ASIEPI
EPBD AS SUPPORT FOR MARKET UPTAKE FOR INNOVATIVE SYSTEMS
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Stimulating innovation with EPBD

What countries can learn from each other

European countries deal with innovations in the context of the European Performance of Building Directive (EPBD) in different ways. These different frameworks cannot be seen separately from other national procedures and systems. All of these systems have their advantages and disadvantages. And although the balance between the pros and cons depends on the national context, countries can learn from each other. Therefore, this report elaborates on various national frameworks and give some possible alternatives.

1 > Introduction

To be able to reach national and international goals on energy saving in the build environment, it is inevitable that we need innovation in buildings and systems. Therefore it is of the utmost importance that legislation based on the Energy performance of Buildings Directive (EPBD) stimulates, or at least not limits, innovations.

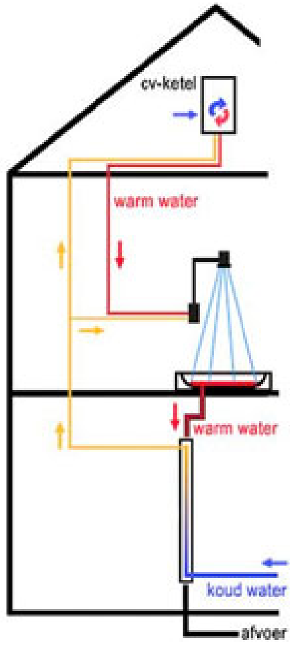
The EPBD requires that all Member States of the EU define an Energy Performance (EP) method and corresponding EP requirement levels. The EPBD prescribes the framework of the EP methods. On national level the EP methods are developed taken into account the national Building Code, building practice, compliance and control schemes and standards and other national behavioural and cultural aspects.

Consequently, what is needed in a country to overcome barriers for innovation will differ. However, that doesn't alter the fact that countries can learn from each other when they are aware of the possibilities and the advantages and disadvantages of the various options.

2 > What is the problem with innovation within the framework of the EPBD?

In a previous report on this subject [1] a manufacturer was cited who described the problem of innovations within the framework of the EPBD for the industry very clearly. When certain products are not included in the national EP calculation procedure, it is a barrier to their market uptake, since the focus on energy efficiency chiefly starts and finishes with fulfilling the EP requirements. Some countries, like Portugal and to a lesser extent Denmark, have a very open procedure, where no or only limited additional frameworks are needed for innovative products to be take into account in the EP calculations. In most countries however, the EP calculations are more rigid and additional frameworks are needed to be able to take into account products outside the scope of the EP calculations.

Perhaps it could be concluded that having a more open method is the solution to avoid barriers for innovation. In some countries this might be true, but in many situations an open and flexible method has several disadvantages too. These disadvantages are comparable to the disadvantages which some of the additional equivalence framework has, as will be shown below.



Example of an innovative system: heat recovery from shower water (source drawing: [6])

Complex technology

The definition which often used for innovative systems or technologies in the context of the EPB regulation is the following:

- systems or technologies that, in most cases, improve the building's energy performance, and
- whose performance cannot be assessed by the standard EP calculation procedure in a particular country.

This definition is one of the main issues related to the assessment of innovations in the context of the EPBD: How can we ensure that a particular innovation really improves, in most cases, the building's energy performance? The procedure on how to assess an innovation is rarely standard; we often deal with complex technology of which only experts can make a proper assessment, and only experts can check whether the assessment was prepared correctly. In this context, a method taking into account innovations in a national method is one thing, but making sure innovations are handled properly, case by case in practice, is a different story.

A second, even more important issue, is that it is important to realise that developing a calculation method of a physical principal is not just a scientific task. An energy calculation means making choices, for instance related to indoor and outdoor climate, user behaviour or default values to simplify more complex models. These choices are often arbitrary (between boundaries), but can influence the outcome of the calculation, sometimes hugely. Different choices can favour different interest groups. If such an interest group performs the equivalence study, it is not difficult to imagine what happens with these influential arbitrary choices. And even when interest groups hire an independent expert, you can imagine the discussion this still can raise with the competition, since arbitrary choices are always debatable.

It will be demonstrated that countries deal differently with this issue.

Remarks:

The information provided is mostly based on the personal experiences of the partners involved in the ASIEPI project and therefore does not necessarily reflect the official position of a country.

The list of MS is based on the information collected within the surveys, but is not intended to be exhaustive.

To simplify, Norway is included in the list of Member States, although it is not a Member of the European Union.

3 > Country experiences

The following countries that participated in this study have a legal framework to assess the energy performance of innovative systems: Netherlands, Belgium, France, Germany, Finland, Spain, Norway and Denmark. The annex of this document summarises these legal frameworks and illustrates them with an example. Every participant in this study was asked to describe advantages and disadvantages of their national method. These are given in the annex.

Roughly speaking there are 3 ways for taking innovations into account in the EPBD:

1. Countries which have an **open method**: most innovations can be taken into account in the method itself (e.g. Denmark and Portugal)
2. Countries which have a **light framework** for equivalence, based on equivalence studies made by the market or by experts, with local control (e.g. Netherlands and Finland)
3. Countries which have a **heavy framework** for equivalence, based on equivalence studies made by a national committee with national control (e.g. Belgium)

The world is not black and white, and there are shades of grey within these 3 ways, but globally all national frameworks of the countries interviewed could be placed in one of these groups.

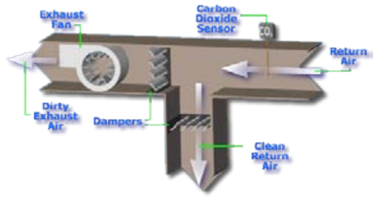
Extra effort, time and costs to make an equivalence study can be a barrier to innovation, but what can also become a barrier to innovation as well is when the actual performance of a product is less than the claimed performance in the equivalence study.

From the point of view of the industry developing the innovation, it could be concluded that the 3 ways described above increase in the strength of the barrier to innovation. The effort, time and/or money involved and the number of procedures increases with each step. On the other hand it could be argued that the first 2 methods can become a barrier to innovation if the actual performance of the innovative product appears to be less than the claimed performance in the equivalence study, due to the poor quality of the study and/or a lack of control. How this can happen will be explained.

Real performance versus claimed performance

As described in paragraph 2, the main issue related to the calculation of the effect of innovative systems is the fact that the development of the calculation method often involves complex physics and partly arbitrary choices. The complexity of the physics makes it hard to develop a proper methodology and makes it difficult to check whether the expert has done a proper job. In practice this can lead to false claims. The EP-level which is claimed, is not achieved in practice due to an inferior performance of the innovation. The consequence of this is clearly seen in practice in some countries. If the actual energy conservation of an innovation is less than claimed, the energy goals will not be reached. In addition, innovations and other products which could have achieved the energy goals are not fully taken advantage of the general support for innovative products, and even the EP-method as a whole, is weakened. Clearly, uncertainty about the actual performance of the innovations is a barrier to innovation as well.

The partly arbitrary choices e.g. user behaviour aspects, which need to be taken into account when a calculation method for innovations is developed, increase this effect. These choices can have a large effect on the energy use of the building and can favour the interest of one market party over another.



Example of an innovation where user behaviour is partly overruled by automation: in this case demand controlled ventilation with CO_2-sensor (source drawing: [6])

> *It could be argued that, for instance, user behaviour aspects are just a matter of statistics. For instance in Norway they state that user behaviour can only be taken into account based on statistical studies. The problem is that of the many user behavioural aspects no statistical figures are known. Especially when you realise that user behaviour is influenced by the technology used: available statistical studies usually do not go beyond the average situation and user behaviour due to the innovation is definitely unknown (especially the user – technology interaction components), since the innovation has not been used in practice. If user behaviour is not fixed when no statistics are known, as in Norway, these choices will be partly arbitrary choices. On the other hand: fixing the user behaviour can be undesirable, since occasionally it is the effect of user behaviour which the innovation tries to improve (e.g. by automatic control).*

In an open method these choices are made by an expert who produces the EP calculation. This is also the case in countries with a light framework, where experts, hired by the market, perform the equivalence studies. In both situations the local authorities might check the studies, but even if they have enough expertise, the question is: is this procedure valid for making the right policy choices? Perhaps it is, especially when the forces in the market are not very strong. But perhaps it is not. A clear example of the latter is the Netherlands, where there is strong competition between industries related to the EP building requirements. Many companies try to convince decision makers that with their product can more effectively meet the EP requirements. So for them it is a marketing tool to show how well their innovations perform in the EP-calculations. In this environment it is less likely to achieve objective influential arbitrary options.

Global technical framework

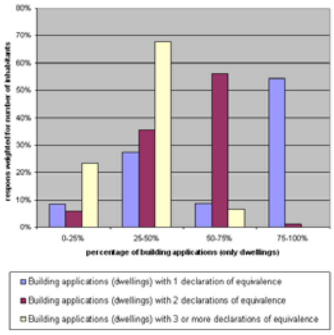
To face these kinds of problems, many countries have at least a global technical framework for equivalence studies in which states that assumptions made in the equivalence study should be similar to the assumptions made in the national EP-method. Some countries go a step further and state that fixed values in the national EP method cannot be changed in equivalence studies. For example: if the amount of ventilation is a fixed value, an innovation which reduces the amount of ventilation needed in a room by introducing a smart detection system cannot be properly rated. This is a protection against unclear claims, but a barrier to systems which really can make a difference. Again the question arises how do we stimulate innovations but protect against faulty claims?

In some countries the national regulations do not allow values to be fixed. Although also in these countries the general rule is that assumptions made in the national EP-method should be used in the equivalence study, there is always the possibility to show equivalence related to one of these assumptions. In these countries effective guidance, specially related to user behavioural aspects is extra important, since even these figures can never be totally prescribed.

Product improvement

Some countries do not differentiate between product improvement and new products. This could be due to the fact that the national regulations forbid excluding any product from an equivalence study. Other countries reduce the need for equivalence studies by having distinct procedures for innovations and product improvements. For instance in France and

Germany equivalence studies are only used for innovations, while improvements of existing products are measured and rated via qualified organizations often following national or EN standards. A weak part of this is the 'product attesting' ('kwaliteitsverklaring' in Dutch) used in the Netherlands. Improvements of existing products can be declared via NEN (Dutch) or EN standards if this is included in the national EP method for the specific product type. The advantage is that this method is fixed so no ambiguous decisions can be made by the expert. This also applies to the German and French systems. The extra advantage of the German and French procedure is that the organization doing the study is accredited, while in the Netherlands, anyone can do the study. Since these studies can be complex, the quality can be debated and it can be difficult to judge the quality and distinguish between real improvements and faulty claims, especially for the local authority. In France the results of the accredited studies are published on public databases, making the data accessible for anyone making an EP calculation. With this the quality control the studies become much easier and the barrier to using the improved product becomes even lower.



Graph shows the number of equivalence studies per application for a Building Permits in the Netherlands in the period 2006-2009. The graph shows that most applications contain one or more equivalence studies: in the Netherlands using equivalence with a Building Permit request is not an exception, it is the rule. (Source: [13]

Upgrade of national methods

An interesting difference between countries is the way they deal with equivalence studies related to the upgrade of the national EP method. Many countries upgrade the national EP method as soon as the equivalence study is ready (or at least as soon as the national regulations allow this procedure to happen), while in other countries it is less evident that the national EP method is upgraded. Of course there is a relation with the thoroughness of the equivalence procedure. Countries like Belgium who have a heavy equivalence procedure and can be quite sure of the quality of the study use it directly to upgrade the method, while in the Netherlands this automatic upgrade is far from evident, but the quality of the study is more debatable. But this is another argument to withhold this automatic upgrade and that is that these countries want to wait and see how valid the claims of the innovations are in reality. History has shown that several innovations which perform well in theory, fail in practice due to numerous, often non-technical barriers. Some countries therefore choose only to integrate a new product in the national EP method after it has been used regularly in buildings and it proves to be an actual energy efficient product.

France has introduced an interesting **two-stage procedure**:

1. An equivalence study can be performed for one building. This study is not valid for other buildings. It can be made by anybody, but it is checked by a national committee of experts enforced by the government. The checking procedure is relatively easy and takes only one month.
2. An alternative is to do an equivalence study for a specific product. In that situation the checking procedure, again by a national committee of experts enforced by the government, is much more stringent and takes six months. But in this case the study is published as a statute of law and becomes part of the French regulation.

The advantage of this system is that there is a relatively easy version of the equivalence procedure in the early stage of a new product, allowing time to test the product in practice without major barriers. Once the product has been proven in practice, and maybe even improved, the more stringent procedure follows and the product becomes part of the national method.

Who pays for the equivalence studies?

Who pays for the studies differs between countries. Some explicitly claim that the manufacturer of an innovation cannot be blamed for the fact that his product is not accepted as a national method and the equivalence study therefore should be paid for by the government. Other countries have the opinion that it is the task of a manufacturer to prove the feasibility and efficiency of their new product. If the product can reduce the EP level significantly, this will be a selling point for the product, so these countries argue that it is logical that the manufacturer pays for the study.

It is important to realise here is that the number of equivalence studies carried out in a country can differ largely and that this number influences the consideration of the pros and cons of a framework for equivalence. For instance, in Belgium recently only a few equivalence studies have been performed, in the Netherlands around three hundred different equivalence studies are currently used within Building Permit requests to lower the EP level. One can imagine that the time and costs involved in the control of the studies surge when hundreds of studies are involved.

Boundaries of the national EP method

A final distinction between national EP methods under discussion is the fact that not all EP methods incorporate similar energy utilities in buildings. For instance Norway only evaluates the energy demand of a building, but no systems are taken into account. Therefore in Norway system innovations cannot be part of an equivalence study simply because it does not take everything into account. In many countries products like dishwashers and washing machines with ‘hot-fill’ (the machine is filled with hot water from the domestic hot water boiler instead of cold water) cannot be taken into account since these products are not ‘building bound’. On the other hand, these products can only be used gas is supplied to the building, which in itself is a building bound measure. Until now, if a manufacturer of these products wants his products rated and even if he proves the measure to be effective, he will not succeed in these countries.

4 > Conclusions from country experiences

It is clear that there are many ways to deal with innovations in the context of the EPBD, all of which have their own pros and cons. Often there are logical explanations behind the differences we see in the European countries.

The differences are partly due to differences in national EP methods themselves. For instance: Denmark has a very open EP method, where many innovative systems can be taken into account. Therefore the need for a legal framework is less than in countries with more strict EP methods, resulting in a different and lighter legal framework.

National legislation is an important parameter which influences the possible framework for innovation. For instance: some countries limit the number of components and systems which can use the principle of equivalence by restricting the definition of innovative systems (e.g. France and Germany). In other countries national legislation does not allow such restrictions and allows that all systems can claim an improved performance by using equivalence, if the manufacturer finds the EP method too conservative for his product (e.g. the Netherlands and Finland).

Also the way compliance and control of the national EP method is handled in a county influences the legal framework for innovative systems. If compliance is high without the need for firm control, the need for a strict legal system for innovative systems might be less. Belgium is an example where it worked in reverse, where compliance in the past proved to be low, resulting in the need for a strict procedure now.

It has already been seen (see IP "Synthesis report: Approaches and possible bottlenecks for compliance and control of regulations" by B. Poel [5]) that cultural aspects related to the interaction between society and government influence the compliance and control of the national EP method in a country. Poel makes obvious in his paper that the relationship between citizens and authorities depends on values that vary from country to country. In some countries a very strict enforcement is the common approach, while in other countries the authorities can apply alternative control schemes partly based on self regulation. This will also influence the framework for innovative systems in these countries. A very open method might work in one country but not in another.

This also depends on the market interest, which apparently differs in different countries. For example, the EP requirement levels in the Netherlands are very strict and the urge to claim better performance of products is high; much higher than in various other countries. Combined with the fact that a claim for better performance is possible by Law without restriction, the amount of claims of the principle of equivalence is very high. The framework for innovation must be able to handle this large number of claims.

We have seen that there are various barriers for innovation:

- heavy procedures which take a lot of effort, time and money can be a huge barrier,
- but also bad quality of equivalence studies can harm the support of innovations in general or even the support of the EP method as a whole. When people see that, due to national legislation, new products are used which claim energy savings, but do not do so in practice, people will not understand this. And since it is difficult for a layman to distinguish between good and bad it is not surprising that they lose confidence in more than the specific products themselves.

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- These barriers result in main issues that the equivalence procedure needs to deal with:
- how to assure the quality of the assessment of complex techniques
- how to deal with influential and partly arbitrary choices required by the method, such as like user aspects
- how to balance the effort, time and cost aspects of these two issues.

Where some countries trust independent experts in the field and a relative light control system on local level, others introduce a heavy control system, using a national committee of experts. It is obvious that without a national committee comprehensive rules are needed to deal with aspects such as user behaviour. Simply fixing these values might not always be satisfactory, and statistical values often might be scarce.

Explicit alternative routes for product improvements might simplify the problem, as might the two step approach used in France where a light procedure can be used in the early stages of the development of an innovation and a more strict procedure after the innovation has proved itself.

It is clear that there is no readymade solution for the issues related to equivalence, but it is clear that countries can learn from each other's experiences.

5 > Guidelines

On basis of the national situations, it was possible to identify some key points of attention that could inspire Member States. As stated previously, how the "principle of equivalence" is implemented in a country depends on several national factors. Consequently, not all points of attention are applicable in all Member States.

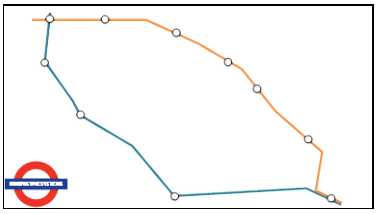
5.1 > EPB regulations should not be a barrier to innovation

Independently of the approach they have implemented, several Member States included in this analysis have reported as the main advantage that *"a principle of equivalence allows any product to get a chance to be taken into account, which is necessary for innovation to have an impact"*.

Therefore…

> It is important that Member States explicitly foresee the possibility of assessing technologies not covered by the standard calculation procedure, so that their EPB regulations do not become a real barrier for innovation.

Several options are available to achieve this goal. However, in any case, the following points of attention should be considered.



The "principle of equivalence" approach should be implemented in a way that is in line with the way in accordance with the EPBD is implementedimplementation.

5.2 > The "principle of equivalence" approach should be considered as an extention of the standard calculation method

Therefore…

> It is important that the "principle of equivalence" approach is implemented in accordance with the EPBD implementation.

For instance:

- the way the equivalence studies are carried out should be compatible with the way the standard calculation procedures was set up; this might require defining a so-called "technical framework", as discussed below
- if a Member States has implemented a strict control scheme, the "principle of equivalence" must not be an escape route to it, and it must also be kept under control
- ideally, it should be possible to introduce the results of the equivalence studies directly into the EP calculation tool(s), especially if the EP calculation tool has to be used to electronically report the EP calculations to the authorities. In this case, the EP calculation tool(s) must be designed in such a way that the result of the equivalence studies *can* be introduced.
- …

In some MS, and for some innovative systems, it is possible to change the value of a specific parameter. In some MS and/or for some innovative systems, the calculations have to be done manually.

The Spanish approach is probably the most developed on this point: an equivalence study includes a piece of software that will be added to the standard calculation tool, as pre-processor or post-processor.

5.3 > The use of the "principle of equivalence" approach should be the exception, not the rule

As the use of the "principle of equivalence" approach has it own disadvantages (see the country situations in annexes), it should be the exception, not the rule.

The possibility to quickly improve the standard calculation procedure depends on several factors, including the status of the document that specifies the procedure. It might be much more complex to update it quickly if it is published as a legal text that must be published in the national law gazette (such as a law, a Governmental order or Ministerial order) than if it is published as a document from a recognised institute.

A specific approach to prove better performances exists in several Member States, as in Netherlands ("kwaliteitsverklaring" or "declaration of quality"), France ("agrément technique" or "technical agreement"), Germany, Belgium... It might require to be validated by a neutral body or not.

By definition, the need to use the "principle of equivalence" approach is reduced if the standard calculation procedure includes as many technologies as possible. This is shown by the German calculation procedure, which includes several systems or technologies which are not included in many other Member States (see [3]). Consequently, the number of equivalence studies is reduced. To achieve this...

> Member States should improve the EPB standard calculation procedures on a regular basis.

On the one hand, when the standard calculation procedures specify a fixed or a default value, it should also specify how to prove better performances than this default value (e.g. "the efficiency has to be measured according to EN 12345").

On the other hand, the existing equivalence studies could be used to identify the technologies that should be integrated in priority into the standard calculation procedures, and could be used as basis for procedure updates. (Technologies that appeared to save energy on paper only could possibly be integrated in such a way that their use is discouraged.)

5.4 > Need for quality and management of complexity

One of the main disadvantages reported by every Member States where the studies can be performed by anyone (DE, DK, FI, FR, ES, NL) is that *"allowing anyone to make the equivalence study might lead to significant differences in the quality of the studies and also to studies of poor quality"*. This disadvantage can be further increased if the evaluation of the equivalence study is the responsibility of the municipalities.

Therefore...

> Given the need for quality, and the complexity of a coherent assessment of innovative systems, it is important to have a framework that can ensure the quality of the studies.

One option would be to have a single body authorised to perform the studies, but this would not match the practice and/or the legal framework of many Member States and also has its own disadvantages (see e.g. § A1.4).

Fortunately, there are other options. Some are related to the way the studies must be carried out, others to the way the studies must be evaluated.

5.5 > How should an equivalence study be carried out?

Some Member States (FR, NL) reported that "the assumptions of the equivalence study have to be similar to the assumptions of the standard calculation procedures". In France, where this also applies, it has been reported that, "as no technical example was presented [as annex of the Title V legislation], the first equivalence study was incomplete and unclear". However, once a template was provided, several studies were performed.

Moreover, this is only possible if the assumptions of the standard calculation procedures are published, which is probably not always the case, especially as by definition, innovative systems are systems not included in the standard calculation procedures.

Even if this may be a difficult task, **it might be useful that Member States that do not have a technical framework for the assessment of innovative systems analyse the necessity to define one, at least a minimal one**….

This technical framework could include the following elements: the type of calculations to be done, the characteristics of the buildings to be simulated, the occupancy pattern, the outdoor climatic conditions, the pollutant emissions, the internal gains…

This technical framework should be in line with the standard calculation procedure; if both have not been written by the same people, at least a close collaboration between them is required.

5.6 > How to evaluate the studies?

In The Netherlands, Vereniging Stadswerk (union for profesionals who work in the field of the physical living environment) may help the municipalities. See: www.senternovem.nl/epn/handhaving/index.asp and www.stadswerk.nl (in Dutch).

In Denmark, SBi publishes FAQ about the EP calculations. See http://www.sbi.dk/miljo-og-energi/energiberegning/anvisning-213-bygningers-energibehov/faq/typiske-sporgsmal-og-svar-faq/?searchterm=None (in Danish).

In some Member States (DE, DK, FI, NL, NO), the alternative assessment is evaluated at municipal level. All those Member States have reported that having an assessment at municipal level is one of the main disadvantages of the system. To overcome this disadvantage, **a first option could be to approve the alternative assessment studies at a sufficiently high administrative level.** However, the implementation of this option can be difficult, as it might need a (more or less drastic) change in the general legal framework.

A second option (if the first one is not possible) could be to have an appropriate support infrastructure for local authorities. For instance, it might be possible:

- to set up a consultative central body that would establishes a technical framework to perform the studies and criteria to accept them (see § 5.5 >),
- to set up a consultative central body that would provide advice on the studies, on request of the municipalities,
- to publish the list of accepted studies.

In The Netherlands, Vereniging Stadswerk has an unpublished database of accepted studies, available for its member www.stadswerk.nl.

A list of criteria for accepting studies would be helpful for both the municipalities and for the experts that make the studies, as obviously they would respect them if they knew that their studies would be evaluated at least on the points mentioned in the list.

Accepted studies are published in France and Belgium, where the evaluation is centralised.

France: www.rt-batiment.fr/batiments-neufs/reglementation-thermique-2005/titre-v-etude-des-cas-particuliers.html (7 studies so far)

Belgium, Flemish Region: www.energiesparen.be/epb/gelijkwaardigheid (5 studies so far)

It must be noted that the municipalities might be reluctant to publish to studies they have accepted, as they might have accepted poor quality studies. However, a centralised publication of accepted studies would not only help municipalities to take a decision, but it would also increase the transparency of the system and it would help the experts in charge of the EP calculations. This is compulsory in Spain.

5.7 > Community support

In Spain, the documents under public consultation can be found on: http://www.mityc.es/energia/desarrollo/EficienciaEnergetica/CertificacionEnergetica/propuestaNuevosReconocidos/Paginas/nuevos.aspx.

In order to have the required community support, it might be useful to have a structured approach for interaction with the market.

For instance, some kind of public consultation might be organised if a technical framework is defined (just as public consultation has been organised for the standard calculation procedure…). This happens in Spain and Belgium.

5.8 > Market information

> It is important to pay attention to inform the market about the possibilities offered by the "principle of equivalence" and to provide information on approved systems.

As said previously, a centralised publication of accepted studies would increase the transparency of the system.

5.9 > Delay and costs issue

> It is important to pay attention to the costs for carrying out studies of equivalence and the time for assessment of innovative systems.

Some Member States reported that there could be a long delay (BE, DK, FR, ES), up to 6 months or 1 year. Only one Member State (NO) reported that the delay could be short. The fact that the system is open or closed seems not to be a determining factor for the delay (it is interesting to note that two Member States with a more open approach reported different delays for obtaining approval for a study).

Some Member States (BE, FI) reported that the cost might be "high" whereas some (NL, DE) reported that the cost might be "low". In one Member State (ES), the cost can be subsidised.

5.10 > Next EPBD revision

The issue of the assessment of innovative systems is not addressed in the EPBD. However…

> As the EPBD should act as a driver for innovation and surely not create barriers to innovation, this issue could be integrated in the next EPBD revision.

Article 3 of EPBD [1] states that:

Adoption of a methodology

Member States shall apply a methodology, at national or regional level, of calculation of the energy performance of buildings on the basis of the general framework set out in the Annex. Parts 1 and 2 of this framework shall be adapted to technical progress in accordance with the procedure referred to in Article 14(2), taking into account standards or norms applied in Member State legislation.

This methodology shall be set at national or regional level.

The energy performance of a building shall be expressed in a transparent manner and may include a CO_2 emission indicator.

Article 3 could require Member States to have a legal framework for the assessment of building technologies that cannot be assessed by the national or regional calculation methodology. It must be noticed that such a legal framework, sometimes known as the "*Principle of Equivalence*", exists already in several Member States…

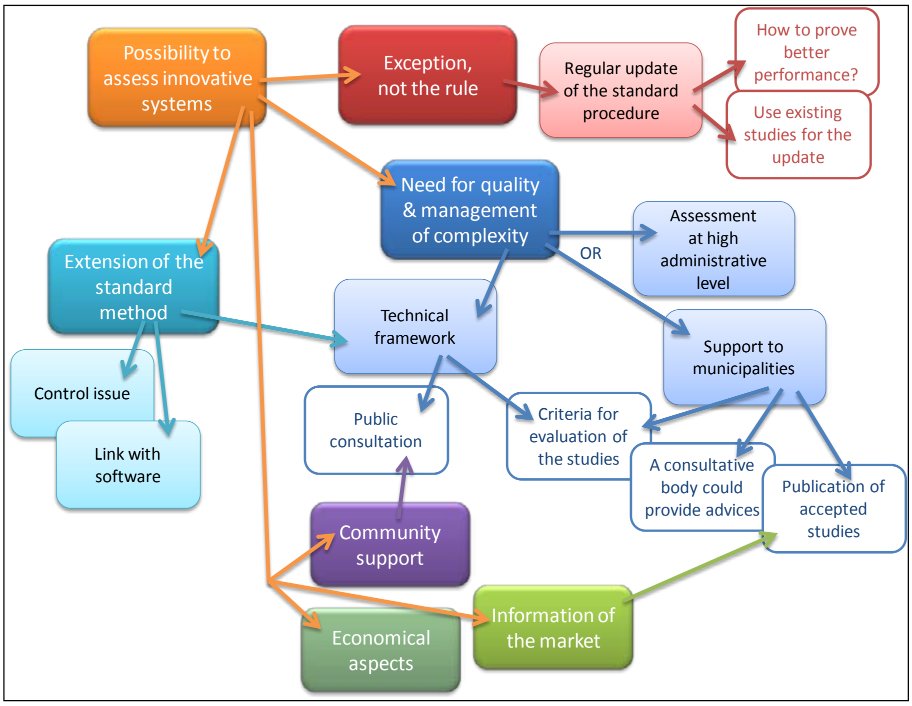
As a first suggestion, the following paragraph could be added to Article 3:

> *In order to stimulate the market uptake of innovative technologies, Member States shall adopt a legal framework for an alternative assessment of building technologies that are not covered by the (national) calculation methodology set in accordance with the first subparagraph of this paragraph.*

6 > Summary of the key points of attention

From the various ways innovative systems are handled by the national EPB approaches, some key points of attention have been identified, as shown in the figure.

These could inspire both the Member States that do not have a framework for the assessment of innovative systems and those that have one but would like to improve it.



The three main points of attention could be summarised as:

1. It is important that Member States explicitly foresee the possibility of assessing technologies not covered by the standard calculation procedure, so that their EPB regulation does not become a real barrier for innovation.

   If a legal framework is defined, the extent of its application should be clearly defined. Is it applicable to systems not covered by the standard calculation procedure only? Is it also applicable to prove a better performance than the one included in the standard calculation procedure? Is there also an approach for "innovative buildings" (which are only valid for a single building)?

2. As this alternative assessment procedure should be the exception rather than the rule, different approaches should be combined (if legally possible) to limit its use. The standard calculation procedure should be updated on a regular basis (on basis of the equivalence studies) and should include the specifications to prove a better performance than the default value.

3. Given the need for quality and the complexity of a coherent assessment of innovative systems, it is important to have a framework that can ensure the quality of the studies. Several options have been identified to go in that direction: e.g. the assessment of the study should not be performed by the municipalities but by at sufficiently high administrative level, a technical framework could be defined,…

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Annex 1 > Belgium

A1.1 > Summary of the Belgian approach

Two facts are very important to understand the Belgian situation:

- the implementation of the EPBD requirements is under the responsibility of the 3 Regions (Flemish Region, Walloon Region and Region of Brussels-Capital),
- the control framework is quite strict, which imposes to have very clear and detailed legal and technical procedures.

The standard calculation procedures have been approved by each regional government and published in the national law gazette as a Governmental Decree. Consequently, it is less evident to have regular updates of the procedures than if the procedures had a lower legal basis (as a Ministerial Decree, a standard or a stand-alone document published by the regional energy agencies).

Currently (January 2010), the procedure is fully operational for innovative systems in the Flemish Region and in the Region of Brussels-Capital. In Brussels, a procedure for innovative buildings has been published, but some details are still to be published. In the Walloon Region, the EP requirements will be in force from May 2010.

The organisation is the Belgian Association for Technical Approvals, who is also the Belgian member of EOTA (UBAtc/BUtgb).

The EPB legislation of the 3 Regions foresees the possibility to use the principle of equivalence.

For innovative systems, only systems that are not included in the standard calculation procedures can use the principle of equivalence; in other words, the principle of equivalence cannot be used to prove better performances than the fixed values mentioned in the standard calculation procedure.

For innovative buildings, the Region of Brussels-Capital has defined a framework for buildings that fulfil EPBD requirements and that reach 8% primary energy savings thanks to their innovative feature(s).

For innovative systems, a technical framework is set up on the basis of the performed studies, for further similar equivalence studies. For innovative buildings, the Region of Brussels-Capital is currently defining a technical framework.

For innovative systems, only one organisation is allowed to make the equivalence study (ATG-E), but various stakeholders are present in the decision process. Once the ATG-E is delivered, the manufacturer has to make it accepted by each Region.

However, the ATG-E does not indicate how to use it in the regional calculation procedures. It's up to each Region to decide how to make the link to its regional calculation procedure. The market expects that the same approach would be adopted in the 3 Regions, but as the 3 Regions do not use the same software, some differences might occur.

The equivalence studies are only for innovative systems in new buildings; they cannot be used to certify existing buildings.

The industry is supposed to pay the study, but the fee does not cover all the costs of UBAtc/BUtgb, especially for the first study in a particular field.

What's particular to Belgium is that the evaluation is centralised and kept under control by the authorities. Currently, the time necessary to get an approval might be relatively long and should be shortened.

A1.2 > Example : demand controlled ventilation system

At the time this report is written, five equivalence studies were approved, all of them for demand controlled mechanical exhaust ventilation system for dwellings. www.energiesparen.be/epb/gelijkwaardigheid

As example, we will take a mechanical exhaust ventilation system for residential buildings ventilation systems, where the exhaust outlets are controlled by presence detection and/or humidity and/or CO_2 sensors. The system is therefore a "demand controlled ventilation system".

In Belgian EPB calculation procedures, the airflow for hygienic ventilation is supposed to be the same, independently of the type of system (natural, mechanical supply, mechanical exhaust, balanced mechanical). Therefore, a company can consider that the aspect "demand control" of its mechanical exhaust system is not included in the EPB calculation procedures and that the principle of equivalence can be applied. The company will ask the Belgian Organisation for Technical Approvals (UBAtc/BUtgb) to carry out a study (ATG-E).

First of all, UBAtc/BUtgb, which is a private organisation, will ask the 3 Regions if they consider that the systems is not included in their EPB calculation procedures. The 3 Regions should confirm that point of view, as they did for the systems accepted so far. Then, UBAtc/BUtgb will nominate a technical rapporteur who has to make the study, on the same way of the previous studies.

Once the study will be performed, the rapporteur will present it to the relevant UBAtc/BUtgb specialised group, which had to approve it. Then, the ATG-E will be delivered to the company. This ATG-E will specify under which conditions it might be used. The company will then submit the ATG-E to the different Regions. On basis of this ATG-E, each Region will decide how to introduce the system in its own official EPB software and will published its decision on its website.

The person that wants to use this ventilation system in its new dwelling may introduce the system as specified by the relevant Region. No further administrative work is necessary because of the use of the "innovative system".

A1.3 > Advantages of the Belgian approach

As the procedure for innovative buildings is not yet fully implemented, we will only discuss the approach for innovative systems, based on ATG-E.

1. The main advantage of the ATG-E approach is that they are carried out with a coherent approach, which is expected to produce good quality studies.

   The fact that all studies are made by one organisation should prevent the risk of having large quality differences between the studies (which is a risk if everyone can make the study and if each local authority has to approve them. Moreover, the coherency goes very far: each year, if any change had occurred in the evaluation process, the existing ATG-E results can be updated to be in line with the similar ATG-E published afterwards.

2. The second main advantage of the ATG-E approach is that one equivalence study can be used for all three regions, even if formally it's a two steps process.

   As the EPBD implementation is a regional competency, three similar but slightly different set of regulations are in force in Belgium. This is not a problem for a building owner, as its building is located in one of the Regions, but this is clearly a barrier for architects and contractors who work in 2 or 3 Regions, and for manufacturers of (innovative) systems. The fact of having only one study is an advantage for the manufacturer of innovative systems, as it reduces the cost, delays and uncertainty. Moreover, the fact that this study will probably be used in the same way in the 3 Regions simplifies the marketing. Another advantage is that the Regions have representatives in the UBAtc/BUtgb. Consequently, once the ATG-E is delivered, they already know every detail about it and how they will decide to use it in their regional regulation and software. The acceptance process by the Regions can therefore be very quick.

3. One equivalence study can be used for several buildings. The link with the official software is expected to be quite easy.

   Neither the so-called EPB rapporteur, who makes the EPB declaration, nor the municipally have to make any administrative work because of the innovative system. This differs from e.g. the Dutch situation, where the same study can be used in several buildings, but where each municipality has to decide on the acceptance of the study on a case by case basis.

4. A large group of stakeholders are involved in the equivalence study.

   Firstly, the ATG-E study is not performed by one single person, but be a team, in close collaboration with of representatives of the Regions. Secondly, the ATG-E must be accepted by a larger group of industry association representatives. This should reduce the risk of giving EP bonuses for "paper" energy savings, and should increase the acceptance of the principle of equivalence scheme by the stakeholders.

5. Some kind of certification of the innovative systems is mandatory.

   This certification is limited to the characteristics that have an impact on the result of the study.

A1.4 > Disadvantages of the Belgian approach

1. The procedure is rather heavy and requires time (typically 1 year).

   This is especially true if no similar studies have been studied in the past, since a new methodology must be developed from scratch.

2. The costs of the equivalence studies are substantial.

   The cost maybe high for the industry (about 12.000 EUR, without certification) but might be not enough to cover all the costs of UBAtc/BUtgb. A higher cost would not be acceptable, mainly because an industry is not responsible for the fact that its product is or is not included in the EPB calculations.

3. The principle of equivalence is only applicable to systems not included in the standard calculation procedure; it other words, it cannot be used for "declarations of quality".

   For some systems, the standard calculation procedure states that the efficiency has to be measured according to a specific standard. For such systems, there is no need for an equivalence study; a measurement can be carried out according to the relevant standard. For other systems, the standard calculation procedure specifies fixed values of their efficiency. For such systems, which are included in the procedure even by a fixed value, the principle of equivalence is not applicable. This might be a barrier for product improvement.

4. In practice, the distinction between "included" and "not included" is not always easy, and therefore there is a committee that decides if the principle of equivalence can be applied.

For some systems, the standard calculation procedure states that the efficiency has to be measured according to a specific standard. For such systems, there is no need for an equivalence study; a measurement can be carried out according to the relevant standard. For other systems, the standard calculation procedure specifies fixed values of their efficiency. For such systems, which are included in the procedure even by a fixed value, the principle of equivalence is not applicable. This might be a barrier for product improvement.

Annex 2 > The Netherlands

A2.1 > Summary of the Dutch approach

It is not easy to change the standard calculation procedure: the EP method is fixed in a national Standard, which is modified only once every few years.

Netherlands uses the principle of equivalence. This procedure can be used to prove better performances that the one included in the standard calculation procedure.

Everybody can make the equivalence study. The one who wants the equivalence study has to pay for it.

The assumptions of the equivalence study have to be similar to the assumptions of the Standard. Usually the result of the equivalence study replaces only a small part of the normal procedure.

The equivalence study is made for the innovative system, not for a building. Although the municipality decides if the equivalence study is correct for each building with the innovative system for which a building permit is applied.

The equivalence study must be approved before starting to build the building, if not no building permit is supplied.

What's particular to the Netherlands is that it is very open, and absolutely not kept under control by the authorities. This leads to various critics from the market.

A2.2 > Example: equivalence certificate of the auxiliary energy use for boilers

The auxiliary energy use for heating is a part of the normal Energy Performance procedure (EPC) in the Netherlands. Calculation of the auxiliary energy use for boilers is a done via a simple standard formula based on the floor area of the building.

A boiler manufacturer claims a lower auxiliary energy use then used in the standard formula. The manufacturer asks a research company to develop an equivalence certificate for its boilers set "Valerie". The boilers set contain 4 different boiler types with various maximum loads. Because the boiler types in the set have the same components, an equivalent calculation methodology of the auxiliary energy use could be developed for the whole set, taking into account the maximum load of the specific types and the energy need of the house in which the boiler is installed. The equivalent formula is based on measurements done with the boiler types in the set. For other sets another formula must be derived.

The vested equivalence certificate can be used for the EP calculation of every new building with a "Valerie" boiler. But because the standard EPC software can't take into account the equivalent formula for auxiliary heating derived for the "Valerie" boilers an alternative route is followed:

1. First the EP is first calculated using the normal EP methodology (and the standard software), so without taking into account the lower energy use for auxiliary energy for heating.
2. The energy reduction due to the more efficient boiler is calculated separately by hand, using the formula derived in the equivalence study. For this information from the standard calculation (the energy need of the house) and the critical parameters of the boiler are used.
3. Finally a new EP is calculated, also by hand, taking into account the reduction of the auxiliary energy for heating.

This example illustrates how the procedure of equivalence works in the Netherlands.

- The alternative method to take into account the innovative boiler is derived on product level.
- The actual energy use however is also influenced by the house in which the product is implemented.
- The formula cannot directly be integrated in the standard EP method, but has to be integrated in the calculation by a hand calculation afterwards.
- The certificate of equivalence has to be attached to every individual Building Permit request where a "Valerie" boiler is used to be able to claim the extra energy reduction of the boiler.
- The equivalence certificate must be approved by the municipality at every individual Building Permit request.

A2.3 > Advantages of the Dutch approach

1. Any product gets a change to be taken into account, which is needed for innovation to have an impact.
2. The costs of an equivalence study are relatively low (differs from case to case) and are paid for by the manufacturer, who uses the study as PR for his innovative system.

   The costs for the equivalence study for the auxiliary energy use for heating for one boiler set is approximately 10.000 EUR.
3. The innovation system has a quick impact on the procedure.

The duration of the equivalence study for the auxiliary energy use for heating is 2 months. Once the study is finished it can directly be used for individual Building Permit requests.

4. One equivalence study can be used for several buildings.

   The equivalence study for the auxiliary energy use for the Valerie boiler set can be used for all buildings with a Valerie boiler. Note that still a small individual calculation is necessary.

5. The equivalence studies are easy to use in the normal calculation procedure, because it replaces a small part of the calculations.

   The new formula to take into account the innovative "Valerie" boiler replaces only a small part of the standard EP calculation. Unfortunately, the standard EP software can't integrate the new formula, so the final step in the equivalence procedure has to be done by hand.

6. The legal framework can be used for innovative concepts and innovative systems.

   The example of the energy use for auxiliary energy is at the level of a building system. In principle larger concepts also can make use of the equivalence procedure.

7. The system has stimulated many successful innovations.

   Since the first equivalence study for auxiliary energy use for heating the auxiliary energy of boilers in general decreased step by step by using innovative systems.

A2.4 > **Disadvantages of the Dutch approach**

1. The quality of the equivalence studies is very different.

   In the example, the manufacturer asks a research company to set up the equivalence study but they could ask anybody or even they could do the study themselves. They methodology used may differ from study to study, as well as the quality of the studies.

2. It is not easy for the municipality to distinguish between good equivalence studies and bad equivalence studies: the equivalence studies are very technical, often you need to be an expert to understand the ins and outs. This means the municipality is incapable of judging the equivalence studies.

   The equivalence study of the auxiliary energy of boilers contains alternative formulas derived from measurements. Only an expert can judge if the boundary conditions taken into account in the study are correct, if the measurements are performed according to the proper conditions, if measurement results are interpreted correctly, etc.

3. The same goes for architects and other decision makers who choose which energy saving measures are implemented in the building: it is not easy to distinguish between real innovations and 'paper' innovations.
4. Because of the quality differences and the difficulty with the control it happens that products get a better assessment than deserved. This results in less real energy saving, larger energy bills, a smaller market for real innovative products and a lack of confidence in the principle of equivalence.
5. A study of equivalence is not integrated in the standardised EP calculation, but it is added to the calculation results afterwards. Often an additional hand or excel calculation is used for this, because the official EP software cannot be used for this. This means that for every building which incorporates an innovative system such an additional calculation needs to be made.

   The formula for the alternative auxiliary energy can't directly be integrated in the standard EP method, but has to be integrated in the calculation by a hand calculation afterwards.

6. It is possible that an equivalence certificate is approved for one building and not for another building.

   The equivalence certificate for the "Valerie" boiler could be approved by the municipality of e.g. Amsterdam and disapproved by the municipality of e.g. The Hage.

7. The equivalence studies are popular, there are many innovative products introduced. Many building permit requests contain one or more innovative products. In light of the problems with the verifiability of the quality of the studies this large quantity of studies is an extra problem.

Annex 3 > France

A3.1 > Summary of the French approach

France was one of the first Member States with an EPB regulation. It has been introduced in 1974 and modified in 1976, 1982, 1988, 2000 and 2005. The next revision will come in force on 2012.

The compliance with the energy regulation can be checked by the Technical Studies Centre (CETE) of the Ministry of Equipment on basis of the submitted EPB declarations and of in site visits. Since 2008, the controls become stricter.

Two frameworks known as "Title V" are available to assess the energy performance of the innovative systems: a principle of equivalence for an innovative system applied to all buildings and a principle of equivalence for just one innovative building.

Beside of that, there is also the "Technical Approval" approach, to prove better performances that the default value included in the standard calculation procedure. The "Title V" approach only focuses on the energy side (how to take into account a new solution/technology in the EPB calculation) while the "Technical Approval" approach look very carefully to other aspects as well (IAQ, acoustics, fire protection, durability, maintenance, installation, handing over...).

Everybody can make the equivalence study. There is no technical framework available to specify how to make the study, but the elements to provide are specified in the EPB regulation and the assumptions of the equivalence study have to be similar to the normal procedure.

The equivalence study is evaluated by the ministry for Ecology Sustainable Development and Spatial Planning, with the support of experts designed by the ministry. If the accepted equivalence concerns an innovative system, it will be a part of the regulation.

The way the principle of equivalence is implemented is considered as positive, but the time necessary to follow the procedure is considered as too long particularly for the equivalence of innovative system.

A3.2 > Example: micro-combined heat and power (Micro-CHP)

Micro-combined heat and power is not a part of the French regulation (RT2005). A company has presented an equivalence study for one type of this technology. It concerns micro-CHP with a Stirling engine and a back up using liquid or gaz.

The company has specified the application field (dwellings with a surface > 50m²,
heat Power of Stirling engine between 4 and 8 kW, electric Power of Stirling engine between 0.5 and 1.5 kW , global heat of the micro-CHP <30 kW, the micro-CHP must be the only system used for heating).

Their technical proposal was to perform the calculation using a condensing boiler and deducing the production of electricity from the final consumption.

The Ministry accepted this approach. A ministerial decree was published on March 21, 2009. Therefore, this equivalence is a part of the regulation for new building RT 2005 and can be applied to all new dwellings.

The alternative method to take into account the innovative boiler is derived on product level.

- The actual energy use however is also influenced by the house in which the product is implemented.
- The formula cannot directly be integrated in the standard EP method, but has to be integrated in the calculation by a hand calculation afterwards.
- The certificate of equivalence has to be attached to every individual Building Permit request where a "Valerie" boiler is used to be able to claim the extra energy reduction of the boiler.
- The equivalence certificate must be approved by the municipality at every individual Building Permit request.

A3.3 > Advantages of the French approach

1. Any product gets a change to be taken into account, which is needed for innovation to have an impact.
2. The costs might be limited.
3. One equivalence study can be used for several buildings.
4. A study of equivalence is integrated in the standardized calculation.

   Once the equivalence is accepted by the Ministry, an official text is published. It was the case for Micro-CHP (see above).

5. The ministry for Ecology Sustainable Development gets support from experts to approve the equivalence studies.

   Once the Ministry received an equivalence study, experts are designed. The equivalence study is distributed to all experts and the first answer to the submitter is sent under one month.

A3.4 > Disadvantages of the French approach

1. The time necessary to obtain an answer for the procedure concerning the system is long.

   The first answer is sent under one month but the final acceptance depends can require more than 6 months for an innovative system.

2. The quality of the equivalence studies is very different, because everybody can make the equivalence studies.

   Depending on the quality, the time for the last publication can be long.

3. No technical example is clearly presented on the EPB regulation

   As no technical example is presented, the first equivalence sent to the Ministry is not complete and not clear.

Annex 4 > Germany

A4.1 > Summary of the German approach

Germany has an energy performance of buildings regulation since 1977.

Many systems (e.g. double skin facades, absorption heat pumps, energy management systems and user dependent control systems) that are called innovative systems in other countries are included in the new holistic German standard for the energy performance of non-residential buildings DIN V 18599.

The EP method is fixed in national standards, which are modified once every few years. For the time between the versions there are two possibilities to include innovative systems or systems with a better performance than presented in the standard:

- The responsible ministries can publish new acknowledged rules of technology in the Federal Law Gazette.
- The accompanying expert group (ministries for buildings of the Federal State and the Laender) can publish interpretation rules which can include new values for the performance of systems.

There are two possibilities two possibilities to include innovative systems not represented in the standards:

- Systems being part of the standard but with better performance than the default values used by the standard: detailed measurement of the efficiency at a certified institute and check/acceptance of the certified value by the German institution DIBT.
- Systems not being part of the standards: use of the principle of equivalence.

Everybody can make the equivalence study. The one who wants the equivalence study has to pay for it. The assumptions of the equivalence study have to be similar to the assumptions of the Standard. Usually the result of the equivalence study replaces only a small part of the normal procedure.

The equivalence study is made for the innovative system (material, components and service systems or their components), not for a building. Although the municipality decides if the equivalence study is correct for each building with the innovative system for which a building permit is applied. In practice the local administration expect a technical expertise made by experts. The equivalence study must be approved before starting to build the building, if not no building permit is supplied.

A4.2 > Examples

A4.2.1 > Example 1: naturally ventilated rooms/zones behind a (mechanically or naturally ventilated) double skin facade

The German standard takes into account only mechanically ventilated rooms behind the double skin façade with no air exchange between façade and room. If a system shall be assessed that is using the air of the double skin façade to ventilate the room, a dynamic simulation has to be performed in order to define the average monthly equivalent air change rate. Alternatively air change rates can be taken from literature (measured air change rates at suitable case study buildings like IEE BESTFACADE). It has to be ensured that the ventilation rates are kept as calculated and are never below the minimum hygienic ventilation rates.

The local administration responsible for building permits will then receive the energy performance of buildings calculation including the resulting ventilation rate and the corresponding study of equivalence on the ventilation rate for the new system and will check them. If the EP calculation and the study of equivalence are accepted, the building owner will receive a building permit. This procedure has to be repeated for each individual building permit (individual case allowance = Zulassung im Einzelfall).

A4.2.2 > Example 2: condensing boiler with higher efficiency than the default values given in the standard

The German standard offers default values for the efficiency of different types of boilers (e.g. standard boiler, low temperature boiler, condensing boiler and improved condensing boiler). If a manufacturer produces a boiler that has a higher efficiency than the underlying measured efficiency value (measured according to defined boundary conditions) of for example the improved condensing boiler he can ask a certified national or international institute to measure his boiler. The measurements have to follow the specified test conditions and the institute will certify the boiler and propose an efficiency that can be used for the calculation with the standard. This proposal has to be assessed by the German Institute for Building Technology (DIBT) and they will derive an official value to be used for the calculation. The value can be published in the Federal Law Gazette.

Then the efficiency value can be used for any energy performance assessment or certification for building that include the boiler.

A4.3 > Advantages of the German approach

1. Many products can already be assessed with the holistic German standard.

   Daylight dependent and user dependent electrical lighting controls are used in more and more new buildings in Germany, mostly in office buildings. As the effect on the energy performance of the building for both lighting energy and cooling energy can be assessed easily by using the standard DIN V 18599-4 architects and lighting planners can compare the system with other energy efficiency measures for buildings and the building owner can be convinced about the advantages and cost savings. No additional time or costs are needed.

2. Any product gets a chance to be taken into account, which is needed for innovation to have an impact due to the two offered possibilities for system not covered by the standard.

3. The costs of an assessment are relatively low (differs from case to case) .

   For the example of the high efficient boiler above, the costs can be considered as fairly low, as the boiler series (different sizes) are certified once but then sold to many different building owners.

   The example individual case allowance will mostly result in less cost efficiency as the approach has to be made for each individual building using the same technology.

4. Nearly all systems can be calculated/simulated.

   Modern simulation programs can assess lots of different technologies. With new technologies coming into the market, also new simulation "types" are developed by research organisations.

5. The innovative system has a quick impact on the procedure.

   As presented above there are two possibilities for including new systems in the standard procedure. That means even between the official standard revisions the efficiency values in the standard can be adapted to correctly assess new systems.

6. The equivalence studies are easy to use in the normal calculation procedure, because it replaces a small part of the calculations.

   The new German standard offers to include detailed characteristic values that are different from the standard value. Then a specific efficiency will be derived from these values. This is a rather simple procedure with the available software programs for the standard.

7. One equivalence study can be used for several buildings.

   This is true for the certified values based on the DIBT but less for the individual case allowance. Here the study may be re-used, but the acceptance of the local administrations case dependent.

A4.4 > Disadvantages of the German approach

1. The quality of the assessments may differ.

   As the studies have to be made by experts who have a certain profession, education or further education defined in the energy decree (see [4]), it is expected that only good quality studies are produced. (However, in at least one case, a check of an individual case allowance has detected a wrong assessment.)

2. It is not easy for the municipality to distinguish between good assessments and bad assessments: the assessments are very technical; often you need to be an expert to understand the ins and outs.

   This is partly covered by the request of expert studies for the principle of equivalence. Alternatively they ask expert organisations when in doubt.

3. It is possible that one equivalence certificate is approved for one building and not for another building.

   However, there is no information that this happens in practice; it is assumed that if one local administration accepts the study and the next doesn't, the expert performing both studies will try to convince the second administration to decide in the same (positive) way. There is however no right for asserting a claim on getting the same decision by different local administrations.

Annex 5 > Spain

A5.1 > Summary of the Spanish approach

The calculation procedure is published in a standard, applicable to both the "national calculation tools" and the "alternative tools" (or commercial software). This standard includes:

- scope (elements, systems and strategies that have to be dealt with),
- for the different boundary conditions, components, systems or strategies: common assumptions of modelling, minimum level of modelling required, default values, data requested to the user.

An innovative building or system is in synthesis a deviation from the above standard, as either they expand the scope (more elements, components, systems or strategies that the initially included) or they treat them in a different way.

The legal framework to assess the energy performance of innovative buildings or systems is contained in two complementary approved documents (one applicable to innovative buildings and other applicable to innovative systems). The free translations of these two document names are:

- "Criteria for acceptance of innovative buildings not able to be treated by the national calculation tools for energy certification of buildings”.
- "Requirements for acceptance of additional capabilities linked to the national calculation tools for energy certification of buildings”.

The coupling between innovative systems and the calculation tool can be undertaken in a pre-processor or a postprocessor stage of the calculation process.

In the pre-processor stage the use of the principle of equivalence is typically implemented by changing default values or default curves of components of the envelope or of thermal equipments. The new values have to be calculated based on a procedure that has to be approved in advance.

In the post-processor stage, the calculation tool send information of the performance (hourly, monthly…) of a certain equipment or system included in the standard to a parallel software or procedure that calculates the performance of an innovative system (not included in the standard). The parallel software has to be approved in advance.

A5.2 > Examples

A5.2.1 > Example 1: biomass boilers

In the standard of calculation, the performance of most of the thermal equipments for heating and cooling production is obtained form a set of nominal values (provided by the user of the tool) and two variations from this nominal value due to a possible climatic dependency and a part-load performance dependency. These two variations are default curves. The association of manufacturers of boilers that use biomass considers that the default part-load performance curves of such boilers underestimate the actual performance of most of the products that exist in the Spanish market. They carry out a study including performance measured data for different boilers type in different laboratories and conclude that for boilers with certain burner characteristics the performance calculated is always better than that derived from the default curves existing in the calculation tools.

They prepare a document for acceptance of an additional capability that consists in a new part-load performance curve for the biomass boilers that include the burner characteristics mentioned. Once this document is approved it is allow to use the new default curve.

Every time the user introduces a deviation of the standard, the calculation tool will send a message informing of this fact and will provide two energy certificates, with and without the deviation. In the example, the two energy classes obtained will correspond respectively to the old and to the new part-load performance curves.

The user will be requested to provide the additional documentation that proves the right to include the deviation. In the example the user will have to include besides the conventional information of the energy certificate some pages including the reference of the approved document and the technical characteristics of the boiler to be used in order to prove that the burner used fulfil the requirements of the approved document.

A5.2.2 > Example 2: solar cooling devices using absorption machines

Solar cooling devices using absorption machines are not included in the standard of calculation.

A software application to be used in the post-processor stage has been developed to deal with this kind of systems. This application has to be previously approved.

Initially, the building is provided with an equivalent system such as a water condensed conventional chiller. The national calculation tool performs a preliminary simulation using the chiller as cooling system during the whole year.

An intermediate tool receives the result of the simulation in two terms:

- hourly values of the cooling provided by the chiller (cool water temperature drops in the evaporator and water flow rates) to meet the cooling needs of the building,
- yearly energy performance of the chiller and its auxiliary, that is, the cooling energy provided and the electrical energy required (by the compressor, pumps, fans), as well as the associated CO2 emissions.

The intermediate tool send the hourly values to the specific software develops to deal with solar cooling systems which performs a new simulation to cover exactly the same cooling requirements of the building but using this time the solar cooling system chosen. The software produces a document (2 pages long) with a summary of the inputs and outputs. The yearly energy performance results of the solar cooling system and its auxiliary are send back to the intermediate tool.

Finally, the intermediate tool produces two energy certificates, using respectively the energy data from the equivalent system (conventional chiller) and the energy data from the innovative system (solar cooling). Obviously, the energy data regarding cooling needs are the same in both certificates

The energy certificate must include as complementary justification the document produced by the software application.

A5.3 > Advantages of the Spanish approach

1. The framework is applicable without changing or updating the Energy Performance Calculation method, as it can be seen in the two examples described.
2. It is transparent and flexible.

   In a very large set of cases of innovative systems proposed, the combination of the pre-processor and the post-processor stages proved to give a satisfactory answer. The use of the double certification provides an understandable index of the actual impact of the innovative systems used.
3. As it uses the principle of equivalence findings from other countries or organizations can be incorporated.

   For instance, the performance of ventilated solar walls (Trombe walls) can be assessed in the pre-processor stage using equivalent parameters derived from the additional heat transfer coefficient and the effective collecting area included in the Annex E (Heat transfer and solar heat gains of special elements) of the "ISO-13790 Energy performance of buildings – Calculation of the energy use for space heating and cooling".
4. The Energy Performance Calculation Method keeps the control of the procedure.

   In all cases, any deviation of the standard is reported and the additional information is required.

A5.4 > Disadvantages of the Spanish approach

1. Everybody can make the equivalence study or to develop a complementary software. Consequently, the quality of the characterization of the innovative systems can be very different.

   It is possible for instance that two association of manufacturers with concurrent products develop two contradictory procedures due to differences of the input data required or of the assumptions performed
2. The contents of the additional documentation can be very different for the same type of component, strategy…

   An agreement must be reached in the quantity, terminology etc of the complementary documents produced by software applications or by other procedures dealing with equivalent products.
3. Getting an approved document is a very time consuming task (around 6 months) including a previous public inquire that last 1 month.
4. Although the conceptual criteria to be met are clear there is no specific independent body that evaluates the proposals.
5. Severe contradictions can be obtained at the level of the innovative buildings as it is not easy for the local authorities to distinguish between good equivalence studies and bad equivalence studies.
6. It is possible that an equivalence certificate is approved for one innovative building in a certain location and not for an analogous building in other location.

   To avoid this, the local authorities will report about the innovative buildings accepted in order to create an open catalogue of innovative buildings at a centralised national level.

Annex 6 > Denmark

A6.1 > Summary of the Danish approach

The energy performance of new buildings is calculated using a simplified calculation program (Be06) that is based on monthly average values (no dynamic simulations).Most systems can be handled indirectly in the calculation procedure. However, not all types of systems are covered in the normal procedure. Examples are: advanced double facades, preheating of ventilation air by ground pipes, phase change materials, microCHP, absorption heat pump etc.

The calculation procedure can be updated quite quickly to be able to take the effect of innovative systems account. A new version of the program would typically occur when implementing new innovative systems. From April 2006 to January 2010, 4 versions were released.

No standardised legal framework exists for assessing the energy performance of innovative systems directly. There is some flexibility in the evaluation of the performance of a specific building: the building owner will ask consulting engineers to make an alternative calculation.

The local authority checks compliance with the Danish Building Regulations and then issues a *building permit.* Proof of compliance with the energy requirements must be made after the completion of the building in order to obtain a *permit to use*; control of compliancy is the responsibility of the local authority.

In case of alternative calculation, the local building authorities will accept or not the assessment, typically made by consulting engineers, often in dialogue with the Danish Building Research Institute, SBi.

In practice the control of the building is performed by the energy consultants who issue the energy certificate. There is no formal format for such applications.

There have been a few examples of equivalence, and they are building specific and not publically available.

A6.2 > Examples

A6.2.1 > Low complexity: wind mill (actual example)

A small wind mill can provide electricity for one or several houses; this electricity production is not covered by the standard calculation procedure. However, electricity produced by windmill could be translated directly into electricity gained by PV-panels, which is included by the standard calculation procedure.

A6.2.2 > Medium complexity: preheating of ventilation air in ground pipes (actual example)

The influence of the preheated ventilation air for the system performance can't be dealt with directly in the normal calculation of the energy demand. Then calculations were made based on measurements, etc. At the end it was decided that the influence of the preheated ventilation air corresponds to the increased efficiency of a heat recovery system used in the normal calculation procedure.

Calculations were made by a consulting company based on measurements from the producer of the heat pump, and national and international guidelines/standards (i.e. test temperatures, humidity etc.).

A6.2.3 > High complexity: thermoactive building components

The influence of thermoactive building components could be translated (through detailed calculations/simulations) into increased efficiency of heating system, increased thermal mass, free night cooling,...

A6.3 > Advantages of the Danish approach

1. It is a flexible way of handling innovative systems. Of course, controllers have to trust the information given by the user. However, in DK it is still considered as an advantage to have an open system that facilitates the use of innovative systems. Moreover, cost-heavy bureaucracy could overshadow the advantages in a small country like Denmark.
2. Any products get a chance to be taken into account.
3. One assessment can be used for several buildings if local authorities agree (best practice examples are typically made publically available (in the compliance checker FAQ) as soon as they exist).
4. The Danish regulations are quite open for innovative systems and the market seems to be reacting well. Innovative systems have been and are being introduced in Denmark all the time, so apparently producers of innovative systems have no significant problems in marketing new products.

A6.4 > Disadvantages of the Danish approach

1. The quality of the assessments could be very different.
2. It is not easy for the municipality to distinguish between good and less good studies as the studies are very technical, often you need to be an expert to understand these. Local authorities seldom consult external experts. However, the controllers are typically to some extent technical experts themselves. If studies are difficult to validate for authorities, they must decide upon the level of effort they put into checking the data.
3. Every building with an innovative system needs in general to be calculated.
4. The procedure could be heavy and requires time.
5. The fact that no *standardised* legal framework exists might be a barrier for the implementation of innovative systems. However, innovative systems have been and are being introduced in Denmark all the time, so producers of innovative systems apparently have no significant problems in marketing new products.

Annex 7 > Finland

A7.1 > Summary of the Danish approach

The EP method is fixed in a national Standard. It is not easy to change the normal procedure: the standard is modified only once every few years.

Finland uses the principle of equivalence. The Building Code specifies that *"Guidelines are not binding and it is possible to apply solutions other than those given in guidelines, provided that such solutions meet the requirements set for construction work."*

This procedure can be used to prove better performances that the one included in the standard calculation procedure.

Everybody can make the equivalence study. The one who wants the equivalence study has to pay for it. The assumptions of the equivalence study have to be similar to the assumptions of the Standard. Usually the result of the equivalence study replaces only a small part of the normal procedure.

The equivalence study is made for the innovative system, not for a building. Although the municipality decides if the equivalence study is correct for each building with the innovative system for which a building permit is applied.

The equivalence study must be approved before starting to build the building, if not no building permit is supplied.

What's particular to the Finland is that it is very open, and absolutely not kept under control by the authorities. This might lead to various critics from the market.

A7.2 > Example: heat recovery

In the Finnish framework, the performance of the heat recovery is handled as a yearly exhaust air heat recovery efficiency, which presents the energetic performance during the heating season. The default value of the exhaust air heat recovery efficiency of the ventilation unit is typically 0.6 x temperature efficiency notified by the ventilation unit manufacturer. This number can be used, if nothing else is stated. Some manufactures have purchased a VTT Certificate to prove better yearly performance of their heat recovery units. This certificate is based on the laboratory measurement of the product performance. The yearly efficiency is derived from the laboratory measurements with a calculation method accepted by the Ministry of Environment Finland.

A7.3 > Advantages of the Finnish approach

1. The framework is open; any innovative system can be evaluated.

   All innovations are welcomed to the Finnish construction market

2. One equivalence study can be used for several buildings.

   If the study is clear and well-founded, it can be reused in the same town and also in other municipalities

A7.4 > Disadvantages of the Finnish approach

1. No harmonized way to evaluate, it's always case by case.

   There is no legal framework for the organisation that makes the equivalence study. Until now neither the person/company who makes the alternative calculation nor the alternative method has to apply to certain rules

2. The municipalities lack technical competence, so it's possible that "stupid" system passes the building permit process.

   Only an expert can judge if the method in the study is correct, if the measurements are performed according to the proper conditions, if measurement results are interpreted correctly, etc. Currently, there has not been reported any mistakes in the building permit process.

3. The costs of an assessment can be high (depends on the case)

   It's always the local municipality, who accepts or rejects the equivalence study. The costs can be high, if the product manufacturer has to make the study for every town. This is mainly a theoretical option.

   A complicated technical product might need laboratory measurements and development of the calculation method, price of the study can easily be 50 000 – 100 000 EUR.

4. The quality of the equivalence studies can be very different.

   There is no legal framework for the organisation that makes the equivalence study. Until now neither the person/company who makes the alternative calculation nor the alternative method has to apply to certain rules. But of course when the calculation does not make sense, the municipality will not approve of it and will not give the building permit. Usually, municipality is more or less conservative in the interpretation of the study.

Annex 8 > Norway

A8.1 > Summary of the Norwegian approach

A8.1.1 > Building permits

There are two ways of checking the energy-efficiency requirements for a new building permit:

- *Simple prescriptive measures*: A list of 11 measures such as U-values, heat recovery efficiency, glazing area. Often this approach cannot be used because one or more of the measures are not satisfied in the building. Instead, one can do…
- *Energy performance calculations*: The regulations set limits on net energy demand [kWh/m²yr], not primary energy. You can use any software that conforms to the national EP calculation method (NS 3031, based upon ISO 13790) or that is verified with EN 15265. Some parameters are fixed and may not be changed (e.g. DHW load, equipment loads, set point temperature). Other parameters have 'default values' that one can improve upon if one provides documentation (e.g. thermal brides, lighting load, VAV flow reduction). The local authorities are not particularly thorough about checking this documentation, so in practice it is largely based on trust since builders will wish to avoid the risk of sanctions/litigation.

In the above context, there are two categories of 'innovative' technologies that are not satisfactorily handled in Norway:

- *Fixed input parameters in EP calculations*: The regulations purposefully give no credit to technology that reduces internal heat gains such as Energy Star IT equipment (except for automatic dimming). The fixed values are rather conservative, and seem to be a bit higher than in other countries. Furthermore, adaptive thermal comfort is not accounted for, since indoor temperature is prescribed. 'Equivalence studies' will not be allowed for these.
- *System efficiency*: The building code limits the net energy demand, not primary energy. Thus the efficiency of energy delivery systems such as boilers, chillers, radiators etc. is not regulated. 'Equivalence studies' for are thus inapplicable in this case.

In summary, accounting for innovative systems is either:

1. not allowed (e.g. Energy Star IT/ adaptive comfort/ efficient showers). A proposed future national passive-house standard will permit less conservative fixed values of internal gains.
2. unproblematic (e.g. light dimming/ VAV/ efficient boilers). In this latter case, systems can be documented by anyone at their own cost, using relevant CEN standards (e.g. EN 15251 for lighting, EN 15316 for heating systems). This efficiency calculation is normally valid only for the specific building. However, energy systems such as boilers and heat pumps might be applicable to all buildings of a similar size, type, and climate. It is up to the local authorities to decide whether the documentation is acceptable for each building permit application involving a 'non-standard' system.

A8.1.2 > Energy labelling (from 2010)

Each building will get two labels. The main one will be for calculated delivered energy, and the secondary one will be for weighted primary energy. Labelling will be done on a free web-based service/database. Here, the user may use the on-line calculation tool (based on the national standard mentioned above), or may upload the results of EP calculations from any other verified software (also mentioned above).

Presently, anybody can label their own house on the web-based labelling software/database. However, labelling of other buildings requires more expertise, so users must provide proof of their qualifications.

Here there is an opportunity for studies to document the efficiency of advanced energy systems that deviate from the default values given in the EP calculation standard.

A8.2 > Examples

The examples are theoretical.

A8.2.1 > Example 1: hybrid ventilation system

A school with an advanced ventilation system with displacement ventilation and demand-control based on CO_2 concentration. Based on earlier field studies and research, the average flow rate is expected to be 50% of design (peak) flow rate. The national EP calculation standard says that "for variable air volume (VAV) systems, a default of 20% reduction in average flow rate can be assumed without documentation, but higher reductions are allowed if the VAV flow rate can be documented by detailed calculations or other studies". Thus the building developer has two choices: they can apply for a building permit straight away with an EP calculation assuming 20% VAV flow reduction, or they can choose to first conduct/commission a study involving advanced controls simulations based on available statistical data on classroom attendance, to calculate and document the likely mean flow rate. After construction, the study documentation and advanced EP calculation can be uploaded to the energy labelling website as documentation to get a better energy class.

A8.2.2 > Example 2: advanced lighting control

The national EP calculation standard prescribes a fixed value for lighting load (2.9~15 W/m² depending on building category). If the building has advanced lighting control, a default of 20% load reduction is assumed with if one does not provide documentation that it is lower. Alternatively the effective lighting energy consumption can be calculated according to EN 15193, in which case no minimum value is prescribed. Let us imagine the case of an office building being designed with automatic light dimming. Just as for the above case, the building developer has two choices: they can apply for a building permit straight away with an EP calculation assuming 20% less lighting load, or they can choose to first conduct/commission and a study using lighting controls simulation software to calculate and document the likely load. After construction, the study documentation and advanced EP calculation can be uploaded to the energy labelling website as documentation to get a better energy class.

A8.2.3 > Example 3: domestic hot water

A building is being designed with energy saving features for domestic hot water (DHW). Vacuum tube solar collectors will be installed together with energy saving showers & taps and waste water heat recovery. The EP calculation for the building permit gives no credit for any of these features. This is because net energy demand is not influenced by energy carrier, and DHW load is a fixed parameter. Thus the builder is not tempted to build a poorly insulated building to compensate for the energy saved on hot water. After construction, the building owner applies for an energy label. They have two choices: they can apply for a label straight away using the default value of system efficiency of solar hot water systems, or they can choose to first conduct/commission and a study to calculate or measure the efficiency of the specific solar system together with the waste water heat recovery. Either way, this building achieves a good energy class, even though the EP calculation does not give credit to the water-volume saving features (showers & taps). This is reasonable, because if the building is sold, one cannot prevent the next owners from replacing the showers & taps with more luxurious ones that use more water.

A8.3 > Advantages of the Norwegian approach

1. Almost all systems can be evaluated within the existing EP calculation framework, within reasonable constraints(see point below). There is no need for a separate legal framework for 'equivalence studies'.
2. The system prevents misuse whereby, instead of ensuring an enduring energy-efficient building envelope, a building designer makes overly optimistic assumptions about technical building services, assumed building operation and occupant behaviour, which may change/deteriorate over the lifetime of the building.
3. The approach is unbureaucratic. Any competent person can document non-standard systems, and the required detail of documentation is not too great. One avoids the costs and time delays for applying for 'equivalence certificates'.
4. New technologies can be quickly accounted for without having to wait for a revision of the 'default' values in the EP calculation standard.
5. Studies of the efficiency of energy delivery systems can be used for several buildings, so long as the loads are reasonably similar.

A8.4 > Disadvantages of the Norwegian approach

1. There remain some innovative systems that cannot be fairly treated, e.g. buildings designs that are promote adaptive thermal comfort, and thus reduce cooling costs.
2. The quality of studies for non-standard systems may be poor, combined with the fact that…
3. The approach is vastly based on trust. The fact that people can label their own homes is very questionable (though the certification system for houses is simpler and more fool-proof than that for other buildings).
4. The authorities may not have the competence to distinguish between good and bad studies. Some studies probably require an independent expert to evaluate it properly.

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