Welcome to BUILD UP

The European Portal for Energy Efficiency in Buildings

Be regularly informed …

30+ relevant new monthly	**20+** events announcements	**20+** publications promoted	Overview articles	Webinars and videos
Be updated with tools, technologies, case studies …	Announce, invite, promote your event	Publish your findings	Be aware of a specific topic every month	Promote, share your activities with the community

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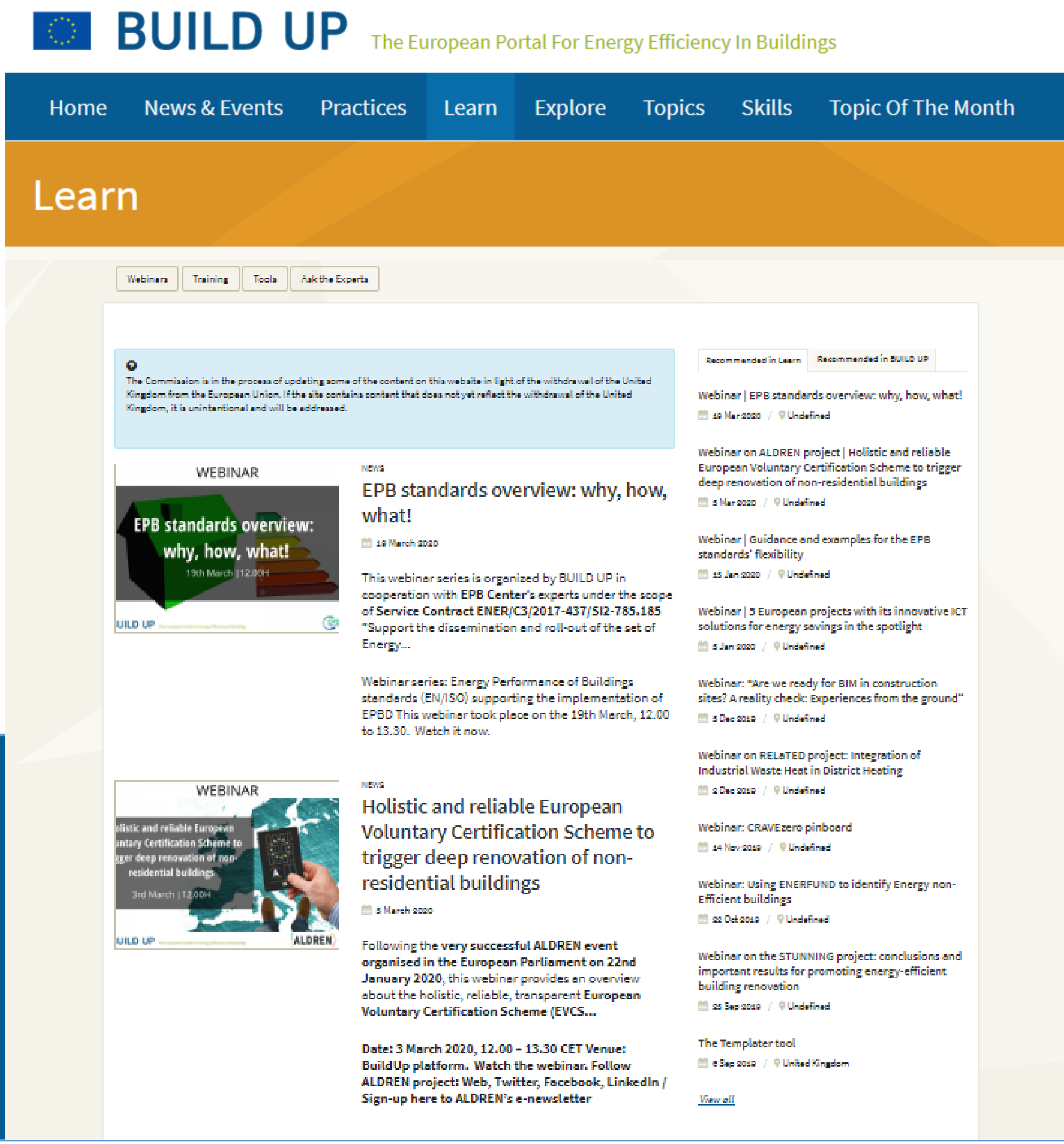

Check our Learn section!

EPB CENTER

BUILD UP The European Portal For Energy Efficiency In Buildings

Webinar 6 – Sept. 8 2020– 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 Jan. 19, Example calculations with the set of EPB standards – (3) Whole building calculations, from components to overall primary energy

Webinar 10, Tuesday Feb. 2, Example calculations with the set of EPB standards – (4) Energy needs combined with specific systems

EPB CENTER

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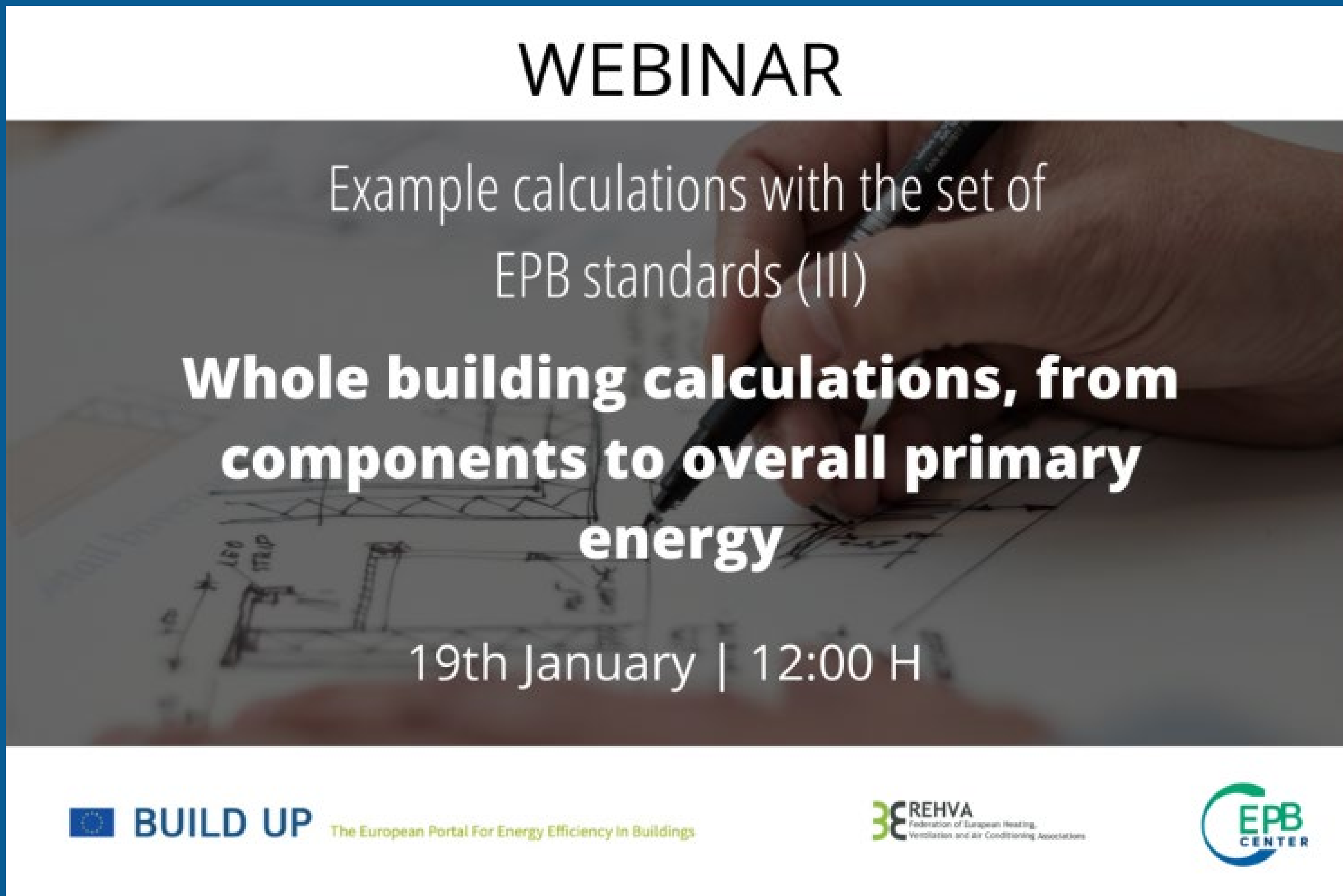

Your service center for information and technical support on the new set of EPB standards

Energy Performance of Buildings standards (EN/ISO) supporting the implementation of the EPBD

Jaap Hogeling
Manager international standards at ISSO
Chair CEN/TC 371 Energy Performance of Buildings
Member ISO/TC 163/WG 4: Joint Working Group (JWG) between ISO/TC 163 and ISO/TC 205: Energy performance of buildings using holistic approach
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The EPB Center is supported by the EU-Commission Service Contract ENER/C3/2017-437/SI2.785185

Start 21 September 2018 for 3 years

www.epb.center

BUILD UP Webinar series
Webinar 9: Calculations with the set of EPB standards (III) – Whole building calculations, from components to overall primary energy 20/01/2021

My background

- CEN/TC 371: Energy Performance of Buildings, chairperson since 2004
- Project leader of the EU Mandate/480 to CEN regarding the development of the set of EPB standards.
- Participation in 5 CEN/TC's and 2 ISO/TC's related to Energy Performance of Buildings
- Manager international standards at ISSO, Rotterdam, the Netherlands
- Initiator of EPB Center (an initiative of ISSO and REHVA)
- Fellow of ASHRAE and REHVA

The goal of example calculations is to demonstrate:

- the functionality : to demonstrate that the calculation works with practical cases and available features to describe energy performance of buildings and HVAC installations
- the sensitivity of the calculation procedure: demonstrate which impact of single data or group of data on selected calculation results have
- the usability: demonstrate the data input (avoiding unnecessary input complexity) , description of practical system configurations, show useful results .

of individual calculation modules and of the whole building calculation procedure.

In this 9th webinar we will focus on EP calculation for a residential building case

- It will be demonstrated how the EPB standards enable to identify the impact of building and system design (insulated / non-insulated, system technology choice, renewables inclusion), outdoor climate (cold to hot) and assumed use patterns (such as occupancy and comfort schedules on the overall energy performance.
- We will also demonstrate how (national) choices for partial and overall EPB numerical indicators can effectively control the energy performance and set reliable minimum energy performance requirements.

EPB calculation standards as tools

- The EP calculation standards are great tools.
- If using **hourly** calculation methods **correctly**, you can extract a lot of useful information to decide on the best building and system design by comparing different possible solutions.
- When properly **build, installed** and correctly **commissioned**, **used** and **operated**, this is the best starting point for a well performing energy efficient and possibly zero-carbon building.

Thank you!

More information on
the set of EPB standards:

www.epb.center

Contact: info@epb.center

This document has 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

Building envelope: starting point of nearly zero-energy building (NZEB): heating and cooling needs and partial performance indicators

Dick van Dijk

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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 9: Example calculations with the set of EPB standards – (3) Whole building calculations, from components to overall primary energy 19th January 2021

My background

- EPB Center expert (> 2017)
- Involved in initiation, preparation and coordination of set of EPB standards (2012-2017)
- Co-convenor of ISO Joint Working Group on the overall set of EN ISO EPB standards, in collaboration with CEN

  ISO/TC 163 & ISO/TC 205, CEN/TC 371
- Convenor of ISO Working Group responsible for few key EPB standards:

  Energy needs heating/cooling, Climatic data, Partial EP indicators (ISO/TC 163/SC 2/WG 15)

Starting point of nearly zero-energy building (NZEB): Energy needs

- EPB standard EN ISO 52016-1: *heating and cooling needs and indoor temperatures*
- “Already presented at previous webinars?!!”
- Correct! But focus today:
  - Illustration of impact of some **national technical choices** (standard conditions of use, simplifications)
  - Illustration of impact of some **design choices** and **how to value** the result in terms of **energy** and **comfort**
  - ➔**Partial performance indicators**
    National policy choices; “post-processing EPB standard” EN ISO 52018-1
  - More general: show that EN ISO 52016-1 is fit for the purpose

On EPB standards and national choices

See webinar 1

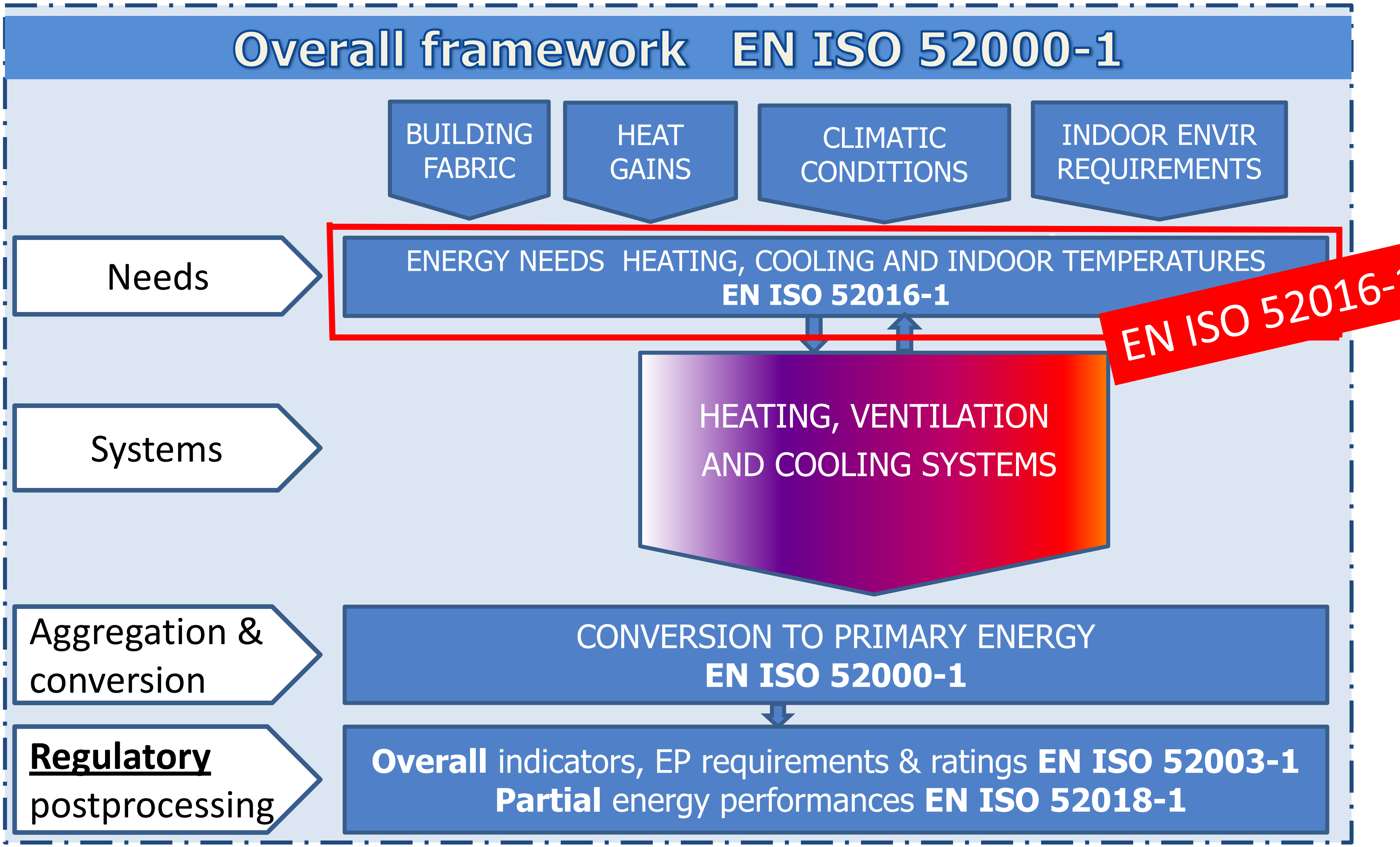
National choices, each EPB standard

Annex A (normative)	Annex B (informative)
• Empty framework	• Framework filled in
• Template for	• Voluntary
– choices	– default choices
– input data	– default input data
– references	– default references
• Lay-out is mandatory	• Use is optional

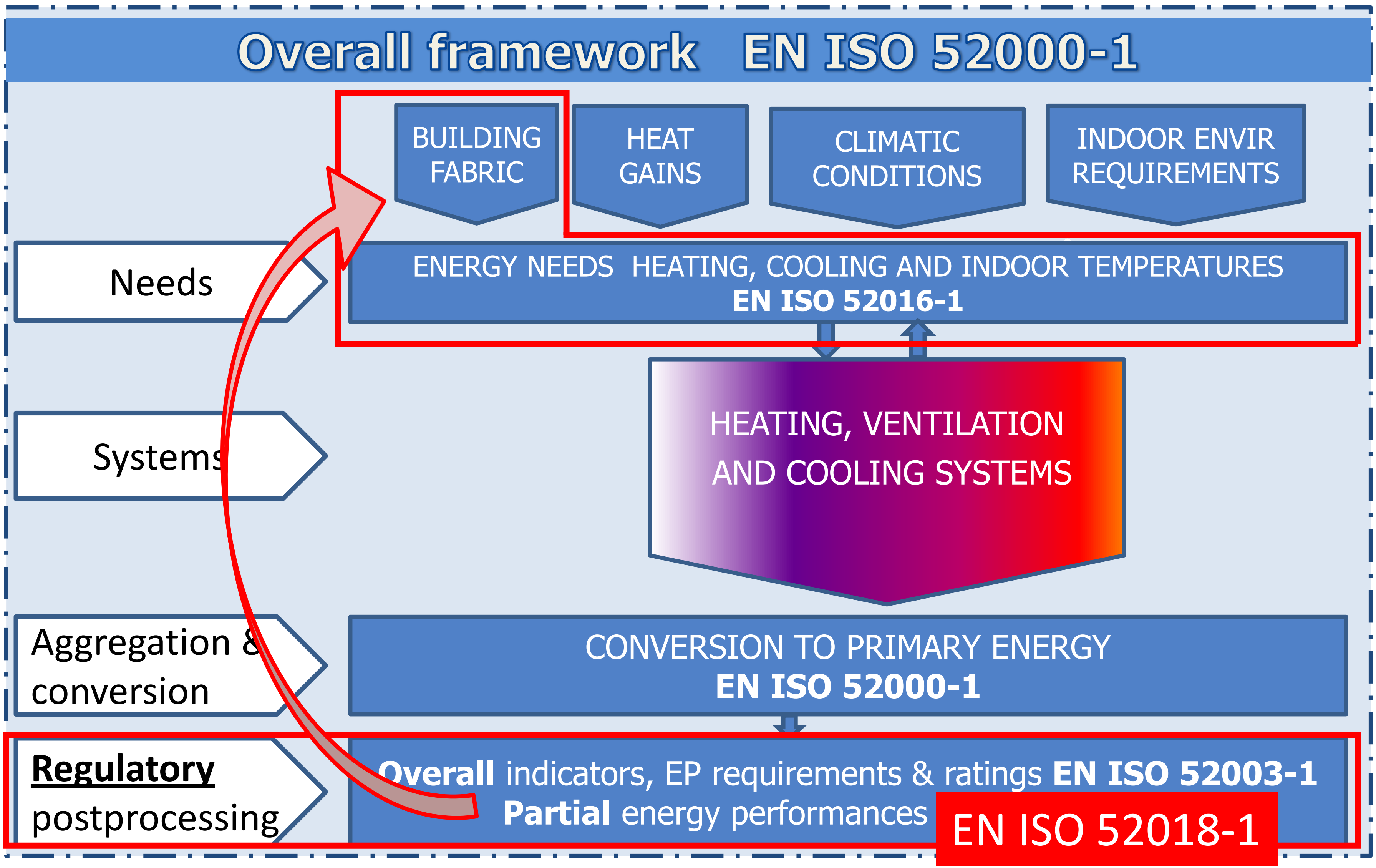
(Other) background information

- For instance:
  - Webinar 2 (March 19): EPB standards overview
  - Webinar 4 (May 26): Hourly versus monthly methods
  - Webinar 7 (Oct. 6): Introduction to the example calculations
  - Webinar 8 (Oct.20): Coupling of thermal zone and heat pump system calculations
  - Overview of full series: https://epb.center/support/webinars

Set of EPB standards: **modular approach**



“Post-processing”: Partial performance indicators



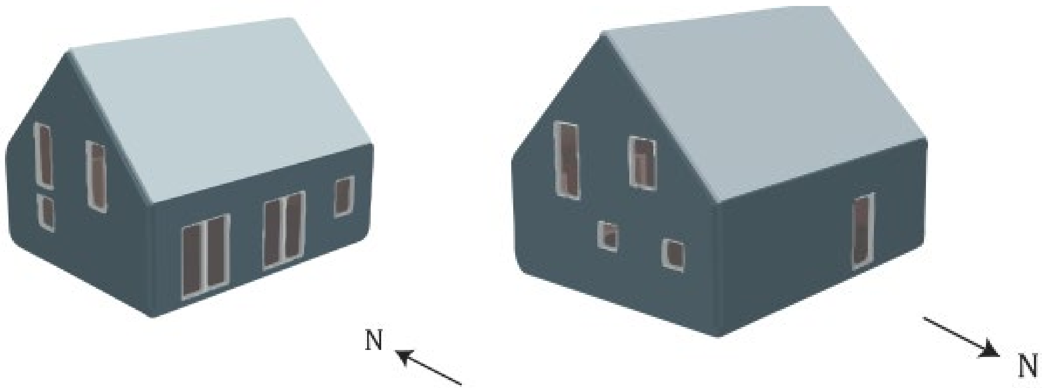
Tools for the example calculations

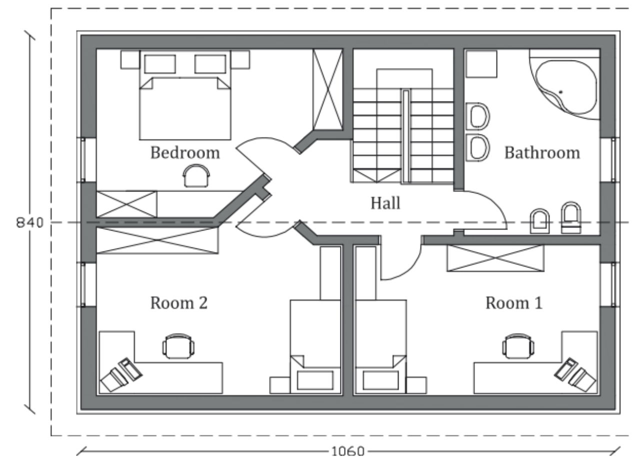
- Spreadsheets for individual standards ("modules")
- Why?

Spreadsheet tools
(publicly available or in preparation)

- To demonstrate and validate each EPB standard
- (!) spreadsheet ≠ corresponding standard:
  - Spreadsheets have some limitations
    - Some 'practical' limitations on input data
    - Some special features not included (e.g.: multi-zone calculation, attached unconditioned spaces, ..)
  - Spreadsheets:
    - **Highest priority: technically correct and transparent**
      - **➔ where possible: all intermediate results are shown**
      - **At each step of calc.: references given to the corresponding clause or formula in the standard**
    - Lower priority: user friendliness and performance (speed)
    - Not intended for daily practice to assess EPB

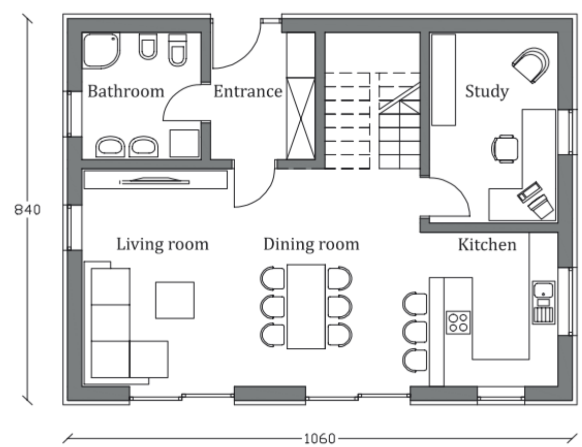
The residential building





Single family house

- 150 m² floor area
- ISO/TR 52016-2 example



Variations

Configurations explored:

- Oslo / Athens
- Hourly calculation method
- Insulated / Uninsulated
- Continuous / Intermittent heating
- (Assumed) operation of movable solar shading
- Minor(?) simplifications
- Absence of system...
- Heat pump / Boiler

Green:
National choices (calculation method, conditions)

Red:
Building and/or system design

Remember:
EN ISO 52016-1: parallel hourly and monthly calculation methods

Hourly calculation of
- energy needs for heating and cooling
- both sensible and latent heat
- indoor temperatures
- heating and cooling load

Same input data and boundary conditions

Monthly calculation of energy needs for heating and cooling
- using national correlation factors to take into account dynamic effects
  - E.g. solar and internal gains, varying conditions of use (temperature and ventilation settings), ..

Extra output:
- Monthly characteristics
- Can be used as basis for generating or validating correlation factors for monthly method

Interested in hourly versus monthly calculations?
Recording of webinar 4

Hourly climatic data

- So called **Test Reference Years** for given region or country (based on EN ISO 15927-4)
- If not available:
  - EC Joint Research Centre (**JRC**) tool: "Typical Meteorological Year **(TMY) generator**": hourly weather data for any location and period of choice
  - New: **EPB Center tool to convert JRC TMY datafile** suitable as input for the set of EPB standards (via EN ISO 52010-1)

Now available!
https://epb.center/documents/tmy-iso-52010-1_conversion/

Base cases

Athens

	Uninsulated			Insulated	
Energy needs (kWh)	Heating	Cooling		Heating	Cooling
Continuous	10207	3670		470	4534
Intermittent	9317	3670		441	4534
%	- 9 %			-6 %	

Observations:

- **National technical choice**: assume continuous or intermittent?
- From heating dominated to cooling dominated
- Heating nowadays small (but comfort if no heating available?: later slides)

Disclaimer

- All results are subject to review
- The final results will be published at the EPB Center website later this year

Base cases

Oslo

	Uninsulated			Insulated	
Energy needs (kWh)	Heating	Cooling		Heating	Cooling
Continuous	46103	3		7992	751
Intermittent	43101	2		7813	749
%	-7 %			-2 %	

Observations:

- **National technical choice**: assume continuous or intermittent?
- Cooling still small (but comfort if no cooling available?: later slides)

Special

Athens: Sensitivity of assumed use of solar shading devices

	Insulated		
Energy needs (kWh)	Heating	Cooling	
Down at solar irrad. > 200 W/m^2 (default)	470	4534	
Down at solar irrad. > 400 W/m^2	249	6272	
%	-47 %	+38 %	

Observations:

- The choice of incident solar radiation level for solar shading use has strong impact on result
- ➔ **National technical choice**: which assumed standard user behaviour is realistic?

Special

Athens: Sensitivity of colour of external opaque surfaces

	Insulated		
Energy needs (kWh)	Heating	Cooling	
Abs factor=0,8 (default)	470	4534	
Abs factor=0,2 (variation)	617	3811	
%	+30 %	-16 %	

Observations:

- Taking into account the color (solar absorptance) of the external surface has impact on result
- ➔ **National technical choice**: default value (which?) or actual value

Special

Athens: What if no heating system present?

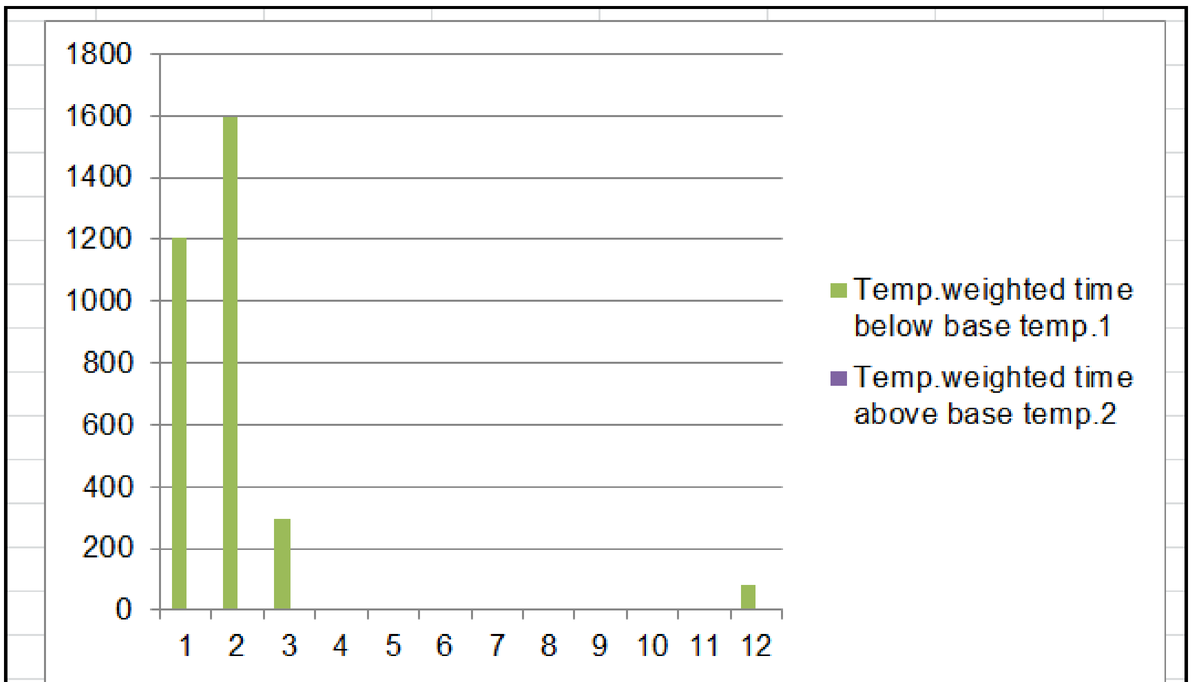
	Insulated		
Energy needs (kWh)	Heating	Cooling	Mean indoor temp. February
Continuous	470	4534	20 °C
No heating system	0	4533	17,6 °C
% of heating+cooling	-9 %		

Observations:

- If no heating system present: 9 % less energy use.
- **National policy choice**: for level playing field, if no system present: **assume** a (default) **system** or add a separate **thermal comfort indicator**

Different ways to indicate discomfort

- Previous slide: average temp. In Feb below threshold
- Other way, e.g.: temperature weighted hours with indoor temperature below 20 Celsius ("accumulated temperature difference")



National policy choice (template/examples in EN ISO 52018): National EPB requirement: maximum allowed value?

Special

Oslo: What if no cooling system present?

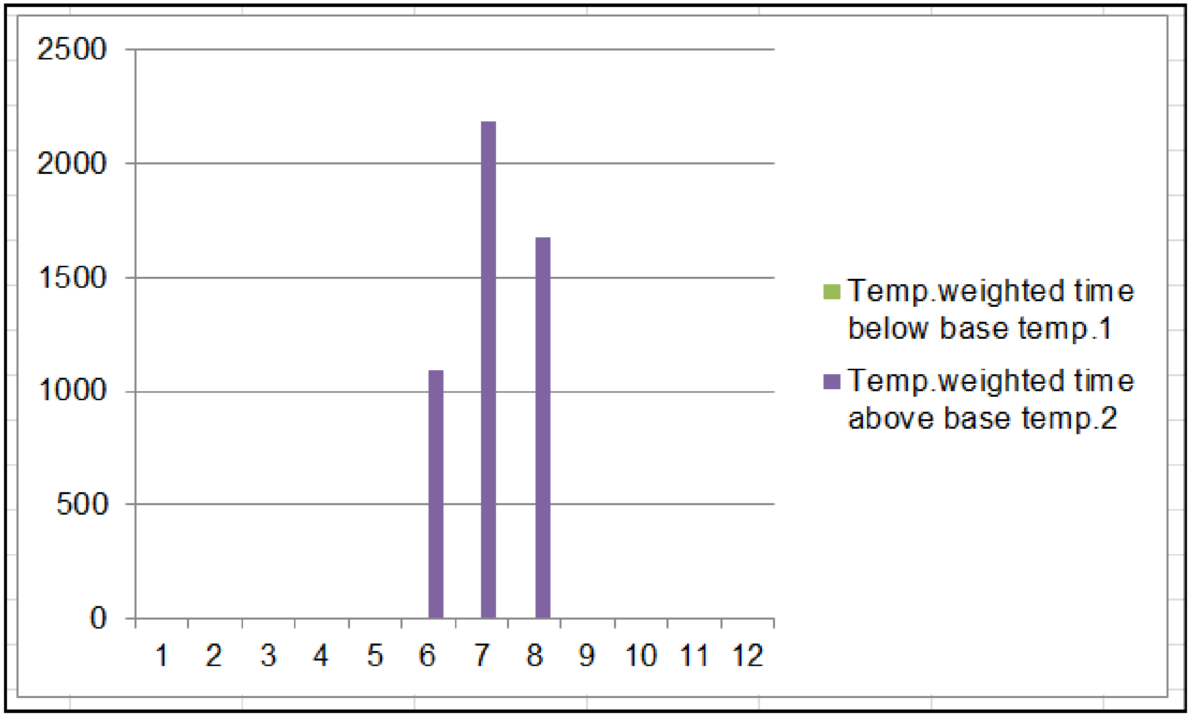
	Insulated		
Energy needs (kWh)	Heating	Cooling	Mean indoor temp. July
Continuous	7992	751	25,9 °C
No cooling system	7976	0	28,9 °C *)
% of heating+cooling		-9 %	*): 2,9 K above 26°C

Observations:

- If no cooling system present: 9 % less energy use.
- **National policy choice**: for level playing field, if no system present: **assume** a (default) **system** or add a separate **thermal comfort indicator**

Different ways to indicate discomfort

- Previous slide: average temp. in July above threshold
- Other way, e.g.: temperature weighted hours with indoor temperature above 26 Celsius ("accumulated temperature difference")

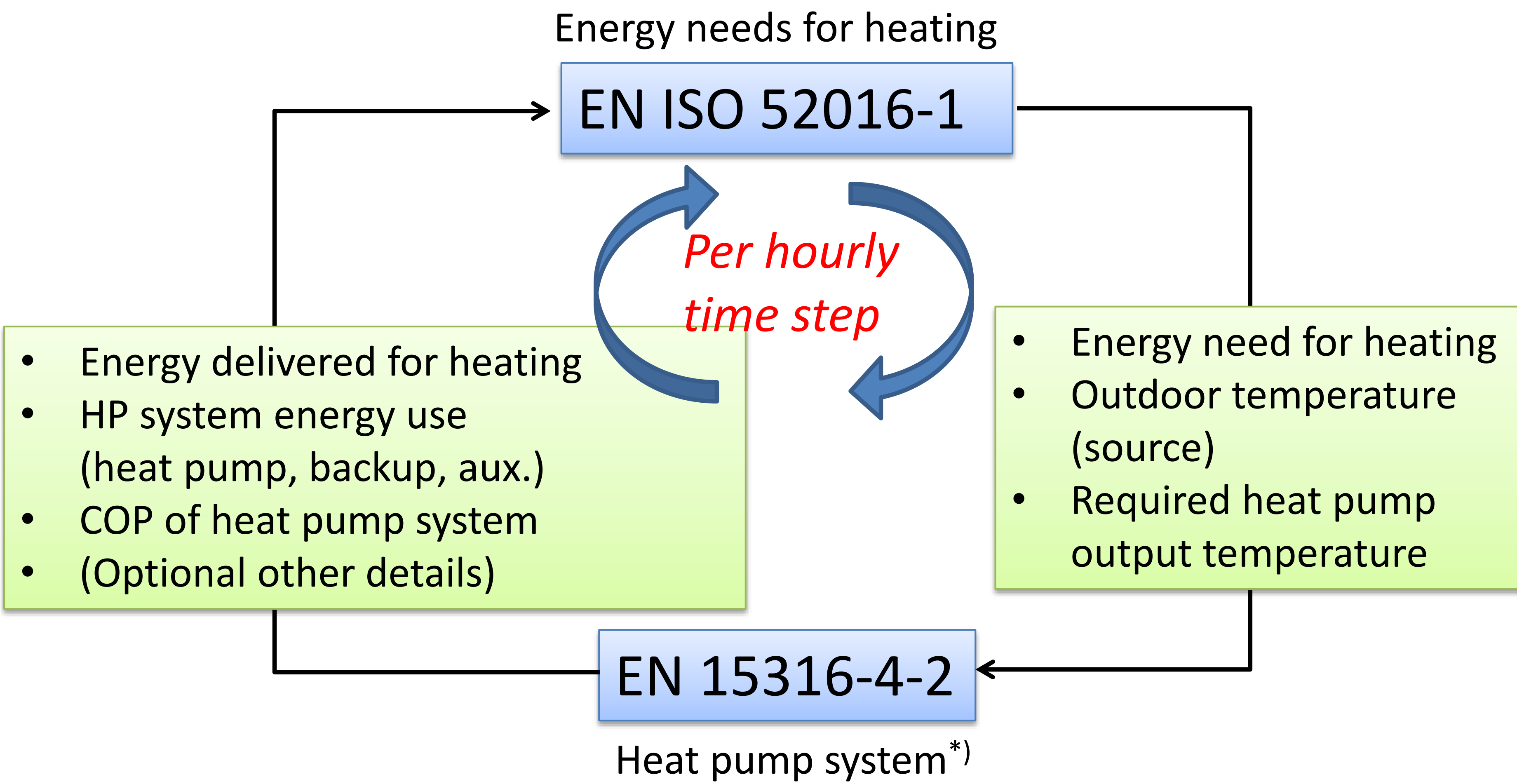


National policy choice
(template/examples in EN ISO 52018):
National EPB requirement: maximum allowed value?

Heat pump system

- **Energy needs for heating and cooling coupled to heat pump system**
- **Why?**
  - Thermal capacity of heat pump depends on the (variable) conditions
  - If capacity is not enough to cover the needs: undersized system
    - ➔ thermal discomfort (can be indicated in same way as shown for absence of systems)
  - Thermal losses of system are variable and, if dissipated in the thermal zone: contribute to internal heat gains

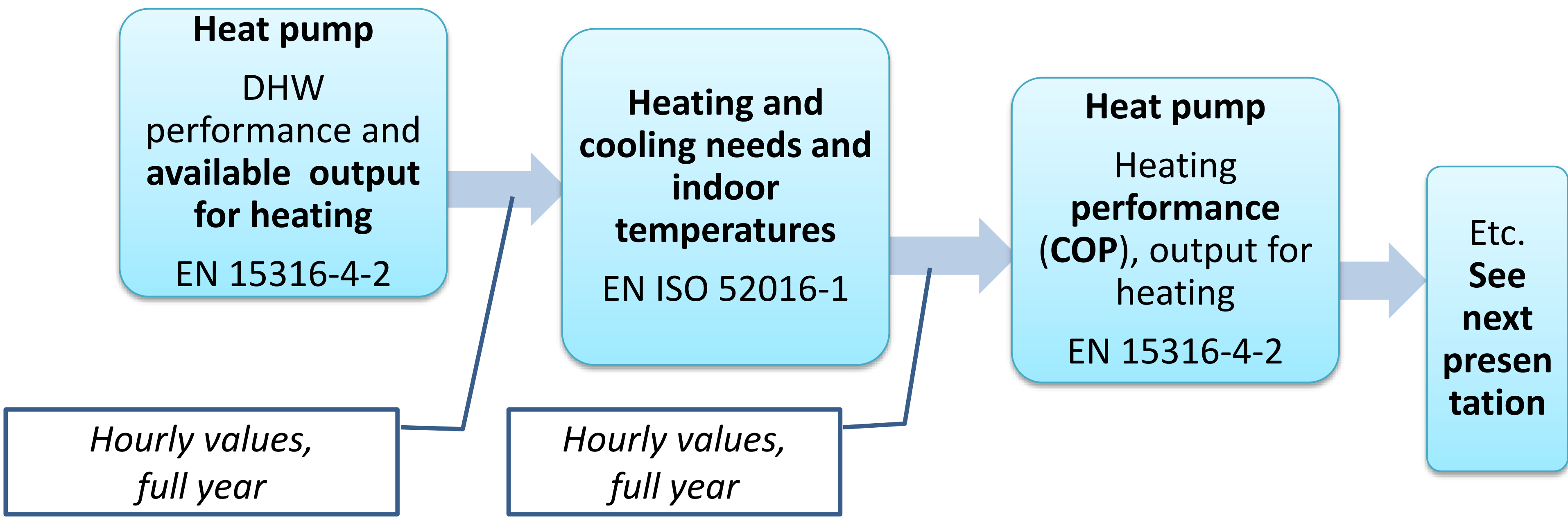
Shown and applied **at previous webinar**: hourly interaction of two spreadsheets (modules)



*): *incl. auxiliary energy and backup (if present)*

Today: simplified

- Hourly interaction aims to show sensitivity for variable hourly properties and conditions
- ➔ can be simplified:



Example

Oslo: small (4 kW) heat pump

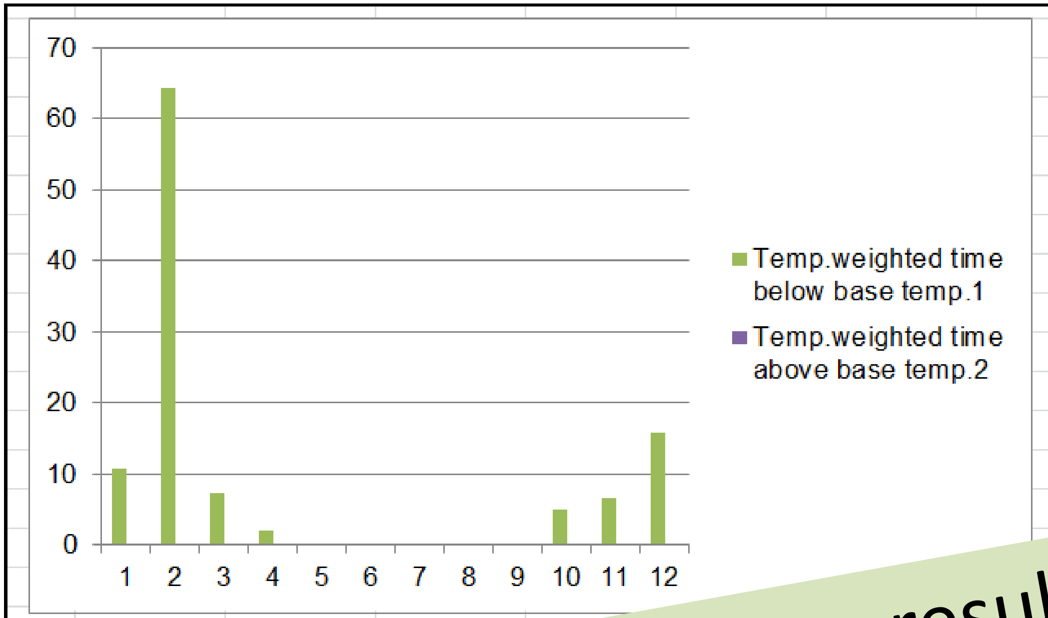
	Insulated		
Energy needs (kWh)	Heating		Mean indoor temp. Feb.
Continuous, boiler	7992		20,0 °C
Continuous, HP	7978		19,9 °C
	-0,2 %		

Observations:

- Slightly undersized heat pump: (negligible) less energy use.
- **National policy choice**: for level playing field, if undersized system: **assume** a (default) **system size??** or add a separate **thermal comfort indicator**

Example

- Oslo, small (4 kW) heat pump



Detailed heat pump results presented in next presentation by Laurent Socal

National policy choice (template/examples in EN ISO 52018): National EPB requirement: maximum allowed value?
In this case: negligible (**thanks to assumed continuous heating**)

Conclusion

- **EN ISO 52016-1**: One of the core EPB standards for calculating the overall EPB
- Focus today:
  - Illustration of impact of some **national technical choices** (standard conditions of use, simplifications)
  - Illustration of impact of some **design choices** and **how to value** the result in terms of **energy** and **comfort, using partial performance indicators** (EN ISO 52018-1)
- Hopefully contributed in showing that EN ISO 52016-1 is fit for the purpose: in terms of **functionality**, **sensitivity & usability**

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:

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Contact: info@epb.center

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

Technical systems: influence of design and operation mode on dedicated indicators and overall building performance

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 9: Calculations with the set of EPB standards (III) – Whole building calculations, from components to overall primary energy
19th of January 2021

My background

- Various 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 the development of 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)

The building

Single family house

Oslo / Athens

Insulated / non insulated

150 m² floor area

Floor heating / radiators

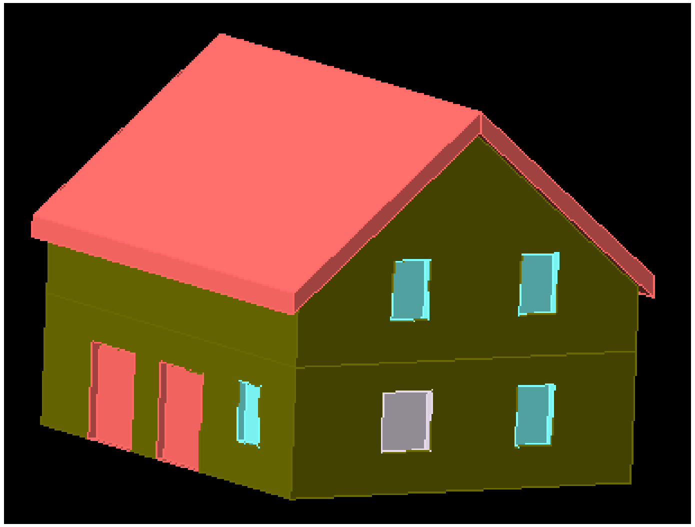
Boiler or heat pump

Dhw store 160 l

No PV or thermal solar

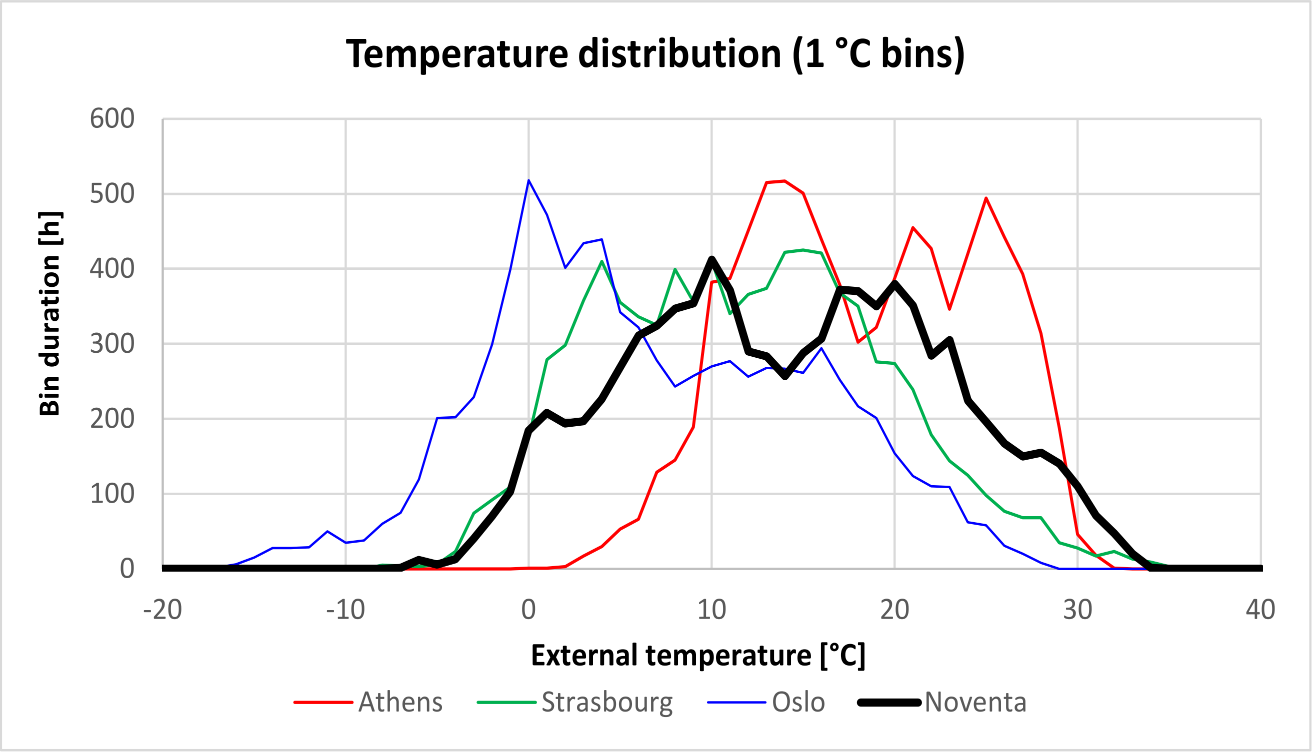
Natural ventilation

n = 0,3 h^{-1} insulated or 0,4 h^{-1} non insulated



Heating needs already explained before

Climate



Generated via TMY and EN ISO 52010

Two extremes considered: Oslo and Athens

Systems calculation

- Challenges for the calculation procedure
  - Take into account the interaction between systems and building envelope: limited power available for heating, during recovery after intermittency or when dhw storage reload is required, losses of the installation, …
  - Avoid iterative calculation that use a lot of time
  - Take into account operating conditions
- Solutions
  - Optimized calculation order
  - Modules that take into account operating conditions

More details on specific calculation procedures of EN standards about heating and domestic hot water systems can be found on Webinar 6

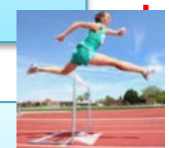
Whole building calculation

DHW needs
EN 15378-3

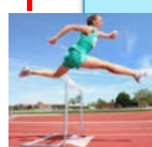
DHW distribution
EN 15316--3

DHW storage
Required input and losses to the heated space
EN 15316-5

Heat pump
Heating performance, output for heating
EN 15316-4-2



Heating and cooling needs
EN ISO 52016

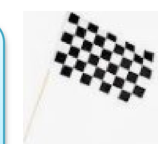


Heat pump
DHW performance and available output for heating
EN 15316-4-2

Boiler (back-up)
Heating and dhw performance
EN 15316-4-1

Cooling system, generation
EN 16798-13

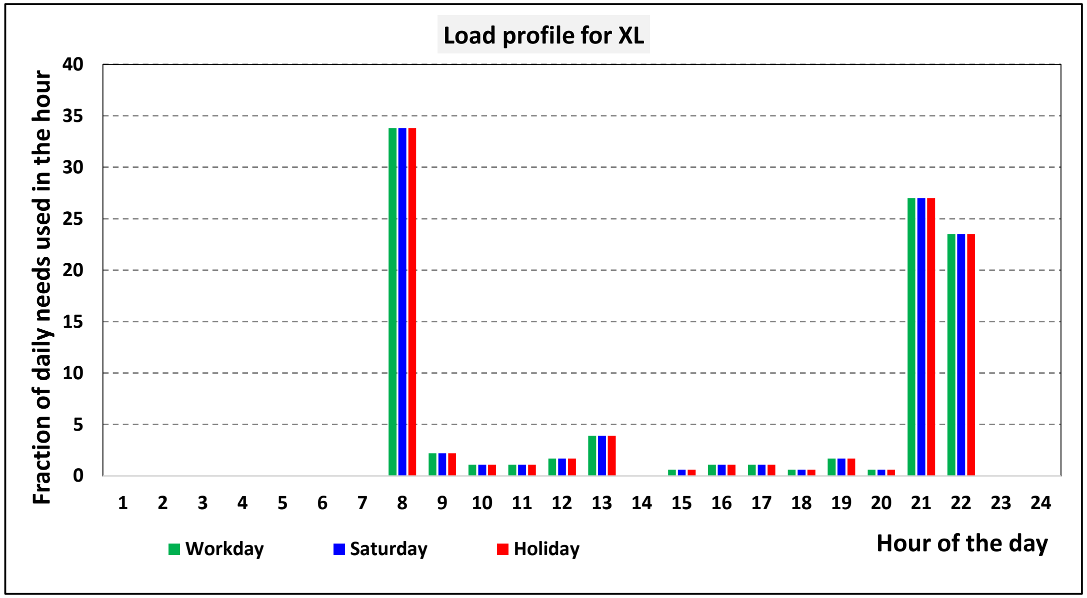
Overall energy performance
EN ISO 52000-1



Dhw needs – EN 15378-3

- Calculate daily needs: volume at θ_{draw}
- Apply a daily profile: XL (same whole week)
- Take into account θ_{cold} 17,8 °C / 6,1 °C
- Get the energy need

θ_{draw}



Dhw needs

212 l/day @42 °C

77 m^3/year

2.162 / 3.207 kWh/year

5,9 / 8,8 kWh/day

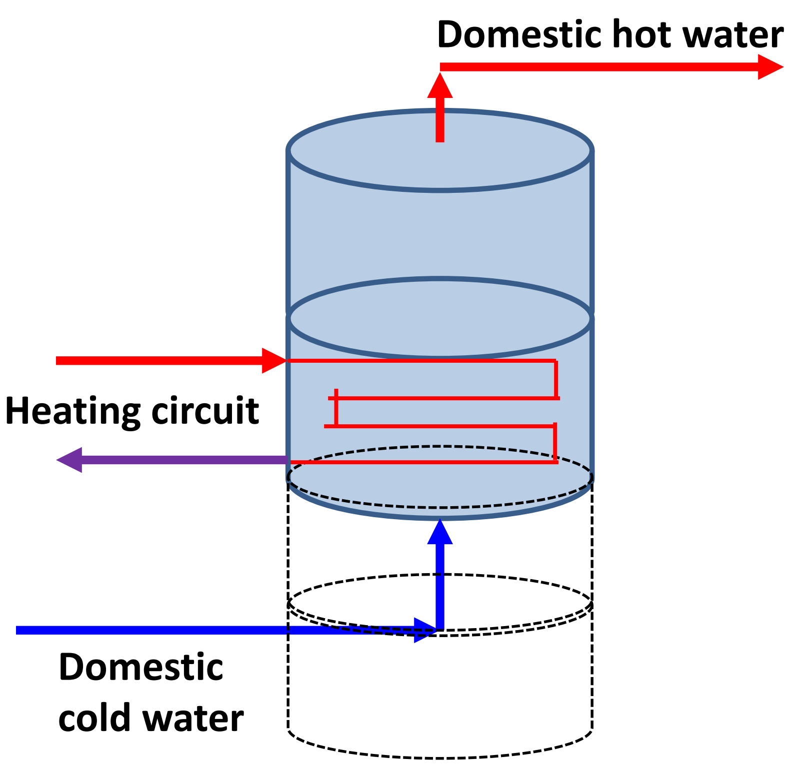
14,4 / 21,4 kWh/m^2year

246 / 366 W average

Athens / Oslo

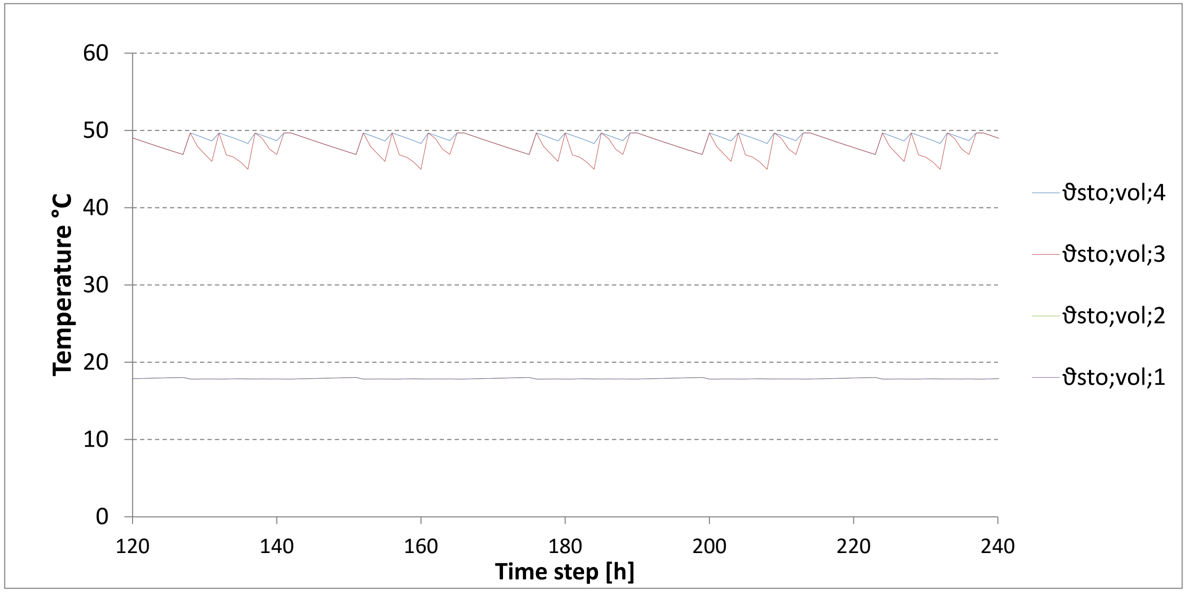
Storage - EN 15316-5

- Uses 2 layers model (no thermal solar in the example)
- Concentrates the time of the heat request in the morning and evening.
- Storage losses: about 10 to 15 %, similar absolute value if installed indoor



Volume	m³	0,16
Diameter	m	0,45
Surface	m²	0,16
Heigth	m	1,01
External surface	m²	1,74
Thickness	cm	4
	m	0,04
Lambda	W/mK	0,04
Loss coefficient	W/K	1,74

Storage EN 15316-5



Storage losses
50…60 W

20…12 %

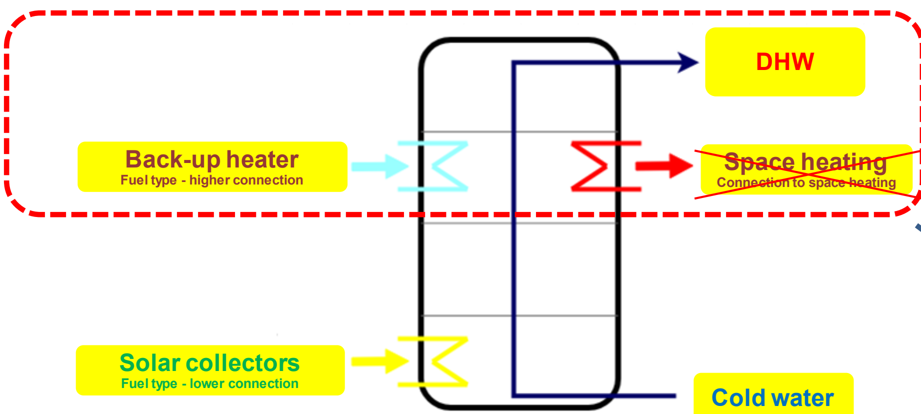
Required input
2.659/3.703 kWh

- Sample result from the spreadhseet for EN 15316-5
- The temperature of two layers is seen at the end of the hour
- Heating (reload) starts at 45°C.
- Possible application: use the spreadsheet with

Storage model

Evolution of temperatures in the storage during the time step

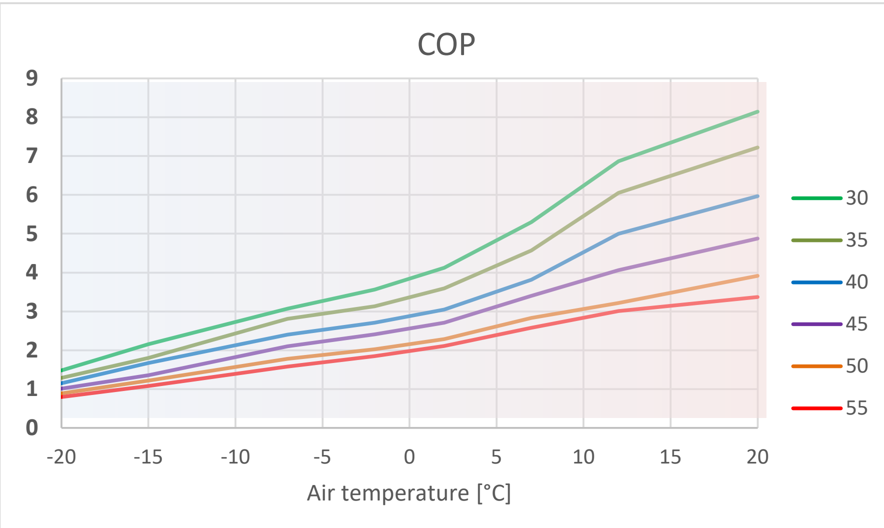
Step		1	2...3	4	5	6	7	8
Description		Initial	DHW draw-off	Heating output	Solar heating	Back-up heater	Layer melting	Heat losses
Layer 4	°C	46,88	46,88	46,88	46,88	46,88	50,00	49,67
Layer 3	°C	46,88	14,29	14,29	14,29	53,12	50,00	49,67
Layer 2	°C	7,54	6,10	6,10	6,10	6,10	6,10	6,25
Layer 1	°C	7,54	6,10	6,10	6,10	6,10	6,10	6,25
Volume withdrawn	l		62,78					
Energy withdrawn	kWh		2,970	0,000				0,059
Energy supplied	kWh				0,000	3,531		

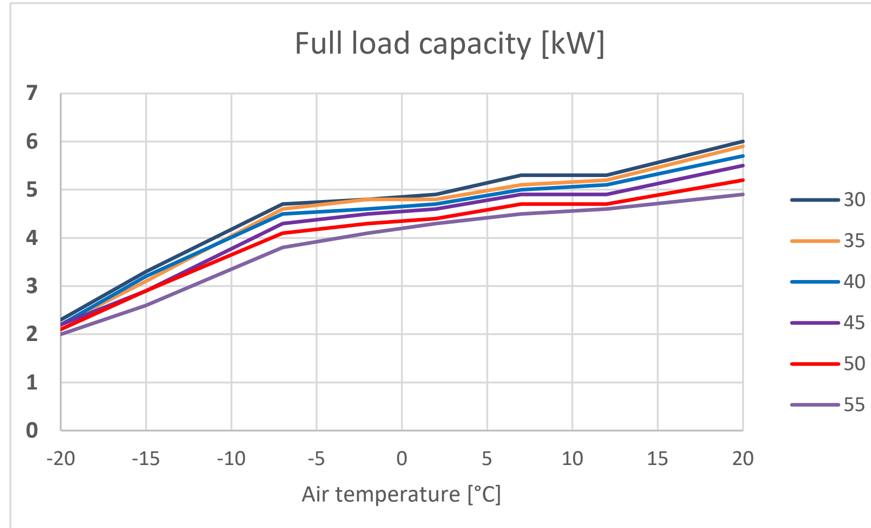


Example of a calculation interval when reload of the store is triggered

Only this part of the model has been used

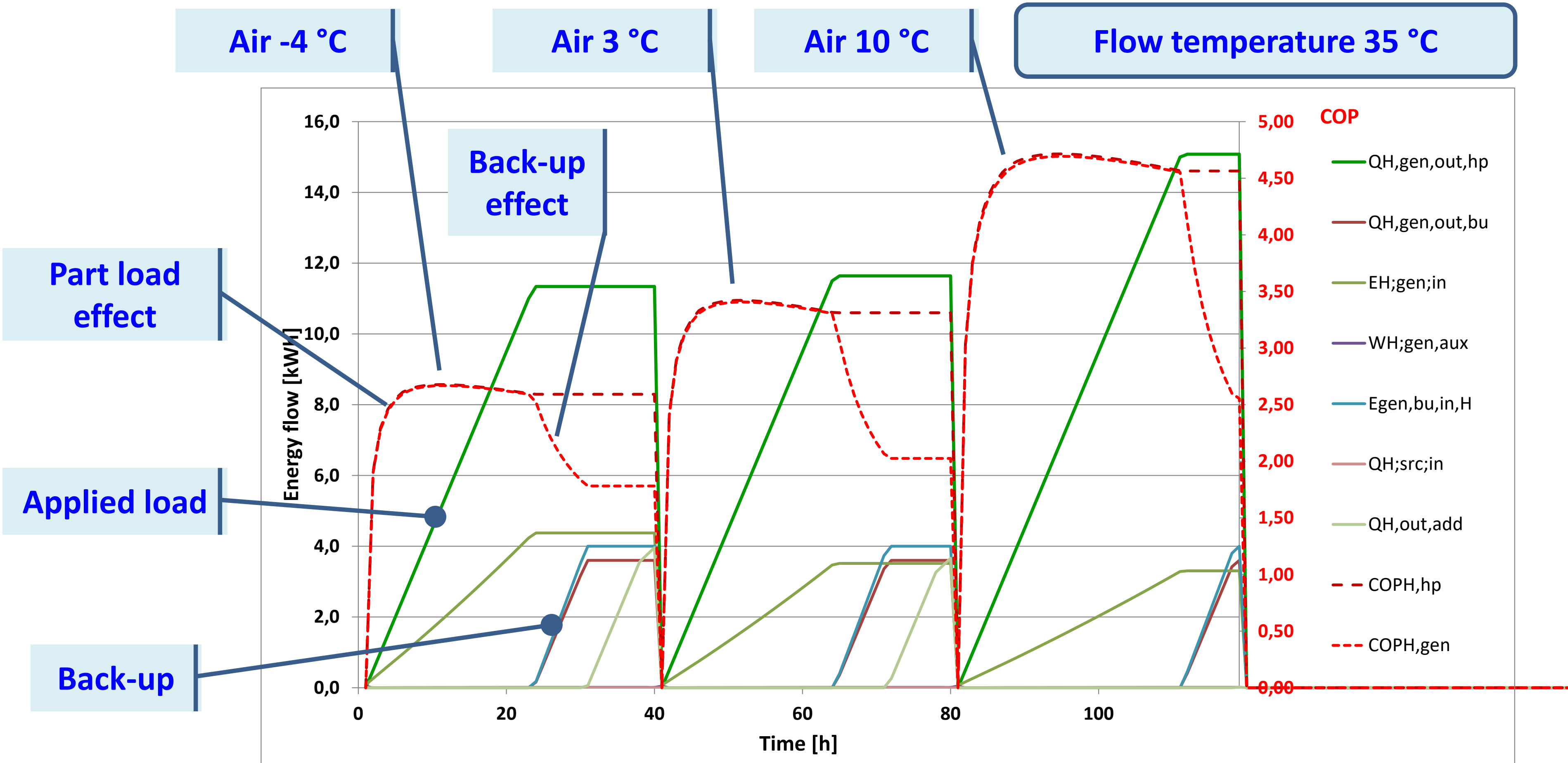
Heat pump: EN 15316-4-2





The performance of the heat pump is strongly dependent on operating conditions
At low external temperatures, full load capacity and COP of AW heat pumps are reduced.
High flow temperature further reduces the COP. Sensitivity is 1…3%/°C
Flow temperature for heating is normally set by a heating curve or it is constant for fan-coils.
This has been taken into account by use of the EN 15316-4-2 spreadsheet
The shown diagram is the representation of a selected heat pump performance map at full load

Part load is also important

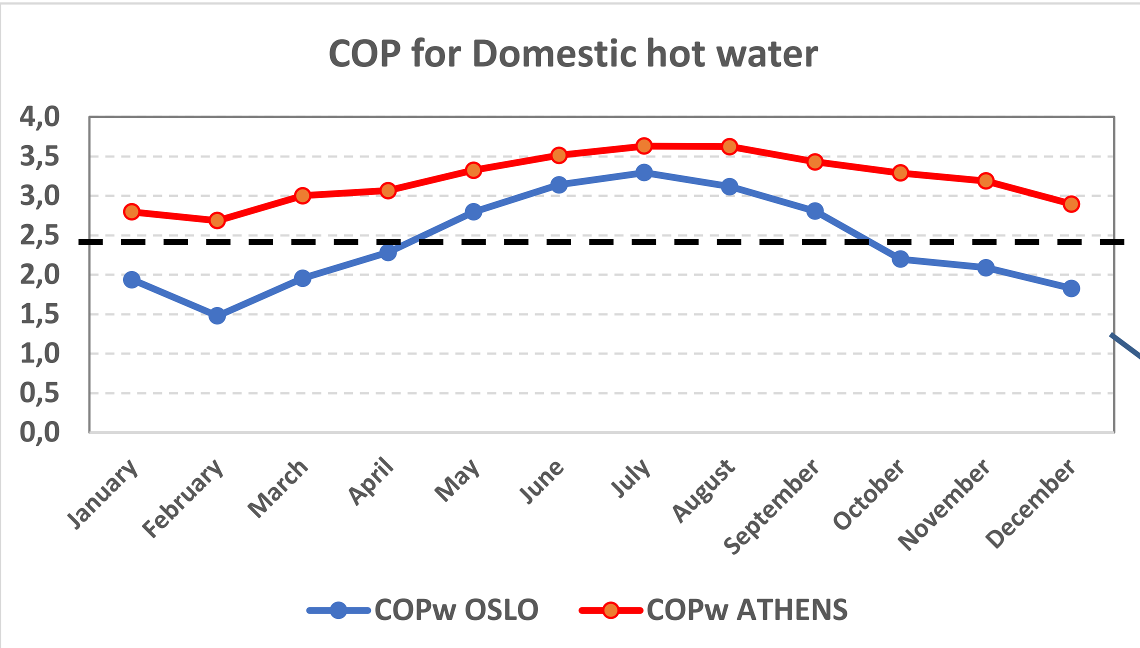


Stress test results for EN 15316-4-2 spreadsheet

Dhw with HP

- Calculate only the domestic hot water part of EN 15316-4-2 (or set required heat for heating =0) to know how much heat can be produced for heating
- Calculation assumptions: store heating ON at 45°C, OFF at 50 °C
- Flow temperature 55 °C
- Athens: **831** kWh electricity → COP = **3,20**
- Oslo: **1616** kWh electricity → COP = **2,30**
- In Oslo, the smallest heat pump is bound to domestic hot water for a couple of hours a day

COP for dhw

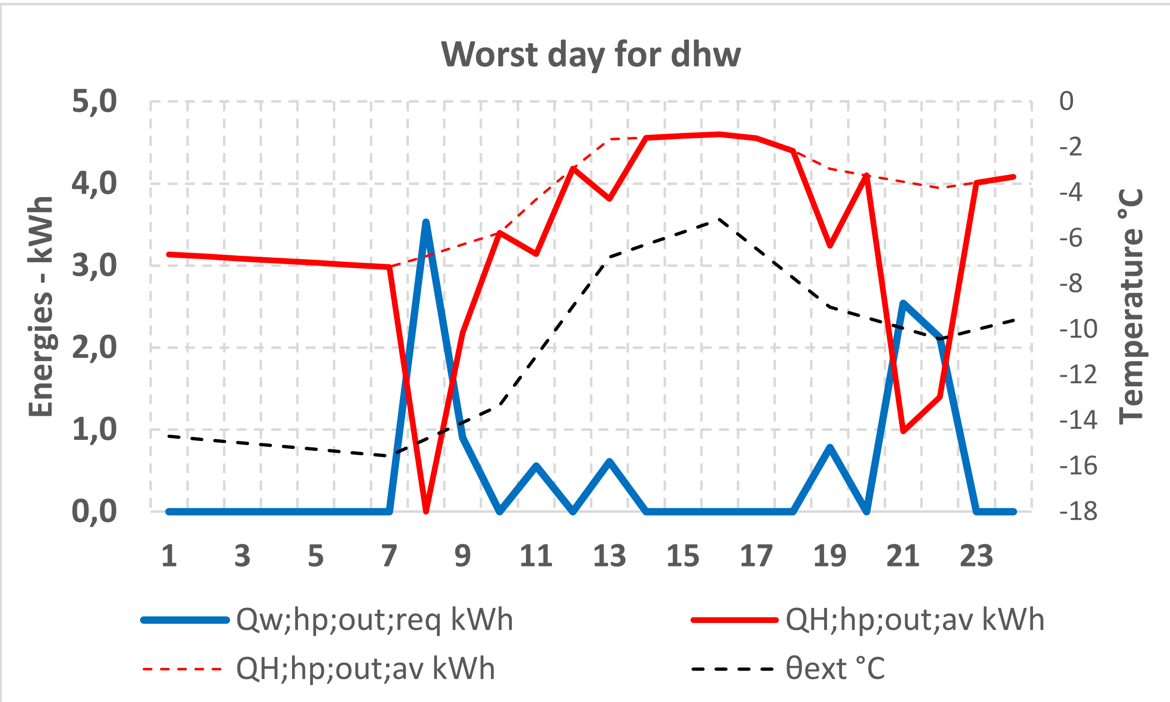


$E_{pnren;el}/E_{pnren;fuel} = ?$

Monthly average of hourly values

A heat pump is not yet always a good idea compared to a boiler if using natural gas
In any case better a heat pump than direct electric… but…
See more in the following about the selection of the generation technology

Some hours may be bound to DHW



Worst day in Oslo

Heat for DHW
11,1 kWh

Could be available for heating: 90,7 kWh

Is available (remaining) for heating: 78,6 kWh

Power reduction: 13 %

The issue might be: what will happen to the building temperature ?
Is there any discomfort ?

Calculating needs

Done by EN ISO 52016 – see previous presentation by Dick van Dijk

EN-ISO 52016 will also tell you how much is the disconfort due to limited available power.

Systems in 2 passes

1st pass: calculate available power for heating

- Control strategy! → Here, heating curve → flow temperature
- Limiting factors → generator + sizing of emitters

2nd pass: calculate heating system

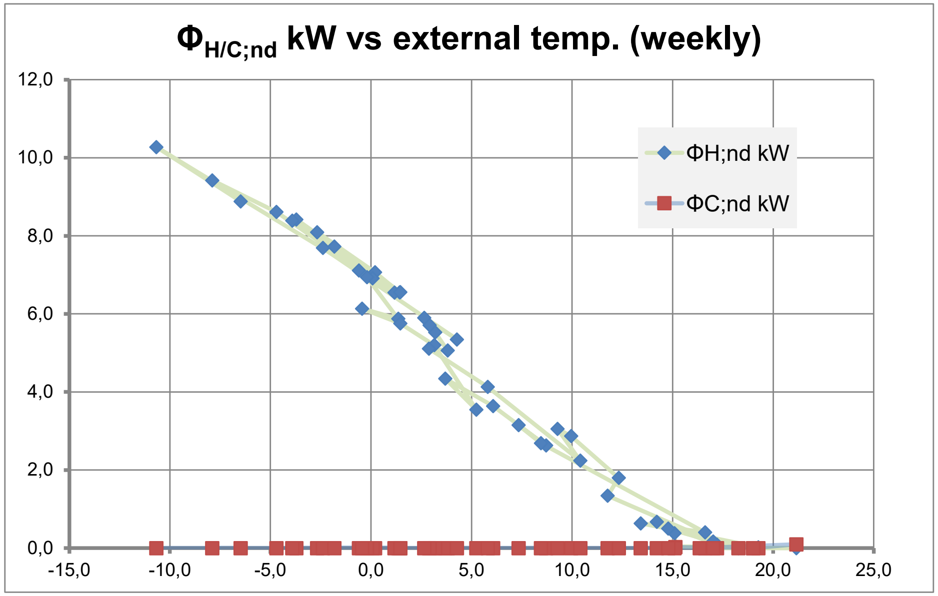
Heating system calculation

- A number of calculations is performed in the following and the results analyzed
- Configurations explored
  - Insulated / low or non-insulated
  - Oslo / Athens
  - Heat pump / Boiler
  - Continuous / Intermittent

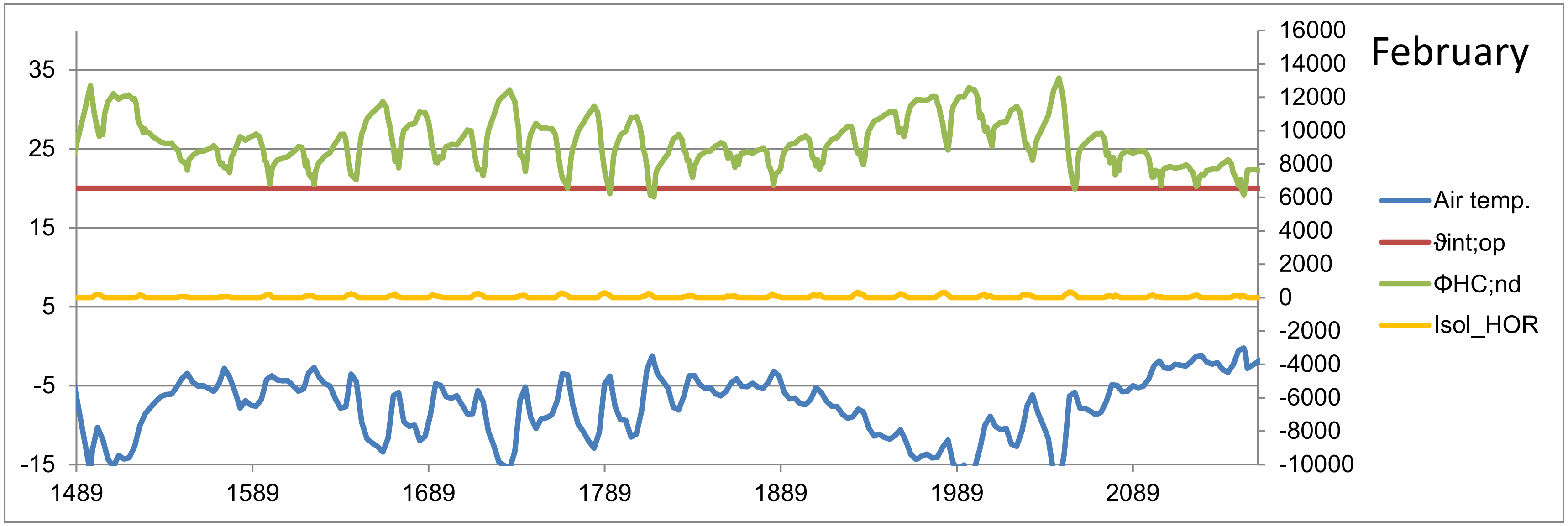
  … not all (!), only some relevant combinations …

OSLO – Low insulation Condensing boiler – Radiators

- "low insulation": U_{walls} = 0,80 W/m²K , U_{roof} = 0,50 W/m²K, …
- Heat load: 13,5 kW = 90 W/m² … maximum for floor heating
- $Q_{H;gen;out}$ 37,030 MWh
- $Q_{W;gen;out}$ 3,703 MWh
- $Q_{C;nd}$ 0,02 MWh
- Typical application is radiators, 70/50 °C
- Heating and domestic hot water with condensing boiler



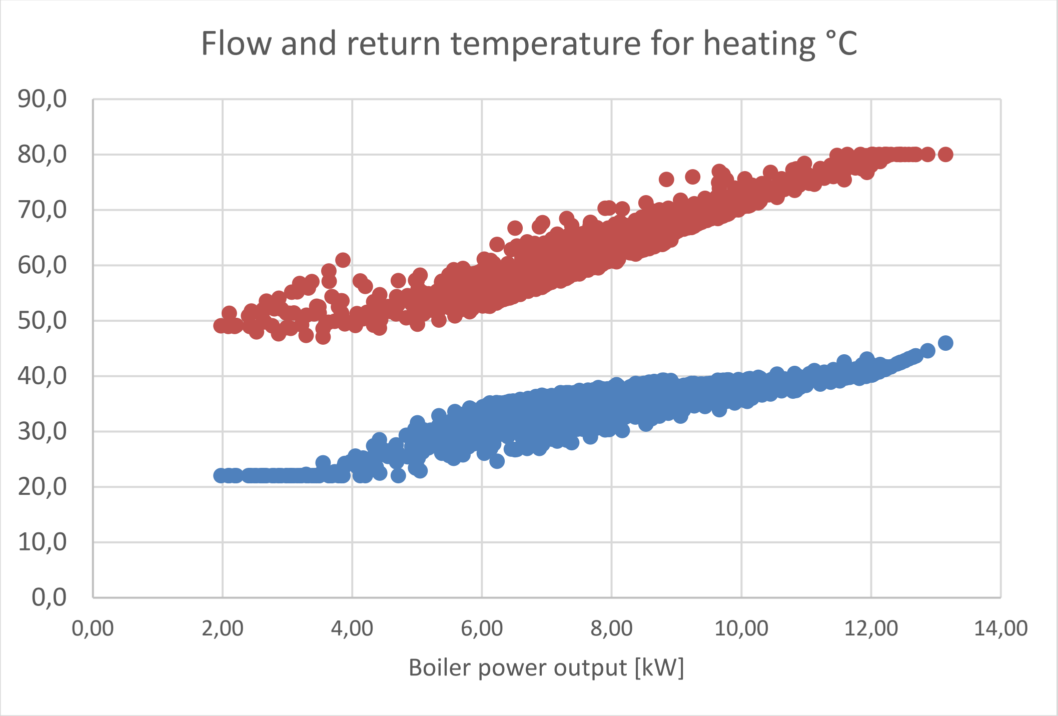
OSLO – Low insulation
Condensing boiler – Radiators



With continuous operation: 20 kW is OK

No effect on indoor air temperature

Return temperature

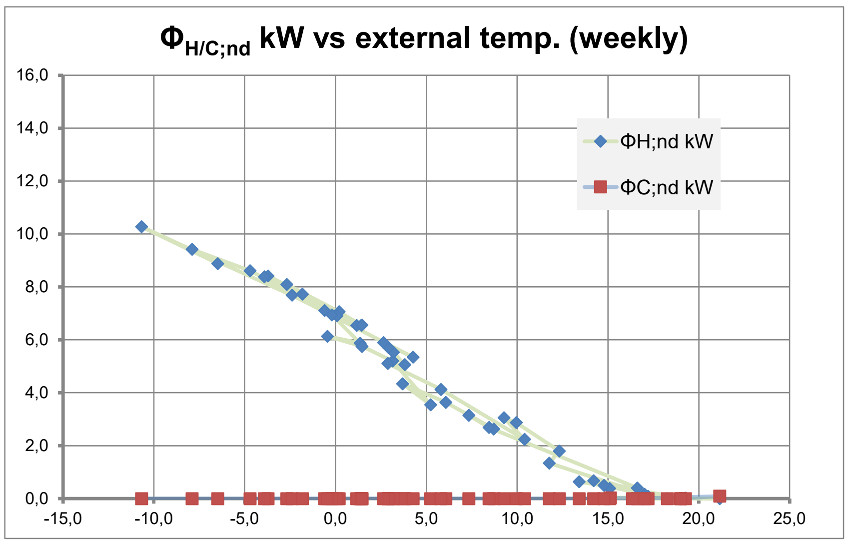


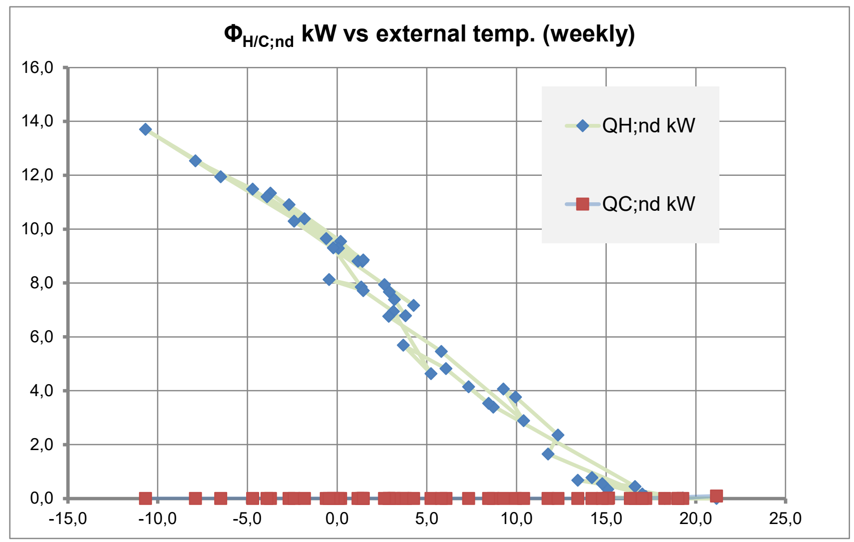
Condensation possible even with low external temperature
and radiators (15 kW nominal power installed on heat load 13,5 kW)
This result is based on radiator size and heating curve setting → optimization

OSLO – Low insulation

Condensing boiler – Radiators – Intermittent operation

- Same as before but with intermittent operation (17/24)
- No significant saving $Q_{H;nd}$ 37,0 MWh → 34,8 MWh **– 5,7%**
- **Higher sizing → emitters 20 kW**



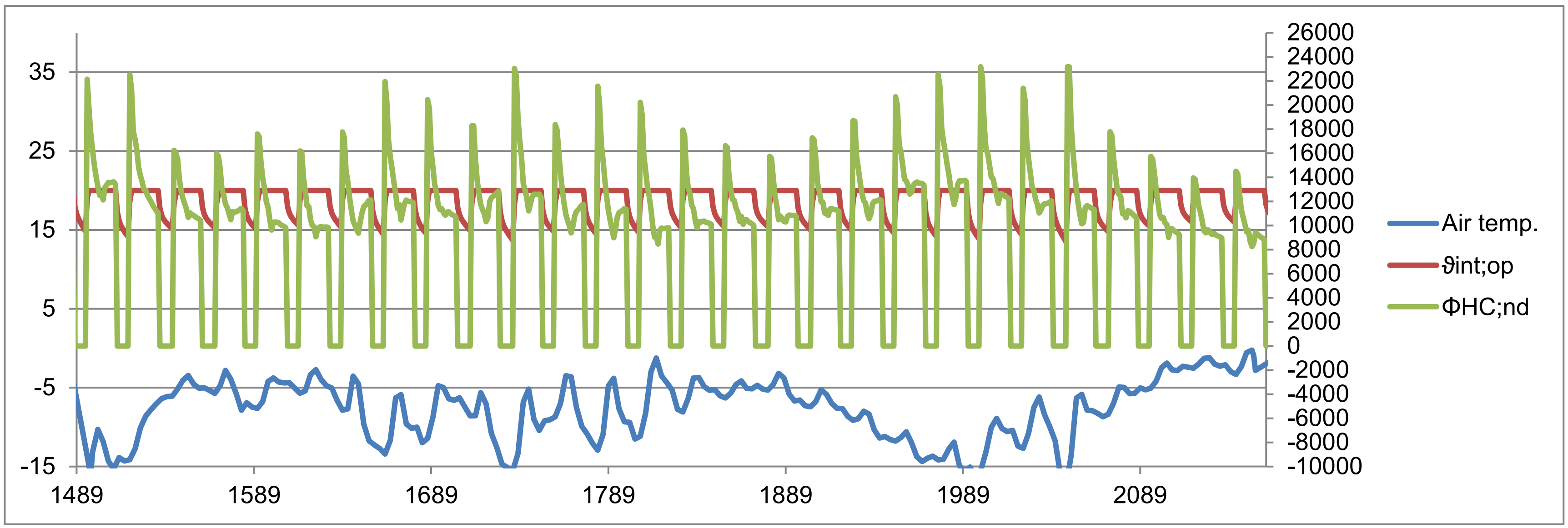


Power required is significantly higher → 24/17 → average power + 40%

OSLO – Low insulation

Condensing boiler – Radiators – Intermittent operation

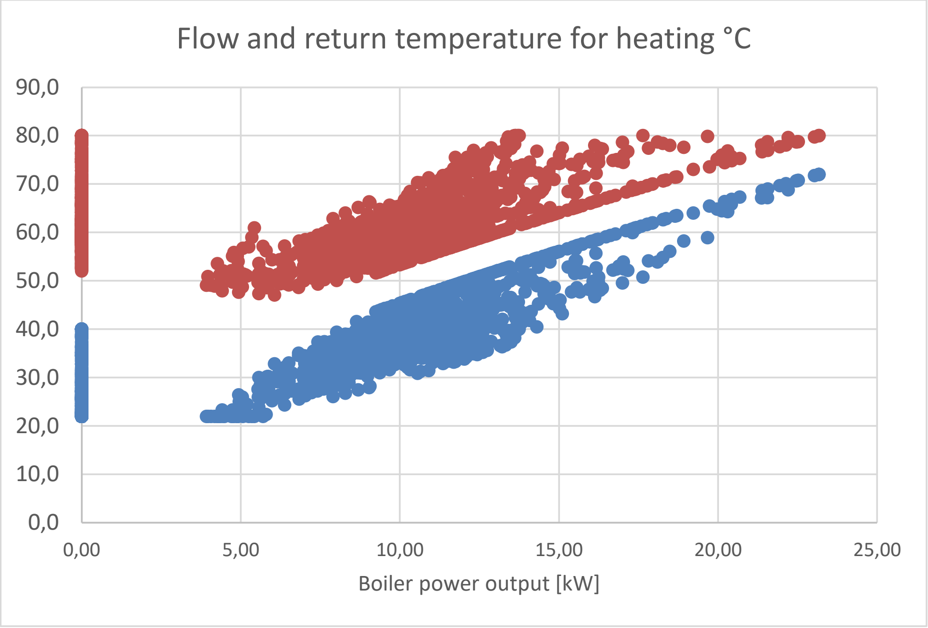
- Same as before but with intermittent operation
- No significant saving $Q_{H;nd}$ 37,0 MWh → 34,8 MWh **– 5,7%**
- Comfort issues: temperature drop up to 6 °C.



OSLO – Low insulation

Condensing boiler – Radiators – Intermittent operation

- Same as before but with intermittent operation



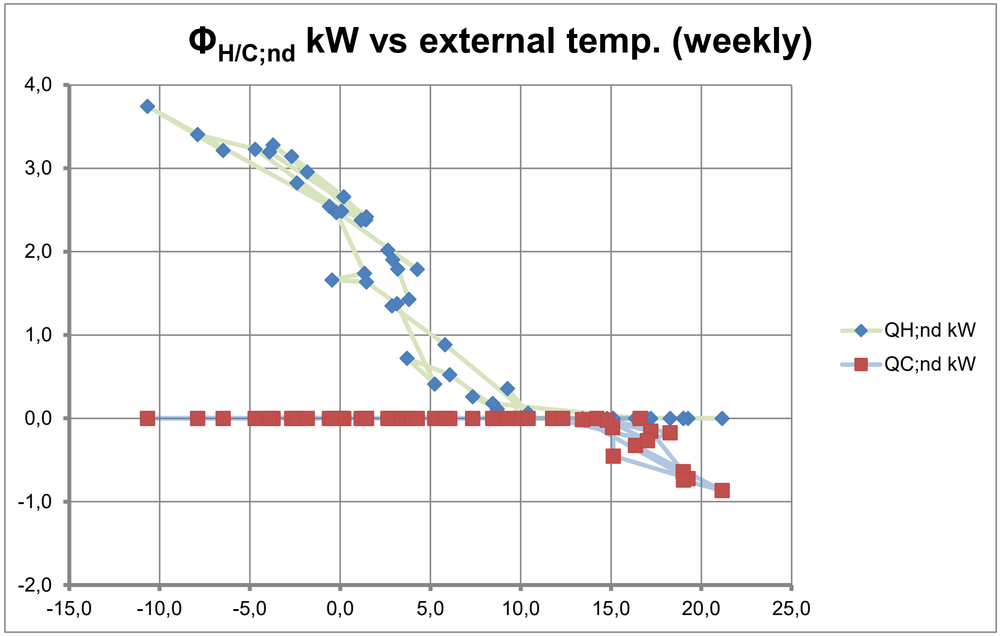
	Continuous	Intermittent
$Q_{X;gen;out}$	40,732 MWh	38,512 MWh
η_{gen}	94,5%	93,7%
$Q_{X;gen;in}$	43,090 MWh	41,071 MWh

Part of the advantage in needs is lost in the decay of efficiency.
This you can't see with monthly…

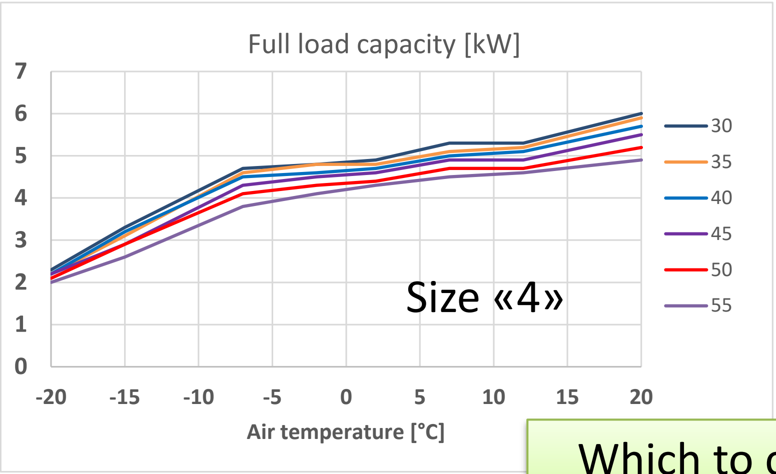
During recovery, power is higher: high return temperature, high temperature difference between flue gas and water return temperature → less efficiency
… and radiators have been increased from 16 to 20 kW

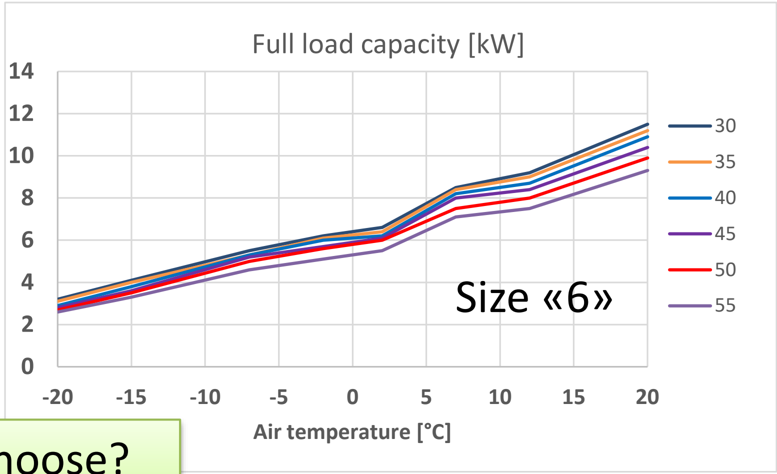
OSLO – Good insulation
Heat pump – Floor heating

- "Good insulation": U_{walls} = 0,22 W/m²K , U_{roof} = 0,11 W/m²K, …
- Heat load: 4,7 kW = 30 W/m²
- $Q_{H;gen;out}$ 7,98 MWh
- $Q_{W;gen;out}$ 3,703 MWh
- $Q_{C;nd}$ 0,75 MWh
- COP_H = 2,88
- COP_W = 2,30
- Possible application is floor heating or low temp radiators
- Heating and domestic hot water with heat pump

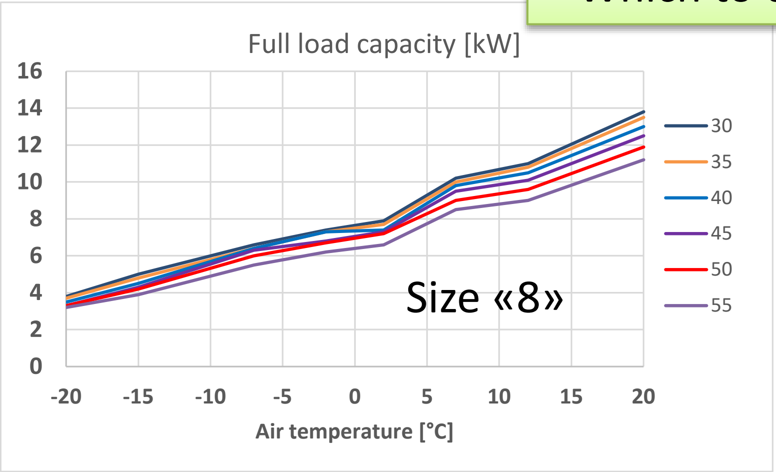


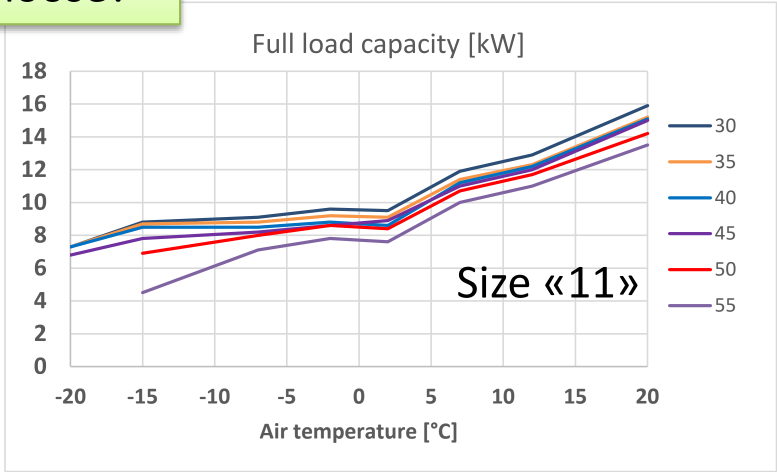
OSLO – Well insulated HP – Floor heating



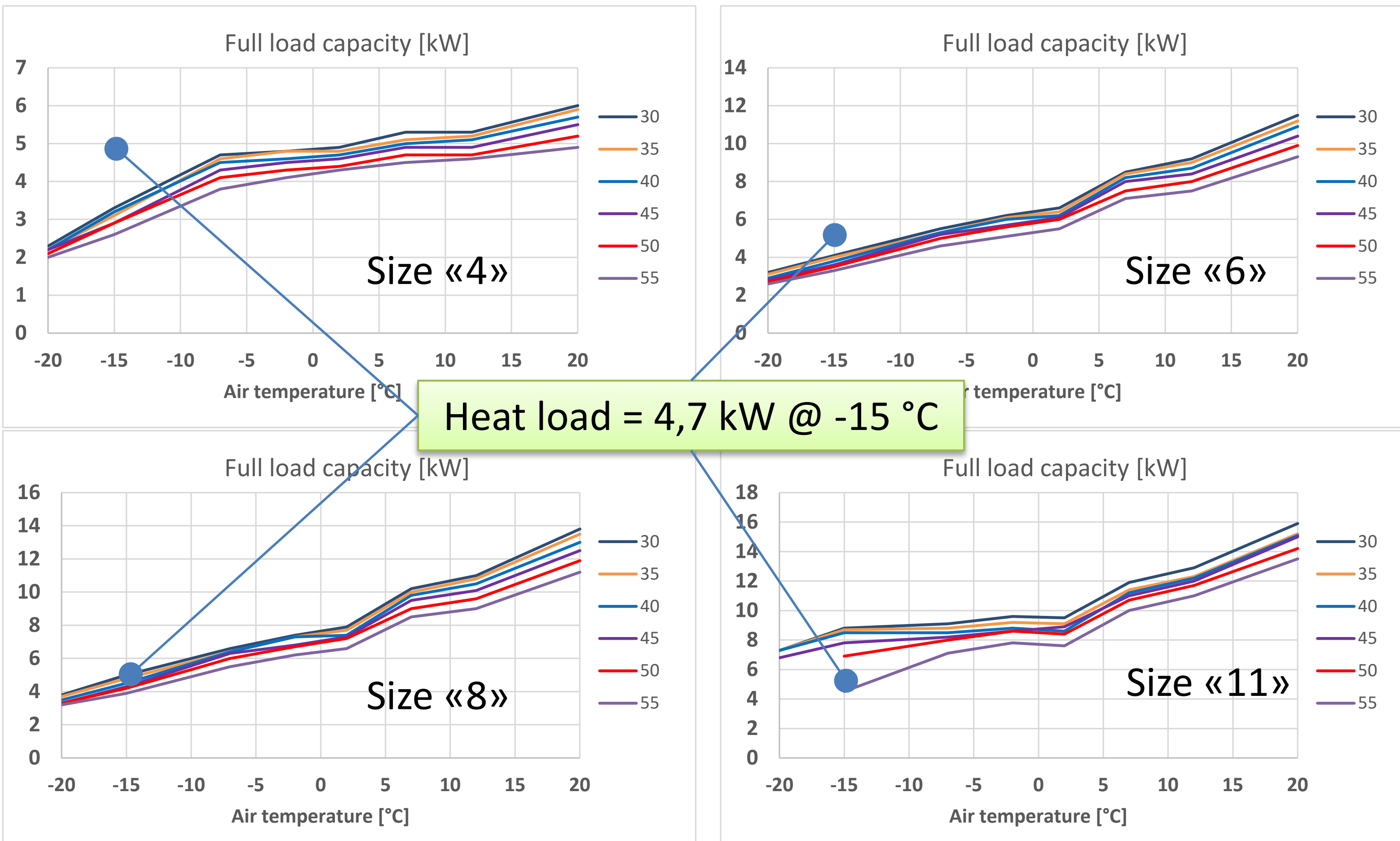


Which to choose?

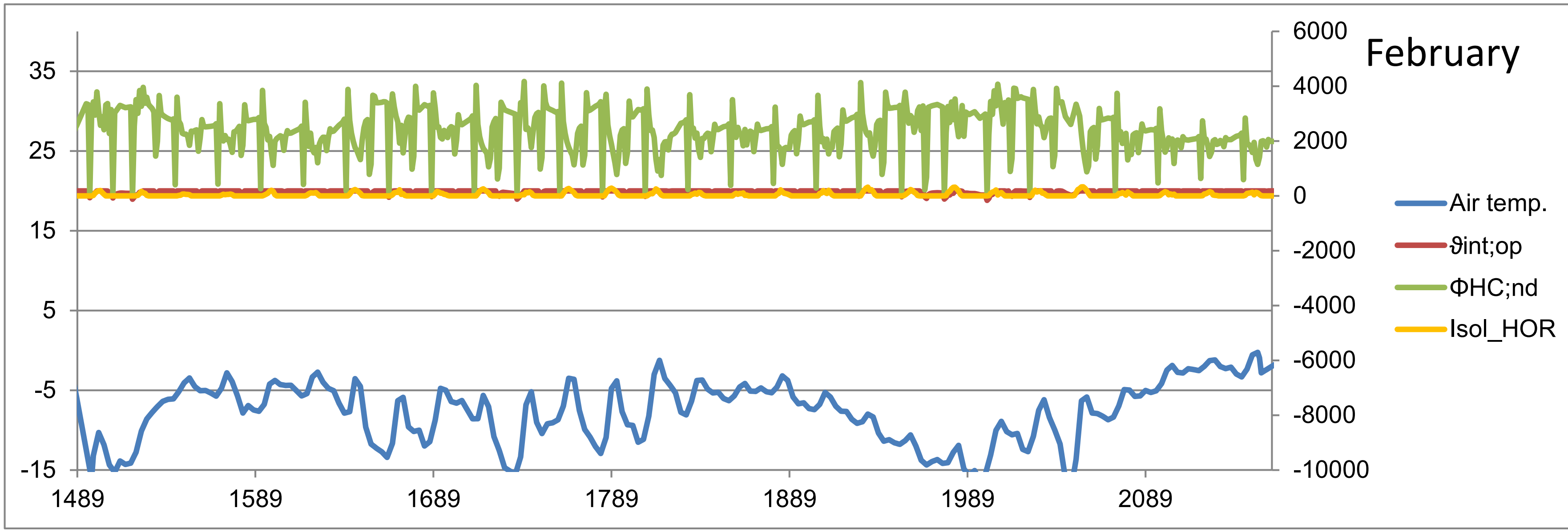




OSLO – Well insulated
HP – Floor heating

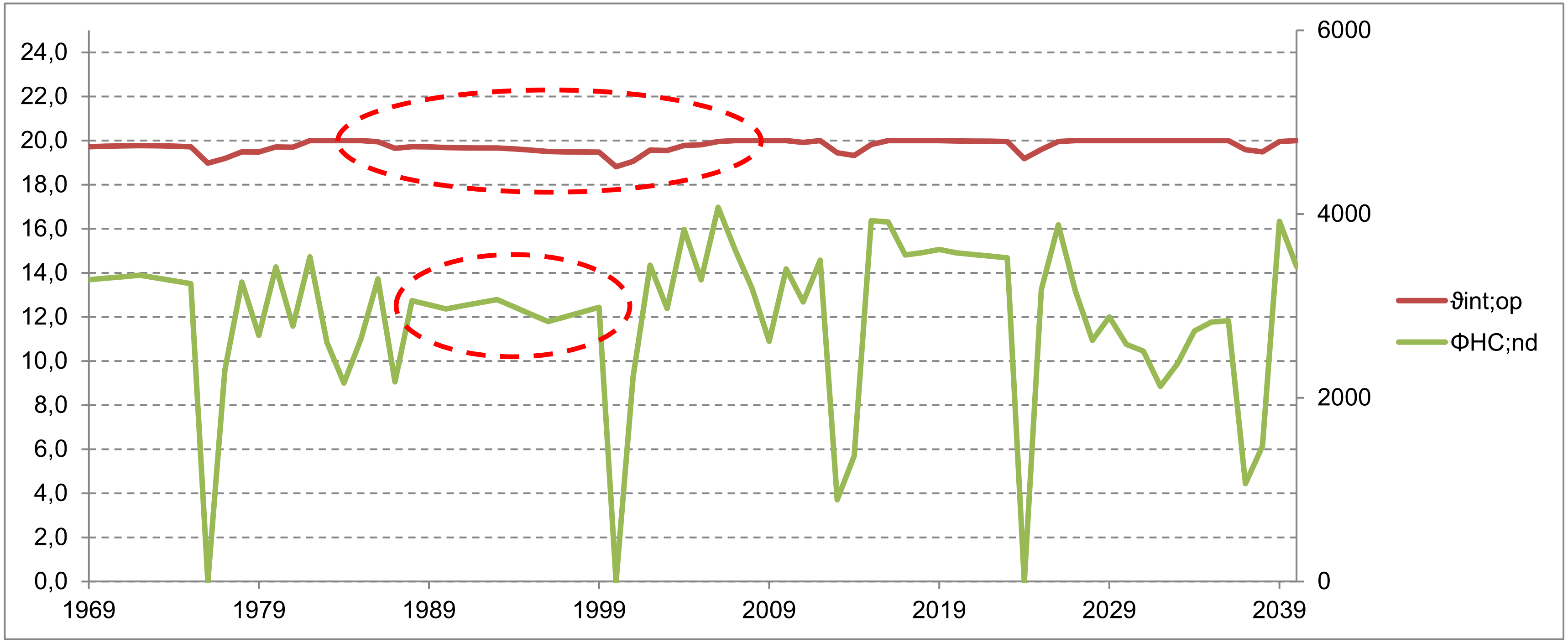


OSLO – Well insulated
HP 4 – Floor heating



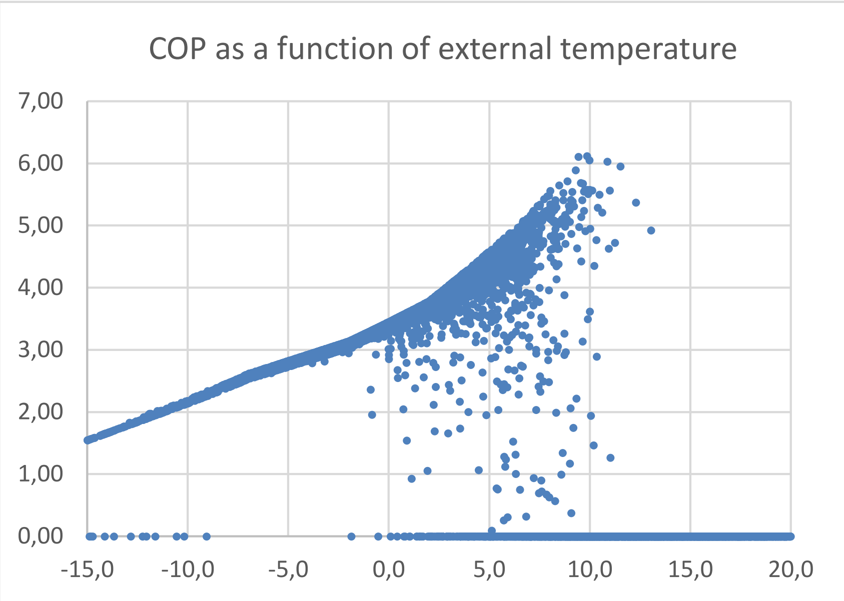
The smallest heat pump is very tightly sized

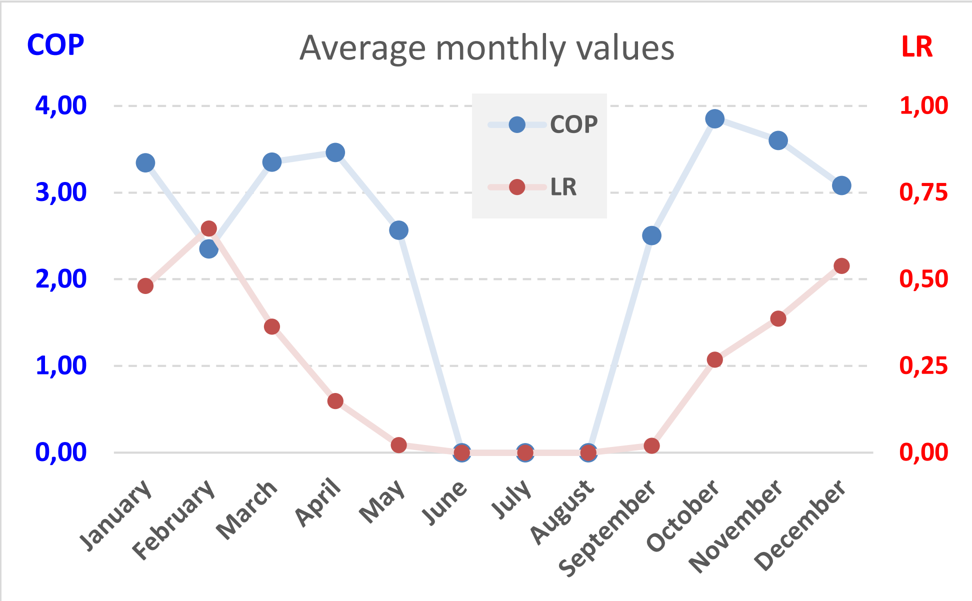
OSLO – Well insulated
HP 4 – Floor heating



The smallest heat pump is very tightly sized
Temperature is not maintained only during one day and when the domestic hot water store has to be reloaded

COP_H of the heat pump



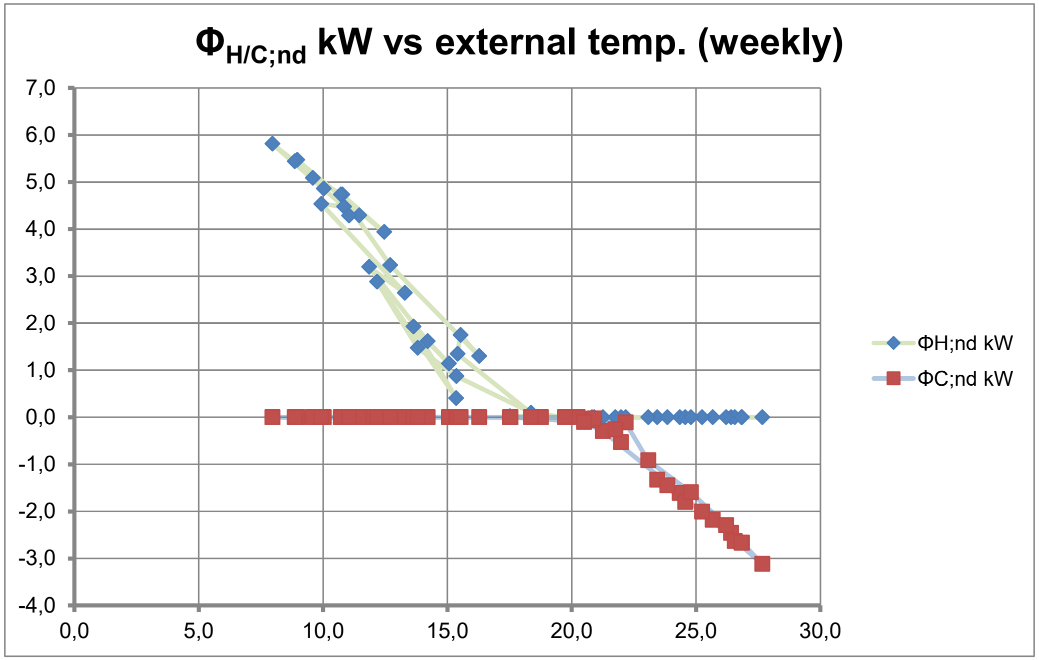


Part load penalizes COP in the warmer months
Spread of points at lower temperatures is reduced because the HP is at high load

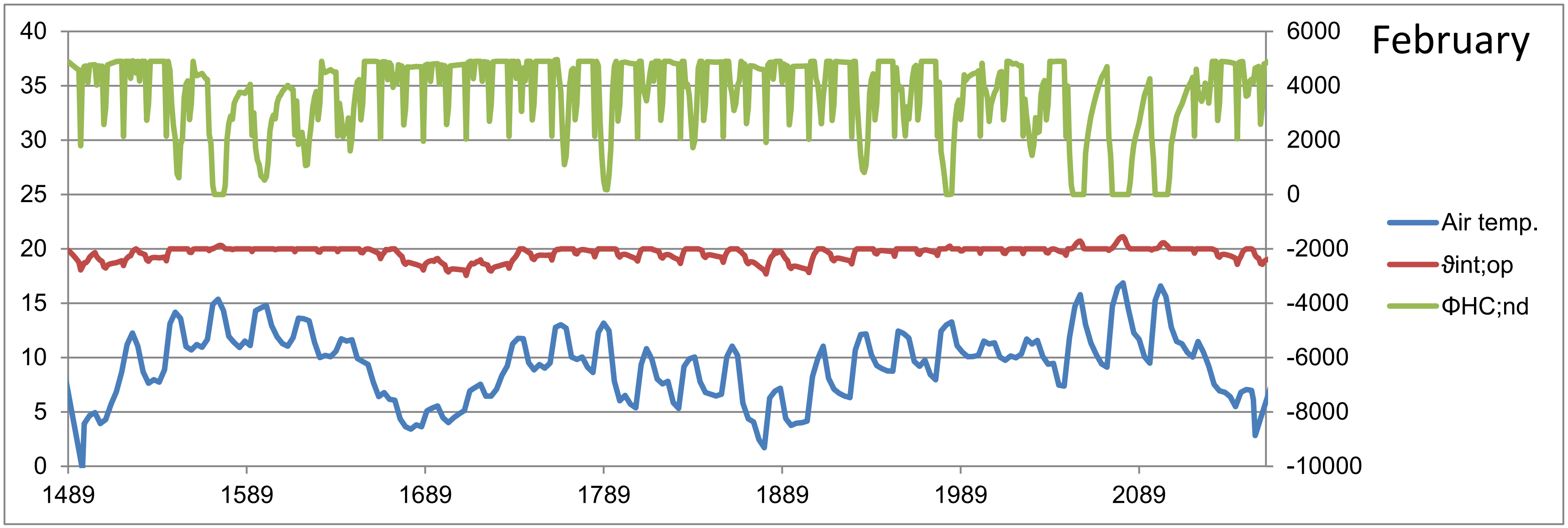
Athens – Non insulated HP 4 – Fan coils

- “Non insulated”: U_{walls} = 1,1 W/m²K , U_{roof} = 1,1 W/m²K, …
- Heat load: 8,5 kW = 57 W/m²
- $Q_{H;gen;out}$ 9,79 MWh
- $Q_{W;gen;out}$ 2,66 MWh

- Average COP_H: 3,36
- Average COP_W: 3,20

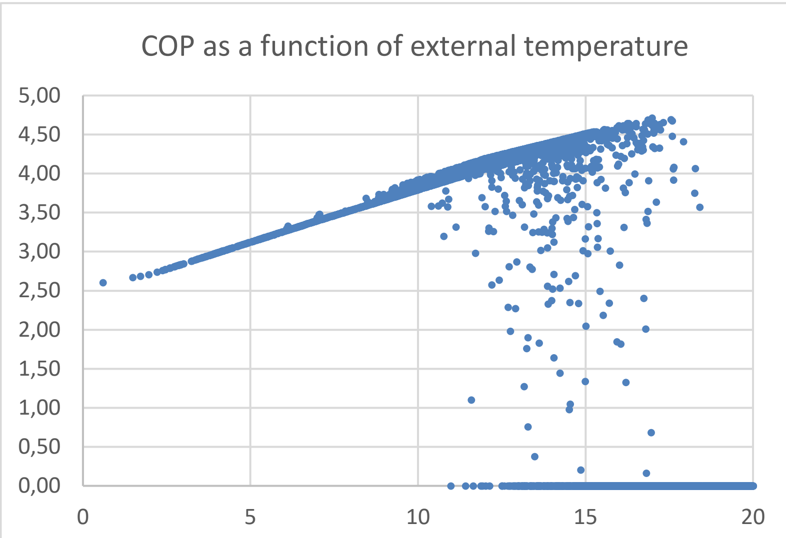


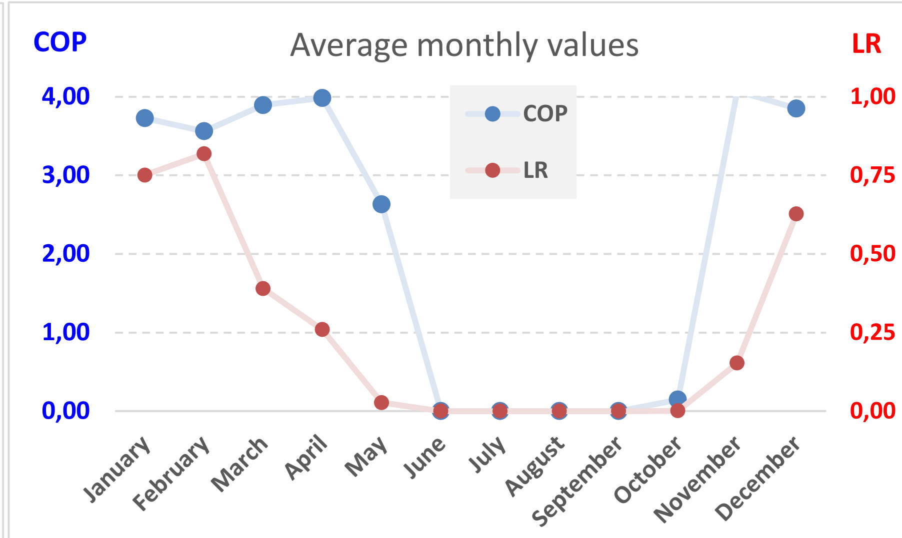
Athens – Non insulated
HP 4 – Fan coils



Insufficient sizing

Athens – Non insulated
HP 4 – Fan coils





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Spread of points at lower temperatures is reduced because the HP is at high load

Athens – Non insulated HP 4 – Floor heating

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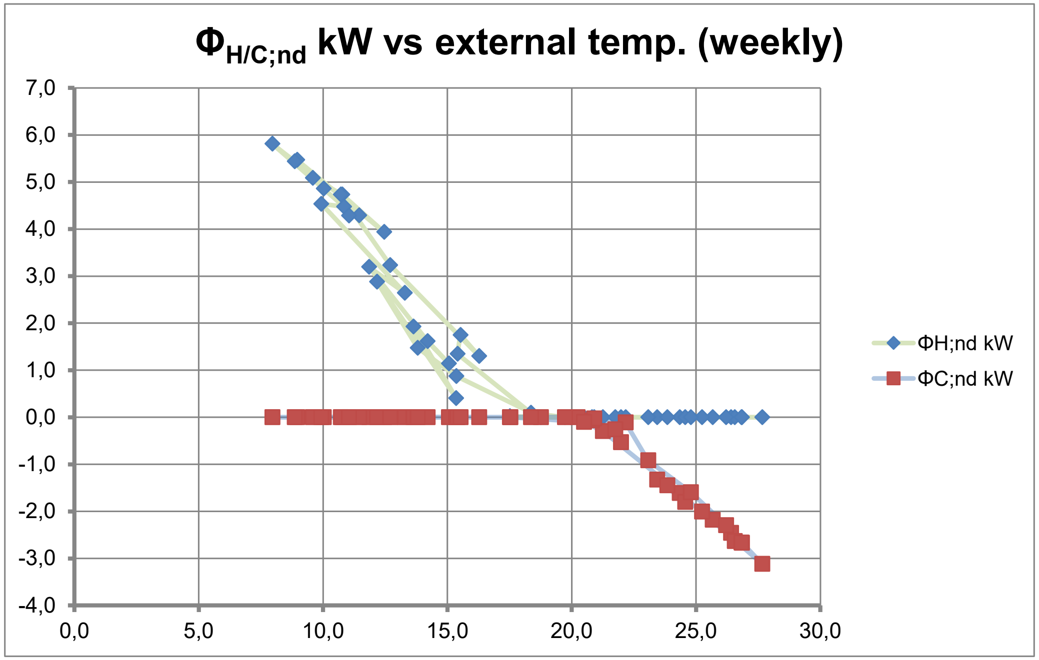
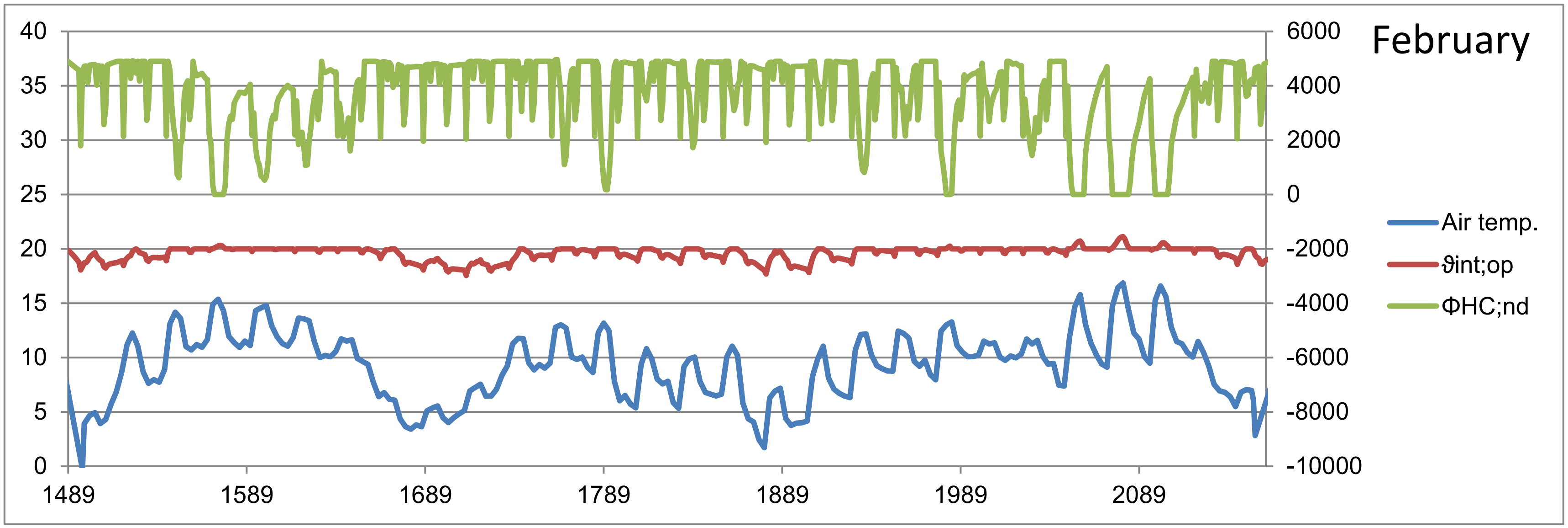
- Heat load: 8,5 kW = 57 W/m²
- $Q_{H;gen;out}$ 9,87 MWh
- $Q_{W;gen;out}$ 2,66 MWh

- Average COP_H: 5,15
- Average COP_W: 3,20

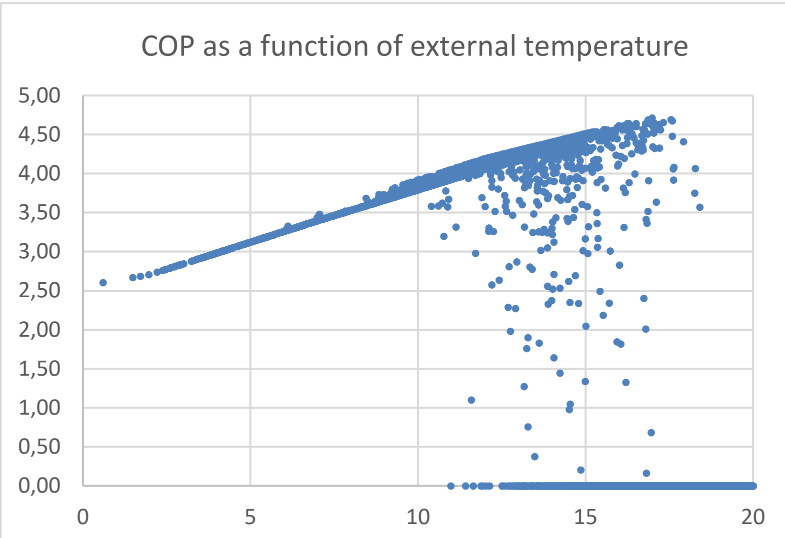


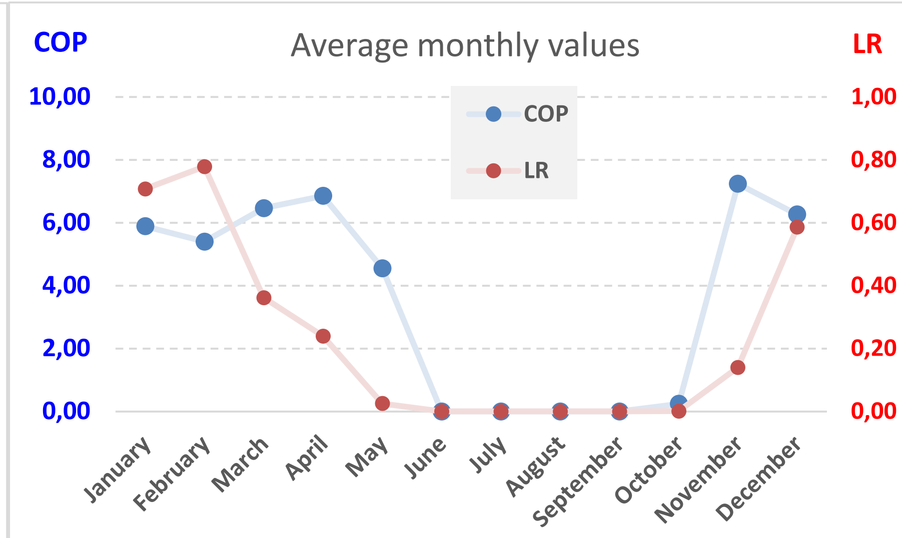
Athens – Non insulated HP 4 – Floor heating



Insufficient sizing → The heaty pump may be sized for cooling in that region…

Athens – Non insulated
HP 4 – Floor heating





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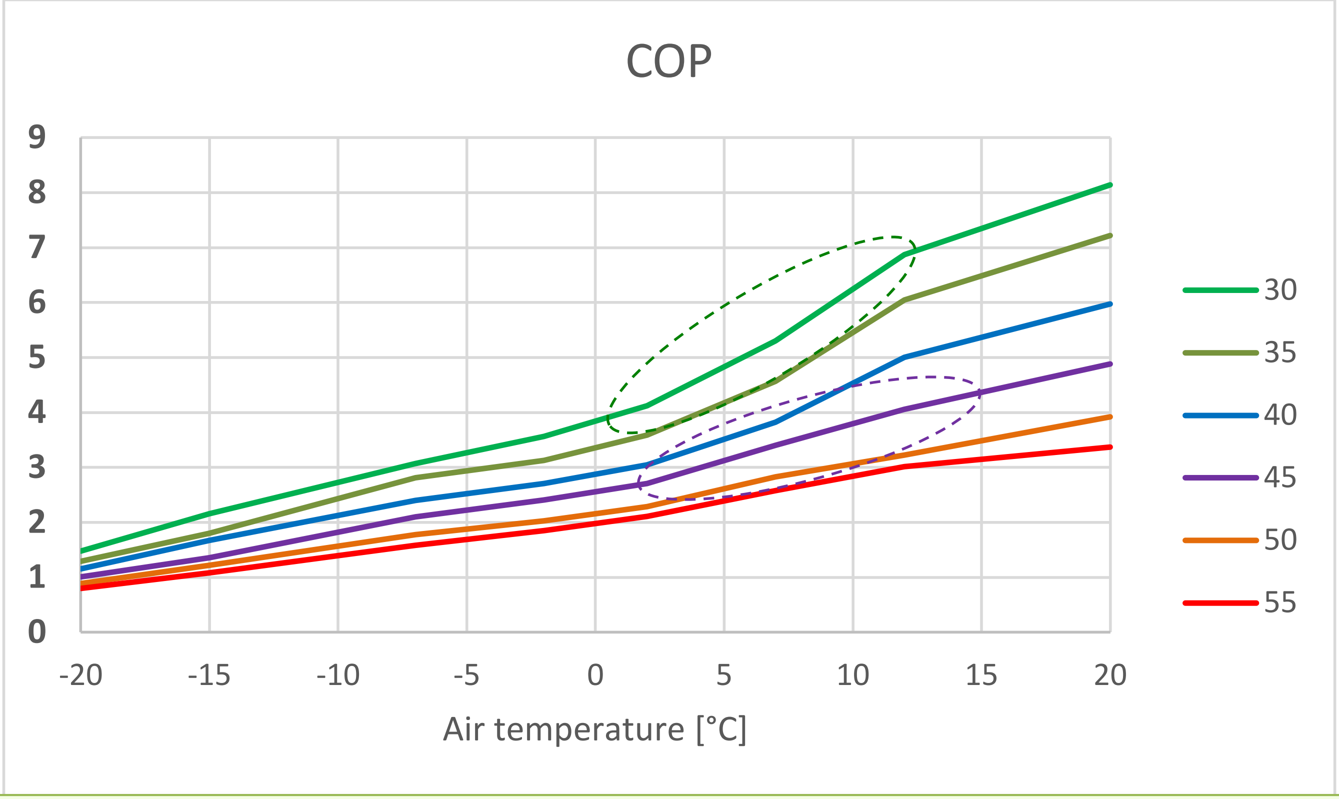
Athens – Non insulated HP – Floor heating



Operating conditions matter!

Some remarks

EN standards and hourly method allow to estimate the energy needs and the efficiency of complex systems, taking into account the dynamic interaction between building envelope and systems.
The hourly method can help identify the correct sizing of a heat pump and how much back-up is required, taking into account heat gains, the interaction with the building envelope and the risk of disconfort.

Heat pumps are very sensitive to operating conditions.
EN standards do take them fully into account.

Intermittent use has heavy implications on sizing and operating conditions, much less on energy needs, at least in the residential sector.

But be careful: if the building and systems don’t conform to specification, if the systems are not properly commissioned, if the gains are not correctly estimated … other results than designed will be obtained …

Is energy performance the whole story?

There are several ways to weight delivered energy : attention is shifting from non-renewable primary energy to CO_2 emission.

However, efficiency focuses only on the operation phase. A lot of resources are incorporated during the construction of efficient buildings and systems.

Example: is it worth to spend thousands of Euros for a more efficient system when the whole yearly cost is some hundreds Euros?

Calculation standards are great **tools**. If EN hourly calculation methods are used correctly you can extract a lot of useful information and design a great energy performance….

But then in the real world…

- are you sure that the building and systems will be correctly commissioned and used?
- is that heating curve properly set for that heat pump in that building?
- are we back-checking the operational results of our designs ?

A good design with a reliable calculation method is just the beginning of the story…

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

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Q&A

Submit your question!