



IEA SHC Task 56 – Building Integrated Solar Envelope Systems for HVAC and Lighting

Detailed performance assessment of Building Integrated Solar Envelope Systems by means of numerical simulation

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IEA SHC Webinar

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Wir bauen Brücken. Seit 1669

Task 56 – Solar Envelopes

Solar envelope solutions

Renewable Energy (RE)

- **Solar Thermal (ST)**
- **Photovoltaics (PV)**

with heat pump, MVHR, etc.

for **heating and DHW** preparation

for **cooling**

- **Daylighting** (focus office buildings)

(→**Presentation M. Hauer, Bartenbach**)



Copenhagen International School

Task 56 – Solar Thermal

Solar Thermal – heating and DHW preparation

- in combination with **heat pump** or
- other systems (e.g. condensing boilers)



Source: Solarwall



Source: Aventa Solar

Task 56 – Daylighting

Daylighting

Shading, glare control, ... influences heating and cooling demand



Source: Cenergia a part of Kuben Management



Source: Merck

Task 56 – Demo

An der Lan (IIG, UIBK, Innsbruck, At)

Evaluation of performance ...

- Passive House
- Innsbruck
- Area_{tot} : 1053 m²
- PV on South facade
- 14 studio apartments
- Common areas
- Electric heating
- Electric DHW



Solar Thermal (ST) and Photovoltaics (PV) and PVT

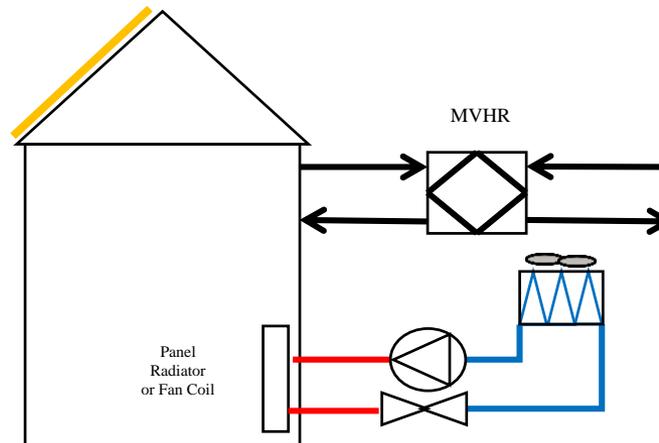
Components

- ST
- BIST
- PV
- BIPV
- PVT
- BIPVT

& Building

- + MVHR
- + **heat pump** for
 - heating
 - DHW preparation
 - cooling

MVHR with air-to-water or air-to-air HP



BIPV – Copenhagen International School



BIPVT - Canada's first institutional solar NZEB

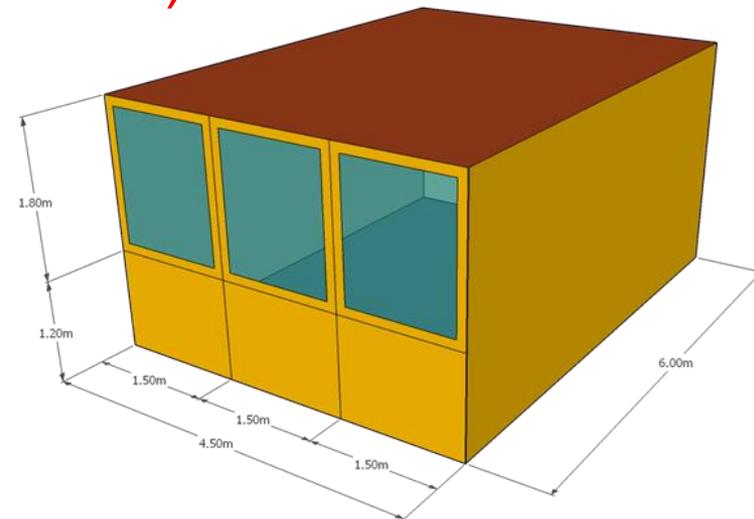
Evaluation of solar envelope solutions

- on component level (e.g. PVT collector performance map)
- system level (e.g. PVT collector as source for heat pump)
- on building level (e.g. SFH in PH standard with HP with PVT collector)
- on district/city/country level
 - **Micro-economic optimization** Costs for building owner/operator (system design/sizing, control, cost reduction)
 - **Macro-economic evaluation** Costs for society (technology ranking, PE/CO₂ savings, costs)

Evaluation of solar envelope solutions on building level:

Building and system simulation (SubT C)

- General methodology
 - Residential buildings
 - Office buildings
- Monitoring
- Design Tools / Decision support tools



Task 56 – Tools

Evaluation of solar envelope solutions: Building and system simulation (SubT C)

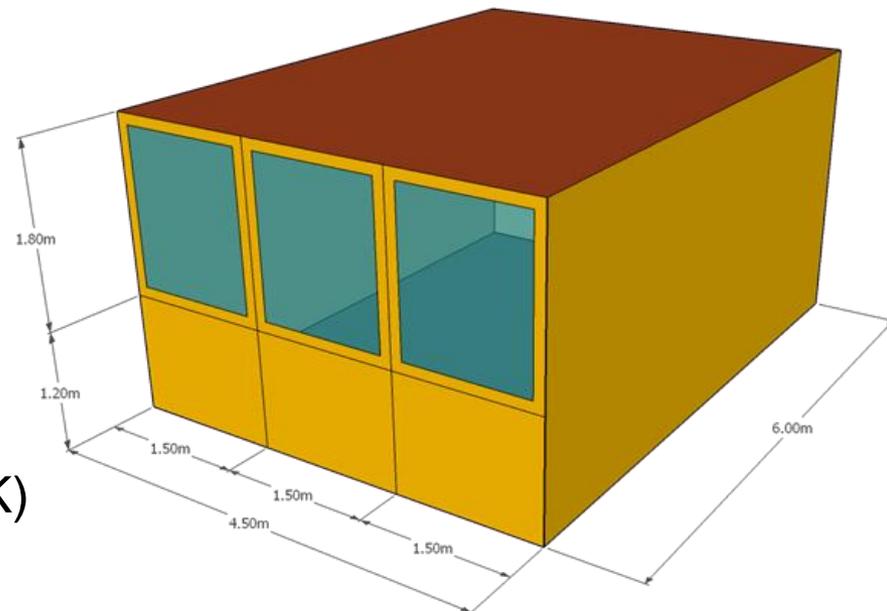
Reference office building

Simulation Tools/Platforms

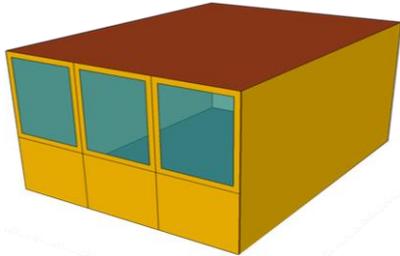
- TRNSYS
- Matlab/Simulink
- Modelica/Dymola
- E+
- IDA ICE

Planning Tools

- Dalec (Bartenbach, Zumtobel, UIBK)
- PHPP (PHI, UIBK)

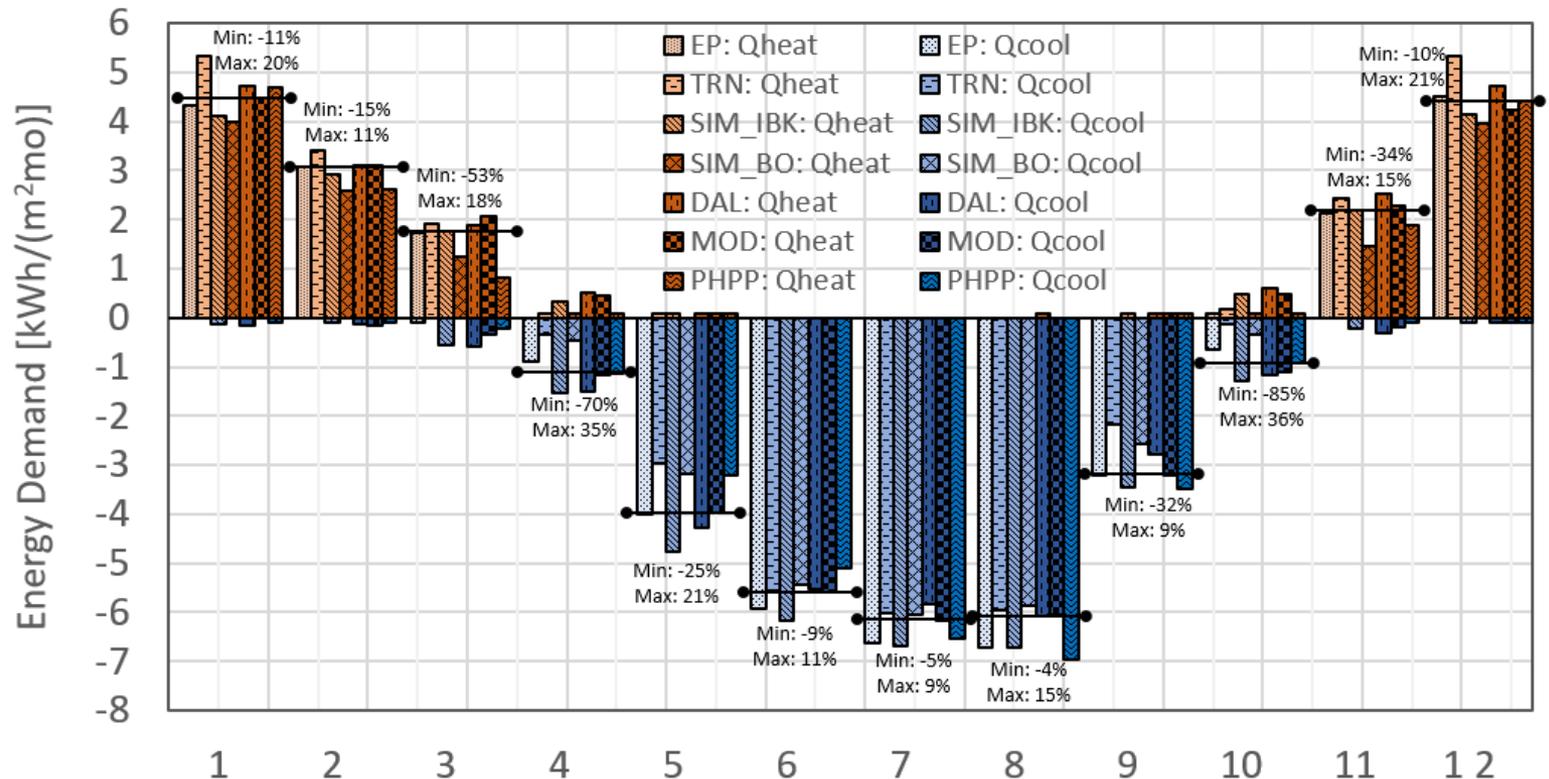


Task 56 – Tools

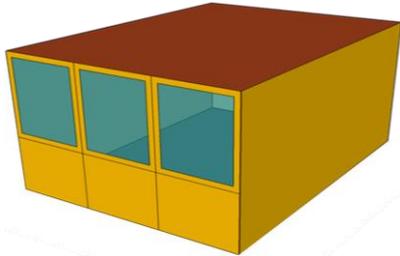


Mara Magni et al. **Comparison Of Simulation Results For A Reference Office Building – Analysis Of Deviations For Different BES Tools**, BS 2019, IBPSA Conferece 2019, Rome

STUTTGART: Monthly Heating and Cooling demands

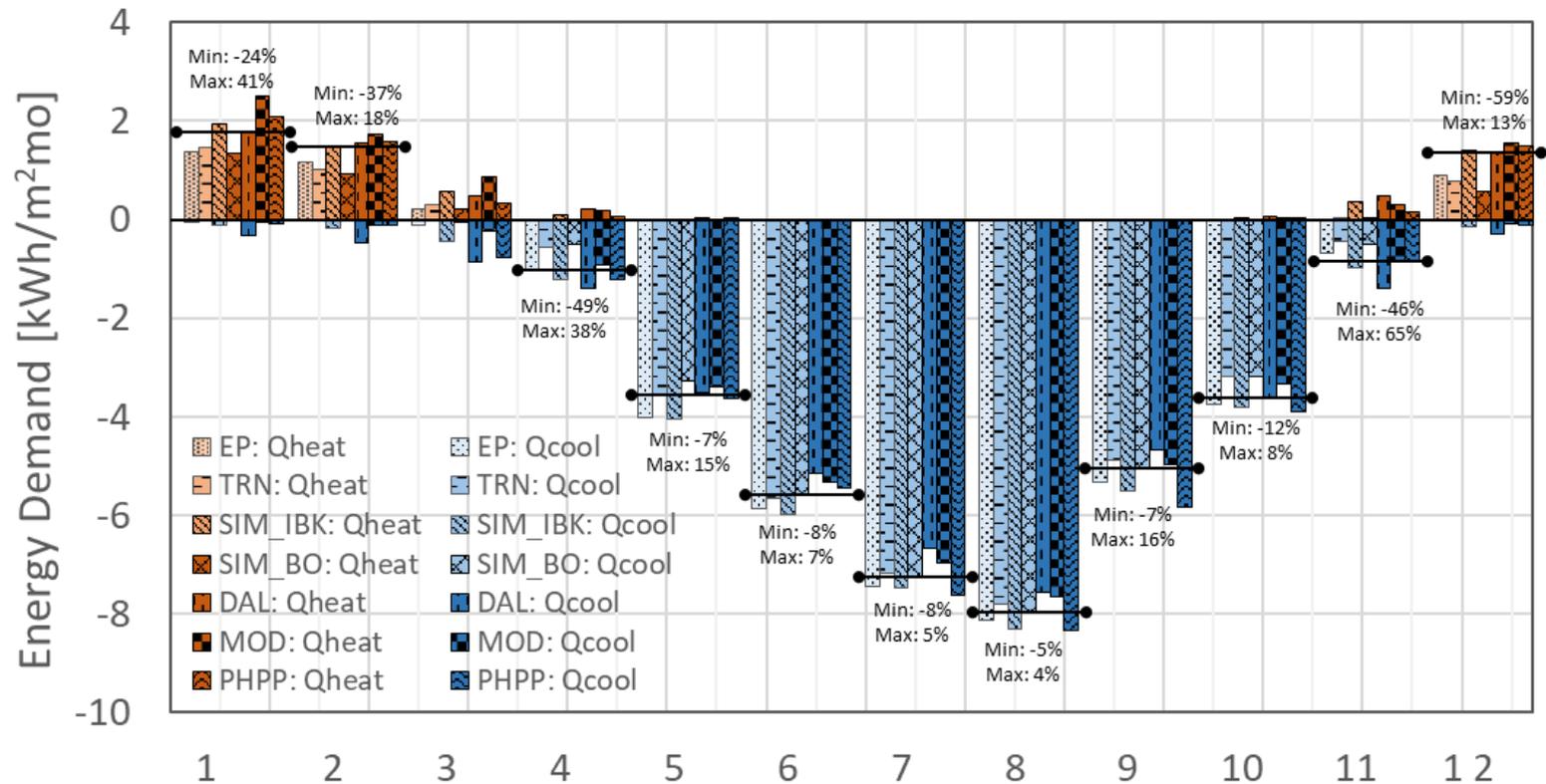


Task 56 – Tools



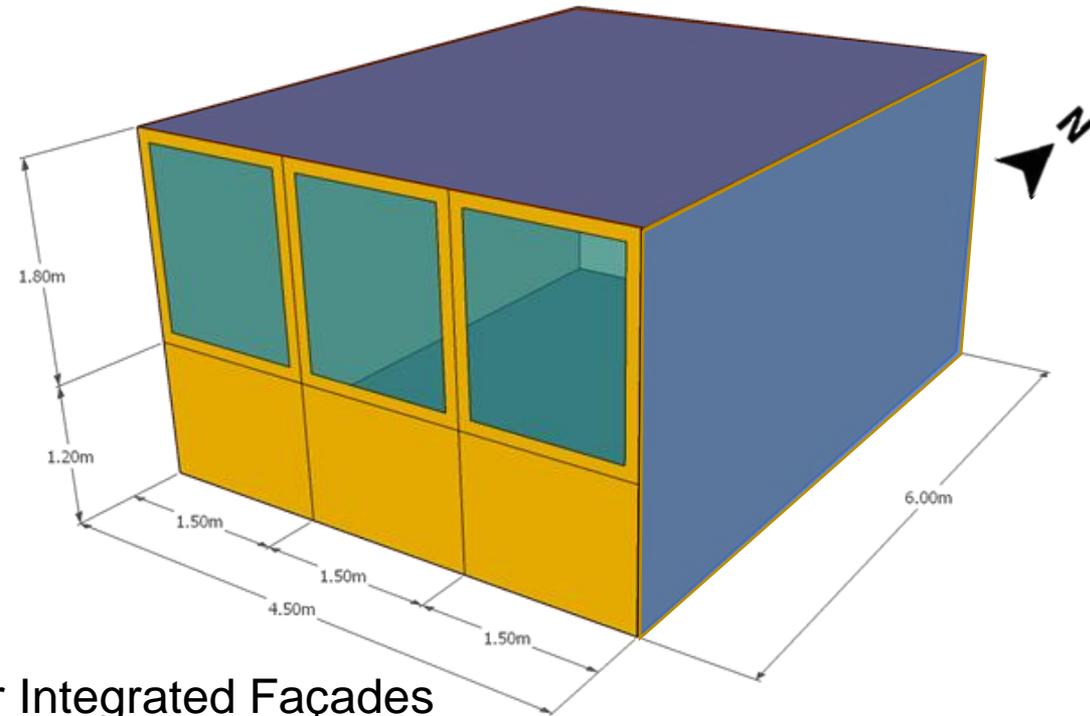
Mara Magni et al. **Comparison Of Simulation Results For A Reference Office Building – Analysis Of Deviations For Different BES Tools**, BS 2019, IBPSA Conferece 2019, Rome

Rome: Monthly Heating and Cooling demands



Task 56 – Office Case Study

- EURAC
- UIBK
- TUE
- Bartenbach
- SBI
- NTNU



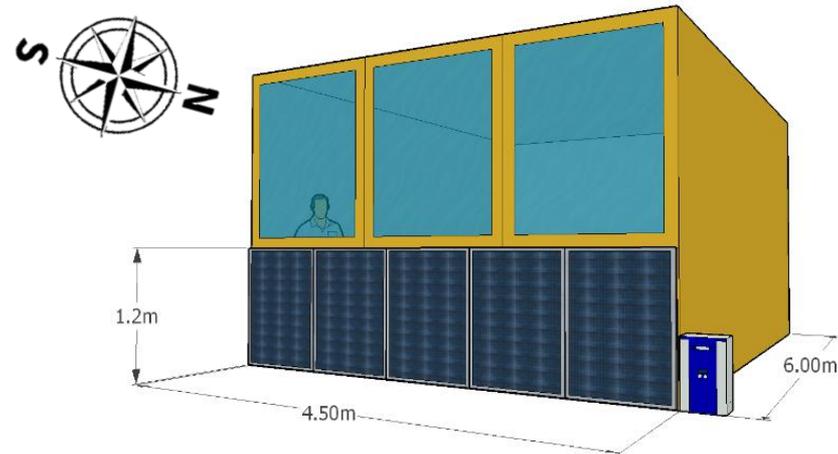
Simulation and Evaluation of Solar Integrated Façades

- BIPV with/without thermal/electric storage
- BIST
- Shading/Daylighting
- **Heat Pump + PV (Heating and Cooling)**

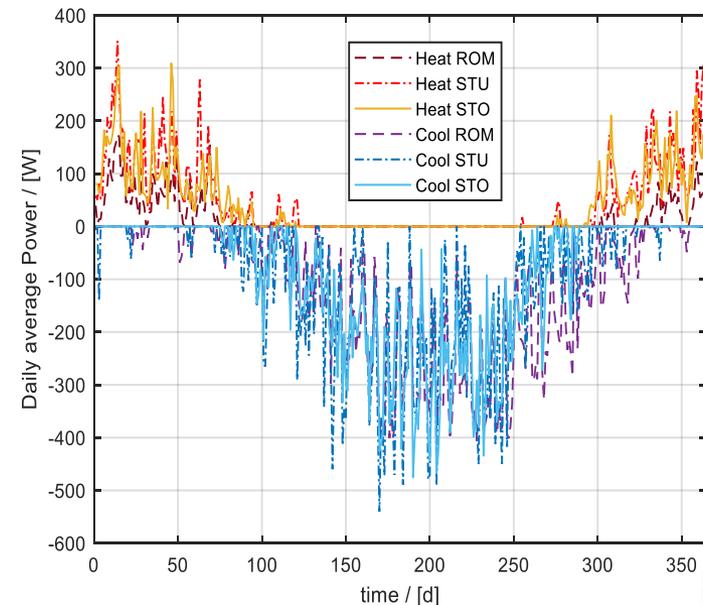
Evaluation of Primary Energy Savings

T56 – Office Case Study

- Rome (ROM)
- Stuttgart (STU)
- Stockholm (STO)

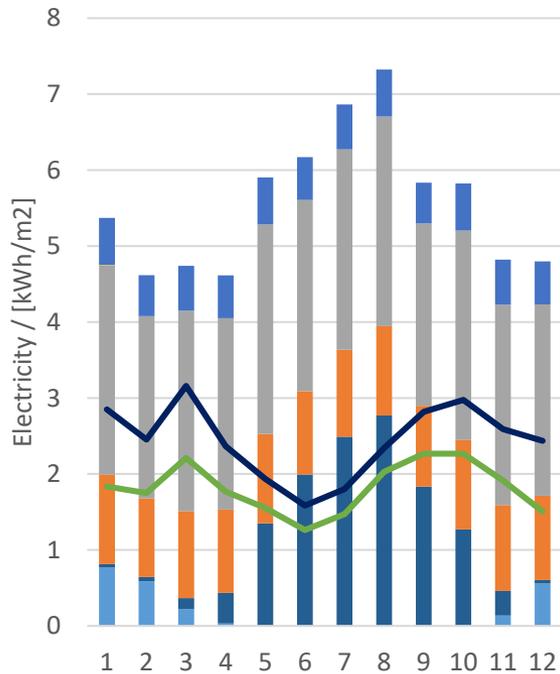


- Heating and Cooling
 - with heatpump
 - with PV

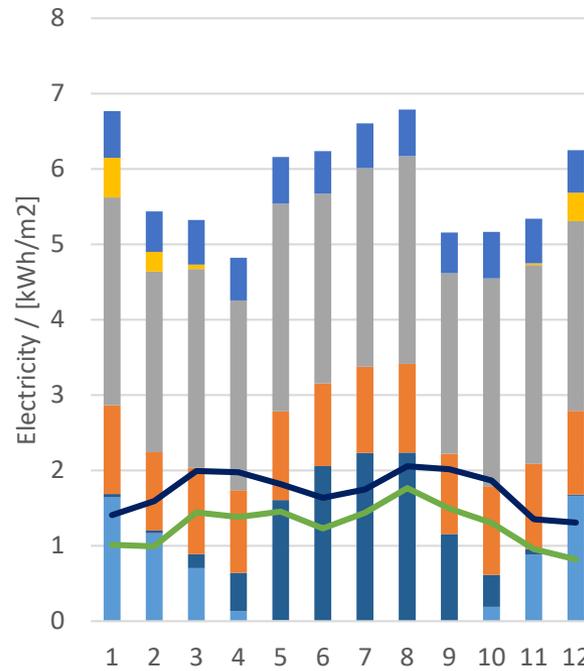


T56 - Electricity Balance

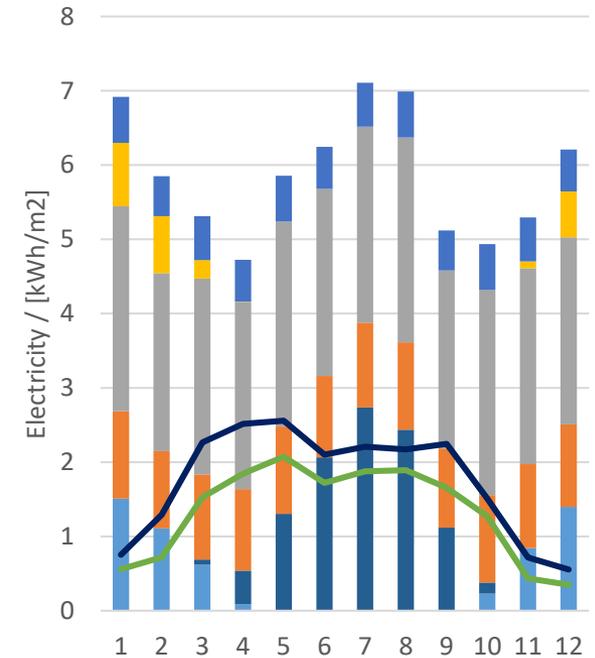
Rome: Case 3



Stuttgart: Case 3



Stockholm: Case 3



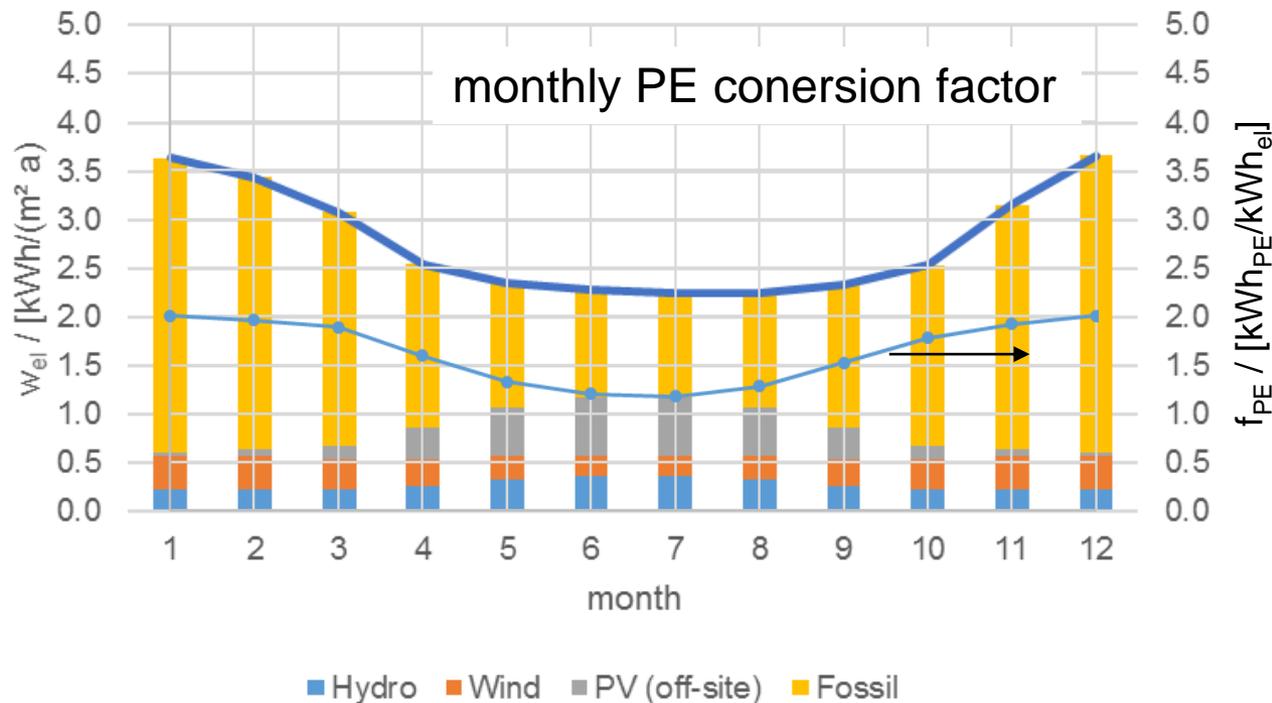
■ Qfans
 ■ Qantifreez
 ■ Qlights
 ■ Qappl
 ■ Qcool
 ■ Qheat
 — Self-cons
 — PV prod.

Case 3: Heat pump for heating and cooling

Task 56 – Primary Energy

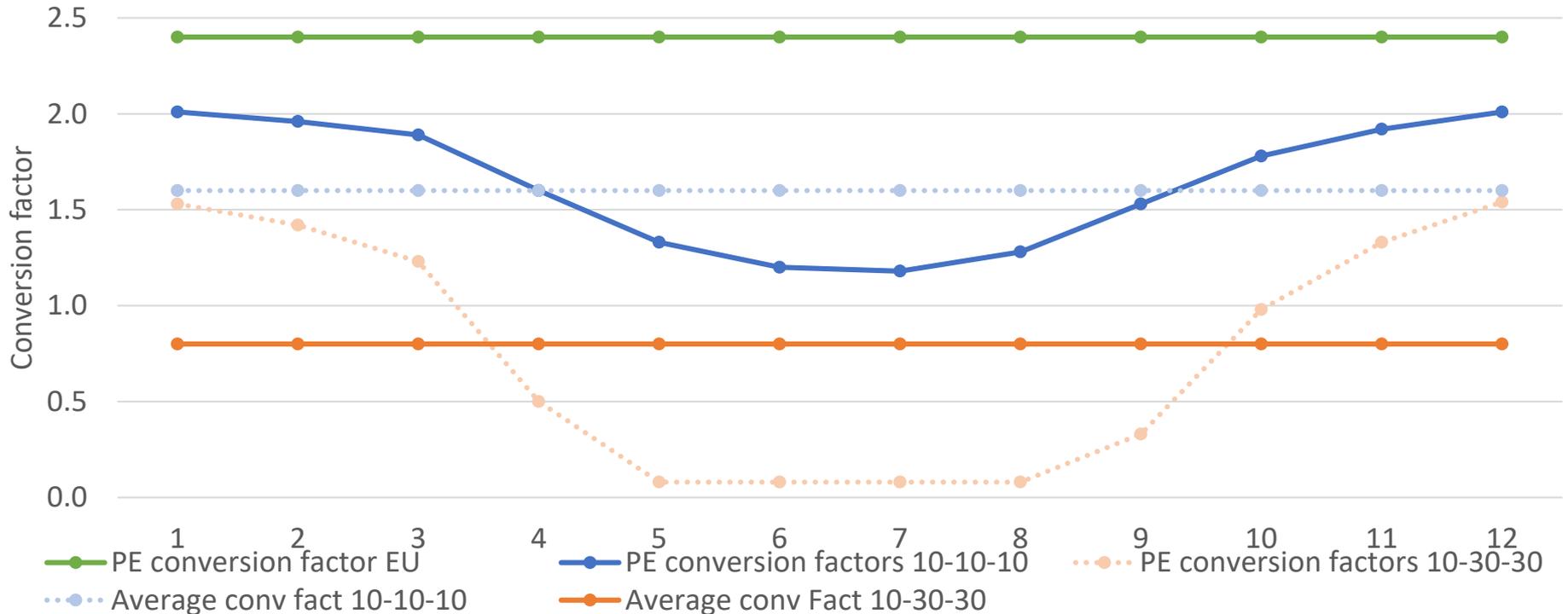
Seasonal variation of electricity mix:

Monthly primary energy conversion factors (UIBK)



Ochs F., et al., **Evaluation of efficiency and renewable energy measures considering the future energy mix**, 7th IBPC Conference Syracuse NY, 2018

(Future) PE scenarios

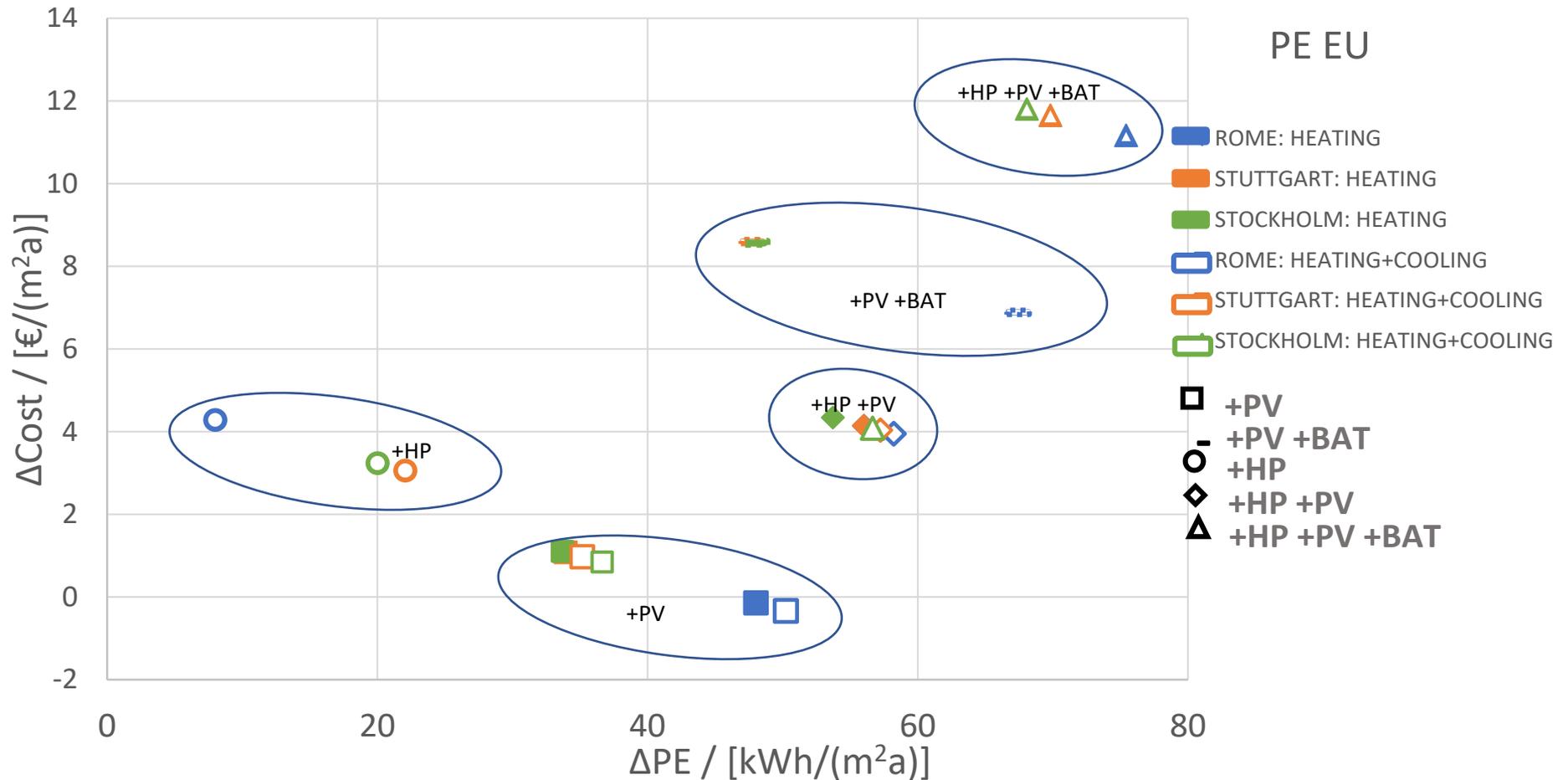


electricity mix with

10-10-10: a share of 10 % hydro, 10 % wind, 10 % PV and 70 % fossil

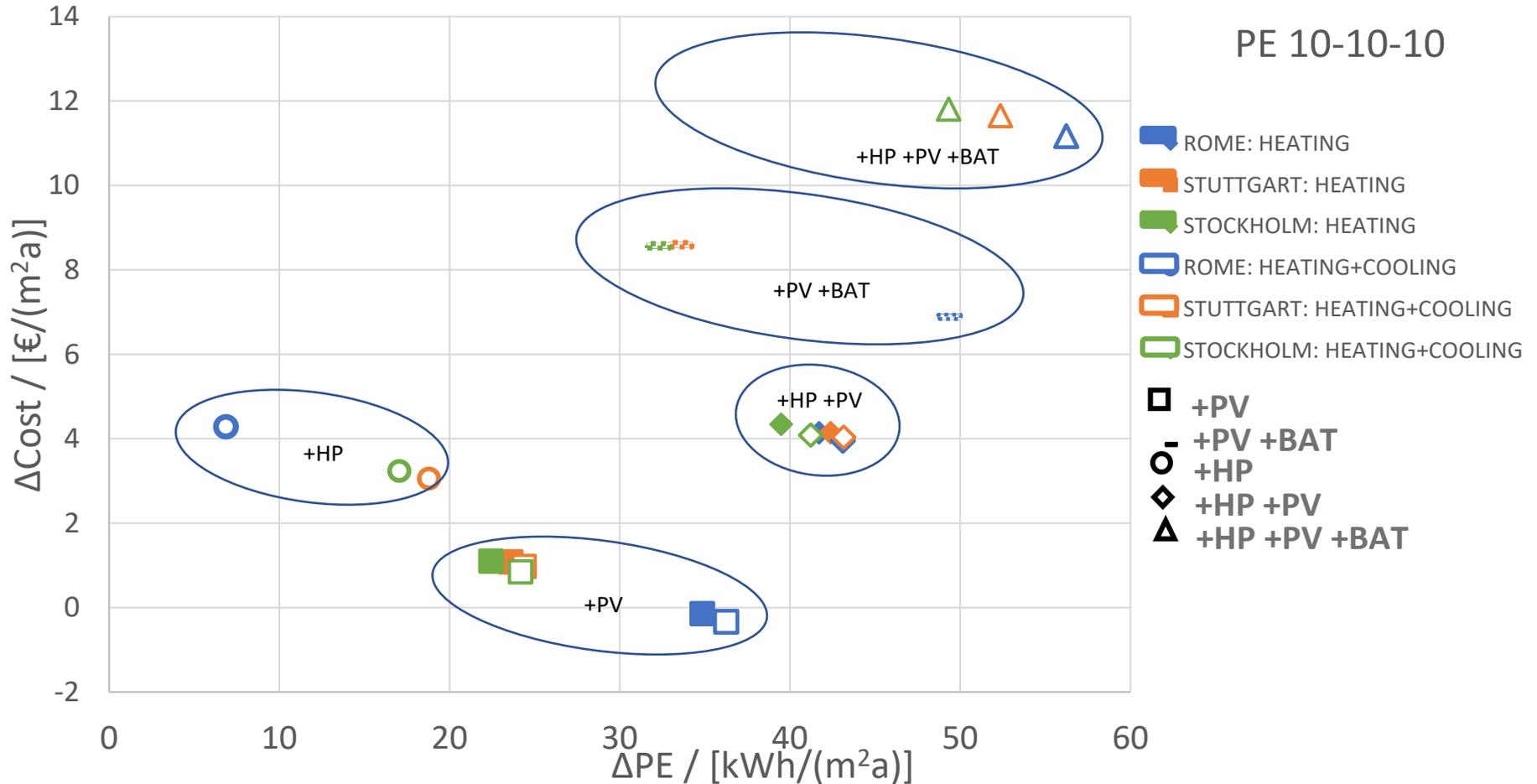
10-30-30: a share of 10 % hydro, 30 % wind, 30 % PV and 30 % fossil

Preliminary Results: costs vs. PE savings

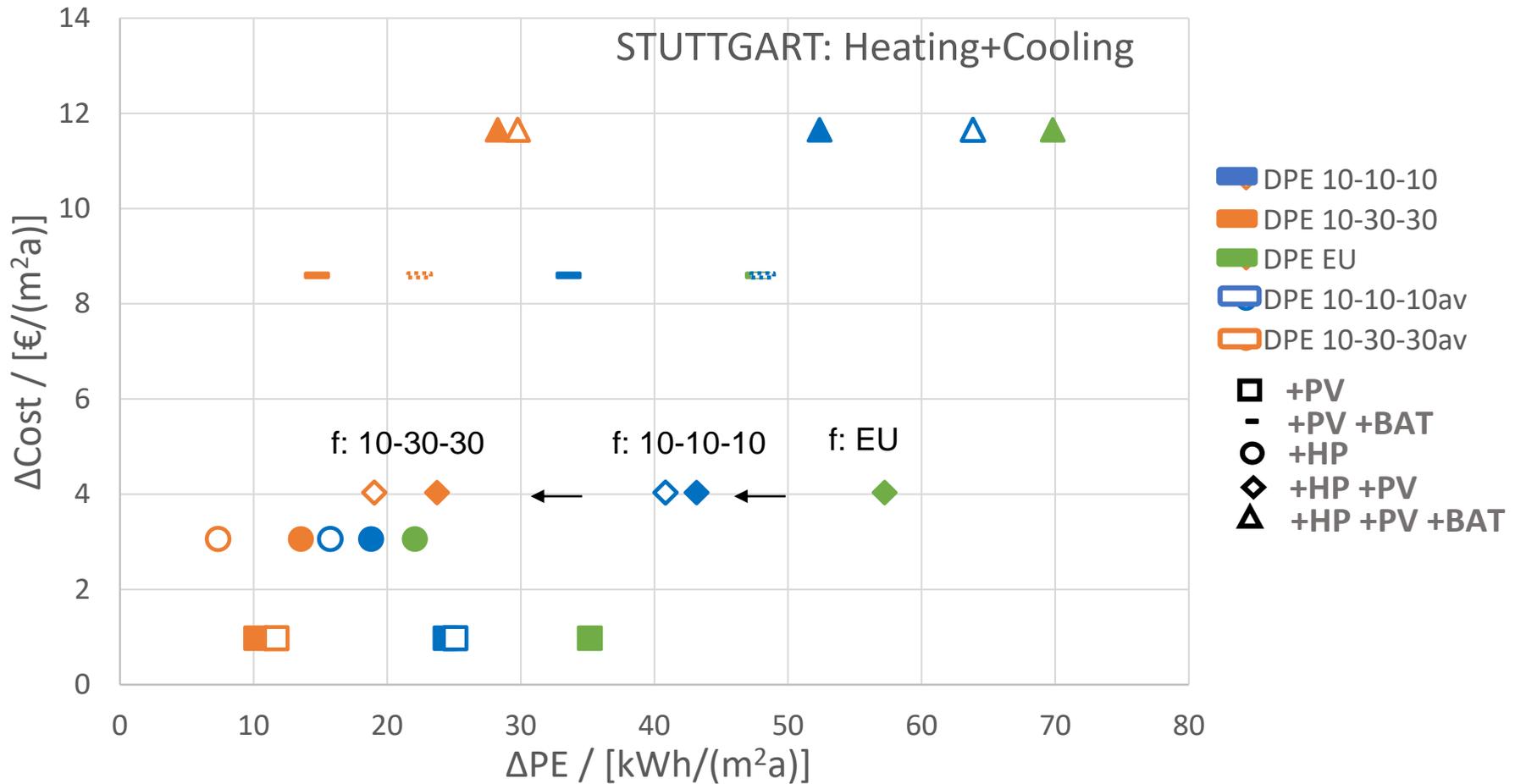


Preliminary Results: costs vs. PE savings

PE 10-10-10



Influence of PE scenario (electricity mix)



Task 56 – Activities

<https://passiv.de/>

Design and Decision support tools

PHPP

- Monthly Energy Balance (EN 13790)
- PH Design (worldwide)
- Passive Solutions
- HVAC

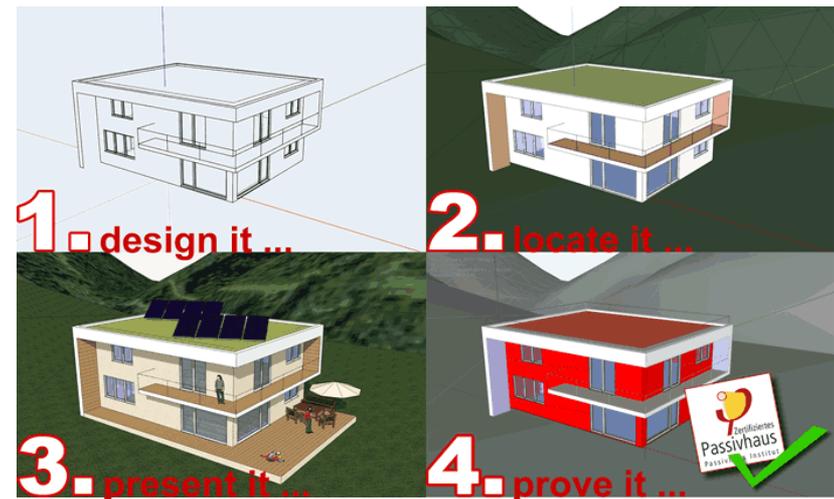


Ongoing work in the field of ...

Prediction of Performance of HPs

PV own consumptions

Primary energy



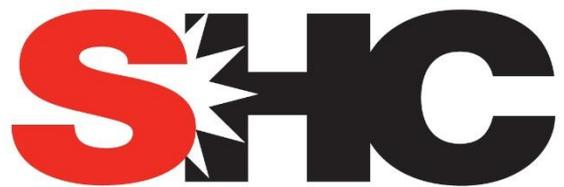
<https://designph.org/>

Conclusions

- Solar Active Facades = Multifunctional Facades
 - Residential (**HP, MVHR, PV, ST, storage, etc.**)
 - Heating
 - Cooling
 - Electricity
 - Office (**daylighting, PV, etc.**)
 - Heating
 - Cooling
 - Electricity
 - Daylighting (→Presentation M. Hauer, Bartenbach)
- Component Level: Development, Characterization, Modelling
- Building Level: Evaluation on Building and system level
 - Simulation
 - Monitoring

Design Tools to foster market penetration

www.iea-shc.org



SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY