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EFFECT OF EPBD ON EUROPEAN BUILDINGS

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Cost-optimal levels for energy requirements

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Eco-design Directive, Energy Label and Ecolabel

CASES:

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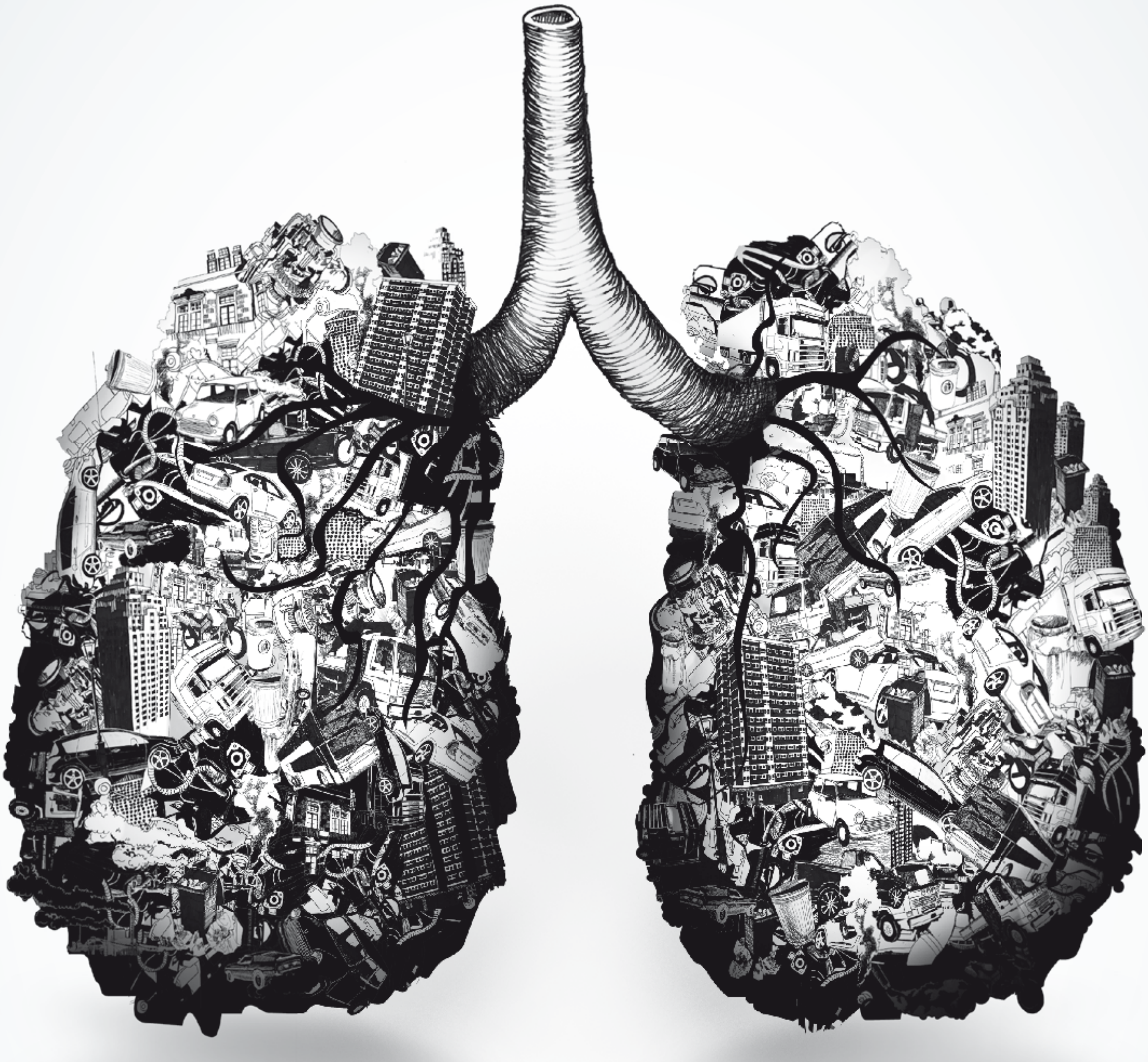

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General Executive: Süleyman Bulak

Editor-in-chief: Olli Seppänen
oseppanen@rehva.eu
Guest Editor: Prof. Eduardo Maldonado
E-mail: ebm@fe.up.pt

ADVERTISEMENTS
Ms Cynthia Despradel
cd@rehva.eu

REHVA OFFICE
Washington Street 40
1050 Brussels, Belgium
Tel: 32-2-5141171, Fax: 32-2-5129062
info@rehva.eu, www.rehva.eu

PUBLISHER
Teknik Yayıncılık Tanıtım A.Ş.
Balmumcu, Barbaros Bulvarı,
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Beşiktaş İstanbul Türkiye
Tel: 90-212-2758359
Fax: 90-212-2749273
www. teknikyayincilik.com

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Moving towards a new Paradigm for the Buildings Sector

Eduardo Maldonado
Guest editor, Portugal
Coordinator of the EU Concerted Action-EPBD
ebm@fe.up.pt

As EU policy makers wisely move us towards a sustainable energy system, the Buildings sector is under great pressure to take a giant step forward and provide its needed contribution for this goal. After first publishing the EPBD in 2002, that required EU Members States to establish an Energy Certification System for buildings, as well as regular mandatory inspections for boilers and air-conditioning systems, the EPBD was recast in 2010 and it came out with even greater challenges.

The 2002 EPBD required EU Member States to have building regulations establishing minimum levels of energy efficiency and to ensure that every new building would meet them. However, it did not set any target on the minimum requirements that MS would be expected to set. It simply expected MS to behave in a responsible way and to establish ambitious minimum requirements. A few years later, it was quite clear that, although every MS had moved in the right direction, the minimum requirements set by many MS were not really ambitious enough yet.

This prompted the 2010 recast of the EPBD, where objective targets were placed on MS to establish ambitious minimum requirements. Firstly, it imposes a "cost-optimal" regulation based on a life-cycle analysis of reference buildings and packages of improvement measures to establish optimal minimum requirements that must be among the best of all the cost-effective solutions. Secondly, and this is where the new paradigm for buildings comes in, it establishes the far-reaching goal that every new building to be constructed within the EU from 2020 onwards must be a "nearly –zero-energy" building (NZEB). This represents a real step-change relative to the present way of designing and building, both from an architectural perspective and from the side of technical systems, including HVAC and lighting. We can't simply go on using the same practices we now use with just small adjustments. Current practices must be overhauled. We must learn new processes and industry needs to develop yet better equipment and tools. Even the workforce needs to be re-trained, because a NZEB must be built by specialized crews. Recognizing this need, the EU Commission has already launched the "BUILD-UP Skills" initiative, involving all MS, with this precise objective: train the workers that will be able to build NZEBs in just a few years from now.

As guest-editor of this issue, I invited a few experts to explain the underlying principles and methodologies for this on-going step-change. You will find a report on the present building stock in Europe; an insider view of why good HVAC designs not always result in well-performing buildings at the end of construction; a detailed explanation about the cost-optimal regulation and how MS are implementing it; a insight of how the NZEB concept is currently being treated by the EU MS; news about better equipment requirements (eco-design); and you will find front-runner examples of NZEBs in a cold and a moderate climate. We also hear how EU's Intelligent Energy programme is supporting these issues.

But real sustainability does not end with building design. The best performing building can easily become an "energy hog" if it is not properly maintained. That's why the new EPBD requires inspections for all heating and cooling (including ventilation) systems, or equivalent measures. A discussion about the possible role of system monitoring as a cost-effective alternative to regular inspections is also included in this issue.

Achieving the new NZEB paradigm in less than a decade is a great challenge that needs everybody's best effort. The HVAC professionals must certainly play an important role at all stages: design, equipment, construction, maintenance, monitoring and auditing. This shall surely remain a hot topic during the next few years. ЗЄ

Interview of Mr. Gordon Sutherland from EACI

As the Senior Project Officer of the Energy-efficiency at the European Commission's Executive Agency for Competitiveness and Innovation Mr Sutherland is now in a privileged position to offer valuable insights into how Intelligent Energy Europe contributed to the current status of EPBD implementation in Europe.

Questions by Prof. Eduardo Maldonado, Coordinator of the EU Concerted Action-EPBD

The EPBD is the main policy tool for energy efficiency in buildings. Intelligent Energy Europe is the main EC programme supporting its implementation. Can you describe why the EC decided that support was necessary for this particular Directive and the objectives that were established?

– To discuss that we would need to take ourselves back to the time of the adoption of the Energy Performance of Buildings Directive in 2002. At that time the work programme of the Intelligent Energy – Europe Programme (2003-2006) was also being put together. As you rightly pointed out, the Programme is the EU's main instrument for overcoming the non-techtnological barriers to the widespread market penetration of energy efficiency and renewable energies. These barriers, which are hindering the use of known, technically proven solutions and approaches, are often categorised as being related to behaviour, capacity, financial or regulatory issues. Given the comprehensive nature of this framework Directive, it would seem logical that the processes for preparing the national legislation and implementing schemes that would put it into practice in each country should be supported. The objectives were – and still are – to support activities of European added value which would support the take-off of the Directive. What I mean by that, is that whilst each country holds the competence for implementing the legislation in relation to its own building stock which is in effect a national asset, there are multiple benefits to be gained from collaboration amongst the body of administrations and stakeholders dealing with this legislation, each of them under differing national and even regional circumstances.

The EPBD was first published in 2002, and IEE started supporting it in 2004. Since then, however, we have seen that priorities for support changed along the years. Can you explain the logic that IEE adopted to decide which topics to support when?

– In the early period there was a definite need for a broad sharing of concepts on how to best transpose and implement the Directive, on how to best prepare the national procedures whilst adequately reflecting national requirements and markets. Very quickly the Commission and the Member States came together in a joint initiative, the Concerted Action which you yourself Co-ordinate and which is financed in full by Intelligent Energy - Europe, on the transposition and implementation of the Directive. That brought together the national bodies charged with implementing the legislation. Through this approach, Intelligent Energy - Europe supports dialogue and collaboration across Europe, helping national administrations to develop tailored approaches to implementing the Directive. That initiative was paralleled by a suite of projects, in the nature of grants supported in part by the Programme, which had the aim of finding practical, on the ground solutions. These solutions ranged from development of training schemes and materials for qualified experts to the methods and means for carrying out inspections of air-conditioning systems. The projects are selected in a competitive process through annual calls for proposals. The logic has always been to support the implementation of the Directive as broadly as possible, subject of course to the submission of proposals for which meet the evaluation criteria. Over the years, the priorities became more focussed to reflect the market requirements.

Can you point out a few important specific outputs from IEE projects that had a contribution towards improved MS implementation of the EPBD?

– That's a challenging question. Not because the projects haven't directly contributed to national implementation, which they have resoundingly, but because many administrations used elements of the projects' outputs and adapted them or incorporated them in their own processes, not in their entirety but in a tailored manner.

IEE project database available at http://ec.europa.eu/energy/intelligent/

Additionally, the projects were carried by consortia of partners across Europe, amongst participants from countries in which the legislative process was dynamic. Remember that the projects need to be carried out by consortia made up of at least three independent organisations from three different countries, although the vast majority of consortia are larger than this and have a broader EU coverage. We need to remember that the national transposition of the Directive implies the incorporation of its requirements into the corresponding building codes in each country. Since most countries revise their building codes at more or less regular intervals, you can appreciate that the process was at varying stages in different countries. That's a challenge for a consortium of partners dealing with, for instance, the form, shape and content of the energy performance certificate in each of the countries participating in the project. Let's take the example of an early project, IMPACT, which in many ways exemplifies a successful Intelligent Energy – Europe project, both in terms of its concept and its results. As early as 2003 a number of countries already had fully fledged energy performance certification schemes, such as in Denmark, or had planned to carry out pilot tests of such schemes. Within the IMPACT project, the experiences from these schemes and pilots were compared. That whole process gave insight into the challenges of the energy performance certification process, not only for the participating countries but also, particularly through the presentation of the results to the Concerted Action EPBD, to all countries implementing the Directive. A variety of issues, such as the shape and form of the certificate and property owners' response to it were investigated by that project. It resulted in a best practice guide outlining the pros and cons of different approaches to energy performance certification, made available in ten languages. Those outputs were on the one hand strategic in nature, on the other hand based on robust analysis of existing schemes and pilots applied to thousands of properties, and the outcomes remain relevant today. But there is a long list of examples from memory: such as the BUDI project where the training materials for expert evaluators form the basis of that used in a number of countries; the AuditAC and HarmonAC projects on auditing and inspection of air-conditioning systems where the methods developed have been incorporated in national approaches; the EPLabel project which provided basic inputs to operational rating schemes for public buildings in a number of countries; and the EPA-NR project – which demonstrated that the CEN EPBD standards offer a comprehensive approach to energy performance certification of buildings.

What about a few outputs that helped policy-making at Commission level?

– The Intelligent Energy – Europe Programme supported a number of projects that helped to inform the policy making process at EU level. Studies on intercomparison of energy performance requirements in different countries in Europe was instrumental in highlighting the challenges of direct comparison of national legislation and the performance levels set therein. These studies informed the dialogue on the cost-optimal methodology which is now embodied in the recast of the Directive. Similarly, the HarmonAC project was instrumental in demonstrating the feasibility of monitoring of air-conditioning systems in tertiary sector buildings in order to flag poorly performing systems which could benefit the most from on-site inspections. These are only two examples, but the whole process is best reflected in the contribution of the Concerted Action. The reports of the Concerted Action provided insight into both the transposition and implementation of the Directive, highlighting which areas could be strengthened. These were used in support of the Commission's proposal for the recast of the Directive prior to its adoption. I should point out that almost all of the projects contributed to the activities of the Concerted Action, and vice-versa.

In a way, the priorities that have been defined for IEE support have an implicit policy background. Can you explain the role of DG ENERGY in this process?

– The priorities of the Programme are adopted by the Directorate General for Energy in consultation with the Intelligent Energy – Europe Committee, the body of representatives from the national administrations that oversee the implementation of the Programme. The Executive Agency for Competiveness and Innovation also takes part in that consultation. The priorities are set on an annual basis, and that allows the focus of the Programme to be adapted on as needs basis. For example, in response to the Energy Efficiency Action Plan of 2006, the priorities at that time called for activities in support of the recast of the Directive. A number of projects from that period, such as the ASIEPI project which aimed to assess the impact of the Directive and provide insight into how it could be strengthened, were instrumental in informing the debate around the new legislation.

As you stated earlier, the EPBD covers different topics. From your experience, in which areas has IEE made greater inroads and where more improvements are still needed?

– Reflecting on what we've already discussed and the specific projects which immediately sprang to mind, the projects and initiatives supported by the Programme have made inroads to successful implementation of the Directive more or less across the board from implementation of certification schemes to setting of performance requirements, from training structures to national awareness campaigns. For sure, they have produced guidance and options, as well as having highlighted possible pitfalls if the legislation isn't put into place effectively. The possible exception would be on the topic of boiler inspections. Although projects in that area have been supported with the general aim of improving performance and quality assurance in boiler installations, this hasn't necessarily been from the direct perspective of the Directive's requirements, but rather from the energy management and voluntary market approach, as opposed to support to the regulatory framework. The ongoing MOVIDA project could help to overcoming that. I should point out that since 2004 roughly 100 projects have been supported in the building sector, with more or less one fifth of them focussing on supporting the regulatory process. The other projects address market transformation, access to finance, capacity building - which includes education and training, as well as awareness raising.

The EPBD applies across the whole of Europe, even beyond the EU 27. Do you see the same level of enthusiasm for IEE projects supporting the EPBD everywhere or do you detect some differences?

– We do study statistics for the Programme as a whole, across all sectors and fields of delivery, but the analysis doesn't go to the level of individual priorities. The calls for proposals through which the projects are selected are open to all EU countries, plus Norway, Croatia, Iceland, Lichtenstein and now the Former Yugoslav Republic of Macedonia. Since it's a competitive process, we wouldn't expect to have equal participation across the whole of Europe in a sample of about 20 projects on this topic. Through the dissemination activities of the projects and the widespread availability of the outputs, as well as through initiatives such as the Concerted Action and Build Up, all of the relevant information and experience can be readily used by organisations in any country which is implementing the Directive. The interest of the Energy Community in the outputs of the projects, with some countries acting as observers in project meetings and workshops, shows there is interest in the projects' findings and outputs not only within the EU 27 but also beyond.

What can Intelligent Energy do to correct that imbalance?

– We put a significant amount of effort into making clear information and guidance online, whilst the Programme is supported by a network of National Contact Points which promote the annual Calls for Proposals through Info Days held in most countries. The staff of the EACI participates in these national events, as well as in the European Info Day in Brussels, the presentations from which are available online. The EACI also offers a pre-check facility, whereby our experts can inform interested parties if their proposal falls within the priorities of the Call. We also strive to have the key outputs of the projects available in the IEE project database as soon as they are available in their final versions, whilst requiring the projects to have appealing and up-to-date websites and encouraging them to use portals to make their results as widely available as possible.

The EPBD is not the only Directive dealing with energy efficiency in Buildings. We also have Renewables, Energy Services and Construction Products, just to mention the most important. Is IEE tackling this challenge and promoting synergies between the Directives? If so, how?

– Intelligent Energy - Europe projects can address more than one sector or more than one policy area. A good example is the integrated initiative launched in 2011 covering energy efficiency and renewable energies in buildings. Additionally, we have Concerted Actions for the Energy Services Directive and the Renewables Directive. Over the last few years there have been a number of exchanges of representatives between these actions. More recently, the Co-ordinators from these actions – yourself included - have met to exchange experiences.

To conclude this first part of the interview, can you identify, from project outcomes so far, the main bottlenecks for EPBD implementation in MS?

– The projects have identified a wealth of options for effective implementation of the Directive, as well as pitfalls that should be avoided. The comprehensive nature of the Directive coupled to the high level of detail required in setting energy performance requirements is perhaps the greatest challenge that administrations face in setting up functional schemes that embody the Directive's requirements. On a more personal philosophical note, we could perhaps say that societies, like people, might have difficulty learning from the mistakes of others. The projects encompass Europe's collective knowledge on implementation of the Directive, it should be sufficient for the administrations that set the national requirements in each country to learn from others. There is no need to face the same challenges twice, or multi-fold. Another major bottleneck will be the construction of nearly zero-energy buildings. This is recognised by the EU and the recently launched Build Up Skills, the EU sustainable construction workforce initiative, has been launched in response to that.

Now, let's try to focus on the future. The EPBD recast is currently being transposed by the MS and its implementation shall start soon. How is IEE planning to support this new EPBD recast?

– From conception to results on the ground, the majority of projects have a medium term delivery time. Although there is scope for having shorter term projects that can deliver market ready results within two years from the time of submission of a proposal, the normal time to full impact would be three to four years, with the impact continuing long after the end of the project. We've seen examples of outcomes from projects launched in 2005, being taken up by national administrations in 2010 and put into daily practice in 2011. That's the case for the EPA-NR software and methodologies. To look to the future, when the integrated initiative on energy efficiency in buildings and renewable energies was launched last year, it focused exclusively on nearly zero-energy buildings. It was obvious that the transposition of the Directive by mid-2012 couldn't be supported by projects which will only start in the coming months. Rather, support to the market transformation and national action plans for nearly zero-energy buildings was well matched to the period when the projects would be carried out, that is between 2012 and 2015, at which stage all countries in the EU should be at the stage of reaching their interim targets for such performance levels.

Is it still too early to have any conclusions from these projects focussing on NZEBs? If so, when do you expect them to be available, as MS must make decisions about NZEB definitions and implementation plans quite soon?

– As stated previously, these projects will deliver final outputs only in 2015, but it's an ongoing process and we'll be expecting the projects to interact at national and European level, as well as with the Concerted Action. The projects will inform the dialogue and vice-versa. That said, the project NorthPass was launched in 2009 with one of the aims to assist in the development of national action plans. The EACI also held a workshop amongst the consortia addressing the topic of high performance buildings in early 2010 which focussed on this topic. The proceedings of that workshop can be found on BUILD UP (www.buildup.eu). A lot of lessons have already been learned. Also, I should point out that the projects are not directly addressing the national application of the definitions of nearly zero-energy buildings, but with the implementation in practice. That is too say, supporting the market transformation to very energy efficient buildings according to the principles of life-cycle costing, coupled to integrated renewables from on-site or nearby. The projects will support the practical application of the nationally defined regulations which will embody the concept of nearly zero-energy buildings.

What about support for NZEBs in the warmer southern European climates? They pose really different challenges than NZEBs in very cold climates. Has IEE focussed on this issue yet?

– Indeed, none of the projects supported under last year's Call for Proposals focus specifically on nearly zero-energy buildings in warmer climates. In the past however, projects such as PASSIVE-ON have focussed on very high performance buildings in those regions. The ASIEPI project also investigated the concept of the Climate Severity Index which can help with dealing with the challenges of designing buildings to optimal performance over the year. We know that design parameters which optimise summer comfort can impinge on winter comfort and vice-versa. It is the annual, holistic optimisation which is important, as confirmed by the findings of the projects.

The Commission recently proposed combining all its Research, Demonstration and Innovation programmes into a single programme, Horizon 2020, including current CIP activities. Does this mean the end of the Intelligent Energy Europe brand, or will it continue with its own autonomy within Horizon 2020? Stakeholders are worried that such a successful programme would suddenly disappear. Can they count on continued support for policy implementation?

– Discussions on the next financial framework 2014-2020 are ongoing at European level, so it isn't possible to comment on the shape or identity of any of the Programmes. In the first instance, one more Call for Proposals is foreseen under the Intelligent Energy – Europe Programme in 2013, and the successful proposals will run from 2014 to 2017. As with other projects they will continue to deliver after their completion. For the future, actions in the spirit of the Intelligent Energy – Europe Programme are currently proposed within Horizon2020, but we'll need to wait for the adoption of the Financial Framework to know the precise nature of those actions. However, as I said, it's 2012 and the market can still expect support for policy implementation from Intelligent Energy – Europe Programme until 2017.

To conclude, two final questions for which I would like to have your personal views as an expert in the field of energy efficiency in the buildings sector. First, I would like to know your opinion about the real impact of the EPBD in Europe. We hear from some that it has been a milestone, others say it had some impact but not enough, others say it hardly improved the buildings sector so far. What is your opinion, looking back at the sector 10 years ago and today?

– The feedback from the projects, of which around 20 dealt exclusively with issues relating to the Directive, reflects what you stated. The ASIEPI project reported that in the period since the adoption of the Directive there has been at least one revision of the building codes in each country. It also pointed out that since many European Member states revise their regulations for buildings in periods of typically 5-7 years, some front runner countries would have tightened their legislation with or with-

Mr. GORDON SUTHERLAND is the Senior Project Officer of the Energy-efficiency Unit at the EACI (the European Commission's Executive Agency for Competitiveness and Innovation) which implements the EU's Intelligent Energy - Europe Programme formerly Project Officer in the field of Energy-efficient Buildings in the same unit. Since 2006 he has been responsible for the projects supporting the implementation of the EPBD. A researcher and practitioner in the field with a long CV related to energy efficiency in buildings even before he joined EACI in early 2006. From 2002 until 2005, Supervising Mechanical Engineer for the Olympic Village (Overlays) and Operations Site Manager of the Dekelia Training Complex, Organising Committee of the Athens 2004 Olympic Games. Between 1989 and 2001, variously at the Centre for Renewable Energy Sources (Passive Solar and Hybrid Systems Programme), the University of Athens (Group Building Environmental Studies), Trane Hellas Air-Conditioning and Lennox Hellas Heating-Cooling, in Greece, and Torpy and Partners - Consulting Engineers, United Kingdom. M.Sc in Energy Conservation and the Environment from Cranfield Institute of Technology, United Kingdom (1988-1989). B. Eng. in Aeronautical Engineering, Glasgow University (1984-1988).

IEE project database available at http://ec.europa.eu/energy/intelligent/

out the Directive. The aim of the Directive is of course for all countries to set appropriate performance levels for their building stock. Prior to the Directive, few countries had minimum energy performance requirements, the main approach being prescriptive requirements for building components and systems. Since the transposition of the Directive, that has changed. We've also seen from the IDEAL EPBD project, which carried out a robust market analysis on consumer response to the energy performance certificate in the residential sector in the period 2008-2011, that in countries where the implementation of the Directive was well advanced home owners are twice as likely to carry out energy efficiency renovations if they have a certificate and are aware of its content. That project showed that the Directive can and does make a difference when properly implemented. It is in the hands of the national administrations to ensure that it is effectively and efficiently implemented in each country. From a personal viewpoint, having worked in the field of energy efficiency in buildings since the late '80s, for the most part with a European perspective, it's clear that the Directive has indeed made a positive difference. That its implementation can be improved is however also clear. Reflecting on the outcomes of the projects we discussed today, the outcomes corroborated the approach to strengthening of the Directive through its recast. In the nature of any legislative process, it will take a few years from the adoption of the recast in 2010 to direct impact on the energy performance of the buildings that we occupy.

And, finally, how can REHVA and the HVAC industry, manufacturers, designers, etc., help improve the implementation of the EPBD?

– By upholding the principles embodied in the Directive as laid down, which are no more than best professional practice. That is, appropriate, holistic energy performance design for buildings and services. By flagging national and local regulations that contradict the Directive's provisions and by raising awareness to ensure that these get changed. By producing relevant guidance for REHVA members and encouraging the use of existing material out there. I should also point out that REHVA has over the years participated in a number of Intelligent Energy – Europe projects with the aim of helping the HVAC industry, manufacturers and designers to move towards a more energy intelligent building stock for Europe. Through actions such as these, REHVA has an important role to play in improving the implementation of the Directive across all EU countries. That said, I'd like to thank you and REHVA for the opportunity to chat about the Intelligent Energy – Europe Programme and also to point out that the outputs of all the projects we've talked about are available either from the project websites or the Intelligent Energy – Europe database at http://ec.europa.eu/energy/intelligent/

Intelligent Energy Europe programme supports the implementation of EPBD

The Path towards 2020: Nearly Zero-Energy Buildings

Hans Erhorn
Head of Department Heat Technology
Fraunhofer Institute of Building Physics
hans.erhorn@ibp.fraunhofer.de

Heike Erhorn-Kluttig
Group Leader Energy Concepts /
Department Heat Technology
Fraunhofer Institute of Building Physics
hk@ibp.fraunhofer.de

Introduction

The recast of the Energy Performance of Buildings Directive, in Article 9, requires Member States to ensure that by 31 December 2020, all new buildings are nearly zero-energy buildings (NZEB) and after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings. Member States shall draw up national plans for increasing the number of nearly zero-energy buildings and shall develop policies and take measures to stimulate the transformation of buildings that are refurbished into nearly zero-energy buildings.

Article 2 of the EPBD defines a nearly zero-energy building to be a building with a very high energy performance. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources produced on-site or nearby.

The Member States are responsible for the practical application of the definition stated in Article 2 and have to document this in their national plans.

The Concerted Action EPBD offers all EU Member States a platform for the exchange and discussion of national approaches, as well as of the challenges the countries face at defining the national application. Also policies and incentives to increase the number of NZEBs and ways to transform existing buildings into NZEBs are analysed in terms of their potential impact.

The continuous path towards higher performance of buildings

In most European countries, energy performance requirements for buildings have been imposed for more than 30 years. Often pilot building projects with ambitious energy goals have been designed, realised and evaluated successfully. The same energy performance levels have then been transferred to the building practice by top runners of the building industry and several years later an important range of builders have chosen this level as their standard energy performance level for buildings. This enabled some years later the governments to tighten the general minimum energy performance requirements to the same level. **Figure 2** shows the development of the energy performance of buildings in Germany, as a typical example of the policies adopted by many EU countries.

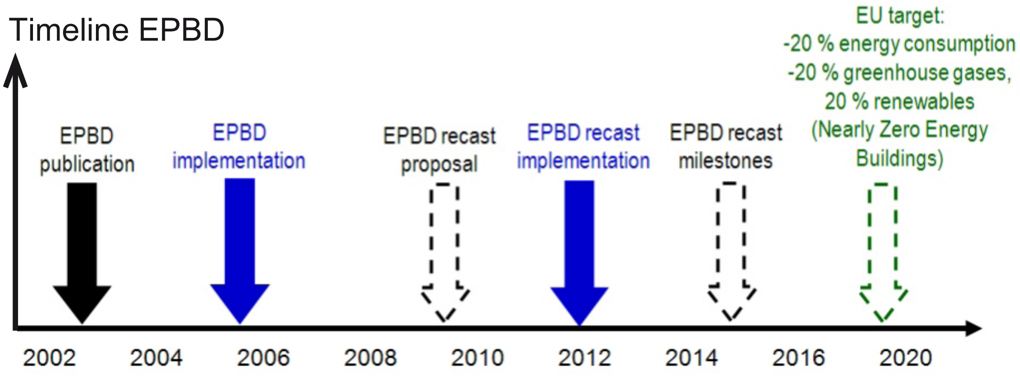


Figure 1. Timeline of the Energy Performance of Buildings Directive and its implementation.

Meanwhile plus-energy-houses have been constructed as pilots and are currently realised by top runners in the building market. All along, innovations have been developed that allow reducing the energy demand continuously. At the

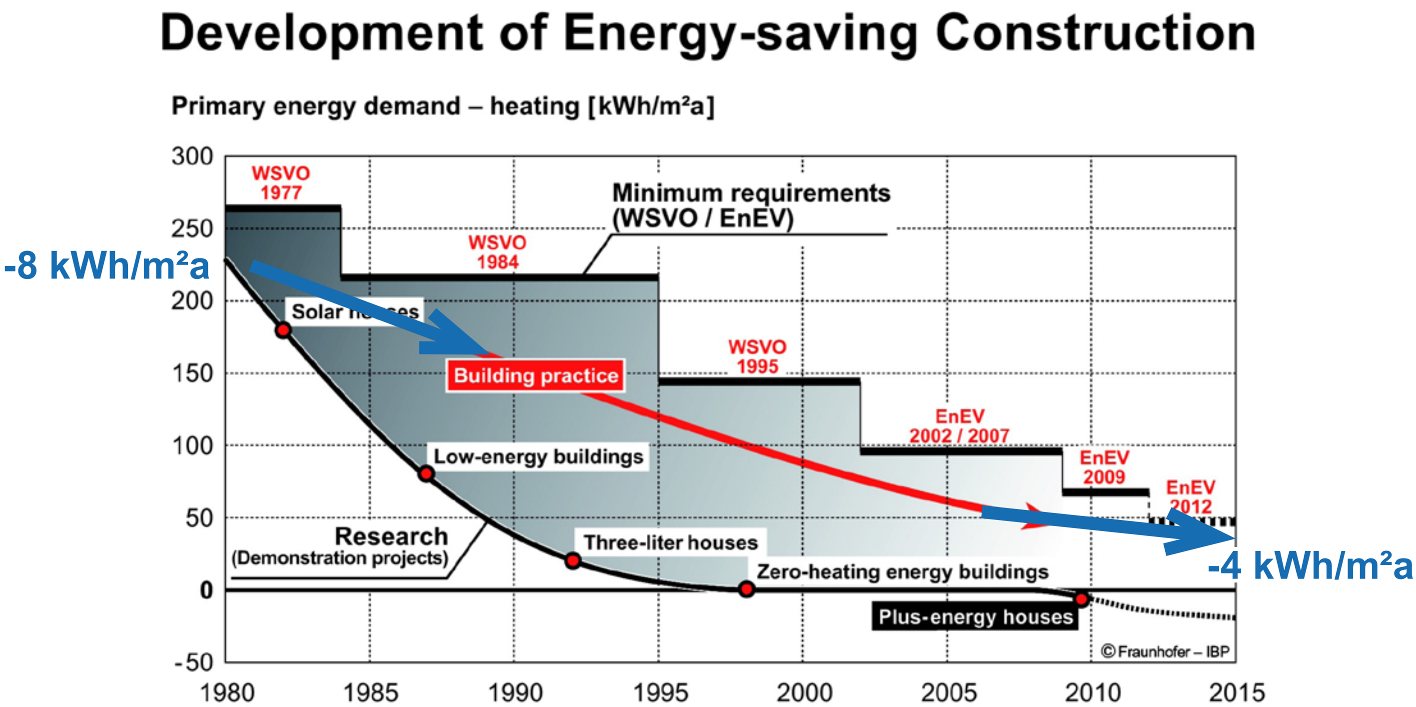


Figure 2. The development of the energy-saving construction in Germany showing the minimum energy performance requirements (upper line), the high performance pilot projects (lower line) and the innovative building practice (middle line) over the last 35 years.

beginning of the process, the cost-efficient potential of energy savings per year that could be explored was significantly higher than today. In the early seventies, the mean reduction potential by new and innovative developments was approximately 8 kWh/m^2a every year. In the last few years, the impact reduced to approximately 4 kWh/m^2a, but there is still a significant energy saving potential available. Based on this trend, it can be estimated that the energy demand will be reduced by half in 2020 solely through the forward projection of the impact of the innovations in the building sector. Additionally, it can be predicted that the energy supply will be steadily transferred from fossil to renewable energy carriers over the next years. Thus we can expect that the primary energy factor values will be significantly decreased until 2020. Electricity will most probably be reduced to a value lower than 2 kWhP/kWhD, but the values of the other energy carriers, such as gas and oil, will also be clearly lower based on the addition of bio fuels. This trend will result in a reduction of the primary energy demand of about 1/3 by 2020. The accumulation of both developments will most probably lead to a primary energy demand of new buildings of less than 40 % of today's energy requirements. This can be forecasted as benchmark for the NZEB development.

Status of the national applications of the nearly zero-energy building definition

One of the first actions of the Concerted Action EPBD was to get an overview on the current national applications of the NZEB definition. It turned out that only very few countries have already established a national definition. Most countries are currently still performing studies on how the definition should look like. **Figure 3** presents an overview on the status of the national applications of the definition of NZEBs.

Only two countries have a national application ready and officially approved. One additional country has the application defined. Two countries have a study on the national application completed while 10 countries are still working on such a study. Eight countries will start with the work later on. This is also the most likely situation for the countries who did not participate in the survey. That means that only 13 % of the Member States are sure how they define the NZEB. Less than half of the countries are currently working on the definition and about a half of the countries will start working on this definition during 2012 or later. Many countries only intend to address this issue after performing the cost-optimal study that is also required by the EPBD recast and is now only due in early 2013.

Several national approaches to the NZEB application have been presented at the Concerted Action and it is self-evident that the applications will be quite different from country to country. They vary from zero carbon to explicit maximum primary energy values. Besides the primary energy indicator required by the new EPBD, many countries also intend to include a list of additional indicators, dealing with the building envelope and also with the building service system efficiency as well as the generated renewable energy. A step-by-step approach in form of a roadmap towards the 2020 goals (NZEB) is planned in most countries.

Example of a national application of the NZEB definition: Denmark

Denmark is one of the two countries that have already set-up their national application of the NZEB definition. The minimum energy performance requirements for buildings are defined by so-called energy frames. The energy frames for new buildings are fixed for 2010, 2015 and 2020. They are different for residential buildings (including other non-residential buildings with similar types of use, like hotels) and non-residential buildings. For buildings with a special use requiring, for example, high ventilation rates, there are additions to the allowed energy frames. The energy frame limits the delivered energy and includes the energy use for heating, ventilation, cooling, domestic hot water and the necessary electricity for operating the building. In the case of non-residential buildings, it also includes the lighting energy. Electricity use has to be multiplied by a conversion factor and excess temperatures are punished by an addition to the calculation.

Supplementary requirements exist for:

- Thermal losses in W/m² dependent on the number of building storeys
- U-values, including an Eref -value for windows depending on the total solar energy transmittance and the transmission coefficient
- Minimum boiler efficiency
- Pipe insulation
- Automatic control
- Low temperature heating

The tightening of the maximum primary energy demand is realised in practice by three influence factors:

- First, by building better insulated buildings with more energy efficient building service systems;
- second, and this will also be the case in most EU countries, the primary energy factor (called conversion factor in Denmark) will drop for both, electricity and district heating. This is already predicted according to **Table 1** and will automatically decrease the primary energy demand of all buildings, existing and new, that use electricity and district heating. District heating is a quite commonly used energy source for buildings in Denmark.
- The last influence factor is the expectation that the use of renewable, on-site or nearby, will grow.

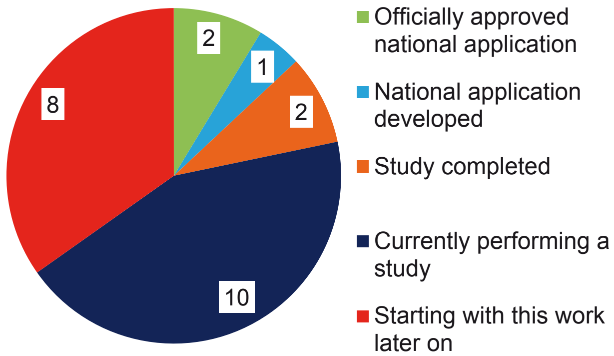


Figure 3. Overview on the status of the development of the national application of the NZEB definition. 23 countries took part in the survey in December 2011.

NZEB topics to be further analysed

The country experts have already started to discuss about several major issues linked with the NZEB definition as written in the EPBD. Those include:

- Which energy aspects have to be taken or will be taken into account?
  - □ Cooling
  - □ Lighting
  - □ Household electricity (as a way to balance energy generated from renewables?)

- Renewable energy contribution:
  - □ What is precisely on-site and nearby? How “nearby” is “nearby”?
  - □ What about biomass (grown somewhere else)?
  - □ What is “a very significant part”?
  - □ Should there be limits for the benefits of renewable energy taken into account, e.g., only up to the amount of self-used energy? If so, how to balance that: on a yearly, on a monthly, or on a hourly basis?
  - □ What about the electricity fed into the grid?

Table 1. Comparison of an extract of the energy performance requirements set in the Danish energy frames for 2010, 2015 and 2020.

Characteristic values		Energy frame 2010	Energy frame 2015	Energy frame 2020
Maximum of delivered energy to	Residential buildings (houses, hotels, etc.)	52.5 + 1650/A in kWh/m^2a	30 + 1000/A in kWh/m^2a	20 kWh/m^2a
	Non-residential buildings (offices, schools, institutions and other buildings)	71.3 + 1650/A in kWh/m^2a	41 + 1000/A in kWh/m^2a	25 kWh/m^2a
Conversion factors	Electricity	2.5	2.5	1.8
	District heating	1.0	0.8	0.6

where A is the heated gross floor area

  - ☐ How to make sure that renewable energy is not balanced twice (at the building and at the local or national primary energy factor)?
  - ☐ Which renewable energy sources can be calculated with national calculation standards, which ones are problematic or still missing?
- What is the comparison between the current national requirements and the national application of the NZEB definition?

The Concerted Action EPBD will work on a matrix that presents all national approaches in a structured way. At the meetings, the challenges listed above will be further analysed and discussed and a report shall be released on this topic when a significant number of countries have reached conclusions about their own national definitions of NZEBs.

Energy performance requirements for buildings in Europe

Marina Economidou
Buildings Performance Institute Europe
Senior Energy Efficiency Expert
Marina.Economidou@bpie.eu

The Building Performance Institute Europe (BPIE) is dedicated to improving the energy performance of buildings across Europe, and thereby helping to reduce CO_2 emissions from the energy used by buildings. BPIE acts both as an international centre of expertise on all aspects of energy efficiency and energy performance in European buildings, and as the European centre for a **Global Buildings Performance Network** (http://www.globalbuildings.org) created by ClimateWorks. Our main focus lays on policy analysis, implementation and dissemination of knowledge through studies, policy briefs and best practices.

Enforcing energy-related requirements during the design or retrofit phase of a building is a key driver for implementing energy efficiency measures in the building sector. Strong building energy codes cannot only bring substantial CO_2 savings and reduced energy bills, but also ensure more comfortable occupant conditions, more employment opportunities and increased energy security. Understanding the latest developments in building codes requires continuous monitoring and evaluation of what is adopted and enforced at country, regional and local level. Through its survey, the Buildings Performance Institute Europe has collected country information on the energy-related requirements in building codes adopted by the EU Member States. With the exception of a few countries, all countries have now embedded regulations for newly constructed, renovated residential and non-residential buildings.

Introduction

Energy codes for buildings comprise the energy efficiency requirements for newly constructed or renovated buildings. These requirements may apply to the building envelope and/or systems and can cover end uses such as heating, ventilation, air conditioning, lighting and water heating.

In Europe, energy codes for buildings are in a dynamic phase. The Energy Performance of Buildings Directive (EPBD, 2002/91/EC) was a major step forward through which Member States (MS) introduced requirements based on a "whole building" approach. In addition to overall building performance, a shift from an approach typically covering maximum permitted U-value only to a more extensive one including technical system requirements (e.g. on HVAC and lighting) has occurred. Moreover, major revisions in the building energy codes should be applied through the consideration of the cost optimality concept followed by the adoption of nearly zero energy standards (as introduced by the recast of the EPBD in 2010 (2010/31/EU)).

Given the environmental and climatic impacts of building codes, it is important to monitor all the key transformations happening at country level. The Building Performance Institute Europe investigated the status-quo of the building energy requirements through an extensive EU-wide survey on the building stock and building-related policies and regulations. This paper presents and discusses the findings of this survey.

Performance based requirements in building codes

In Europe, around 40% of the existing building stock was constructed before the 1960s when building energy codes were minimal (BPIE, 2011). It was only when the oil prices increased in the 1970s that several Member States introduced requirements for the thermal performance in their building codes with the exception of some Scandinavian countries which have had requirements in place since the mid-1940's. New residential buildings in Europe are estimated to consume about 60% less energy on average than those buildings constructed before the mid-1970s (World Bank, 2010). Enforcing energy-related requirements during renovations is, hence, of crucial importance.

Following the EPBD in 2002, requirements have gradually started shifting from prescriptive to a performance-based approach which is regarded as a major change in the building code trends. For many countries the

EPBD was the means of introducing new elements in their building codes prior to which there were no energy performance requirements concerning the building as a whole or specific elements. Nearly all countries have now adopted a national methodology which sets performance based requirements for new buildings. For countries in which prescriptive requirements existed before 2002 (e.g. Czech Republic, Belgium, Estonia, Bulgaria, Hungary, Ireland, Poland), there was a shift towards a holistic-based (i.e. whole building) approach whereby existing single element requirements in many cases were tightened. In some cases, the single element requirements are just supplementary demands to the energy performance requirements ensuring the efficiency of individual parts of a building is sufficient (e.g. Denmark). In others, they act as alternative methods where the two approaches exist in parallel (e.g. Norway, Spain, Poland, Switzerland); the first based on the performance of single elements and the second on the overall performance of a building. Typically in these cases, the single-element approach is preferred in major renovation projects while the performance-based in new constructions.

A detailed assessment of the energy performance requirements are provided in **Table 1**. It can be seen that many different approaches have been applied and no two countries have adopted the same approach. A variety of calculation methods are used and major differences exist in definitions (e.g. definitions of primary and final energy, heated floor area, carbon conversion factors, regulated energy and total energy requirement etc.). The setting of building code requirements with legally binding performance targets, is normally based on either an absolute (i.e. not to exceed) value, generally expressed in kWh/m^2a, or on a percentage improvement requirement based on a reference building of the same type, size, shape and orientation. Some countries (e.g. Belgium) express the performance requirement as having to meet a defined "E value" on a 0 to 100 scale, or on an A+ to G scale (e.g. Italy and Cyprus). Typically, these requirements cover heating consumption levels while in some cases more end-uses are included. It is also interesting to note that in many countries the requirements extend only to certain building types, usually just covering the residential sector.

Most methodology procedures are applied as software programmes. Software quality assurance accreditation is undertaken in only about half of the countries, a finding which has been drawn by the Concerted Action 2010 Report (CA-EPBD, 2010). About 50% of MS have already introduced changes to their methodology procedures to either; tighten requirements, achieve greater conformity with CEN standards, include additional technologies and/or to correct weaknesses/gaps in earlier EPBD methodology procedures.

Requirements on Heating, Ventilation and Air-conditioning systems

Different prescriptive requirements also exist in relation to maximum U values, minimum/maximum indoor temperatures, requirements for minimum ventilation rates and boiler and/or air-conditioning plant efficiency.

Most countries have introduced requirements to ensure minimum levels of ventilation within buildings. These are generally based upon metabolic rates and activity within the building. The requirements associated with ventilation relate principally to health, comfort and productivity; however they do have direct impact on energy requirements. Examples of different ventilation-related requirements in country building codes are presented in **Table 2**. These may apply as technical requirements on the ventilation systems (e.g. ventilation systems with heat recovery) or specified ventilation rates in designated areas of buildings. Given the increasing use of mechanical ventilation system, the fan power requirement in low energy buildings is becoming an increasingly important issue. A number of countries (e.g. Austria, Denmark, France, Estonia and Poland) have therefore introduced minimum requirements for specific fan power (generally expressed in W/l.s or $kW/m^3.s.$). Non-quantitative requirements also exist in some countries like Latvia and Hungary and this is an issue which needs to be addressed in several countries. As excessive or insufficient ventilation can lead to considerable energy wastage and uncomfortable conditions, many countries have introduced requirements to limit the air permeability/airtightness of buildings. Some of these requirements are listed in **Table 3**.

Most countries have requirements associated with the minimum performance of boilers and air-conditioning systems. Examples include minimum boiler efficiency levels and in some cases like Germany ban of old inefficient boilers (see **Table 4**). Additionally, many building codes require minimum levels of daylight to be achieved within buildings, whilst ensuring that solar gains do no result in significant overheating and/or the requirement for air conditioning. Building requirements associated with limiting solar gains vary from simple approaches (e.g. limiting window areas on building aspects exposed to solar gains) through to re-

Table 1. Performance-based requirements for new buildings.

	Single Family Houses	Apartment Blocks	Offices	Educational Buildings	Hospitals	Hotels & Restaurants	Sports facilities	Wholesale & retail trade
AT	H: 66 kWh/m^{2}a	H: 66 kWh/m^{2}a	H: 22.75 kWh/m^{3}a C: 1 kWh/m^{3}a	H: 22.75 kWh/m^{3}a C: 1 kWh/m^{3}a	H: 22.75 kWh/m^{3}a C: 1 kWh/m^{3}a	H: 22.75 kWh/m^{3}a C: 1 kWh/m^{3}a	H: 22.75 kWh/m^{3}a C: 1 kWh/m^{3}a	H: 22.75 kWh/m^{3}a C: 1 kWh/m^{3}a
BE - Br	E70		E75	E75				E75 (services)
BE - Wl	E<100, E_{spec}<170 kWh/m^{2}a, Overheating<17500 Kh/an	E<100, E_{spec}<170 kWh/m^{2}a, Overheating<17500 Kh/an	E<100	E<100				
BE - Fl	From 2012, E70 From 2014, E60	From 2012, E70 From 2014, E60	From 2012, E70 From 2014, E60	From 2012, E70 From 2014, E60				
BG	F:122-146 H&C: 82.5-102.5 kWh/m^{2}a	F: 90-146 H&C: 50.0-102.5 kWh/m^{2}a	F: 80-132 H&C: 40.0-82 kWh/m^{2}a	F: 56-98 H&C: 40-82.0 kWh/m^{2}a	F: 180-242 H&C: 50-102.5 kWh/m^{2}a	F: 176-230 H&C: 50-102.5 kWh/m^{2}a	F: 90-134 H&C: 40-82 kWh/m^{2}a	F: 90-134 H&C: 40-82 kWh/m^{2}a
CH	Space heating demand (effective energy): 5 litre heating oil equivalent per m^2 (based on MuKEn 2008)							
	H: 54 kWh/m^{2}a	H: 42 kWh/m^{2}a	H: 46 kWh/m^{2}a	H: 43 kWh/m^{2}a	H: 44 kWh/m^{2}a	H: 58 kWh/m^{2}a	H: 40 kWh/m^{2}a	H: 36 kWh/m^{2}a
CY	A or B category on the EPC scale							
CZ	F: 142 kWh/m^{2}a	F: 120 kWh/m^{2}a	F: 179 kWh/m^{2}a	F: 130 kWh/m^{2}a	F: 310 kWh/m^{2}a	F: 294 kWh/m^{2}a	F: 145 kWh/m^{2}a	F: 183 kWh/m^{2}a
DE	New buildings must not exceed a defined primary energy demand for heating, hot water, ventilation, cooling and lighting installations (lighting installations only for commercial) based on of a reference building of the same geometry, net floor space, alignment and utilisation.							
DK	P: 52.5+1650/A kWh/m^{2}a	P: 52.5+1650/A kWh/m^{2}a	P: 71.3+1650/A kWh/m^{2}a	P: 71.3+1650/A kWh/m^{2}a	P: 71.3+1650/A kWh/m^{2}a	P: 71.3+1650/A kWh/m^{2}a	P: 71.3+1650/A kWh/m^{2}a	P: 71.3+1650/A kWh/m^{2}a
EE	P: 180 kWh/m^{2}a	P: 150 kWh/m^{2}a	P: 220 kWh/m^{2}a	P: 300 kWh/m^{2}a	P: 400 kWh/m^{2}a	P: 300 kWh/m^{2}a	P: 300 kWh/m^{2}a	P: 300 kWh/m^{2}a
EL	The Primary energy requirement for new and renovated building in Greece is = 0.33 – 2.73 x Reference Building energy performance							
ES	The energy performance requirements is not expressed in units of kWh/m^{2}a							
FI	This is based on thermal transmittance (heat loss) measured in units of W/K. For a single family house, a typical value is 134 W/K							
FR-H1	P_{FF}: 130 kWh/m^{2}a P_{ESH}: 250 kWh/m^{2}a	P_{FF}: 130 kWh/m^{2}a P_{ESH}: 250 kWh/m^{2}a	n/a	n/a	n/a	n/a	n/a	n/a
FR -H2	P_{FF}: 110 kWh/m^{2}a P_{ESH}: 190 kWh/m^{2}a	P_{FF}: 110 kWh/m^{2}a P_{ESH}: 190 kWh/m^{2}a	n/a	n/a	n/a	n/a	n/a	n/a
FR -H3	P_{FF}: 80 kWh/m^{2}a P_{ESH}: 130 kWh/m^{2}a	P_{FF}: 80 kWh/m^{2}a P_{ESH}: 130 kWh/m^{2}a	n/a	n/a	n/a	n/a	n/a	n/a
HU	P: 110-230 kWh/m^{2}a	P: 110-230 kWh/m^{2}a	P: 132-260 kWh/m^{2}a	P: 90-254 kWh/m^{2}a				
IE	MPEPC = 0.6 & MPCPC = 0.69	MPEPC = 0.6 & MPCPC = 0.69	MPEPC & MPCPC should not exceed 1	MPEPC & MPCPC should not exceed 1				
IT	Regulations for new buildings are based on a set limit for heating, DHW, cooling and lighting. Only Class A+ to C buildings comply with requirements for new buildings							
LT	Min Class C buildings: 80 kWh/m^{2}a for buildings over 3000 m^2, 100 kWh/m^{2}a for buildings between 501 and 3000 m^2, 115 kWh/m^{2}a for buildings up to 500 m^2.							
LV	No performance requirements are set							
MT	No performance requirements are set							
NL	P: 68388-68552 MJ/a	P: 35595-36855 MJ/a						
NO	N: 120-173 kWh/m^{2}a	N: 115 kWh/m^{2}a	N: 150 kWh/m^{2}a	N: 120-160 kWh/m^{2}a	N: 300-335 kWh/m^{2}a	N: 220 kWh/m^{2}a	N: 170 kWh/m^{2}a	N: 210 kWh/m^{2}a
PL	F: 142 kWh/m^{2}a H&C: 108 kWh/m^{2}a	F: 123 kWh/m^{2}a H&C: 99 kWh/m^{2}a	F: 174 kWh/m^{2}a H&C: 183 kWh/m^{2}a	Requirements for other non-residential buildings apply				
PT	P: 203 kWh/m^{2}a F: 80 kWh/m^{2}a	P: 203 kWh/m^{2}a F: 80 kWh/m^{2}a	P: 407 kWh/m^{2}a F:122 kWh/m^{2}a	P: 174 kWh/m^{2}a F: 52 F kWh/m^{2}a	P: 465 kWh/m^{2}a F:140 kWh/m^{2}a	P: 523/1395 kWh/m^{2}a F: 157/419 kWh/m^{2}a	P: 233 F:70 kWh/m^{2}a	P: 1279 F: 384 kWh/m^{2}a
RO	No performance-based requirements are set							
SE	F_E: 55-95 F_{NE} 110-150 kWh/m^{2}a	F_E: 55-95 F_{NE} 100-140 kWh/m^{2}a	F_E: 55-95 F_{NE} 100-140 kWh/m^{2}a	F_E: 55-95 F_{NE} 100-140 kWh/m^{2}a	F_E: 55-95 F_{NE} 100-140 kWh/m^{2}a	F_E: 55-95 F_{NE} 100-140 kWh/m^{2}a	F_E: 55-95 F_{NE} 100-140 kWh/m^{2}a	F_E: 55-95 F_{NE} 100-140 kWh/m^{2}a
SI	P: 170-200 H&C: 50 kWh/m^{2}a	P: 170-200 H&C: 50 kWh/m^{2}a	P: 163-180 kWh/m^{2}a for social housing, for non-residential H&C: 30-50 kWh/m^{2}a, for non-residential (public investment) H&C: 20-40 kWh/m^{2}a					
SK	P: 80-160 H&C 42-86 kWh/m^{2}a	P: 63-126 H&C: 27-53 kWh/m^{2}a	P: 120-240 H&C: 16-56 kWh/m^{2}a	T: 42-84 H&C: 28-56 kWh/m^{2}a	T: 101-201 H&C: 27-70 kWh/m^{2}a	T: 94-187 H&C: 14-71 kWh/m^{2}a	T: 48-95 H&C: 28-56 kWh/m^{2}a	T: 81-161 H&C: 27-70 kWh/m^{2}a
UK	17-20 $kgCO_2$	16-18 $kgCO_2$	Other TER (Target carbon dioxide Emission Rate) values apply for non-domestic buildings					

Legend of Table 1:

P:	Primary Energy
F:	Final
N:	Overall Net energy demand limit (includes all electricity for lighting and appliances)
T:	Total delivered energy
H:	Heating
C:	Cooling
H&C:	Heating and cooling
MPEPC:	Irish Maximum Permitted Energy Performance Coefficient
MPCPC:	Irish Maximum Permitted Carbon Performance Coefficient
ESH (subscript):	Space heating provided by electricity (incl. heat pumps)
FF (subscript):	Space heating provided by Fossil Fuels
E (subscript):	Electrically heated building
NE (subscript):	Non-electrically heated building

Notes for Table 1:

AT:	Based on gross floor area and gross building volume
BG:	Based on assumption of DD=2100, A/V=0.2 for SFH, A/V=0.8 other, 32% share of glazing for upper limit and DD=330, A/V=1.2, 32% glazing for lower limit
CH:	Effective space heating demand for a typical building shape calculated on the basis of the SIA-norm 380/1:2009
DK:	A denotes the gross heated floor area in the Danish formulate, example 73.1 P @80 m^2 58 P @300 m^2
EE:	Heated floor area
FI:	For a single family house with building volume 522 m^3, gross floor area 163 m^2, and height between floors 3m.
FR:	H1, H2 and H3 represent the three main climatic regions in France
IE:	MPEPC and MPCPC denote the Maximum Permitted Energy Performance and Maximum Permitted Carbon Performance Coefficients used in the Ireland scheme
NO:	In Small houses, calculated overall net energy demand is limited to 120+1600/m^2 heated floor area.
PL:	Based on formula EPH+W=73+ΔEP for A/Ve<0.2; EPH+W=55+90 A/Ve+ ΔEP for 0.2< A/Ve<1.05; EPH+W=149.5++ΔEP for A/Ve>1.05 for residential buildings
PT:	Electricity production efficiency is approx. 0.30. For a 120 m^2 building, max energy needs (in kWh/m^2a) are 52-117 for heating, 198 for cooling, 38.9 for DHW
SI:	Requirements by 31.12.2014
SK:	Based on assumptions for shape factor, internal air temperature, floor to floor height, air change rate, degree days, etc.
UK:	The UK requirements are based on achieving a % reduction in CO2 emissions over a notional building of the same size/shape.
SE:	Electric heated buildings divided in three climatic zones: 95, 75, 55 kWh/m^2a

Table 2. Examples of different (non-exhaustive) ventilation-related requirements in country building codes.

AT Mechanical ventilation systems must be equipped with a heat recovery system when installed in new buildings or when renewed in the course of a renovation procedure. In major renovated or newly constructed non-residential buildings, the maximum heating energy consumption is reduced by 2 kWh/m^3a or 1 kWh/m^3a, if not more than half of the useful area is supplied by a mechanical ventilation system with heat recovery. In major renovated residential buildings, the maximum permitted calculated heating energy consumption is reduced by 8 kWh/m^2a.

DK Mechanical ventilation systems must meet the following requirements for specific electricity consumption for air transportation:

- 1800 J/m^3 in constant air volume (CAV) systems
- 2100 J/m^3 a max air volume for variable air volume (VAV) systems
- 800 J/m^3 for exhaust ventilation systems
- 1000 J/m^3 for ventilation systems for one dwelling

LV Ventilation systems shall be designed and installed:

- to protect human health using the space as intended;
- to ensure adequate air quality, sanitary requirements and standards of comfort level;
- in order to ventilation system does not encourage a flame or smoke spread and to prevent explosive gas and vapour mixture formation.

PL Ventilation (in-blow) fan:

- Complex AC installation 1.60
- Simple ventilation installation 1.25

Draught fan:

- Complex AC installation 1.00
- Simple ventilation installation 1.00
- Air out-blow installation 0.80

ES Minimum ventilation by person:

- IDA 1: hospitals, clinic, laboratories and day-care centres ⟶ 20 dm^3/s
- IDA 2: office, reading rooms, museums, rooms of courts, classrooms of education and swimming pools ⟶ 12,5 dm^3/s
- IDA 3: commercial buildings, cinemas, theatres, assembly halls, rooms of hotels, restaurants, bars and similar, gymnasiums and rooms of computers ⟶ 8 dm^3/s
- IDA 4: air of low quality ⟶ 5 dm^3/s

Table 3. Examples of different airtightness requirements in country building codes.

AT	In naturally ventilated buildings, maximum n_{50} is 3.0. In mechanically ventilated buildings, maximum n_{50} is 1.5.
BE	Default value of 12 $m^3/h\ m^2$ is used in methodology if no pressure test is available. Actual test result is used in the calculation if available
BG	In apartments with high airtightness, n_{50} <2.0 h^{-1}, with medium airtightness n_{50}=2.0-5.0 h^{-1} and with low n_{50}>5h^{-1}. In SFH with high airtightness, n_{50}<4.0h^{-1}, with medium airtightness n_{50}=4.0–10.0 h^{-1} and low airtightness n_{50}>10.0 h^{-1}
CY	Not regulated in building codes
CZ	Recommended maximum for common buildings is 4.5 h^{-1}, low energy buildings 1.5 h^{-1} and passive houses 0.6 h^{-1}. For mechanically ventilated buildings w/o heat recovery 1.5 h^{-1}, with heat recovery 1.0 h^{-1}
DE	For naturally ventilated buildings, n_{50} is 3.0h^{-1} and for mechanically ventilated buildings, n50 is 1.5h^{-1}
DK	Airtightness must be better than 1.5 l/s m^2, tested @ 50 Pa
ES	Air permeability of windows and doors depend on the climatic zone. For zones A and B (Class 1, 2, 3 and 4), maximum air permeability is 50 $m^3/h\ m^2$. For zones C, D and E (class 2, 3 and 4), maximum air permeability is 27 $m^3/h\ m^2$.
EL	Air penetration for the reference building, is taken equal to 5.5 $m^3/h\ m^2$ frame.
EE	For small buildings, maximum airtightness is 6 $m^3/h\ m^2$ (for new buildings) and 9 $m^3/h\ m^2$ (for existing buildings). For large buildings, maximum airtightness is 3 $m^3/h\ m^2$ (for new buildings) and 6 $m^3/h\ m^2$ (for existing buildings).
FI	n_{50} equal to 2.0 is used for reference building heat loss in Finnish Building Code. For EPC, n_{50} of 4 is considered unless the measured value is different. Air change rate in new apartments should be at least 0.5 h^{-1}.
FR	Airtightness under 4 Pa of building envelope is limited to 0.8 $m^3/h\ m^2$ for SFH, 1.2 $m^3/h\ m^2$ for other residential buildings, offices, hotels educational and health care buildings and 2.5 $m^3/h\ m^2$ for other buildings.
HU	Not regulated in building codes
LT	For naturally ventilated building, maximum n50=3 1/h, for mechanically ventilated buildings, maximum n50=1.5 1/h
LV	Maximum n50 in dwellings is 3 $m^3/h\ m^2$, 4 $m^3/h\ m^2$ in public buildings, 6 $m^3/h\ m^2$ for industrial buildings. For ventilated buildings, maximum n_{50} is 3 $m^3/h\ m^2$.
MT	Not regulated in building codes
NL	For residential buildings, 200 d m^3/s @10 Pa and for non-residential buildings 200 d m^3/s per 500 m^3 @10 Pa
NO	Maximum n_{50} is 3
PT	For residential buildings, the requirement is 0.6h^{-1}. Requirements for non residential buildings with mechanical ventilation exist depending on type of use
SI	For naturally ventilated buildings, maximum n_{50} is 3.0, for mechanically ventilated buildings, maximum n_{50} is 2.0
SK	For SFH with high quality windows, maximum n_{50} is 4 h^{-1} and for all other buildings is 2 h^{-1}. Other values apply for buildings with double glazed windows with seals or single glazed windows without seals.
UK	Maximum n_{50}=10 $m^3/h\ m^2$

quirements for complex modelling and simulation to demonstrate that effective measures have been adopted to provide solar protection. The Concerted Action report recommended that much greater attention should be given to the issue of estimating the impact of summertime overheating in the methodology in order to reduce the rapid increase in demand for air-conditioning (CA-EPBD, 2010).

Although most of the countries have now inspection schemes for boilers and/or air conditioning systems, data collection on the number of inspections done by each Member State is still at a very low level. Insufficient data makes it difficult to formulate an appropriate evaluation on the effectiveness of these schemes. Moreover, Finland, France, Ireland, the Netherlands, Slovenia, Sweden and the UK have opted for option b (advice to the users) of article 8 regarding the EPBD requirement for inspection of boilers. This shows that not all Member States have inspection schemes in place. With the implementation of the EPBD recast (Article 18, Directive 2010/31/EU), independent control systems for energy performance certificates and inspection reports should be established. However, the design of effective systems is pre-requi-

Table 4. Examples of different (non-exhaustive) heating system requirements in country building codes.

BG	Minimal efficiency requirements for boilers are in % and function of the boiler nominal capacity(Pn) in kW: 1. standard boilers - 87 + 2 log Pn; 2. low temperature boilers - 90 + 2 log Pn; 3. condensing boilers - 93 + 2 log Pn
DE	Prohibited use of boilers filled with liquid or gaseous fuels which were installed or set up before October 1, 1978. Prohibited use of electrical thermal storage systems according to the provisions if the heating in the buildings is produced exclusively by electrical thermal storage systems.
DK	Oil boilers must have efficiency, according to CE-labelling scheme not less than 93% at full load and 98% at part load. Gas boilers must be condensing with efficiency, according to CE-labelling scheme not less than 96% at full load and 105% at part load.
UK	Gas boilers (the primary heating systems used in UK homes) must meet a minimum efficiency of 86% using the SEDBUK methodology.

site for the success of these schemes so information exchange of past experiences and best practices between the Member States is very important.

Conclusion

Energy codes are in general a very cost-efficient regulatory measure whose benefits can go well beyond energy savings. The implementation of the EPBD has resulted in a step-change in the energy requirements in building regulations across Europe. The survey undertaken by BPIE shows large variations in the approaches adopted by different countries. Whilst there are a small number of countries which are still to implement requirements on heating, cooling or ventilation, many Member States have now requirements in place as a result of the EPBD.

Adopting, implementing, and enforcing codes requires rigorous procedures by the authorities. It is generally accepted that compliance and enforcement of building energy codes is undertaken with less rigour compared to other building regulations such as structural integrity and fire safety. Whilst data on compliance levels are scarce, studies suggest that non-compliance in Europe can reach up to 50% levels in certain regions (Fraunhofer ISI et al, 2009). However, as the energy performance requirements become stricter (e.g. in line with EPBD recast provision on nearly zero-energy buildings), the gap between the theoretical performance during design phase and the actual energy performance in-use may increase substantially. While energy codes offer a very attractive opportunity to reduce CO_2 emissions of buildings in a cost-effective way, low compliance levels will bring significant lock-in effects in CO_2 savings. If the EU Member States are to deliver the climate and environmental targets related to buildings in the coming years, it is critical that they focus and invest more on control and enforcement procedures.

References:

The World Bank, Mainstreaming Building Energy Efficiency Codes in Developing Countries Global Experiences and Lessons from Early Adopters, Energy Sector Management Assistance Program, 2009. http://www.esmap.org/esmap/sites/esmap.org/files/WP_204_GBL_Mainstreaming%20Building%20Energy%20Efficiency%20Codes%20in%20Developing%20Countries.pdf

European Commission, DIRECTIVE 2002/91/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2002 on the energy performance of buildings (EPBD). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:001:0065:0065:EN:PDF

European Commission, DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the energy performance of buildings (EPBD recast) http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF

CA-EPBD, Implementing the Energy Performance of Buildings Directive – Featuring country reports 2010. http://www.epbd-ca.org/Medias/Downloads/CA_Book_Implementing_the_EPBD_Featuring_Country_Reports_2010.pdf

Buildings Performance Institute Europe, Europe's Buildings under the Microscope – a country by country review of the energy performance of buildings, 2011. http://dl.dropbox.com/u/4399528/BPIE/HR_%20CbC_study.pdf

Fraunhofer ISI, ENERDATA, ISIS, Technical University Vienna, Wuppertal Institute for Climate, Environment and Energy WI, Study on the Energy Savings Potentials in EU Member States, Candidate Countries and EEA Countries, Final Report for the European Commission Directorate-General Energy and Transport, EC Service Contract Number TREN/D1/239-2006/S07.66640, March 2009, revised. http://ec.europa.eu/energy/efficiency/studies/doc/2009_03_15_esd_efficiency_potentials_final_report.pdf

HVAC in the recast EPBD – inspection, advice, or monitoring?

Bruce Young
BSc MSc
Core Theme Leader (Inspections)
of the EPBD Concerted Action programme
YoungB@bre.co.uk

Introduction

The original Energy Performance of Buildings Directive requires regular inspection of heating and air-conditioning systems, with the alternative of energy efficiency advice for heating systems only. The recast Directive allows greater flexibility: advice instead of inspection can be given for air-conditioning as well as heating, and in both cases automatic monitoring systems can be introduced to reduce the frequency or intensity of inspection. The Member States of the European Union are now considering whether or not to take up these new options in their individual decisions about how to implement the Directive at national level.

HVAC under the recast Energy Performance of Buildings Directive

The recast Directive has new provisions for regular inspection of heating and cooling systems. The definition of what has to be inspected has been changed, and the scope and contents of the inspection report have been specified in greater detail. For example, some references to "boilers" have been widened to "heating systems". Most importantly, there are new alternatives: energy efficiency advice can now be offered instead of regular inspection of air-conditioning systems, and for both heating and cooling systems automatic monitoring can become a partial substitute for inspection. These alternatives would reduce inspection costs for building owners individually and might prove to be more cost-effective routes to energy saving nationally.

Advice on heating and air-conditioning systems

Advice rather than inspection of heating systems has always been accepted as an alternative implementation of the Directive, and about half of the EU Member States have chosen it for transposition of the first EPBD (2002). By "advice" is meant general information on efficient heating systems, not specific to a particular building, with the aim of promoting improvements to energy performance. This is distinct from advice given with detailed knowledge of a particular installation, as that normally has to be preceded by an inspection or audit of some kind. It is necessary to show that, on a national scale, the overall impact on energy saving is broadly equivalent.

Member States with a history of regulation for heating appliances (such as "chimney sweep" laws) tended to favour inspection schemes and others preferred advice. But the distinction is not clear-cut, and EPBD Concerted Action did not get simple answers to questions about which option had been chosen. In practice there are a number of mixed regimes in which inspection is compulsory in some circumstances (governed by system type, size, fuel) while advice is given in others.

Now, under the recast Directive, the "advice" alternative can be chosen for air-conditioning systems too. This brings air-conditioning into line with heating, and indeed the relevant wording of Article 15 (*Inspection of air-conditioning systems*) of the new recast Directive is almost identical to that of Article 14 (*Inspection of heating systems*). Advice is expected to cover modification and replacement of existing systems, and alternative solutions (that may include inspection) to assess efficiency and sizing. And of course the overall impact of giving advice must be equivalent to inspection.

Regular inspection

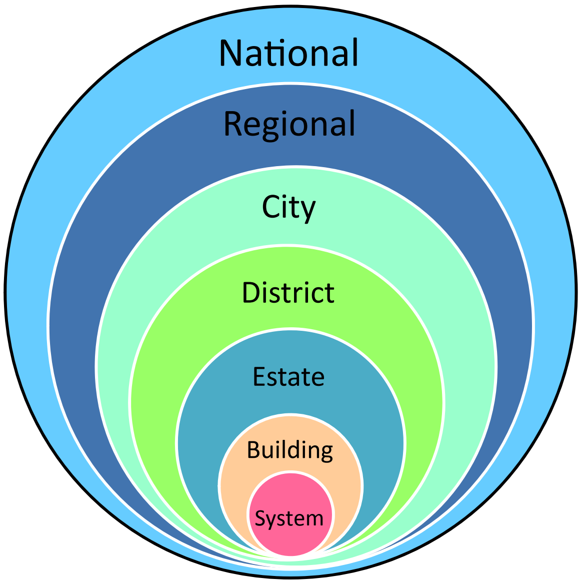
In contrast to advice, the requirements for inspection schemes are set out in some detail. For inspection there are three clauses of the Directive covering system size limits, frequency of inspection, and the need to assess system efficiency and plant size relative to demand. There is an obligation to produce an inspection report, which must include recommendations for improvement, and may (though not must) compare performance with that of a new system of the same type and best alternative type. The report is to be handed over to the owner or tenant of the building, and by implication must therefore be written in terms he can reasonably be expected to understand. An independent control system has to be established to verify a statistically significant percentage of the inspection reports.

Electronic monitoring and control

Now there is a third option, to the extent that automatic monitoring can be recognised as a partial substitute for inspection. Monitoring and control is mentioned in three places in the recast Directive, sending a strong signal that it is regarded as having significant energy saving potential.

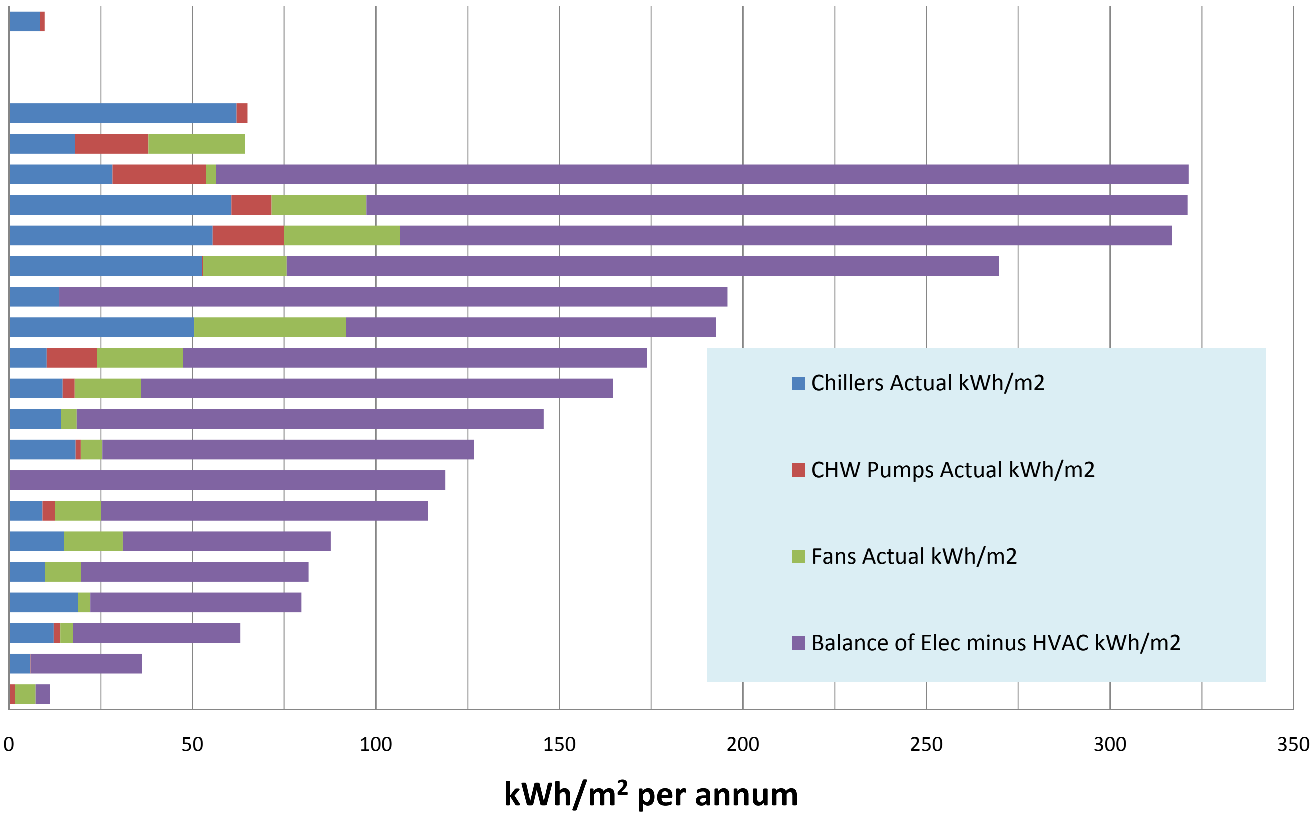
The requirements for HVAC inspection say that the frequency of inspections may be reduced, or the intensity of them lightened, where an electronic monitoring and control system is in place. For technical building systems (defined as heating, cooling, ventilation, hot water, lighting) another part of the Directive says Member States shall encourage intelligent metering systems and may encourage the installation of active control systems such as automation, control and monitoring systems that aim to save energy.

Intelligent metering is the subject of a separate policy initiative under the Energy Services Directive, but in this context its purpose is to enable building monitoring rather than supply consumer information. Electronic monitoring and control is already well established in non-domestic buildings in the form of building management systems (BMSs), though they are not always installed with the primary aim of saving energy.



Levels of inspections, advice, and monitoring.

If monitoring is to become a credible substitute for inspection it will have to be done on a large scale and made widely available, allowing buildings to be compared with one another. Although energy data is collected by existing BMSs, it is not normally stored for long term analysis nor transmitted to a general database from which large numbers of installations can be analysed sys-



AC system components energy use in different buildings

tematically. Data from a large number of buildings over long periods is needed to enable benchmarks to be developed, technical building systems compared, and their energy performance ranked. Badly performing building systems can then be singled out for further attention.

A pilot project to do that is iSERV *(Inspection of HVAC systems through continuous monitoring and benchmarking)*, funded by Intelligent Energy Europe, which is designed to carry out continuous monitoring of 1 600 buildings in 20 Member States. The data collection and transmission arrangements are simple and so the project has a low entry cost for participants. iSERV is a large project that expects to create a valuable dataset on energy usage by HVAC systems across Europe, and it hopes to spawn a number of similar schemes that will continue in operation once the project has finished.

Next steps in implementation

It remains to be seen how many Member States will choose the advice option for air-conditioning. Seven of them have said they are considering doing so, subject to a favourable assessment of the relative costs and benefits. While inspection can be carried out cheaply if combined with servicing, the requirement for the inspection report to include an assessment of plant sizing and efficiency may call for skills beyond those of a normal service technician. The Directive makes clear that inspection must be carried out by qualified or accredited experts, in an independent manner. Advice, in the form of general information not requiring a building visit, can be provided to everyone more cheaply but might not have the same impact. Member States have to consider what form advice will take and how they will be able to demonstrate to the European Commission, in a report to be prepared every three years, that the impact on energy saving is at least as great as if inspection had been carried out instead.

The Directive may provide the stimulus to set up wide area building monitoring schemes, if Member States do indeed "reduce or lighten" the financial burden of plant inspection where monitoring is installed. It is not known how many intend to allow for this explicitly when they transpose the Directive into national legislation in July this year.

Conclusions

What will Member States choose – inspection, advice, monitoring, or a mixture? Will large monitoring schemes emerge to make the third alternative a realistic option, and who will take the initiative in creating them? These questions are the subject of continuing interest and discussion in EPBD Concerted Action.

Inspection has the advantage of enabling recommendations for improvement to be given from knowledge of the current state and configuration of each installation. Recommendations can be made specific and relevant. But this is expensive unless combined with other onsite activity. It also carries a number of further obligations, which are more onerous in the recast Directive. Compulsory inspection of all installations at regular intervals, even those found to be in good order on the previous occasion, does not make best use of available resources: furthermore it may be viewed by customers as an imposition and treated simply as a compliance exercise.

Advice avoids the expense of sending highly trained personnel to site but is uncertain in its reach. The energy saving impact of both inspection and advice is difficult to measure, needing surveys to reveal how building owners have reacted. "Equivalence reports" (prepared by Member States who choose the advice option) have to assess and compare impact, and for the hypothetical inspection option that was not chosen it can only be speculative. The most recent equivalence reports of June 2011 are being analysed, and may later be summarised in an overview from the European Commission.

Wide area monitoring is a fairly new idea, not yet developed and probably not "ready to go" by July 2013 (the date that the new legislation is applied to most buildings). Meanwhile it is important not to exclude the option by drawing up national legislation too narrowly in 2012. New regulations can use conditional wording, such as "*…an inspection scheme, with frequency of inspection modified for buildings that are part of an approved monitoring scheme…*". An approved scheme would need to be linked to some more limited form of inspection, targeted at the worst performing buildings, and it is here that inspection has the best prospect of encouraging improvement. Unlike advice, a monitoring scheme in conjunction with limited inspection does not have to be proved to have equivalent impact to a full inspection scheme. The necessary qualifications for an "approved monitoring scheme" can be settled later once more experience has been acquired, and this is a topic to which EPBD Concerted Action will return to help the EU Member States reach decisions.

References

Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast).

iSERV website www.iservcmb.info

REHVA Journal January 2012: Ian Knight: Assessing electrical energy use in HVAC systems.

Introducing cost-optimal levels for energy requirements

Kim B. Wittchen
Senior Researcher
Danish Building Research Institute, SBi
Aalborg University, Denmark
kbw@sbi.dk

Kirsten Engelund Thomsen
Senior Researcher
Danish Building Research Institute, SBi
Aalborg University, Denmark
ket@sbi.dk

Introduction

The recast of the Directive on the Energy Performance of Buildings (EPBD) states that Member States (MS) must ensure that minimum energy performance requirements for buildings are set "***with a view to achieve cost-optimal levels***", and that the cost-optimal level must be calculated in accordance with a comparative methodology. The ultimate goal of this is to achieve a cost-optimal improvement of buildings' energy performance (new and existing) in reality.

Methodology for calculating cost-optimal levels

EPBD recast and Comparative Methodology Framework

According to the EPBD recast "***assure that minimum energy performance requirements for buildings or building units are set with a view to achieving cost-optimal levels***". MS must also: "***take the necessary measure to ensure that minimum energy performance requirements are set for building elements that form part of the building envelope and that have a significant impact on the energy performance of the building envelope when they are replaced or retrofitted, with a view to achieving cost-optimal levels***" (EPBD Art. 4.1 and also in Recital 14).

Cost-optimal levels are defined as "***the energy performance level which leads to the lowest cost during the estimated economic lifecycle***". MS will determine this level taking into account a range of costs like investments, maintenance, operating costs and energy savings. The economic lifecycle is defined by each MS. It refers to the estimated economic lifecycle of a building or building element.

The EPBD requires MS to report on the comparison between the minimum energy performance requirements and the calculated cost-optimal levels using the Comparative Methodology Framework provided by the Commission (EPBD Arts. 5.2, 5.3, 5.4 and Annex III). The report must also provide all input data and assumptions made. The Comparative Methodology Framework from the Commission consists of a Regulation document accompanied by Guidelines to enable MS:

- To define reference buildings.
- To define energy efficiency measures.
- To assess the final and primary energy needs of the reference buildings and the impact of the improvement measures.
- To calculate the cost of the energy efficiency measures by applying the principles of the comparative methodology framework.

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

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

The EPBD recast does not demand that MS set their minimum performance requirements at levels that are cost-optimal. It does however require them to report how their requirements differ from cost-optimal levels (implicitly as far as underperformance is concerned). If there are "significant" differences, i.e. exceeding 15% (meaning that their energy requirements are more than

15% above the cost-optimal level) MS should justify their existing energy requirements or describe how to reduce the difference.

Timeline

- A proposal for the framework was adopted by the European Commission on 16 January 2012.
- The Council voted by 1 March 2012 and there were no objections.
- This framework has to be accepted by the European Parliament and the Council.
- MS need to submit their reports to the Commission at regular intervals of maximum five years, with the first report due by June 2012 according to the recast. This date will be extended.

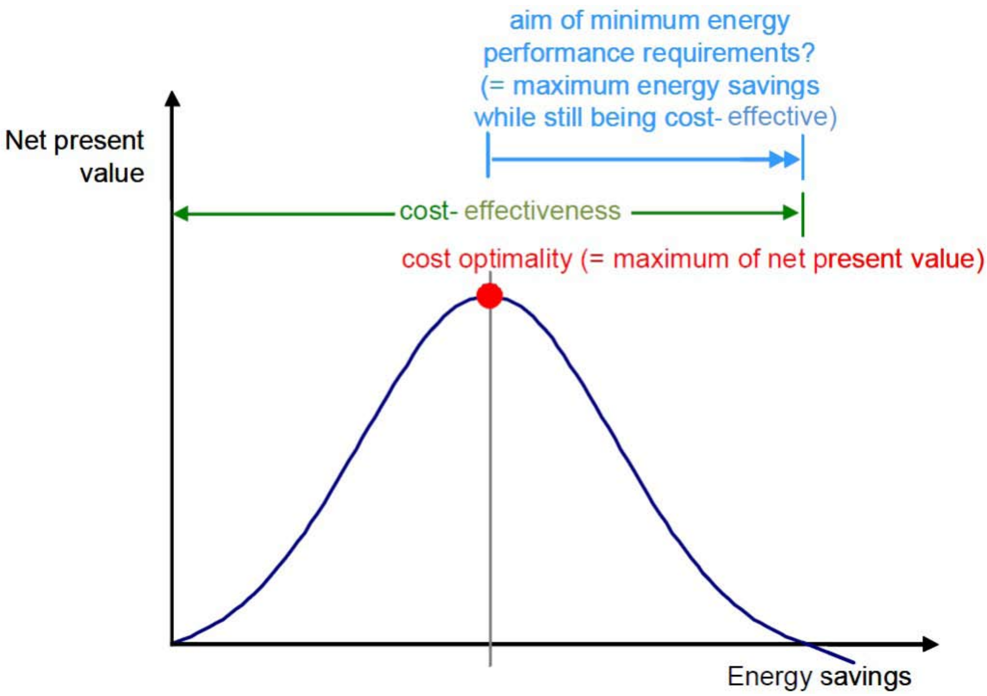


Figure 1. Scheme presenting cost optimality and cost effectiveness.

Cost effectiveness vs. cost optimality

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

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

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

Early experience

In December 2010, a working group of the Concerted Action EPBD was established to study the proposed first draft of the methodology for calculating cost-optimal levels and give feed-back to the Commission. Some main results from this work can be summarised as:

- Comparative framework can be a powerful instrument to guide MS and improve their energy requirements
- Excessively rigid comparison methodology can have a negative effect on setting national requirements
- To define reference buildings, there is a distinction between new and existing buildings
- The reference buildings should become as representative as possible for the national building typologies and changes in building tradition

- There is hardly any experience in setting up reference buildings for the existing stock
- In many cases, there is no sound statistical bases for "reference buildings"
- Should we create realistic buildings that are recognisable or should we focus on simplified schematic buildings reflecting some basic characteristics?
- How do we take into account the actual energy performance of the building (element) when applying measures?

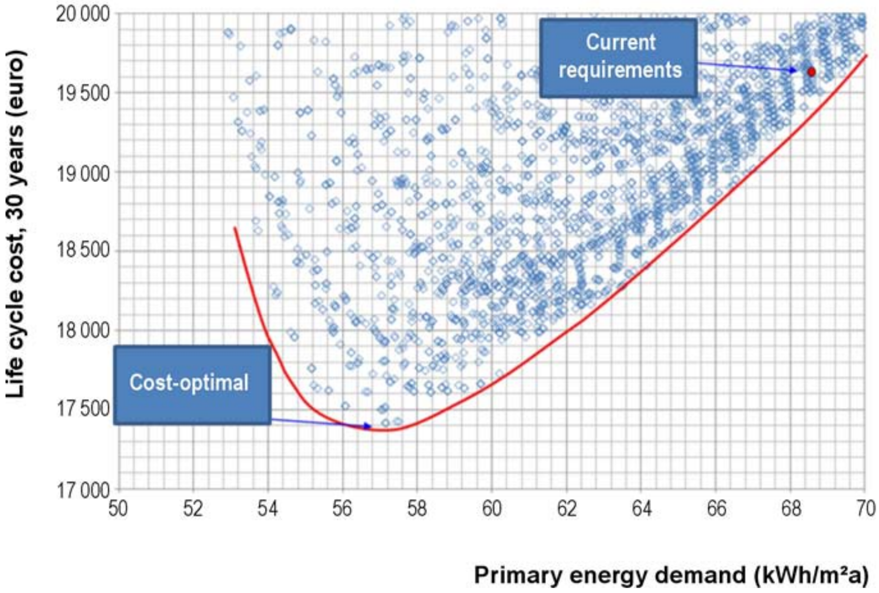


Figure 2. Example calculations for a country with current building energy requirements far from the cost-optimum point. It is clear that cost optimality can be improved significantly compared with the current requirements.

A summary report ("Cost-optimal levels for energy performance requirements") from this work is available at www.epbd-ca.eu or www.buildup.eu/publications.

Some MS have carried out calculations of cost-optimal levels in order to investigate the implications on their national energy regulations. In the illustrations below, part of this early experience is presented. If the current building energy regulation requirements are far above cost-optimal levels, calculations will show a curve with a clear optimum. On the other hand, if the current building energy requirements are already near the optimum, cost calculations seems to present flat curves.

Cost-calculation perspective

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

- of societal as a whole: the "macro" economic perspective
- of individual end-users
- of idealised end-users (private): the "micro" economic perspective

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

Macroeconomic calculation levels include costs of greenhouse gas emissions and exclude taxes and subsidies. MS must determine the discount rate in the macro-economic calculation after having performed a sensitivity analysis with at least two different rates, one of which should be with 3%.

MS must carry out both the micro and the macro calculations, but MS still have the prerogative to decide which perspective will be the final national benchmarks.

Reference buildings

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

MS has to establish at least 9 reference buildings – one for new and two for existing buildings, for respectively single-family, multi-family, and office buildings. Yet, Annex I includes a list of building categories into which buildings should be adequately classified for the purpose of the energy performance calculation:

- single-family houses of different types
- blocks of flats
- offices
- educational buildings

- hospitals
- hotels and restaurants
- sports facilities
- wholesale and retail trade services buildings
- other types of energy-consuming buildings.

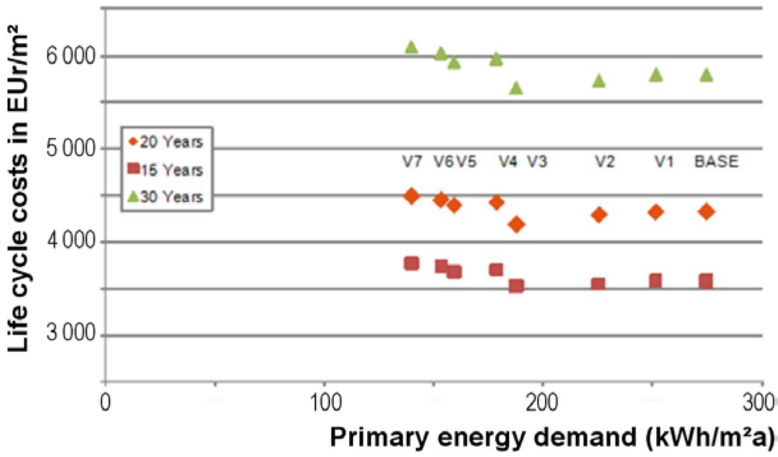


Figure 3. Calculations of cost-optimal levels for a country with current requirements (base) already near the cost-optimal point. The curves show that it is difficult to identify the cost optimal level if the current requirements are near the optimal point.

Ideally reference buildings are defined based on the characteristics of the building stock and the research purpose they are intended for. They can have two main purposes: to represent the aggregate stock of buildings affected by regulation; and to identify sectors that would be disadvantaged by requirements that might, nevertheless, be cost-optimal overall. Due to the limited statistical knowledge about the building stock, the choice of reference buildings has a more arbitrary nature. This arbitrary element in picking reference buildings might be a source of deviation and inconsistency in the cost-optimum comparison. Also the use of different service systems in comparably constructed buildings and as well as different user typologies will multiply the number of reference buildings.

There have been several EU projects in the past dealing with this issue, but also some actual projects collect information on existing national reference buildings or try to develop national sets of reference buildings with IEE TABULA being one of them. TABULA aims to create a harmonised structure for European building typologies with focus on residential buildings (www.building-typology.eu).

Existing building stock

In addition to energy performance requirements for new buildings, MS must also set requirements for cost-optimal levels for the existing building stock. Some issues for consideration regarding procedures for achieving cost-optimal levels for the existing building stock can be emphasised:

- Acceptance can be a problem as the user knows the energy bill, the investments and savings – and if they do not converge, it will raise discussions.
- Multi-criteria vs. single-criteria performance decision-making will become an issue as other aspects than energy play a very important role in the investment of improvements.
- Private vs. societal perspective needs to be addressed. Different outcomes from the different approaches may raise a discussion on which perspective should become decisive.
- There may be competing investments to investments in energy-saving measures like lifestyle improvements (kitchen, garden, roof, etc.), new home electronics; education of children, etc.
- Split incentive between actors, within large companies, in case of selling (added property value).
- Whole building or component requirements can result in different solutions with the risk that one optimal solution identified e.g. on component level will be a hindrance for a better (later) solution on whole building level.
- Many of the energy improvements in the existing building sector will be driven by major renovation, and information on the combination of other planned works and energy improvements is crucial to communicate in a proper way to ensure cost-optimal solutions.

Final remarks

MS must compare their national minimum requirements with cost-optimal levels and report on the outcome. In case there is a significant gap that cannot be justified, MS should take measures to bring the requirements in line with cost-optimal levels. It is important to understand that a too rigid comparison methodology can have a negative effect on setting national requirements, e.g. exposing that a MS prescribe requirements that are stricter than those calculated by using the methodology for calculating the cost-optimal levels, even though there may be well substantiated reasons why a MS should impose stricter requirements. A rigid EU methodology can reduce the reliability on the national level and also the flexibility to modify the national approach. The emphasis of justification of requirement levels towards the Commission by means of reference buildings and lists of measures may increase the risk that reality is too easily confused with reference buildings and seemingly cost-optimal levels based on reference buildings turn out to be sub-optimal in reality. It is thus important that the reference buildings developed in MS become as representative as possible for the national building typologies and changes in building tradition.

Without doubt, a Comparative Methodology Framework is a powerful instrument to guide MS in the process of checking the level of their minimum energy performance requirements and to improve the energy performance of their building stock. Sharing of knowledge and experience between MS will also be stimulated through the common procedure laid down in the Framework.

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

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

Analysing the cost effectiveness of measures in the existing building stock is common practice in consultancy for specific buildings. For the purpose of setting or comparing energy performance requirements, measures have to be judged in a more general and transparent way in order to be valid for enforcing requirements. There is hardly any experience of how to do this properly. It is therefore of great importance to organise knowledge exchange and share experience. 3E

Eco-design Directive, Energy Label and Ecolabel

– Relationships and compatibility with the Energy Performance Buildings Directive

This short article describes a few examples and some further questions about relationships between different EU regulations. The aim is not to give full answers, but to give some background to discussions. This contribution is an update and continuation to previous articles on the subject, dealing with products related to ventilation and air-conditioning systems and the needs to link EPBD standards and product standards together in a systematic way.

More about the EU legislation and related issues are dealt with in another article, which gives an introduction to REHVA "EU Regulations" webpages, established in spring 2011.

Jorma Railio
REHVA Fellow
Finland
jorma.railio@gmail.com

Figure 1 – also shown on the Eco-design page of REHVA "EU regulations" pages (see www.rehva.eu/en/eco-design) – shows the principle of the relationships between eco-design, energy label and eco-label for a certain product. Eco-design will give minimum requirements for the environmental performance of the product – and products which do not fulfil these minimum requirements will not receive the obligatory CE marking and have no access to the market. The energy labelling includes a product classification A to G. Only products in the best class can receive the eco-label. This is the simple principle and shows the way – the real practice is still different.

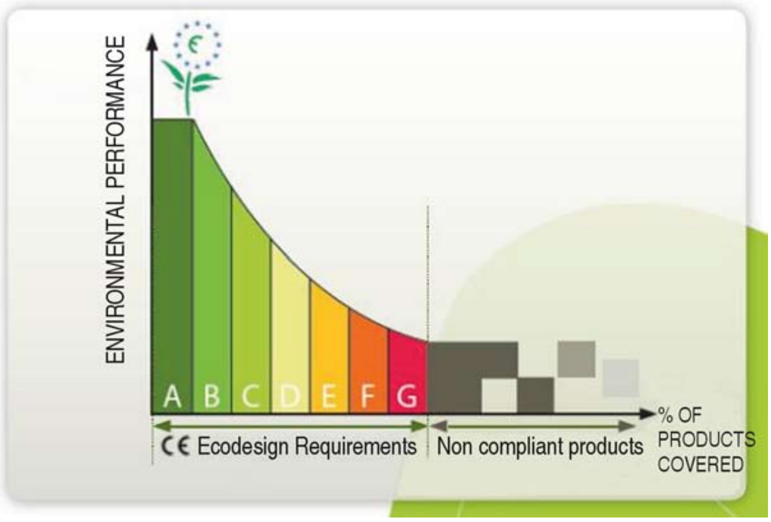


Figure 1. The principle of relationships between eco-design, energy label and eco-label.

The relationships between Eco-design and EPBD have been taken up in the author's previous articles in REHVA Journal in early 2011. The article "Regulations Based on the Eco-design of Energy Related Products Directive", in REHVA Journal 1/2011 as follows:

> *"EPBD concentrates on buildings as a whole, deals the systems to some extent. Eco-design deals with products and is taking the first steps towards systems. But the picture is still fragmented. The links between products, systems and buildings are weak – and the "Lots" are not necessarily covering all essential products in the system."*

The work towards Eco-design regulations always starts with a preparatory study, known as "Lot" – follow the link above for more information about how these regulations are prepared. The following product examples are here to show the complexity of the whole issue.

Example 1. Fans

The question about fan performance in "real world versus test facility (ISO 5801)" came up in a series of field tests. A study in early 1980's in Finland revealed that a typical overall efficiency (including all possible losses due to the motor, controls, casing, drive etc.) was around 20% and just slightly better for large fans, while ISO 5801 tests could end up in figures between 80 and 90%. Similar studies – but somewhat more from the system point of view – were done in Sweden also in 1980's. As a result, the term Specific Fan Power (SFP) was launched in some guidelines. From those days both the fan efficiencies and SFP values have improved, but still the difference is a major issue.

Now the fan performance is subject to many activities and discussions. One very recent study, referred in more detail in this issue by Brelih and Seppänen, reveals that the fan efficiencies in real installations have not improved as much as could have been expected, on average from around 30% to around 30%.

The SFP is one major step towards full system consideration, but also other system aspects exist. More about this issue can be read from EN 13779 (Annex D). The difficulty is that SFP – of a fan or even of an air handling unit (AHU) is not just a product characteristic but also depends on the system and therefore arguments against using SFP as an eco-design criterion can be justified. On the other hand, elimination of the system effects by calculations is possible using different assumptions in a transparent way, ending up into a kind of "default SFP for a product" (fan or AHU). But, fans and AHU's today more and more operate at variable air flows, and this makes the "elimination" issue very complicated and debatable. The discussions are still going on, and we can see probably very soon, whether or not the ongoing "Lot 6" can find a widely acceptable solution in this question. See also Rene Kemna's presentation (http://tinyurl.com/8xhhxgz).

Example 2. Heat recovery – efficiencies, standards

Temperature ratio vs. yearly efficiency: Only fragments of news compared to what was written a year ago. The amendment of EN 13053 has been approved, and Eurovent has been very active in establishing revised rules for AHU certification, based on the amended issues. But the discussion also here goes on. In the meantime, decisions have been made towards revision of EN 308 for heat recovery devices, but it is still somewhat open how this will be organised so that the users of EN 308 can influence properly in the process if CEN/TC 110 will do the revision work. As described in the previous article, the overall efficiency of the heat recovery **system** can be totally different from the measured efficiency of the **heat exchanger**. This issue is indeed also very complicated.

Residential vs. non-residential: The question about possibly non-compatible standards was taken up in Kemna's presentation:

> Heat recovery residential: thermal efficiency (based on temperature differences in/outputs)
>
> Heat recovery non-residential: overall energy efficiency (thermal efficiency minus electricity consumption to overcome the heat exchanger pressure drop)

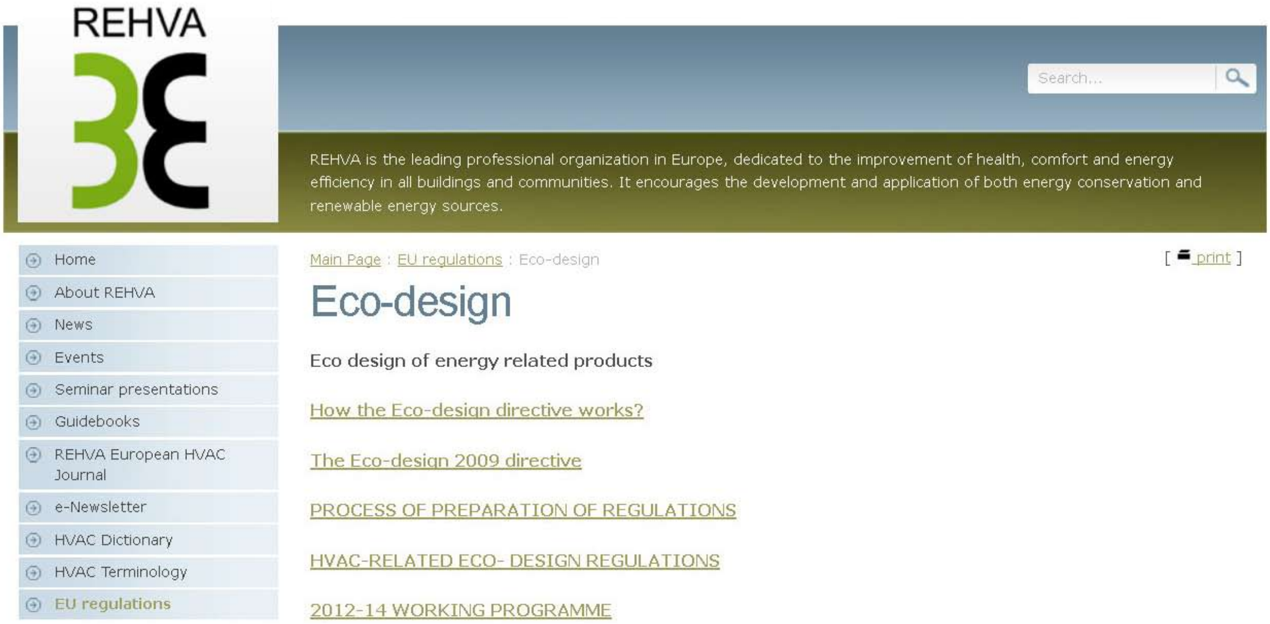
Example 3. Ducts, ductwork components and air handling units - leakage

This kind of system effect is actually taken into account in two of the EPBD standards, EN 15241 and EN 15242. The current standards give a rough but pragmatic approach how to take the leakages into account in energy calculation, plus formulas for a more accurate calculation. In the next revision, hopefully, a reliable but practicable method will be developed to calculate both the heating and/or cooling energy wasted because of the leakages, and the addition to electrical energy consumption of fans due to the same leakage.

The energy waste due to leakages has been estimated in a study done in the ASIEPI project (summarized in REHVA Journal 2/2011 by Schild and Railio), ending up in somewhat surprising figures on European scale. Another study, carried out by Fraunhofer Institute in Germany, ending up in a total figure very close to the finding in ASIEPI. But – one of these figures dealt with the heating and cooling energy wasted in leaky ducts, and the other figure dealt with the wasted electrical energy to fans moving the air that leaks away! So, the total wasted energy is actually the sum of the two figures! Therefore this issue must not be ignored – at least all ducts and air handling units to be installed should be quality-controlled and their tightness classes tested and found appropriate.

Example 4. Filters

To optimize air filtration in a ventilation or air-conditioning system is probably a much more complicated issue than the other products taken up here. Efforts towards a kind of energy rating system of filters are going on at least among Eurovent. The difficulty is, in simple words: "the higher filtration efficiency, the higher pres-



http://www.rehva.eu/en/eco-design

sure drop and the higher energy consumption". The truth is not that simple. The question is: how to decrease energy losses due to filtration without affecting negatively to the main function of the filter i.e. removal of particles and other impurities from the air? In the new REHVA Guidebook 11, also energy questions have been taken up. Certain recommendations for filter selection have been presented in EN 13779 (Annex A), but this also will need revision and possibly new considerations, depending on the final outcome of the still ongoing debate on the vote of the filter standard EN 779.

References

EN 308 Heat exchangers. Test procedures for establishing performance of air to air and flue gases heat recovery devices

EN 779 Air filters for general ventilation.

EN 13053. Ventilation for buildings - Air handling units - Rating and performance for units, components and sections

EN 13779. Ventilation for non-residential buildings - Performance requirements for ventilation and room-conditioning systems

EN 15241, Ventilation for buildings - Calculation methods for energy losses due to ventilation and infiltration in commercial buildings

EN 15242, Ventilation for buildings - Calculation methods for the determination of air flow rates in buildings including infiltration

ISO 5801. Industrial fans - Performance testing using standardized airways

Railio, J. & Airaksinen, M., Heat recovery – yearly efficiency. REHVA Journal 1/2010

Railio, J., Regulations Based on the Eco-design of Energy Related Products Directive, REHVA Journal 2/2011

Schild, P. and Railio, J., Airtight ductwork, the Scandinavian success story. REHVA Journal 2/2011, p. 26-29.

Gustavsson, J. et al, Air filtration in HVAC systems. REHVA Guidebook 11.

Brelih, N and Seppänen, O., How to improve the efficiency of fans in Air handling units. REHVA Journal 2/2012

Kemna, R, Ventilation products regulations based on Ecodesign directive (http://tinyurl.com/8xhhxgz)

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SOLAR XXI: A Portuguese Office Building towards Net Zero-Energy Building

Helder Gonçalves
PhD, Director of the Energy Laboratory,
National Energy and Geology Laboratory, Portugal
email: helder.goncalves@lneg.pt

Laura Aelenei
PhD, Researcher,
National Energy and Geology Laboratory, Portugal
email: laura.aelenei@lneg.pt

Carlos Rodrigues
Researcher,
National Energy and Geology Laboratory, Portugal
email: carlos.rodrigues@lneg.pt

Introduction

Solar Building XXI, built in 2006 [1], at LNEG Campus in Lisbon, pretends to be an example of a low energy building using passive systems both for heating and cooling (ground cooling) towards a Net Zero-Energy Building (NZEB) [2]. The main façade has a PV system with heat recovery which assists the heating in winter

time. In summer a ground cooling system (earth tubes) is used to cool the building, together with night cooling strategies. Net Zero-Energy Buildings Performance has gained more attention since the publication in 2010 of the EPBD recast [3]. Successful implementation of such an ambitious target depends on a great variety of factors. For designers and code writers these include: balancing climate driven-demand for space cooling and heating with climate-driven supply for renewable energy resources. With a literature full of theoretical advice and a building industry rife with myths about the value of technologies, the present paper intends to unveil a sustainable framework for sharing insights into NZEB methodology applied to a Portuguese solar office building, SOLAR XXI, currently underway to reach the Net Zero-Energy Goal. Under the common work which is developed also in SHC Task 40-ECBCS Annex 52, "Towards Net Zero Solar Energy Buildings" [4], the authors of this paper are currently engaged in studying possible strategies for "upgrading" Solar XXI to NZEB status.

Table 1. SOLAR XXI Building - general data.

General characteristics	
Location	Lisbon Latitude 38°46'20.27" north Longitude 9°10'39.83" west
Owner	National Energy and Geology Laboratory (LNEG)
Project co-ordinator	Helder Gonçalves helder.goncalves@lneg.pt
Architect	Pedro Cabrita, Isabel Diniz
Building costs (tax included	800 €/m^2
Typology	Office building
Climate data	Temperate Heating period 5.3 month Heating Degree Days 1190°C (Tb 20°C)
Main stimulation of the project	Test, experimental, research
Site context	Urban
Building construction	High
Number of occupants	20 pc
Number of stories	3 pc
Number of buildings	1pc
Heated net floor area	1200 m^2
Gross floor area	1500 m^2
Total envelope area	1436 m^2
Envelope to volume ratio	0.4 m^{-1}

SOLAR XXI Building

Solar XXI building was built in Lisbon in 2006 as a demonstration project [1], [2]. The building is considered a very high efficient building, from the national regulation point of view, with a difference in energy performance 1/10 regarding a standard Portuguese office building. From the NZEB goal perspective, the building, which design is based on a combination of passive design techniques with renewable energy technologies (PV, solar collectors) may be currently considered, a nearly Zero Energy Building. Some of general building characteristics are summarized in **Table 1**.

NZEB concept

Net Zero Energy Building (NZEB) concept may be defined as a building that over a year is neutral (i.e., it delivers as much energy to the supply grids as it uses from the grids) when energy efficiency measures are successfully combined with energy renewable sources. According to this, the net zero-energy performance may be achieved as a result of executing two fundamental steps: first reduce building energy demand, and second, generate electricity or other energy carriers, to get enough credits to achieve the desired energy balance. In the first step passive approaches play a fundamental role in addressing NZEB design, as they affect directly the loads put on the buildings mechanical and electrical systems, and indirectly the strive for renewable energy generation.

Energy efficiency comes first

Thermal optimization of the building envelope

One of the strategies adopted in the design of SOLAR XXI building in order to reduce the thermal loads and provide a good thermal comfort conditions consisted in optimization of building envelope. The characterization of the elements of the building envelope is summarized in **Table 2**. All the building has an external insulation and so the thermal bridges influence was reduced significantly while the building thermal inertia was preserved.

Use of the solar gains

The Solar XXI building main façade (South oriented) is covered by windows and PV modules by equivalent proportions. This large glazing area (about 46% of the south façade and 12% of building conditioned floor area) interact directly with the office rooms permanently occupied, collecting direct solar energy, providing heat and natural light to these spaces. Increasing the solar heat gains in winter time consisted one of the dominant

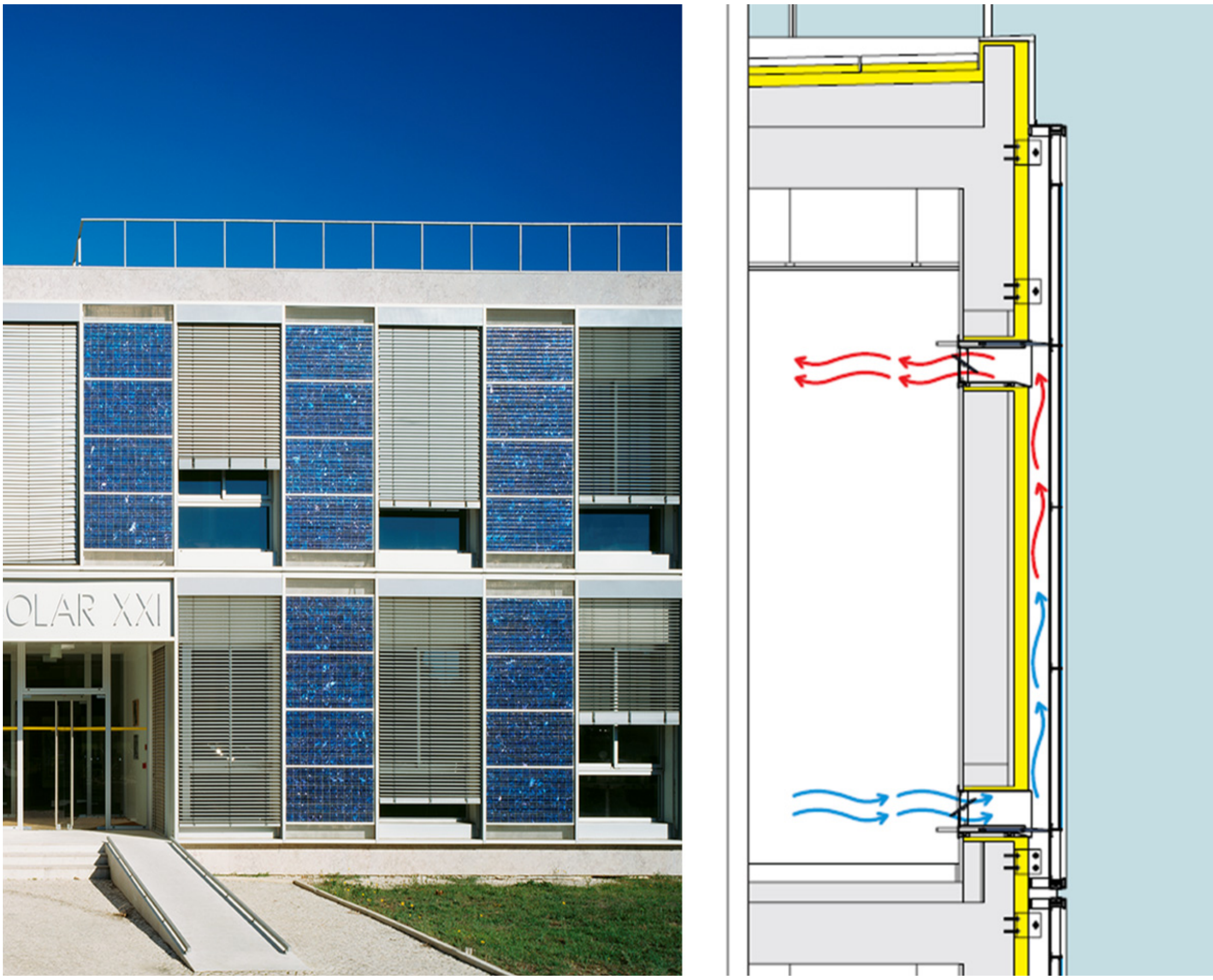

Figure 1. BIPV-T and Windows shading. BIPV-T scheme.

strategies in the building design, by adopting essential features such as location, size and orientation (south) of the main glazing area.

Thermal Building Integrated Photovoltaic (BIPV-T)

In addition to the use of direct solar gains through the windows, the BIPV-T system integrating south building façade is also contributing for the improvement of the indoor climate during heating season in the day time hours, when the heat released in the process of converting solar radiation into power is successfully recovered (**Figure 1**). As a heating strategy, in winter time during the days with high solar radiation, the temperature of the air heated by BIPV-T and insufflated into the offices can rich 30°C [2].

Windows shading

Solar XXI building uses a set of efficient measures and strategies which contribute for diminishing the building cooling loads. The building has no active cooling system and a number of design measures are incorporated to reduce the summertime heat load. Venetian blinds adjustable by the users were placed outside the glazing to limit direct solar gains. When applied externally, become a very important measure for summer period, since they minimize the direct solar incidence.

Table 2. SOLAR XXI Building - Envelope technical data.

Building elements	Material	U value (W/m^{2}K)
External walls	Brick wall + ETICS (6 cm)	0.45
Roof	Concrete with external insulation (10 cm)	0.26
Thermal bridges	Concrete with external insulation (6 cm)	0.55
Windows	Transparent double glazing	3.50
Envelope (average)		**0.88**

Ground Cooling System

A ground cooling system provides incoming pre-cooled air into the building using the earth as a cooling source. The system consists of 32 tubes with 30 cm diameter, buried at 4.5 m depth (**Figure 2**). The ground temperature varies from 13 to 19°C throughout the year, so it represents an excellent cooling source during summer season. The air enters into the tubes array 15 m away from the building, cross the tubes circuit cooling to a temperature near the ground and is injected into the building office rooms by natural convection or forced convection using small fans. The system operates with great efficiency in the hot summer days, when the indoor temperature is significantly higher, by pushing the fresh air from the buried pipes. The air temperature injected inside the office rooms ranges between 22–23°C, resulting in a decrease of the indoor air temperature between 2 and 3°C.

Natural ventilation/Natural lightning

The natural ventilation plays an important role in Solar XXI building in both seasons. Natural ventilation is provided due to cross wind and stack effect via openings in the façade and roof level. The façade openings together with adjustable vents on all office room doors provide the cross ventilation, allowing the air to flow from inside to outside and vice versa. In the building central hall there is a skylight, which allows for natural ventilation by stack effect (**Figure 3**). The set of ventilation strategies (day and night) provide a high comfort level in the summer, especially when applicable during night period minimizing the thermal loads accumulated during daytime within the building and its temperature. The location and dimension of central skylight as a main light distributor in the central hall is fundamental, as also the translucent vents in the doors which communicate from south and north spaces to corridor and the glazing areas

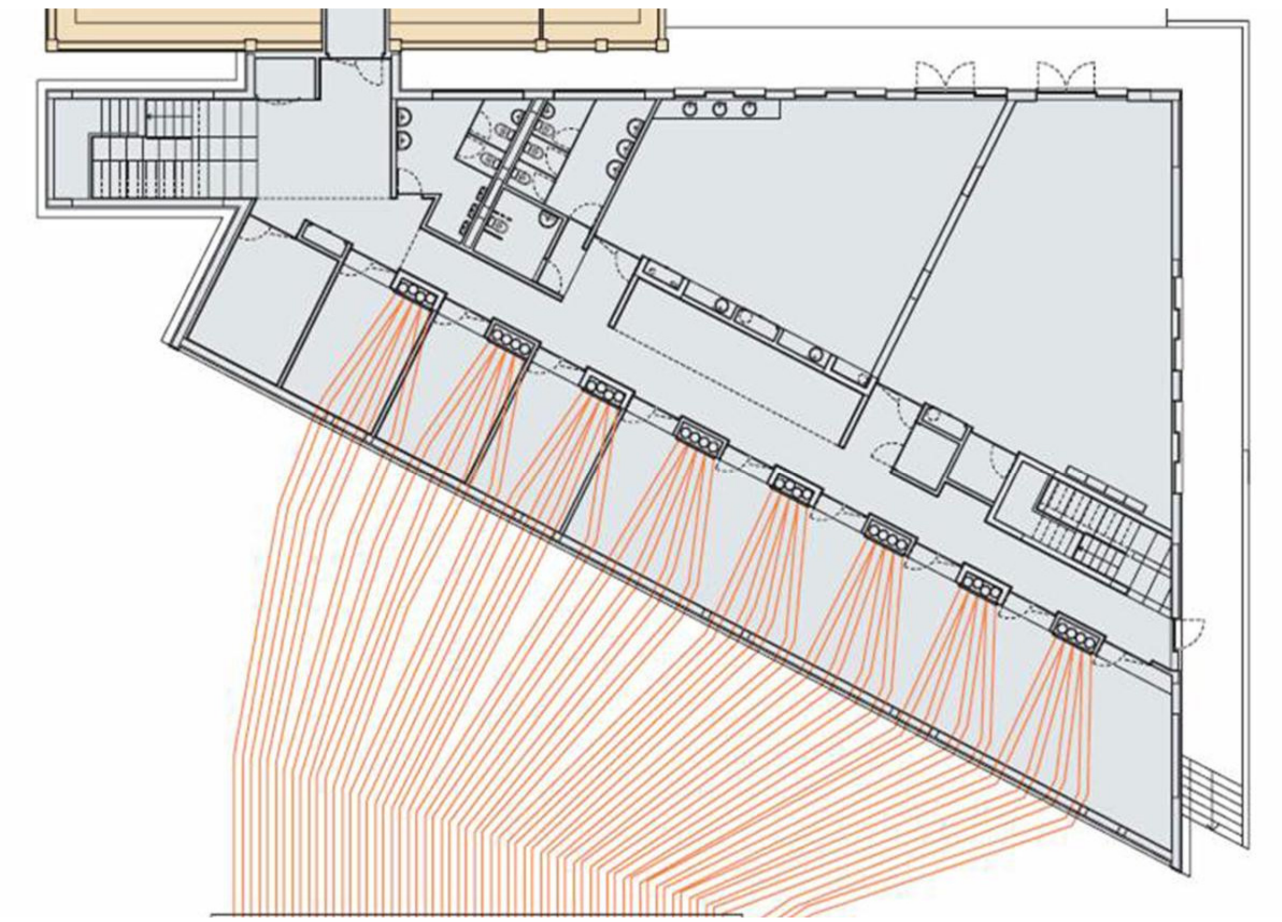

Figure 2. Ground cooling system scheme.

Figure 3. Natural ventilation/Natural lighting.

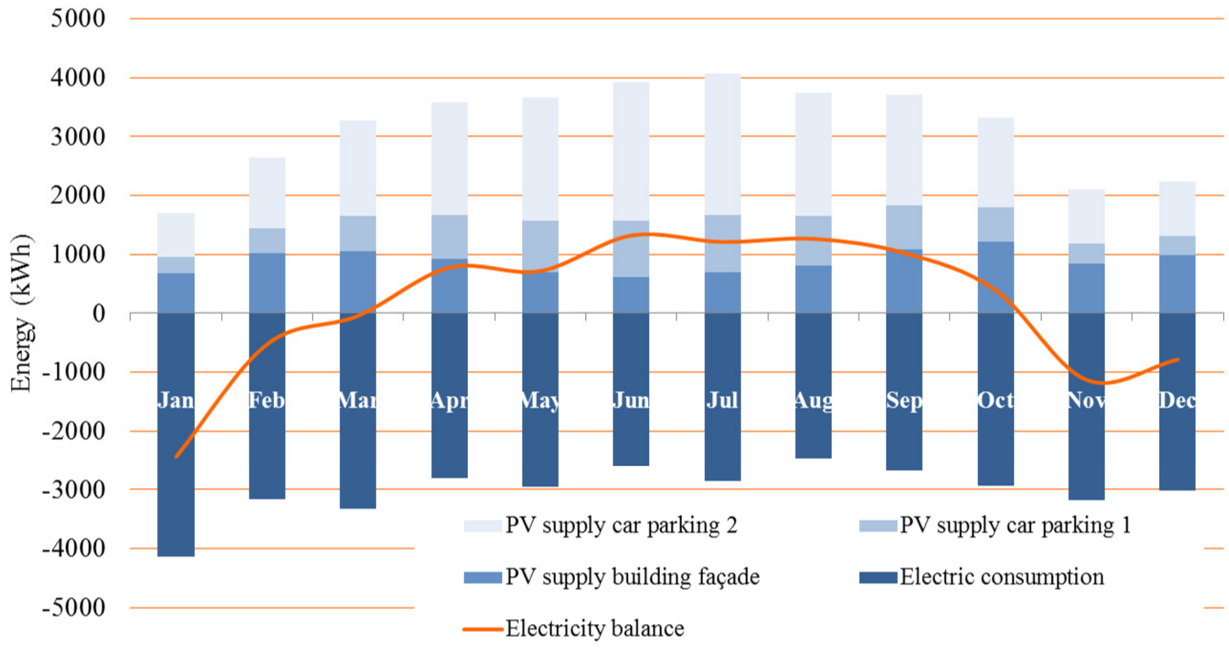

Figure 4. Solar XXI - monthly electric energy consumption/PV (façade + parking) energy supply.

distributed all over the building envelope. These important features adopted in the building design led to a reduction of the electric light building consumption.

Energy supply

The integration of renewable energy systems in the Solar XXI design was one of the main objectives of the project. The SOLAR XXI building Renewable Systems are summarized in **Table 3**. The last monitoring analysis performed in 2011 has shown a total amount of electric energy consumption of 36 MWh, versus an amount of electricity produced by the three PV systems of the almost 38 MWh. The monthly distribution of the electric energy consumed by Solar XXI versus the energy supplied by the PV system (façade + parking) for the 2011 is presented in **Figure 4**.

SOLAR XXI - The path towards NZEB performance

As it has been described above, the Solar XXI integrates efficient solution sets and strategies, from the features reducing building energy demands, to integration of the renewable energies. **Figure 5** shows the Solar XXI performance from an energy balance approach perspective versus the critical steps towards NZEB performance. If designed as a standard office building in accordance with the current Portuguese

Table 3. SOLAR XXI Building - Renewable Energy Systems data.

RES	Integration	Area (m^2)	Installed Peak power (kW)	Productivity (kWh/kW)
76 PV multicristalline silicon modules	Building façade	96	12	1 004
100 PV amorphous silicon	Car parking 1	95	6	1 401
150 PV CIS thin-film modules	Car parking 2	110	12	1 401
CPC Thermal Solar Collectors	Building roof	16	11 MWh, from which 5 MWh being used	

Building Code, Solar XXI would consume approximately 101 kWh/m².y including typical user related loads (**a**). If one would have performed improvements at level of the building envelope (and still continue with typical user related loads), the building would have consumed 90 kWh/m².y (**b**). On the basis of the improved building envelope and the outlined passive techniques and strategies, Solar XXI building annual energy consumption is 43 kWh/m².y (**c**). This consumption is offset with a credit of 35.85 kWh/m².y energy generated by the photovoltaic and solar thermal collectors (**d**), thus, the final balance of the building points out a near zero-energy performance.

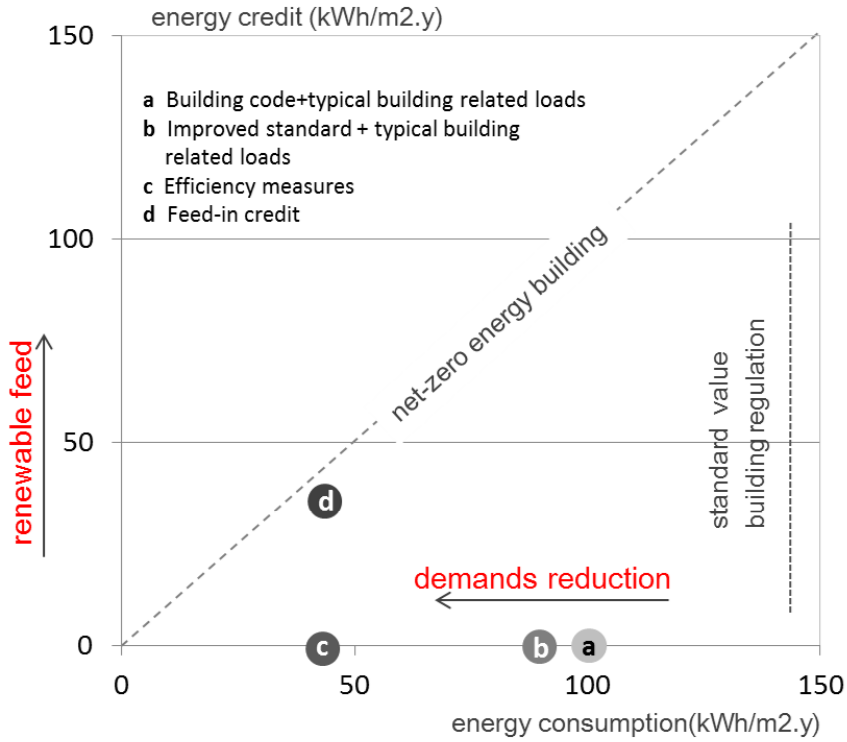

Figure 5. SOLAR XXI - the path to net zero-energy performance.

Conclusion

With this paper the authors were able to share the main findings of the research carried in the design process of an office building currently underway to reach NZEB performance. Along the lines of the paper it has been shown the road traversed by Solar XXI on its way towards reaching zero-energy performance objective. It is believed that the set of solutions adopted the building envelope, the daylighting performance characteristics, the natural ventilation strategies, the passive heating and cooling techniques, together with the integrated renewable energy systems, qualifies the Solar XXI building for exemplary energy performance. Solar XXI building energy performance is about ten times the energy performance of a standard new office building in Portugal [5]. Looking at the energy balance of the building from a NZEB perspective, it was shown that the wise combination of standard and innovative energy performance measures with renewable systems is able to achieve the zero-energy performance without significant efforts. The authors of this work are hoping that the lessons learned during design, construction and operation of the building will provide useful clues to all interested in developing outstanding energy projects in Southern European countries and other countries. At the same time it is also important that this work help policy makers and stakeholders identify (and counteract) the barriers against broader implementation of NZEB´s.

References

[1] Helder Gonçalves, Pedro Cabrito (2006) A Passive Solar Office Building in Portugal, PLEA 2006.

[2] H. Gonçalves et al, (2010). Solar XXI-Em direcção à energia zero / Towards zero energy, @LNEG 2010, Lisbon, (IBSN:978-989-675-007-7).

[3] The Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings, Official Journal of the European Union, 53, 2010.

[4] The IEA SHC Task 40 / ECBCS Annex 52 'Towards Net Zero Energy Solar Buildings (NZEBs); http://www.iea-hc.org/task40/index.html

[5] L. Aelenei et al, (2010). The Road Towards "Zero Energy" in Buildings: Lessons Learned from SOLARXXI Building in Portugal, Proceedings of EuroSun 2010, Gratz, Austria.

Energy Efficient and Sustainable – Federal Buildings in Germany

Olaf Böttcher
Dr.-Ing. Commissioner for Energy in Federal Buildings
Federal Institute for Research on Building, Urban Affairs and Spatial Development within the Federal Office for Building and Regional Planning; Head of Department "Energy-Optimized Building"
olaf.boettcher@bbr.bund.de

Dr.-Ing. Olaf Böttcher
Born 1970, studied Energy Engineering at the TU Berlin. After graduating in 1998, he worked as a Research Associate at the TU Berlin (Hermann-Rietschel-Institute for Heating, Ventilation and Air Conditioning, PhD there in 2003). Since 2006 at the Institute for Rehabilitation and Modernization of Buildings (IEMB). Since 2009 Head of Division "Energyoptimized Building" at the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) within the Federal Office for Building and Regional Planning (BBR). Since November 2008 Federal Energy Commissioner by order of the Federal Ministry of Transport, Building and Urban Development (BMVBS).

Introduction

After the German reunification in 1990 the German Government has decided to move from Bonn (former capital city) to Berlin. In association with that move lots of Federal Buildings in Berlin had to be refurbished for that purpose or were newly erected. It was a main objective of the German Government that the Federal Buildings have a very high sustainable and energetic standard in general. For that reason, already in 1991 it was decided by the Federal Government to establish a Commissioner for Energy in Federal Buildings. First the focus of the work was on the Federal Buildings in Berlin, but meanwhile it is widened to all Federal Buildings. The main tasks for that person are:

- Minimization of the energy demand/ consumption in Federal Buildings
- Optimization of the energy supply concepts in Federal Buildings
- Monitoring of assorted Federal Buildings in the first years of operation
- Certification of the Energy demand of assorted Federal Buildings regarding to the German Energy Saving Ordinance
- Consulting the Federal Ministry for Transport, Building and Urban Development in questions of energy efficiency in buildings, and technical components and systems

In addition to the work of the Commissioner for Energy and to support a consistent high standard in Federal Buildings, a "Guideline for Sustainable Building"

Figure 1. 20 Years Commissioner for Energy in Federal Buildings – Examples of a successful work.

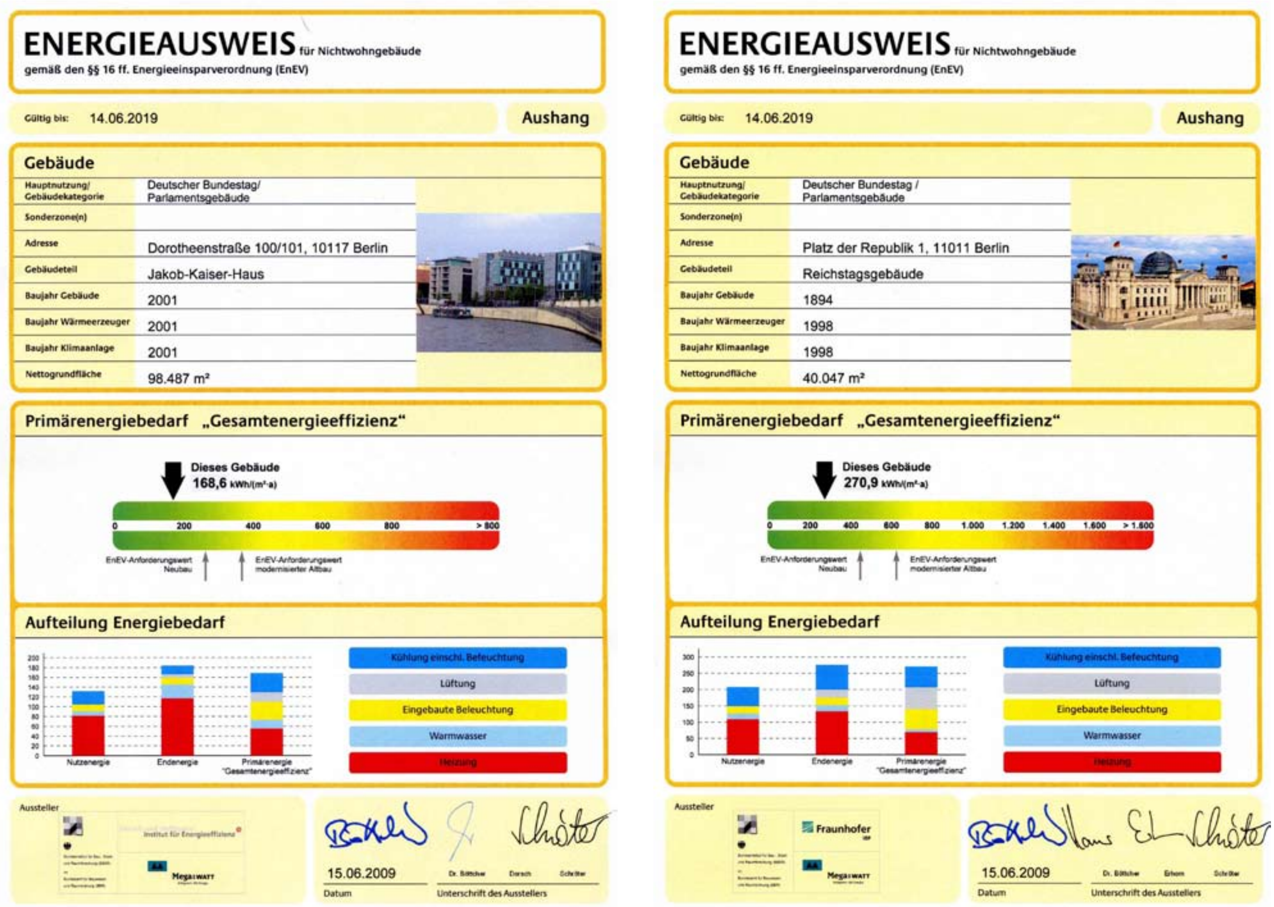

Figure 2. Energy Certificates of the Jakob-Kaiser-Haus (left) and the Reichstag Building (right). (source: BBSR)

was published by the Federal Ministry for Transport, Building and Urban Development in 2001. This guideline has to be taken into account in the planning process of all Federal Buildings. Meanwhile it became a standard planning tool in other public or private building projects too. A revision of that guideline for new buildings was done, which was inaugurated by an edict in 2011 and completed by the Assessment System for Sustainable Building. The revision of the guideline for existing buildings and for the operating of buildings, including the particular assessment systems, is still in process. It is foreseen to finish the work in 2012.

After 20 years of implementation the position of a Commissioner for Energy in Federal Buildings, it is time to look on the achieved results. For that the energetic quality of governmental buildings in Berlin was analyzed and is shown below. Further more it is reported about a former Lighthouse-project which is still in operation and an actual Lighthouse-Project, which is still in erection-phase.

Results

By order of the Federal Ministry for Transport, Building and Urban Development, the Commissioner for Energy in Federal Buildings has certified 39 assorted Buildings of the German Government in Berlin. As examples, the results for the Jakob-Kaiser-Haus (new erected) and the Reichstag Building (energetically refurbished) are shown in **Figure 2**.

The certificates are documenting the high energetic quality of both buildings. The calculated specific Primary Energy Demand (arrow above the multicoloured bar) of the buildings in both cases is significant below the reference values from the Energy Saving Ordinance 2007 (arrows beneath the multicoloured bar). For the comparison between the results for the “real” building and the requirements of the Energy Saving Ordinance, each certificate contains two reference values - the reference value for new erected buildings and the reference value for energetically refurbished buildings. The latter reference value is 40 percent higher than the reference value for a new erected building.

The results shown in **Figure 2** are typical for all of the 39 certified Federal Buildings. All observed buildings were found to have a higher energetic standard than required by the German Energy Saving Ordinance 2007. This is especially mentionable because the buildings were planned regarding to the energetic specifications and requirements of the German Thermal Insulation Ordinance of 1995. Often already the harder energetic requirements of the EnEV 2009 (came into effect at 1st October 2009 and is still actual) were adhered.

Regarding to the requirements of the Energy Saving Ordinance 2007, the span of undercutting the reference values is from 20 to 60 percent for the specific annual Primary Energy Demand Q_P respectively up to 75 percent for the specific Heat Flow by transmission H_T'.

As the result of the strategic work in the planning process of the different buildings, a high sustainability and energy efficiency were achieved. The main principles of this strategic work are the reduction of the energy demand of a building to a minimum as the most important task, followed by the implementation of the most efficient and ecological energy supply concept. Some detailed measures are mentioned as follows:

- no cooling in rooms with normal use (for instance offices)
- no domestic hot water supply
- maximization of using daylight
- broad use of renewable energies
- preferable use of combined heat and power generation
- high level of heat protection for winter and summer cases

As example for the realization of the above mentioned measures, the energy supply concept of the Buildings of the German Bundestag and the Office of the Federal Chancellor in the Spreebogen is going to be explained a little bit deeper.

The core of the energy supply concept for the Buildings of the German Bundestag in the Spreebogen is the use of 8 combined heat and power generators with a total electrical power of 3 200 MW in sum. The generators are using bio fuel. All buildings are connected to each other to ensure an optimal distribution of the produced heat and electricity. In addition with PV-systems on the roofs of different buildings (see **Table 1**) and the use of two separated storages (Aquifer) in the ground (60 m depth for cooling purposes, 300 m depth for heating purposes), with this concept up to 60% of the total energy demand of the buildings could be covered by renewable energies. The Office of the Federal Chancellor has a combined heat and power generator too and is also equipped with PV-systems on the roof. A subsurface connection to the Buildings of the German Bundestag is possible in general but in practice not in use.

Table 1. Photovoltaic systems in Federal Buildings in the Spreebogen in Berlin.

	Area in m^2	installed Power in kW_{Peak}	Form
Reichstag	300	39	monocrystalline
Jakob-Kaiser-Haus	420	46	monocrystalline
Paul-Löbe-Haus	3.240	123	amorphous
Office of the Federal Chancellor	1.270	149	monocrystalline

One of the more recent Lighthouse-projects for energy efficiency and sustainability in Federal Buildings is the new Main Building of the Federal Agency for the Environment (UBA) which was erected in Dessau. This building went in operation in 2005 after ten years of planning and erection. During the planning phase it was implemented a broad monitoring concept. The energetic monitoring of the building was intensively accompanied by the Commissioner for Energy in Federal Buildings in the first years of operation. The energy supply concept and an image of the building are shown in **Figure 3**.

The building is mainly heated by district heating. But, there are also some assistance systems to support the heat production. The ventilation system is equipped with high efficient heat recovery systems and a huge ground to air heat exchanger (5 000 m² of heat exchanging surface) is used to pre-heat or pre-cool the outside air. Furthermore solar thermal collectors were installed, which are mainly producing the heat for an adsorption chiller. This chiller is producing about 40% of the required cooling. About 50% of the cooling demand is produced by using free cooling systems (i.e., the use of the recooling plants without a simultaneous use of the chillers) and a compression chiller is in operation for less than 10%. The electricity predominantly comes from

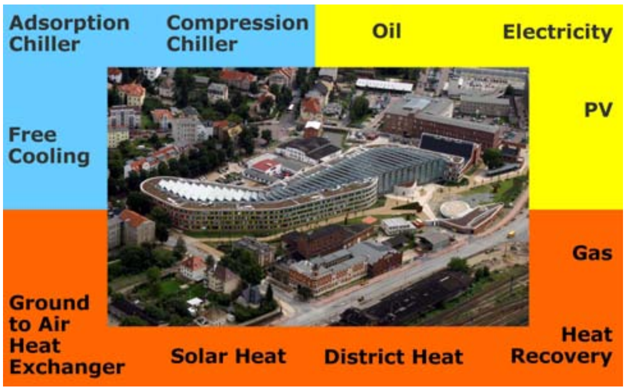

Figure 3. Energy supply concept of the Federal Agency for the Environment in Dessau. (source: BBSR; photography: Busse)

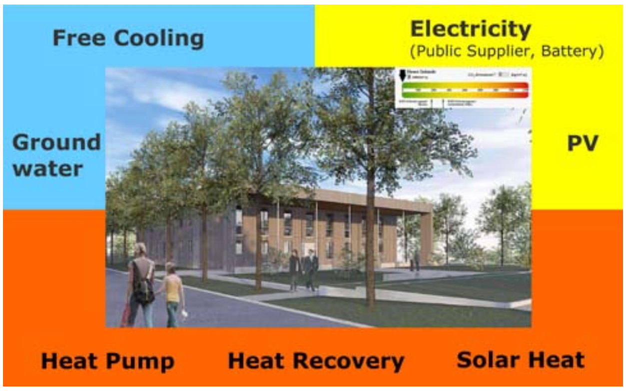

Figure 4. Image and Energy-Supply-Concept of the Net-Zero-Energy-Building of the Federal Agency for the Environment in Berlin (source: BBSR; graphics: Braun-Kerbl-Löffler Architekten + Ingenieure; Christopher Kühn)

the public grid complemented by a PV-system with an installed power of about 32 kWpeak. Gas is exclusively used for the staff-restaurant (a separate building on the site) to cook and to produce heat and domestic hot water.

The monitoring of the operation of the building in the first years was affected by lots of small successes but also failures. It took about 3 years to achieve a stable operating of the building in the boundary parameters that were expected. First, in 2008 there was a primary energy consumption less than 100 kWh/(m²a). But, the efforts of the monitoring process combined with lots of optimizations paid off, because since 2008 there is a permanently undercut of the mentioned energetic benchmark year by year.

One special task of the project was the optimization of the interacting of the ground to air heat exchanger and the heat recovery systems. Each system separately leads to a reduced demand of final energy. But, if both systems are working in line, they are influencing each other. As example, the optimized operation of the ground to air heat exchanger is reducing the potential of the heat recovery systems. However, monitoring allowed the development of an optimized strategy for the operation of both systems. So, the focus was the increase of the energy efficiency of the whole system and not only its single parts individually.

In a present Lighthouse-project, we are planning a Net-Zero-Energy-Building for Federal purposes. "Net-Zero" means that the annual energy demand of the building is totally covered by using renewable energies in an annual balance. To fulfil the plan of a Net-Zero-Energy-Building, consequently we decided to take into account in our energy balance not only the building related energy demand (Heating, Lighting, Cooling, Ventilation, and Domestic Hot Water) but also the user related energy demand (PC's, coffee machines, etc.).

The building will be an office. An image of that building and the energy supply concept is shown in **Figure 4**. The building is heated using an electrically powered water/water heat pump which is also mainly providing the heat for the required domestic hot water. Furthermore, a solar thermal collector is installed on the roof to assist the heat pump. As environmental source for the heat pump, ground water is used. The energy demand for heating is reduced by using a high efficient heat recovery system in the ventilation system. For cooling purposes it is foreseen to use ground water too. To reduce the energy demand for cooling, it is also possible to open the triple-glazed windows.

Realizing a building with highest energy requirements means a compact building form that has a relationship as ideal as possible between the external surfaces and the volume. At the same time, sufficient surfaces for solar energy use are also required. In the present case, the compact rectangular structure has got a large roof. On the one hand the roof is ensuring the required area for the solar systems and on the other hand it is optimizing the shading on the south side. The order of the functions and uses in the two floors has been optimized from an energetic perspective too. To protect the offices from overheating and at the same time to optimize the daylight use, they are orientated to west, east and north, while the meeting rooms in the upper floor and the showering areas, including the changing areas, are situated to the south. Auxiliary rooms are located in the building's core.

The façade consisting of prefabricated wooden panels. The U-values for the opaque parts of the building envelope are in the range of 0.10 W/(m²K). The windows with integrated sun protection can be opened and have an U-value of 0.80 W/(m²K) in total. The planned structure enables a high degree of air tightness and as few thermal bridges as possible.

Calculations indicate a total annual electricity demand of 48 000 kWh/a to run the building. The PV-System on the roof of the building was designed on the basis of that result. The 380 modules of the chosen PV system have a performance of about 58 kWpeak. With that system configuration, an annual power generation of about 50 000 kWh/a is forecasted. The generated power is directly used, stored in a small battery system or fed into the grid of the site.

In addition to energy efficiency and a broad use of renewable energies, the ecological focus of the planning measures lies in the resource-friendly use of building materials, a gentle approach to the surface area used and low local and global environmental effects. As result of the efforts in the planning phase, the global warming potential resulting from construction and operating the building is extremely low compared to a conventional building.

The operating of the building in an annual balance is climate neutral. Therefore it will be the first Federal Building which fulfils already the actual CO_2 saving policy of the Federal Government regarding to Federal Buildings. In 2010, as part of the Sustainability Strategy of the Federal Government, it was felt the decision to develop the Federal Building stock into a climate neutral one. That means that all new Federal Buildings from 2012 will be erected in a "Nearly Zero Energy Standard" and the stock of existing buildings will be energetic refurbished in a way that reduces the energy demand for room heating by 20% until 2020 and the primary energy demand by 80% until 2050. At present, the work on an energetic refurbishment roadmap with a view of achieving the political objectives and the definition of the above mentioned energetic standard for federal Buildings is in progress. 3E

Implementation of the cost-optimal methodology according to the EPBD recast

The EPBD recast states that Member States (MS) must ensure that minimum energy performance requirements for buildings are set "with a view to achieving cost-optimal levels". The cost-optimal level must be calculated in accordance with a comparative methodology.

Kim B. Wittchen
Senior Researcher
Danish Building Research Institute, SBi
Aalborg University, Denmark
kbw@sbi.dk

Kirsten Engelund Thomsen
Senior Researcher
Danish Building Research Institute, SBi
Aalborg University, Denmark
ket@sbi.dk

The Commission has established a comparative methodology framework for calculating cost-optimal levels of minimum energyperformance requirements for buildings and building elements. A proposal for the framework was adopted by the European Commission on ***16 January 2012***. This framework has to be accepted by the European Parliament and the Council as both have the right to oppose within 2 (+2) months.

The Council voted by ***1 March 2012*** and there were no objections, so it seems that the methodology will soon be approved and will come into force after being published in the official Journal.

There is a legal document - the Regulation, based on a CEN package of standards, which is accompanied by Guidelines outlining how to apply the framework for calculating the cost-optimal performance level.

The comparative methodology framework requires MS:

- To define reference buildings that are characterised by and representative of their functionality and climate conditions. The reference buildings must cover residential and non-residential buildings, both new and existing ones;
- To define energy efficiency measures that are assessed for the reference buildings. These may be measures for buildings as a whole, for building elements, or for a combination of building elements;
- To assess the final and primary energy need of the reference buildings as well as the reference buildings with their defined energy efficiency measures applied, and
- To calculate the costs (i.e. the net present value) of the energy efficiency measures during the expected economic life cycle applied to the reference buildings, taking into account investment costs, maintenance and operating costs, as well as earnings from energy produced.

MS are requested to report to the Commission all input data and assumptions used for these calculations and the results of the calculations for two perspectives: societal level or the level of the private investor. MS can then choose which one to apply at the national or regional level. MS need to submit their reports to the Commission at regular intervals of maximum five years, with the first report due by ***June 2012*** according to the Recast. ***This date will be extended*** until one year after the date of publication of the regulation in the official Journal, i.e.

till March 2013, because, according to the Directive, the framework should have been ready in June 2011.

The main purpose of the framework is to detect gaps between the cost-optimal level and the national energy performance requirements in force. It is not the purpose to harmonise requirements and not the purpose to compare across MS.

If the result of the benchmarking performed shows that the minimum energy performance requirements in force are significantly less energy efficient than cost-optimal levels of minimum energy performance requirements (i.e. exceeding 15%), the MS need to explain this difference. In case the gap cannot be justified, a plan needs to be developed by the respective MS, outlining appropriate steps to reduce the gap significantly by the next review of the energy performance requirements.

The new procedures under the Lisbon treaty require the Commission to consult with MS experts and other stakeholders, but the Commission has the sole responsibility of taking the final decision on the delegated act. The Council ofthe European Parliament cannot amend the text, but only accept or reject it in its entirety. The Commission held two expert meetings on a cost-optimal methodology framework on 16 March and 6 May 2011 respectively.

The purpose of the meetings, which was attended by participants from MS and other stakeholders, was twofold: Firstly to obtain experts' input on key scope and methodology issues and secondly to get a better understanding of current cost effectiveness methodologies applied in the MS. A questionnaire with 23 questions was sent to the experts ahead of the first meeting, covering the topics:

- The need for consistency between the nearly zero energy target and the cost-optimal requirements;
- The degree of detail needed for the reference buildings as well as other input data;
- The perspective for cost optimality (societal level or the level of the private investor);
- Cost optimality at the building element level;
- The need to include lighting systems for the non-residential sector;
- Energy price development trends and their best data sources;
- The need to address demolition as part of the methodology.

At the second meeting the Joint Research Centre of the Commission presented the draft reporting template, which addresses the following main elements:

- Reference buildings (e.g. key characteristics, how they are defined, new vs. existing, technical details);
- Type of energy efficiency measures;
- Calculation of energy demand (e.g. for heating, cooling, etc., per energy carrier, etc.);
- Global cost calculation (e.g. sensitivity analysis, etc.)
- Cost-optimal level for reference buildings;
- Comparison.

A representative from the Concerted Action EPBD reported that four main issues for discussion were needed:

- The private vs. societal perspective;
- Cost optimality being a range/curve and not a single point;
- Reference buildings are difficult to identify, primarily for 3 existing buildings;
- The suggestion that costs and prices should be identified/set by MS.

Furthermore, the Concerted Action EPBD proposed that the approach should be not to go into too much detail at this point in time; the Concerted Action can be used to gain knowledge and evaluate the methodology; to perform sensitivity studies to determine dominant parameters in cost-optimal analysis; and adapt and adjust the approach based on knowledge gained.

A report from the Concerted Action EPBD "Cost-optimal levels for energy performance requirements" is available on: http://www.epbd-ca.eu or http://www.buildup.eu/publications/22209. 3E

Ecodesign of energy related project
– progress with Boilers and water heaters

After a long delay, the draft regulations for boilers (Lot 1) and water heaters (Lot 2) have proceeded, and the relevant documents for eco-design, labelling and testing and calculation of boilers and water heaters are in interservice consultation, and have been submitted to Member States for review in February 2012, and voting in Regulatory Committee is expected in autumn 2012. The following information is taken from the draft regulation texts, with just a few explanatory notes added.

Boilers

The scope of Boiler Regulation will include boiler space heaters, cogeneration space heaters and heat pump space heaters providing heat to water-based central heating systems for space heating purposes, and boiler combination heaters and heat pump combination heaters providing heat to water-based central heating systems for space heating purposes and additionally providing heat to deliver hot drinking and sanitary water. These heaters are designed for using gaseous or liquid fuels, including from biomass to some extent, electricity and ambient or waste heat.

The boiler regulation concerns a wide range of products, and for different products and product characteristics (seasonal space heating efficiency, water heating energy efficiency, sound power level and emissions of nitrogen oxides), the entry into force of requirements is different, starting from two years from entry into force of the Regulation, as given in Annex II of the draft regulation.

At the same time, the Commission has submitted a draft regulation establishing requirements for energy labelling of, and the provision of supplementary product information for heaters with a rated heat output ≤ 400 kW, packages of space heater ≤ 400 kW, temperature control and solar-only system ≤ 400 kW and packages of combination heater ≤ 400 kW, temperature control, solar-only system ≤ 400 kW and passive flue heat recovery devices.

Water heaters

Water heaters Regulation should be limited to water heaters which are dedicated to providing drinking and sanitary hot water. Products providing heat both for space and water heating purposes should be covered by a separate Regulation.

From one year after this Regulation has entered into force the energy efficiency of water heaters shall not fall below the minimum values given in Annex I of the regulation. More stringent requirements shall enter into force two years after the first date.

Also for water heaters, a draft regulation for energy labelling has been submitted - The products to be covered are conventional water heaters, heat pump water heaters and solar water heaters with a rated heat output ≤ 400 kW, hot water storage tanks with a storage volume ≤ 2 000 litres and packages of water heater and solar-only system.

Huge savings potential with improved efficiency of boilers and water heaters

The cost effective savings potential from Boilers and Water Heaters is very large. The products account for almost a quarter of EU CO_2 emissions. The studies show that at the LLCC level the savings potential is around 30%, or around 6% of total EU CO_2 emissions (current LLCC level v. average currently sold). The proposed regualtions will lead to an overall reduction in CO_2 emissions of about 190 Million tonnes in 2020 (120 Mt boilers, 70 Mt water heaters) and over 280 Million tonnes in 2025 (180 Mt boilers, 100 Mt water heaters). They represent an estimated overall annual saving to the public (after higher investment costs) of around 60 Billion € in 2020 rising to 150 Billion € in 2025 (over 1% of GDP).

The overall effect on the manufacturers and installers of boilers and water heaters should be positive. The estimated total revenue for the purchase and installation of boilers and water heaters doubles by 2015 (compared to BAU) and by 2020 is around € 95Billion as against €45 Billion under BAU.

The major market transformation is needed to achieve these savings will not be easy to achieve in practice, this may cause a number of problems. However, there has not been any major disagreement that the savings suggested are technically feasible, and cost effective.

The analysis shows that it is not enough that the burner/heat exchanger assembly is efficient at steady state, but that it should be part of a well designed system comprising heat generator, pumps, controls, and perhaps heat pumps or solar etc. that are optimized to work efficiently in response to the varying demands (and operating conditions) placed on it. The model presented in annex gives a robust estimate of how well any particular combination can be expected to do this. Some of crucial elements appear to be:

1. Smart controls to ensure that the individual rooms are heated only as much as required.
2. Hydraulic balancing (and controls) to minimize the water return temperatures.
3. Appropriate contribution of renewables (solar, heat pumps etc.)

The proposal for Ecodesign regulation for water pumps has been approved by the European Council on 10 Feb.

More information at:
http://ec.europa.eu/energy/efficiency/studies/ecodesign_en.htm

Jorma Railio

 EU policy EU policy EU policy

Industry, Research and Energy committee of the European Parliament backs binding national targets and CO_2 set aside plan

EU countries would have to set themselves binding national energy efficiency targets, and save energy by specific means such as renovating public buildings, under a draft EU directive approved by the Energy Committee on Tuesday February 28. This directive would not only save energy, but also reduce CO_2 emissions, and hence demand for emission allowances under the EU's emissions trading scheme, notes the committee.

Energy efficiency can become a driver of the EU economy by reducing dependence on imports, creating jobs, freeing up financial resources, boosting competitiveness, and reducing greenhouse gas emissions.

The EU has set itself the task of achieving 20% primary energy savings in 2020 (currently a non-binding target), but the Commission estimates that if no measures are taken, the EU will only achieve half of that by 2020.

"This vote is a major sign that Parliament, with a majority including most political parties, takes rising energy costs and energy poverty seriously. Energy efficiency offers possibilities for job creation - notably in the building sector. Now governments have a choice: protect citizens against energy poverty and create many job opportunities or allow big energy companies to make ever-increasing profits" said reporter Claude Turmes (Greens/EFA, LU).

Binding targets

Parliament called for a binding target in a resolution passed in December 2010. Energy Committee MEPs call now for binding national targets - not included in Commission's initial proposal - to be based on specific reference values for each EU country. Achieving these targets will contribute to the overall EU target of 20% energy savings. By June 2013, the Commission will need to check whether Member States are on track to achieve these targets, and by June 2014 it should come forward with a proposal for energy savings targets for 2030, says the text.

ETS set-aside

The text calls on the Commission to report, no later than the date of the entry into force of this directive, on the impact of incentives to invest in low-carbon technologies and the risk of carbon leakage. MEPs also ask the Commission to consider whether to take measures, before the start of the third phase of the EU's emissions trading scheme (ETS), "which may include withholding of the necessary amount of allowances".

Renovating public buildings

Buildings account for 40% of the EU's energy consumption and 36% of its CO_2 emissions. Under the proposed new measures, Member States would need to start renovating 2.5% of the total floor area of public buildings with a total useable area of more than 250 m² by January 2014, or find alternative ways to achieve equivalent energy savings, such as giving priority to "deep" (i.e. thorough) renovation projects. Energy companies would have to achieve "cumulative annual end-use energy savings equal to at least 1.5% of their energy sales, by volume, averaged over the most recent three-year period", by helping their final customers to make savings. EU Member States could stipulate that this help must go, as a matter of priority, to households suffering energy poverty. Member States could also find alternative ways to achieve the same energy savings.

Public procurement

Public bodies that purchase or rent products, services, systems and buildings would need to set energy performance requirements as technical specifications, taking into account cost effectiveness based on a whole life-cycle analysis and thus making sure that that they buy or rent products with a high energy efficiency performance.

Energy audits

From July 2014, all large enterprises would be required to undergo an energy audit every 4 years, to be carried out by qualified and accredited experts.

Fair bills

EU countries would need to establish a single point of contact to provide advice on energy services and direct consumers to accredited providers for energy services and goods, whilst minimum requirements for billing would need to apply to all Member States. Electricity and gas bills should be based on actual consumption and issued on a monthly basis or every two months in the case of natural gas, says the text.

Promoting efficiency in heating and cooling

Member States would need to put in place "national heating and cooling roadmaps" by January 2015 for developing high-efficiency cogeneration and efficient district heating and cooling networks. These roadmaps should be based on detailed cost-benefit analyses of specific climate conditions, economic feasibility and technical suitability for each region.

Financing facilities

Another idea mooted by MEPs is to establish financing facilities for energy efficiency measures. These facilities would be funded by revenue from fines imposed for failure to comply with the directive and money from cohesion, structural and rural development funds. The report was approved in committee with 51 votes in favour, 6 against and 3 abstentions.

Next steps

The Energy Committee decided (31 votes in favour, 22 against and 5 abstentions) to give the rapporteur a mandate to proceed with the negotiations with the Council. The plenary vote will take place only after the end of these negotiations. According to the earlier published time schedule the final voting will take place in the committee May 8th and in the Parliament later in the summer.

REHVA has created a new community on BUILD UP

REHVA created a new community in Build Up:
Reference Buildings for Energy Performance and Cost-Optimal Analysis.

This community shares information on "reference buildings" in European countries, at national and European levels. "Reference buildings" can be used as "the most representative building" for a country or a European region in order to perform energy performance simulations or models. What are the reference buildings developed by the Member States to meet the requirements of the EPBD Directive? Which reference buildings can we have in Europe to perform simulations?

The community on the **BUILD UP platform** (http://www.buildup.eu/communities/refbuild) – The European Portal for energy efficiency – was created in order to get a wide network on the topic. We invite you to register on the BUILD UP portal (if not yet registered) and join the community.

REHVA Annual Meeting and Conference

REHVA's next Annual Conference and Meeting will be hosted by the REHVA Romanian member AIIR/AGFR in Timisoara from April 17 – 20, 2012.

The 2012 REHVA Annual Conference will focus on HVAC Technology in Energy Retrofitting. The range of topics includes:

- EU policy and regulations for building retrofitting
- Cost effective inspections for better energy efficiency
- Energy efficient equipment for retrofitting

Many other interesting topics will be covered and some case studies will also be presented. If you are interested in recent development in energy retrofitting, then you should attend the REHVA Conference and Annual Meeting in Timisoara. The conference brings together an international group of researchers, professionals and practitioners and who routinely improve the energy efficiency, operating costs, and environmental impacts of buildings. The organizers are striving to make the 55th conference in Timisoara a great and memorable event!

For more information visit: www.rehva-am2012.ro
Registrations are now open.

VENTILATION 2012

- The 10th International Conference on Industrial Ventilation in Paris

September 17–19th 2012, Paris, Maison de la Mutualité

The aims of industrial ventilation are to protect health, to prevent environmental pollution and to guarantee high product quality. These aims should be achieved with constant concern for energy efficiency and for sustainable development.

This conference will allow experts in industrial ventilation, in occupational hygiene, and in climate-control engineering for buildings and industrial processes, ventilation and filtration equipment designers, technical managers from industrial groups, managers of service-sector buildings, institutional opinion leaders, and academics to present their research and development and to compare their practices in the field of industrial ventilation.

Share your research results with your colleagues worldwide.

For more information visit: www.inrs-ventilation2012.fr

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Measure, control, balancing and shut-off with one valve – the innovative EPIV characterised control valve with electronic flow rate setting now also allows this for larger nominal sizes from DN 65 to DN 150. Valve sizing and selection are considerably simplified, and hydraulic balancing is made much easier with EPIV. The flow rate can be individually adjusted and the sensor-monitored electronic flow rate controller guarantees control stability as well as maximum convenience. Thanks to its bubble tight closure the EPIV effectively prevents energy losses in the water circuits.

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The World Sustainable Energy Days 2012

The "World Sustainable Energy Days" conference held in Wels, Upper Austria, offered three inspiring days with a unique combination of events on sustainable energy covering energy efficiency and renewable energy sources for buildings and industry.

From 29 February to 2 March, the World Sustainable Energy Days (WSED), one of the largest annual conferences in this field in Europe, took place in Wels, Upper Austria. At the conference, latest technology trends, outstanding examples and European strategies were presented and the "*Energiesparmesse*", an important energy exhibition, offered opportunities to establish new partnerships.

More than 750 participants from 52 countries all over the world attended the World Sustainable Energy Days, which was organised by the O.Ö. Energiesparverband, the energy agency of Upper Austria.

Upper Austria is the right location for such a conference: by 2030, all electricity and space heating in the region will come from renewable energy sources. Already today, the region has a leading role in energy efficiency and renewable energy sources.

These were the highlights of the World Sustainable Energy Days 2012:

- **The European Pellet Conference** - the world's largest annual conference on pellets presenting technology and policy trends, markets, innovation, sustainability, finance, business models; including for the first time the "Pellet Academy" & the "World Pellet Business Forum".

- The conference **WSED next!** presented works and achievements of young researchers in the fields of energy efficiency and in biomass. Based on a call for papers and the evaluations of a scientific committee, 60 young researchers (picture in the middle) from 26 countries from all over the world were selected and presented their projects in oral and poster presentations.

- **Energy Efficient Buildings & Services:** The conference "**Nearly Zero Energy Buildings**" put the focus on the recent discussion on how to achieve "high-energy performance" buildings in new construction & renovation under cost optimality requirements. At the conference "**Energy Efficiency Watch**", representatives of the European Commission, of the European Parliament and of Member States, gave a very a very timely update on the progress of energy

efficiency policies in the European Union, with a focus on energy services.
In addition, a CA-EPBD stakeholder meeting took place where the topic "**NZEB: The vision for 2020**" focusing on the national definitions of NZEBs and issues relating to cost-optimality was discussed among experts.

- The conference **"Biomass Partnerships"** presented successful business models and partnerships for biomass heating, including contracting, district heating and supply chain co-operation.

- **Technical site-visits**
Complenting the conferences, technical site-visits on Nearly Zero Energy Buildings as well as on wood pellets and wood chips offered the opportunity to see best practice examples.

- **Trade Show "Energiesparmesse"**
Almost every delegate used also the opportunity to visit the "Energiesparmesse", which is the leading trade show on renewable energy and energy efficiency with more than 104 000 visitors and 1 600 exhibitors (in 2012).

The World Sustainable Energy Days have become a regular annual meeting point for stakeholders in energy efficiency and renewable energy sources. In the last years, the conference attracted more than 10 000 participants from 98 countries!

Mark the date for the World Sustainable Energy Days 2013 in your diaries: **27 February – 1 March 2013, deadline for the Call for Papers is 8 October 2012**.

Planned conference topics will include wood pellets and Nearly Zero Energy Buildings as well as an event for young researchers in sustainable energy. Further information will be published in the coming months at www.wsed.at

World Sustainable Energy Days 2012

More information:

Conference website www.wsed.at or
O.Ö. Energiesparverband,
Landstrasse 45, 4020 Linz/Austria,
T: +43-732-7720-14386, office@esv.or.at, www.esv.or.at

Pellets market development in Upper Austria

In Upper Austria, a region in the North of Austria with about 1.4 million inhabitants, renewable energy sources (RES) provide 34% of the primary energy consumption, 15% of that comes from biomass and the share of renewable heating is 46%. Biomass has a high political priority and the regional government has adopted the target to reach 100% RES space heat by 2030. Pellets make an important contribution to achieve this ambitious target. Presently more than 21 000 wood pellets central heating installations are in operation – most of them in one family homes but increasingly also larger installations for multi-family homes and public buildings. For new low energy buildings, pellet stoves are widespread. Pellet market development is supported by comprehensive market development programmes well adapted to the current needs of the market and ranging from training of installers (at the beginning of the market development or later on for attracting new consumer groups) to a recent pellet campaign.

Pellets are also an important economic factor: the region of Upper Austria has pioneered biomass heating in the last two decades and achieved global leaderships in small-scale systems. Leading European boiler producers are located in the region. Based on the successful home market they are exporting pellets technology all over Europe and to the US market. 25% of all biomass boilers installed in the EU are produced in Upper Austria.

A network of companies active in the field of energy efficiency and renewable energy sources – the Oekoenergie-Cluster (OEC, www.oec.at) – which is managed by the O.Oe. Energiesparverband, the regional energy agency – supports companies in their business development. 160 companies are partner of the network achieving a turn-over of 1.8 billion Euro and 7 300 employees.

O.Ö. ENERGIESPARVERBAND

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INTELLIGENT ENERGY EUROPE

Energy efficiency, comfort in the home and buildings, renewables…

Interclima+elec 2012 confirms industry dynamism

Interclima+elec and idéobain have just closed their doors after attracting 87,842 visitors, including 10,517 members of the general public visiting idéobain -- a satisfactory level of visitors given the air traffic problems and extreme weather conditions, which held back visits by installers and maintenance companies who had their work cut out during the severe cold.

Yet again this year, Interclima+elec was able to confirm its position as the reference event for energy efficiency and the use of renewables in buildings. It also offered professionals the opportunity to gain a better grasp of the challenges of the new regulatory provisions and to discover the most innovative equipment solutions.

Interclima+elec, the meeting place for a dynamic profession

For the 40th anniversary of the Interclima element, (The world's first HVAC and cooling exhibition was launched in 1972), all the industry's players were on hand. Installers and operating-maintenance companies remain the largest visitor category (41%) ahead of merchants (14%) and specifiers-owners (15%). The big winner at the 2012 show was the section dedicated to the electrical industry and here the Smarthome space was a great success.

Launched in 2010 and dedicated to home automation and multimedia solutions for the residential and service sectors, this show within the show saw the return in strength of the sector's undisputed leaders such as Legrand, Schneider Electric, Hager, Siemens and ABB.

As to PV Energy, the totally new space launched this year to meet the specific requirements of those involved in photovoltaic solar, it aims to permanently establish itself by integrating the generation of electricity by buildings into Interclima+elec.

Interclima+elec, an information platform par excellence

Almost 140 lectures and special events were attended by some 6,500 visitors eager to learn about the latest developments in the HVAC, electrical engineering and building facilities management sectors.

A major new development in 2012 was the creation of exhibitor workshops, which, for the first time, allowed members of the industry to organize their own conference sessions aimed at show visitors. The result was a special area that was often packed and that hosted presentations of innovations, lecture series offering advice to installers and a focus on developments in trades and products.

A programme of exclusive events

Alongside events dedicated to the industry's various different trades, such the Installateur Awards, which provided recognition for professionals pursuing their trade with passion and professionalism, or the Internet Awards, which highlighted the best industry and company sites operated by the show's exhibitors, the awards ceremony for the Smarthome Awards was one of the highlights of the show.

Since 2010, this competition has been an opportunity to pay homage to home automation installers and integrators responsible for model projects.

The show also provided its President, Joseph Le Jollec, with a platform from which to present the Energy Performance + Architecture Award to its 2012 winner, Matthias Sauerbruch, one of the pioneers of 'double skin' façades. The occasion was a tribute to the commitment of the Berlin practice of Sauerbruch Hutton to sustainable development as applied to architecture.

Interclima+elec: the major lines of development

At the end of this year's show, Joseph Le Jollec issued an invitation to all interested parties to think about the potential synergy to be generated from events dedicated to the envelope of the building and ones focusing on energy efficiency. Such a comprehensive approach would allow the creation of a communication platform in step with the strategic challenges facing these two sectors. This would also result in improved visibility at a European level for a show such as Interclima+elec, by creating a major event devoted to the entire building industry.

HEAT4U: Europeans opt for gas absorption heat pumps and renewable energies to heat up their homes

On January 26th 2012, one of the most important research projects funded by the European Community has been presented with the purpose of developing an indoor heating solution that can provide a significant contribution to the use of renewable energies and to rational energy consumption. The European Commission supports a Consortium of 15 companies gathered under the HEAT4U project, whose goal is to further develop the gas absorption heat pump technology so as to make it available for existing small-size residential buildings, which are the main contributors to polluting emissions in the Old Continent.

Innovation and technology: this is the two-pronged foundation of HEAT4U, i.e. one of the most important international research projects in the area of climate change and energy efficiency applied to the built environment, which also falls under the Seventh Framework Programme for Research (FP7) promoted by the European Community.

15 among the most important European organizations in the energy, industrial, and research fields are involved in such project, namely Robur – which is also the project coordinator, – Pininfarina, ENEA, Polytechnic University of Milan, D'Appolonia and CF Consulting from Italy; Bosch Thermotechnology, E.ON and the Fraunhofer Institute research centre from Germany; GDF Suez and Gas Reseau Distribution France from France. The consortium also includes UK-based British Gas, the Polish Flowair, and the two Slovenian companies Primorje and ZAG. The overall investment for such effort amounts to close to 10 million euro.

The challenge for this project, which shall continue through to 2014, is to implement the gas absorption heat pump technology – which is currently used for heating condominiums, commercial and industrial buildings, and public administration facilities – also in the area of single-family detached residential homes. What is even more important is the goal of building heat pumps that can be installed in existing buildings, which, according to recent studies carried out by the European Union, account for approximately 49% of the overall energy consumption in terms of primary energy and for 36% of greenhouse-gas emissions. Gas absorption heat pumps shall also be presented as a means for improving the heating efficiency of the existing residential building stock, which, by itself, accounts for over 60% of the built environment in enlarged Europe.

"It is no coincidence that several among the European directives aimed at reducing harmful emissions actually encourage a modernization of heating systems and the implementation of advanced retrofitting projects with a view to making buildings more energy efficient, especially in those cases in which it would be harder to achieve more appropriate thermal insulation solutions," explains Mr. Luigi Tischer, Strategic Business Director for Robur and coordinator of the HEAT4U international project.

According to the goals of the HEAT4U project, the investment required for each heating unit for the residential building market shall make the gas absorption heat pump technology one of the most competitive solution on the heating market.

For further information about the project, please visit www.heat4u.eu/en/

REHVA signed MoU for cooperation with an Indian organisation

On February 23rd 2012, at ACREX exhibition in Bangalore a Memorandum of Understanding was signed by the Federation of European Heating, Ventilation and Air-conditioning Associations (REHVA) and the Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE). The purpose of this Memorandum of Understanding (MoU) is to strengthen the relationship between REHVA and ISHRAE and to promote substantial and tangible actions to increase the co-operation between the two associations.

ACREX India HVAC&R exhibition is the largest exhibition in South Asia the theme of the exhibition was **"For a Greener Tomorrow" returns to Bangalore.** The 13th edition of ACREX India was held from 23rd to 25th February 2012 at Bangalore organized by Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE) with the professional expertise of Nürnberg Messe (NM) and Bangalore International Exhibition Services (BIES).

If you are interested in participating this co-operation please contact Olli Seppänen oseppanen@rehva.eu.

REHVA plans to participate also ACREX 2012 in Mumbai March 6-8, 2013.

REHVA and ISHRAE have the following objectives for this co-operation:

1. Promote communication and information exchange between the two organizations
2. Encourage participation at official meetings of both organizations
3. Promote and share knowledge of standard development activities relating to development of standards and guidebooks
4. Promote co-operation between ISHRAE and REHVA technical committees.
5. Sponsor and jointly organize training and educational seminars
6. Strive to develop and harmonize standards.
7. Cooperation in the development of and participation in conferences and exhibitions
8. Promote communication and information exchange regarding building energy performance and certification.

The presidents of ISHRAE Mr V Krishnan and REHVA president Prof. Michael Schmidt signed a memorandum of understanding in Bangalore, India, during a ceremony at the ACREX exhibition on February 23rd .

ISHRAE is an Indian organisation with approximately 12 000 individual members dedicated to advancing the arts & sciences of heating, ventilation, air conditioning and refrigeration to serve humanity and to promote energy efficiency and a sustainable building development in India.

India – EU cooperation in focus in a summit meeting on February 2012

The cooperation between India and EU is supported also by Joint Statement from a India-European Union summit meeting which held in New Delhi on 10 February 2012. The Republic of India was represented by the Prime Minister, Dr. Manmohan Singh. EU was represented by Mr. Herman Van Rompuy, President of the European Council, and Mr. José Manuel Durão Barroso, President of the European Commission.

CLIMA 2013 Congress

It is my great pleasure to invite you to the **CLIMA 2013 Congress**, the leading international scientific and engineering congress in the field of HVAC (Heating, Ventilating and Air-Conditioning). This meeting is a joint event of the ***11th REHVA World Congress and the 8th International Conference on Indoor Air Quality, Ventilation and Energy Conservation in Buildings***, which will take place in Prague, Czech Republic, on **June 16 – 19, 2013**.

The CLIMA 2013 is organised by the REHVA member ***Czech Society of Environmental Engineering (STP)*** with participation of the professional congress organizer ***GUARANT International spol. s r. o.***. This meeting offers a platform for the exchange of technical and scientific knowledge, technical solution and experience among scientists, engineers, architects, academia and industry, facility managers, building owners and policy-makers in a wide range of topics related to the HVAC industry, Building industry and Building Services.

Related to the motto: ***"Energy efficient, smart and healthy buildings"***, the congress will feature contributions from scientists and practitioners on the following topics:

- Energy Efficient Heating, Cooling and Ventilation of Buildings
- Renewable and High-Efficient Energy Sources
- Advanced Heating, Cooling, Ventilation and Air-Conditioning Systems for Buildings
- Energy Efficient Domestic Hot Water Supply Systems
- Sanitary Systems – Hygiene of Domestic Water Supply Systems, Efficient Use of Potable Water, Environmental Friendly Sewage Disposal
- Advanced Technologies for Building Acoustics
- Artificial And Day Lighting
- Technologies for Intelligent Buildings
- Quality of Indoor Environment
- Building Certification Schemes
- Integrated Building Design
- Commissioning and Facility Management
- HVAC Best Practise Examples
- Directive on Energy Performance of Buildings Implementation
- Zero Energy Buildings
- HVAC in Historical Buildings
- Fire Safety of the Buildings

On behalf of the organizing Committee, I warmly invite you to join us in the historical and beautiful city of Prague, Czech Republic, for the CLIMA 2013.

Please visit www.clima2013.org for details.

Professor Karel Kabele
President, CLIMA 2013

Optimising Ventilative Cooling and Airtightness for [Nearly] Zero-Energy Buildings, IAQ and Comfort

The joint '33rd AIVC Conference' and '2nd TightVent Conference' will be held in downtown Copenhagen (Denmark), Wednesday 10 and Thursday 11 October 2012.

The conference aims to focus on ventilation and infiltration in nearly zero-energy buildings and more particularly on challenges and perspectives for ventilative cooling (the use of ventilation systems to cool indoor spaces) as well as the rationale and solutions for better building and ductwork airtightness.

Visit www.aivc.org or www.tightvent.eu for additional information and registration.

The conference is organized by the International Network on Ventilation and Energy Performance (INIVE) on behalf of the Air Infiltration and Ventilation Centre (AIVC) and TightVent Europe (the Building and Ductwork Airtightness Platform) with support from VELUX.

In cooperation with

International BUILDAIR Symposium

International Energy Agency
Energy Conservation in Buildings and Community Systems Programme

REHVA
Federation of European Heating, Ventilation and Air-conditioning Associations

New VDI – Guidelines March 2012

VDI 2077/3.2 "Energy consumption accounting for the building services; Heat and hot-water-supply installations; Cost allocation in connected installations" *(Draft Guideline)*

This guideline applies to the distribution of costs in heat supply systems. The cost for the energy used by, and for the operation of, heat supply systems must be distributed both independent on consumption and consumption-dependent. This guideline is the first standard to offer a method that can be applied to distribute the cost incurred by complex systems. Systems where the cost for energy is billed directly by the energy provider based on an agreed tariff are not covered by this guideline.

VDI 2078 "Calculation of cooling load and room temperatures of rooms and buildings (VDI Cooling Load Code of Practice)" *(Draft Guideline)*

This guideline serves to determine the cooling load, room air temperature and operative room temperature for rooms of all types with and without air-conditioning, taking into account all relevant parameters influencing the thermal response of the room. Installation components affecting thermal response, such as mechanical or natural-draught ventilation and surface heating or cooling, are an integral part of the calculation method not requiring approximations any more. The method has been enhanced significantly with respect to the previous version, e.g. with respect to the coupling between thermal calculation, mode of operation, active installation components and control strategies. Furthermore, an extension and completion of the compatible meteorological data has been achieved, the scope was extended to cover all types of buildings with and without air-conditioning, component cooling and window ventilation. The latter allows calculations serving to demonstrate compliance with summertime insulation requirements. The calculation core for VDI 2078 is described in VDI 6007 Part 1, the window model in VDI 6007 Part 2, providing solar shading information.

VDI 3802/2 "Air conditioning systems for factories; Capture of air pollutants at machine tools removing material"

The operation of machine tools necessitates the protection of personnel from hazardous substances in the air and the prevention of damage to persons or building, especially through explosions. The guideline serves to provide manufacturers of machine tools, planners of extraction systems and the users or such system with recommendations for dimensioning and designing extraction devices for machines and the required filters. A method for determining the required extract air flows is specified. Economic aspects are taken into account, keeping air flows as small as possible so as to minimize the energy demand. Options for functional checking are given, extract-air cleaning techniques and the protection from fire and explosions are described.

VDI 6007/1 "Calculation of transient thermal response of rooms and buildings; Modelling of rooms"

The calculation method described in this guideline serves as the basis for calculations of the non-steady state thermal response of rooms and buildings. It allows to calculate the loads and room temperatures taking into account the thermal characteristics of the components as well as their non-steady response (adiabatic/non-adiabatic). The method, then, also allows to assess the thermal and building-physical properties of rooms and buildings. The guideline limits itself to the specification of the calculation core. Further algorithms are only addressed insofar as their description requires further specification in order to achieve comparability of the results. The specific boundary conditions for a given task such as the calculation of the cooling load (VDI 2078) or the energy demand (VDI 2067) are given in the pertinent documents. The algorithms have been completed for the calculation of component cooling/heating to include exterior components.

VDI 6007/2 "Calculation of transient thermal response of rooms and buildings; Modelling of windows"

This guideline is intended to offer the planner a high-performance tool for the calculation of energy characteristics, particularly of the total energy transmission coefficient decisive for summertime cooling loads. The energetic behaviour of modern transparent facades becomes accessible to simulation and tables for cooling-load calculations can be established. The method uses five solid layers but can, in principle, calculate any number of solid layers. Tabulated values for cooling-load calculations are given for six selected glass combinations, and standard values for three different systems of two-layer facades.

REHVA Dictionary for professionals by professionals

The REHVA dictionary is a reliable glossary of technical words and terms used in the building services. The dictionary is made by professionals for professionals. Available **freely** to everyone, with more them 12 000 words translated in 15 languages, it is an up to date user friendly glossary. **Romanian** is the new language recently added to the REHVA dictionary. Soon to be added is Croatian.

15 languages

Danish – Dutch – English – Finnish – French – German – Hungarian – Italian – Polish – Portuguese – Romanian **NEW !** – Russian – Spanish – Swedish – Turkish

Visit: www.rehvadictionary.eu

X. International HVAC+R Technology Symposium

The Tenth Biannual Symposium on HVAC+R Technologies will take place on **April 30th to May 2nd 2012 in Istanbul, Turkey**. This symposium, organised by the Turkish Society of HVAC & Sanitary Engineers, will be held with the participation of the representatives of the universities and companies. You are invited to participate in this important meeting where new products will be exhibited and where papers on new technological developments will be presented.

The main objective of the symposium is to provide an atmosphere to discuss scientific and technological developments in the fields of heating, refrigerating, ventilating, air-conditioning and sanitary engineering applications and to benefit from the know-how and experience of engineers, contractors, academicians and manufacturers.

Turkey has served as a bridge enabling the flow of information, technology and commerce between the East and the West. This particular symposium in Istanbul, which will be accompanied by an exhibition, aims to provide a similar bridge in the field of HVAC and Sanitary technologies.

For more information visit: www.ttmd.org.tr/2012sempozyum/en
Registrations are now open.

REHVA annual reception in Chicago

REHVA hosted its annual REHVA reception at the Palmer House Hilton on Monday, 23 January 2012. That event took place in Chicago during the ASHRAE winter meeting. This reception provided a golden opportunity to network and exchange with other associations in the Heating, Ventilation, Air-conditioning and refrigeration field. More than 200 guests attended the cocktail from all over the world. It was very successful!

Light+Building 2012

The world's leading trade fair for Architecture and Technology

Around 2 100 exhibitors take part in Light+Building at Frankfurt Fair and Exhibition Centre and almost half of the 180 000 visitors comes from outside Germany. Every two years, the industry presents its latest innovations for the fields of lighting, electrical engineering and house and building automation at the world's leading trade fair for architecture and technology. The main theme at Light+Building 2012 is energy efficiency.

Light+Building is the world's biggest trade fair for lighting and building-services technology and presents solutions that cut the energy consumption of a building at the same time as increasing the level of comfort. At the fair, everything is represented, from LED technology, via photovoltaic and electro-mobility, to intelligent electricity usages with smart metering and smart grids. Thanks to the combination of lighting and networked building-services technology, the companies can present an integrated spectrum of products and services that make a decisive contribution to exploiting the energy-saving potential of buildings to the full. Don't miss this opportunity to attend the event and experience the latest innovations relating to energy-efficient solutions and sophisticated design - live!

You are invited to the REHVA seminar focusing on lighting with top speakers "*Role of lighting and HVAC in zero energy buildings*" April 16th, 11.00 – 13.00 in Frankfurt during the exhibition.

light+building

For more information contact info@rehva.eu

REHVA
Federation of European Heating, Ventilation and Air-conditioning Associations
SUPPORTER

REHVA SUPPORTERS

A REHVA supporter is a company or an organisation that shares the same objectives as REHVA. Our REHVA supporters use the latest European technologies to make their products. The REHVA Supporters are also members of reHVAClub. For more information about REHVA supporters' program, please contact info@rehva.eu or call +32 2 5141171.

AERMEC air conditioning
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camfil FARR
CIAT
CLIMESPACE GDF SUEZ
DAIKIN

Demark CONSTRUCT confortul de partea ta
EMERSON Network Power
Enventus ENERGY RECOVERY
EPEE European Partnership for Energy and the Environment
ES-SO EUROPEAN SOLAR-SHADING ORGANIZATION Energy Savings & Comfort

EUROVENT CERTIFICATION
evapco
Flanders FOREMOST IN AIR FILTRATION
FläktWoods
FRITERM TERMİK CİHAZLAR SANAYİ VE TİCARET A.Ş.
GEA

GRANLUND
Halton CARE FOR INDOOR AIR
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SKANSKA
Smits van Burgst
somfy
Swegon
Systemair
TANGRA

TROX TECHNIK The art of handling air
ULEFOS NV
uponor
vabi software
WILO Pumpen Intelligenz.
zehnder

Events & Fairs in 2012

EVENTS 2012

28 March	REHVA and AICARR seminar at MCE, HVAC in Zero Energy Buildings	Fiera Milano, Italy	www.rehva.eu
29 March	4th International Symposium Solar and Renewable Cooling	Stuttgart, Germany	www.cep-expo.de
30 March	6th International Conference on Application of Biomass Gasification	Stuttgart, Germany	www.cep-expo.de
29 – 31 March	CEP® Clean Energy & Passivehouse 2012	Stuttgart, Germany	www.cep-expo.de
9 - 15 April	Simurex 2012	Cargese, France	http://simurex.ibpsa.fr/
16 April	REHVA Seminar in Light and Building	Frankfurt, Germany	www.rehva.eu
17 - 20 April	REHVA Annual Conference and Meeting	Timisoara, Romania	www.rehva-am2012.ro
17 - 19 April	XVI European AVOK-EHI Symposium "Modern energy-efficient equipment for heating, water and air-conditioning of buildings"	Moscow, Russia	www.abok.ru
18 - 21 April	International construction forum Interstroyexpo 2012	St. Petersburg, Russia	www.abok.ru
19 - 20 April	Workplace and Indoor Aerosols Conference	Lund, Sweden	www.eat.lth.se/aerosols2012
26 - 27 April	2012 Annual Conference on Renewable Heating and Cooling	Copenhagen, Danmark	www.euroheat.org/
30 April - 2 May	X. International HVAC+R Technology Symposium	Istanbul, Turkey	www.ttmd.org.tr/2012sempozyum
2 - 6 May	16th International Passive House Conference 2012	Hanover, Germany	www.passivehouseconference.org
8 May	5th EHPA European Heat Pump Forum	Milan, Itlay	http://www.ehpa.org
24 - 25 May	Romanian International Cconfernce on Eenergy Perfromance of Buildings	Bucarest, Romania	www.aiiro.ro
24 - 25 May	Conference on "Creating a climate for the desired objects of cultural heritage: monuments, museums, buildings for religious purposes"	Moscow, Russia	www.abok.ru
6 - 8 June	Conférence IBPSA France 2012	Chambery, Fance	http://www.ibpsa.fr/
18 - 22 June	EU Sustainable Energy Week 2012 in Brussels	Brussels, Belgium	www.eusew.eu
25 - 27 June	10th IIF/IIR Gustav Lorentzen Conference on Natural Refrigerants	Delft, The Netherlands	www.gl2012.nl
8 - 12 July	Healthy Buildings	Brisbane, Australia	www.hb2012.org/
3 - 7 September	ICCCS 2012 - International Symposium on Contamination Control 2012	Zurich, Switzerland	www.icccs2012.ethz.ch
14 September	33rd AICVF Congress	Brodeaux, France	http://aicvf.org/blog/agenda/congres-2012/
17 - 19 September	Ventilation 2012	Paris, France	www.inrs-ventilation2012.fr
10 – 11 October	33rd AIVC Conference and 2nd TightVent Conference	Brussels, Belgium	www.aivc.org
17 – 19 October	47th Conference of Plants – "Plants for the Early Third Millennium"	Sinaia, Romania	www.aiiro.ro
12 - 14 November	7th International HVAC Cold Climate Conference	Calgary, Alberta, Canada	http://ashraem.confex.com/ashraem/icc12/cfp.cgi
5 - 7 December	43th International congress of Heating, Air Conditioning and Refrigeration	Belgrade, Serbia	www.kgh-kongres.org/

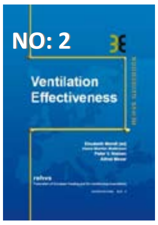
FAIRS 2012

27 - 30 March	MCE - Mostra Convegno Expocomfort 2012	Fiera Milano, Italy	www.mcexpocomfort.it
15 - 20 April	Light + Building	Frankfurt, Germany	www.light-building.messefrankfurt.com
17 - 19 April	International Trade Fair & Conference "SHK – ISH Moscow 2012"	Moscow, Russia	www.abok.ru
2 - 5 May	ISK - SODEX 2012	Istanbul, Turkey	www.hmsf.com
10 - 12 May	RENEXPO® Central Europe, 6. International Energy Trade Fair	Budapest, Hungary	www.renexpo.hu
9 – 11 October	Chillventa 2012	Nuremberg, Germany	www.chillventa.de/en/
9 – 12 October	Finnbuild 2012	Helsinki, Finland	www.finnbuild.fi
17 - 18 October	CEP® Clean Energy & Passive House Expo	Budapest, Hungary	www.cep-expo.hu

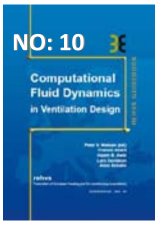
REHVA GUIDEBOOKS

REHVA
Federation of European Heating, Ventilation and Air-conditioning Associations

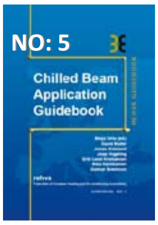
REHVA Guidebooks are written by teams of European experts



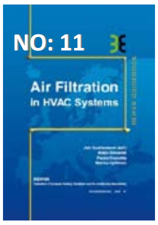
Improving the ventilation effectiveness allows the indoor air quality to be significantly enhanced without the need for higher air changes in the building, thereby avoiding the higher costs and energy consumption associated with increasing the ventilation rates. This Guidebook provides easy-to-understand descriptions of the indices used to mesure the performance of a ventilation system and which indices to use in different cases.



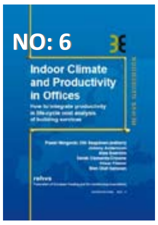
CFD-calculations have been rapidly developed to a powerful tool for the analysis of air pollution distribution in various spaces. However, the user of CFD-calculation should be aware of the basic principles of calculations and specifically the boundary conditions. Computational Fluid Dynamics (CFD) – in Ventilation Design models is written by a working group of highly qualified international experts representing research, consulting and design.



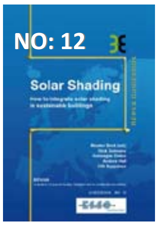
Chilled beam systems are primarily used for cooling and ventilation in spaces, which appreciate good indoor environmental quality and individual space control. Active chilled beams are connected to the ventilation ductwork, high temperature cold water, and when desired, low temperature hot water system. Primary air supply induces room air to be recirculated through the heat exchanger of the chilled beam. In order to cool or heat the room either cold or warm water is cycled through the heat exchanger.



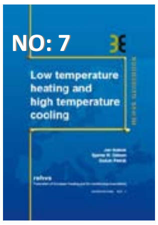
Air filtration Guidebook will help the designer and user to understand the background and criteria for air filtration, how to select air filters and avoid problems associated with hygienic and other conditions at operation of air filters. The selection of air filters is based on external conditions such as levels of existing pollutants, indoor air quality and energy efficiency requirements.



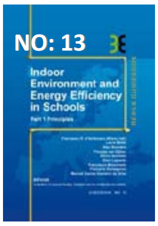
Indoor Climate and Productivity in Offices Guidebook shows how to quantify the effects of indoor environment on office work and also how to include these effects in the calculation of building costs. Such calculations have not been performed previously, because very little data has been available. The quantitative relationships presented in this Guidebook can be used to calculate the costs and benefits of running and operating the building.



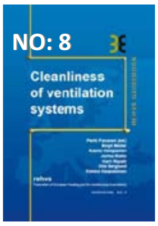
Solar Shading Guidebook gives a solid background on the physics of solar radiation and its behaviour in window with solar shading systems. Major focus of the Guidebook is on the effect of solar shading in the use of energy for cooling, heating and lighting. The book gives also practical guidance for selection, installation and operation of solar shading as well as future trends in integration of HVAC-systems with solar control.



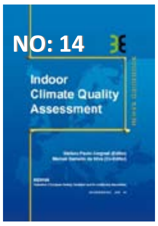
This Guidebook describes the systems that use water as heat-carrier and when the heat exchange within the conditioned space is more than 50% radiant. Embedded systems insulated from the main building structure (floor, wall and ceiling) are used in all types of buildings and work with heat carriers at low temperatures for heating and relatively high temperature for cooling.



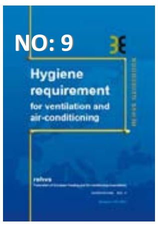
School buildings represent a significant part of the building stock and also a noteworthy part of the total energy use. Indoor and Energy Efficiency in Schools Guidebook describes the optimal design and operation of schools with respect to low energy cost and performance of the students. It focuses particularly on energy efficient systems for a healthy indoor environment.



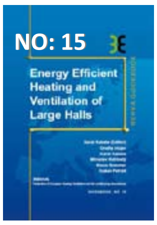
Cleanliness of ventilation systems Guidebook aims to show that indoor environmental conditions substantially influence health and productivity. This Guidebook presents criteria and methods on how to design, install and maintain clean air handling systems for better indoor air quality.



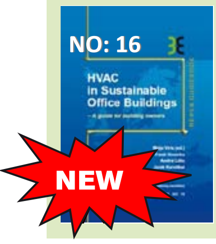
This new REHVA Guidebook gives building professionals a useful support in the practical measurements and monitoring of the indoor climate in buildings. Wireless technologies for measurement and monitoring has allowed enlarging significantly number of possible applications, especially in existing buildings. The Guidebook illustrates with several cases the instrumentation for the monitoring and assessment of indoor climate.



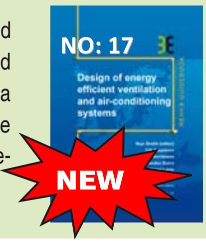
Hygiene requirement is intended to provide a holistic formulation of hygiene-related constructional, technical and organisational requirements to be observed in the planning, manufacture, execution, operation and maintenance of ventilating and air-conditioning systems. These requirements for ventilating and air-conditioning systems primarily serve to protect human health.



This guidebook is focused on modern methods for design, control and operation of energy efficient heating systems in large spaces and industrial halls. The book deals with thermal comfort, light and dark gas radiant heaters, panel radiant heating, floor heating and industrial air heating systems. Various heating systems are illustrated with case studies. Design principles, methods and modeling tools are presented for various systems.



This guidebook talks about the interaction of sustainability and Heating, ventilation and air–conditioning. HVAC technologies used in sustainable buildings are described. This book also provides a list of questions to be asked in various phrases of building's life time. Different case studies of sustainable office buildings are presented.



This guidebook covers numerous system components of ventilation and air-conditioning systems and shows how they can be improved by applying the latest technology products. Special attention is paid to details, which are often overlooked in the daily design practice, resulting in poor performance of high quality products once they are installed in the building system.