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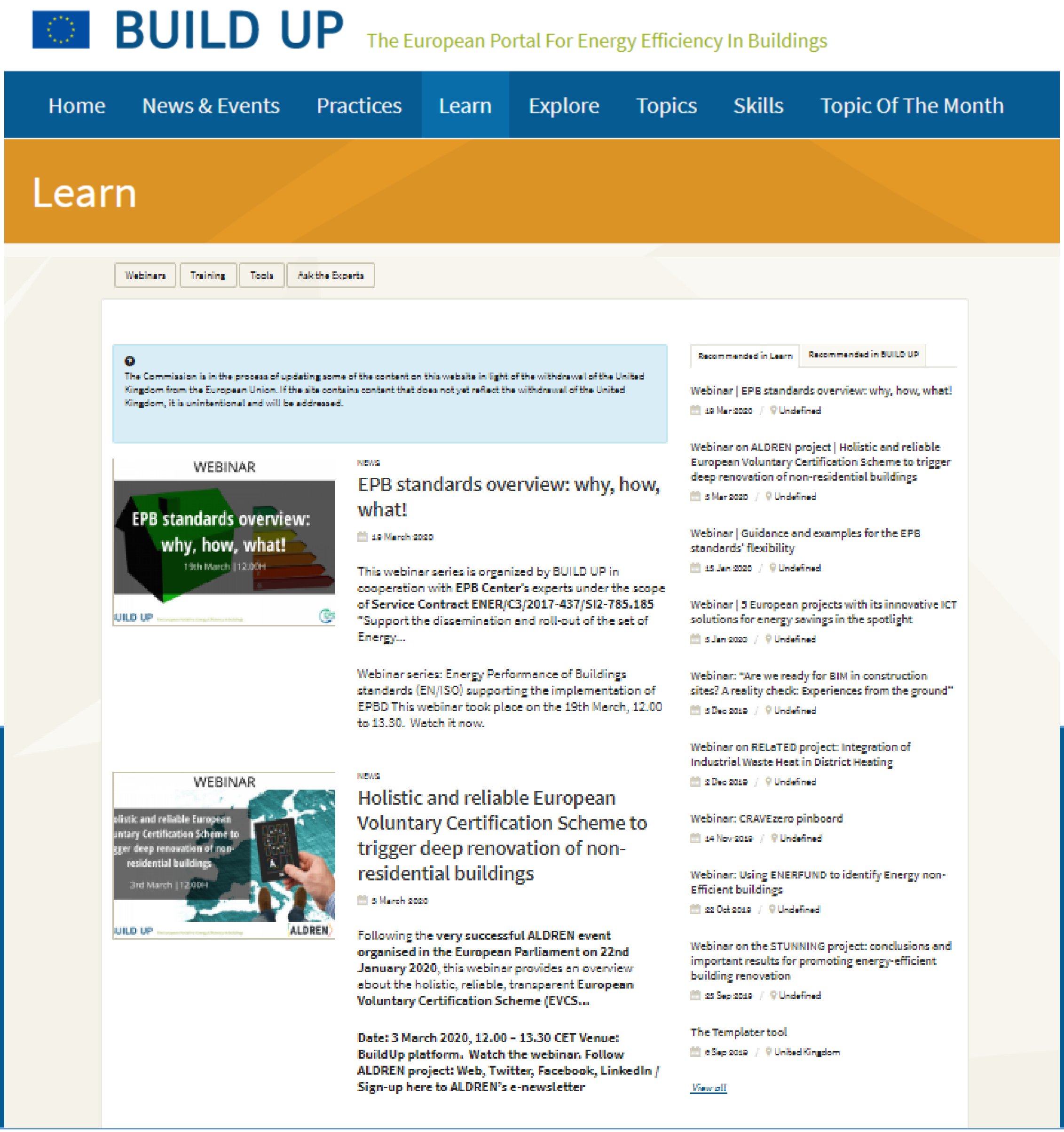

BUILD UP The European Portal For Energy Efficiency In Buildings

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Learn

Webinars | Training | Tools | Ask the Experts

The Commission is in the process of updating some of the content on this website in light of the withdrawal of the United Kingdom from the European Union. If the site contains content that does not yet reflect the withdrawal of the United Kingdom, it is unintentional and will be addressed.

NEWS

EPB standards overview: why, how, what!

19 March 2020

This webinar series is organized by BUILD UP in cooperation with EPB Center's experts under the scope of Service Contract ENER/C3/2017-437/SI2-785.185 "Support the dissemination and roll-out of the set of Energy...

Webinar series: Energy Performance of Buildings standards (EN/ISO) supporting the implementation of EPBD This webinar took place on the 19th March, 12.00 to 13.30. Watch it now.

NEWS

Holistic and reliable European Voluntary Certification Scheme to trigger deep renovation of non-residential buildings

5 March 2020

Following the very successful ALDREN event organised in the European Parliament on 22nd January 2020, this webinar provides an overview about the holistic, reliable, transparent European Voluntary Certification Scheme (EVCS...

Date: 3 March 2020, 12.00 – 13.30 CET Venue: BuildUp platform. Watch the webinar. Follow ALDREN project: Web, Twitter, Facebook, LinkedIn / Sign-up here to ALDREN's e-newsletter

Recommended in Learn | Recommended in BUILD UP

Webinar | EPB standards overview: why, how, what!
19 Mar 2020 / Undefined

Webinar on ALDREN project | Holistic and reliable European Voluntary Certification Scheme to trigger deep renovation of non-residential buildings
5 Mar 2020 / Undefined

Webinar | Guidance and examples for the EPB standards' flexibility
15 Jan 2020 / Undefined

Webinar | 5 European projects with its innovative ICT solutions for energy savings in the spotlight
5 Jan 2020 / Undefined

Webinar: "Are we ready for BIM in construction sites? A reality check: Experiences from the ground"
5 Dec 2019 / Undefined

Webinar on RELaTED project: Integration of Industrial Waste Heat in District Heating
2 Dec 2019 / Undefined

Webinar: CRAVEzero pinboard
14 Nov 2019 / Undefined

Webinar: Using ENERFUND to identify Energy non-Efficient buildings
22 Oct 2019 / Undefined

Webinar on the STUNNING project: conclusions and important results for promoting energy-efficient building renovation
25 Sep 2019 / Undefined

The Templater tool
6 Sep 2019 / United Kingdom

View all

Check our Learn section!

Webinar 6 – 8th September 2020 (12h00-13h30 CET) – Heating systems in the EPB standards

Webinar 7, **Tuesday Oct. 6**, Example calculations with the set of EPB standards – (1) Introduction and overarching calculation procedures

Webinar 8, **Tuesday Oct. 20**, Example calculations with the set of EPB standards – (2) Energy needs combined with specific systems

Webinar 9, **Tuesday Dec. 8**, Example calculations with the set of EPB standards – (3) Whole building calculations, from components to overall primary energy

Webinar 10, **Tuesday Jan. 19**, Example calculations with the set of EPB standards – (4) Energy needs combined with specific systems

WEBINAR

Heating systems in the EPB standards

8th September | 12.00 H

BUILD UP The European Portal For Energy Efficiency In Buildings

REHVA Federation of European Heating, Ventilation and Air Conditioning Associations

EPB CENTER

Your service center for information and technical support on the new set of EPB standards

Role and place of the heating and domestic hot water systems in the overall building performance

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This project is facilitated by the
EU-Commission Service Contract
ENER/C3/2017-437/SI2.785185
Start: 21 September 2018 for 3 years

BUILD UP Webinar series
Webinar 6: *Heating systems in the EPB standards*
08 September 2020

My standardisation background

- Convenor of **ISO TC205/WG9**
  focussing on the energy efficiency of HVAC systems
- Convenor of two CEN working groups:
  - **CEN TC 371/WG1** on the overall approach
  - **CEN TC 228/WG4** on heating and DHW systems
- Involved in the preparation and coordination of the set of **EPB standards** under **Mandate 480** (2012-2017)
- **EPB expert** (> 2017)

Summary

- The **place of the heating and DHW system** standards in the **overall EPB framework and systematics**

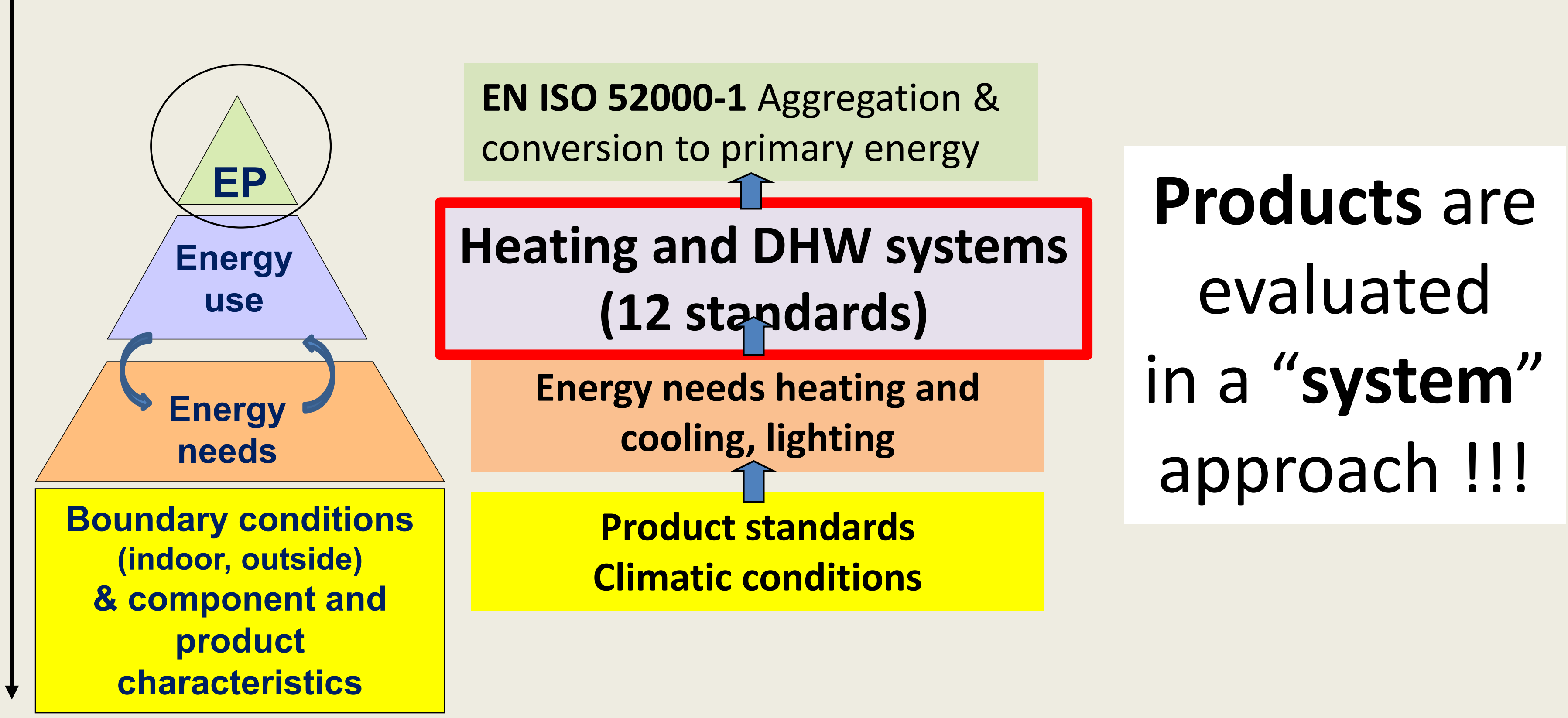
- **Heating system key data**, **evolution** and **new challenges** to draw the **general picture of the situation** and the **contribution** of the heating and DHW standards

- Two examples of **impacts**, **understanding** and **conventions** to underline that, as for a all new things, **training is needed** to apply the new standards correctly

- **Conclusion**

Place of heating / DHW standards in the Core set of EPB standards (~50)

Overall EPB Framework (modular structure)



EP

Energy use

Energy needs

Boundary conditions (indoor, outside) & component and product characteristics

EN ISO 52000-1 Aggregation & conversion to primary energy

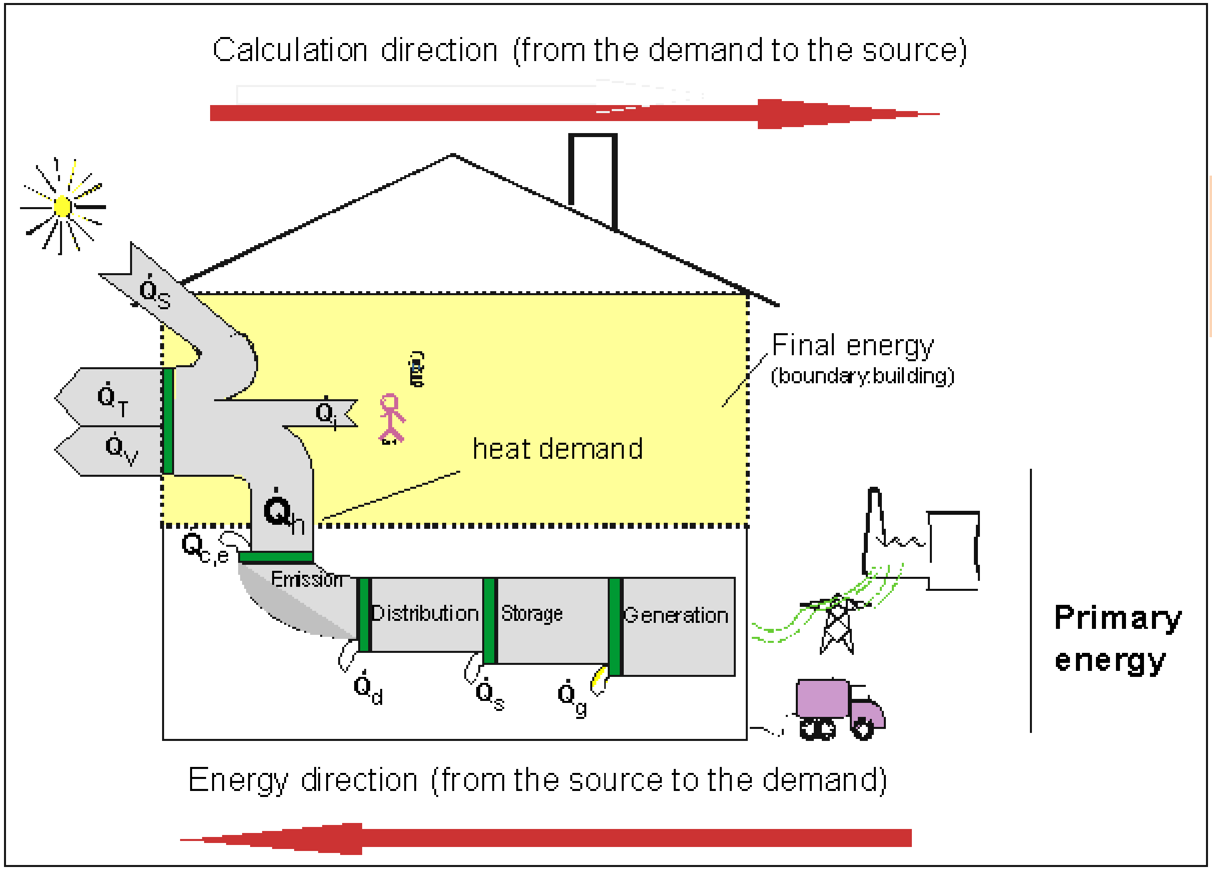
Heating and DHW systems (12 standards)

Energy needs heating and cooling, lighting

Product standards
Climatic conditions

Products are evaluated in a "**system**" approach !!!

Energy calculation: General structure of heating and DHW standards **EN 15316 - series**



Energy needs

Emission (e.g. radiators)
EN 15316 - **2**

Distribution(e.g. pipes, pumps)
EN 15316 - **3**

Generation (e.g.boiler, CHP)
EN 15316-**4** -**X**

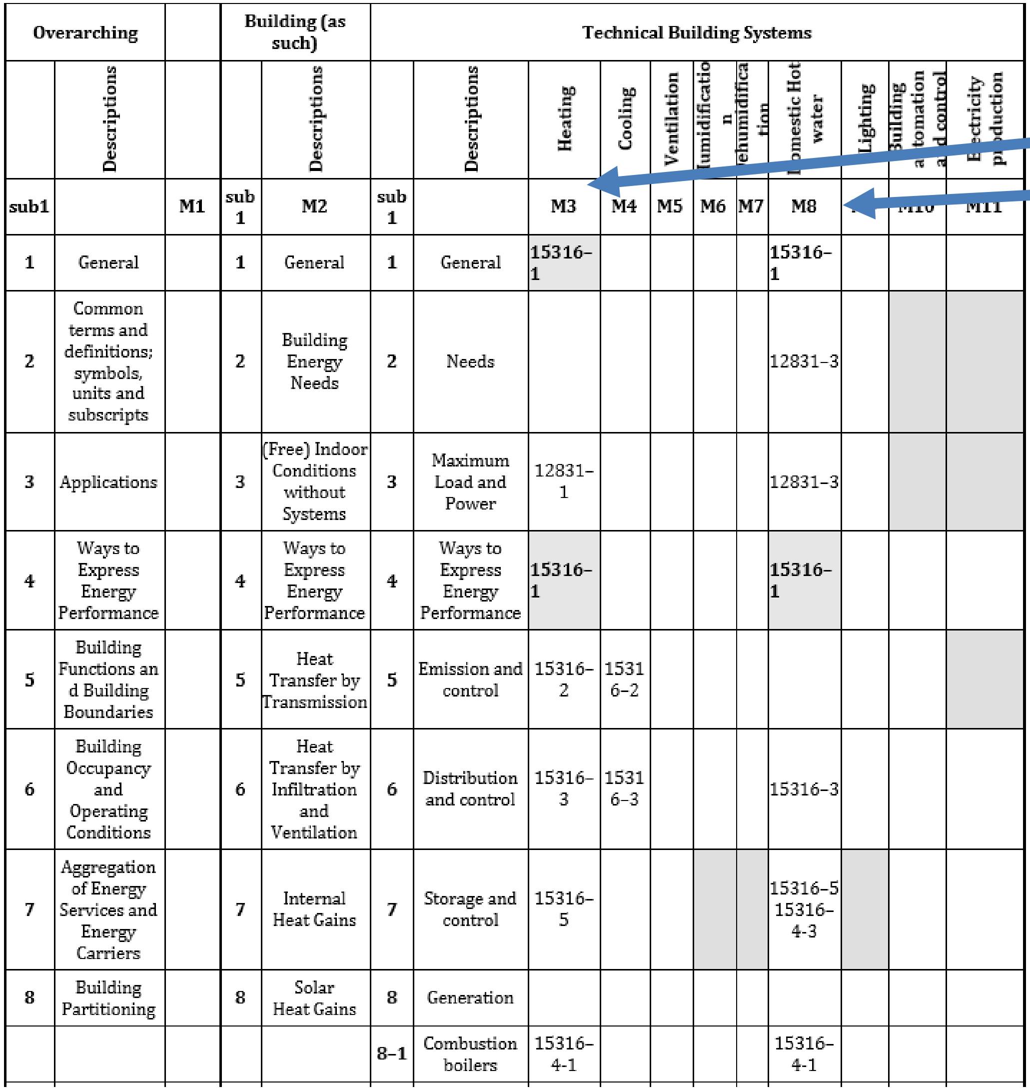
Storage
EN 15316- **5**

Delivered Energy

Primary Energy

Systematic numbering

independent from ISO, CEN standard number



Overarching			Building (as such)		Technical Building Systems										
	Descriptions			Descriptions		Descriptions	Heating	Cooling	Ventilation	umidificatio n	ehumidifica tion	omestic Hot water	Lighting	uilding automation and control	Electricity production
sub1		M1	sub 1	M2	sub 1		M3	M4	M5	M6	M7	M8	[illegible]	M10	M11
1	General		1	General	1	General	15316–1					15316–1			
2	Common terms and definitions; symbols, units and subscripts		2	Building Energy Needs	2	Needs						12831–3			
3	Applications		3	(Free) Indoor Conditions without Systems	3	Maximum Load and Power	12831–1					12831–3			
4	Ways to Express Energy Performance		4	Ways to Express Energy Performance	4	Ways to Express Energy Performance	15316–1					15316–1			
5	Building Functions and Building Boundaries		5	Heat Transfer by Transmission	5	Emission and control	15316–2	15316–2							
6	Building Occupancy and Operating Conditions		6	Heat Transfer by Infiltration and Ventilation	6	Distribution and control	15316–3	15316–3				15316–3			
7	Aggregation of Energy Services and Energy Carriers		7	Internal Heat Gains	7	Storage and control	15316–5					15316–5 15316–4-3			
8	Building Partitioning		8	Solar Heat Gains	8	Generation									
					8–1	Combustion boilers	15316–4-1					15316–4-1			

Column = System (uses)

M3 = Heating ; **M8** = DHW

Lines = System parts (subsystems)

-2=needs, -**3**=load, **-5**=emission, etc

DHW **Needs** M8-2

Heating Load = Sizing M3-3,
DHW M8-3

Heat **Emission** M3-5,

Heat **Distribution** M3-6,
DHW Distribution M8-6

Storage M3-7, M8-7

Generation M3-8, M8-8

Heating and DHW standards are **not only** energy calculation

Inspection

EN 15378-1-Inspection of boilers, heating systems and DHW, M3-11, M8-11

- **Support to transpose EPBD requirement on inspection**

Measured energy

EN 15378-3 Measured energy performance, Module M3-10, M8-10

- **Support to close gap between measured and calculated energy (avoid a “diesel” gate)**

Economic calculation

EN 15459 Economic evaluation procedure for energy systems, M1_14

- **Support to transpose EPBD requirement on economic feasibility**

Heating system key data

- Buildings currently account
    - **40 % of Europe's total energy consumption**
    - **36 % of its CO2 emissions**

mostly for **heating and cooling**.

- **35 %** of EU buildings are over **50 years old**, nearly **75 %** are **energy inefficient**
- **Renovating** existing buildings could reduce significantly energy consumption only **1.2 %** of buildings are **renovated each year**, only **15%** incorporate **significant energy efficiency improvements**.
- **total market share of heating systems** in buildings is ~ **20 billion EURO** (heat emitters account for approx. 12,5 % of the total system costs).

HVAC professionals play an **important role in energy efficiency update**
especially in **renovation**
where **heating and DHW systems** are often **upgraded first**

Heating and DHW systems evolution and new challenges

In the past:

- Important was the **dimensioning** (sizing) of heating systems (**kW**) (power of generation, emission, etc)
- **Products** were **characterised as products (**and not as part of a “system”) at **nominal power** and the **related efficiency**

Heating and DHW systems evolution and new challenges

Now:

- Dimensioning of heating systems is still important
  but **energy consumption** must be evaluated **(kWh**) to **get the building permit**
- But very often the **Evaluation** is more **related to compliance** (fulfil regulations) than to **real performance**
  e.g. mostly only monthly calculation methods, standard climate conditions, etc
- **Products** are characterised also **by part load** (**Ecodesign**) and as **part of a system**
- **No EU level playing field – 34 different national / regional regulation**

Heating and DHW systems evolution and new challenges

In the future (2020 - 2050)

- **Nearly zero** energy buildings (new buildings **after 31 December 2020**). (Problem is the definition of nZEB, not harmonised EU wide)
- Buildings are **no longer energy consumer** but also **energy producer**
- **EU Green Deal** (**EU CO2 neutral in 2050**), huge **EU funding needs EU comparability**
- No "**Building gate**" (→calculated consumption should be close to real consumption) Evaluation of heating and DHW systems in the new EPB standards is hourly and more related to real performance
- **Change of systems**: from **fossil fuels to renewables, more storage, less power**, more **complex interacting** systems more **sensible to boundary conditions**

These **evolutions** and **new challenges** are **already taken into account** in the new set of EPB Standards related to heating and DHW systems

How to adapt to the new challenges ?

Professionals need to be **trained** on:

- more **complex heating systems** e.g. renewables and storage,
- more **boundary conditions dependent** systems (e.g. heat pumps),
- on **new indicators** (e.g. share of renewable, primary energy, onsite, nearby distant).

Professional and **Industrials** need:

- a **common level playing field** for **fair competition** between products for the optimization of buildings energy performance,
- **common databases** and **tools** (HVAC systems are still the weak point in software tools).

European standards are

- key to create level playing field
- an advantage for mutual recognition of qualifications among EU Member States (qualification and training should be recognized EU wide)

A **first EU-wide qualification and training scheme** based on **EPBD mandated CEN standards** for HVAC professionals has been created (see CEN-CE: CEN standard CErtified Experts **https://www.cen-ce.eu/**)

Example 1

Impact of **energy choice** of **heating systems** (beyond “final” energy)

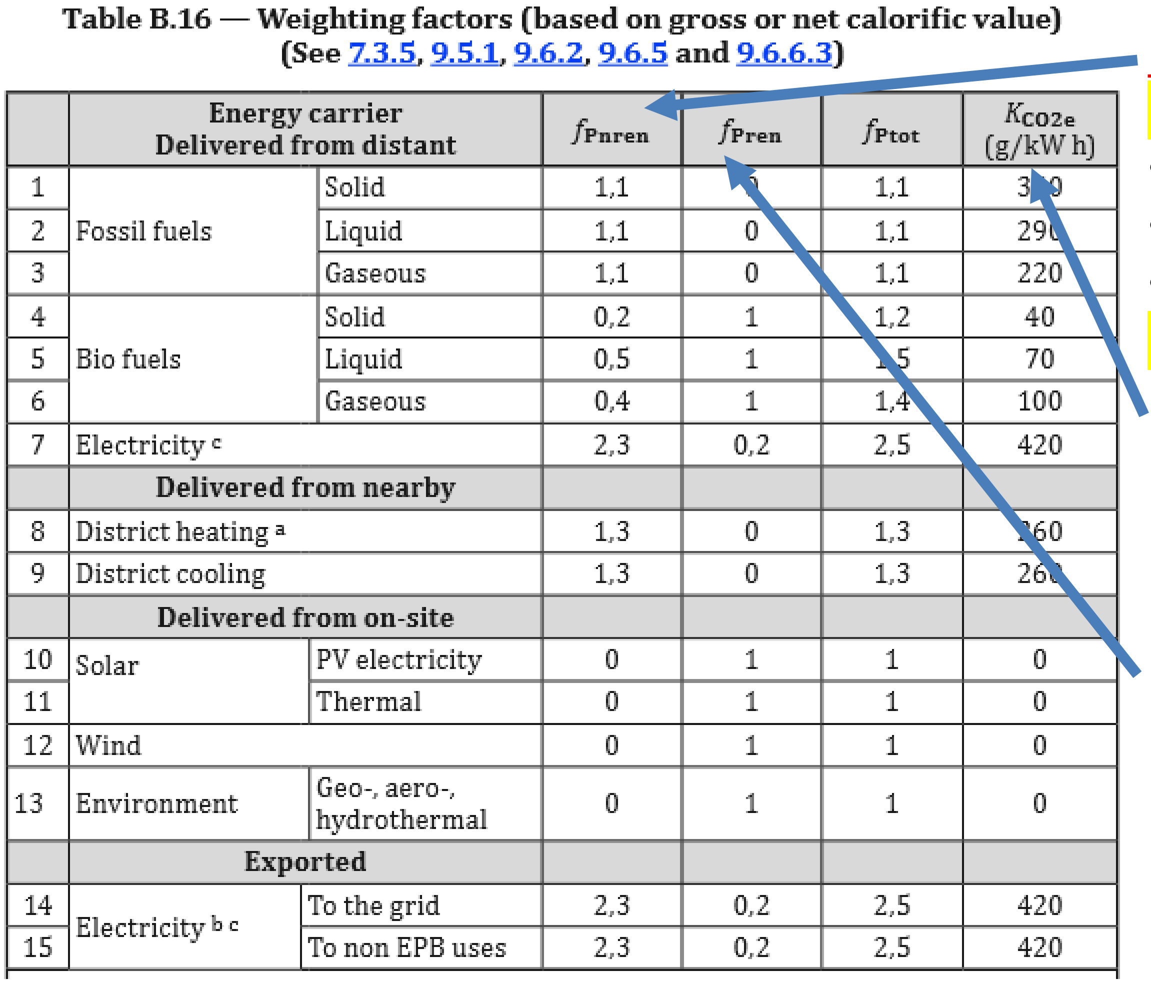


Table B.16 — Weighting factors (based on gross or net calorific value)
(See 7.3.5, 9.5.1, 9.6.2, 9.6.5 and 9.6.6.3)

	Energy carrier Delivered from distant		f_{Pnren}	f_{Pren}	f_{Ptot}	K_{CO2e} (g/kW h)
1	Fossil fuels	Solid	1,1	0	1,1	3[illegible]0
2		Liquid	1,1	0	1,1	290
3		Gaseous	1,1	0	1,1	220
4	Bio fuels	Solid	0,2	1	1,2	40
5		Liquid	0,5	1	1,5	70
6		Gaseous	0,4	1	1,4	100
7	Electricity [c]		2,3	0,2	2,5	420
	Delivered from nearby					
8	District heating [a]		1,3	0	1,3	260
9	District cooling		1,3	0	1,3	260
	Delivered from on-site					
10	Solar	PV electricity	0	1	1	0
11		Thermal	0	1	1	0
12	Wind		0	1	1	0
13	Environment	Geo-, aero-, hydrothermal	0	1	1	0
	Exported					
14	Electricity [b c]	To the grid	2,3	0,2	2,5	420
15		To non EPB uses	2,3	0,2	2,5	420

Non renewable primary energy f_{Pnren}

Indicator for **energy performance**

- 1.1 for gas
- 0.2 for wood
- 2.4 for electricity

Difficult to install direct elec. heating

CO2 emission coeff (g/kWh)

- 220 for gas
- 40 for wood
- 420 for electricity (**final energy**)

Renewable primary energy f_{Pren}

Indicator **renewable energy ratio**

- 0.0 for gas
- 1.0 for wood
- 1.0 for PV electricity

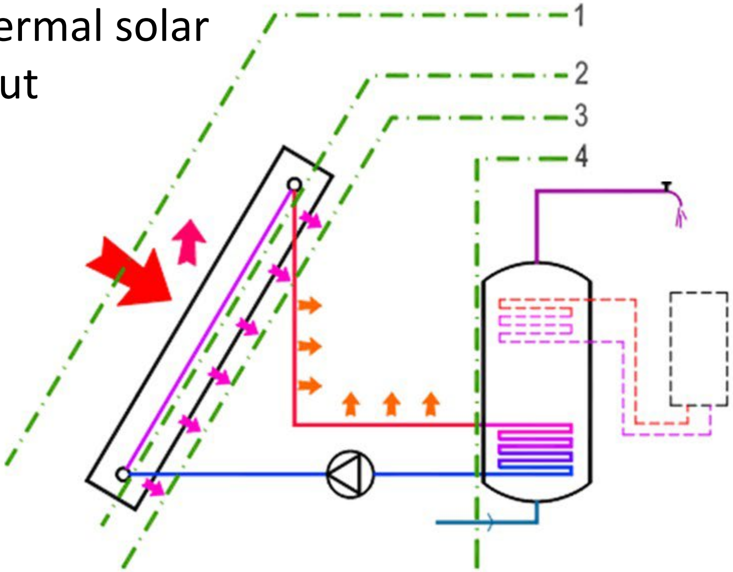
RER **mandatory** in several countries

Example 2:

Definition of **assessment boundary** **Impact** on **primary energy factor** (thermal solar)

KEY

1. Incident solar radiation
2. Captured solar radiation
3. Panel output
4. Thermal solar output



The **assessment boundary (**where the delivered and exported energy are measured or calculated) could be placed at **several places**

- intuitively one may go for boundary (1), the primary energy source (the **incident solar irradiation).**If it is **placed on other places** (e.g. the captured solar radiation (2), it is **including building specific technical system characteristics** (e.g. characteristics of the panel surface reflected incident solar irradiation, efficiency). In that case **the PEF is 1** and the **losses "inside" the assessment boundary are counted explicitly**.
- **By convention** it is very often placed at **panel output (3**). It is considered that the **efficiency of all panels is 100 %** ("Direct equivalent method)". This is to highlight the positive effect of non-combustible RES fuels on climate change. The **PEF is 1** (no losses are explicitly counted). The "real" performance of the panel is taking into account when calculating the panel output.

Conclusion

- The **advanced features** of **EPB standards on heating and DHW** systems (e.g. dynamic approach closer to reality, renewables) complete the holistic approach of buildings and **help HVAC professionals** to **uptake the new challenges.**
- To reach **the EU's energy and climate targets**, a **qualified building workforce** is needed. **HVAC Professionals** need to be **trained** on the **new upcoming challenges**: e.g. nZEB, renewables, state of art (standardization).
- **EU funding** (e.g. related to the green deal) must be **based on common EU rules** otherwise no common reliable EU target can be monitored.

European standards on heating and DHW systems are

- **a support for HVAC professionals to face the new challenges,**
- **key** to create **an EU wide common level playing field for HVAC products,**
- **an advantage for mutual recognition of qualifications** among EU Member States, qualification / training could be recognized EU wide because based on a common, standardized methodology.

Thank you!

EPB Center is also available for specific services requested by individual or clusters of stakeholders

More information on
the set of EPB standards:
www.epb.center
Contact: info@epb.center

Parts of this document have been produced under a contract with the European Union, represented by the European Commission (Service contract ENER/C3/2017-437/SI2-785.185).

Your service center for information and technical support on the new set of EPB standards

EPB standards on heating and domestic hot water systems: advanced features and tips & tricks

Laurent Socal

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This project is facilitated by the
EU-Commission Service Contract
ENER/C3/2017-437/SI2.785185
Start: 21 September 2018 for 3 years

BUILD UP Webinar series
Webinar 6: Heating systems in the EPB standards
08 September 2020

My background

- Wide professional experience as installer, designer, commissioning, software analysis, standardisation and training activity related to the HVAC sector.
  Also working in the industrial sector (pharma) on environmental (IPPC) and energy issues (energy audits, energy management systems)
- Convenor of the Italian mirror group on heating systems
- Task leader for several EN standards,
  - ***EN 15378-3*** *on measured energy performance*
  - ***EN 15378-1*** *on the inspection of heating system*
  - ***EN 15316-4-8*** *on local and radiant heaters*
  - ***EN 14336*** *installation and commissioning of heating systems*
- Active member of CEN/TC 228 WG4 and WG1
- Involved in the preparation and coordination of the set of **EPB standards** under **Mandate 480** (2012-2017)
- **EPB center expert** (> 2017)

Introduction

Energy performance is a required design objective of new and renovated buildings and associated systems

No EP → No building permit !

Energy performance shall be integrated into the sizing process,
possibly using integrated calculation tools and the same description of the building and systems for sizing and energy performance

There is very often a **gap between calculated and actual energy performance**

There are several features embedded in the EN-EPB standards that are not obvious at a first glance but that can be quite useful, also beyond the bare standard energy performance calculation.

A good energy performance calculation may provide useful information for sizing

On-going changes in heating systems

- **Technology shift** for generation:
  from combustion to heat pumping
- Several other **generation technologies** available
- **Reduced needs** due to high insulation and increased gains influence: efficient part load operation and good room temperature control required
- Availability of electronically controlled pumps and shift to **variable flow rate operation** of distribution networks
- Technical water **storage often needed** to match use and generation, to improve generator performance at low load and to connect several heat sources and uses.

Hourly method

The new EN standards support hourly calculation

The hourly calculation interval enables several new possibilities

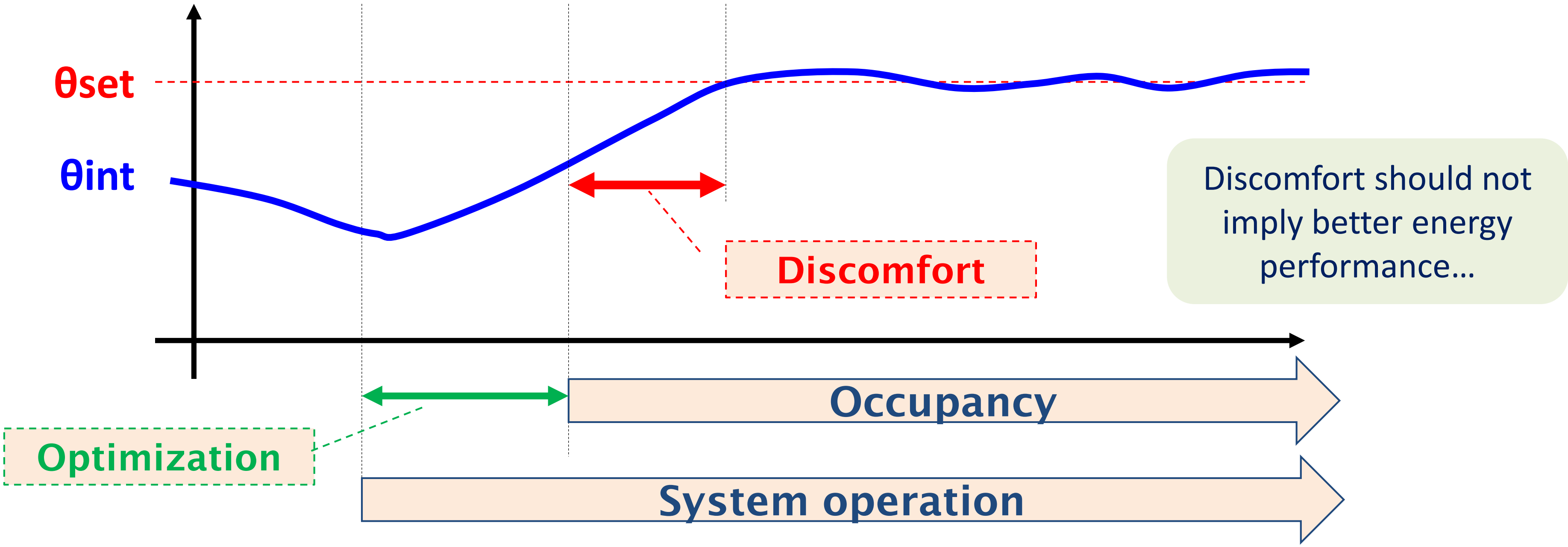
- **Easy handling of priorities** when dealing with several generators, e.g. determining the load to the following generator in the sequence
  With the monthly method you need a turn-around such as calculating critical generators like heat pumps with monthly bins to check if they can fulfill the load
- Taking into account **dynamics for storage** and thermal solar
- In connection with EN ISO 52016, taking into account the effect of **intermittent operation and limited power**

Operation schedule

There are also some new aspects to consider: you have to define not only the comfort schedule but also the operation schedule

- **Comfort schedule**: at what time a certain level of comfort is required to achieve a standard service
  The reference to evaluate a disconfort
- **System operation schedule**: at what time the system is turned on, e.g. the set-point is set on comfort level.
  This has to anticipate the comfort schedule to enable recovery of comfort conditions

System operation schedule



Discomfort should not imply better energy performance…

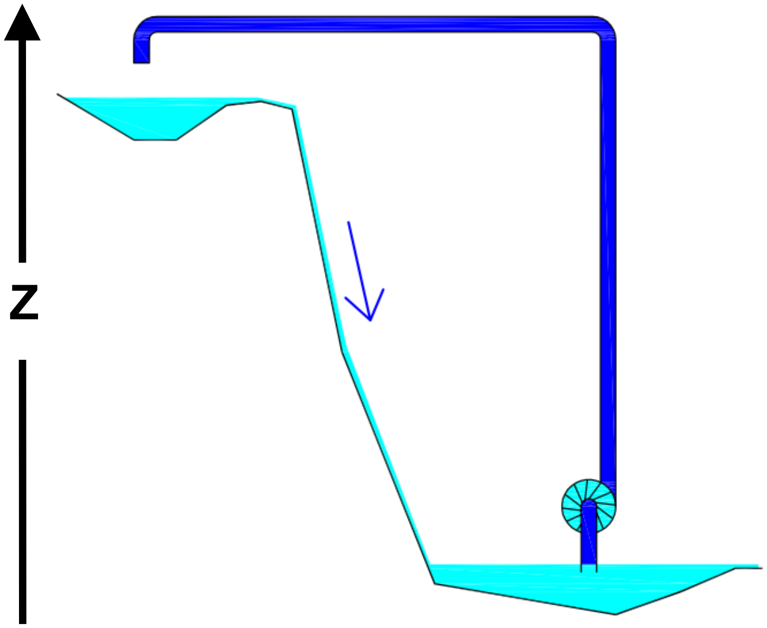
Requirement: comfort during occupancy schedule → System operation has to anticipate

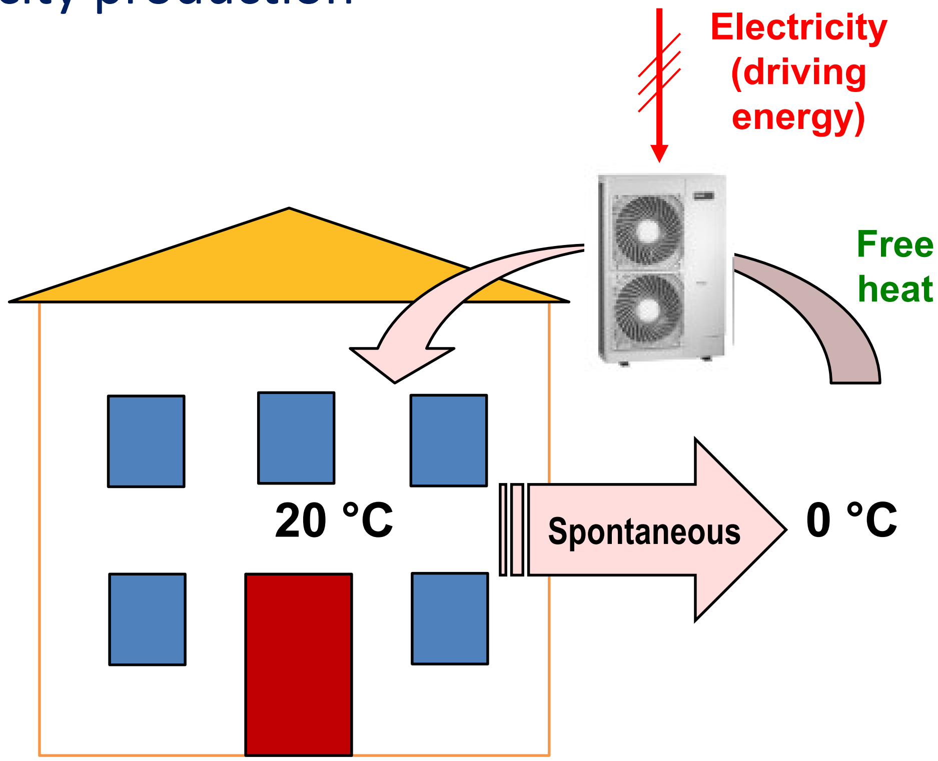
- **Hourly method**
  - can identify time required to reach comfort conditions (recovery power → generator sizing)
  - can take into account accumulation of energy during non-occupancy (TAB)
  - can estimate the benefit of optimized start-stop (BACS)
- **Monthly method**: hard to take into account transients and dynamics – default factors required

Technology shift to heat pumping

Rationale for the shift

- instead of converting energy into heat (boiler, electric resistance), force the transfer of heat where needed with a heat pump
- you can leverage on-site electricity production with PV, wind, etc,

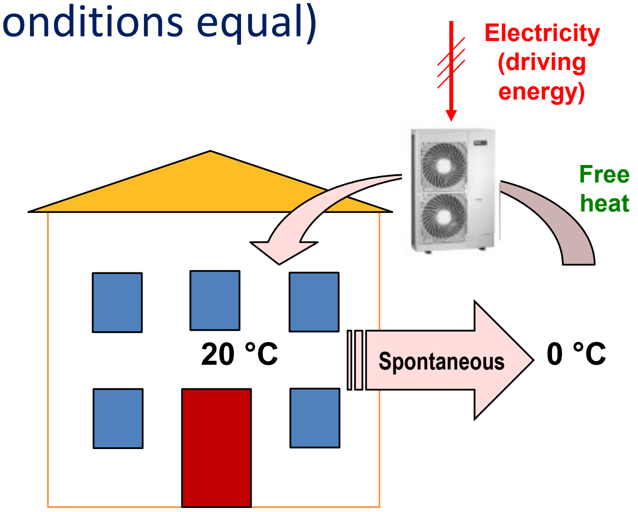




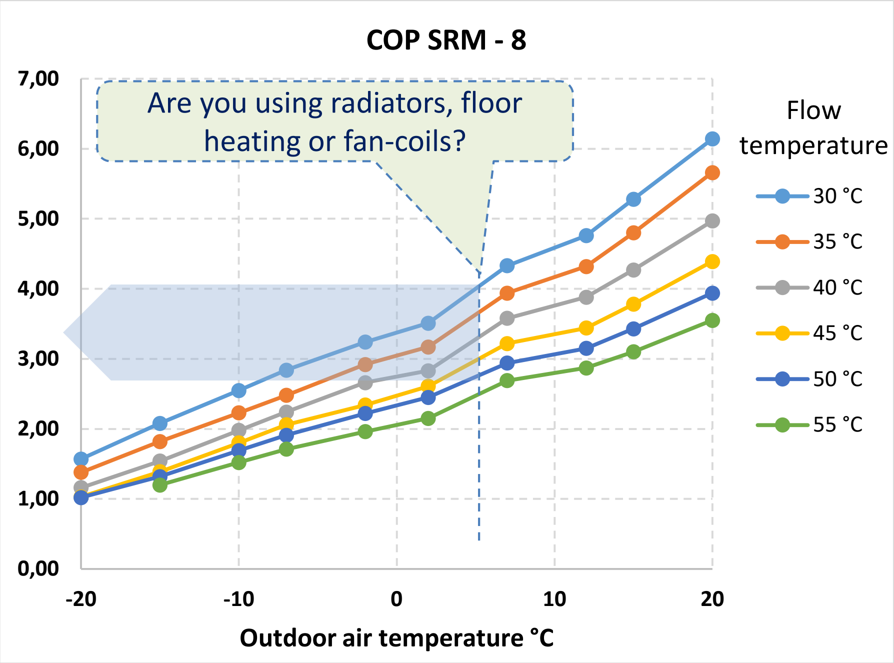
Technology shift to heat pumping

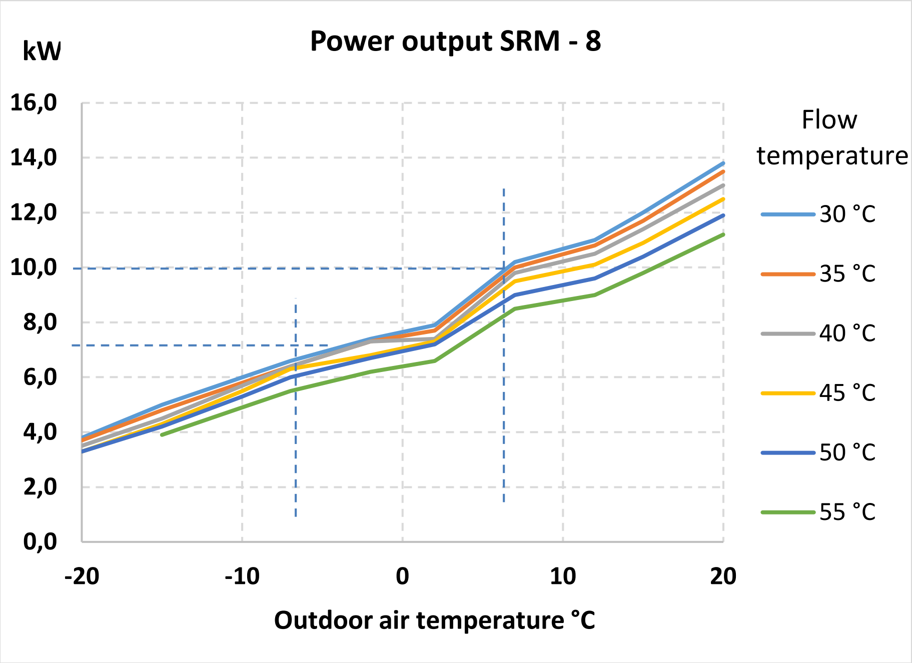
Points of attention of heat pumps

- **Heat pump performance is extremely sensitive to operating conditions**:
  - Maximum power depends on cold source temperature, with range 1/2 into the operation range if air is used as the heat source
  - **Efficiency (COP) depends on both sources temperatures**, with range 1/4 into the operation range and sensitivity 1…2% efficiency gain/loss per °C change of the source temperature
  - **Efficiency (COP) also depends on part load operation**, with an increase of efficiency which is usually up to 20 % (all other conditions equal) at minimum modulation and then decreases
- Heat pump sizing is critical because the specific initial cost (€/kW) is high and operation at very low load is not efficient.
- A back-up is often included as a safe guard or for special tasks (legionella)
- The sun is available in summer. In winter only a few hours…



Sample data on heat pump

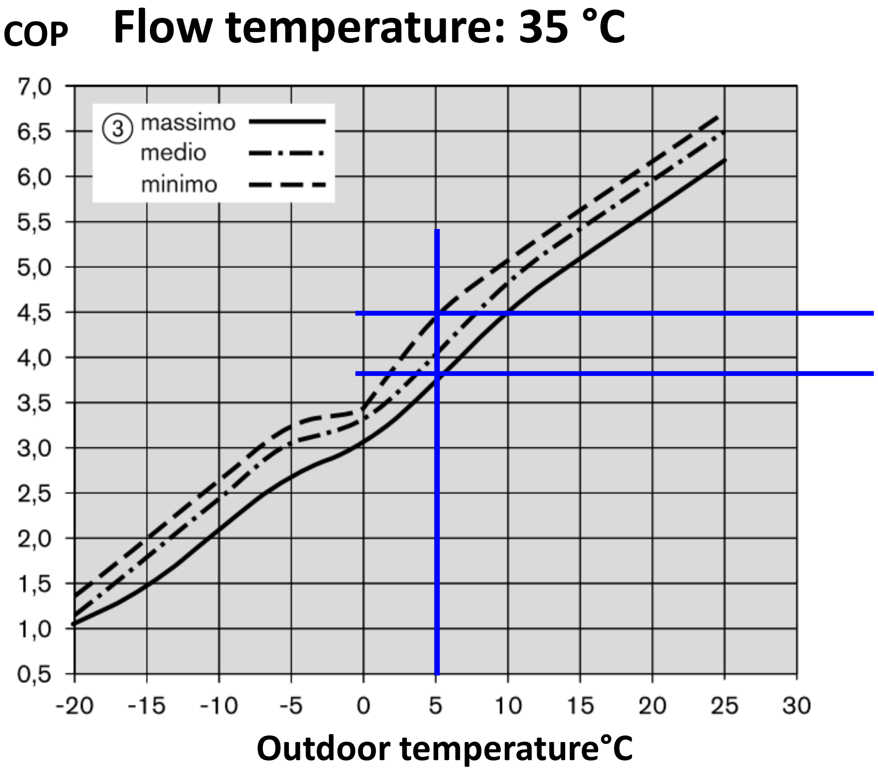




COP range in practical application range:
1,5…6 = ¼
Sensitivity on flow temperature at 7°C Air:
-37,5% / 25 °C = 1,5%/°C

Power output decreasing with temperature
High cost per kW installed
→ Sizing is critical
→ Back-up may be required

Sample data on heat pump



COP correction, full load to minimum continuous load 4,5/3,8 = 1,18

Sample influence of part load

EN-EPB standards answer

Hourly heat pump performance calculation standard offering

- Possibility to use either data from EN 14511 or from EN 14825 (the standards providing the heat pump product data)
  for the best representation of the performance map
- Check of the operational limits (temperatures and power) to determine back-up requirement
  - Product limitation: allowable temperature range and maximum power
  - Control option: controlled bivalence point
- Priority between domestic hot water and heating
- Water temperature calculation in the general part (see after)
- Conversion procedure from monthly data to monthly bins for residual support of monthly calculation

That’s even not enough for HPs…

New products allowing new configurations are increasing their market share and will have to be included in the calculation process:

- Four pipes units, capable of simultaneous heating and cooling (non residential)
- Direct expansion and condensation systems, capable of transferring heat directly between rooms in the building
- Thermodynamic heat exchangers, using exhaust air to provide heat

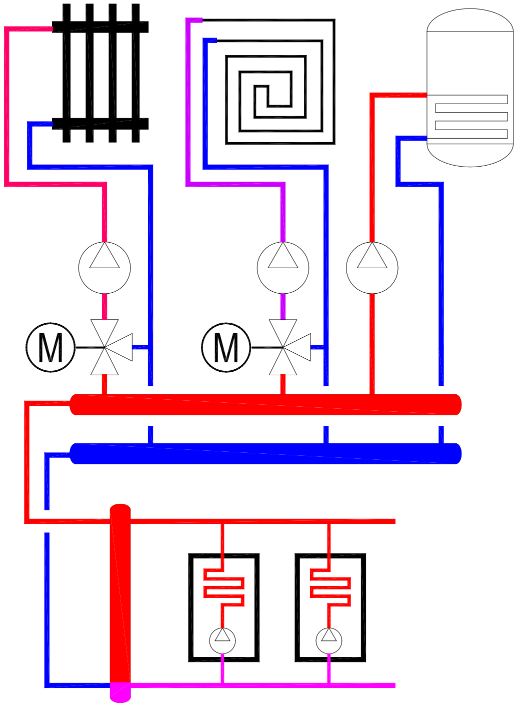
Further development of (EPB) standards required to be future proof…

Calculation of operating temperature

EN 15316-1 (the general part of the series of standards on heating and DHW systems) includes a series of modular procedures to calculate the operating conditions (temperatures and part load for pumps) of the heating fluid.

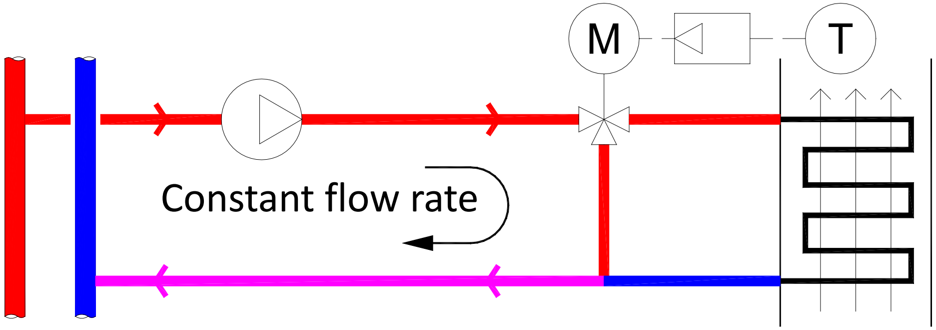
- Annex C (normative):
  utilization circuits modules with constant / variable flow rate and/or temperature
- Annex D (normative):
  generation circuits modules with direct connection or independent flow rate

Necessary for condensing boilers and heat pumps

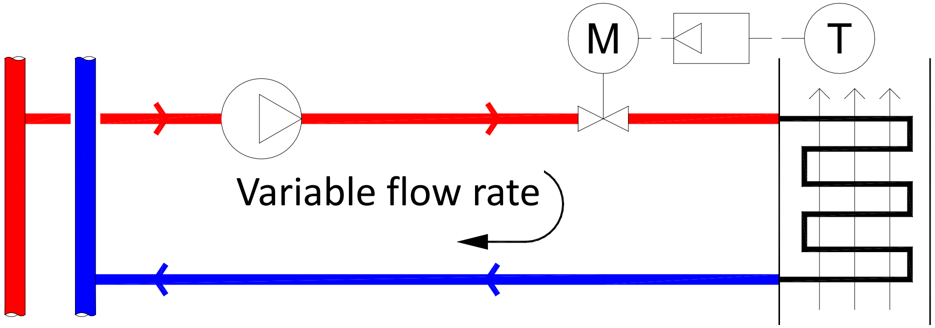


Example 1: heating coil

Common solution
Maximum auxiliary energy
Maximum pipe losses
No condensation



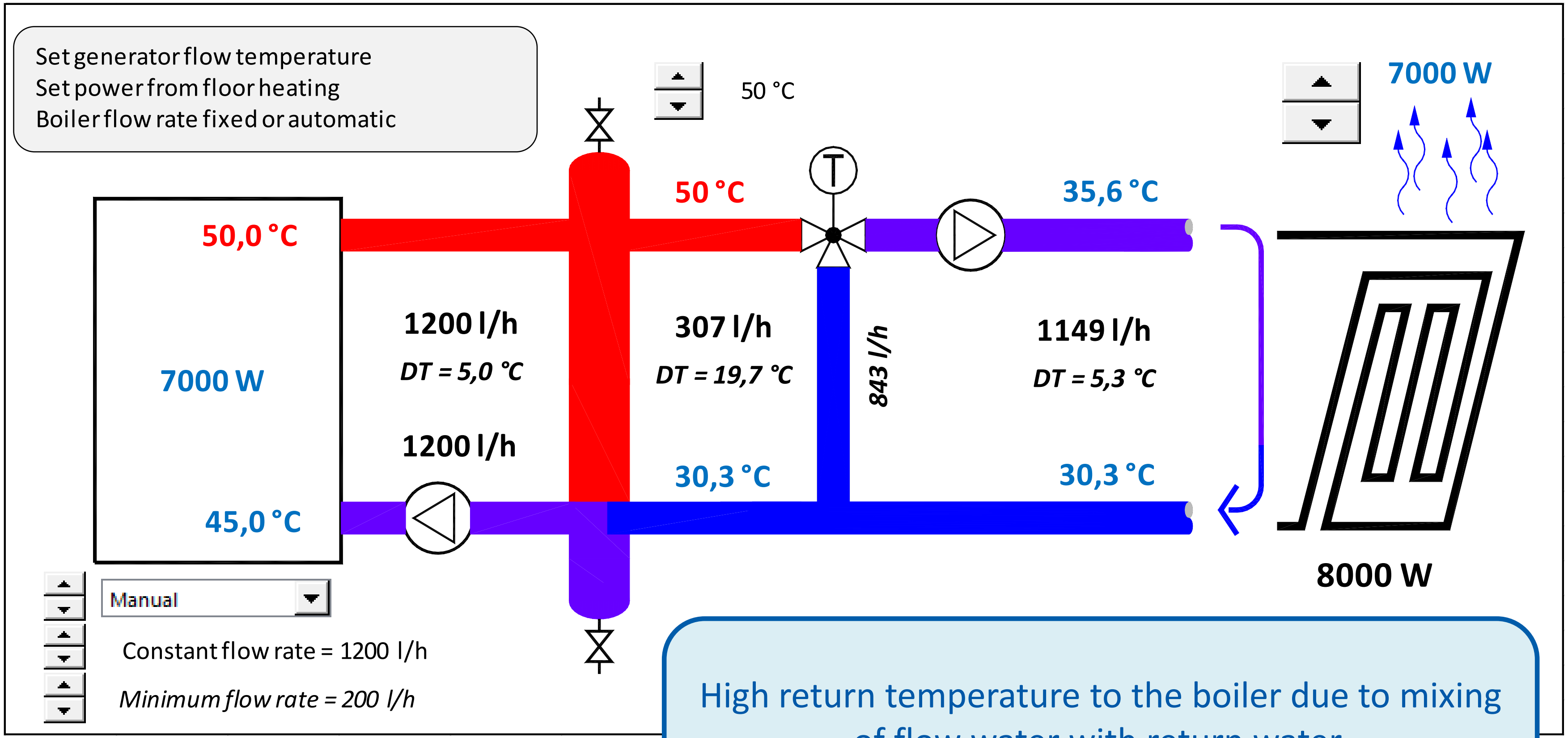
Better solution
Minimum auxiliary energy
Minimum pipe losses
Possible condensation



The user module identifies the different temperature, flow rate and part load regime which will be used by distribution and generation modules.

… hope somebody will set-up correctly… see last slides…

Example 2: generator connection



Set generator flow temperature
Set power from floor heating
Boiler flow rate fixed or automatic

Manual

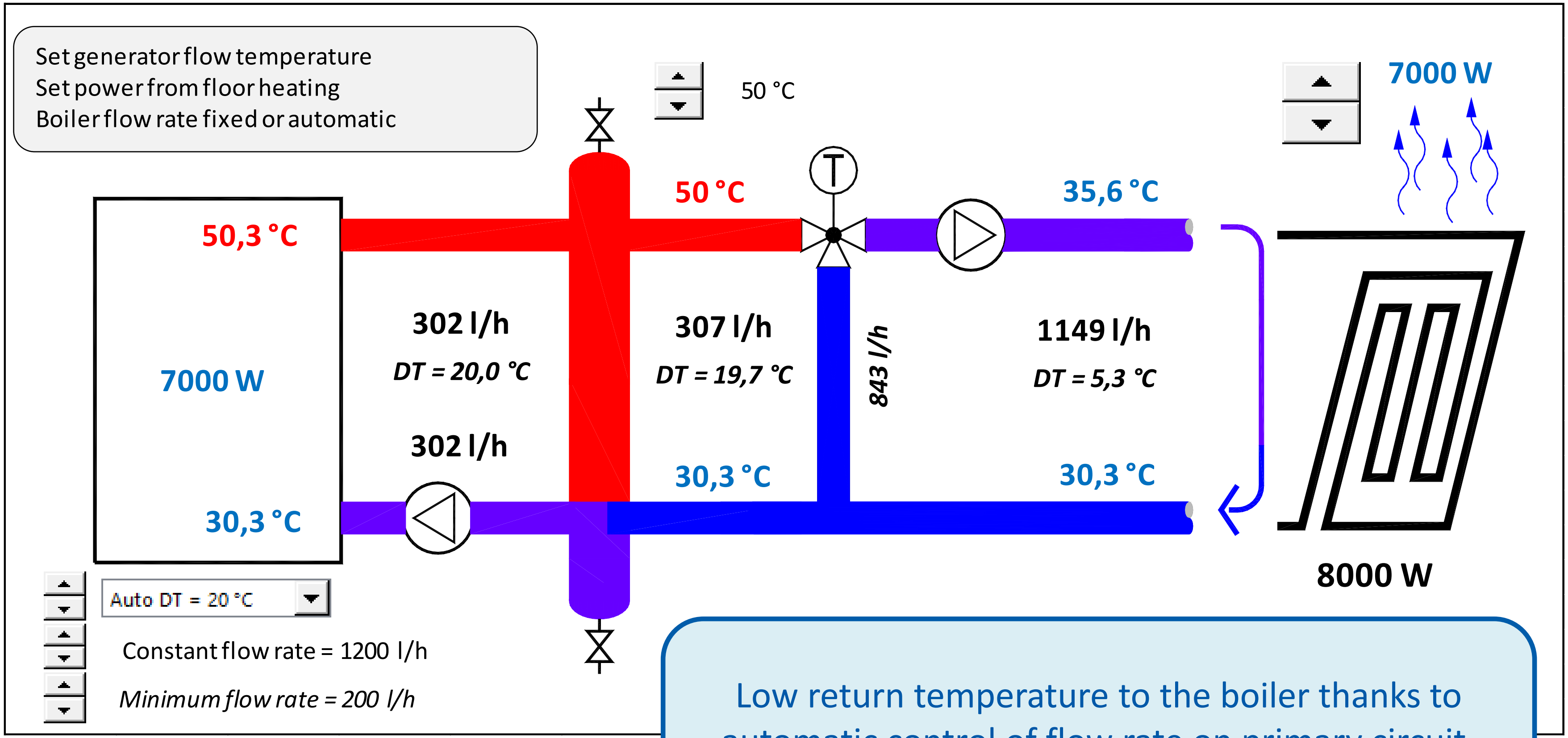
Constant flow rate = 1200 l/h

Minimum flow rate = 200 l/h

High return temperature to the boiler due to mixing of flow water with return water.

The generator module will show low condensation

Example 2: generator connection

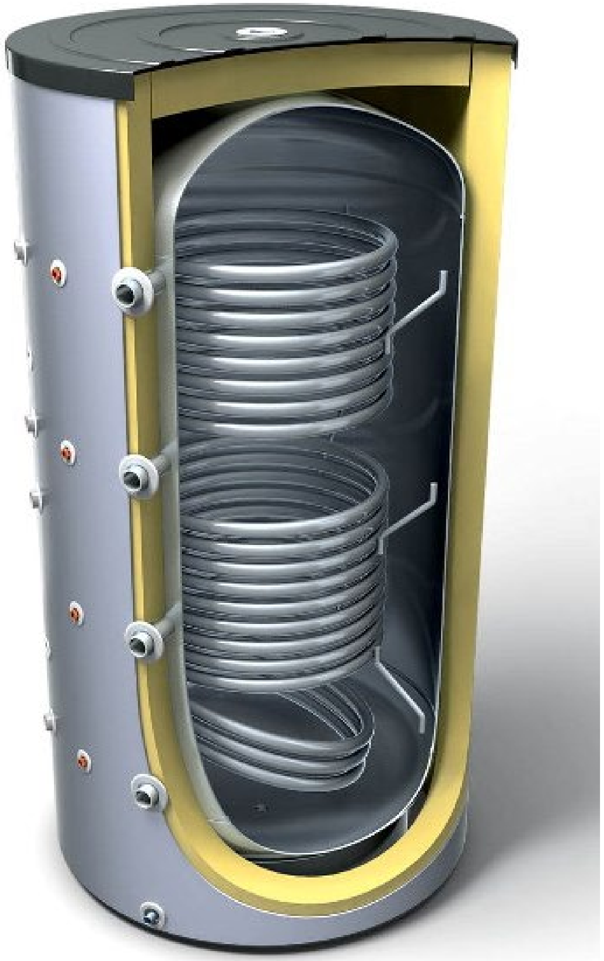


Low return temperature to the boiler thanks to automatic control of flow rate on primary circuit.
The generator module will show high condensation

Dinamic storage calculation

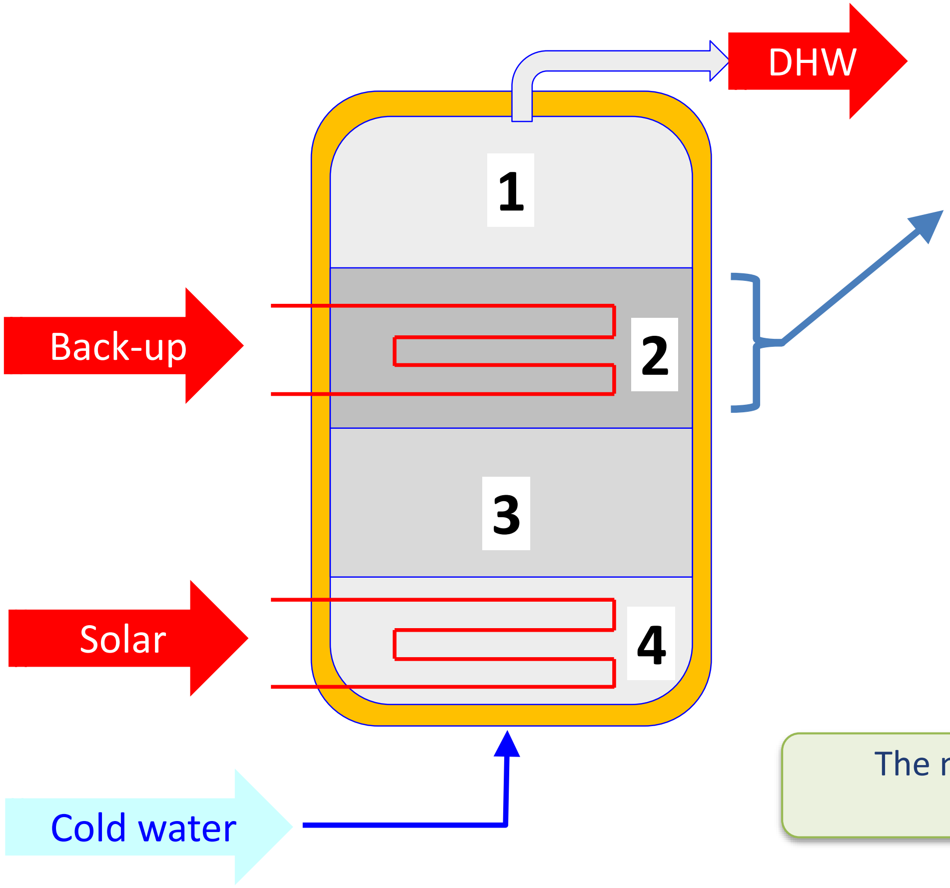
DHW storage

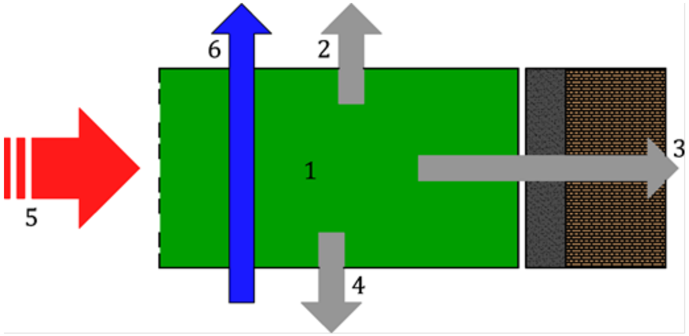
- Looks like obvious that there is dynamics: by definition you accumulate energy to decouple time of use and time of production
- EN 15316-5 introduces a dynamic calculation with 1 hour calculation interval. Looks fine for thermal solar
- No significant additional data needed. **Get the most from the same data as monthly.**



Water storage model

The water storage model of EN 15316-5 in short





Key

1 layer *i*
2 thermal conduction with the upper layer
3 contribution of layer *i* to thermal losses
4 thermal conduction with the lower layer *i-1*
5 energy input into volume *i*
6 energy exchange due to mass transfer (flow of water draw off)

The model also includes heat extraction for heating, not shown here for simplicity

Storage calculation

Evolution of temperatures in the storage during the calculation interval

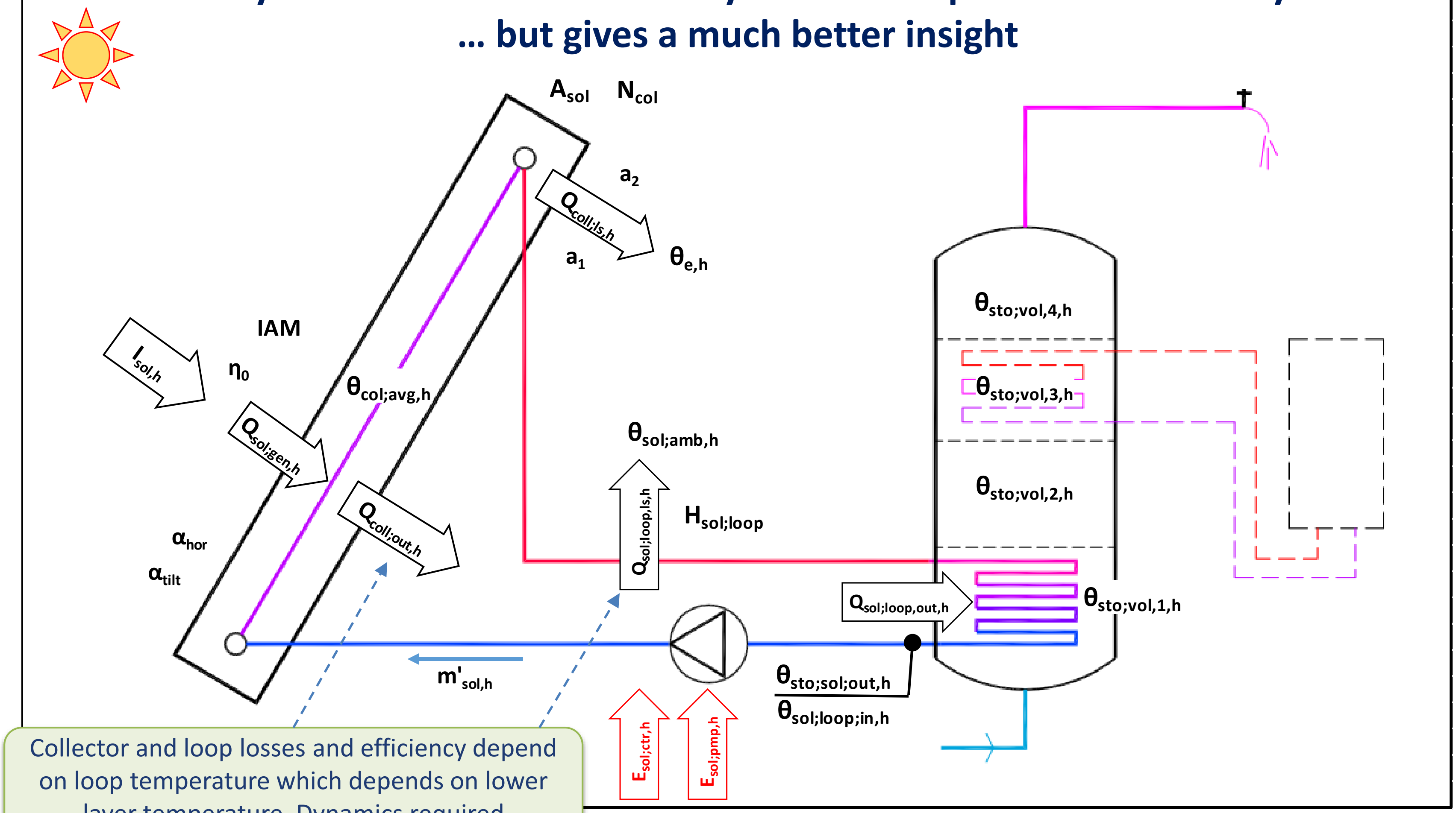
Step		1	2…3	4	5	6	7	8
Description		Initial	DHW draw-off	Heating output	Solar heating	Back-up heater	Layer melting	Heat losses
Layer 4	°C	49,25	46,07	46,07	46,07	46,07	60,00	59,59
Layer 3	°C	48,66	46,07	40,00	40,00	73,93	60,00	59,59
Layer 2	°C	46,07	30,40	30,40	30,40	30,40	33,35	33,18
Layer 1	°C	25,96	12,00	12,00	40,74	40,74	33,35	33,18
Volume withdrawn	l		93,59					
Energy withdrawn	kWh	4	4,000	0,317				0,085
Energy supplied	kWh				2,000	1,771		

- Domestic hot water withdrawal = water shift upwards
- Heating supply from layer 3 with minimum required temperature (in this case 40 °C)
- Solar heating connected to layer 1
- Back-up heating to bring back layers 3 and 4 to the set-point (On @ 45 °C, Off @ 60 °C)
- Layer melting: no warmer layer below a colder layer
- Store heat losses, per layer depending on layer temperature and loss coefficient

Coupling storage with thermal solar

Hourly method works with exactly the same input data as monthly…

… but gives a much better insight



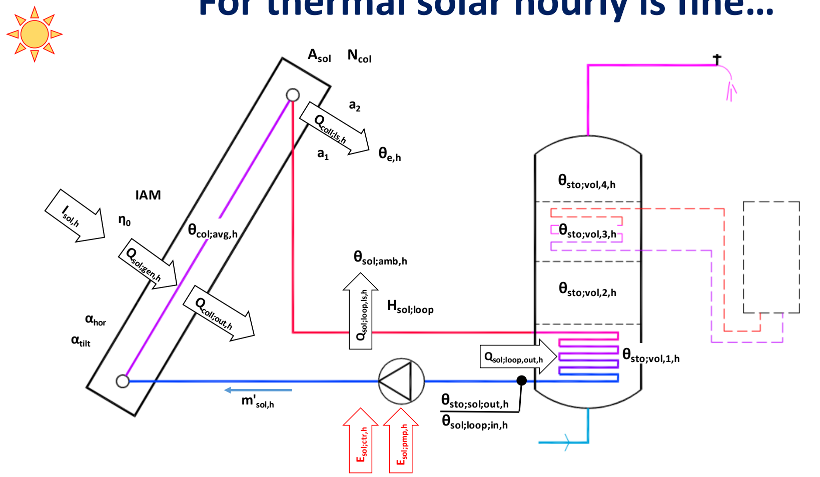
Collector and loop losses and efficiency depend on loop temperature which depends on lower layer temperature. Dynamics required

Benefits of hourly dynamics

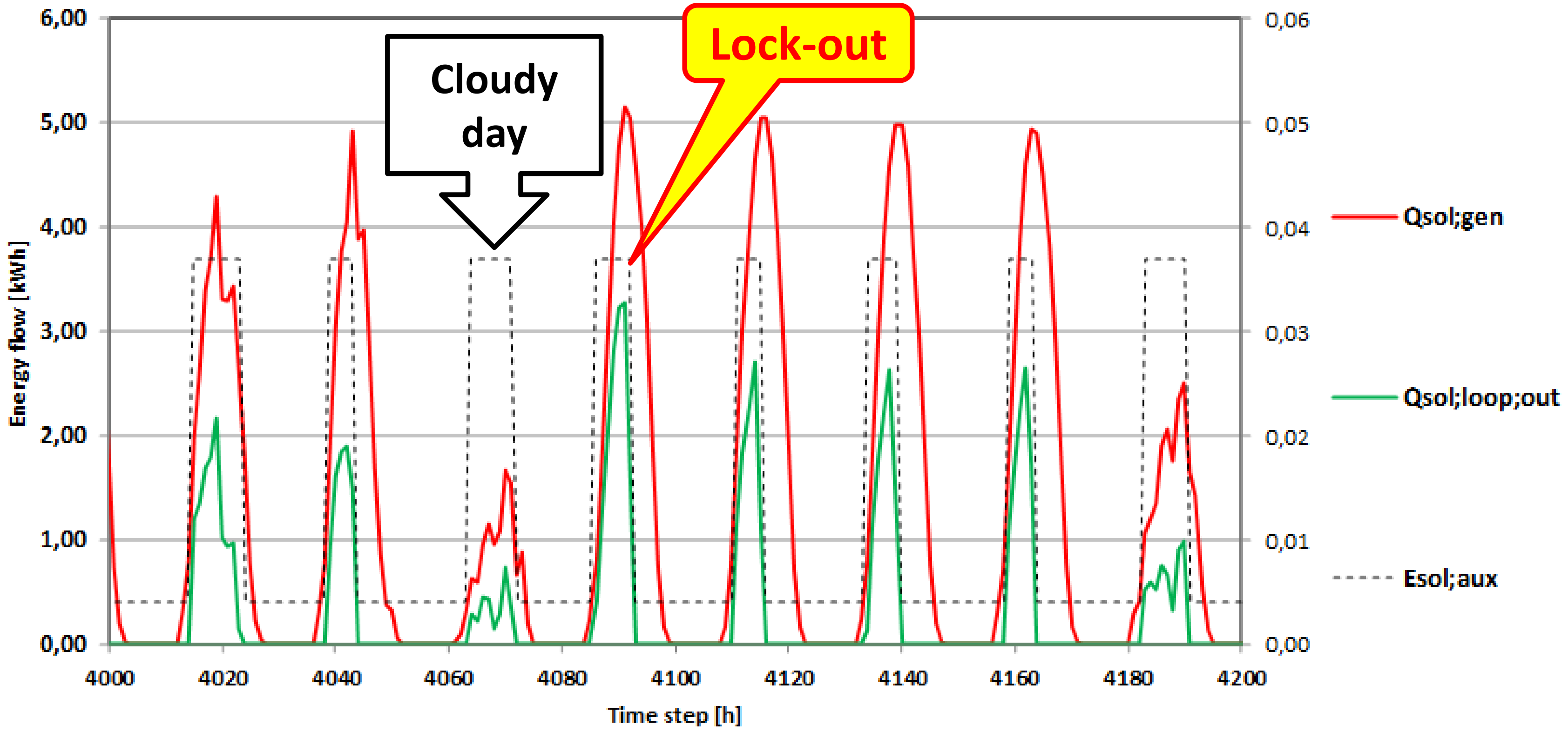
DHW Water storage coupled with thermal solar

- You remove the hidden assumption that the system will always work: detect overheating and lock-out
- May help sizing and design…
- **Does not require significant additional input…**

For thermal solar hourly is fine…



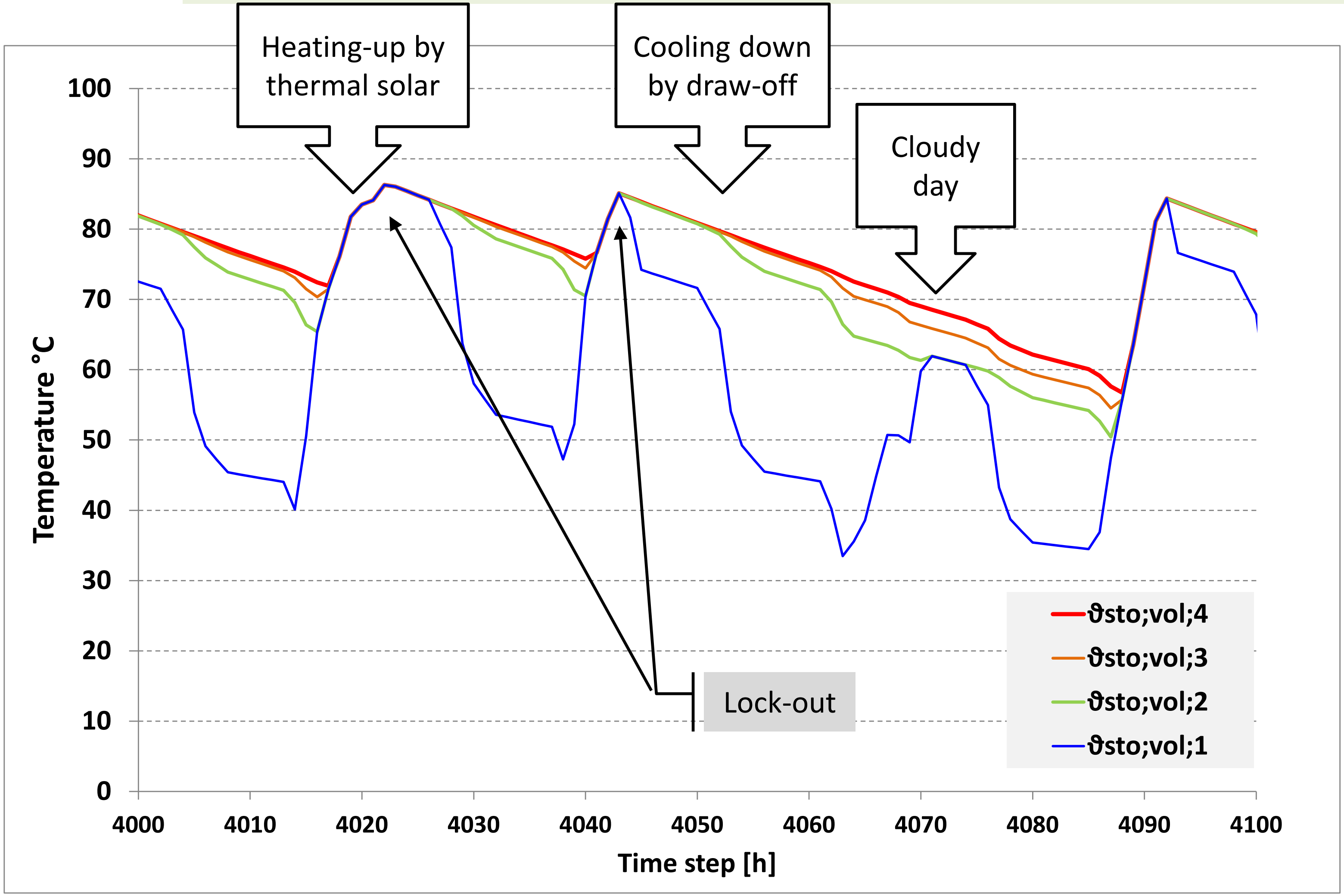
Coupling storage with thermal solar



Cloudy day

Lock-out

Coupling storage with thermal solar



Heating-up by thermal solar

Cooling down by draw-off

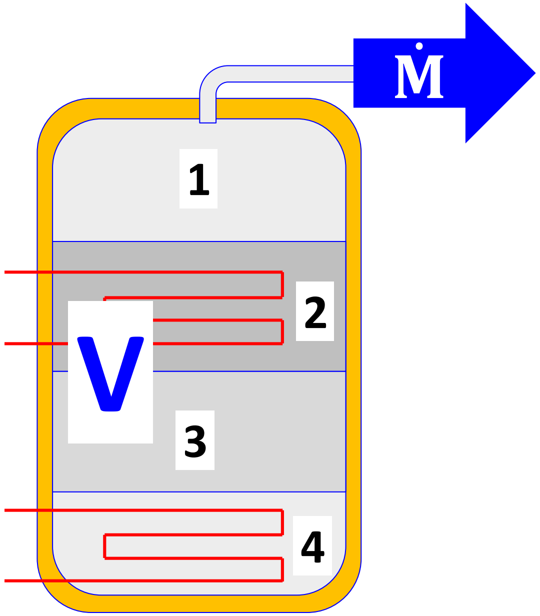
Cloudy day

Lock-out

Is hourly always OK?

If the draw off volume in one calculation interval exceeds the layer volume, the method will loose reliability.
If it exceeds the tank volume then it is probably wrong.

This can be corrected with sub-hour intervals for high draw-off relative to layer volumes
(no additional input data!)

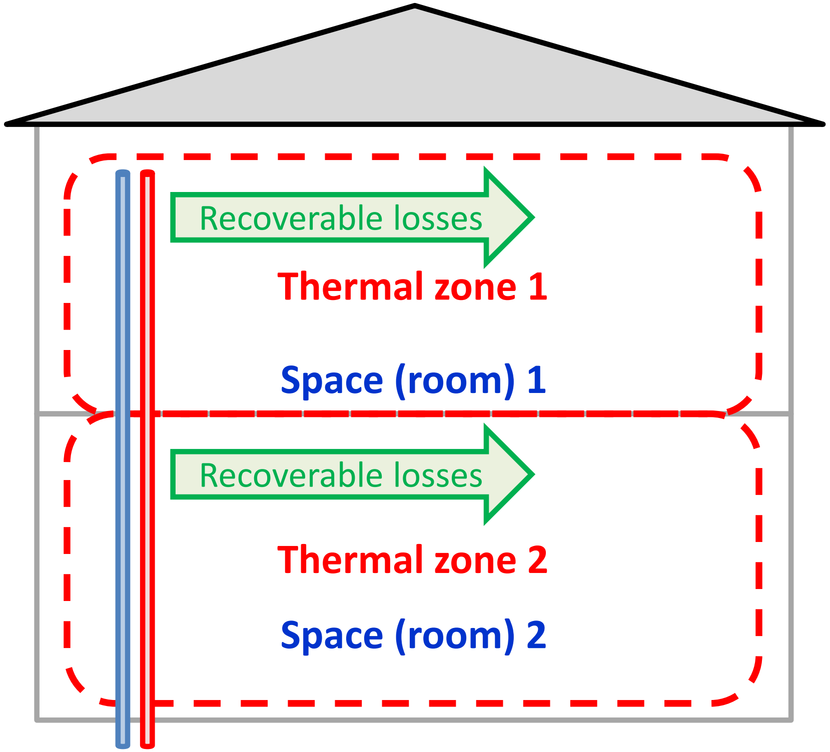


EN 12831-3 about domestic hot water needs for sizing and energy performance, introduces a minute by minute calculation so that no draw off can upset the layers: this calculation is nearly the same as that defined in 15316-5

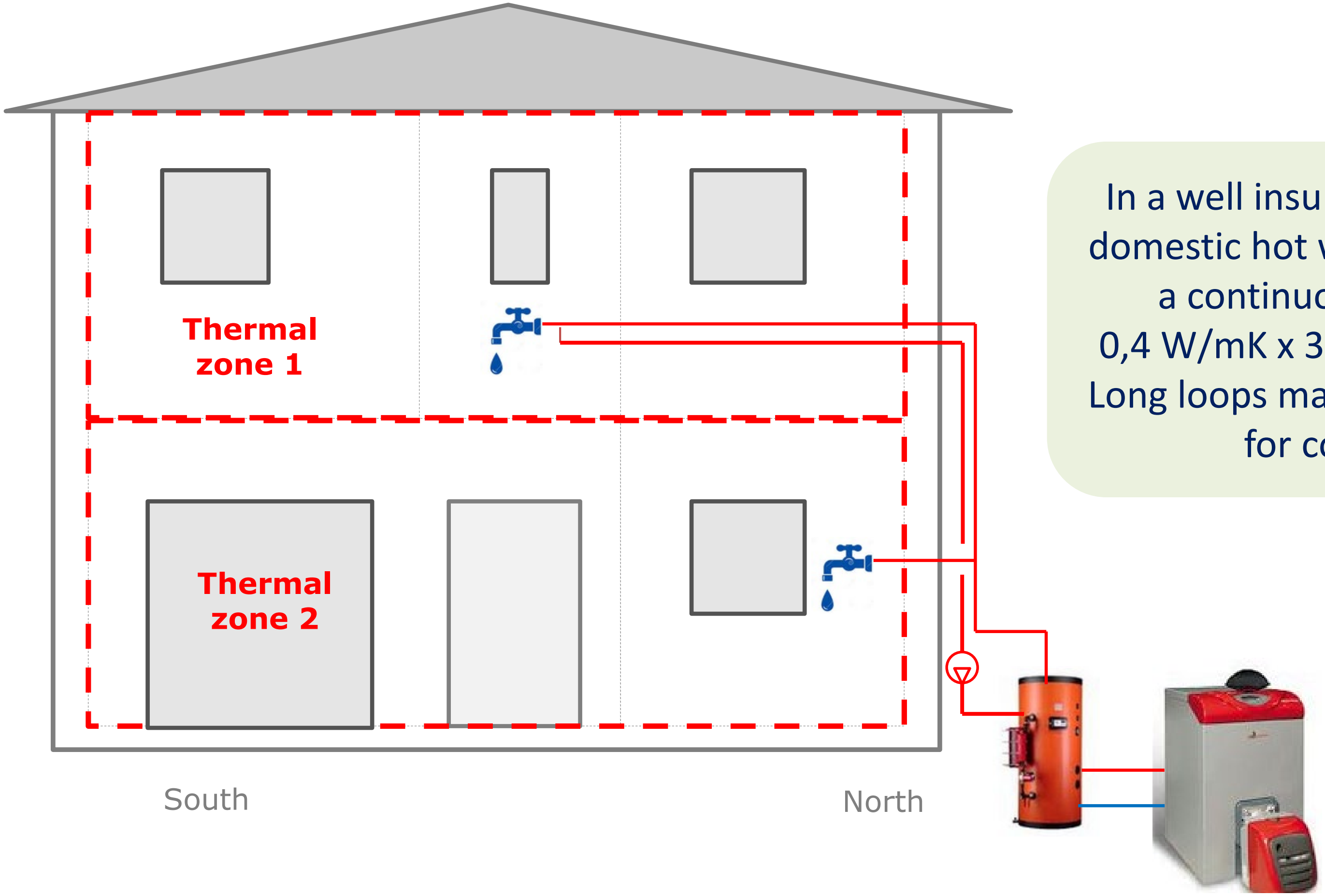
→ **potential convergence of energy performance an sizing methodologies…**

Handling recoverable losses

- Thermal zone: set of spaces (≈rooms) that share the balance between losses and gains.
- Explicit accounting of recoverable losses requires that they are included in the right zone
- Heat loosing components (e.g. installation components) shall be located with respect to thermal zones or losses shall be allocated with a default rule.
- Needs calculation precedes system calculation: iteration or send recoverable losses to next calculation interval.



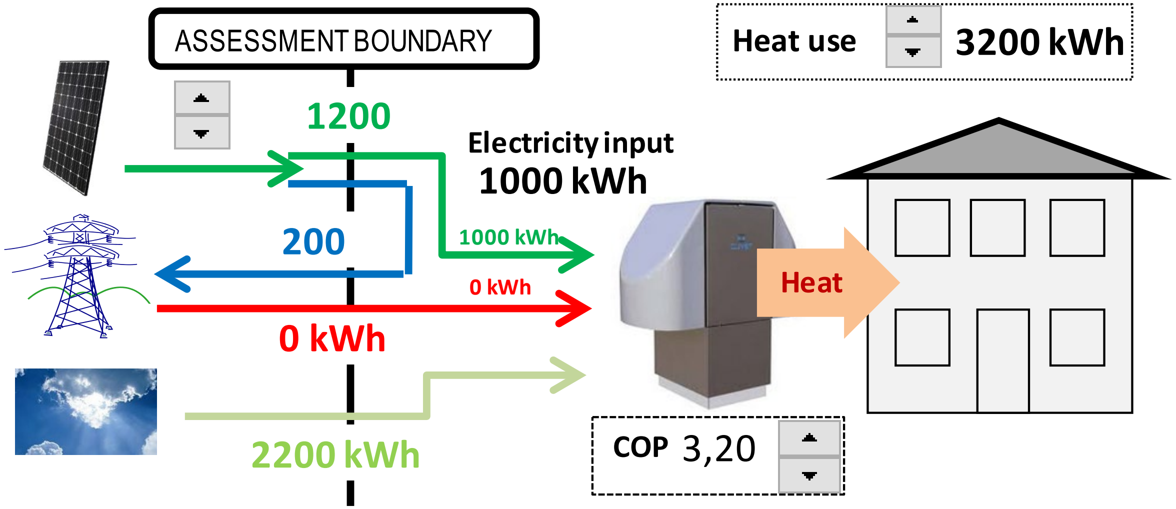
Handling recoverable losses



In a well insulated building, domestic hot water loops are a continuous heating
0,4 W/mK x 30 °C = 12 W/m
Long loops may be significant for cooling

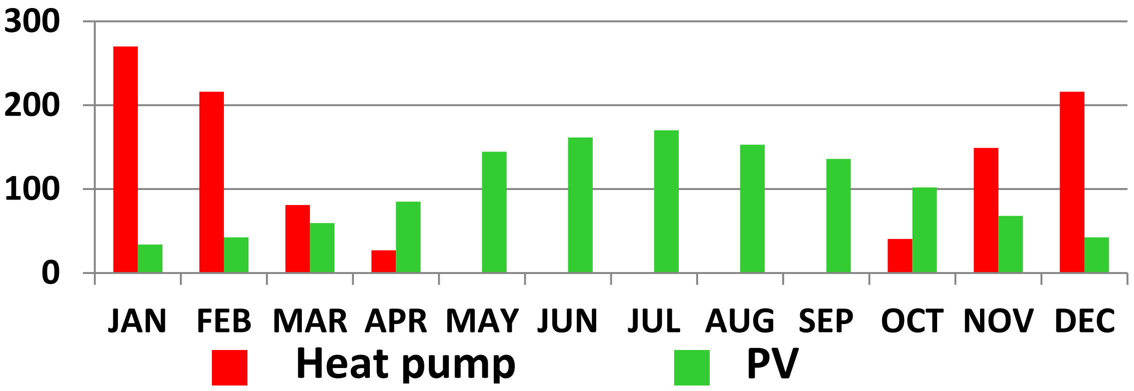
Using PV for a heat pump

Hourly calculation explicitly takes into account matching of production and demand for that specific configuration hour by hour.



Monthly may identify matching month by month but fails to identify night/day marching between production and demand

→ Matching factor needed



Other H&W sub-systems

In general, there is no significant dynamic effect for boilers , cogeneration units, heat pumps, space heating emission and control. The same calculation methods may be used for monthly and hourly calculation…

The advanced feature: generators sequence

- **Monthly method**: tricky to identify the part of load left to a back-up generation device. Statistical factors needed
- **Turn-around**: use the bin method for the generation so that you explore the full range of loads and not only average loads
- **Solution**: hourly method identifies the load to back-up heater but shall be mitigated to identify “false alarms”.

More details on hourly versus monthly calculation procedures: Webinar 4
https://epb.center/news/news_events/fourth-webinar-epb-standards-hourly-vs-monthly-met/

Closing the gap between calculated and measured

You can't improve it if you can't measure it

If you aim at a goal you should look if you are approaching it…

We build sophisticated buildings

We build complex installations

We calculate energy performance with detailed standards

Do we really check if we get what we promised or expected?

Do we compare calculated with actual performance?

Do we check if we really improved the energy performance after implementing energy conservation measures?

Is there any standard about how to measure and how to compare measured and calculated?

The gaps

Actually there are several “gaps”…

Is the calculation correct, e.g. do we take correctly into account influencing factors?

Is the “standard” condition “representative“?

Are the building and system installed as designed?

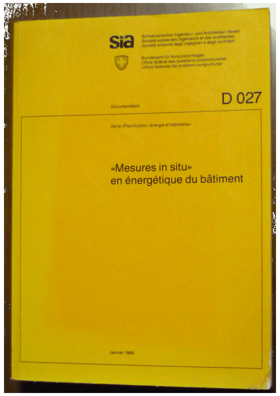
Are the building and system commissioned and operated as designed?

Have the measured data been acquired and processed correctly ?

EN 15378-3 measured energy performance

The standard covers:

- Rules to collect, convert and filter data about actual delivered energy
  - Conversion, solid fuels, non heating energy use, etc.
  - Separate non homogeneous data (H, NH, HNH)
- Rules to normalize or standardize measured delivered energy
  - Linear regression techniques
  - Calculation of balance temperature
  - Normalization of result
- Rules to validate the results
  - Statistic indicators (R^2, …)



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Société suisse des ingénieurs et des architectes
Società svizzera degli ingegneri e degli architetti

Bundesamt für Konjunkturfragen
Office fédéral des questions conjoncturelles
Ufficio federale dei problemi congiunturali

Documentation

D 027

Serie «Planification, énergie et bâtiments»

«Mesures in situ»
en énergétique du bâtiment

Janvier 1989

Primary intent of EN 15378-3: supporting measured energy performance assessment
With some tips and tricks, you can do much more …
(to be added to the next revision of the standard)

What is an energy signature?

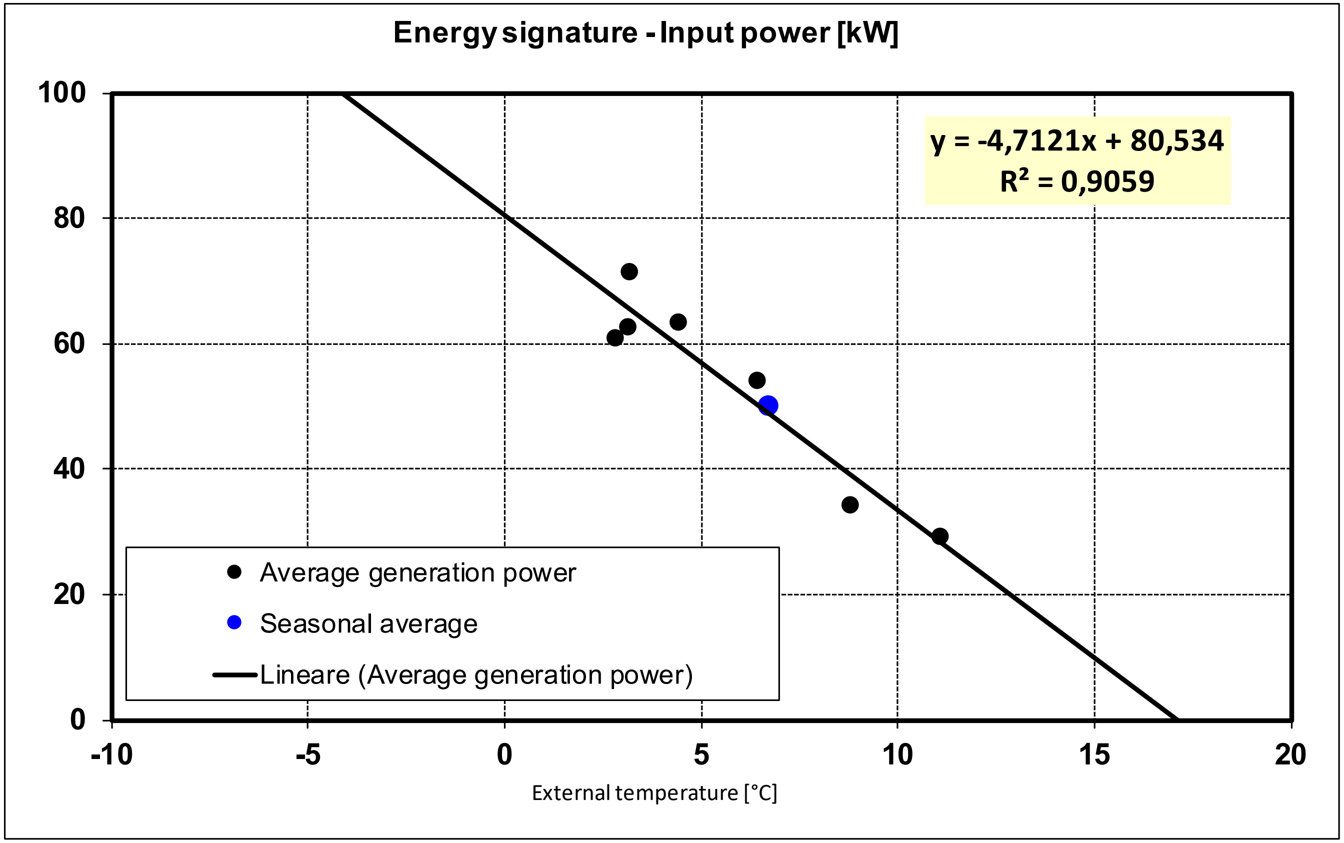
ENERGY SIGNATURE BASED ON FUEL READINGS - NATURAL GAS

Date		15/10/03	13/11/03	07/01/04	12/01/04	29/01/04	09/02/04	15/03/04	20/04/04	Season
Interval days	g		29	55	5	17	11	35	36	188
Interval hours	h		696	1.320	120	408	264	840	864	4.512
Daily operation hours	h/gg		17	17	17	17	17	17	17	
System operation time	h		493	935	85	289	187	595	612	3.196
Gas meter reading	Sm³	0	1.738	6.963	7.496	9.364	10.744	14.630	16.475	
Natural gas use	Sm³		1.738	5.225	533	1.868	1.380	3.886	1.845	16.475
	MWh		16,9	50,7	5,2	18,1	13,4	37,7	17,9	159,8
Average generation power	kW		34,2	54,2	60,8	62,7	71,6	63,3	29,2	50,0
Average generation power on 24 h	kW		24,2	38,4	43,1	44,4	50,7	44,9	20,7	35,4
Calculation external temperature	°C		8,8	6,4	2,8	3,1	3,2	4,4	11,1	6,7
Interval degree days	GG		325	746	86	287	185	545	321	2.495

You should be able to manage that:
reading a fuel meter once a week and recording outdoor temperature.

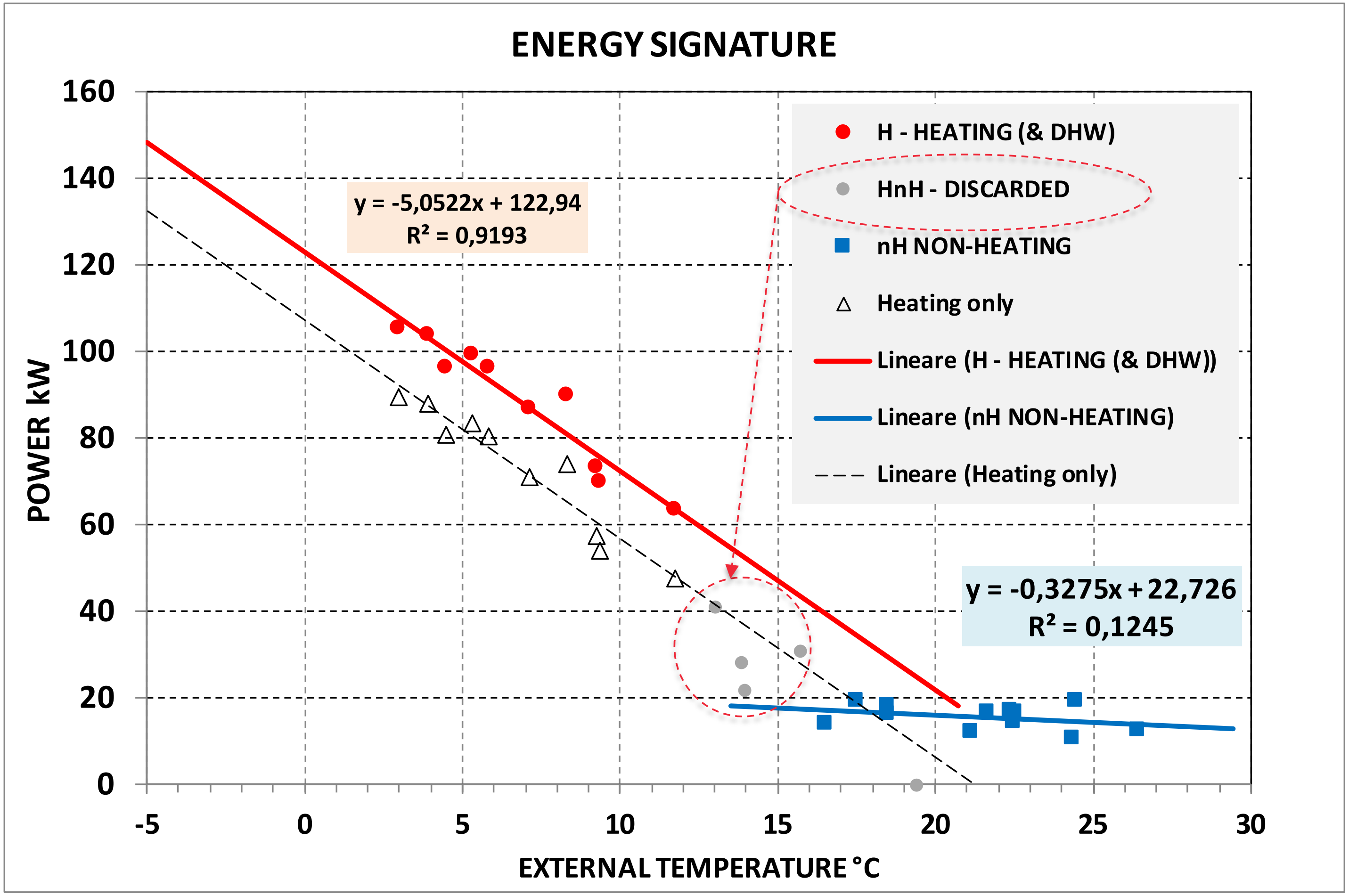
This should be readily available with “smart” metering… why are you measuring what?

Looks like …

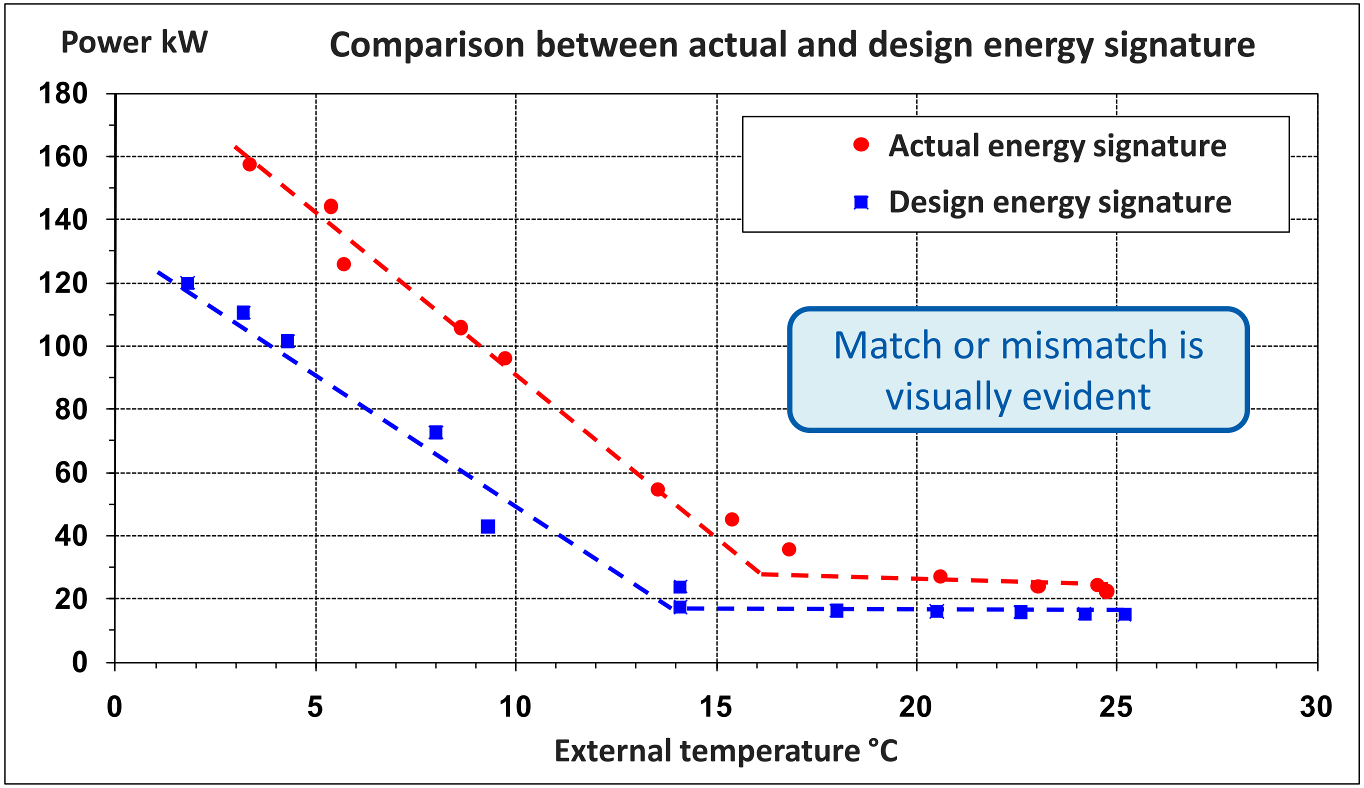


… You need a higher power when its cold out there…

Doing this «the official way»



Application: design versus measured

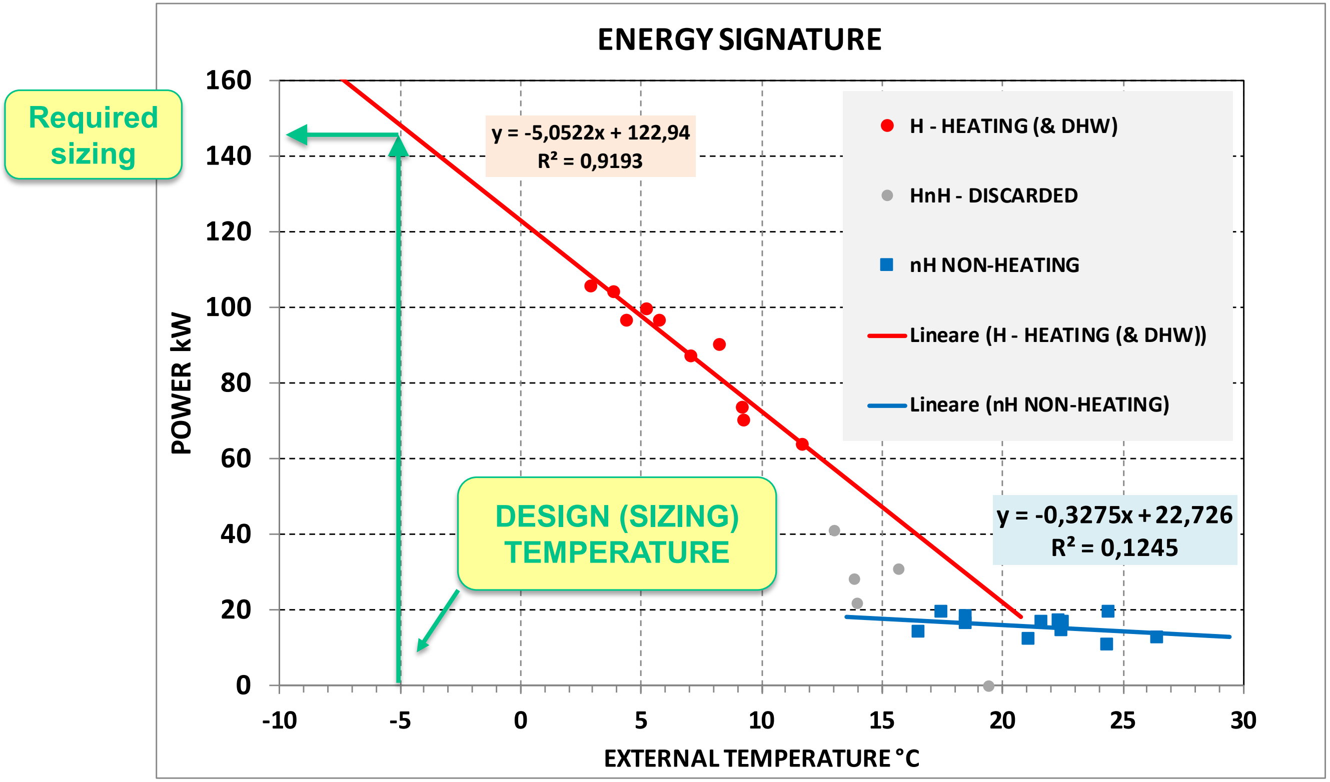


Match or mismatch is visually evident

The results of any monthly or hourly calculation can be presented as an energy signature and visually compared with the measure one

This comparison is not exhaustive. If a difference appears, reasons shall be investigated
… but if don’t even start comparing we will never know if our instruments are calibrated…

Application to sizing

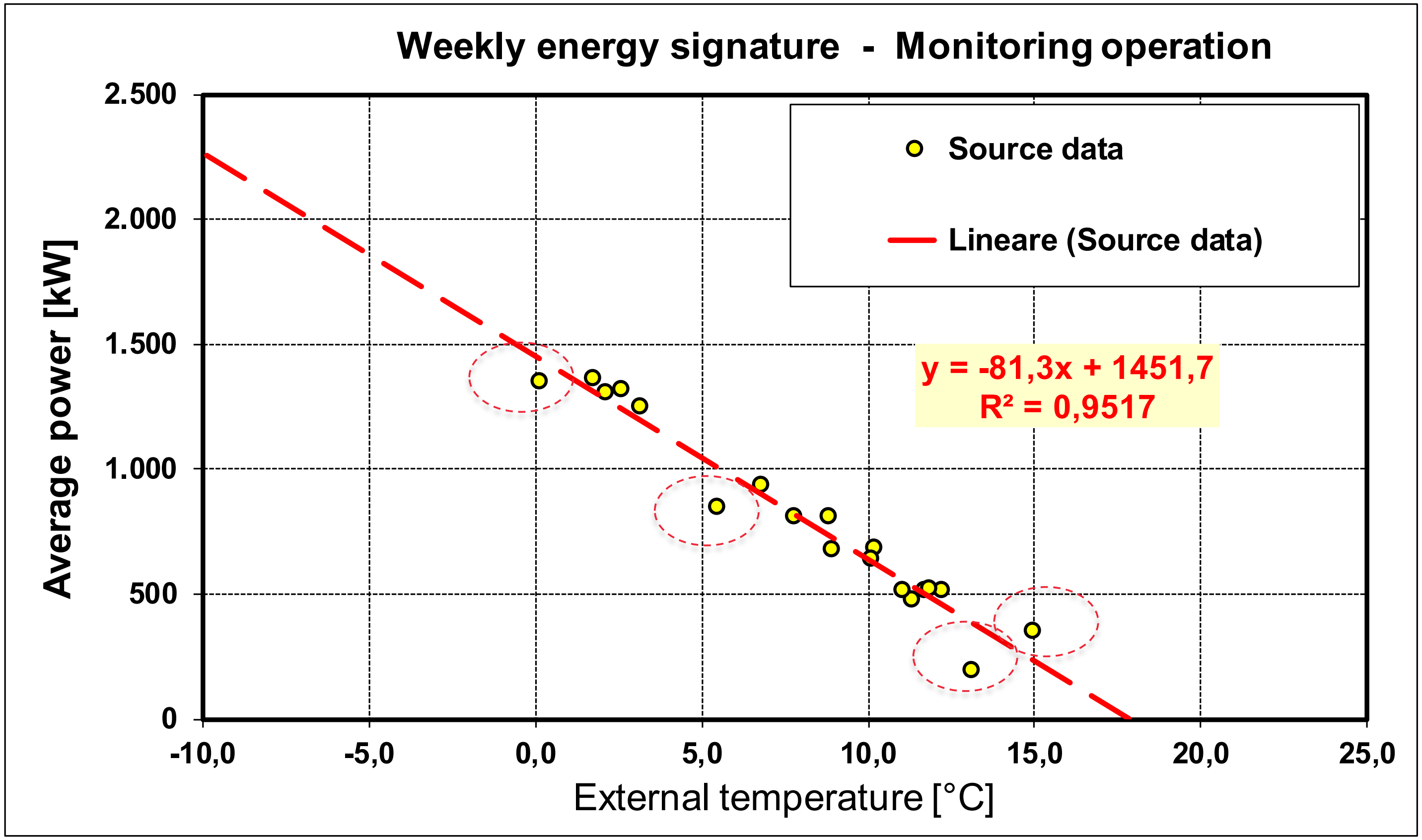


Existing buildings: sizing of boilers based on actual delivered energy

New buildings and deep renovation projects: sizing of heat pumps based on design energy signature.

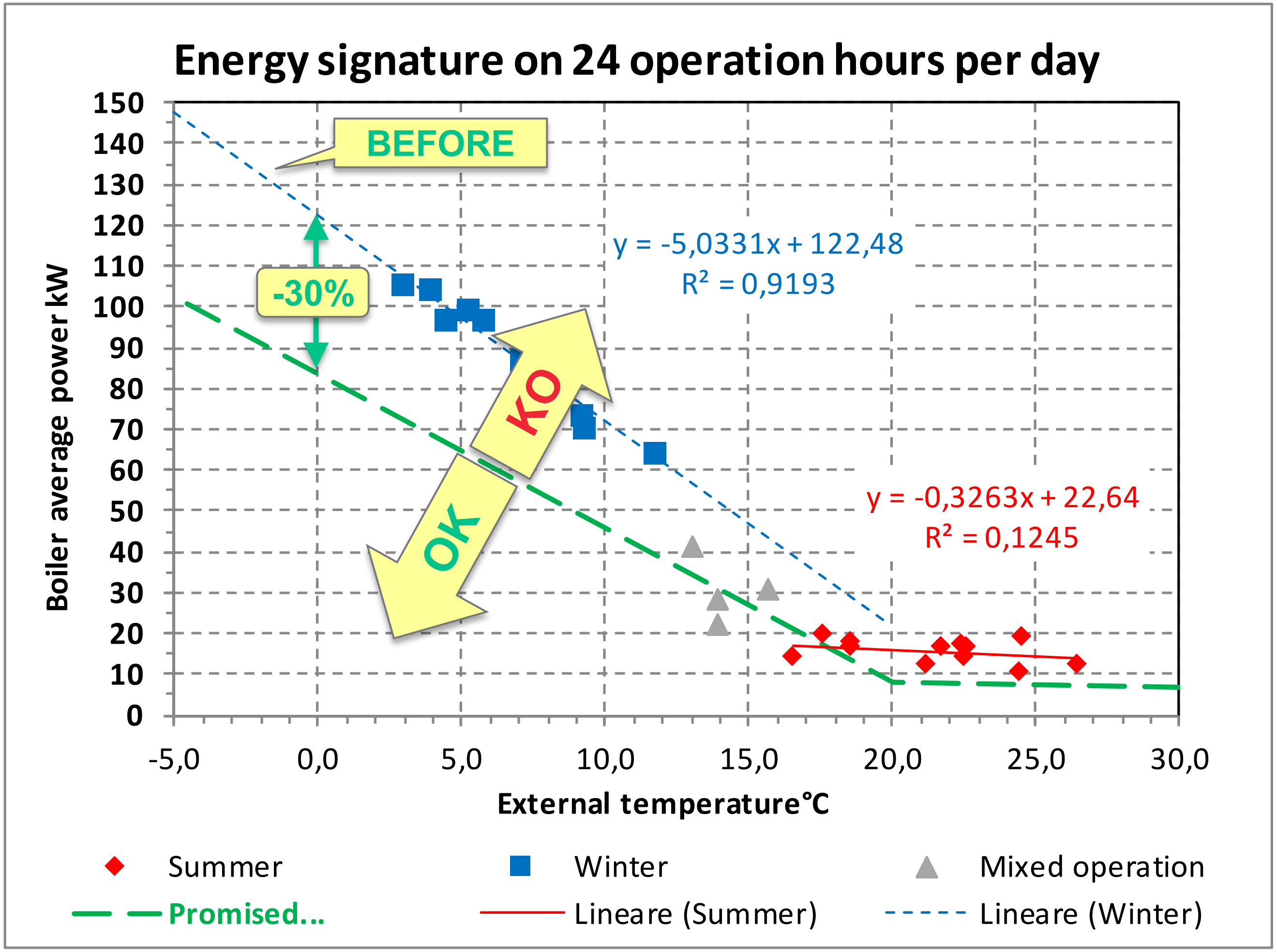
The energy signature provides visually the required power in design conditions

Application to monitoring



Outliers with respect to design or reference energy signature are to be investigated

Application to checking renovation



They promised 30% reduction in delivered energy after renovation...

Let's see...

Why measure energy performance with EN 15378-3

The energy signature method described in EN 15378-3 is a simple tool to:

- Present the results of energy performance calculation
- Visually compare design energy use and actual energy use
- Size boilers on existing systems
- Size heat pumps on new systems taking into account heat gains
- Monitor operation of systems and quickly detect issues
- Check result of a renovation (IPMVP level «C»)
- Get information about indoor average temperature without entering the building…

… to be extended to cooling and ventilation

The spreadsheet on EN ISO 52016-1
https://epb.center/documents/demo-en-iso-52016-1/
provides the energy signature in the output, to enable comparison with measured energy use.

What about installation?

EN 14336 deals with the installation and commissioning of heating and domestic hot water systems.

This standard is currently under revision to cover new technologies and to make it fit for the commissioning process.

It will directly address the gap between “designed” and “installed” and “set to work”.

This includes features such as:

- Keeping control over changes during the construction process
- Performing and documenting complete testing and setting before hand-over

Please find the mistake…

Conclusion

The EU building stock still consists of a majority of buildings with sub-optimal insulation and dominant heating needs, where sophisticated calculation tools don’t help that much. The renovation rate is low, new buildings and deep renovation involves some 2…3 % of building stock per year.

However, all new buildings in the EU shall be high performance and there are ambitious plans for systematic deep renovation of existing buildings.

EN-EPB Standards include several advanced features that are required to deal with high performance buildings and additional tools that will be very useful to reduce the gaps between designed energy performance and actual energy performance.

Modern calculation tools and **trained experts** are needed to achieve the expected results.

Modern tools does not necessarily mean more complex input data

Thank you!

EPB Center is also ‘available’ for specific services requested by individual or clusters of stakeholders

More information on
the set of EPB standards:

www.epb.center

Contact: info@epb.center

Parts of this document have been produced under a contract with the European Union, represented by the European Commission (Service contract ENER/C3/2017-437/SI2-785.185).

Q&A

Submit your question!