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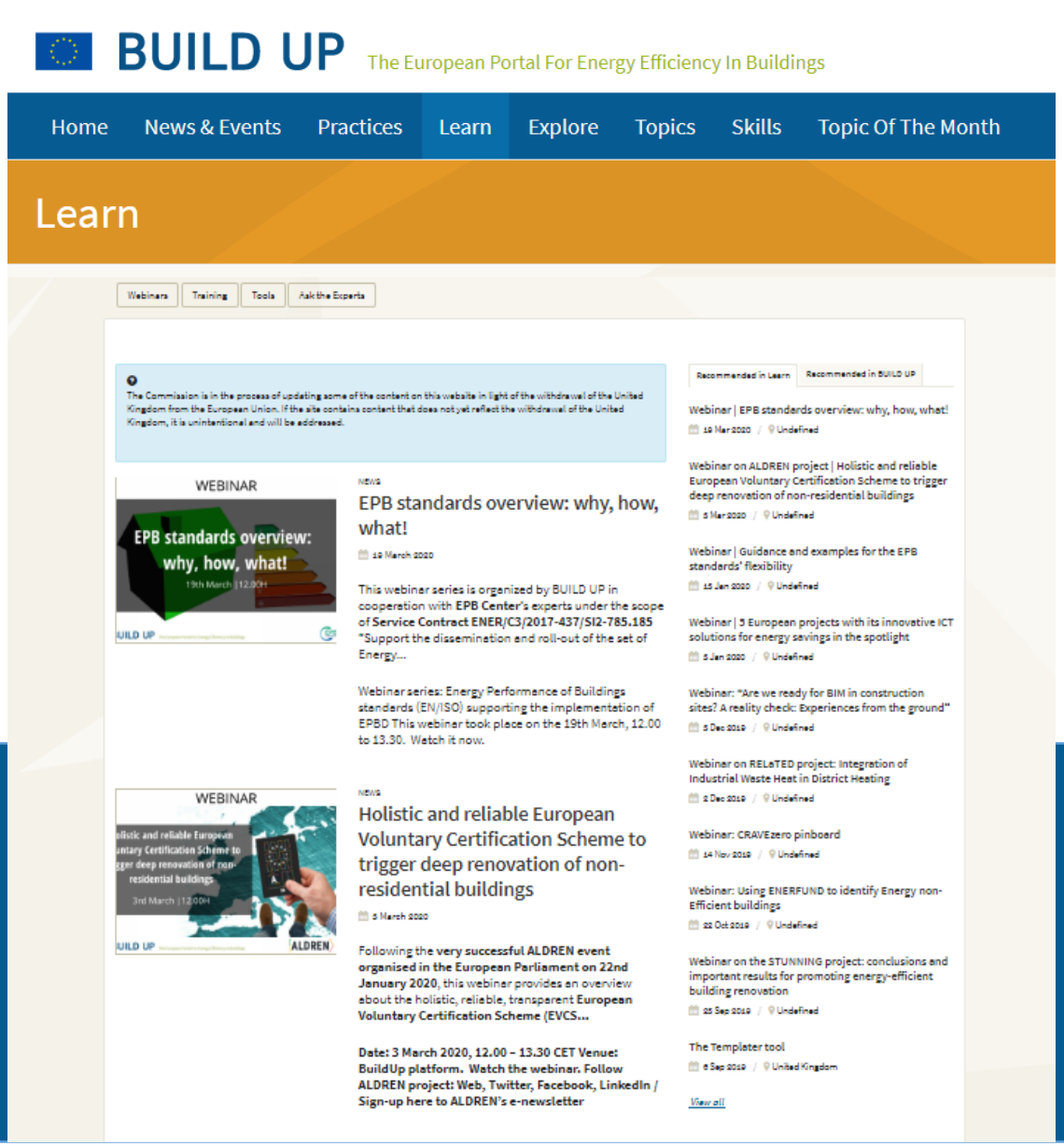

Check our Learn section!

CEN-CE

CEN EPB Standards Certified Experts

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 785018.

Upskilling building sector professionals: CEN-CE scheme

CEN-CE

CEN EPB Standards Certified Experts

Build Up portal webinar

5th May 2020

12h00 – 13h30 CEST

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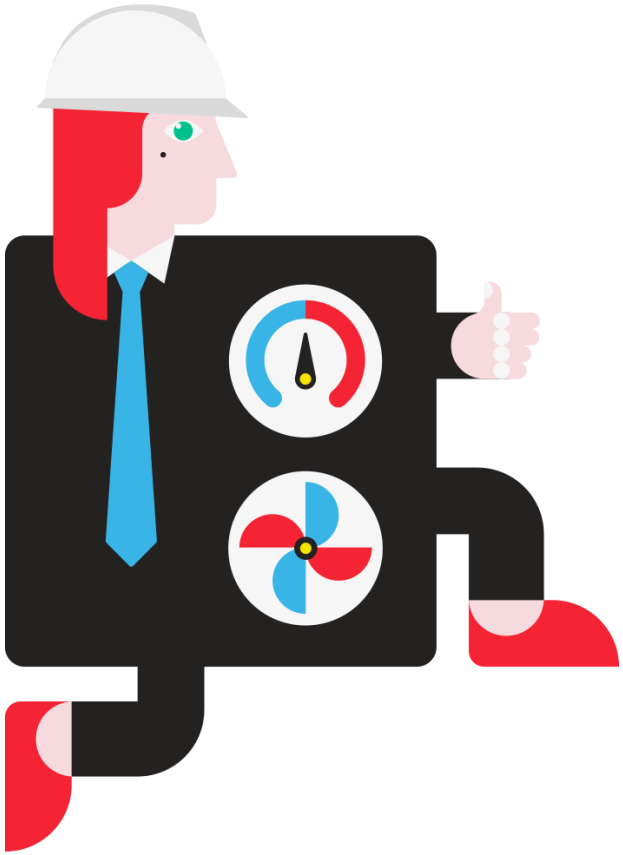
AGENDA

Moderator

Giulia Leghissa



12h00	*Introduction by the moderator*	
12h05	**CEN-CE in a nutshell**	**Johann Zirngibl**
12h15	**CEN-CE certified experts**	**Jana Bendžalová**
12h25	**CEN-CE training: why, how, what?**	**Damir Dović**
12h40	**Professional tools integrating EPB standards**	**Laurent Socal**
12h50	**Online pilot training and LMS**	**Andrei Lițiu**
13h00	*Moderated Q&A*	

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CEN-CE in a nutshell

Johann ZIRNGBL, Emilien PARON, CEN-CE coordinator
johann.zirngibl@cstb.fr; emilien.paron@cstb.fr

CSTB
le futur en construction

10h20

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Short CV of presenter:

Name: Johann ZIRNGIBL

Current position:

H2020 projects, CEN and ISO standardization

Previous work experience:

Director International Development CSTB / France

Head of Division Energy Systems CSTB / France

Academic degree(s) / title(s) completed studies:

Engineer, Senior Scientist / Energy efficiency of Building (HVAC)

Responsibilities:

Project manager in national, international research projects

Expert for the European Commission, World Bank, EBRD

Convenor in European (CEN) and International (ISO) standardization

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1) What is CEN-CE – the key aims

H2020 - Project on increase **Construction skills of professionals**

related to

Reducing energy consumption *and* ***carbon footprint (climate change)***
EU commitments and related EU Directives (e.g. EPBD)

CEN-CE: CEN standards Certified Experts

EU-wide training / certification scheme based on EPBD mandated CEN standards

CEN-CE is focused on use of **CEN (European) standards** developed in:

- **CEN/TC 228 Heating and waterbased cooling systems (HVAC);**
- **CEN TC/371 Overarching standard** for **global indicator.**

- CEN-CE should be run as a **self-funded business case** after the H2020 project;
- **Training and certification materials** could be **used in cooperation with existing scheme providers including recognition.**

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The CEN-CE team

CSTB
France

ENBEE
Slovakia

REHVA
Belgium

FSB
Croatia

SLR
Italy

5 partners;

5 Member States;
Scientific, educational, technical and professional background.

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2) Why CEN-CE now?

- **EU Commission** mandate **CEN** to develop standards supporting **Member States** to implement the **EPBD** (Energy Performance of Building Directive);
- Standards positively voted in **January 2017** and published in 2017;
- Training is needed to **bring them into application.**

CEN-CE is 1st EU wide common training and certification scheme based on these mandated CEN standards

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3) Setting the scene – CEN-CE ecosystem

The EU building stock

- **~ 35 %** of all buildings in the EU are older **than 50 years;**
- **~ 75 %** of these building are **energy inefficient;**
- **Only 15%** incorporate significant energy efficiency upgrade in renovation.

The EU commitments

- **EBPD**: new constructions **nZEB buildings** <31.12.2020;
- **EU Green Deal**: **carbon neutrality by 2050.**

To **bridge the gap** between the EU Building stock and EU commitments **qualified workforce** is needed

HVAC professionals will **play an important role** in implementing energy efficient solutions, because HVAC systems are replaced in shorter intervals

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4) The game changer – New challenges for HVAC

Fulfilling the EU commitments **is a new challenge** and **request skills to be able to perform high quality energy and low carbon renovation**

HVAC professionals must be able to:

- provide a **reliable** estimation of the savings (keep the promises made);
- design for **performance (**not only for **compliance),** be able to communicate on performance (common indicators);
- improve **significantly** the **energy performance, switch** to **low carbon;**
- upgrade installation to be **"2050 compatible"** (avoid lock-in effect by sub-optimal installation) .

Higher degree of technical skills – training is needed

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5) What is the CEN-CE added value ?

- CEN-CE scheme addresses a **strong market request** (support of stakeholders including the EU Commission);
- Certification / training based on **European and ISO standards** is an advantage for **recognition** of skills among different countries;
- **Standardization** is also key to create **level playing field** for **products** European wide (technical neutral assessment, fair competition);
- **EU Green Deal** could be the **linchpin**. Need for a standardized EU building quality benchmark. Eu funding based on EU standardized rules;
- CEN standards are already used by many EU Member States (mandatory) and existing certification schemes (voluntary);
- **Recognition of the market** on **quality**, **visibility** because based on best **recognized know-how.**

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6) The next steps – market demand and roll-out

Where is the market demand?

- **Increased Professional skills in sizing and energy use**
  CEN-CE experts will be better prepared for the new challenges (nZEB's, cost optimum, integration of renewables, Green Deal);
- **Industrials (front runners)**
  Modular structure of standards related to products (e.g. Heat pumps), CEN-CE training could complete existing industrial training.
  Trainees will get at the same time recognized know-how and be certified;
- **Existing Voluntary (e.g. environmental) / mandatory (e.g. EPC's)**
  Member States using more and more standards.

Practical roll-out of the CEN-CE scheme :
Stand alone or **complete existing schemes**

Thank you for your attention

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CEN-CE certified experts

Jana BENDŽALOVÁ
bendzalova@enbee.eu

ENBEE
Environment & Building Energy Efficiency

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CEN-CE

is a piece of the EPB puzzle supporting the EPBD implementation

by set up a large-scale training / qualification scheme
to prepare certified experts on CEN standards for

calculation of energy performance of building (M480)

✓ Could stand alone or can be **included as a module in existing training scheme**

Business case → **depending on the demand**
→ mandatory or voluntary use of CEN standards

Part of the business strategy is the promotion of CEN standards.

→ CEN-CE provides feedback to CEN/TC 228, CEN/TC 371 for revision

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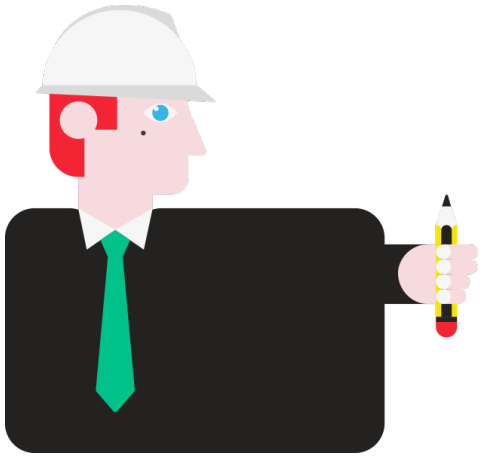
The European Qualifications Framework (EQF)

Makes qualification achieved more **readable and understandable** across different countries and systems



Knowledge – Skills - Competences

Level 4

- **skills required to generate solutions**
- self-management within the guidelines, supervise a routine work

Level 5 + 6

- **Comprehensive specialist, advanced knowledge,**
- skills required to develop **creative solutions to abstract problems demonstrating mastery and innovation, solve complex and unpredictable problems**
- management and supervision of work with unpredictable change, develop performance
- manage complex activities, decision making in unpredictable work or study.

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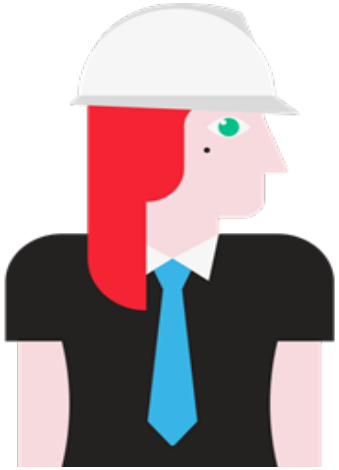
CEN-CE certified experts – demand drivers



Gain recognition for performance, comparability, reliability by using the **best know-how** based on **European standards.**

Industry → **Correct consideration of products** in EP of building - level playing field for products - **participated in development of CEN standards**-occassion to bring them into practice

Education / training institutions → **Part of trainings/ education on EP at Universities, vocational trainings**

Certification / accreditation schemes for EPB → Reliability, **quality** of **e**xperts for voluntary or mandatory schemes (EPC, energy auditors)

Professionals → **New skills, know-how, recognition** by market

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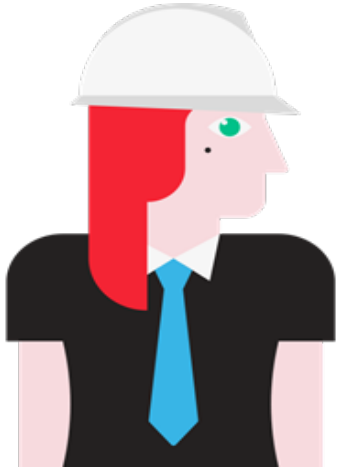
CEN-CE certification context



Based on

- ✓ **survey of existing schemes**
  IngReeS, Build Up Skills Pillar II, Passive house, ASHREA,
  how to keep the quality of operators EU / World wide,
- ✓ **market needs,** requirements of the industry, national mandatory accreditation of experts,
  Voluntary certification schemes e.g. EPBD Art. 11(9)

Modular structure

- expert can be trained only for **selected standards** (e.g. heat pumps, PV, measured energy, economic) that allows:
  - ✓ different background of experts
  - ✓ specific product based interest by industry
- offers training courses in a **short format** to enable **acquiring skills on a step-by-step basis**

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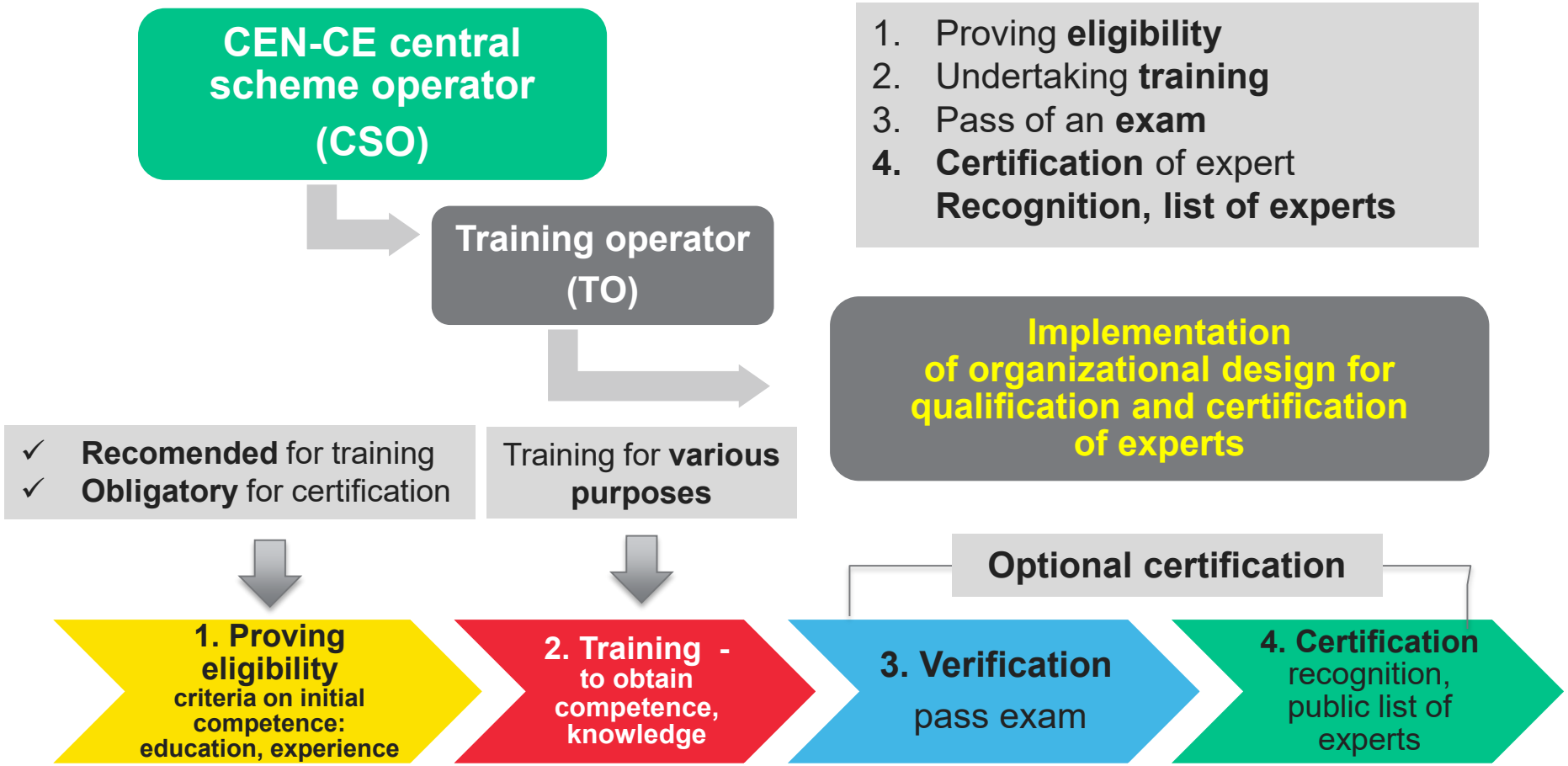
Operational and organizational structure of the CEN-CE scheme



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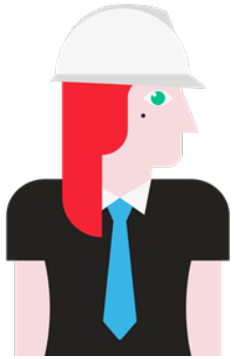
The CEN-CE scheme



1. Proving eligibility

- **only recommended** for undergoing training for understanding the content of the training
- **obligatory** for certification to ensure the quality and reliability of CEN-CE certified expert

Levels of professionals (EQF):

- Lower level
  Level 4 – installers
- Higher level
  Level 5 - designers,
  Level 6 - engineers, architects, ...

The criteria on initial competence:

✓ **Education**:
- Level 4 – lower education
- Level 5 - upper secondary school leaving certificates
- Level 6 – university degree

✓ **Relevant experience**

2 years during the last 6 years.

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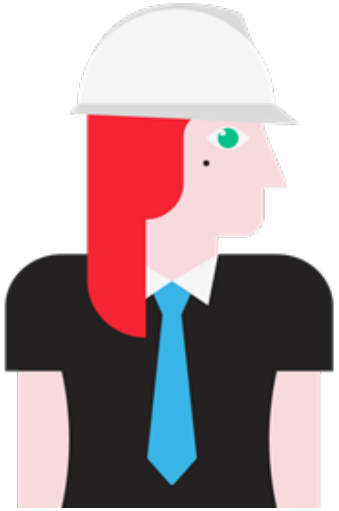
The CEN-CE scheme



2. Training

provides knowledge, skills, competence.

Training materials:

- ✓ modular structure (per standard)
- ✓ common templates
- ✓ Handbook, Excel, ppt, matrix of slides for two EQF levels, didactic, e-learning

Expert can be trained **for dedicated level** (lower, higher level professionals).

The length of training: 2 - 4 h / standard depending on the complexity of the standard.

Initial competence (education, experience) just recommended for training for understanding topic

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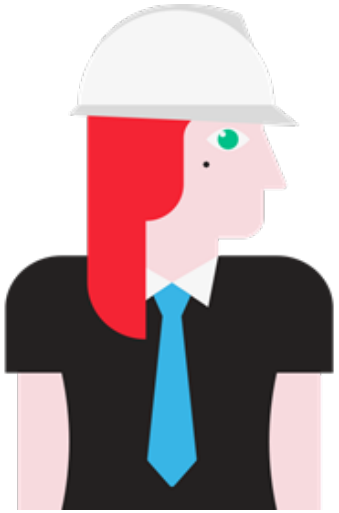
The CEN-CE scheme



Two levels of exam (EQF):

Level 4 - installers
Level 5+6 - engineers, architects ...

3. Pass of an examination - assessment of learning outcomes

According to the benchmark of exiting schemes the options for exam are:

- ✓ presence
- ✓ remote, e-learning
- ✓ self-assessment (informative)

More options will be possible.
The structure will depend also on the IT tool development and testing.

Set of questions for exam.

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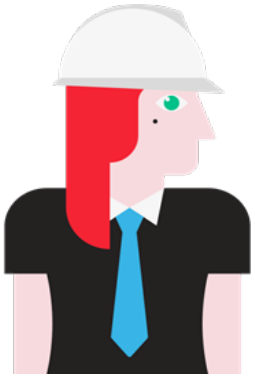
The CEN-CE scheme



4. Certification, recognition of experts

The eligibility criteria for certification:

1) **initial education** and relevant **experience**
2) mandatory **training**
3) the successful **exam**

Levels of professionals (EQF):

- Lower level
  Level 4 – installers
- Higher level
  Level 5 - designers,
  Level 6 - engineers, architects, ...

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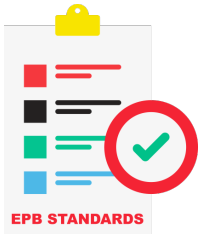
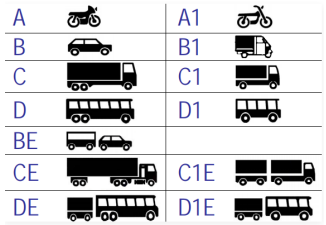
The CEN-CE scheme

Certification, recognition

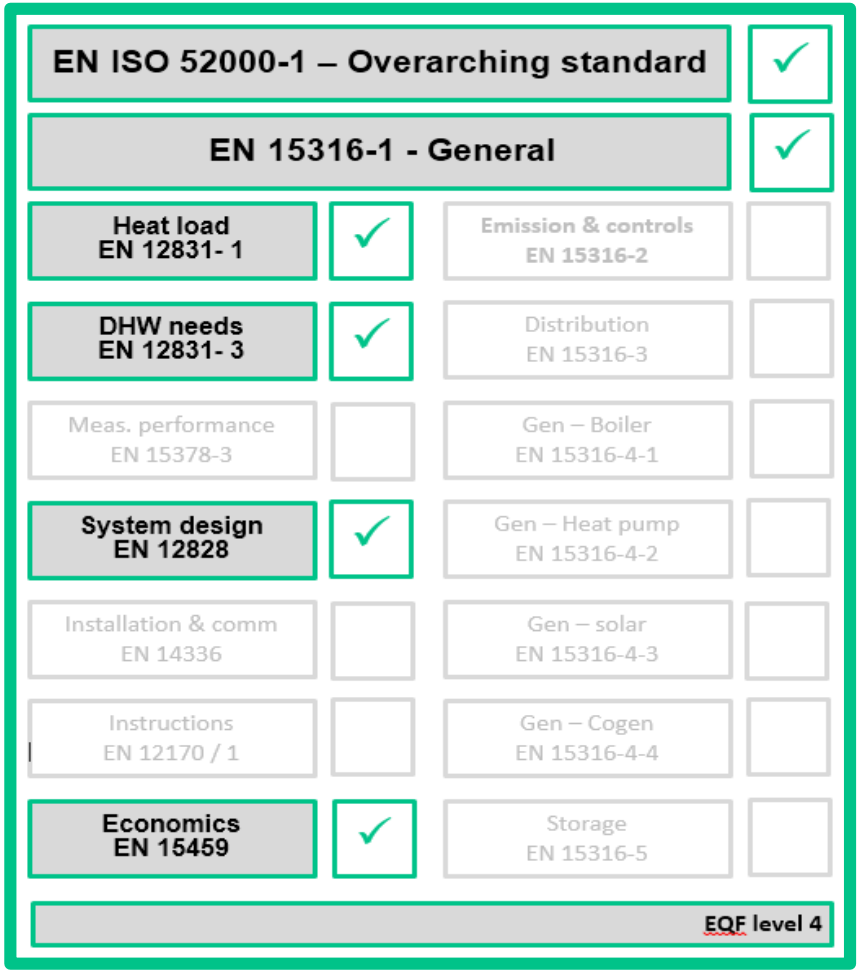
CERTIFICATE

- after passing successful exam
- common template of certificate
- all standards will be listed, relevant will be highlighted (as a driving license)





- **differentiation of experts according to competence** (few vs. all standards)
- public list of CEN-CE certified experts on website of CSO



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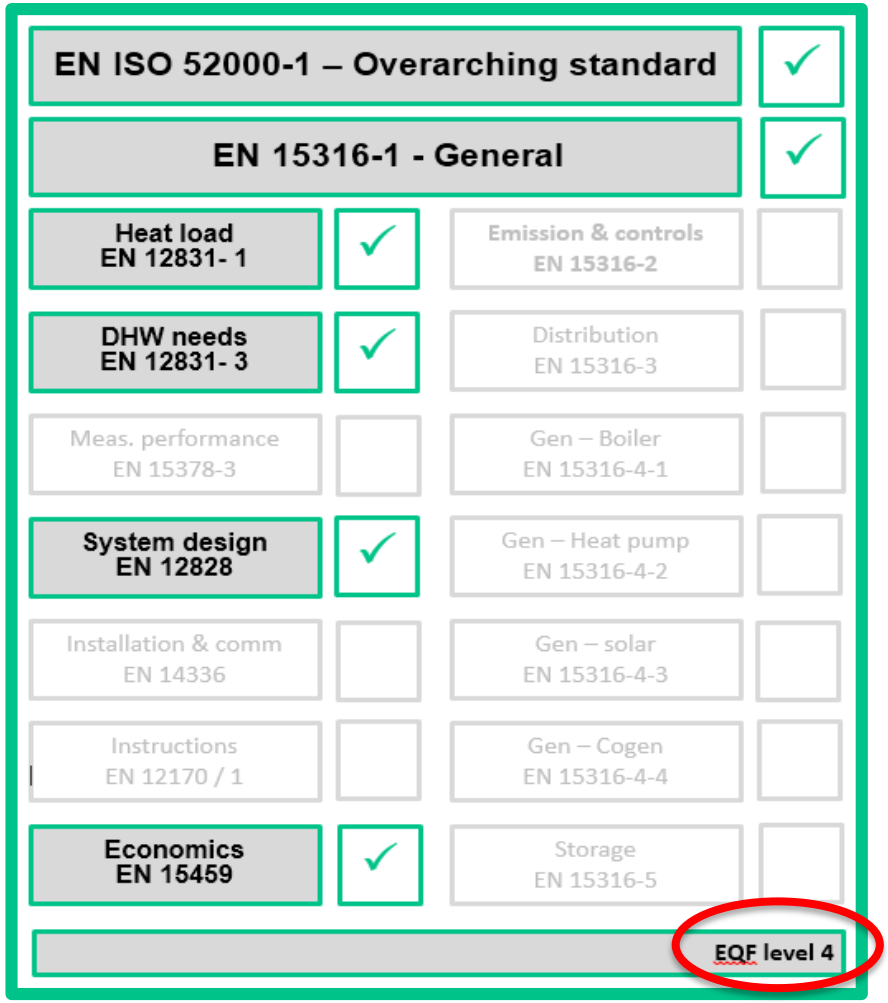
The CEN-CE scheme

Certification, recognition

CERTIFICATE

EQF level according to:

- **Level of training** (two levels based on complexity: EQF 4, EQF 5+6)
- **Level of initial education:**
  - EQF 4 – installers, managers, any education
  - EQF 5 – designers – high school - leaving certificates
  - EQF 6 – engineers, architects - university degree



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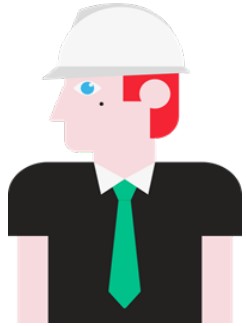
Training scheme operators



CEN-CE scheme can be overtaken by any organisation

CEN-CE central scheme operator (CSO)

Training operators (TO)

Quality control
- launch training, master training materials in EN
- **issuing licenses** for TO
- monitoring, surveillance
- issuing certificates
- registration, databases
- public list of CEN-CE experts
- on-line platforms

- market uptake
- provide trainings
- **localization of training**
- ensures that experts achieve learning outcomes
- **reporting to CSO**

The Learning Management System – on-line e-learning and exam - under development.

The **self-financing of the scheme** is important for quality assurance.

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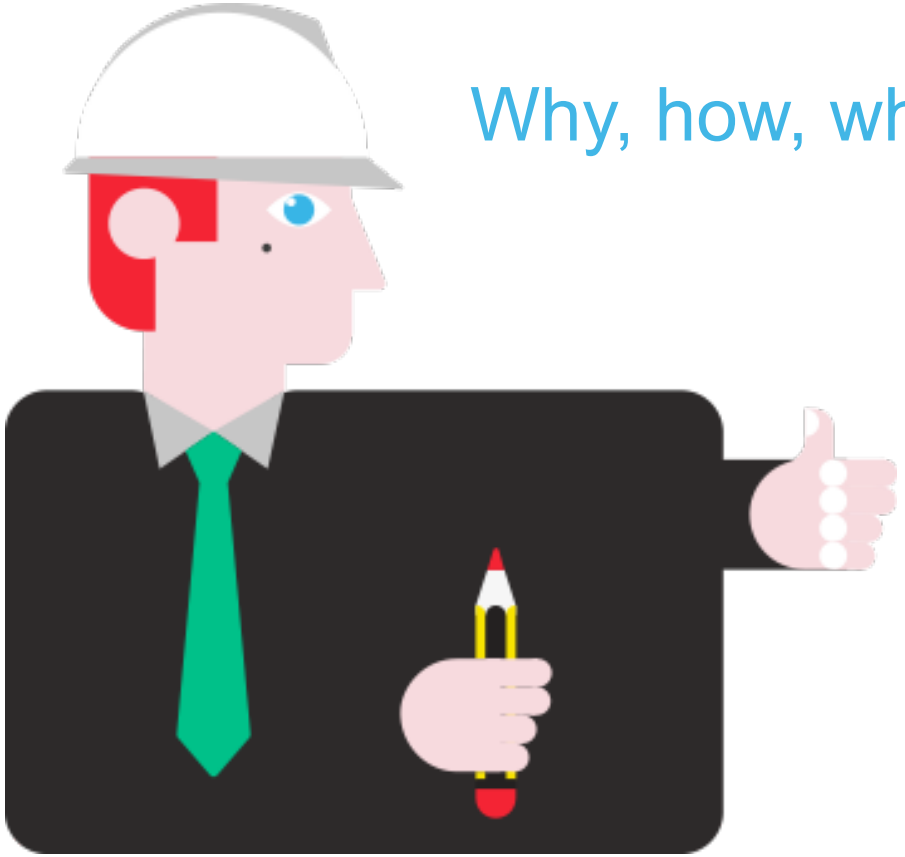
CEN-CE training

Why, how, what?



CEN-CE

CEN EPB Standards Certified Experts

BUILD UP WEBINAR

5th of May 2020

Damir Dović

FSB

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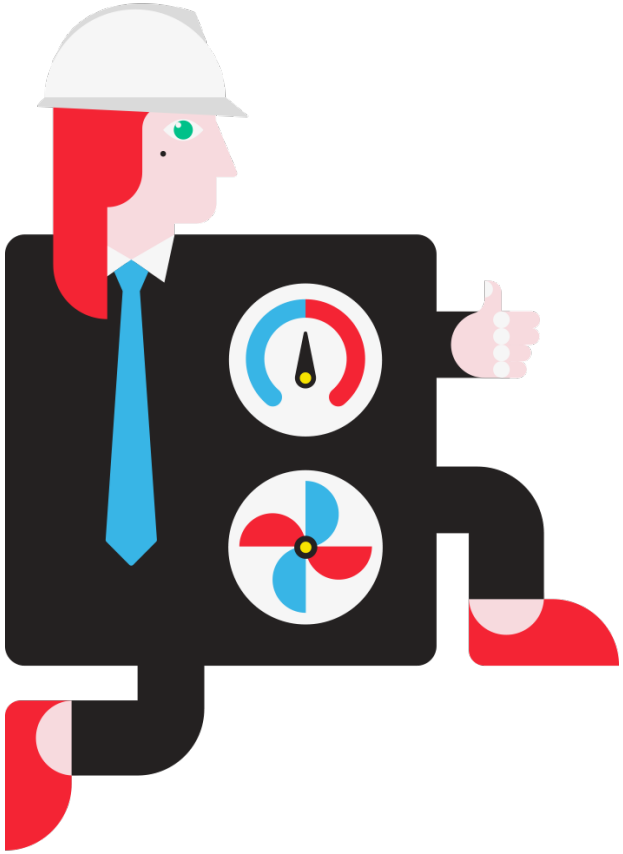

1. Why?
2. How?
3. Examples
4. What?

CEN-CE

CEN EPB Standards Certified Experts

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Why?

- To reach EU 2030 climate/energy targets, a successful implementation of nZEB standards in new and renovated buildings is crucial
- Design of nZEBs requires more detailed/accurate calculations taking into account all technical system components and optimization of tech. solutions
- Implementation of nZEB standards is a challenge for engineers, installers and national methodology developers
- There is a lack of knowledge among engineers in EPB calculations (only energy certifiers are obliged to enroll the training courses)
- An adequate training supported by the calculation tool (software) is needed
- The experience of the consortium members show that the training on individual technical topics is not enough to ensure good quality of installation
- The awareness raising of professionals specialised in one of the skills on other skills (e.g. the sizing and the energy calculation) will help to increase the quality

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Why?

EN 15316 standards can be used for:

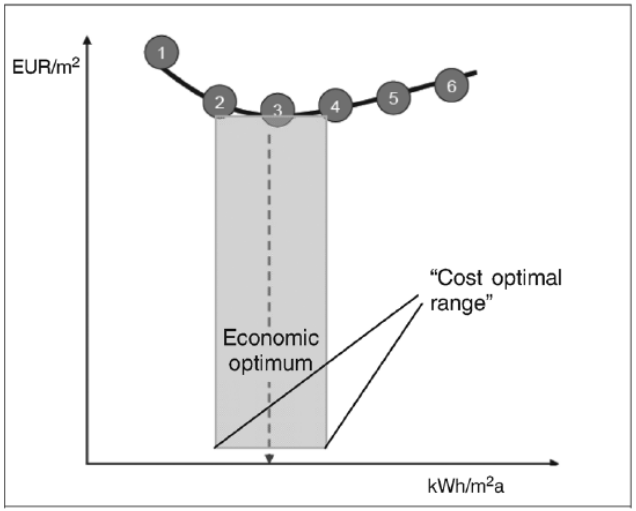
a) Performing energy performance calculations:

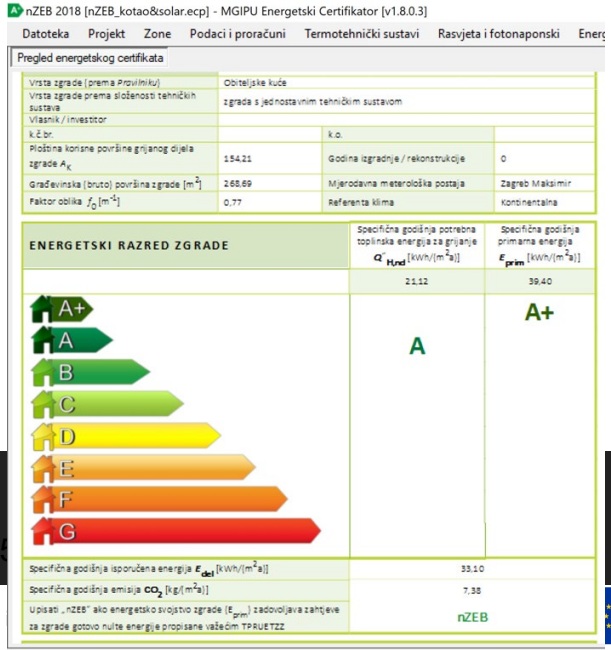
- verification of national min. energy performance requirements
- issuing EPC
- optimizing tech. systems at design stage (cost. optimal solutions)

b) Sizing of the system components (e.g. solar collectors, PV, boilers)

c) Comparison with measured and simulated energy consumption

Data input to calculation tool (spreadsheets, software) can be implemented in a a relatively fast and simple way, most of input values are available as default ones.





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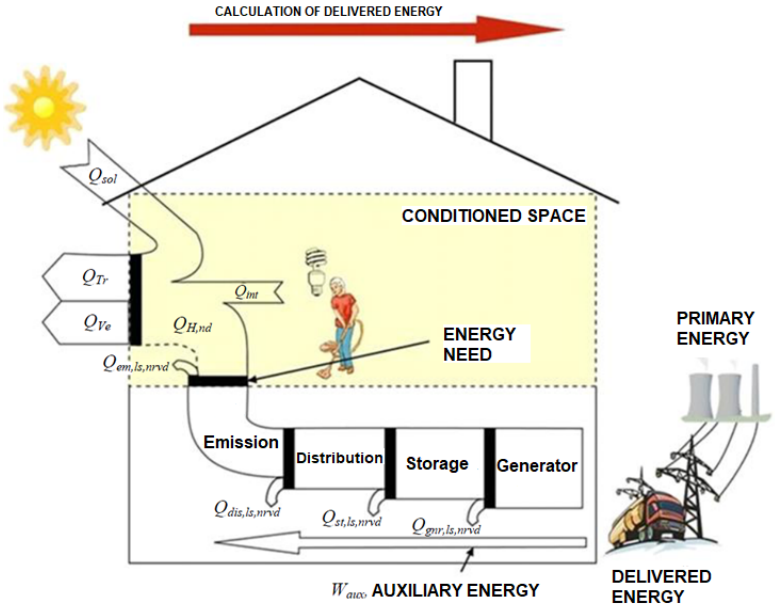
How?

The training comprises EN 15316 series related standards

modular approach - expert can be trained separatelly for selected standards

Heating&DHW systems



Heat load EN 12831- 1	EN 15316-1 - General	Emission & controls EN 15316-2
DHW needs EN 12831- 3		Distribution EN 15316-3
Meas. performance EN 15378-3		Gen – Boiler EN 15316-4-1
System design EN 12828		Gen – Heat pump EN 15316-4-2
Installation & comm EN 14336		Gen – solar EN 15316-4-3
Instructions EN 12170 / 1		Gen – Cogen EN 15316-4-4
Economics EN 15459		Storage EN 15316-5

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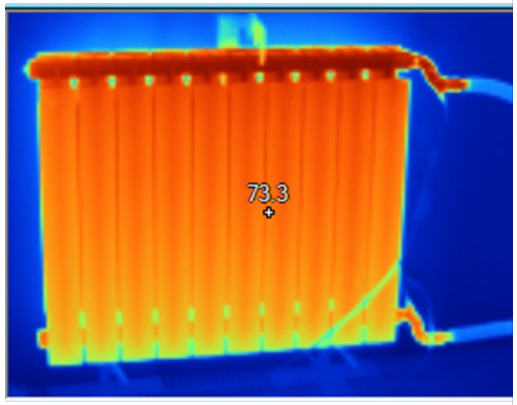
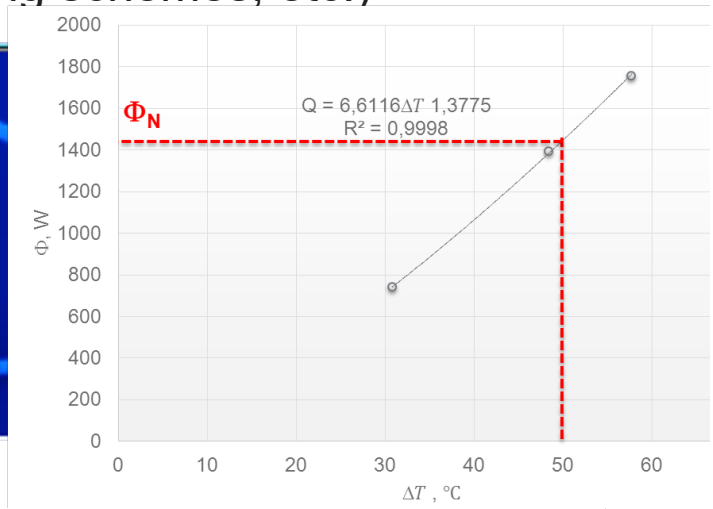
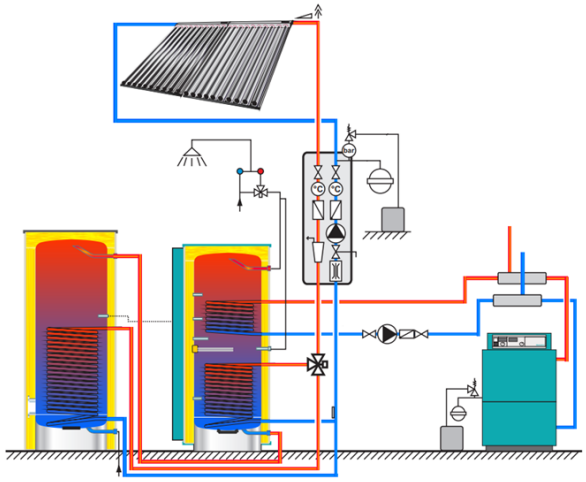
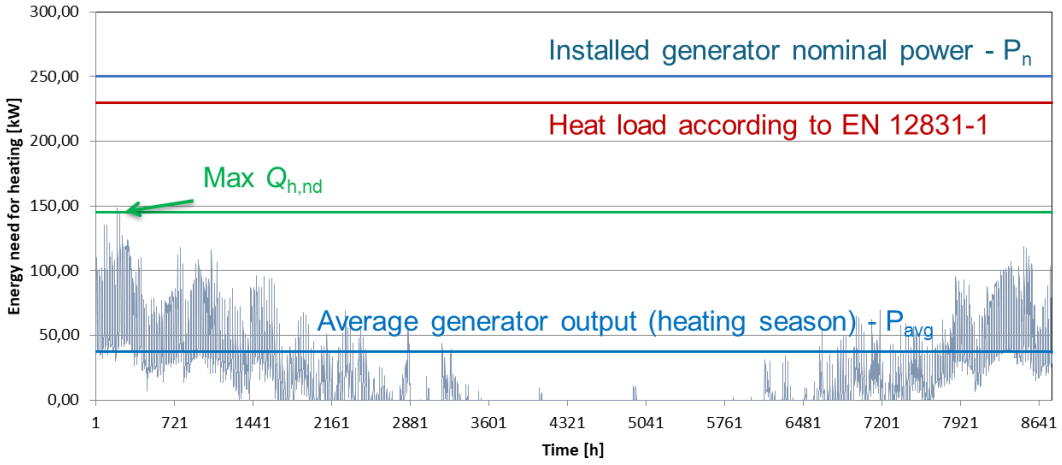
How?

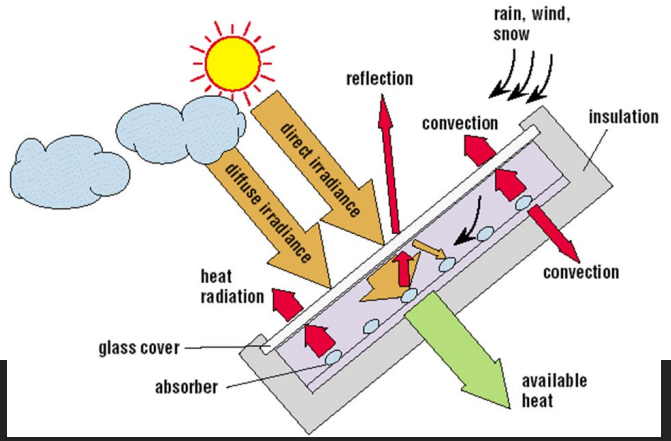
1. First part of each Module lecture is devoted to fundamentals and physics (e.g. types of solar collectors, influencing parameters on thermal output and efficiency, connecting schemes, etc.)











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How?

2. In the second part input values to the calculation procedure and their origins are explained

Annex to Solar Keymark Certificate - Summary of EN ISO 9806:2013 Test Results

Collector name	Gross area (A_g)
	m^2
Vitosol 100-FM SV1F	2.51

Performance parameters test method	Steady state - indoor		
Performance parameters (related to AG)	η0,hem	a1	a2
Units	-	W/(m²K)	W/(m²K²)
Test results	0.749	3.542	0.042

Annex to Solar Keymark Certificate - Summary of EN ISO 9806:2013 Test Results

		Licence Number	011-7S2672 F
		Date issued	2017-01-13
		Issued by	Sommer
Licence holder	Viessmann Werke GmbH & Co. KG	Country	Germany
Brand (optional)	Viessmann	Web	http://www.viessmann.com
Street, Number	Viessmannstrasse 1	E-mail	- - -
Postcode, City	35107 Allendorf (Eder)	Tel	+49 (0)6452-70-0

Collector Type	Flat plate collector, glazed

Collector name	Gross area (A_g)	Gross length	Gross width	Gross height	Power output per collector Gb = 850 W/m²; Gd = 150 W/m² ϑm - ϑa: 0 K	10 K	30 K	50 K*	70 K*	90 K*
	m²	mm	mm	mm	W	W	W	W	W	W
Vitosol 100-FM SV1F	2.51	2 380	1 056	73	1 880	1 781	1 518	1 202	870	519
Power output per m² gross area					749	709	605	479	346	207

Performance parameters test method	Steady state - indoor		
Performance parameters (related to AG)	η0,hem	a1	a2
Units	-	W/(m²K)	W/(m²K²)
Test results	0.749	3.542	0.042

Incidence angle modifier test method	Quasi dynamic - outdoor								
Bi-directional incidence angle modifiers	No								
Incidence angle modifier	Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°
Transversal	$K_{\theta T,coll}$	1.00	0.99	0.97	0.94	0.89	0.80	0.62	0.32	0.00
Longitudinal	$K_{\theta L,coll}$	1.00	0.99	0.97	0.94	0.89	0.80	0.62	0.32	0.00

Heat transfer medium for testing			Water	
Flow rate for testing (per gross area, A_G)		dm/dt	0.018	kg/(sm²)
Maximum temperature difference for thermal performance calculations		$(\vartheta_m-\vartheta_a)_{max}$	90	K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)		ϑ_{stg}	145	°C
Effective thermal capacity, incl. fluid (per gross area, A_G)		C/m²	5.33	kJ/(Km²)
Maximum operating temperature		ϑ_{max_op}	- - -	°C
Maximum operating pressure		$p_{max,op}$	600	kPa
Testing laboratory	TÜV Rheinland Energy GmbH		http://www.tuv.com/solarthermie	
Test report(s)	21232812.001 21238010.001	Dated	21.06.2016 23.01.2017	

Comments of testing laboratory — Datasheet version: 5.01, 2016-03-01

As the collectors is operating with a discontinuous performance curve behavior, the performance curve above the switching point of about 50°C (absolute temperature) will be described by the following parameter η0, a1*, a2* (related to ...):*
[A Gross] 0.779 /// 5.549 /// 0.009
The overall behavior (over the full temperature range) is approximately described by the following set of parameters [related to ...] :
[A Gross] 0.755 /// 4.468 /// 0.021 ; [A Aperture] 0.814 /// 4.813 /// 0.023

TÜVRheinland®
TÜV Rheinland Energy GmbH
Am Grauen Stein
51105 Köln

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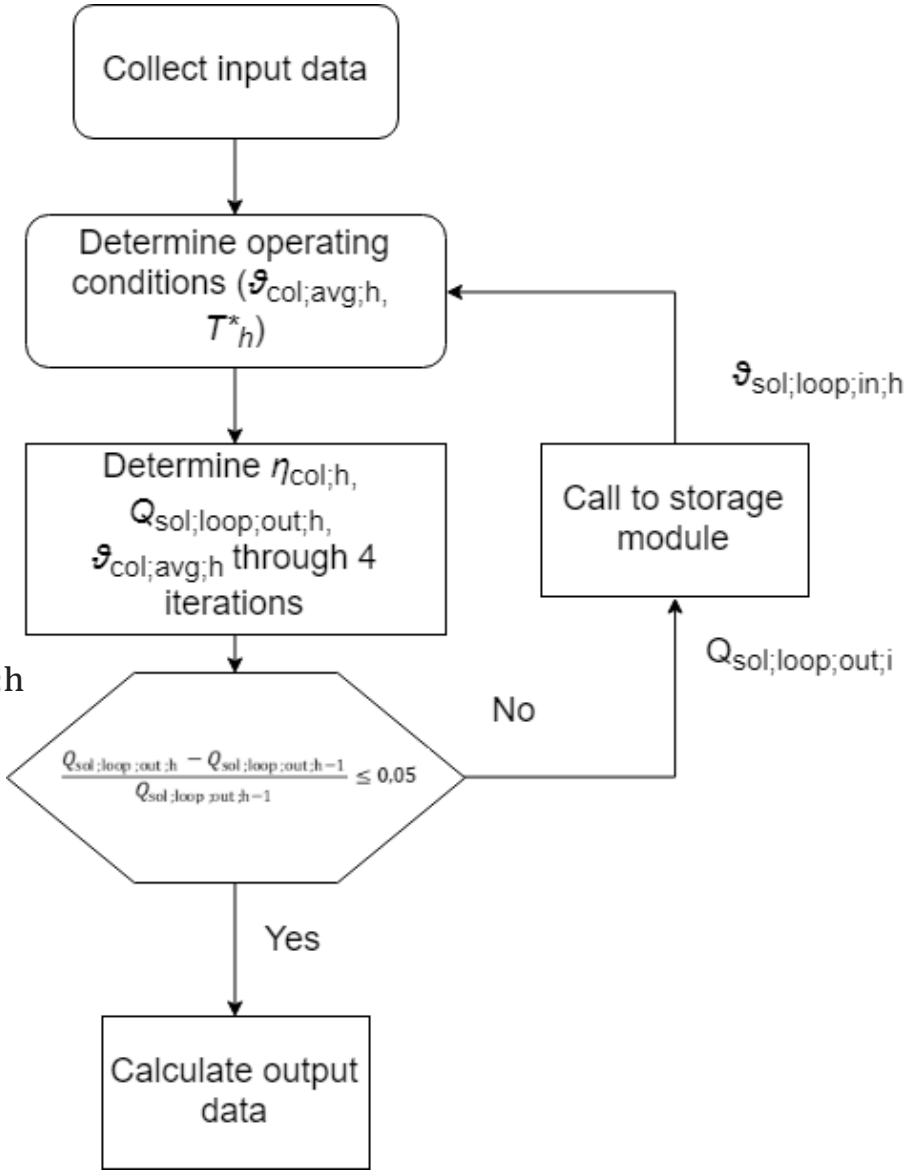
How?

3. In the third part the calculation procedure is explained where calculation flow chart
and basic equations are presented



$$\eta_{\mathrm{col;h}} = \eta_0 \cdot K_{\mathrm{hem}}(50°) - a_1 \cdot T^*_{\mathrm{h}} - a_2 \cdot T^*_{\mathrm{h}} \cdot I_{\mathrm{sol;h}}$$

$$Q_{\mathrm{sol;out;h}} = \eta_{\mathrm{col;h}} \cdot I_{\mathrm{sol;h}} \cdot A_{\mathrm{sol}} \cdot t_{\mathrm{ci}} \cdot 0{,}001$$

$$\vartheta_{\mathrm{col;avg;h}} = \vartheta_{\mathrm{sol;loop;in;h-1}} + \frac{0{,}4 \cdot I_{\mathrm{sol;h}} \cdot A_{\mathrm{sol}}}{\dot{m}_{\mathrm{col}} \cdot C_{\mathrm{W}} \cdot 2}$$

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How?

4. In the fourth part the output values are discussed

Name	Symbol	Software name	Unit	Value	Range	Intended designation	Varying
Energy flow data							
Heat generated in the collector apsorber	$Q_{sol;gen}$	Q_sol_gen	W/(m^2.K)		[0…∞]	M1-9	YES
Collector heat output	$Q_{sol;col;out}$	Q_sol_col_out	kWh		[0…∞]	M1-9	YES
Collector loop heat output	$Q_{sol;loop;out}$	Q_sol_loop_out	kWh		[0…∞]	M1-9	YES
Collector loop heat losses	$Q_{sol;loop;ls}$	Q_sol_loop_ls	kWh		[0…∞]	M1-2	YES
Recoverable heat losses of collector loop	$Q_{sol;loop;ls;rbl}$	Q_sol_loop_ls_rbl	kWh		[0…∞]	M1-2	YES
Auxiliary (electrial) energy consumpiton in the collector loop	$E_{sol;aux}$	E_sol_aux	kWh		[0…∞]	M1-9	YES

$$W_{\mathrm{sol;aux;h}} = \left(P_{\mathrm{sol;crt}} + P_{\mathrm{sol;pmp}}\right) \cdot t_{\mathrm{ci}} \quad [\mathrm{kWh}]$$

$$Q_{\mathrm{sol;loop;rbl;h}} = Q_{\mathrm{sol;loop;ls;h}} \quad [\mathrm{kWh}]$$

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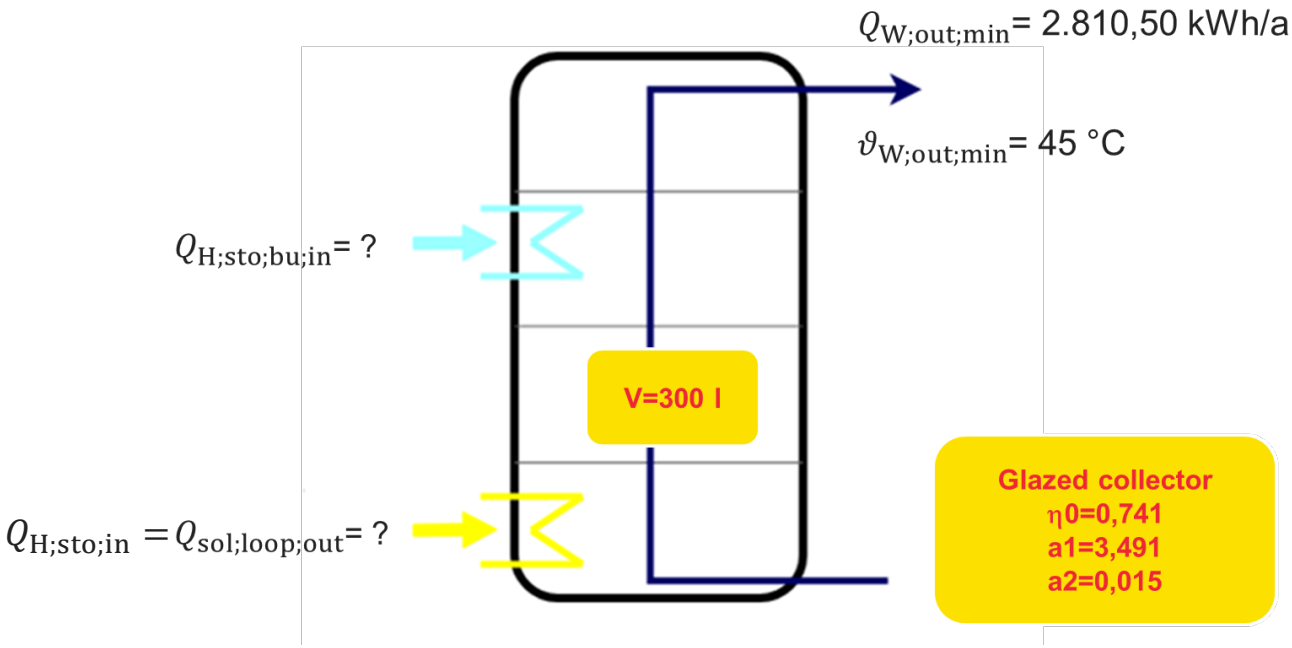
How?

5. The fifth part is devoted to the work with spreadsheets through examples

For this purpose trainers will use handbooks which provide array of equations following the order they are implemented in spreadsheets, along with the explanations that faciliate use of spreadsheets and understanding of calculation procedure



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Handbook examples (storage, solar)

5.4 Energy calculation – Method B

Table 9. Inputs to thermal loss calculations

Name	Symbol	Unit	Origin
Ambient temperature	ϑ_{amb}	°C	Table 7
Part of the thermal losses transmitted to the room	f_{space}	-	Table 7
Stand-by losses coefficient	$H_{ls;ls}$	W/K	For default data Eq. (1a) For EcoDesign data Eq. (1b)

Storage tank thermal losses are calculated by:

$$Q_{sto;ls} = f_{sto;dis;ls} \cdot \frac{H_{sto;ls}}{1000} \cdot \left(\vartheta_{sto;set;on} - \vartheta_{sto;amb}\right) \cdot t_{ci} \quad [\text{kWh}] \qquad \text{(SU) EN 15316-5:2017} \qquad (57)$$

Note: $f_{sto;dis;ls}$ is defined in 5.2.10.

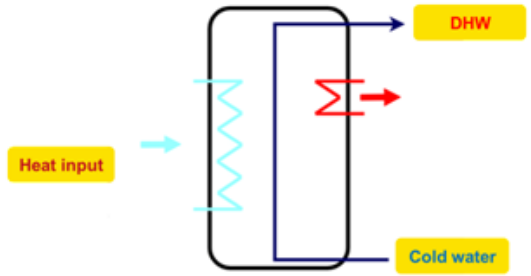

Figure 6. Graphical representation of a storage module mathematical model (Method B)

Storage tank water content temperature after the withdrawn of energy for DHW and thermal losses is calculated by:

$$\vartheta_{sto;tmp1} = \vartheta_{sto;t-1} + \frac{\left(-Q_{W;out} - Q_{sto;dis;ls} - Q_{W;dis;noconsum}\right) \cdot 1000000}{\rho_W \cdot C_{p;w} \cdot V_{sto;tot}} \quad [°C] \qquad \text{(CEN-CE)} \qquad (58)$$

where $Q_{W;out} = \min\left(Q_{W;sto;out;req}; \rho_W \cdot C_{p;w} \cdot V_{sto;tot} \cdot \left(\vartheta_{sto;t-1} - \vartheta_{W;cold}\right)/1000000\right)$.

NOTE: If $\vartheta_{sto;t-1} < \vartheta_{W;out\,min}$ $\quad Q_{W;out} = 0$.

Energy to be supplied by other system is calculated:

5.1.2 Energy calculation

Table 9. Inputs to the calculation

Name	Symbol	Unit	Origin
Peak collector efficiency	η_0	-	Table 11 or Ecodesign data
First order heat loss coefficient	a_1	W/(m².K)	Table 11 or Ecodesign data
Second order heat loss coefficient	a_2	W/(m².K²)	Table 11 or Ecodesign data
Hemispherical incidence angle modifier	$K_{\tau\alpha n}$ (50°)	-	Table 11 or Ecodesign data

The flowchart of the calculation procedure is shown on Fig. 1.

The air temperature surrounding the collector loop is determined in relation to its location by:

SOL_LOC_HS (heated space): $\vartheta_{sol;amb;h} = \vartheta_{i;hr}$ [°C]
SOL_LOC_NHS) non-heated space): $\vartheta_{sol;amb;h} = (\vartheta_{i;hr} + \vartheta_{e;h})/2$ [°C]
SOL_LOC_OUT (outside): $\vartheta_{sol;amb;h} = \vartheta_{e;h}$ [°C]

(49) EN 15316-4-3:2017 *(5)*

where:
$\vartheta_{i;hr}$ – air temperature in heated room [°C];
$\vartheta_{e;h}$ – outside air temperature [°C].

The installed collector area is calculated by:

$$A_{sol} = A_{sol;mod} \cdot N_{col} \quad [\text{m}^2] \qquad \text{(SU) EN 15316-4-3:2017} \qquad (6)$$

NOTE: $A_{sol;mod}$ should be referred to the area (gross or aperture) used for determining collector efficiency parameter - EN 12975-2 (aperture area) or the current EN ISO 9806 (gross area).

5.1.2.1 Initial calculations

Table 10. Constants and physical data

Symbol	Value	Unit
c_w	4186	J/(kgK)

The first estimation of the average collector water temperature determined by:

$$\vartheta_{col;avg;h} = \vartheta_{sol;loop;in;h-1} + \frac{0{,}4 \cdot I_{sol;h} \cdot A_{sol}}{\dot{m}_{col} \cdot C_W \cdot 2} \quad [°C] \qquad \text{(SU) EN 15316-4-3:2017} \qquad (7)$$

where
$\vartheta_{sol;loop;in;h-1}$ – storage outlet temperature to the collector loop from previous time step [°C], see Handbook on EN 15316-5
When h=1 (start of calculations) $\vartheta_{sol;loop;in;h-1}$ is equal to the initial temperature of the bottom volume of the storage tank

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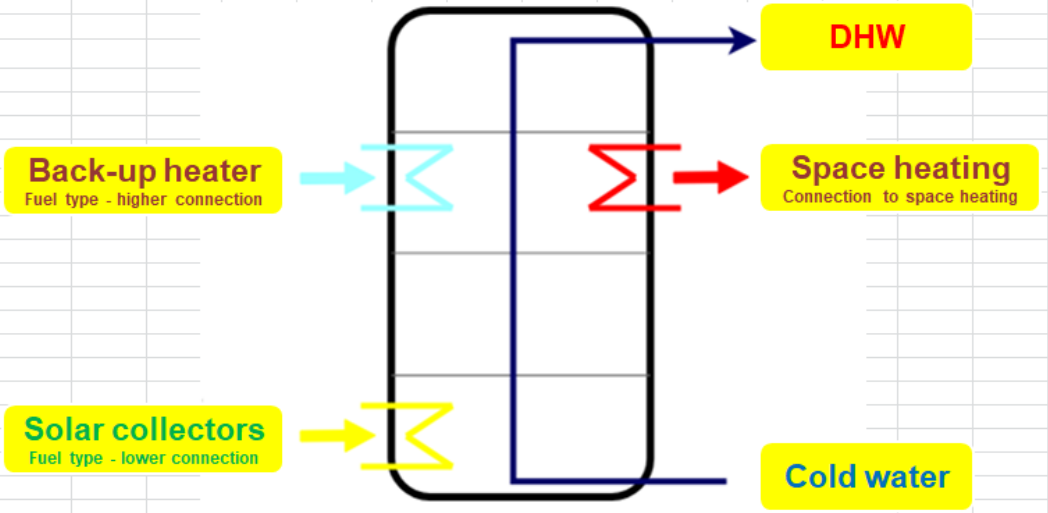
Example of input data

Spreadsheet interface for storage tank (Method A)

PRODUCT DATA				
Product descriptive data				
Storage unit type				
Solar storage	STO_H_TYPE			
Storage unit use				
Domestic hot water	STO_H_USE	STO_USE_W		
Fuel type - lower connection				
Direct connection	STO_H_FUEL_VOL1	STO_FUEL_NOEXC		
Fuel type - higher connection				
No heat source	STO_H_FUEL_VOL3	STO_FUEL_NO		
Hydraulic connection to space heating				
Exchanger (hot water)	STO_HCONN	STO_H_CONN_HEX		
Product technical data				
Volume total	$V_{sto,tot}$	V_sto_tot	L	300
Stand-by losses coefficient	$H_{sto,ls}$	H_sto_ls	W/K	2,77128129
Stand-by losses correction factor	$f_{sto;dis;ls}$	f_sto_dis_ls	-	1
Set temperature	$\vartheta_{sto;set;on}$	theta_sto_set_on	°C	60
Heat exchanger - lower connection	$H_{sto;H;exh;vol;1}$	H_sto_H_exh_vol_1	W/K	
Heat exchanger - upper connection	$H_{sto;H;exh;vol;3}$	H_sto_H_exh_vol_3	W/K	
Heat exchanger - space heating service	$H_{sto;H;exh;out}$	H_sto_H_exh_out	W/K	4000
Set temperature for back-up heater ON	$\vartheta_{sto;set;on;bu}$	theta_sto_set_on_bu	°C	50
SYSTEM DESIGN DATA				
Storage location				
Boiler room	STO_LOC	STO_LOC_BLR		
Stand-by losses correction factor	ideal case			



Graphical representation of a storage module mathematical model

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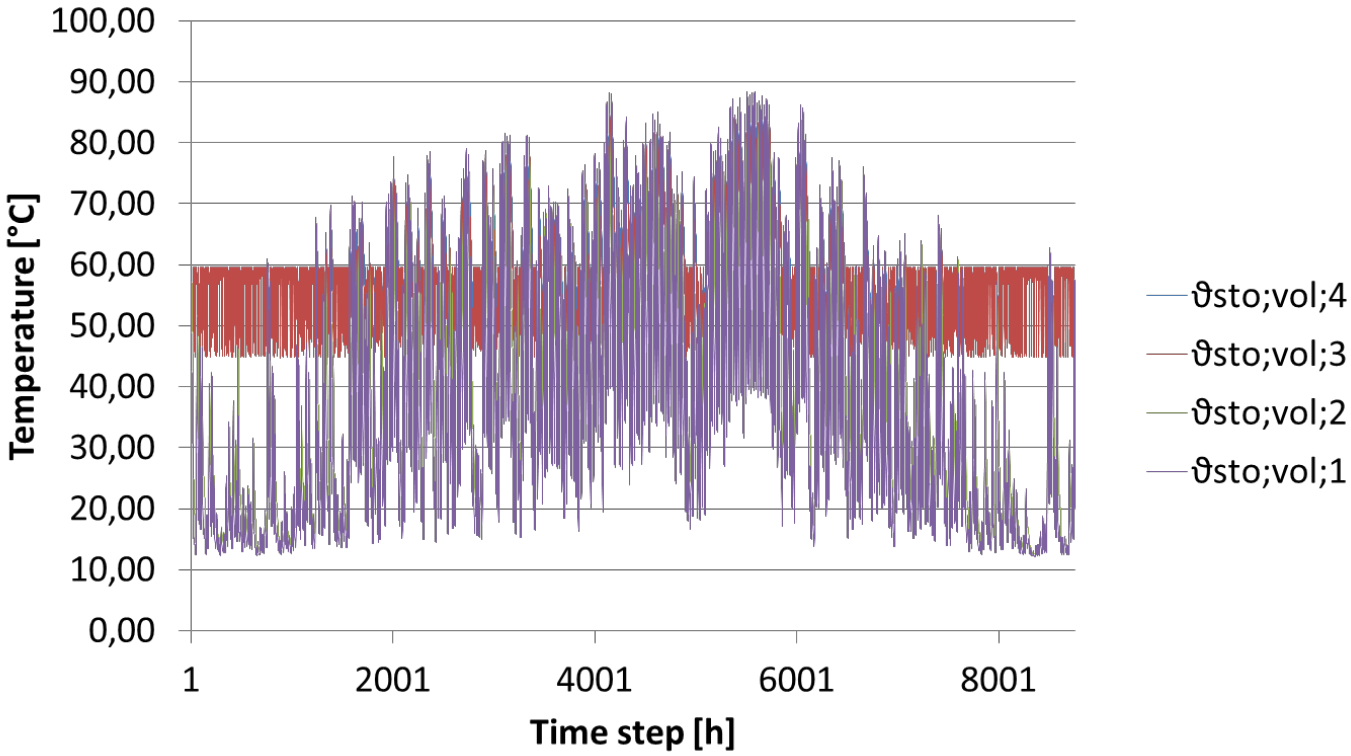
How?

6. The last part of Module lecture deals with analysis of the most influencing parameters on the intermediate values and final result (sysbstem energy output)



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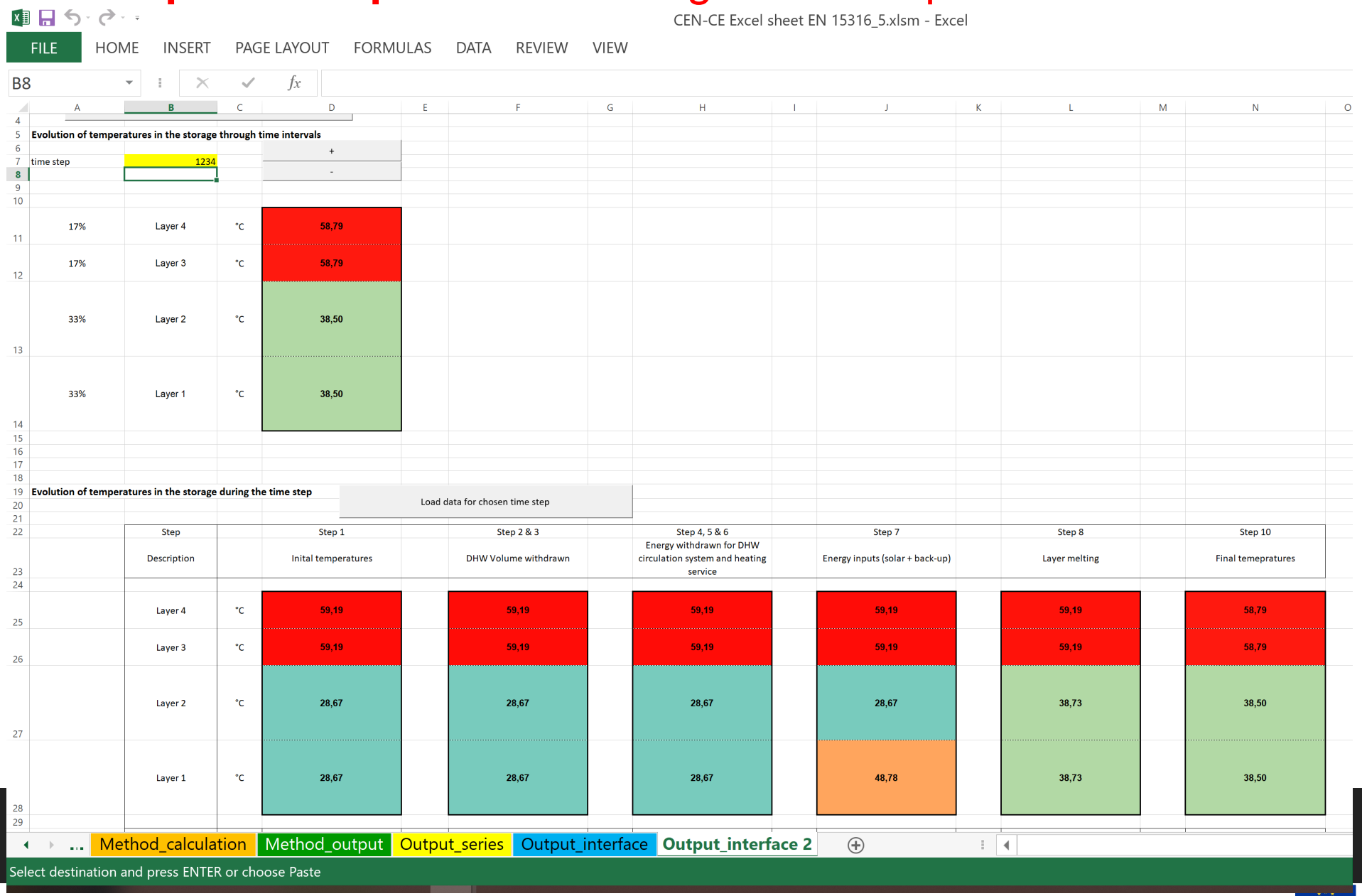
Example of output data - storage tank temperatures



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Example of output data

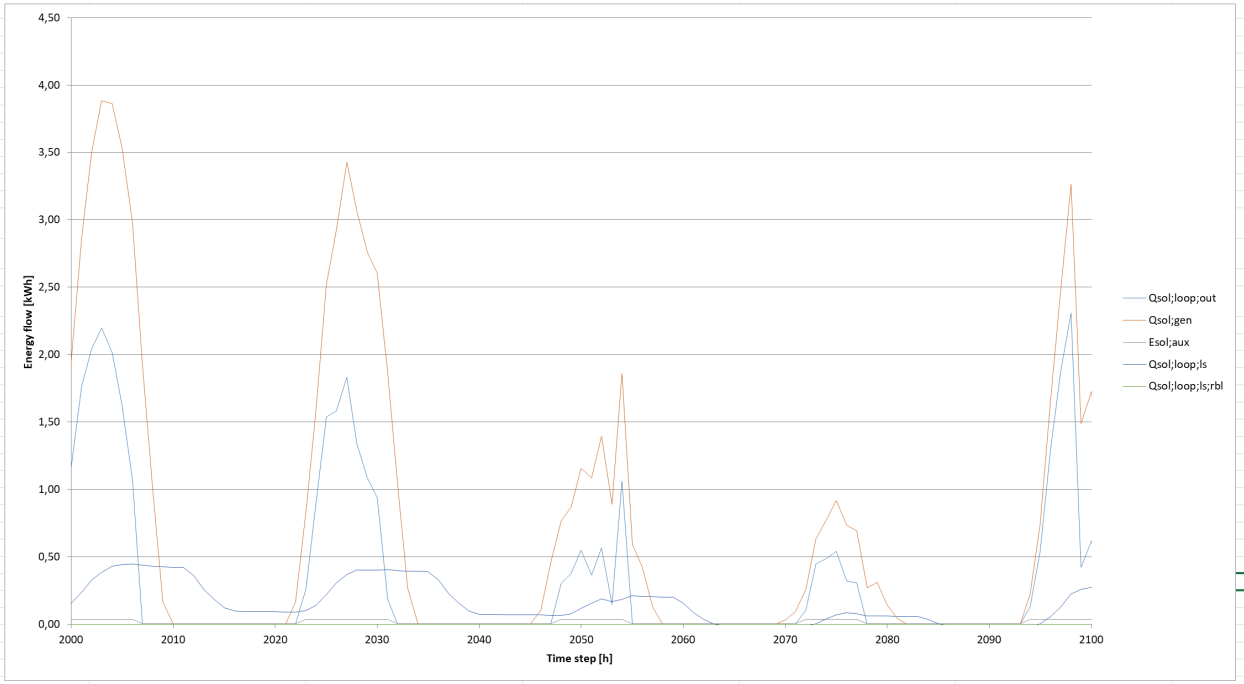
Solar system energy flows

Annual values			
Heat generated in the collector apsorber	kWh	$Q_{sol;gen}$	5.218,16
Collector heat output	kWh	$Q_{sol;col;out}$	3.245,20
Collector loop heat output	kWh	$Q_{sol;loop;out}$	2.631,93
Collector loop heat losses	kWh	$Q_{sol;loop;ls}$	1.154,46
Recoverable heat losses of collector loop	kWh	$Q_{sol;loop;ls;rbl}$	0,00
Average solar collector efficiency		$\eta_{col,h}$	0,46
Auxiliary (electrial) energy consumpiton in the collector loop	kWh	$E_{sol;aux}$	125,03

Time series for chart output	
Settings	
Number of first time steps	2000
Number of last time steps	2100

Apply settings

Preview settings	
Collcetor loop heat output	Show
Heat generated in the collector apsorber	Show
Auxiliary (electrial) energy consumpiton in the collector loop	Show
Collector loop heat losses	Show
Recoverable heat losses of collector loop	Show



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Example of output data

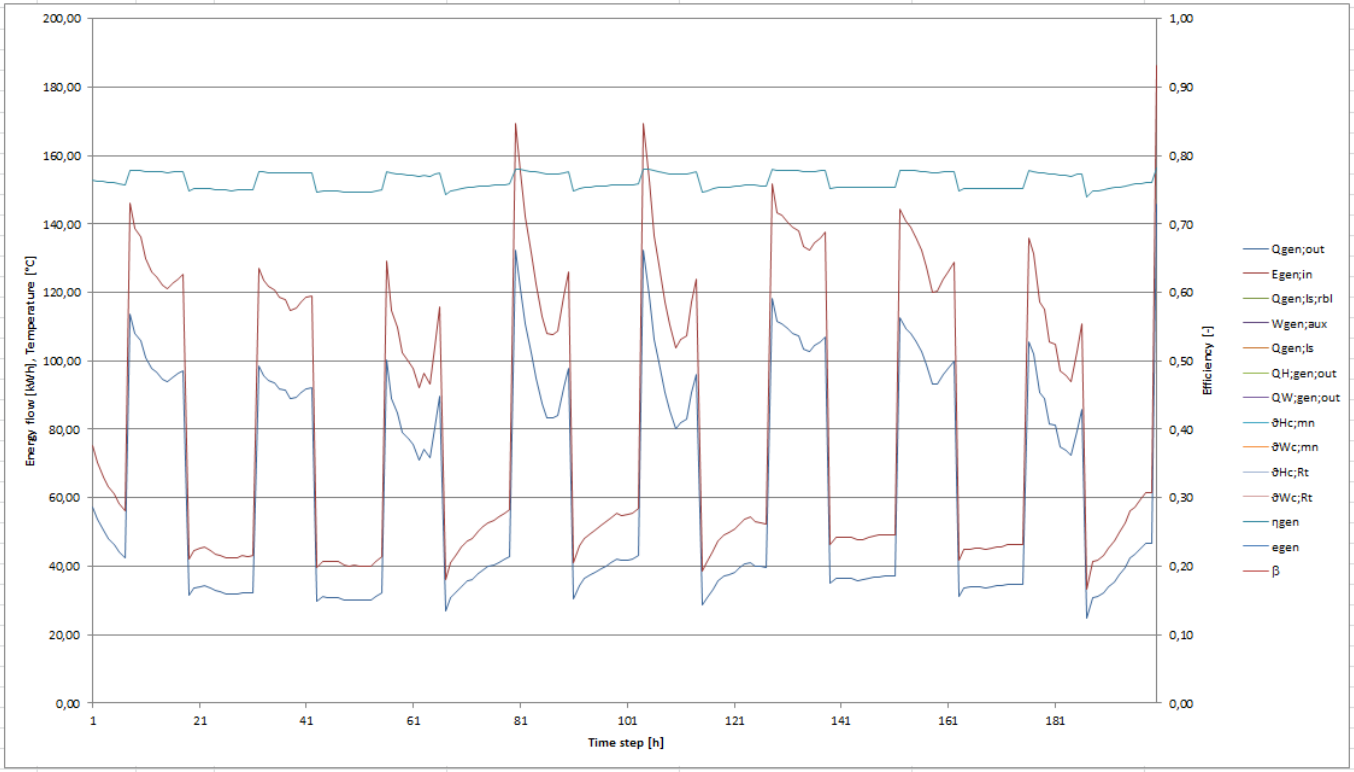
Hot water boiler energy flows

Annual values			
Generator heat output	kWh	$Q_{gen;out}$	1.478,42
Fuel heat input	kWh	$E_{gen;in}$	1.928,06
Total heat losses	kWh	$Q_{gen;ls}$	450,33
Total recoverable heat losses	kWh	$Q_{gen;ls;rbl}$	30,73
Total auxiliary energy	kWh	$W_{gen;aux}$	0,91
Total heat output deficiency	kWh	$Q_{gen;bu}$	0,00
Total load factor	-	β	0,30
Generator efficiency (gross calorif value)	-	η_{gen}	0,77
Expenditure factor	-	ε_{gen}	1,30

Time series for chart output	
Settings	
Number of first time steps	1
Number of last time steps	200

Apply settings

Preview settings	
Total generator heat output	Show
Generator heat output - SH	Dont show
Generator heat output - DHW	Dont show
Fuel heat input	Show
Total heat losses	Dont show
Total recoverable heat losses	Dont show
Total auxiliary energy	Dont show
Generator efficiency (gross calorific value)	Show
Expenditute factor	Dont show
Load	Dont show
Average water temperature - heating	Dont show
Average water temperature - DHW	Dont show
Return water temperature - heating	Dont show
Return water temperature - DHW	Dont show



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Example

Solar hot water system - influence of storage tank volume

Lowest energy consumption!

V=500 l m_{col}=0.02 kg/sm²	V=300 l m_{col}=0.02 kg/sm²	V=200 l m_{col}=0.02 kg/sm²
$Q_{sto;ls}$= 1.166,23 kWh/a	$Q_{sto;ls}$= 935,96 kWh/a	$Q_{sto;ls}$= 782,77 kWh/a
$Q_{H;sto;bu;in}$= 1.125,81 kWh/a	$Q_{H;sto;bu;in}$= 1.101,48 kWh/a	$Q_{H;sto;bu;in}$= 1.138,71 kWh/a
$Q_{sol;loop;out}$= 2.840,38 kWh/a	$Q_{sol;loop;out}$= 2.631,93 kWh/a	$Q_{sol;loop;out}$= 2.449,12 kWh/a

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Example

Solar hot water systems - influence of m_{col} and $Q_{W;sto,out,req}$

Basic case

V=300 l m_{col}=0.02 kg/sm²	**V=300 l** m_{col}=0.01 kg/sm²	**V=300 l** m_{col}=0.02 kg/sm² $Q_{W;sto,out;req}$ = 5.621,04 kWh/a (50% increase)
$Q_{sto;\,ls}$= 935,96 kWh/a $Q_{H;sto;bu;in}$= 1.101,48 kWh/a $Q_{sol;loop;out}$= 2.631,93 kWh/a	$Q_{sto;\,ls}$= 921,32 kWh/a $Q_{H;sto;bu;in}$= 1.119,85 kWh/a $Q_{sol;loop;out}$= 2.604,81 kWh/a	$Q_{sto;\,ls}$= 790,78 kWh/a $Q_{H;sto;bu;in}$= 3.124,03 kWh/a $Q_{sol;loop;out}$= 3.279,03 kWh/a

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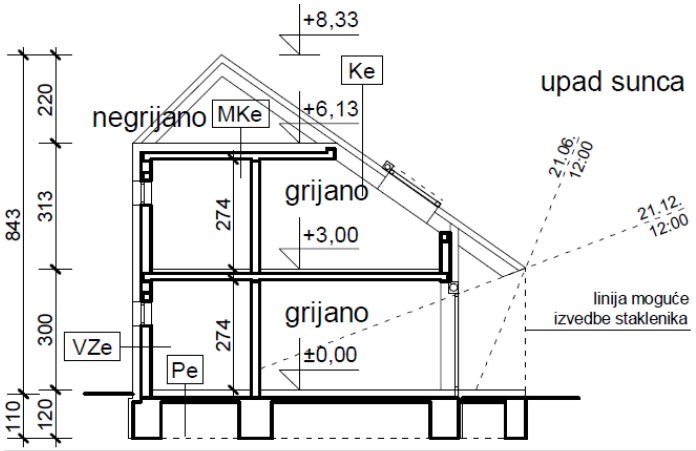
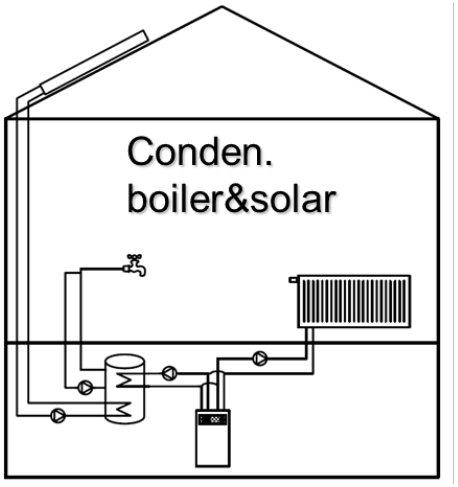
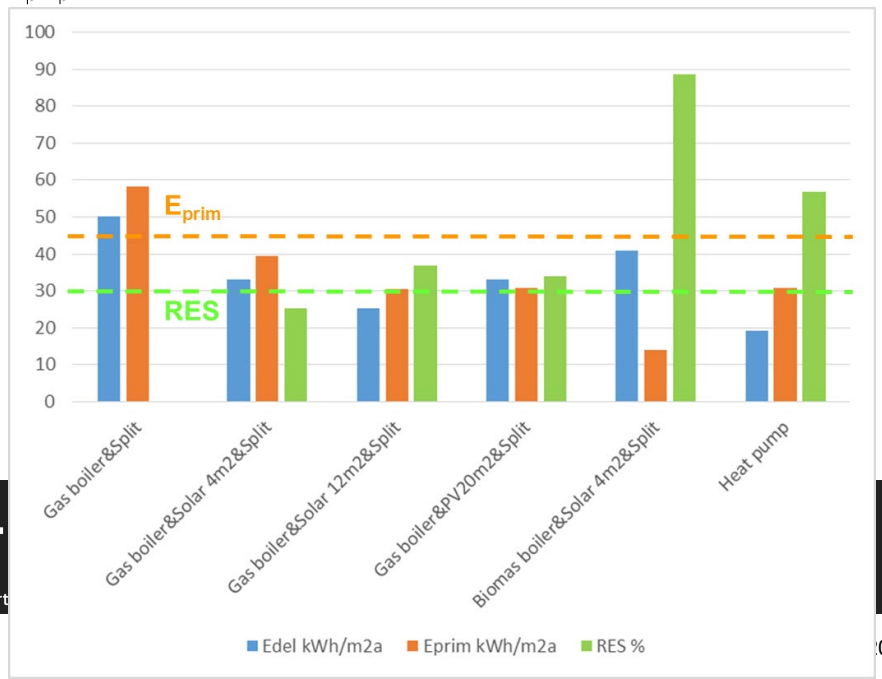
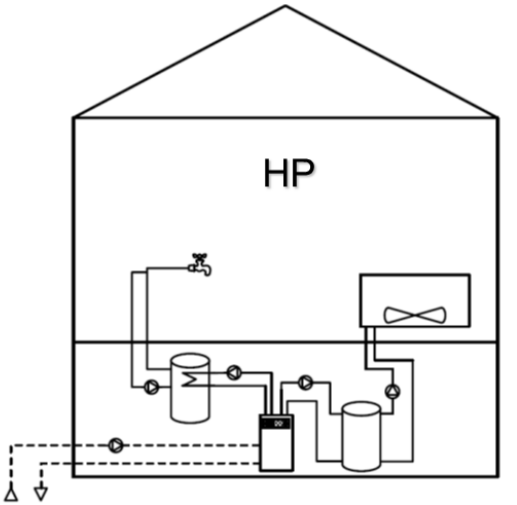
How?

7. At the end of the training, an integral calculation example will be presented in order to demonstrate use of the standards for design, sizing and energy optimization of the technical system solution





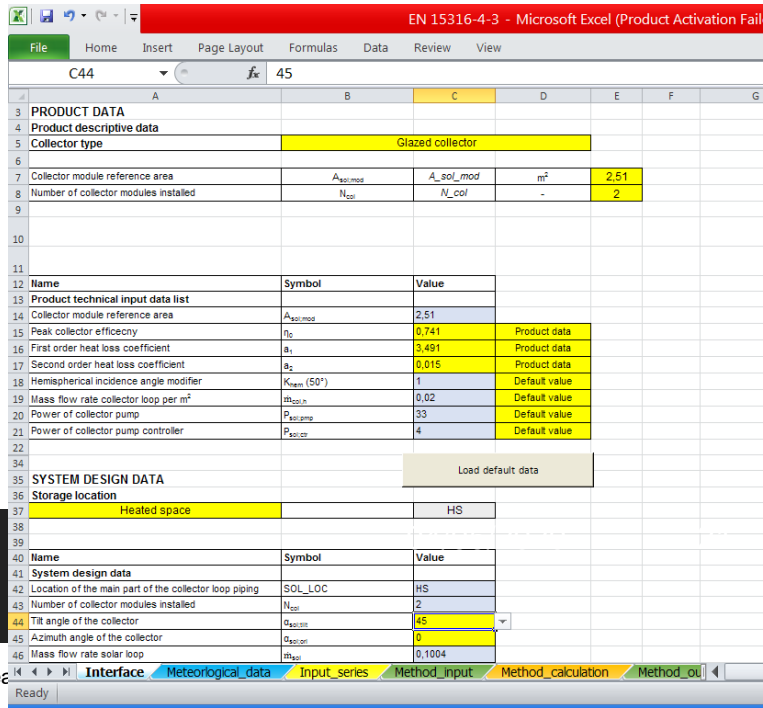




0 research and innovation programme under grant agreement No. 785018

How?

- The training is interactive
- Trainees participate in training during spreadsheet exercises, by filling in input data for a given example and by performing parametric analysis
- The emphasis in on nZEBs
- At the end of the training each trainee will define heating/DHW system for a given building of nZEB class
- The proposed technical solution will be discussed in light of technical and economical feasibility as well
- The exams consisting of multiple choice questions will be written after each module
- After completition of the training and passing exams for particular Modules, the trainees will be given a corresponding certificate



CEN-CE
CEN EPB Standards Certified Experts

CEN-CE training
Damir DOVIĆ

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What?

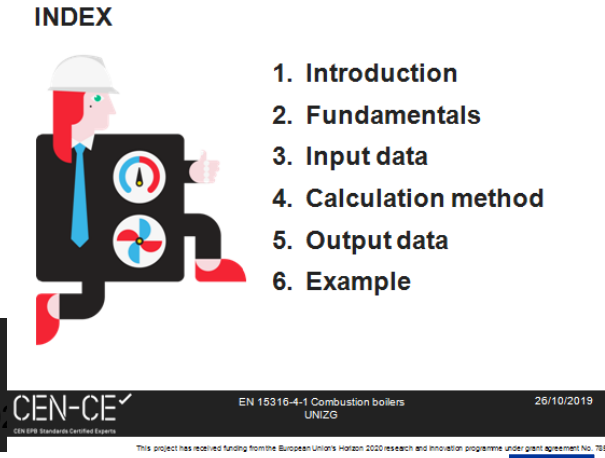
Training outcomes

Provide knowledge – skills – competence – reliability

Training materials (for each standard) :

- handbook
- one page presentation of the topic
- ppt presentation with comments for trainers
- spreadsheets with examples to show the main influences and possibilities
- commented input / output list of data
- didactics for trainers (2 pages/standard).
- questions and answers (correct and 3 incorrect answers) for exam (15 questions/standard)

English version of training materials will be translated as primary in French, Italian, Croatian and Slovak language.



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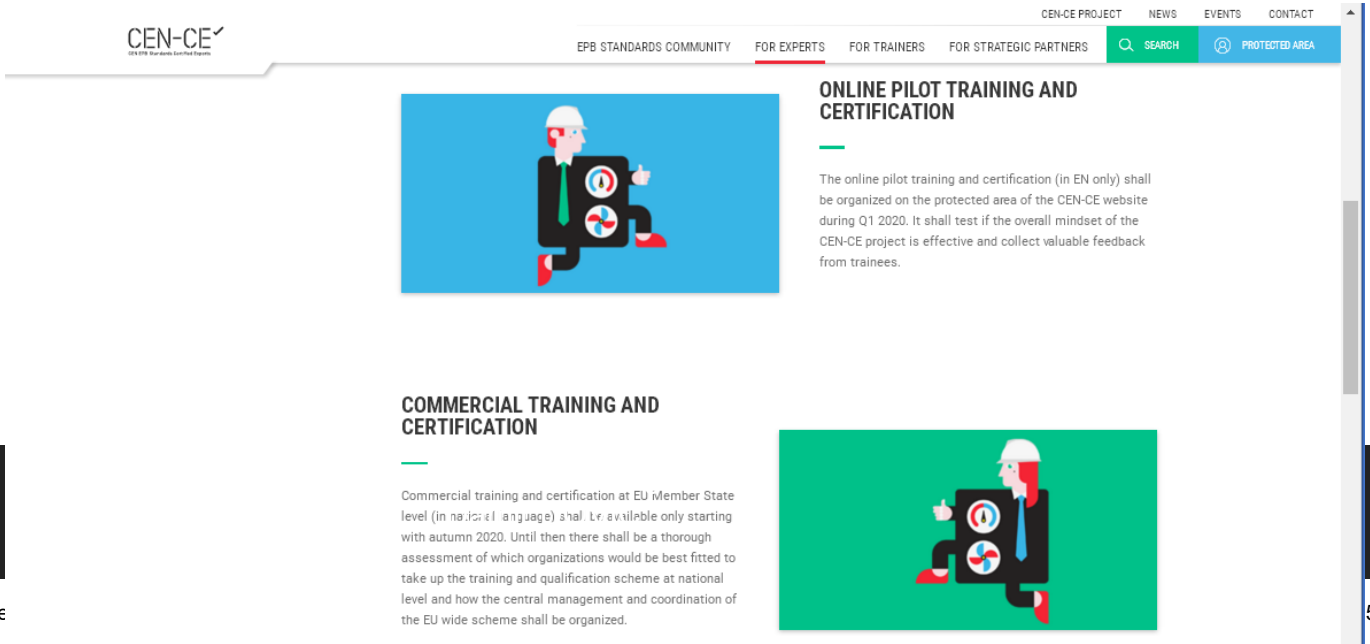
What?

are the steps of becoming a CEN-CE standards certified expert:

- Application and proof of eligibility (initial competence criteria);
- Undertaking training (competence, knowledge);
- Verification (passing examination);
- Certification & recognition (public list)

Targeted groups: designers, installers (level 4 in EQF), engineers, architects, national calculation methodologies developers (level 5, 6 in EQF)

The training and certification is available also online as e-learning.



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5018

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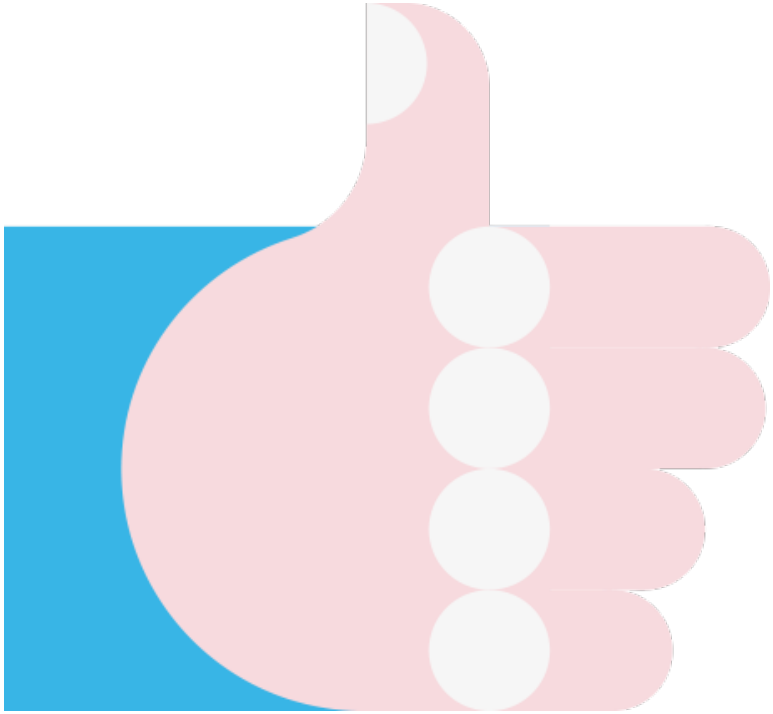
E-mail: ddovic@fsb.hr

THANK YOU



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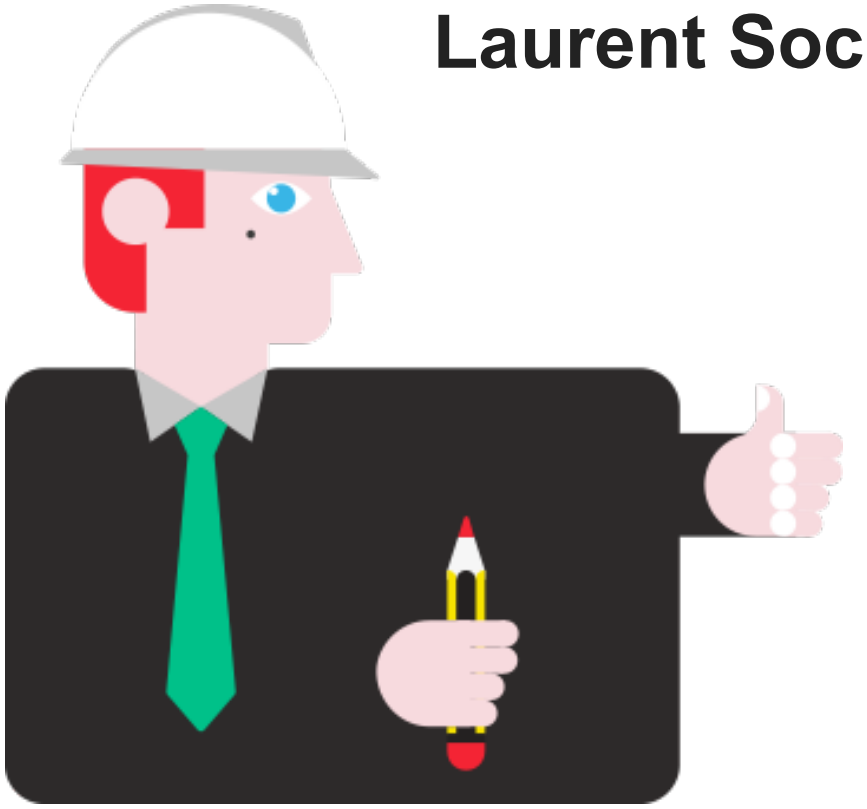
Professional tools integrating EPB standards



Laurent Socal

CEN-CE

CEN EPB Standards Certified Experts

Build-up webinar

Showcasing CEN-CE scheme

5th of May 2020

12h00 – 13h30

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Professional tools integrating EPB standards

Laurent SOCAL
socal@iol.it

SLR

11h00

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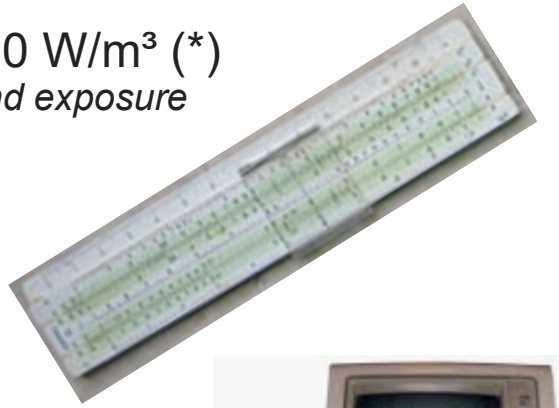
Background

- **Up to ≈ the years '70** it was just heat load → 20…40 W/m³ (*)
  (*) values depending on climate, type of building, space position and exposure
- **Then** the worry was energy need for heating
  → *losses minus useful gains*
- **Then** came primary energy and renewables
- **Now** we care about primary energy
  for all comfort services (H, C, W, V, HU/DHU, L, …)
- **Buildings and systems are more an more complex**
- There are new technologies available
- Technical systems are more and more complex
- **Performance requirements are tough**
- **Calculation methods** for legal purposes have to follow to be representative and to evaluate correctly the effect of the various technologies.



Software calculation tools are needed

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Why professional calculation tools

The «***designer***» has two tasks that need calculation:

- **Sizing**: assemble a set of objects and/or devices so that services can be provided even in the worst case operating conditions
- **Energy calculation**: Check how does the whole behave along a reference year of operation and check legal requirements

Professional tools are needed to facilitate the following steps

- **Description** of the building and systems → graphics input
- Finding **data** about components → integrated data-base
- Performing the **calculation** as required by standards → algorithms
- Presenting **results** and giving feed-back → graphic output
- Checking **compliance** with legal requirements → checks
- Compiling standardized **reports** for legal purpose → XML output *(EPCs, building permits, incentive application, energy audits, …)*

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Basic tool: hand held calculator

- Totally flexible but no predefined algorithm
- Limited computation capability
- No helpful interface
- No data base
- Elementary output
- Requires experienced user, understanding the topic, and knowing benchmarks
- **Typical application**:
  - **Rough sizing**
  - **Screening** for mistakes of software results (rule of thumb calculation)

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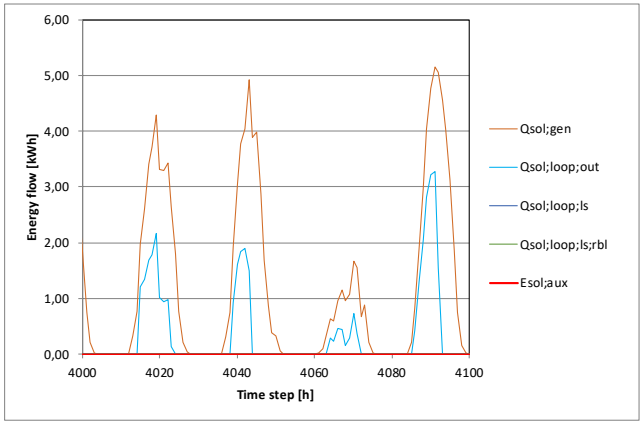
Experimental tool: Excel sheet

- **Totally traceable**
- Some interface capability
- Some data-base capability
- Hard to calculate an entire building + systems
- Slow calculation compared to software
- **Can be customized** but this requires expertise
- **Typical application**:
  - **Standards development**
  - **Software validation (documenting test cases)**
  - **Teaching and training**
  - Calculation of simple cases
  - Custom design approach

Product technical input data list					
Collector module reference area	$A_{sol;mod}$	m²	2,51		Default data
Peak collector efficiency	η_0	p.u.	0,741	Product data	0,800
First order heat loss coefficient	a_1	W/m²K	3,491	Product data	3,500
Second order heat loss coefficient	a_2	W/m²K²	0,015	Product data	0,000
Hemispherical incidence angle modifier	K_{hem} (50°)	p.u.	0,94	Default data	0,94
Mass flow rate collector loop per m²	$\dot{m}_{col,h}$	kg/s m²	0,02	Default data	0,02
Power of collector pump	$P_{sol;pmp}$	W	33	Product data	40,06
Power of collector pump controller	$P_{sol;ctr}$	W	4	Product data	2,51
Collector liquid specific contents		l/m²	0,2		
System design data					

Load default data

Latent specific heat	$c_{ev;loop}$	kJ/kg	2160,0		
Maximum latent energy stored	$Q_{coll;sto;max}$	kWh	0,9		$Q_{coll;sto;max} = \frac{c_{ev;loop} \times m_{coll;w}}{3600}$
Loss factor at boiling temperature	$a_{\theta;coll;boil}$	W/mK	5,6		$a_{\theta;coll;boil} = a_1 + a_2 \times (\theta_{coll;boil} - \theta_e)$
Radiation needed to keep boiling	$I_{\theta;coll;boil}$	W/m²	1161,5		$I_{\theta;coll;boil} = \frac{a_{\theta;coll;boil} \times (\theta_{coll;boil} - \theta_e)}{\eta_0 \cdot K_{hem}}$
Radiation during the hour	$I_{sol;h}$	W/m²	0,0		
Stored energy change					
Net solar irradiance above boiling	$I_{sol;ev}$	W/m²	0,0		$IF\ COLL\_STA_{h-1} = TRUE:\ I_{sol;ev} = I_{sol} - I_{\theta;coll;boil}$ $IF\ COLL\_STA_{h-1} = FALSE:\ I_{sol;ev} = 0$



Nowadays Excel = Manual calculation

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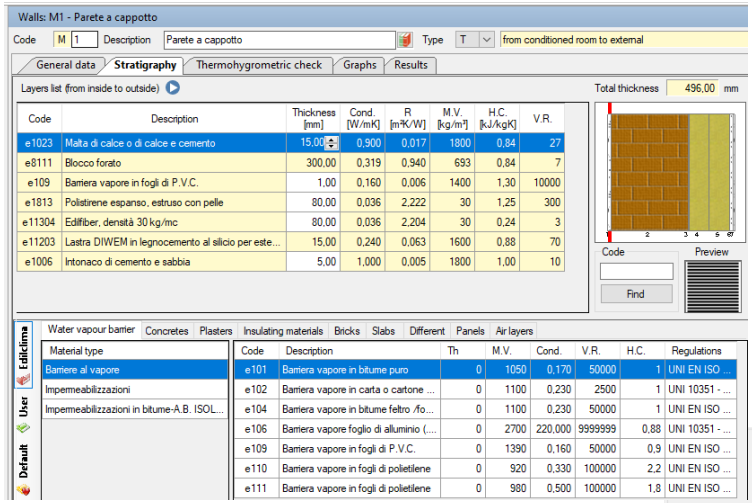
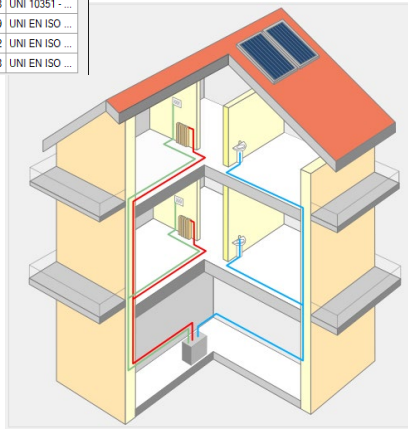
Professional tools: application software

- Well developed interfaces
- Integrated databases
- Fast calculation
- Little modeling skills required
- Declared algorithms
- Some countries require validation
- Cannot be customized beyond integrated options
- **Typical application:**
  - **Professional productive use**
  - **Energy performance calculation** of any type building





Professional software is developed for methods in use in a country (need a market)

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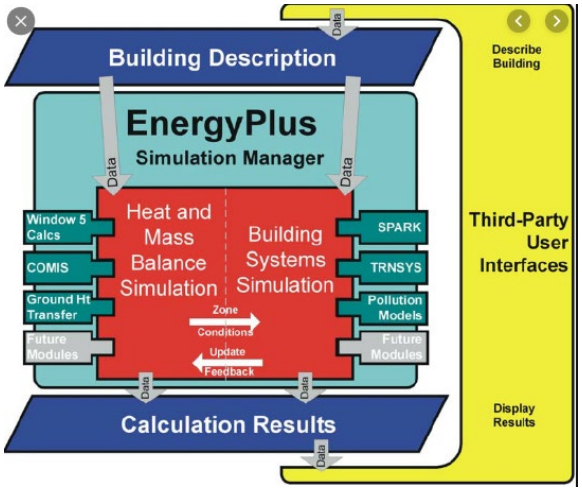
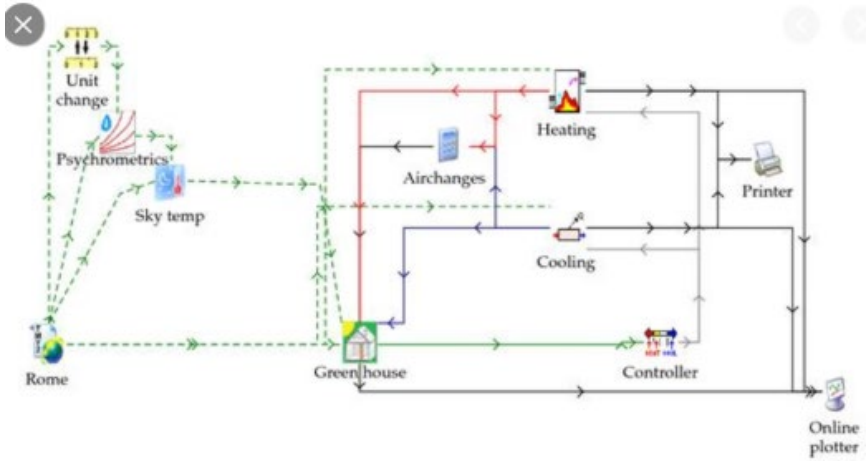
Simulation tools (E+, TRNSYS, …)

- General purpose scientific tools
- Text interface or third party interface
- Little traceability, a lot of “black boxes”
- Applies its own algorithm or to be programmed
- Not linked to data bases
- Long calculation time
- Each case shall be developed on its own
- Expert modeling skills required
- Generally intended to cover either building physics or systems
- **Typical application:**
  - **Research**
  - **Design of specific comfort solutions**





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EPB standards: software-proof and regulation-fit

EPB standards are intended to support energy performance regulation and the required application software. DTR (CEN-TS 16629:2014) established a set of rules for that purpose.

Objectives	Solution
Software proof modules	Demonstration Excel
Tested links between modules	Software tool
	Processing several modules together
Use for regulation	Traceable equations
	Traceable options
Application software validation	Demonstration excel to build and document test cases
Connecting with data bases	Type of input data

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The link between software and EPB standards

- Without **professional software**, no energy performance calculation scheme can be applied effectively, neither monthly nor hourly.
  XLS tools are limited to algorithm testing, test case development and software validation.
- It is a big investment to develop a professional energy performance calculation software from scratch (some millions Euros) and then you have to maintain and update it and support users.
  Obviously, you need a significant market to pay the effort
- An EPB professional software is likely to be developed if a large EU country adopts EN-EPB standards

  EXAMPLE of such a country: Italy
  - Software based on EPB standards is already being developed
  - Already available: hourly method for needs, systems configuration, etc

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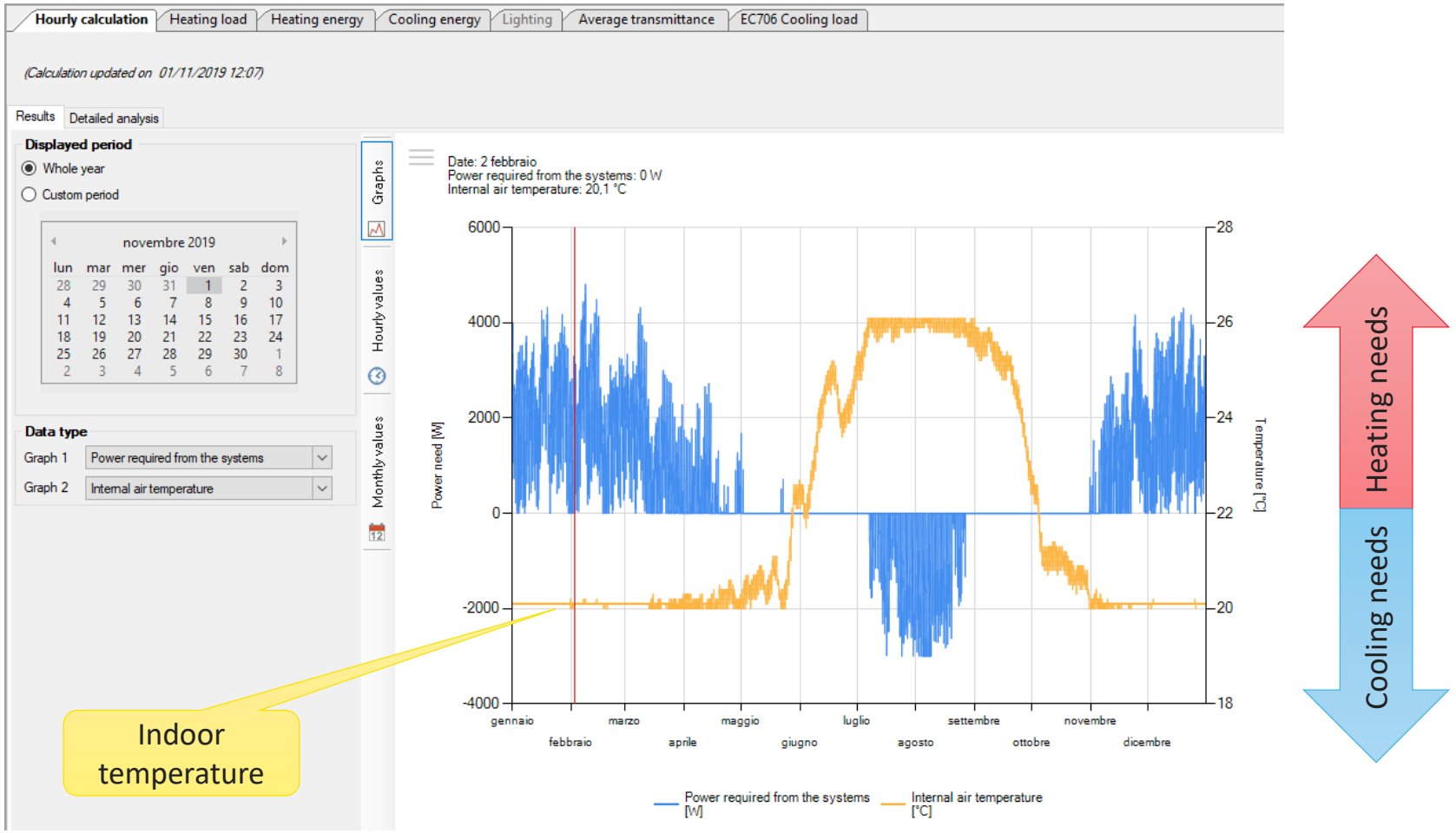
Hourly needs calculation according to EN 52016



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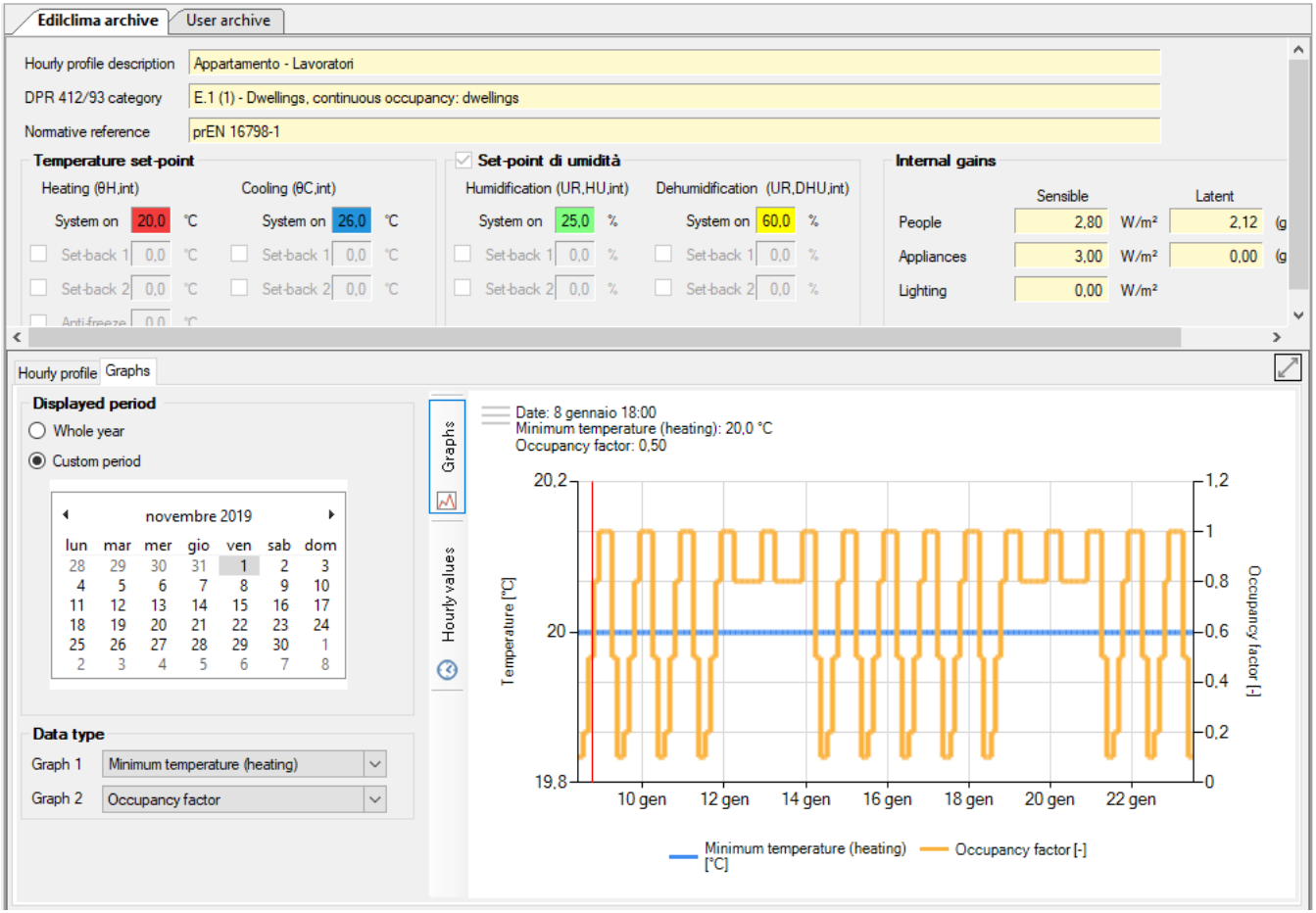
Defining hourly profiles



Defining hourly operating conditions means selecting the room category, just like monthly.

If needed , profile can be easily tailored for audit purpose

The graph gives the feed-back

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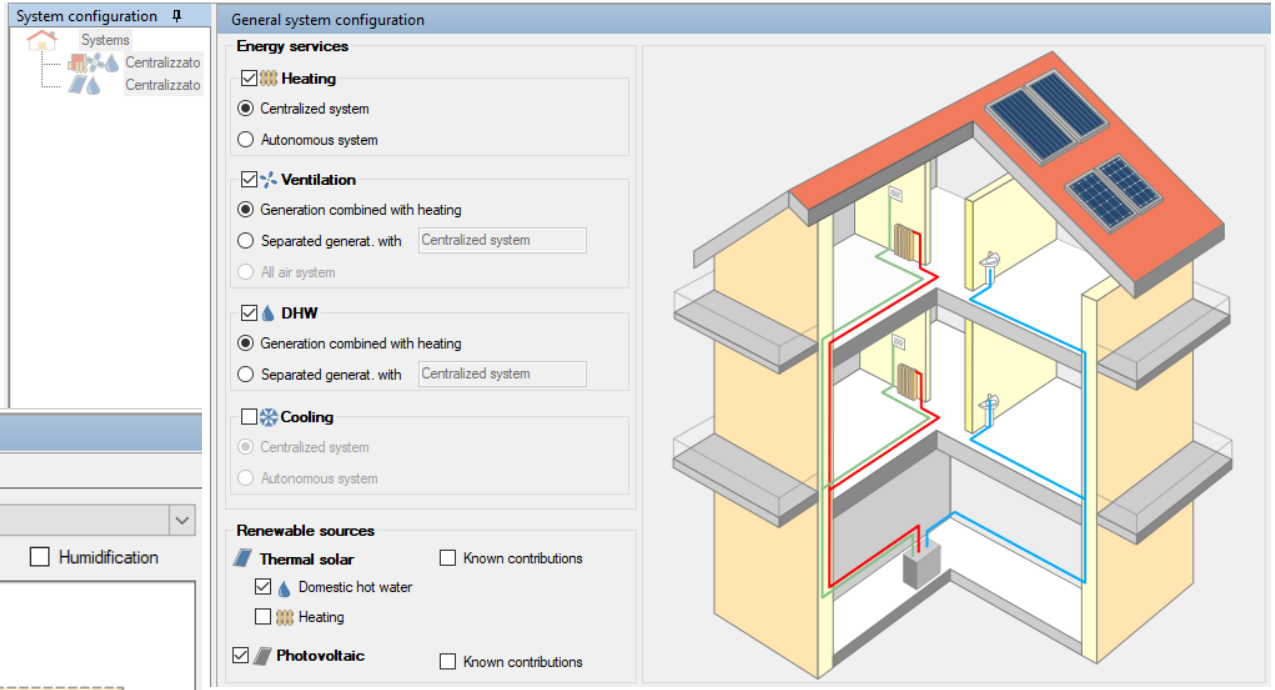
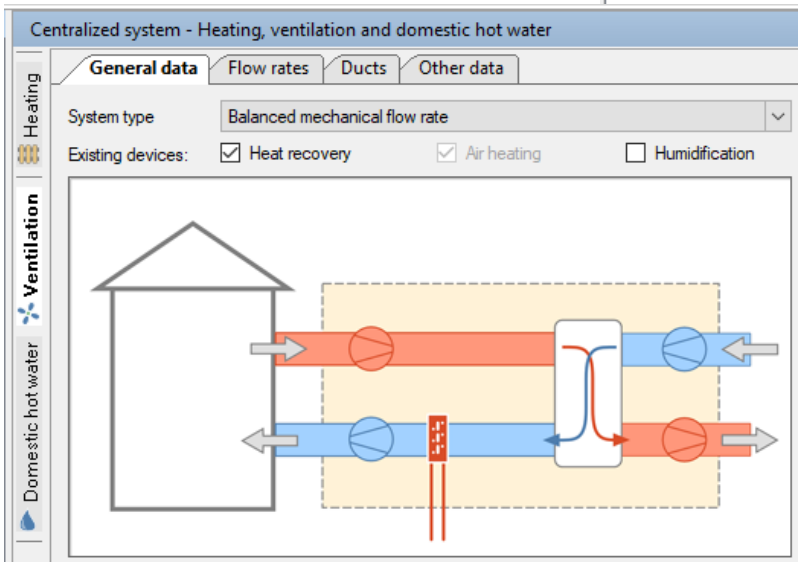
Technical system configuration

General configuration of systems for all services





Detailed configuration of system for each service

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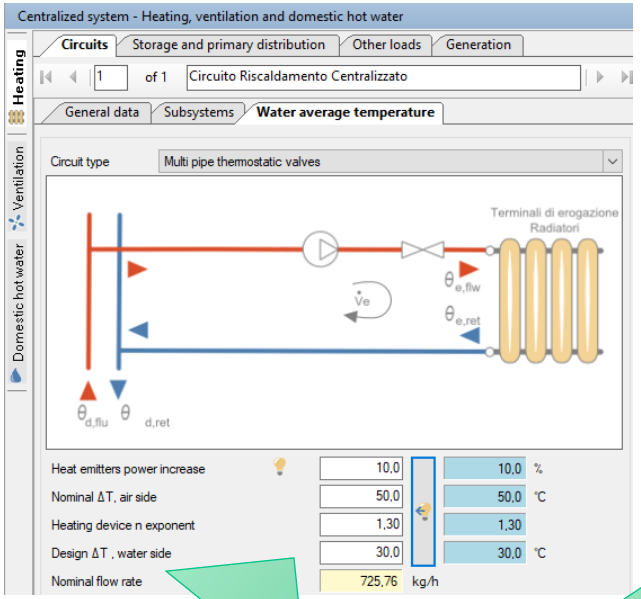
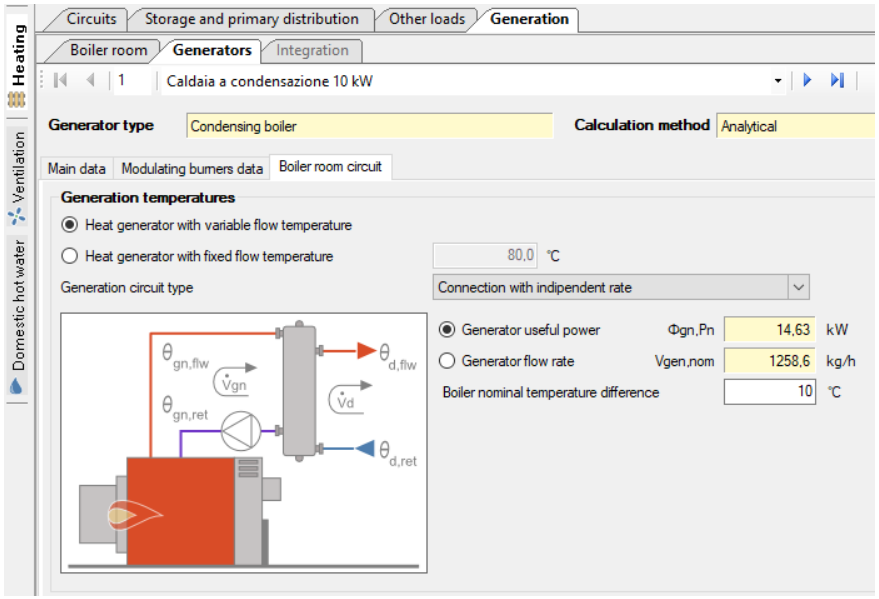
Calculation of operating conditions: EN 15316-1

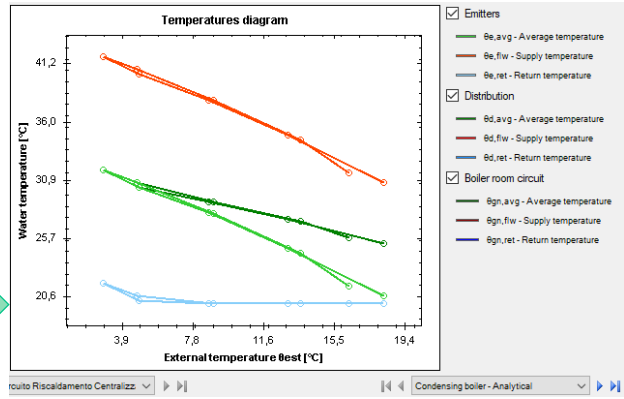




1: Emission and control configuration

2: Generation configuration

3: Operating conditions em, dis and gen temperatures



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Calculation tools are just big calculators

An energy performance calculation software is just a big calculation machine with an extended keyboard

- **Who uses a calculation tool** …
  - **shall know** which is the right **input data**
  - **shall always be aware of what is calculated and how**
    → *check intermediate and final results to keep control*
- **The calculation tool**
  - **Shall have a clear interface** to facilitate use …
    "*An interface, if you have to explain it, then it is wrong…*"
  - **Shall give adequate feed-back** so that
    the user knows what's going on and
    is always in control of the calculation procedure (avoid black box)

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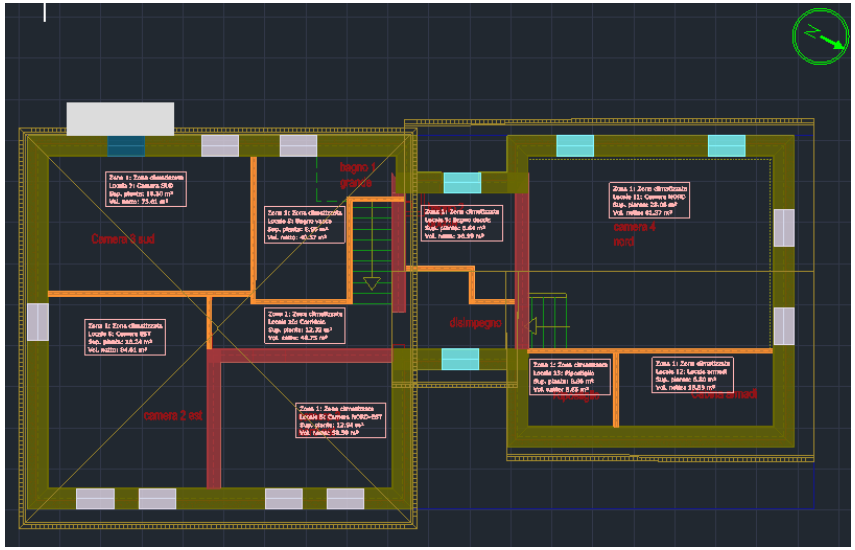
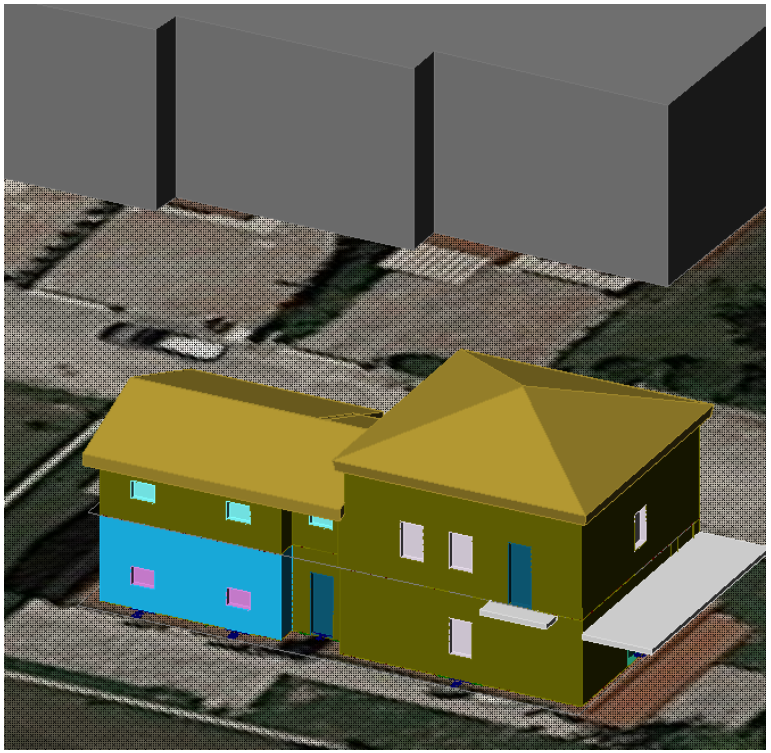
Clear interface…





Drawing 2D with a drawing
in the background.
Simple input of building description.
Less mistakes in inserting building
elements length and area

Result is presented 3D
Feed-back on what has been input
in 2 D like overhangs
and neighboring buildings
Plot on Google maps top check
orientation and obstructions

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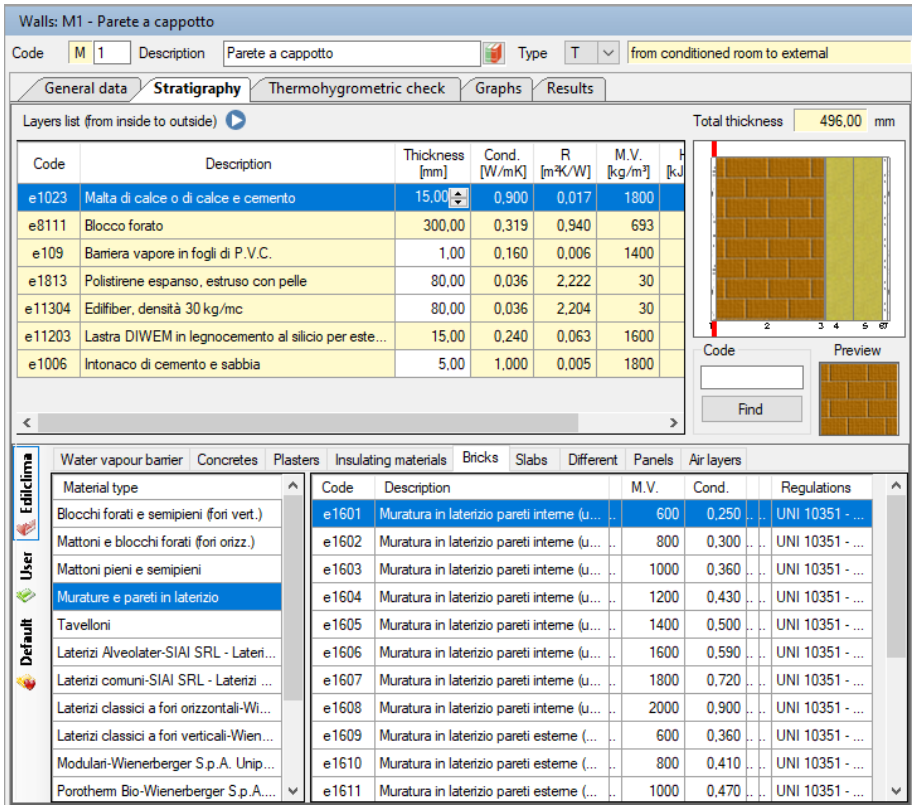
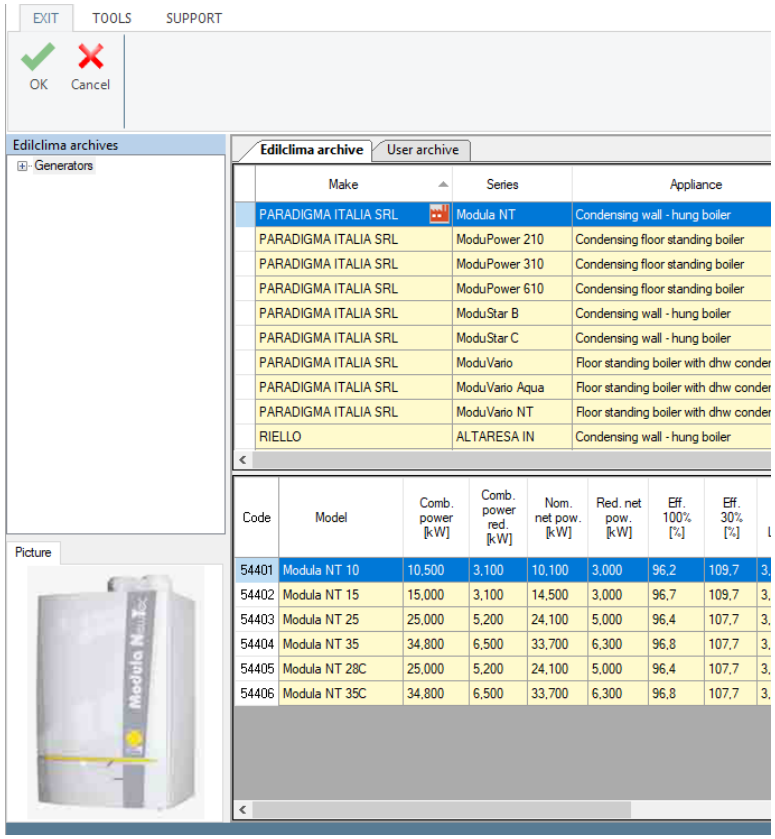
Data base…





Data base may include simple materials properties and entire product description
Reduced risk of wrong input, **connection with manufacturer data (EPREL?)**

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What is the software doing?

To get the correct results you need to apply …

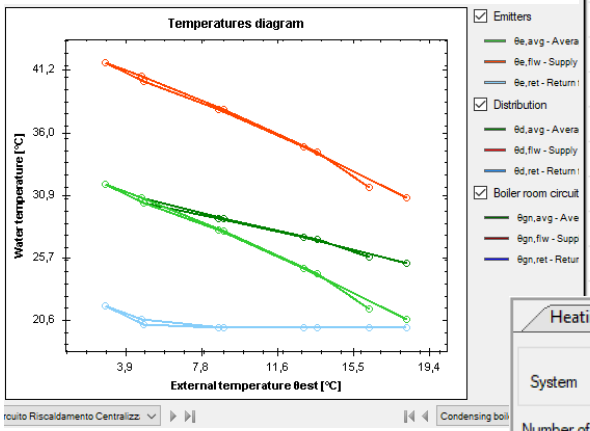
- the right calculation
- to the right input data

Validation of software

- gives some confidence that algorithm is correct
- but doesn't protect against wrong input

The user is responsible for input

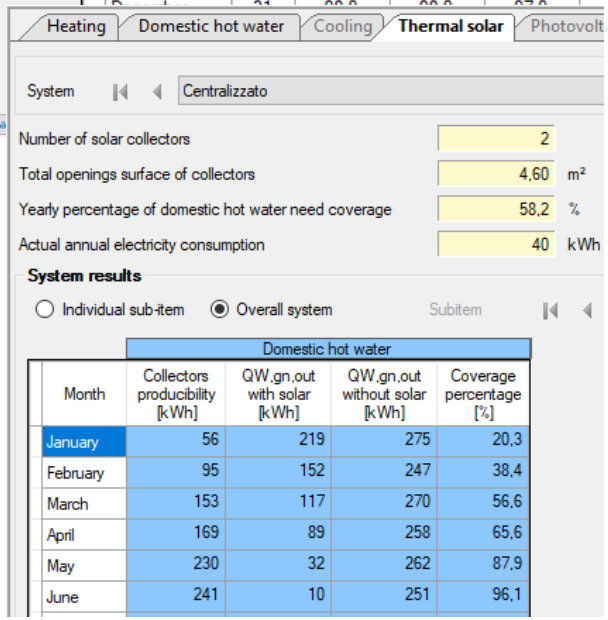
- **A good interface** prevents wrong input (feed-back, checks)
- **A good training and experience** are needed to identify the right input and reduce the risk of mistakes



Heating system - monthly details

Hydronic + aeraulic system

Month	Days	ηH,em [%]	ηH,rg [%]	ηH,du [%]	ηH,gen,p,nren [%]
January	31	98,0	98,0	97,0	102,3
February	28	98,0	98,0	97,0	102,3
March	31	98,0	98,0	97,0	101,9
April	30	98,0	98,0	97,0	100,6
May	22	98,0	98,0	97,0	72,1
June	-	-	-	-	-
July	-	-	-	-	-
August	-	-	-	-	-
September	4	98,0	98,0	97,0	90,8
October	31	98,0	98,0	97,0	100,2
November	30	98,0	98,0	97,0	101,9
					102,3



	Domestic hot water			
Month	Collectors producibility [kWh]	QW,gn,out with solar [kWh]	QW,gn,out without solar [kWh]	Coverage percentage [%]
January	56	219	275	20,3
February	95	152	247	38,4
March	153	117	270	56,6
April	169	89	258	65,6
May	230	32	262	87,9
June	241	10	251	96,1

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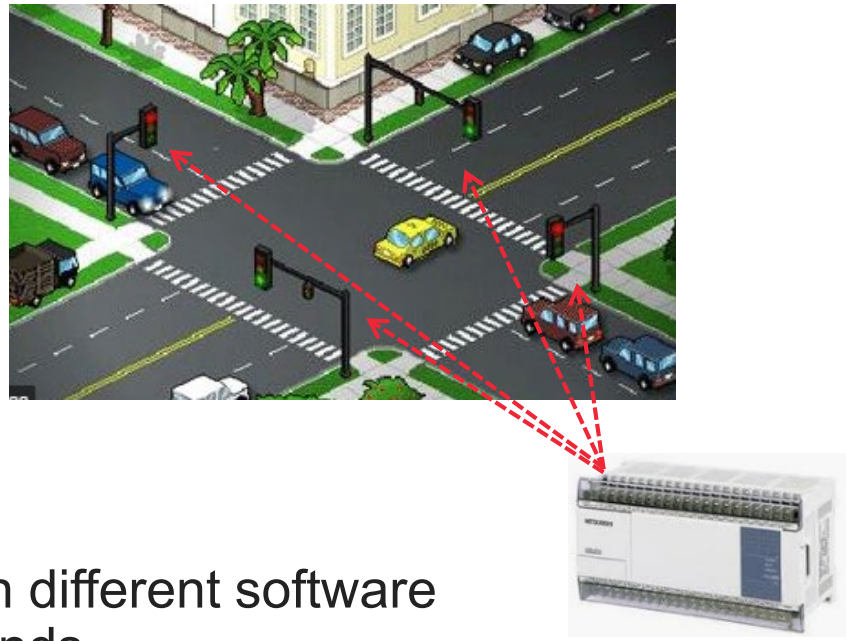
The principle: parallel, asymmetric processing

Case study: **PLCs and safety**
(traffic lights, oxygen control, etc.)

«*Safety Integrity Level*»
SIL required for safety critical tasks



Basic approach: 2 identical PLCs.

- Protects again hardware failures
- Doesn't protect against software issues and failures

Better approach: 2 different PLCs with different software shall produce the same results/commands.

- Protects against hardware failures *(sync needed to avoid false errors)*
- Good for software issues and failures: it's very unlikely to have the same mistake in two different software programmed by two different people

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Parallel, asymmetric processing in action…

Processor 1
Software

Strictly obeys to input and algorithm
No fantasy
No initiative
No awareness
Damn fast
Can handle tons of details
Shall be programmed
Doesn't learn from experience
(… not yet)

For optimum performance they have to work in parallel

Processor 2
Brain

Evaluates input
Has fantasy
Has initiative
Can invent new solutions
Should be aware
Damn slow in calculation
Can handle few numbers
Shall be trained
Learns from experience
(… not always)

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Procedures, software and training

- **Professional software** based on standards is required for massive application, e.g. EPCs and building permits production.
  This is coming in countries that are going to use EPB standards
- **When selecting software…**
  … look for ease of input, data base availability and user feed-back
- **When using software, keep your brain on-line**:
  always check if intermediate results are consistent
  and final result is plausible (parallel asymmetrical processing)
- **Be prepared and trained to understand what happens**
  Training is the key to maximize the benefit of experience…

Procedures and software do not replace expertise

Standards, tools and software may help experts, suggest values, guide calculation, define and perform detailed and complex algorithms but there is no automatic design or energy calculation software (at least not yet…)

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Conclusion and summary

- **Calculation tools** are needed to support HVAC design activities
  → software
- **Setting legal requirements** requires
  → traceable and comprehensive methods
- **EPB standards** are designed to be software proof and unambiguous
- **Professional software** is the right level of tools for productive use
- **A market** where EPB standards will be used already exists.
  Professional software based on EPB standards
  is already under development there
- **Software is a tool**,
  → it has to be user friendly and give clear **feed-back**
- **Professionals** using software tools shall keep control of calculations
  → **experience and training**

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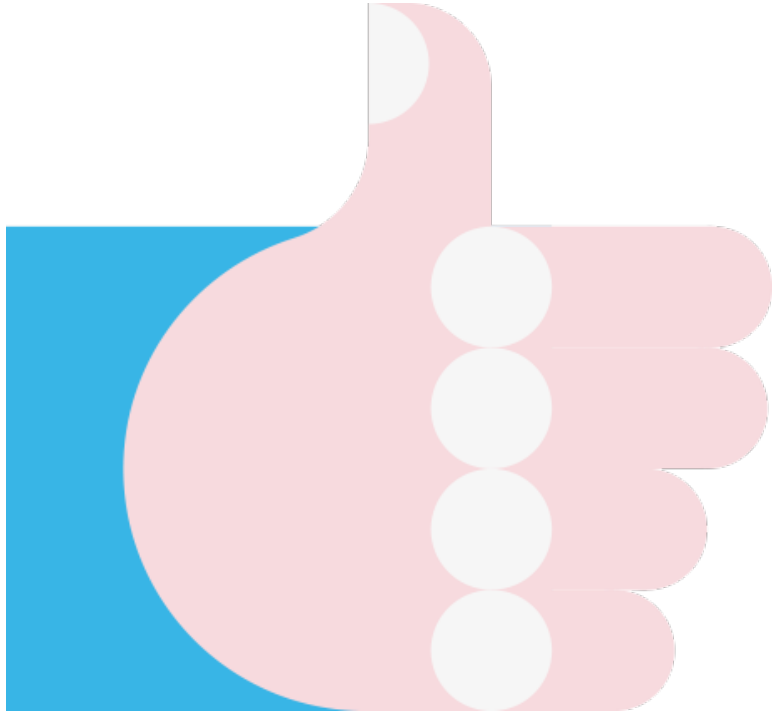
THANK YOU



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CEN-CE online pilot training and Learning Management System

Andrei Vladimir LIȚIU
avl@rehva.eu

REHVA
Federation of European Heating, Ventilation and Air Conditioning Associations

Build Up portal webinar
5th May 2020
12h00 – 13h30 CEST

12h50

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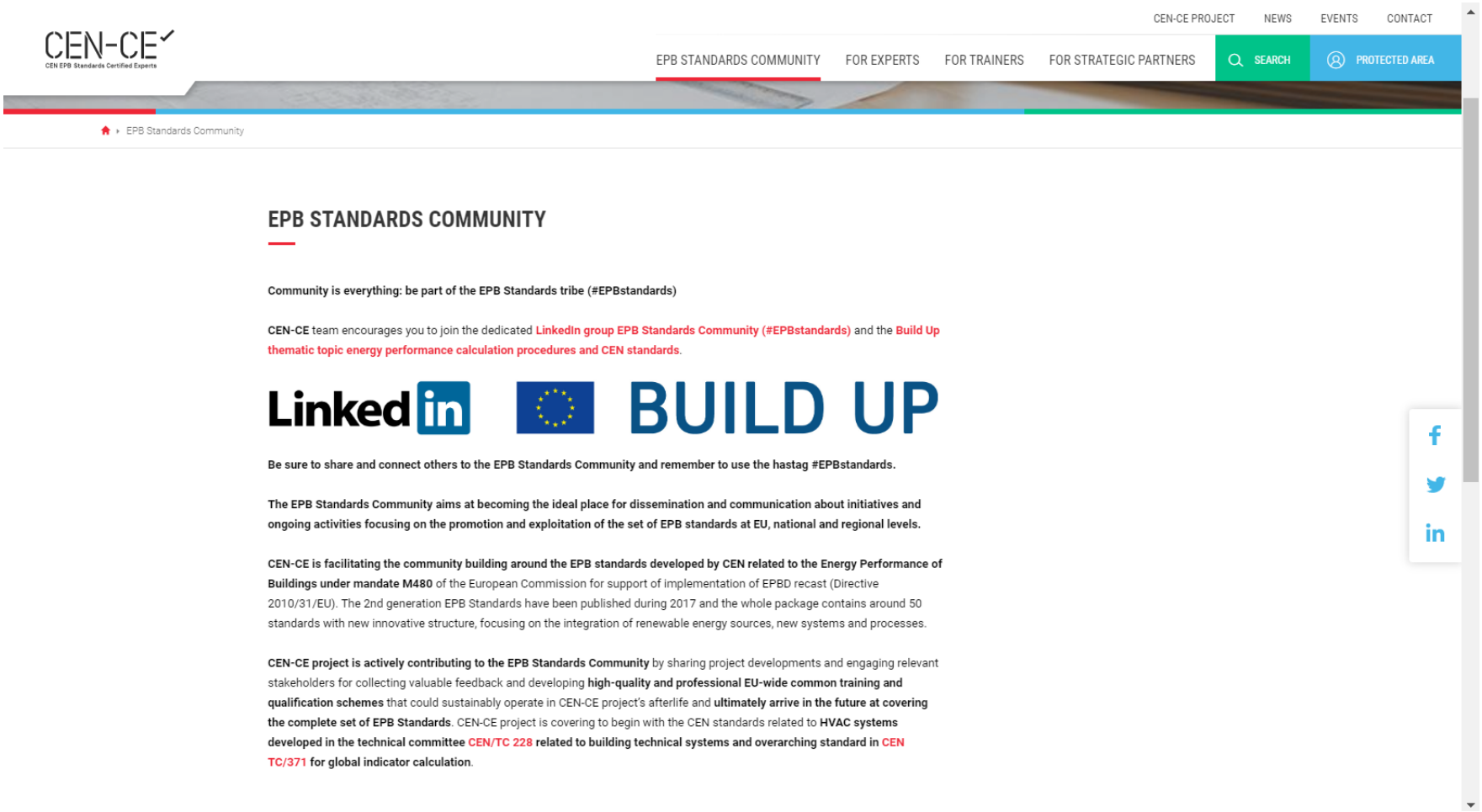
EPB standards Community



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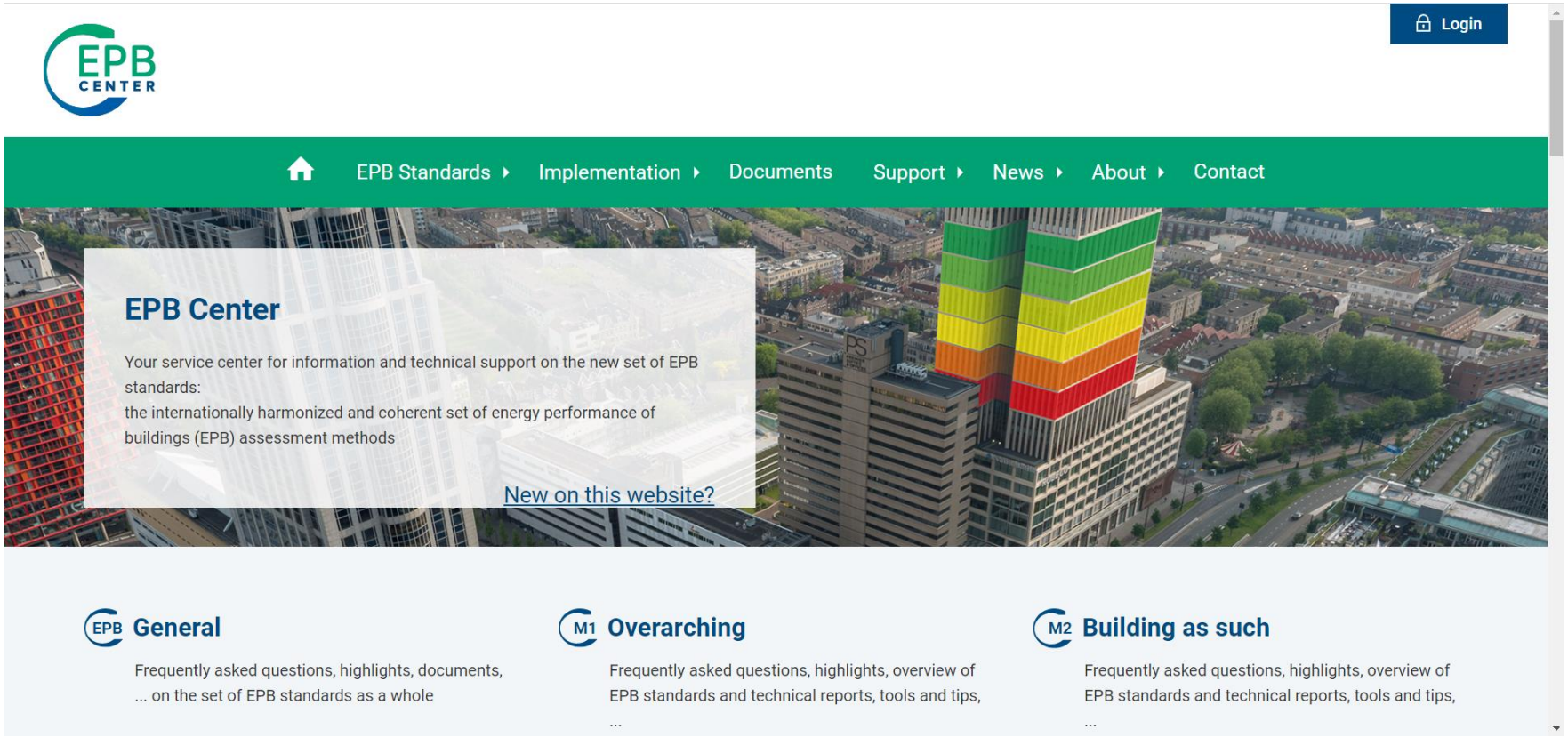
EPB Center



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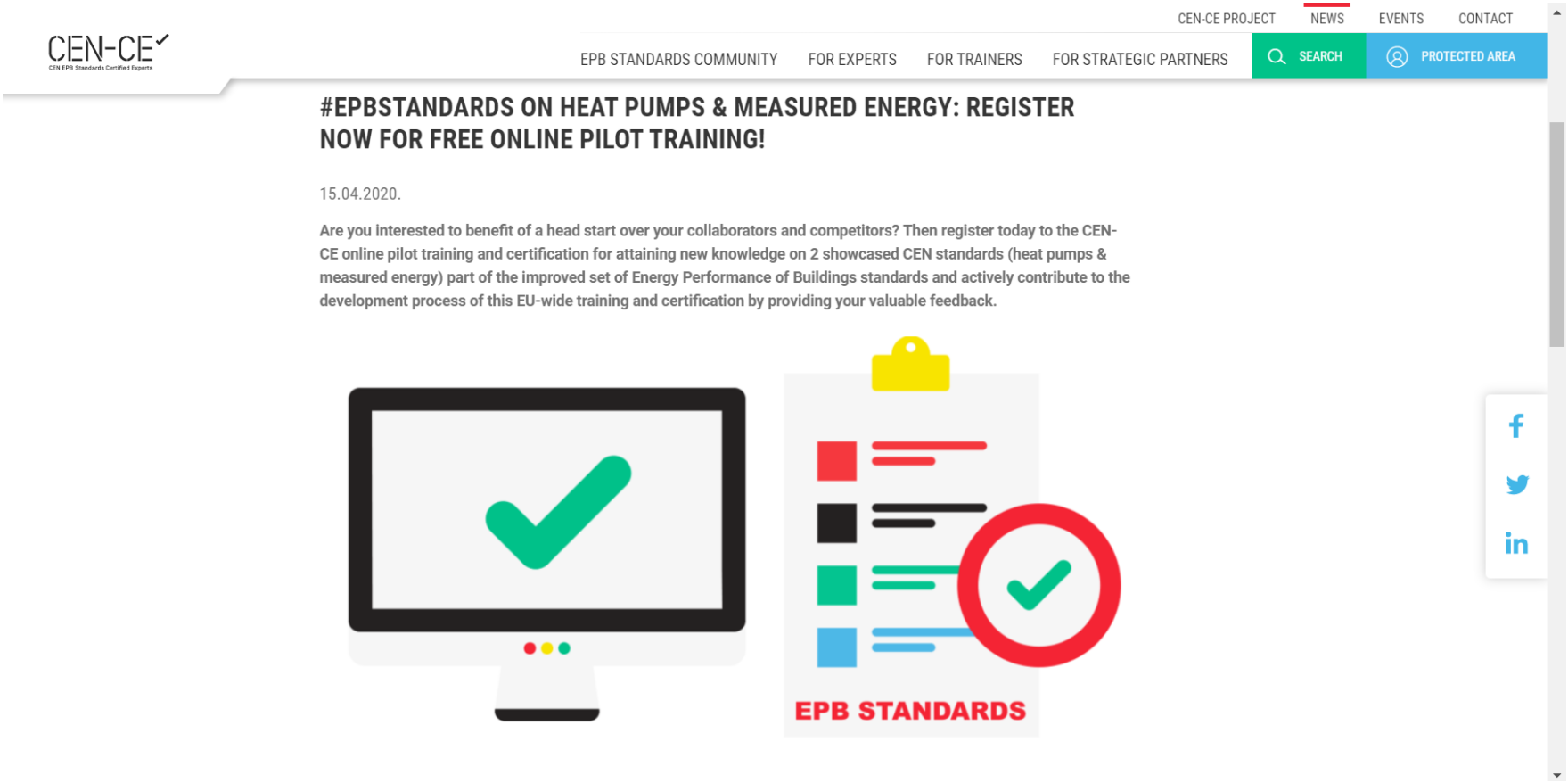
CEN-CE online pilot training and certification



Read more!

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CEN-CE online pilot training and certification

Interested in becoming CEN EPB Certified Expert?

Register now!

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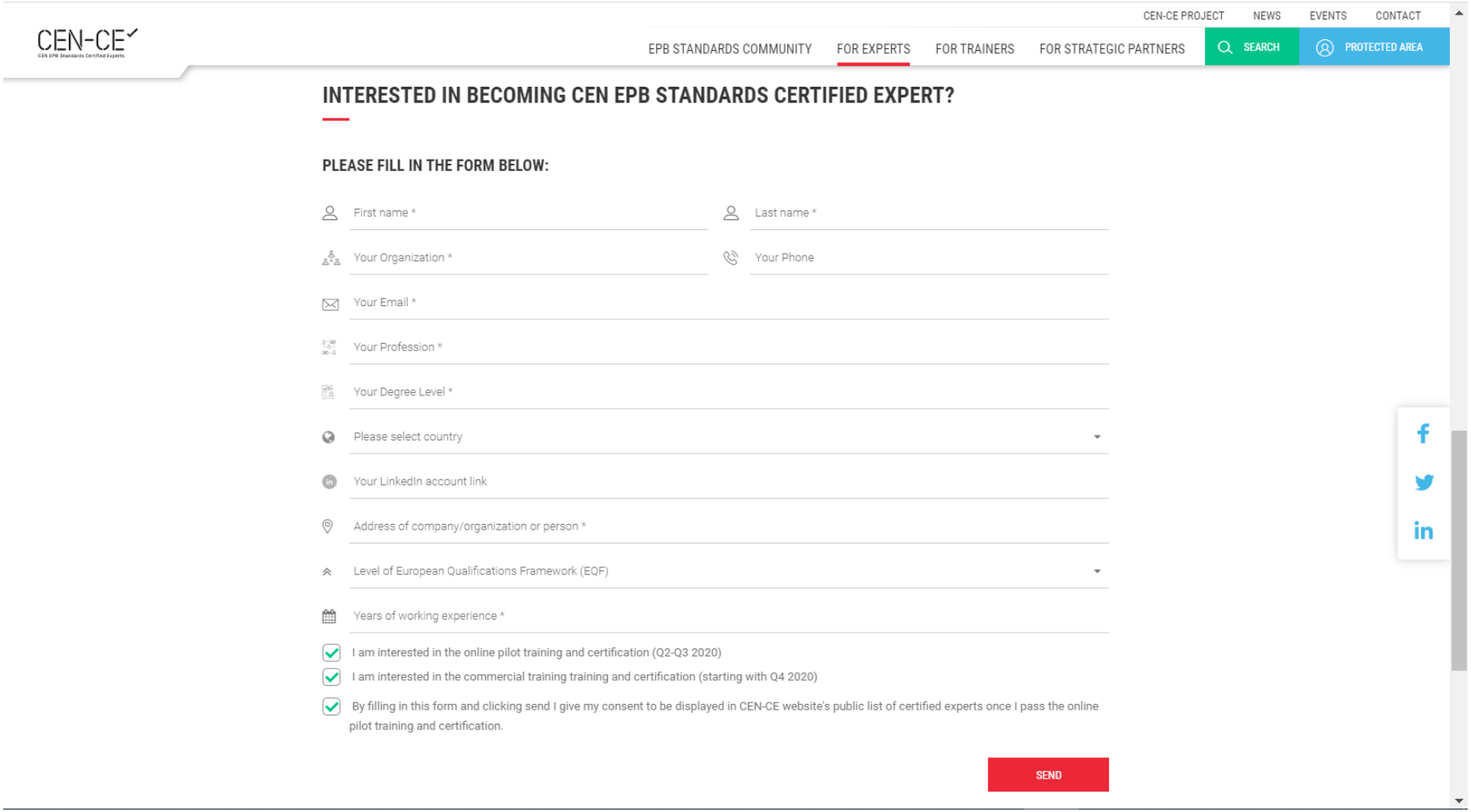
CEN-CE online pilot training and certification



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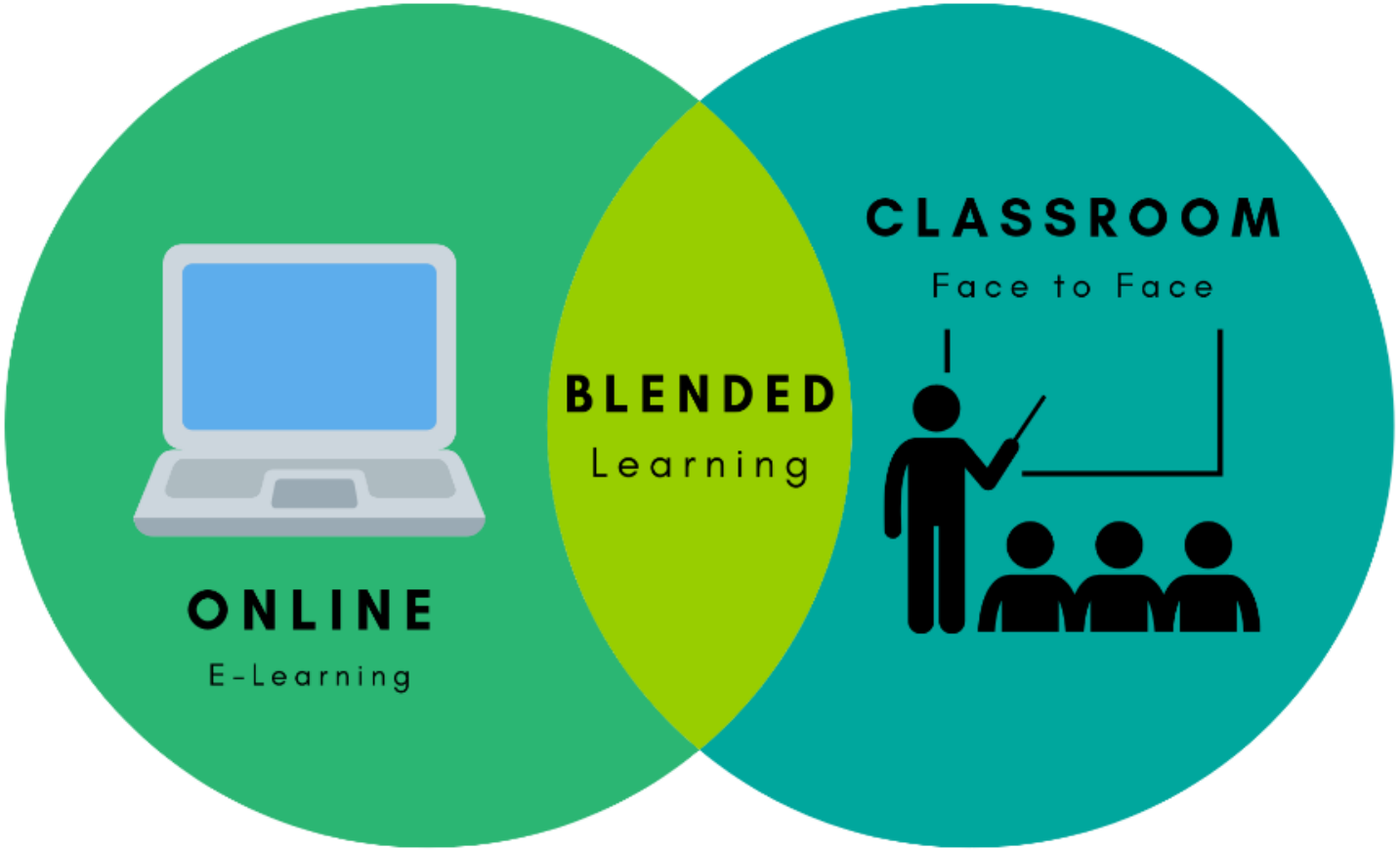
CEN-CE LMS tailored to the needs of SMEs



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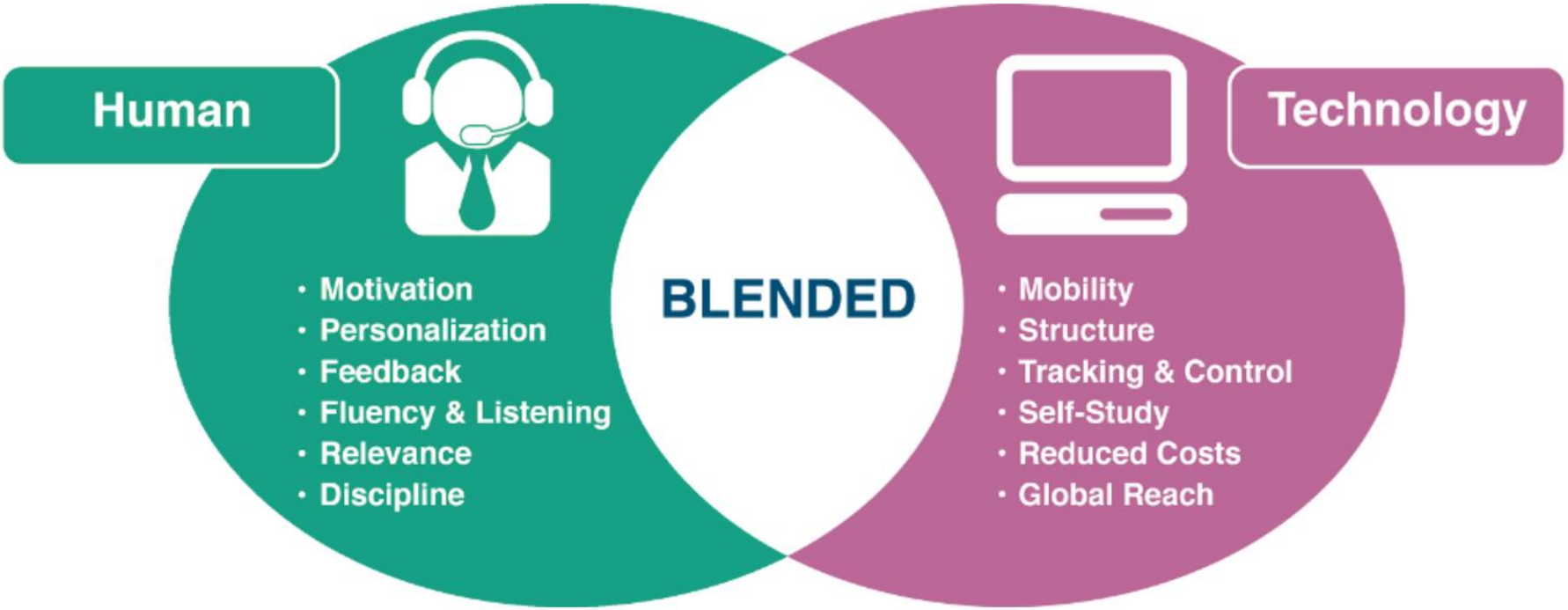

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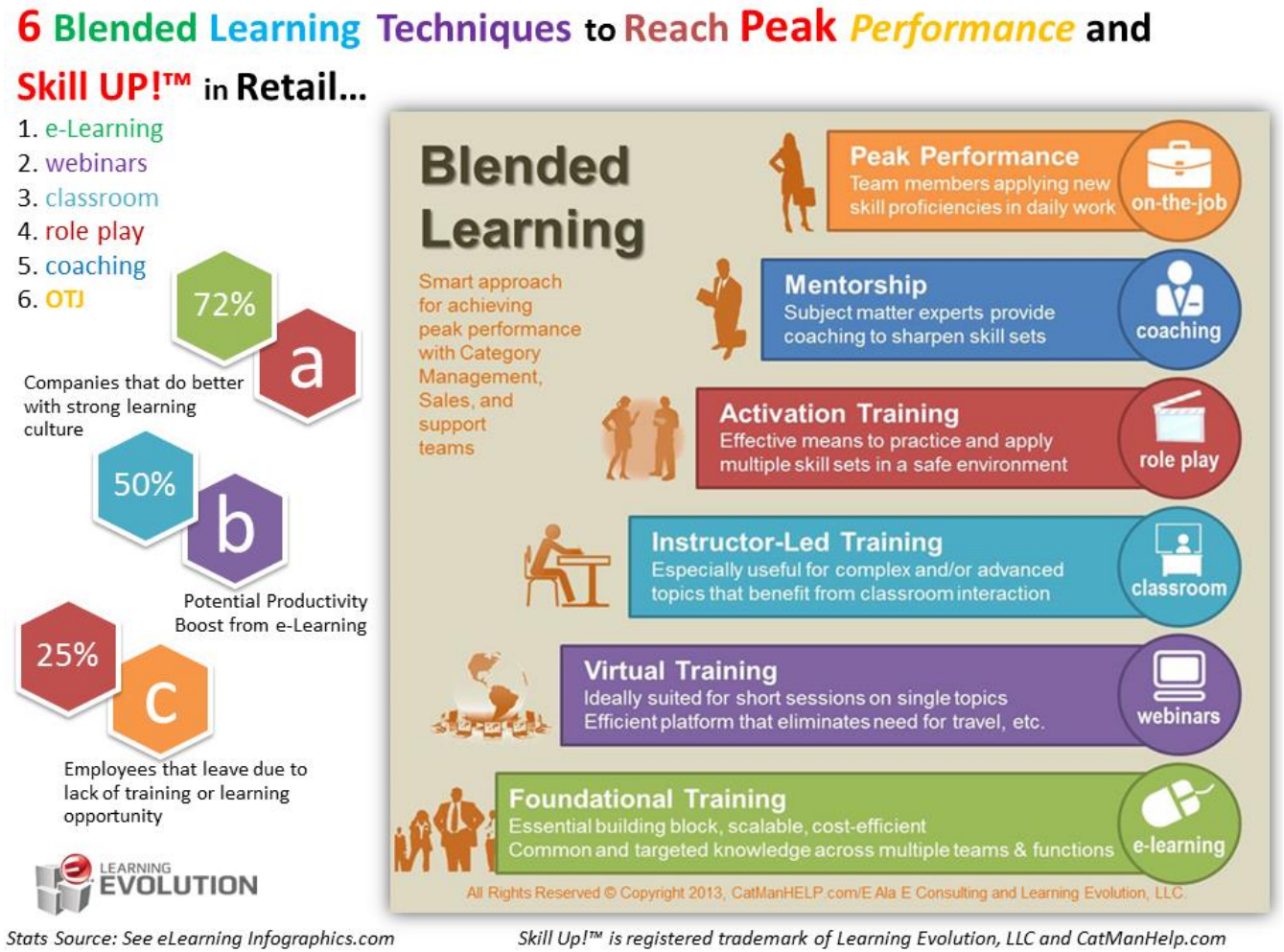
CEN-CE LMS tailored to the needs of SMEs



Stats Source: See eLearning Infographics.com

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EU-wide building performance LMS ?!

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CEN-CE

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Moderated Q&A session

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