
BUILD UP
The European portal for energy efficiency
and renewable energy in buildings
WEBINAR

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 870072.

BUILD UP
The European Portal For Energy Efficiency in Buildings

cultural E+

eurac research

University of Stuttgart
Institute for Acoustics and Building Physics
Life Cycle Engineering GaBi

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Agenda outline

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	Presentation	Speaker
10:00 – 10:05	**Presentation of BUILD UP, introduction to the webinar topic, and presentation of the agenda**	*BUILD UP Team member*
10:05 – 10:20	**Overview on Positive Energy Buildings and solution sets**	*Francesco Isaia, Eurac Research*
10:20 – 10:40	**Energy performance assessment and harmonized control strategies**	*Francesco Turrin, Eurac Research*
10:40 – 10:45	**Poll discussion #1**	*Francesco Turrin, Eurac Research*
10:45 – 11:05	**Environmental lifecycle impact (LCA)**	*Roberta di Bari, University of Stuttgart*
11:05 – 11:10	**Poll discussion #2**	*Roberta di Bari, University of Stuttgart*
11:10 – 11:30	**LCC (Life-Cycle Cost) and discussion on new business models**	*Hermann Leis, SIZ Energieplus*
11:30 – 11:35	**Poll discussion #3**	*Hermann Leis, SIZ Energieplus*
11:35 – 11:55	**Q&A discussion**	*Moderated by BUILD UP*
11:55 – 12:00	**Closing remarks and thank you from BUILD UP**	*BUILD UP Team member*

Before starting…

- Where are you joining us from?
- What is your profession?

Please, answer in the chat!

Overview on Positive Energy Buildings and solution sets

Francesco Isaia (EURAC)

16/05/2023

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 870072

Climate and cultural-based solutions for Plus Energy Buildings

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Main project objective:

to define modular and replicable solutions for residential Plus Energy Buildings (PEBs), accounting for climate and cultural differences, while engaging all key players involved in the building life cycle.

More info on our project website: https://www.cultural-e.eu/

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What is a Plus Energy Building (PEB)?

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A Plus Energy Building is an energy efficient building that produces more final energy than it uses via locally available renewable sources over a time span of one year*.

Positive balance reached by ensuring a good dynamic matching between load and generation providing building flexibility.

\+ generation

− load

Positive balance reached by ensuring the lowest greenhouse gas emissions.

Building uses include both building operation and user related energy consumption.

Heating

Cooling

Domestic Hot Water

Auxiliaries

Ventilation

Plug Loads

PEBs shall ensure an added value providing accessible, comfortable and healthy indoor environments.

Energy generation shall be performed by renewable energy systems located within building footprint.

It can be extended to adjacent lots as long as there is a physical connection and direct control of renewable energy generation system.

Ownership of the buildings or lots, neighborhood grid infrastructure and building management is a must.

PEB shall ensure an added value providing easy access to e-mobility.

*The definition applies to all-electric buildings and the energy balance is based on measured or predicted final energy between load and generation. In case of new buildings electrification is an inevitable process. In case other renewable energy vectors are used in the building (i.e. biomass, biogas...), final energy balance shall be zero.

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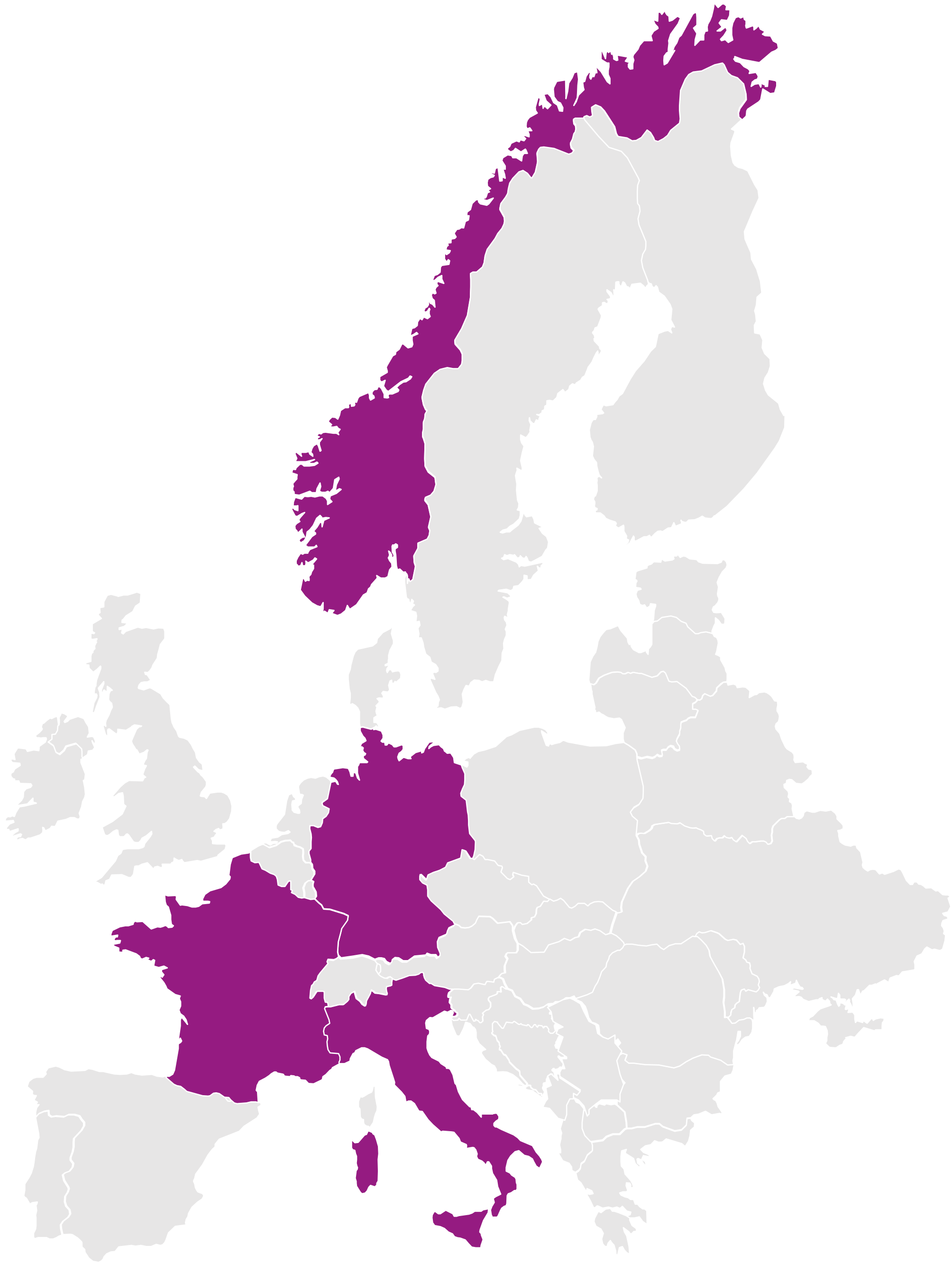
www.cultural-e.eu

Cultural-E geoclusters

Geoclusters are a subdivision of EU area according to:

- **Climatic** aspects
- **Cultural** aspects
- **Social** aspects

The chose geoclusters are: Mediterranean (Italy), Continental (Germany), Oceanic (France), Subarctic (Norway)



Cultural-E key technology developments

Smart air Movement

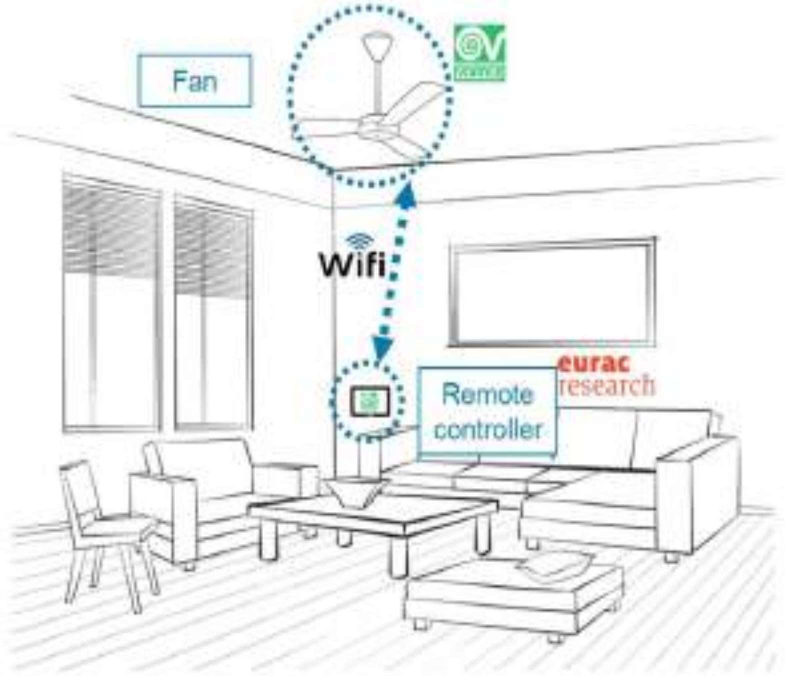
Active Window System

Packaged Heat Pump

Cloud-based HMS

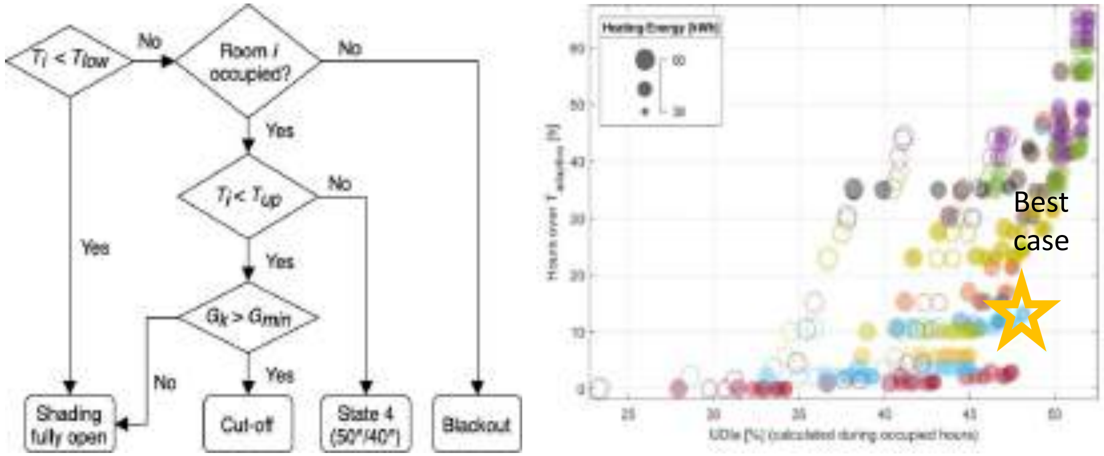
Strategies for building flexibility

Smart air movement



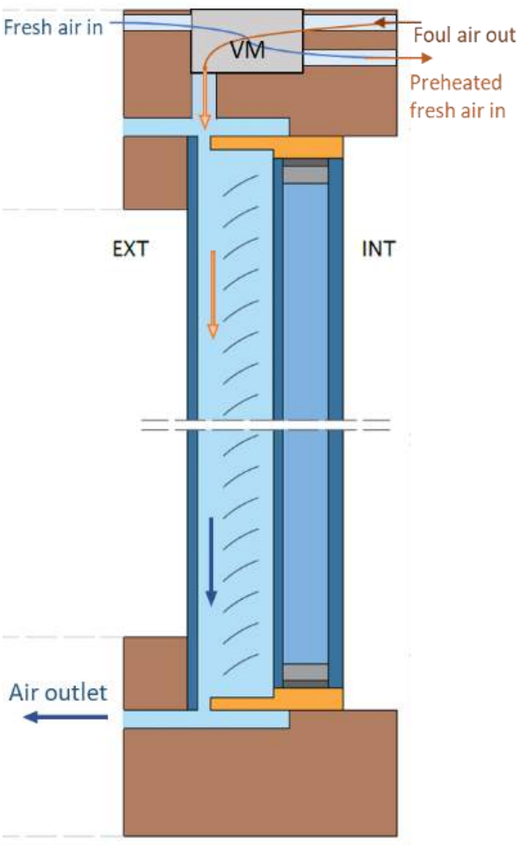
	Building	Clima	Qth_SC NO CF [kWh]	Qth_SC CF [kWh]	Qth_SC difference [kWh]	Qth_SC difference [-]	Wel_HVAC_SC NO CF [kWh]	Wel_HVAC_SC CF [kWh]	Wel_HVAC_SC difference [kWh]	Wel_HVAC_SC difference [-]	Cost reference [€]	Cost saving during summer season [€]
1	LowRise	Mediterranean	10096	6080	-4017	-40%	3600	2897	-703	-20%	2340	-457
2	LowRise	Continental	952	66	-887	-93%	392	130	-262	-67%	255	-170
3	LowRise	Oceanic	6646	2997	-3649	-55%	2178	1573	-605	-28%	1416	-393
4	LowRise	Sub-Arctic	673	66	-606	-90%	290	63	-227	-78%	189	-148
5	HighRise	Mediterranean	44985	18807	-26177	-58%	24608	11462	-13146	-53%	15995	-8545
6	HighRise	Continental	6127	627	-5500	-90%	2451	732	-1719	-70%	1593	-1117
7	HighRise	Oceanic	31150	20286	-10864	-35%	14488	11549	-2940	-20%	9417	-1911
8	HighRise	Sub-Arctic	1963	267	-1696	-86%	979	301	-678	-69%	636	-440

Active Window System

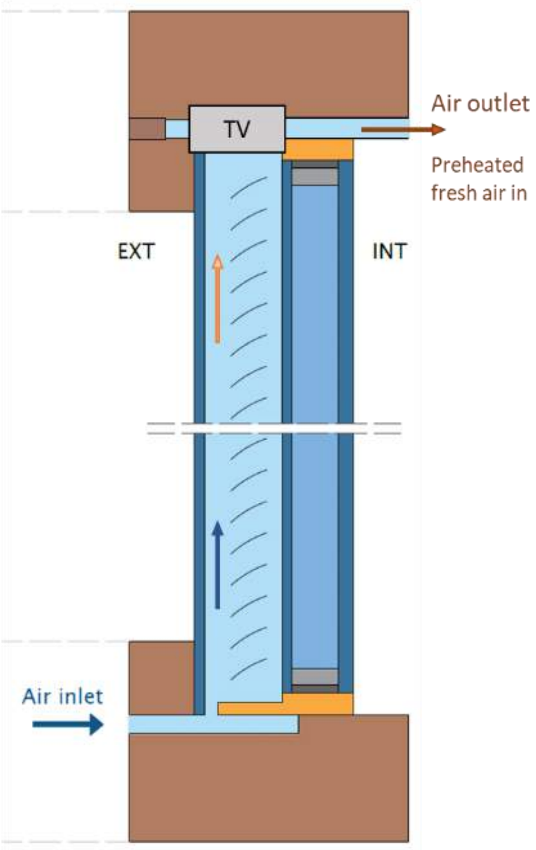


Shading control algorithm optimization

Active Window System

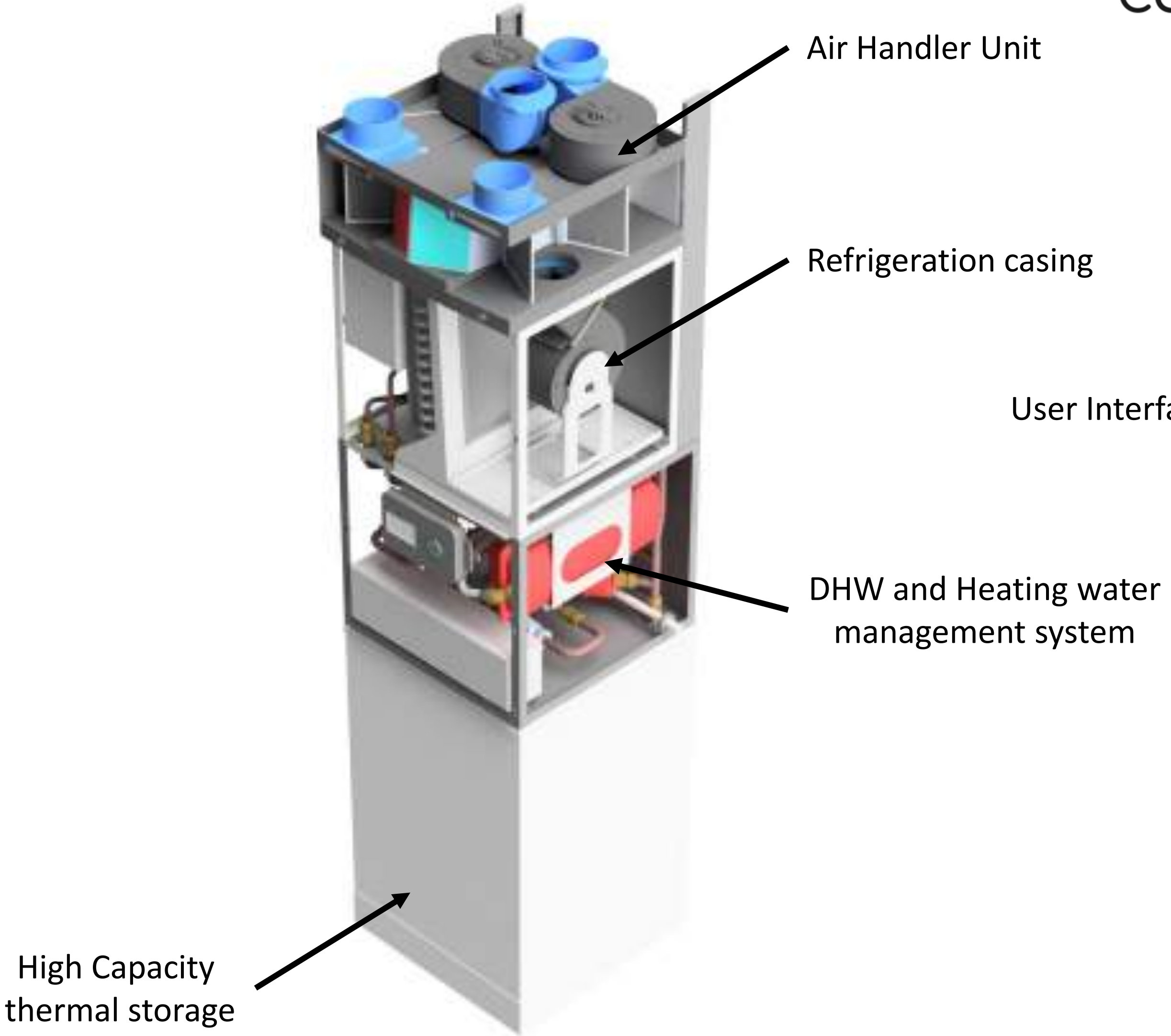


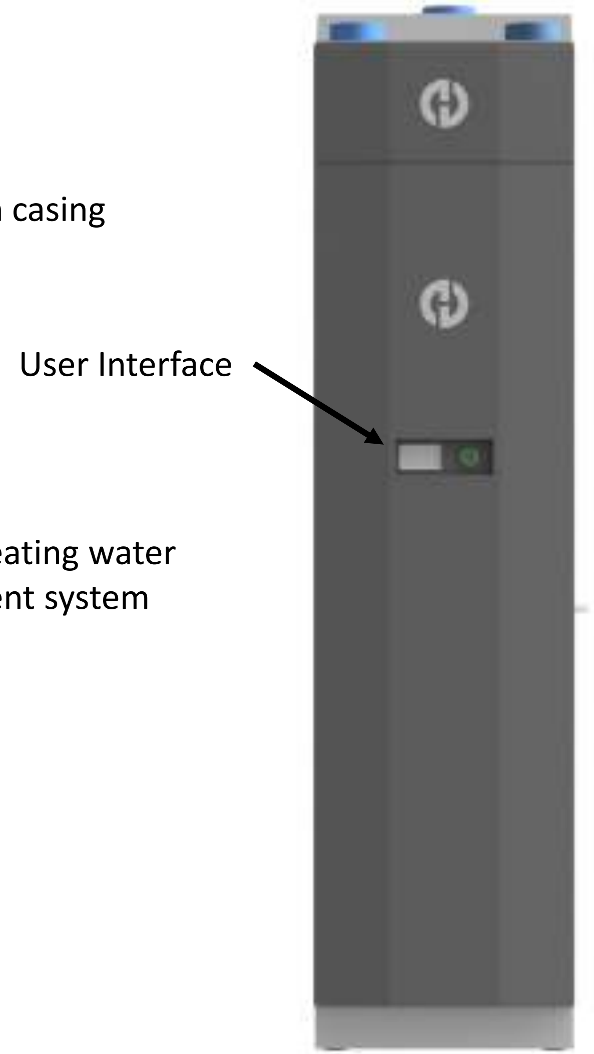
Option 2: Mechanical ventilation machine



Option 3: Trickle vent

Packaged Heat Pumps





Packaged Heat Pumps

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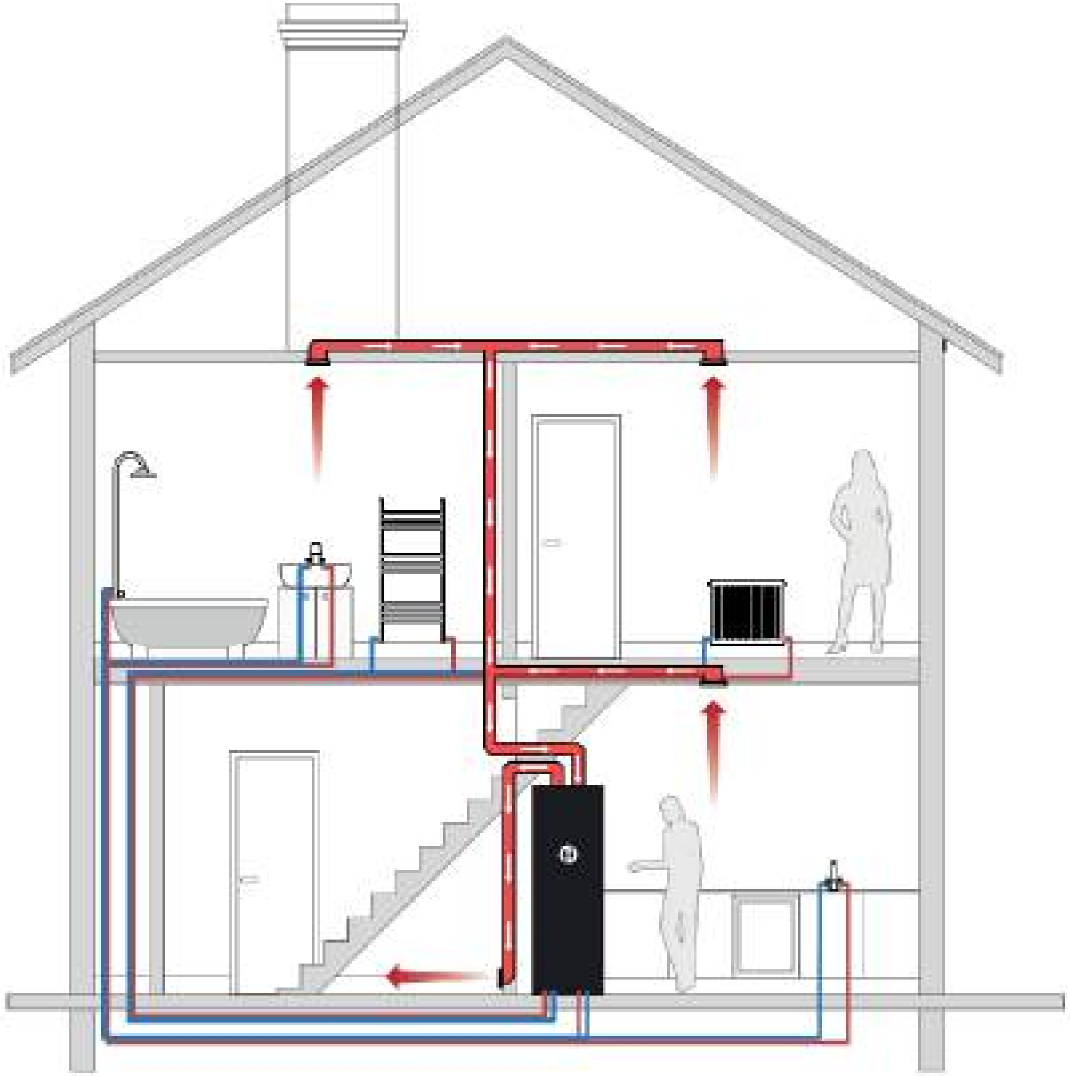
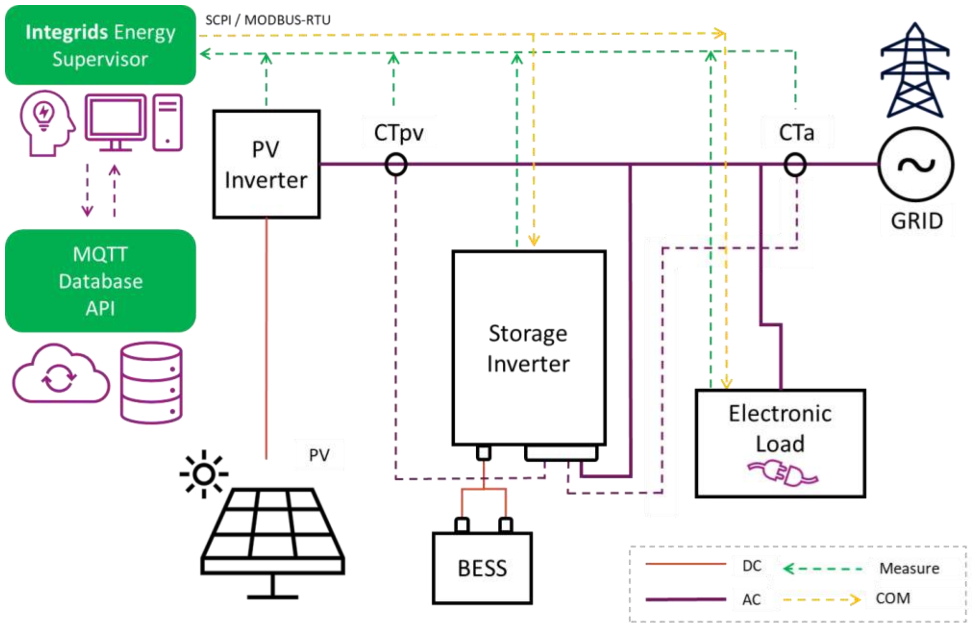
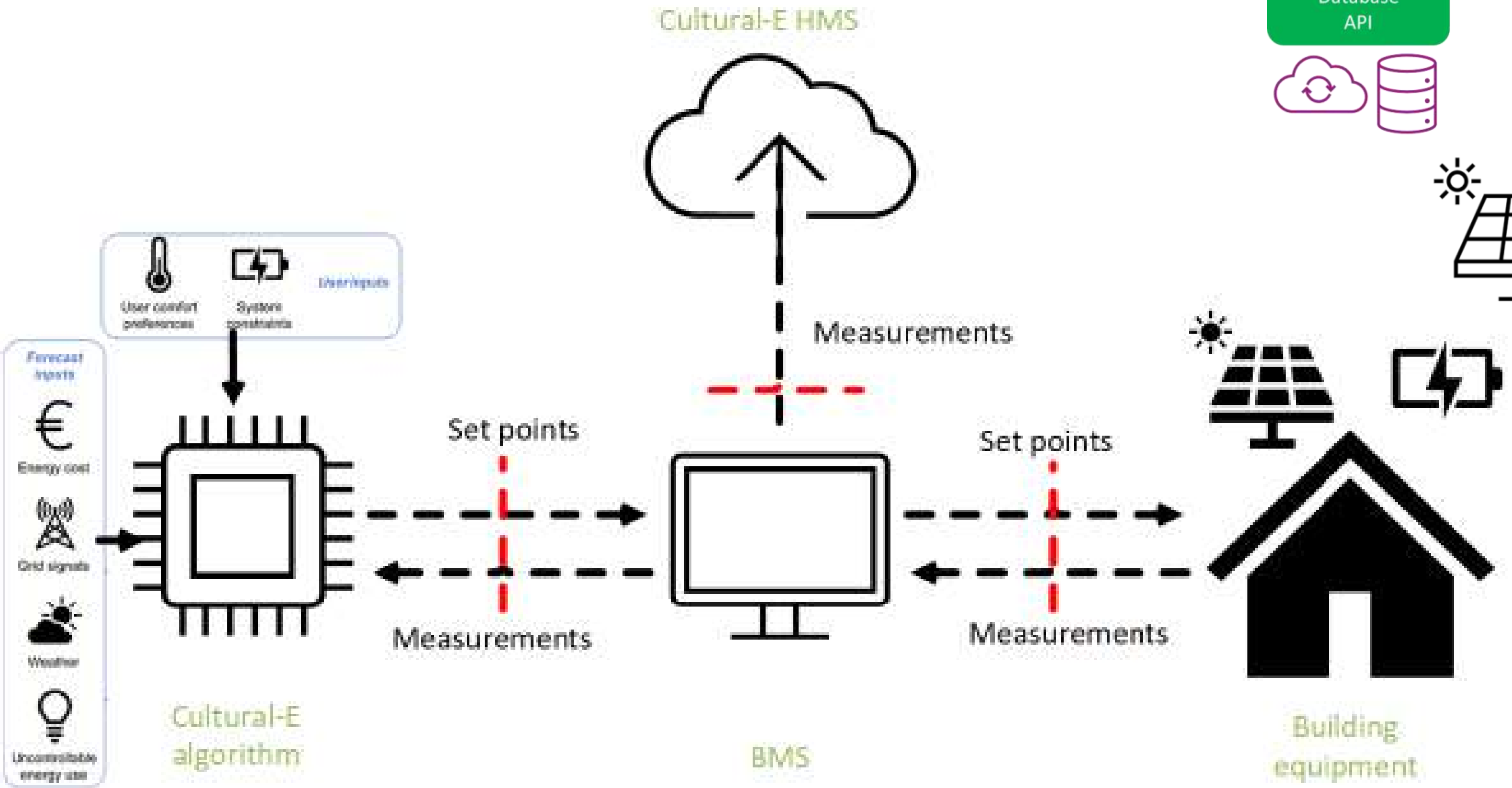


Cloud-based HMS and building flexibility





Solution sets and control strategies

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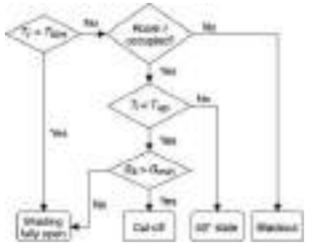
Smart air Movement

Active Window System



Packaged Heat Pump

Cloud-based HMS

Strategies for building flexibility

Other control logics related to:

- PV production
- Thermal Energy Storage (TES)
- HVAC system
- Battery Energy Storage System (BESS)
- Mechanical ventilation

Next presentations

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Thank you for your attention!

Francesco Isaia (Eurac)
francesco.isaia@eurac.edu
+39 0471 055 758

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Energy performance assessment and harmonized control strategies

Francesco Turrin, EURAC Research

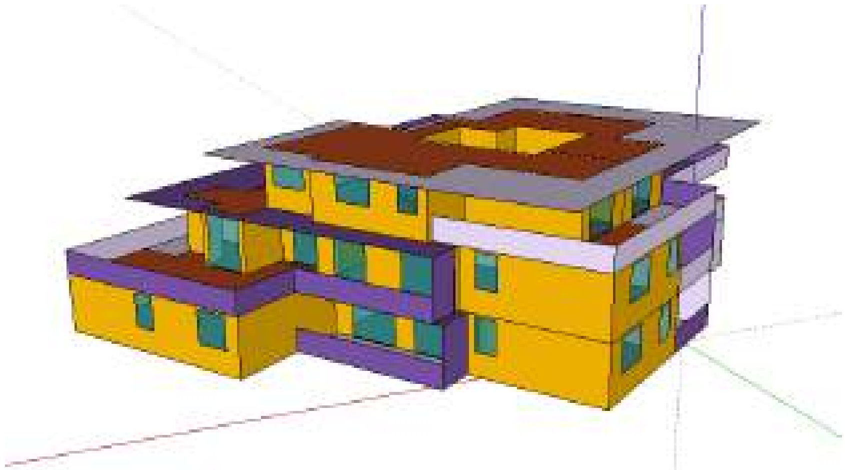
16/05/2023

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 870072

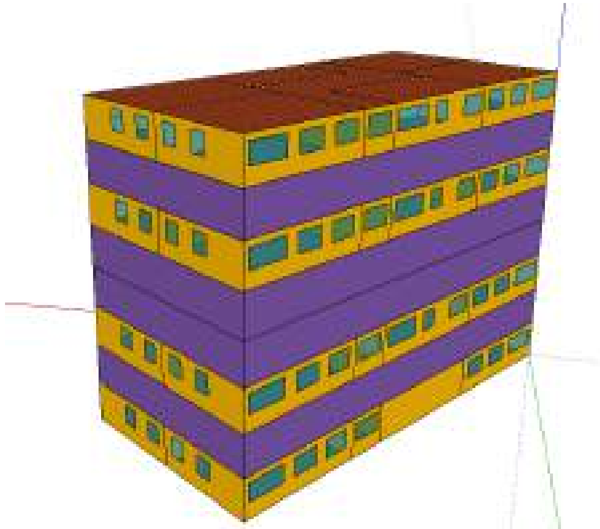
Simulations method

- Software adopted for the simulation activity: ***TRNSYS*** v.18.02
- Simulation time-steps: 5 minutes

BUILDING ARCHETYPES



Low-rise building (3 floors – 663 m²)



High-rise building (7 floors – 2912 m²)

HIGH-PERFORMANCE ENVELOPE

Geocluster	Reference Country	Thermal Transmittance U-VALUE External Wall [W/m²K]	Thermal Transmittance U-VALUE Windows [W/m2K]
Mediterranean	Italy	0.18	1.3
Continental	Germany	0.15	0.8
Oceanic	France	0.18	0.8
Sub Artic	Norway	0.11	0.8

Developed solution sets

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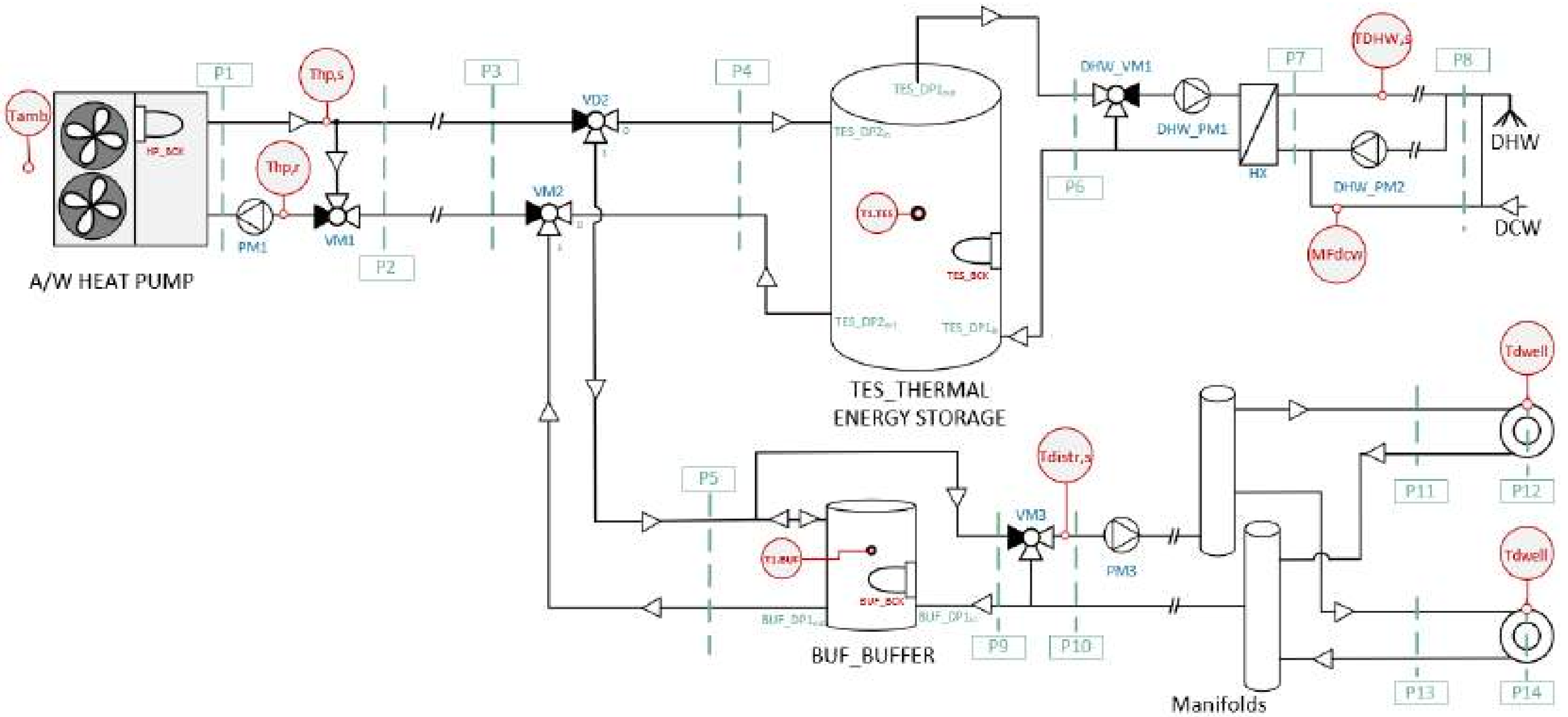
Centralized solution set → generic Air-to-Water Heat Pump system with project´s technologies

System/service	Technology
DHW production	Centralized Air-to-Water Heat Pump + TES with recirculation loop
Space heating	Centralized Air-to-Water Heat Pump + puffer
Space cooling	Centralized Air-to-Water Heat Pump + puffer
Emission system	Fan coils
Air movement	Ceiling fan
Ventilation	Decentralized ventilation system
Shading system	External Venetian blinds
Renewable Energy source	PV + BESS

P&Id of energy system



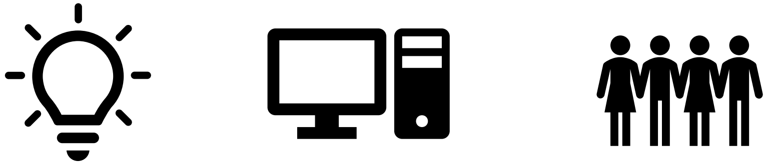
Simulation Inputs

- WEATHER DATA: EPW files for each reference climate (Mediterranean, Continental, Oceanic, Sub-Artic)

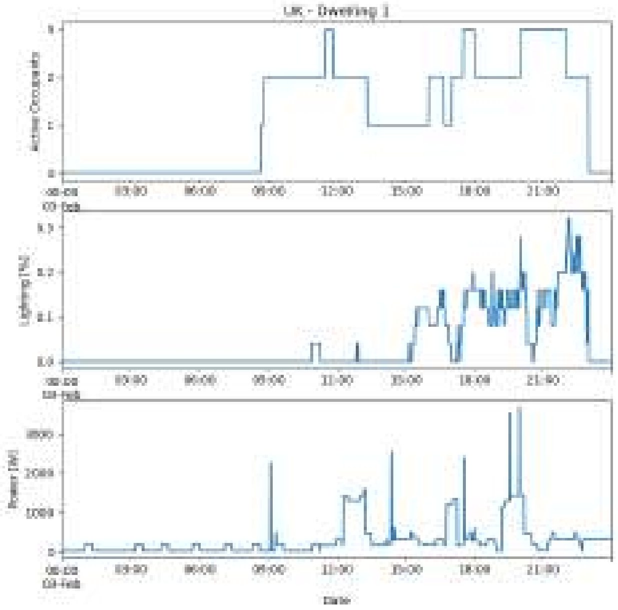
- H/C SET POINTS:

	Mediterranean	Continental	Oceanic	Sub-Artic
Set Point Heating System	20	21	20	22
Set Point Cooling System	26	26	24	27

- INTERNAL GAINS:



<u>Stochastic profiles produced for each geocluster</u>, which are defined on statistically defined use of the building and occupants‘ habits



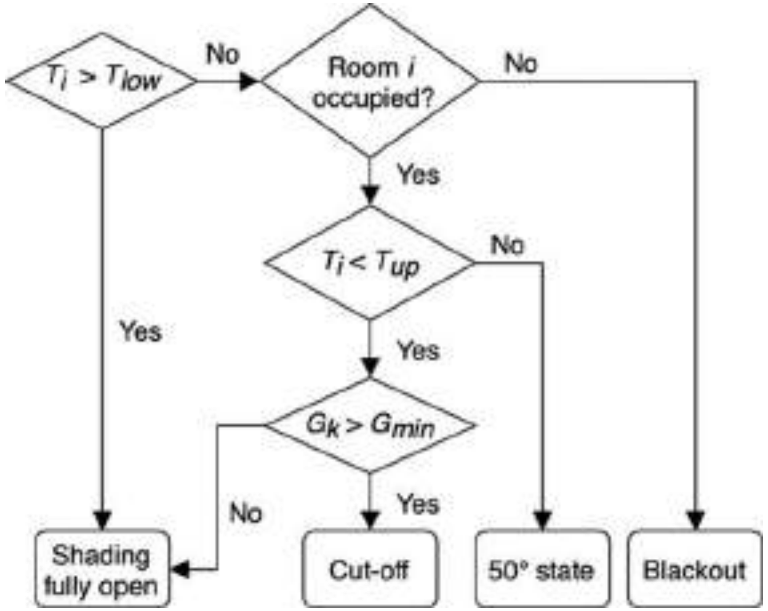
Control strategy and harmonization of technologies

- The goals that we wanted to reach with the control system are:

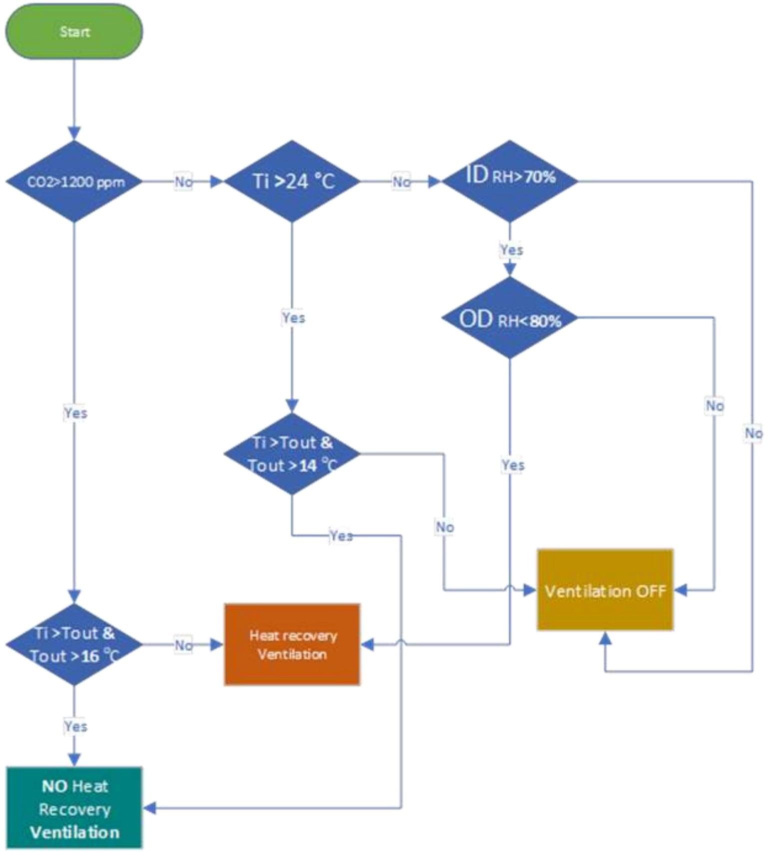
  1. Harmonization of the control strategies of the different components in one controller
  2. Guarantee the comfort for the user
  3. Adapt to variations imposed by the user (e.g. windows opening)
  4. Optimization of system’s performance
  5. Load shift to match RES production

Control strategy and harmonization of technologies

- Basic control logics of the different components:

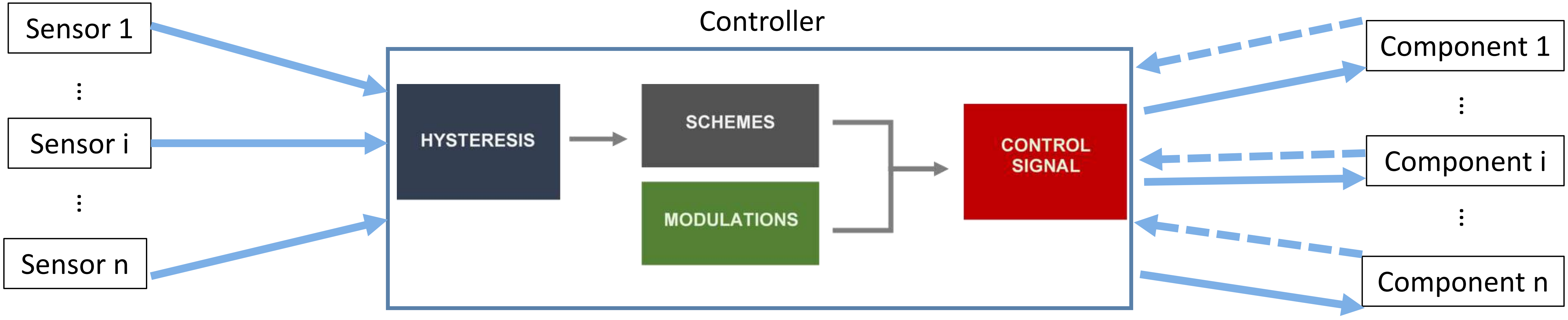


Parameter	External Venetian Blinds	Integrated Venetian Blinds
T_i	Thermal zone internal temperature	
T_{low}	22°C	22°C
T_{up}	26°C	25°C
G_k	Irradiance incident on facade	
G_{min}	300 W/m²	300 W/m²



Control strategy and harmonization of technologies

- How is the control implemented?
  1. The control is implemented in different blocks

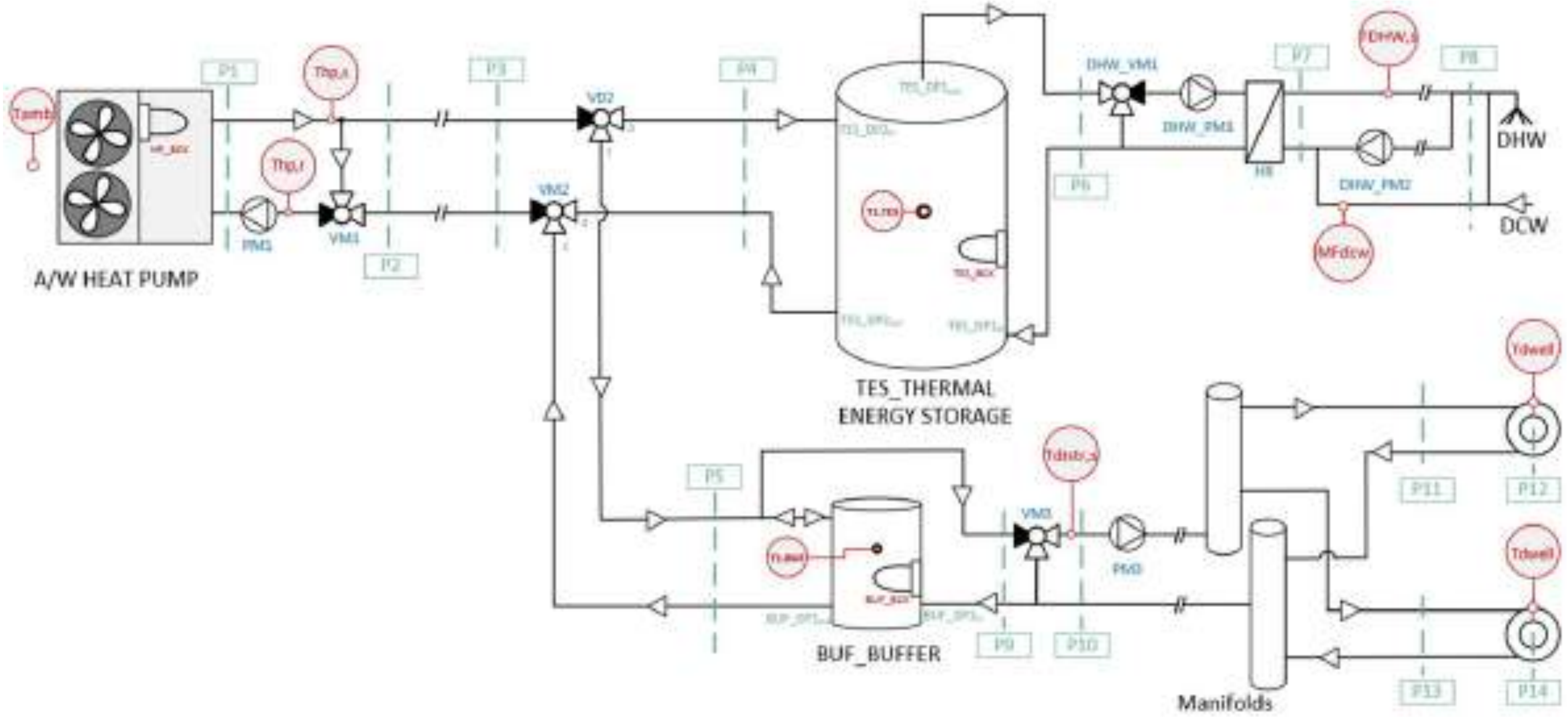


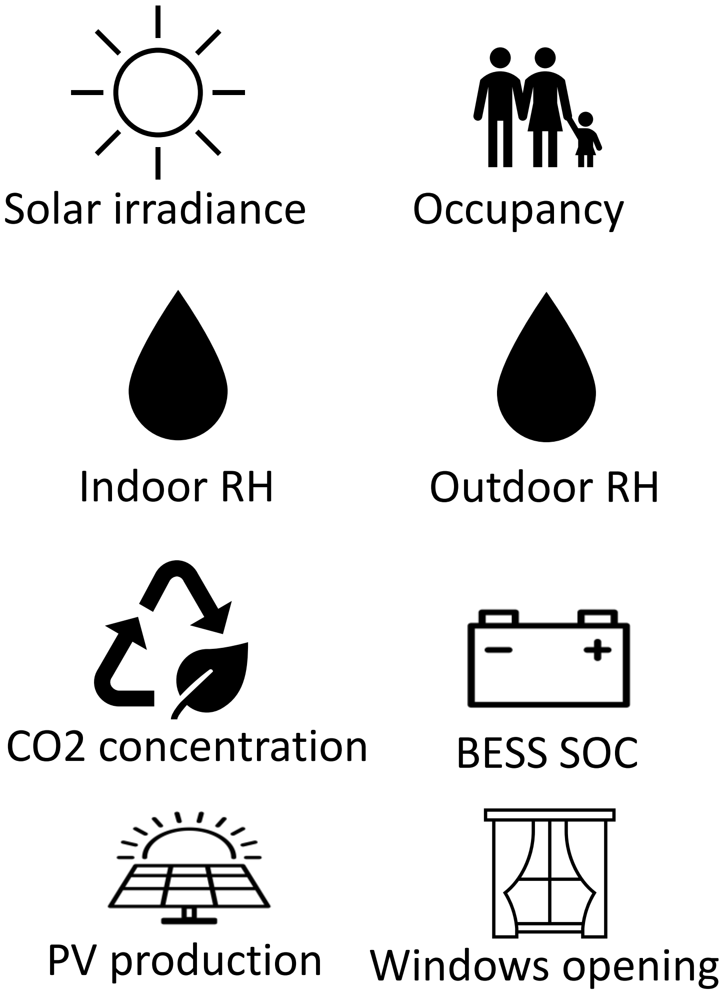
Control strategy and harmonization of technologies

- How is the control implemented?
    1. The control is implemented in different blocks
    2. The components give feedback signals to the controller
    3. The different sensors acquire the information and send them to the controller
    4. The hysteresis compare the incoming signals with the provided setpoints (upper and lower dead bands)
    5. The signals provided by the hysteresis are used to define the working schemes of the system
    6. The modulations are computed according to the acquired information arriving from the sensors
    7. Schemes and modulations are combined to generate the control signals that act on the actuators in the system
    8. For advanced control only → daily prediction of electrical energy consumption and production

Control strategy and harmonization of technologies

- Sensors





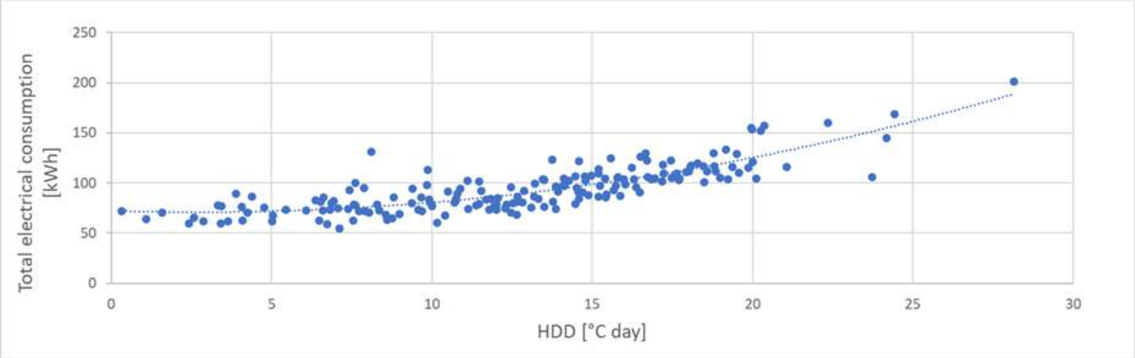
Implementation of solution sets in TRNSYS
Control strategy and harmonization of technologies

- Harmonization of technologies

1. When the windows are open the heating setpoint in winter is shifted down to avoid to waste thermal energy
2. When the ceiling fans are activated (during summer operation) the cooling setpoint is shifted up to reduce the consumption while maintaining the thermal comfort
3. The BESS prioritizes the direct use of electricity
4. The heat pump setpoints are modified in accordance with the current status of the energy system
5. Change of the setpoints (TES and indoor temperature) in accordance with the predicted PV production and predicted building electricity consumption on a daily basis to try to match energy demand and production

Control strategy and harmonization of technologies

Prediction of daily electrical energy consumption

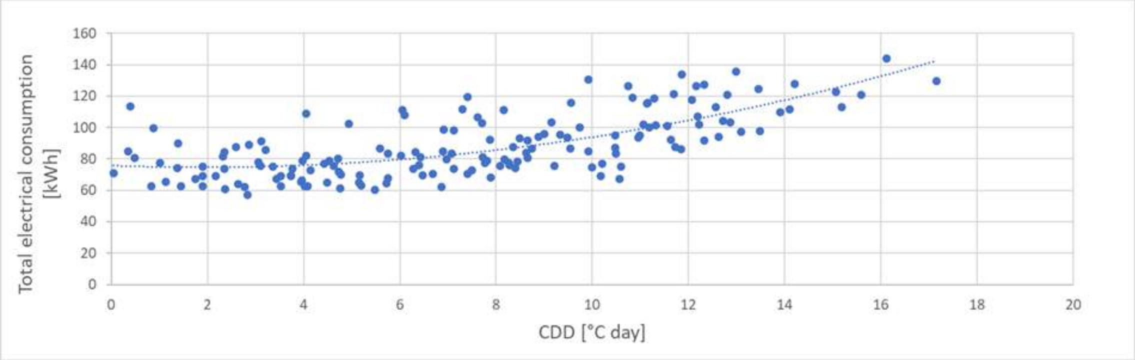


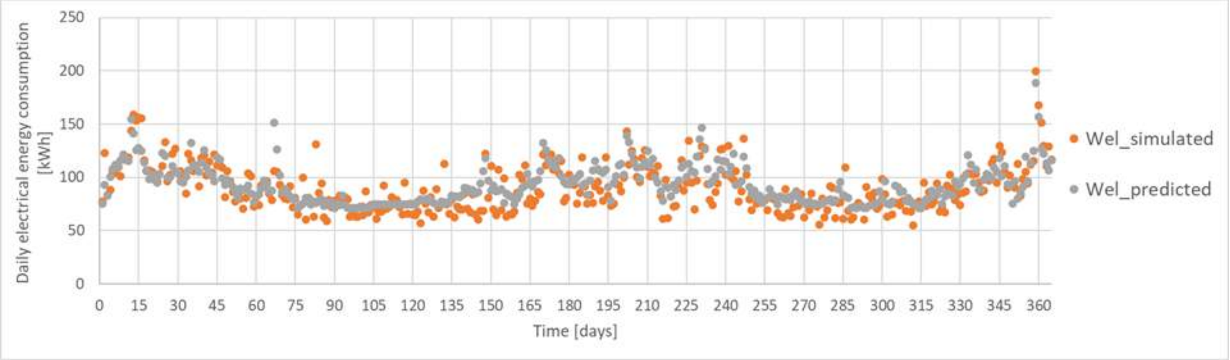
$$HDD = MAX(20 - T_{air,ave,day}, 0)\ [°C * day]$$

$$CDD = MAX(T_{air,ave,day} - 15{,}0)\ [°C * day]$$

$$W_{el,predicted} = A_{0,H} + A_{1,H} \cdot HDD + A_{2,H} \cdot HDD^2\ [kWh]$$

$$W_{el,predicted} = A_{0,C} + A_{1,C} \cdot CDD + A_{2,C} \cdot CDD^2\ [kWh]$$

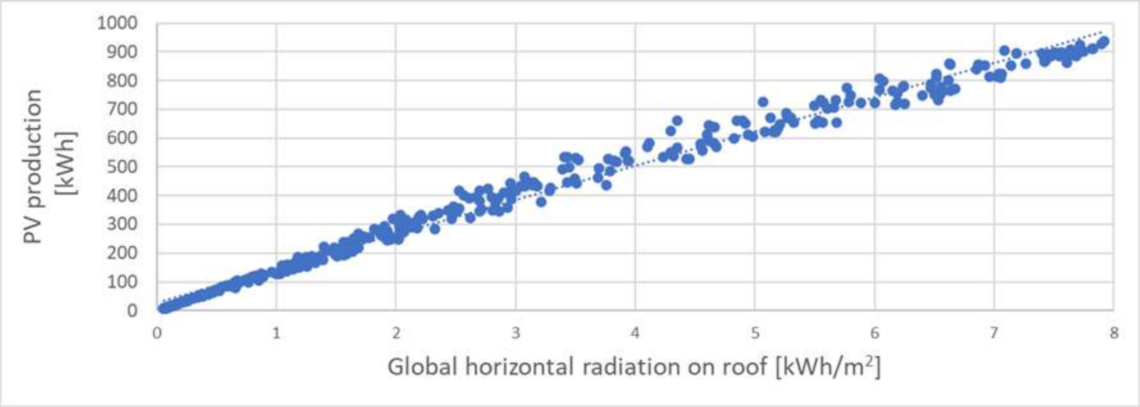


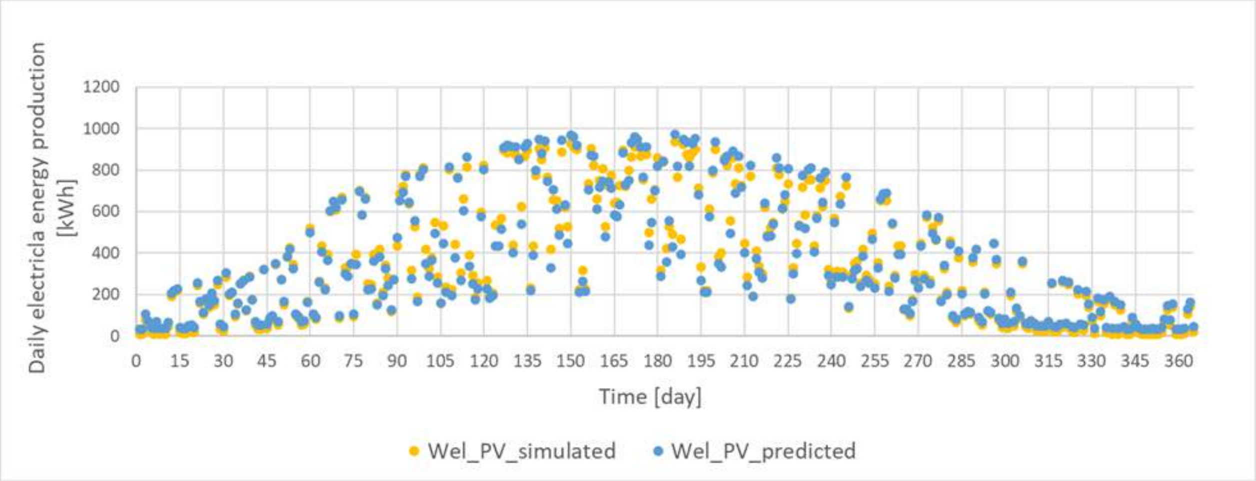


Control strategy and harmonization of technologies

Prediction of daily electrical energy production

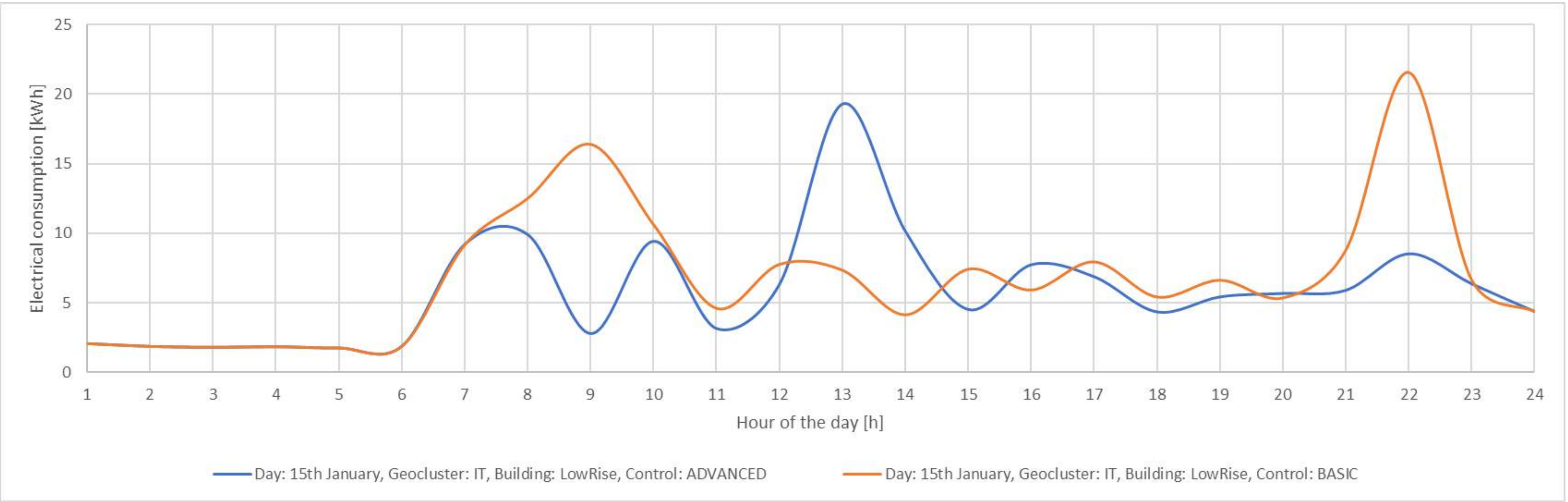
$$W_{el,PV,predicted} = A_{1,PV} \cdot IT_{roof}\ [kWh]$$





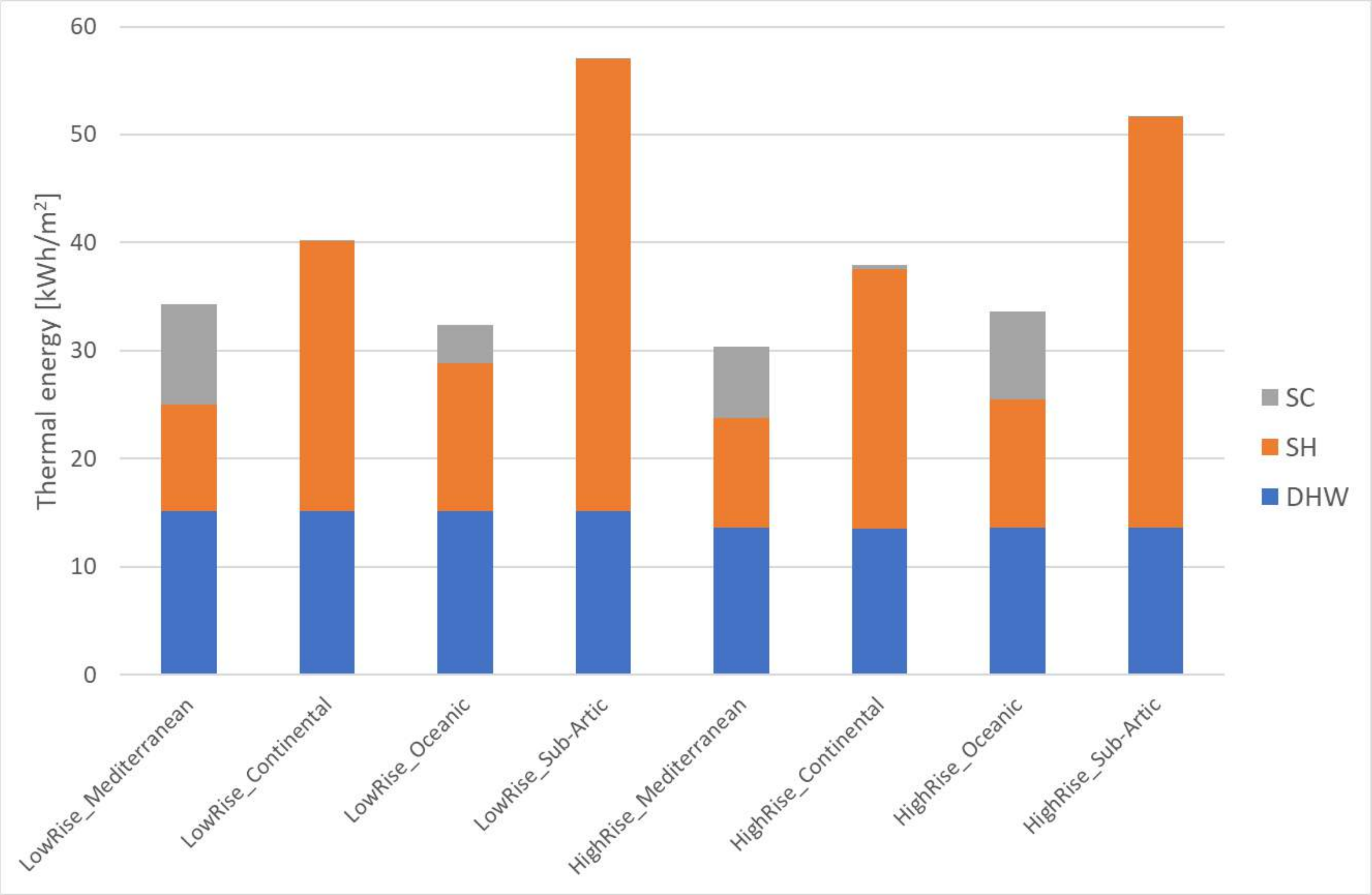
Control strategy and harmonization of technologies

Prediction of daily electrical energy production



Simulation's results

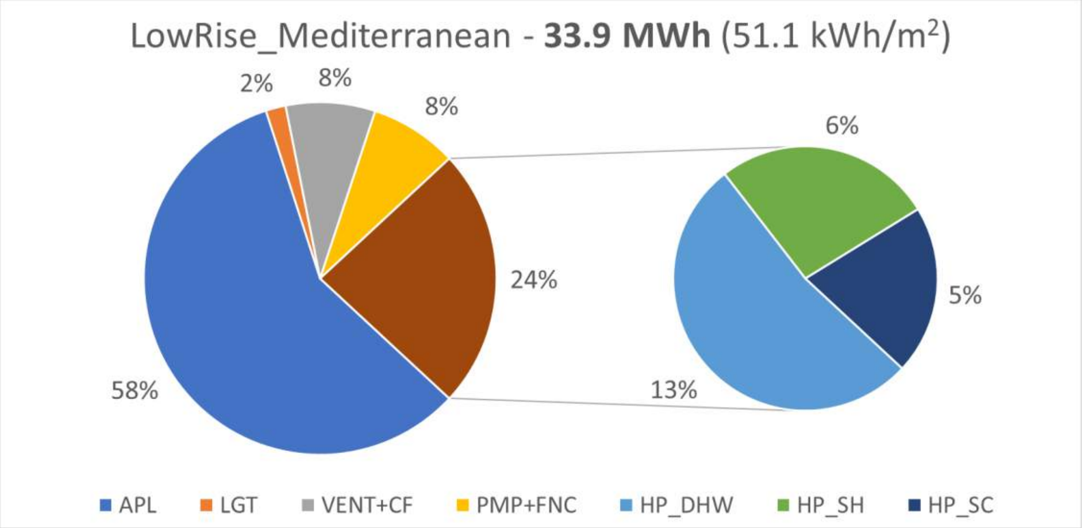
Thermal energy provided by the energy system to the building

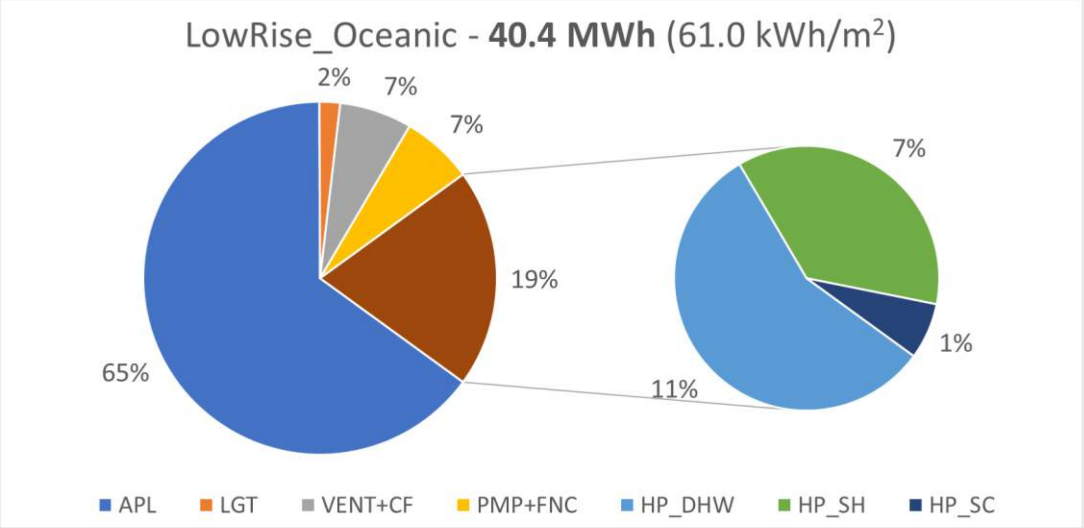


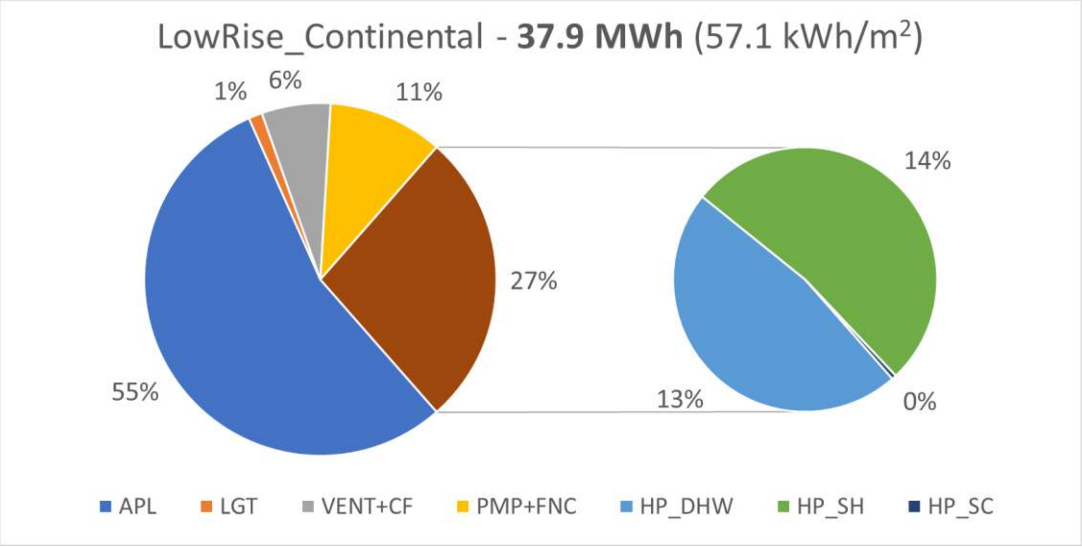
		CO_2 concentration	Yearly hours within indoor temperature ranges	Yearly hours within indoor relative humidity ranges
		[ppm]	[%]	[%]
LowRise	Mediterranean	702	99.3%	92.9%
	Continental	650	97.5%	96.9%
	Oceanic	710	100.0%	88.5%
	Sub-Artic	704	99.7%	94.0%
HighRise	Mediterranean	697	98.8%	94.1%
	Continental	644	96.5%	97.4%
	Oceanic	850	98.4%	89.9%
	Sub-Artic	705	92.6%	92.3%

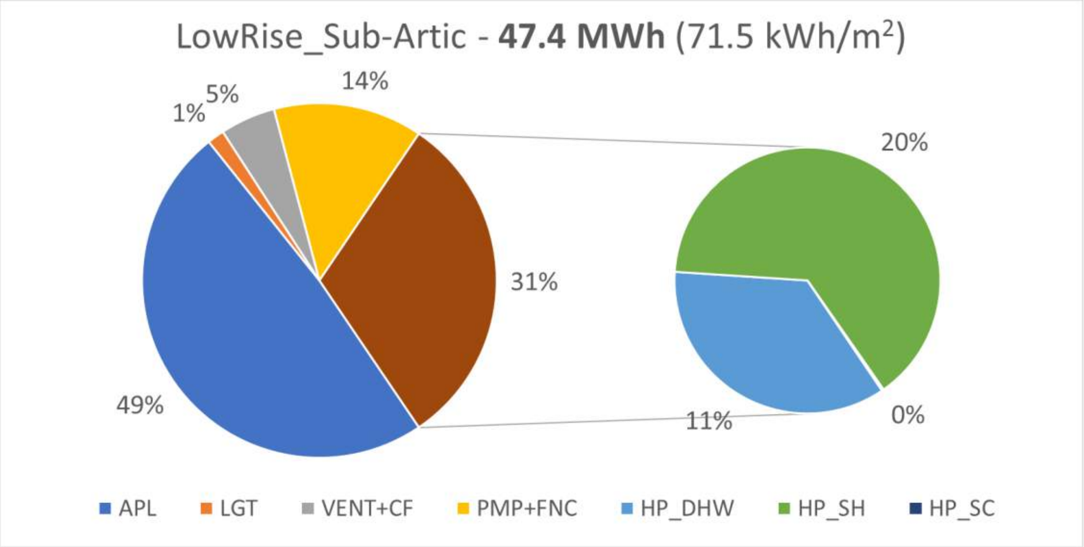
Simulation's results

APL → plug-load
LGT → Lighting
VENT+CF → Ventilation and ceiling fans
PMP+FNC → pumps, valves, fan coils and auxiliaries
HP → Heat Pump for (DHW, SH and SH)









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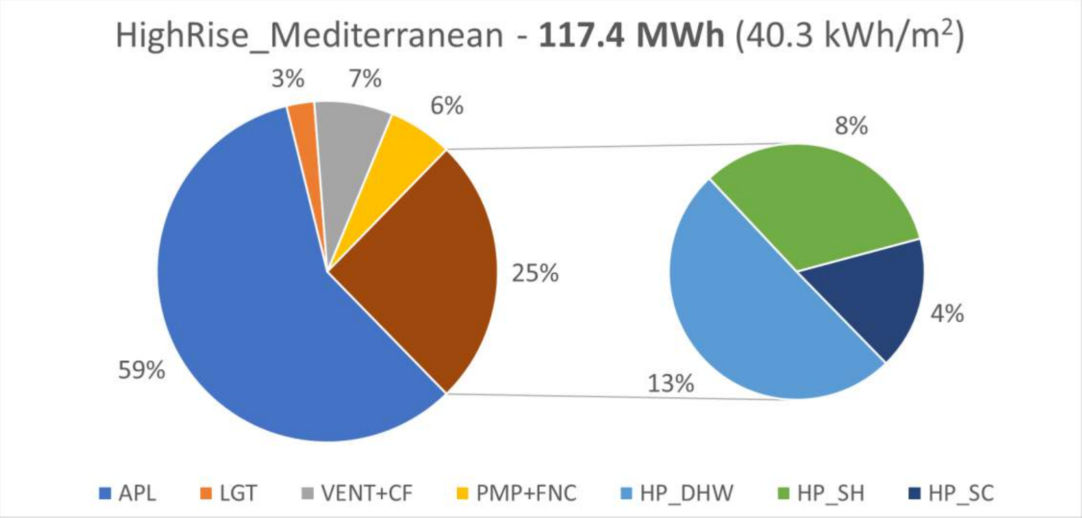
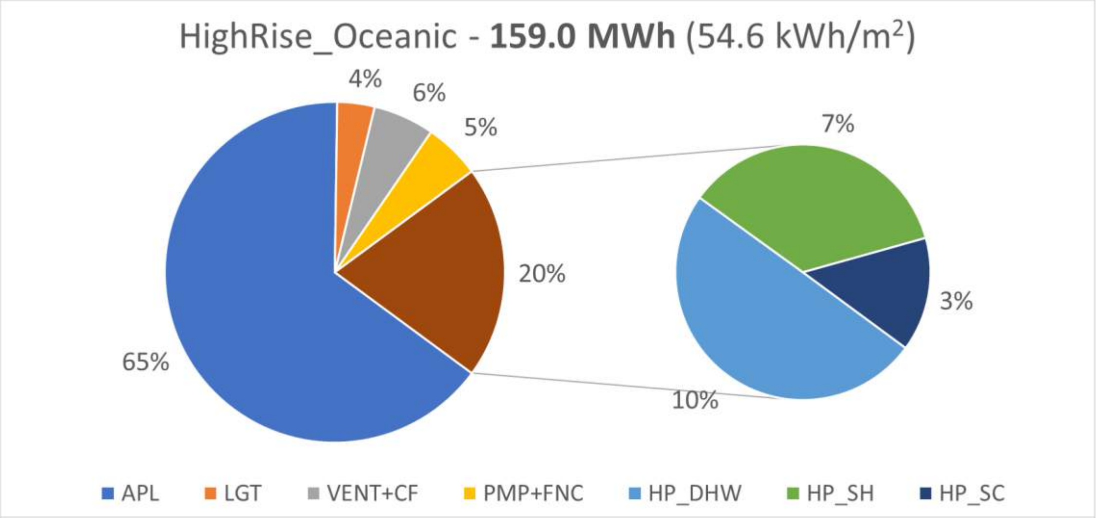
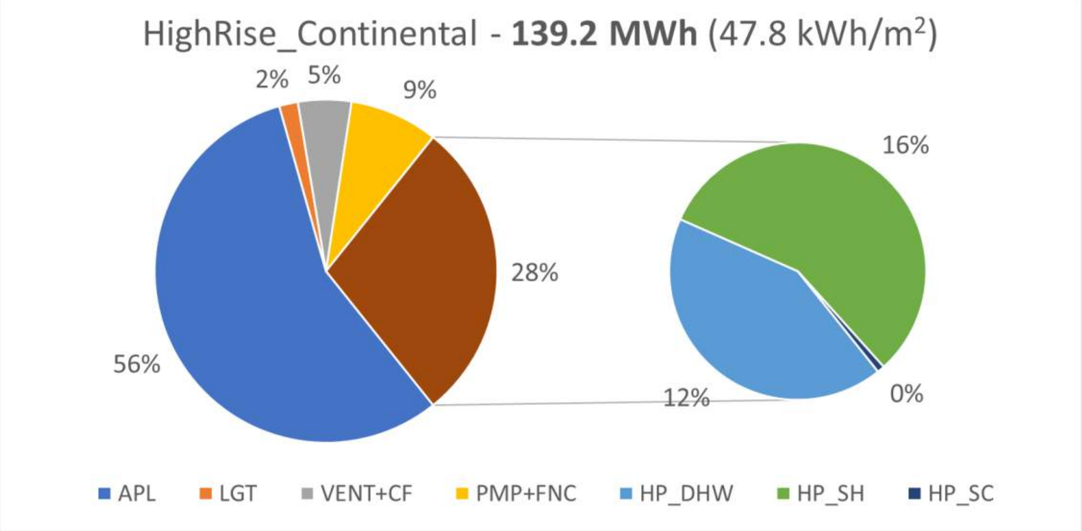
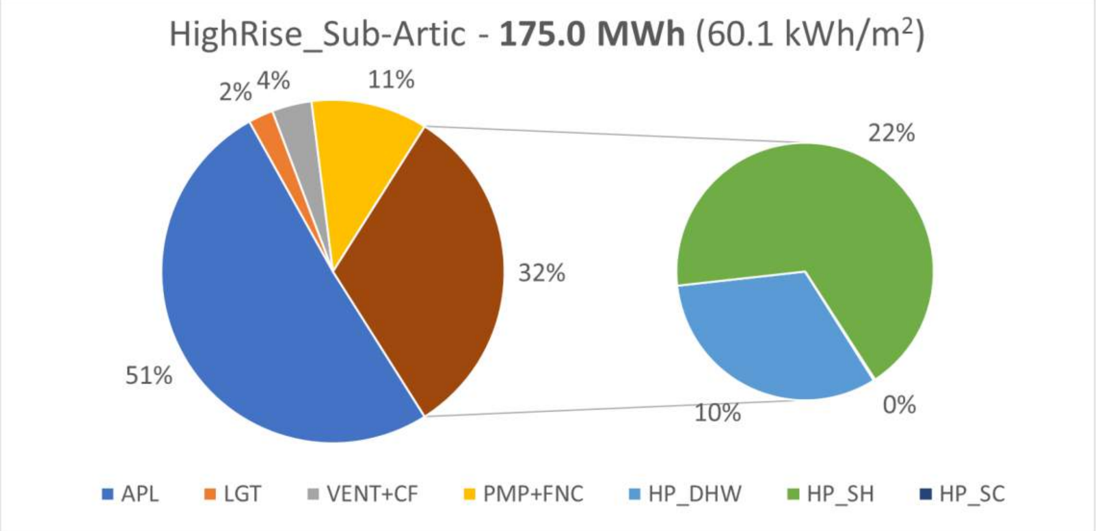


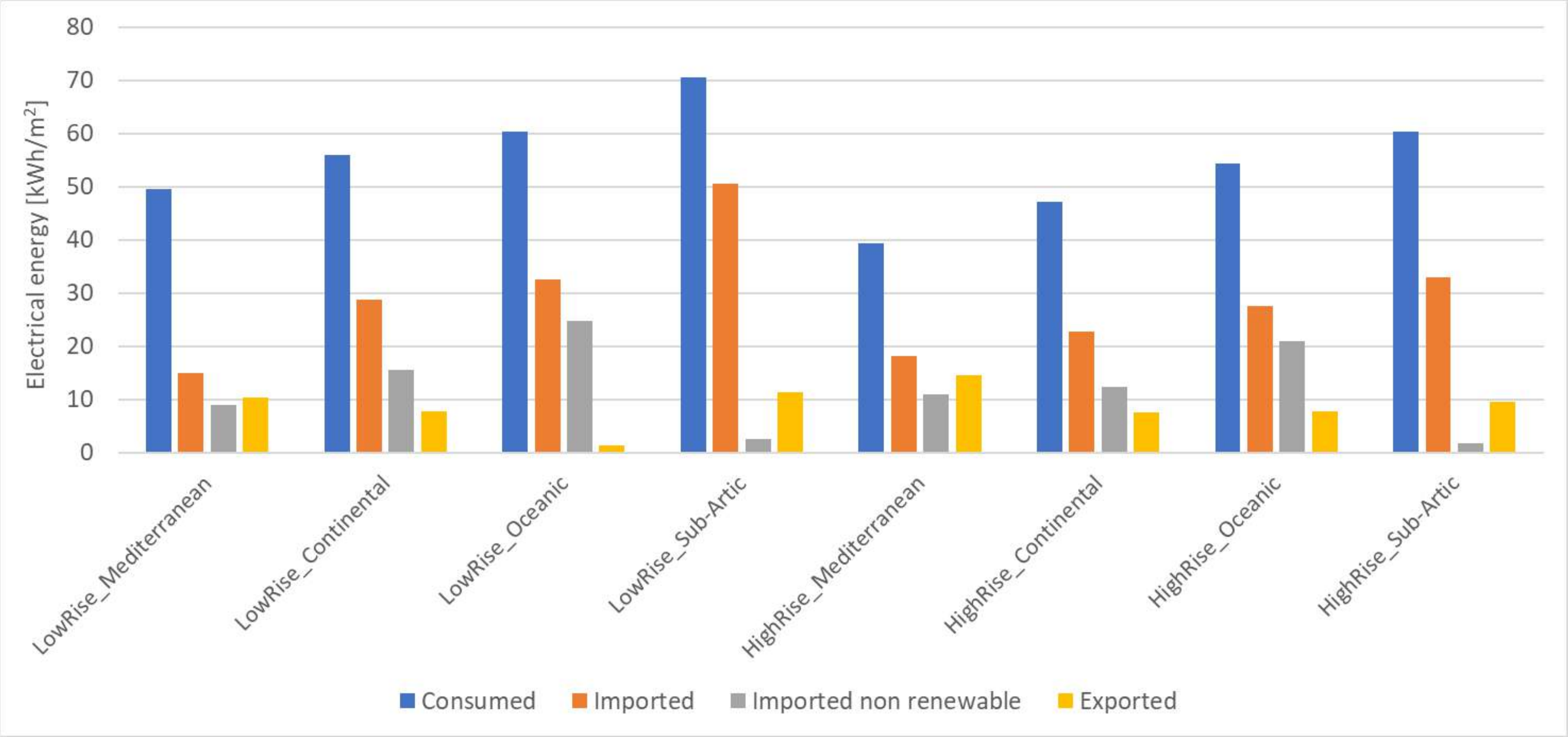






Simulation's results

Energy balance



		Self sufficiency [%]	Self consumption [%]
LowRise	Mediterranean	71.6%	59.2%
	Continental	50.4%	59.9%
	Oceanic	46.4%	70.4%
	Sub-Artic	30.7%	52.7%
HighRise	Mediterranean	57.6%	50.1%
	Continental	54.3%	63.2%
	Oceanic	51.7%	62.7%
	Sub-Artic	47.1%	61.5%

Conclusions

- It is possible to reduce the total consumption of a building by implementing a control that harmonizes the operation of different technologies
- The energy system proposed as reference is able to provide a sufficient comfort to the user in each climate, but it is not the optimal solution for each geo-cluster
- The Continental and Sub-Artic climates have a very little space cooling demand, which can be covered by implementing a device to force air movement such as ceiling fans. However, the lower height of the ceiling might be a constrain
- In each application, most of the total electrical consumption is due to plug loads, which are difficult to reduce or to shift in time. Users' awareness is fundamental
- The advanced control is able to shift the thermal loads to match the RES production. Nevertheless, it is not able to reduce the total electrical energy consumption
- The high-rise building has a lower specific energy consumption, mainly due to the lower S/V ratio
- With the considered PV surface and size of the BESS it is not possible to cover the entire building load, meaning that the building is not self-sufficient. Increasing the size of the PV would increase the self-sufficiency while increasing the size of the BESS would increase the self-consumption. However, there are seasonal behavior (especially in norther climates) which must be considered
- To reach the Plus Energy Building goal it is necessary to compare the exported electrical energy account only for the non-renewable imported energy. This achievement of this goal also depends on the national energy mix. In the analysis nuclear power was not considered as renewable

Thank you for your attention!

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Francesco Turrin

francesco.turrin@eurac.edu

+39 0471 055648

Institute for Renewable Energy

Eurac Research

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 870072

POLL 1

Moderated by Francesco Turrin

Environmental lifecycle assessment of Plus Energy Houses

Roberta Di Bari, University of Stuttgart

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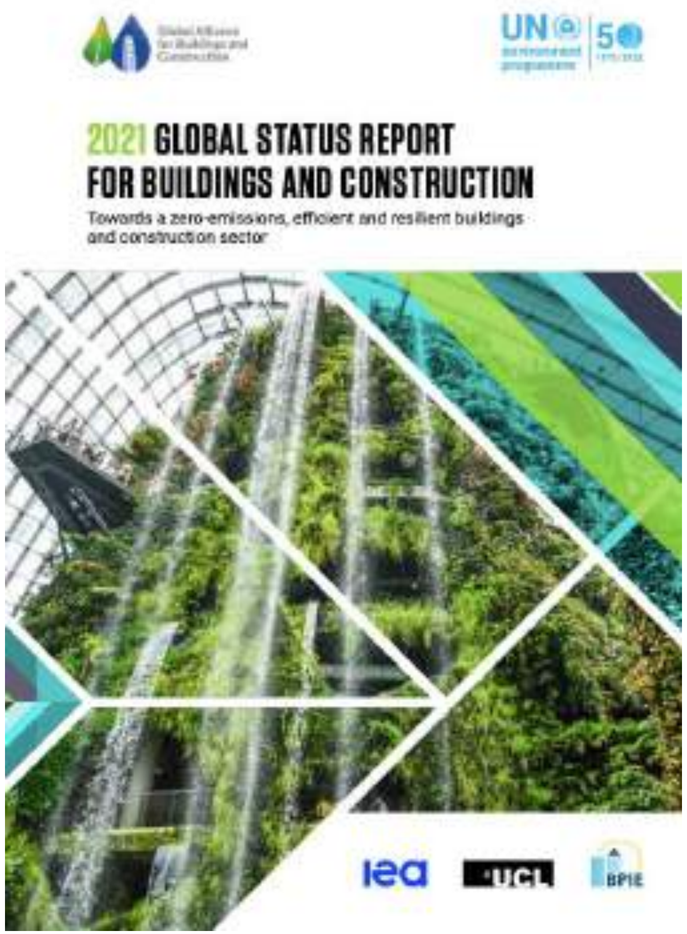
Introduction

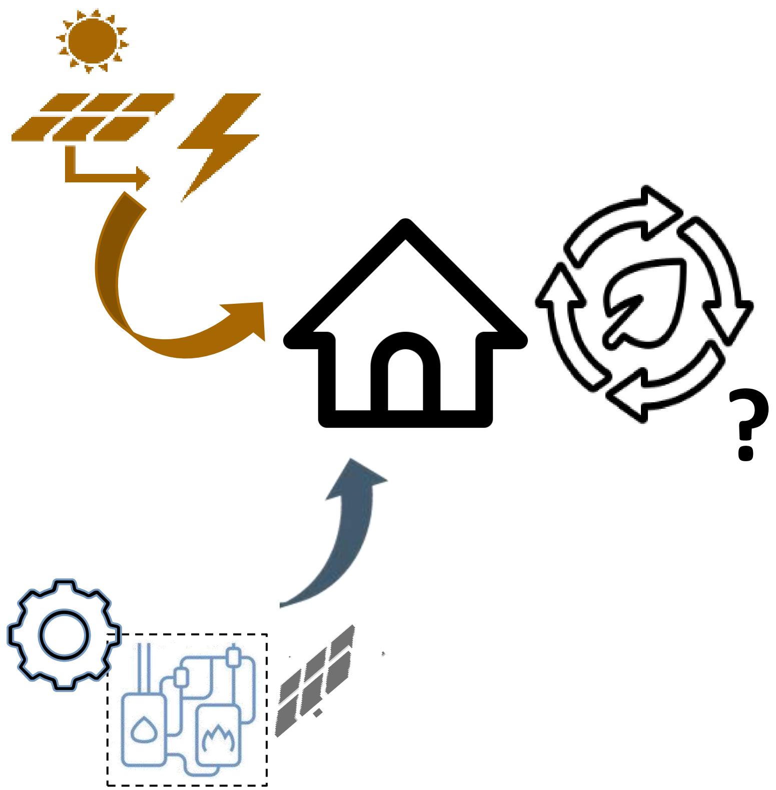
- *Global Status Report 2021: urgent application of measures for decreasing emissions and energy consumption in buildings*
- *Passive and zero-energy building offer new perspectives aiming also to carbon neutrality by 2050*



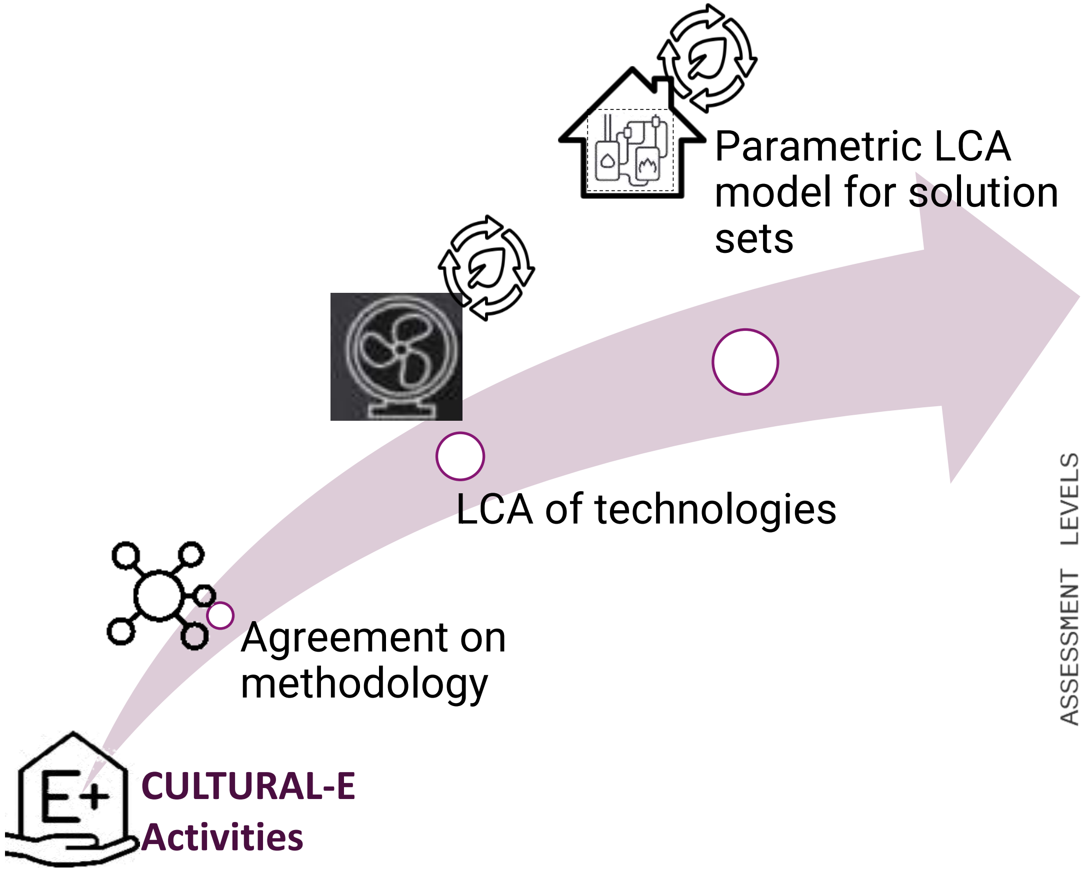
Introduction

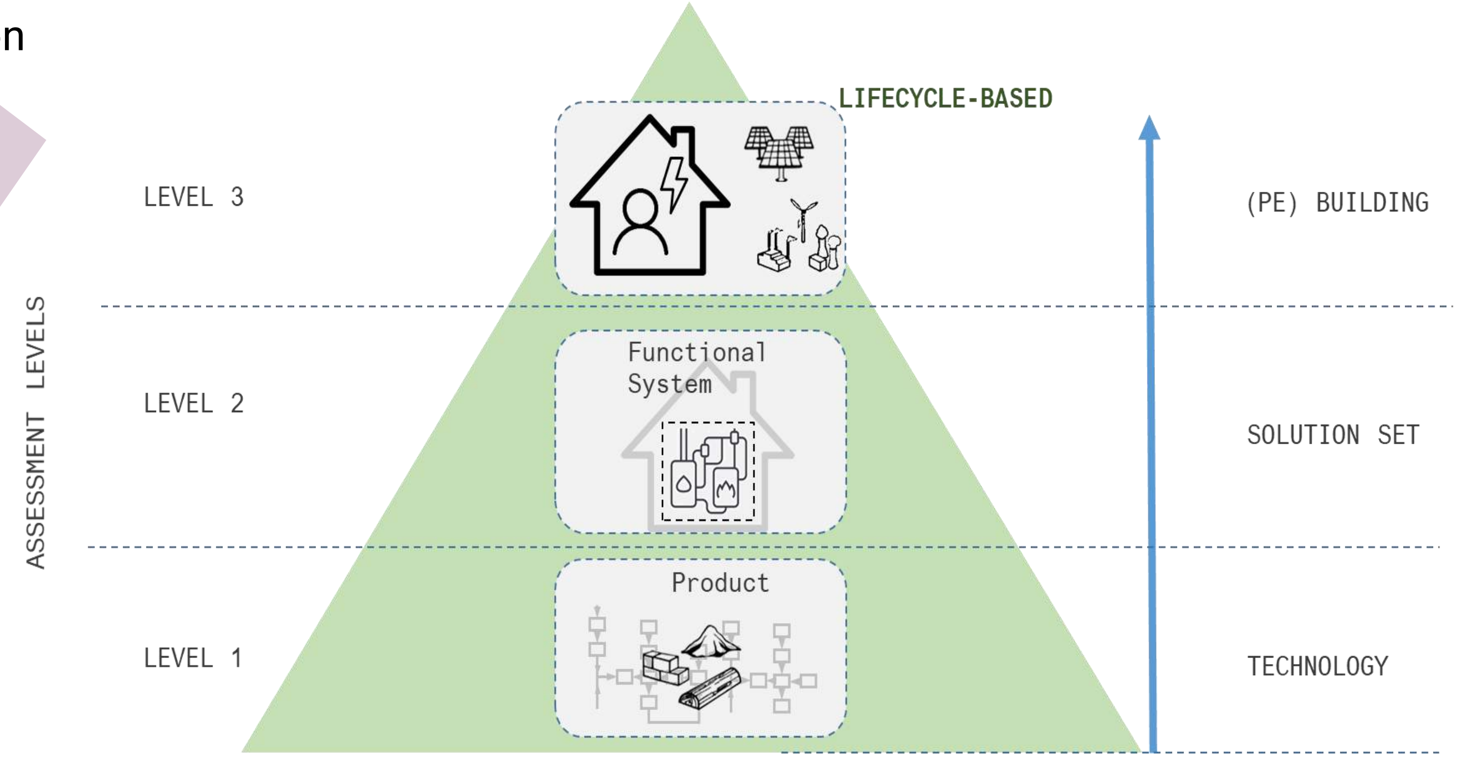
Increasing interest in Plus Energy Buildings (PEBs)

- *Decrease operational energy consumption*
- *Increasing amount of materials and installation components*
- *Life Cycle Assessment (LCA) for quantifying lifecycle environmental impacts*



Life Cycle Assessment of PEHs in CULTURAL-E





LCA of CULTURAL –E technologies

Goal of the analysis

Comparing innovative technologies with traditional ones

Identify improvements potential

Provide feedbacks to developers

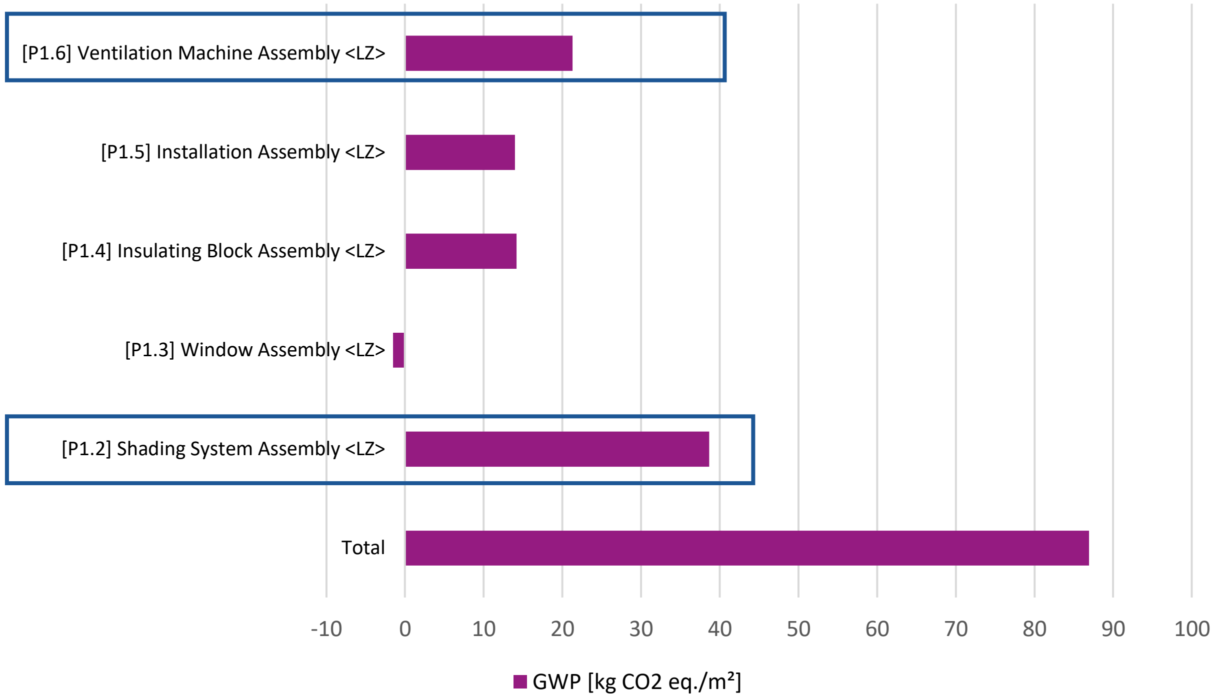
LCA of CULTURAL –E technologies

Opportunities

Ventilations and shading systems affects mostly the GWP. The production of both technology does not belong to own developer.

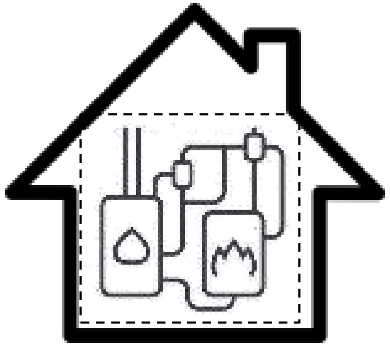
AWS introduces functional assemblies not envisaged normally with traditional technologies.

EUROFINESTRA Active window (AWS)

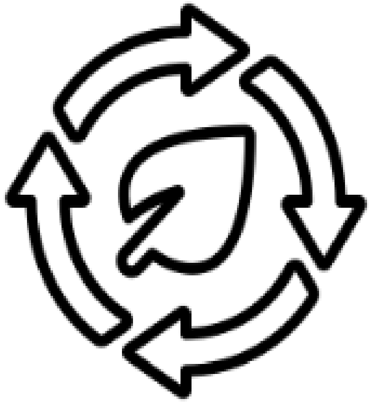


LCA of CULTURAL-E solution sets

Goal of the analysis



Parametric modelling
for LCA

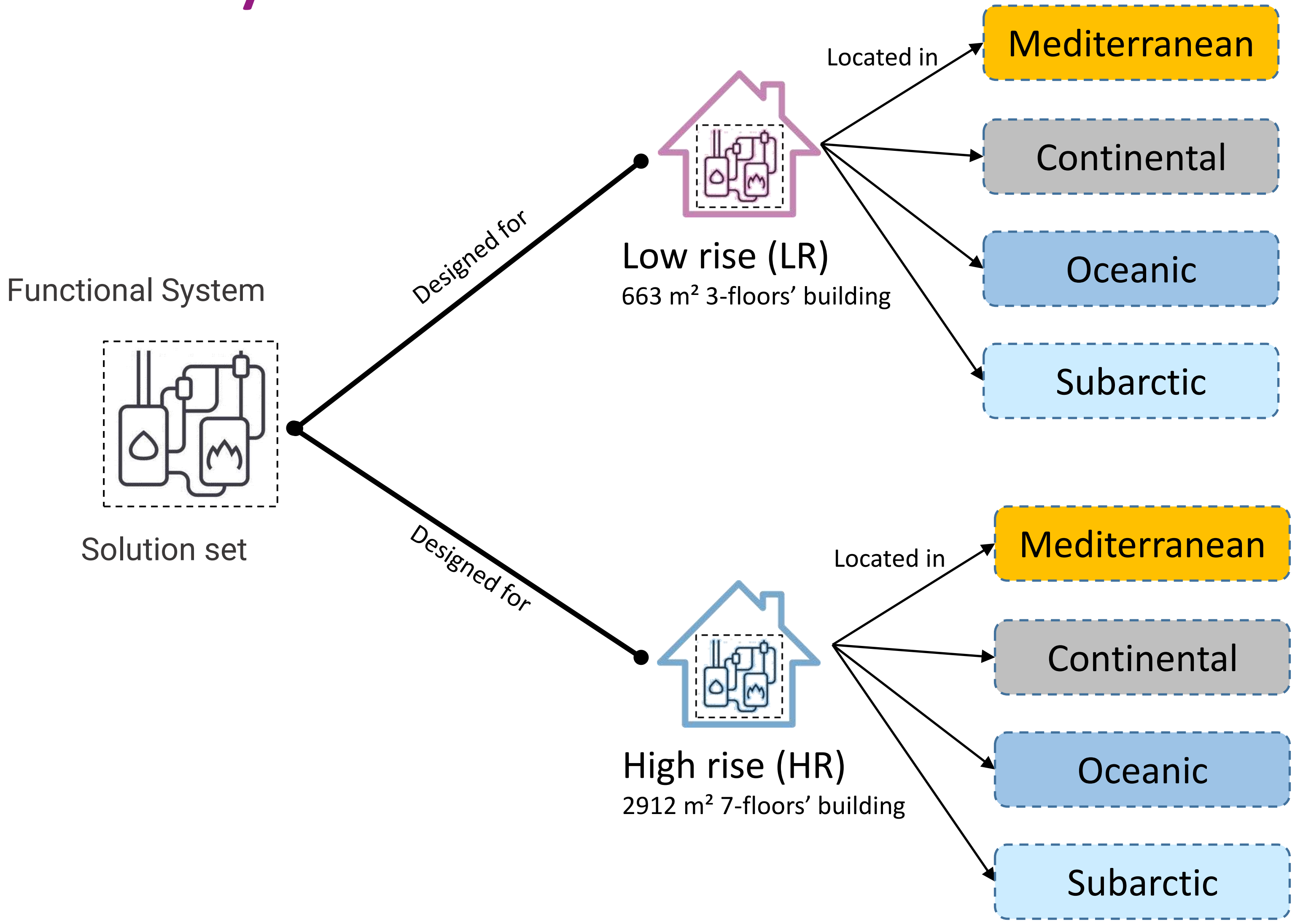


Assess their environmental

potential

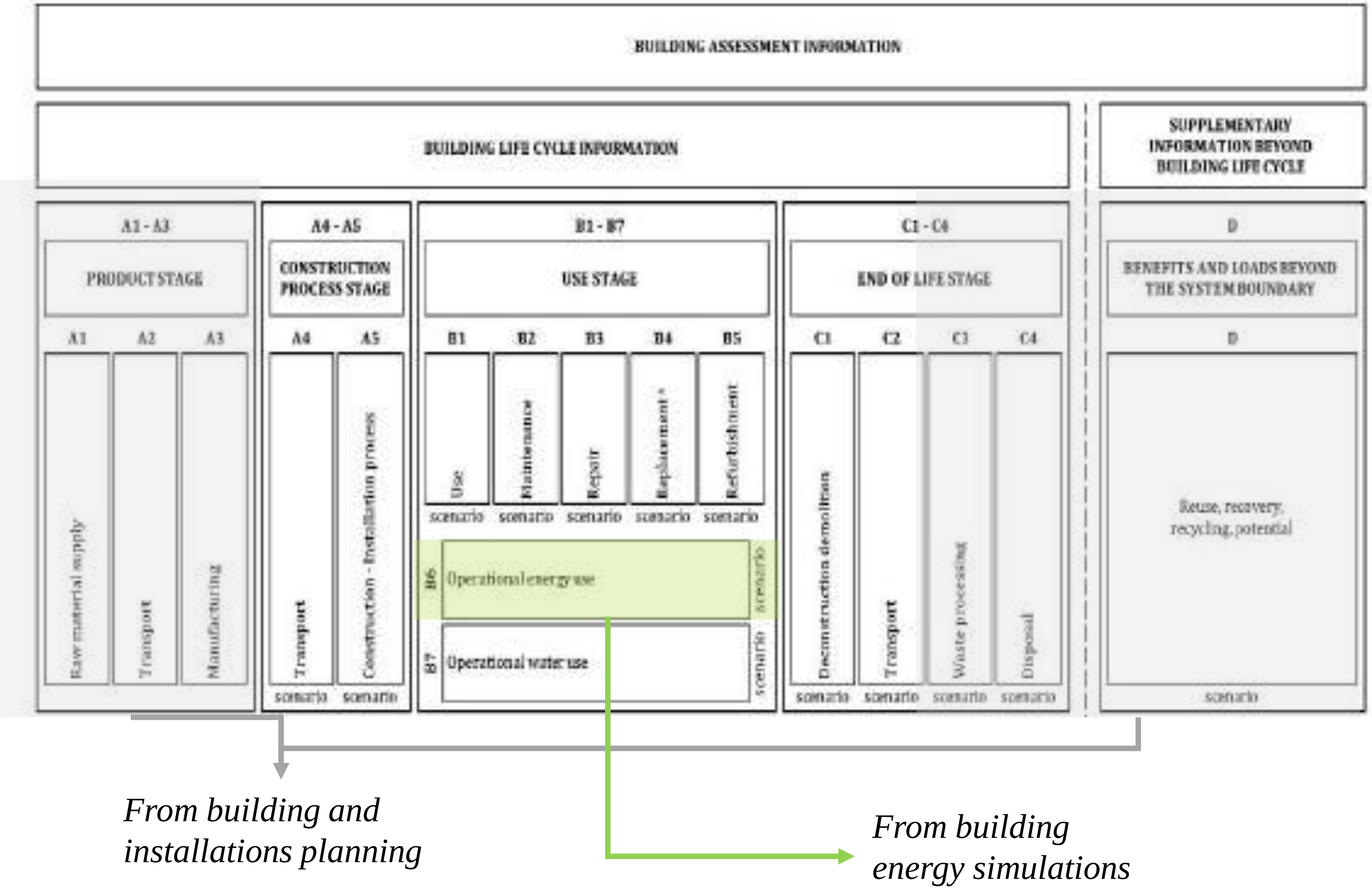
Explore benefits in different
climate- cultural contexts

Case study and results



8 Total Case studies

Case study and results

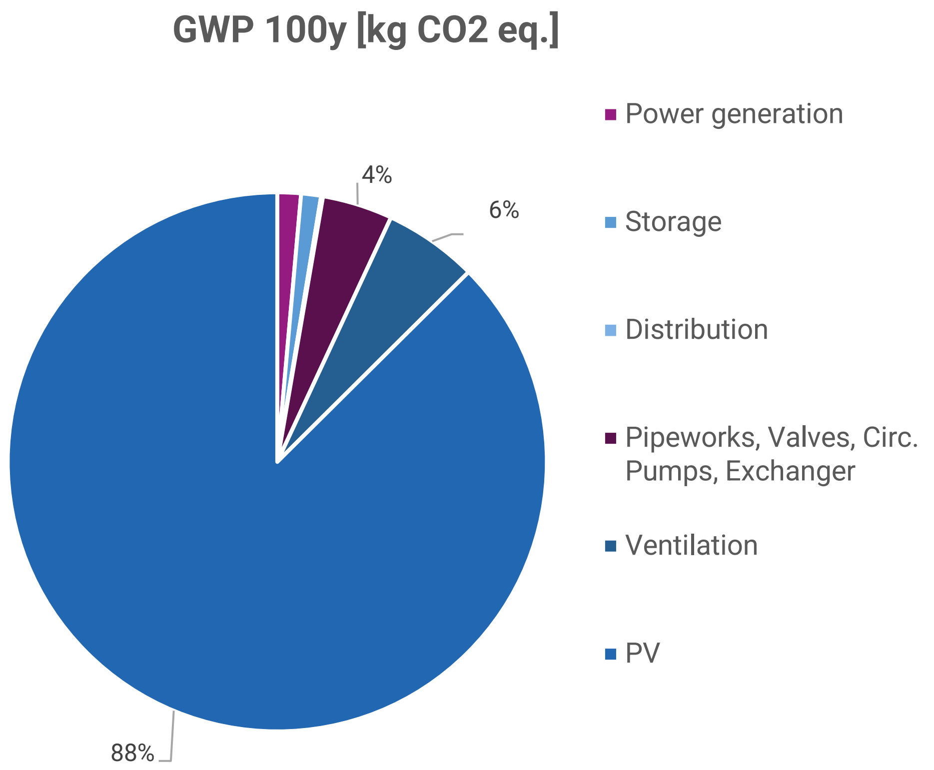


LCA specifications (based on ISO 14044)	
FU (functional unit)	1 m² NFA*y
Lifespan duration	30 years
Impact categories	Global Warming Potential - GWP in kg. CO_2 eq.
Environmental database	Ökobau.dat, Environmental Product Declaration (EPDs)

Case study and results

Component type	Specifications	LR	HR
PWG	Air-Water heat pump - heating, cooling, DHW by fresh water stations	50 kW	150 kW
TES	Water Storage+ Heating/Cooling buffer in stainless steel units – XPS insulation	1000 l + 500 l Buffer	3000 l + 1500 l Buffer
DISTR	Low temperature fan coil, free cooling	950 W	950 W
VEN	Ventilation and air treatment		
PIP	Copper pipes with XPS insulation. Stainless steel elements (Valves, Circulation pumps and Heat exchanger)	ø52cm x 3m ø38mm x 10m ø38mm x 10m	ø52cm x 3m ø38mm x 22m ø38mm x 22m
PV	Average technology with battery, sized to provide a positive balance	240 m² (estimated)	528 m² (estimated)

Component	**LR**	**HR**
	GWP [kg CO_2 eq.]	GWP [kg CO_2 eq.]
Tot. embodied [impact/m²]	**111.8**	**57.36**
Tot. embodied [impact/m²*y]	**3.762**	**1.948**

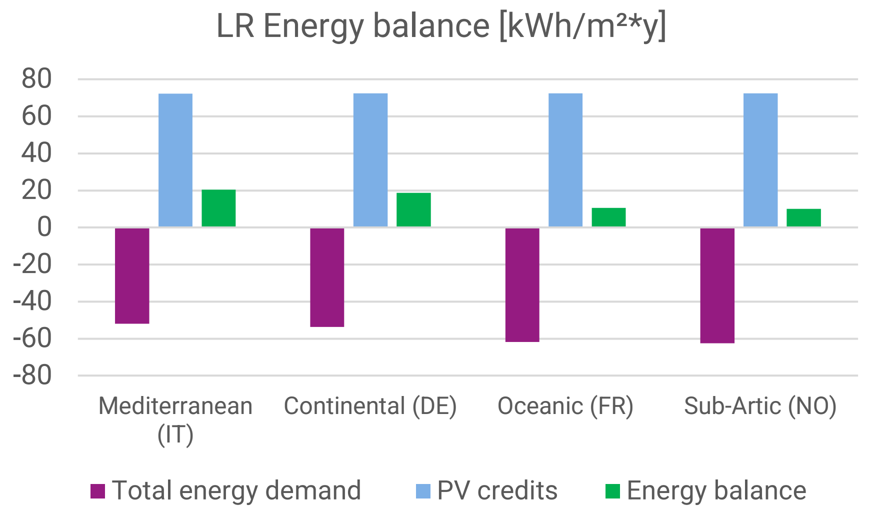


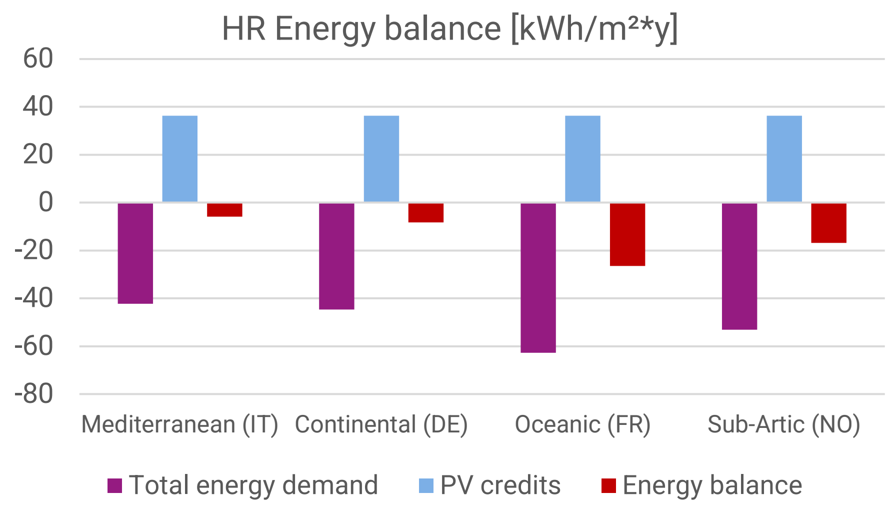
Case study and results

Electricity mix	(IT)	(DE)	(FR)	(NO)
[kg CO_2 eq./kWh]	0.285	0.337	0.057	0.027

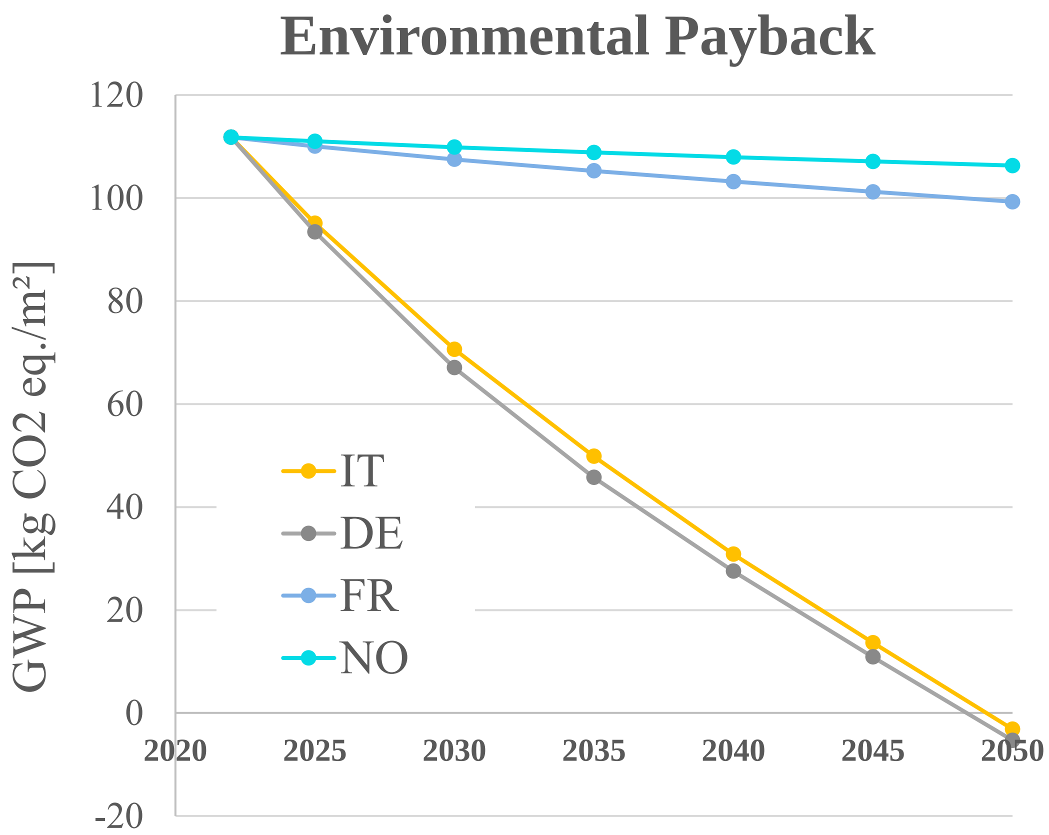
LOW RISE	Mediterranean (IT)	Continental (DE)	Oceanic (FR)	Sub-Artic (NO)
Energy balance [kWh/m²*y]	+20,4	+18.8	+10.6	+10.0
[kg CO_2 eq./m²*y]	-5.80	-6.34	-0.6	-0.31

HIGH RISE	Mediterranean (IT)	Continental (DE)	Oceanic (FR)	Sub-Artic (NO)
Energy balance [kWh/m²*y]	-5.9	-8.3	-26.5	-16.8
[kg CO_2 eq./m²*y]	1.69	2.81	1.51	0.52





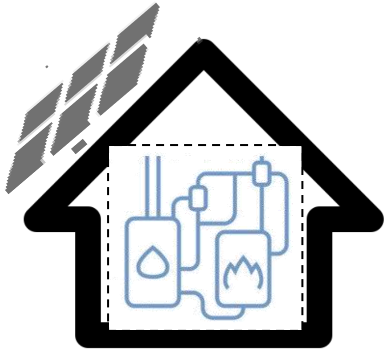
Case study and results



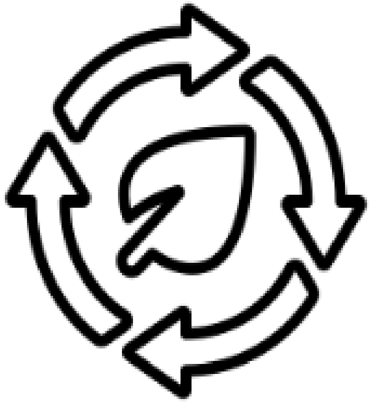
- → **Payback (PB) periods** calculated by assuming a variable (*dynamic*) electricity mix (EU scenario 2020).
- → Italian and German examples reach environmental payback periods by 2050.
- → In the French and Norwegian cases, slower trend
- → Payback periods affected by the carbon intensities of current national electricity generation.

LCA of CULTURAL-E demo cases

Goal of the analysis



LCA on an actual (non-fictive) case study



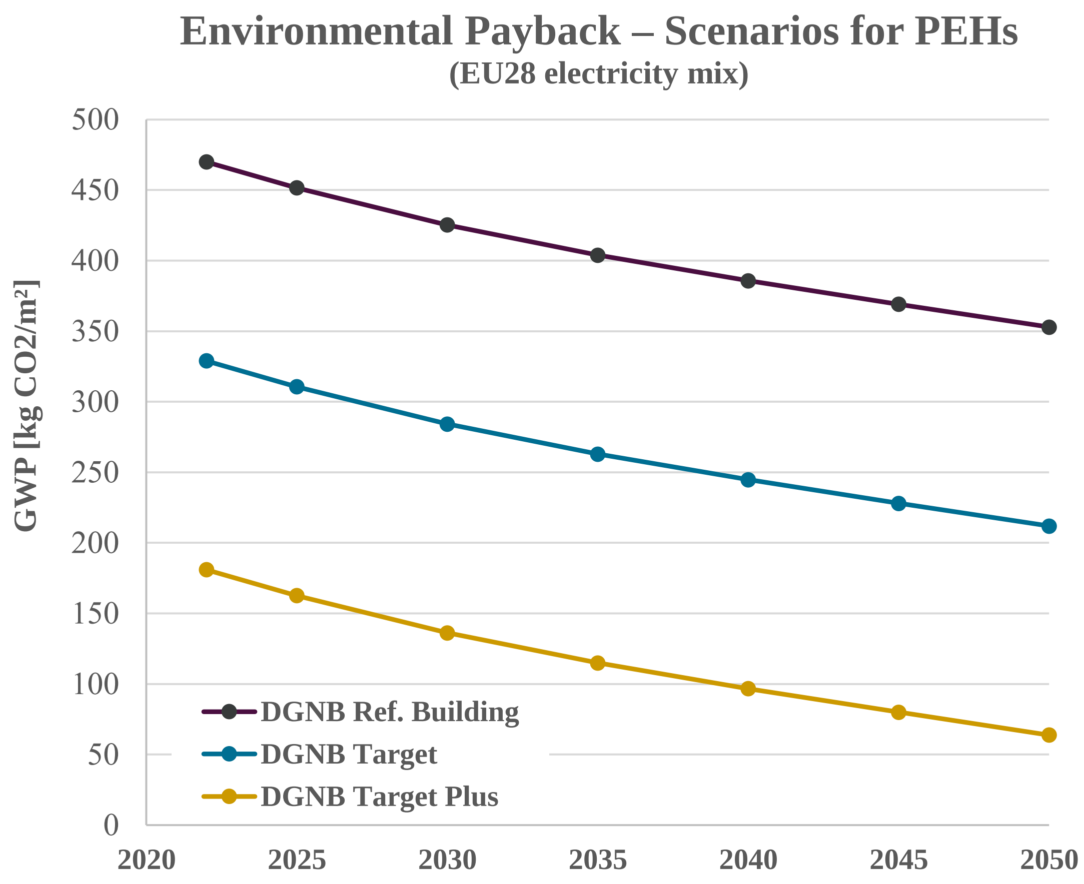
Assessment environmental potential

Explore benefits in different climate- cultural contexts

Outlooks for LCA of PEHs

- **3 Scenarios for Germany according to DGNB reference and target values**

- **PB Periods**
  - Reference Building: year 2159
  - Target Building: year 2116
  - Target Plus building: year 2070



Conclusion

- Performance level differences

- Effects related to
  - design choices,
  - cultural-climate context and
  - national energy generation.

Conclusion

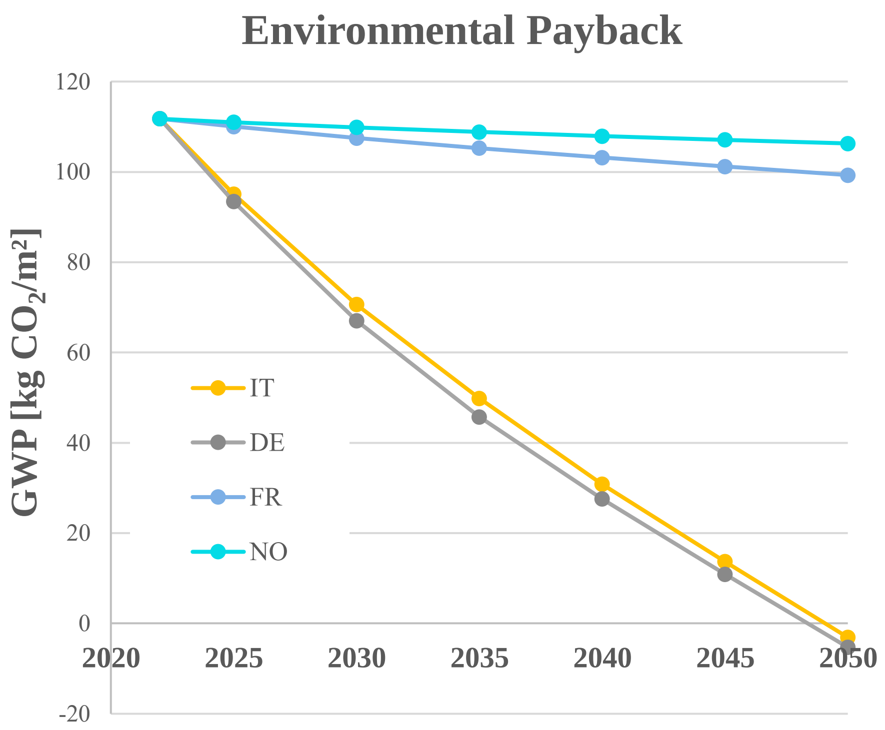
- **Design choices**
  - PV modules are main responsible of total embodied impacts.
  - Building type may dictate also the operational energy. Within high rise buildings, other surfaces besides roofs need to be spotted aiming at a positive energy balance.

- **Climate context**
  - Due to lower temperatures and annual solar yields, Continental and sub-arctic area reached less energy credits.
  - Continental and sub-arctic area present also higher user-related energy consumption

Conclusion

- **National energy generation**
  - higher effectiveness in Italian and German contexts.

All analyses and observations to be addressed also *on the whole building level*



Thank you for your attention!

Roberta Di Bari

University of Stuttgart
Institute for Acoustics and Building Physics
Department of Life Cycle Engineering

Email: roberta.di-bari@iabp.uni-stuttgart.de

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POLL 2

Moderated by Roberta Di Bari

LCC and Business Models to Support PEB Dissemination

Dr. Hermann Leis

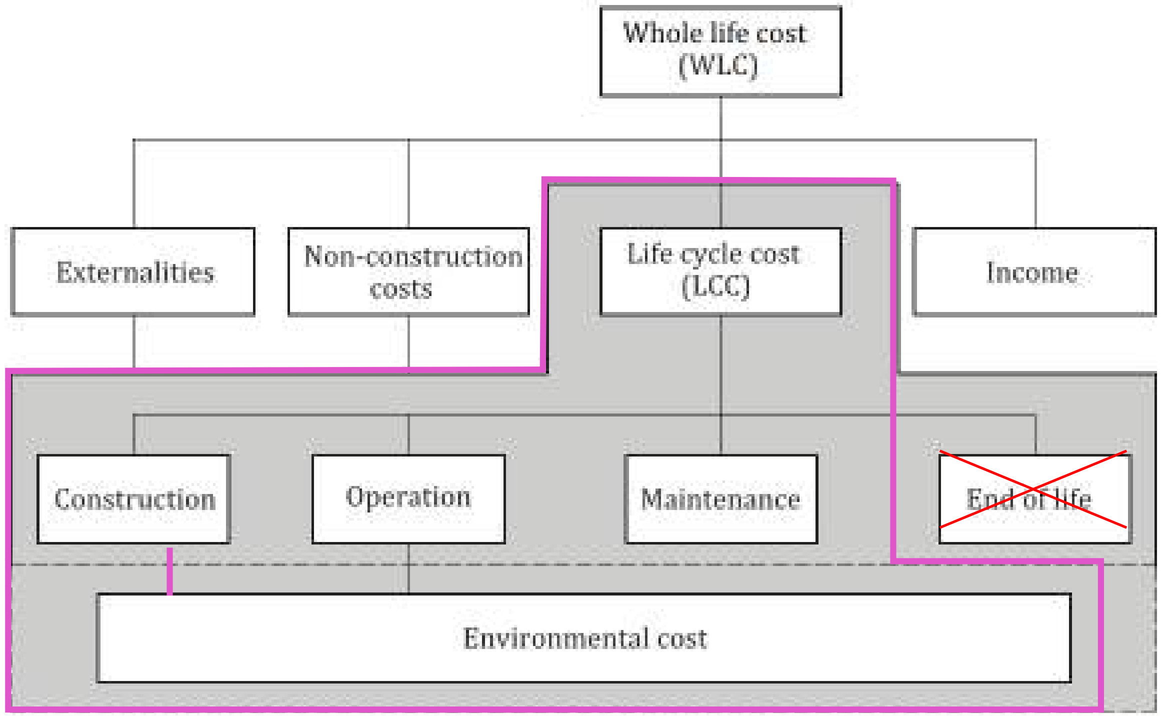
siz energieplus

16th May 2023

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 870072

Overview LCC

Costs included in LCC



End of life costs are neglegted, because of too many unknowns to quantify these costs, which will only be incurred in 30 or 50 years.

Environmental cost:

e.g. taxes, CO_2- or other levies, co-impacts

reference: ISO 15686-5:2017

LCC analysis of PEB

Considered cost

- Construction cost
- Cost for replacement due to limited life span
- Maintenance + service
- Energy cost (operation)
- Revenues from energy sales (PV-electricity)

LCC analysis of PEB

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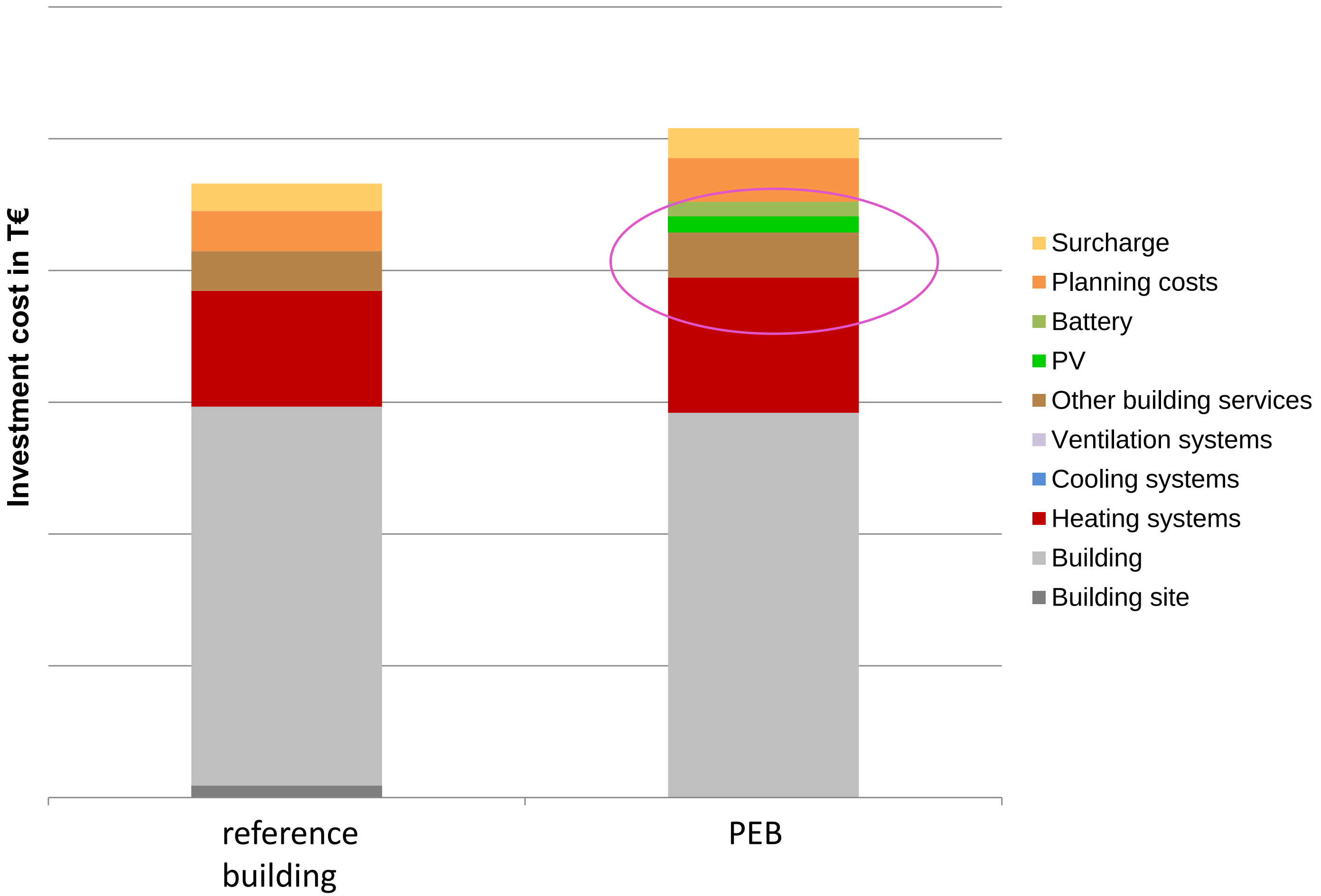
Boundary conditions

- Time horizon of 30 years
- discount rate 1%
- price increase rates for
  - investment: 1,0 %
  - maintenance: 0,5 %
  - energy: 2,0 %

LCC results

- Total annual cost = discounted total cost of 30 years
  - capital cost
  - maintenance cost
  - energy cost
  - revenues

Initial investment cost

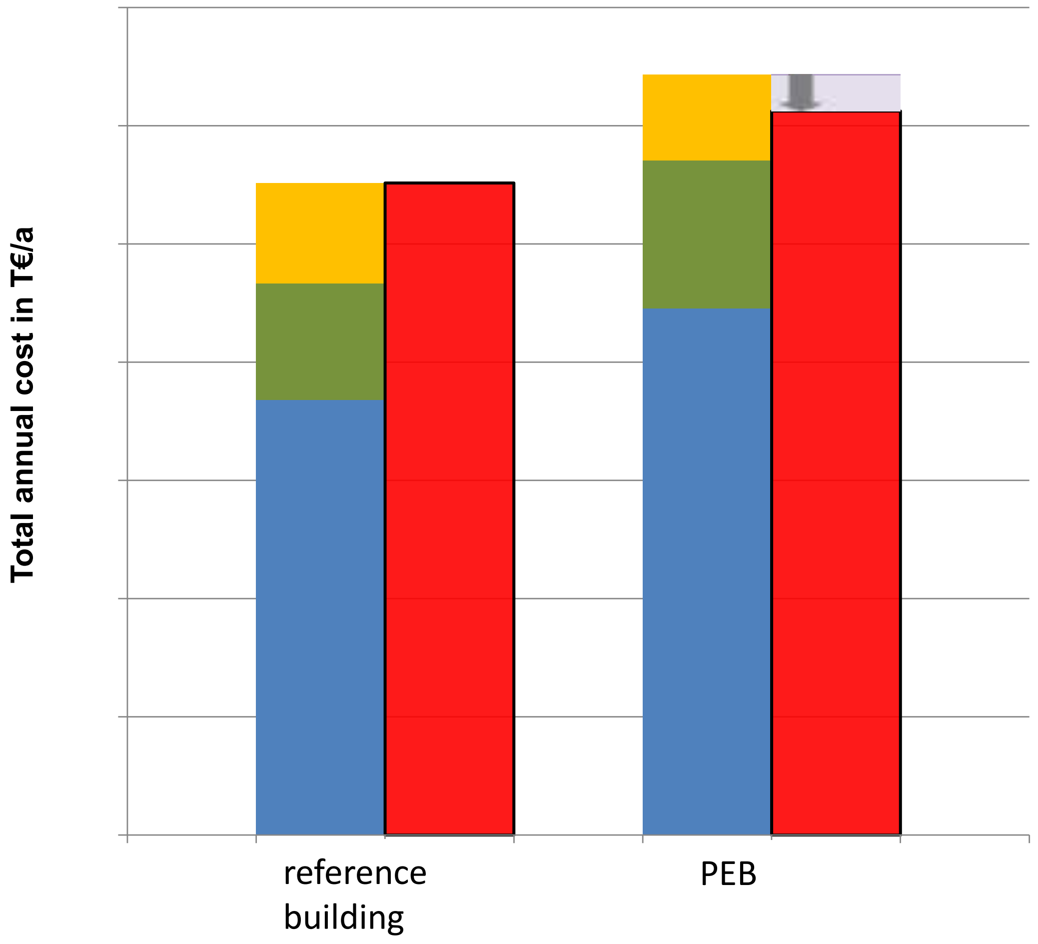


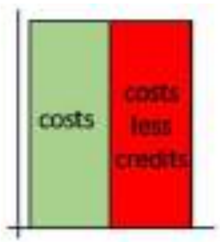
Graph shows exemplary data

Higher investment cost for:

- Heating system
- PV pannels
- Battery
- HMS (house management system)

LCC with limited self-use of PV-electricity





Left column

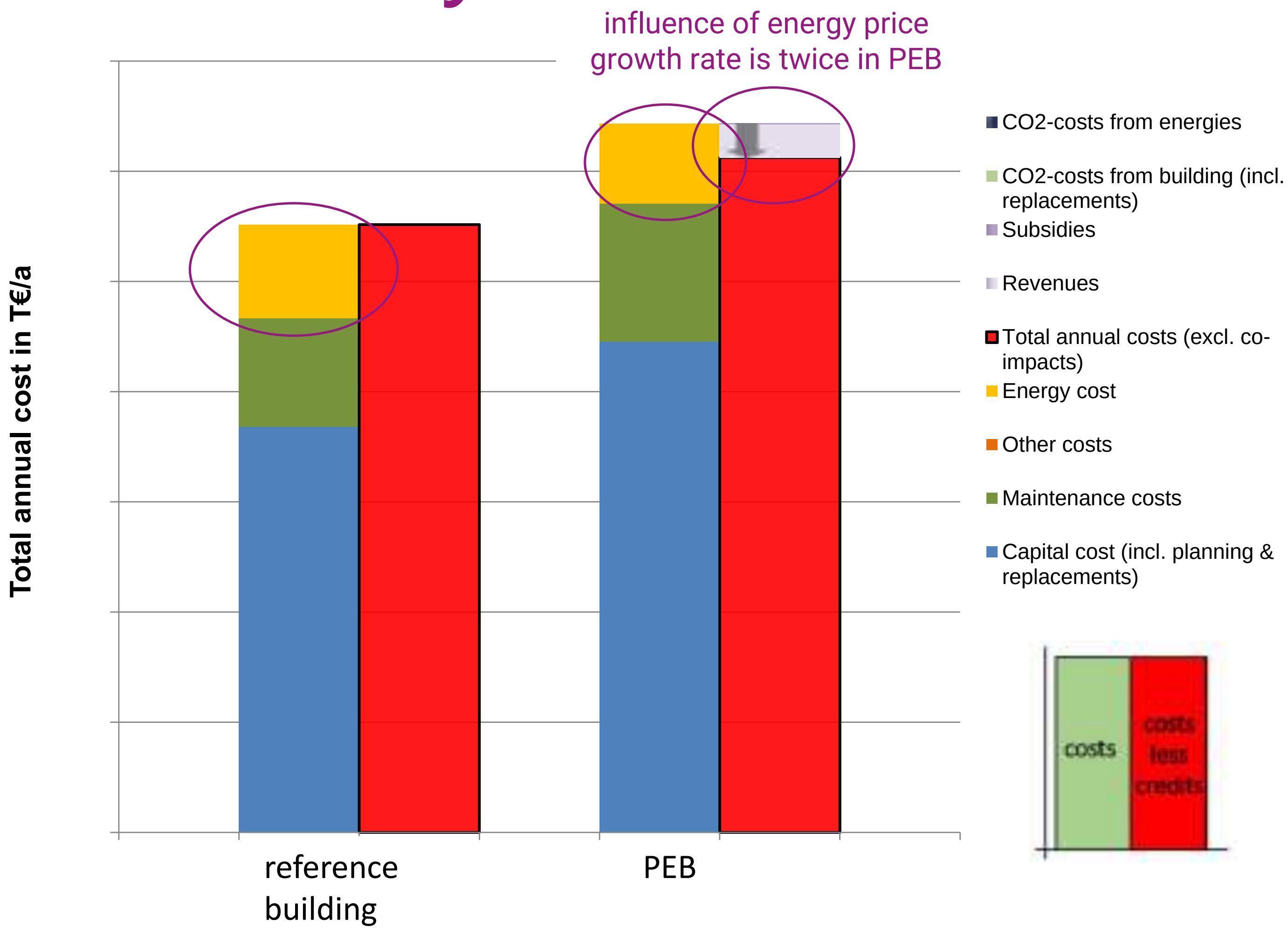
- capital cost
- maintenance cost
- energy cost

Right column

- revenues
- subsidies
- resulting cost (red)

Graph shows exemplary data

LCC with limited self-use of PV-electricity



Graph shows exemplary data

Disadvantage
- higher capital cost
- higher maintenance cost

Benefits
- less energy cost
- sale of electricity to tenants of neighbors possible

➔ Sale of produced electricity is crucial for rentability

➔ Price growth of energy cost is important
  - high price growth leads to higher rentability

LCC analysis shows

- Surplus of produced PV is the only directly marketable output
- It is difficult to reach an economic benefit with PEB

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Resulting Targets

- Maximisation of roof-surface for PV installation necessary (architecture requirement).
- Marketing of PV electricity.
- The marketing of PV electricity must be made as simple as possible (political / legal requirement).

Business models

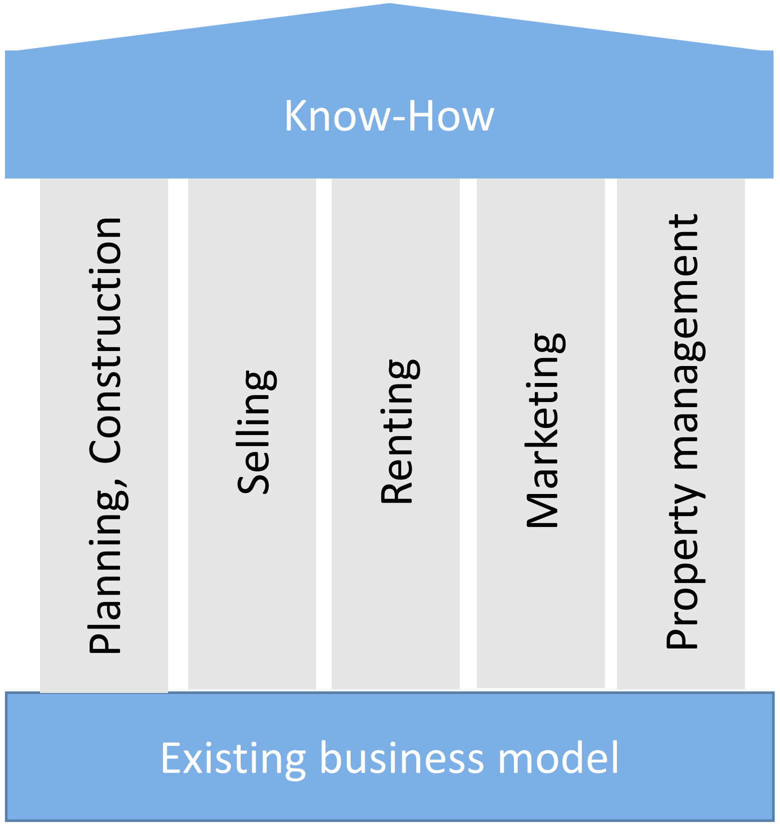
Goals for Business Models

- Support of dissemination of PEB (Plus Energy Buildings)
- Target Group: “Building construction companies”
  - general contractors
  - private social housing providers
  - private cooperative housing association
  - cities, communities: municipal housing
- Identification of potential barriers in national regulations
- Include neighborhoods in business models

Various (Demo) Companies

	DE	FR	IT	NOR
company	**Wohnbau Studio**	**Vilogia**	**Abitcoop**	**Baerum Community**
type	general contractor	private social housing provider	private cooperative housing association	municipal housing, municipal buildings
business segment	selling, renting, real estate agent	renting	selling	renting
market	free market	restricted market (rent, billing,…)	cooperative members	limited market
customer relationship	no further contact after selling, rented units: property management is contracted	complete property management (metering, billing, operation, maintenance,…)	no further contact after selling	complete property management (metering, billing, operation, maintenance,)
possibility for further services/value proposition	possible	existing, restrictions due to market segment	no possibilities	existing, limitations due to market segment

Column Concept



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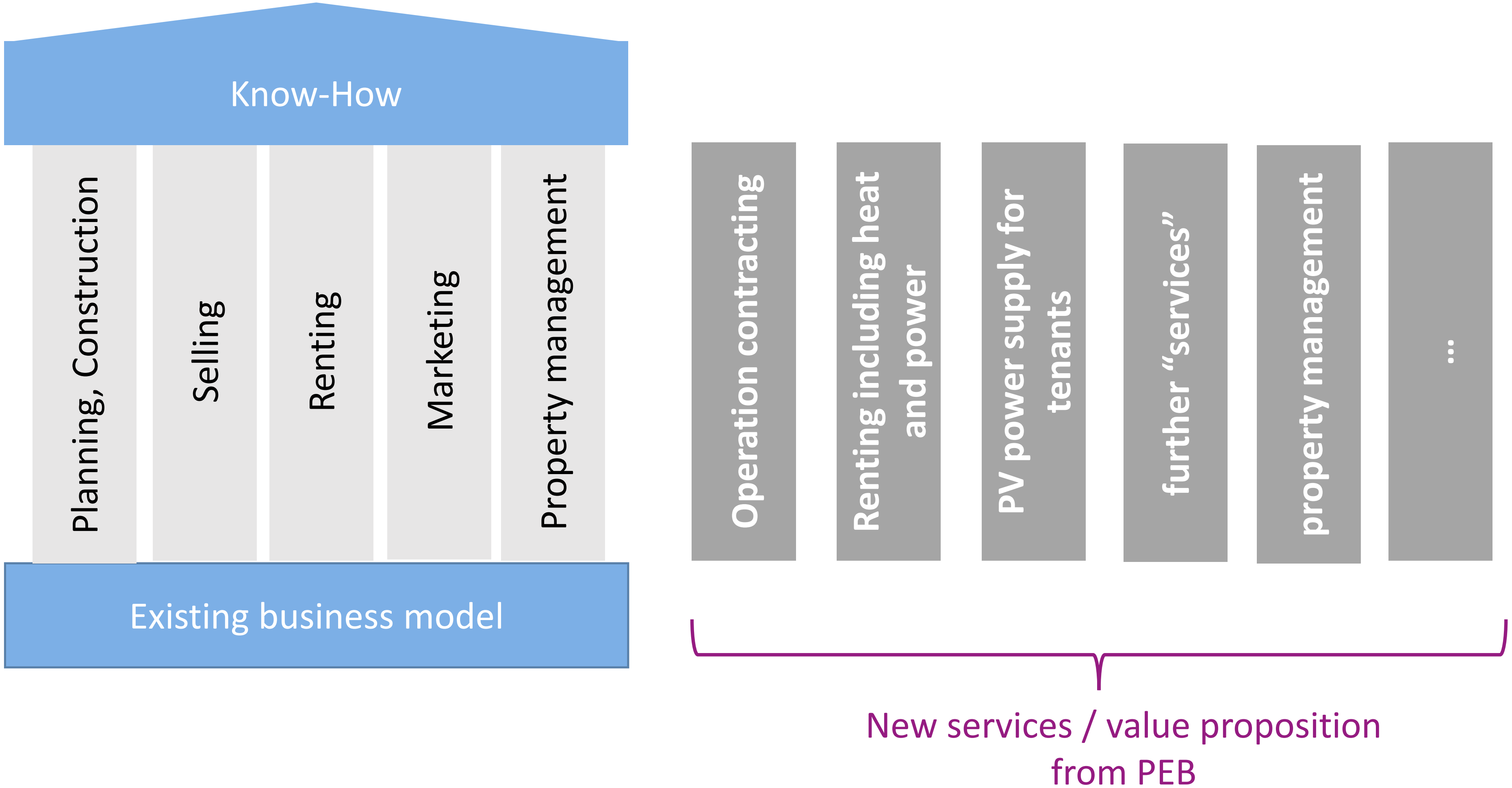
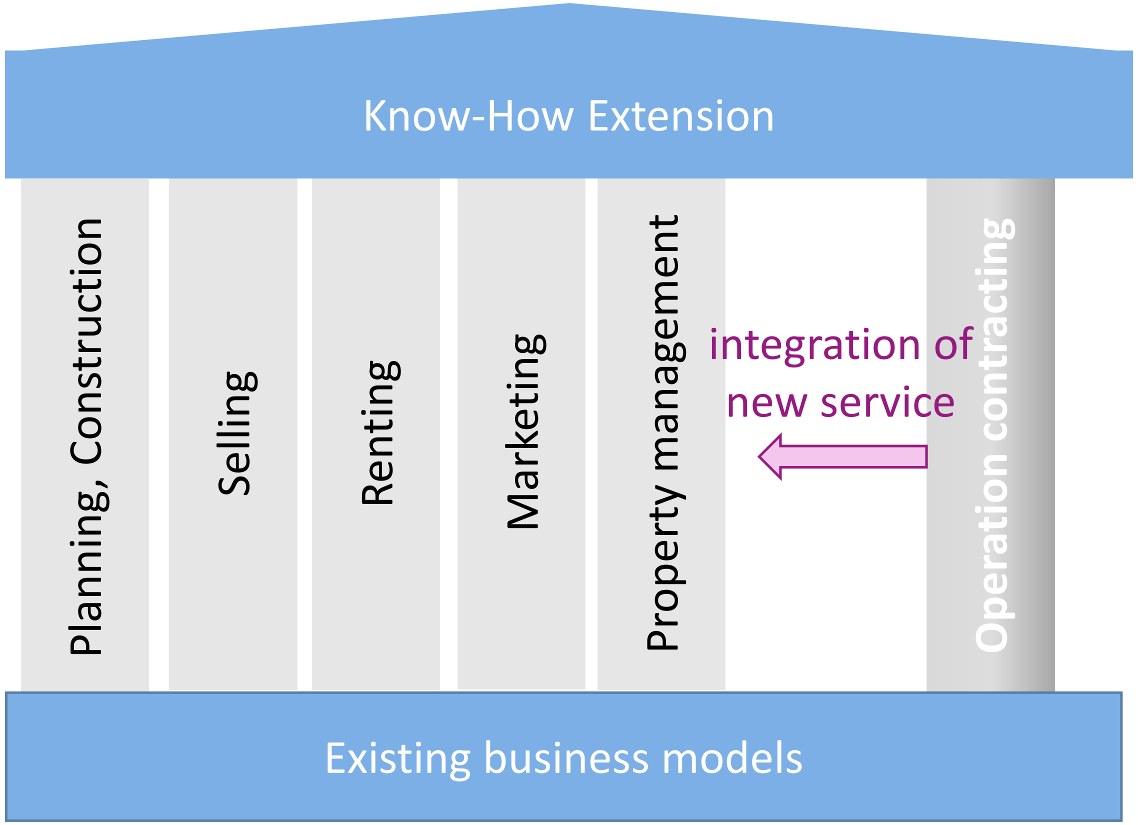


Extension of Business Model



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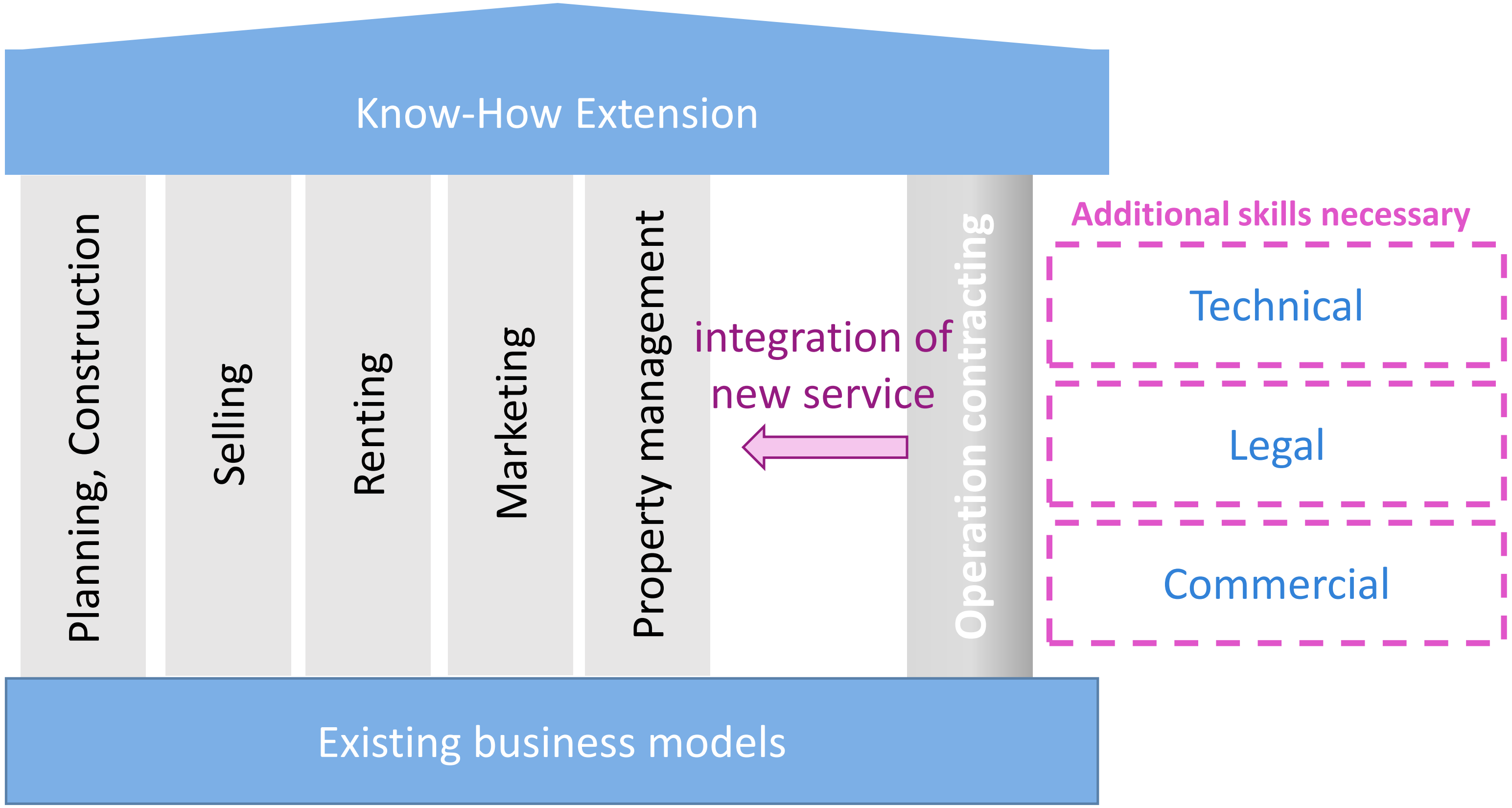

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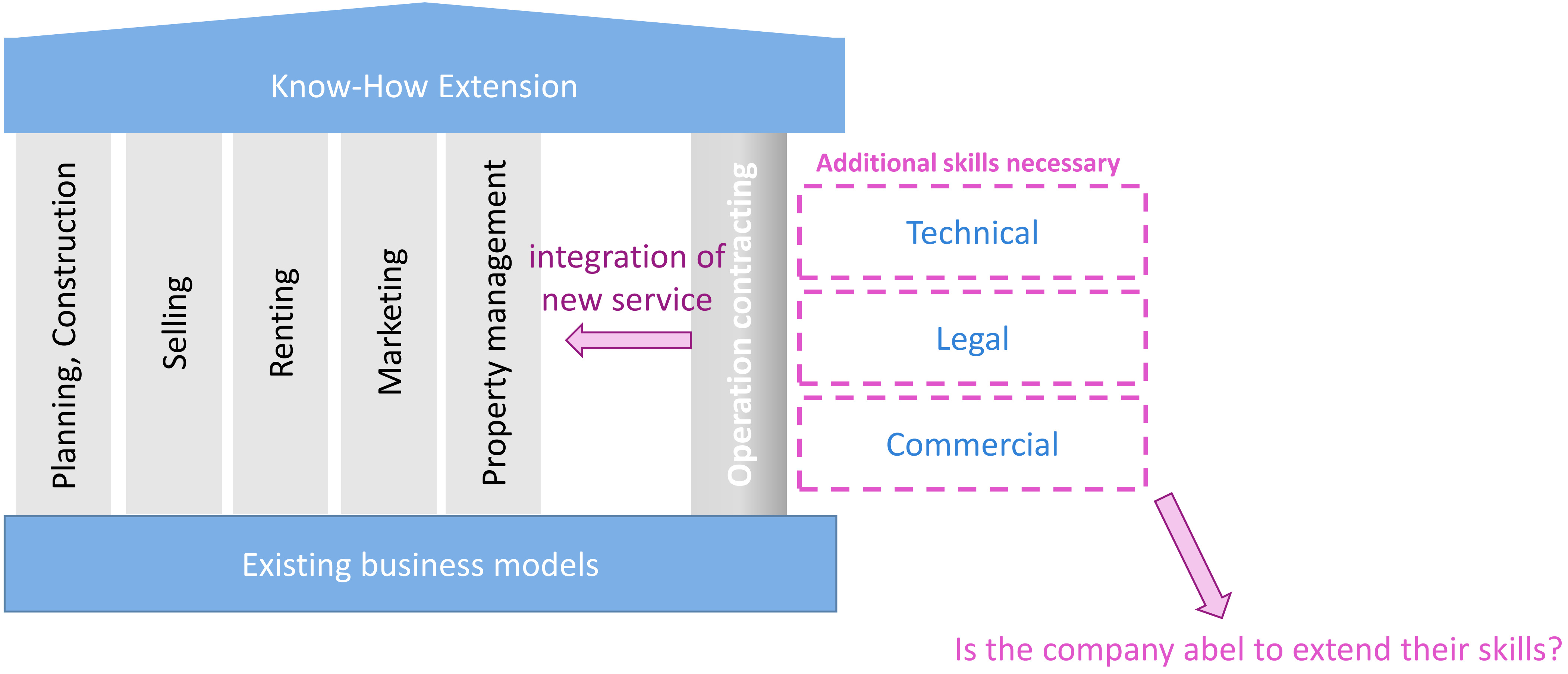

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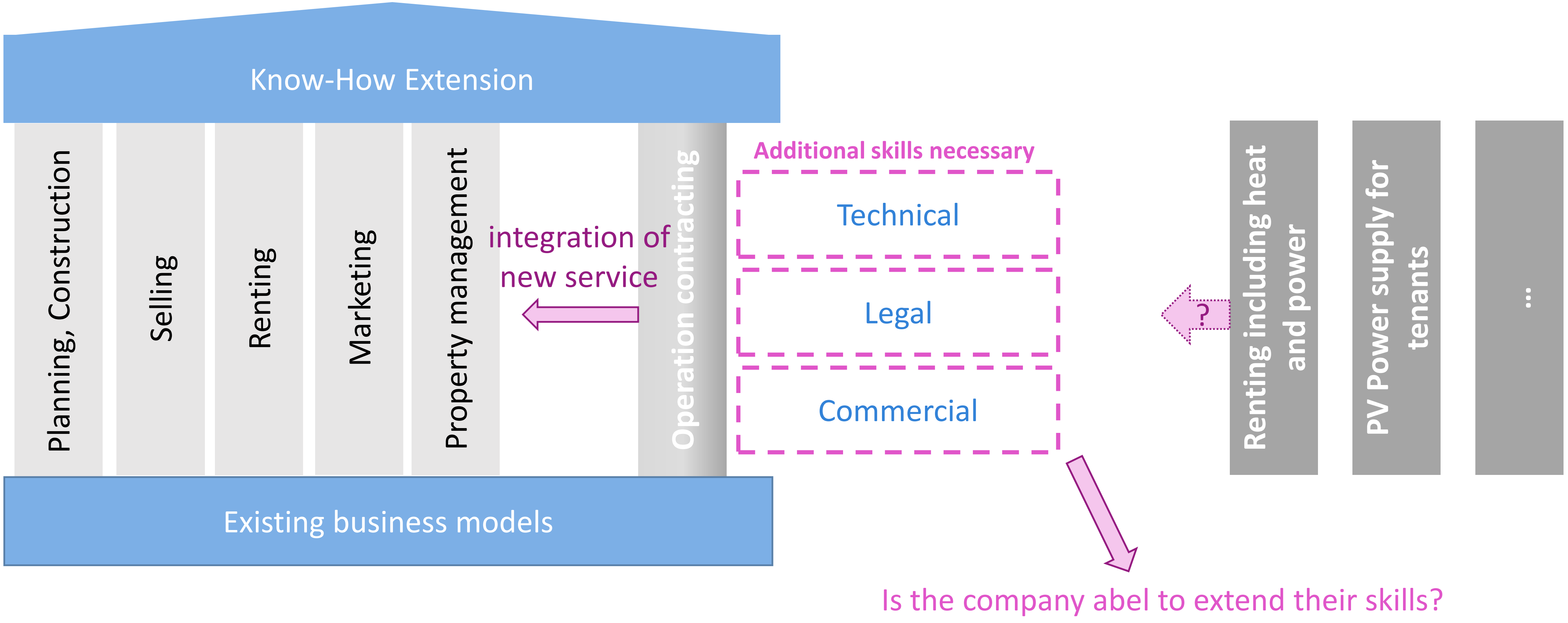
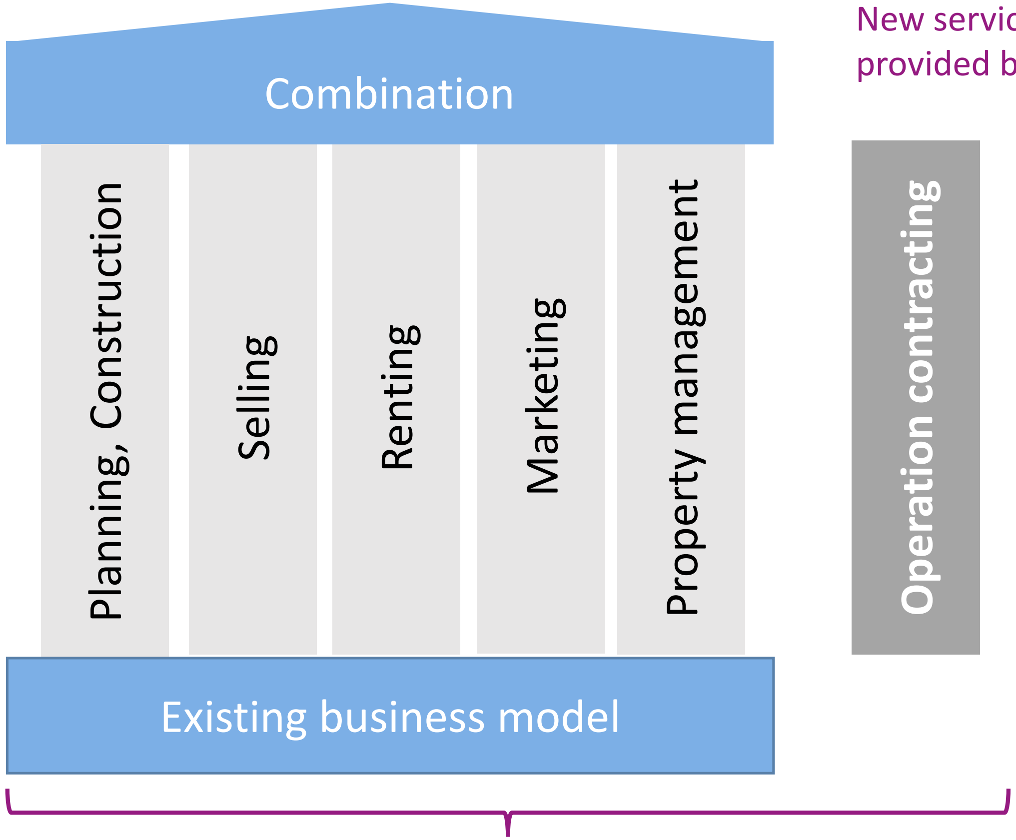


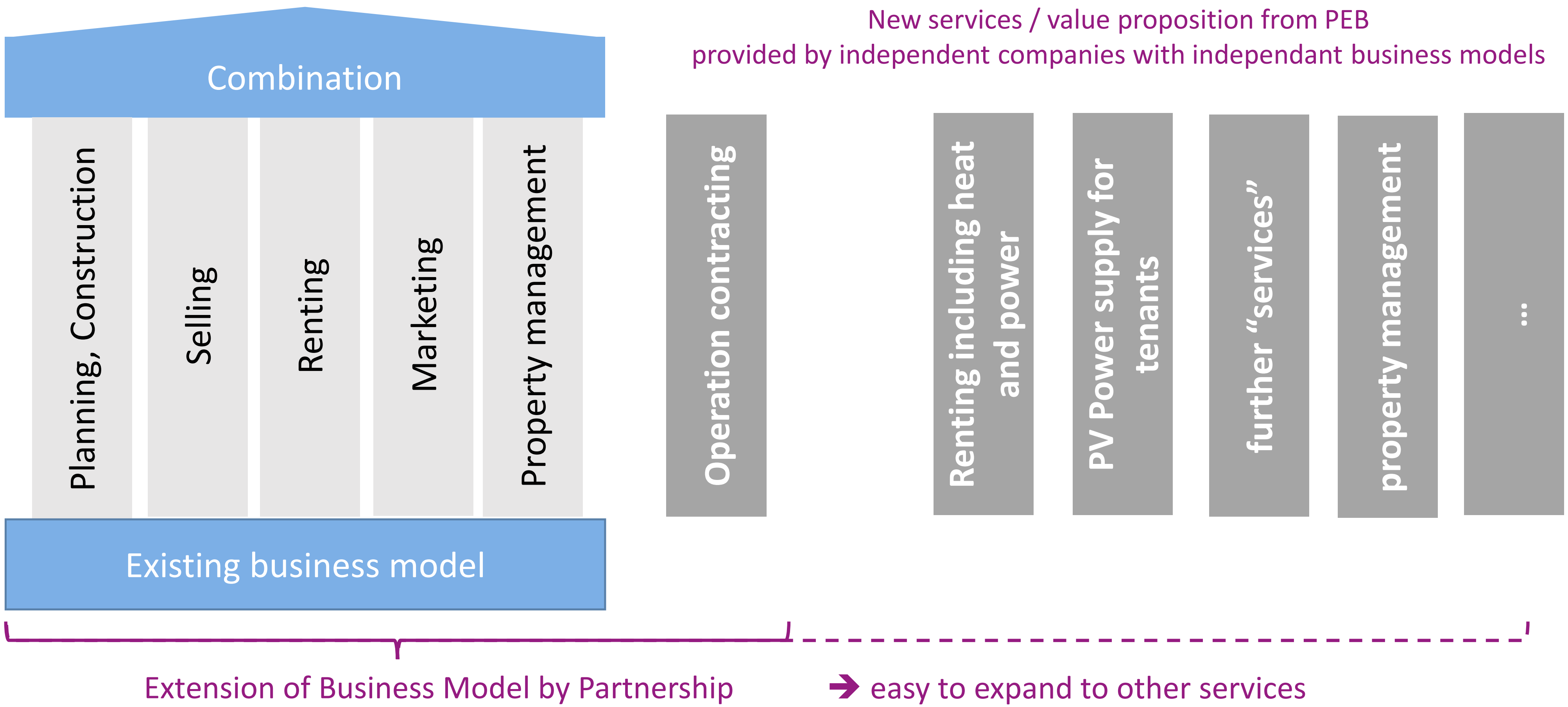
Business Partnership

New services / value proposition from PEB
provided by independent companies with independant business models



Extension of Business Model by Partnership

Business Partnership



Influence on business models

Fast change of economical boundary conditions

- price increase in building sector
- price increase of energy cost

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Legal framework is country specific

- very heterogeneous

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Legal framework is changing

- energy communities
- marketing of local generated electricity, PV
- …

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- Strong influence on set up of business models.
- Impossible to develop general business models.

Influence on business models

cultural E+

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- Strong influence on set up of business models.
- Impossible to develop general business models.

➔ The goal is to develop basic ideas that must be adapted to country specific situations.

New services / value proposition from PEB

- lower electricity cost for tenants due to local PV – generation
- green power supply for tenants
- renting including heat and/or power
- heat and power supply by building owner
- green e-vehicle charging with PV - power
- support for energy efficient use of the apartment by feedback-app
- property management, as after sales service, using HMS services
- heat and power supply for neighborhood
- high IEQ as additional value controlled by HMS?
- …
- … further ideas welcome

POLL 3

Moderated by Hermann Leis

BUILD UP
The European portal for energy efficiency and renewable energy in buildings

cultural E+

eurac research

University of Stuttgart
Institute for Acoustics and Building Physics
Life Cycle Engineering GaBi

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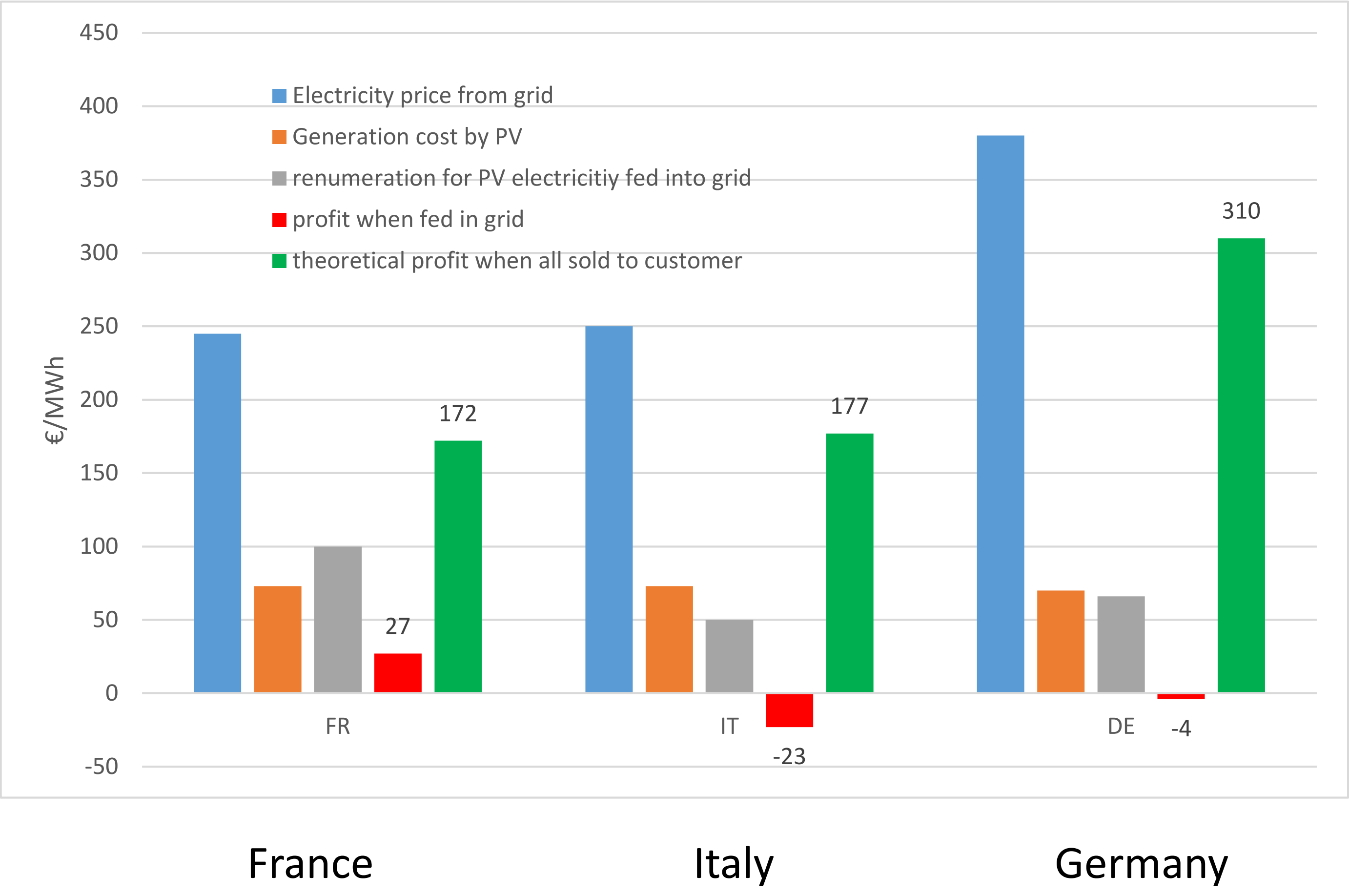
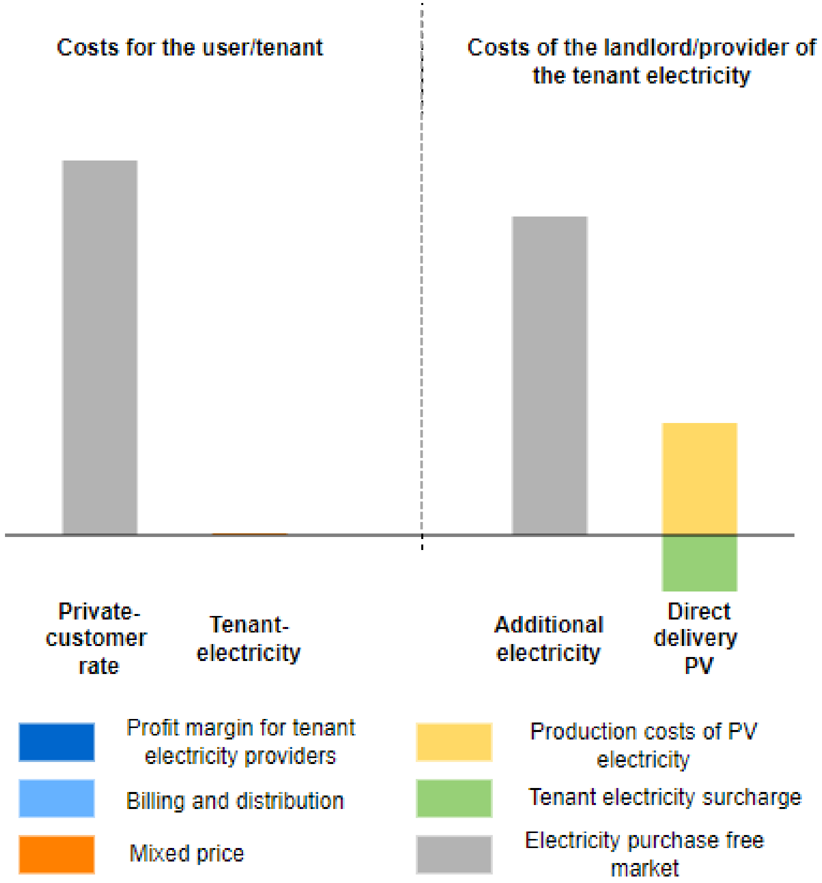
Example PV - Marketing

Current situation in marketing of PV - electricity



- Feeding into grid results in low profit or even loss
- High potential profit when direct sale of PV-electricity is possible
- Potential customers:
  1. tenants
  2. neighbors

Current model for selling PV electricity to tenants (D)



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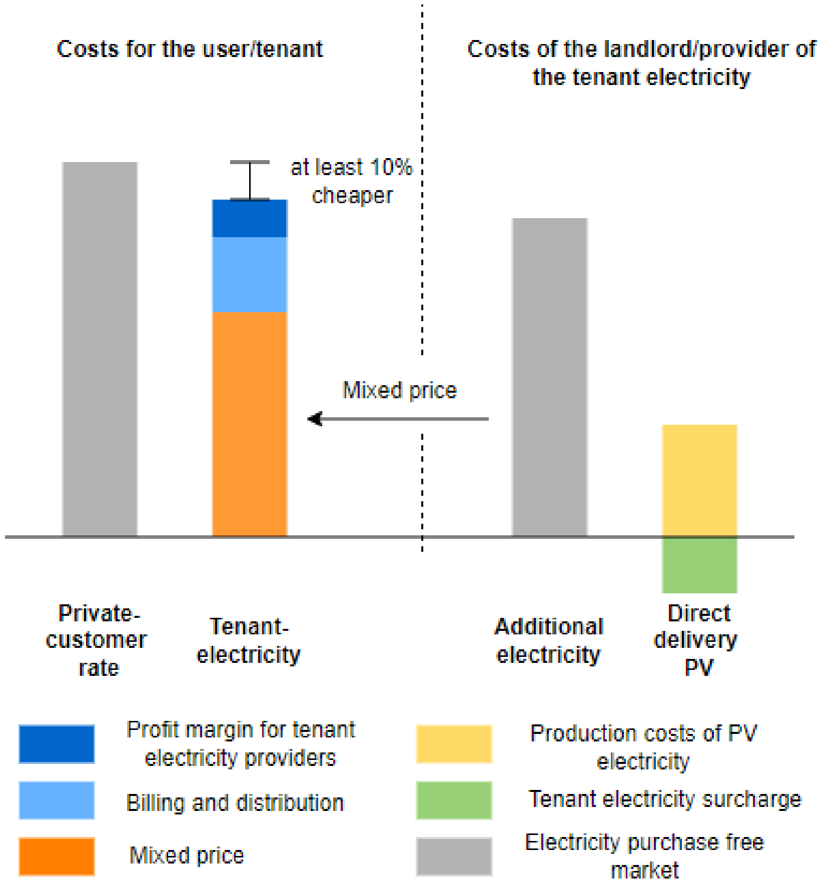

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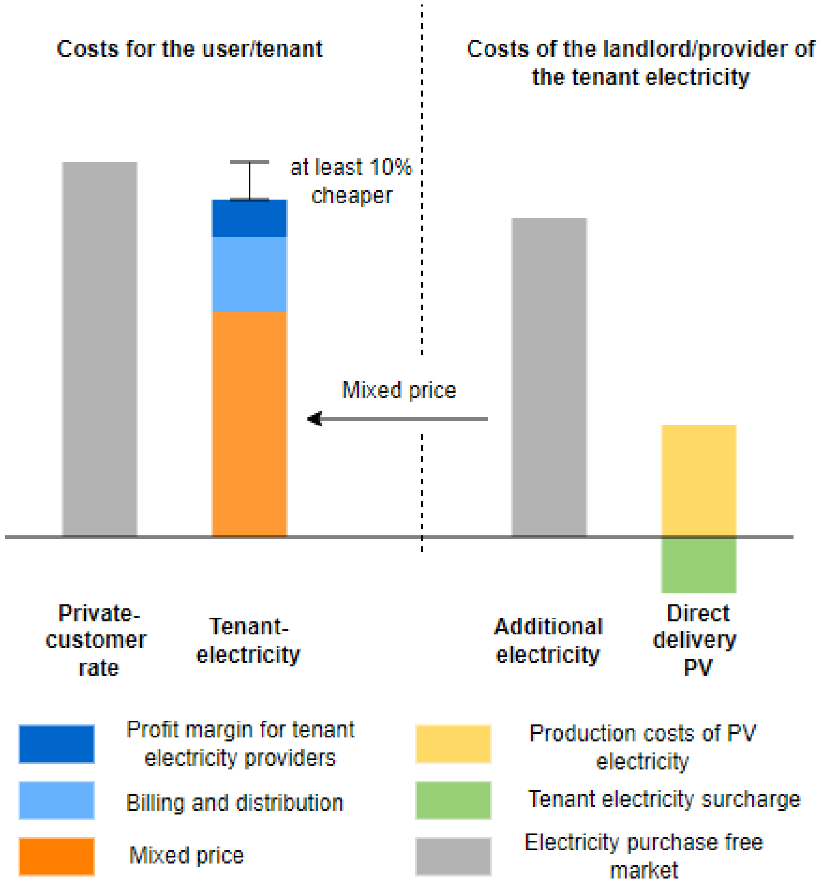

Landlord / Owner

- is energy supplier
- is the only provider for the tenant
- Has to calculate a mixed price of own electricity production and bought electricity
- gets a certain grant (country specific)
- price for tenant has to be lower than standard electricity price to motivate tenants buying locally produced electricity
- has all rights and obligations towards the grid operator and the end consumer like the big power supplier (in particular contract design, invoicing, electricity labeling, registration, notification,…)

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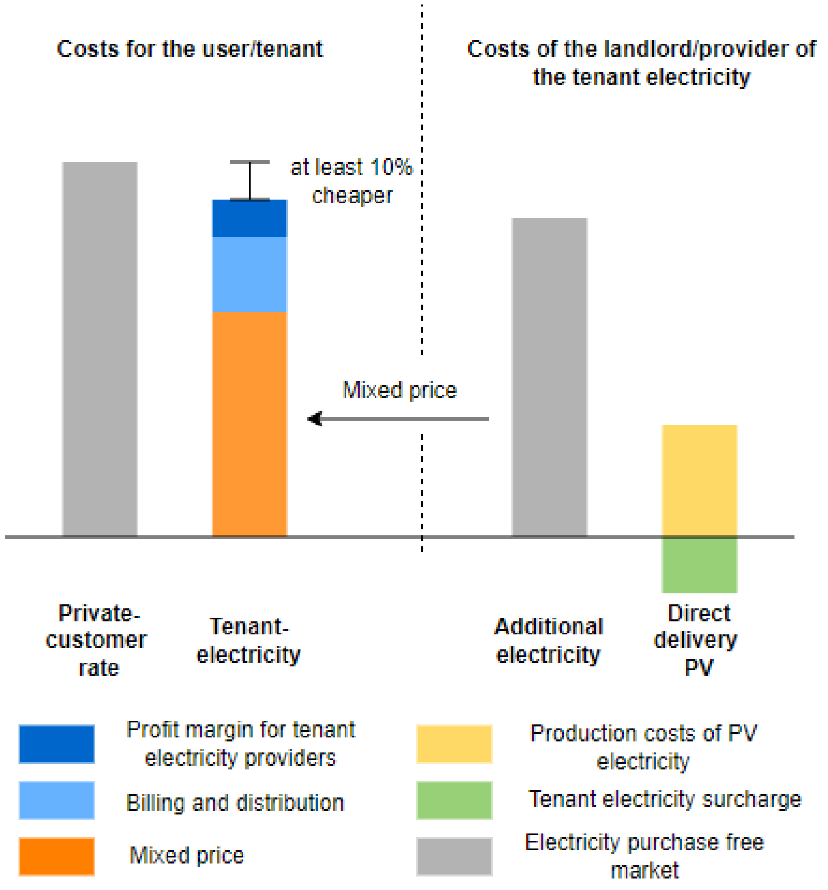

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barrier for landlord / owner to extend his business model
=> business partnership with specialized companies on this topic

What Business Model?

If marketing of PV electricity is simple and straight forward without restrictions and unnecessary obligations

→

- Integration in existing business model possible.
- Increase of rentability of PEB for construction/owner company

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If marketing of PV electricity is complicated with legal limitation, restrictions and unnecessary obligations

- Partnership necessary for PV-marketing
- Value added for Partner not for construction/owner company

What Business Model?

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If marketing of PV electricity is complicated with legal limitation, restrictions and unnecessary obligations

- Partnership necessary for PV-marketing
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current situation in most countries

Thank you for your attention!

Dr. Hermann Leis

siz energieplus

Technical advisor

Hermann.leis@stz-egs.de

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Q&A discussion

Thank you!


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