

Solar Energy in Multi Family Houses

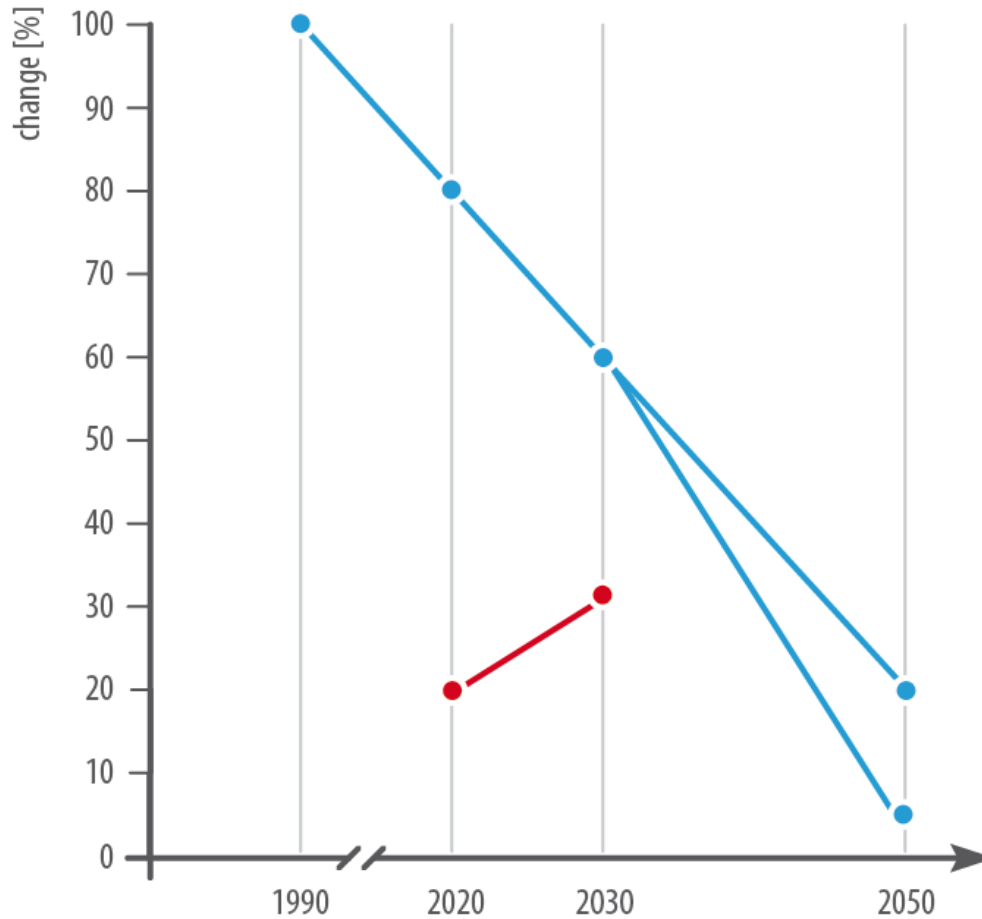
Oliver Rosebrock, M. Sc.

13.04.2019



European
Climate Initiative
EUKI

EU Goals for 2050

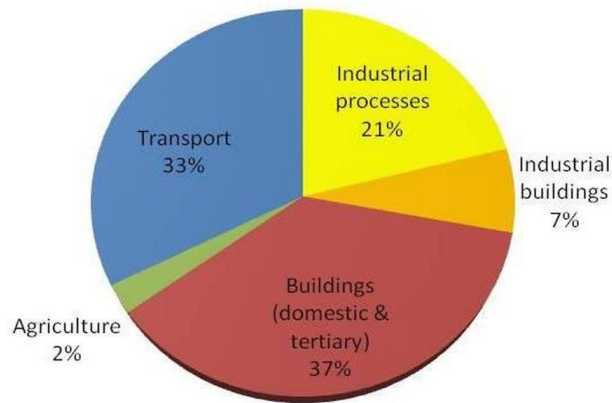


RE 2030 32 % share

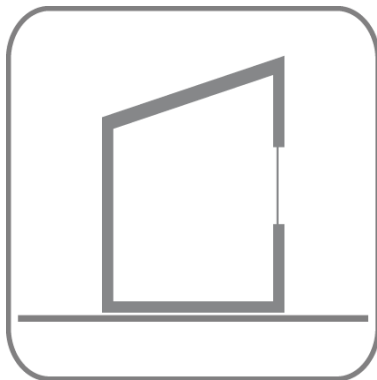
**CO₂ – emissions 2050
– 80 % to – 95 %**

EU Goals for 2050

Share of total EU energy consumption

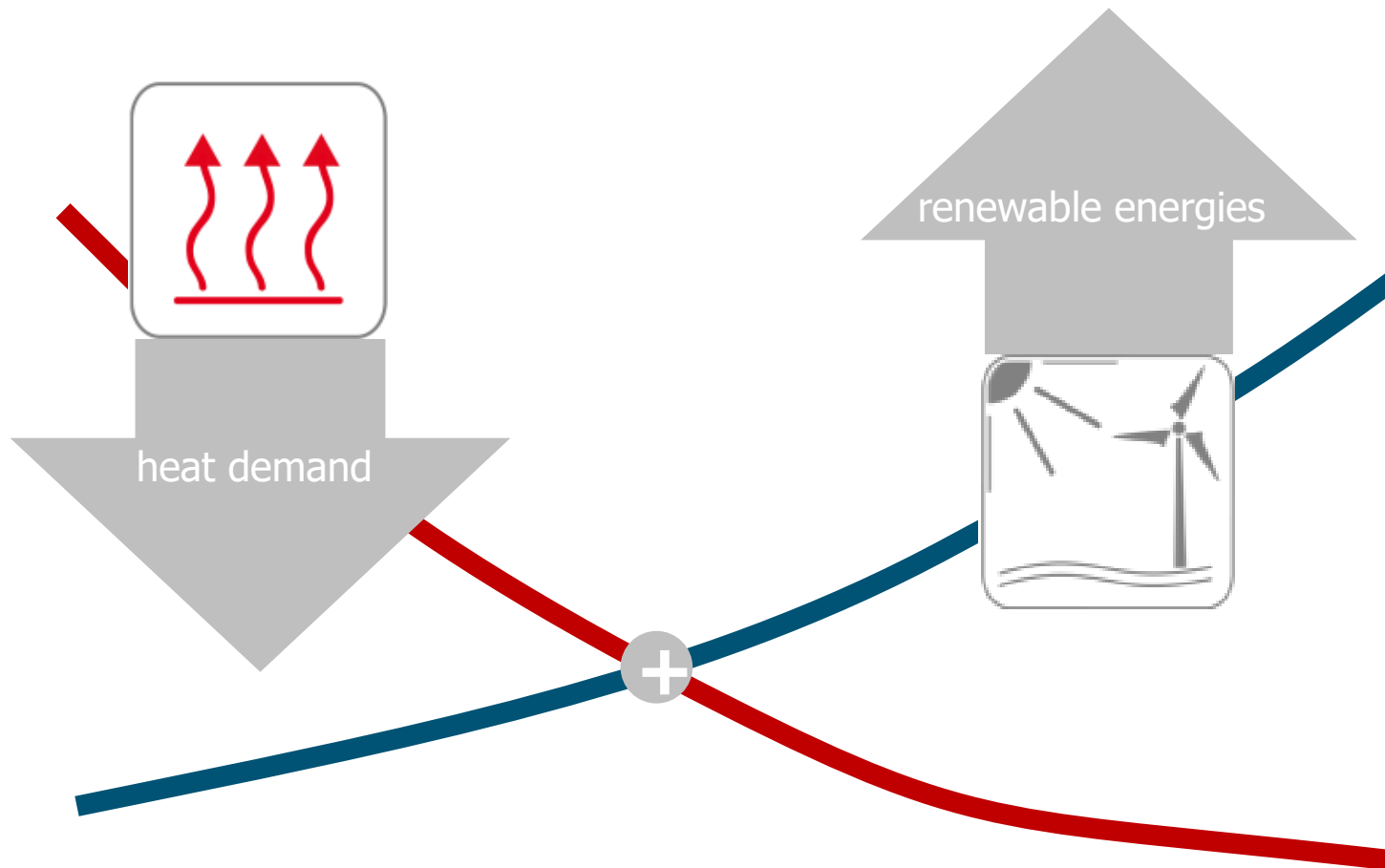


source: <https://www.energyworldmag.com/eu-energy-consumption-is-now-bellow-its-1990-level/>



> 1/3 of total consumption

How reduce the energy demand for buildings?



Renewable energy in buildings



solar radiation



environmental heat



wind and water



biomass



Potential of RE in buiding



solar radiation



environmental heat



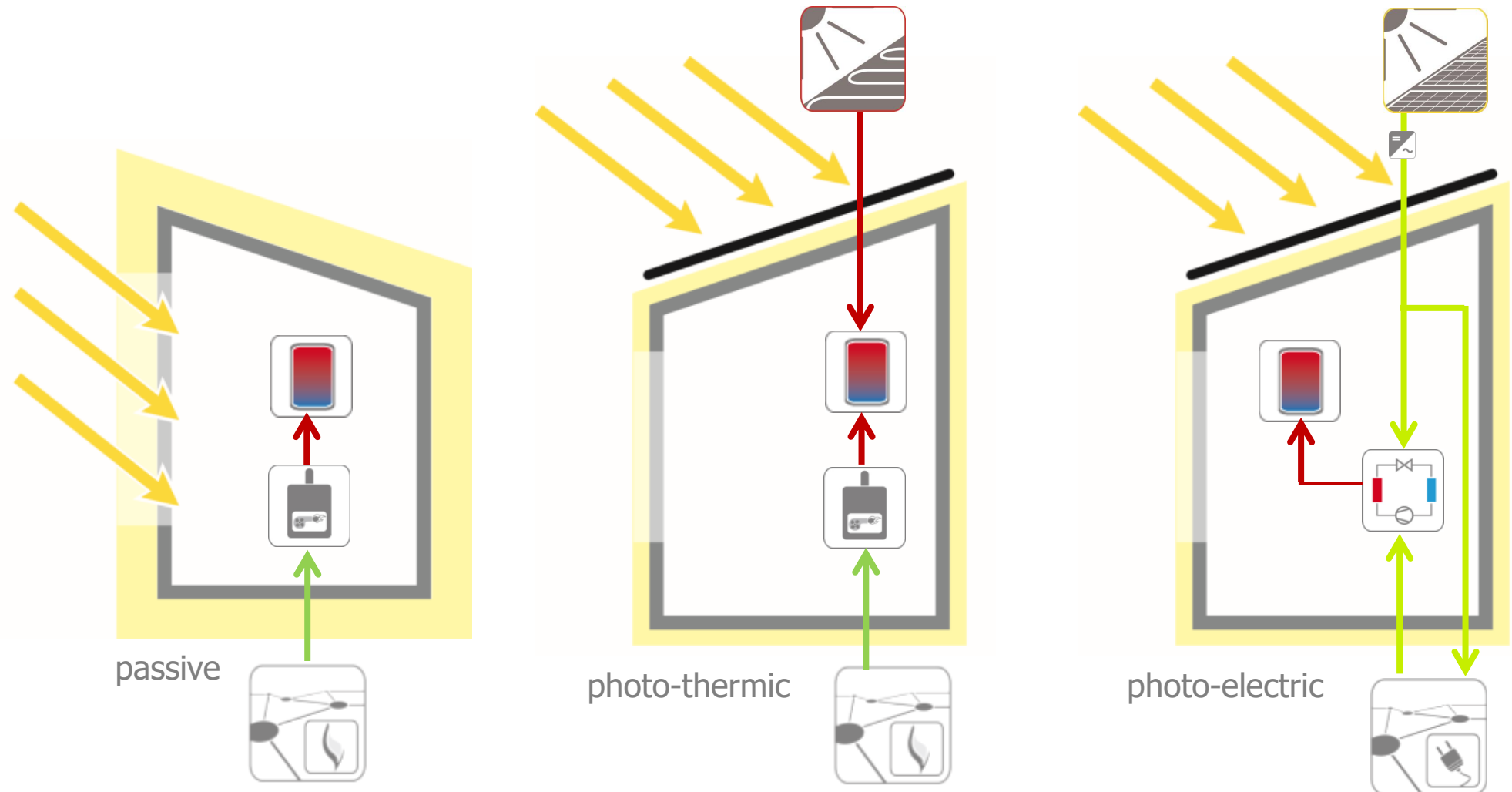
wind and water



biomass



integration of solar energy in buildings



ST or PV ?

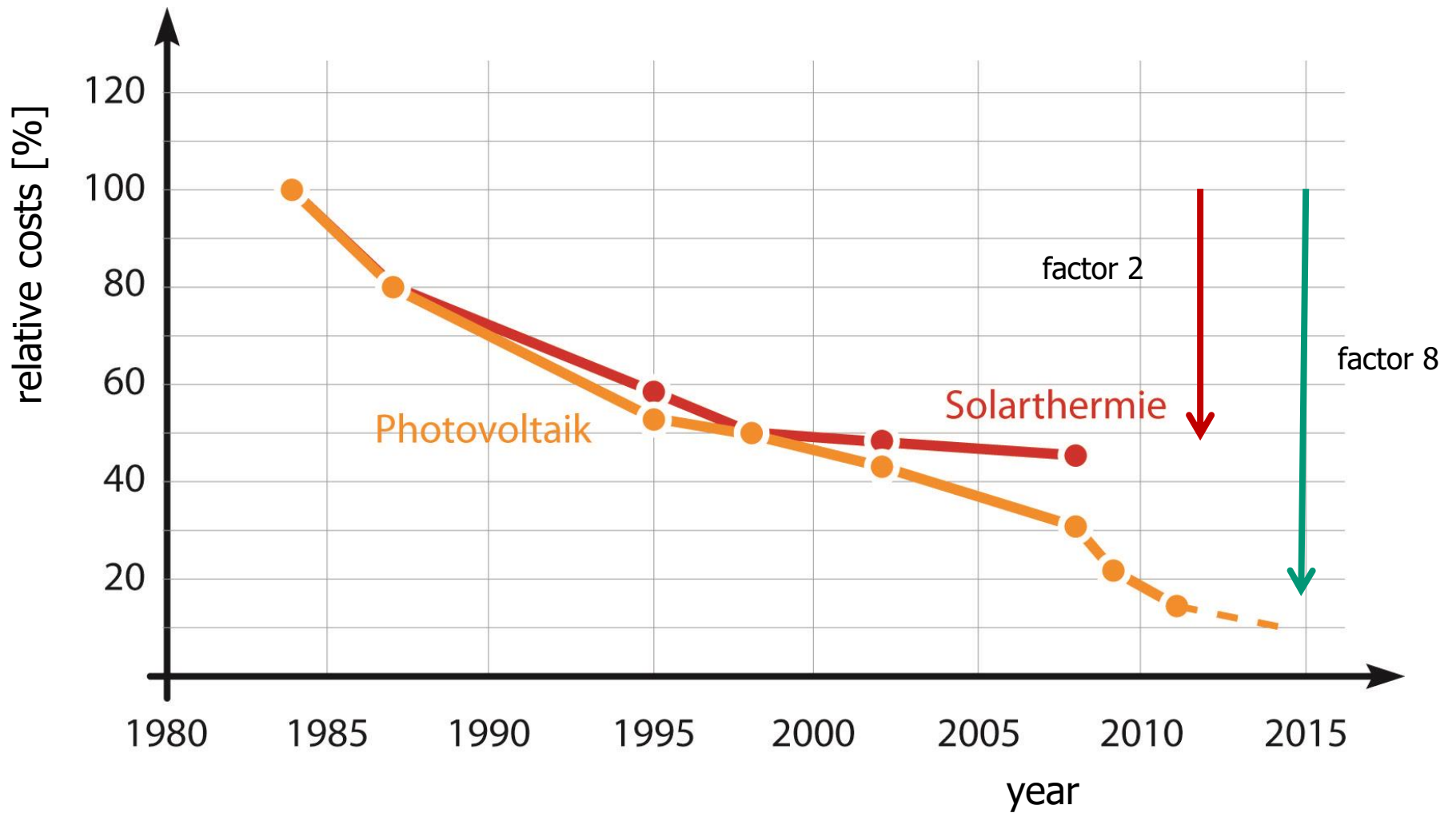


**Solarthermal
Collectors**



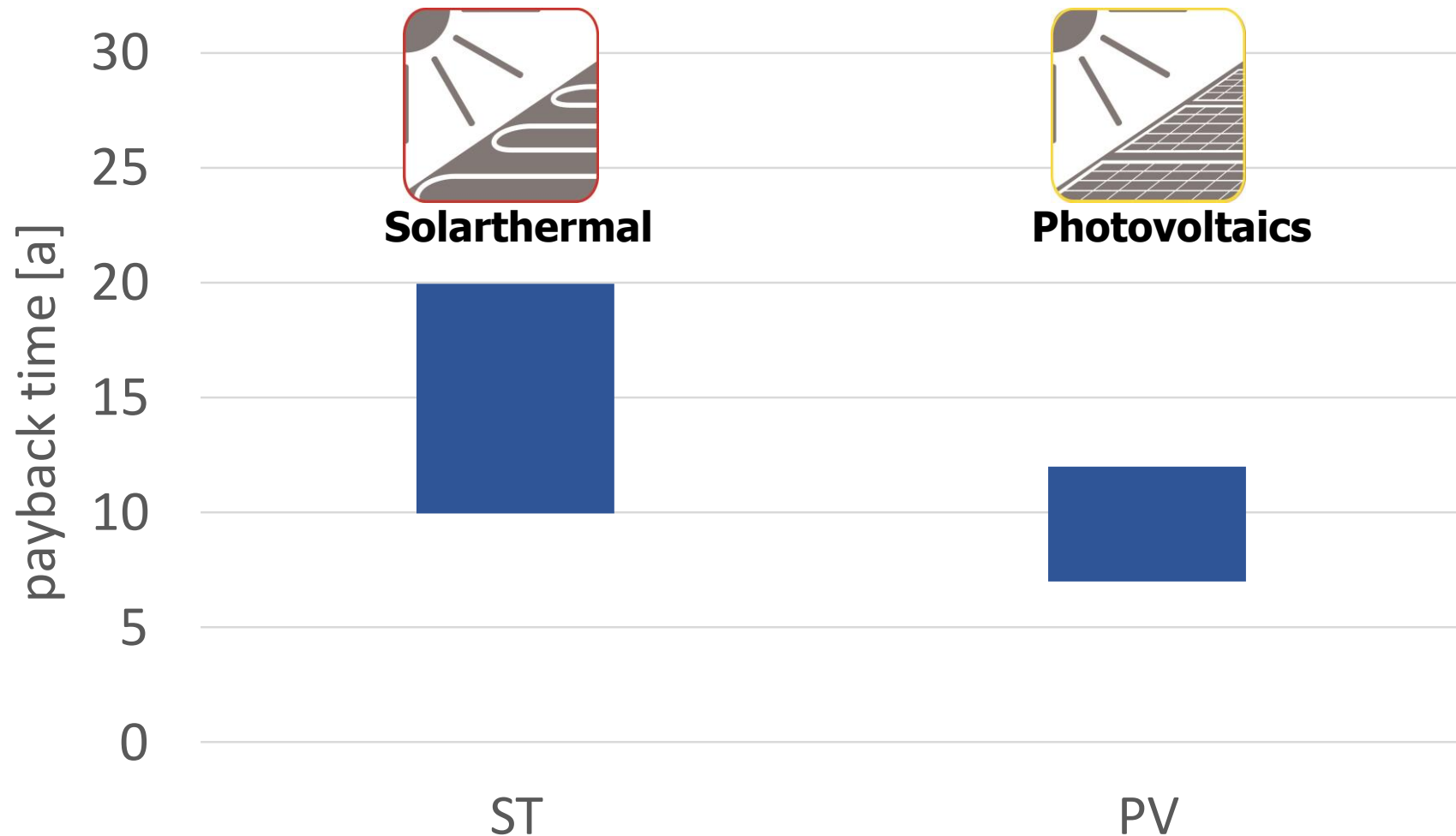
Photovoltaics

development of system costs



Quelle: 2010\SYSCOST1.XLS

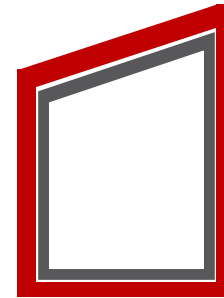
payback time of investment



PV or insulation?

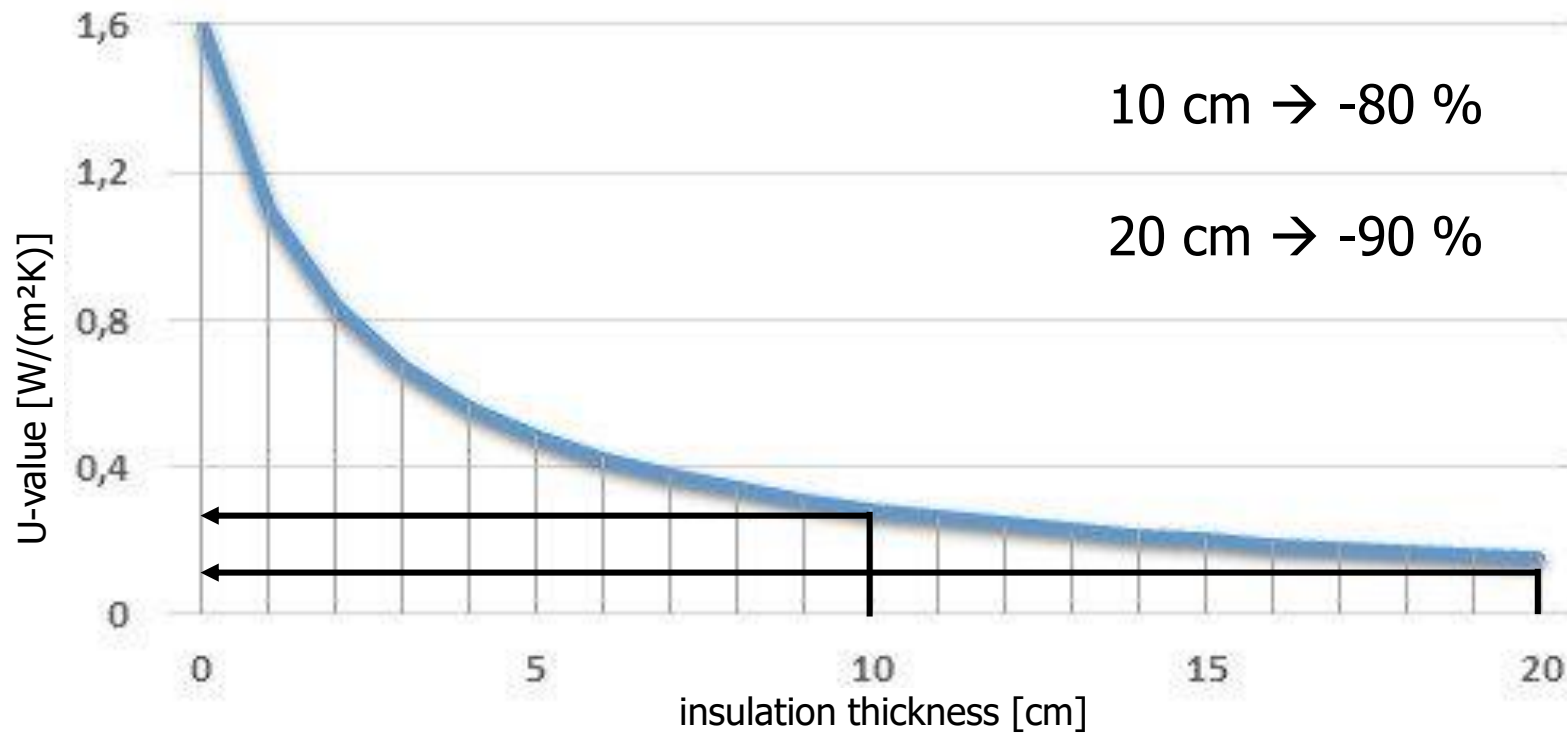


Photovoltaics

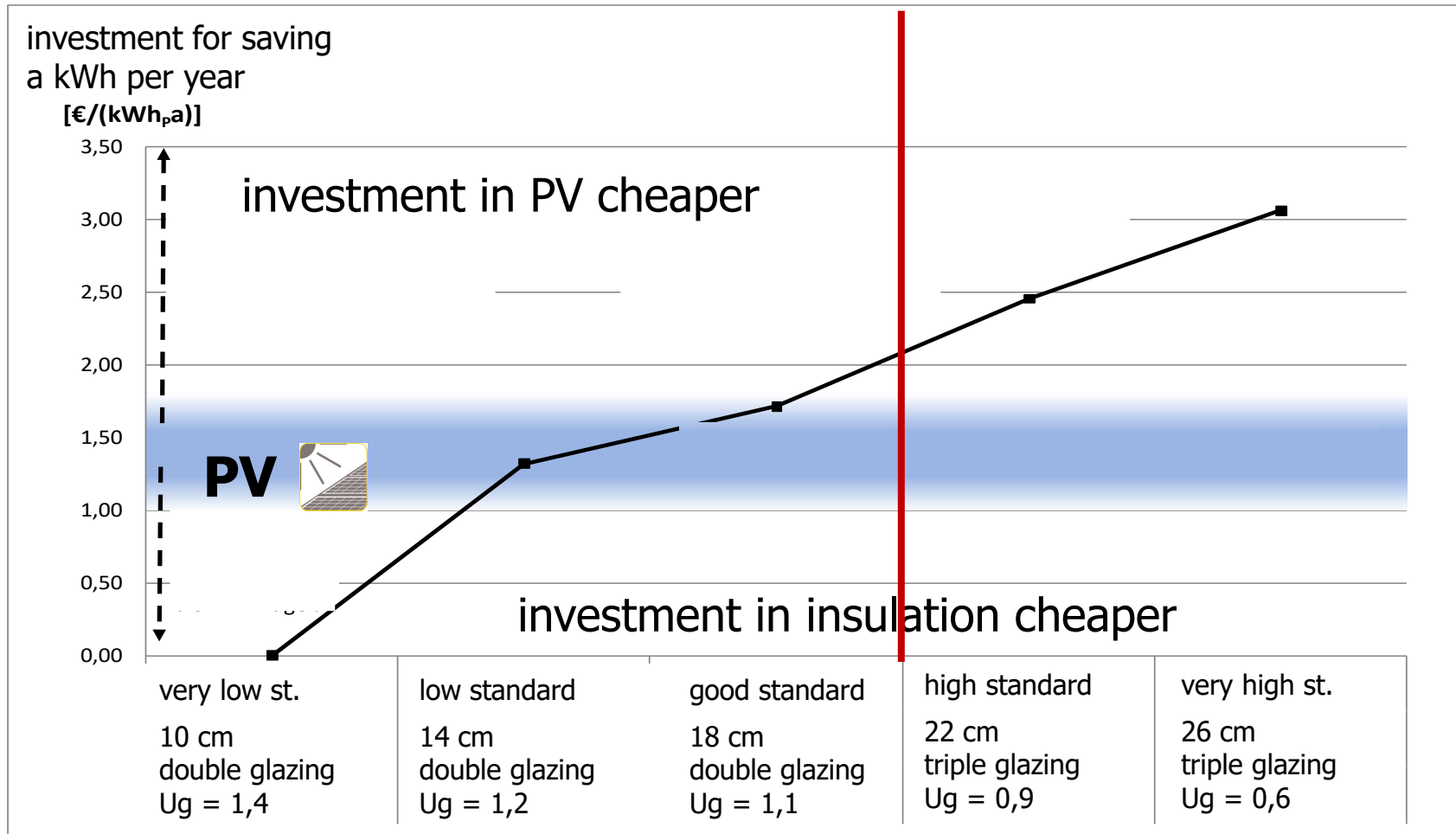


Insulation

insulation or RE?



insulation or RE?



And in Lithuania?



EUKI: SOL results

- Typical MFH house (~ 14.000 units)

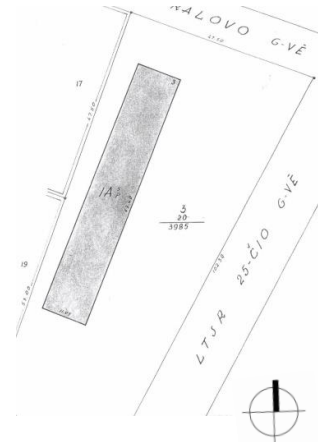
2760 m² living area

55 flats

area 63,4 m x 11,05 m

5 storeys

~ 30 % window area ratio on „long side“



EUKI: SOL results

- Typical MFH house (~ 6.000 units)

2043 m² living area

38 flats

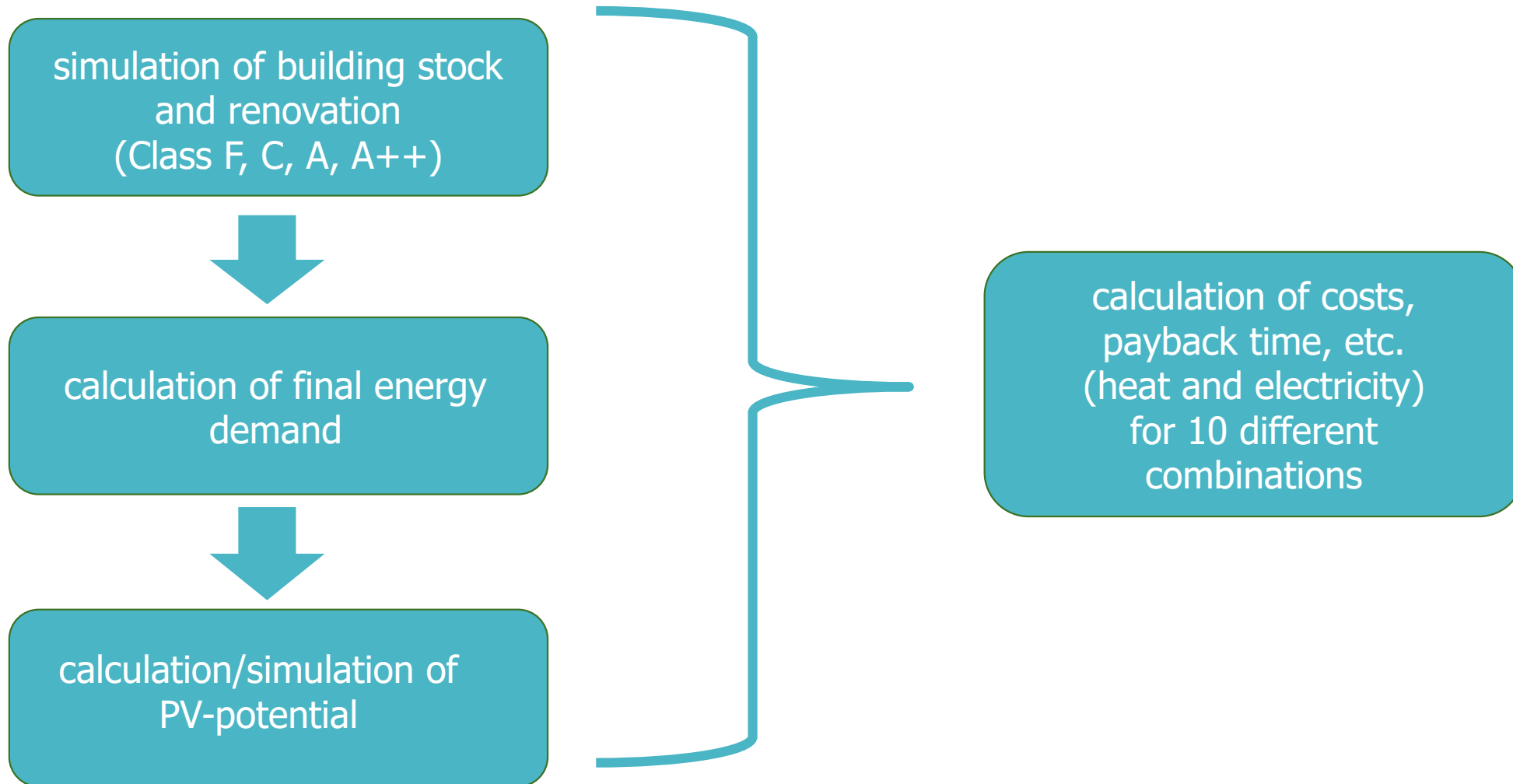
area 39 m x 15 m

5 storeys

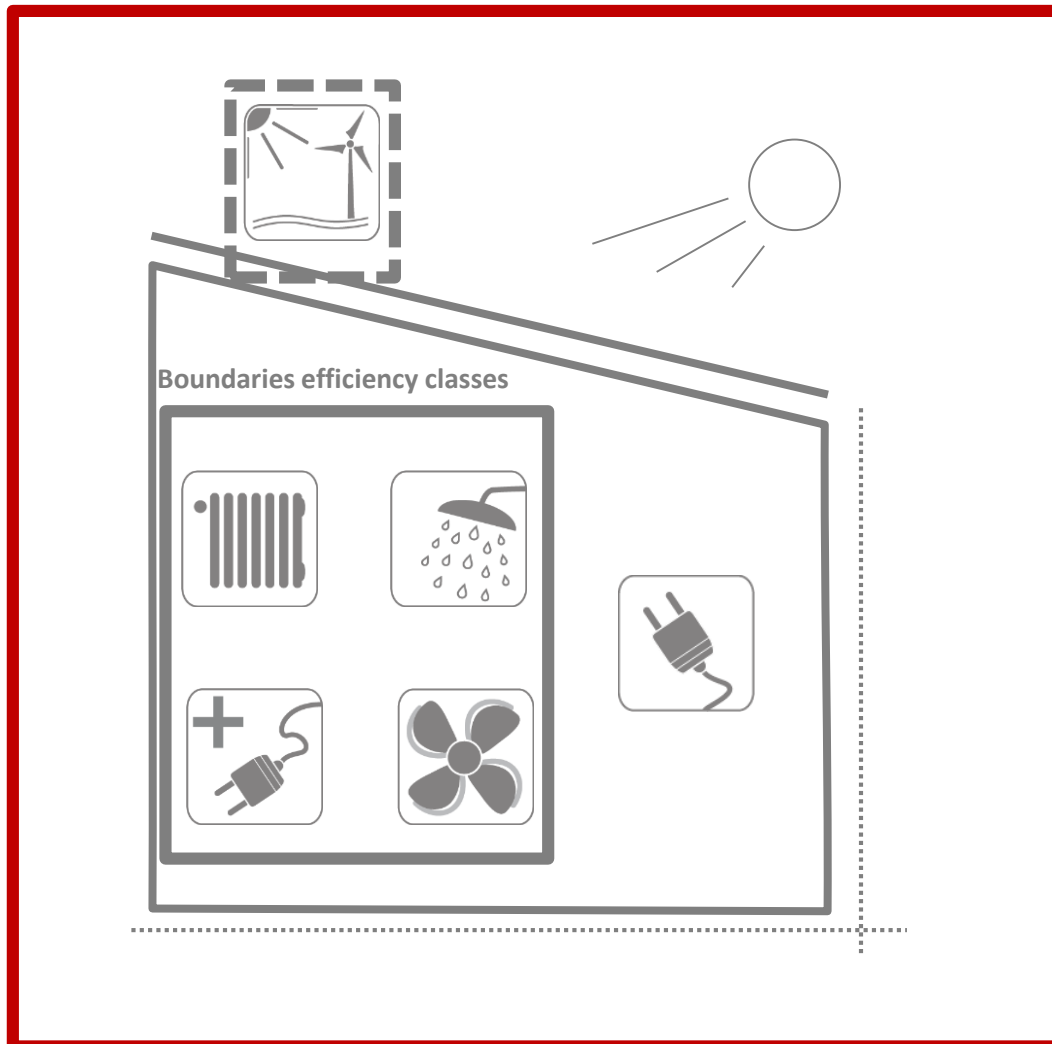
~ 30 % window area ratio on all sides



EUKI: SOL results



What we are looking at



heating



domestic hot water



auxiliaries



ventilation

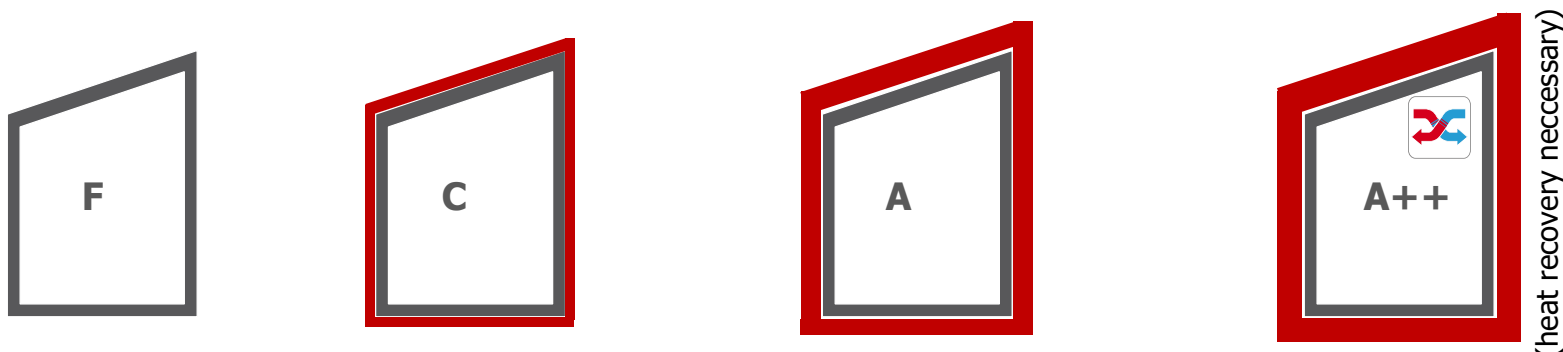


renewable energy (for heating)



household electricity

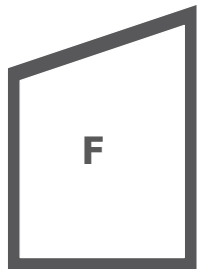
EUKI: SOL results



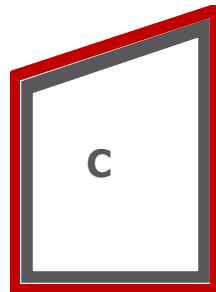
U-Value [W/(m²K)]	stock	Class C	Class A	Class A++
Roof	0,85	0,16 → 16 cm ins.	0,10 → 31 cm ins.	0,08 → 40 cm ins.
Wall	1,27	0,25 → 12 cm ins.	0,12 → 26 cm ins.	0,10 → 32 cm ins.
Floor	0,93	0,25 → 10 cm ins.	0,14 → 21 cm ins.	0,10 → 31 cm ins.
Window	2,5	1,6 → double glaz.	1,0 → double glaz.	0,7 → triple glaz.
n ₅₀	3 h ⁻¹	2 h ⁻¹	1 h ⁻¹	0,6 h ⁻¹

EUKI: SOL results

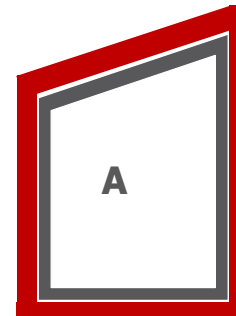
brick house



155
kWh/(m²a)



70
kWh/(m²a)



50
kWh/(m²a)



15
kWh/(m²a)



60
kWh/(m²a)

60
kWh/(m²a)

60
kWh/(m²a)

60
kWh/(m²a)



23
kWh/(m²a)

23
kWh/(m²a)

23
kWh/(m²a)

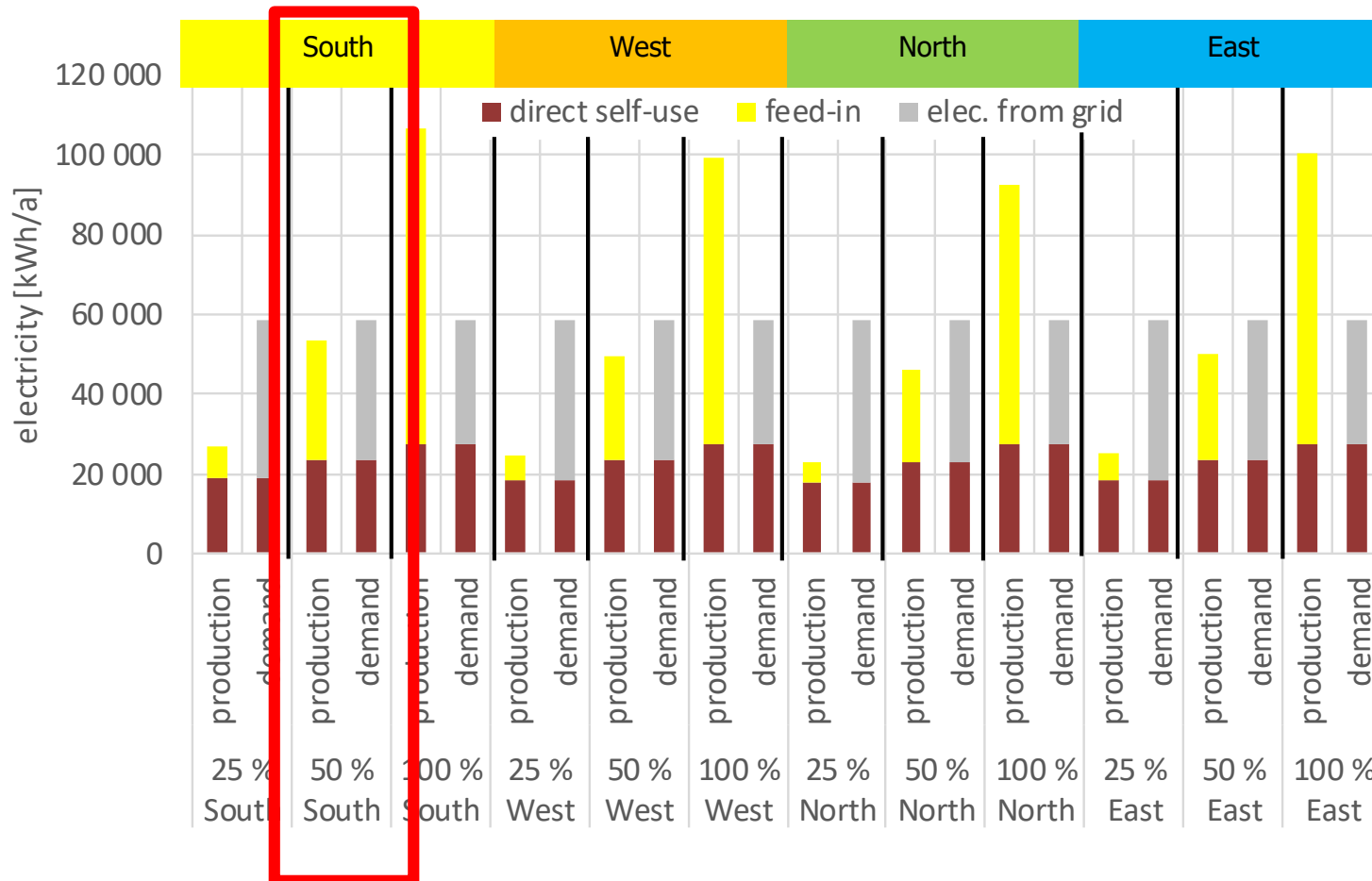
26
kWh/(m²a)

increase by ventilation system



EUKI: SOL results

Simulation of PV-Integration



EUKI: SOL results

- Investigation of 10 variants

 building stock, no PV

 renovation to C, no PV

 renovation to A, no PV

  building stock, 25 % PV

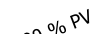
  renovation to C, 25 % PV

 renovation to A++, no PV

  building stock, 50 % PV

  renovation to C, 50 % PV

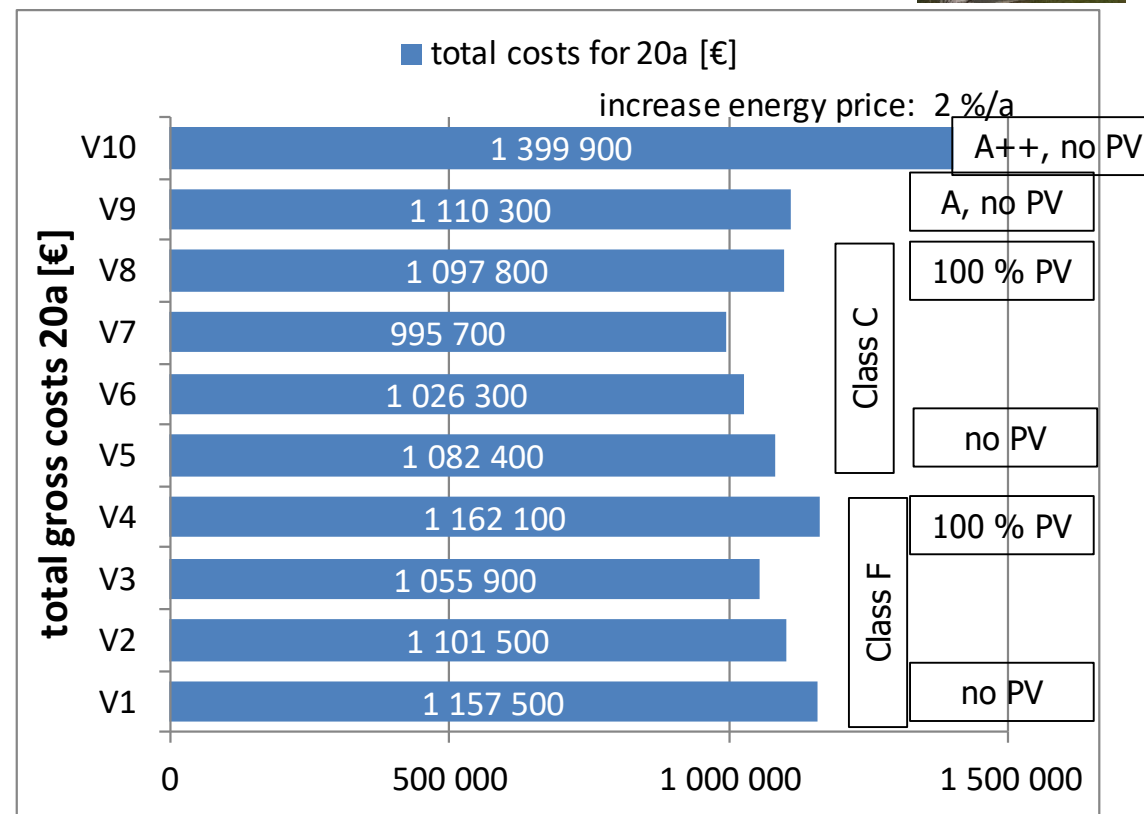
  building stock, 100 % PV

  renovation to C, 100 % PV

EUKI: SOL results

total costs 20 years

both measures have a huge impact on energy costs

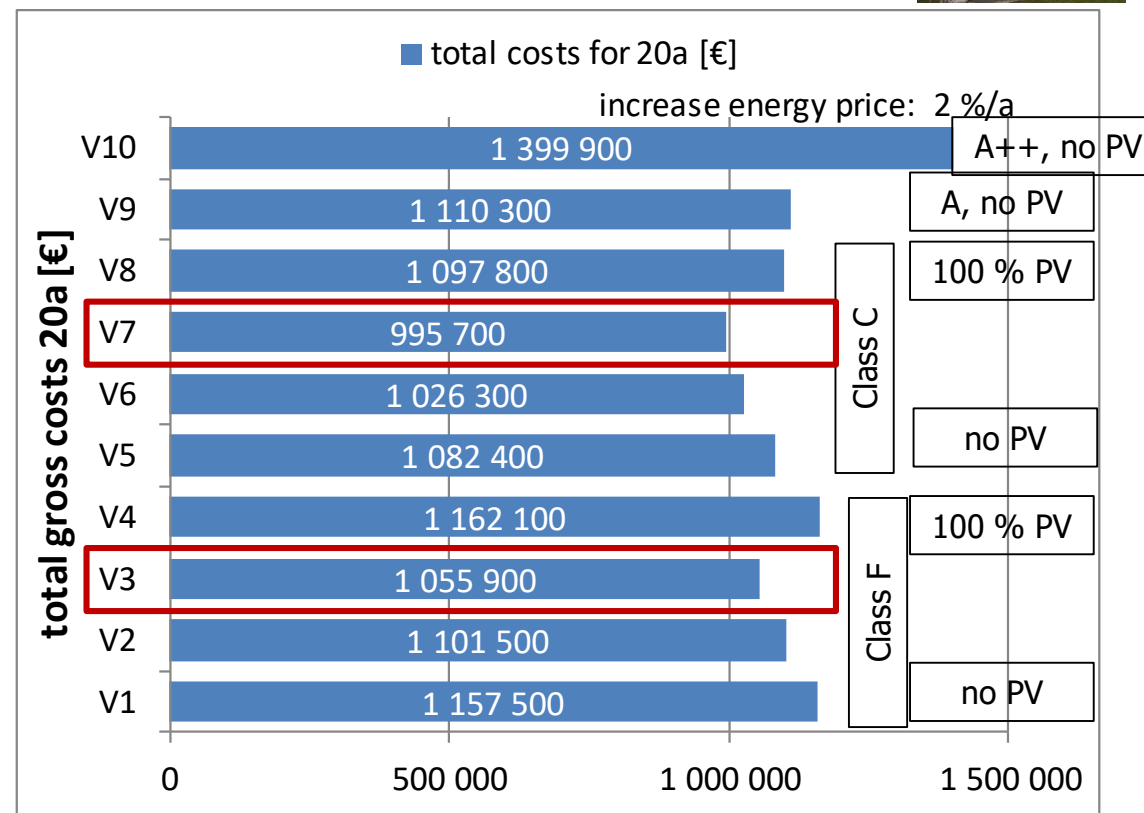


EUKI: SOL results

total costs 20 years

both measures have a huge impact on energy costs

integration of PV is less cost-effective than insulation to Class C (V3 to V7)



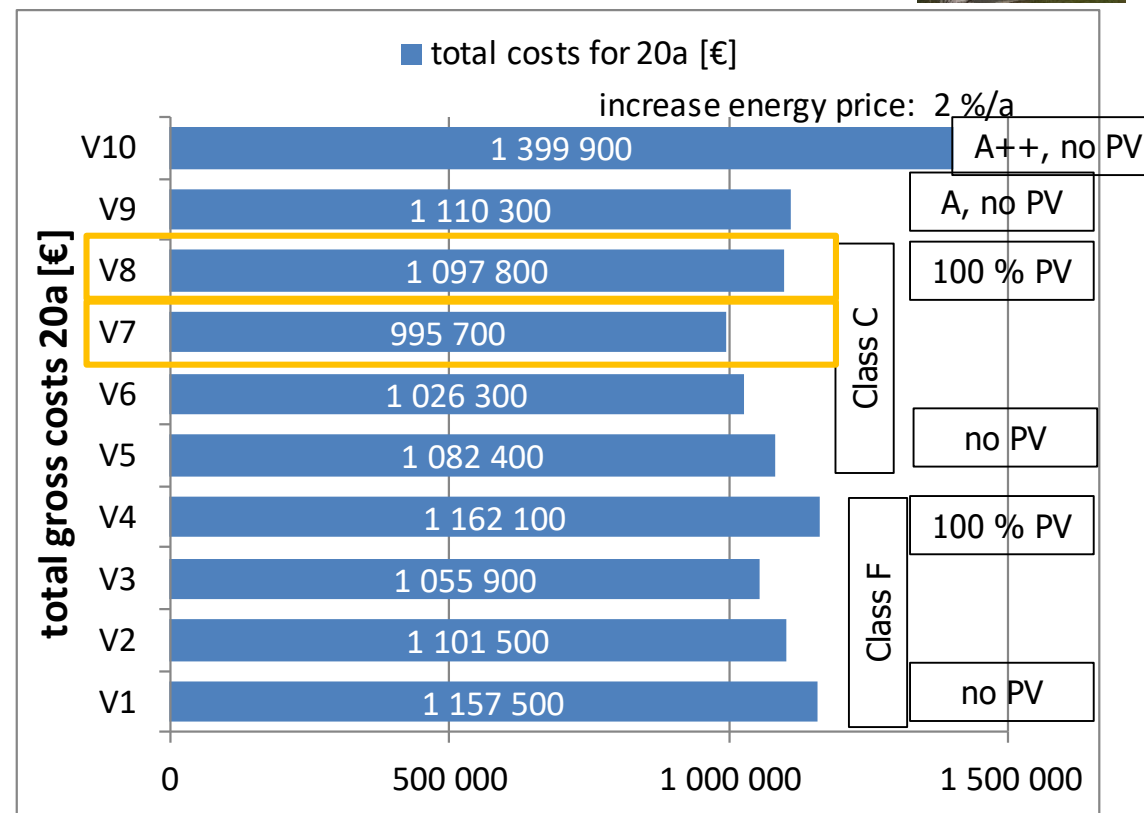
EUKI: SOL results

total costs 20 years

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integration of PV is less cost-effective than insulation to Class C (V3 to V7)

no cost-effectiveness for additional PV larger than PV area that covers demand (V7 to V8)



EUKI: SOL results

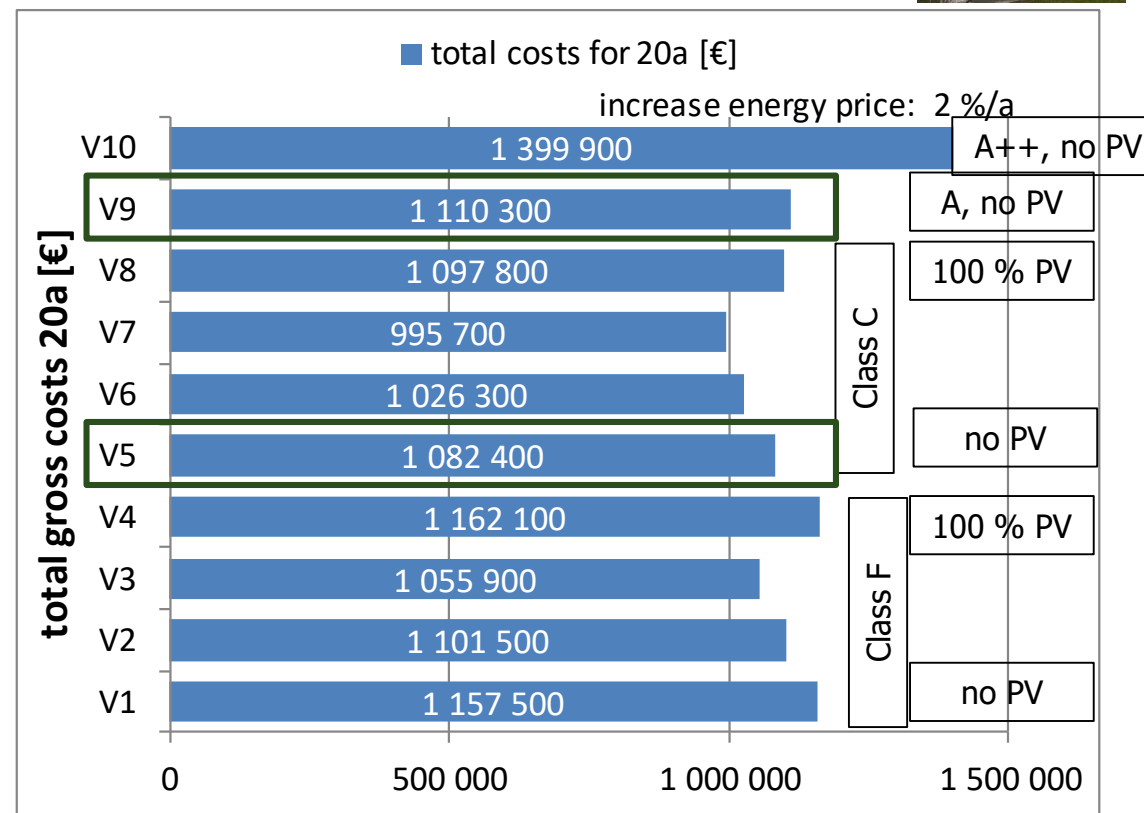
total costs 20 years

both measures have a huge impact on energy costs

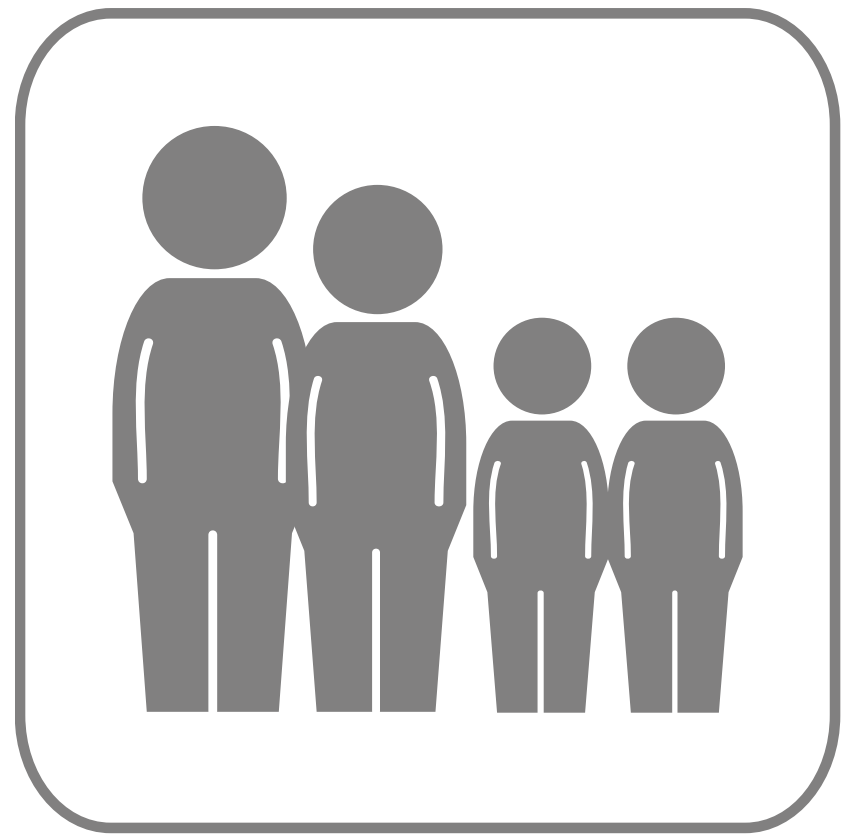
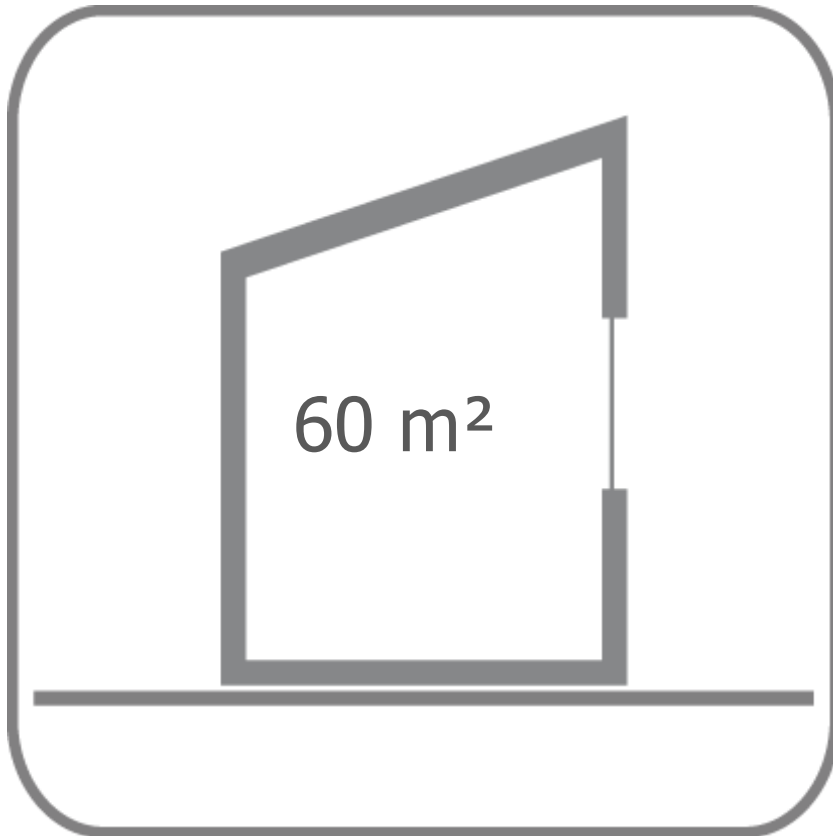
integration of PV is less cost-effective than insulation to Class C (V3 to V7)

no cost-effectiveness for additional PV larger than PV area that covers demand (V7 to V8)

cost-effectiveness of insulation decreases for higher standards than C (V5 to V9)



energy demand 4 Persons in a 60 m² flat

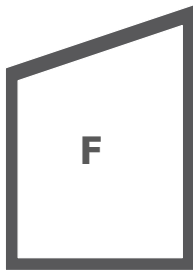


How to improve the energy consumption and costs?

EUKI: SOL results



60 m²



825 €/a



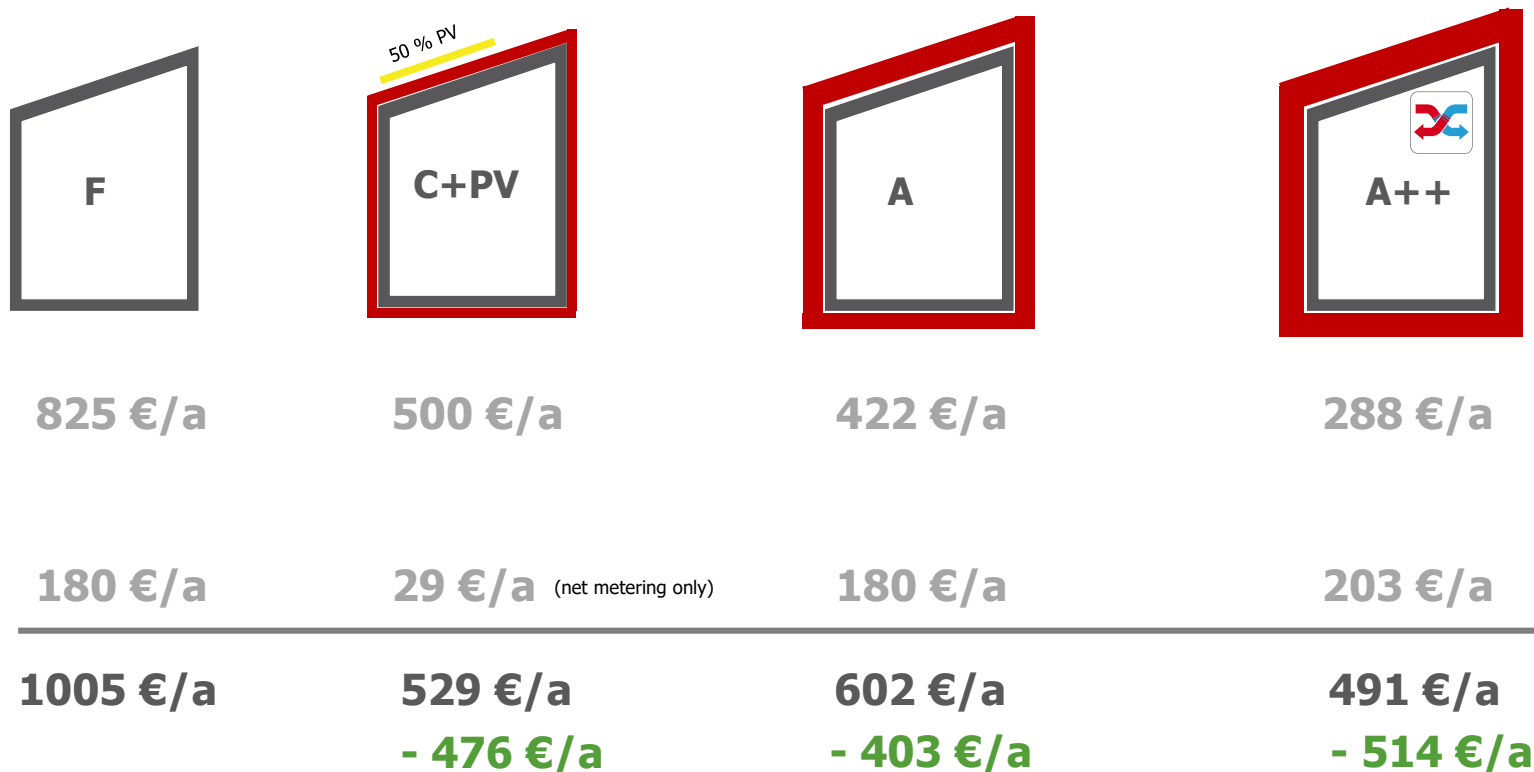
180 €/a

1005 €/a



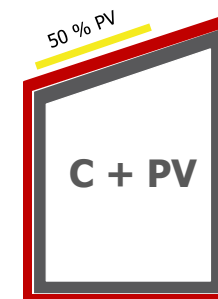
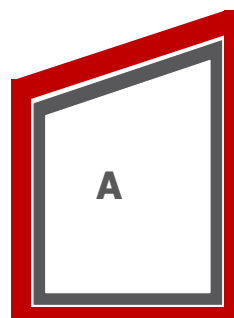
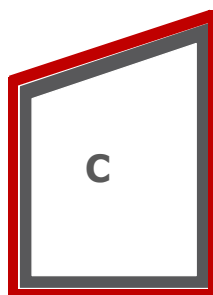
Assumptions:
costs district heating: 0,064 €/kWh
costs electricity: 0,13 €/kWh

EUKI: SOL results



Assumptions:
costs district heating: 0,064 €/kWh
costs electricity: 0,13 €/kWh

EUKI: SOL results



**energy costs
reduction
(compared to F)**

- 325 €/a

- 403 €/a

- 514 €/a

- 476 €/a

investment
(60 m² of 2760 m²)

6.715 €

9.271 €

15.760 €

8.226 €

payback
(w/o maintenance or
energy price increase)

20 years

23 years

31 years

17 years

Assumptions:
costs district heating: 0,064 €/kWh
costs electricity: 0,13 €/kWh

Recommendation

- energetic renovation is necessary and economic
- PV-integration is senseful and economic (with funding)
- due to high heating demand PV less cost-effective than insulation to Class C
- cheapest option: insulation to Class C and 50% PV
- PV-generation should not exceed the house's consumption
- implementation of pricing models for the direct use of PV-electricity necessary necessary
- cheapest option for 20 years: energetic renovation + 50 % PV



Thank you for your attention!

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