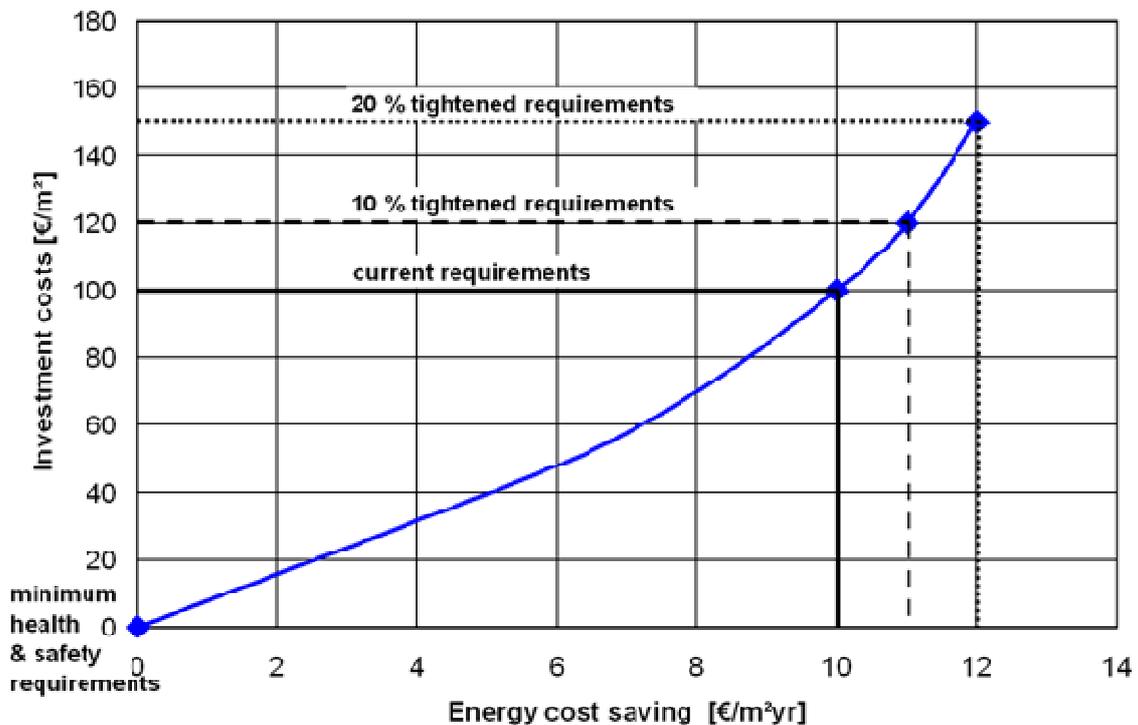


Figure 2. Exemplary cost-benefit diagram of different level of requirements (FhG).

Figure 2 shows the huge influence of the baseline on the economic assessment of the tightening of energy performance requirements. If the result of a 20 % tightening is compared to the current requirement (50 €/m<sup>2</sup> additional costs versus a saving of 2 €/m<sup>2</sup> yr.), a much longer payback time (25 years) will occur than if the results are compared to the minimum health and safety requirement (no energy saving aspects, just avoidance of condensation and mould growth). The result of the comparison with the minimum health and safety requirements is 150 €/m<sup>2</sup> additional costs versus 12 €/m<sup>2</sup> yr., i.e., 12.5 years - half of the previous payback for the same measure but with a different baseline.

With existing buildings, an additional baseline could be the current state of the building. This would however be very complicated to calculate on national level as the energy quality and other influences like the type of construction are very diverse over the whole building stock.

## 3.2 Sensitivity studies

Many calculation parameters, like investment costs, energy prices and their expected increase as well as discount (interest) rates are not really fixed but, rather:

- Based on assumptions,
- average values for a country but in reality dependent on the region or even town, or
- average values for a period of time but in reality changing slowly or more rapidly (e.g. oil price), or
- depending on specific negotiations of the building owner with for example the energy supplier (energy prices for towns or big companies) or the construction companies.

Thus, the net present value calculation can be strongly influenced by such assumed parameters or average parameters, but the result of the calculation is not necessarily valid for all building owner types, all regions and all cases. Furthermore some values like the price increase and the interest rates are predicted based on available experiences. If the real price increase and/or interest rate are different, the calculation may result in (slightly) wrong numbers.

Therefore, the calculations have to be extended by sensitivity studies. In these studies, the unclear parameters have to be varied and the deviation of the results has to be analysed in order to investigate whether the general statement is still valid or how much the real result can differ.

## 4 Reference buildings<sup>1</sup> and energy saving measures

Article 5 of the EPBD (recast) requires MS to establish the comparative methodology framework in accordance with Annex III and to differentiate between different categories of buildings. Annex III states that MS shall define reference buildings that are characterised by and representative of their functionality and geographic location, including indoor and outdoor climate conditions. The reference buildings shall cover residential and non-residential buildings, both new and existing ones.

There is no further clarification on the required reference building types for the cost-optimal assessment. Yet, Annex I includes a list of building categories into which buildings should be adequately classified for the purpose of the energy performance calculation:

- Single-family houses of different types.
- Blocks of flats.
- Offices.
- Educational buildings.
- Hospitals.
- Hotels and restaurants.
- Sports facilities.
- Wholesale and retail trade services buildings.
- Other types of energy-consuming buildings.

This classification could be used or further developed for the reference buildings of the cost-optimal methodology.

Ideally, reference buildings are defined based on the characteristics of the building stock and the purpose they are meant for. They can have two main purposes:

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<sup>1</sup> It has to be mentioned that the term reference building is used in the MS in different perspectives. Some countries use this term to define the energy performance requirements via a 'reference building approach'. This is not a representative building type but a mirrored building with the same geometry, user profiles, etc. and a defined set of (reference) technologies, which results in a maximum allowed primary energy use for this specific building.

- To represent the aggregate stock of buildings affected by regulation;
- and to identify sectors that would be disadvantaged by requirements that might, nevertheless, be cost-optimal overall.

Due to the limited (or lack of) knowledge about the building stock, the choice of reference buildings has a more arbitrary nature. This arbitrary element in picking reference buildings might be a source for deviations and inconsistencies in the comparison. Moreover, the use of different service systems in comparably constructed buildings, as well as different user typologies will multiply the number of reference buildings.

Additionally, the building size might have an influence on the results. Therefore, it could make sense to further categorise building types such as blocks of flats (small multi-family houses vs. high-rise blocks of flats), office buildings (small office buildings vs. large office towers), etc. The size partly also influences the necessary or possible building service systems. Some cost-saving technologies might not be useable in bigger size buildings while other might become cost-efficient especially in large buildings.

Several past and current EU projects collect(ed) information on existing national reference buildings or try to develop national sets of reference buildings. The Intelligent Energy Europe project TABULA (contract no. IEE/08/495/SI2.528393) is one of them. TABULA aims to create a harmonised structure for European building typologies ([www.building-typology.eu](http://www.building-typology.eu)) with residential buildings in focus.

The possible list of energy saving measures will probably show less diversity. An important issue for the existing building stock is the extent to which the effect of an energy saving measure depends on the present performance of the building or building element. Adding insulation to a non-insulated or to a moderately insulated structure has a greater impact than adding it to a well-insulated one. This can be handled by differentiating the reference buildings for the existing stock, but this complicates assessment (and it is likely to result in more complex regulations). A related question is whether regulations should be cost-effective for all reference buildings. For the sake of consistency and transparency, it is important to clarify the definitions and the quality/validity of the underlying data and assumptions of the set of reference buildings and measures.

Some packages of measures, such as combining insulation measures with a new heating system, can result in synergy. Insulation measures do not only reduce the energy use of the building but, rather, they also decrease the heating load, offering the possibility to use smaller and cheaper heating units and emission systems<sup>2</sup>. This cost reduction can only be achieved if both types of measures are considered as a combination.

Bundling of systems has to be taken into account especially if the goal of the energy performance requirements is to reach the maximum energy saving while still being cost-effective.

## 5 Calculation method

The EPBD indicates that the EC will be delivering just a framework of a method and not a method itself. National assessment methods differ substantially (regarding energy and cost benefit calculations) and also the process to establish or tighten requirement levels differs. As cost-efficient requirements are strongly depending on the used assessment method, the MS have to use their own assessment method even if it is not fully based on a CEN standard, otherwise the results cannot be compared to the real situation in the country. However Annex III of the EPB Directive urges that the national methodologies should be based on relevant CEN standards.

Calculation of cost efficiency is likely to be defined by MS in different ways, even though it may be based on the same CEN standard, and, in many cases, this is not the only aspect that is taken into consideration when tightening requirements. For example, MS also consider the skills needed to apply a certain technology, and its availability within the country's workforce and macro-economic effects are of importance. The question is how to derive consistent judgements on cost optimal levels adopted by different MS when there is a huge diversity in methods, definitions and assumptions that dominate the outcome. The risk in this approach is that the validity of many national input variables and assumptions should be checked in order to validate the outcome of the comparison.

<sup>2</sup> The effect of insulation upon the cooling needs and cooling system size cannot be forgotten and must also be taken into account.

In addition to different calculation methods, each MS also expresses its energy requirements differently. Some MS for instance are setting whole building requirements based on primary energy per floor area, while others use an indicator that also neutralises the shape of the building. Others use the notion of reference building that has already been described, fixing the reference values for each system and building component. Accordingly, energy requirements for existing buildings can be set on whole building or element level, even though the energy performance must be given as a numerical indicator of primary energy for the whole building.

## 6 Summary and recommendations

### 6.1 Uncertainties in the approach in general

Cost optimality as a theoretical concept is well established. However, in the context of comparing minimal requirements that should be set with a view to achieving cost optimal levels per MS, its application is far from straightforward. In particular, there are choices of methodology (for example, between a societal or end-user perspective) which have significant impact on the outcomes. There is no clear-cut “right” or “wrong” approach to this type of choice as each addresses a different issue and different MS place different emphasis on each issue. More detailed procedural decisions (such as the choice of reference buildings) will also affect outcomes. Inevitably, there is general uncertainty about much of the input data.

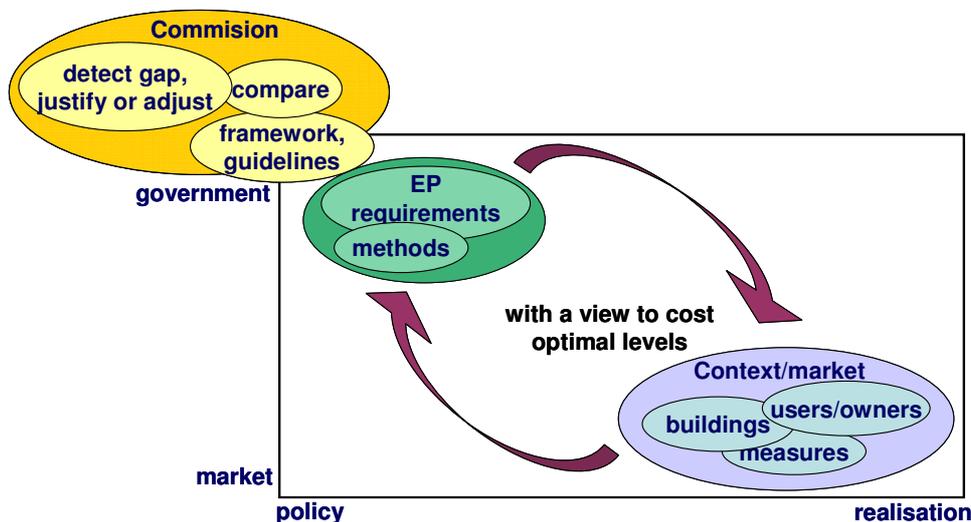


Figure 3. Map of cost optimal framework for setting requirements and compare (BuildDesk.nl).

Another source of uncertainty is the stratification in three levels that should be dealt with (real buildings; national legislation; EU framework).

The ultimate goal is to achieve a cost optimal improvement of buildings in reality. This should be enforced by national minimum energy performance requirements. The step from the specific building to national requirements is already complex and it requires a subtle process and sufficient knowledge of the building stock and the market. Feedback loops between government and market through survey studies and consultation are essential to achieve an effective approach. The pitfall is that reference cases and typical measures are defined and that they are considered being reality. Learning cycles mirroring legislation with reality are crucial for effective implementation. This also implies that modification of legislation over the years is important.

The European Commission asks MS to compare their national minimum requirements with cost optimal levels and report on the outcome. In case there is a significant gap that cannot be justified, MS should take measures to bring the requirements in line with cost optimal levels. It is important to understand that a too rigid comparison methodology can have a negative effect on setting national requirements, e.g. exposing that a MS prescribe requirements that are stricter than that calculated using the cost optimal methodology, even though there may be well substantiated reasons why a MS should impose stricter requirements. A rigid EU methodology can reduce the reliability on national level and also the flexibility

to modify the national approach. The emphasis of justification of requirement levels towards the Commission by means of reference buildings and lists of measures may increase the risk that reality is too easily confused with reference buildings and seemingly cost optimal levels based on reference buildings turn out to be sub-optimal in reality. It is thus important that the reference buildings developed in MS become as representative as possible for the national building typologies and changes in building tradition.

Apart from these risks, it is without doubt that a Comparative Methodology Framework is a powerful instrument to guide MS in the process of checking the level of their minimum energy performance requirements and to strongly improve the energy performance of their building stock. Sharing of knowledge and experiences between MS will also be stimulated through the common procedure laid down in the Framework.

## 6.2 Spectrum for designing the framework

In terms of practical implementation, there is a spectrum of choices to design the framework, between two extremes:

- A tightly-defined procedure defining all parameters needed for the calculation at EU level with which all MS should attempt to comply.
- A framework allowing MS to adjust to national conditions (subject to there being reasonable supporting evidence).

The first of these two extremes would ensure more (but imperfect) comparability between MS, but it requires them to carry out assessments that are additional to those that they need to do to satisfy national assessment requirements. When the framework requires national assumptions to be replaced by prescribed EU-data, the outcome of the comparison might be less valid for the specific practice in a MS. Consequently, adjustment of the requirements has the risk of being cost suboptimal in reality for buildings that have to comply with the requirements.

The second option, to allow MS a free choice, seems closer to the intent expressed in the EPBD Recast (to identify whether minimum performance requirements are reasonably close to being cost-optimal) - but only in the context which each Member State chooses to operate. The free choice provides MS with the ability to better attune to the national context and create more effective requirements. The deviation of the approach between MS increases the need for supportive evidence and can require a less harmonised report to the Commission.

Some MS may choose to analyse many reference buildings and perform several sensitivity studies, while MS with longer experiences, over several decades, in setting cost effective requirements will know where to focus and how to justify their approach. They should not be obliged to perform too many calculations, with the risk that the Commission will find the information hard to analyse, while a more focused approach is also easier to judge by the Commission.



A balance should be found between the harmonisation of the comparison procedure with the results transparently reported in a reporting format. Furthermore, the comparison procedure must easily match the national calculation procedure. The approach could be to allow modification from a prescribed approach under the condition that they can be justified properly.

## 6.3 Defining the reference buildings and energy saving measures

To define reference buildings there is a distinction between new buildings and existing buildings.

### New buildings

For new buildings, there is no clear population in statistical terms as a basis for a reference. The reference buildings need to reflect future building characteristics and expected energy/indoor climate concepts in a proper way, in order to study cost optimal ambition levels. In many countries, there is experience using this reference building approach for setting minimum energy performance requirements

for different building categories. A limited inquiry among the 4 countries showed that a number of countries defined a set of reference buildings (3-6 residential buildings and 1-25 non-residential buildings - see full report for more detailed information) based on expert judgement combined with acceptance of the stakeholders in the market. Through the years, these sets were revised and they form an accepted basis for cost efficiency studies. Typically, these buildings are rather simple, although they reflect all necessary building characteristics and possibilities to incorporate energy saving concepts, to create valid results from the sensitivity studies.



From the experience of several countries, it seems a satisfactory approach to have experts, in consultation with the market, define a number of not too complicated reference buildings for different user typologies. Based on these buildings, sensitivity studies can lead the way to cost optimal levels.

### Existing buildings

For existing buildings, there is hardly any experience in the MS regarding definition of reference buildings for the purpose of setting minimum requirements in a cost efficient or optimal way. Reference buildings can be used to assess cost optimal levels for the comparison of minimum requirements for the existing buildings or building units as a whole, or for requirements related to building elements as such (e.g. roof, wall, heating system, and cooling system). Reference buildings can be defined based on the use, geometry, age, energy performance characteristics, user patterns, maintenance condition of the elements, etc. Based on knowledge of the building stock - e.g. by statistical analyses of data collected in the energy performance certification schemes - an intelligent composition of a consistent set of reference buildings can lead to a significant reduction of the needed number of reference buildings, without affecting the quality of the cost optimal comparison.



When comparing minimum energy performance requirements, extensive cost efficiency studies can be executed for all building categories and related reference buildings. However, it is of great importance also to allow a more comprehensive set of references and to provide the flexibility in the framework to do so. Of course, the reduction to a smaller but still consistent set should be justified to the Commission regarding its validity for all relevant building categories.

## 6.4 Energy saving measures

Putting together a list of energy saving measures is relatively simple. In the case of new buildings, packages of measures will be taken into account to establish cost optimal levels. In identifying the packages, it is important to apply the so-called *Trias Energetica*<sup>3</sup>. In case of the existing buildings stock, the energy saving of the measure depends on the energy characteristics of the building as it is in reality. Both packages and single measures can be applied to existing buildings undergoing a major renovation. In case of maintenance or renovation, the cost for energy measures should be defined as additional cost. These costs are sometimes hard to determine. Preferably, the *Trias Energetica* should also apply for the existing building stock. In practice, with maintenance driven interventions in a building, this is not always possible. The diversity and practical restrictions that occur in the existing stock complicate the energy efficiency analyses and cause a lot of uncertainties. Nevertheless, improving the existing building stock is crucial for the realisation of the climate targets.



Analysing the cost efficiency of measures in the existing building stock is common practice in consultancy for specific buildings. For the purpose of setting or comparing energy performance requirements, measures have to be judged in a more general and transparent way in order to be valid for enforcing requirements. There is hardly any experience how to do this properly. It is therefore of great importance to organise knowledge exchange and to share experiences. The framework should take into account the fact that adjustments and refinement shall be needed in the near future.

<sup>3</sup> *Trias Energetica* is a simple and logical concept that helps to achieve energy savings, reduce our dependence on fossil fuels, and save the environment. The 3 elements of *Trias Energetica* are:

1. Reduce the demand for energy by avoiding waste and implementing energy-saving measures.
2. Use sustainable sources of energy like wind, solar power and water.
3. Use fossil fuel energy as efficiently as possible and only if sustainable sources of energy are unavailable.

## 6.5 Calculation method and parameters

In order to be in line with the national context, it is essential that MS use the national methods in force while comparing the minimum energy performance requirements with cost optimal levels. This results in a lot of different calculation methods with as many sets of definitions. Also the value of parameters depends on the way they are defined in the national methodology. However, the energy calculation has to be in line with Annex I of the EPBD (recast) and the principles of the cost effectiveness calculation will be outlined in a CEN standard that has to be applied. A limited number of parameters can be set at European level. The Commission will prescribe some values like a trend in the development of the most common fuel prices.



Allowing national approaches for the calculation and parameters implies that the methodologies as well as input data and constant parameters should be explained and justified in a transparent way to the Commission. Otherwise, a fair justification of the minimum energy performance requirements is not possible.

## 6.6 Future directions

The Concerted Action EPBD has stated its willingness to help to develop and test workable procedures, and hopes that future collaboration between MS and the Commission will result in procedures which are, as far as is possible, clear, robust and widely acceptable.

Since 2011, there is a dedicated Core Theme on this topic in the Concerted Action EPBD. Questions and issues related to the topic will thus be discussed over the years to come.

The draft of the framework of the methodology was published by the EC in June 2011 and therefore MS are encouraged to give comments and early experiences at the next Concerted Action meeting in December 2011.

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