ISSN 1307-3729

REHVA

Federation of European Heating, Ventilation and Air Conditioning Associations

# The REHVA European HVAC Journal

Volume: 49 Issue: 6 December 2012 www.rehva.eu

## ENERGY EFFICIENT RENOVATION

- Renovation experience from Hungary, Slovakia and Romania
- Heat pumps in refurbishment of existing buildings


An interview with
**Mr. Adrian Joyce,**
The Director of the Renovate Europe Campaign

**The REHVA European HVAC Journal** www.rehva.eu

Volume: 49 Issue: 6 December 2012



**ADVERTISEMENTS**
Ms Cynthia Despradel
cd@rehva.eu

**SUBSCRIPTIONS and CHANGES OF ADDRESSES**
REHVA OFFICE:
Washington Street 40
1050 Brussels, Belgium
Tel: 32-2-5141171, Fax: 32-2-5129062
info@rehva.eu, www.rehva.eu

**PUBLISHER**
Sektorel Fuarcılık A.Ş (Inc.)
Balmumcu, Barbaros Bulvarı,
Bahar Sok, Karanfil Ap.
Beşiktaş İstanbul Türkiye
Tel: 90-212-2758359
Fax: 90-212-2749273
www. teknikyayincilik.com



In cover Mr. Adrian Joyce, photo by OS

# Contents

**EDITORIAL**

**4** Large scale RES integrated refurbishment R&D is needed
Marija Todorovi

**5** **NEWS**

**INTERVIEWS**

**18** Interview with Mr. Adrian Joyce, The Director of the Renovate Europe Campaign

**21** Interview with Mr. Ismo Grönroos-Saikkala, Head of Sector, the Energy Efficiency Unit, Directorate-General for Energy

**ARTICLES**

**23** Nearly-zero, Net zero and Plus Energy Buildings – How definitions & regulations affect the solutions
Karsten Voss, Igor Sartori & Roberto Lollini

**28** Use of biofuels in the district heating system of Riga
Normunds Talcis & Egils Dzelzītis

**34** Energy saving potential by retrofitting residential buildings in Europe
Cristina Becchio, Ilaria Ballarini, Stefano P. Corgnati & Vincenzo Corrado

**40** Energy-efficient refurbishment of public buildings in Serbia
Sanja Petrović Bećirović & Mileva Vasić

**45** Heat pumps in refurbishment of existing buildings
Renato Lazzarin, Filippo Busato & Marco Noro

**50** Calculated and measured energy use before and after thermal renovation for Romanian apartment buildings
Silviana Brata, Ioan Bistran, Ioan Silviu Dobos & Sorin Brata

**CASE STUDIES**

**54** Effect of refurbishment on thermal comfort and energy use in residential multifamily building
Hana Pustayová & Dušan Petráš

**58** Energy Efficient Refurbishment of Hospital Buildings in Hungary
Zoltán Magyar

**REHVA WORLD**

**62** FinnBuild 2012 – a successful showcase for the Finnish construction industry

**PUBLICATIONS**

**64** VDI- Guidelines published October – December 2012

**67** CIBSE's Knowledge Portal – a great success

**68** Important CIBSE titles published in 2012

**PRODUCT NEWS**

**69** Trailblazing Belimo Energy Valve™ knows where the energy is used

**70** CIAT supplies air conditioning into the national library in Uzbekistan

**74** **EVENTS IN 2012 – 2014**

## Advertisers

✓ Swegon ........... Front cover interior
✓ Lindab ........................................ 7
✓ AHRI ........................................ 9
✓ Hitema .................................... 33
✓ Eurovent.................................. 37
✓ ACREX 2013 ........................... 39
✓ Vaisala ...................................... 65
✓ ODE ......................................... 66
✓ Belimo...................................... 71
✓ Friterm ..................................... 72
✓ ISH Frankfurt... Back cover interior
✓ REHVA Guidebooks .....Back cover

## In the next issue of REHVA Journal

Theme: **Air tightness of building envelope and air ducts**.

Guest Editor: **Dr. Rémi Carrié**, Senior Consultant from INIVE.

Email: **remi.carrie@inive.org**

Send the manuscripts of articles for the journal to **oseppanen@rehva.eu**

# Large scale RES integrated refurbishment R&D is needed

***Marija Todorovic***

Prof. Dr, University of Belgrade, Serbia

Fellow ASHRAE,
Fellow REHVA,
Associate Fellow of WAAS

Research Professor Center for Sustainable Healthy Buildings, Kyung Hee University, Korea

Permanent Guest Professor Southeast University, School of Energy & Environment, China

Building sector not only has the largest potential for reduction of GHG emissions, but also that potential is relatively independent of the cost per ton of $CO_2$ eqv. achieved. In addition to the energy consumed during the building operation, energy is used for building materials and component manufacturing, as well as for buildings construction (embodied energy). Embodied energy in existing buildings (percentage of which the highest) is clear evidence that the largest energy savings can be achieved by the refurbishment of the existing buildings, particularly residential (highest percentage of the existing).

Energy related impacts of buildings must be considered in their life-cycle analysis focusing all factors relevant to energy use, GHG emissions, and implementing a holistic approach to determine and analyze total building performance: energy flows and interactions between the different technical systems of buildings – HVAC&R and other technical systems, as well as a multiple-domain comfort and IEQ (thermal, light, air quality, acoustics, noise, ionizing and electromagnetic radiation, etc.).

Beside, a series of actions towards Energy Efficiency Improvement and Renewable Energy Sources, conducted by the professionals, national and international organizations, and globally intensive media attention, as well as the governmental bodies policies on the energy saving measures introduced worldwide, realization of the planned activities is far behind the predictions and expectations. Consequently, concerning the share of buildings in the final energy consumption, and related near and midterm energy saving targets, it is hard to expect that required deep energy refurbishment, planned by the corresponding National Energy Efficiency Action Plans (NEEAPs), can be realized if there are missing developed of "industrial" scale buildings architecture and construction refurbishment technologies and corresponding integrally harmonized HVAC/RES systems, and engineering technologies, developed and validated based on the relevant R&D results. To reach predicted energy saving targets a large scale building energy refurbishment industry has to be developed for all types of buildings.

Energy Refurbishment Industry – Buildings Refurbishment/HVAC/RES industry - commercialized integrated refurbishment design and engineering as a whole integrated process (including codes and standards), is to be established. To approach this goal there is a need for financial support to HVAC and construction industry for the joint R&D, aimed at founding large, industrial scale RES integrated refurbishment technologies and systems for different types of existing buildings/HVAC combinations, including related design and commercial manufacturing.

Developed, mature, commercially available on the market, pre-constructed HVAC/RES/HP and/or HVAC/RES/DHS/HP systems and unified retrofitting construction works as well as corresponding mechanical and electrical subsystems would eliminate important technical and technological barriers to spread deep energy refurbishment projects conducted integrally with decentralized solar, wind, ground or groundwater source HP implementation at the building level, at its yard and/or at the municipal level. In addition, development of the specific hardware and software within the building/HVAC retrofitting system can directly increase competitiveness of related HVAC, heat pumps and other RES systems, including renovated/refurbished Zero and Energy Plus Buildings and smart-grid optimal intelligent control systems industry.

# European Heating Industry appointed new Secretary General

**EHI, the Association of the European Heating Industry, appointed Ms. Federica Sabbati as its new Secretary General, starting on16 August 2012. Born in Trieste, Italy, Federica Sabbati came to Brussels in 1997, initially working in the European Parliament for the young European liberals (LYMEC) and the ELDR Party. In 2000, Federica joined Liberal International, a London-based worldwide organisation grouping liberal parties from across the world. From 2007, Federica was Secretary General of the European Liberal Democrat and Reform Party (ELDR), the organisation representing liberal democrats parties in Europe, based in Brussels. She holds a university degree in International Relations from the University of Trieste (Gorizia base), Italy, and a Master's Degree in Russian and Post Soviet Studies from the London School of Economics.**

REHVA journal had an opportunity to have an interview with the new secretary general focusing on some important questions on the future developments energy efficient heating.

Interview by **Prof. Olli Seppänen**, Editor-in Chief, REHVA Journal

### How can the modern heating technology to improve the energy efficiency of existing buildings?

- Renovating the EU existing heating appliances stock, made predominantly of fossil fuel heaters with low efficiency, has the biggest potential and is the most effective way of contributing to energy saving in the EU building sector and the achievement of the 20/20/20 energy targets.

98% of EU private dwellings have a fossil fuel heat generator (121 out of 122.4 million), and around 89% of those are non-efficient. Only 10% (12 million) use condensing technology (best available technology for gas and oil heating appliances) and 1 million (< 1%)

**EHI, the Association of the European Heating Industry**, represents and promotes the common interests of 35 market leading company members in the European heating sector, which produce advanced technologies for heating in buildings, including: boilers, burners, heat pumps, micro CHP, solar thermal, geothermal, biomass and radiators. In addition, members comprise 13 national industry associations from the EU Member States, Liechtenstein and Switzerland. The industry invests massively in research and development in order to create technically advanced, safe and energy efficient heating systems.

are electrical heat pumps or micro-combined heat and power (micro-CHP).

Only replacing an old fossil fuel boiler by a modern condensing appliance will realise more than 20% energy saving. In this context, condensing technology is therefore key to the modernization of the installed stock, particularly due to its affordability and the existing installation conditions.

The further development of the heat pump and micro-CHP markets across Europe in a sustainable way are, of course, equally important to improve the energy efficiency of the building stock.

We, in EHI, are of the opinion that in order to maximise the energy efficiency potential, the right solution should be chosen for every situation, taking into account cost-effectiveness, heat demand, climatic conditions, physical feasibility, etc. The key lies in ensuring the efficient performance of the heating system as a whole (including heat emission, heat distribution, heating controls).

### EPBD expands the boiler inspections to heating system inspections – what are the major savings which can be expected from those inspections?

- Directive 2002/91/EC provided for the inspection of boilers, with Directive 2010/31/EU this has extended this to accessible parts of heating systems, such as the heat generator, control system and circulation pumps.

As an alternative to inspections Member States may opt to provide advice to users concerning the replacement of boilers, other modifications to the heating system and alternative solutions to assess the efficiency and appropriate size of the boiler. The overall impact of this approach should be equivalent to that of inspections. To my knowledge no Member State has provided a figure or calculation of the expected energy savings from inspections. It would also be very difficult to do so.

Regular maintenance involves in practice regular cleaning of soot in oil fired boilers thus ensuring that appliances function correctly. For gas fired appliances there is in general no additional gain from the appliance inspection because there is no deterioration of their efficiency by any deposits of soot or so.

In the same way there is little to be gained from inspecting circulation pumps, they either function or they don't in which case they would need to be replaced and this would already have been identified by the owner well in advance of any inspection.

For the control system it may be a different issue, if the persons carrying out the inspection would also assess and calculate the heating system and check if the controls would fit in the most optimal manner.

Because there is no harmonised calculation methodology available, it is very difficult to check or compare the statements made by Member States.

### How can renewable sources combined best with traditional heating systems and boilers?

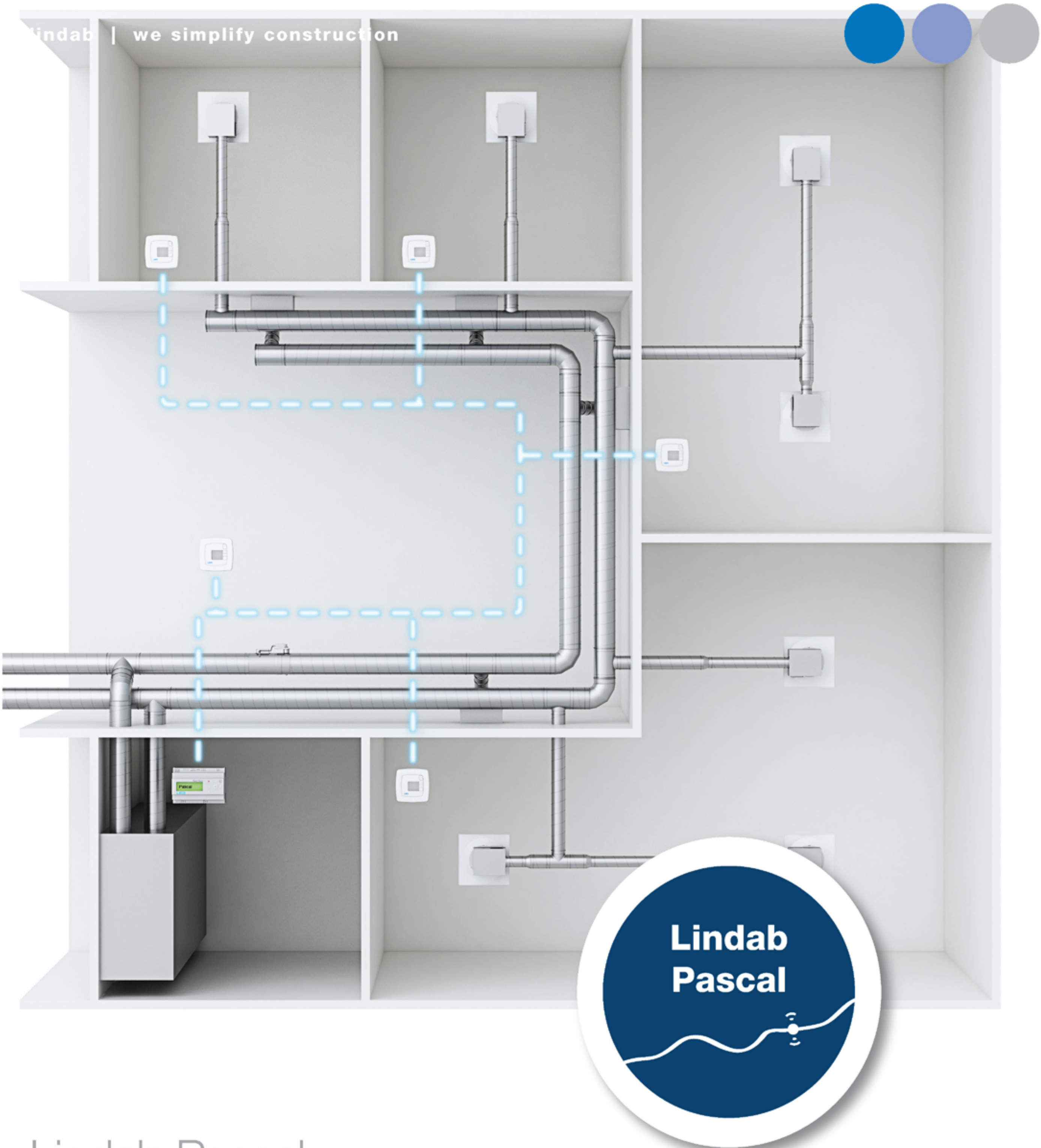
- Several solutions are available on the market at the moment. Perhaps the most well known is the combination of condensing boiler technology with solar thermal systems, for space heating and hot water production. There are multiple advantages to using such a system. It is an affordable solution, contributes to reduction of $CO_2$ and other emissions, it is easy to install and extremely flexible (both for new build and retrofit, can be part of a new installation or an add-on to an existing system).

A heating system with great potential for the future is also the combination between electrical heat pumps and condensing boilers, what we call a hybrid heat pump system. This kind of solution is meant to maximise the advantages of both technologies and is a further proof that the industry drive is to go beyond the energy efficiency of individual appliances.

### What are the most important opportunities for EHI in the near future?

One of the most important tasks of EHI is the follow up the regulations and development horizontal activities. We feel that there is lack of consistency between DGs which reduces the productivity and increases the cost. Too rapid changes in policy and regulation will reduce the predictability and increase the over-all cost.

We follow closely the technical development of micro generation, heat pump technology with combination of boilers. However, the real challenge and an opportunity is the renovation of heating systems of existing buildings. We see also heating system inspection as an increasing opportunity to promote the energy efficient technology of our members. ℈




# Lindab Pascal

## Simplified VAV solution with full potential...

Lindab is now launching the next generation of VAV system with the purpose of simplifying and optimizing all phases of the building construction from design to operation. This solution saves you for unnecessary energy use, regulation equipment in the ducts and a complicated installation. Lindab Pascal, the most simplified solution on the market with all you need for an optimized VAV system.
Lindab - We simplify construction...

www.lindab.com

# REHVA signed MoU for cooperation with a Japanese organisation

**On August 4th 2012, at the Technical University of Denmark in Lyngby a Memorandum of Understanding was signed by the Federation of European Heating, Ventilation and Air Conditioning Associations (REHVA) and the Society of Heating, Air Conditioning and Sanitary Engineers of Japan (SHASE).**

The purpose of this Memorandum of Understanding (MoU) is to strengthen the relationship between REHVA and SHASE and to promote substantial and tangible actions to increase the cooperation between the two associations.

REHVA President, Professor Michael Schmidt and the President of SHASE, Shinsuke Kato, have signed a Memorandum of Understanding in Lyngby to promote communication and information exchange between the two organizations. This agreement aims to boost the knowledge of standard development activities in Japan and in Europe. The MoU will strengthen the cooperation which has included the translation of four REHVA Guidebooks (GB 1 Displacement ventilation, GB 2 Ventilation efficiency, GB 6 Indoor climate and productivity and GB 10 CFD) in Japanese.

The Memorandum stresses the need to develop and harmonize Japanese, European and international standards on heating, ventilation and air conditioning. Such common standards are important to an improvement of health, comfort and energy efficiency in all buildings and communities, events, trainings.

Potential future activities foreseen within the framework of the Memorandum include the following:

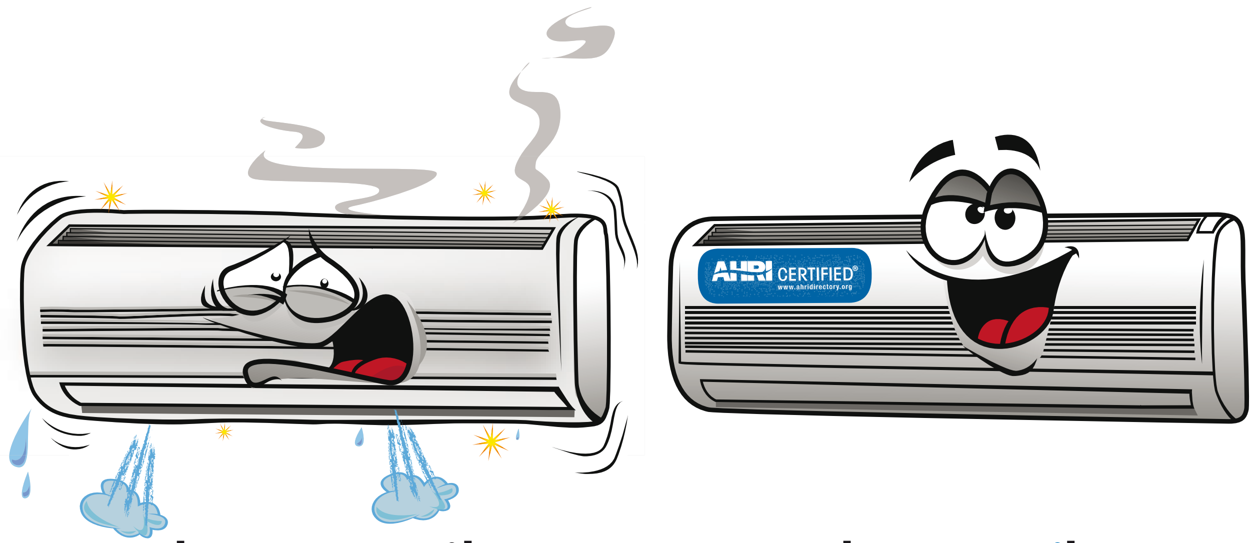
- Promotion of the co-operation between SHASE and REHVA technical committees. Several REHVA Guidebooks will be translated in the near future by SHASE.
- Encourage participation at official meetings of both organizations.
- Promote the knowledge of standard development activities in Japan and in Europe.


From left to right, Prof. **Bjarne Olesen** (REHVA Vice-President), Prof. **Michael Schmidt** (REHVA president), **Shinsuke Kato** (SHASE president) and **Jan Aufderheijde** (REHVA Secretary General).

REHVA has signed several memorandums of understandings with other international organisations in the field of heating, ventilation and air conditioning such as ASHRAE, IIR, AIVC, INIVE, CCHVAC and ISHRAE.

## SHASE

Established in 1917, SHASE, The Society of Heating, Air Conditioning and Sanitary Engineers of Japan, is a major organization with a history of over 90 years. It is also the only scientific society in the field of air conditioning and sanitary engineering in Japan with more than 16 000 individual members and 500 company members. It main objective is to develop the science of building mechanical service system and environmental engineering including heating, ventilation, air conditioning and sanitary engineering through education, publication, research, collaboration, standard and qualifying examination.




[ Not AHRI Certified® ]  [ AHRI Certified® ]

# The choice is clear.

## *Why take a risk?*

Specify AHRI Certified® to *be sure* that HVACR and water heating equipment will perform as advertised.

AHRI CERTIFIED®
www.ahridirectory.org

*Globally Recognized. Industry Respected.*

Scan here to learn more about AHRI's certification programs.

# ACREX India 2013:

## Showcasing the HVAC and Refrigeration industry's progress towards an eco-friendly environment

ACREX INDIA 2013
7-8-9 MARCH 2013
Bombay Exhibition Centre, Goregaon (E), Mumbai
www.acrex.in

Global demand for HVAC equipment will rise 6.2% annually through 2014. The Asia-Pacific Region will outpace the world average, led by China and India. A rapidly progressing building and infrastructure industry in India contributes about 20% to the growth of the country's economy. This industry is now heading towards generating "Green Projects" which are environment-friendly. In a pursuit to do this, the industry is adopting the use of environment friendly construction materials and equipments.

The rapid rise in the demand for growth and distribution of fresh foods and vegetables across the globe has been the prime factor for increasing investments in the cold chain industry. There is now demand for energy efficiency, better technology and convenience in cold chain and its management. The latest reports show that better energy efficiency means lesser power consumption and increased output, with minimal pollution.

Such increase in the demand for HVAC&R equipments and technology with green solutions has motivated **Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE)** with the professional expertise of UBM India to present the **14th edition of ACREX India. ACREX India 2013** with the theme ***"Dedicated to an eco-friendly environment"*** **will be held at the Bombay Convention & Exhibition Centre, Goregaon, Mumbai from 7th to 9th March 2013**. REHVA, the Federation of European HVAC Associations is one of the supporters of the exhibition.

REHVA Journal will publish a special issue for the ACREX exhibition to introduce European technology in India focusing on the products of REHVA Supporters. REHVA will also organise five training sessions during ACREX on solar shading, kitchen ventilation, air distribution, surface cooling, and air conditioning. REHVA is also preparing a seminar with EC DG ENERGY and ISHRAE on European and Indian energy regulations.

ACREX India 2013 will present over 350 global exhibitors spread over an exhibition space of 10,000 sq. mt and will see participation from 20 countries and attract 20,000 trade visitors. The 14th edition of ACREX India will also offer the industry an opportunity to learn, interact and network at the three interactive panel discussions, six technical seminars and eight workshops. The panel discussions, seminars and workshops will be addressed by global experts in the field of HVAC&R equipments, their management, safety, sustainability and the allied building services.

The event will showcase a wide range of HVAC&R equipments, technology and services. Some of the product categories at the show are: Packaged Chillers, Air Handling & Distribution Products, Unitary Products (Air Conditioners), Products (Refrigeration), Refrigeration Accessories, Water Distribution, Electricals, Services, Contractors, Ventilation Equipments, etc. The event will offer an opportunity for the entire HVAC&R industry to network and establish strategic business alliances with global real estate developers and builders, Architects, Interior Designers, MEP consultants, Engineering companies, Project Managers, After Sales & Maintenance Contractors, Facility Managers, End users from the private and public sector for Residential, Commercial and Industrial Buildings.

Supported by INTELLIGENT ENERGY EUROPE

# Saving energy in real HVAC systems – the **iSERVcmb** project at the halfway stage

## Largest IEE supported project

The iSERVcmb project has now completed 18 months of its 3 year funded period. It has already achieved some notable outputs and impacts including:

- A sophisticated stand-alone spreadsheet suitable for collating and understanding HVAC systems in new and existing buildings. This spreadsheet has been endorsed by CIBSE and REHVA as meeting professional standards for this purpose.
- The on-line database is up and running, with a series of specific reports currently being written to leverage the data in the database on the buildings and the systems installed.
- 35 buildings, 213 HVAC systems and 1,096 HVAC components have been entered into the database at the present time.
- A first set of HVAC component benchmarks by activity have been produced from existing data sources to demonstrate how the benchmarking of systems and activities can be presented and displayed. These have been used to provide the first benchmarks in the systems entered on the database.

## Achieved energy savings in a participating building

iSERV predicted electrical energy savings of between 5 to 60% in individual HVAC systems assuming no previous focus on reducing energy use. McKenzie House in Cardiff University has achieved a reduction in its overall BUILDING electricity use of over 30% since efforts to reduce energy use started in 2005, of which 22% (or 43 kWh/m²) is due to better control of the existing HVAC equipment. In this one building the monetary value of the electrical savings alone is over €80,000 per annum.

## Participating in iSERV

The project is still looking for owners with HVAC systems which have dedicated energy monitoring for at least some of their HVAC components. If you are interested in helping set new benchmarks for HVAC systems components and potentially saving significant amounts of money please register your interest at www.iservcmb.info and one of the iSERV partners will contact you to tell you how to enter your system into the project on-line database.



# Final version of the **Energy Efficiency Directive**

The text of **Directive 2012/27/EU on energy efficiency** was published on Nov 14, 2012 in the Official Journal of the EU. The Directive brings forward legally binding measures to step up Member States' efforts to use energy more efficiently at all stages of the energy chain – from the transformation of energy and its distribution to its final consumption. Measures include the legal obligation to establish energy efficiency obligations schemes or policy measures in all Member States. These will drive energy efficiency improvements in households, industries and transport sectors. Other measures include an exemplary role to be played by the public sector and a right for consumers to know how much energy they consume. The directive is available in the major EU languages also at the Build Up portal: **www.buildup.eu/publications/32236**

# HEAT4U Project Promotes Gas Absoption Heat Pums

Robur, coordinator of the HEAT4U Project , hosted institutional representatives, managers from top firms and HVAC professionals in a Conference entitled "HEAT4U, 1st year, first results", held on the 11th and 12th October 2012 at Fortezza Viscontea in Cassano d'Adda, near Milan. The aim of the conference was to highlight the latest regulatory scenarios and incentive measures in the field of energy efficiency and thermal renewable energy, including European, Italian and local best practices.

14 among the most important European organizations in the energy, industrial, and research fields are involved in such project, namely Robur – which is also the project coordinator, - Pininfarina, ENEA, Polytechnic University of Milan, D'Appolonia and CF Consulting from Italy; Bosch Thermotechnology, E.ON and the Fraunhofer Institute research centre from Germany; GDF Suez and Gas Reseau Distribution France from France. The Consortium also includes UK-based British Gas, the Polish Flowair, and the Slovenian company ZAG. The challenge for this project is to implement the Gas Absorption Heat Pump technology –currently used for heating light commercial facilities– also in the area of single-family detached residential homes, particularly in existing buildings, which, according to recent studies carried out by the European Union, account for approximately 49% of the overall energy consumption in terms of primary energy, and for 36% of greenhouse-gas emissions. The high energy efficiency, the considerable renewable energy rate and the absence of investment in infrastructure shall make the Gas Absorption Heat Pump technology one of the most competitive solutions in the heating market.

After the opening speeches by Mr. **Samuele Furfari** -Directorate-General for Energy and Transport, Mr. **Sebastiano Serra** – Head of the Technical Secretary of the Italian Ministry for the Environment and Mr. **Roberto Moneta** - Technical Secretary of the Italian Ministry of Economical Development the conference focused on the first results achieved by the HEAT4U Project with the speech of **Luigi Tischer**, the Project Coordinator. A first important result is the analysis on market opportunities and value chain of Gas Absorption Heat Pumps for existing residential buildings and the development of the technology, in particular the optimization of the capacity modulation, reducing power consumption and sound pressure.

Moreover, construction of test laboratories at the Politecnico di Milano and at the Fraunhofer Institute was started according to EN12309 protocol. The first prototypes have fully confirmed the performances expected and the solution of the technological challenges posed by this project, namely bringing the Gas Absorption Heat Pump technology into the typical power range of single-family detached residential homes and reaching an estimated global efficiency on primary energy of 150%.

Mr. **Paolo Pininfarina**, President of Pininfarina, focused on the development of design and aeroacustic optimization. The work began with an analysis of aeroacustic benchmark with equivalent heat pump units. Then, different design solutions have been carried out. Styling, functionality, innovative, user friendly, robust: these are the keywords of the design work.

The development of the HEAT4U Project has already had a positive effect on the professional range of Gas Absorption Heat Pumps currently available on the market: a significant reduction in power consumption and in sound pressure.

Two real cases of installation with Gas Absorption Heat Pumps have been introduced. Aiming at reducing energy bills, the Technical Department of Carrefour Italy has chosen absorption technology in ten of its supermarkets. Just the Carrefour supermarket in Cusago (near Milan), with sixteen Gas Absorption Heat Pumps installed, has cut $CO_2$ emissions by up to 53.6 tons in comparison to conventional boilers, equivalent to those absorbed by 7,314 trees. The case of the new school campus in Agordo, integrating several sources of renewable energy, such as aerothermal, geothermal and solar energy, is a unique facility of its kind in Europe. Today, thanks to geothermal Gas Absorption Heat Pumps installed, the institute has a consumption of only 24 kWh/m² per year, while the old building was requiring more than 140 kWh/m² per year of primary energy. The refurbishment thus enabled the management to save up to 80% on operating costs compared with the previous building. The conference was opened and closed by Benito Guerra, President of Robur.

More information at **www.heat4u.eu** and **www.robur.com**

Under the EU's Seventh Framework Programme for Research

# REHVA News from Moscow

## Control of radiator heating system is necessary in achieving the predicted energy savings

In 2008 Moscow switched from selective capital renovation of residential buildings, requiring replacement of the roof, worn out utility pipelines, replacement of electrical cabling and elimination of external walls defects if needed, to complex capital overhaul with modernization presuming, in addition to the abovementioned works, thermal insulation of the building envelope; replacement of windows and balconies with energy efficient and more airtight ones; commercial metering of heat consumption for heating and hot water supply in each building; implementation of automated control stations for heat consumption of buildings for heating and individual automatic regulation of heat delivery from heating appliances using thermostats. The capital renovation volumes have increased by more than 10 times.

It was presumed that this will reduce the thermal energy consumption for heating by more than 2 times and provide for achievement of annual specific heat consumption indicators close to new construction projects (corresponding to indicators of Northern American countries for 2000). However comparison of the results of actual measured heat consumption of residential buildings after the capital renovation with thermal insulation of building with indicators of the energy certificate of designs of the same buildings shows that only one third of the expected savings of thermal energy is achieved, 2/3 is discharged to the outside literally and figuratively through the side windows.

The analysis showed that this overconsumption of heat is related to oversized heating appliances for creation of a reserve, and installing the heating controllers without taking this into consideration, and thermostats did not reduce the heat delivery from heating appliances because there were no thermostatic heads installed with the maximum temperature setting of 26°C. This means that in case of full opening of the valve (and the mentality of a Russian resident is such that he is not looking for intermediate positions of the thermostatic head, plus thermostats are not graduated by temperature degrees) thermostat will not close automatically while the room temperature is below 26°C. Naturally, even the most heat loving residents consider such temperature excessive and open windows, releasing the heat to the outside.

In order to exclude overheating of buildings in the operating mode it was proposed to determine the design thermal energy consumption for heating (and ventilation in residential buildings with natural ventilation system, when the ventilation loads are taken into consideration during selection of heating appliances) on the stage of preparation of the building energy certificate using the methods described in AVOK Manual. The resulting value has to be compared to the design heat consumption for heating (and ventilation) determined in the "Heating and Ventilation" section during the heating system calculation, and, taking into consideration the reserve heating surface of heating appliances, recalculate the temperatures of heating media in supply and return pipelines of the heating system. After that setup the controller to maintain the schedule of changes of heat carrier temperatures taking into consideration the increasing share of household heat emissions in the building's thermal balance with increasing outside air temperature, and circulation pump – to provide for design consumption of heating media (when the heating media increases in the return pipeline of the heating system above the schedule, reduce the pump engine rotation frequency).

Subsequent natural tests confirmed that after implementation of the abovementioned solutions in a building, the design savings of thermal energy for heating were reached over the heating period, and comfortable conditions were maintained inside rooms – inside air temperature 20–22°C and nominal air exchange rate – 25–30 m³/h per person. In the nearby similar buildings the thermal energy consumption for heating exceeded the design values by 30–35%, the air temperature was 22–25°C.

# Summary of the REHVA Seminar on Buildings and HVAC-Products Related to the EU Energy Efficiency Regulations

**The REHVA annual technical seminar took place at "Thon Hotel Bristol Stephanie" in Brussels on October. The seminar covered the "hot topics" related to energy efficiency from Commission legislation to the European standardization.**

Some updates on EU policies for energy efficiency and recent developments on the Directives on Energy Efficiency, Energy Performance of Buildings and Eco-design and Energy-labelling were presented by **Clemens Haury** from the European Commission. The approval of the Energy Efficiency Directive (EED) gives many possibilities to close the energy efficiency gap between the "current status" forecast and –20% objective for year 2020 by altogether 11%. The major influence of EED is in the obligation to renovation. However, the compromises at the final approval stage – including some "watering" of the extent of obligatory renovation of public buildings - looks to result in remaining 3% gap, and in a need for some new measures. In EPBD implementation, only a few EU Member States have done all required implementing measures within the given schedule.


**Clemens Haury**
DG Energy European Commission

The work that REHVA has done so far for harmonized definition of Nearly Zero Energy Building has by now received positive feedback from the Commission, and also from CEN for the soon starting active phase of revision of the CEN-EPBD standards. The current status and next steps in the Task Force for revised definition were summarized by **Jarek Kurnitski**, Vice President REHVA. The communication with CEN has been positive – the definition was found very useful, but some changes are needed in order to meet the needs of CEN. Work is still needed in some key items, for example the system boundary for renewables, equations for calculation of the share of renewables – and several minor improvements of the wording of definitions. It looks that the revision will be published in early 2013, so that also the deadline for implementation of the cost-optimal methodology can be met.

**Ari Ilomäki**, chair of CEN TC 350 introduced the work of CEN/TC 350 and the standard package in preparation, partly in joint efforts between CEN and ISO. These issues have not been much known among our profession, even though their high relevance, to buildings but also to many HVAC products. Health and comfort characteristics are in the scope, including ventilation.

The president of ISHRAE, Indian Society of Heating Refrigerating and Air conditioning Engineers **Sushil K. Choudhury** presented the history and activities of his society. He also highlighted the collaboration between ISHRAE and REHVA, including mutual promotion of the ACREX events and books sales. Since its foundation in 1981, ISHRAE has grown rapidly. It has currently about 10000 members in 40 local chapters

Eurovent Certification was presented by **Sylvain Courtney** from Eurovent Certification. Eurovent Certification prepares voluntary certification schemes for several product types for air conditioning and ventilation. More and more the work is now focused on products subject (regulations either already existing, or in preparation) to mandatory ecodesign and labelling requirements.

**Francis Allard** from the University of La Rochelle showed French policy and regulations for retrofitting. France has launched regulations in 2007 for building retrofitting, supported by voluntary building labelling and financial incentives. Since then, strategies have been developed further to reduce the overall primary energy use of existing buildings, with target to 75% savings in the long run. Still just 35% of building retrofitting is initiated by energy saving reasons, and in most cases improvements are limited to the building envelope not the technical building systems.

**Bjarne W. Olesen**, Vice President REHVA gave a brief overview of the potential new standards for air cleaners. Ventilation is needed for human health, but also a major energy user. Air cleaning technology has been developed to applications where ventilation is not possible such as submarines. These applications could be used in buildings to substitute, at least partly, ventilation. Some promising test results have been achieved using a desiccant rotor. However, test standards and product certification schemes have to be developed further.

**Donald Leeper** from CIBSE, The Chartered Institution of Building Services Engineers showed the benefits of display energy certificated in the United Kingdom. The actual energy efficiency of buildings is not necessarily as good as predicted at the design stage. In fact, in many relatively new buildings the "credibility gap" is rather wide – and looks to grow even wider due to the increasing complexity of buildings. Typically the gap is not due to a single failure, but a sum of several minor issues: lack of feedback to the designer, lack of proper commissioning, lack of proper information to the users.

**Frank Hovorka** from Caisse des Dépôts presented the performance on HVAC systems and the impact of the life cycle on the building value. He gave examples how energy efficiency of buildings can be improved in existing buildings in real practice. The key issue is to convince the building owner, and this can be done only through systematic, reliable and understandable data. This must include a careful assessment of the actual building, including assessment of the impact of occupant behaviour. The assessment can finally result in a "Building passport". Attention must be paid also to occupant awareness, only proper and understandable user information can change occupants' behaviour. **CD**

All the full presentations are available at **www.rehva.eu/en/technical-information**.

# New online portal for buildings performance data in Europe

**The Buildings Performance Institute Europe (BPIE) launched in November its data hub for buildings performance and related policies in Europe, www.buildingsdata.eu. The comprehensive open data portal presents facts and figures collected for 'Europe's Buildings under the Microscope' study released end of 2011. It includes a wide variety of technical data never collected EU-wide before.**

The data hub has been created to assist policy makers at EU and Member State level, technical experts, building professionals, researchers, academics, consultants, NGOs and the broader energy efficiency in buildings community. All users can access country profiles, search specific parameters, generate overviews and graphs as well as screen the underlying data. The tool allows for cross-country comparisons and cost free downloads. Only the access to the original data requires prior registration. Suggestions for data updates and corrections will be possible through online forms.

The BPIE data hub has the ambition to become an in-depth source for anyone interested in energy efficiency in European buildings. The data will be improved on an ongoing basis and over time, the hub will get enriched with additional topics and information generated through data exchange projects and research partnerships.

# Successful Chillventa 2012 focused on air conditioning and heat pumps

Some 29,000 trade visitors and 200 congress participants made their way to Nuremberg for Chillventa and Chillventa Congressing, which closed its doors on 11 October. More than 910 companies from all over the world presented their latest products and trends for the fields of refrigeration, air conditioning, ventilation and heat pump. The proportion of international visitors rose again and has now reached 55%. In other words, more than one in two visitors came from outside Germany.

The mood in the refrigeration, air conditioning, ventilation and heat pump sectors is sound to good again. This is confirmed by both exhibitors and visitors. The new opening days of Tuesday to Thursday were well accepted," says Richard Krowoza, Member of the Management Board of NürnbergMesse.

A new Chairman of the Chillventa Exhibition Committee was elected as scheduled. Hans-Joachim Socher, General Manager at Walter Meier, replaces Heinrich Reuß. "I am looking forward to my new tasks as Chairman of


the Exhibition Committee. Chillventa 2012 was a real success. It is the industry's most important international platform. I and my colleagues on the committee will be available to help and advise the organizers," says Socher in an initial brief statement.

More information at **www.chillventa.de**

The next Chillventa takes place in the Exhibition Centre Nuremberg from 14–16 October 2014. **CD**

## International symposium

# GEOTABS

**January 22nd, 2013**
**Hanover, Germany**

– Towards Optimal Design and Control of Geothermal Heat Pumps Combined with Thermally Activated Building Systems in Offices

The Technical University Braunschweig and the University of Leuven with partners from an international project GEOTABS are happy to host the **GEOTABS Symposium - the international expert forum on optimal combination of near surface geothermal energy and thermally activated buildings systems**.

The international symposium will focus on:

- experiences in enhanced design and operation of the GEOTABS in office buildings
- all relevant aspects concerning basic concepts and technologies, system simulations, monitoring and control, users´ comfort and standards.

Speakers from research centers, industry and engineering companies will share their experiences and findings of the international project GEOTABS. Join this exceptional event and take the chance to learn from experts about the improved design, suitable operation and optimization of systems with ground coupled heat pumps (GCHP) and thermally activated building systems (TABS) in office buildings.

The GEOTABS symposium is organized in cooperation with the research program EnBop (Commissioning) funded by the German Ministry of Economics and Technology.

For more information and registration please visit **www.geotabs.eu/symposium-2013**

News

# The number of registered participants is record high for Clima 2013 Conference

In June 2013, Prague will host one of the most significant professional events of the year focused on heating, ventilation and air conditioning in buildings – the **REHVA Congress CLIMA 2013**. The Congress will be the 11th REHVA international Congress in a row and, integrating also in the programme the IAQVEC, the 8th Conference on Indoor Air Quality, Ventilation and Energy Conservation in Buildings. Professor **Karel Kabele**, the president of the Clima 2013 Congress is glad to announce that "more than 1000 experts from 60 countries have submitted their abstracts for presentations at the conference with theme, Energy Efficient, Smart and Healthy Buildings", see the number of accepted abstract by topic in **Figure 1**.

The topics show a well balance conference presentations between energy efficiency and quality of indoor environment. One of the main objectives of the conference is to promote and develop technology which aims at the same on energy efficiency and healthy, comfortable indoor environment.

The Clima conference attracts again participants from all continents, about half from Europe but significant delegations also from Asia and North America. Good participation from outside Europe may be partly due to cooperation agreements which REHVA has negotiated with ASHRAE from USA, China Committee of HVAC, Indian HVAC Association ISHRAE, and Japanese Association SHASE. Japanese interest in Europe is shown with the highest number of submitted abstracts (**Figure 2**). The international participation of the Clima Conference offers an excellent opportunity for international contacts and exchange of information.

The Chamber of Czech Authorised Engineers and Technicians active in the construction industry (CKAIT) and well-known Czech Technical University (CVUT) take patronage over the Congress; moreover negotiations are being held to win a support by certain Czech ministries and the Prague Magistrate. The interest of sponsors is also satisfying where the company TA Hydronics has already gained the position of the Diamond Partner, and Daikin and 2VV the position of Bronze Partner.

In addition to the technical and scientific programme, a wide social program is being prepared pro the Congress participants and their accompanying persons. The programme offers opportunity to discover the most famous places in Prague and the Czech Republic at the time of the Congress like the Municipal House where the Farewell Congress Night-Out – dinner with a rich cultural and social programme will take place.

The Congress is organised by STP, a Czech member of the REHVA in co-operation with Guarant, its professional partner; thus it is possible to register now at **www.clima2013.org** where you can also find the up-to-date information.

1. Energy Efficient Heating, Cooling and Ventilation of Buildings, **249**
2. Renewable and High Efficient Energy Sources, **66**
3. Advanced Heating, Cooling, Ventilation and Air Conditioning Systems for Buildings, **120**
4. Energy Efficient Domestic Hot Water Supply Systems, **12**
5. Sanitary Systems - Hygiene of Domestic Water Supply Systems, Efficient Use of Potable Water, Environmental Friendly Sewage Disposal, **10**
6. Advanced Technologies for Building Acoustics, **2**
7. Artificial and Day Lighting, **20**
8. Technologies for Intelligent Buildings, **58**
9. Quality of Indoor Environment, **239**
10. Building Certification Schemes, **30**
11. Integrated Building Design, **47**
12. Commissioning and Facility Management, **33**
13. HVAC Best Practise Examples, **18**
14. Directive on Energy Performance of Buildings Implementation, **49**
15. Zero Energy Buildings, **75**
16. HVAC in Historical Buildings, **37**
17. Fire Safety of the Buildings, **12**

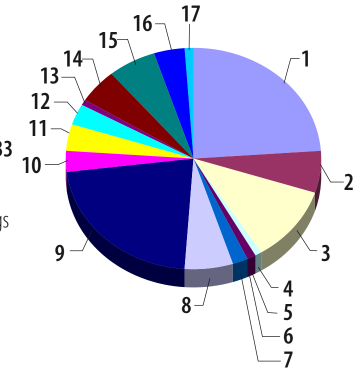



**Figure 1.** Topics of 1098 submitted abstracts from which 389 were returned to authors for improvements.

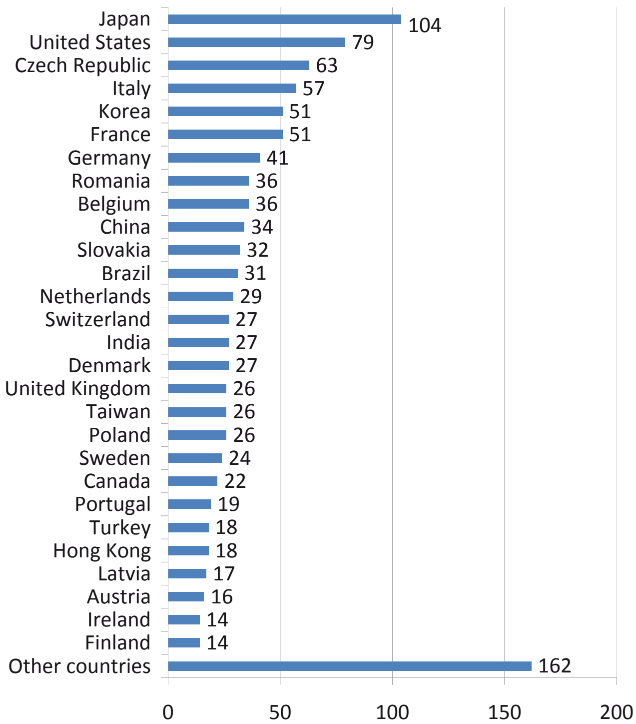



**Figure 2.** Ranking of the countries based on the number of submitted abstracts.

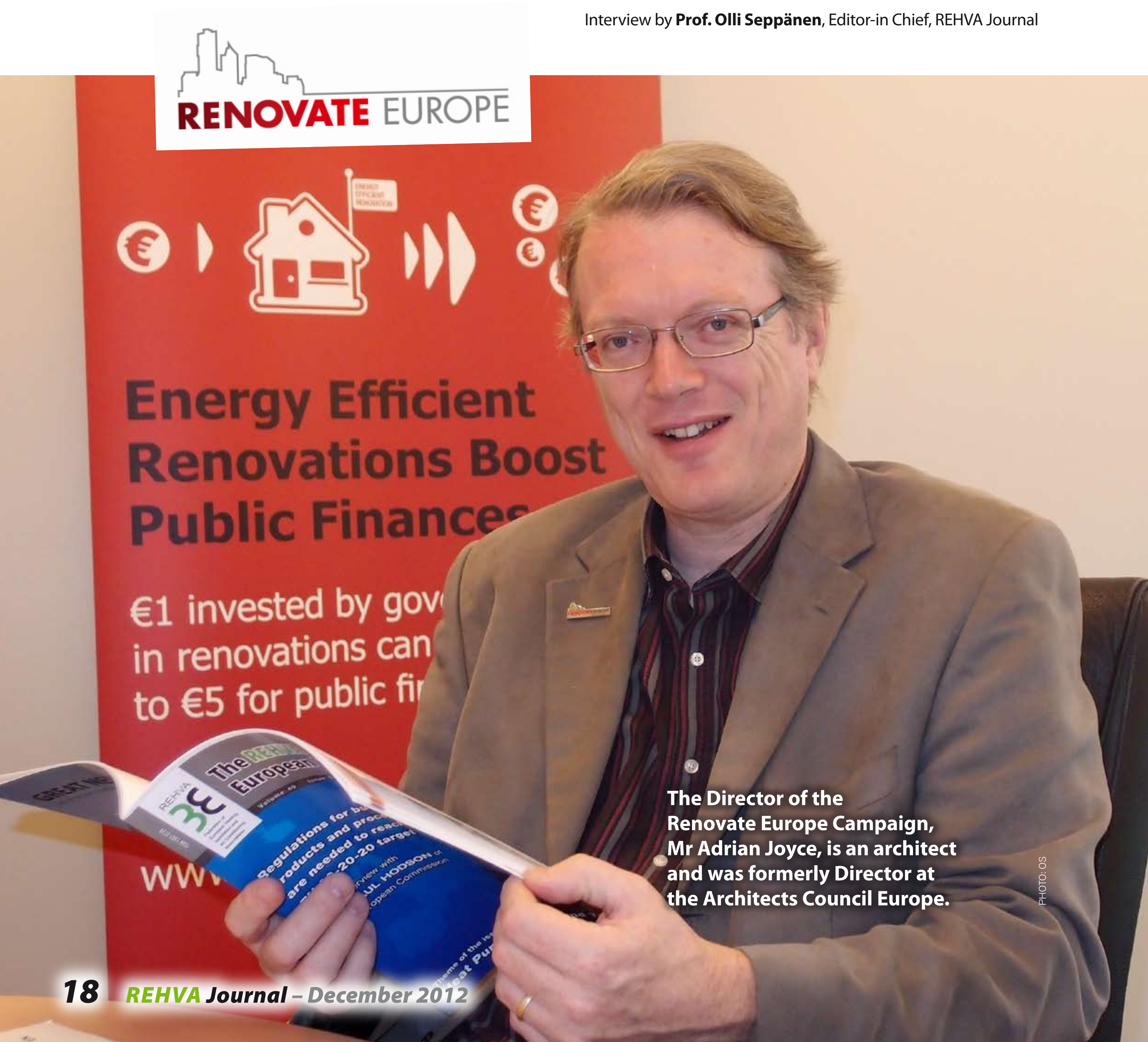
**Register now at** www.clima2013.org

# Interview with Mr. Adrian Joyce,

## The Director of the Renovate Europe Campaign

**The REHVA journal had an opportunity to conduct an interview with Mr Adrian Joyce the Director of the Renovate Europe Campaign which is an EU level Campaign initiated by EuroACE in 2011. Its headline objective is to reduce the energy demand of the existing EU building stock by 80% by 2050 as compared to 2005 consumption levels. In order to achieve this objective, it will be necessary to increase the renovation rate of buildings in the EU by a factor of 2.5 to reach 3% per year by 2020 and to maintain that rate until 2050. Investing in building renovation could accrue up to €40 billion per year for public finances with an additional "one-off" boost to GDP in the range of €153 to €291 billion for the years up to and including 2017. This is according to a new report prepared by Copenhagen Economics for the Renovate Europe Campaign [1].**

Interview by **Prof. Olli Seppänen**, Editor-in Chief, REHVA Journal




**The Director of the Renovate Europe Campaign, Mr Adrian Joyce, is an architect and was formerly Director at the Architects Council Europe.**

PHOTO: OS

### What would be the benefits of the Renovate Europe campaign?

- The Renovate Europe Campaign, which has 23 partner companies and associations, estimates that achieving its goal "to reduce the energy demand of the existing EU building stock by 80% by 2050 as compared to 2005 consumption levels" would boost activity in the EU construction sector by up to €830 billion per year by 2020 (at 2011 prices), securing up to two million direct and indirect jobs in the EU. In addition we would increase our energy security, reduce $CO_2$ emissions, improve the quality of life for EU citizens and boost public finances.

To achieve the goals of the Campaign and thus reap the benefits it offers, Member States must put ambitious building renovation roadmaps to 2050 in place with intermediate targets for 2020, 2030 and 2040 that will be used to benchmark progress. In parallel, sources of funding that can be used to stimulate renovation in line with the 2050 Roadmaps must be put in place.

### You had an important Conference on October 11th in Brussels- what were the main results and conclusions?

- We know that many Member States are still hesitant about whether or not to invest in energy efficient building renovation programmes, despite the requirements of the recently adopted Energy Efficiency Directive. We published in this conference a new report "Multiple benefits of investing in energy efficient renovation of buildings" prepared by Copenhagen Economics for the Renovate Europe Campaign. The findings in this report should provide the final convincing arguments for those Member States, thus leading them to act. Investing in energy efficiency of buildings is a good investment in the short-term, the medium-term and the long-term. (The report is available at our website http://www.renovate-europe.eu/)

The report shows that when the challenge of renovating the EU building stock is taken up with a high level of ambition, permanent increases in revenue for public finances will result. The report also provides a number of policy recommendations for European governments to help boost public finances through renovation. These include shifting or reducing incentives such as favourable tax treatment of heating and electricity use in buildings to encourage a lower usage, thus rendering energy efficient renovation of buildings more attractive. Modernising rent regulation to allow landlords and tenants to share the benefits from energy efficient renovations is another example.

### What are the bottle necks preventing ambitious renovation of buildings in Europe?

- Financing is still the most important obstacle, particularly in the current economic climate but not the only one. The member states have not yet realised all the benefits that an increased renovation rate in the member countries will bring and it is one of the most important tasks of this campaign to raise the awareness of these over-all benefits. I am personally willing to speak in the events organized in the Member countries for professionals, building owners or authorities. Regarding the time frame we also have the problem of the inertia in the member states and in the construction industry. New legislation will, in many cases, be needed to push renovation as the construction sector is, in general, very conservative and may not be ready or willing to offer the services needed for ambitious renovations. This is particularly the case with house owners. In many countries the majority of dwelling are single family buildings, especially in UK and Ireland.

In the commercial sector the terms of lease contracts are one major obstacle for renovations. If the tenant pays the energy bills, there is no motivation for the building owner to make any improvements in the energy efficiency of buildings. The mechanisms that split the benefit should be developed.

The construction sector is very conservative and I have seen from personal experience that a big push from regulations is needed if we are to achieve our goals! The regulations should be progressively more demanding in line with the long term strategies and road maps which, in turn, have to be made publicly available so that the industry and building owners have enough time to prepare for the necessary changes.

### How can IAQ be guaranteed in energy renovation?

- This is an extremely important issue. It is important to avoid the similar problems we had after the first energy crisis in 70´s when the buildings were made too air tight and ventilation was forgotten. We have to always remember that buildings are made for people and the indoor environment should be optimal for the activities in the building. Good, healthy, indoor environment shall always be the first objective. Healthy buildings can also be very energy efficient. European CEN standards have set good criteria for healthy building, and can be used also on national level if national building codes are not adequate. The indoor climate evaluation should also be included in the heating and air conditioning inspections which are mandatory according to EPBD.

### EU is behind the 20-20-20 goals. Do you think it still is possible to reach those targets, what about the 2050 goals with 80% reduction of greenhouse gases?

- Buildings account for 40% of Europe's energy consumption. As such, concrete and ambitious action to tackle unnecessary energy use in the EU's building stock should be the absolute priority of European Energy Policy.

The deep renovation of Europe's existing buildings will save 32% of the total primary energy used in Europe. This saving is equivalent to the combined total energy production of the European coal and nuclear energy sectors or a saving of 4 billion barrels of foreign oil per year.

However, of Europe's existing buildings, only about 1.2% are renovated and about 0.1% demolished in any given year. Even if the 1.2% of buildings being renovated incorporated the highest standards of energy efficiency, the European Union would miss its 20% energy saving targets for 2020. In fact, this alone will deliver almost zero absolute reductions in energy use from the built environment.

Missing the energy savings targets means turning our backs on new jobs, money savings for consumers and small businesses, but it is also refusing to use available, proven technologies, to effectively curb carbon emissions.

European governments must make the right choice for the future, and pick the deep renovation of buildings as frontrunner for an ambitious energy agenda.

Reducing energy demand has the potential to save taxpayers money while making their homes more comfortable; it has the potential, as already pointed out, to create 2 million new jobs and to pave the way to sustainable growth.

I know that the goals are really ambitious but they can be reached if all Member States fully implement the directives the European Parliament and Council of Ministers have approved. These directives show that political will exists at EU level, but the real challenge is to ensure that this translates into real action in the Member States over the coming years.

### What is the motivation for renovation as energy is still so cheap?

- In addition to the energy savings that renovation of the existing buildings stock will bring, there are a range of co-benefits, which can also be harvested. By reducing energy consumption and focusing on indoor climate issues when renovating, co-benefits can be achieved such as reduced outlay on government subsidies, and improved health due to less air pollution and a better indoor climate, both of which also lead to fewer hospitalisations and improved worker productivity.

Harvesting renovation opportunities could bring huge benefits to the EU economy over the coming decades. Based on available estimates of the potential for energy savings from the energy efficient renovation of buildings, the Copenhagen Economics Study suggests a monetised permanent annual benefit to society of €104-175 billion in 2020 depending on the level of investments made from 2012 to 2020, €52-75 billion from lower energy bills, and at least €9-12 billion from the co-benefits of reduced outlay on subsidies and reduced air pollution from energy production. If the health benefits from improved indoor climate are included, the benefits are increased by an additional €42-88 billion per year. These health benefits are evident, but very uncertain to estimate, and should be interpreted accordingly. If investments are continued after 2020, these annual benefits can be doubled by 2030.

### What is your opinion as an architect on the most feasible technology for renovation? Which technology/measures should be implemented first?

- In think that it is important to develop cost effective renovation packages for the typical buildings in each Member Sate. I support the principles the Commission has developed when requesting all Member States to develop reference buildings that are representative for the building stock, and apply the set of measures to find the cost optimal solution. These measures should include the improvement of the thermal properties of the building envelope as well as the improvement of the building services such as heating, lighting, air conditioning, ventilation and domestic hot water. After the energy use is reduced the demand should be covered by cost effective renewable sources and, finally, by clean fossil fuels as available. 3E

**EuroACE, The European Alliance of Companies for Energy Efficiency in Building**

Website: **http://www.euroace.org**

## Reference

[1] Multiple Benefits of Investing in Energy Efficient Renovations – Impact on Public Finances. A Study by Copenhagen Economics. Released at Renovate Europe Day, 11 October 2012. www.renovate-europe.eu/Multiple-Benefits-Study

# Interview with Mr. Ismo Grönroos-Saikkala,

## Head of Sector, the Energy Efficiency Unit, Directorate-General for Energy

**As the Head of a Sector at the European Commission's energy efficiency unit Mr Grönroos-Saikkala is in a key position to offer valuable insights into how the Ecodesign of Energy Using Products Directive is being implemented. His Sector is in charge of developing Ecodesing regulations. REHVA Journal was pleased to get an interview from Mr Saikkala-Grönroos during his visit in Helsinki during FINNBUILD exhibition for the seminar organized by REHVA and the Finnish member of REHVA, FINVAC.**


**The Directives on Ecodesign (ED*) and Energy Labelling (ELD**) cover product groups relevant for the energy performance of buildings including heating products, motors, fans and lighting. While the EPBD requires Member States to set requirements at system level and does not prescribe the level of the requirements (except for the fact that they have to be cost-optimal), the ED and the ELD address specific product groups and, in case of the ED, set specific minimum requirements. In the future, more Ecodesign requirements will be adopted for products that are part of technical building systems, and possibly also part of the building envelope (e.g. windows).**

Interview by **Prof. Olli Seppänen**, Editor-in Chief, REHVA Journal

### Which products will be regulated next based on the Ecodesign directive?

- Currently, we are preparing regulations for about 12 product groups to be adopted before the end of 2013. This work includes the regulations for the heaters and water heaters that are almost completed. We have worked with them for several years. Most likely these regulations will be finalized and published early 2013. The preparation of these regulations has taken time as so many types

* 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-using products.

** Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products


of equipment is included: oil boilers, gas fires boilers, heat pumps etc. Additionally, we have some 20 more regulations to be adopted before the end of 2014. The regulations have to deal equally and objectively all products. When adapted the regulations apply to products sold or manufactured in any Member State.

### What is the definition of product? Can a building be a product and regulated on the base of the Ecodesign directive?

- The Ecodesign directive, in principle, would allow regulation of any product or system if it is placed on the market or put into service (at the moment of receiving the CE-marking). In these lines, in principle, even a building placed on the market, could be considered as a product.

### How can compliance of products related Ecodesign regulations be controlled? Is it a task of the Commission or Members States or who? How can the products NOT meeting the regulations be taken out of market?

- Compliance is the responsibility of national market surveillance authorities. The Commission can take measures to coordinate and support, or in the case of non-existent or inappropriate national level action, resort to legal measures against a member state not fulfilling its duties.

In principle when national market surveillance authority identifies a non-compliant product the authority has the right, and the obligation, to remove the product from market and issue a fine on caused damage, if appropriate. The exact action depends on the product and applicable legislation in question.

### What is the estimated effect of the Ecodesign directive on primary energy use in Europe?

- It has been calculated that the first twenty Ecodesign regulations would save some 400 TWh on an annual basis by 2020, equivalent to some 35 Mtoe of final energy. In primary energy this would correspond close to 90 Mtoe.

### Are Ecodesing regulations also giving criteria /requirements other product properties than energy related?

- Any significant environmental aspect can be regulated if it is cost-effective (no unproportionate negative effects).

### Are indoor air quality and safety issues included in the Ecodesign regulations?

- EU has separate legislation for health and safety. Indoor air quality and health regulations are prepared by DG SANCO (Health and Consumers). Ecodesign regulations set requirements on significant environmental impacts of a product, considering the whole life-cycle of the product.

### What is the role of CEN and other standards in relation to Ecodesign regulations?

- The performance of a regulated product is measured on the basis of harmonized European standard, which are developed by the European standardization organizations such as CEN and CENELEC on the basis of a standardization mandate issued by the European Commission.

### What is the Eco labeling and energy labeling? Are they part of Ecodesign regulations?

- No, the labels are not part of the Ecodesign directive. Ecodesign requirements remove the worst performing products from the market. The mandatory energy lebelling requirements guide consumers towards the most cost effective/energy efficient products. The voluntary Ecolabel indicates products with highest environmental performance.

### Which HVAC product will be included in the next working programme?

- The Commission is preparing currently an Ecodesign working plan for the years 2012 - 2014. In the priority list, there are no HVAC related products included in the draft working plan. However, other products such as windows and insulation materials, smart appliances/meters that are included in the draft plan may be of interest for people working in the buildings sector. Also, there is a plan to study the energy saving potential of the power generating equipment.

# Nearly-zero, Net zero and Plus Energy Buildings

## – How definitions & regulations affect the solutions

**The topic of Zero Energy Buildings (ZEBs) has received increasing attention in recent years, up to inclusion in strategic energy policy papers in several countries. However, despite the emphasis placed on the goals, the various ZEB definitions applied mostly remain generic and are not yet standardised.**

***Karsten Voss***
University Wuppertal
Building Physics & Service Technology
Germany
kvoss@uni-wuppertal.de

***Igor Sartori***
SINTEF Building and Infrastructure
Oslo, Norway
igor.Sartori@sintef.no

***Roberto Lollini***
EURAC research
Bolzano, Italy
roberto.lollini@eurac.edu

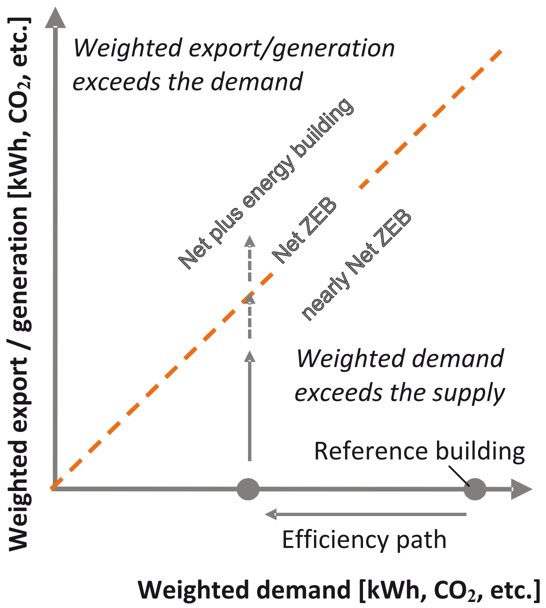



**Figure 1.** Graph representing the path towards a Net Zero Energy Building (Net ZEB), with the nearly and plus variants. Source: University Wuppertal, btga.

## Introduction

The term ZEB is used commercially without clear agreement on its content [1, 2]. In general, a ZEB is understood as a grid-connected, energy-efficient building that balances its total annual energy consumption by on-site generation and associated feed-in credits. To emphasize the balance concept – in contrast to an autonomous building – the term *Net* has been introduced, so that one can speak of Net ZEB and the variants nearly Net ZEB or Net plus energy building, as shown in **Figure 1**.

Since the 2010 recast of the EC Energy Performance of Buildings Directive [3], the discussion has become even more intensive. REHVA published a proposal in the May 2011 issue of its Journal [4]. The EPBD Concerted Action offers a platform for member states to discuss the various national approaches to formulate relevant definitions at the building code level [5]. The on-going IEA activity "Towards Net Zero Energy Solar Buildings" was formed in 2008 as a scientific forum at the international level [6]. The authors of this paper are members of the subtask, "Definitions & large-scale implications".

Over the past few years, the IEA working group has analysed relevant publications on the ZEB topic and has published a comprehensive review [7]. This review was followed by a recently published article addressing a consistent definition framework [8], a project data base [9] and a book including a set of well-documented ex-

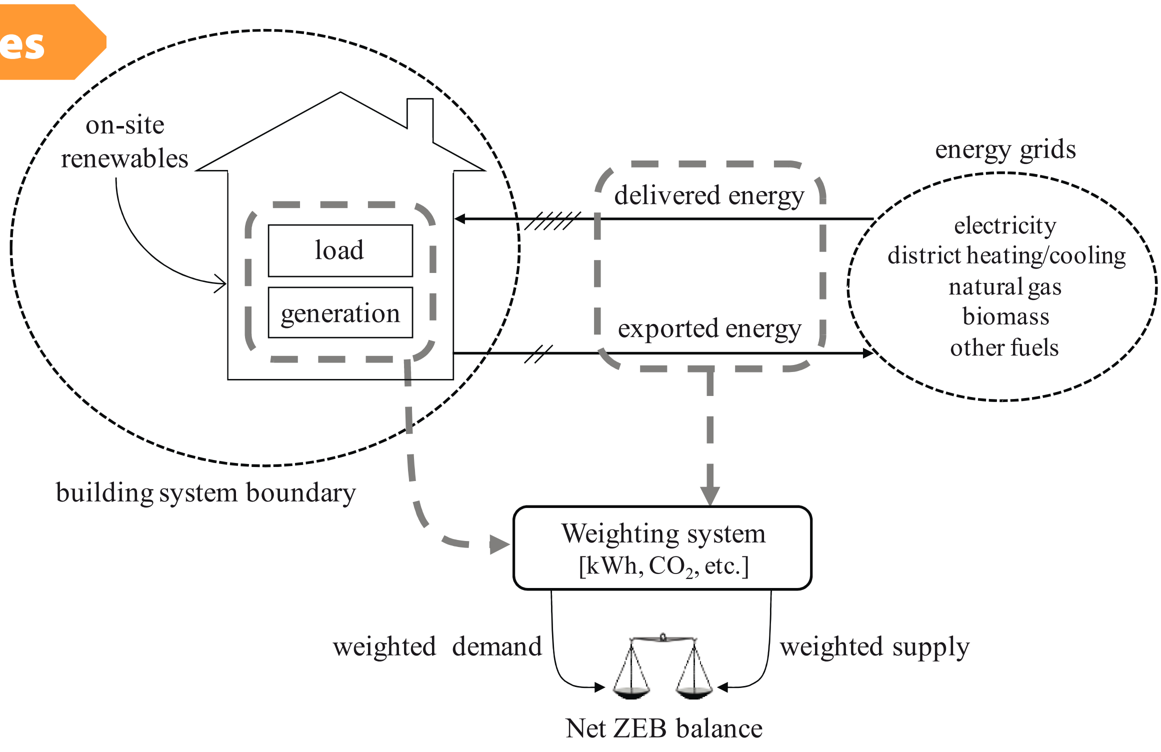



**Figure 2.** Sketch of the connection between buildings and energy grids showing the relevant terminology, source [8].

emplary buildings covering a wide range of typologies and climates [10]. This paper summarizes the most relevant findings, adding to the information provided in previous issues of the REHVA Journal.

## Physical and Balance Boundaries

Building codes focus on a single building and the energy services that are metered. Therefore, it is possible to distinguish between a physical boundary and a balance boundary. The combination of physical and balance boundaries defines the building system boundary, see **Figure 2**.

The physical boundary identifies the building (as opposed to a cluster or a neighbourhood). The energy analysis addresses energy flows at the connection point to supply grids (power, heating, cooling, gas, fuel delivery chain). Consequently the physical boundary is the interface between the building and the grids. The physical boundary therefore includes up to the meters (or delivery points). The physical boundary is also useful to identify so-called "on-site generation" systems; if a system is within the physical boundary (within the building distribution grid before the meter) it is considered to be on-site, otherwise it is off-site. Typical on-site generation systems are PV and micro CHP, which allow energy to be exported beyond the physical boundary. The yield of solar thermal systems is typically consumed entirely on-site due to technical limitations at the connection point to district heating systems. Therefore solar thermal systems are mostly treated as demand-reduction technology (efficiency path, x-axis in **Figure 1**). A typical off-site option is a share in a wind energy turbine which is financed by the building budget. This option would allow economically feasible options to balance the building energy consumption [11], but should be considered within the primary energy factor for the imported electricity to avoid double counting. However, the EPBD addresses only energy generated on-site or nearby. Therefore, while the concept of 'nearby' still needs to be better defined, off-site solutions seem to be beyond its scope.

The balance boundary identifies which energy services are considered. In the EPBD, energy balance calculations take into account the technical services for heating, cooling, ventilation and domestic hot water (and lighting in the case of non-domestic buildings). Plug loads and central services are not included, but are typically included when metering energy use at the point of delivery. Some pilot projects also include the charging of electric vehicles on-site (before the meter [8]). Although these loads are not related to the building performance, a holistic balance including all electric consumers on-site helps to characterise the grid interaction in more detail (see below). Electric cars include batteries, thereby increasing the "on-site" storage capacity.

Other forms of energy consumption that do not appear in the annual operational phase but belong to the life cycle of a building may be considered within the balance boundary, such as embodied energy/emissions related to construction materials and installations. The recently formulated definition in Switzerland and the one under development in Norway address this issue [9, 10]. The result of a recent study on the life-cycle energy balance of low-energy

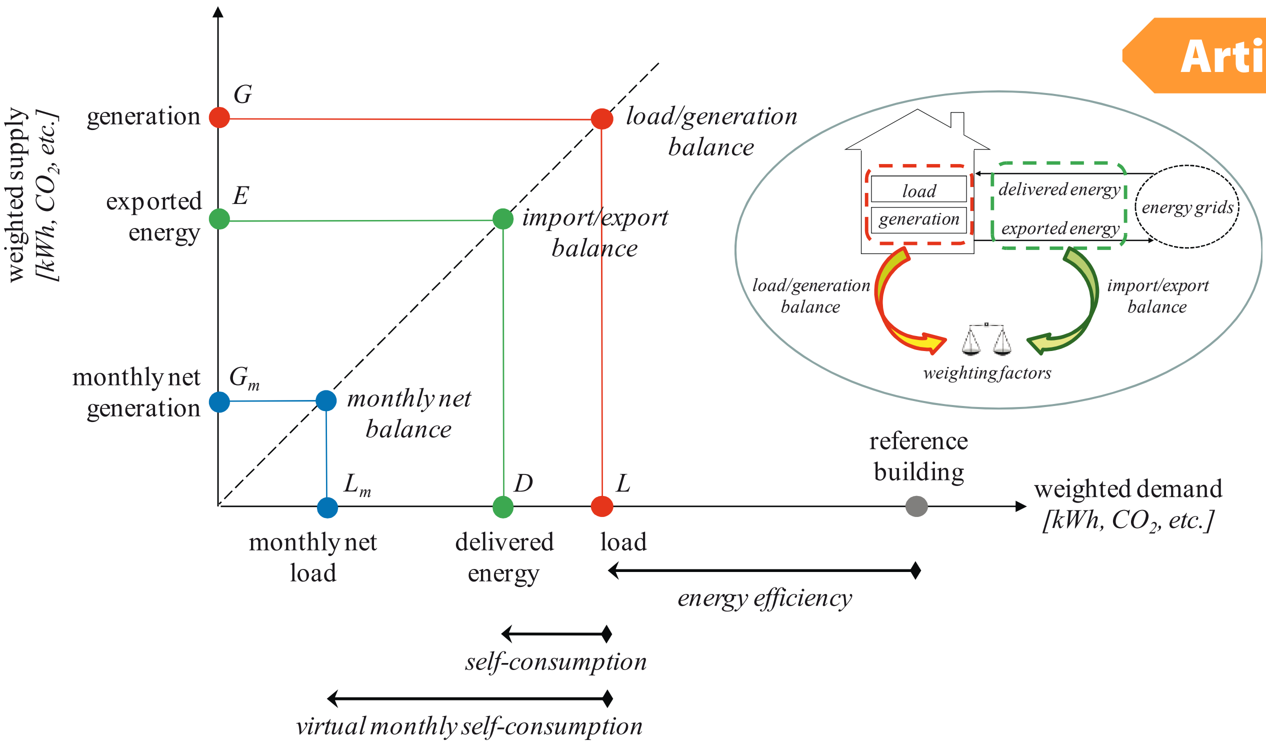



**Figure 3.** Graphical representation of the three types of balance: import/export balance between weighted exported and delivered energy, load/ generation balance between weighted generation and load, and monthly net balance between weighted monthly net values of generation and load, source [8].

and net zero-energy buildings indicates that the embodied energy of a building increases only slightly when the step towards nearly and net ZEBs is taken. This is due to the domination by structural building elements compared to energy-saving measures or generation systems [11].

## Weighting Systems

The weighting system converts the physical units of different energy forms into a common metric to facilitate the balancing process, **Figure 2**. According to the EPBD recast, the metric of the balance for a nearly ZEB is primary energy. Nevertheless, some countries prefer carbon emissions as the primary metric. Examples of weighting factors are documented in EU standards such as EN 15603 but many different factors are used in national building practice, reflecting the specific national or local power grid structure (annex 1 in [8]). Factors develop with time and are not physical constants. Most countries typically apply factors which take only the non-renewable component of the primary energy content into account. This is the background leading to the low conversion factors for biomass or biofuels, resulting in market stimulation for such energy supply solutions for Net ZEBs. Some countries apply politically adjusted (increased) factors in order to reflect the regionally limited availability of biomass and biofuels from sustainable forestry or agriculture (e.g. Switzerland [16]). In other countries, politically adjusted (decreased) factors are applied to electricity in order to include the expected 'greening' of the power sector in accordance with national and EU road maps (e.g. Denmark [17] and Norway [18]). Such 'discounting' of electricity favours all-electric solutions such as systems based on heat pumps, facilitating achieving the Net ZEB target in connection with decarbonised power grids (with a high share of renewable energy). Similarly, discounted values for the district heating/cooling grid would make the Net ZEB target more feasible in connection with thermal grids based on large shares of renewable energy and/or waste as fuel.

Typically, symmetrical weighting factors are applied when balancing imported and exported energy; energy delivered by the grid and fed into the grid is given the same value. Other developments weight asymmetrically to stimulate on-site generation approaches (Germany 2012: 2.4 kWh primary energy per kWh electricity delivered from the grid, 2.8 kWh primary energy per kWh electricity exported to the grid [19]). Weighting factors may vary seasonally (or even at the daily or hourly level) as discussed below.

## Balance Types

The Net ZEB's annual balance between weighted demand and weighted supply is often implicitly understood as the so-called *import/export balance*, indicated by the green line in **Figure 3**. Weighted delivered and exported energy quantities can be used to calculate the balance when monitoring a building, as long as all consumptions are included. Separating some components of the consumption out of the balance creates the need for more sophisticated (sub-)metering.

Such quantities are known in monitoring, but in the design phase they could be calculated only if there were good estimates of "self-consumption": the share of on-site generation that is immediately consumed in the building. Self-consumption differs according to the type of generating technology, the type of building, the climate and the user behaviour because it depends on the simultaneity between generation and consumption. Currently there is not enough knowledge about self-consumption to establish standardised self-consumption fractions. This is one of the points which were left open in the previous REHVA article on a Net ZEB definition [4]. In order to enable the import/export balance calculation in the design phase planners need to have data on end uses patterns, e.g. for appliances, cooking, hot water use, etc. with sufficient time resolution. In the same way as weather data are standardized to provide reference climates for dynamic simulations, user profile data may be standardized to enable an import/export analysis under reference conditions.

As the EPBD recast mainly addresses building performance requirements in the planning phase, it focuses on the balance between weighted on-site generation and the calculated energy demand, the so-called *load/generation balance* (red line in **Figure 3**). These quantities do not cross the building system boundary, so the grid interaction is disregarded. The advantage is that both quantities can be calculated independently in the absence of detailed information on time-dependent load and generation profiles with high resolution. The main difference between the two balance types is the self-consumed fraction of energy generated on site, resulting in different numbers.

The load/generation balance in the understanding of the EPBD recast addresses generation by renewable sources only. This means that a CHP system fuelled by natural gas and exporting power to the grid is not taken into account on the generation side, whereas it typically is included with its power generation on the export side of the import/export balance. While solar thermal gains are counted as load reduction in the import/export balance (no heat exported), these gains are counted as on-site renewable generation within the load/generation balance and for the fraction of renewables covering the load. As the EPBD calls for a "significant share" of renewables to cover the remaining load of a Net ZEB or nearly-Net ZEB, the total share of renewables needs to be clearly defined.

As most national energy codes apply calculations on a monthly basis, generation and consumption may be calculated and compared on a monthly level, allowing a so-called *virtual load match* to be determined. Monthly on-site generation up to the level of the monthly load is counted as virtual self-consumption (= reducing the load, efficiency path in **Figure 1**). Only the monthly residuals, i.e. monthly generation surplus or remaining load, are added up to determine annual totals. Such a balancing method may be called *monthly net balance* (blue line in **Figure 3**). One application is in the version of the German building energy code that has applied since 2009 [20].

In the monthly net balance the annual surplus characterizes the service taken over by the grid to overcome the seasonal mismatch between load and generation. However, in the case of multiple delivered energy forms, the annual surplus is also influenced by the substitution effect; i.e. when exported electricity is also used to compensate for other forms of energy that have been imported, e.g. gas or biomass. In the case of multiple forms of exported energy, e.g. both electricity and heat, the annual surplus is also distorted by the different weighting factors. Finally, the result depends on the balance boundary with respect to plug loads and central building services: excluding part of the loads increases the monthly surplus (assuming constant generation). High-resolution net metering in the building operation phase typically results in a lower load/generation match and higher export than that estimated by the monthly net balance. The monthly net balance is a simplified approach for the design phase, when high-resolution profiles are not available.

## Transient Characteristics

Buildings using on-site generating systems have different abilities to match the load and benefit from the availability of energy sources and the demands of the local grid infrastructure, namely the power grid and in a few cases the heating/cooling grid. Differences occur in:

- the temporal match between energy generation on site and the building load (load match)
- the temporal match between the energy transferred to a grid and the demands of a grid (grid interaction), and
- the (temporal) match between the types of energy imported and exported (fuel switching).

As mentioned above, load matching and grid interaction have to be discussed with respect to the form of energy and the temporal resolution. Calculations have to be made for each form of energy separately. Simple monthly net metering is sufficient to describe and investigate the seasonal performance (**Figure 4,** simplified example of an all-electric building), whereas high-resolution simulation or monitoring is needed to describe daily and hourly fluctuations [21, 22]. Load matching and grid interaction is almost irrelevant in the context of fuel-based energy supply but is of major importance for the electricity grid interaction.

Increasing the load match is not an intrinsically favourable strategy for a grid-connected building. The value – expressed in the weighting metrics, or in an equivalent monetary value – of the exported energy to cover loads somewhere else in the grid may be higher than losses associated with on-site storage solutions to increase matching. The value may vary depending on the season and time of day, due to the varying fraction of renewable power available in the grid. The choice between on-site storage and export will depend on such dynamic values. There is no *a priori* positive or negative implication associated with high or low load match. However, a load match calculated on monthly values (=monthly net metering) will at least give a first order insight to characterize the service taken over by the grid to overcome the seasonal mismatch of load and generation (calculated on each single energy carrier, so without the distortions affecting the monthly net balance).

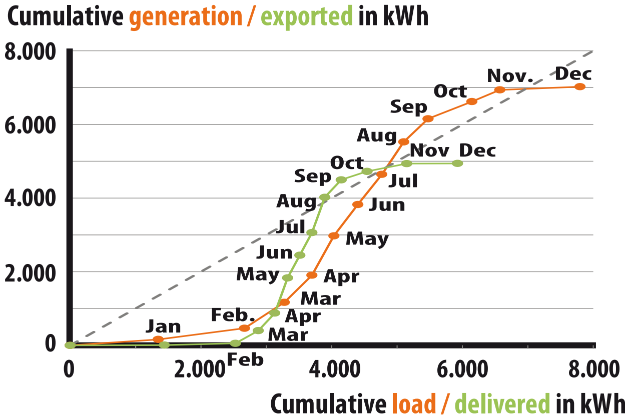



**Figure 4.** Monitoring results for a small all-electric, nearly Net ZEB in Germany. The building is the Wuppertal University entry to the Solar Decathlon Europe 2010 in Madrid [23]. The data based on 5-min resolution are expressed as a load/generation balance as well as an import/export balance including all on-site loads. Monitoring started in September 2011; data for July/August 2012 have been estimated. Source: University Wuppertal, btga

Weighting factors with seasonal/monthly variation applied within building energy code systems present a possible future method to influence the balancing results and to stimulate beneficial and sustainable developments. The factors for the power grid can address differences in the fraction of renewables. In the case of a grid with high penetration of solar power generation, large seasonal differences will be typical for most climates. Low weighting factors during summer as compared to higher factors during winter would stimulate building energy solutions which operate to the benefit of the grids. Time-dependent electricity tariffs are a typical measure within "smart grids" to communicate such issues at the financial level.

## Conclusions

The report underlines the complexity of the topic and the implications of definitions and regulations for appropriate solutions. Nationally specific formulations have to clarify the balance boundaries, the balance type and the weighting with respect to the EPBD, the already established national building energy code framework and the strategic energy plan. As load match and grid interaction become important characteristics in future green and smart grids, it is important that calculation procedures reflect these issues. The import/export balance including all types of on-site (before the meter) generation and loads in a harmonized way seems to be the suitable approach in the medium-long term. However, there is a need to more knowledge on transient load patterns in the planning phase. The load/generation balance combined with a monthly net balance approach may serve as a compromise.

Asymmetrical and time-dependent weighting factors for grid-based energy are important components of a future method. Such an approach would be in line with tariff systems which communicate the strategy to consumers at a financial level. However, this does not mean that a net-zero or nearly net-zero energy building would have net or nearly zero energy costs. This is due to the cost of using the grid and related taxation.

As an aid to studying the various definition options, a spread-sheet tool for planning and monitoring data analysis that addresses the most relevant combinations of balance boundaries, balance types and weighting factors will be made available by the IEA working group at the end of 2012 (check [6] for free download). A standardized monitoring procedure with protocols to check the targets has been developed. The procedure includes sixteen steps belonging to three different phases of the accomplishment of a monitoring campaign [24].

## Acknowledgements

The work presented in this paper has been largely developed in the context of the joint IEA SHC (International Energy Agency, Solar Heating and Cooling) Task 40/ECBCS (Energy Conservation in Buildings and Community Systems) Annex 52: Towards Net Zero Energy Solar Buildings.

## References

See the complete list of references of the article in the html-version at www.rehva.eu -> REHVA European HVAC Journal

Articles

# Use of biofuels in the district heating system of Riga

**The increasing demand for energy, the shortage of the reserves of fuel, as well as the environment pollution and the global climate changes are the reasons for the growing interest in renewable energy resources in Latvia where the share of renewable energy resources account for one third in the total balance of primary energy resources. Wood and hydro energy are the two major types of renewable energy resources. Latvia has set the goal to increase the share of renewable energy resources up to 40% by 2020. The biggest possibilities for the use of local renewable energy resources refer to heat production – this applies to energy resources, like granulated wood or wood chips (hereinafter referred to as biofuel) with the highest efficiency. This article demonstrates the use of biofuel and the possibilities of increasing its share, as well as measures for increasing the efficiency of the biofuel fired heat sources in the district heating system of Riga.**

***Normunds Talcis***
M.sc.ing. JSC
„RĪGAS SILTUMS" Board Chairman, Riga, Latvia
normunds.talcis@rs.lv

***Egils Dzelzītis***
Dr.habil.sc.ing.
Riga Technical University, Riga, Latvia
egils@lafipa.lv

## District heating system in Riga was established in 1958

District heating system consists of the supply network of heat energy and heat production sources for a city or a part of a city. The district heating system is a modern heat energy supply system, which provides a possibility to produce heat in cogeneration cycle and to use biofuel, as well as other advanced technologies the application of which is not efficient or feasible in local heat sources. At present JSC "RĪGAS SILTUMS" is the operator of the district heating system in Riga and is in charge of providing heat energy supply to households, state authorities and businesses in Riga. JSC "RĪGAS SILTUMS" plays an important role in the heat supply of Latvia accounting for 53% of the total volume of the district heat supply provided by the district heating systems.

The company purchases approximately 70% of the heat required for the needs of Riga city from CHP plants of an independent producer and produces the remaining approximately 30% by itself (**Table 1**).

**Table 1.** Heat production capacities of the district heating system.

| | Heat capacity, MW |
|---|---|
| **Owned by operator, including:** | **942** |
| DHP "Imanta" | 405 |
| DHP "Ziepniekkalns" | 104 |
| DHP "Zasulauks" | 257 |
| DHP "Daugavgrīva" | 32 |
| DHP "Vecmīlgrāvis" | 63 |
| 38 automated small local boiler houses | 81 |
| **Heat sources owned by others, including:** | **1657** |
| TEC-1 | 493 |
| TEC-2 | 1148 |
| Juglas jauda | 16 |
| **Total installed heat capacity** | **2599** |

The implementation of the rehabilitation project of Riga district heating system started in 1996 and was aimed at achieving considerable improvement of the efficiency of Riga district heating system, ensuring its competitiveness and reducing the impact of the district heating system upon the environment. Within the framework of the rehabilitation it was planned to eliminate the centralised heat substations, to reconstruct individual heat substations and pipeline networks, to close non-efficient medium and small capacity heat sources and to connect the relevant consumers to the district heating, as well as to reconstruct the major heat sources of JSC „RĪGAS SILTUMS". In the course of implementing the rehabilitation project the arrangement of the heat metering system, improvement of the service level and establishment of the possibilities of control of the heat consumption by heat consumers were defined as the priority areas.

## Individual heat metering installed from 1996

3000 heat meters were installed in Riga until September 1996 based upon the initiative of the house owners. In the course of implementing the guidelines of the rehabilitation project of the district heating system, the installation of heat meters started in 1996 both at consumer side and in heat sources. The costs of procurement and installation of heat meters were included in the heat tariff. In October 1997 the installation of 6000 heat meters was completed and it permitted to transfer to the system of settlements with heat consumers based upon the actual consumption of heat. The metering of actual heat consumption encouraged the arrangement of the internal heat supply systems of buildings, thanks to the optimisation of the flow of network water and hot water consumption. Residents, in their turn, can accurately account for the consumed water based upon the readings of the meters installed in apartments and adjust their consumption to their economical abilities. Settlements for heat based upon meter readings increased the consumers' interest to save the heat energy, supplied to the building, and to demand provision of higher quality heat. The measures of saving and improving the heat quality yielded their results because the heat sales to households decreased.

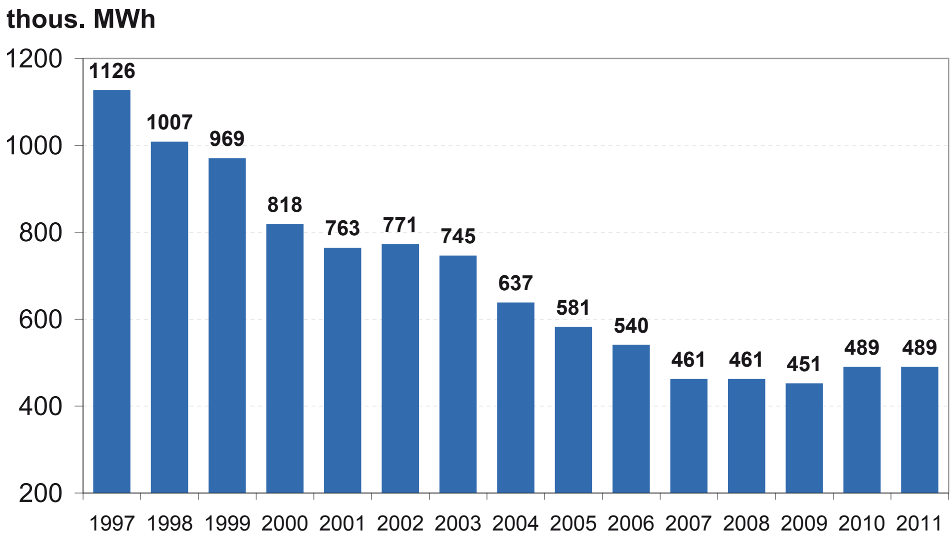



**Figure 1.** Heat losses in DH networks.

## Individual heat substations

Before 1997 approximately 46% of the heat consumers connected to Riga district heating system received heat via central heat substations (places where the heat carrier is produced for ensuring space heating and domestic hot water supplies to a group of buildings). When hot water was supplied and space heating was provided via the central heat substations it was not possible to guarantee the high quality of service to the customers. In autumn and spring periods the premises were overheated (the adjustment possibilities were limited). In the result heat was not used efficiently. For the purpose of providing the required amount and quality of heat to heat consumers, improving the security of the heat supply and achieving more efficient use of heat JSC "RĪGAS SILTUMS" was consistently implementing the measures aimed at reducing the heat demand, including the implementation of the program of elimination of central heat substations and setting up individual automated heat substations. Within this program 3008 modern individual heat substations were constructed in the buildings. All the 185 central heat substations and the hot water networks associated with them with the total length of 134.77 km were eliminated by the end of 2001. At present more than 8000 individual heat substations have been modernised.

## Reduction of heat transmission losses

For the purpose of ensuring the operation of the district heating system and its competitiveness on the heat market the good technical condition of the elements of the heat supply systems has to be maintained. The main and distribution heat networks are major elements of the district heating system. By maintaining the good technical condition of the main and distribution heat networks JSC "RĪGAS SILTUMS" provides high quality heat supply to customers and is reducing transmission heat losses and leakages of the heat carrier. Generally, thanks to the implementation of the measures aimed at reducing the transmission heat losses it was possible to reduce the transmission heat losses in Riga district heating system approximately 2.3 times (**Figure 1**).

## Quality of biofuels

In order to reduce dependence on one type of fuel, to improve the security of heat supply and to reduce carbon dioxide emissions, the sustainable justified diversification of fuel was defined as the priority aimed at rapid and considerable increase of the share of biofuel. The requirements were set to

**Figure2.** The biofuel fired boiler house at the plant Vecmilgravis.

- composition (bark, stones, sand, metal items, ice, etc.
- fraction size: 20…50 mm – 89…90%, 100 mm – not exceeding 1%, 5 mm - not exceeding 10%
- heating value – 2800 kWh/kg;
- moisture – 30…55%.

Three types of production of the biofuel were recognised:

1. Planned production of energy wood chips by cutting the forest trees and chipping the round timber at specially equipped places;
2. At the felling areas where the waste of the forest cutting works is being utilised (branches, stems, bushes, etc.) – the timber is chipped at the site and transported to boiler houses;
3. In the course of cleaning the protective areas, constructing roads and carrying out the maintenance of overhead power lines – the chipping of the wood is done at the site and then it is transported to boiler houses;

## Use of biofuels in the Riga DH system

Taking into account the particular circumstances when the operator of the district heating JSC "RĪGAS SILTUMS" can operate only the heat production plants owned by itself, the first biofuel fired unit in the district heating system of Riga was installed in 1996 at the heat plant "Daugavgrīva". The biofuel prefurnace with the heat capacity 7.5 MW and with the efficiency rate up to 75% was added to the existing steam boiler.

On September 30, 2008 Riga was the first European capital, which has signed the Covenant of Mayors. The Covenant of Mayors is the main document of forming the European energy policy uniting 3000 cities in the European Union and other countries.

The Covenant of Mayors is an ambitious initiative by the European Commission expressing the unilateral undertaking to reduce the $CO_2$ emissions caused by the EU by 20% until 2020, and achieving this by means of improving energy efficiency by 20% and increasing the share of renewable energy sources in the total energy consumption by 20%.

Taking into account the above, as well as the rapid increase of natural gas prices and the support available from the EU structural funds, JSC „RĪGAS SILTUMS" has actively engaged in the use of biofuel in its production sites. The use of biofuel contributes to the fuel diversification aimed at more intense use of local renewable energy resources and reduces the impact of the natural gas upon the heat price.

Along with the development of the biofuel incineration technologies and in the course of continuing the increase of the share of biofuel in Riga district heating system in 2010 a biofuel fired boiler house with the capacity of 14 MW and the efficiency rate up to 85% was constructed in the heat plant „Vecmīlgrāvis" (**Figure 2**) and it is operated at the base load.

In summer period only the operation of the biofuel fired boilers is envisaged in the heat plants „Daugavgrīva" and „Vecmīlgrāvis". For the purpose of ensuring the compensation for the daily changing heat loads - heat accumulators were installed in the heat plants and they are covering the heat loads during the peak hours and charge the load of the boilers during night hours.

The development measures implemented at the heat plant „Vecmīlgrāvis" permitted to improve the operational efficiency of this heat source and has increased the share of use of the biofuel in the total production scope from 2.4% to 6.4%.

## Further development of the biofuel usage

By increasing the share of use of the biofuel, the impact of the increase of natural gas prices upon the heat production costs will be reduced. Currently two modernisation projects have been initiated providing for the installation of highly efficient heat production units using biofuel:

- a cogeneration unit producing up to 22 MW heat and 4 MW electricity with the total efficiency rate up to 97% will be installed at the heat plant "Ziepniekkalns";
- the installation of the water heating boiler with the capacity of 20 MW and the fluidised bed furnace allowing to burn a wide range of biofuel is planned in the modernisation project of the heat plant "Zasulauks".

In both above mentioned projects the flue gas utilisation technologies (flue gas condensers) will be installed ensuring the efficiency rate of the boiler operation close to 100%. The maximum automation level and construction of the automated storage of biofuel is planned to be placed at the boiler houses. The implementation of the projects will permit to save the natural gas consumption of approximately 11.2 mill. n.m$^3$/year, at the same time increasing the consumption of biofuel by approximately 112 thous. loose m$^3$/year.

Following the implementation of the projects of biofuel at the heat plants "Ziepniekkalns" and "Zasulauks" the share of biofuel in the total production volume will reach 5.82% (**Figure 3**).

By year 2014, thanks to the implementation of the modernisation projects providing for the use of biofuel in the heat plants "Ziepniekkalns" and "Zasulauks", the total consumption of biofuel in Riga district heating system will increase from approximately 0.03 mill. loose m$^3$ per year to approximately 0.4 mill. loose m$^3$ per year or more than 13 times.

Along with the planned increase of the share of energy produced on the basis of the biofuel in the total volume of heat production for Riga district heating system, also measures for improving the efficiency of biofuel fired heat sources are consistently implemented. In the near future, in addition to fossil biofuel fired water heating boilers at the heat plant „Vecmīlgrāvis", it is planned to installed condensers of flue gases. The condensers of flue gases will be installed in the flue gas channel behind the boiler and flue gas treatment devices, and by means of

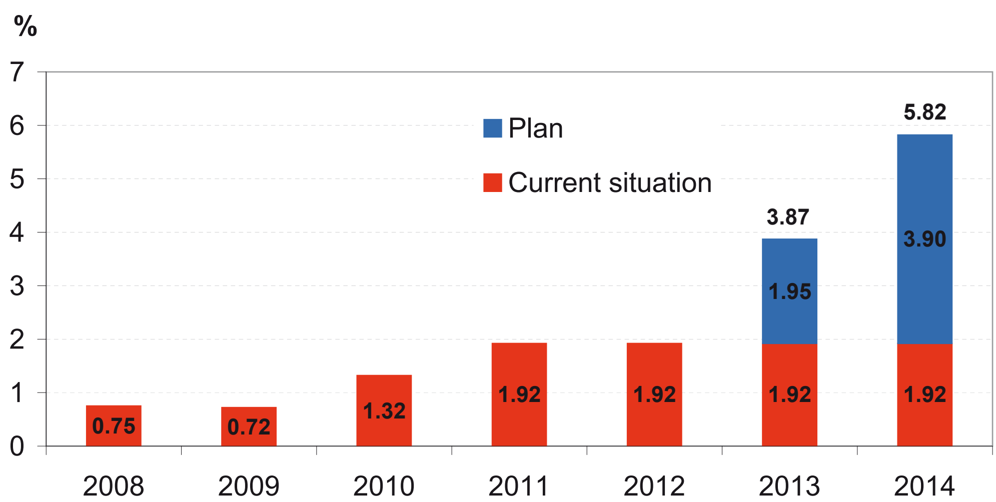



**Figure 3.** Increase of the share of biofuel in heat sources (%).

spraying water in the flue gas flow it is possible to recover a considerable portion of the heat of the flue gas produced in the process of combustion of the biofuel. The installation of the flue gas condenser will result in the increase of the efficiency of use of the biofuel by 15% (**Figure 4**), as the temperature of emitted flue gases is decreased.

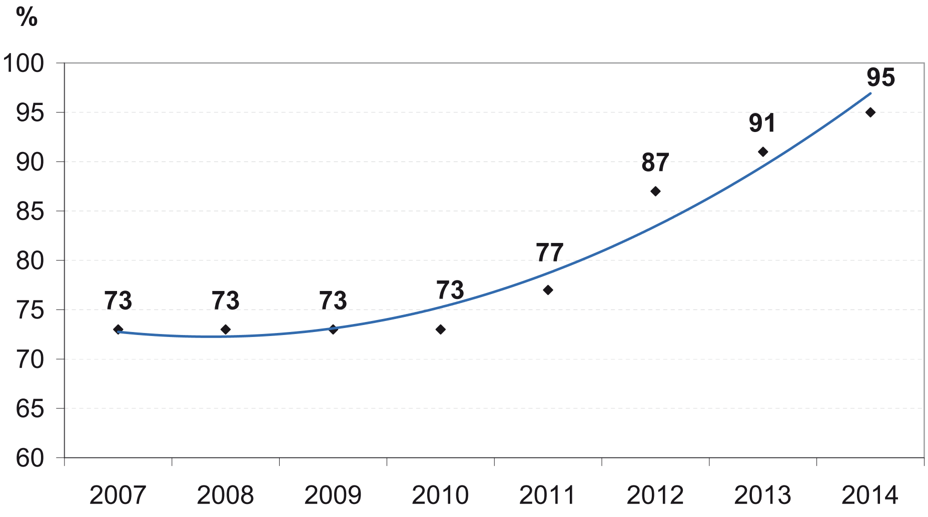



**Figure 4.** The dynamics of the improvement of the average efficiency of use of biofuel.

Reviewing further possibilities of the use of wood chips we have studied the implementation of the gasification of wood chips in heat production and power generation. Taking into account that low-capacity units are used now in practice we are planning to consider the possibilities of installation this type of equipment in the small scale heat sources where the winter loads range from 16 to 17 MW and in summer the load decreases to 2 MW. Considering the high capital investment in the wood chips gasification equipment it should be operated for the maximum number of hours during year. If the process of gasification of wood chips is compared to the classic process of incineration of wood chips the gasification process is characterised by a better proportion in producing heat and electricity. Taking into account that electricity is a much more profitable product that can be sold on the market, the technology with the maximum electricity generation during a year is more profitable. It is planned to install the wood chips gasification unit with the heat capacity of 1.9 $MW_{th}$ and electrical capacity of 1.0 $MW_{el.}$

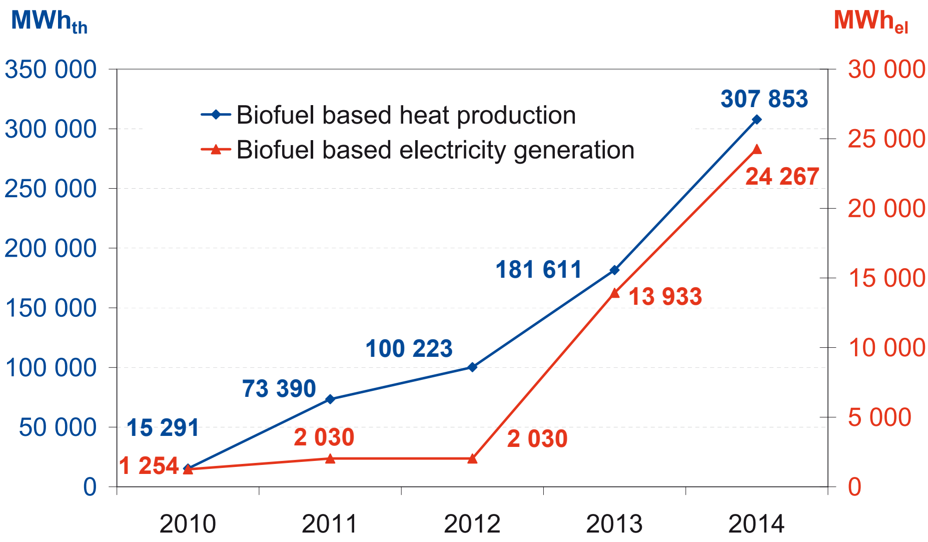



**Figure 5.** Biofuel based heat production and electricity generation.

## Generation of electricity at biofuel fired heat sources

In order to improve the efficiency of a heat source, to provide auxiliary power supply and to sell the surplus electricity, which would contribute to the improvement of the overall efficiency of the district heating system, in 2004 the modernisation project of the heat plant „Daugavgrīva" was implemented with the installation of the steam turbine with the electrical capacity of 0.5 $MW_{el.}$ and construction of the heat storage tank with the volume of 100 m³. In 2007 the capacity of the turbine was increased up to 0.6 $MW_{el.}$ Due to the implementation of the modernisation project at the heat plant „Ziepniekkalns" – construction of the biofuel fired cogeneration unit with the electrical capacity of 4 MW, the electricity generation based on biofuel will increase more than 19 times in 2014 compared to 2010 and will amount to 24 thous. MWh per year (see **Figure 5**).

## Conclusions

In the current situation in the fuel market when the prices of fossil fuels increase rapidly the use of biofuel for production of heat and generation of electricity is economically justified. However, I would also like to point out that each situation has to be analysed on case by case basis. The example described by me provides an insight of the use of biofuel in the district heating system. When a new biofuel based technologies with high efficiency parameters are applied for the heat production, these units can be used in the existing and newly constructed production sources.

When biofuel based energy production sources are built or reconstructed, the load of the units has to be carefully assessed. It is because the investments in biofuel based units are much higher than the investments in the units using natural gas. Therefore, in the course of planning it is necessary to ensure that the selected biofuel based units use the heat produced in the process to the maximum extent and are loaded during the whole year.

The district heating system provides a possibility for the efficient use of biofuel in heat sources because the heat sources are linked within a common system. When several sources operate within a joint system it is possible to ensure that the biofuel based units are efficiently loaded. If the biofuel based production sources are utilised efficiently within the district heating system this provides an opportunity to produce heat the costs of which are competitive in the heat market.

## References


[1] Zigurs A., Budjko Z., Cers A. etc. Biomass projects schemes in Latvia // 16th European Biomass Conference & Exhibition, Proceedings of the International Conference held in Valencia, Spain 2-6 June 2008. - Valencia: 16th European Biomass Conference & Exhibition, 2008. - 2443-2447.p.

[2] Zigurs A., Budjko Z., Cers A. etc. Cost effective biomass conversion for energy in Latvia // 16th European Biomass Conference & Exhibition, Proceedings of the International Conference held in Valencia, Spain 2-6 June 2008. - Valencia: 16th European Biomass Conference & Exhibition, 2008. - 1478-1482.p.

[3] Zigurs A., Cers A., Jirgens M. etc. Financing schemes for biomass in Latvia // World Sustainable Energy Days 2008. - Wels: World Sustainable Energy Days, 2008. - 1-9.p.

The full length version of this article is availbale at the journal website http://www.rehva.eu/en/rehva-european-hvac-journal

# Energy saving potential by retrofitting residential buildings in Europe

***Cristina Becchio***
TEBE Research Group, Department of Energy, Politecnico di Torino, Italy
cristina.becchio@polito.it

***Stefano P. Corgnati***
TEBE Research Group, Department of Energy, Politecnico di Torino, Italy

***Ilaria Ballarini***
TEBE Research Group, Department of Energy, Politecnico di Torino, Italy

***Vincenzo Corrado***
TEBE Research Group, Department of Energy, Politecnico di Torino, Italy

**The national *building typologies* can be used as data sources for forecasting and evaluating the energy saving potential and the carbon dioxide emission reductions for each European country. Thereby the main objective of the IEE TABULA project has been to create a harmonized structure of the European building typologies and to identify representative building types. Two levels of building retrofit have been considered: a *standard refurbishment*, applying measures which are commonly used in the country; an *advanced refurbishment*, applying measures which reflect the best available technologies. The evaluation of each reference building type has been performed in each country by using the national EPBD asset rating method and by showing the energy performance before and after the refurbishment. Statistical information of construction methods and of heating systems has made possible the use of the reference building types as models for the assessment of the energy performance of the whole national building stock.**

The present paper reports the first outcomes of the application of the above described methodology to the national residential building stocks of four countries representative of the North, Middle, South and East European Countries. It summarizes the results presented in the TABULA report "*Application of Building Typologies for Modelling the Energy Balance of the Residential Building Stock*".

## Introduction

Building typologies developed during the TABULA project can be exploited as a basis for analysing the national housing sector. Specifically, as shown in **Figure 1**, starting from global statistics at national and regional level and from the corresponding available residential building samples divided in classes, some reference building types have been selected in order to obtain a relevant characterization of the analyzed buildings. They have been chosen as representative of a large portion of the national residential building stock. Different modelling approaches were chosen by the partners depending on the available statistical data. Some defined a set of synthetic buildings reflecting building stock averages; others applied a set of generic example buildings from the national TABULA typologies.

For each reference building type two refurbishment measures have been considered: a *standard refurbishment* through the application of measures commonly applied within the country; an *advanced refurbishment* through the introduction of measures that reflect the use of the best available technologies. Finally additional information about the number and the frequency of each specific building type has made possible the application of statistical models in order to estimate the overall energy performance, energy saving potentialities, carbon dioxide emissions reductions of the building stock at national/regional level.

This paper shows the first outcomes of the application of the above described Energy Balance Method at the national residential building stock of four countries:

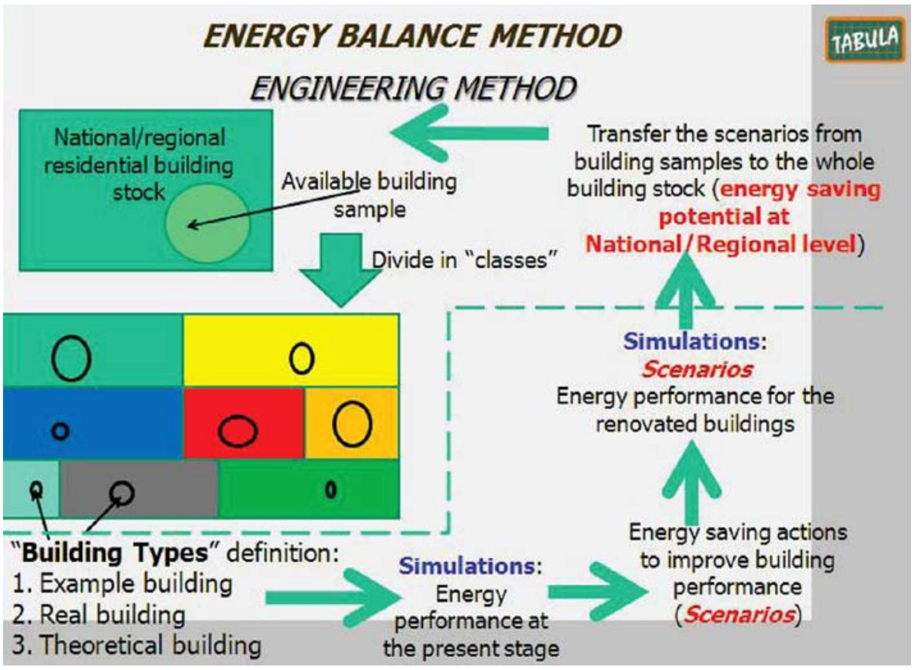



**Figure 1.** Procedure for Energy Balance Method used in the TABULA project to predict the potential impact of energy efficiency measures on national housing sector.

- Denmark, as a representative of the North European countries;
- Germany, as a representative of the Middle European countries;
- Italy, as a representative of the South European countries;
- Czech Republic, as a representative of the East European countries.

The data presented in this paper have been extrapolated from the TABULA report "Application of Building Typologies for Modelling the Energy Balance of the Residential Building Stock" and from the "National Scientific Report" on the TABULA project of the four analysed countries.

## Denmark

The energy balance of the Danish residential buildings was calculated using synthetical average buildings. These were split within nine different construction periods and three building types (single family houses SFH, terraced houses TH, block of flats AB).

In order to estimate energy saving potentials the national Energy Balance method was used.

Refurbishment measures were applied only to the envelope and consisted in two different levels of thermal insulation: details about retrofit actions are reported on the full length version of this paper on the web site. Consequently, the energy saving potential was calculated only in term of net energy demand for heating and DHW. The results of the analysis are presented in term of energy saving and $CO_2$ emission reduction in **Table 1**.

## Germany

The analysis of the German building stock was conducted on a set of six synthetical average buildings. Two building size classes (single family houses with one or two dwellings and multifamily houses with three or more dwellings) and three construction periods according to different levels of energy saving national regulations were considered (see full length version of this paper on the web site).

The energy balance model was developed on basis of the available statistical input data. The energy demand for space heating of the considered six building types was calculated according to a seasonal energy balance approach. In this way an estimation of energy saving potentials in the German building stock for heating and hot water supply was carried out. Details about retrofit actions are reported on the full length version of this paper on the web site.

Energy saving potential obtained by retrofitting the German residential building stock is reported in **Table 2**.

**Table 1.** Annual energy saving potential (in terms of net energy demand for space heating and DHW) and $CO_2$ emissions reductions by standard and advanced refurbishment of Danish residential building stock.

| Reference building type | Original State | | Standard Refurbishment | | | Advanced Refurbishment | | |
|---|---|---|---|---|---|---|---|---|
| | $Q_{H,W,p}$ | $t_{CO2}$ | $\Delta Q_{H,W,p}$ | Δ% savings | $\Delta t_{CO2}$ | $\Delta Q_{H,W,p}$ | Δ% savings | $\Delta t_{CO2}$ |
| | [$10^3$GWh] | [$10^6$t] | [$10^3$GWh] | [-] | [$10^6$t] | [$10^3$GWh] | [-] | [$10^6$t] |
| SFH and TH | 31.5 | --- | 14.6 | -46% | --- | 15.6 | -50% | --- |
| AB | 12.1 | --- | 5.3 | -44% | --- | 5.9 | -49% | --- |
| | 43.6 | --- | 19.9 | -46% | 3.1 | 21.5 | -49% | 3.4 |

**Table 2.** Annual energy saving potential (in terms of primary energy for space heating and DHW) and $CO_2$ emissions reductions by standard and advanced refurbishment of German residential building stock.

| Original State | | Standard Refurbishment | | | Advanced Refurbishment | | |
|---|---|---|---|---|---|---|---|
| $Q_{H,W,p}$ | $t_{CO2}$ | $\Delta Q_{H,W,p}$ | Δ% savings | $\Delta t_{CO2}$ | $\Delta Q_{H,W,p}$ | Δ% savings | $\Delta t_{CO2}$ |
| [$10^3$GWh] | [$10^6$t] | [$10^3$GWh] | [-] | [$10^6$t] | [$10^3$GWh] | [-] | [$10^6$t] |
| 661 | 136 | 304 | -46% | 63 | 512 | -77% | 100 |

**Table 3.** Annual energy saving potentialities (in terms of primary energy for space heating and DHW) and $CO_2$ emissions reductions by standard and advanced refurbishment for Italian residential building stock.

| Reference building type | Original State | | Standard Refurbishment | | | Advanced Refurbishment | | |
|---|---|---|---|---|---|---|---|---|
| | $Q_{H,W,p}$ | $t_{CO2}$ | $\Delta Q_{H,W,p}$ | Δ% savings | $\Delta t_{CO2}$ | $\Delta Q_{H,W,p}$ | Δ% savings | $\Delta t_{CO2}$ |
| | [$10^3$GWh] | [$10^6$t] | [$10^3$GWh] | [-] | [$10^6$t] | [$10^3$GWh] | [-] | [$10^6$t] |
| SFH (until 1900) | 50.6 | 10.3 | 38.8 | -77% | 7.9 | 42.8 | -85% | 8.7 |
| SFH (1921-1945) | 22.1 | 4.5 | 17.8 | -81% | 3.6 | 19.4 | -88% | 3.9 |
| MFH (1946-1960) | 127.2 | 25.8 | 98.2 | -77% | 19.9 | 105.5 | -83% | 21.4 |
| AB (1961-1975) | 419.5 | 85.2 | 301.2 | -72% | 61.2 | 349.9 | -83% | 71 |
| AB (1976-1990) | 364.3 | 74 | 204.4 | -56% | 41.5 | 255.4 | -70% | 51.9 |
| AB (1991-2005) | 76.6 | 15.6 | 32 | -42% | 6.5 | 42.3 | -65% | 8.6 |
| | 1060.5 | 215.3 | 692.5 | -65% | 140.6 | 815.4 | -77% | 165.5 |

**Table 4.** Annual energy saving potentialities (in terms of primary energy for space heating and DHW) and $CO_2$ emissions reductions by standard and advanced refurbishment for Czech Republic residential building stock.

| Reference building type | Original State | | Refurbishment | | |
|---|---|---|---|---|---|
| | $Q_{H,W,p}$ | $t_{CO2}$ | $\Delta Q_{H,W,p}$ | Δ% savings | $\Delta t_{CO2}$ |
| | [$10^3$GWh] | [$10^6$t] | [$10^3$GWh] | [-] | [$10^6$t] |
| SFH (until 1979) | 11.9 | 5.5 | 7.7 | -65% | 3.6 |
| SFH (1980-2001) | 12.7 | 5.9 | 4.8 | -38% | 2.2 |
| SFH (2002-2010) | 5.5 | 2.6 | 1.1 | -20% | 0.5 |
| APT (until 1979) | 6.1 | 2.9 | 3.2 | -52% | 1.5 |
| APT (1980-2001) | 15.2 | 6.5 | 5.3 | -35% | 2.3 |
| APT (2002-2010) | 5.4 | 2.6 | 1 | -19% | 0.5 |
| | 56.8 | 26 | 23.1 | -41% | 10.6 |

## Italy

In Italy, six reference building types were created to represent the housing stock for the purpose of Energy Balance analysis (single family house SFH, multi-family house MFH, apartment block AB; see full length version of this paper on the web site).

These reference buildings were chosen according to statistical analysis: they are representative of a suitable significant portion of the entire national building stock considering both the construction age and the building size (i.e. number of apartments, floor area) and they belong to the "Middle Climatic Zone" (from 2100 to 3000 heating degree days), which is the most representative of the Italian climate (about 4250 municipalities on a total number of 8100).

The official national calculation method (Technical Specification UNI/TS 11300 - National Annex to CEN Standards) for energy certificates was applied for the evaluation of the energy demand of the selected reference buildings and to assess the energy saving potential due to energy retrofit actions according to two different scenarios (standard and advanced refurbishment). Details about retrofit actions are reported on the full length version of this paper on the web site.

Energy saving potentialities obtained applying the mentioned retrofit measures at the Italian residential building stock are reported in **Table 3**.

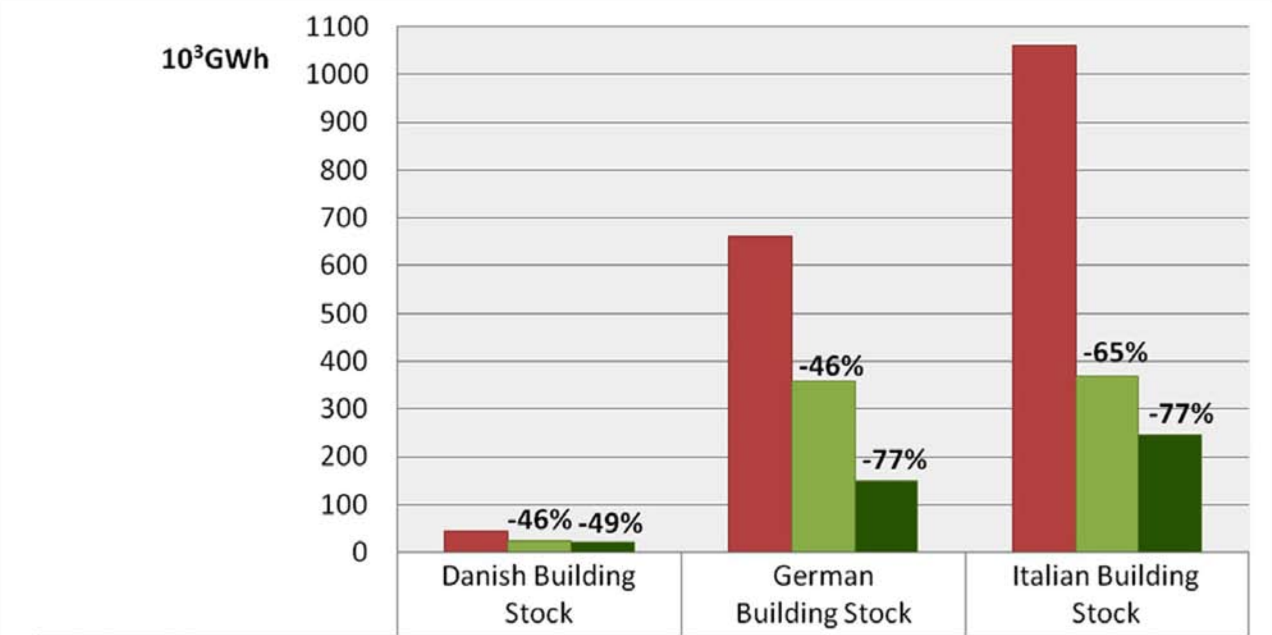
## Czech Republic

Six reference building types were created to represent the Czech Republic housing stock for the purpose of Energy Balance analysis. This set of buildings was categorized by size (single family house SFH, multi-family house and apartment block APT) and age (see full length version of this paper on the web site).

The buildings are theoretical buildings based on the analysis of available statistical data and on the knowledge of historical standard requirements for the U-values of the building envelope and the usual efficiency of the heating and DHW systems.

The energy balance model was created on basis of the statistical data. The delivered energy and the energy demand for space heating of the considered six groups of buildings was calculated using national calculation method.

In this case the refurbishment measures were fixed on the basis of recent studies. Details about retrofit actions are reported on the full length version of this paper on the web site. The results of the analyses are shown in **Table 4**.




| | Danish Building Stock | German Building Stock | Italian Building Stock |
|---|---|---|---|
| Original State | 43.6 | 661 | 1060.5 |
| Standard Refurbishment | 23.7 | 357 | 368 |
| Advanced Refurbishment | 22.1 | 149 | 245.1 |

**Figure 2.** Comparison between annual energy saving potential by applying a standard refurbishment and an advanced one to the Danish, German and Italian building stock.

## Conclusion

The analysis shows that building typologies can be a helpful tool for modelling the energy consumption of national building stocks and for carrying out scenario analyses beyond the TABULA project. The consideration of a set of representative buildings, which reflect the current state of the building national stock, makes it possible to have a detailed view on various packages of refurbishment measures for the complete buildings stock or for its sub-categories. The effects of different insulation measures at the respective construction elements as well as different system supply measures including renewable energies can be considered in detail with fast analysis.

As general rule, when two different level of retrofit were considered it is noted that the standard refurbishment is associated with high relative percentage of energy saving (**Figure 2**): the energy saving due to a standard refurbishment is bigger than the saving variation between a standard refurbishment and an advanced refurbishment. In fact, national building stock is often characterized by low energy performance and even the application of basic energy renovations may provide significant increases in energy performance and consequent reduction of $CO_2$ emission (the case of Italy is exemplificative of this trend). Thereby from an economic point of view it is more convenient to apply standard refurbishment measures at the national building stock than advanced ones that are the most expensive.

It was highlighted that, even with standard refurbishments, energy saving over 45% can be achieved. As a consequence of this big saving potential, suitable policies to address energy retrofit actions of existing buildings are crucial.

Finally, the quality of future model calculations will depend very much on the availability of statistical data. For reliable scenario analyses, information about the current state of the building stock and about the current trends is needed. The availability and regular update of the relevant statistical data will be an important basis for the development of energy strategies in the building sector. 3E

The full length version of this article is availbale at the journal website http://www.rehva.eu/en/rehva-european-hvac-journal

# Energy-efficient refurbishment of public buildings in Serbia

**In order to contribute to global initiatives for reducing energy consumption through energy efficiency increase, Serbia has adopted a set of related national regulations and invested in several large energy-efficient projects targeting the sector of public buildings. Since inefficient or inappropriate energy use in public buildings was often found to be coupled with compromised indoor comfort conditions, national energy efficiency projects have been particularly designed to target facilities providing services to the most vulnerable population, such as schools, health care and social care institutions. Implementation of high technical norms related to building elements and equipment to be installed when conducting energy efficient refurbishments has proven to be highly beneficial with respect to both energy savings and improved comfort conditions. Reduced emissions and use of renewable energy sources were found to be of high importance as well.**

***Sanja Petrović Bećirović***
Energy Efficiency and Environmental Specialist, Energoprojekt ENTEL, Belgrade, Serbia, spetrovic@ep-entel.com

***Mileva Vasić***
Energy Generation and Energy Efficiency Specialist, Energoprojekt ENTEL, Belgrade, Serbia, mvasic@ep-entel.com

## Inefficiency in the use of energy

Energy shortage, energy conservation, energy efficiency – the terms we hear more and more often when discussing somewhat grim predictions about the future of global energy supply, energy security and environmental problems associated with energy generation. Together with increased reliance on renewable energy sources, energy efficiency increase was recognized as one of the measures that can lead to somewhat better energy future if implemented systematically and methodically.

Inefficient use of energy represents a major concern in Serbia. Consumption of primary energy per every unit of GDP is significantly higher than in the EU (13 times higher than in Germany, 10 times higher than in France) [1]. Many studies have pointed out that Serbia has a large energy efficiency improvement potential in the building sector, primarily resulting from the fact that largest portion of Serbian building stock are buildings built during the '70s and the '80s, with brick walls and no thermal insulation, deteriorated wood/metal fenestration and worn-out metalwork. In case of individual boilers (usually burning coal or fuel oil), heating installations are often in very poor condition, without properly insulated distribution lines, non-operating control equipment and out of order radiator valves. As a result, efficiency of the systems is low, which coupled with poor building envelope features causes valuable energy to be wasted. Having in mind financial hardships Serbia is facing today, any effort to reduce excessive energy consumption is considered largely beneficial.

In line with global attempts, Serbia has adopted a series of regulations that are intended to contribute to national energy efficiency increase, including National Energy Efficiency Action Plan adopted in 2010, as well as Decree on Energy Efficiency in Buildings and Decree on Modalities of Issuing and Content of Building Energy Performance Certificates, that came in force in late 2012. In addition, the new Law on Rational Energy Use is expected to be adopted in early 2013. As specified in the National Energy Efficiency Action Plan, building sector is expected to contribute largely to national energy efficiency increase, with 9% reduction in the final energy consumption planned to be achieved until 2018 [2].

## Serbia Energy Efficiency Project (SEEP)

Public sector has been identified as a sector that needs to set an exemplary role in the implementation of energy efficiency measures [3], [4]. In line with such intention, Serbia has implemented several projects aimed at energy-efficient refurbishment of public buildings, particularly schools, health care and social care institutions. The largest energy efficiency project is *Serbia Energy Efficiency Project (SEEP)*, funded through IDA credit and IBRD loan and with foreseen total investment value of 49 million USD [1]. The project was planned to be implemented in phases, carried out from 2004 through 2013. The project objective is to improve energy efficiency in public buildings in Serbia and to provide more affordable space heating services, as well as more functional and healthy environment for the end-users. **Table 1** summarizes the number of public facilities included in the first and the second project phase, while **Figure 1** illustrates location-wise distribution of associated buildings [5].

## Energy Saving Opportunities Identified

Measures implemented in public buildings included in the scope of SEEP project have been selected so as to provide the best cost-effective building refurbishment i.e. to result in the largest energy savings in the shortest span of time. Individual measures included intervention on building envelope, boiler room modernization, fuel switch (natural gas as an alternative to coal or fuel oil), installation of thermostatic radiator and balancing valves, installation of variable flow pumps and automatic control systems. Although energy audit of each build-

**Table 1.** The scope of **S**erbia **E**nergy **E**fficiency **P**roject.

| Facility type | Project Phase | |
|---|---|---|
| | Phase 1 (SEEP1) 2004-2008 | Phase 2 (SEEP2) 2009-2012 |
| Schools (elementary and secondary education level) | 16 | 28 |
| Health care institutions | 12 | 29 |
| Social care institutions | – | 5 |
| **TOTAL** | **28** | **62** |

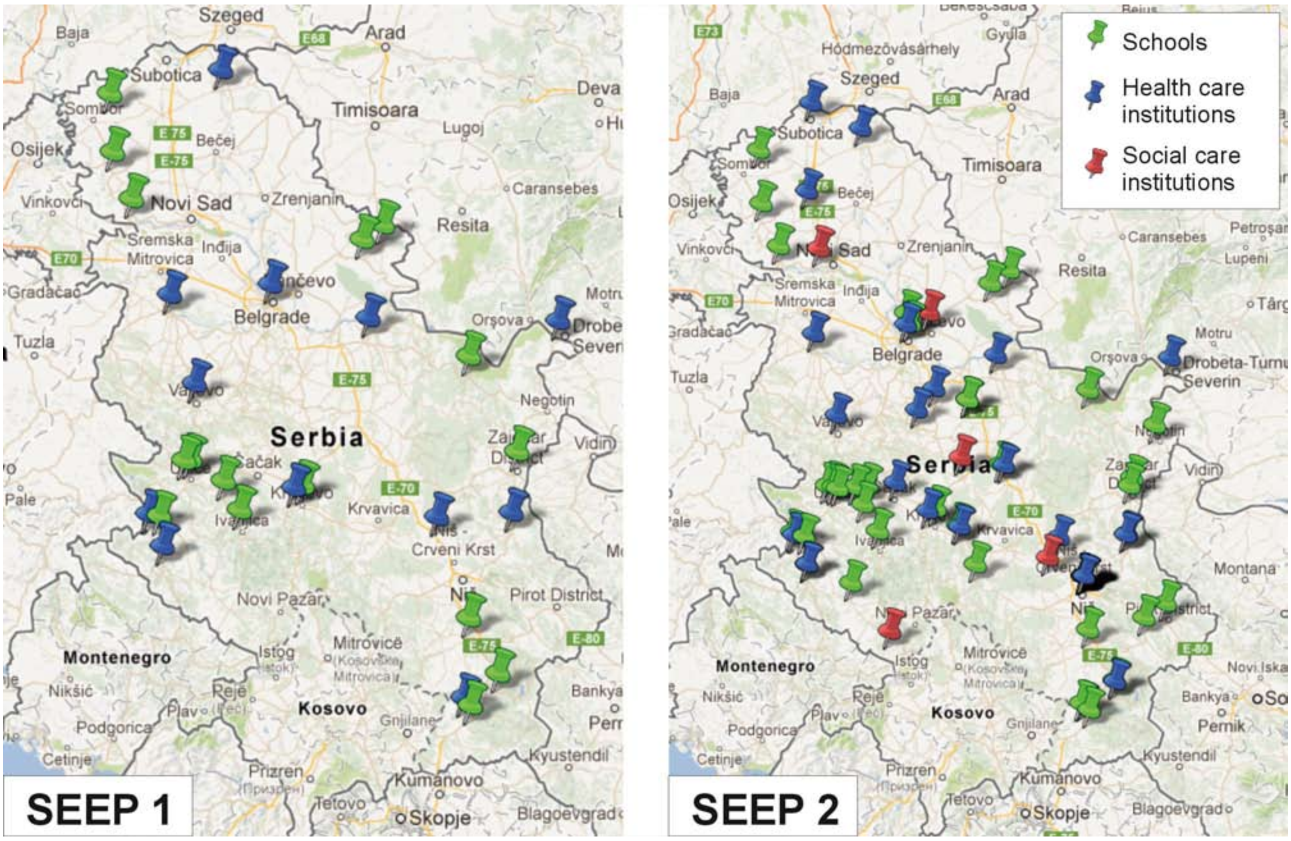



**Figure 1.** Locations of public buildings included in the scope of SEEP project.

ing enabled identification of all feasible refurbishment measures, only the cost-optimal combination of energy efficient improvements was implemented.

**Table 2.** Individual measures applied in the buildings included in the scope of SEEP2 project.

| Type of measure | Share of buildings where measure was applied |
|---|---|
| Façade joinery replacement | 79% |
| Façade insulation | 37% |
| Attic/sloped roof/flat roof insulation | 69% |
| Installation of thermostatic radiator valves | 69% |
| Installation of balancing valves | 21% |
| Installation of variable flow pumps | 6% |
| Modernization of boiler room | 24% |
| Fuel switch | 2% |
| Lighting system upgrade | 13% |

It should be mentioned that replacement of worn out façade joinery and installation of thermostatic valves have found their way into the most of implemented energy efficiency packages, as seen in **Table 2**. This demonstrates particularly poor condition of fenestration systems prior to refurbishments, whose replacement, apart from resulting in significant energy savings, considerably improved end-user comfort by reducing infiltration. Installation of thermostatic radiator valves enabled heating regulation and prevented potential overheating in buildings whose heat loses were considerably reduced. On the other hand, fuel switch, as financially, administratively and technically more complex and demanding, was implemented only in one social care institution in the town of Pančevo, located near the capital city of Belgrade, where new gas-fired boiler was installed to replace light fuel oil fired boiler utilized previously. This was deemed largely beneficial for local population, having in mind that Pančevo inhabitants frequently struggle with elevated pollution levels due to large industrial complexes, including oil refinery, petrochemical plant and fertilizer factory, located and operating in the very town of Pančevo.

Energy savings achieved in each group of buildings are depicted in **Figure 2**. Clinical Centre of the City of Niš is presented as an individual building group since it represents a 19-building complex. As seen in **Figure 2**,

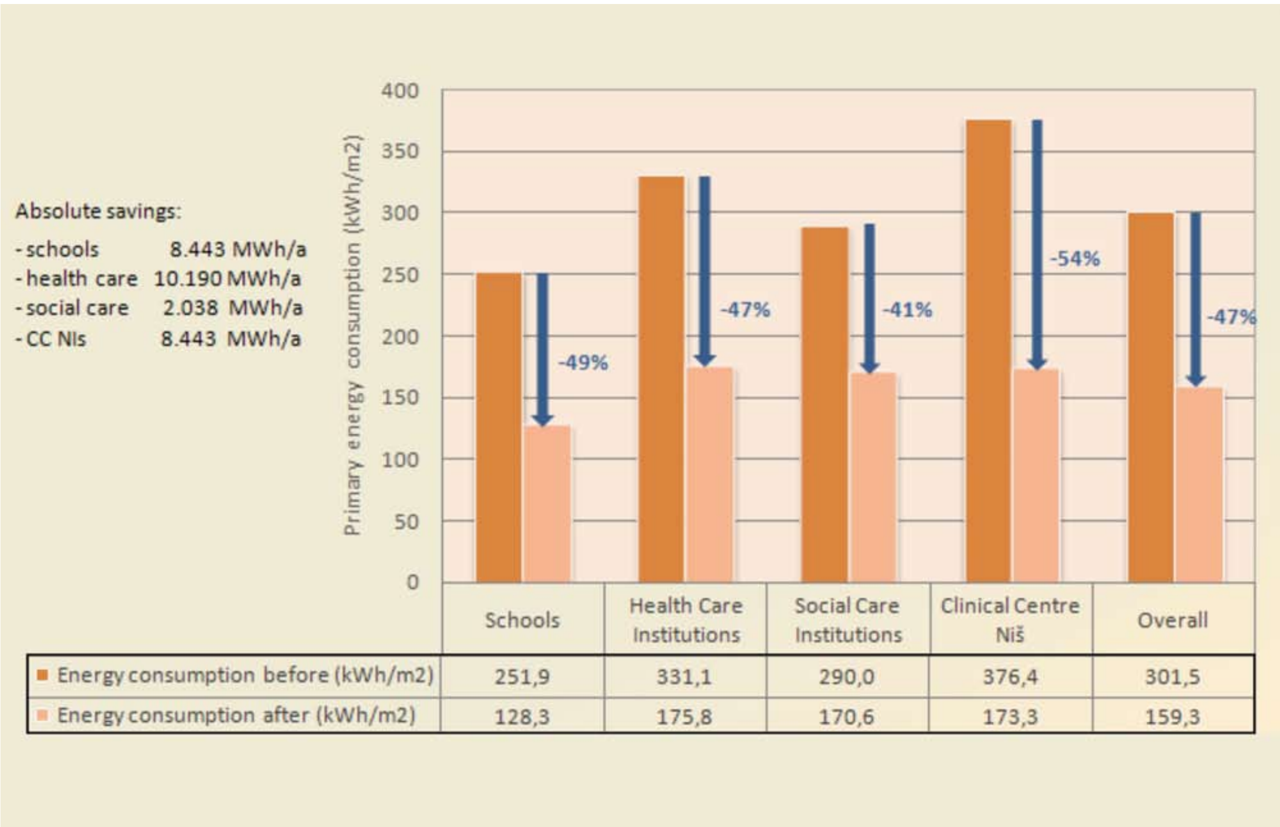



**Figure 2.** Annual energy savings achieved in public buildings included in the scope of SEEP2 project.

in average, 47% energy consumption reduction has been achieved in 62 refurbished public buildings. Although the consumption values presented surely leave room for additional improvements, it is important to mention that only a small handful of buildings have been fitted with full set of energy efficiency measures, while majority were only fitted with a couple of improvements selected as the cost-effective refurbishment solution. This was mainly due to budgetary constraints as well as situations when end-users failed to conduct prerequisite repair works that were deemed necessary in order to implement certain energy efficiency improvement. In addition, facilities were required to remain fully operational during the entire work execution, which significantly slowed down the works and was particularly challenging in case of health care and social care institutions.

It is also worth mentioning that measurements conducted in some of the refurbished schools prior to improvements have indicated that indoor temperatures in the classrooms were only 15…16°C. The fact that proper indoor temperatures were measured following the refurbishments points out to the conclusion that energy savings achieved have been reduced by the fact that portion of potentially "saved" energy needed to be used to provide required indoor conditions and necessary end-user comfort.

Savings achieved in health care facilities are particularly important when considering the overall annual energy consumption, since hospital heating systems are designed to operate continuously i.e. 24/7 and achieve higher indoor temperatures when compared to social care institutions and particularly when compared to schools whose heating systems are usually completely shut-down (or operate at reduced capacity) during overnight/ weekend and holiday periods. This is more evident when specifying that absolute annual energy consumption of 62 considered buildings have been reduced by 29.114 MWh in total, where 64% of this annual value is attributed to savings achieved in 29 health care institutions, while 29% comes from the savings achieved in 28 schools. The remaining 7% results from refurbishments carried out in 5 social care institutions.

## Economics of energy savings

Investment costs associated with execution of energy efficiency improvements amounted to 11.6 million EUR, where 47% of the funds was used to increase energy efficiency in schools, while 6% to improve situation in social care institutions, as seen in **Figure 3**. Interestingly enough, the identical 47% of the funds enabled improvements of health care institutions (individual hospitals and the complex of Clinical Centre of Niš) although significantly larger area was services (total

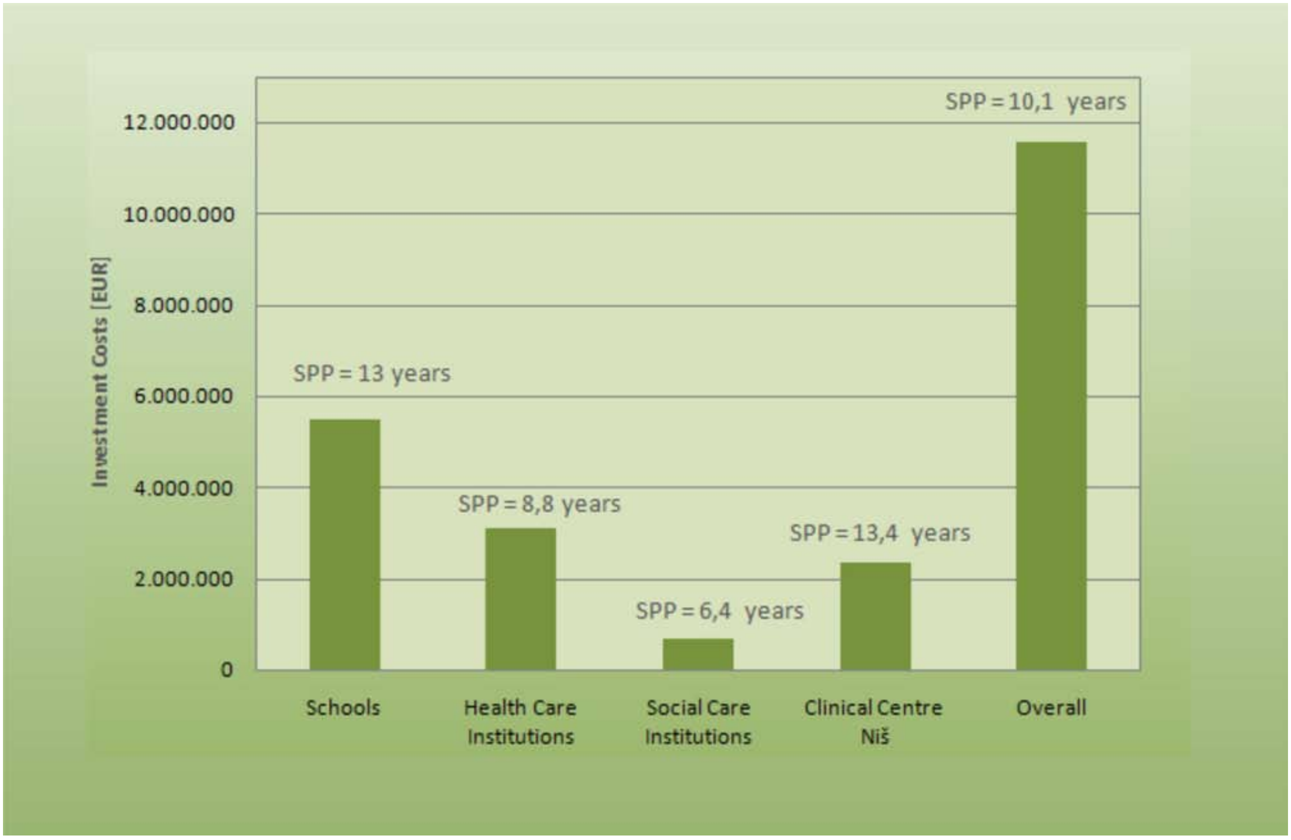



**Figure 3.** Investment costs and simple payback period associated with SEEP2 refurbishments.

heated area of the health care institutions amounted to about 124 000 m² in contrast to total heated area of the schools that reached approximately 70 800 m²).

Analysis of financial data points out to the conclusion that such situation was attributed to much complex layout of the schools considered, with many of them requiring additional repair or fine works in order to enable proper implementation of intended energy saving measures. With respect to simple pay back period (SPBP) of the investment made, **Figure 3** above illustrates that predominant use of low-price domestic coal, as in the Clinical Centre of Niš, resulted in SPBP of over 13 years. On the other hand, reduced consumption of expensive fuel, such as fuel oil, enables faster return on investment, evident in case of social care institutions. Higher SPBP associated with energy efficient refurbishment of educational institutions results from higher investment costs associated with reasons mentioned earlier.

Apart from energy savings and financial benefits achieved, environmental effects, reflected through reduced $CO_2$ emissions, and social benefits, manifested through increased public awareness about the energy efficient refurbishments, were deemed to be equally important.

## Use of renewable energy sources

Besides SEEP project, Serbian public authorities have invested or have planned to invest in a number of similar refurbishment projects, with many of them aimed towards replacing traditionally used fossil fuels with renewable energy sources. For example, in 2008, a 14 kW heat pump based heating system, with energy extracted from the nearby well, was installed to heat elementary school in a village near the town of Varvarin in Central-Eastern Serbia. In addition, 35 kW solar collectors have been installed on the roof of Railway Student Housing building in Belgrade, generating energy sufficient to meet 63% of total heat demand of the facility mentioned. Installation of 28 kW solar collector system on the roof of an elementary school in Belgrade has again proven to be largely beneficial in terms that 72% of total energy demand of the school is now met by solar system installed.

A recent study, conducted with a goal to promote the use of geothermal energy in balneology, has shown that refurbishment of building envelope of Rehabilitation Centre in Mataruška Spa in Central Serbia would enable heat demand of the Centre to be reduced by 57%, thereby enabling a 96 kW heat pump utilizing locally available geothermal water to replace the existing 740 kW liquid fuel fired boiler [7]. Even if financial constraints manage to prevent the planned building refurbishment to be carried out, a 220 kW heat pump is deemed to be sufficient to meet the current energy demand of the facility considered.

## Combined heat and power generation

As part of the Serbian national energy efficiency initiative, a 6.5 million EUR worth project was carried out in the Clinical Centre of Serbia, the top medical care, research and educational institution in the country. The Centre comprises 23 specialist clinics and 9 emergency and other centres housed in 76 buildings located in the very centre of the capital city of Belgrade. In order to replace formerly utilized 19 coal and oil fired boilers distributed throughout the heavily polluted Clinical Centre's area, a new, dedicated, gas-fired, combined heat and power (CHP) generation unit, as well as three hot water boilers, generating 40 $MW_{th}$ in total, was constructed and commissioned in 2009. The CHP plant was designed to be of sufficient capacity to provide all the heat, auxiliary steam and power needed for uninterrupted operation of the Clinical Centre. The fuel switch was deemed particularly important having in mind sensitive population that uses services of the Centre, coupled with the fact that the Centre is located in the central, traffic intense area of the capital. Financial aspects of plant operation were made favourable by properly selected capacity of the CHP unit (1.8 $MW_{th}$ and 1.8 $MW_e$) which was designed so as to be sufficient for all year round operation, while also providing necessary amount of sanitary hot water.

## Conclusion

Based on the result achieved in the projects specified, it is concluded that implementation of energy efficiency improvements in public buildings in Serbia, as well as implementation of energy efficient technologies and use of renewable energy sources, has proven to be highly beneficial, both with respect to reduced energy consumption and carbon footprint, as well as associated financial and social benefits. In fact, following well documented success of energy efficiency projects conducted up to date, Serbia is now in the process of selecting another 56 public building that will be refurbished in energy efficient manner. Taken together, it may be concluded that energy efficiency projects carried out in Serbia demonstrate benefits of national energy-related policies and measures promoted through national legislation and carefully selected financial incentives.

## References

See the complete list of references of the article in the html-version at www.rehva.eu -> REHVA European HVAC Journal

The full length version of this article is availbale at the journal website http://www.rehva.eu/en/rehva-european-hvac-journal

# Heat pumps in refurbishment of existing buildings

**This article analyses the opportunities of heat pump applications in the refurbishment of existing buildings. The first issue is the temperatures in the heating system. The high original design temperature for the radiator system, mostly incompatible with the heat pump operations, is mainly due to poorly insulated buildings. The improvement of the building envelope insulation during the refurbishment makes it possible to reduce the radiators supply water temperature and improve the COP of heat pump.**

**The second problem is the production of domestic hot water (DHW). While the boiler selection can be driven by the instantaneous need of domestic hot water, thus to higher heating capacity than that required for space heating, the heat pump selection – given the higher capacity cost, since the higher technology level of the product – should be conducted more carefully. First of all the heat pump requires a hot water storage with an adequate sizing of the heat exchanger and of the DHW set point. The risk is that the heat pump cannot supply its heating capacity to the storage, particularly when in summer its capacity is higher due to the favorable source temperature: the heat pump would then be heavily modulated, requiring a long time to satisfy the DHW demand.**

***Renato Lazzarin***
University of Padova – Department of Management and Engineering
renato@gest.unipd.it

***Filippo Busato***
University of Padova – Department of Management and Engineering

***Marco Noro***
University of Padova – Department of Management and Engineering

## Effect of temperatures on performance

Heat pumps can result in a great advantage even in the refurbishment of buildings, providing that its different behavior from a traditional boiler is carefully considered.

First of all a heat pump requires a heat source: availability and thermal level of the source strongly influence the performance both in capacity and efficiency. Whereas the thermal level of the produced heat little modifies a boiler performance, it changes strongly the heat pump efficiency, and even less, its capacity.

The usual upper thermal limit for a heat pump is around 60°C: this creates problems with the most widespread heat distributing devices in the existing buildings, the radiators, and other questions regarding to the DHW (Domestic Hot Water) production.

The first cost of a heat pump is much more dependent on its capacity than boiler capacity. Thus a higher capacity device has a higher cost; moreover when the heat pump is electrically driven a more expensive power engagement with the utilities is due.

Then the selection of the heat pump capacity is of paramount importance. The capacity is generally lower than the design load. This is particularly true for air source heat pump, as an outdoor air temperature reduction faces a heat pump capacity reduction just when the load is increasing.

If the heat pump capacity is selected after the design load, apart the costs just reminded, the heat pump almost always operates at part load with potential performance reductions.

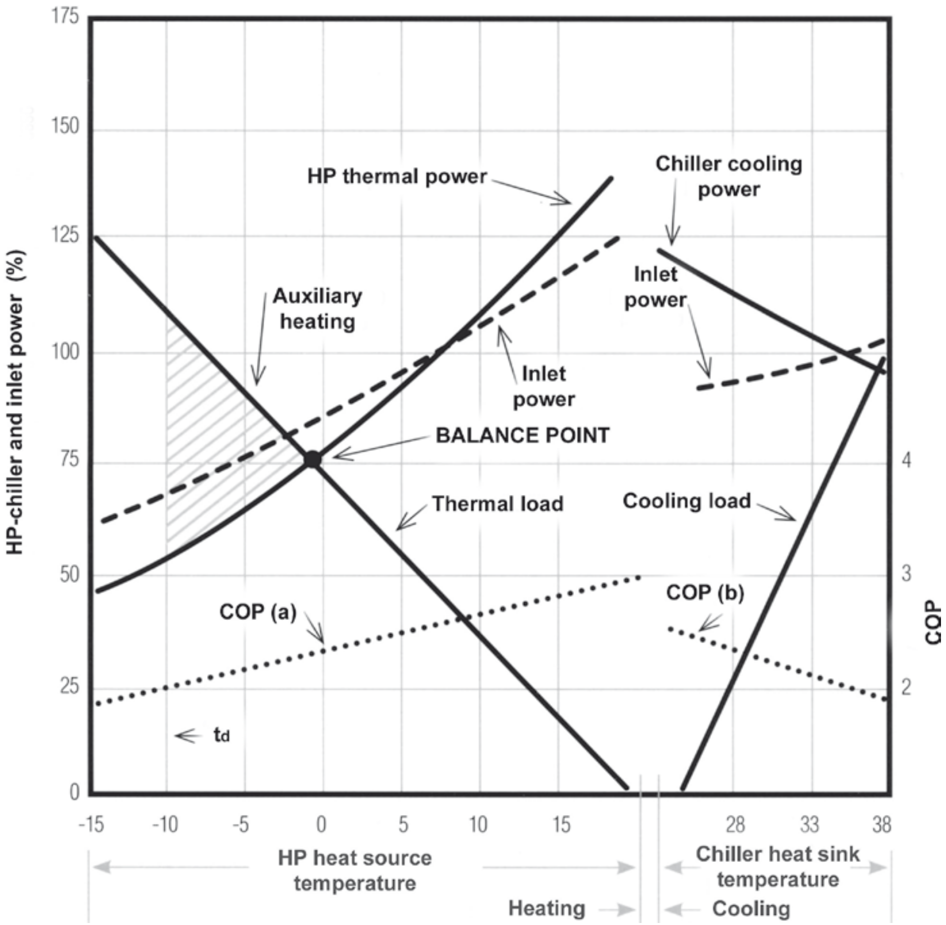



**Figure 1.** Thermal-cooling power produced, electrical power supplied to the heat pumps both in heating and cooling mode, COP and thermal and cooling loads of the building as a function of outdoor air temperature.

**Figure 1** better explains: it represents winter and summer loads of a building, considering that they are essentially dependent on the outdoor air temperature. Loads are given by two straight lines with opposite slope, rising from zero to the left (winter) and to the right (summer). The figure shows the heat pump capacity both in winter and summer, the former increasing and the latter decreasing with the outdoor air temperature. The intersection between the heat pump heating capacity and the load is referred to as the balance point, in the figure just little below 0°C. For higher temperatures the heat pump fully satisfies the loads, whereas at lower temperatures an auxiliary heating is needed such as a small gas boiler or electrical resistance heating. The optimal selection of the balance point is probably one of the most critical elements of the design.

The main data requested for the heat pump application in a refurbishment are:

- Cumulative curve of the heating (and cooling) building demand as a function of the outdoor temperature in a given location;
- Heating distributing devices characteristics;
- Assumed trend and amount of DHW demand;
- Electricity and natural gas tariffs, present and likely future;
- Availability and properties of the heat source for the heat pump.

The most relevant elements in the refurbishment are discussed in the next chapters.

## Heat pump types

A first important classification is between electrical and gas driven heat pumps. The latter can be absorption or motor driven. Another important classification regards the heat pump source, frequently outdoor air for the easy availability, but also surface or well water or the ground. Outdoor air is the most common source in refurbishment as drilling is often prevented by the existing buildings and infrastructure. If a mechanical ventilation system is provided, then a suitable source can be the recover on the exhausted air. The selection of the heat pump type is in some way connected to the possible source. In fact electrical heat pumps are particularly sensitive to the temperature difference between the heat source and the thermal useful effect. A typical example is illustrated in **Figure 2** where for a low source temperature (air at 2°C) COP and PER (Primary Energy Ratio for an electricity conversion factor of 0.45) are evaluated as a function of the hot water temperature. In the interval from 30°C to 60°C COP and PER are almost halved.

Absorption heat pumps are less sensitive and motor driven heat pumps are intermediate. An absorption heat pump PER is represented in the temperature field from 45 to 65°C in **Figure 3**: at lower supply temperature the behavior is a little less favorable, but surely better at higher temperature, particularly starting from 50°C.

The selection of the most suitable heat pump type is fundamental in refurbishment. The most important elements to be considered are:

1) The temperature differences, as already mentioned;
2) The availability (and the relative cost) of electricity and natural gas;
3) The possibility of an eventual easy exhaust of the combustion gases;
4) The availability of a suitable heat source;
5) The ratio between winter and summer loads.

## Heat distribution

In residential buildings the most common heating devices are hot water radiators. Low temperature radiant emitters are recently more widespread than radiant floors or ceilings. A recent study in Germany reports that radiators represent 53% of the heat emitters in existing buildings, while combined systems 20%, and floor heating systems only 2%.

It is really unlikely that even the heat distributing devices are replaced during a refurbishment as it would mean to let out the inhabitants for a period of at least 15 days. Then the radiators are kept usually intervening on the insulation and on the central heating plant. The radiators sizing is usually based on a supply temperature of 80°C and a return at 60°C in design conditions. Thus nominal thermal emission is obtained with a temperature difference of 50°C (difference between the average temperature of the radiator, 70°C, and the room temperature of 20°C).

In spite of its name a radiator exchanges heat mainly by convection (about 70-80%) and the thermal emission can be evaluated as the product of the nominal emission and the ratio of the two temperature differences (the actual and the nominal calculated by EN442 standard) raised to an exponent $n$, usually around 1.3:

$$P_{eff} = P_{EN\,442}\left(\frac{\Delta t_{eff}}{50}\right)^{n}.$$

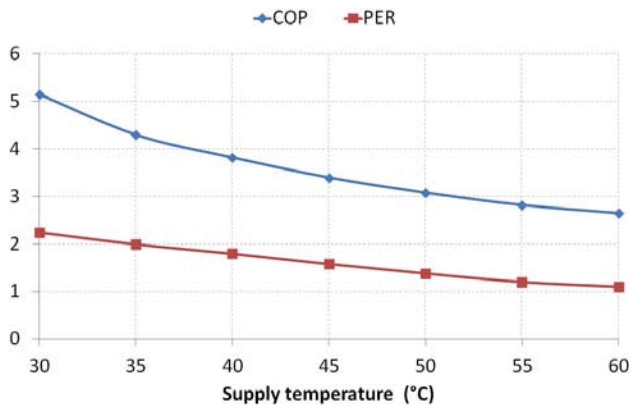



**Figure 2.** Coefficient of Performance (COP) and Primary Energy Ratio (PER) of a typical electric heat pump depending on the supply temperature in a water based heating system (outdoor air temperature 2°C).

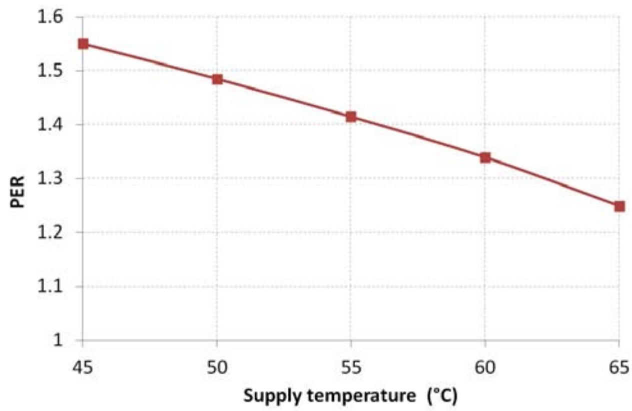



**Figure 3.** Primary Energy Ratio of a typical absorption heat pump as a function of supply temperature.

**Figure 4** illustrates the emission reduction as a function of the inlet temperature (a 5°C lower temperature is considered at the outlet). A supply temperature of 55°C, consistent with the heat pump utilization, gives an emission slightly less than 60% of the nominal value. For a design temperature of –5°C the corresponding load could be for an outdoor condition of 5°C. It could be also the design load for a refurbishment providing good insulation even only on windows.

Besides, as reminded above, the heat pump heating capacity should not be selected according to the design

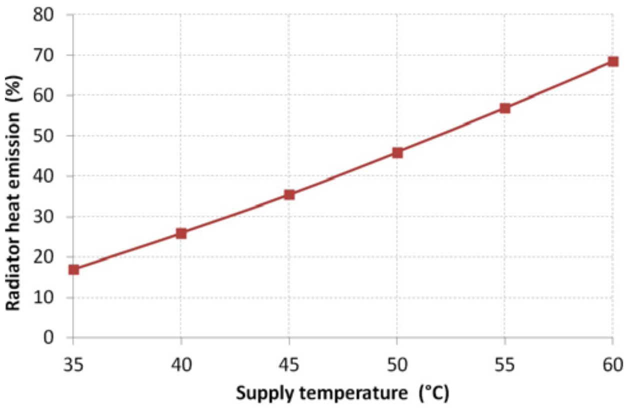



**Figure 4.** Radiator heat emissions as a function of supply water temperature.

conditions as for a boiler: the cost would be high and the heat pump would be almost always operating at part load. Even a heat pump equipped with an inverter for a continuous capacity control would not always be the best solution as the control seldom arrives below 30% of the nominal capacity. Instead, selecting correctly a balance point, the heat pump satisfies completely the load at higher temperatures, whereas at lower temperatures an auxiliary heating is provided, normally a boiler in the refurbishments. A boiler can easily provide the higher temperatures requested by the radiators in case of very cold weather.

## Production of domestic hot water

A building refurbishment usually allows a significant reduction of the loads, but DHW demand remains the same or it is even increasing.

A DHW storage must be provided as the heat pump does not allow the instantaneous production. When storage already exists with built-in heat exchanger, sized for a gas boiler, it must absolutely be replaced with a storage equipped with a much higher capacity heat exchanger.

The DHW set point is to be determined considering the heat pump temperature limits. If the highest temperature supply of the heat pump is of 60°C, setting the storage temperature only some degrees below that value makes the heat pump to operate at part load for hours, as the bottle neck is just the heat exchange that is proportional to the temperature difference. Thus, besides the long time requested to storage charging at low efficiency, the building heating is not assured meanwhile. Provided a minimum value of at least 5°C in the temperature difference, sizing and quality of the heat exchanger is of paramount importance.

The most critical operation for DHW production is not, as one might think, at a low temperature of the heat source, but at higher temperatures when the heat pump capacity increases. Let us consider a heat pump that gives 18 kW for 7°C heat source (outdoor air) reference temperature. When the air temperature is 35°C, this heat pump capacity arrives at 28 kW. A gas boiler sized built-in heat exchanger is able to exchange around 20-30 kW for 80°C inlet temperature and 20°C temperature difference. The heat pump should operate with 5°C temperature difference, that means 4 times lower heat exchange. If the heat pump gives 28 kW, while only 6 kW can be exchanged, the machine operates at part load with frequent ON-OFFs. Even a heat pump equipped with an inverter and variable speed compressor cannot be a solution, because the speed reduction goes seldom below 1/3 of the top speed (typically the inverter frequency field is from 30 to 90 Hz). Moreover, the capacity reduction is not proportional to the compressor speed. In fact when the refrigerant flow is reduced, also pressure drop at inlet/outlet of compressor and friction are lowered. Consequently the refrigerant density is higher, so that a volumetric flow reduction of 50% produces a capacity reduction of about 30%. Such a coupling of heat pump and heat exchanger does not work satisfactory even in winter. In fact for a 15 kW heating capacity, a 6 kW heat exchanging ability obliges the heat pump to produce DHW for 2.5 longer time than it would be necessary. During this period no ambient heating is provided.

The solution is a generously sized built-in or external heat exchanger. A selection of a heat exchanger able to exchange 100 kW for the classical 20°C temperature difference solves the just described problems, as it can exchange 25 kW for 5°C temperature difference.

## Heat pump in the refurbishment of apartment buildings

Most of heat pump applications in residential buildings are actually for single-family houses, both because builders of apartment buildings tend to the cheapest solutions on the market for the heating plant and for tariff problems.

However, the most suitable heat pump application is just on apartment buildings (**Figure 5**). Here a short list of advantages:

- Significant economy of scale. The unitary capacity cost lowers with the heat pump capacity.

- Fewer problems regarding DHW production as the simultaneous load of all the apartments is unlike. A well sized storage can equipped with a timer for nocturnal charging at lower electricity tariffs.
- The plant can be used for summer cooling.
- Higher capacity heat pumps often operate at some percent higher COP.
- The overall engaged power is lower than the sum of the requested power of many single apartment heat pumps.

A thorough analysis is presented in the full paper version, considering a comparison of heat pumps vs. condensing boiler in apartment buildings located in the three cities of Athens, Strasbourg and Helsinki.

**Figure 5.** A centralized heat pump in an apartment building. [Courtesy of Robur]

## Conclusions

The heat pump can be an excellent solution in refurbishment of existing buildings. The selection of type and capacity must be carefully considering the heating system and its operating temperatures, the insulation provided to the building and the availability of a suitable heat source. The right selection of the balance point as a function also of the load cumulative curve is particularly sensitive.

Temperature levels for the heat emitters, climatic conditions for an outdoor air source and electricity and gas tariffs lead to the choice between electrically or gas driven heat pumps.

The use of the heat pump in apartment buildings is normally very favorable. Economic evaluations suggest simple payback periods of around 5 years for a suitable heat source with the further advantage of summer cooling allowed by the reverse cycle heat pump.

## References

See the complete list of references of the article in the html-version at www.rehva.eu -> REHVA European HVAC Journal. 3E

# Calculated and measured energy use before and after thermal renovation for Romanian apartment buildings

**The objective of the article is to analyse the energy use for space heating and production the domestic hot water (DHW) before and after the thermal refurbishment of five blocks of flats in Timisoara, Romania which have been included in the multi-annual National Program, financed in 2009, to increase of the energy performance of blocks of flats. In addition we estimate the factors that lead to the differences between the calculated and measured energy use, and recommend some energy saving measures for the future.**

***Silviana Brata***
"Politehnica" University of
Timisoara, Romania,
silviana.brata@gmail.com

***Ioan Silviu Dobos***
REHVA vice-president; Dosetimpex,
Timisoara, Romania,
ioansilviu@dosetimpex.ro

***Ioan Bistran***
Dosetimpex,
Timisoara, Romania,
ioan.bistran@gmail.com

***Sorin Brata***
student,
"Politehnica" University of
Timisoara, Romania,
sorin.brata@gmail.com

## Regulatory background

The Directives 2002/91/CE and 2010/31/EU regarding the energy performance of buildings, recommended that each energy performance of buildings should be determined independently nationally based on a methodology that includes the thermal insulation of buildings, and the modernization of the building installations. [1] [2] [6]

As a result of EPBD 2002 directive Romania enforced the 372/2005 law that regarded the increase in building energy performance. The law covers the general framework for the energy performance of buildings including calculation methodology. In 2006, the Mc001/2006 methodology for determining the energy performance of buildings was elaborated and approved.

The National Program for Thermal Refurbishment initiated by the Ministry of Development, Public Works and Buildings for increasing the energetic performance of residential buildings is based on the Government Emergency Ordinance OUG 174/2002, and OUG 18/2009 and the applicable methodology Norms. This program was initiated out of the need to reduce the energy consumption of buildings while maintaining and assuring a degree of indoor comfort. If the energy consumption is reduced, the heating costs of buildings and the greenhouse gas emissions will be reduced, thus also improving the urban aspect of cities in a noticeable way.

## Thermal refurbishment measures and financing

The thermal refurbishment measures have been taken, with regards to the all the quality requirements and the mandatory norms afferent to law no.10/1995 for multi-story buildings and their installations, built after a standard type during 1950 and 1985, in heavily populated urban areas, which are connected to the central district heating network. For reducing the energy use, the following measures have been taken:

- Thermal insulation of the exterior walls;
- Thermal insulation of the basement floors;
- Thermal insulation of the terrace-type roofs;
- Sealing/replacing the exterior walls and windows;
- Thermal insulation of the pipes from the technical rooms and replacing it where heavy losses have registered;

| | Case 1 | Case 2 | Case 3 | Case 4 | Case 5 |
|---|---|---|---|---|---|
| Before refurbishment |  |  |  |  |  |
| Net heated area, [m$^2$] | 4.843 | 5.303 | 3.135 | 2.712 | 2.325 |
| Net heated volume, [m$^3$] | 13.252 | 14.501 | 8.465 | 7.458 | 6.207 |
| After refurbishment |  |  |  |  |  |

**Figure 1.** Case buildings before and after renovation.

- Thermal energy metering;
- Installing heating cost allocator and thermostatic radiator valves for the heating units;
- Measuring individual domestic hot water consumption.

At that time, the financing for the technical documentation and for the refurbishment works had been made as follows: 34% from the state budget, 33% from the local budgets and 33% from the reparation funds of the House Tenants' and Flat Owners' Association.

## Heating energy use of blocks of flats

Five blocks of flats in chosen to the study (**Figure 1**) were built during 1970 – 1977, and had exterior walls of large prefabricated panels made out of reinforced concrete with three-layer panels with

- Interior resistance layer;
- Thermal insulating layer;
- Exterior layer for protection of the thermal insulation.

An exception from this pattern is the block of flats Case 4, built in 1965, with brick walls.

The exterior windows are partial double windows with simple glass and partially insulating glass windows. The air change rates were estimated to be (0.7 - 0.8) h$^{-1}$. The interior two pipe hot water radiator heating units are supplied from energy thought the centralized municipal thermal energy station.

During the first phase of the process, the energy use was calculated for the following climatic data scenarios:

- The energy simulation before the thermal refurbishment:
  - conventional year
  - year 2007;
- The energy simulation after the thermal refurbishment:
  - conventional year
  - year 2010;

**Table 1.** Monthly average of outdoor temperatures, in °C.

| | Annual Average | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conventional year | 10.6 | –1.6 | 1.2 | 5.8 | 11.2 | 16.3 | 19.4 | 21.1 | 20.4 | 16.5 | 11 | 5.6 | 0.8 |
| 2007 | 12.4 | 4.4 | 5.5 | 8.6 | 12.7 | 18.3 | 22.4 | 24.2 | 23 | 14.8 | 10.7 | 4.2 | 0 |
| 2010 | 11 | –1 | –1 | 6 | 12 | 16 | 20 | 23 | 22.2 | 16.4 | 9.4 | 9.1 | 0 |

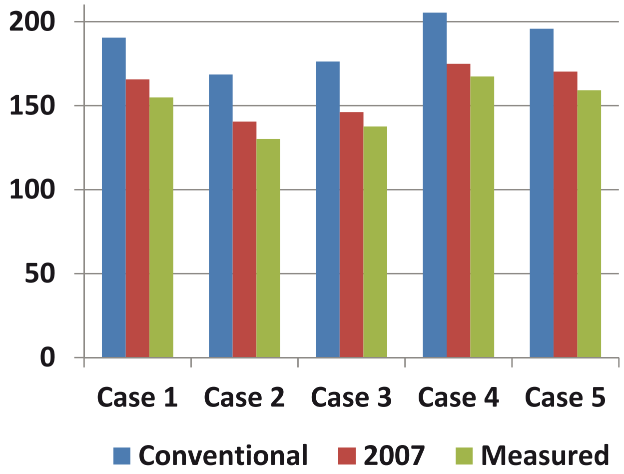



**Figure 2.** Calculated energy use before thermal refurbishment using conventional or 2007 weather data and measured energy use, in kWh/m²a.

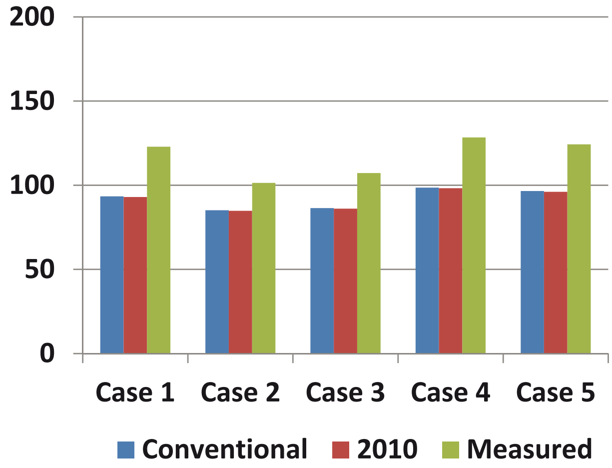



**Figure 3.** Calculated energy use after thermal refurbishment using conventional or 2010 weather data and measured energy use, in kWh/m²a.

In the second phase of the process the calculated energy use [3][4][5] were compared with the consumption registered on the invoices, based on the thermal energy meter readings. The energy demand was determined at the boundary of the building.

Taking into consideration the two calculus hypotheses, we have the following energy use distribution:

- before the thermal refurbishment (**Figure 2**):
  - conventional year: (168.6 – 205.4) kWh/m²a, most belonging to the energy class D (House 2 belonging to the energy class C);
  - year 2007: (140.5 – 174.9) kWh/m²a
  - measured values: (130.2 – 167.4) kWh/m²a
- after thermal refurbishment, **Figure 3**:
  - conventional year: (85.1 – 98.6) kWh/m²a, belonging to the energy class B;
  - year 2007: (84.8 – 98.2) kWh/m²a, belonging to the energy class B;
  - measured values: (101.4 – 128.4) kWh/m²a, belonging to the energy classes B and C;

The study showed that through the thermal refurbishment of buildings there was an estimated reduction of energy use of 50%. In reality the consumption was lowered with approximately (20 – 25)%.

## Energy use for DHW

The energy use for preparing DHW is determined according to the net surface and the average number for occupying the block of flats in the Timis County, from which Timisoara is part of. **Figures 4 and 5** synthesize the energy use before and after the thermal refurbishment in all the five cases taken into consideration:

- before the thermal refurbishment, **Figure 4**:
  - conventional year: (61.9 – 97.2) kWh/m²a, belonging to the energy classes D and E;
  - measured values: (38.1 – 55.8) kWh/m²a, belonging to the energy class C;
- after the thermal refurbishment, **Figure 5**:
  - conventional year: (50.4 – 7.2) kWh/m²a, belonging to the energy classes C and D;
  - measured values: (31.8 – 46.8) kWh/m²a, belonging to the energy classes B and C;

Besides the reduction of the energy use for production of DHW, determined by the refurbishment measures, the reduction of DHW can also be motivated by the increase of the hot water costs with 62.6%, during 2010 – 2011 compared to 2007 – 2008.

## Conclusions

The causes for the differences between the measured and calculated consumption are estimated as follows:

- for the heating installation:
  - incorrect estimation value of the thermal resistance;
  - actual indoor temperatures can be higher than the conventional ones; Energy demand depends strongly on indoor temperature shown in **Table 2.**
- air change rates can be higher than the conventional (estimated) air change rates. Energy demand depend strongly on air change rate as shown in **Table 3**.
- not using heating cost allocators.

**Table 2.** Effect of indoor temperature on heating energy demand (Case 1).

| Temperature, °C | 20 | 22 | 23.3 |
|---|---|---|---|
| Energy demand, kWh/m²a | 93.4 | 110.2 | 122.2 |

**Table 3.** Effect of air change rate on heating energy demand (Case 1).

| Air change rate, $h^{-1}$ | 0.7 | 0.9 | 1.1 |
|---|---|---|---|
| Energy demand, kWh/m²a | 93.4 | 108.0 | 123.2 |

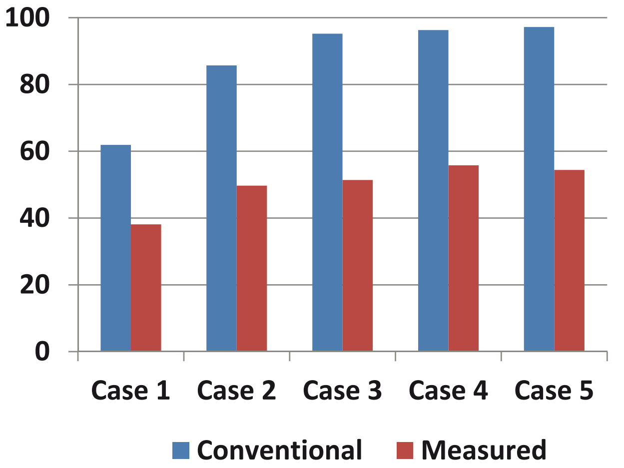



**Figure 4.** Calculated (conventional year) and measured use of energy for DHW before the refurbishment.

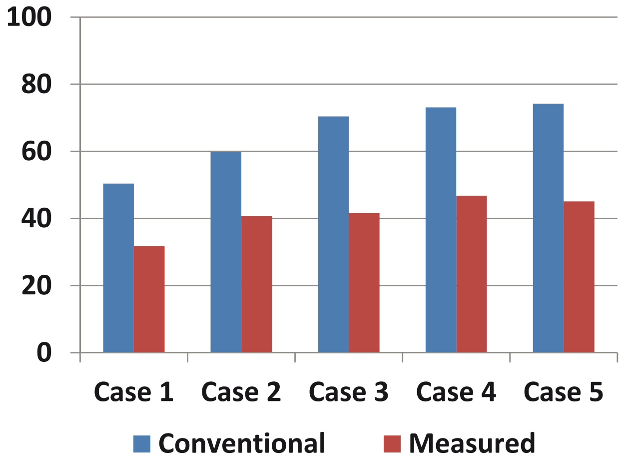



**Figure 5.** Calculated (conventional year) and measured use of energy for DHW after the refurbishment.

- for the domestic hot water installation:
  - the conventional (estimated) number of people may be different than the real one;
  - the temperature values for the DHW preparation and supply and the temperature of the cold water that enters the DHW installation may be different than the values from the conventional calculus;
  - the calculation of the heat losses from supplying the consumer with DHW, presents differences in the proposed volume calculation methods of the DHW, corresponding to the losses of water, which is calculated according to the following:
    - specific DHW losses
    - dimensioning factors
    - table values

By analysing all the case study results, the following recommendations for reducing costs are proposed:

- a better understanding on behalf of the owners and tenants of the way how the building functions,
- installing heating cost allocators onto each heating unit;
- periodic analysing the energy bills;
- quantifying the energy cost reduction potential with up to 50% from the initial situation (at the moment the reduction being up to 20 – 25%);
- reducing the indoor temperature and the number of air change rates to the point of indoor comfort;
- energy consultancy.

## References

[1] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings. http://www.energy.eu/directives/2010-31-EU.pdf

[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=OJ:L:2003:001:0065:0071:EN:PDF

[3] Metodologia de calcul al performanţei energetice a clădirilor MC 001/2006:
Partea I – „Anvelopa clădirii", indicativ Mc 001/1 – 2006;
Partea a II – a – „Performanța energetică a instalațiilor aferente clădirii;
Partea a III –a – „Auditul şi certificatul de performanţă a clădirii".

[4] Program de calcul al performanţei energetice a clădirilor Doset-PEC.

[5] Implementarea Metodologiei Mc001/2006 în practică. - Conf. Dr. Ing. Silviana BRATA, Universitatea "Politehnica", Timişoara; Dr. Ing. Ioan Silviu DOBOŞI, Dosetimpex SRL Timişoara; Prof. Ioan BISTRAN, Dosetimpex SRL Timişoara (Revista Instalatorul Nr. 4 - 2012).

[6] Zoltan Magyar – „Buildings in the key role in the EU Energy Efficiency Action Plan", The Rehva European HVAC Journal, Volume:48, Issue:3, May 2011, pag. 86-88.

The full length version of this article is availbale at the journal website http://www.rehva.eu/en/rehva-european-hvac-journal

# Effect of refurbishment on thermal comfort and energy use in residential multifamily building

**The article presents a case study performed on a multifamily residential building situated in Slovakia. The building is a typical representative of the old panel houses built in era of the massive prefabrication in Slovakia. The objective of the study was to clarify the relationship between energy consumption, energy efficiency measures and the indoor environment.**

**The evaluation of the thermal comfort in apartments was carried out by means of a questionnaire distributed to the inhabitants. At the same time energy audit was performed to find out the causes of high energy consumption and identify the energy saving potential. Based on information obtained from an energy audit, the building model was constructed in simulation program IDA ICE. The real (measured) energy consumption was obtained from the administrator of the building. Through these simulations of the building a profiles of the heat balance and air temperature were determined, which depend on different conditions. Results were compared with subjective evaluation. The results show how the measures taken to reduce the energy consumption may influence the thermal comfort of indoor environment.**

***Hana Pustayová***
Slovak University of Technology in Bratislava,
Faculty of Civil Engineering, Slovakia
e-mail: hana.pustayova@gmail.com

***Dušan Petráš***
Professor
Slovak University of Technology in Bratislava,
Faculty of Civil Engineering, Slovakia

## Residential buildings in Slovakia

The situation in the housing sector in Slovakia has been changing seriously during last 15 years. According to the Housing census, held in 2008, in the Slovak Republic there were 5 412 254 inhabitants. Total housing stock amounted to 1 988 000 of which 1 768 000 permanently inhabited. It means that there were 367 dwellings, respectively about 327 inhabited dwellings per 1 000 inhabitants (Ministry of Construction and Regional Development in Slovakia, 2011). The new housing production has decreased considerably in comparison with years before 1990. The production was highest in 1970's, when mainly panel buildings constructed of prefabricated, pre-stressed concrete were built.

Poor insulation and inadequate heating systems must be addressed given the constant increase in energy costs. The lack of funds adds to the challenge. In addition, the population expects better housing conditions. In 2006, a survey indicated that more than 50% of the population was unsatisfied with their housing situation.

We can conclude dwelling houses were constructed using almost only one technology in many decades. Consequently, the number of different structural systems is restricted. This fact can be an advantage for the refurbishment of buildings in Slovakia.

## Evaluation of energy use and thermal environment

Because every building is unique, each project must be treated separately to find individual energy efficient possibilities. An energy audit was performed as a first step to reveal actual energy efficiency potential of building. This process consisted of building inspection, evaluation and analysis of the existing situation and various energy efficient measures that could be implemented in order to reduce the energy consumption (Dahlsveen and Petráš, 2005).

The values of real measured energy consumption were obtained from the administrator of the building.

Simulations were performed in the IDA Indoor Climate and Energy (IDA ICE), which is a tool for simulation of thermal comfort, indoor air quality and energy consumption in buildings.

For the purpose of subjective evaluation a questionnaire was created and completed by inhabitants of the building. Each questionnaire consisted of number of questions which were divided into four main parts:

- Basic information about respondent
- Building constructions
- Thermal comfort (general thermal comfort and local thermal discomfort)
- Ventilation habits

The evaluation of thermal environment was performed using PMV and PPD indices.

The PMV index predicts the mean value of the thermal votes of a large group of people, on the 7-point thermal sensation scale, exposed to the same environment.

The PPD index establishes a quantitative prediction of the number of thermally dissatisfied people. The PPD predicts the percentage of a large group of people likely to feel too warm or cool, i.e. voting hot (+3), warm (+2), cool (–2) or cold (–3) on the 7-point thermal sensation scale (CEN CR 1752).

For subjective evaluation of thermal comfort acceptability scale was used. This scale is continuous and is divided into two parts - from clearly unacceptable (–1) to just unacceptable (–0.01) and from just acceptable (+0.01) to clearly acceptable (+1).

When the PMV value has been determined, the PPD can be determined from the equation:

$$PPD = 100 - 95 \cdot e^{-(0.03353 PMV^4 + 0.2179 PMV^2)} \quad (1)$$

## Case building

The building is situated in Bratislava, Slovakia and was built in 1987. The building consists of 9 floors and 1 underground garage. On the 1st floor there are entrances and common premises serving mainly as storage spaces, 2nd to 9th floor form the residential part (**Figure 1**).

a)

b)

**Figure 1.** Front side (south facade) of the building.
a) before renovation, b) after renovation.

External walls are made of porous concrete panels, 300 mm thick. During the renovation the building was insulated with polystyrene (thickness 80 mm) which was added to the building on the outside of the facade. The flat roof was considered to possess insufficient thermal insulation; therefore the thickness of insulation was also increased during renovation. Original windows in common premises are constructed with wooden frames and double glazing. All of them have been replaced by plastic windows with significantly improved heat transfer coefficient than prior to renovation. The entrance of building was also renovated. Floors are without insulation, except the floor above the unheated 1st floor.

Heat and DHW is supplied from a heat exchange station connected to the building. The piping is led through the wall of the building. The main branch is led under the ceiling of the 1st floor from which other branches are rising to the residential part, and are led in shafts. The main branch was insulated, unlike the distribution parts led in shafts, which are without any kind of insulation. After renovation the thermal insulation from main branch was replaced for a more recent type possessing increased insulation properties. Heat in the residential apartments is emitted by means of radiators. During the renovation most of the old control valves, have been replaced by thermostatic valves with manual regulation. As the last step the heating system was hydraulically balanced.

## Energy use and thermal environment before and after renovation

Since the start of renovation energy consumption of the building has been decreasing year by year as the energy efficient measures have been implemented. In 2007, thermal insulation of the facade, thermal insulation of the roof and replacement of all windows took place. In 2008 the heating system was balanced and old valves in apartments were replaced by thermostatic valves with manual regulation. In 2009, complete renovation of the building was finished. By implementing energy efficient measures the energy performance has been improved by 45%. Energy consumption was also simulated in programme IDA ICE4 as presented in **Table 1**.

Further on the **Figure 2** show the monthly energy use of typical floor of the building. Heating season in Bratislava where the building location is from October to April.

**Table 1.** Annual heating energy consumption of the whole building in 2007 and 2009.

| Year | Energy consumption* measured [kWh] | Energy consumption* simulated [kWh] |
|---|---|---|
| **2007** | 248 472 | 239 192 |
| **2009** | 93 095 | 107 344 |

The simulation program also provides the fluctuation of indoor temperature during the year as shown in figures below. Although considerable amount of energy was saved, the range of simulation temperature of building was not substantial changed. This fact approved, that building in original condition was in bad physical condition and had inappropriate thermal protection, which caused escape supplied heat from the building.

During the heating season the indoor air temperature was 99% of time in the range of 21 – 25°C which is the specification of the category I for living spaces in the standard EN 15 251.

The subjective evaluation of the indoor environment was carried out in years 2007 and 2009. The personal questionnaires were completed by representatives of 75 percent of the residents of the apartments. Questionnaires were completed two times: before and after the renovation. For the results to be comparable, surveys were carried out in approximately the same season i.e. the middle of heating season. General thermal sensation of the inhabitants was indicated by a tick on the 7-point scale and perception of the temperature was tick on acceptability scale. **Figure 3** presents the responses of thermal sensation and inhabitant's perceived temperature in their apartments: before renovation and after complex renovation.

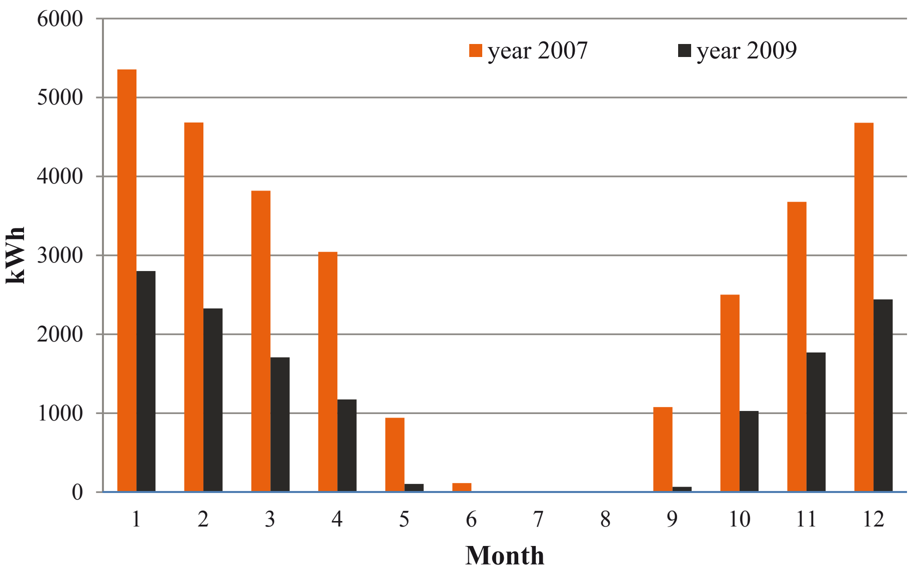



**Figure 2.** Monthly energy use for heating of typical floor of the building before and after the renovation.

In the questionnaires people were asked also to mark the thermal environment they would be satisfied with. Inhabitants preferred thermal sensation between slightly warm and warm, PMV presents value 1.45. It is a

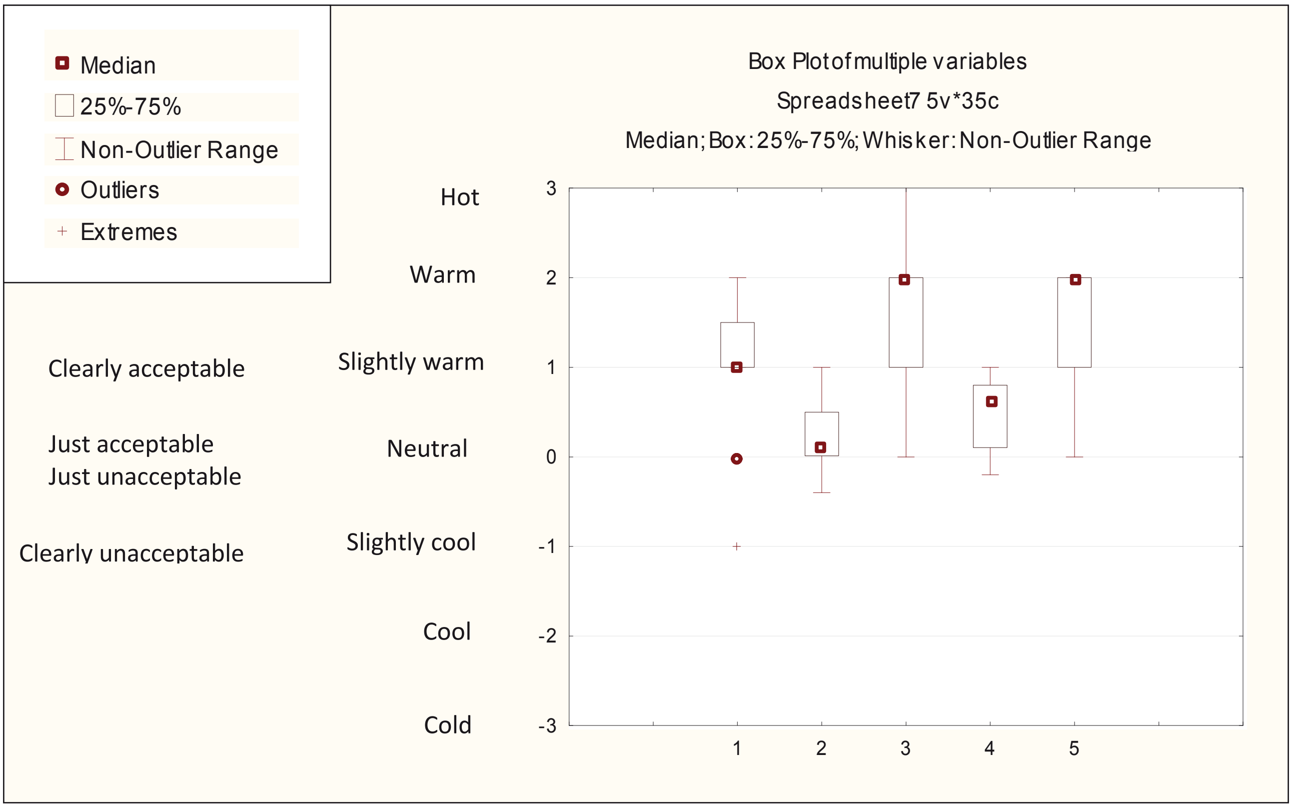



**Figure 3.** Evaluation of thermal sensation in apartments during whole period of refurbishment.

1- Thermal sensation –before renovation,
2- Thermal acceptability before renovation,
3- Thermal sensation –after renovation,
4- Thermal acceptability after renovation,
5- Ideal thermal sensation for occupants in the building

good indicator for comparison of inhabitant's perception during the survey. **Table 2** also shows results of subjective evaluation using PMV and PPD indices, in each year.

## Conclusions

This study focuses on the relationship between energy consumption and thermal comfort. Although the complex renovation of residential building can clearly contribute to improvement of indoor environment, without thorough planning and implementation it may influence the indoor environment in an undesirable way. In order to keep the energy consumption on the desired low level, we should ensure correct operation and maintenance of the building. This case study also shows that occupant behavior influences energy consumption. It is very important to educate occupant's new behavior as the difference between indoor environment before and after renovation is significant.

**Table 2.** Thermal sensation and acceptability of indoor environment.

| | Thermal sensation | |
|---|---|---|
| | 2007 before renovation | 2009 after renovation |
| PMV | 1,12 | 1,61 |
| PPD% | 31,3 | 56,8 |
| | Thermal acceptability | |
| | 0,18 | 0,52 |

## Acknowledgement

The publication is supported by Scientific Grant Agency of the Ministry of Education of Slovak Republic and Slovak Academy of Sciences (VEGA) 1/1052/11.

## References

See the complete list of references of the article in the html-version at www.rehva.eu -> REHVA European HVAC Journal

# Energy Efficient Refurbishment of Hospital Buildings in Hungary

***Zoltán Magyar***
PhD, REHVA vice-president
Head of HVAC Department
University of Pecs, Hungary
zmagyar@pmmik.pte.hu

**According to the Hungarian decrees (7/2006 TNM and 40/2012 BM) in case of substantially renovated buildings, the specifications given for the doors and windows, slabs, walls, and floors have to be met, besides, the overall energy characteristics of the building must be below the specified value. The required figures of overall energy characteristics are specified for residential and accommodation-type buildings, office blocks, and educational buildings; buildings of other purposes belong to "other" category. There are no specific requirements for healthcare facilities, thus, the energy consumption of healthcare institutions, and the energy characteristics of some specific buildings of this type have to be surveyed by taking the requirements of the relevant Hungarian decrees into consideration.**

## The procedure of preparing an energy audit and assessment

The procedure includes the following:

- establishment of the requirements;
- identification of energy-consuming systems;
- establishment of actual energy consumption;
- comparison of actual energy consumption and the designed figures;
- proposing energy-saving measures.

The tasks of energy audits and assessment do not include exact cost-and-return-on-investment calculations since they would require asking for quotations, which belongs to the scope of feasibility studies. However, all energy audits are required to include calculations with at least approximate precision which help the owners or decision-makers decide which investments to launch or else which investments require the accomplishment of feasibility studies.

The aim of energy audits, therefore, is to survey the energy consumption of the buildings concerned, and proposing energy-saving initiatives for refurbishment. However, as it is specified in EU directives, indoor environmental requirements have to be taken into consideration for energy-saving measures. Concerning the air supply of healthcare institutions, the Hungarian standard is suggested by MSZ 03-190:1987 can be taken into account. In case of and public spaces and offices, the CEN report CR 1752 and standard EN 15251 are applicable.

As for the institutions surveyed, energy assessment has been carried out according to the following steps:

1. Identification of the buildings to be surveyed within the scope of the audit. Establishing the internal requirements (according to the data available or the function of the premises concerned).
2. Collecting the design documentation available (architectural and engineering implementation-plans, implementation plans of electrical network designs, technical specifications etc.).
3. Identification of power-supply systems, and areas of consumption. Clarification of the site-plan.
4. Collecting the utility and maintenance contracts, data of energy consumption (settling bills) concerning the previous 3 years.
5. Preliminary site survey, discussions with building operators and technical staff, recording operating experience.
6. Establishing actual consumption data according to the available bills. Analysis of consumption data, determination of average energy-consumption characteristics by taking heating degree-days into consideration, assessment of committed quantities. Analysis of energy cost, establishment of the actual-consumption-dependent and independent cost proportions.
7. On-site survey of building envelop and the associated HVAC and lighting-technology systems, field measurements (parameters of indoor climate, circulation time of DHW).

8. Assessment and summary of the results of the on-site measurements.
9. Heating-technology sizing of the buildings, according to the actual function of the premises (rooms), the current internal environmental requirements, and the current status of the building structure.
10. Determining the actual primary energy demand of the HVAC systems.
11. Comparison of the actual and design figures, exploring the reasons for any differences.
12. Proposing energy-saving measures. Assessment of the energy impact of the proposed initiatives according to the expected changes in specific heat loss figures, and the primary energy demand of HVAC and lighting-technology systems.
13. Analysis of payback times according to specific investment costs.

## Evaluation of energy saving measures

The heating-technology sizing for the individual buildings and the establishment of primary energy demand of HVAC systems, and the analyses of the energy impacts of energy-saving measures have been carried out by means of the Hungarian WinWatt design software.

We have elaborated the energy-saving measures concerning building-structure renovation, and modernisation of HVAC systems and the electric network. The building-structure refurbishment in general includes the replacement or modernisation of doors and windows, and the external thermal-insulation of the building concerned.

Modernisation of the heating system, by all means, shall include the replacement or renovation of outdated heating systems, hydronic balancing, installation of radiators with thermostatic valves.

Concerning water supply, by installing water-saving faucets, toilet tanks, and urinal rinse tanks, the amount of water used and thus the total operation costs can be reduced. In case of healthcare facilities, prevention of legionella infection is particularly important. This can be achieved by providing sufficient DHW, and establishing suitable hot-water systems (by the elimination of stagnant water-line sections, and providing satisfactory circulation).

The modernisation of electric networks includes the replacement of the existing lighting system with energy-saving alternatives. When replacing the fluorescent lamps, the transition to modern electrical ballasts is also advisable. Additional savings can be realised by installing motion-detector lighting design, where it seems appropriate. It is generally recommended to check the efficiency of the electric-power-consuming machinery and equipment, and to replace the outdated ones. Thereby inductive idle power is also going to be reduced, implying further cost saving. A further option, in order to reduce reactive performance, is offered by installing multiple power factor correction units. In this case, the instrumental analysis of the impact of the performance to be compensated to the network, and, if necessary the installation of filter-circle power factor correction units are recommended.

In addition to the above, in order to rationalise energy consumption, it is always recommended to provide energy training to the staff, users and operator in order to realise energy-conscious behaviour.

## Technical systems in case buildings

In case of the institutions involved in the study, a total of 18 buildings and the related HVAC systems and lighting systems have been assessed, predominantly according to their primary energy consumption. The buildings are located in Hungary, Gyor [2] and Derecske [1].

The structure of the dominantly brick-masonry buildings were seriously deteriorated. With the exception of some buildings no significant renovations have been completed, only on-going repairs and facade renovations have been implemented. Consequently, in the majority of the buildings most of the problems have been implied by the outdated windows and roof structures. (In relation to this, in the buildings concerned draught problems have been experienced almost constantly.)

The heating and domestic hot water supply, with one exception, is provided by the district-heating network. Natural gas and steam are used for technological purposes only. The heat emitters of the buildings are usually cast-iron radiators, typically installed without thermostatic radiator valves. The pipe networks are of mixed design (one-pipe without bypass, one-pipe with bypass and two-pipe systems).

On the secondary side pumps with constant speed were installed. In many cases the control on the second side does not function adequately, therefore, manual control is applied. The hydronic balancing of the systems have not been accomplished, the relevant valves needed for it are missing. In several cases, technological heat usage is wasteful.

**Table 1.** The thermal energy use of buildings according to the survey.
$Q_{tr}$ [kW] = total heat loss of the building
$q_{calc}$ [W/(m³K)] = calculated specific heat-loss coefficient
$q_{all}$ [W/(m³K)] = allowed value of specific heat-loss coefficient
$q_h$ [kWh/(m²a)] = net thermal-energy value of heating
$E_h$ [kWh/(m²a)] = primary energy demand of the heating system
$E_{DHW}$ [kWh/(m²a)] = primary energy demand of the DHW system

| | Characteristics of the present state | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Premises | V [m³] | $Q_{tr}$ [kW] | $q_{calc}$ [W/(m³K)] | *$q_{all}$ [W/(m³K)]* | *$q_{calc}/q_{all}$ [%]* | $q_h$ [kWh/m²a] | $E_h$ [kWh/(m²a)] | $E_{DHW}$ [kWh/(m²a)] |
| Derecske | **Paediatric surgery** | 1059 | 47 | 0,857 | *0,454* | *189%* | 235,0 | 298,8 | 14,7 |
| Gyor | **Híd-street site** | 8680 | 252 | 0,592 | *0,304* | *195%* | 183,4 | 222,1 | 47,1 |
| Győr, Magyar **Street** | **Building"A"** | 44152 | 1009 | 0,319 | *0,200* | *160%* | 84,3 | 118,4 | 48,2 |
| | **Building"B"** | 36241 | 701 | 0,257 | *0,244* | *105%* | 77,4 | 109,9 | 48,2 |
| | **Building"C"** | 29273 | 833 | 0,411 | *0,200* | *206%* | 119,4 | 160,8 | 48,2 |
| | **Building"E"** | 29839 | 748 | 0,417 | *0,223* | *187%* | 113,9 | 154,3 | 48,2 |
| | **Clinic** | 9968 | 267 | 0,414 | *0,245* | *169%* | 114,0 | 154,8 | 48,0 |
| Győr, Zrínyi Street | **Nursing ward "A"** | 3119 | 88 | 0,385 | *0,219* | *176%* | 106,4 | 137,0 | 46,2 |
| | **Nursing ward "B"** | 4664 | 122 | 0,479 | *0,242* | *198%* | 95,7 | 124,4 | 45,8 |
| | **Dermatology** | 2428 | 76 | 0,531 | *0,287* | *185%* | 109,6 | 140,9 | 46,2 |
| | **Psychiatry block** | 17637 | 468 | 0,356 | *0,237* | *150%* | 126,4 | 158,1 | 45,4 |
| | **Infectology** | 3402 | 113 | 0,450 | *0,200* | *225%* | 126,1 | 159,1 | 46,2 |
| | **Isotope diagnostics** | 4548 | 120 | 0,482 | *0,220* | *219%* | 95,1 | 123,6 | 45,8 |
| | **Laboratory, pharmacy** | 4563 | 128 | 0,438 | *0,273* | *160%* | 136,5 | 170,5 | 45,8 |
| | **Oncology** | 8790 | 183 | 0,279 | *0,200* | *140%* | 78,9 | 104,8 | 45,8 |
| | **Morgue** | 956 | 40 | 0,785 | *0,315* | *249%* | 138,3 | 175,7 | 48,1 |
| | **Pulmonology** | 7283 | 200 | 0,507 | *0,235* | *216%* | 154,9 | 191,1 | 45,8 |
| | **Lung screening** | 2160 | 67 | 0,486 | *0,271* | *179%* | 102,2 | 132,6 | 46,6 |

The faucets are traditional and single-lever mixing design. The flush of the toilets are of mixed types; it is either supplied by upper flushing tanks, or, in the renovated toilets, (about 15%) there are flushing tanks equipped with flush-stop function. Domestic hot water is circulated in the majority of the buildings, however, according to users' complaints, circulation is insufficient. This was justified by on-site measurements as well. The electric systems of the buildings were installed predominantly in the seventies, and they represent the technological standards of the era concerned. The estimated average age of lighting systems can be between 20-30 years, in most cases they are outdated and fail to meet the modern-day standards. In some specific buildings, energy-effective (and reliable) operation is hindered by 20-30-year-old distributor-fuse equipment. Meanwhile, the gradual replacement of lighting units to modern mirror-reflection energy-efficient versions began in the recent years.

## Results of the energy audit and assessment

In the following the assessment of energy saving initiatives and their estimated effect are presented.

- Installation of thermostatic radiator valves and their adjustment.
- Replacement or modernisation (by replacing their seals and by applying the so-called Duplo-Duplex method) of doors and windows.
- Decrease of filtration by the alteration of internal space connections.
- Subsequent external thermal insulation (walls and slabs).
- Complete thermal insulation of the building (Subsequent external thermal insulation and replacement or modernisation of doors and windows.

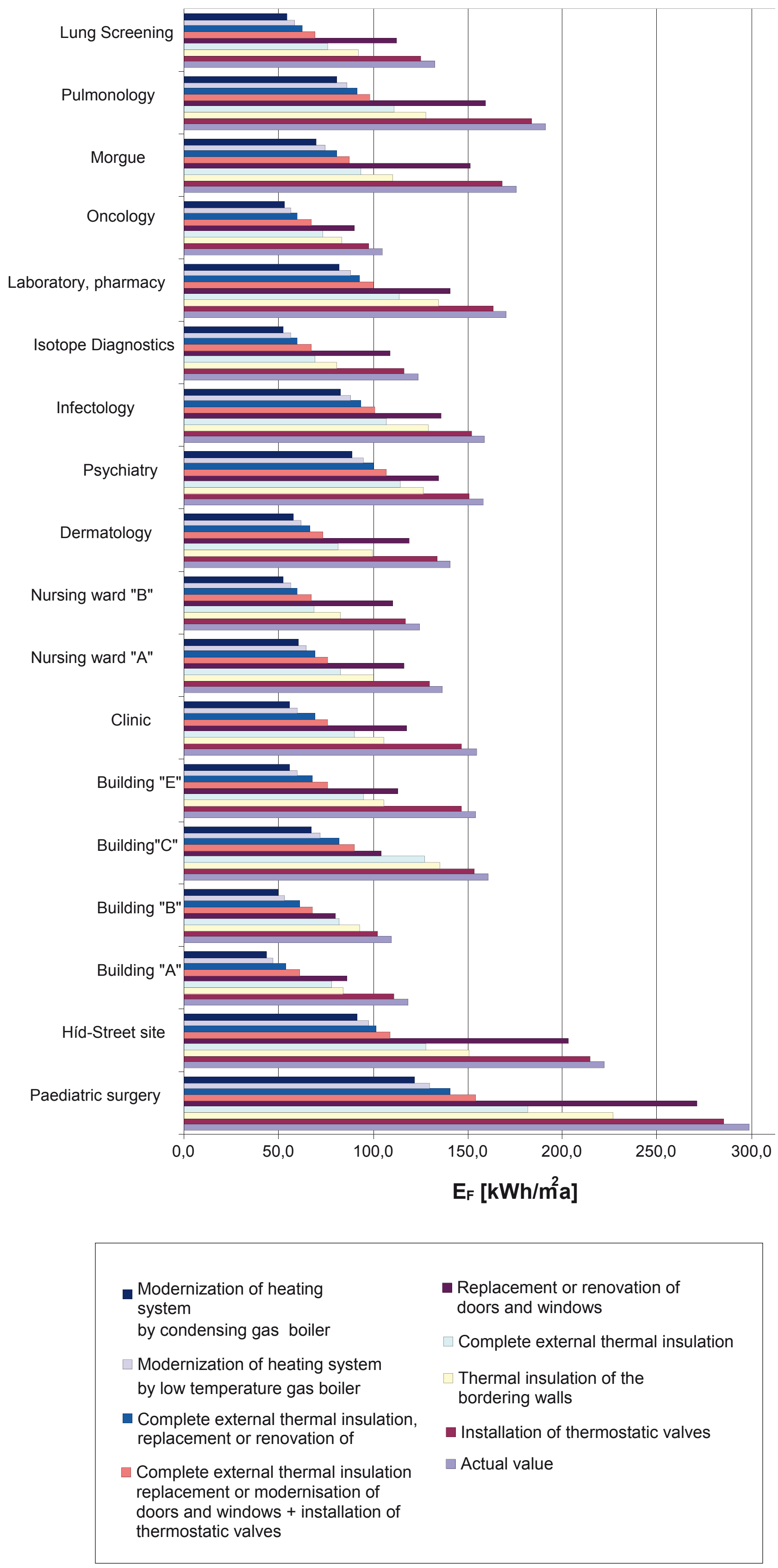



**Figure 1.** The calculated impact of energy-saving measures on primary energy demand of heating systems.

- Complete thermal insulation of the building and modernisation of the heating system (exchange of radiators, installation of thermostatic radiator valves, balancing valves and balancing the heating system).
- Complete modernisation with individual gas boiler (total thermal insulation of the building and modernisation of the heating system, installation of individual gas boiler with control by outdoor temperature and variable speed pumps).
- Complete renovation with individual condensing gas boiler total thermal insulation of the building and modernisation of the heating system, installation of individual gas boiler with control by outdoor temperature and variable speed pumps).

**Remark:** In case of hospitals with several pavilions this solution does not make management with state-of art technology possible or the application of alternative fuels. It can be a good solution in case of clinics.

**Table 1** shows the actual energy consumption of different parts of the hospital. Based on the calculation different measures were suggested. The estimated reduced energy consumption in primary energy demand is presented in the **Figure 1**.

## Conclusion

The article presented the possible energy efficient refurbishment in Hungarian hospitals. The current energy consumption is show in the table. The effects of the energy saving options are presented in **Figure 1**. Based on this study the energy efficient refurbishment has started and will be completed soon. A few years later the real energy consumption will be compared with the calculated measures.

## References

1. Feasibility Study on the Energy Refurbishment of the Premises of the City Council of Dereceske, Hungary; Comfort Consulting Ltd. 2007.
2. Feasibility Study on the Energy Refurbishment of Aladar Petz County Hospital, Hungary, Comfort Consulting Ltd. 2007.
3. Kontra, J.: Experience Concerning Energy Reconstruction of Hospitals; Hungarian HVAC Magazine, Budapest, 2004.
4. Magyar,Z. - Leitner,A. - Berenyi, A.: Energy audit of Healthcare Institutions, Hungarian HVAC Magazine, Budapest, 2007. 3E

The next Finnbuild exhibition will take place in October 9-12, 2014

More information at **www.finnbuild.fi**

# FinnBuild 2012

## – a successful showcase for the Finnish construction industry

Finland's largest building and building services trade fair, FinnBuild 2012, was held at the Helsinki Exhibition & Convention Centre on 9–12 October 2012. This year's event was the 20th, the first FinnBuild was organized in 1974.

FinnBuild and the other simultaneously arranged fairs gathered more than 32.500 professional visitors of the building and building services industry, as well as students of the construction trade.

The economic recession did not show its marks at FinnBuild. The exhibition was bigger than two years ago. This year almost 18.000 m² of exhibition space was booked, and the exhibitors represented 16 different countries, including the Baltic countries, Sweden, Denmark and China.

### Awarded products

For the third time, an impartial jury chose the FinnBuild Highlights, which were announced in the beginning of the exhibition. The Highlights exhibition showcased a selection of the most interesting innovations at the fair. The Highlights of 2012 FinnBuild were:

- KLIK Partition wall framework by Muotolevy,
- adjustable crowbar by Hultafors,
- Ruukki® smart roof (alert system for snow on the roofs),
- Uponor HOME net service for HPAC purchasing,
- Lindab InCapsa (combining of installation and casing of the ventilation duct in one working stage),
- Vexve Verto (remote readable water meter),
- Fitfire+ and HT1000° by Suomen Hormistokeskus (a new technique for repairing chimneys and ventilation ducts).

## REHVA –FINVAC seminar at FinnBuild

All presentations of REHVA- FINVAC seminar are available at **www.rehva.eu** -> seminar presentations

A seminar on "Implementation of the EU energy policy and objectives in Finland" attracted about 200 participants, mainly designers and building owners. It was organized by Federation of European Heating, Ventilating and Air-conditioning Associations REHVA, The Finnish Association of HVAC Societies FINVAC and FinnBuild.

This seminar focused on how the energy use of buildings can be saved and made more effective. Implementation of the energy policy and objective in Finland were compared to the objectives and policy set by the European Union. The seminar also describes the current use of energy in buildings and illustrates opportunities to improve the energy efficiency of building further. An important topic of the seminar was also how to reach in Finland is to reach the objectives set to build nearly zero energy buildings and defined for the use of renewable energy sources. Speaker of the seminar are well recognized experts in Finland and internationally.

Ismo Grönroos-Saikkala

Jarek Kurnitski

Jorma Railio

Mika Vuolle

Half of the presentations at seminar were in English and half in Finnish. All presentation are available at www.rehva.eu -> seminar presentations. The presentations in English were:

- *Improvement of energy efficiency of buildings in EU* by Policy Officer **Ismo Grönroos-Saikkala**, Energy Efficiency Unit, DG Energy, European Commission.
- *EPBD implementation situation - Finland slowing down* by Senior Lead, Built Environment, D.Sc. (Tech.) **Jarek Kurnitski**, Sitra, the Finnish Innovation Fund.
- *HVAC products subject to stringent mandatory energy requirements sooner or later* by Chairman **Jorma Railio**, REHVA Technology and Research Committee
- *Cost-optimal level study of energy performance requirements for buildings* by Lic.Sc. (Tech.) **Mika Vuolle**, Equa Simulation Finland Oy.

The next Finnbuild exhibition will take place in October 9-12, 2014

More information at **www.finnbuild.fi**



▶ Helsinki Exhibition & Convention Centre hosted five other professional events simultaneously with the FinnBuild fair: the fair for technical infrastructure InfraExpo, Arena - the fair for constructing the sporting arenas - and the Environment and Municipal Engineering, Water and Wastewater, and Waste and Recycling events.

The culmination of FinnBuild was on Friday, when the exciting finals of the SPAN bridge competition took place. 9 student teams had planned and constructed one meter wide wooden bridges, which were tested on Friday afternoon. The bridge of the winning team carried an almost 400 kg load.

Text and photos by OS 3E

# REHVA supporters strongly visible at FinnBuild


Halton, the leader in air distribution, presented new products for air distribution, chilled beams and emergency ventilation.


Swegon introduced a complete, demand controlled, energy efficient air conditioning and ventilation system "Tellus".


Koja, the Finnish representative of Italian Rhoss, presented heat pump systems for cold climate.


Grundfos is the leading supplier in Finnish market for pumps for buildings, industry and infrastructure.


FläktWoods is the market leader in fans and many other products.


Systemair introduced new product for the smoke and emergency ventilation.


Lindab has developed a new system for demand controlled ventilation.


Belimo actuators are used by many Finnish manufacturers and contactors.


Camfil Farr focused on High Performance City Filter and a heated frost protected outdoor air grille (in picture)

# VDI Guidelines published October – December 2012

### VDI 2169 "Functional checking and yield rating of solar thermal systems"

This guideline is intended for planners and executing companies, pointing out the options for functional checking and checking of output of solar thermal components in installations and listing the prerequisites to their application

### VDI 6003 "Water heating systems; Comfort criteria and performance levels for planning, evaluation and implementation"

The guideline provides information about the expert planning, evaluation and implementation of water heating systems that are built in sanitary facilities of residential properties and similar buildings.

### D VDI 2073/1 "Hydraulic systems in building services; Hydraulic circuits"

Each distribution system in a building must be tailored to the conditions in the building and calculated individually to meet user requirements. This guideline is intended to specify the fundamentals for the design of hydraulic distribution systems. It aims at conveying, to the planning engineer, contractor or user of a heating or air-conditioning or other hydraulically supplied system the basics of the conceptual design of the structure of hydraulic distribution systems to be observed for various applications.

### VDI 2077/ 3.1 "Energy consumption accounting for the building services; Determination of reimbursable costs of heat generation by CHP systems"

The guideline is applied to cogeneration systems (CHP generation systems) subject to the German heating-cost ordinance (HeizkostenV), where heat is used completely (excluding emergency cooling), and describes methods for billing those costs for heat generation which can be apportioned.

### VDI 2262/2 "Workplace air; Reduction of exposure to air pollutants; Processing and organization measures"

The guideline is addressed to employers. By way of example it provides guidance and ideas on how to comply with legal stipulations regarding occupational health and safety for air pollutants. A well-structured and documented organization aids in ensuring unimpeded and controllable production processes. The generation and release of air pollutants during the production process must be avoided or reduced. Air pollutant concentrations in the air at the workplace can be reduced by preventing or reducing emission and by air-conditioning.

D = Draft Guideline

### D VDI 3807/2 "Characteristic values of energy consumption in buildings; Characteristic heating-energy, electrical-energy and water consumption values"

This guideline applies to the use of characteristic energy and water consumption values for buildings supplied with heating energy, electrical energy and water, especially where values for individual buildings are compared to the averages and standard values given in this guideline.

### VDI 6025 "Economy calculation systems for capital goods and plants"

This guideline deals with all dynamic methods of calculation of economic efficiency for capital goods and plants, which are characterized by the following features: use of different change rates for various costs or types of payment, explicit allowance for costs and payments which occur at different periods, i.e. doing away with average cost rates per period, in contrast to the static method, and taking account of the uncertainty or risk of future costs or payments.

### VDI 6008/1 "Barrier-free buildings; Requirements and fundamentals"

The present part 1 of the series of guidelines shows the main needs and basics for planning barrier free buildings regarding the technical building services. The supplements also deal with broader, user-specific needs of people of all ages with and without mobility limitations or disabilities.

### VDI 6008/2 "Barrier-free buildings; Aspects of sanitary installation"

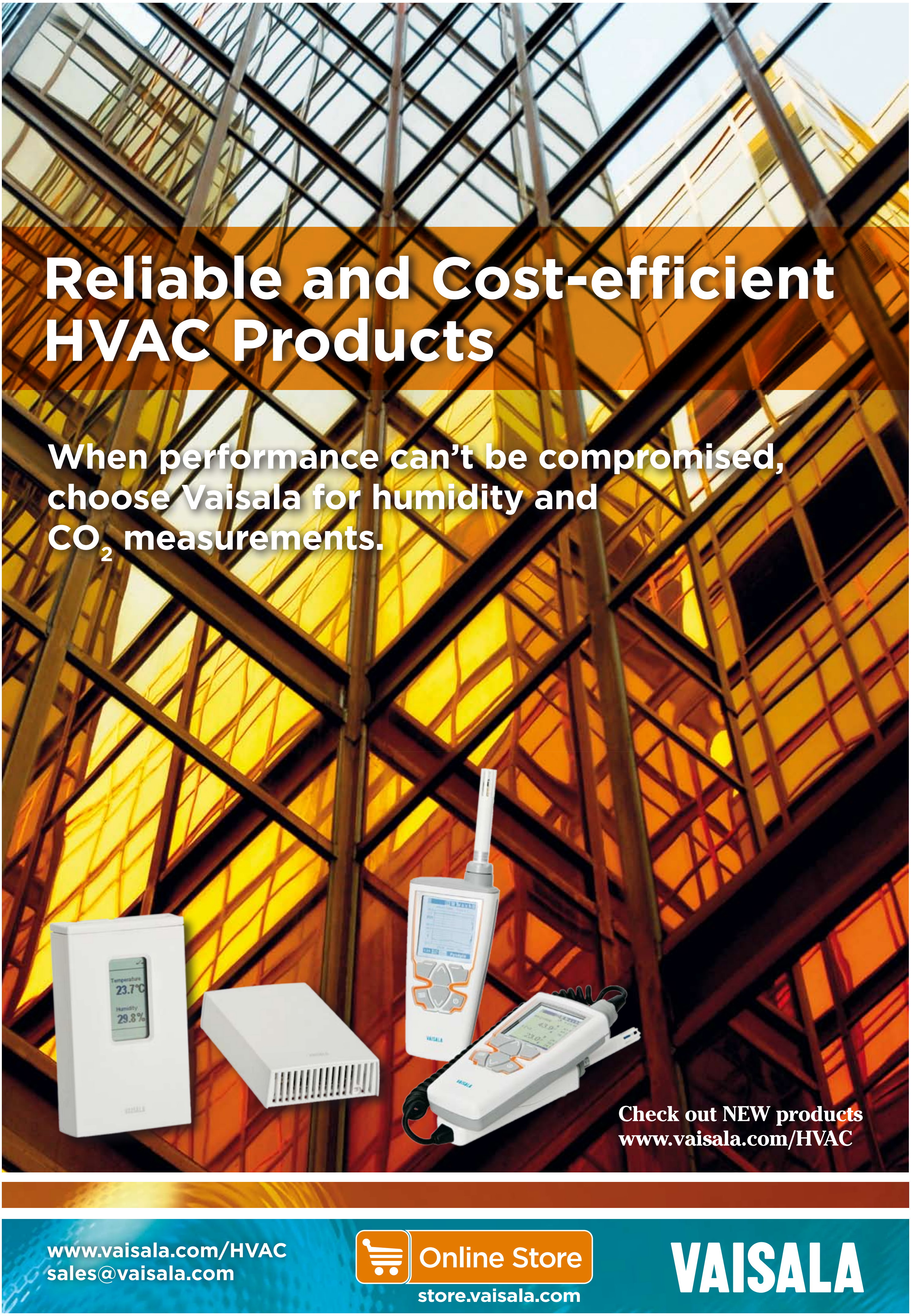
The guideline gives a summary overview of the main needs of persons and the requirements they place on sanitary installations. This guideline deals with requirements and solution approaches in real estate properties regarding sanitary installations and their useful combinations with solutions from electrical installation and furnishing.

### D VDI/VDE 6008/3 "Barrier-free buildings; Aspects of electrical installation and building automation"

The guideline gives a summary overview of the main needs of persons and requirements they place on electrical installations and building automation.

### D VDI 6022/7.1 "Ventilation and indoor-air quality; Branch-specific guides; Waste treatment plants"

The guideline is complementary, industry-specific information on VDI 6022 Part 1 for use in waste treatment plants. It applies to design, construction and operation of all HVAC systems and equipment and their centralized and decentralized components that influence the supply air in waste treatment plants according to Waste Law.


Reliable and Cost-efficient HVAC Products
When performance can't be compromised, choose Vaisala for humidity and $CO_2$ measurements.
Temperature 23.7°C
Humidity 29.8%
Check out NEW products
www.vaisala.com/HVAC
www.vaisala.com/HVAC
sales@vaisala.com
Online Store
store.vaisala.com
VAISALA

# HIGH QUALITY
# HIGH PROFIT
# HI ODE!

## Insulate for energy efficiency and make a profit by using ODE products!

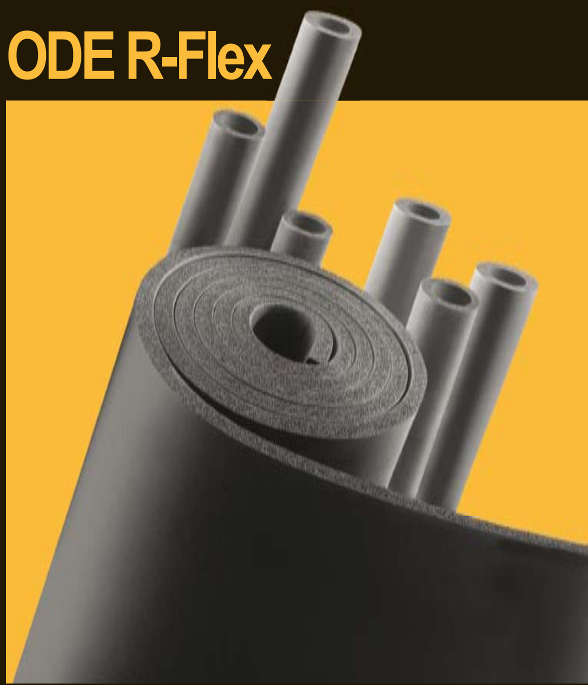
The biggest difference of ODE from the brands that you trust their quality, is to offer under the best sale conditions. Also, ODE produce thermal, fire, waterproofing and sound insulation materials with global standards and sells them to the World.

### ODE's Top Sellers

### ODE Starflex

Glasswool

### ODE R-Flex



Elastomeric rubber foam

ODE®

Insulation is our love

İstanbul - Turkey Tel: +90 212 210 49 06 Fax: +90 212 210 49 07 export@ode.com.tr

www.ode.com.tr

# CIBSE's Knowledge Portal – a great success

**www.cibseknowledgeportal.co.uk**

The jewel in CIBSE's crown, the Knowledge Portal, has proved a tremendous success since its launch in late 2011. It has already received over 100 000 visitors from 151 countries.

Visitors have downloaded more than 38 000 documents since CIBSE made its vast reservoir of technical information available to help members design projects, specify equipment and help deliver high-performance buildings.

All CIBSE publications are available online at the Portal, including its building services and lighting guides, commissioning codes, applications manuals and technical memoranda.

They can be searched and cross-referenced using dynamic search tools; entries can be browsed by title or identified using text search.

This free access has dramatically improved the flow of valuable technical information to building services engineers. It has also cut costs for the Institution by reducing postal charges and making it easier to revise and update documents.

Best practice on all aspects of building services engineering is available.

However, only one in three CIBSE members have registered to use the Portal - so two thirds have still not taken advantage of this significant member benefit.

CIBSE members are given free access to full texts as electronic (PDF) files, where available. There are also a number of CIBSE briefings, bulletins and similar documents included in the Portal, while CIBSE books can be bought as hard copy with preferential prices for CIBSE members.

Complimentary titles from leading publishers can also be found. These are only available to buy as hard copy at present, but CIBSE members benefit from preferential pricing.

An up-to-date list of more than 3 000 British Standards relevant to building services engineers is included. Each entry is hot-linked to the BSI Shop website page, with more information on that standard and how to purchase it.

CIBSE guides offer comprehensive technical guidance on key areas of building services engineering; technical memoranda (TMs) and application manuals (AMs) focus on specific areas, such as building energy metering or natural ventilation in non-domestic buildings, and again offer in-depth technical guidance.

The knowledge series (KSs) publications offer accessible introductions and practical guidance on particular areas. The commissioning codes (CCs) present current standards of good commissioning practice and the lighting guides (LGs) give essential information for any lighting specialist.

The availability of such a wide range of technical and practical guidance to the full building services community should make it easier to meet government and client targets for high quality buildings.

The Institution is now developing the next version of the Portal - version 1.1, aiming for launch later this year. KP2 will follow in 2013. CIBSE is very keen for members' input into the new versions so any knowledge gaps are identified and plugged, and welcome any comments and suggestions for the Knowledge Portal itself.

Members and others keen to help develop the Portal should contact Nick Peake via **npeake@cibse.org**

## New REHVA Guidebooks

**HVAC in Sustainable Office Buildings** – *A bridge between owners and engineers*

**Editor:** Maija Virta. **Contributing Authors:** Frank Hovorka, Andrei Litiu and Jarek Kurnitski

This book was created for building a bridge between the real estate community and the engineering community. It explains the challenges of property valuation based on real data and how the sustainability and HVAC-technology can have an impact on value. HVAC in Sustainable Office Buildings gathers the latest HVAC- and other technologies used in sustainable buildings and gives some real case study examples. Maybe the most important part in terms of improved communication between the owners and engineers is the list of questions to be asked during the life time of a building. It is impossible to give the right answers in this book, but we can raise some pertinent questions. As climates and cultures are different, as well as existing building types and energy production, the same solutions do not solve problems universally.


REHVA

**REHVA Guidebooks are available at www.rehva.eu or through REHVA National Members**

Federation of European Heating, Ventilation and Air-conditioning Associations

# Important CIBSE titles published in 2012


## TM44 Inspection of air conditioning systems – new edition

CIBSE TM44 is used as the guidance for air conditioning inspections in the UK, the Republic of Ireland, Malta and Gibraltar. The guidance is primarily intended to support inspections which are carried out for compliance with the EPBD, but will also be useful to anyone who wishes to assess the energy efficiency of an air conditioning system.

With the benefit of the experience gained over the past three years, and to clarify some of the questions about air conditioning system inspections that have arisen over that period, the TM has been revised. The revision also takes into account the reporting templates produced by the Department for Communities and Local Government for the production of reports in England and Wales. These templates will also form the basis for statutory lodgement of air conditioning inspection reports, which will be required in England and Wales as from 6th April 2012 under amendments to the Energy Performance of Buildings Regulations 2007. The revision has also provided the opportunity to incorporate the separate legislative requirements for Northern Ireland and Scotland in the main text of the TM, rather than as separate addenda.

TM44 provides guidance on conducting an air conditioning inspection to satisfy the requirements of the EPBD Directive as expressed in the various regulations in the UK. The focus is on systems that use refrigerants to produce cooling. Some of the guidance may also be applicable to elements of other forms of cooling systems, such as those that use pipes or ducts built into the fabric of the building (e.g. cooled deck or ceiling slabs), or those which use aquifers or local water sources to provide cooling solutions.

## Guide F Energy efficiency in buildings - new edition

This 2012 edition of CIBSE Guide F includes a new section on 'developing an energy strategy'. This reflects the changes to planning policy, which now include targets for reducing carbon dioxide emissions from new developments and the need to submit a detailed energy strategy report as part of the planning application.

Energy management has moved up the corporate agenda, aided by the work of the Carbon Trust and the implementation of the CRC Energy Efficiency Scheme. Part B of this Guide (covering the operation of the building) has been updated to include more information about carbon management, and the need for improved metering and monitoring.

In addition, the section on energy efficient refurbishment has been expanded in recognition of the pressing need to upgrade the existing building stock and the opportunities to improve performance.

This edition incorporates the new and revised guidance that has been published since 2004. This includes key CIBSE documents and publications by the Carbon Trust and BSRIA. These key references have informed many of the updates and are referenced throughout the Guide.

## Introduction to energy efficiency – Companion to Guide F

This new document 'Introduction to energy efficiency' constitutes a companion guide to the 2012 edition of CIBSE Guide F, which has been fully updated from the previous 2004 edition which it supersedes. It introduces the main Guide and summarises:

(1) the current policy agenda,
(2) the changing role of building services engineers,
(3) the key themes of Guide F.

This publication is primarily intended to provide guidance to those responsible for the design, installation, commissioning, operation and maintenance of building services. It is not intended to be exhaustive or definitive and it will be necessary for users of the guidance given to exercise their own professional judgement when deciding whether to abide by or depart from it.

All CIBSE titles are available in hard copy or in PDF at **www.cibseknowledgeportal.co.uk**

# Trailblazing Belimo Energy Valve™ knows where the energy is used

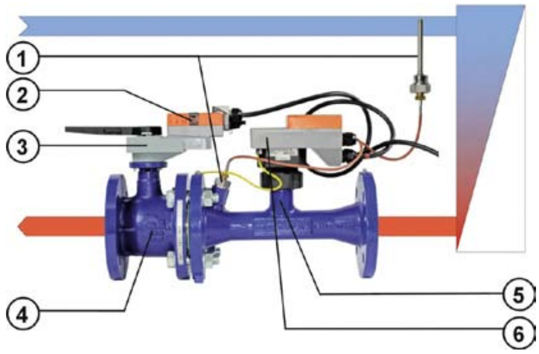
Measuring, controling, balancing and shutting with only one valve – the pressure-independent characterised control valves from Belimo have been making this possible for some time now. The provider from Switzerland has now developed this unique technology further and is offering trailblazing new possibilities with the intelligent Energy Valve: The consumption values of the water circulations are recorded and saved through the integration of state-of-the-art web technology. Available for call-up at any time for the previous 13 months, the energy monitoring supplies the bases not only for monitoring and analysing hot and cold water circulations, but also for optimising them with respect to energy.

As the world's leading specialist for electrical damper actuators and motorised valves in heating, air-conditioning and ventilation, Belimo invests considerably more in research and development than others do. At the forefront of this process is the determination to improve the controls of HVAC systems by means of decentralised logic, to reduce the consumption of water and energy and to improve the transparency of the processes.

## Simple valve design, optimised consumption

Exemplary for this development is the new *Energy Valve*. First of all, it combines – as does the electronically controlled, pressure-independent EPIV characterised control valve that was already introduced in 2010 – the «measuring», «controlling», «balancing» and «shutting» functions in a single valve. This offers a whole series of unique advantages: expenditure for valve design, for example, is considerably reduced, because there is no need to calculate the $k_{vs}$ value. In addition, the flow rate is measured electronically on a permanent basis and is immediately adjusted automatically in the event of pressure changes. The desired setpoint is maintained at all times, energy losses caused by pressure fluctuations are avoided. And hydraulic balancing, which is otherwise associated with great effort and expense, is dispensed with.

The mechanical parts of the *Energy Valve* are based on the Belimo characterised control technology that has proven itself millions of times over and for which the patented characterising disk guarantees an equal-percentage valve characteristic curve. The form-fit sealing of the ball-shaped valve cone closes off the valve absolutely air bubble tight, even with high differential pressures. In contrast to conventional metal seats, the seals exhibit no signs of wear – leakage losses are thus reliably avoided over the years.

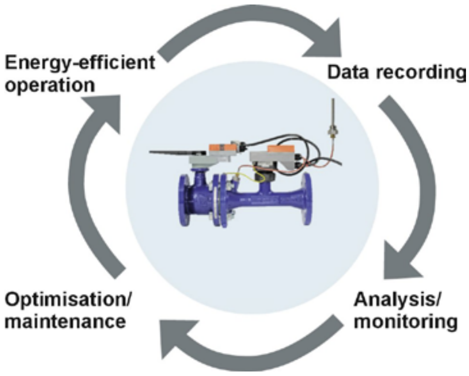



The Belimo Energy Valve™ can measure, control, balance and shut. And it is the first valve to also show where the energy is going.
1) Temperature sensors; 2) Integrated Web server; 3) Actuator; 4) Characterised control valve; 5) Measuring pipe with velocity sensor; 6) Sensor electronics.

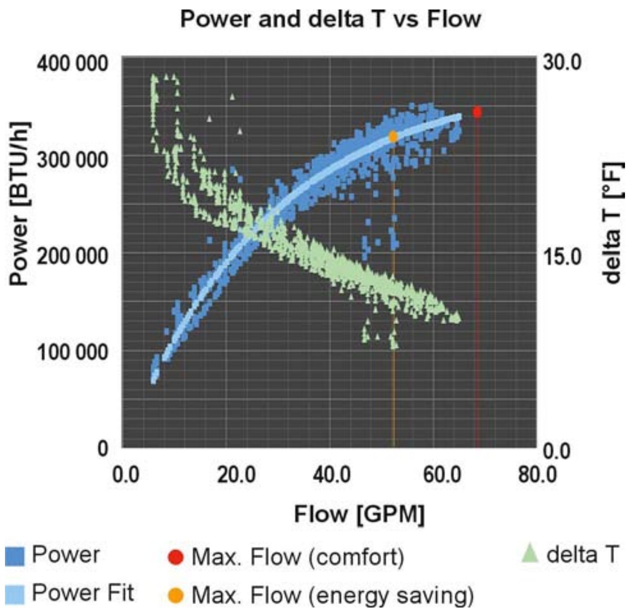
## Intelligent energy monitoring

But that's not all. With the *Energy Valve* – besides the flow rate sensor – two additional sensors also measure the medium temperatures in the supply and return as a fifth function. That means that energy consumption for heating and cooling is determined on a continuous basis and then saved on the web server integrated in the actuator. The current consumption values can be called up at any time – either onsite with a laptop (RJ45 Ethernet interface) or through the management system. Because the measurement data remain saved for 13 months, analyses and documentation are possible over extended periods in order to discover where the energy is going and where it is not being used efficiently.

The *Energy Valve* is used for modulating water-side control of air processing and heating systems in closed cold or hot water circulations. If the conditions in the system change after the commissioning of the system, then this will be recognised with the aid of the data provided by the valve. Thus, for example, reductions in output performance caused by the soiling of the heat exchanger can be readily detected on the basis of the reconstructable characteristic curve, and suitable measures can be taken up in response. Furthermore, additional functions contained in the *Energy Valve*, e.g. the «ΔT manager», enable the continuous operation of the heat exchanger in the range that is optimum with respect to energy. This supports energy-optimised operation and ensures that the systems will maintain their value throughout the entire period of operation.




With the data recorded by the Belimo Energy Valve™, the system can be monitored, analysed and optimised for energy-efficient operation.




The web server in the Belimo Energy Valve™ can reconstruct earlier system data: This makes it easier to make adjustments on retrofit projects.

## Use with retrofit measures

It is often discovered, when valves are replaced in older systems, that the system data have become lost over time or that they are unknown due to various adaptations that are made. Here, too, the *Energy Valve* offers an irresistibly simple solution. Missing data can be reconstructed without difficulty with the aid of the integrated web server. This means that the maximum flow rate can be set precisely and that it can be optimised at any time if necessary.

The combination of innovative valve technology and state-of-the-art IT thus brings about something that was previously not possible: The simple monitoring and optimisation of the energy consumption of heating and cooling circuits with the aid of intelligent valves. The contemporary demand for ensuring a responsible handling of resources and maximum economic efficiency is optimally met. That is why the future belongs to the *Energy Valve* and its trailblazing technology. The Energy Valve from Belimo is available starting summer 2012 in the nominal widths of DN 65 to DN 150.

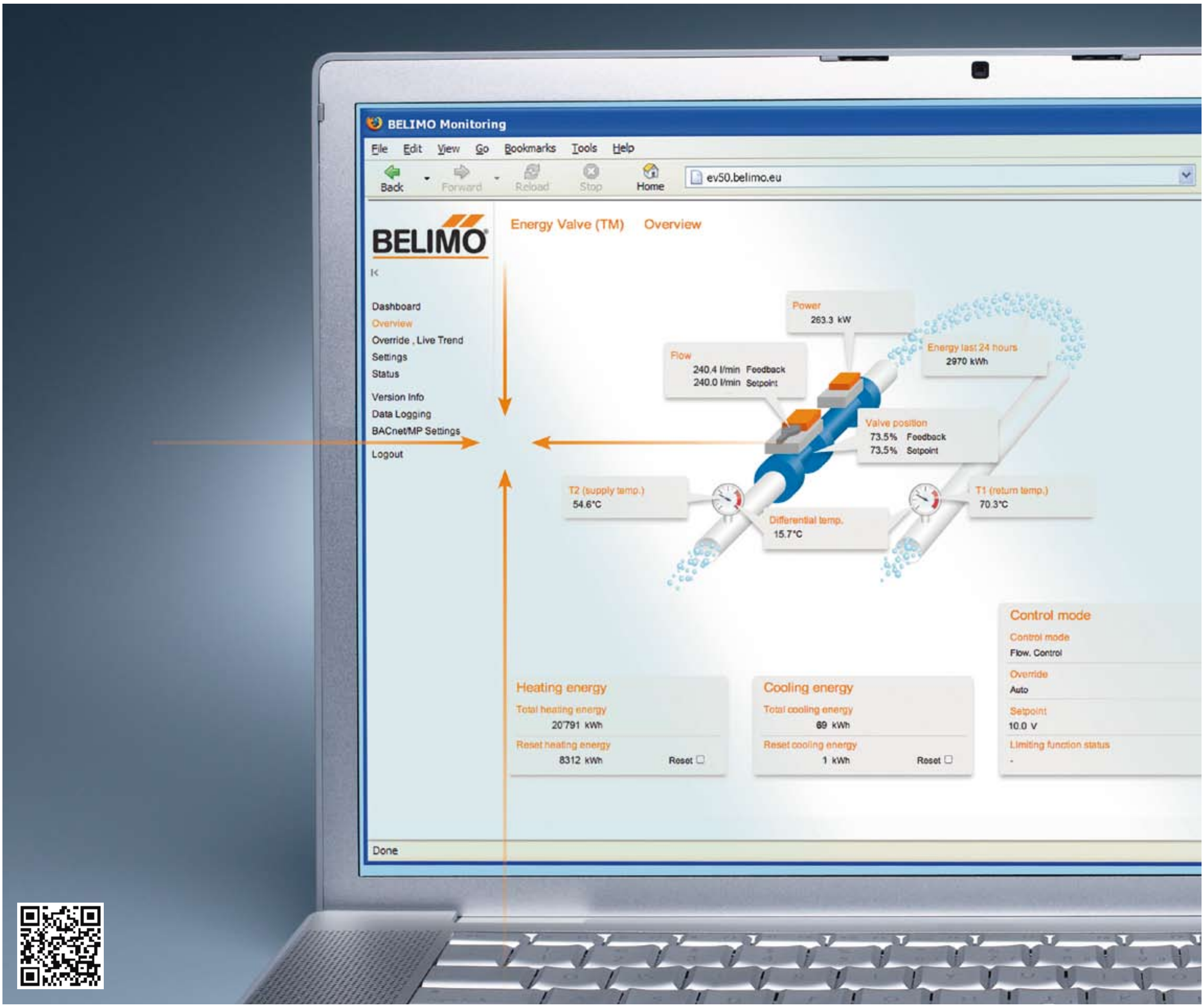
More information under **www.belimo.eu**

## CIAT supplies air conditioning into the national library in Uzbekistan

The contract, which amounts to over €1.5 M, is a major achievement as this is the largest building constructed in Central Asia in 2011. The entire installation, from the chillers to the comfort units, and including technical assistance, was supplied by CIAT. The Uzbekistan national library is the country's biggest library. It houses more than 3.5 million printed works, including 200,000 copies of documents that date from the fifteenth to the nineteenth centuries. 500,000 people use the library every year. Inaugurated in 2011, a new building covering an area of 38,000 sq. m comprising reading rooms, storage rooms, a conference centre with seating for 960 people, and a book museum, was added. The book storage areas are kept at a constant temperature of 18°C.

It took only 6 months to finalize the design work for the new building, order all the equipment for the finishing work (air conditioning, lifts, glazing, etc.) and install it.

The CIAT group carried out the entire air handling installation and equipped the building with 18 Airtech air treatment units, 28 Expair precision air handling cabinets, 50 Magma ventilation and air extraction units, 205 Major Line comfort units, 4 Powerciat LXH chilled water production units (cooling-only version with HPS (High Power System) hydraulic system), 3 ITEX gasketed plate heat exchangers, and 2 domestic hot water tanks. One of the main difficulties was to supply chillers that could be installed on the roof, and assembled and dismantled on site.




# We make energy currents visible. You optimise the water circuits.

## EXPERIENCE **EFFICIENCY**

In addition to the flow rate, the sensors in our electronically regulated Energy Valve™ also measure the temperatures in the supply and return lines, e.g. with heat exchangers. The values are saved in the integrated webserver for up to 13 months and are visible, e.g. onsite on the laptop. The current consumption can also be depicted on the management system. This way, you can analyse and document which direction the energy is flowing to and optimise the energy flows of the hot and cold water circuits at any time.

**BELIMO Automation AG,** Brunnenbachstrasse 1, CH-8340 Hinwil
Tel. +41 43 843 61 11, Fax +41 43 843 62 68, info@belimo.ch, www.belimo.com

# HVAC & R products solution partner for those who want to live at the summit

***Nasuh Mahruki***
***Yılmaz Sevgül***

*2010 Everest Expedition sponsor*

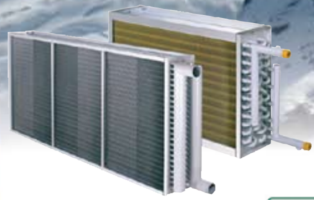
***$CO_2$*** Gas Coolers and Unit Coolers

Starbox Condensing Units & Air Cooled Condensers

OEM Finned Pack Heat Exchangers & Steam Coils

Wet / Dry Coolers with Ecomesh Spray System & V-Type Dry Coolers

Blast Freezers & Air Coolers



Air Heating and Cooling Coils Using Water & Software FRTCOILS V.2

EUROVENT CERTIFIED PERFORMANCE
www.eurovent-certification.com

| CERTIFIED GEOMETRIES | ID No |
|---|---|
| F 2522 - 3/8" | 03. 04. 065 |
| F 3833 - 5/8" | 03. 04. 315 |
| F 4035 - 1/2" | 03. 04. 316 |
| F 4035 - 5/8" | 03. 04. 317 |
| F 3228 - 1/2" | 10. 09. 503 |

TÜV NORD ISO 9001 · EUROVENT member of · TEİD · rehva Federation of european heating and airconditioning associations Supporting Member · WE EMBRACE AND PRACTICE INDUSTRY CODE OF ETHICS · TSEK · CE · АИ46 · member of ISKID AIR CONDITIONING & REFRIGERATION MANUFACTURERS' ASSOCIATION · ISKAV Heating, Cooling, Air Condition Research and Education Foundation Founder member

**Head office / Factory:**
İstanbul Deri Organize Sanayi Bölgesi Dilek Sokak No:10
X-11 Özel Parsel Tuzla 34957 İstanbul / TURKEY
**Tel:** +90 216 394 12 82 (pbx) **Fax:** +90 216 394 12 87

e-mail: info@friterm.com
web: www.friterm.com

FRITERM®
since 1979

REHVA
Federation of European Heating, Ventilation and Air Conditioning Associations
SUPPORTER

# REHVA SUPPORTERS

AERMEC – AHRI Air-Conditioning, Heating and Refrigeration Institute – AIR TRADE CENTRE Durable HVAC Solutions – ALFA LAVAL – atlantic CLIMATISATION ET VENTILATION – BELIMO

Caisse desDépôts – camfil FARR – CIAT – CLIMESPACE GDF SUEZ – DAIKIN – Demark CONSTRUCT – EMERSON Network Power

Enventus ENERGY RECOVERY – EPEE European Partnership for Energy and the Environment – ES-SO EUROPEAN SOLAR-SHADING ORGANIZATION – EUROVENT CERTIFICATION – evapco – Flanders FOREMOST IN AIR FILTRATION – FläktWoods

FRITERM – GEA – Granlund – GRUNDFOS – Halton – Hidria

ICADE Foncière-développeur – LIFA AIR – Lindab – LU-VE GROUP – MOTAN WALL HUNG GAS BOILERS – RETTIG – RHOSS www.rhoss.it

SKANSKA – Smits van Burgst – somfy – Swegon – systemair – TANGRA

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

---

The REHVA European HVAC Journal

## Subscribe NOW for 2013!

| Company: | Department: |
|---|---|
| Last name: | First name: |
| Address: | |
| | |
| Postal Code: | City: |
| Country: | |
| E-mail: | |
| Signature: | Date: |

☐ YES! I would like to subscribe to the **REHVA JOURNAL** for one year. Please, return your subscription form or change of address to REHVA office.

REHVA – Rue Washington, 40 - 1050 Brussels - Belgium
Telephone: +32 2 514 11 71 - Telefax: +32 2 512 90 62
e-mail: info@rehva.eu - website: www.rehva.eu

☐ I want to register for the REHVA e-newsletter.

*Shipping information will not be used for any other purpose than mailing of REHVA Journal and will not be given to third party.

Send information of your event to Ms Cynthia Depradel cd@rehva.eu

# Events in 2012 - 2014

## Conferences and seminars 2012

| | | | |
|---|---|---|---|
| December 5 – 7 | 43th International congress of Heating, Air Conditioning and Refrigeration | Belgrade, Serbia | www.kgh-kongres.org/ |
| December 6 – 7 | 7 th International Energy Forum on Solar Building Skins | Bressanone, Italy | www.energy-forum.com |

## Conferences and seminars 2013

| | | | |
|---|---|---|---|
| January 22 | GEOTABS - Towards optimal design and control of geothermal heat pumps combined with Thermally Activated Building Systems in offices | Hannover, Germany | www.geotabs.eu/symposium-2013 |
| January 26 – 30 | ASHRAE 2013 Winter Conference | Dallas, Texas, USA | www.ashrae.org/membership--conferences/conferences/dallas-conference |
| February 8 – 9 | ACRECONF | New Delhi, India | www.acreconf.org |
| April 8 – 10 | ISH China & CIHE | Beijing, China | www.ishc-cihe.com |
| April 10 – 11 | European Biomass to Power | Krakow, Poland | www.wplgroup.com/aci/conferences/eu-ebp3.asp |
| April 15 – 17 | 3rd International Conference in Microgeneration and Related Technologies in Buildings - Microgen III | Naples, Italy | www.microgen3.eu |
| May 9 – 11 | 5th International Conference on Amonia Refrigeration Technology | Ohrid, Macedonia | www.mf.edu.mk |
| May 27 – 28 | 36th Euroheat and Power Congress | Vienna Austria | www.ehpcongress.org |
| May 30 – 31 | Energy Performance of Buildings and Related Facilities | Bucharest, Romania | www.aiiro.ro |
| June 3 – 8 | eceee 2013 Summer Study on energy efficiency | Toulon/Hyere, France | www.eceee.org/summerstudy |
| June 7 – 8 | The Latest Technology in Air Conditioning and Refrigeration Industry | Milan, Italy | www.centrogalileo.it/milano/CONGRESSODIMILANO2013english.html |
| June 16 – 19 | 11th REHVA world congress Clima 2013 | Prague, Czech Republic | www.clima2013.org |
| June 19 – 21 | Intersolar Europe 2013: Innovative Technologies and New Markets | Munich, Germany | www.intersolar.de |
| June 22 – 26 | 2013 ASHRAE Annual Conference | Denver, Colorado | www.ashrae.org/membership--conferences/conferences/ashrae-conferences/denver-2013 |
| June 24 – 28 | EU Sustainable Energy Week 2013 in Brussels | Brussels, Belgium | www.eusew.eu |
| June 26 – 28 | Central Europe towards Sustainable Building Prague 2013 | Prague, Czech Republic | www.cesb.cz/en |
| September 25 – 27 | 5th International Conference Solar Air-Conditioning | Kurhaus Bad Krotzingen, Germany | www.otti.eu |
| September 25 – 29 | International Conference on Sustainable Building Restoration and Revitalisation | Shanghai, China | www.wta-conferences.org/conference/1869 |
| October 3 – 4 | CLIMAMED - VII Mediterranean Congress of Climatizacion | Istanbul, Turkey | www.climamed.org |
| October 15 – 16 | European Heat Pump Summit | Nürnberg, Germany | www.hp-summit.de |
| October 15 – 18 | IAQ 2013 - Environmental Health in Low Energy Buildings | Vancouver, British Columbia, Canada | www.ashrae.org/membership--conferences/conferences/ashrae-conferences/iaq-2013 |
| October 16 – 18 | Building Services for the Third Millenium | Sinaia, Romania | www.aiiro.ro |
| October 18 – 19 | COGEN Europe Annual Conference & Dinner | Brussels, Belgium | www.cogeneurope.eu |
| October 20 – 21 | Energy Efficiency & Behaviour | Helsinki, Finland | www.behave2012.info |
| October 24 | 50th REHVA anniversary | Brussels, Belgium | www.rehva.eu |

## Exhibitions 2013

| | | | |
|---|---|---|---|
| January 28 – 30 | AHR Expo | Dallas, Texas, USA | www.ahrexpo.com |
| February 5 – 8 | Aqua-Therm Russia 2013 | Moscow, Russia | www.aquatherm-moscow.ru/en/home/ |
| February 26 – March 1 | Climatizacion | Madrid, Spain | www.ifema.es/web/ferias/climatizacion/default.html |
| February 27–March 1 | World Sustainable Energy Days - the WSED 2013 | Wels, Austria | www.wsed.at |
| March 7 – 9 | ACREX 2013 | Mumbai, India | www.ishrae.in |
| March 12 – 16 | ISH Frankfurt | Frankfurt, Germany | www.ish.messefrankfurt.com |
| November 4 – 8 | Interclima+Elec | Paris, France | www.interclimaelec.com |

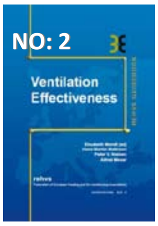
## Exhibitions 2014

| | | | |
|---|---|---|---|
| April 1 – 4 | NORDBYGG 2014 | Stockholm, Sweden | www.nordbygg.se |
| March 18 – 21 | MCE - Mostra Convegno Expocomfort 2014 | Fiera Milano, Italy | www.mcexpocomfort.it |
| March 30- April 4 | Light + Building | Frankfurt, Germany | www.light-building.messefrankfurt.com |
| May 7 – May 10 | ISK - SODEX 2014 | Istanbul, Turkey | www.hmsf.com |
| October 14 – 16 | Chillventa 2014 | Nuremberg, Germany | www.chillventa.de/en/ |
| September 30 – October 3 | Finnbuild 2014 | Helsinki, Finland | www.finnbuild.fi |

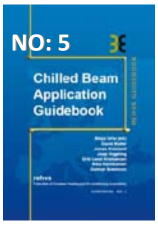
REHVA Federation of European Heating, Ventilation and Air-conditioning Associations

# REHVA GUIDEBOOKS

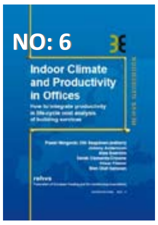
## REHVA Guidebooks are written by teams of European experts



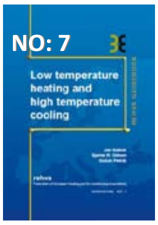

Improving the ventilation effectiveness allows the indoor air quality to be significantly enhanced without the need for higher air changes in the building, thereby avoiding the higher costs and energy consumption associated with increasing the ventilation rates. This Guidebook provides easy-to-understand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



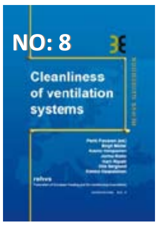

Chilled beam systems are primarily used for cooling and ventilation in spaces, which appreciate good indoor environmental quality and individual space control. Active chilled beams are connected to the ventilation ductwork, high temperature cold water, and when desired, low temperature hot water system.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



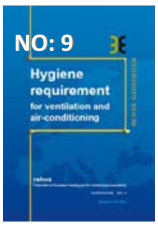

Indoor Climate and Productivity in Offices Guidebook shows how to quantify the effects of indoor environment on office work and also how to include these effects in the calculation of building costs. Such calculations have not been performed previously, because very little data has been available. The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



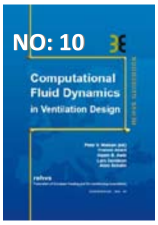

This Guidebook describes the systems that use water as heat-carrier and when the heat exchange within the conditioned space is more than 50% radiant. Embedded systems insulated from the main building structure (floor, wall and ceiling) are used in all types of buildings and work with heat carriers at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



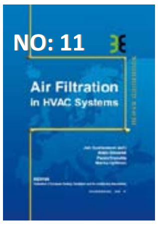

Cleanliness of ventilation systems Guidebook aims to show that indoor environmental conditions substantially influence health and productivity. This Guidebook presents criteria and methods on how to design, install and maintain clean air handling systems for better indoor air quality.



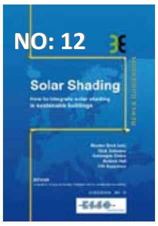

Hygiene requirement is intended to provide a holistic formulation of hygiene-related constructional, technical and organisational requirements to be observed in the planning, manufacture, execution, operation and maintenance of ventilating and air-conditioning systems. These requirements for ventilating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



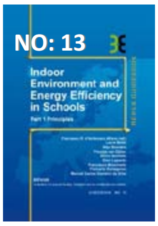

CFD-calculations have been rapidly developed to a powerful tool for the analysis of air pollution distribution in various spaces. However, the user of CFD-calculation should be aware of the basic principles of calculations and specifically the boundary conditions. Computational Fluid Dynamics (CFD) –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



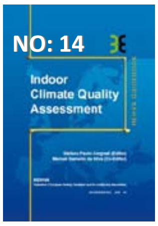

Air filtration Guidebook will help the designer and user to understand the background and criteria for air filtration, how to select air filters and avoid problems associated with hygienic and other conditions at operation of air filters. The selection of air filters is based on external conditions such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



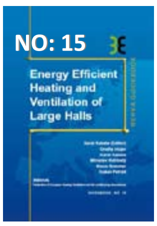

Solar Shading Guidebook gives a solid background on the physics of solar radiation and its behaviour in window with solar shading systems. Major focus of the Guidebook is on the effect of solar shading in the use of energy for cooling, heating and lighting. The book gives also practical guidance for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



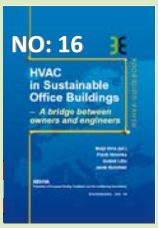

School buildings represent a significant part of the building stock and also a noteworthy part of the total energy use. Indoor and Energy Efficiency in Schools Guidebook describes the optimal design and operation of schools with respect to low energy cost and performance of the students. It focuses particularly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



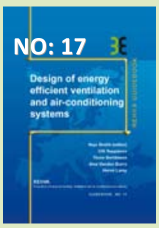

This new REHVA Guidebook gives building professionals a useful support in the practical measurements and monitoring of the indoor climate in buildings. Wireless technologies for measurement and monitoring has allowed enlarging significantly number of possible applications, especially in existing buildings.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




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




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




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

www.rehva.eu ● info@rehva.eu ● REHVA Office: 40 rue Washington, 1050 Brussels—Belgium ● Tel + 32 2 514 11 71 ● Fax +32 2 512 9062

**REHVA Guidebooks are available at www.rehva.eu or through REHVA National Members**