REHVA

Federation of European Heating, Ventilation and Air Conditioning Associations

LG/REHVA Seminar, 02 June 2016, PARIS

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REHVA

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1. What is REHVA?

(founded 1963)

REHVA is a professional organisation representing more than 100.000 building services engineers

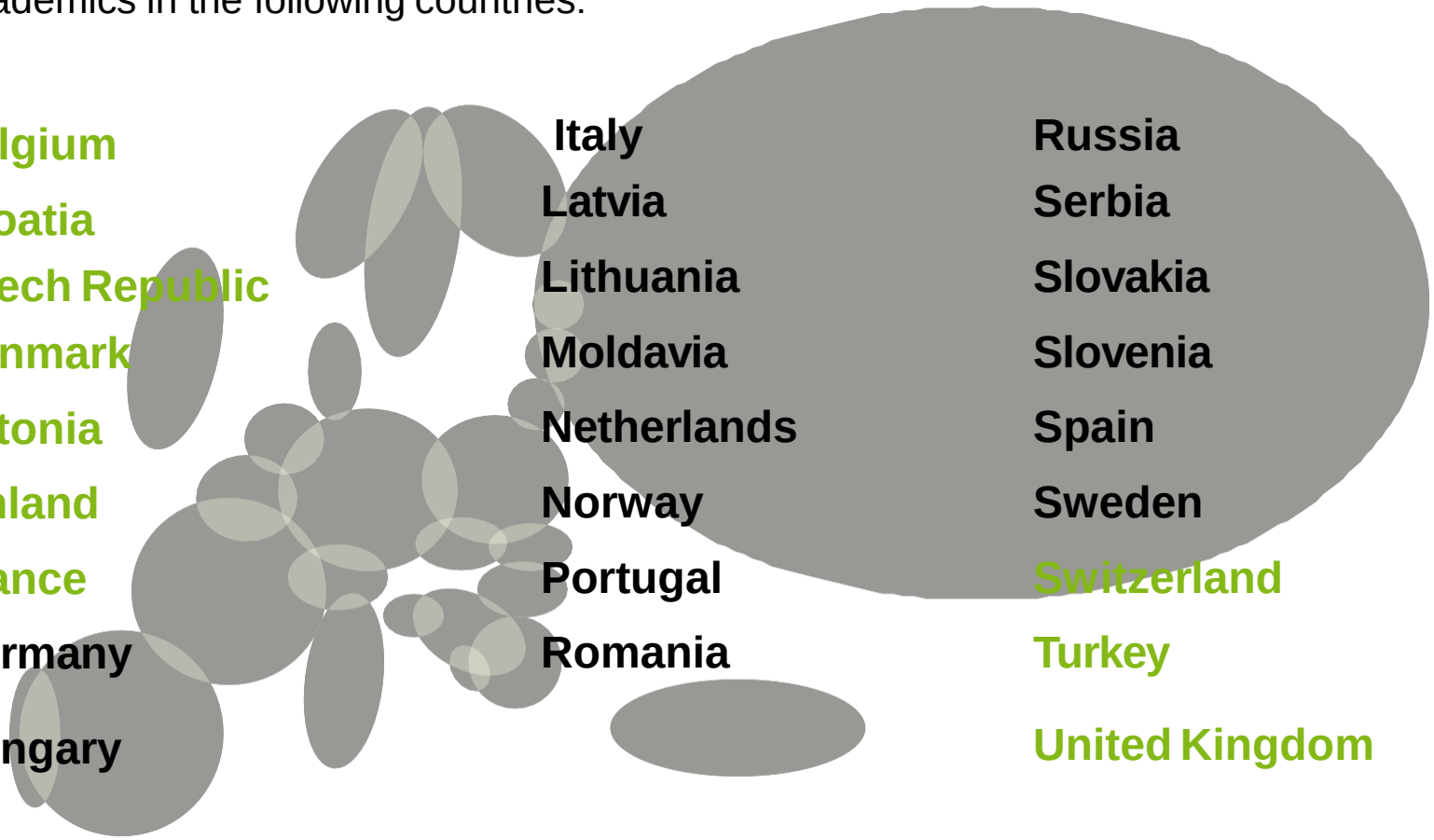
(heating, ventilation and air conditioning for energy efficient, healthy buildings)

from 27 European countries

REHVA

REHVA Network

27 Member Associations in Europe, representing 100 000 practitioners and academics in the following countries:



Belgium
Croatia
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Denmark
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Latvia
Lithuania
Moldavia
Netherlands
Norway
Portugal
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Slovakia
Slovenia
Spain
Sweden
Switzerland
Turkey
United Kingdom

REHVA

REHVA Members

Atic for HVAC professionals

Danvak

EKVÜ

FINVAC The Finnish Association of HVAC Societies

VDI

MAGYAR ÉPÜLETGÉPÉSZETI KOORDINÁCIÓS SZÖVETSÉG

AiCARR Cultura e Tecnica per Energia Uomo e Ambiente

LATVIJAS SILTUMA, GĀZES UN ŪDENS TEHNOLOĢIJAS INŽENIERU SAVIENĪBA

LIŠTIA

ASOCIAȚIA INGINERILOR DE INSTALAȚII DIN REPUBLICA MOLDOVA AIIRM

NORSK VVS ENERGI- OG MILJØTEKNISK FORENING

ORDEM DOS ENGENHEIROS

ASOCIAȚIA INGINERILOR DE INSTALAȚII DIN ROMÂNIA AIIR

AGFR ASOCIAȚIA GENERALĂ A FRIGOTEHNIȘTILOR DIN ROMÂNIA

AFCR ASOCIAȚIA FRIGOTEHNIȘTILOR ȘI CRIOGENIȘTILOR DIN ROMÂNIA

ABOK

kgh

STP

SITHOK

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Atecyr Asociación Técnica Española de Climatización y Refrigeración

CIBSE

ENERGI & MILJÖ TEKNISKA FÖRENINGEN

SWKI SICC SITC

TVVL

TURKISH SOCIETY OF HVAC & SANITARY ENGINEERS TTMD 1992 TURKEY

Activities of REHVA members

- **Member associations represent about 100.000 experts in HVAC**
- **Co-operation with more than 1.500 industrial companies**
- **Over 20 journals with more than 110 issues per year**
- **Close to 100 congresses per year- focus on HVAC and energy**
- **Hundreds of training events**
- **Support to more than 10 regular international exhibitions**

REHVA

REHVA Organisation

GENERAL ASSEMBLY (GA)
Long term policy
Mission
Budget
Election of Board

REHVA OFFICE
Implementation of the annual action plan
Daily management of contacts and finances
Assistance for committees
Sales of REHVA guidebooks
Assistance to REHVA journal

EUROPEAN PROJECTS
Project management
Dissemination

DAILY MANAGEMENT
Correspondence
Membership
Services
Finances

BOARD OF DIRECTORS
Implement GA decisions and policy
Financial and legal responsibility
Short and long term planning
Supervising the REHVA office and Committees

TREASURER
Budgets
Follow up the budget
Financial reports

TECHNOLOGY & RESEARCH COMMITTEE
Tasksforces
Technical guidebooks and reports
Networks of experts

PUBLISHING & MARKETING COMMITTEE
Website
Sales of publications
REHVA journal
REHVA dictionary
Promotional material

EDUCATION COMMITTEE
Student Competitions
Common courses
Educational material
Directory of Educational Institutions
Directory of National Contact persons
Organizing seminars and symposiums by REHVA

AWARD COMMITTEE
Announcement and selection
Gold Medal
Professional Awards
Young Researchers Award
Fellows

SUPPORTERS COMMITTEE
Services to supporters
New supporters
Promoting the development of European HVAC industry
Tasksforces

EXTERNAL RELATIONS COMMITTEE
The European Commission
Other EU Bodies
Relationships with other associations
Relationship with other (non-HVAC) organizations

MEMBERSHIP COMMITTEE
Services to members
Relationships with national associations

REGIONS

COP

SCANVAC

REHVA

Daily Work under the Committees

1. Technology and research
2. Publishing and marketing
3. Educational and Training
4. Supporters
5. Awards
6. External relations
7. Membership

REHVA

REHVA Journal

- Focus on European HVAC technology, policy and regulations
- Six issues a year
- Technical articles
- Website **www.rehva.eu**
- International editorial board
- Prof. Jaap Hogeling, Editor-in-Chief

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REHVA Newsletter

www.rehva.eu

Free subscription Min six issues a year

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

Newsletter Issue 4/2013

July 2013

REHVA Community News

57th REHVA General Assembly

During the 57th REHVA General Assembly, the former President Michael Schmidt thanked the members of the board having contributed to his presidential term as good collaborators.The President-elect Karel Kabele was installed as the new President. He and the Assembly warmly thanked Michael Schmidt for his important contribution to REHVA's development during his term.
Mr Valentin Tonu, the representative of the Moldavian Association, AIIRM, was presented by the President as observer during the 57th General Assembly. The proposal was made to accept Moldavia as new member in 2014.
President Karel Kabele informed the audience that the next REHVA Annual Meeting will take place in Düsseldorf (Germany) from 28-30 April 2014, the REHVA Annual Meeting 2015 in Riga (Latvia) from 7 till 9 May 2015 and the next CLIMA Congress will be organized by DANVAK and take place in Aalborg (Denmark) from 22 till 26 May 2016.

REHVA elects new Board

On 15 June 2013, the General Assembly elected through a voting process four new board members : Ioan Silviu Dobosi–AIIR (Romania) is re-elected, Jarek Kurnitski–EKVU (Estonia) is re-elected, Manuel Gameiro da Silva–Ordem dos Engenheiros (Portugal) and Frank Hovorka–AICVF (France) were elected. Lars Nielsen–DANVAK (Denmark) is elected as reserve board member. The President was the first to congratulate the elected members with their board membership and their responsibilities.

The new REHVA board after the elections, from left to right: Jarek Kurnitski, Zoltan Magyar, Frank Hovorka, Paolo S. Corgnati, Karel Kabele,Jan Aufderheijde, Ioan Silviu Dobosi, Manuel Gameiro da Silva

Send material to **info@rehva.eu**

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Bulletin to REHVA supporters

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

SUPPORTER

REHVA BULLETIN

for our Supporters

No. 3-2013

REHVA Office, 40 rue Washington, 1050 Brussels - Belgium www.rehva.eu - info@rehva.eu - Tel: +32-2-5141171

Editorial board: Jorma Railio, Ioan Silviu Dobosi, Frank Hovorka, Lars Nielsen, Jan Aufderheijde

INSIDE THIS ISSUE

REHVA welcomes a new supporter

Eneko S.A has joined the reHVAClub of supporters in the beginning of June 2013. Eneko meets the needs of the sector with its effective and cost-efficient technology products complying with Turkish and European standards, while keeping up the quality on ventilation and heat/energy recovery systems.

eneko

New REHVA Guidebooks

(For more information see http://www.rehva.eu/index.php?id=6)

- Legionellosis Prevention in Building water and HVAC Systems - a Practical Guide for Design, Operation and Maintenance to Minimize the Risk (GB nr 18)
  Editors: Sergio La Mura, Cesare Maria Joppolo, Luca Alberto Piterà
  Contributing authors: Jean Pierre Angermann, Mark Izard
- Mixing Ventilation - Guide on mixing air distribution design (GB nr 19)
  Editor: Dirl Mülle
  Contributing authors: Claudia Kandzia, Risto Kosonen, Arsen Krikor Melikov, Peter Vilhelm Nielsen
- Advanced system design and operation of GEOTABS buildings (GB nr 20)
  Authors: Franziska Bockelmann, Stefan Plesser, Hanna Soldaty
  Co-Authors: Wim Boydens, Daniel Costola, Arno Dentel, Thomas Dippel, Lukas Ferkl, Adrian Görtgens, Lieve Helsen, Jan Hoogmartnes, Bjarne W. Olesen, Wout Parys, Maarten Sourbron, Clara Verhelst, Jan Verheyen and Christian Wagner
- REHVA nZEB technical definition and system boundaries for nearly zero energy building (Report nr 4)
  Editor: Jarek Kurnitski
  Contributing authors: Francis Allard, Derrick Braham, Dick van Dijk, Christian Feldmann, Jacquelyn Fox; Jonas Gräslund, Per Heiselberg, Frank Hovorka, Risto Kosonen, Jean Lebrun, Zoltan Magyar, Livio Mazzarella, Ivo Martinac, Vojislav Novakovic, Jorma Railio, Olli Seppänenn Igor Sartori, Johann Zirngibl, Michael Schmidt, Maija Virta, Karsten Voss and Asa Wahlström

REHVA General Assembly 2013

REHVA General Assembly meeting gathered nearly 90 participants on 15 June 2013 in Prague. REHVA warmly thanked its Czech member STP for organising a very nice event. German association VDI will hold the next 2014 GA meeting in Düsseldorf (Germany) which will take place April 29. During the GA, a new board was unanimously elected. Two Board Members saw their mandate renewed. Bjarne W. Olesen decided to step down due to other professional activities. Former President Michael Schmidt came at the end of his term and thanked the members of the board having contributed to his presidential term as good collaborators.

The President-elect Karel Kabele was installed as the new President. He and the Assembly warmly thanked Michael Schmidt for his important contribution to REHVA's development during the two last years. The new REHVA Board now consists of President: Karel Kabele (STP, Czech Republic) and Vice-Presidents: Stefano P. Corgnati (AiCARR, Italy), Ioan Silviu Dobosi (AIIR, Romania), Manuel Gameiro da Silva (Ordem dos Engenheiros, Portugal), Frank Hovorka (AICVF, France), Jarek Kurnitski (EKVU, Estonia), Zoltan Magyar (ETE, Hungary) and Jan Aufderheijde as SG .

- Six times a year
- Focus on EU/EC regulations
- EPBD
- Ecodesign
- Funding
- Events

Send material to **info@rehva.eu**

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REHVA dictionary

- REHVA multilingual HVAC dictionary
  www.rehvadictionary.eu
- 12 000+ HVAC words
- 18 languages
  Czech – Danish – Dutch – English – Finnish – French – German – Hungarian – Italian – Norwegian – Polish – Portuguese – Romanian - Russian –Slovenian – Spanish – Swedish – Turkish
- **Contacts: Chiara Girardi @ cg@rehva.eu**

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REHVA Technical Guidebooks

- Displacement Ventilation
- Ventilation Effectiveness
- Electrostatic Precipitators for Industrial Applications
- Ventilation and smoking
- Chilled Beam Application
- Indoor Climate & Productivity in Offices
- Low Temperature Heating and High Temperature Cooling
- Cleanliness of Ventilation Systems
- Hygiene Requirement for ventilation and air conditioning
- Computational Fluid Dynamics in ventilation design
- Air Filtration in HVAC Systems
- Solar Shading – How to integrate solar shading in sustainable buildings
- Indoor Environment and Energy Efficiency in Schools
- Indoor Climate Quality Assessment – Evaluation if indoor thermal and indoor air quality
- Energy Efficient Heating and Ventilation of Large Halls
- HVAC in Sustainable Office Buildings - A bridge between owners and engineers
- Design of energy efficient ventilation and air-conditioning systems
- Legionellosis Prevention in Building Water and HVAC Systems
- Mixing Ventilation – Guidebook on mixing air distribution design
- Advanced system design and operation of GEOTABS buildings
- Active and Passive Beam Application Design Guide

REHVA Guidebooks

21 Guidebooks

Available on www.rehva.eu or through National associations

Translation and printing of REHVA guidebooks

- **Displacement Ventilation:** Dutch, Finnish, German, Hungarian, Italian, Japanese, Latvian, Norwegian, Portuguese, Russian, Slovenian, Spanish, Turkish
- **Ventilation Effectiveness:** Hungarian, Japanese, Latvian, Portuguese, Russian, Slovenian
- **Chilled Beam:** French, Hungarian, Italian, Polish, Portuguese, Slovenian, Spanish, Turkish
- **Indoor Climate & Productivity:** Dutch, Italian, Japanese
- **Low Temperature Heating and High Temperature Cooling:** Chinese, Finnish, Hungarian, Italian, Portuguese, Slovenian, Turkish
- **Cleanliness of Ventilation Systems:** German, Italian, Portuguese
- **Hygiene Requirement:** Italian, Portuguese
- **CFD in ventilation design:** Italian, Japanese
- **Air Filtration in HVAC Systems:** Italian, Portuguese
- **Solar Shading:** Finnish, French, Swedish, Portuguese
- **Indoor environment and energy efficiency in schools – Part 1 principles:** Italian, Portuguese
- **Indoor climate quality assessment – Evaluation of indoor thermal and indoor air quality**: Italian, French
- **HVAC in Sustainable Office Buildings – A Bridge Between Owners and Engineers**: French
- **Design of Energy Efficient Ventilation and Air Conditioning Systems**: Portuguese, Turkish

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REHVA participation in exhibitions

- AHR Expo
- Aqua- Therm Prague
- Chillventa
- ISH
- ACREX
- ISK Sodex
- Light and Building
- Mostra Convegno

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REHVA Supporters

- EU and EC information
- Logos on website
- Networking
- Free **REHVA** Journal
- Free set of guidebooks
- Participation in **REHVA** activities
- Dictionary
- **REHVA** seminars
- Social Media Activities

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REHVA Supporters

AAF INTERNATIONAL
AERMEC air conditioning
AIR TRADE CENTRE Durable HVAC Solutions
amca INTERNATIONAL
BAC
BELIMO
camfil
CIAT
CRIOMEC SA GALATI ROMANIA
DAIKIN
Demark CONSTRUCT confortul de partea ta
DencoHappel
Doset IMPEX
eneko
EPEE European Partnership for Energy and the Environment
ESTIA EUROPEAN SOLAR SHADING ORGANIZATION Energy Savings & Comf
Eurovent Certita CERTIFICATION
EUROVENT THE EUROPEAN COMMITTEE OF HVAC&R MANUFACTURERS
evapco
FläktWoods
FRITERM TERI
Granlund
Halton
GRUNDFOS
Lindab
LIFA AIR
LG Life's Good
RETTIG
Royal HaskoningDHV Enhancing Society Together
SKANSKA
SMAV
Smits van Burgst
somfy
Swegon
REHVA
systemair
TANGRA
TROX TECHNIK The art of handling air
uponor

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2. REHVA position paper on the European Commission review of the 2010/31/EU - EPBD

Jarek Kurnitski; Karel Kabele; Frank Hovorka; Jorma Railio; Stefano P. Corgnati; Manuel Carlos Gameiro da Silva; Zoltan Magyar; Ioan Silviu Dobosi; Jan Aufderheijde; Nathalie Wouters; Anita Derjanecz;

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General remarks

REHVA supports and acknowledges the main principles of EPBD

1. Improvement of energy performance in new buildings with cost optimal minimum energy performance requirements
2. Improvement of energy performance in existing buildings with incentives

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General remarks

- MS have conducted cost optimal calculations with the same (regulated) methodology providing comparable results

- MS have had to set stringent requirements – leading to real and cost effective improvement of energy performance in new buildings which can be seen as the biggest successes of EPBD

- More ambitions targets of EPBD, such as nZEB, are still in progress in most of MS

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Energy efficiency generated indoor environment quality (IEQ) problems

- EPBD includes the statement that indoor climate cannot be compromised when improving energy performance

- in practice the EPBD was implemented in most MS without paying attention to indoor environmental quality which has led to serious IAQ and mould problems especially in renovations

- key issue - controlled ventilation

- the heat recovery ventilation will serve as one of energy efficiency measures, improving IEQ and energy efficiency at the same time

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Energy efficiency generated indoor environment quality (IEQ) problems

EPBD shall handle ventilation as a separate area besides heating and cooling

1. The revised EPBD shall set a clear mandate for Member States to define minimum ventilation and Indoor Environmental Quality (IEQ)
   - Define minimum ventilation airflow rates which take into account the intended use of the building and the pollutant generation in rooms;
   - Address the issue of the quality of the installed ventilation system and its regular maintenance.

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Energy efficiency generated indoor environment quality (IEQ) problems

EPBD shall handle ventilation as a separate area besides heating and cooling

2. REHVA recommends developing a common methodology for an indoor environmental quality (IEQ) indicator to be used together with primary energy indicator.

IEQ indicator

- shall be reported in a transparent way in the energy performance certificates

- shall provide information about indoor air quality (ventilation rate) and about the indoor thermal environment (summer and winter).

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Energy efficiency generated indoor environment quality (IEQ) problems

EPBD shall handle ventilation as a separate area besides heating and cooling

IEQ indicator

- shall be implemented based on the EN 15251 (new number prEN 16798-1) standard defining I-IV indoor climate categories.
- indoor climate category shall be added to energy performance certificates
- indoor climate category could be provided separately for air quality (ventilation rate), temperature in summer and temperature in winter.

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Energy efficiency generated indoor environment quality (IEQ) problems

EPBD shall handle ventilation as a separate area besides heating and cooling

3. EPBD shall include the requirement of regular inspection and maintenance of ventilation systems in addition to existing requirement of inspection of air conditioning system.

- Assessment of the system efficiency
- Assessment of the sizing in relation to the indoor air quality requirements of the building
- In building with continuous monitoring and control systems in place, Member States may reduce the frequency of such inspections as appropriate

REHVA

Energy efficiency generated indoor environment quality (IEQ) problems

EPBD shall handle ventilation as a separate area besides heating and cooling

4. General framework for the calculation of energy shall consider ventilation and IEQ appropriately by taking into account at least the following aspects:

- air-conditioning installations;
- ventilation systems including mechanical, hybrid and natural ventilation
- air-tightness of the building envelope and ventilation system;
- indoor environmental conditions and indoor environmental quality

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Energy efficiency generated indoor environment quality (IEQ) problems

EPBD shall handle ventilation as a separate area besides heating and cooling

5. Minimum ventilation requirements shall be especially addressed in the articles dealing with major renovation

- in deep and integrated renovation is more complicated compared to new buildings
- the risk that renovation measures will not include controlled ventilation is evident if minimum ventilation requirements are not set as prerequisites of incentives
- minimum ventilation requirements together with energy performance requirements shall be included in every grant and financial support schemes for energy refurbishment

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Energy efficiency generated indoor environment quality (IEQ) problems

EPBD shall handle ventilation as a separate area besides heating and cooling

All issues listed in previous 5 points are well addressed in European EPB standards. Therefore it is important that EPBD will clearly refer to European standards with the statement that national requirements and methodologies should be in line with European standards, in order to strengthen the role of European standards and to foster harmonisation.

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Knowledge gap related

Different development level of energy calculation methodologies in MS as well as inexact definition of major energy uses to be accounted in EPBD, has led to the situation where MS use highly different energy calculation methodologies and have set nZEB requirements varying from 20 to 270 kWh/m^2/y primary energy. REHVA draws attention that in the case of higher national nZEB values they represent real energy use of buildings, i.e. calculated and measured energy performance is expected to provide similar results. In the case of very low values they are likely to represent only a small fraction of real, measured energy use.

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Knowledge gap related

Credibility of the entire energy performance certificate system is in danger if EPC values report only a small fraction of real energy use, i.e. do not match with reality from consumer point of view.

To date situation with EPCs and nZEB requirements (which should represent EPC class A) will be evaluated and necessary corrective actions to be taken in the review process in order to restore the credibility of the EPC system

Knowledge gap related

1. REHVA has concluded that remarkable differences of nZEB values are caused mostly by the different energy uses included, however the calculation methodologies (input data) have also a large effect on the outcomes.

REHVA suggest that EPBD energy performance definition should define explicitly major energy uses to be accounted and shall not include “inter alia” formulation.

REHVA energy experts recommend that all major energy uses to meet the energy demand associated with a typical use of the building will be accounted, i.e. including appliances, plug loads and lighting

Knowledge gap related

2. To help the development of national calculation methodologies the EPBD and its Annexes should define common grounds making sure that all MS require and measure similar and comparable values.

REHVA recommends including an EC mandate in the EPBD to issue a delegated regulation on energy accounting similarly as was done to prepare the regulation on the cost optimal calculation.

Knowledge gap related

3. Linked to nZEB, EPBD Annex I provides eight building categories.

- Many MS have set nZEB requirements for residential and non-residential building categories only.
- Building category specific nZEB requirements are important, because usages, intensities and operation times vary a lot between different building types and optimal EE and RES measures differ accordingly.
- In order to achieve that EP requirements steer to cost effective design solutions, appropriate nZEB requirements and standard use input data has to be defined for each building category

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Knowledge gap related

4. Metering systems are essential both for new buildings and major renovations

- It is feasible and very cost-effective in terms of measured energy savings achieved, to collect operational data at the level of individual sub-meters from new and existing buildings

- The best impact was achieved when meters served very clear end uses, such as lighting, small power, chillers/cooling system, ventilation system, space heating and domestic hot water systems.

Knowledge gap related

4. Metering systems are essential both for new buildings and major renovations

- This allowed to locate the problems and to determine actions to reduce the non-intended energy use in straightforward manner

- There is also well known solid evidence on individual domestic hot water metering savings

LG/REHVA Seminar, 02 June 2016, PARIS

3. nZEB implementation progress and open issues in national applications

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REHVA nZEB Task Force

- TF prepared nZEB technical definition and set of system boundaries for primary energy indicator and RER calculation in 2011
- in 2013 it was revised in cooperation with CEN, resulting in REHVA Report No:4
- TF is following nZEB technical, regulatory and policy progress
- Latest, ongoing analyses on RE contribution and RER indicator based on data from 8 nZEB office and school buildings across the EU

Screening of energy frames and nZEB in 2013

- **Differences in energy frames:**
  - Primary energy not yet used in all countries
  - Some countries (Germany, France) use reference building method, fixed values in other countries
  - Both simulation (Estonia, Finland) and monthly methods (Germany, Denmark) used
- **Inclusion of energy uses depends on country:**
  - Germany/residential – heating energy only (space heating, DHW and heating of ventilation air)
  - Germany/non-residential – cooling and lighting also included (appliances not)
  - Denmark – appliances and in residential also lighting not included
  - Sweden – appliances and user's lighting not included (facility lighting incl.)
  - Estonia, Finland, Norway – appliances and lighting included (all inclusive)
- **RES (on site renewable energy production) is not accounted in all countries or is accounted differently**

Map of European climatic zones

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Region	Country	nZEB Energy performance					RES	
		Values	Unit	Metric	Energy uses for:	Building type	EP calculation	nZEB req.
Zone 1-2 (Catania, Athens)	Cyprus	180 210	kWh/m²/y	Primary energy	heating, cooling, hot water, lighting	Residential Non-residential	No No	25% 25%
Zone 3 (Budapest, Bratislava, Ljubjana)	Slovakia	54 32 60	kWh/m²/y	Primary energy	Heating, hot water, ventilation, cooling (non-res), lighting (non-res)	Detached Apartment Offices	N.a. N.a. N.a.	50% 50% 50%
Zone 4 (Paris, Amsterdam Berlin, Brussels, Copenhagen, Dublin, London, Macon, Nancy, Prague, Warsaw)	Belgium BXL	45 95 - 2,5*(V/S)	kWh/m²/y	Primary energy	heating, cooling (non-res), hot water, lighting (non-res), auxiliary electricity	Residential Offices, educational	Yes Yes	- -
	Belgium Walloon	60	kWh/m²/y	Primary energy	heating, hot water, auxiliary electricity	Residential and non-res.	N.a.	50%
	Belgium Flemish	30 40	kWh/m²/y	Energy use	Heating, cooling, hot water, ventilation, auxiliary systems	Residential Office and school	Yes Yes	>10 kWh/m²y >10 kWh/m²y
	France	50 70 110	kWh/m²/y	Primary energy	heating, ventilation, cooling, hot water, lighting, auxiliary systems	Residential Office Office AC	No No No	- - -
	Ireland	45	kWh/m²/y	Energy load	heating, ventilation, hot water, lighting	Residential	N.a.	-
	Netherlands	0	[-]	Energy perform. coefficient (EPC)	heating, ventilation, cooling, hot water, lighting	Residential/ non-residential	Yes Yes	- -

Data from CA EPBD Oct 2013 (Kurnitski et al. REHVA Journal 2/2014)

Region	Country	nZEB Energy performance					RES	
		Values	Unit	Metric	Energy uses for:	Building type	EP calculation	nZEB req.
Zone 5 (Coopenhagen, Tallinn, Helsinki, Riga, Stockholm, Gdansk, Tovarene)	Denmark	20 25	kWh/m²/y	Primary energy	heating, cooling, ventilation, hot water, lighting (non-res)	Residential Non-residential	Yes Yes	51-56% 51-56%
	Estonia	50 100 100 130	kWh/m²/y	Primary energy	heating, ventilation, cooling, hot water, lighting, auxiliary electricity, appliances	Detached house Apartment Office Hotel	Yes Yes Yes Yes	- - - - -
	Latvia	95	kWh/m²/y	Primary energy	heating, cooling, domestic hot water, ventilation, lighting	Residential/ non-residential	N.a.	-
	Lithuania	<0,25	[-]	Energy perfor-mance indicator C	heating	Residential/ not-residential	N.a.	50%

Data from CA EPBD Oct 2013 (Kurnitski et al. REHVA Journal 2/2014)

BPIE factsheet on nZEB definitions 2015 www.bpie.eu

					nZEB definition for new buildings						nZEB definition for existing buildings		
Country	Status of the definition	Main reference(s)	Year of enforcement		EPBD scope of nZEB definition [1]	Numerical indicator	Maximum primary energy [kWh/m²y]		Share of renewable energy	Other indicators	Status of the definition	Maximum primary energy [kWh/m²y]	
			Public	Non-public			Residential buildings	Non-residential buildings				Residential buildings	Non-residential buildings
Austria	✓	OIB Guidelines 6	1/01/2019	1/01/2021	✓ [7]	✓	160	170 (from 2021)	Minimum share proposed in the draft of OIB guidelines for all buildings	EP, CO_2	✓	200	250 (from 2021)
Belgium - Brussels	✓	Amended Decree of 21/12/2007	1/01/2015	1/01/2015	✓	✓	45	~90 [2]	✓ Qualitative	EP, OH	✓	54	~ 108 [2]
Belgium - Flanders	✓	Regulation of 29/11/2013	1/01/2019	1/01/2021	✓	✓	30% PE [5]	40% PE [5]	✓ Quantitative [4]	EP, OH	Under development		
Belgium - Wallonia	Under development	Consolidated report to EC	1/01/2019	1/01/2019	✓	Under develop-ment			Quantitative	EP	Under development		
Bulgaria	Still to be approved	National nZEB Plan, BPIE study	1/01/2019	1/01/2021	✓	Still to be approved	~30-50	~40-60	Quantitative	EP	As for new buildings	~30-50	~40-60
							Included in the calculation; building needs to comply with class A					Included in the calculation; building needs to comply with class A	
Croatia	✓	Regulation OG 97/14, National nZEB Plan	1/01/2019	1/01/2021	✓	✓	33-41[3]	Under de-velopment	Minimum share in current requirements for all buildings	EP	ND		
Cyprus	✓	Decree 366/2014, Law 210(I)/2012	1/01/2019	1/01/2021	✓	✓	100	125	✓ Quantitative	EP	✓ As for new buildings	100	125
Czech Republic	✓	Regulation 78/2013 Coll.	2016-2018 depending on size	2018-2020 depending on size	✓	✓	75-80% [2,5]	90% [5]	✓ Quantitative	EP, TS	✓ As for new buildings	75-80% [2,5]	90% [5]
Denmark	✓	Building Regulations 2010	1/01/2019	1/01/2021	✓	✓	20	25	✓ Qualitative	EP, OH, TS	✓ As for new buildings	20	25
Estonia	✓	Regulation 68:2012	1/01/2019	1/01/2021	✓ [7]	✓	50-100 [2]	90-270 [2]	✓ Qualitative		✗		
Finland	Under development	Consolidated report to EC	1/01/2018	1/01/2021	✓ [7]	ND			ND		ND		
France	Definition of Positive Energy Buildings under development [8]	Thermal Regulation 2012, National nZEB Plan	28/10/2011	1/01/2013	✓	✓	40-65 [2,3]	70-110 [2,3]	✓ Quantitative [4]	EP, OH, TS	✓	80 [3]	60% PE [2]
Germany	Under development	KfW Efficiency House, National nZEB plan	1/01/2019	1/01/2021	✓	Under develop-ment	40% PE [5]		Minimum share in current requirements for all buildings	EP	Under development	55% PE [5]	
Greece	Under development	Law 4122/2013	1/01/2019	1/01/2021	ND	ND			Minimum share in current requirements for all buildings		Under development		
Hungary	Under development	Amended decree 7/2006, study by University of Debrecen	1/01/2019	1/01/2021	✓	Under develop-ment	50-72 [2]	60-115 [2]	✓ Quantitative	EP	Under development		
Ireland	✓	Draft definition in National nZEB Plan	1/01/2019	1/01/2021	✓	✓	45	~60% PE [5]	✓ Quantitative [4]	CO_2	Under development	75-150	

BPIE factsheet on nZEB definitions 2015 www.bpie.eu

					nZEB definition for new buildings						nZEB definition for existing buildings		
Country	Status of the definition	Main reference(s)	Year of enforcement		EPBD scope of nZEB definition [1]	Numerical indicator	Maximum primary energy [kWh/m²y]		Share of renewable energy	Other indicators	Status of the definition	Maximum primary energy [kWh/m²y]	
			Public	Non-public			Residential buildings	Non-residential buildings				Residential buildings	Non-residential buildings
Italy	Still to be approved (under publication)	Draft of the new EPBD decree	1/01/2019	1/01/2021	✓	Still to be approved	Included in the upcoming updated version of the National nZEB Plan [2,3]		Quantitative	EP, TS	✓ As for new buildings	Included in the upcoming updated version of the National nZEB Plan [2,3]	
Latvia	✓	Regulation 383/2013	1/01/2019	1/01/2021	✓	✓	95	95	✓ Quantitative	EP	✓ As for new buildings	95	95
Lithuania	✓	Regulation STR 2.01.09 :2012	1/01/2019	1/01/2021	✓	✓	Included in the calculation; building needs to comply with class A++		✓ Quantitative	EP	✓ As for new buildings	Included in the calculation; building needs to comply with class A++	
Luxembourg	✓ Details to be fixed	National nZEB Plan	1/01/2019	1/01/2021	✗ [6]	✓	Included in the calculation; building needs to comply with class A-A-A		✓ Qualitative	EP, CO_2	ND		
Malta	Under development	National nZEB Plan	1/01/2019	1/01/2021	✓	Current values to be revised	40	60	Qualitative	EP	ND		
Netherlands	✓	National nZEB Plan	1/01/2019	1/01/2021	✓	✓	Included in the calculation; building needs to comply with energy performance coefficient = 0		✗	EP	ND		
Norway	Under development	Presentation by Research Centre on Zero Emission Buildings	1/01/2021	1/01/2021	✓	Under development			Minimum share in current requirements for all buildings	CO_2 (main indicator), EP, TS	ND		
Poland	Under development	Consolidated report to EC	1/01/2019	1/01/2021	✓	Under development	60-75 [2]	45-70 [2]	✗		ND		
Portugal	Under development	Law 118/2013	1/01/2019	1/01/2021	✓	In current requirements for buildings			✗		ND		
Romania	✓	National nZEB Plan	1/01/2019	1/01/2021	✓	✓	93-217 [2,3]	50-192 [2,3]	✓ Quantitative	CO_2	ND		
Slovakia	✓	Decree 364/2012	1/01/2019	1/01/2021	✗ [6]	✓	32-54 [2]	34-96 [2]	✓ Quantitative	EP	ND		
Slovenia	Still to be approved	Official Journal 17/14, National nZEB Plan	1/01/2019	1/01/2021	✓	Still to be approved	45-50 [2]	70	Under development	EP	Still to be approved	70-90 [2]	100
Spain	Under development	Decree 235/2013	1/01/2019	1/01/2021	✓	Under development	Included in the calculation; it is foreseen that buildings will need to comply with class A		Minimum share in current requirements for all buildings	CO_2 (main indicator)	Under development		
Sweden	Under development	National nZEB Plan	1/01/2019	1/01/2021	✓	Under development	30-75 [2,3]	30-105 [2,3]	✗		ND		
UK (England)	✓ Details to be fixed	National nZEB Plan, presentation by Zero Carbon Hub	1/01/2018 (from 2016 for residential buildings) [9]	1/01/2019 (from 2016 for residential buildings) [9]	✓	✓	~ 44 (2)	ND	✓ Qualitative	CO_2 (main indicator), EP, TS	ND		
							Included in the calculation; building will need to comply with carbon emissions ~ 0						

RES in energy frames and nZEB applications (2015 data)

- In 2013 RES was not yet implemented in present calculation frames in 5 out of 10 countries with nZEB application
- Most of energy frames were not yet ready to support exported energy:
  - Full utilization on annual bases: Denmark, Estonia, net plus energy program in Germany
  - Monthly bases (limited to the amount of the delivered electricity each month and the rest of exported is not accounted): Germany
  - Not accounted: Finland, Norway, Italy, …
- 8 out of 13 countries have set specific indicator for RES in nZEB application (2015 data)
- There is no information that nearby RES has implemented in any country, however ongoing in DK, FI … – but mostly a future issue to be solved with RES inclusion and exported energy

Towards nearly zero energy buildings Denmark

Indicator		Energy frame 2010	Energy frame 2015	Energy frame 2020
Maximum of primary energy to	Residential buildings (houses, hotels, etc.)	52.5 + 1650/A in kWh/m²a	30 + 1000/A in kWh/m²a	**20 kWh/m²a**
	Non-residential buildings (offices, schools, institutions and other buildings)	71.3 + 1650/A in kWh/m²a	41 + 1000/A in kWh/m²a	**25 kWh/m²a**
Primary energy factors	Electricity	2.5	2.5	1.8
	District heating	1.0	0.8	0.6

Towards nearly zero energy buildings Estonia

Primary energy requirements for 9 building types (apply from Jan 9, 2013)

	nZEB A kWh/(m^2 a)	Low energy B kWh/(m^2 a)	Min.req. new C (cost opt.) kWh/(m^2 a)	Min.req. maj.ren. D (cost opt.) kWh/(m^2 a)
Detached houses	50	120	160	210
Apartment buildings	100	120	150	180
Office buildings	100	130	160	210

- nZEB and low energy requirements officially given (not yet mandatory)
- Primary energy factors:
  - Electricity 2.0
  - Fossil fuels 1.0
  - District heat 0.9
  - Renewable fuels 0.75

nZEB requirements summary 4/2015

- Primary energy and % of minimum EP requirements are used as nZEB EP indicator in most of countries
- The range of values varies remarkably from positive energy buildings up to 270 kWh/m^2/y primary energy:
  - from to 20 kWh/m^2/y to160 kWh/m^2/y in residential buildings, but usually targets aim at 45 kWh/m^2/y or 50 kWh/m^2/y
  - Values from 25 kWh/m^2/y to 270 kWh/m^2/y are reported for non-residential buildings with higher values given for hospitals.
  - Remarkable differences caused mostly due to different energy uses included, but the methodologies/input data have an effect and evidently there are differences in the ambition level
- nZEB primary energy values show a **reduction by factor of 1.6 in Estonia and by 2 in Denmark** compared to current EP minimum requirements of office buildings (reduction of **40-50%**)

Open nZEB issues

Open nZEB issues

1. Energy uses accounted:
   - major difference if accounting or not appliances & lighting
2. System boundary
   - onsite and nearby RES accounting (follows or not energy meters)
3. Time step: hourly vs. monthly calculation
4. Period and type of balance when accounting RES export
   - Annual or limitations for instance on monthly level
5. Numerical indicators of energy performance
   - Primary energy not yet fully established
   - Qualitative/quantitative RES accounting
6. Building categories
   - Standard uses and requirements for non-residential buildings

Energy uses accounted

- 7 countries out of 13 account appliances (AT, BG, EE, FI, LV, LT, NL), the rest do not
- 6 countries account lighting in residential buildings (EE, FI, FR, LT, SE, UK)
- Appliances and lighting correspond to 50-60 kWh/m^{2}y primary energy in residential buildings

Inclusion of appliances and lighting – EE

- VV No 68: 2012 – Minimum requirements for energy performance
- Minimum requirements are given for 9 building types, for new buildings and for major renovation
- nZEB and low energy building requirements officially given together with cost optimal minimum requirements

Primary energy factors:

- Electricity 2.0, Fossil fuels 1.0, District heat 0.9 and Renewable fuels 0.75

	nZEB [kWh/m²y]	Low energy [kWh/m²y]	Min. req. NEW [kWh/m²y]	Min. req. Major REN [kWh/m²y]
EPC class	**A**	**B**	**C**	**D**
Detached houses	50 **(0[a])**	120	160 **(110[a])**	210
Apartment buildings	100 **(41[a])**	120	150 **(101[a])**	180
Office buildings	100 **(62[b])**	130	160 **(128[b])**	210

[a] without lighting and appliances, [b] without appliances

Building categories

- Steering to optimal design solutions: define standard use/ nZEB requirement for each building category
- Usages, intensities and operation times vary a lot between different building categories – optimal EE and RES measures differ accordingly
- EPBD Annex I building categories are relevant except hospitals
- **Hospitals** (EE nZEB=270) could be replaced with clinics/health-care centers (12/24 and 5/7 operation instead of 24/24 and 7/7 operation with high loads from hospital equipment)
- **Industrial buildings** (very often without significant heat gains from the process) will deserve a separate category
- Grocery stores another specific category because EP depends mostly on the refrigeration condensation heat utilization

The effect of building categories – EE

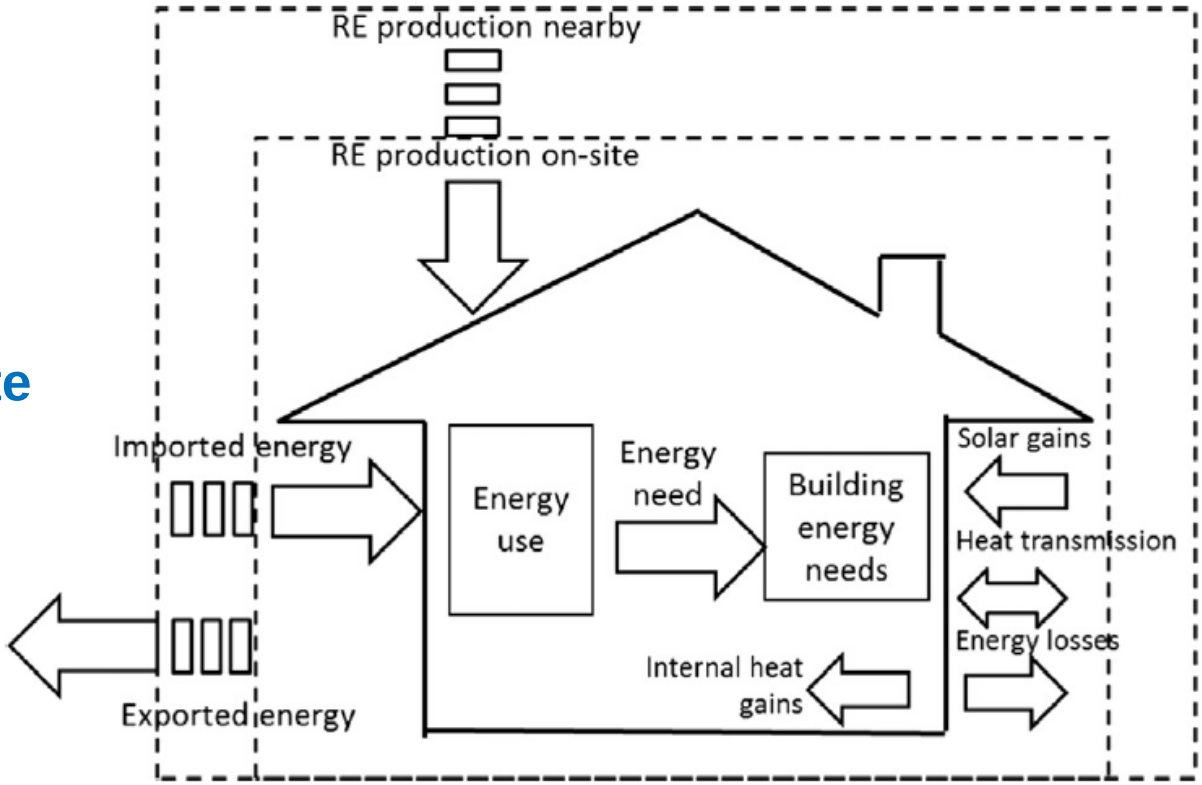
VV No 68: 2012 – Full set of EP requirements/standard use input data

EPC class Building category	nZEB A kWh/(m² y)	Low energy B kWh/(m² y)	Minimum req. NEW (cost opt.) C kWh/(m² y)	Minimum req. Major REN D kWh/(m² y)
Detached houses	**50**	120	160	210
Apartment buildings	**100**	120	150	180
Office buildings	**100**	130	160	210
Hotels and restaurants	**130**	160	210	270
Public buildings (theatres, sport halls, museums etc.)	**120**	150	200	250
Shopping malls	**130**	160	230	280
Schools	**90**	120	160	200
Day care centres	**100**	140	190	240
Hospitals	**270**	300	380	460

nZEB system boundaries

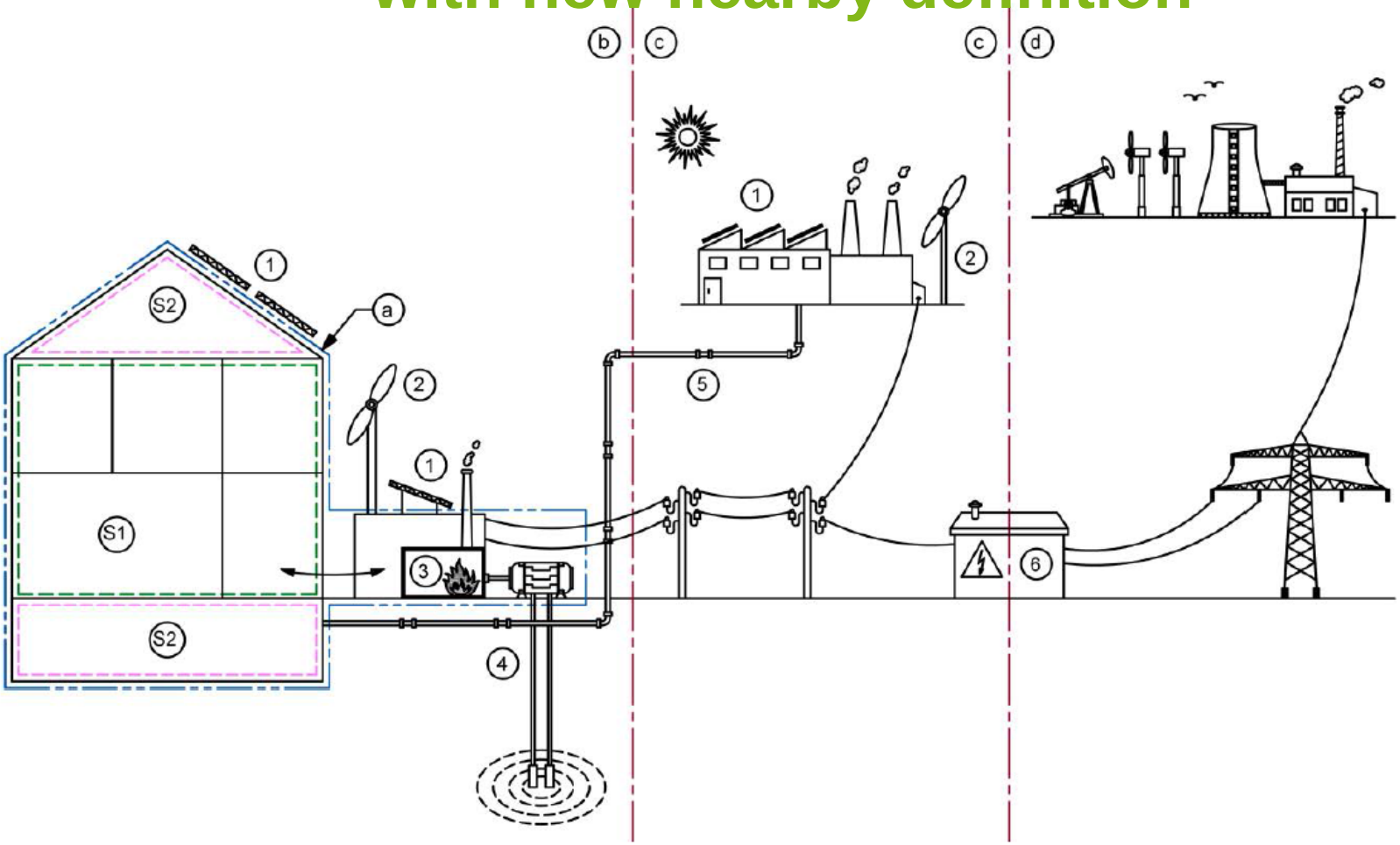
4-level system boundary needed to enable transparent calculation:

1. **Energy need**
2. **Energy use**
3. **Delivered and exported on-site**
4. **Nearby RE**



D. D'Agostino / Journal of Building Engineering 1 (2015) 20–32

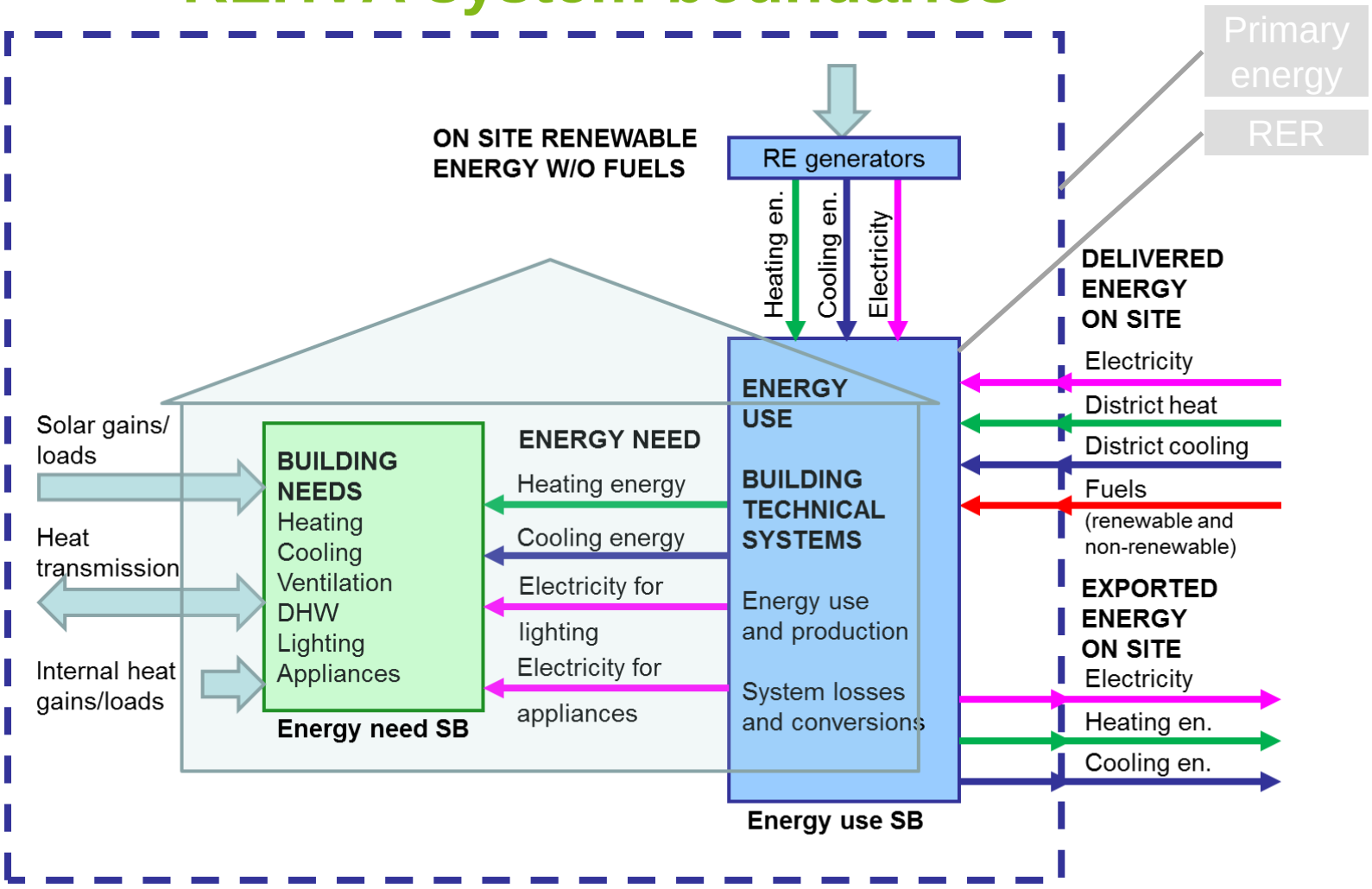
prEN ISO/DIS 52000-1:2015 system boundary with new nearby definition



Key

a	Assessment boundary (use energy balance)	S1	Thermally conditioned space	1	PV
b	On-site	S2,	Space outside thermal envelope	2	Wind
c	Nearby			3	Boiler room
d	Distant			4	Heat pump
				5	District heating / cooling
				6	Substation (low voltage and possible storage)

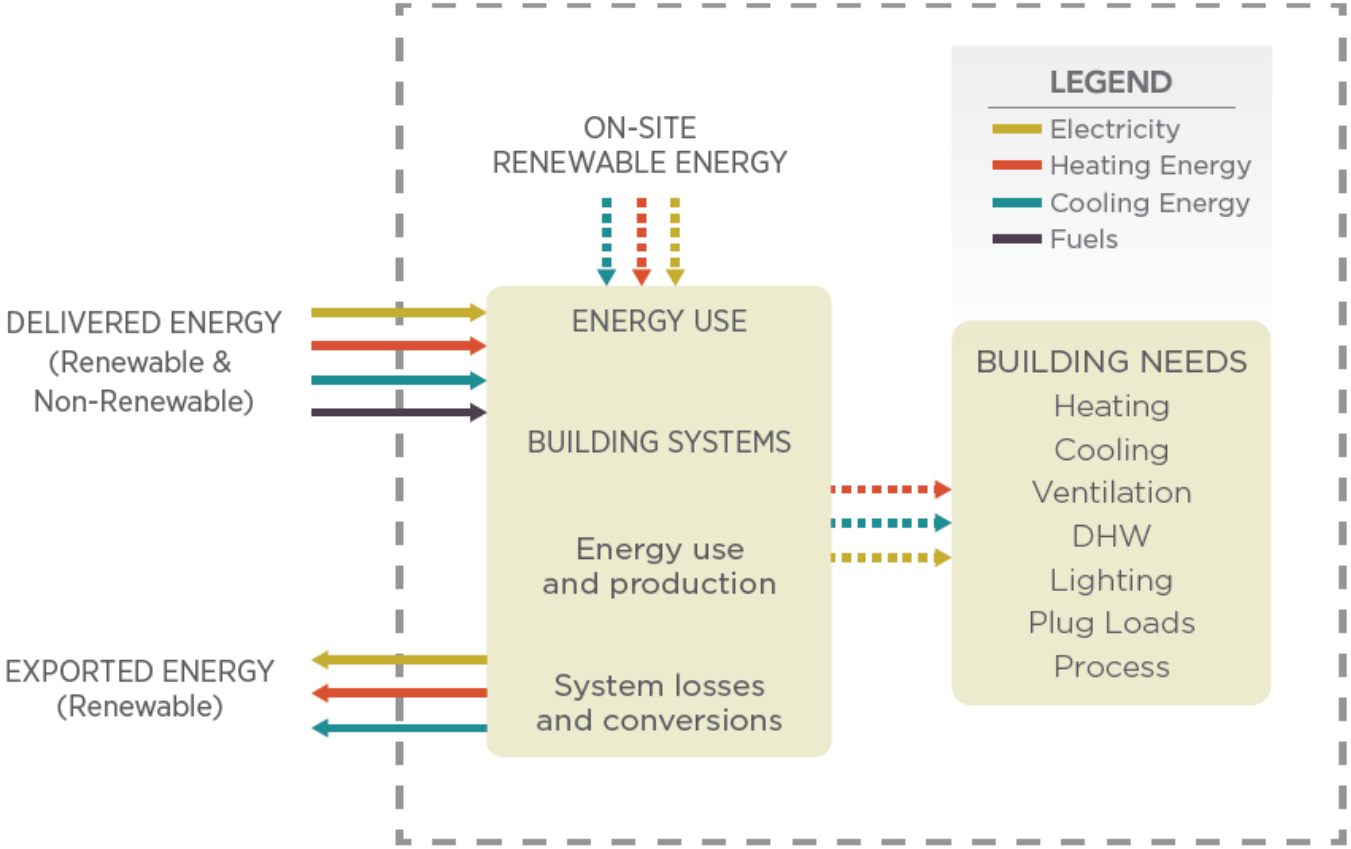
REHVA system boundaries



Building site boundary = system boundary of delivered and exported energy on site

- System boundaries (SB) for energy need, energy use and delivered and exported energy calculation. The last one may be interpreted as the building site boundary.
- Demand reduction measures can be distinguished from RE solutions in the energy use SB, not in the delivered/exported energy SB

US DOE Site Boundary for ZEB Accounting



Notes

1. The dashed lines represent energy transfer within the boundary
2. The solid lines represent energy transfer entering/leaving the boundary used for zero energy accounting

- Launched Sept 15, 2015
- http://energy.gov/eere/buildings/articles/doe-releases-common-definition-zero-energy-buildings-campuses-and

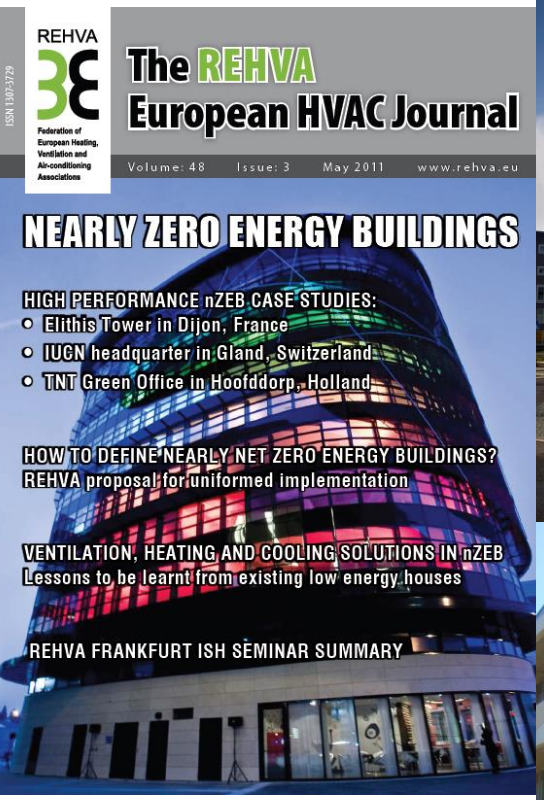
Renewable energy contribution indicator (RER renewable energy ratio) – useful or not

REHVA nZEB TF buildings: RER assessment

	Location	Type	Data	Heating	Cooling	Renewable
FRA	Dijon, France	Office	Measured	Biofuel	Free cooling + chiller	PV
SUI	Gland, Switzerland	Office	Simulated	GSHP	Boreholes	PV
NL1	Hoofddrop, the Netherlands	Office	Simulated	GSHP	GSHP	BioCHP+SC
FIN	Helsinki, Finland	Office	Simulated	District heat	Boreholes	PV
NL2	Haarlem, the Netherlands	Primary school	Simulated, hourly	GSHP	GSHP	PV+SC
SWE1	Stockholm, Sweden	Office	Simulated, hourly	District heat	Boreholes	Wind
SWE2	Helsingborg, Sweden	Office	Measured, hourly	GSHP	Boreholes	PV
EST	Rakvere, Estonia	Office	Simulated, hourly	District heat	Open wells	PV

Older nZEB case studies

- Buildings 1-4 are nZEB office buildings in France, Netherlands, Switzerland and Finland
- Reported in REHVA Journal (3/2011, 2/2012, 5/2012)



nZEB Task Force latest buildings (5-8 in the Table)

DSK-II school, Haarlem, the Netherlands

Construction year 2014

3 900 m²

Extra nZEB cost 250 €/m² estimated

General description	Primary school with zero energy consumption, meaning the total amount of energy used for the building itself on an annual basis is roughly equal to the amount of renewable energy produced on site.
Energy performance	**Net-zero energy building** without accounting small power equipment loads, achieved with large on-site PV, heat pumps and energy wells.

Entré Lindhagen office building, Sweden

Construction year 2014

65 000 m²

Extra nZEB cost 55 €/m² estimated (w/o wind farm investment)

General description	Skanska head office, Nordea office nZEB building, energy consumption 55 % less than code requirement, building demonstrates low speed ventilation and Skanska Deep Green Cooling, a ground cooling system without heat pump or chiller. Triple Leed Platinum. For core and shell, for Skanska interior design, for Nordea interior design.
Energy performance	**Net-zero energy building** (small power equipment loads accounted) without accounting district heat, achieved with nearby wind farm, district heating and boreholes. **Nearly zero energy building** if the share of wind farm is not accounted.

Väla Gård office building, Sweden

Construction year 2013

1 750 m²

Extra nZEB cost 230 €/m² estimated

General description	Skanska office in Helsingborg. A nZEB office building, energy consumption is nearly zero or plus including tenant power over the year. LEED certified Platinum.
Energy performance	**Net zero energy building** (small power equipment loads accounted) or **plus energy building** w/o small power, achieved with extensive on-site PV, ground source heat pump and boreholes.

Rakvere Smart Building Competence Centre office building, Estonia

Construction year 2014-2015

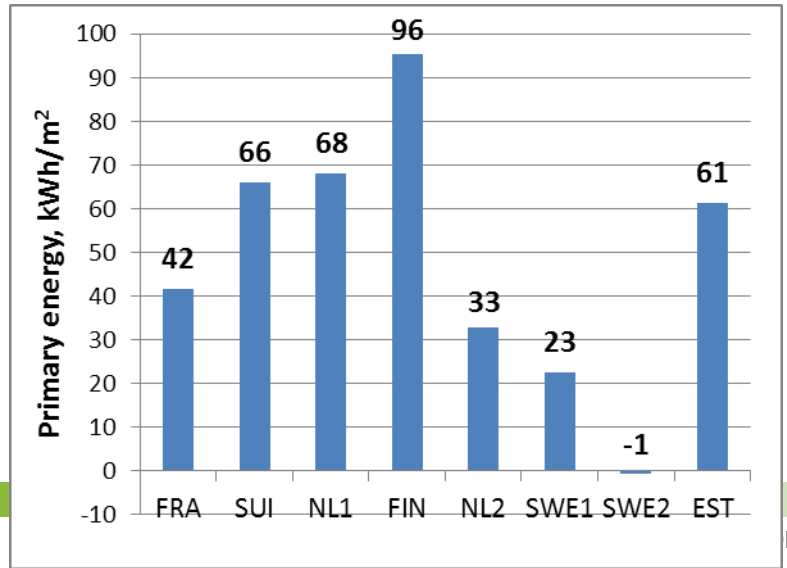
2 170 m²

Extra nZEB cost 200-300 €/m² estimated

General description	Estonian first nZEB office building, primary energy consumption 60 [illegible] n code requirement, building demonstrates smart building automation systems.
Energy performance	**Nearly zero energy building** (small power equipment loads accounted), achieved with on-site PV, district heating and energy wells.

Delivered, on-site and nearby generated, and primary energy

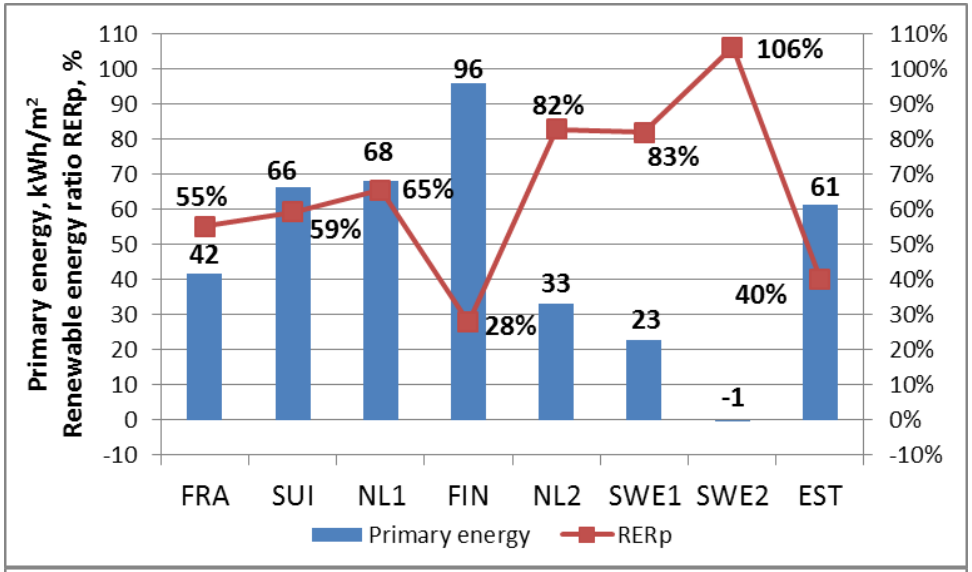
	FRA	SUI	NL1	FIN	NL2	SWE1	SWE2	EST
Heating	10,5	6,0	13,3	38,3	20,5	32,2	10,0	25,0
Cooling	2,4	6,7	3,3	0,3	3,2	1,3	0,5	2,0
Fans & pumps	6,5	8,1	17,5	9,4	11,8	13,2	3,0	9,7
Lighting	3,7	16,3	21,1	12,5	12,5	16,5	12,6	11,3
Appliances	21,2	26,8	19,2	19,3	5,0	16,9	12,6	18,5
On site electricity	-15,6	-30,9	-73,8	-7,1	-36,5		-39,0	-19,6
Nearby electricity						-47,9		
BioCHP fuel			184					
Exported heat			-50,0					
Primary energy	**42**	**66**	**68**	**96**	**33**	**23**	**-1**	**61**

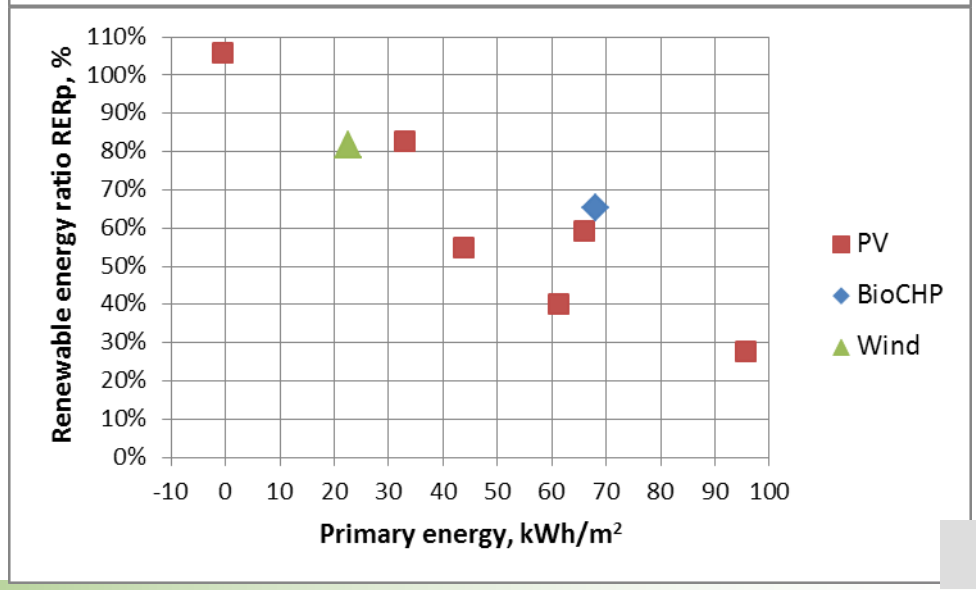


	Primary energy factors		
	nren	ren	tot
Biofuel	**0.5**	0.5	1.0
District heat	**0.7**	0.3	1.0
Electricity	**2.0**	0.2	2.2

RER indicator vs. primary energy

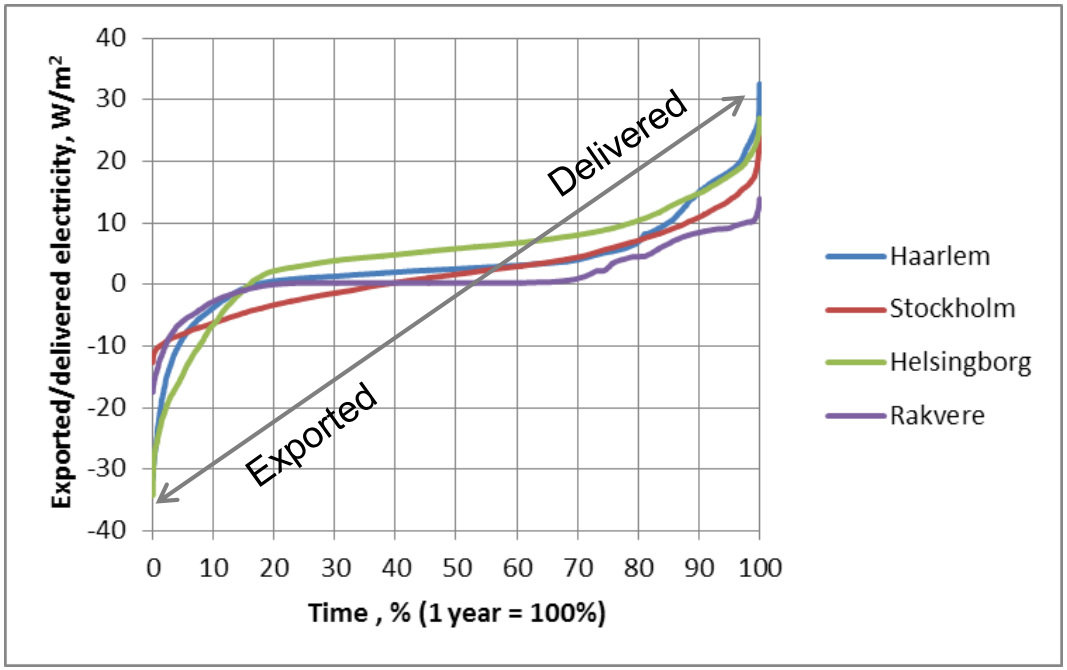
- Good (negative) correlation between primary energy and RER
- Not very technology dependent
- >100% RERp does not allow to draw conclusions on the grid load





What additional information RER provides?

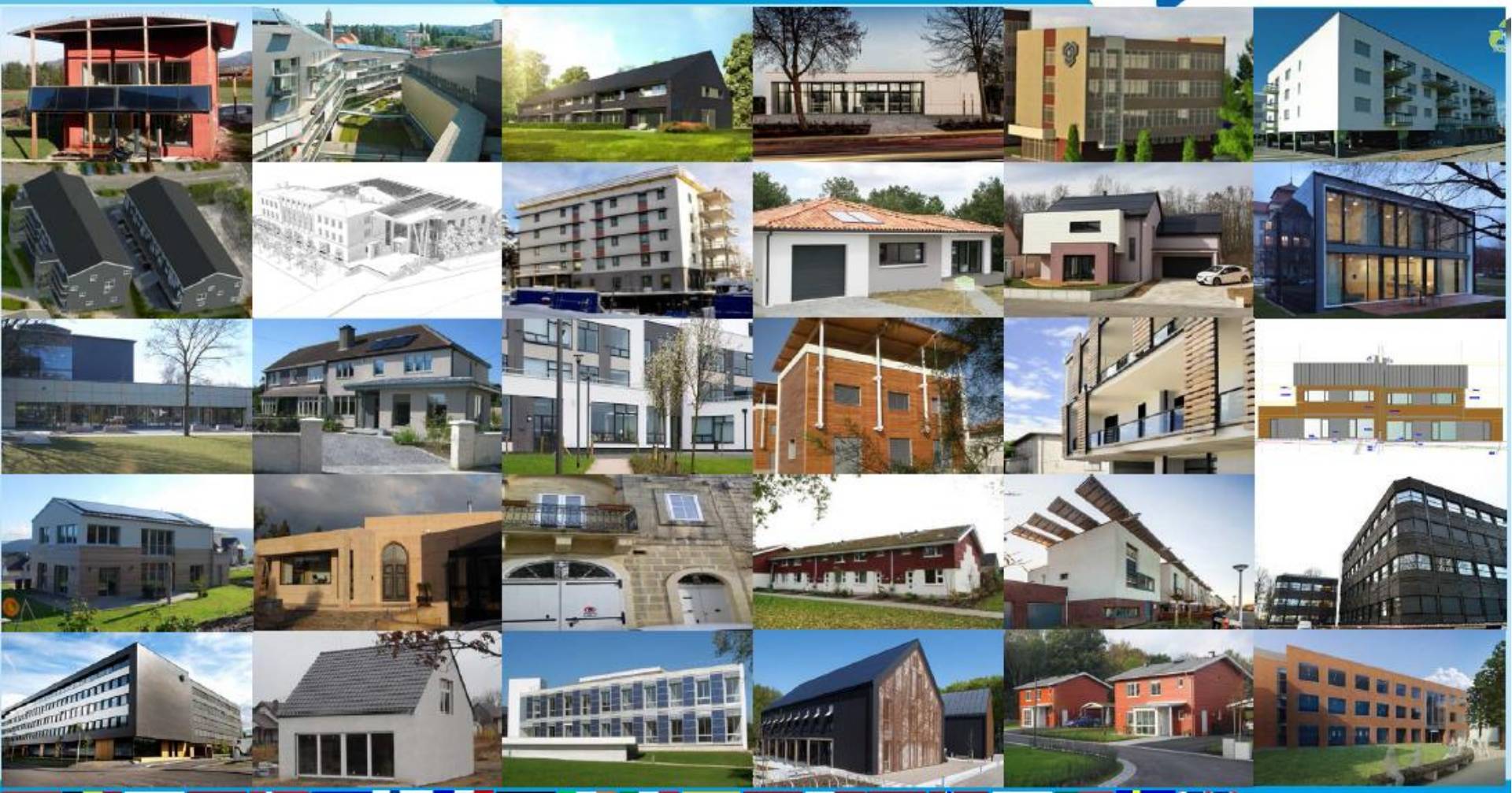
- RER is not very sensitive on the use of total/ren, or nren primary energy factors or calculation without factors
- Annual RER value does not allow to estimate the grid load
- W/m^2 delivered and exported electricity indicators (hourly values) provide more information



	Haarlem	Stockholm	Helsingborg	Rakvere
Max delivered, W/m^2	32,6	24,2	27,0	13,9
Max exported, W/m^2	-31,6	-12,6	-34,2	-17,5
10th percentile, W/m^2	-3,8	-6,2	-6,5	-2,7
90th percentile, W/m^2	15,0	10,9	14,8	8,4

Selected NZEB Examples in MS

CONCERTED ACTION
ENERGY PERFORMANCE
OF BUILDINGS



FOR A SUSTAINABLE FUTURE

Selected NZEB Examples in MS Analysis

CONCERTED ACTION ENERGY PERFORMANCE OF BUILDINGS

Costs: 52 % Total costs available, 33 % Additional costs available

	Additional costs of the selected examples of NZEBs compared to the energy level according to the current national requirements		
	Average	Lowest	Highest
% of total costs	11	0	25
€/m²	220	0	473

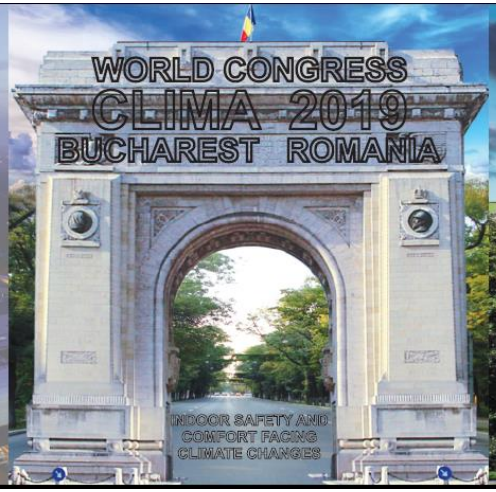
Conclusions

- To date, an official definition with numeric indicators is available in 15 MS (+ Brussels Capital Region and Flanders)
  - In 3 countries implementation in the legislation is in progress
  - In the remaining 9 MS (plus Norway and the Belgian Region of Wallonia), the definition is still under discussion
- The most urgent open nZEB issues to be harmonized are energy uses included (to be comparable), system boundaries and RES inclusion (to be transparent) and building categories (to be meaningful for design choices):
  - Exclusion of the energy uses may led to situation where calculated energy use represents only a small fraction of measured energy use in real buildings
  - Requirements set only for residential and non-residential show that majority of countries cannot tackle the eight building categories specified in EPBD recast Annex I
- nZEB extra cost of about +200 €/m^2 remains a challenge, however some examples of 55-100 €/m^2 do exist

4. CLIMA 2019 – REHVA World Congress

	FRIDAY MAY 24	SATURDAY MAY 25	SUNDAY MAY 26
08:30	REHVA Committee Meetings	REHVA Board Meetings	REHVA Courses
10:00	Coffe Break	Coffe Break	Coffe Break
10:30	REHVA Committee Meetings	REHVA Board Meetings	REHVA Courses
12:00	Networking Lunch	Networking Lunch	Networking Lunch
13:30	REHVA Committee Meetings	REHVA General Assembly	
15:00	Coffe Break	Coffe Break	
15:30	REHVA Committee Meetings	REHVA General Assembly	
17:00			
17:30			
18:30	REHVA Welcome Reception	REHVA Dinner	

	SUNDAY MAY 26	MONDAY MAY 27		TUESDAY MAY 28		WEDNESDAY MAY 29
08:30		Oral Sessions	Workshop	Oral Sessions	Workshop	Oral Sessions
10:00		Coffe Break		Coffe Break		Coffe Break
10:30		Oral Sessions	Workshop	Oral Sessions	Workshop	Oral Sessions
12:00		Networking Lunch		Networking Lunch		Networking Lunch
13:30		Keynote Lectures		Keynote Lectures		Keynote Lectures
15:00		Coffe Break		Coffe Break		Coffe Break
15:30	Opening Ceremony	Oral&Poster Sessions	Workshop	Oral&Poster Sessions	Workshop	Closing Ceremony
17:00	Break	Break		Break		
17:30	Keynote Lectures					
18:30	Welcome Reception	City Reception		Banquet		



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Federation of European Heating, Ventilation and Air Conditioning Associations

LG/REHVA Seminar, 02 June 2016, PARIS

Dr. Eng. Ioan Silviu Doboși

General Manager - S.C. DOSETIMPEX S.R.L.
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Thank you for your attention

REHVA