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THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION

## HORIZON 2020

- **New EU Research Programme Horizon 2020 – an opportunity for HVAC industry**
- **Nearly Zero Energy hotels**
- **Water and energy nexus at the building level**
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## Contents

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### EDITORIAL

- 5** New EU research programme Horizon 2020 – an opportunity for HVAC industry  
Olli Seppänen

### ARTICLES

- 7** Nearly Zero Energy hotels  
Tiziana Buso, Jarek Kurnitski, Stefano Paolo Corgnati, Andrei Litui and Anita Derjanecz
- 12** Water and energy nexus at the building level  
Claudia Agudelo-Vera, Will Scheffer, Ilse Pieterse-Quirijns and Mirjam Blokker
- 16** Why energy monitoring and feedback is essential to achieve sustained energy efficiency in EU buildings  
Ian Knight
- 20** New Ecodesign regulations from the Commission  
Jorma Railio
- 24** Cooling of residential buildings in Germany  
Ronny Mai and Thomas Hartmann

- 30** Weather data available for 122 European cities  
Cornelia Baugirdis, Jürgen Masuch, Karl-Josef Albers and Klaus Hollenbach
- 32** Energy piles and other thermal foundations for GSHP  
Tony Amis and Fleur Loveridge
- 36** Suitability of foundation heat exchangers for ground source heat pump systems in European climates  
James R. Cullin, Jeffrey D. Spittler and Signhild E.A. Gehlin

### 41 RESEARCH NOTE

### 42 NEWS

### 48 REHVA NEWS

### 50 PRODUCT NEWS

### 53 PUBLICATIONS

### 56 EVENTS

## Advertisers

- |                                       |                                     |
|---------------------------------------|-------------------------------------|
| ✓ light+building 2014.....Front cover | ✓ Swegon ..... 57                   |
| .....interior                         | ✓ WSED 2014..... 58                 |
| ✓ MCE 2014 ..... 4                    | ✓ Friterm ..... 63                  |
| ✓ Lindab..... 6                       | ✓ ACREX 2014 ..... 65               |
| ✓ Belimo..... 50                      | ✓ REHVA Guidebooks ..... Back cover |

## Next issue of REHVA Journal

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# New EU research programme Horizon 2020

## – an opportunity for HVAC industry



**OLLI SEPPÄNEN**  
Professor  
Editor-in-chief

Horizon 2020 is the biggest EU Research and Innovation programme ever, with nearly €80 billion of funding available over 7 years (2014 to 2020) – in addition to the private investment that this money will attract. It is expected to generate more breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market.

The programme offers opportunities in several sub-areas for REHVA and its affiliates. The programme is important not only for research units but also for business, as it provides the guidance and the need for technical development till the year 2020.

The Horizon 2020 programme is open to participation by researchers from across the world. In addition, targeted international cooperation activities are included across the societal challenges, enabling and industrial technologies and other relevant parts of the programme.

A number of areas have been identified for special focus in the first Horizon 2020 Work Programme published in December 2013. The programme is well written and gives both background information and objectives for future research. More information on Horizon 2020 Programme is available at: <http://ec.europa.eu/programmes/horizon2020/>

At least the following four focus areas are relevant to readers of the REHVA Journal:

- Competitive low-carbon energy (2014 budget: €359 million)
- Energy efficiency (€98 million)
- Smart cities and communities (€92 million)
- Water innovation: boosting its value for Europe (€67 million)

The EU aims to reduce greenhouse gas emissions by 20% below 1990 levels by 2020, with a further reduction of 80–95% by 2050. The aim of the ‘Competitive low-carbon energy’ call is to support this transition by tackling the entire innovation process, covering a wide range of technology readiness levels, combining R&D with market uptake and addressing non-technological issues (standardisation, social sciences and humanities, impact analysis, etc).

About 40% of EU final energy consumption is by buildings and around 25% by industry. Activities under the ‘Energy efficiency’ focus area will deliver energy savings in these two sectors. The first calls invite proposals to carry out research and demonstration of more energy-efficient solutions – e.g. building components or highly energy-efficient heating and cooling systems.

Two thirds of the EU population lives in urban areas, using 70% of the energy. Research carried out under ‘Smart cities and communities’ will aim at finding solutions with high market potential in fields such as energy efficiency in neighborhoods, providing digital services and information for citizens or smart mobility services. For example, EU funding could help develop nearly-zero energy districts.

Water is fundamental to human health, food security, sustainable development and the environment. For example, activities could include bringing innovative water solutions to the market, harnessing water research and innovation results for the benefit of industry, policy makers and citizens in Europe and worldwide as well as integrated approaches to water management and climate change.

The 2014–15 working programme for focus area 10, ‘Secure, clean and efficient energy’, was published in December 2013. The first deadline for proposals is 20.3.2014. It covers some areas to improve the energy efficiency of existing buildings, specifically

- Manufacturing of prefabricated modules for renovation of buildings
- Energy strategies and solutions for deep renovation of historic buildings

The second deadline is 5.6.2014, and includes area of heating and cooling, specifically

- Technology for district heating and cooling
- Removing market barriers to the uptake of efficient heating and cooling

The third deadline of 9.12.2014 covers almost all the remaining energy efficiency related topics.

The most convenient access to the calls and working programmes is through BUILD UP portal news section: <http://www.buildup.eu/news/39087> ■



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# Nearly Zero Energy hotels



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**Keywords:** hotels, nZEB, neZEH, energy use, refurbishment

The focus of the European project neZEH on hotels raised the question of how to define requirements for nearly Zero Energy Buildings when complex buildings are concerned. This paper presents the first steps made to enter this topic, including a review of the existing hotel buildings stock energy performances.

## Introduction

According to the UNWTO-UNEP study (2008) [1] tourism contributes around 5% to global CO<sub>2</sub> emissions, out of which hotels and other types of accommodation account for 1%.

This comparatively small footprint is nevertheless important in the EU strategies to achieve the 2020 goals, as proved by the projects dealing with the hospitality sector promoted by the IEE in the last years, such as HES<sup>1</sup> and RELACS<sup>2</sup>, and neZEH project which started in spring 2013.

The most recent goal to be achieved within the hotel sector goes beyond the generic increase in the energy efficiency and use of renewables: the neZEH project aims at retrofitting existing hotels to achieve the nearly zero energy level.

Among the several building uses, focusing on the existing building stock of the hotel sector could be an asset for leveraging the nearly Zero Energy Building (nZEB) 2020 goal because:

- hotels' guests may replicate at home the architectural solutions they experienced in the hotel;
- energy consumption in hotels is usually higher than in residential buildings, providing more opportunities for consistent energy savings;
- as the hotel sector is highly competitive, it is very likely that the advantages gained by some hotels toward the nZEB goal will push other to imitation.

**1** The **Hotel Energy Solutions** is an UNWTO-initiated project in collaboration with a team of United Nations and EU leading agencies in Tourism and Energy. The project delivers information, technical support & training to help Small and Medium Enterprises (SMEs) in the tourism and accommodation sector across the EU 27 to increase their energy efficiency and renewable energy usage. <http://hotelenergysolutions.net/en>

**2** The **RELACS (REnewable energy for tourist Accomodation buildings)** is a IEE project - launched at the end of May 2010 in Modena - involving partners from 10 countries. It aims to involve and motivate a significant number of accommodations throughout Europe (at least 60) in implementing renewable energy technologies as well as energy efficiency measures on their buildings. <http://www.relacs.eu/home.php>

### The neZEH project

Nearly Zero Energy Hotels (neZEH) is a 3-years long project supported by the Intelligent Energy Europe (IEE) program, started in April 2013. It involves a consortium of 7 European Countries (Croatia, France, Greece, Italy, Romania, Spain, Sweden) and 10 partners, among whom REHVA provides the technical expertise in the field of buildings energy performances.

The project aims at accelerating the refurbishment rate of existing buildings into nZEB in the hospitality sector and promoting the front runners. Particularly, neZEH focuses on the SME hotels, which represent the 90% of the European hospitality sector and are usually the most reluctant to commit to energy saving measures and to the use of renewable energies. In order to convince hotel owners to invest significantly in refitting their buildings, successful examples of existing neZEH will be showcased (**Figure 1**). The interested hoteliers will be supported in designing feasible and sustainable renovation projects: 14 pilot projects will be implemented in 7 Countries to prove the profitability of deep refurbishments achieving NZE hotels.

To achieve these goals, neZEH works within the legal framework of the nZEB implementation in each partner Country, tackling the main market barriers that prevent SME hotel owners from investing in major refurbishment projects.

Originally the project was supposed to use existing national legal requirements, but the delay in the transposition of the EU nZEB definition in most of the involved Countries, lead REHVA to face a new task: the definition of Country specific reference values using available benchmarks.

The outcomes of this preliminary study are shown in the following paragraphs.

### Actual energy use of existing hotels

To understand the relevance of the energy costs on the operational costs of a tourist accommodation building at the present stage, an overview of the available data on energy use of existing hotels is provided.

#### **BPIE data hub**

After its major study *Europe's Buildings under the Microscope* (2011) [2], BPIE created a data hub for the energy performance of buildings. Refining the search for energy use of hotel buildings, relevant available data are listed for some European Member States by building age group. For this article the information extracted is per country as a maximum to minimum range of delivered energy use level set by the age groups values (**Table 1**).

#### **Hotel Energy Solutions**

The Hotel Energy Solutions (HES) project reported significant variations of energy use in facility types



**Figure 1.** One of neZEH project showcases: the zero energy Stadthalle Hotel in Vienna.



within the hotel sector. However, it concluded that regarding climatic conditions, overall energy use levels can be relatively constant (energy needs for cooling and heating balance out), but with significant differences in the necessary technologies to reduce energy use in different climate zones.

In addition, HES provided:

- average energy use levels according to available certification schemes for the energy performance of hotels (e.g. Accor, Nordic Swan, LowE, WWF/IBLF, Thermie) i.e. delivered energy use range **200–400 kWh/(m<sup>2</sup>·a)** with average energy use **305–330 kWh/(m<sup>2</sup>·a)**;
- definition of five energy performance ratings, shown in **Table 2**.

Comparing the values inferred from BPIE data hub and from HES, a similar range of energy use in hotels is highlighted.

### ENTRANZE

To determine Country specific values, data from ENTRANZE<sup>3</sup> project were used. The project delivered an EU online data mapping tool including buildings' energy uses updated at 2008 (the last year with available data not affected by the economic crisis). Data about the current situation of energy use in buildings in the European Countries involved in the project were given with an energy breakdown by energy source. In the context of neZEH, data for residential buildings (**Table 3**) were used.

**Table 3.** Energy use in residential buildings with energy breakdown by energy source for the Countries involved in the ENTRANZE project.

Country	Residential Buildings Energy Consumption 2008 level [kWh/(m <sup>2</sup> ·a)]	Residential Buildings Energy Breakdown by Energy Source					
		District Heating [%]	Oil [%]	Coal [%]	Gas [%]	Biomass [%]	Electricity [%]
Croatia	195	8	14	0	31	15	32
France	202	4	19	0	33	14	30
Greece	205	1	49	0	4	16	30
Italy	124	0	16	0	54	7	23
Romania	248	15	4	1	27	42	11
Spain	115	0	31	0	22	13	33
Sweden	240	33	3	0	0	14	49

Consistently with the conclusions drawn by HES, which affirms that energy use levels can be relatively constant among hotels as far as energy needs for climatization are concerned, these were the functions considered to define the average energy use of hotels. These functions, here

**Table 1.** Max ... min range of energy use for hotel buildings in some European Member States, extracted from the BPIE data hub.

N°	Country	Years	Hotels and restaurants [kWh/(m <sup>2</sup> ·a)]
1	Bulgaria	1946 ... 2004	350 ... 217
2	Czech Republic	1900 ... 2002	430 ... 290
3	France	1975 ... 2005	397 ... 292
4	Latvia	1940 ... 2010	185 ... 140
5	Norway	1983 ... 2011	296 ... 220
6	Slovakia	1951 ... 2006	545 ... 190

**Table 2.** Hotels' energy performance rating defined in the HES project.

N°	Energy performance rating	Range [kWh/(m <sup>2</sup> ·a)]
1	Excellent	< 195
2	Good	195 ... 280
3	Average	280 ... 355
4	Poor	355 ... 450
5	Very poor	> 450

3 The objective of the ENTRANZE project is to assist policy makers in developing integrated, effective and efficient policy packages achieving a fast and strong penetration of NZEB and RES-H/C focusing on the refurbishment of existing buildings in line with the EPBD and the RED. <http://www.entranze.eu/>

**Table 4.** Energy use in hotels with details of the increased contribution for ventilation and cooling with respect to values for residential buildings.

Country	Hotels Added Ventilation Delivered Energy [kWh/(m <sup>2</sup> ·a)]	Hotels Added Cooling Delivered Energy [kWh/(m <sup>2</sup> ·a)]	Hotels Added Ventilation Primary Energy [kWh/(m <sup>2</sup> ·a)]	Hotels Added Cooling primary energy [kWh/(m <sup>2</sup> ·a)]	Hotels Hosting Function Primary Energy 2008 level [kWh/(m <sup>2</sup> ·a)]
Croatia	19,3	10,0	57,9	30,0	397,8
France	19,3	6,3	49,8	16,1	352,4
Greece	19,3	10,0	56,0	29,0	417,5
Italy	19,3	10,0	42,1	21,8	221,5
Romania	19,3	6,3	54,0	17,5	394,7
Spain	19,3	10,0	45,4	23,5	240,0
Sweden	19,3	3,8	52,1	10,1	519,8

named “hosting function”, will be further specified in the paragraph *The typical energy use of a hotel*.

To use the data provided by ENTRANZE in the specific context of hotels, the energy needs for the hosting functions were considered similar to the residential buildings’ ones, with an additional contribution of energy for cooling and ventilation. While the extra ventilation-related energy use was constant, the relevance of the additional cooling load depended on the climate zone. With national primary energy factors, the primary energy use of existing hotels at 2008 level was calculated, as shown in **Table 4**.

### Definition of benchmarks for neZEH

One of the main expected outputs of the neZEH project is the setting up of hotels renovation projects in line with the definition of nZEB. Moreover, it is important to demonstrate to hoteliers that achieving the nZEB target is cost-effective by providing existing examples of neZEH. Both these tasks entail a practical definition of neZEH.

#### *The typical energy use of a hotel*

The first issue to be faced is how to define in a hotel the “typical use of the building”, upon which the energy performance of the building is based (EPBD, Article 2) [3].

Different hotels may offer different facilities, which entails a wide gap in the energy needs even among buildings with the same general use classification. Hotels can have similar energy consumption related to their hosting function, typically related to energy use in guestrooms, but diverse energy needs when the offered facilities are concerned.

The approach to the problem chosen by the authors was to compare the reference values for primary energy dealing only with the hotels’ energy use for the hosting functions.

The selection criteria for specifying the hosting functions was suggested by the EPBD (2002) [4], affirming that the energy performance of a building derives from the climatic indoor environmental quality targets set for it. The energy performance of a building for its standard use (heating, cooling, ventilation, hot water, lighting) must refer to the standard indoor environmental conditions, which in a hotel are the comfort conditions required for guests and workers, as recommended in EN15251 [5]. With these premises, the standard zones of a hotel to be considered among the hosting functions were selected: guests’ rooms; reception hall; offices; bar and restaurant; meeting rooms.

#### *Reference values for the definition of a neZEH*

The second key aspect was the definition of proper reference values for Primary Energy and integration of Renewable Energy Sources.

To define neZEH, available definitions of nZEB were grouped according to the geographical division proposed by the Ecofys report 2013 [6], in order to consider regional disparities regarding, among others, climatic and economic differences. The selected Countries representing Zones 1 (Mediterranean Europe), 2 (Eastern Central Europe), 3 (Western Central Europe) and 4 (Northern Europe) were respectively Italy, Slovakia, France and Estonia.

The final reference values are presented in **Table 5**.

It is worth noting that, at this stage, the available definitions exploited are not referred to the achievement of the cost-optimal level, despite its fundamental role for obtaining a concrete reduction on buildings' energy consumptions – especially in retrofit actions.

From primary energy values of existing hotels (Table 4) and neZEH values of Table 5, the Country specific reduction percentages were calculated. For a coherent comparison between the current and the nearly-zero energy consumption, the benchmarks set for neZEH were increased by the contribution of appliances (final values are shown in Table 6). The appliances impact was quantified as an extra energy use of 7 kWh/m<sup>2</sup> weighted by the national primary energy factors. With these adjustments, the reduction percentages, displayed in Table 6, ranged between 67 to 81% of the primary energy of existing hotels, with an average decrease of 74.5%, meaning that primary energy use of existing building stock need to be reduced by factor of 4 in average (varied between 3–5).

## Conclusions

The first steps within the neZEH project allowed the authors to have an overview of the current situation of the European hotels' energy consumptions and of how ambitious are the targets set for reaching the nearly zero energy level.

Some available national consistent nZEB definitions allowed to determine benchmark values for nearly zero hotels in four climate zones. Comparison with existing buildings showed that the primary energy use of existing hotels is in average by factor 4 higher relative to determine neZEH benchmark values.

**Table 5.** Summary of the requirements for nearly zero energy hotels in Europe.

Zone	EP [kWh/m <sup>2</sup> ·a]	Energy uses	RES [%]
Zone 1	55	Heating,	50
Zone 2	60	cooling,	35
Zone 3	95	domestic hot water,	35
Zone 4	115	HVAC aux, lighting	25

Being the national implementation of the nZEB definition late at the national level, the neZEH project had to face the hard task of defining its own benchmarks, by exploiting the information available so far. Therefore, despite the rigorous methodology followed to define the neZEH benchmarks, some critical considerations are needed:

- the existing definitions exploited refer to new buildings;
- the figures are now settled as fixed figures, which do not take into account the cost-optimality approach.

Considering the cost-optimal level of energy performance for refurbished buildings will necessarily lead to an increase of these benchmarks. While new buildings can nowadays be easily designed as zero energy buildings, refurbishment actions have to face many technical constraints which may not allow to reach the target. ■

**References:** See the complete list of references of the article in the html-version at [www.rehva.eu](http://www.rehva.eu) -> REHVA Journal

**Table 6.** Reduction percentages of primary energy for existing buildings to calculate national benchmarks for hotels.

Country	Hotels hosting function Primary Energy 2008 level [kWh/(m <sup>2</sup> ·a)]	Hotels hosting function Primary Energy neZEH benchmark (with appliances added) [kWh/(m <sup>2</sup> ·a)]	Percentage reduction [%]
Croatia	398	76	81
France	352	117	67
Greece	418	76	82
Italy	222	71	68
Romania	395	79	80
Spain	240	72	70
Sweden	520	136	74

# Water and energy nexus at the building level



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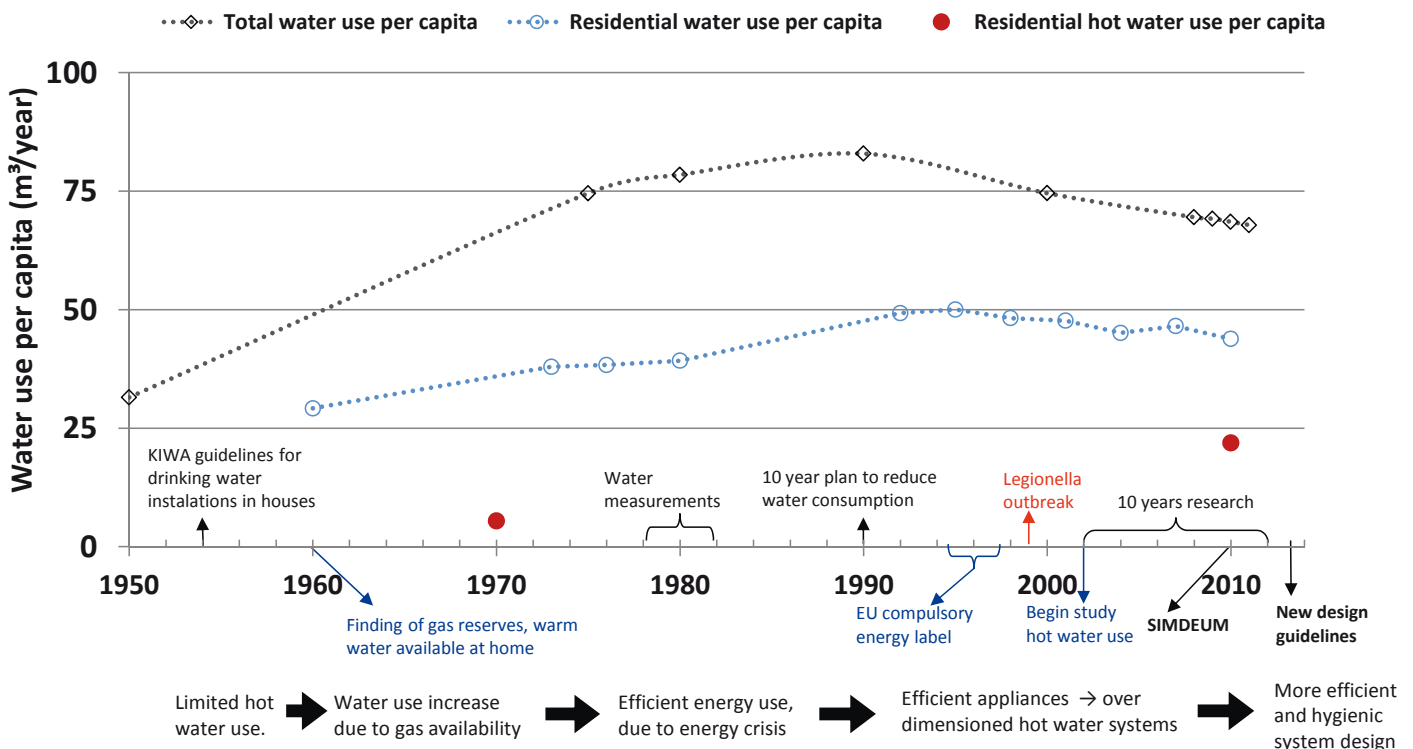
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**Keywords:** water use, water consumption DHW, domestic hot water, water system, simulation, shower, hotels

## Introduction

In recent years, the attention given to the water-energy nexus has grown. Although insight in the energy needed to run our water systems has gained, little is known about

the water-energy nexus at the building level, specifically, regarding hot water use. For the Netherlands, total water consumption per capita and residential water consumption is well known, see **Figure 1**. However, reference to



**Figure 1.** Overview of the changes in the total and residential water consumption per person per year, in the Netherlands.

hot water use is often not reported. In 1970, hot water consumption was estimated at 15 litres per person per day (l/pd). Currently it is estimated that a person uses about 60 l/d of hot water of 40°–60°C, for personal cleaning and kitchen use. Additionally, 13 l/pd of hot water is heated in the washing machine and dishwasher (Blokker et al., 2013). For non-residential buildings, there are no comparable estimates available. Until 2013, the design of the drinking water and hot water system of non-residential buildings was based on outdated assumptions on peak water demand and on unfounded assumptions on hot water demand. In this article we describe the influence of changes in (hot) water use at the building level in the last decades, in the Netherlands. Results show the close interdependency between water and energy over time, and describe an integrated approach towards a more efficient design considering water and energy flows at building level simultaneously.

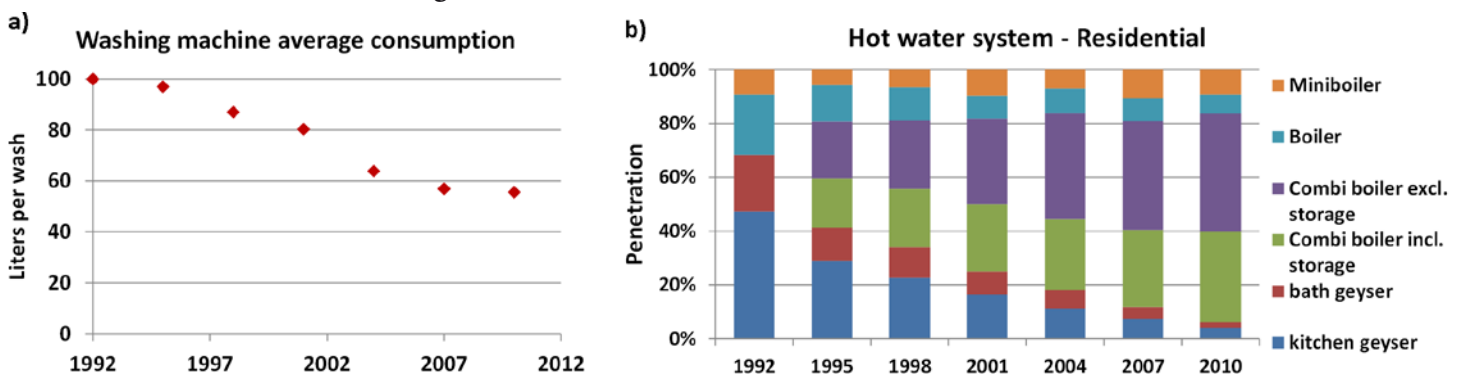
### Introduction of hot water

In the Netherlands, piped drinking water supply began in 1853 and in 1950 the ratification of the Water Supply Act, made nation-wide coverage mandatory. In 1954, the guidelines for the construction of drinking water installations adopted the method to calculate the peak consumption from the German Guidelines<sup>1</sup>. In the 1960s, a period characterized by rapid growth, prosperity and social changes began, driven by the discovery of large quantities of natural gas. Within a few years, almost all Dutch households started to use natural gas, pushing the development of new appliances, and stimulating the adoption of showers. Low gas prices and national campaigns to promote hygienic practices, led to changes in routines by increasing showering frequency. By 1970, 99% coverage of piped drinking water was achieved and 97% of the new houses had hot water and a shower or a bath, see **Figure 1**. Such historical

development data for non-residential buildings are not available.

### Towards a more efficient water and energy use

Changes in technology penetration and in user behaviour, led to an increase in the water demand, with a peak in the 1990s. In 1991 the government established the third 10 year plan to slow down this trend. Transitions after the 1990s can be logically related to technological development such as water saving devices, where, National and European regulations have been a catalyst. To slow down the increasing hot water use, the National Consultation for Hot Water Platform<sup>2</sup> was formed. In 1994 guidelines for drinking water systems in households<sup>3</sup> was published considering the reduction of water and energy consumption and the consequences for the design of drinking water systems. In 1995 the government, water companies, energy companies and other relevant market parties signed a cooperation declaration Approach for Hot Water Conservation<sup>4</sup>. In 1997 European legislation made energy labelling mandatory for washing machines, and for dish washers in 1999, which specifies the energy and water consumption of an appliance and grades overall energy performance. As a consequence, the average consumption per washing load of washing machines is almost halved starting from 100 litres in 1992 (**Figure 2a**). Most of the energy consumption of washing machines is for heating water, thus less water per cycle means lower energy use. Furthermore, new European norms of sanitary fixtures were developed that take specific water consumption into account, e.g. NEN-EN 1112 of 1997. Energy efficiency has been a constant driver in the last two decades, as shown in the transition towards more energy-efficient systems to heat water at residential level (**Figure 2b**). This transition has been supported by technological developments while comfort and user behaviour were not affected.



**Figure 2.** Transition towards more efficient energy efficient appliances in the last two decades a) average water consumption per wash, b) penetration of different hot water systems at residential level.

1 Richtlijnen voor de aanleg van drinkwaterinstallaties

2 Nationaal Overlegplatform Warmwater

3 ISSO - 30 Tapwaterinstallaties in woningen

4 Aanpak Warmwaterbesparing

Despite all these changes in appliances and increasing hot water use, Dutch guidelines on design of drinking water installations for non-residential buildings were, until recently, based on measurements carried out between 1976 and 1980 and there were no guidelines for predicting hot water use. As a result, suppliers of heating systems use company specific guidelines. In general, these old guidelines overestimate the peak demand values. These peak values are crucial for the optimal design of the water system. Badly designed systems are not only less efficient and therefore more expensive, but can also cause stagnant water, possibly leading to increasing health risks.

### Determining design rules for efficient water-energy design at the building level

In the late 1970s, it was found that the “new” dangerous *Legionella* bacteria could grow in hot water. It was only after 1999, after a catastrophic outbreak, that strict regulations for *Legionella* prevention in drinking water were introduced in The Netherlands. Audits of water companies made clear that a lot of water systems were not safe enough. The need for safe and reliable (hot) water systems was recognized, giving a boost to the development of new insights for the design and implementation of hot water installations. In 2001, guidelines for drinking water installation for buildings ISSO-55 were published, in which (hot) water use was still based on old measurements and calculation methods.

Understanding hot water demand is essential to select the correct type of water heater as well as the design capacity of the hot water device. For a proper design of (hot) water systems, the instantaneous peak demand or maximum momentary flow ( $MMF_{cold}$ ), the peak demand of hot water, i.e. maximum momentary flow ( $MMF_{hot}$ ) and the hot water use (HWU) need to be determined. A reliable estimation of these values for an arbitrary building (type and size) by on-site measuring would require an intensive and expensive measuring campaign and would consume a lot of time. Therefore, in 2003, the water companies and the installation sector (TVVL / Uneto - VNI) commissioned KWR Watercycle Research Institute to investigate the possibilities of simulating the (hot) water demand patterns. This led to the development of SIMDEUM® (SIMulation of water Demand, and End-Use Model). SIMDEUM simulates water demand over the course of the day on a per-second basis, based on information on end uses, fixture characteristics and user behaviour.

### Approach to simulate (hot) water use patterns

SIMDEUM for non-residential water demand follows a modular approach. Each building is composed of functional rooms, characterised by its typical users and water-using appliances. The characteristics of the users and the appliances are different for each type of building and are extensively described (Blokker et al., 2010; Blokker et al., 2011). Different categories were researched viz. office, hotel, nursing home. Within each category different typologies were defined. The typologies vary in types of appliances, like types of toilets, flow of showers, and in the type of users, like business or tourist hotel guests. With this approach, water demand patterns over the day for cold and hot water demand were simulated for a specific building. From these daily water demand patterns, the characteristic peak demand values of cold and hot water during various time steps were derived. These characteristics formed the basis for new design guidelines. A more detailed description and validation of the method is described in Pieterse-Quirijns et al., (2013). The validation shows that the model predicts the cold and hot water daily demand patterns reasonably well to good. **Figure 3** shows the validation for a nursing home.

With this 10 year study, more insight into the actual (hot) water consumption was gained. Simulating the water demand patterns with SIMDEUM showed to be a reliable method to predict water peaks and daily water patterns, leading to an update in the guidelines for design of hot water systems. Detailed insight into water use per functional room was also gained, allowing for a customized design per building. **Figure 4** shows the variation of (hot) water consumption per bedroom for a business hotel with two different shower types and for different hotel size. It shows 40–50% of total water use in hotels is heated.

Based on the results, new design rules were determined and better understanding of the water and energy nexus at building level according its function was gained. The design rules allow a better choice of the hot water system, resulting in smaller systems using less energy. Additionally, the stagnancy of water is reduced, thus less hygienic problems are expected. In the revised version of the ISSO 55 guidelines, the new design rules based on SIMDEUM are included.

### Integrated approach for water and energy

The end-use approach of SIMDEUM allows simulating and understanding hot water demand for different buildings. SIMDEUM determines (hot) water use as well as the energy use related to water-use activities, providing a better understanding of the water-energy nexus at

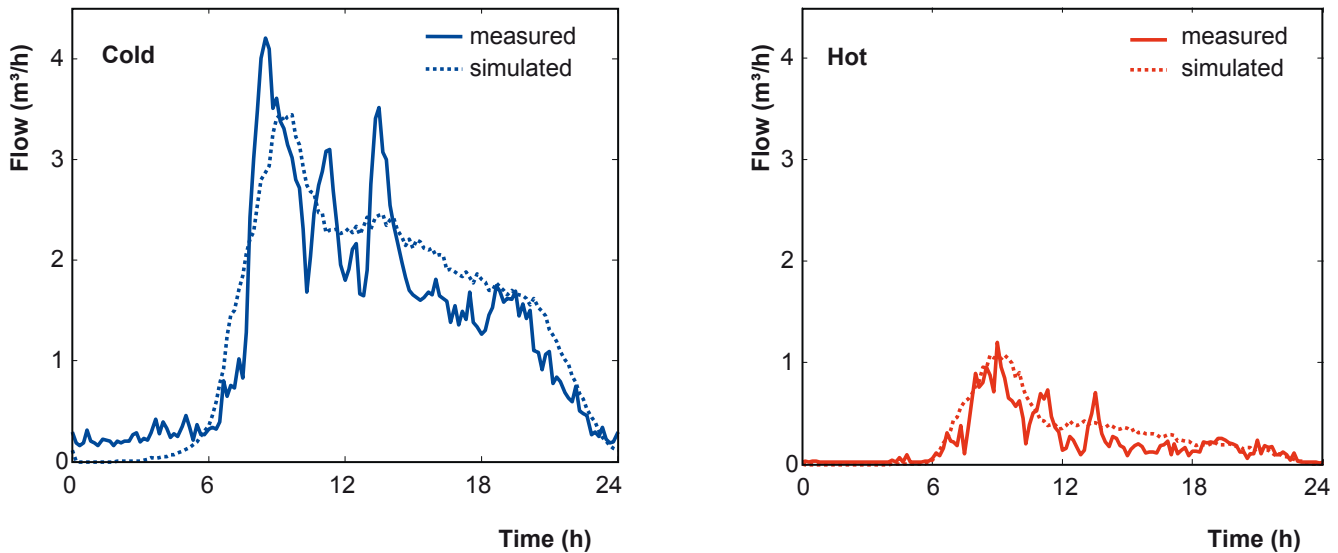


Figure 3. Validation of the design rules for cold and hot water use in a nursing home.

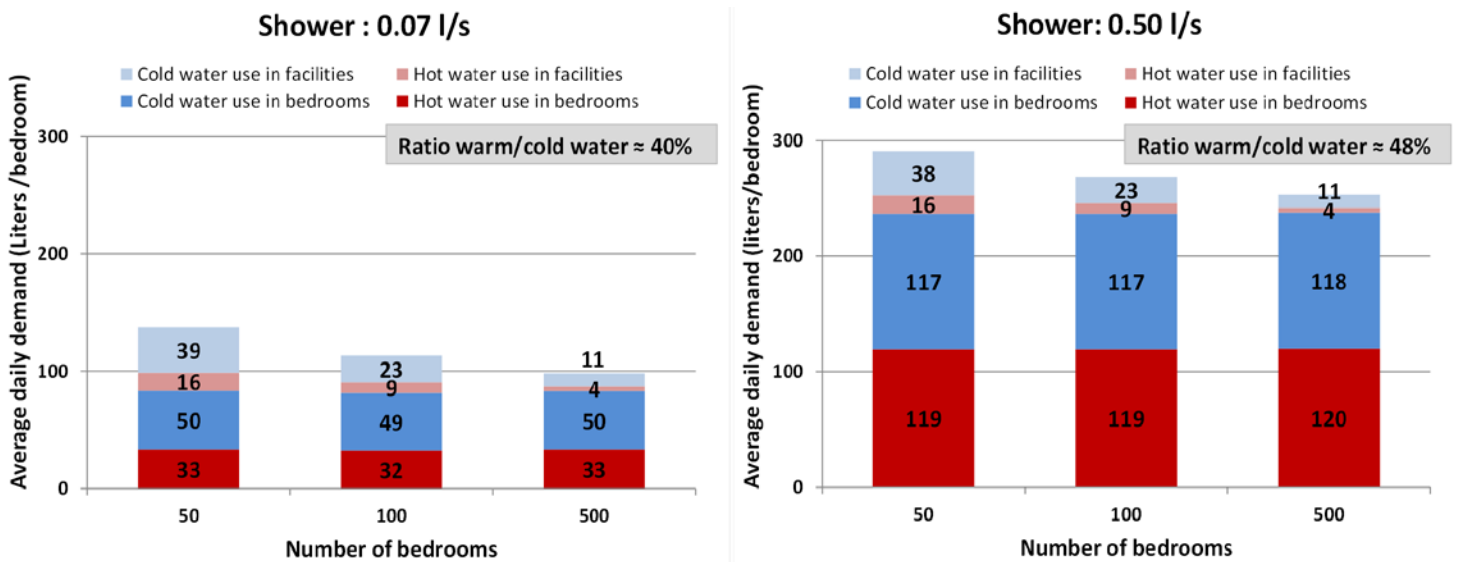


Figure 4. Variations in the daily water use in a business hotel according to number of bedrooms. a) for a water saving shower head and b) for a luxurious shower head.

the building level. Furthermore, recent technological developments such as drain water heat recovery systems, require insight into the characteristics of the drainage loads. SIMDEUM is being extended to calculate discharge characteristics, which can be used for instance to design these new systems. Moreover, SIMDEUM's approach facilitates scenario studies considering changes of fixture characteristics, legislations or user behaviour, to predict future water and energy use of buildings.

### Conclusions

Water-energy nexus at the building level is strong but complex since it is specific for each building type.

Moreover, it depends on user behaviour and fixture characteristics, which change over time driven by different factors, from legislation to comfort. New flexible approaches such as SIMDEUM, which consider water and energy simultaneously, support the design of more efficient resource use at building level. ■

**References:** See the complete list of references of the article in the html-version at [www.rehva.eu](http://www.rehva.eu) -> REHVA Journal

# Why energy monitoring and feedback is essential to achieve sustained energy efficiency in EU buildings

**Keywords:** monitoring, inspections, AC inspections, electricity use, EPBD, air conditioning, Harmonac project, iSERV project



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## Simplifying a problem

The EU has produced The Energy Efficiency Directive [1], the original and recast Energy Performance of Buildings Directives [2,3], and the Eco-design of Energy-Related Products Directive [4] amongst other legislation all designed to achieve one end – the reduction of **unnecessary** energy use within the EU.

This paper proposes that achieving low energy consumption buildings across Europe could be significantly simplified for all actors by making **all legislation** revolve around more detailed measurements, analysis and feedback of energy end use – energy efficiency being the ultimate target of the legislation and also an accurately quantifiable parameter based on existing technologies.

The paper supports this hypothesis by presenting a brief look at the emerging results from iSERVcmb ([www.iservcmb.info](http://www.iservcmb.info)), a European Commission funded IEE project that examines the achieved impact from trialling such an approach in Buildings and Heating, Ventilating and Air Conditioning (HVAC) Systems across the EU Member States. The iSERVcmb project implements a detailed Monitoring, Feedback and Benchmarking system for energy use in buildings, but the principles of measure, record, analyse, benchmark and feedback, could equally be applied to the Industrial and Transport sectors.

## Predicting Energy Efficiency in Buildings

The actors and parameters affecting power demands and energy use within buildings are well known, but we are aware from predicted and measured performance data for recent buildings that there is often still a significant performance gap between modelled energy predictions and reality.

There is, however, now a practical and affordable alternative approach to the use of computer models alone for predicting the in-use energy performance of buildings. This alternative approach has arisen in recent years from the rapid reduction in the cost of detailed energy sub-metering along with the almost universal embedding of intelligence and connectivity into even the smallest electronic component. For building services this manifests itself in the form of internet connected Air Handling Units, Pumps, Cold Generators, etc.

The ready availability of data on the actual energy consumption of individual items of equipment, along with other useful parameters such as temperatures, flow rates, etc., means that we can now use statistical information to help predict the likely energy performance ranges for buildings. The reliability of such an approach still depends on accurate characterisation of the main parameters which contribute towards this energy use but the time demands appear considerably less onerous than for modelling. The approach also allows for frequent feedback on performance being achieved.

A 'measured data' based approach at this level of detail also has the critical advantage of using actual operational data for specific items in specific buildings serving specified activities. This means the end user can understand not only what is being used but can also pinpoint where it is being used. The IEE HARMONAC [5] and iSERVcmb projects have observed that this type of data



**Table 1.** iSERV estimates and measurements of costs and benefits for recast EPBD compliance options.

Topic	Inspection	Monitoring	Advice
Cost	<b>100 – 250 EUR</b> (Compliance) <b>0.5 – 2.5 EUR/m<sup>2</sup></b> (EPBD)	<b>0.1 to 2.0 EUR/m<sup>2</sup></b> setup <b>0.1 to 3.0 EUR/m<sup>2</sup></b> ongoing	Not known
Savings	Estimate (HARMONAC): <b>2.0 to 3.2 EUR/m<sup>2</sup></b> at best	Measured (small sample): <b>9.0 – 14.0 EUR/m<sup>2</sup>/a</b> (electrical) Up to 33% building elec use	Not known
<b>Net savings</b>	<b>-100 to -250 EUR or -0.5 to 2.7 EUR/m<sup>2</sup></b>	<b>1.0 to 13.0 EUR/m<sup>2</sup>/a</b>	<b>Not known</b>
Impact assessment	No feedback route	Data allows precise 'before' and 'after' impact studies	No feedback route
Comments	<ul style="list-style-type: none"> <li>– Difficult to show impact.</li> <li>– Savings not likely to be sustainable where intervention is needed.</li> <li>– Savings difficult to maintain.</li> </ul>	<ul style="list-style-type: none"> <li>– Initial setup can be costly.</li> <li>– Requires more attention than inspection or advice.</li> <li>– Provides detailed understanding of energy use.</li> <li>– Reduces investment risk.</li> <li>– Proven real energy savings.</li> <li>– Helps maintain savings</li> <li>– Provides data for design decisions</li> </ul>	<ul style="list-style-type: none"> <li>– Difficult to show impact.</li> <li>– No mechanism for drawing attention to energy use.</li> <li>– Not clear how it will help maintain energy savings.</li> </ul>

appears critical in persuading the end user to undertake action when it can be shown to lead to a likely useful energy saving.

The IEE iSERVcmb project is based on the above alternative approach and its impact is being trialled in operational buildings in at least 20 EU Member States.

### Operation of a Monitoring and Feedback Benchmark scheme at Member State level

The iSERVcmb project has been undertaken to explore the impact on energy use of implementing a metering and feedback system at building services component level across the EU Member States as encouraged by the recast EPBD in Articles 8, 14 and 15:

*“Member States shall encourage the introduction of intelligent metering systems whenever a building is constructed or undergoes major renovation ... Member States may furthermore encourage, where appropriate, the installation of active control systems such as automation, control and monitoring systems that aim to save energy.”*

Strictly speaking iSERVcmb is an intelligent use of Metering Systems to provide Feedback to Actors to enable energy savings. At this stage of implementation it was considered neither sensible nor desirable to provide active automatic control of systems via the project – though this would have been feasible.

### The iSERVcmb project impact

The full details of iSERVcmb are available from the project website ([www.iservcmb.info](http://www.iservcmb.info)). For this paper only the measured or estimated costs and energy savings from iSERVcmb compared to acceptable recast EPBD legislative alternatives are presented in **Table 1**.

The Inspection costs presented are actual costs taken from a sample of EU MS's and cover the two types of Inspection that seem to be undertaken in practice – a 'compliance' Inspection cost and a 'proper' Inspection in the spirit of the EPBD intentions. The 'compliance' Inspection reports appear to be universally ignored by the recipients, so they are considered to be a net cost in the savings section. All other costs presented have been measured or calculated from operational buildings, except the net savings presented. Here the completed sample is too small at present to have confidence in the measured savings shown, so a conservative range of 1 to 13 Euros/m<sup>2</sup> has been presented based on expected final performance ranges to be obtained from the 1400+ systems in iSERV.

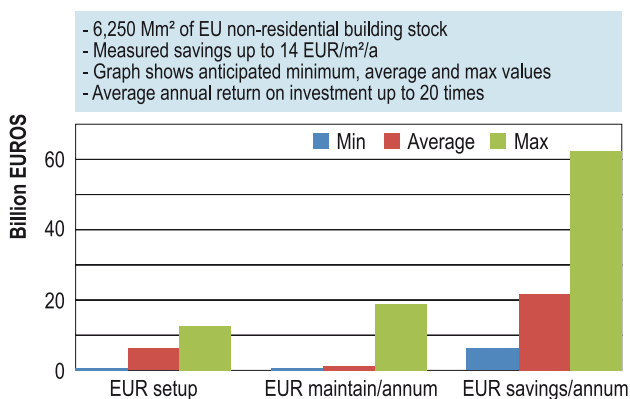
The table also shows the anticipated impact on energy use from each of the three compliance options offered by the EPBD. The new route of providing 'Advice' has not been able to be assessed but expectations based on observations during the HARMONAC and iSERVcmb projects suggest this will probably have less impact than hoped for, as there is no clear compliance requirement

and therefore owners are likely to react with little enthusiasm, as they have already reacted to Inspections.

## Potential savings to accrue at EU level

From the figures shown in **Table 1** the ranges of calculated costs and potential saving values at stake from implementing an iSERVcmb-type approach at the EU level are presented in **Figure 1**. This calculation uses the non-residential floor area estimate from BPIE [6].

**Figure 1**, derived from the findings of the iSERVcmb and HARMONAC projects, shows that the risk of not achieving substantial annual energy and net cost savings across the EU MS would appear low. The EU's potential **annual** cost savings from energy reductions are calculated to be between 6 and 60 Bn Euros, with an average saving likely to be just over 20 Bn Euros. The estimated annual cost of maintaining the Monitoring system are anticipated to be below 1 Bn Euros across all EU MS, with most of these costs borne by the end users – who should also accrue most of the savings. It appears that annual returns on investment will be significantly greater than costs on average.



**Figure 1.** Potential maximum/minimum/average costs and returns from implementing iSERVcmb across the EU Member States.

## Implementing an Automatic Monitoring & Feedback (aMF) system at EU MS level

The route to implementation of an iSERVcmb-type approach first needs legislation to permit aMF systems and benchmarking at the individual MS level, as already provided for in the recast EPBD.

However, the recast EPBD also now allows the provision of Advice as a means of compliance, as well as retaining the Inspection route, both of which appear easier for MS to enact. Therefore they are currently the more appealing route for many MS legislators.

It is anticipated that once iSERVcmb has shown the energy and cost savings possible from implementing a benchmark-type approach to achieving energy efficiency in buildings that a number of MS may be persuaded to implement such an approach as the third alternative for end users during their transposition of the recast EPBD or its future evolution. This would allow those organisations who wish to employ automatic monitoring as a means of controlling their energy use to also use the same data to help meet their compliance obligations.

Once an aMF benchmark system has been implemented at a Member State level then this is a win-win situation for both the MS and the organisations who adopt this approach to compliance.

## Conclusions

This paper has provided a brief overview of why independent large-scale Energy Monitoring, Feedback and Benchmarking systems are likely to be the key to helping achieve significant energy reductions in existing and future buildings in the EU.

The main hurdles to achieving energy efficiency in real buildings that such an approach would help overcome include:

- The reduction of risk to all actors trying to achieve energy savings in specific building design and operation situations
- Allowing end users to participate in their energy use reduction by providing them with a route to do so
- Establishing better market conditions for energy efficient products for manufacturers
- Establishing a clearer basis for an Energy Services market, thus allowing the establishment of better trust between the parties involved
- Establishing a clear link between design intent and achieved results, thereby allowing robust energy efficiency solutions to become established. This is essential to understanding what is possible for low or zero energy buildings to achieve when servicing real end use activities
- Dividing ownership of the energy consumption between landlords and tenants, allowing clear responsibility for achieving energy savings in specific areas.

The potential energy savings at stake are substantial, and appear to be achievable for very attractive rates of return in many cases. It is hoped that the iSERVcmb project will prove persuasive enough to trigger the widespread deployment of Monitoring and Feedback systems throughout the EU MS. ■

## Acknowledgements

The author wishes to acknowledge the contributions of all the Partners and contributors to the iSERVcmb project in producing the information presented in this paper. The author also wishes to thank the European IEE programme for funding the iSERVcmb project and to note that the sole responsibility for the content of this paper lies with the author. It does not necessarily reflect the opinion of the European Union. Neither the EACI nor the European Commission are responsible for any use that may be made of the information contained herein.

## References

- 1 Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC Text with EEA relevance. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32012L0027:EN:NOT>. Accessed 09/12/2013
- 2 Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002L0091:EN:NOT>. Accessed 20/11/2013
- 3 Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast). <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32010L0031:EN:NOT>. Accessed 20/11/2013
- 4 Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products (Text with EEA relevance). <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009L0125:EN:NOT>. Accessed 09/12/2013
- 5 Knight I et al – "HARMONAC - Harmonizing Air Conditioning Inspection and Audit Procedures in the Tertiary Building Sector. Energy Consumption in European Air Conditioning Systems and the Air Conditioning System Inspection Process – FINAL REPORT", Intelligent Energy Europe Project Number: EISAV/EIE/07/132/2007. European Commission, October 2010. ISBN: 978-1-899895-50-2. [www.harmonac.info](http://www.harmonac.info) and [http://www.eaci-projects.eu/iee/page/Page.jsp?op=project\\_detail&prid=1605](http://www.eaci-projects.eu/iee/page/Page.jsp?op=project_detail&prid=1605) Accessed 20/11/2013
- 6 Buildings Performance Institute Europe (BPIE) - Europe's buildings under the microscope: A country-by-country review of the energy performance of buildings, October 2011. ISBN: 9789491143014

## IEA Heat Pump Centre Focuses on HP Efficiency in Real Conditions



In technical product development in any field, one needs to track performance of the product, to check if a specific modification resulted in an improvement or not. Also, the end user wants his purchased and installed product to perform as specified (at least), and needs methods to check this. Further, other actors along the developing, marketing and dissemination chain need to be aware of the end-user's reaction and needs – and preferably be able to anticipate them. All this calls for performance monitoring and evaluation.

The topic of the recent issue of the IEA Heat Pump Centre Newsletter is Heat pump performance monitoring and evaluation. A summary of the long-term heat pump field monitoring is provided, as well as evaluations of a part-load performance of an air conditioner, and of a foundation heat exchanger. Also, a method for on-line monitoring and evaluation of heat pump performance is described. In addition, you will find a Strategic Outlook from the US.

The IEA HPC Newsletter is a newsletter/journal from the IEA Heat Pump Centre (HPC) with four issues per year. The HPC is an international information service for heat

pumping technologies, applications and markets. Visit the website at [www.heatpumpcentre.org](http://www.heatpumpcentre.org)

The IEA Heat Pump Centre Newsletter can be downloaded (free for readers in HPP member countries) from [www.heatpumpcentre.org/en/newsletter/Sidor/default.aspx](http://www.heatpumpcentre.org/en/newsletter/Sidor/default.aspx)

*The Heat Pump Centre (HPC) is the central information activity of the IEA Heat Pump Programme (HPP). HPP operates under the International Energy Agency (IEA) and was founded in 1978. The current member countries are Austria, Canada, Denmark, Finland, France, Italy, Germany, Japan, the Netherlands, Norway, South Korea, Sweden, Switzerland, United Kingdom and the United States.*

*The IEA Heat Pump Programme is a non-profit organisation under which participants in different countries cooperate in projects in the field of heat pumps and related heat pumping technologies such as air conditioning, refrigeration and working fluids (refrigerants). Under the management of an Executive Committee representing the member countries, the Programme carries out a strategy to accelerate the use of heat pumps in all applications where they can reduce energy consumption for the benefit of the environment.*

# New Ecodesign regulations from the Commission



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The Ecodesign Framework Directive 2009/125/EC establishes a framework for setting ecodesign requirements for energy-related products. It is a key instrument of EU policy for improving the energy efficiency and other aspects of the environmental performance of products. The Eco-design directive does not set binding requirements on products by itself, but it provides a framework (rules and criteria) for setting such requirements through implementing measures. For products intended to consumer use, binding rules for energy labelling are usually prepared in parallel with ecodesign regulations. In the author's previous articles in REHVA Journal 1/2013 and 4/2013, some main principles and a few processes of preparation were introduced. This article gives some further news on "hot topics" relevant to HVAC, plus brief notes on a few new studies.

**Keywords:** ecodesign, energy related products directive, boilers, solid fuel boilers, space heaters, residential ventilation, ventilation units

The preparation of the implementing measures is a long process - the preparatory work in the "Lots" and other phases are introduced in more detail on REHVA EU Regulations webpages, at <http://www.rehva.eu/index.php?id=79>.

REHVA, as an acknowledged stakeholder, was invited by DG Energy to submit a position paper by end of September as part of the review of the Energy Labelling and the Ecodesign Directives. With contribution of the members and supporters, the REHVA submitted the position paper, which was published in the REHVA News section in the REHVA Journal October issue (5/2013) and at the REHVA website: [http://www.rehva.eu/fileadmin/news/ecodesign\\_labelling\\_rehva\\_position.pdf](http://www.rehva.eu/fileadmin/news/ecodesign_labelling_rehva_position.pdf).

The position paper, generally speaking, supports the main principles of the Ecodesign and Energy Labelling Directives, but also expresses deep concern on many features of the legislation process and gives a few recommendations to improve coordination with other linked legislation, standardization and certification processes, to extend stakeholder consultation to cover the entire regulatory process, to pay attention to health and environmental issues in parallel with energy issues, and to improve the information flow to stakeholders about the rapidly changing and growing EU regulations.

The position paper also states "...Many product groups have already voluntary certifications systems including the performance criteria developed by industry. Very few of these have been acknowledged during the preparation of the regulations. These certification systems are well established in the market and should be used as a starting point when developing new regulations." For a few product groups, however, existing certification schemes are applicable even now and can be further developed to offer a verification programme completely in line with new EU regulations.

## Boilers and space heaters – some highlights from discussions

As informed in REHVA Journal 5/2013, the new Labelling and Eco-design regulations for liquid and gaseous fuel boilers and water heaters have been published in the Official Journal in September 2013. Energy labelling criteria for space heaters are described in an article in the same issue.

The status of the regulatory process for solid fuel boilers and local space heaters was introduced in REHVA Journal 4/2013.

For solid fuel boilers (Lot 15), the upper limit of rated heat output was extended from 500 kW to 1 000 kW, bringing some new manufacturers within the scope. This change has caused some concern among stakeholders, who have serious doubts about the availability of reliable test facilities for large >500 kW boilers.

As a whole, the new proposal received several critical comments before the Regulatory Committee meeting. The most critical comments concerned the changed emission requirements which, according to several national responses, were considered too stringent. Some comments stated also that the required low concentrations cannot be measured with reasonable accuracy. This indicates a need for new measurement methods and equipment, possibly new or completely revised standards and pre-normative research.

Instead of step by step tightening requirements, now all main requirements would enter into force four years after publication of the regulation. This is also one reason of concern, because the stakeholders' feedback indicates major needs for product development and also major changes in production lines.

At the time of writing this article the situation is still open, because no consensus was possible at the scheduled meeting of the Regulatory Committee.

For local space heaters (Lot 20), as in the case of solid fuel boilers, changes have also been made in the proposals, including the scope and the list of excluded products. In the case of heaters using solid fuels, the emission limits were regarded by stakeholders unrealistic as in the case of solid fuel boilers. And it looks also very difficult to give a regulation which treats electrical space heaters in an equal way as heaters using other energy carriers. At the time of writing this article, it looks possible that the regulation will be split into two, one for heaters using solid fuels (possibly merged with solid fuel boiler regulation), and one for electrical local space heaters.

## Ventilation units – approaching the final voting

For Ventilation units, the Consultation Forum was held in October 2012 to discuss the draft regulation. The draft was based on the “Ventilation” parts of ENER Lot 10 and ENTR Lot 6. One key issue there

is that the borderline between “residential ventilation units” and “non-residential ventilation units” has now been defined. Units with fans of less than 125 W power input were regarded as “residential”, and larger ones as “non-residential”. The proposed regulation, however, gives the manufacturer the possibility to decide the category of the unit independently of the size. Labelling requirements are being prepared for “residential ventilation” only.

The main requirements were proposed for the efficiency of heat recovery, which has been proposed to become mandatory in all supply/exhaust ventilation units of all sizes, and for the maximum energy consumption of the fans, expressed in different terms for residential and non-residential units. For residential units, the specific power input (SPI) shall not exceed a given maximum value, and for non-residential units it was proposed to a minimum fan efficiency and a maximum face velocity in the unit, as defined in EN 13053.

In September 2013, a new Working Document was sent to the Member States for comments, in order to prepare the final voting at the Regulatory Committee, scheduled to be held in December 2013. Now the borderline between “residential” and “non-residential” units is expressed in a different way, instead of fan power this is now related to the nominal air flow, as follows:

*“Residential ventilation unit” (RVU) means a ventilation unit fulfilling one of the following conditions:*

- (a) *the maximum flow rate does not exceed 250 m<sup>3</sup>/h;*
- (b) *the maximum flow rate is between 250 and 1 000 m<sup>3</sup>/h, and the manufacturer declares its intended use as being exclusively for a residential ventilation application”*

For residential ventilation units, the main requirement is now expressed as a “Specific Energy Consumption for ventilation per m<sup>2</sup> heated floor area of a dwelling or building” (SEC). The main parameters affecting the SEC value are the recovered heat from extract air and the fan energy consumption, but also many other parameters like the type of control of the unit, the motor and drive type, and possible defrosting are also taken into account. This SEC value was actually introduced already in 2012 but only in the Consultation Forum draft for Labelling, not for Ecodesign. The SEC value actually depends on the climate, which also makes both the definition and the calculation very complicated. So, the SEC value cannot be purely

regarded as a value for a product only, and it is interesting to see how stakeholders in different countries and climates will find it. For most of the parameters, default values are given in the draft Regulation.

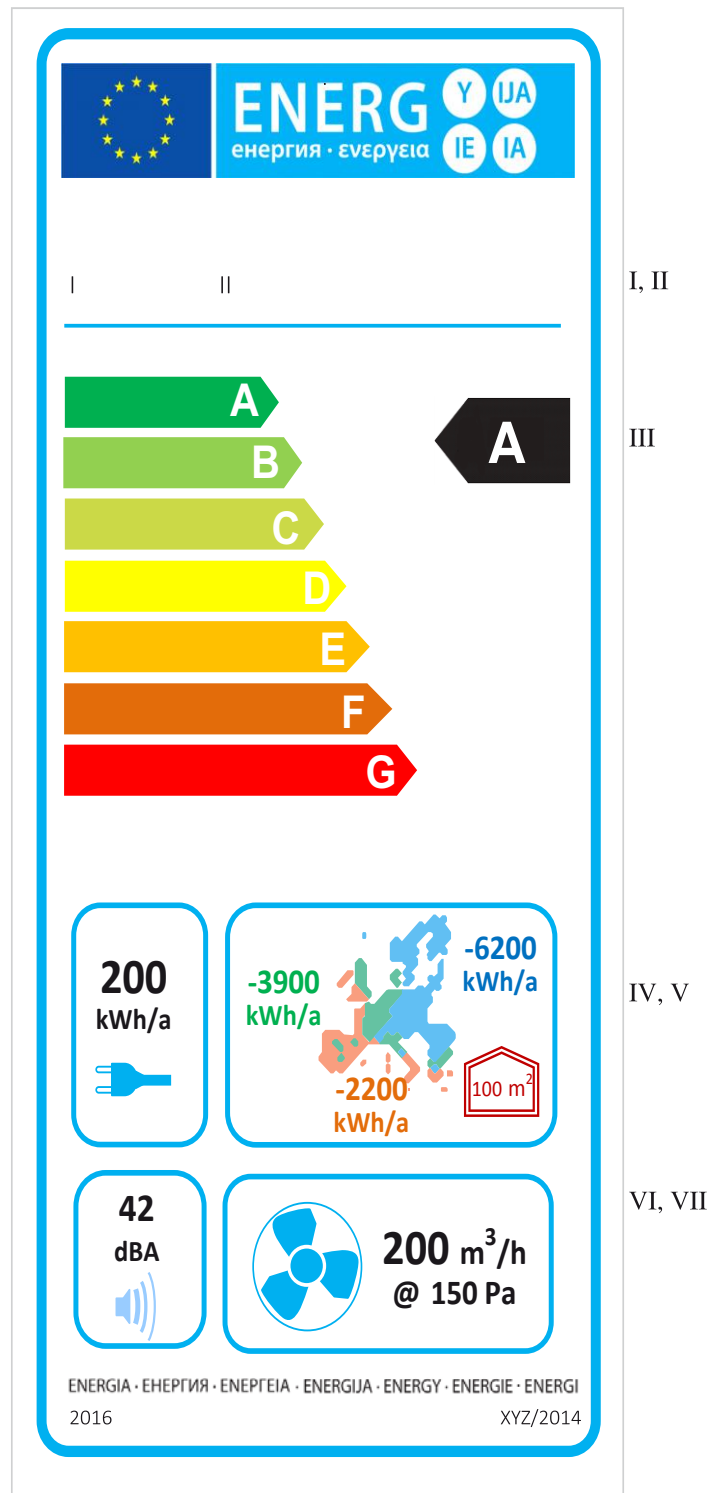
The SEC value also determines the energy class in the energy label of residential ventilation units. The label shall also include the following information, see **Figure 1**:

- annual electricity consumption
- heating energy saved (in “cold”, “average” and “mild” climates)
- sound power level
- maximum flow rate.

The most significant change for non-residential ventilation units was to replace the fan efficiency and face velocity requirement by the Specific Fan Power (SFP). However, the SFP is defined in a new way, different from the definition in the current EN 13779, here as “internal specific power of ventilation components”, taking into account only the filters and heat recovery components and excluding from the calculation all air treatment components. The ongoing revision of EN 13779, however, can give an opportunity to bring the product and system requirements in line with each other.

The proposed maximum internal specific fan power of ventilation components is depends on the nominal air flow and the type of heat recovery unit. In addition, the equation to determine the maximum internal SFP includes an “efficiency bonus” if the heat recovery system has an efficiency higher than minimum, and also a “filter correction” which is kind of penalty in case the ventilation unit is equipped by lower class filters than a “reference configuration”, in which the supply side filter is a clean fine filter F7 and exhaust side filter is a clean medium filter M5. In addition, the maximum SFP depends on the nominal air flow of the unit.

If the proposed regulations are approved at the Regulatory Committee, then the requirements will enter into force in two steps: first in 1<sup>st</sup> of January 2016, and more stringent requirements in 1<sup>st</sup> of January 2018. For example, the minimum efficiency of a non-residential ventilation unit with a run-around heat recovery will be 63% from 1<sup>st</sup> of January 2016,



**Figure 1.** Proposed layout of the energy label for residential ventilation units. The label shall provide the following information: (I) supplier’s name or trade mark, (II) supplier’s model identifier; (III) energy efficiency class - energy efficiency is indicated for an ‘average’ climate; (IV) annual electricity consumption, (V) annual heating saved (AHS) with a map of Europe displaying three indicative heating seasons and corresponding colour squares, accompanied by a ‘house’ symbol with the text ‘100 m<sup>2</sup>’ (VI) sound power level (LWA) in dB, (VII) maximum flow rate in m<sup>3</sup>/h

and 68% from 1<sup>st</sup> of January 2018, for other types of heat recovery system the minimum is 67% (2016–) and 73% in 2018.

### Central heating and cooling products – Consultation Forum

Compared to boilers and ventilation units, these products are “one lap behind”, Consultation Forum in mid-December 2013, indicating the final voting in Regulatory Committee approximately in autumn 2014.

The products covered by the original “Lot 21” are now accompanied by a few groups of cooling products. The entire scope of the draft regulation is the following:

- a) air heating products, with a nominal load or rated heat output not exceeding 1 MW,
- b) cooling products with a rated cooling output not exceeding 2 MW.
- c) fan coil units;
- d) high temperature process chillers.

The Regulation shall not apply to products meeting at least one of the following criteria:

- a) products covered under the scope of Regulation on ecodesign requirements of local space heaters;
- b) products covered under the scope of Regulation No 206/20115 on ecodesign requirements for room air conditioners and comfort fans;
- c) chillers with leaving chilled water temperatures of less than +2°C;
- d) products designed for using predominantly biomass fuels;
- e) products using solid fuels;
- f) products that supply heat or cold in combination with electric power (‘cogeneration’) as a result of a fuel combustion or conversion process;
- g) products within the scope of Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions (integrated pollution prevention and control)

So, the draft regulation is intended to cover products for several different purposes, some of these products are excluded from other regulations. The regulations are proposed to enter into force in three tiers, starting from 1<sup>st</sup> of January 2017. It may also be possible to split up the proposed regulation into more product-specific ones, but this will be subject to the outcome of the Consultation Forum. It will therefore be important to manufacturers and other stakeholders to actively follow the later stages of the regulatory process. ■

### New preparatory studies

- **ENER Lot 28** Ecodesign Preparatory Study on pumps for private and public waste water and for fluids with high solid content. Project website: <http://lot28.ecopumps.eu/>
- **ENER Lot 29** Ecodesign Preparatory Study on pumps for private and public swimming pools, ponds, fountains and aquariums, as well as clean water pumps larger than those regulated under Lot 11. Project website: <http://lot29.ecopumps.eu/>
- For both Lots 28 and 29, second stakeholder meeting was held at the end of May 2013, and third meeting was originally scheduled for December 2013. The “Document” pages on project websites contain links to the most recent task reports and also the outcomes of second stakeholder meetings.
- **ENER Lot 30** Special motors (not covered in Lot 11): Requirements for electric motors are specified in Regulation 640/2009. The aim of lot 30 is to identify improvement potential outside the scope of lot 11. See <http://www.eco-motors-drives.eu/Eco/Documents.html> for project documents. The second stakeholder meeting was held in February 2013, and an intermediate stakeholder meeting in June 2013.
- **ENER Lot 31** Compressors: Project website: <http://www.eco-compressors.eu/> The scope of this preparatory study is described briefly as: “Lot 31 - Products in motor systems outside the scope of the Lot 30 and the Regulation 640/209 on electric motors, in particular compressors, including small compressors, and their possible drives.” The first stakeholder meeting was held on 14 March 2013, and the outcome of the meeting is available on the project website.

For each study, registered stakeholders will receive announcements of new published documents and coming meetings by e-mail.

# Cooling of residential buildings in Germany – prospect or dead end?



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**Keywords:** cooling, air conditioning, summer temperatures, passive cooling, active cooling, precooling, SEER, cooling energy

In addition to the classical fields of building systems engineering in residential buildings, such as heating and domestic hot water, in Germany increasingly more options such as ventilation and cooling are discussed or used.

The reasons for this approach are different. So increased user requirements for the comfort, the discussion of the climate change or the subjective feeling of very hot summer in the recent past can be named.

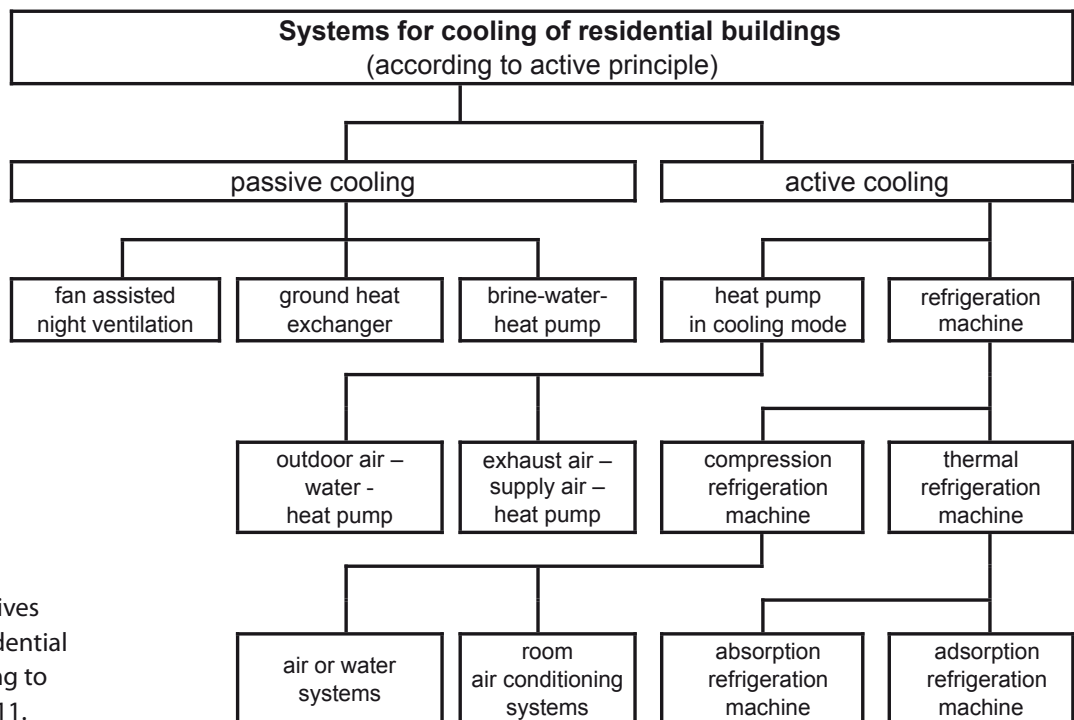
While the focus of the observations in residential buildings is mainly on the winter conditions, the summer room climate in the spotlight moves slowly. Intensive

considerations about the technical, energetic and economic optimization are required to meet the requirements of the summer room conditioning, which are reflected in the current version of the DIN V 18599.

## Energy balancing for cooling of residential buildings in DIN V 18599

### Overview of cooling systems

To facilitate the further development of the German energy saving regulations, the standard DIN V 18599 has been revised and released in 2011. One of the main innovations is the balancing for cooling of residential buildings in part 6. The described cooling systems of residential buildings are classified according to **Figure 1**.



**Figure 1.** Alternatives for cooling of residential buildings according to DIN V 18599-6: 2011.



The focus is on technical solutions, which are realized in connection with heating or ventilation systems. Typical solutions are e. g. use of heat pumps in cooling mode, but also the passive cooling (including ground heat exchangers or fan assisted night ventilation). Of course, conventional cooling systems, such as compression refrigeration machine and split- / multisplit-systems are mapped.

**Precooling versus cooling**

A major difference to cooling in non-residential building represents the often restricted performance of the cooling systems of residential buildings. For this a part load factor  $f_{c,part}$  and a precooling factor  $f_{c,limit}$  are introduced. The part load factor describes the case, that not the entire used area of the building is cooled:

$$f_{c,part} = \frac{A_{N,c}}{A_N}$$

$f_{c,part}$  part load factor  
 $A_{N,c}$  cooled used area (according to design)  
 $A_N$  used area

The precooling factor takes into account, that not all cooling systems for residential buildings for a complete coverage of energy need for cooling being interpreted. This can be caused by limitation of cold generation (e.g. ground heat exchanger or fan-assisted night ventilation) or by a limitation of cold control and emission in the room or cold distribution (e. g. air cooling systems or floor cooling):

$$f_{c,limit} = \min(f_{c,limit,g}; f_{c,limit,ced})$$

$f_{c,limit}$  precooling factor  
 $f_{c,limit,g}$  precooling factor by limitation of cold generation  
 $f_{c,limit,ced}$  precooling factor by limitation of cold control and emission in the room or cold distribution

The purpose of precooling systems is to reduce the room temperature without guaranteed conditions

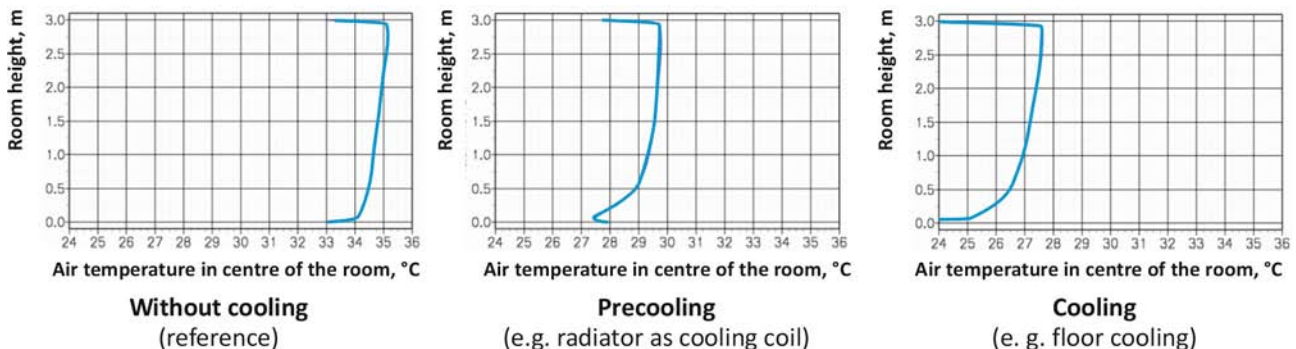


Figure 2. Vertical temperature gradient as a function of the cooling system (examples).

(such as compliance with Category A according to [EN ISO 7730] irrespective of the cooling loads). The resulting thermal conditions in the room can be exemplarily illustrated on the vertical temperature gradient (Figure 2). A cooling is done, however, with the aim of achieving defined comfort conditions even at higher loads and must have corresponding performance reserves.

A precooling (examples of active cooling systems in Table 1) can be the result of a limited cooling capacity (e.g. cold generation by free cooling or cooling by radiators as cooling coil in the room).

Table 1. Maximum cooling capacity of selected systems for active cooling according to DIN V 18599-6.

Control Emission Distribution	Generation			
	Outdoor air – water – heat pump	Exhaust air – supply air – heat pump	Compression refrigeration machine	Room air conditioning systems
Ceiling cooling	20 W/m <sup>2</sup>	–	45 W/m <sup>2</sup>	–
Floor cooling	20 W/m <sup>2</sup>	–	20 W/m <sup>2</sup>	–
Radiator as cooling coil	2.5 W/m <sup>2</sup>	–	2.5 W/m <sup>2</sup>	–
Fan coil	20 W/m <sup>2</sup>	–	45 W/m <sup>2</sup>	–
Ventilation system	–	5 W/m <sup>2</sup>	5 W/m <sup>2</sup>	–
Split / multisplit system	–	–	–	45 W/m <sup>2</sup>

As a result you get a precooling factor in dependency of

- cold generation,
- cold control and emission in the room,
- cold distribution,
- building type and
- level of heat insulation.

Examples for the precooling factors in a new single-family house show **Table 2** for active cooling and **Table 3** for passive cooling according to DIN V 18599-6.

If the precooling factor reached a value of 1, a full cooling can be realized with the system, the energy need for cooling meets completely. With precooling factors less than 1, the energy need for cooling can be partly covered.

**Table 2.** Precooling factor  $f_{c,limit}$  of selected systems for active cooling according to DIN V 18599-6 – new single-family house.

Control Emission Distribution	Generation			
	Outdoor air – water – heat pump	Exhaust air – supply air – heat pump	Compression refrigeration machine	Room air conditioning systems
Ceiling cooling	1.00	–	1.00	–
Floor cooling	0.98	–	0.98	–
Radiator as cooling coil	0.36	–	0.36	–
Fan coil	1.00	–	1.00	–
Ventilation system	–	0.60	0.60	–
Split / multisplit system	–	–	–	1.00

**Table 3.** Precooling factor  $f_{c,limit}$  of selected systems for passive cooling according to DIN V 18599-6 – new single-family house.

Control Emission Distribution	Generation			
	Brine – water – heat pump	Fan assisted night ventilation	Ground heat exchanger (without bypass)	Night ventilation and ground heat exchanger
Ceiling cooling	0.73			
Floor cooling	0.73			
Radiator as cooling coil	0.36		–	
Fan coil	0.73			
Ventilation system	0.60	0.10	0.44	0.51
Split / multisplit system	–	–	–	–

**Generator cooling output and final energy demand for cold generation**

The generator cooling output is determined in accordance with part load and precooling effects of the cooling system as well as heat gains during control and emission in the room, distribution and storage:

$$Q_{rc,outg} = Q_{rc,b} \cdot f_{c,part} \cdot f_{c,limit} + Q_{rc,ce} + Q_{rc,d} + Q_{rc,s}$$

- $Q_{rc,b}$  energy need for cooling
- $f_{c,part}$  part load factor
- $f_{c,limit}$  precooling factor
- $Q_{rc,ce}$  control and emission heat gains for cooling
- $Q_{rc,d}$  distribution heat gains for cooling
- $Q_{rc,s}$  storage heat gains for cooling

This results in the annual final energy demand depending on the type of cold generation. For compression refrigeration machines or heat pumps in cooling mode applies:

$$Q_{rc,f,electr,a} = \frac{Q_{rc,outg,a}}{EER \cdot PLV_{av}}$$

- $Q_{rc,f,electr,a}$  annual final energy demand for cold generation (electricity input)
- $Q_{rc,outg,a}$  annual generator cooling output
- $EER$  energy efficiency ratio
- $PLV_{av}$  mean part load value

**Table 4** using the example of new single-family house with default values to show the resulting seasonal energy efficiency ratio (SEER = EER \* PLVav).

**Table 4.** Seasonal energy efficiency ratio SEER of selected systems for active cooling according to DIN V 18599-6 – new single-family house.

Control	Generation					
	Outdoor air – water – heat pump	Exhaust air – supply air – heat pump	Compression refrigeration machine		Room air conditioning systems	
			Outgoing temperature cooling		Split	Multi-split
			6°C	16°C		
On / Off	2.11	2.55	2.18	2.95	1.90	1.40
Inverter controlled	3.10	–	–	–	2.83	2.77
Digital scroll	–	–	2.37	3.19	–	–

Similarly for the annual final energy demand for cold generation (heat input) of thermal refrigeration machines:

$$Q_{rc,outg,therm,a} = \frac{Q_{rc,outg,a}}{\zeta \cdot PLV_{av}}$$

- $Q_{rc,outg,therm,a}$  annual final energy demand for cold generation (heat input)
- $Q_{rc,outg,a}$  annual generator cooling output
- $\zeta$  nominal heat capacity ratio
- $PLV_{av}$  mean part load value

### Background of the characteristic values in DIN V 18699-6 : 2011

#### Definition of load profiles

For the assessment of the efficiency of different technologies it was necessary to have information about the trend of a cooling load of a refrigeration period time. These calculations were carried out in accordance to different structural building properties, to reflect the influence of different building age classes. Therefore a classification according to the building age respectively the insulation standard was done (Table 5).

For each residential building class beyond the influence of typical parameters like thermal storage capacity, share of window area, building orientation, type of shading system was studied and divided in 3 categories of buildings (Table 6), in which for all variants the thermal heat protection in summer is maintained.

**Table 5.** Classification according to the residential buildings age.

Class of residential building	Old building (low insulation standard)	Old building (ordinary insulation standard)	New building (high insulation standard)
Built year	to 1995	Since 1996	New building
Insulation standard	–	German “WSchV 1995”	German “EnEV 2009”
U-value external wall	1.0 W/m <sup>2</sup> K	0.5 W/m <sup>2</sup> K	0.28 W/m <sup>2</sup> K
U-value external window	2.5 W/m <sup>2</sup> K	1.8 W/m <sup>2</sup> K	1.3 W/m <sup>2</sup> K
U-value roof, top floor ceilings	0.8 W/m <sup>2</sup> K	0.3 W/m <sup>2</sup> K	0.2 W/m <sup>2</sup> K
U-value wall or ceiling covered unheated rooms / ground covered walls	1.0 W/m <sup>2</sup> K	0.5 W/m <sup>2</sup> K	0.35 W/m <sup>2</sup> K

As a result it could be shown, that a differentiation of building age is necessary in the standardization process.

In addition to the building properties the kind of building usage is responsible for the trend of the cooling load. In this context the usage-specific internal thermal gains for different rooms of a residential building (living room, bedroom, bath, kitchen) from EN ISO 13791 were used and a load profile for a children’s room and humidification effects in all profiles were added. Based on the room profiles averaged flat-profiles were derived for single-family houses (EFH) and multi-family houses (MFH), which correlate in the daily total amount with the values for the internal heat sources of DIN V 18599-10 (45 Wh/m<sup>2</sup>d for single family houses and 90 Wh/m<sup>2</sup>d for multi-family houses). The determined usage profiles were validated using measured data for 10 different residential buildings and showed a good agreement in this field.

Taking into account the boundary conditions described a lot of cooling load profiles were determined for the single- and multi-family houses. Figure 3 shows the frequency distribution of the cooling hours in residential rooms of single-family houses in comparison to the complete flat as an exemplary for the building Category 2.

All living rooms show a similar frequency distribution of the cooling hours like the complete flat. As a result of the investigations it was found that there is no need for a differentiation between different rooms of a flat.

**Table 6.** Categorization of typical parameters for the cooling demand.

Building category	Category 1	Category 2 (standard)	Category 3
Thermal storage capacity	Thermal mass class S	Thermal mass class M	Thermal mass class L
Share of window area	10% of ground floor, 2 windows, 1 direction	20% of ground floor, 3 windows, 2 directions	30% of ground floor, main facade fully glazed
Building orientation	Main window area orientated to the east	Main window area orientated to the west	Main window area orientated to the south
Window type (g-value)	Double glazing g = 0.8	Heat protection glazing g = 0.6	Solar protection glazing g = 0.4
Type of shading system	Internal glare protection activated only in case of direct solar radiation	External solar protection activated only in case of direct solar radiation	External solar protection activated from an amount of 200 W/m <sup>2</sup>

Therefore residential buildings also in the cooling case can be calculated with the existing single-zone model.

**Cooling capacity**

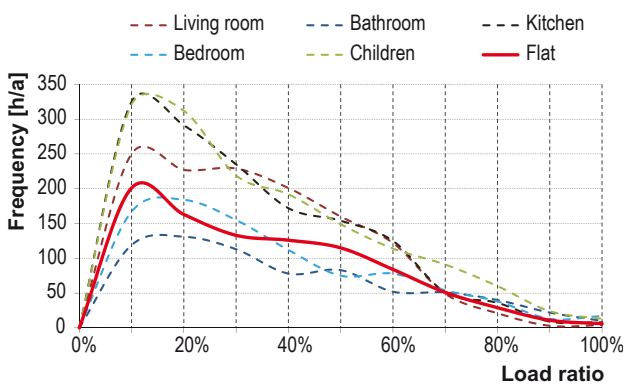
According to **Figure 3** the maximum frequency of the cooling hours occurs at very low cooling load. Thus cooling systems with a low cooling capacity could reach comfortable room temperatures in this part load range.

In the standardization process the maximum value of the cooling load in the load profile corresponds to the maximum required cooling capacity. If the installed system can't deliver the complete required cooling capacity it is defined as a "part cooling system". This capacity deficit could be a consequence of a limited cooling capacity of the generation and distribution system (e.g. an air based Free Cooling system with a ground heat exchanger) or of the control and emission system (e.g. cold water flowed floor heating).

**Part load values**

The efficiency of a chiller is usually described through the energy efficiency ratio EER. The nominal cooling capacity is required only in few hours of the year. According to **Figure 3** cold generation systems in residential buildings work the most time in the part load range. The reduction of the cooling capacity comes from an integrated capacity control system, which can be designed as a continuously control (e.g. variable speed control) or a staged system (e.g. ON-OFF operation). The more efficient this capacity control system works, the more efficient the complete cooling system is.

To map this effect in the normative value method, the part load value was established. Through multi-



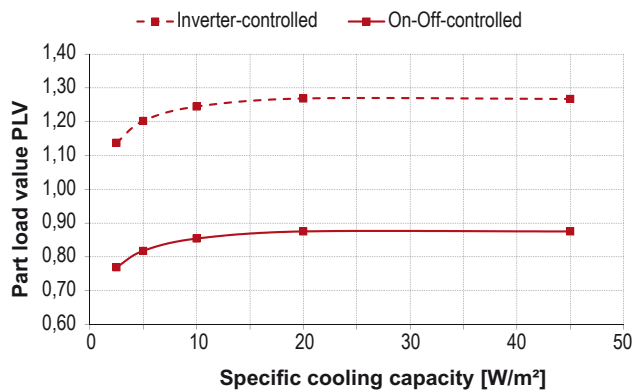
**Figure 3.** Frequency distribution of the cooling hours in different rooms of existing single-family houses with ordinary insulation standard (German "WSchV 1995", building Category 2).

plication with the nominal energy efficiency ratio EER, the seasonal energy efficiency ratio SEER of a chiller can be calculated. The SEER value characterizes the relation between the annual net energy demand for cooling and the necessary required final energy demand. A cooling system with high energy efficiency (low final energy demand) must have a high nominal energy efficiency ratio EER and additionally a high part load value PLV.

A variety of part load values for different system boundary conditions and various kinds of building usages contains the German standard DIN V 18599-7: 2011 in annex A for non-residential buildings. Taking into account a possible capacity limitation of the residential buildings control and emission and distribution systems and based on the typical load profiles for residential buildings (**Figure 3**) part load values PLV for active cooling systems in residential buildings were determined for the first time. **Figure 4** shows the part load values PLV of a reversible outdoor air – water heat pump in the cooling mode exemplary for existing single-family houses with an ordinary insulation standard (German "WSchV 1995").

In general the inverter-controlled heat pump is more energy efficient than the ON-OFF-controlled heat pump because it has higher part load values in cooling mode.

If the specific cooling capacity of the control and emission system decreases fewer than 20 W/m<sup>2</sup> the cooling capacity of the heat pump must be reduced. This correlates with a reduction of the energy efficiency. At the same time the precooling factor decreases fewer than the value of 1.0. For that the cooling capacity limitation of



**Figure 4.** Part load value PLV of a reversible outdoor air – water heat pump in existing single-family house with ordinary insulation standard (German "WSchV 1995", building Category 2).

the control and emission system is responsible, because not in the whole cooling period the required cooling capacity could be transferred into the room. **Figure 5** shows the trend of the precooling factor in dependence of the cooling capacity limitation of the control and emission system exemplary for existing single-family houses with different insulation standards.

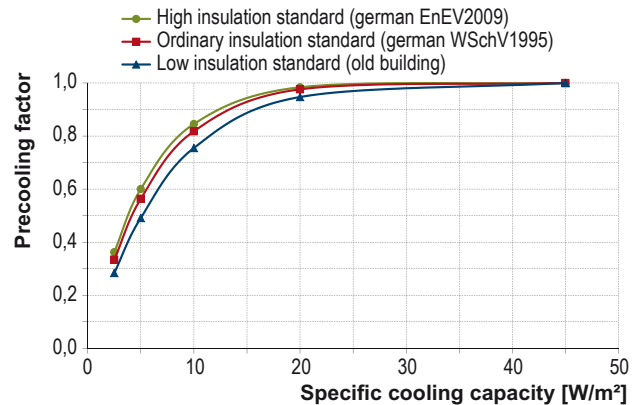
The precooling factor describes the relationship between the provided cooling energy of the installed cooling system and the required overall cooling energy demand as an area-weighted average of all rooms in a single family house. This factor tends to be slightly higher in good insulated buildings than in low insulated old buildings.

At all systems decreases the transferred cooling energy rate if the control and emission limitation increases. At air based ventilation systems with a cooling capacity of maximum  $5 \text{ W/m}^2$  only the half of the required annual cooling energy demand may be provided.

## Conclusion

Reversible heat pump sale shows, that cooling of residential buildings in Germany leaving the niche in recent years. As reasons, increased user requirements for the comfort, the discussion of the climate change or the subjective feeling of very hot summer in the recent past can be named.

Nevertheless, in Germany no general trend for cooling of residential buildings should be noted. Structural measures for the summer heat protection in addition to moderate weather conditions are the reason for preferring compensation of cooling loads to using technical systems. However, in new residential buildings can originate cooling loads by approximately  $30 \text{ W/m}^2$ . These are always more frequently at least proportionally covered by technical systems that take over most other functions (heating, ventilation) in the building.



**Figure 5.** Precooling factor in dependence of the cooling capacity limitation of the control and emission system (building Category 2).

With current German standard DIN V 18599: 2011 cooling for residential building is part of the framework of the energy saving regulation (EnEV) for the first time in Germany. Attention is paid to the peculiarities in comparison with air conditioning of non-residential buildings.

Due to the typical cooling of residential buildings, which often is realized as an additional feature of existing equipment (e.g. in combination with heat pumps or ventilation), a new definition of the cooling target arises.

In DIN V 18599-6: 2011 precooling and part cooling effects are described and quantified to enable comparison of cooling systems both from the perspective of the energy balance and thermal comfort. The focus is consequently on typical residential cooling systems without neglecting the conventional refrigeration. The energetic balance method provides the opportunity to create an adequate cooling effect with efficient technologies usually without major additional investments in residential buildings and to localize at the same time inefficient systems in advance. ■

## References

- EN ISO 13791:2004. Thermal performance of buildings – calculation of internal temperatures of a room in summer without mechanical cooling – General criteria and validation procedures.
- EN ISO 7730:2005. Ergonomics of the thermal environment – Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria.
- DIN V 18599:2011-12. Energy efficiency of buildings – calculation of the net, final and primary energy demand for heating, cooling, ventilation, domestic hot water and lighting
  - Part 2: Net energy demand for heating and cooling of building zones
  - Part 6: Final energy demand of ventilation systems and air heating systems for residential buildings
  - Part 7: Final energy demand of air-handling and air-conditioning systems for non-residential buildings
  - Part 10: Boundary conditions of use, climatic data
- EnEV 2009. Verordnung über energiesparenden Wärmeschutz und energiesparende Anlagentechnik bei Gebäuden (Energieeinsparverordnung – EnEV) in der Fassung der Bekanntmachung vom 29. April 2009. German energy saving regulations in the version of the announcement of April 29, 2009.
- WSchV 1995. Wärmeschutzverordnung (WärmeschutzV) in der Fassung der Bekanntmachung vom 16. August 1994. German heat protection regulations in the version of the announcement of August 16, 1994

# Weather data available for 122 European cities

## Short explanation of content of VDI 4710 Part 4 by

CORNELIA BAUGIRDIS, JÜRGEN MASUCH, KARL-JOSEF ALBERS AND KLAUS HOLLENBACH

**Keywords:** climate data, weather data, outdoor temperature, outdoor humidity, wind

### Introduction

The basis for the VDI climate data for 122 European stations, described here by way of examples, was established by the German Institute for Standardization (DIN) who, in cooperation with the German Meteorological Service (DWD), published comprehensive statistics of meteorological data in the first, 1979 edition of DIN 4710 (covering only West Germany at the time) and in the new, 2003 edition, revised to include 15 climate zones in Germany as a whole.



European climate stations VDI 4710.4 (without Germany).

The climate data listed there are  $t, x$  correlations, one-day-variation curves of outdoor air temperature and humidity on fine, cloudy and overcast days, and radiation and wind data for calculating the energy demand of heating and air-conditioning systems.

The manner of preparing and representing the data in tables was adopted for the climate data published by the VDI.

Whereas the climate data published by the DIN were still determined on the basis of measured data from the latest completed climate normal period (1961–1990), the climate data published by the VDI are generally based on measured data from the years 1991–2005 so that recent changes in climate (climate change) are also taken into account.

The second meteorological half-period (2006–2020) is due to be analysed in 2021. It will then become immediately evident how the climate will have continued to change.

DIN 4710 is currently being revised, and will be a compilation of all presently available meteorological calculation data. Below, an overview is given of the pertinent activities by the VDI together with the DWD, part of which will again contribute to DIN 4710.

### VDI climate data for 20 non-European sites

With the 2008 edition of VDI 4710 Part 1, the VDI for the first time published a compilation of climate data for 20 non-European stations, mostly based on measured data from the years 1990–1999 the scope of the standard being similar to that of DIN 4710.

The selection of stations provides an overview of the diversity of climate zones from Alaska to Australia, and allows a quick and reliable statement to be made about the local meteorological situation.

Statements about the climate at sites remote from the stations can only be made with reservations. However,

the German Meteorological Service (DWD) points out that the global network of measurement stations of the World Meteorological Organization (WMO) supplies data for approximately 5.500 stations, which the DWD can evaluate in terms of, e. g.,  $t,x$  correlations, then to be presented in analogy to DIN 4710.

### VDI climate data for 15 climate zones in Germany

Current discussions on climate change gave rise to the question to what extent the basis of data of DIN 4710 (1961–1990) was outdated.

In 2008, the VDI published VDI 4710 Part 3 based on measured data from the years 1991–2005 in order to provide a more up-to-date basis of data for the  $t,x$  correlations for 15 climate zones in Germany as published in DIN 4710.

### VDI climate data for 122 European sites

Following publication of VDI 4710 Part 3 pertaining to the German climate zones, the Federation of European Heating, Ventilation and Air-conditioning Associations.

(REHVA) suggested that the German procedure of data provision be extended to cover a larger number of European stations.

The results have now been published in the bilingual German-English draft standard VDI 4710 Part 4, made available through REHVA to all national associations for discussion.

This is not at all meant to curtail the competence of the national meteorological organizations. On the contrary, they are requested to have a critical look at the respective results made available for 122 European stations. However, similar evaluation of the data affords a comparability of results which is independent of national borders and national evaluation procedures.

Supplementing the comments the introduction to be given here will also point out some specifics that are relevant to this European standard.

A similar analysis of the 15-year period from 2006 to 2020 to be performed in approximately the year 2021 is envisioned to quickly reveal the continuing climate change through comparison of the new results with those found here (for 1991 to 2005).

### Comparison of basic evaluations for four example stations

Some basic evaluations, as compiled randomly in the table below, are quickly derived from the  $t,x$  correlations and are shown directly at the tables so that standard questions are already solved.

Basic evaluations for four European example stations:

Extreme temperatures for selection of air conditioning installations		Reykjavik	Vienna	Yekaterinburg	Seville
Risk 0.1%/a (about 8h/a) exceeding of the selected value					
Winter temperature [°C]		-12	-12	-32	+1
Summer temperature [°C]		+18	+33	+31	+42
Summer enthalpy [kJ/kg d.a.]		41	71	64	84
<b>Energetic parameters</b>					
Degree days ref. 19 deg C [Dd]		5.141	3.317	6.084	476
Humidification gram hours ref. 5g/kg dry air [gh/kg d.a.]		8.921	5.261	15.498	377
Dehumidification gram hours ref. 10g/kg dry air [gh/kg d.a.]		2	2.523	1.023	2.852

### Conclusion

The random examples and their analysis are meant to illustrate how an overview of the meteorological impacts of a site can nowadays be gained from a unified representation, using modern tools. As a matter of course, only some aspects are described (outdoor air temperature, humidity, wind). However, using such tools, building services planners will be more confident in their statements than if they have to limit themselves to their own evaluations based on local, often incomplete, data.

Meanwhile, evaluations in terms of test reference years (TRY) are available for many sites, which also offer important assistance in analyses. Normally, however, only up to approx. 15 % of the data are measured data whereas the remainder has been calculated from measured data using statistical methods. A TRY is calculated such that the entire data record is true to averages. Therefore, the  $t,x$  correlations given here can be used to check the quality of a TRY by deriving a  $t,x$  correlation from the TRY and then comparing it to the correct correlation.

VDI 4710 Part 4 is submitted for discussion to REHVA, the Federation of European Heating, Ventilation and Air-Conditioning Associations. ■

# Energy piles and other thermal foundations for GSHP

## – Developments in UK practice and research



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**Keywords:** energy piles, thermal piles, energy geo-structures, energy foundations, ground source heat pumps, piling, retaining walls, GSHP

### Introduction

In a typical scheme all or part of the building foundation is equipped with geothermal loops connected to a ground source heat pump, leading to delivery of, on average, 15% to 25% of the building heating and cooling requirements. The concept of energy piles is not new. The approach was pioneered in Austria in the 1980s (Brandl, 2006) and taken up in a number of other northern European Countries (e.g. Koene et al, 2000, Pahud & Hubbuch, 2007, Desmedt & Hoes, 2007). A single energy pile may deliver between 25 to 50 W/m depending on its size, construction details, the surrounding soil types and how the system is operated (Bourne-Webb, 2013). These figures are not dissimilar to borehole heat exchangers, but if anything, the larger diameter of many energy piles offers the opportunities for greater heat transfer rates.

Even without considering heat transfer rates, placing geothermal loops into the buildings foundation, thereby creating energy piles or other thermal foundations is simply a “no brainer”, they provide a very simple, low cost and time saving solution compared to other ground loop options. Firstly, the intention is never to increase the size of foundations, rather use the structurally designed requirements and calculate the amount of heating and cooling that can be provided from the foundations; only very few projects have been designed around the geothermal requirements. Secondly, geothermal loops can be attached to structural reinforcement cages being installed within

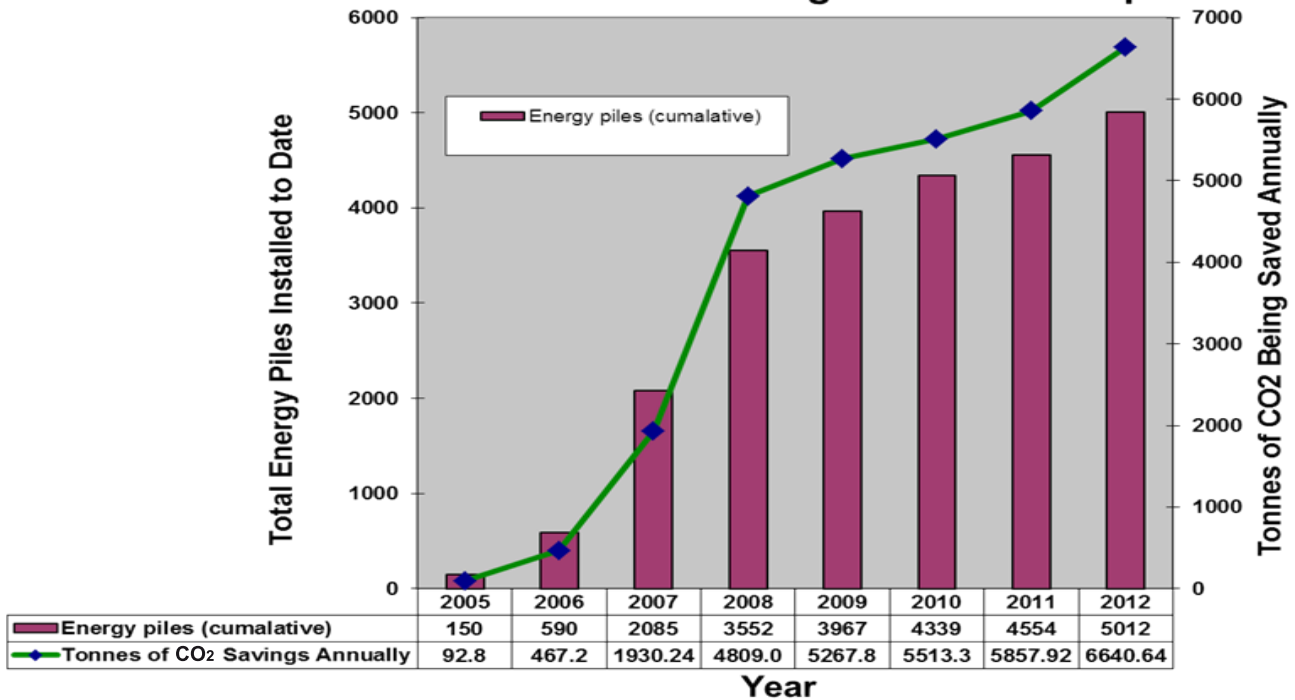
the foundation, thus adding little additional cost to a project compared to other geothermal solutions. Additional minimal steelwork is only required where cages do not extend the full depth of the pile and also for continuous flight auger type piles. Thirdly significant advantages can also be applied on the construction programme; with good early coordination the installation of geothermal loops using the buildings foundation will require little to no additional time being added.

### Energy Piles in the UK

In the UK heat pump systems more generally were slow to take off, principally due to the availability of relatively inexpensive gas. However, as all energy prices are rising and the difference between electricity and gas costs is reducing, the UK heat pump industry is consequently expanding (Research and Markets, 2012). As part of this expansion, installing geothermal loops into building foundations is becoming increasingly popular in the UK (**Figure 1**) and with recent changes in planning policy is likely to become increasingly so. In Central London there are very costly penalties for buildings that do not achieve the 40% energy savings above Building Regulations Part L. In addition the UK Renewable Heat Incentive is making all types of renewable heat and especially GSHP schemes more attractive. Significant growth is expected in 2014 as the final parts of the incentive scheme come into place and consequently the costs of energy piles and other ground loops schemes will decrease further.



### Energy Piles Installed In The UK & Resultant Annual CO<sub>2</sub> Savings To Date At Sept 2012



**Figure 1.** Energy Piles Installed in the UK and Resultant Annual CO<sub>2</sub> Savings (to date at September 2012).

There have recently been a number of landmark energy pile schemes constructed in the UK as well as numerous smaller projects. GI Energy has recorded over 50 projects across the UK with installed and functioning systems. Most of these 50 projects GI

Energy have completed, with the most notable being the 2 MW heating and cooling solution at One New Change (**Figure 2**) which is currently delivering annual energy savings of £65K and saving almost 300 Tonnes of CO<sub>2</sub> every year. GI Energy have also recently commenced work on two similar sized energy pile projects during 2013 for Network Rail (the UK rail asset owner) at London Bridge Station and also at a New London Embassy Building.



**Figure 2.** The One New Change Development, near St. Paul's Cathedral, has a Gross Floor Area of 52 000 m<sup>2</sup> made up of 31 000 m<sup>2</sup> of office space and 21 000 m<sup>2</sup> retail space.

Geothermal Loops have been successfully installed into all foundation types and in both large scale commercial and residential developments. There are a multitude of options for installing geothermal loops. For a project to be successful it is recommended that a GSHP specialist should be appointed early in the development of a project to assist in providing various options with a view to identifying the best value solution, which may even be a combination of ground loop techniques. To this end it is important to

set clear guidance on roles and responsibilities and ensure coordination is central to all parties. The UK Ground Source Heat Pump Association Thermal Pile Standard sets our clear guidance on roles and responsibilities in this respect (see book reviews).

It is not just foundation piles that are suitable for installation of ground loops. GI Energy, the UK's leading GSHP specialist, also completed geothermal loop installation into the first diaphragm retaining wall at the Bulgari hotel in Knightsbridge in 2010 after much early coordination with the project management team. The project also included energy piles and is now delivering over 200 kW of heating and cooling. GI Energy with WSP, the consultant, won the Concrete Societies Sustainability award for this project and most recently the project won the prestigious Architecture of the Year Award in the New Build Hotel category at the European Hotel Design Awards. The UK's largest Civil Engineering project, Crossrail has also offered the opportunity to equip piled foundations and retaining walls with geothermal loops, refer to **Figure 3**.

## Research for a Sustainable Future

The last decade has seen an increase in research into energy pile applications at UK Universities. Roger Bullivant, a piling contractor with a strong business in the domestic housing sector, was keen to develop energy pile solutions and worked with Nottingham University to develop a test bed site (Wood et al, 2010a). The first year of operation showed the viability of short energy piles for the domestic market. However, it also illustrated some limitations of existing design methods such as Earth Energy Designer when applied to such short heat exchangers for which it was not designed (Wood et al, 2010b). The research also suggests that for heating dominated domestic properties it will be important to ensure appropriate solar recharge in the summer months to provide for the long term sustainability of schemes.

Research into the thermal performance of energy piles is also going on at the University of Southampton. A key result from the work is the importance of the contribution from the concrete within the pile to the short term thermal storage within the heat exchanger (Loveridge



### Crossrail Stations London

- System:
  - Diaphragm Wall & Energy Piles®
- Size:
  - 150kW – 300kW Heating
  - 150kW – 300kW Cooling
- Collector type:
  - Energy Piles
  - Energy D. Wall
- On Site:
  - Farringdon Street
  - Tottenham Court Road
  - Bond street
  - Fisher Street
  - Paddington



**Figure 3.** Energy Foundations Installed for the Crossrail Project in London.

& Powrie, 2013a). The heat capacity of the ground heat exchanger is not normally taken into account in traditional ground loop design methods, but research suggests that this approach could lead to underestimation of the energy capability of energy piles (Loveridge & Powrie, 2013b). This means that the true potential for energy piles is yet to be fully realised.

Some resistance to the adoption of energy piles arises from concerns that the temperature changes that will occur within the piles may impact the structural and geotechnical performance of the pile. Despite the successful operation of energy piles schemes in Austria for many decades some Clients require more robust assurance. Cambridge University and collaborators have been working to set out the mechanisms of thermo-mechanical response of energy piles (Bourne-Webb et al, 2013) and to develop new design approaches which will allow any such concerns to be allayed. Other work has also shown that previous

approaches may have overestimated the temperature changes that would be occurring in the soil surrounding the piles (Loveridge et al, 2012) and this is also helping to show that properly designed and operated energy piles will pose no risk to the structural operation of the foundations.

## Conclusions

Energy piles and other thermal foundations are a technology with a growing take up in the UK. Implementation of energy piles has been supported by an active group of researchers who are working with industry to show the benefits of making dual use of building foundations. A number of successful projects have recently been implemented and these include the developments at One New Change and the Bulgari Hotel in London. With the recent UK Government incentives for renewable heat, the potential for further adoption of energy pile solutions is growing fast. ■

## References

- Bourne-Webb (2013) Observed response of energy geostructures, In: Energy Geostructures Innovation in Underground Engineering, Edited by Laloui, & Di Donna, A., Wiley, London, 2013.
- Bourne-Webb, P., Amatya, B., & Soga, K. (2013) A framework for understanding energy pile behaviour, Proceedings of the Institution of Civil Engineering, Geotechnical Engineering, 166(2), 170–177.
- Brandl, H. (2006) Energy foundations and other thermo active ground structures, *Geotechnique*, 56 (2), 81 – 122.
- Desmedt, J. & Hoes, H. (2006) Case study of a BTES and energy piles application for a Belgian hospital, Proceedings ECOSTOCK 2006, May 31 – June 2, New Jersey, US, The Richard Stockton College of New Jersey. [Online]. Available from: [https://intra.web.stockton.edu/eyos/energy\\_studies/content/docs/FINAL\\_PAPERS/9A-2.pdf](https://intra.web.stockton.edu/eyos/energy_studies/content/docs/FINAL_PAPERS/9A-2.pdf) [Accessed 24 August 2010].
- Koene, F. G. H., van Helden, W. G. J. & Romer, J. C. (2000) Energy piles as cost effective ground heat exchangers, In: Proc. TERRASTOCK 2000, Stuttgart, Germany, 28 August – 1 September. pp227–232.
- Loveridge F A, Amis T & Powrie W (2012), Energy Pile Performance and Preventing Ground Freezing, Proceedings of the 2012 International Conference on Geomechanics and Engineering (ICGE'12), Seoul, August, 2012.
- Loveridge, F. & Powrie, W. (2013a) Performance of Piled Foundations Used as Heat Exchangers, 18th International Conference for Soil Mechanics and Geotechnical Engineering, Paris, France, September 2–5, 2013.
- Loveridge, F. & Powrie, W. (2013b) Temperature response functions (G-functions) for single pile heat exchangers, *Energy*, 57, 554–564.
- Pahud, D., & Hubbuch, M. (2007) Measured thermal performance of the energy pile system of the dock midfield of Zurich airport, In: Proceedings European Geothermal Congress 2007, Unterhaching, Germany, 30 May – 1 June.
- Research and Markets (2012) Renewable Energy - Ground and Air Source Heat Pumps Market - UK 2012-2016 Analysis, March 2012.
- Wood, C. J., Liu, H. & Riffat, S. B. (2010a) An investigation of the heat pump performance and ground temperature of a pile foundation heat exchanger system for a residential building, *Energy*, 35, 3932–4940.
- Wood, C. J., Liu, H. & Riffat, S. B. (2010b) Comparison of a modeled and field tested piled ground heat exchanger system for a residential building and the simulated effect of assisted ground heat recharge, *International Journal of Low Carbon Technologies*, 5, 137–143.

# Suitability of foundation heat exchangers for ground source heat pump systems in European climates



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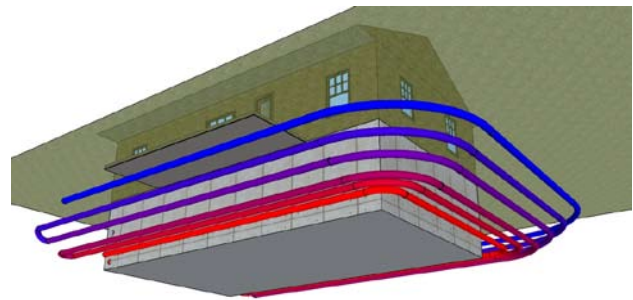
**Keywords:** energy foundations, ground source heat pumps, GSHP, foundation heat exchanger, FHX, vertical ground heat exchanger, VGHX

## Introduction

Ground source heat pump (GSHP) systems are used worldwide, with an estimated installed total heating capacity of around 18 GW across 1.7 million units. While GSHP systems are highly efficient, their main disadvantage compared to conventional systems is a significantly higher first cost, due to drilling of boreholes for vertical ground heat exchangers (GHX), or excavation for horizontal GHX. In general, the length of GHX piping and, consequently, the first cost, depend on both the total annual heating and cooling loads and their distribution over the year, as well as ground thermal properties, undisturbed ground temperature, and GHX design, as well as other factors.

For low energy buildings the greatly reduced heating and cooling loads (as compared to conventional construction) provide for the possibility of using a smaller GHX. Previous work (Spitler et al., 2010; Xing et al., 2012) has detailed foundation heat exchangers (FHXs) that are placed within the excavation made for the basement and foundation, along with other excavations used for utility trenching. By eliminating separate excavation or drilling, the first cost of the GHX may be significantly reduced. **Figure 1** shows a schematic of a typical FHX system around a house.

The United States' Oak Ridge National Laboratory has experimentally demonstrated that an FHX-based GSHP system is feasible for several different houses in Tennessee (Shonder and Spitler 2009, Lu, et al. 2011). Additionally, a small-scale study has been performed



**Figure 1.** Schematic of foundation heat exchanger installation around house. (Figure courtesy of Edwin Lee.)

for several house types in various European climates (Spitler et al., 2010), as well as a larger study of 17 U.S. locations (Cullin et al., 2012). The Spitler, et al. (2010) study did not include freezing and thawing of the soil; this tends to over-predict the temperature drop during winter. Therefore, this article addresses several northern European climates with a newer improved simulation model that includes freezing and thawing of the soil. Snow cover is still not addressed – partly for lack of data, but also because the worst case occurs when the weather turns cold before the snow falls. The relative importance of modeling the freezing/thawing and snow cover for ground heat transfer is discussed by Xu and Spitler (2011). But first, we review the previous European study for climates where freezing/thawing is relatively unimportant.

## Fhx In Five European Climates

The Spitler, et al. (2010) study chose ten European locations to give a geographically-diverse set. A recent update of the Köppen-Geiger climate classification scheme (Kottek et al. 2006) was consulted. The seven non-Nordic locations are summarized in **Table 1**. For two of the climate zones (Cfb and Csa) two locations were chosen to increase the geographical diversity.

Several versions of a prototypical house were used to generate hourly heating and cooling loads for the above locations using the EnergyPlus (Crawley et al., 2001) program. Two configurations – single story (1S) and two-story (2S) – and two insulation levels – “very high insulation” (VHI) and “high insulation” (HI) were used, as described in **Table 2**. All four variations of the building were simulated with a FHX completely encircling the building.

**Table 3** summarizes the results of the simulations in terms of minimum and maximum EFT. The resulting seasonal COPs were not reported in that work.

## Case Study In Nordic Climate

In order to investigate in more detail, the range of FHX applicability in Nordic climates, a case study was performed. This study involved developing heating loads for a single-story (plus basement) house for seven different locations across Sweden. The house, as summarized in **Table 4**, is intended to resemble a typical house in southern Sweden, built prior to 1960 with “advanced refurbishment”, as described by the TABULA project (Institut Wohnen und Umwelt, 2012). EnergyPlus (Crawley et al., 2001) was used to determine the hourly heating loads, heat pump performance and FHX performance. The FHX layout, with six pipes configured as in **Figure 2**, is based on the layout from the Oak Ridge experimental facility (Shonder and Spitler 2009) and completely encircles the house. The thermostatic setpoint for heating was 21.5°C. The FHX uses a 30% propylene glycol solution.

**Table 1.** Selected Locations and Corresponding Climates.

Location	Climate Zone
Madrid, Spain	BSk (Mid-latitude steppe)
Milan, Italy	Cfa (Humid subtropical)
London, UK Frankfurt, Germany	Cfb (Marine/warm summer)
Marseille, France Athens, Greece	Csa (Interior Mediterranean)
Porto, Portugal	Csb (Coastal Mediterranean)

**Table 2.** Summary of the four simulated buildings.

	HI		VHI	
	1S	2S	1S	2S
Floor Area (m <sup>2</sup> )	148			
Window U-factor (W/m <sup>2</sup> K)	1.8			
SHGC	0.36 (covering 29% of the north and south facades and 3% of the east and west facades)			
Lighting and casual gains (W/m <sup>2</sup> )	8.2			
Constant infiltration rates	0.5 ACH			
Length-to-width ratio	1.56	1	1.56	1
U <sub>wall</sub> (W/m <sup>2</sup> K)	0.25	0.25	0.20	0.20
U <sub>roof</sub> (W/m <sup>2</sup> K)	0.16	0.16	0.13	0.13

The FHX simulation in EnergyPlus environment utilizes a dual coordinate system finite volume method (Lee, et al. 2013). This model was validated against 12 months of experimental data (Lu, et al. 2011). At the ground surface, a full surface heat balance (**Figure 2**) including

**Table 3.** Summary of results without auxiliary horizontal GHX.

LOCATION	Minimum Entering Fluid Temperature (°C)				Maximum Entering Fluid Temperature (°C)			
	1S, VHI	2S, VHI	1S, HI	2S, HI	1S, VHI	2S, VHI	1S, HI	2S, HI
Madrid, Spain	6.8	4.7	6.2	4.3	23.6	26.2	23.9	36.0
Milan, Italy	7.6	3.7	6.6	1.7	27.3	28.7	27.5	35.2
London, UK	4.0	1.0	3.2	-0.5	17.6	17.6	17.6	17.6
Frankfurt, Germany	2.1	-1.3	1.3	-2.5	18.2	18.2	18.2	18.2
Marseille, France	7.8	5.8	7.1	4.7	24.1	32.5	24.4	33.1
Athens, Greece	11.5	9.5	11.0	9.6	28.0	30.6	28.4	39.3
Porto, Portugal	11.7	9.9	11.2	9.8	23.0	23.9	23.0	29.8

conduction, convection, short- and long-wave radiation and evapotranspiration is implemented. Recent work (Xu and Spitler 2011) has indicated that the additional accuracy gained from considering water migration is negligible, especially considering the additional computation time required to analyze it. However, freezing and thawing of the moisture in the soil is included; the insulating effect of snow cover on the ground surface is not included.

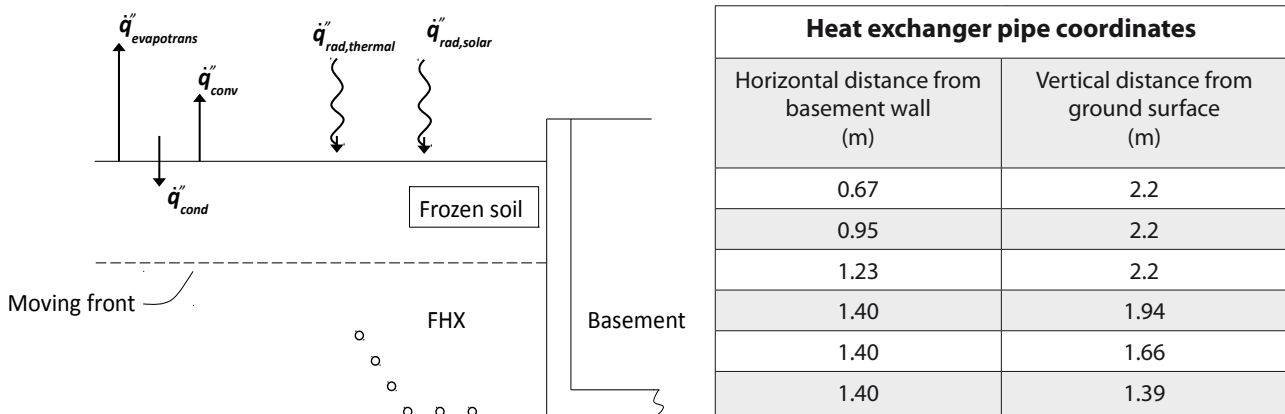
Five locations across Sweden were selected for the Nordic climate case study: Gothenburg, Jönköping, Karlstad, Malmö, and Stockholm. Two more locations, Kiruna and Östersund, were also initially selected, but heat pump EFT were too low to make FHX systems feasible in those climates, and they were excluded from the further study. Hourly weather parameters for each site were taken from IWEC (Thevenard and Brunger 2001) and IWEC2 (Huang 2010) data. For each location, a two-year simulation was performed to assess whether a FHX would be suitable for locations in a Nordic climate. For this assessment, both the minimum heat pump EFT

**Table 4.** Summary of the typical Nordic house.

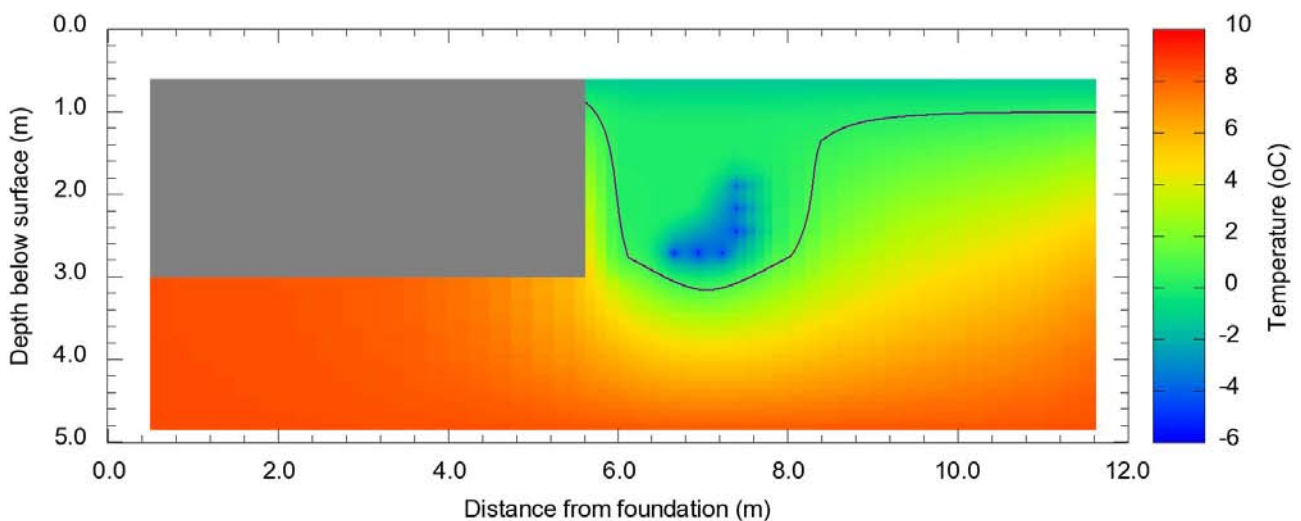
Total ground floor area	125 m <sup>2</sup>
Wall U-value	0.26 W/m <sup>2</sup> K
Roof U-value	0.06 W/m <sup>2</sup> K
Window U-value	0.76 W/m <sup>2</sup> K
Basement floor and wall U-value	0.20 W/m <sup>2</sup> K
Roof area	125 m <sup>2</sup>
Window area	22 m <sup>2</sup>

and the temperatures in the soil at the basement wall were checked, as low heat pump temperatures could cause equipment failure while freezing at the foundation could result in structural damage. **Table 5** lists the minimum heat pump EFT over the course of the second year, for both the FHX system and, for comparison, a system utilizing a vertical ground heat exchanger (VGHX).

**Figure 3** shows the temperatures in the soil for the hour that the fluid temperature is coldest in Gothenburg, which occurs on 29 January. The grey block in the



**Figure 2.** FHX surface heat balance including soil freezing front, and coordinates for heat exchanger pipes.



**Figure 3.** Soil temperature profile for coldest hour in Gothenburg.

**Table 5.** Comparison of foundation heat exchanger (FHX) and vertical ground heat exchanger (VGHX).

	FHX				
	Gothenburg	Jönköping	Karlstad	Malmö	Stockholm
Main Floor HP Heating Provided (kWh)	14536	13971	15350	12710	15114
HP Total Electric Energy Consumption (kWh)	5380	5144	5725	4590	5632
HP Run Time (hr)	1163	1122	1228	1017	1209
HP Minimum EFT (°C)	-6.4	-6.6	-8.2	-5.0	-8.0
HP Mean EFT (°C), heating supply-weighted	-2.4	-2.1	-3.0	-0.9	-2.9
Pumping Energy Consumption (kWh)	14.1	13.6	14.9	12.3	14.6
System Total Energy Consumption (kWh)	5394	5158	5740	4602	5647
System Seasonal COP	2.69	2.71	2.67	2.76	2.68
	VGHX				
	Gothenburg	Jönköping	Karlstad	Malmö	Stockholm
Main Floor HP Heating Provided (kWh)	14411	13840	15232	12598	15000
HP Total Electric Energy Consumption (kWh)	4979	4820	5329	4227	5230
HP Run Time (hr)	1153	1113	1219	1008	1200
HP Minimum EFT (°C)	-4.2	-5.4	-5.7	-2.5	-5.5
HP Mean EFT (°C), heating supply-weighted	0.3	0.1	-0.6	2.1	-0.4
Pumping Energy Consumption (kWh)	17.5	16.9	18.5	15.3	18.2
System Total Energy Consumption (kWh)	4996	4837	5347	4242	5248
System Seasonal COP	2.88	2.86	2.85	2.97	2.86
FHX System Penalty compared to VGHX system, $\lambda=1.3$ W/m-K	7.7%	6.4%	7.1%	8.2%	7.3%
FHX System Penalty compared to VGHX system, $\lambda=1.8$ W/m-K	4.1%	3.0%	2.9%	5.0%	3.8%

upper left of the figure indicates the basement region. A purple line has been added to indicate where the ground is frozen. For the five cities the profile is similar, there is no additional freezing of the soil immediately adjacent to the basement wall; while the ground does freeze at the surface due to climate, and immediately around the FHX as heat is extracted from the soil, the frozen soil zone does not extend to the foundation.

The energy consumptions of the FHX systems were compared to systems utilizing a single 50 m deep VGHX. Using EnergyPlus, both systems were simulated for each

of the five feasible locations. **Table 5** shows the heating provided, as well as heat pump, pumping, and total energy consumption, for both the FHX and VGHX systems. Additionally, **Table 4** lists two temperatures for each system: the minimum heat pump entering fluid temperature, and the mean heat pump entering fluid temperature, weighted by the heating supplied to the zone. The last two rows give the system “penalty” for using a FHX instead of a VGHX, in terms of the additional total energy required; the first of these two is for an FHX installed in a typical heavy, damp soil, while the second is for a soil with a higher thermal conductivity.

Overall, the systems with the FHX consumed about 3–8% more energy than the systems with the VGHX, due to less favorable entering fluid temperatures. Neither system has particularly high seasonal coefficients of performance – in the case of the FHX system this is mainly an effect of the constraints of using only the perimeter of the house basement; were the system to be augmented by additional horizontal GHX, the COP would be increased, as would the margin of safety. Likewise, the VGHX is relatively short compared to typical practice – this is possible because of the highly insulated building envelope, but a deeper VGHX would yield higher heat pump entering fluid temperatures and higher seasonal COP.

## Conclusions

A previous parametric study of FHX operation in several European climates showed that the FHX appears to be a suitable alternative to conventional GHX used with residential GSHP systems for a wide range of climates. This paper presents a simulation-based case study investigating climates in Sweden, as examples of climate

conditions in the Nordic countries, to determine where the technology may be feasible. In locations in middle-to-southern Sweden, the FHX appears to be feasible. For locations farther north, heat pump EFT are too low for the FHX to be feasible. Compared to VGHX systems, the FHX systems consume roughly 3–8% more energy due to less favorable ground temperatures. Augmenting the FHX system with additional ground heat exchanger will increase its performance. Conversely, an FHX may be an inexpensive and suitable complement to boost an existing VGHX in Nordic climates, when the building load has increased due to building extensions or when replacing an older heat pump unit with a newer heat pump with higher COP.

The simulation was experimentally-validated in a US location (36° N), so experimental testing in a Nordic climate prior to commercial implementation would help to better understand the behavior of FHX systems in colder climates, particularly since the simulation used in this work did not include snow cover in its analysis. ■

## References

- Crawley, D.B., L.K. Lawrie, F.C. Winkelmann, W.F. Buhl, Y.J. Huang, C.O. Pedersen, R.K. Strand, R.J. Liesen, D.E. Fisher, M.J. Witte and J. Glazer. 2001. EnergyPlus: Creating a new-generation building energy simulation program. *Energy and Buildings* 33(4): 319–331.
- Cullin, J.R., L. Xing, E. Lee, J.D. Spitler, and D.E. Fisher. 2012. Feasibility of foundation heat exchangers for ground source heat pump systems in the United States. *ASHRAE Transactions* 118(1):1039–1048.
- Huang, J. 2010. ASHRAE Research Project 1477-RP – Development of over 2,500 weather files for international locations. Final Report. ASHRAE.
- Institut Wohnen und Umwelt. 2012. Typology approach for building stock energy assessment: Main results of the TABULA project. Final Project Report. Located at [http://www.building-typology.eu/downloads/public/docs/report/TABULA\\_FinalReport.pdf](http://www.building-typology.eu/downloads/public/docs/report/TABULA_FinalReport.pdf).
- Kottek, M., Greiser, J., Beck, et al. 2006. World Map of the Köppen-Geiger climate classification updated. *Meteorologische Zeitschrift* 15(3): 259–263.
- Lee, E.S., D.E. Fisher and J.D. Spitler. 2013. Efficient Horizontal Ground Heat Exchanger Simulation with Zone Heat Balance Integration. *HVAC&R Research*. In Press. DOI:10.1080/10789669.2013.774887
- Shonder, J., and J.D. Spitler. 2009. Foundation heat exchangers: Reducing the first cost of ground source heat pumps. *IEA Heat Pump Centre Newsletter* 27:22–23.
- Spitler, J.D., D.E. Fisher, J.R. Cullin, L. Xing, E. Lee, S.J. Rees, and D. Fan. 2011. Foundation heat exchanger model and design tool development and validation. Final report to Oak Ridge National Laboratory. Available online at [http://www.hvac.okstate.edu/Papers/FHX\\_2013.pdf](http://www.hvac.okstate.edu/Papers/FHX_2013.pdf)
- Spitler, J., L. Xing, J.R. Cullin, D. Fisher, J. Shonder, and P. Im. 2010. Residential ground source heat pump systems utilizing foundation heat exchangers. *Proceedings of Clima 2010*. Antalya, Turkey. 9–12 May.
- Thevenard, D. and Brunger, A. 2001. "ASHRAE Research Project 1015-RP typical weather years for international locations." Final Report, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Atlanta GA.
- Xing, L., J.R. Cullin, J.D. Spitler, P. Im, and D.E. Fisher. 2012. Foundation heat exchangers for residential ground source heat pump systems – Numerical modeling and experimental validation. *HVAC&R Research* 17(6): 1059–1072.
- Xu, H., and J.D. Spitler. 2011. Prediction of importance of moisture transport, snow cover and soil freezing to ground temperature predictions. *Proceedings of the Nordic Symposium on Building Physics*. Tampere, Finland. 29–31 May.



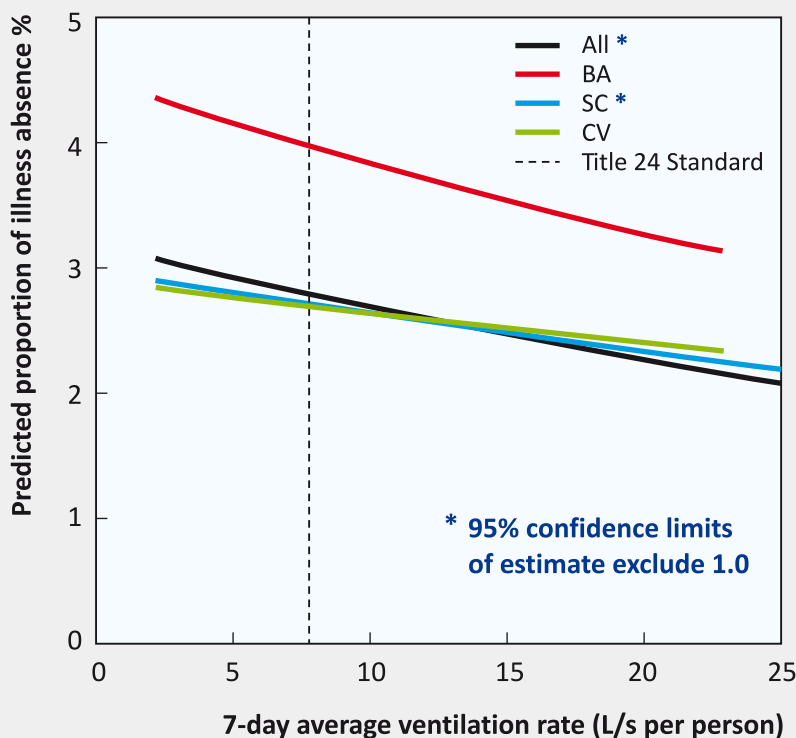
# Classroom ventilation and illness absence in California elementary schools

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**Background** – Classroom ventilation rate (VR) standards are needed that adequately protect human health while minimizing unnecessary consumption of energy. While limited evidence suggests that lower VRs in school classrooms are associated with increased student absence and health effects, this relationship needs confirmation. We conducted a multi-year study to investigate associations between classroom ventilation rates and student absence (as an indicator for health).

**Methods** – This study included one school district in each of 3 major California climate regions; in each district, 9–10 schools across the socioeconomic range; and in each school, two each of 3<sup>rd</sup>, 4<sup>th</sup>, and 5<sup>th</sup> grade classrooms. Daily classroom VRs in each classroom were estimated using real time indoor CO<sub>2</sub> from web-connected sensors. School districts provided daily classroom illness absence and demographic data. We used adjusted zero-inflated negative binomial regression models to estimate relationships between classroom VRs (prior 7-day average) and daily illness-related absence.

**Results** – In the 162 studied classrooms in 28 schools in 3 districts, most VRs were lower than the CA standard of 7.1 L/s -person with 95% of VRs in the Central Valley district below the standard. Overall model estimates (**Figure 1**) showed a 1.6% decrease in illness absence per VR increase of 1 L/sec per person. Increasing the average California K-12 classroom VR up to the 7.1 L/s-person standard was associated with a 3.4% reduction in illness absence and, based on estimates of attendance-linked school revenues and energy costs of ventilation, \$33M in increased revenue to schools but only \$4M in higher energy costs. Higher VRs would provide additional estimated net benefits.



**Figure 1.** Estimated illness absence proportions at different ventilation rates in the three school districts (BA = Bay Area, SC = South Coast, CV = Central Valley and all).

**Conclusion** – Results of this study, using real-time measurements of classrooms in multiple climate regions of California, suggest that current classroom ventilation rates are usually below standards, and that increasing ventilation rates up to the current standards or higher would provide, in addition to health benefits to students, substantial economic benefits to schools, far exceeding increased energy costs. ■

**This research note is based on the paper:**  
 Mark J. Mendell, Ekaterina A. Eliseeva, Molly M. Davies, M. Spears, Agnes B. Lobscheid, William J. Fisk, and Michael G. Apte: Association of Classroom ventilation with reduced illness absence: a prospective study in California elementary schools. *International Journal of Indoor Environment and Health, Indoor Air*, 23:515-528, December 2013.



# HORIZON 2020

The New EU  
Framework Programme for  
Research and Innovation

2014-2020



## HORIZON 2020 Energy programme

The Commission launched the HORIZON 2020 Energy programme – €5.7 billion for Secure, clean and efficient energy

SUMMARY BY ANITA DERJANECZ, REHVA OFFICE, BRUSSELS

The European Commission presented for the first time calls for projects under Horizon 2020 in December 2013. Worth more than €15 billion over the first two years, the funding is intended to help boost Europe's knowledge-driven economy, and tackle issues that will make a difference in people's lives.

In the new EU financial period 2014-2020 the previous two major research and innovation funding programmes supporting energy related issues will be merged in the H2020 Energy programme with a significantly increased budget of €5.7 billion for the *Secure, clean and efficient energy* programme in the coming seven years.

The European Commission organized an EU level Energy Information Day about the new Horizon 2020 Energy (H2020 Energy) programme calls in Brussels on 5 December 2013. The Information Day provided essential information on the calls for proposals, which will be open in 2014 and 2015. The main areas covered by the programme are Energy Efficiency, Competitive Low Carbon Energy and Smart Cities and



Calls	2014 (M€)	2015 (M€)
Energy Efficiency	97,5	98,15
Smart Cities and Communities	92,32	108,18
Competitive Low-Carbon Energy	359,1	372,33
SMEs and Fast Track to Innovation	33,95	37,26
Part B – other actions	75	61
Euratom Fission	48,3	39,6
Part B – other actions	0,3	15,0

Source: presentation of Philippe Schild, DG RTD.

Calls and annual budgets of the Energy programme.

Communities. Activities extend from research to market including activities similar to the previous Intelligent Energy Europe Programme in facilitating market uptake of energy technologies and services, fostering of social innovation and accelerating the cost effective implementation of the Union's energy policies.

## Energy Efficiency

The *Energy Efficiency* call is the most relevant for the buildings sector including the several HVAC related research and market uptake actions in 4 major areas:

- A. Buildings and consumers
- B. Heating and cooling
- C. Industry and products
- D. Finance for sustainable energy

Topics*	Short-hand Description	2014 (M€)	2015 (M€)
EE1, EE2	EeB PPP: Pre-fabricated modules and New Energy Efficient Buildings	8	9
EE3	EeB PPP: Historic Buildings	5	
EE18	SPIRE Topic PPP: Heat recovery	8	8
EE6, EE12, EE13	Demand response in building blocks, socio-economic research and technology for DHC	8,5	13,35
EE11	ICT for energy efficiency	8,5	8,5
EE4, EE5, EE7, EE8, EE9, EE10, EE14, EE15, EE16, EE17	Market uptake in Buildings, Consumers, Industry and Products Empowering public authorities and its stakeholders	34,5	32,8
EE19, EE20, EE21	Finance for sustainable energy including project development assistance	25	26,5

## Competitive Low-Carbon Energy

Beside this the *Competitive Low-Carbon Energy* call supports research and the market uptake actions in the field of renewable electricity and heating/cooling, while a Public Private Partnership Energy Efficiency of Buildings (EeB PPP) supports research and demonstration activities on the refurbishment of historic buildings.

In the two upcoming years different topics will be launched within the above calls as presented in the enclosed summary tables.

The first calls are supposed to be launched on 11 December 2013 in Horizon 2020 website<sup>1</sup>.

<sup>1</sup> <http://ec.europa.eu/research/horizon2020>

Topics*	Short-hand Description	2014	2015
LCE1	New knowledge & tech.	20	
LCE2, LCE11	RES – Research	60*	59*
LCE3, LCE12	RES - Demonstration	73*	80*
LCE4, LCE14	Market uptake	20	20
LCE5, LCE6, LCE7	Smart grids	60	71,48
LCE8, LCE9, LCE10	Storage	44,15	26

\*Corresponds to the topic code in the work programme.  
[Source: presentation of Philippe Schild, DG RTD]

All presentations of the information day are published in the event website<sup>2</sup> ■

<sup>2</sup> [http://ec.europa.eu/research/conferences/2013/energy\\_infoday/infoday\\_energy\\_en.htm](http://ec.europa.eu/research/conferences/2013/energy_infoday/infoday_energy_en.htm)

## Delegated Acts of the Construction Products Regulation

In October 2013, the European Commission published the Delegated Acts that supplement the Construction Products Regulation (CPR). According to the Commission's proposal, manufacturers of construction products will be able to upload digital "declarations of performance" on their websites. These documents must accompany the majority of construction products sold, in order to give information on their essential characteristics (e.g. fire resistance, mechanical strength or energy efficiency). Today, all such declarations are individually communicated to the customer by post or email. Online availability of these declarations should enable faster communica-

tion through the supply chain, reduce producer costs and facilitate sales of construction products. The proposal will also make it easier for consumers to find out what performance they should expect from the product they are about to buy. The objective of the CPR, in force since July 2013, is to ensure the availability of reliable and accurate information on the performance of construction products, based on technical specifications that are harmonised across all EU countries. More information on the CPR can be found on the Commission website<sup>3</sup>.

<sup>3</sup> [http://ec.europa.eu/enterprise/sectors/construction/legislation/index\\_en.htm](http://ec.europa.eu/enterprise/sectors/construction/legislation/index_en.htm)

## France launches an action plan on Indoor Air Quality

MYRIAM TRYJEFACZKA Sustainability Manager, Camfil Group myriam.tryjefaczka@camfil.com

On Wednesday, 23 October the French Government published the Action Plan on Indoor Air Quality. It is led by the Ministry of Ecology, Sustainable Development and Energy, the Ministry of Social Affairs and Health and the Ministry of Territorial Equality and Housing.

The Action Plan outlines short, medium and longer term actions which will be integrated into the National Health and Environment Plan (Plan National Santé Environment - PNSE).

Amongst other measures, it proposes to take further actions to limit the sources of indoor air pollution and suggests increasing the consideration of indoor air quality in existing initiatives (such as labels and certifications) to encourage sustainable materials and practices and proper implementation of ventilation and airing.

To improve the quality of the installed ventilation systems, the government intends to mobilize Building industry professionals and integrate initial and

throughout life trainings on energy performance in the building, elements for airing / ventilation, especially for retrofits.

A general educational work is forecasted on issues of indoor air quality in the context of enhancing energy performance of buildings.

In buildings located in priority area for the quality of outdoor air, and in buildings open to sensitive population, the plan will examine best technical requirements of air intakes and ventilation systems.

The new regulation on Indoor air Quality of public buildings will be applicable in 2015 to day care centers and nursery schools. The Government is considering to anticipate its application for hospitals (initially planned in 2025).

**More information:**

<http://www.developpement-durable.gouv.fr/Lancement-du-plan-d-actions-pour,34492.html>

## Heat Pump Industry welcomes agreement on new F-Gas Regulation

The European Commission, the Council and the Parliament agreed in December on a compromise text of the F-Gas Regulation review. The European Heat Pump Association (EHPA) congratulates the negotiating parties for the achievement to finalise a first reading agreement. The association supports a quick finalisation to give the heat pump industry legal certainty for the near future. The final text is based on a phase down scenario that will reduce the amount of refrigerant to be placed on the market by 79%. Apart from that, an additional ban applies to singlesplit air conditioners. EHPA believes that the phase down scenario is already strong enough and no further bans were necessary. Nonetheless, the industry will continue its efforts to make heat pumps the most efficient heating and cooling technology using renewable energy. This will have to integrate new low GWP refrigerant alternatives. As EHPA members have followed the revision of the regulation closely, they are in particular pleased that the policymakers have taken

crucial points into consideration. This includes the sound definition of hermetically sealed equipment as well as the inclusion of pre-charged equipment in the phasedown via a traceability scheme (instead of a ban). This will eventually be beneficial to efficiency and the environment. Thomas Nowak (Secretary General of EHPA): "We are happy about the trilogue compromise. It gives legal certainty to the heat pump industry, which can now start working on delivering its contribution to the phase down." As such EHPA hopes that the Plenary will and Council will follow this agreement and formally adopt the document in early 2014.

*The Brussels based European Heat Pump Association EEIG (EHPA) represents the majority of the European heat pump industry. It has more than 107 members from all parts of the industry's value chain: heat pump and component manufacturers, research institutes, universities, testing labs and energy agencies.*

# Status of new CEN Energy Performance of Buildings Standards in November 2013

This article is an update of the article by Jaap Hogeling: Status of new CEN EPB Standards, published in the REHVA Journal, 4/2013 page 29



JAAP HOGELING

Chairperson of CEN/TC 371  
CEN Program Committee on EPB standards

## prCENTS 16629: Technical Specification (TS): Detailed Technical Rules for the set of energy performance of buildings standards

This TS provides guidance for the drafting the EPB-standards.

**Status:** At the last CEN/TC371 meeting, the 4th of July 2013, it was decided to publish this TS for TC-Approval (TCA). This means that CEN will send this version to all National Standard Bodies (NSB's), the CEN member organisations, for comments and acceptance. In January 2014 this TS will be sent out by the CEN-management to the NSB's for TCA; there is a 3 months period for all NSB's to react-vote to be received before April 2014.

## Over-arching standard on the energy performance of buildings (prEN15603:2013)

This over-arching standard on the integrated energy performance of buildings re-uses the main elements of EN 15603:2008 (Overall energy use and definition of energy rating) and core elements of other key EPD standards, including common definitions, terms and symbols, offering a systematic, clear and comprehensive, modular structure. Consequently, its scope is significantly wider than the scope of EN 15603:2008.

**Status:** The prEN15603 has been published for Public Enquiry (closed last October 2013). The result of the enquiry was quite positive, most of the CEN members voted yes on the possible acceptance as an European Standard. (15 Yes, 4 No, 10 Abstain, 4NV). The No-votes can be resolved by two changes and some more clarification:

- Indicate the normative Annex A as informative and make only the reporting format normative and include the defaults and options only in an informative Annex.

- Support and allow more explicit visibility for the Monthly Calculation procedures although the standard will continue to support hourly procedures as most favourite.
- Give more clarification on how the partitioning should be handled. Provide a well thought-out detailed approach as guidance for the MS's to set up national partitioning rules where needed. The standards will not contain obligatory criteria on how to partition buildings.

### As reminder: the Annex A of prEN15603: On default options and values includes the following:

- A.1 General provisions for national adaptation
- A.2 Type of ratings according to building type and assessment purpose
- A.3 Building categories
- A.4 Building services included in the energy performance calculation
- A.5 Assessment boundaries
  - A.5.1 The conditioned space (or reference area) of the assessed building or building unit
  - A.5.2 The building site
- A.6 Overheads included in the primary energy factors
- A.7 Primary energy factors
- A.8 Energy flows to be included in the energy balance
- A.9 Renewable energy flows part of the renewable energy ratio calculation
- A.10 Other data
- A.11 Distribution rules criteria

## prCENTR 15615: The Accompanying Technical Report to prEN15603:2013

For all EPB standards it is decided that they shall only include **normative** text as is expected in standards. All documentation and justification of the procedures including worked examples is informative text and included in a separate Technical Report connected to almost each EPB-standard. This is to avoid confusion and unpractical heavy normative standards.

Given the number of topics to be dealt with, the over-arching standard prEN15603 (currently about 97 pages) is a complex document. The prEN15603 includes many equations linking together energy related parameters, tables with default values and choices regarding on-site energy production, the use of renewable vs. fossil energy,

energy export, links to inspection, product properties, assessment conventions, etc..

**Status:** At the last CENTC371 meeting, the 4th of July 2013, it was decided to publish this TR for TC-Approval (TCA). This means that CEN will send this version to all National Standard Bodies (NSB's), the CEN member organisations, for comments and acceptance. In January 2014 this TS will be send out by the CEN-management to the NSB's for TCA; there is a 3 months period for all NSB's to react-vote to be received before April 2014.

### Start of phase 2

A first kick-off work shop meeting with the key-experts of the 5 expert teams connected to the respective CEN TC's (TC89; 156; 169; 228; 247) has been held at CEN-meeting Centre in Brussels on the 3rd of July 2013.

Project Phase 2 focuses on the improvement and expansion of the current set of CEN-EPB standards on the basis of the findings (see also results CENSE project and reports of CAP-EDMC-LC) and set of requirements developed in Phase 1 (the Over-Arching standards, the connected TR, the two Technical Specifications and several supporting tools, like templates, checklists and the software tool). The actual revision of the standards will be carried out under the responsibility of the relevant CEN/TC's.

To mention some of the issues: Checking the software-proof-ness of the equations given in the separate standards or parts of standards by producing an excel program and calculation example connected to each WI. General checking of the appropriateness of the current standards, in particular the application of the standards for existing buildings. More focus on models and input data which are to be suited to existing buildings. More focus on passive cooling techniques and the assessment of the energy performance of cooling systems. Harmonisation and if possible integration of the inspection standards on systems for heating, cooling and ventilation. Where needed, expansion of the procedures to NZE-buildings by way of renewable sources of energy, and procedures for energy producing buildings, with consideration given to alternative systems. Integrated approach for calculating minimum performance requirements for different technical building systems and the thermal performance of a building (building envelope) etc.

### Work Program Phase 2

About 100 Work Items: Resulting in about 50 standards or parts thereof and about 50 TR's connected to these standards. Some of these WI's may still be merged and some of the TR's may cover more parts of a standard or more standards. This will shorten the list but not the work.

**Table.** The schedule of working groups preparing individual EPBD related CEN standards.

Date	Deliverables	Required status and next steps
2013.12.31	Submission of complete first Working Draft by experts to WG (draft-prEN +outline-TR +XLS-file with in/output variables)	Most WG's will meet Dec'13/ Jan'14/Febr'14 after which the drafts will go to the TC's.
2014.04.30	After acceptance of WG/TC: Submission to CCMC/CS for Enquiry.	WG's continue to work on TR's and Calculation tool
2014.08.31	Circulation by CCMC/CS for Enquiry.	The draft TR's will be available as TC-documents
2015.01.31	Public Enquiry closed	Prepare FV version EN and TCA for prTR
2015.08.31	After acceptance if WG/TC: Submission draft EN to CCMC/CS for FV	TCA procedure of TR's closed
2015.12.31	Circulation by CCMC/CS for FV	TC's decide on publication TR
2016.02.28	Formal Vote closed	
2016.03.31	Final version submitted to CCMC/CS for publication	Final version of TR published

### Planning Phase 2

We started this July 2013, all WI's will be registered by the 5 TC's before end of 2013. The first TC-Working Group drafts will be ready by December 2013. WG's are expected to discuss the draft prEN's by the end 2013 or beginning 2014, with the final target for delivery for enquiry to CEN Management Centre before end of April 2014. It is expected to finish the enquiry stage of most or, if possible, all EPB-standards before the end of 2014/ beginning of 2015. We should keep in mind that many of the standards will not fundamentally change.

The connected Technical Reports: All standards are accompanied by a TR, some standards may share one referenced TR. It is our intention to finish these TR's after the enquiry of the standards, which allows us to include the results of the enquiry in these TR's. To support the enquiry a draft version of these TR's will be available as TC document to allow access during the enquiry because the TR's include essential background information, justifying, explaining and showing worked out examples. ■

#### Central coordination within CEN team of Task Leaders/experts under CEN TC 371:

CEN TC 371 organises this central coordination team (CENTC371-CTL) in cooperation with the other relevant CEN TC's. The project Teams on different clusters, related to the five CEN TC's:

CEN TC 89 Thermal performance of buildings and building components; CT-leader: Dick van Dijk.

CEN TC 156 Ventilation for buildings; CT-leader: Gerhard Zweifel.

CEN TC 169 Light and lighting; CT-Leader Soh el Moghtader & Jan de Boer.

CEN TC 228 Heating systems in buildings; CT-leader: Johann Zirngibl.

CEN TC 247 Controls for mechanical building services; CT-leader: Dan Napar.

## BUILD UP web portal



The BUILD UP web portal aims to reap the benefits of Europe's collective intelligence on energy reduction in buildings.

BUILD UP aims to reduce the energy consumption of buildings across Europe by transferring best practices to the market and fostering their adoption. The European Commission established the initiative in 2009, to support Member States in implementing the Energy Performance of Buildings BUILD UP Directive (EPBD).

The BUILD UP platform has become a benchmark in European energy efficiency in buildings. Its accessibility and user-generated content offers a collaborative, critical and creative approach to analysing where energy efficiency is today and where it is headed in the future. It also sets a precedent and prime example of environmental conscientiousness and cooperation that echoes far beyond Europe's borders.

After 4 years in operation with 9512 registered users the platform offers:

- 3 595 publications on energy efficiency
- 2 515 news items
- 1 109 links to energy related sites
- 454 cases of energy efficient buildings
- 268 tools for energy analysis
- 53 communities (discussion groups on specific topic)

All this interactive information helps building professionals to improve skills and learn more about the latest information on energy legislation. It will help them interact with others and access the latest news and events in the field, a database of resources, guidelines and tools, and a database of real examples.



BUILD UP provides public authorities for energy issues with access to many resources on the legislation, toolkits and guidelines produced by other cities, regions or countries, and a way to share expertise with their peers.

This platform involves umbrella organisations such as energy agencies, industrial associations or non-governmental organisations with an interest in energy saving in buildings and enables them to tell others about their activities and share their successes.

### BUILD UP Webinars

BUILD UP offers also high level free Web Seminar through WebEx system with internationally recognised expert as speakers. Video recordings are available at the portal. The topics and addresses of the four interesting seminars are:

- Building and Ductwork Airtightness: Legislative Drivers, New Concerns and New Approaches: <http://www.buildup.eu/news/38207>
- Energy-efficient retrofitting of residential buildings: a holistic approach is required: <http://www.buildup.eu/news/38208>
- Superinsulating materials: State of the art applications and long term performance: <http://www.buildup.eu/news/38814>
- Indoor air quality and thermal comfort: Conserving energy, maintaining health: <http://www.buildup.eu/news/39371>

# REHVA Annual Conference and Meeting 2014



The VDI-Technical Division Building Services will host the REHVA Annual Meeting 2014 in Düsseldorf. REHVA-internal meetings, the General Assembly and the REHVA technical conference will be held from 28<sup>th</sup> to 30<sup>th</sup> April. Leading experts from the international building services community will be guests in Germany. More than 150 visitors are expected, when the VDI welcomes the members of REHVA, the Federation of European Heating, Ventilation and Air Conditioning Associations.

The **technical conference “Energy efficient, smart and healthy buildings”** will be organised on April 30<sup>th</sup> at the **Maritim Hotel Düsseldorf Airport**. The 2014 REHVA Annual Conference will mainly focus on Green Buildings/nZEB, building automation and control systems, important standards and REHVA EC projects. Many other interesting topics will be covered and some case studies will be presented. The conference language is English.

Prof. Dr.-Ing. Birgit Müller of the University for Applied Sciences in Berlin will be chairing the conference. Well-known experts from the European REHVA Network will present the topics, focusing on the European point of view.

The scope of the conference will be to offer researchers, industry, building owners, end users, consultants, engineers, architects, policy-makers, etc., a platform for the exchange of scientific knowledge and innovative technical solutions. Extend your personal network with all the visitors of the Annual meeting, get to know about REHVA and VDI activities and take part in the REHVA conference 2014!

The conference fee will be 189€ and includes conference proceedings, refreshments and lunch. Each participant will also receive a personal copy of one of the following VDI-Standards: VDI 3813 part 2, VDI 3817, VDI 4710 part 4, VDI 6022 or VDI 6028 part 1.1. We recommend an early registration due to a limited number of participants. Please register online for the Conference via the website [www.vdi.de/rehva-am-2014](http://www.vdi.de/rehva-am-2014).

**More information:** [www.vdi.de/rehva-am-2014](http://www.vdi.de/rehva-am-2014)

## Tentative Conference Programme

April 30, 2014 Maritim Hotel Düsseldorf Airport, Düsseldorf, Germany

Energy efficient, smart and healthy buildings

09:00	<b>Opening.</b> Prof. Dr.-Ing. Birgit Müller VDI
09:05	<b>Welcome Introduction.</b> Prof. Karel Kabele, REHVA President
<b>Section 1: Energy Efficiency</b>	
09:10	<b>Energy efficient and green buildings in Germany.</b> Dipl.-Ing. Thomas Kleist VDI, GREYDOT, Germany
09:30	<b>REHVA Definition on nZEB.</b> Prof. Jarek Kurnitski, Tallinn University of Technology, Estonia
09:50	<b>Influence of Building Automation and Control Systems on energy standards.</b> Prof. Dr.-Ing. Martin Becker VDI, University of Applied Sciences Biberach, Germany
10:10	<b>Building services in listed or historic buildings – VDI-Standard 3817.</b> Dipl.-Ing., Dipl.-Chem. Rainer Kryschi VDI, Kryschi Wasserhygiene, Germany
10:30	<b>Coffee</b>
<b>Section 2: Ventilation</b>	
11:00	<b>Hygiene in air-conditioning systems – new development of VDI-standard 6022.</b> Dr. Andreas Winkens VDI, Ingenieurbüro Winkens, Wegberg, Germany
11:20	<b>Cooling Loads – the new standard VDI 2078.</b> Prof. Dr.-Ing. Uwe Franzke VDI, ILK-Dresden, Germany
11:40	<b>Weather Data for building services.</b> Prof. Dr. Livio Mazzarella, Polytechnic University of Milan, Italy
12:00	<b>Mixed Ventilation – the new REHVA-Guidebook No. 19.</b> Prof. Dr.-Ing. Dirk Müller VDI, E.ON Energy Research Center RWTH Aachen, Germany
12:20	<b>Lunch</b>
<b>Section 3: European good practices and frontrunners - EU projects of REHVA</b>	
13:30	<b>REHVA Cooperation in EU projects.</b> Anita Derjanecz, REHVA Project Officer
13:45	<b>Nearly Zero Energy Hotels - case studies and the definition of a NZEH.</b> Stefano Corgnati PhD., REHVA vice-president
14:00	<b>BUILD UP portal: achievements and new priorities (TBC).</b> Peter Wouters PhD., INIVE EEIG, Belgium
14:15	<b>REHVA Student Competition Awards Ceremony.</b> Prof. Dr. Manuel Gameiro da Silva, REHVA vice president
14:30	<b>REHVA Student Competition Winner Presentation</b>
14:50	<b>Summary.</b> Prof. Dr.-Ing. Birgit Müller VDI
15:00	<b>End of the conference</b>



# REHVA - iSERV Technical Seminar



REHVA's next Seminar will be held at the Thon Hotel EU in Brussels, Belgium on the 13<sup>th</sup> February 2014 from 10.00 to 16.00. REHVA is organising its 2014 Technical Seminar together with the iSERV project consortium around the topic: *Energy Efficient Operation of HVAC Systems*. iSERV is approaching to its end, so it is time to discuss project results and their further use in an EU-level seminar inviting also high level EC speakers.

The Conference will be covering topics such as energy efficient buildings, EU policies and implementation, energy efficient operation of HVAC systems the iSERVcmb project and a parallel discussions about the deployment of iSERV results the policy and industry perspective.

The speakers of the Conference are invited top experts of their field representing policy makers from European Commission, leaders from important organisations, scientists from top universities and professionals from member states of the European Union.

Come and share your experience and expectations. We will be delighted to see you at this occasion. It is also an occasion to network with others companies.

Lodging is available at the Thon Hotel EU. Advance registration is 125 € per person.

**More information** about the REHVA Technical Seminar or to register, please visit [www.rehva.eu](http://www.rehva.eu) or contact [info@rehva.eu](mailto:info@rehva.eu).

## Programme

10.00– 10.30 **Registration and welcome coffee**

10.30– 10.45 > **Welcome**  
Karel Kabele, REHVA President

10.45– 11.00 > **Keynote address**  
Steven Beckers, Lateral Thinking Factory (TBC)

### Section 1: Energy efficient buildings - EU policies and implementation

11.00– 11.20 > **Policy Instruments to constrain the growth in Air Conditioning Energy Consumption**  
Roger Hitchin, Building Research Establishment

11.20– 11.45 > **European policies of buildings energy efficiency – challenges and policy updates**  
Marie C. Donnelly, Director, DG Energy

11.45– 12.10 > **Supporting EPBD in the 2014-2020 financial period – the future of Intelligent Energy Europe**  
Vincent Berrutto, Head of Unit, European Commission Executive Agency for Competitiveness and Innovation (EACI)

12.10– 12.30 > **Q&A**

12.30– 13.30 **Buffet Lunch**

### Section 2: Energy efficient operation of HVAC systems – the iSERVcmb project

13.30– 13.50 > **Inspection of HVAC Systems through continuous monitoring and benchmarking – outcomes of the iSERVcmb project**  
Ian Knight, project coordinator, Welsh School of Architecture, Cardiff University

13.50– 14.20 > **Lessons learnt from iSERV**  
John Woollett, Swegon and Peter Dymant, Camfil

14.20– 14.50 > **Energy efficient operation of buildings - good practices from IEE projects**  
Pau Garcia-Audi, European Commission Executive Agency for Competitiveness and Innovation (EACI)

> **Q&A**

### Parallel discussions about the deployment of iSERV results – policy and industry perspective

15.15– 16.15 **1. Legislation and policy recommendations from iSERV**  
Moderated by Ian Knight, Cardiff University

**2. What can producers and system operators gain from iSERV?**  
Moderated by Zoltan Magyar, REHVA vice-president

## Daikin's successful VRV IV heat pump

Daikin has set the standard yet again with the 4<sup>th</sup> generation of VRV. With the launch of VRV IV in autumn last year Daikin offers three revolutionary innovations: variable refrigerant temperature, continuous heating on heat pump and the VRV configurator for simplified commissioning.

And the product is very well accepted by the market. First year results of installed systems show efficiency improvements of up to 40% on an annual basis.

The revolutions in short:

- Variable Refrigerant Temperature. Making possible annual cost savings of 28%, by adapting the system to the weather conditions and offering many customization options to optimize the system towards the building owner needs.
- Continuous heating during defrost. Equipping a heat pump with a heat vessel allowing continuous heating – even in defrost mode – making VRV IV the best heat pump alternative to traditional heating systems
- VRV configurator. Thanks to this revolutionary feature, less time is needed for commissioning, and multiple systems can be managed in the same way.



More information: [www.daikineurope.com/vrv-iv](http://www.daikineurope.com/vrv-iv)



New in nominal diameters  
DN 15 to DN 150

EXPERIENCE  
EFFICIENCY

Electronical pressure-independent valve EPiV.  
The clever way to control the flow rate.

Measuring, controlling, balancing and shutting with one ready-to-install unit – this is how you increase efficiency during planning, implementation and operation:

- Time-saving and safe valve selection
- Rapid, simple installation and commissioning
- Automatic, permanent hydraulic balancing through the valve
- Securing of the correct amount of water with differential pressure changes and with partial loads
- No energy losses thanks to air bubble tight-closing valve
- Real time information of the measured flow rate

Water is our element: [www.belimo.eu](http://www.belimo.eu)

## A valve with four functions from Belimo

### EPIV pressure-independent characterised control valve

**B**elimo now offers the EPIV pressure-independent characterised control valve in the nominal diameters DN 15 to DN 150. This extends the fields of application of this innovative, electronically controlled valve. Because of the fact that it combines the four functions of measuring, controlling, hydraulic balancing and shutting in one ready-to-install unit, its utilization enhances efficiency during planning, implementation and operation:

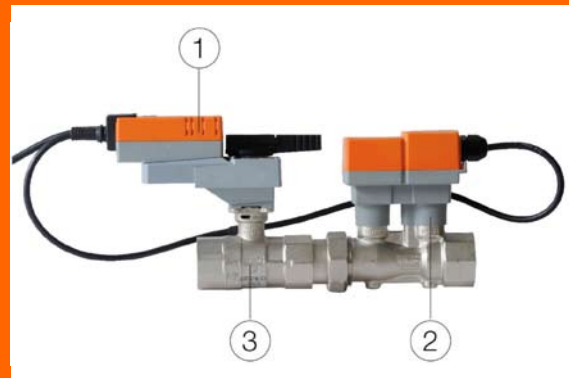
- Time-saving and safe valve selection in accordance with maximum volumetric flow
- Rapid, simple installation and commissioning
- Automatic, permanent hydraulic balancing through the valve
- Securing of the correct amount of water with differential pressure changes and with partial loads
- No energy losses thanks to air bubble tight-closing valve (leakage rate A in accordance with EN 12266-1)
- Real time information of the measured flow rate

The integrated electronic flow control ensures that the required volumetric flow is secured. The respective measured values can be called up as real time information. The EPIV can be operated with medium temperatures from -10°C to +120°C and with a system pressure (ps) of 1600 kPa. Both conventional communication and communication via the Belimo MP bus<sup>®</sup> is possible with all types.

**More information:** [www.belimo.eu](http://www.belimo.eu)



**The innovative pressure-independent characterised control valve EPIV from Belimo is now available in the nominal diameters DN 15 to DN 150.**



- ① *Electronic flow control*
- ② *Integrate flow measurement*
- ③ *Air bubble tight-closing characterised control valve.*

*The Belimo Group is a leading global manufacturer of innovative actuator solutions for heating, ventilation and air-conditioning technology. The Group achieved sales of CHF 445 million in 2012 and employs just under 1300 people. For information on the company and its products, visit [www.belimo.com/investorrelations](http://www.belimo.com/investorrelations).*

*The shares of BELIMO Holding AG have been traded on SIX Swiss Exchange since 1995 (BEAN).*



# A new generation of air purifier from Camfil



Camfil launched in 2013 the only air purifier on the market able to filter all types of indoor air pollutants: microorganisms, allergens, fine and ultrafine particles and gases, including formaldehyde, benzene, VOCs, odors.

Equipped with patented H13 HEPA filters and a double molecular filtration stage, **Camcleaner City** is ideal for improving indoor air quality in offices, hotels and meeting rooms, booths in underground parking, basements, kindergardens, schools or health care centers and patient waiting rooms.

Different from other air purifiers, **Camcleaner City** doesn't generate any secondary air pollutant (unlike other technologies, such as photocatalysis, cold plasma). It eliminates odors and major indoor air pollutants and protects the health of occupants.

Simple, silent, with a modern design, it can be easily installed everywhere, in any indoor environment, to treat specific indoor air pollution or in places without effective ventilation.

Designed for 130 to 340 m<sup>3</sup>/h air flow, it has a very low appetite for energy (42 W only).

Maintenance is made easy, a warning LED signal indicates the need to change filters.



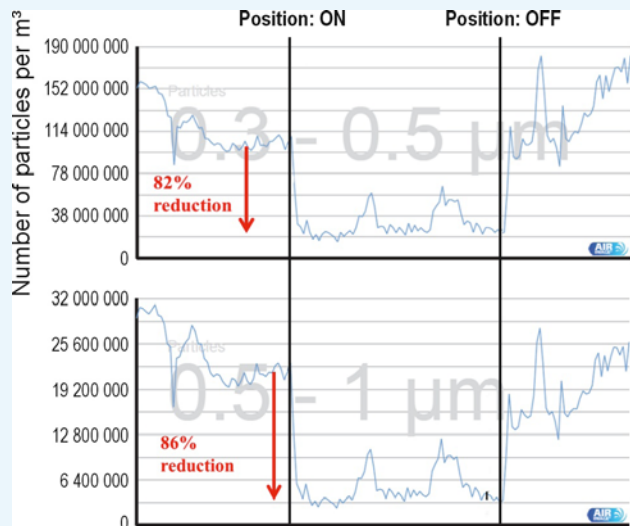
## Camfil's expertise at customer's service

Prior and after implementing the Camcleaner solution, Camfil can perform measurements of particles pollution, VOCs and aldehyde.

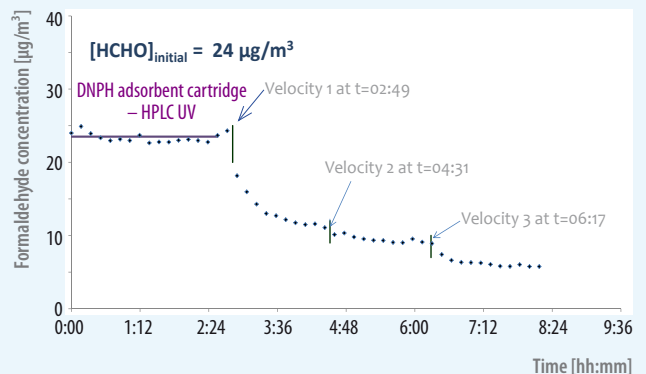
Our VOC and aldehydes test kit targets 39 identified molecules: (30 VOCs (benzene, tetrachloroethylene, xylenes, toluene,...) and 9 aldehydes (formaldehyde, acetaldehyde,...). Aldehydes are measured according to EU ISO 16000-4-2011 standard.

The Camfil Group is a world leader in the development and production of air filters and clean air solutions, with 23 production units and R&D centres in the Americas, Europe, South East Asia and the Asia-Pacific region.

### Proven Efficiency against formaldehyde and particles



Camcleaner City's efficiency against fine and ultrafine particles measured in a hotel meeting room (67 participants).



Camcleaner City's efficiency against formaldehyde measured in an independent laboratory. Formaldehyde Initial concentration 25 µg/m<sup>3</sup> removed at 3 velocities, in 28 m<sup>3</sup> room, 18±2°C. Formaldehyde HPLC analysis used DNP adsorbent cartridges for sampling.

The Group, headquartered in Stockholm, Sweden, has 3 428 employees and sales in the range of SEK 4.9 billion. International markets account for almost 90% of sales.

With 50 years of experience in air filtration products and solutions, Camfil delivers value to customers all over the world while contributing to something essential to everyone – clean air for health, well-being and performance.

More information: [www.camfil.com](http://www.camfil.com)

## VDI Guidelines published November – December 2013

### **VDI 2050/1 “Requirements for technical equipment rooms; Technical bases for planning and execution”**

Technique areas are cost-relevant factors which are often minimised by optimising utilisation areas at the expense of the subsequent costs of operation and maintenance. The persons responsible are often not the ultimate operators or users of the systems, and the balancing influence of the operating costs is therefore lacking. Early decisions about the amount of space needed for the individual technique rooms and service shafts are essential, particularly with a view to economical operation and maintenance.

### **VDI 3805/32 “Product data exchange in the building services; Distributors/collectors”**

The objective of this standard is to provide a set of rules for the exchange of product data in computer-aided planning processes for the building services product range of distributors and collectors on the basis of the standard VDI 3805 Part 1.

### **D VDI 4703 “Facility Management; Lifecycle-cost-based tender”**

This standard serves as guidance for the lifecycle-based tender. It aims at creating conditions under which offers can be compared over their entire lifecycle. The specifications and information required to creating comparability are defined and structured in this standard. The standard is intended for use by persons planning an investment. The lifecycle cost calculation in accordance with VDI 4703 is based on the calculation procedure of VDI 2067 Part 1.

### **D VDI 6010/3 “Technical safety installations for buildings; Integrated system test”**

The series of standards VDI 6010 applies to safety devices in buildings. Part 3 gives information about the organization, implementation and documentation of black building tests in buildings. The standard is intended in particular to prove the public requirements in initial tests, periodical tests and tests after an important modification. It can also be used to verify the fulfillment of private agreements.

### **VDI 6028/1.1 “Assessment criteria for Building Services; Technical quality for sustainable buildings”**

In this standard, evaluation criteria for the sustainability of building services are provided. The criteria are applicable to all trades of building services. Evaluating the technical quality of the TGA will be treated separately from usage requirements. It's only about the valuation of the plant itself, not to evaluate the impact on the use and

operation of the facilities. Compliance with the usage requirements is provided in the evaluation.

### **VDI 2067/40 “Economic efficiency of building services installations; Energy effort for generation”**

This standard describes the calculation of the energy effort for heat and cold generation. Input energy may originate in the environment or fuels (solid, liquid, gaseous) or may be electrical. The standard allows to evaluate the energy efficiency of generators to be installed or existing ones already in use. This standard and the other parts of the series of standards VDI 2067 represent an overall system, which means that the standard is to be applied in conjunction with these parts.

### **VDI 3810/4 “Operating and maintenance of buildings and building installations; Ventilating and air-conditioning installations”**

The standard applies to the operation and maintenance of ventilating and air-conditioning (VAC) installations and VAC equipment (centralised as well as decentralised). It targets in particular cost groups 430 through 434 and 439 as per DIN 276. It does not apply to household equipment as specified in the German Product Safety Act (ProdSG). The standard offers the owner and operator of installations recommendations for the safe, specified and economic operation of VAC installations.

### **D VDI 4700/3 “Terminology of civil engineering and building services; Symbols (mainly ventilation and air conditioning)”**

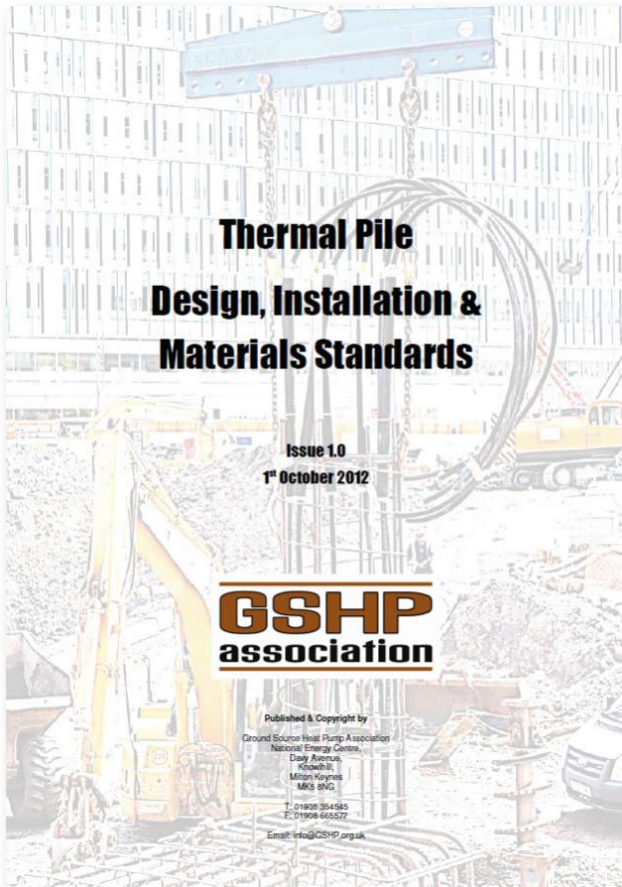
In national and European standards, a multitude of symbols are used, which have identical meanings but different notations. On the one hand, this is due to internationalisation in standardisation (e.g. DIN EN, DIN EN ISO), on the other hand, to technical rules being drafted by different bodies and the symbols being used in various branches of industry. This standard specifies the preferred usage of symbols in standards.

### **VDI 6022/6 “Ventilation and indoor-air quality; Air humidification on decentralised devices; Planning, construction, operation, maintenance”**

This standard applies to standalone units for the intended and local humidification of air as well as for decorative water-carrying devices (such as fountains, cascades and water walls) which affect the air humidity in a room. Units originally intended for residential use, which are used in workplaces are also subject to the requirements specified by this standard.

**D** = Draft Guideline

## GSHPA Thermal Pile Standard Published in the UK



Recently the Ground Source Heat Pump Association has taken the lead in the UK in setting standards for design and installation of ground source heat schemes, aiming to raise standards throughout the industry. As part of this process a Thermal Pile Standard (GSHPA, 2012) was released in 2012. This document is the first specification for energy piles, tackling important issues such as contractual arrangements, required training for designers and installers, design and material requirements, thermal response testing, required testing and monitoring and as built records. The standard also includes a series of annexes which provide further technical information in certain areas.

GSHP schemes have many interfaces and it is important to manage those interfaces properly during the design and construction process. This is particularly important for the case of energy piles, as the specialist

geothermal contractor now also needs to work with the piling Contractor as well as other trades. The GSHPA Thermal Pile Standards recommends the appointment of a Coordinator, whose job is specifically to look after interfaces such as these that are essential to the smooth running of any project.

The standard also covers the additional factors that must be considered when designing an energy pile system rather than a more routine borehole heat exchanger system. Thermally the design must account for the shorter length and larger diameter of the heat exchangers and take account of the beneficial short term thermal storage that is available within the pile concrete. Thermo-mechanically additional considerations are also required. There is no evidence that routine energy pile operation will have a detrimental impact on the pile structural and geotechnical performance, however, additional checks may be required during design, for instance to confirm that any small amounts of additional displacement at the pile head are acceptable to the structure above. It is also important to ensure sensible temperature limits are established, both to protect the foundation and the heat pump.

It is also important not to neglect the practical details and Section 9 of the standard covers loop installation, protection, trimming and headering. It is essential that the pipe loops, typically connected to the steel reinforcing cage, are protected from falling concrete by placing that concrete using a tremmie pipe rather than allowing free fall to occur. The upper part of the pipes also need protecting so that when the top part of the pile concrete is later trimmed to its final level no damage to the pipes occurs.

As research on energy piles is moving fast the standard will undoubtedly need updating in the coming years. However, it currently forms the most complete document of its kind in the world. The standard may be obtained for free from [http://www.gshp.org.uk/GSHPA\\_Thermal\\_Pile\\_Standard.html](http://www.gshp.org.uk/GSHPA_Thermal_Pile_Standard.html).

GSHPA (2012) *Thermal pile design, installation and materials standard*, Ground Source Heat Pump Association, Milton Keynes, UK, October 2012.

# Important publications from CIBSE in 2013



CIBSE Chartered Institution of Building Services Engineers, UK

## AM12 Combined Heat and Power for Buildings

First published in 1999, this new edition takes the growing concerns over global warming and the recognition of the role that CPH can play in delivering low carbon buildings into consideration. Revised and updated it contains new sections including:

- a new chapter on district heating applications
- more information on assessing environmental benefits
- more detail on tri-generation and thermal storage

## Ground Source Heat Pumps

The purpose of this Technical Memorandum (TM51:2013) is to provide information for practitioners to enable ground source heat pumps to be properly applied, and their environmental and economic potential to be realised. Specifically it aims to provide:

- understanding of the technology and its application
- information on the availability and comparability of systems
- clarity on how GSHPs comply with building regulations, SBEM and Environment Agency regulations
- understanding of the design, integration and procurement process
- information on maintenance, training and resources
- information on real performance with case studies

## Minimising the Risk of Legionnaires' Disease

These Technical Memoranda (TM13:2013) set out to give guidance on the appropriate design, installation, commissioning, operation and maintenance procedures necessary to minimise the risk of infection by Legionella from water systems within a building. Principles are highlighted, and practitioners in these fields are encouraged

to apply them to their own particular building services applications.

## The Limits of Thermal Comfort: Avoiding Overheating in European Buildings

This Technical Memorandum (TM52:2013) is about predicting overheating in buildings. It is intended to inform designers, developers and others responsible for defining the indoor environment in buildings. It includes the recommendations of the Overheating Task Force, which has sponsored and published this document.

## Evaluating Operational Energy Performance of Buildings at the Design Stage

This guidance (TM54:2013) will help to turn low energy designs into low energy buildings that achieve the design energy targets. It is one of several CIBSE actions to promote more effective assessment of energy performance. ■



All CIBSE titles are available in hard copy or in PDF at <https://www.cibseknowledgeportal.co.uk/>

# EU Sustainable Energy Week 23 to 27 June 2014

The dates are set for next year's leading event dedicated to energy efficiency and renewable energy solutions! From the EU Sustainable Energy Week (EUSEW) will take place in Brussels and across Europe.

Launched in 2006 as an initiative of the European Commission, the EUSEW has become a reference point for public authorities, energy agencies, private companies, NGOs and industry associations engaged in helping to meet the EU's energy and climate goals. The EUSEW 2014 has already kicked off with the opening of the Sustainable Energy Europe and ManagEnergy awards. Visit <http://www.eusew.eu> to find out how to take part.

In the coming weeks and months, the EUSEW website will be updated with useful information for both events'

organisers (Energy Days) and participants to plan their involvement in the forthcoming EUSEW. So watch this space for further announcements!

Remember you can also keep track of EUSEW's latest developments on social media. Be part of our online communities at: [facebook.com/euenergyweek](https://www.facebook.com/euenergyweek), [twitter.com/euenergyweek](https://twitter.com/euenergyweek), and [linkedin.com/groups/EU-Energy-Week-4197341/about](https://www.linkedin.com/groups/EU-Energy-Week-4197341/about).

Every year EU Sustainable Energy Week (EUSEW) gathers hundreds of organisations and individuals. Through bottom-up efforts, organisers of EUSEW Energy Days, events and activities connect directly with citizens and energy stakeholders at the local, regional and national levels. The combined results of EUSEW efforts are helping Europe reach its energy goals.

# XI<sup>th</sup> International HVAC+R Technology Symposium in Istanbul, May 8–10, 2014

Organized biannually by Turkish Society of HVAC and Sanitary Engineers (TTMD), the XI<sup>th</sup> International HVAC+R Technology Symposium will take place on May 8–10, 2014 in Istanbul Expo Center based in Istanbul World Trade Center. This year, the symposium will be held in parallel with International HVAC & Refrigeration Exhibition (ISK-SODEX 2014) which has visited by more than 82 000 national and international visitors last year. Thus, we are expecting to draw further attention from sector professionals.

This symposium, serving as a meeting center for east and west in terms of geography, commerce, information and technology, will be held with the support and

participation of national and international institutions, academicians from universities and the representatives of the companies.

Each year, the symposium is becoming more international. We welcome the relevant national and international papers which aim to gather the engineers, researchers, designers, contractors and academicians working in Sanitary Engineering field and to discuss and share the scientific and technological developments and new design issues.

**More information:**

<http://www.ttmd.org.tr/sempozyum2014/eng/>





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Swegon's GOLD RX is totally unique. It is the first ventilation system for high volumes of air flow to achieve Passive House accreditation. Twelve sizes of GOLD RX for air flow volumes of up to 2.5 m<sup>3</sup>/s have been approved as complying with the criteria of the Passive House Institute for energy use and recovery. Outstanding quality, best energy efficiency and state-of-the-art technology – GOLD has been setting the standard since 1994 and continues to impress. Trust the original.

Swegon is an innovative and environmentally-conscious manufacturer of market-leading products and solutions that provide an invigorating indoor climate for the well-being of people and buildings. Swegon is a Swedish company in the Latour Group with sales of approximately SEK 3.2 billion. It is represented in 40 countries and has a workforce of 1,450 employees.

*If you would like to find out more about our Passive House accreditation and GOLD RX, please visit:*

[www.swegon.com](http://www.swegon.com)



**Swegon**

International Conference

# World Sustainable Energy Days 2014

26 - 28 February 2014  
WELS, AUSTRIA

## CONFERENCES:

-  **European Nearly Zero Energy Buildings Conference**
-  **European Energy Efficiency Policies Conference**
-  **Innovative Building Technologies Conference**
-  **European Pellet Conference**
-  **WSED next Conference for Young Researchers**
-  **Trade Show "Energiesparmesse"**
-  **B2B-Meetings**
-  **Technical site-visits**
-  **Poster Presentations**

The World Sustainable Energy Days are one of the largest annual conferences in this field in Europe, offering a unique combination of events on sustainable energy.

Since more than 20 years, experts and decision makers from all over the world flock to Upper Austria to attend the events - in 2013, more than 800 decision makers from 61 countries participated in the conference!

The conference is held in parallel to the Energiesparmesse, a major trade show on energy efficiency and renewable energy, with more than 1,600 exhibitors and 100,000 visitors annually.

[WWW.WSED.AT](http://WWW.WSED.AT)





2014

## World Sustainable Energy Days 26 - 28 February 2014

### World Sustainable Energy Days

#### Conference Programme online

The World Sustainable Energy Days (WSED, [www.wsed.at](http://www.wsed.at)), one of the largest annual conferences in this field in Europe, offers a unique combination of events on high energy efficiency in buildings and renewable energy heating.

For more than 20 years, experts and decision makers from all over the world flock to Upper Austria to attend this event - in 2013, more than 800 experts from 61 countries participated!

The conference is organised by the OÖEnergiesparverband, the energy agency of Upper Austria, and takes place from 26-28 February 2014 in Wels/Austria.

**The World Sustainable Energy Days 2014 programme offers a unique combination of events with carefully selected topics:**

- **The European Nearly Zero Energy Buildings Conference:**

Highlights energy efficient buildings supplied with renewable energy through 3 sessions: NZEB policies & market overview, NZEB market transition – how to make it happen? And an overview of NZEBs implementation in member states and regions. Key speakers are NZEB experts from the European Commission, European Parliament, BPIE, CEN and Ecofys.



- **The WSED next Conference (Energy Efficiency & Biomass):**  
Presents the work of young researchers in the fields of biomass and energy efficiency. The event includes a young researchers award and a R & D Networking Platform for young researchers. This year, the “**Young researchers award**” will be awarded for the first time.
- **The Innovative Building Technologies Conference:**  
Is dedicated to the latest developments in technological solutions for nearly zero energy buildings (new construction and renovation). The conference highlights building technologies for today and the future. Building technology experts from REHVA, Fraunhofer Institut and ZAE Bayern, among others, will present key NZEB technologies.
- **The Energy Efficiency Policies Conference:**  
Offers an update on the implementation of the EU energy efficiency policies and how they can drive innovation and employment. The current status of EED implementation and good practice examples for national energy efficiency policies and implementation will be presented.

Furthermore, the WSED programme includes also the following events:

- **European Pellet Conference:**  
The world’s largest annual conference on pellets presents technology and policy trends, markets, innovation, sustainability, finance and business models.
- **B2B Meetings:**  
Bilateral meetings offer the possibility to find new business partners in the fields of biomass & energy efficiency.
- **Trade Show "Energiesparmesse":**  
Leading trade show on renewable energy and energy efficiency with 100,000 visitors and 1,600 exhibitors annually.
- **Technical site-visits:**  
Technical site-visits to best practice examples in Upper Austria for wood pellets & wood chips (25 Feb.) and Nearly Zero Energy Buildings (28 Feb.).
- **Poster Presentation:**  
The poster presentation displays successful initiatives and projects on energy efficiency and renewable energy.

### Programme for European Nearly Zero Energy Buildings Conference on Thursday, 27 February 2014

#### 14.15 NZEB policies & market overview

- **Opening & welcome**  
Rudi Anschöber, Regional Minister for Energy, Upper Austria
- **Transition to sustainable buildings – strategies and roadmaps to 2050**  
John Dulac, International Energy Agency (IEA)
- **Progress in implementing the EU Buildings Directive**  
Claudia Canevari, European Commission, DG Energy
- **The implementation of the EU Buildings Directive in Austria**  
Gerhard Dell, OÖ Energiesparverband, Austria
- **Is cost-optimality driving buildings towards NZEB?**  
Bogdan Atanasiu, Buildings Performance Institute Europe
- **CEN building standards in practice**  
Jaap Hogeling, CENTC 371 Programme Committee on EPBD, ISSO, The Netherlands

#### NZEB Market transition - how to make it happen?

- **The city of the future – research & technology development**  
Michael Paula/Theodor Zillner, Federal Ministry for Transport, Innovation & Technology, Austria
- **Turning energy efficiency into sustainable business - a European roadmap**  
Luc Bourdeau/Stefano Carosio, E2BA-Energy Efficient Building Association
- **European financing opportunities for building efficiency**  
Reinhard Six, European Investment Bank
- **Business models for upscaling building renovation**  
Paul Kenny, Tipperary Energy Agency, Ireland

#### 18.30 End of the conference day

#### 19.30 Evening event

Upper Austria is an ideal 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 holds a leading role in energy efficiency and renewable energy sources.

**More information:** Conference website [www.wsed.at](http://www.wsed.at) or OÖ Energiesparverband, Landstrasse 45, 4020 Linz/ Austria, T: +43-732-7720-14386, [office@esv.or.at](mailto:office@esv.or.at), [www.esv.or.at](http://www.esv.or.at) ■

## Nordbygg 2014

Northern Europe's largest and most important construction industry event! Nordbygg gives you a perfect grasp of developments in the construction, building services installations and real estate industry. More than 800 exhibitors from over 30 countries will be taking part with exciting innovations, smart solutions and new ideas.

### New Concepts Reinforce Nordbygg

Sweden's Construction Week and Sustainable Days are two new concepts set for launch at Nordbygg 2014 that are certain to reinforce the fair's position as the leading Nordic venue for business and progress in the urban development industry.

These initiatives will be introduced at next year's Nordbygg in light of the Swedish Construction Federation's predic-

tion of full-speed economic recovery for the construction industry in 2014. Its latest forecast anticipates construction investment growth of one percent in 2014, mainly due to increased housing construction.



April 1-4, 2014  
www.nordbygg.se

In the meantime, sustainability issues are gaining ground in the industry – something that will be reflected very clearly at Nordbygg 2014, thanks in no small part to the new concept Nordbygg Sustainable Days – Featuring Germany. Energy Smart Renovation is another not-to-be-missed feature, with a whole new take on the issue.

**More information:** [www.nordbygg.se](http://www.nordbygg.se)

## light+building

The world's leading trade fair for Architecture and Technology

30.03.2014 - 04.04.2014  
Frankfurt, Germany

Around 2,300 exhibitors take part in Light+Building at Frankfurt Fair and Exhibition Centre and almost one in two of the over 196,000 visitors comes from outside Germany. After Germany, the top ten visitor nations are The Netherlands, Italy, Austria, France, Switzerland, Great Britain, China, Spain, Belgium and Sweden. The most important visitor target groups are architects, interior architects, designers, planners, engineers, artisans, the distributive trades and industry.

Every two years, the industry presents its latest innovations for the fields of lighting, electrical engineering, house and building automation and software for the construction industry at the world's leading trade fair for architecture and technology. The main theme at Light+Building 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.

**More information** is available on the exhibition website.  
<http://light-building.messefrankfurt.com/frankfurt/en/aussteller/willkommen.html>

### REHVA Seminar in Light+Building

Building Management Systems and Energy Efficiency  
Monday, 31st of March 2014

## ISH China & CIHE launches Building Water Supply and Drainage section at the 2014 edition



**N**oted as one of Asia's largest HVAC and sanitation exhibitions, ISH China & CIHE – the China International Trade Fair for Sanitation, Heating, Ventilation & Air-Conditioning, is adding a new and highly in-demand section on Building Water Supply and Drainage to its 2014 edition. Scheduled to take place from **13–15 May 2014** at Beijing's New China International Exhibition, the show will once again be organised by Messe Frankfurt (Shanghai) Co Ltd and Beijing B&D Tiger Exhibition Co Ltd. The three-day event expects to welcome over 950 exhibitors and is estimated to cover more than 85,000 sqm of exhibition space across six halls with the latest innovations and practical solutions in HVAC and sanitation technology.

Mr Li Hongbo, General Manager, Beijing B&D Tiger Exhibition Co Ltd shared: "Based on the Chinese government's recent energy policy initiatives, demand for green and intelligent HVAC solutions is growing quickly. End-users as well as property and infrastructure developers are looking for the best HVAC solutions offered by suppliers. And ISH China & CIHE will highlight recent solutions and products that can meet government regulations while maintaining a comfortable living environment."

Mr Richard Li, General Manager of Messe Frankfurt (Shanghai) Co Ltd said: "ISH China & CIHE's sanitation section has proven to be more and more popular among buyers and industry professionals each year. Focused on water-saving technology, the fair provides an unmatched platform for professionals and suppliers to discuss various solutions as well as installation methods while also discover new business opportunities. To add on to this already popular area, I am excited to announce that we will be launching a new section on building water supply and drainage for

the 2014 show. This new section will aim to provide a one-stop destination for construction purchasing."

With the rapid development of China's building industry has come the increased integration of water supply and drainage systems into buildings. The concept of building water supply and drainage is quickly growing from just an individual user focus, to a building-wide necessity across the country. Building water supply includes domestic, recycled and fire water supply systems, while drainage encompasses sewage, waste and rainwater systems.

As China's living standards continue to rise, efficient water supply and drainage systems are being integrated not only into residential properties but also commercial buildings such as hotels, office spaces, entertainment venues and much more. The fast-growing market presents a wealth of opportunities to suppliers able to cater to property developers, project-based business professionals and many others.

Working with this information, ISH China & CIHE will launch its latest specialty area "Building Water Supply and Drainage" at the 2014 show. The section will showcase advance products, technologies and solutions for this important market.

As China's leading HVAC and sanitation fair, ISH China & CIHE aims to provide global manufacturers, buyers and retailers a professional trading and purchasing platform for brand building, product procurement and technical exchange.

ISH China & CIHE is headed by the biennial ISH event in Frankfurt, the world's leading trade fair for the Bathroom Experience, Building, Energy, Air-conditioning Technology and Renewable Energies, taking place 10–14 March 2015. Furthermore, the next edition of ISH Shanghai & CIHE is scheduled to take place from 3–5 September 2014 at the Shanghai New International Expo Center.

**More information:**

[www.ishc-cihe.com](http://www.ishc-cihe.com) or email [info@ishc-cihe.com](mailto:info@ishc-cihe.com)



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info@friterm.com  
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# ACREX India 2014

## – heading towards carbon neutral



ACREX India 2014 is South Asia's largest exhibition on Air Conditioning, Refrigeration & Building Services. Acrex India 2014 will take place at Pragati Maidan in New Delhi from **February 27 to March 1, 2014**. More than 450 companies from Asia, Europe and North America will participate in the exhibition. As a first of its kind, ACREX India has started an initiative that aims at reducing its carbon footprint to set an example for environment-friendly and energy-efficient development in the heating, ventilation, air conditioning and refrigeration (HVAC&R) sector. ACREX India 2014 is organized by the Indian Society of Heating, Refrigeration and Air Conditioning Engineers (ISHRAE) and NürnbergMesse India.

The Indian construction industry progressed at a Compound Annual Growth rate (CAGR) of 15.10 percent between 2008 and 2012. This growth was supported by the country's expanding economy, increased government spending on public infrastructure, high urbanization and a supportive foreign direct investment (FDI) system. For the next five years, the construction industry's growth is expected to remain strong as a result of the government's commitment to improve India's infrastructure. "The positive development of the construction and infrastructure sector offers numerous business opportunities for the HVAC & R industry," says Sonia Prashar, Managing Director of NürnbergMesse India. "With ACREX India we offer the global industry a platform to expand their business and to benefit from these positive developments."

Mr. Ashish Rakheja, Chairman ACREX India 2014 shared his vision for the show, apart from many of his "WOW" ideas of aiming to have ACREX India 2014 as carbon neutral, acknowledging the latest industry innovations this year's ACREX India 2014 would also have a special Architects Forum, where architects would display their models of the future building concepts.

### Towards a carbon neutral exhibition

The exhibition focuses on energy-efficient technologies and latest innovations. As representative of a future-oriented industry, ISHRAE has decided to set an example for responsible use of natural resources: To compensate unavoidable emissions caused due to the exhibition, the organization is going to plant 10,000 trees all over India. In fact the launch of ACREX India 2014 saw more than 200 attendees planting the trees virtually through an NGO



named **Sankalp Taru**. The NGO would plant these trees on behalf of delegates, Exhibitors & Visitors of ACREX India 2014 and ISHRAE Members. These trees can be located through GPRS system and their growth can be also monitored from time to time. Another step which ISHRAE would be exploring is reusing and recycling of the waste which would be generated during ACREX India 2014. Every exhibitor is invited to contribute to the reduction of the exhibition's carbon footprint by following the principle of three "Rs": Reduce, Recycle and Reuse.

### Sharing expertise at ACREX India 2014

ACREX India presents the entire spectrum of the refrigeration and air conditioning industry, ranging from air conditioning systems, refrigeration equipment, temperature control and ventilation to building technologies and services. Industry-leading companies like Carrier, ebmpapst, Daikin Airconditioning India Pvt. Ltd. (DAIPL), Bry Air Asia Pvt. Ltd., Mitsubishi Electric India Pvt. Ltd., Intertek and Marathon Electric have already booked their booth. The international interest in the show is also high: Germany, Italy, the USA and China have confirmed their participation with country pavilions.

**More information:** [www.acrex.in](http://www.acrex.in) and [www.frontale-india.com](http://www.frontale-india.com)





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# ACREX India 2014

27 Feb - 1 Mar 2014

PRAGATI MAIDAN, NEW DELHI

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# Events in 2014 - 2015

## Conferences and seminars 2014

January 18–22	ASHRAE 2014 Winter Conference	New York, NY, USA	<a href="http://www.ashrae.org/membership--conferences/conferences">www.ashrae.org/membership--conferences/conferences</a>
February 13	REHVA-iSERV Technical Seminar	Brussels, Belgium	<a href="http://www.rehva.eu">www.rehva.eu</a>
February 24–26	First International Conference on Energy and Indoor Environment for Hot Climates	Doha, Qatar	<a href="http://www.ashrae.org/HotClimates">www.ashrae.org/HotClimates</a>
February 26–28	World Sustainable Energy Days 2014	Wels, Austria	<a href="http://www.wsed.at">www.wsed.at</a>
February 26–28	49th AiCARR International Conference	Rome, Italy	<a href="http://www.aicarr.org">www.aicarr.org</a>
March 18–19	International Workshop Quality of Methods for Measuring Ventilation and Air Infiltration in Buildings	Brussels, Belgium	<a href="http://www.aivc.org/News/Newsflash_20131009.html">www.aivc.org/News/Newsflash_20131009.html</a>
March 19	REHVA - AiCARR Seminar - Towards nearly zero retrofitted buildings	Milan, Italy	<a href="http://www.rehva.eu">www.rehva.eu</a>
March 31	REHVA Seminar - Building Management Systems and Energy Efficiency	Frankfurt, Germany	<a href="http://light-building.messefrankfurt.com/frankfurt/en/aussteller/willkommen.html">http://light-building.messefrankfurt.com/frankfurt/en/aussteller/willkommen.html</a>
April 2–3	8th International Conference Improving Energy Efficiency in Commercial Buildings (IEECB'14)	Frankfurt, Germany	<a href="http://iet.jrc.ec.europa.eu/energyefficiency/conference/8th-international-conference-improving-energy-efficiency-commercial-buildings-ieecb%E2%80%9914">http://iet.jrc.ec.europa.eu/energyefficiency/conference/8th-international-conference-improving-energy-efficiency-commercial-buildings-ieecb%E2%80%9914</a>
April 3–4	4th CIBSE ASHRAE Technical Symposium 2014 - "Moving to a New World of Building Systems Performance"	Dublin, Ireland	<a href="http://www.cibse.org/symposium2014">www.cibse.org/symposium2014</a>
April 7–8	ASHRAE High Performance Buildings Conference	San Francisco, California	<a href="http://www.hpbmagazine.org/hpb2014">www.hpbmagazine.org/hpb2014</a>
April 10–13	2014 Windsor conference-Counting the Cost of Comfort in a Changing World	Windsor, United Kingdom	<a href="http://nceub.org.uk">http://nceub.org.uk</a>
April 28–29	2014 Euroheat & Power Annual Conference and 60th anniversary	Brussels, Belgium	<a href="http://www.buildup.eu/fr/events/38110">www.buildup.eu/fr/events/38110</a>
April 30	REHVA Annual Conference	Dusseldorf, Germany	<a href="http://www.rehva.eu">www.rehva.eu</a>
May 8–10	TTMD XI. International HVAC+R Technology Symposium 2014	Istanbul, Turkey	<a href="http://www.ttmd.org.tr/sempozyum2014">www.ttmd.org.tr/sempozyum2014</a>
May 13–15	11th IEA Heat Pump Conference 2014	Montreal, Canada	<a href="http://www.geo-exchange.ca/en/canada_to_host_the_11th_international_energy_agenc_nw211.php">www.geo-exchange.ca/en/canada_to_host_the_11th_international_energy_agenc_nw211.php</a>
June 23–27	"Sustainable Energy Week EU Sustainable Energy Week"	Brussels, Belgium	<a href="http://www.eusew.eu">www.eusew.eu</a>
June 28–July 2	ASHRAE 2014 Annual Conference	Seattle, WA, USA	<a href="http://ashraem.confex.com/ashraem/s14/cfp.cgi">http://ashraem.confex.com/ashraem/s14/cfp.cgi</a>
July 7–12	Indoor Air 2014	University of Hong Kong	<a href="http://www.indoorair2014.org">www.indoorair2014.org</a>
August 31–Sep 2	11th IIR-Gustav Lorentzen Conference on Natural Refrigerants - GL2014	Hangzhou, China	
September 10–12	ASHRAE/IBPSA-USA Building Simulation Conference	Atlanta, GA, USA	<a href="http://ashraem.confex.com/ashraem/emc14/cfp.cgi">http://ashraem.confex.com/ashraem/emc14/cfp.cgi</a>
September 21–24	Licht 2014 - Den Haag Holland	Haag, The Netherlands	<a href="http://www.licht2014.nl">www.licht2014.nl</a>
September 24–25	35th AIVC Conference - 4th TightVent Conference - 2nd venticool Conference	Poznań, Poland	<a href="http://www.aivc.org">www.aivc.org</a>
October 18–19	CCHVAC Congress	China	
October 19–22	Roomvent 2014	Sao Paulo, Brazil	<a href="http://www.roomvent2014.com.br">www.roomvent2014.com.br</a>

## Exhibitions 2014

January 21–23	AHR Expo	New York, NY, USA	<a href="http://www.ahrexpo.com">www.ahrexpo.com</a>
February 4–7	Aqua-Therm Moscow	Moscow, Russia	<a href="http://www.aquatherm-moscow.ru/en/">www.aquatherm-moscow.ru/en/</a>
February 27–March 1	ACREX 2014	New Delhi, India	<a href="http://acrex.in/">http://acrex.in/</a>
March 4–7	Aqua-Therm Prague	Prague, Czech Republic	<a href="http://www.aquatherm-praha.com/en/">www.aquatherm-praha.com/en/</a>
March 18–21	MCE - Mostra Convegno Expocomfort 2014	Fiera Milano, Italy	<a href="http://www.mcxpocomfort.it">www.mcxpocomfort.it</a>
March 30–Apr 4	Light + Building	Frankfurt, Germany	<a href="http://www.light-building.messefrankfurt.com">www.light-building.messefrankfurt.com</a>
April 1–4	NORDBYGG 2014	Stockholm, Sweden	<a href="http://www.nordbygg.se">www.nordbygg.se</a>
May 7–10	ISK - SODEX 2014	Istanbul, Turkey	<a href="http://www.hmsf.com">www.hmsf.com</a>
May 13–15	ISH China & CIHE	Beijing, China	<a href="http://www.ishc-cihe.com">www.ishc-cihe.com</a>
October 1–3	Finnbuild 2014	Helsinki, Finland	<a href="http://www.finnbuild.fi">www.finnbuild.fi</a>
October 14–16	Chillventa 2014	Nuremberg, Germany	<a href="http://www.chillventa.de/en/">www.chillventa.de/en/</a>

## Conferences and seminars 2015

January 24–28	ASHRAE 2015 Winter Conference	Chicago, IL, USA	
April 16–18	International Conference Ammonia and CO2 Refrigeration Technologies	Ohrid, Republic of Macedonia	
May 6–8	Advanced HVAC and Natural Gas Technologies	Riga, Latvia	
May 7–9	REHVA Annual Conference	Riga, Latvia	
October 20–23	Cold Climate HVAC	Dalian, China	<a href="http://www.coldclimate2015.org">www.coldclimate2015.org</a>

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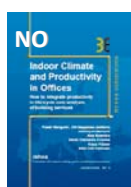
REHVA Guidebooks are written by teams of European experts



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 measure the performance of a ventilation system and which indices to use in different cases.



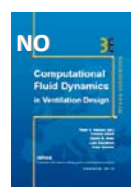
Chilled beam systems are primarily used for cooling and ventilation in spaces, which appreciate good indoor environmental quality and individual space control. Active chilled beams are connected to the ventilation ductwork, high temperature cold water, and when desired, low temperature hot water system. 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.



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.



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.



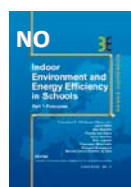
CFD-calculations have been rapidly developed to a powerful tool for the analysis of air pollution distribution in various spaces. However, the user of CFD-calculation should be aware of the basic principles of calculations and specifically the boundary conditions. Computational Fluid Dynamics (CFD) –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



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.



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.



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.



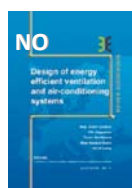
This new REHVA Guidebook gives building professionals a useful support in the practical measurements and monitoring of the indoor climate in buildings. Wireless technologies for measurement and monitoring has allowed enlarging significantly number of possible applications, especially in existing buildings.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



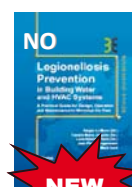
This guidebook is focused on modern methods for design, control and operation of energy efficient heating systems in large spaces and industrial halls. The book deals with thermal comfort, light and dark gas radiant heaters, panel radiant heating, floor heating and industrial air heating systems. Various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



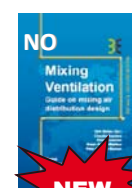
This guidebook talks about the interaction of sustainability and heating, ventilation and air-conditioning. HVAC technologies used in sustainable buildings are described. This book also provides a list of questions to be asked in various phases of building's life time. Different case studies of sustainable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



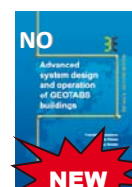
This guidebook covers numerous system components of ventilation and air-conditioning systems and shows how they can be improved by applying the latest technology products. Special attention is paid to details, which are often overlooked in the daily design practice, resulting in poor performance of high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



This Guidebook is a practical guide for design, operation and maintenance to minimize the risk of legionellosis in building water and HVAC systems. It is divided into several themes such as: Air conditioning of the air (by water – humidification), Production of hot water for washing (fundamentally but not only hot water for washing) and Evaporative cooling tower.



In this guidebook most of the known and used in practice methods for achieving mixing air distribution are discussed. Mixing ventilation has been applied to many different spaces providing fresh air and thermal comfort to the occupants. Today, a design engineer can choose from large selection of air diffusers and exhaust openings.



This guidebook provides comprehensive information on GEOTABS systems. It is intended to support building owners, architects and engineers in an early design stage showing how GEOTABS can be integrated into their building concepts. It also gives many helpful advices from experienced engineers that have designed, built and run GEOTABS systems.



In this REHVA Report in cooperation with CEN, technical definitions and energy calculation principles for nearly zero energy buildings required in the implementation of the Energy performance of buildings directive recast are presented. This 2013 revision replaces 2011 version. These technical definitions and specifications were prepared in the level of detail to be suitable for the implementation in national building codes.

