



Task 48 



Task 53 

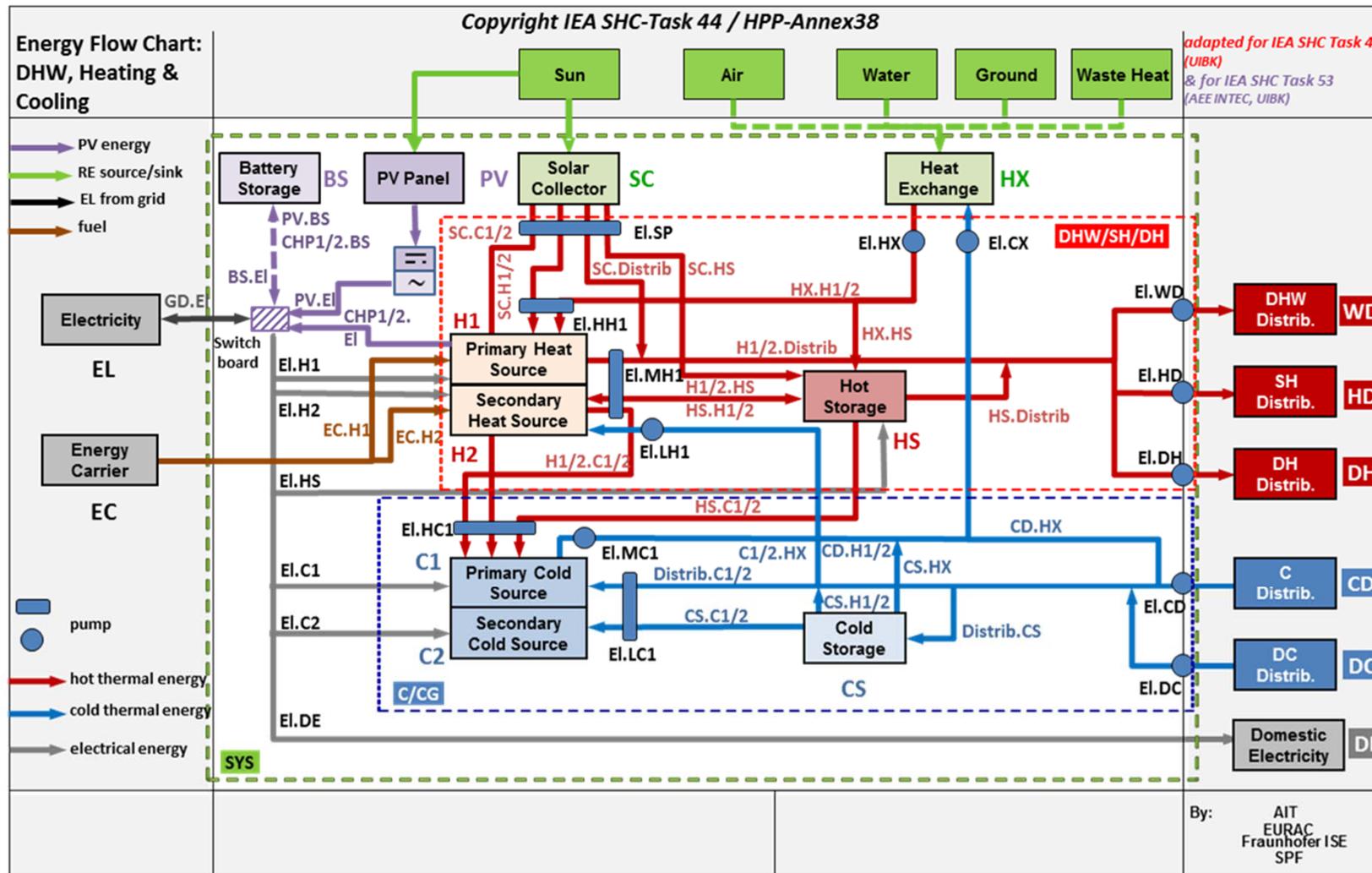
IEA SHC Task 48 / IEA SHC Task 53 Solar Cooling monitoring and assessment



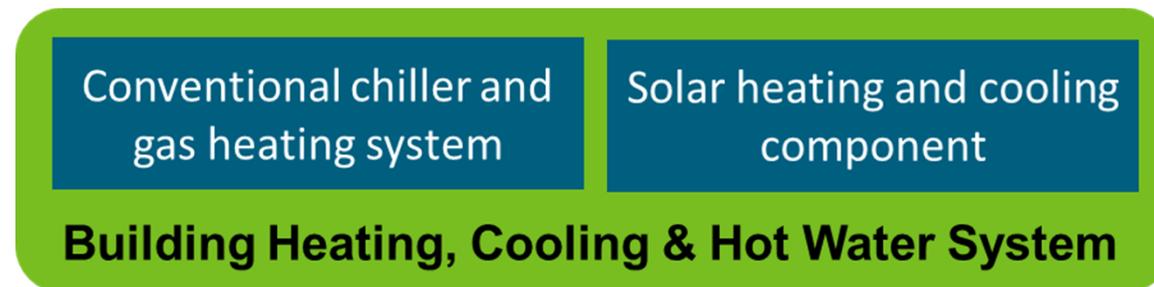
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Solar Heating and Cooling can be complex



Rating systems for Solar Heating and Cooling



- Fair key figure ... comparable with SEER?
- How to combine gas and electricity in one key figure?
- Benchmarks for and against
 - Solar cooling
 - Conventional system

→ Technical and economic evaluation Excel TOOL

Introduction

- Several Key Performance Indicators developed in IEA SHC Task 48 and adapted for IEA SHC Task 53
 - Efficiency on building & component level
 - Electricity / Primary Energy / CO2 Emissions
- Excel Tool for evaluation of systems
 - Technical assessment
 - Indicative economic analysis
- 10 examples were collected in Task48

Technical Assessment – Selected Key Figures

- Seasonal Performance Factor (**SPF**)

- Electrical - SPF_{el}

$$SPF_{el} = \frac{\sum Q_{out}}{\sum Q_{el,in}}$$

- Thermal - SPF_{th}

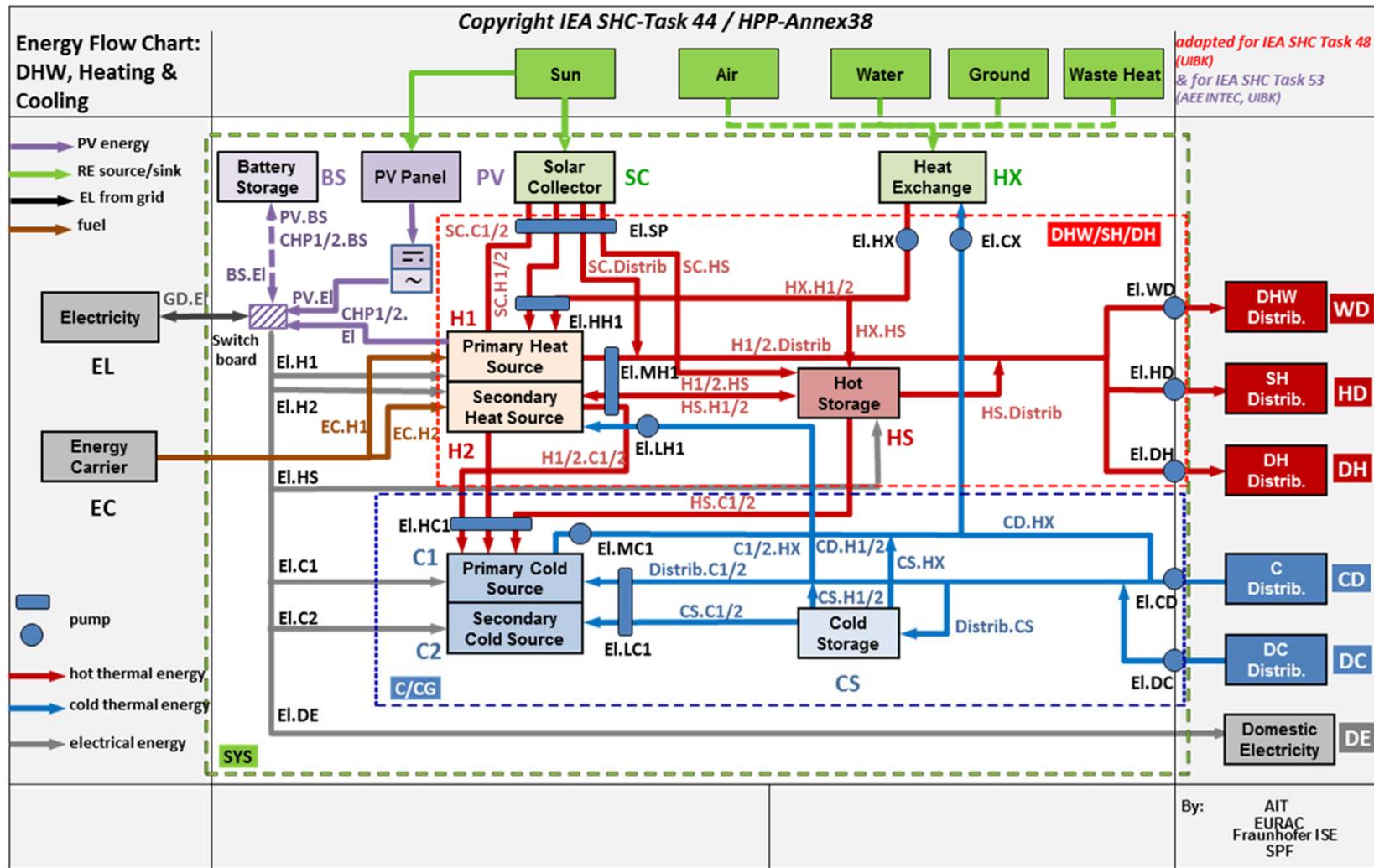
$$SPF_{th} = \frac{\sum Q_{out}}{\sum Q_{in}}$$

- Equivalent Seasonal Performance Factor (**SPF_{equ}**)

primary energy flows expressed in electrical equivalent units used to compare with any (non-) renewable system

$$SPF_{equ} = \frac{\sum Q_{out}}{\sum Q_{el,in} + \sum \frac{\varepsilon_{el} * Q_{th,in}}{\varepsilon_{in}}}$$

Technical assessment – boundary



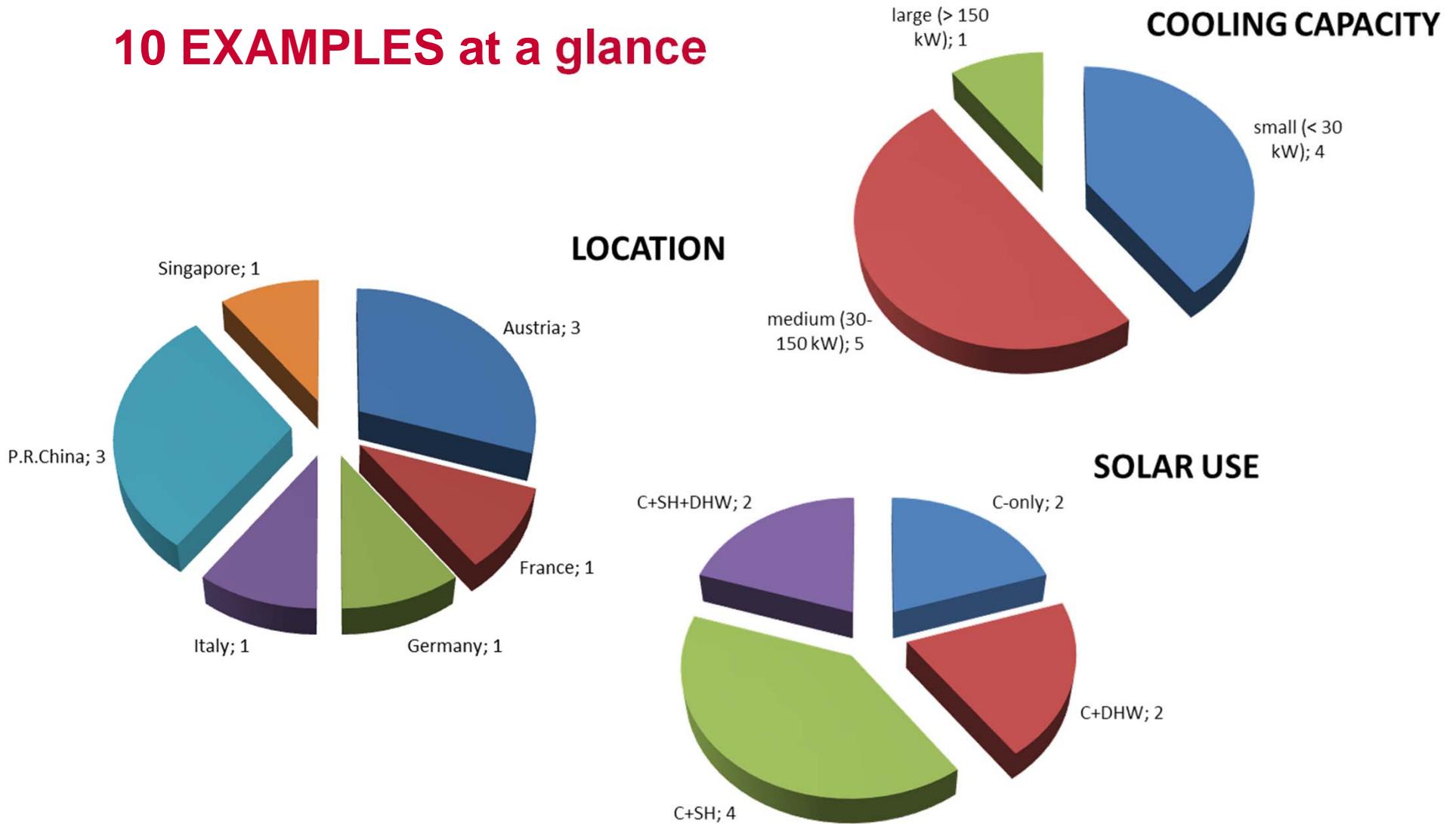
Systems & components

- Technical and economic data available for

	components
Solar Thermal Collectors (SC)	<ul style="list-style-type: none"> Flat Plate Collector Evacuated Tube Collector
Photovoltaic (PV)	<ul style="list-style-type: none"> Photovoltaic Panels BOS (balance of system)-components
Heating (H1, H2)	<ul style="list-style-type: none"> Natural Gas Boiler Pellets Boiler Heat Pump (not reversible/reversible) Absorption Heat Pump (not reversible/reversible) Combined Heat&Power Plant District Heating (as heat source)
Cooling (C1, C2)	<ul style="list-style-type: none"> Air-Cooled Vapour Compression Chiller Water-Cooled Vapour Compression Chiller Absorption Chiller (Single Effect & Double Effect) Adsorption Chiller District Cooling (as cold source)
Storage (HS, CS, BS)	<ul style="list-style-type: none"> Hot Storage Cold Storage

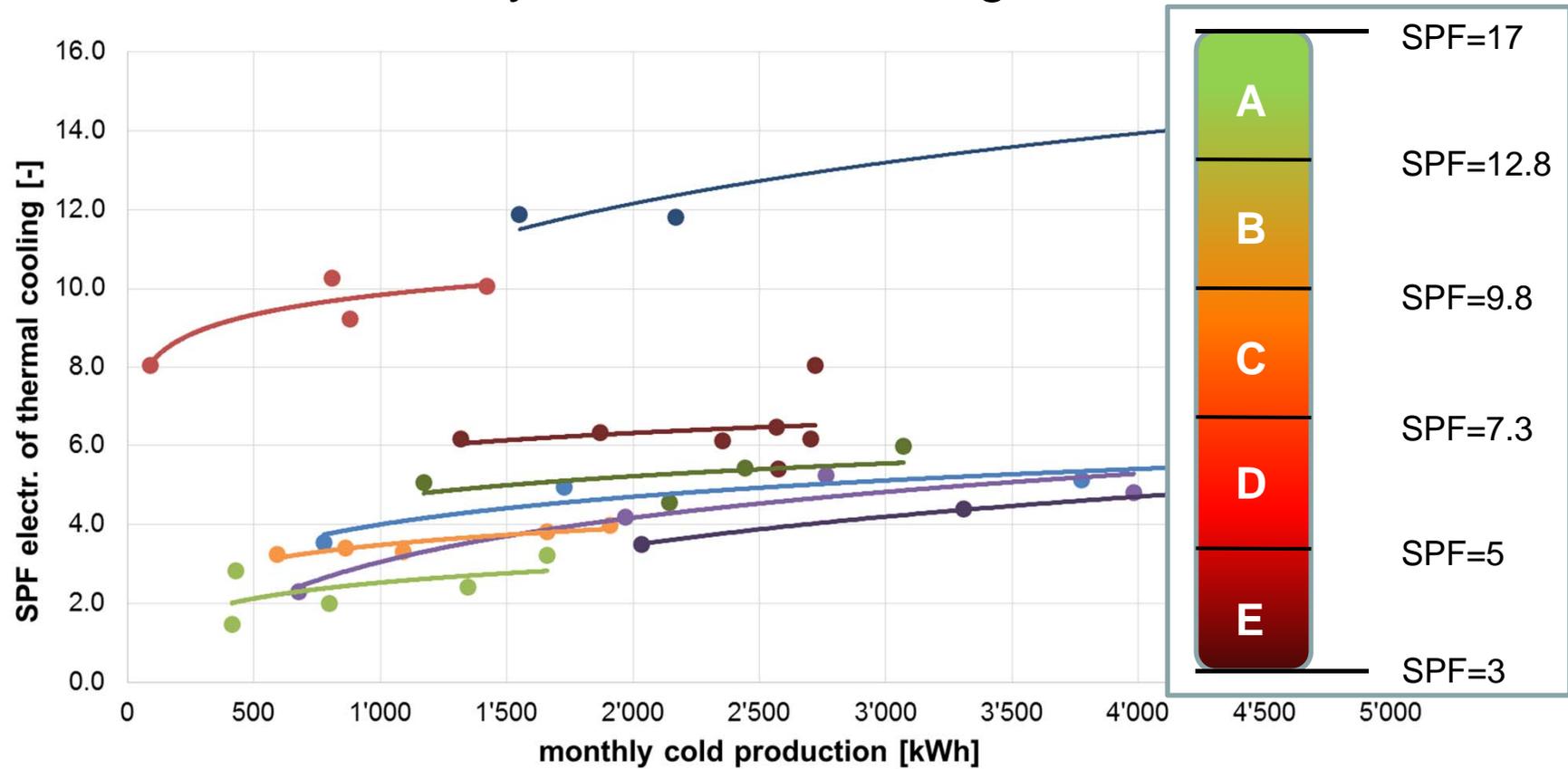


10 EXAMPLES at a glance



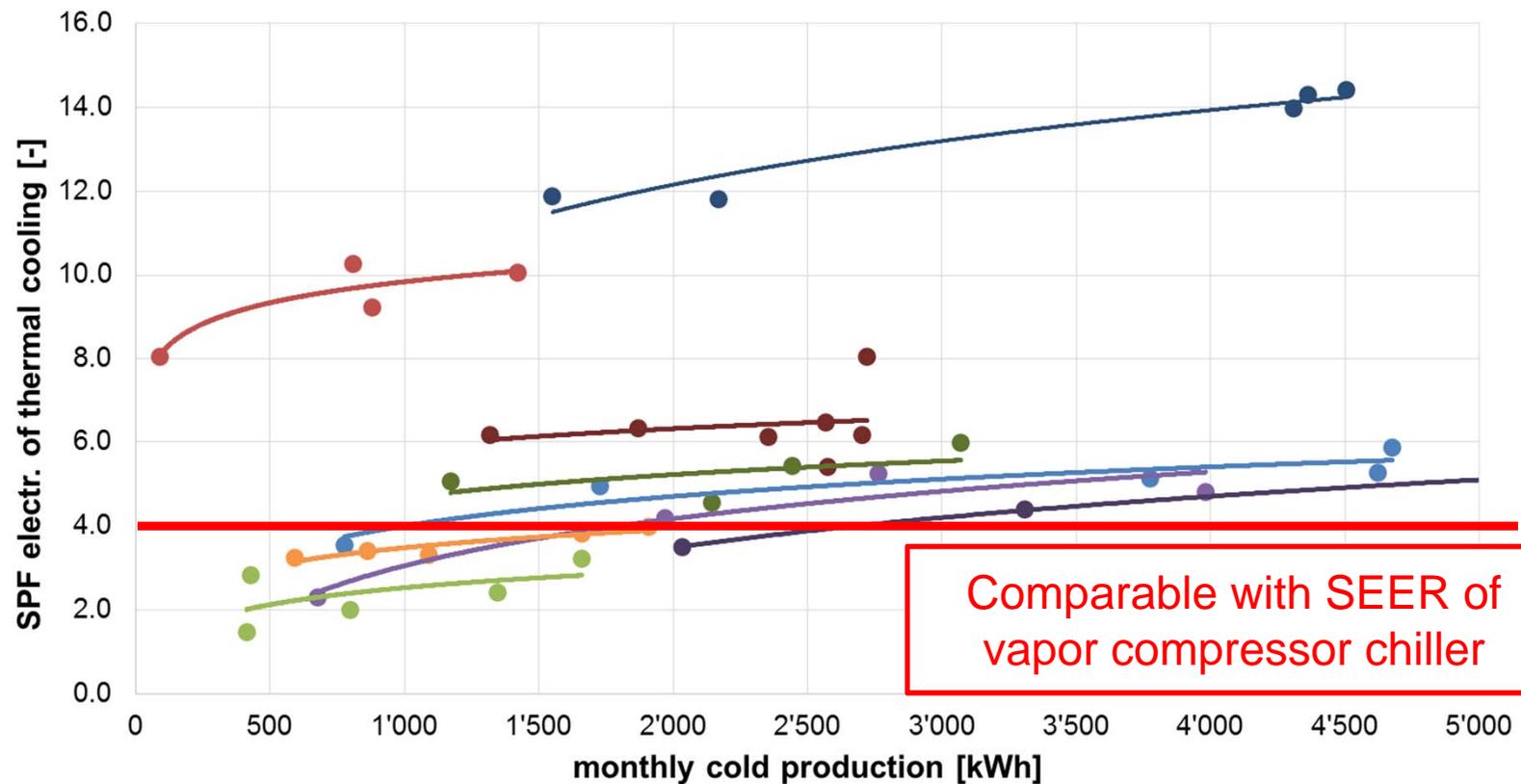
SUB-system Efficiency

- Electrical efficiency of thermal cooling



SUB-system Efficiency

- Electrical efficiency of thermal cooling



Labelling

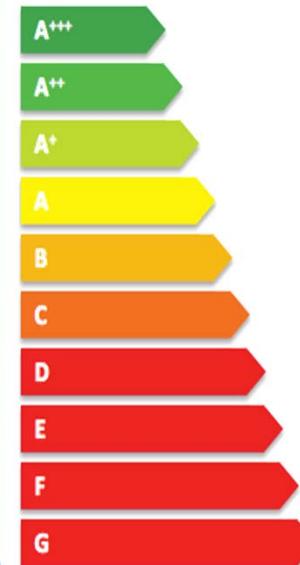
- 4 sub-system's and building performance!
- Rated **Primary Energy savings** of (non-renewable)

$$f_{sav.NRE.PER.i} = 1 - \frac{PER_{NRE.ref.i}}{PER_{NRE.i}}$$

Rating levels:

> 90 %
90 - 80 %
80 - 70 %
70 - 60 %
60 - 50 %
50 - 40 %
40 - 30 %
30 - 20 %
20 - 10 %
< 10 %

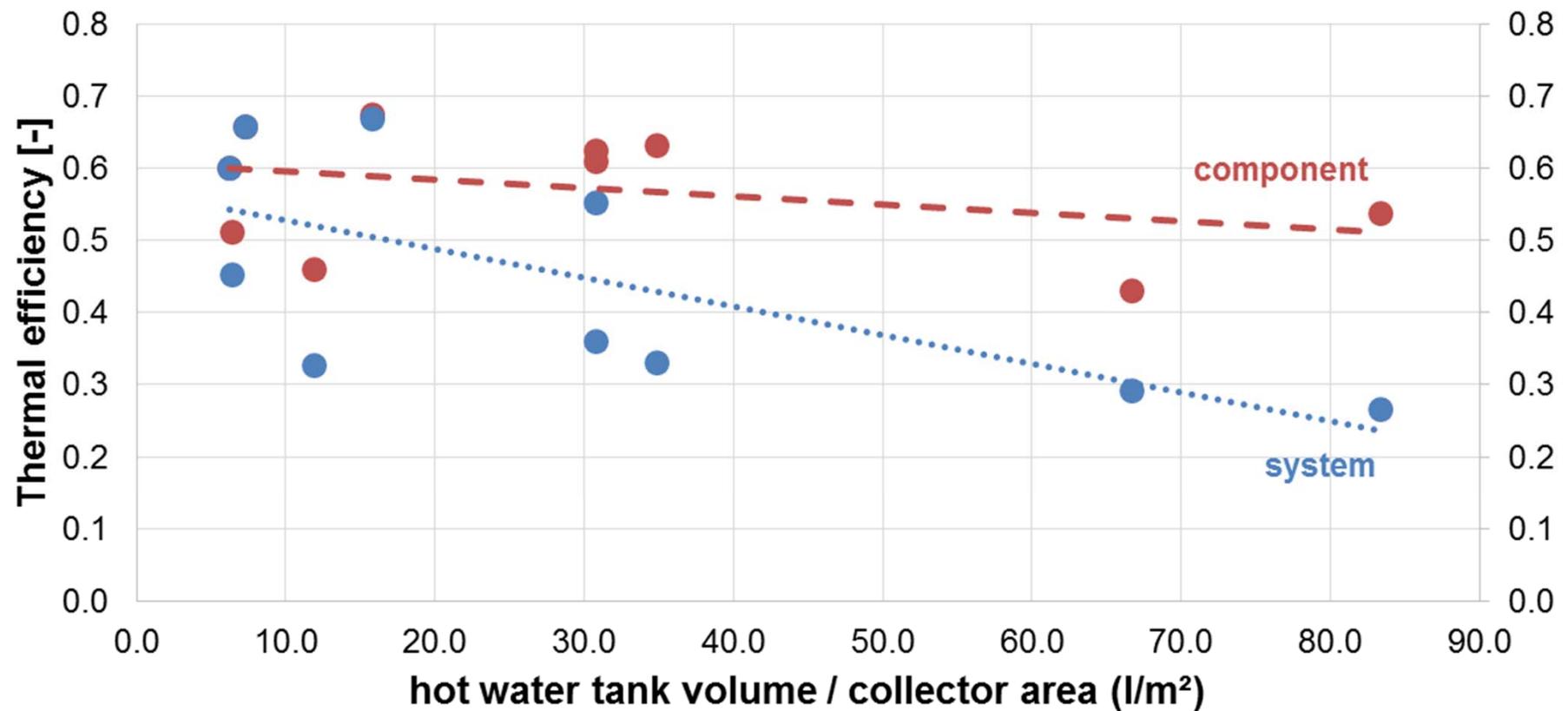
Energy label of the system



Rating of the
regarding system

SUB-system vs. system

- Thermal performance of the chiller / System



Indicative Economic Analysis

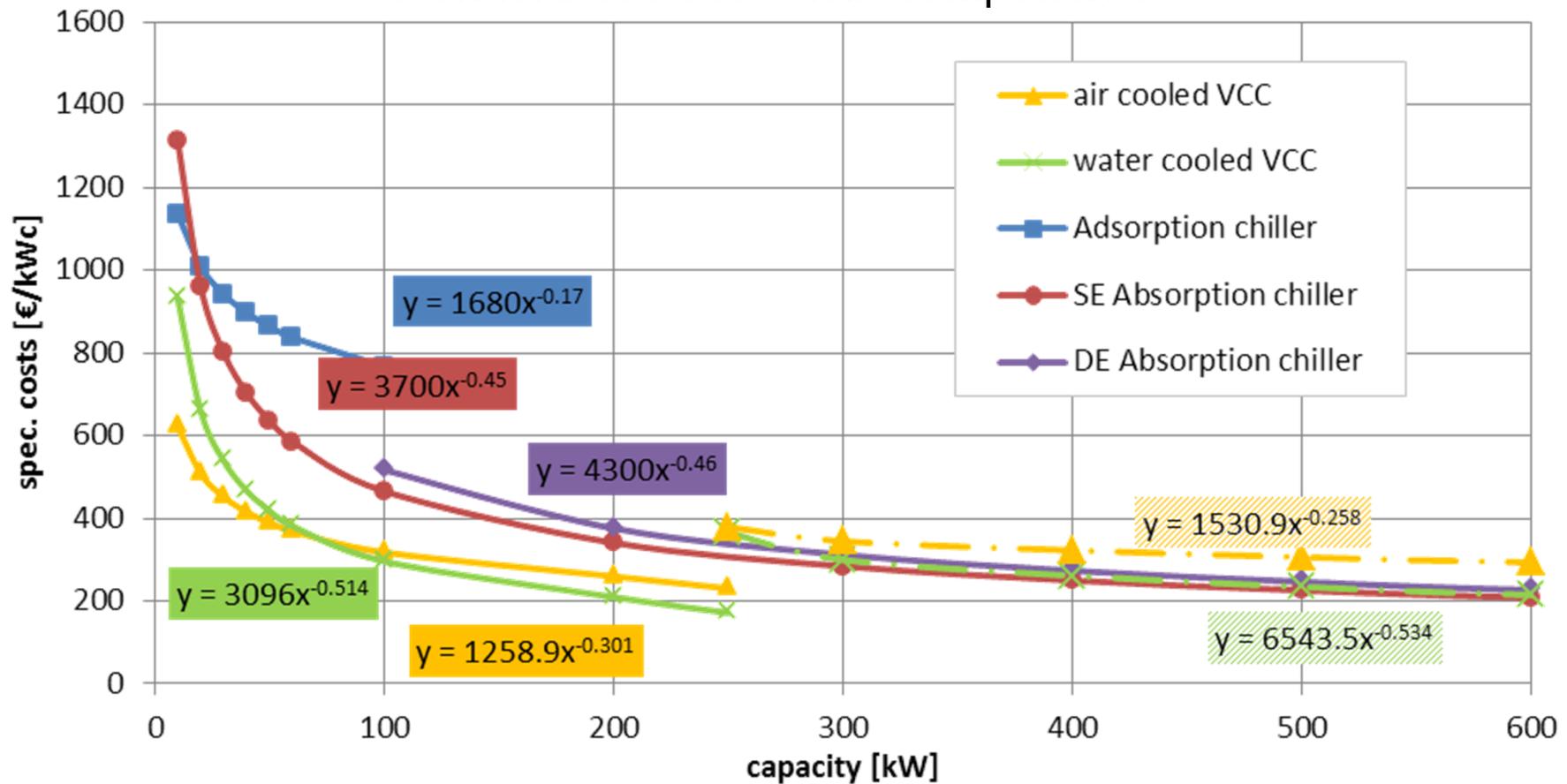
- Method & input values based on VDI- and EN-standards
- Annualized costs for
 - Investment
 - Replacement & residual value
 - Maintenance & service
 - Operational costs (energy, water)

→ Levelized costs of energy
(Cooling + Space Heating + Domestic Hot Water)

$$\text{cost ratio} = \frac{\textit{levelized costs SHC}}{\textit{levelized cost REF}}$$

Economic base (I)

Standard costs for main components



Economic base (II)

Economics

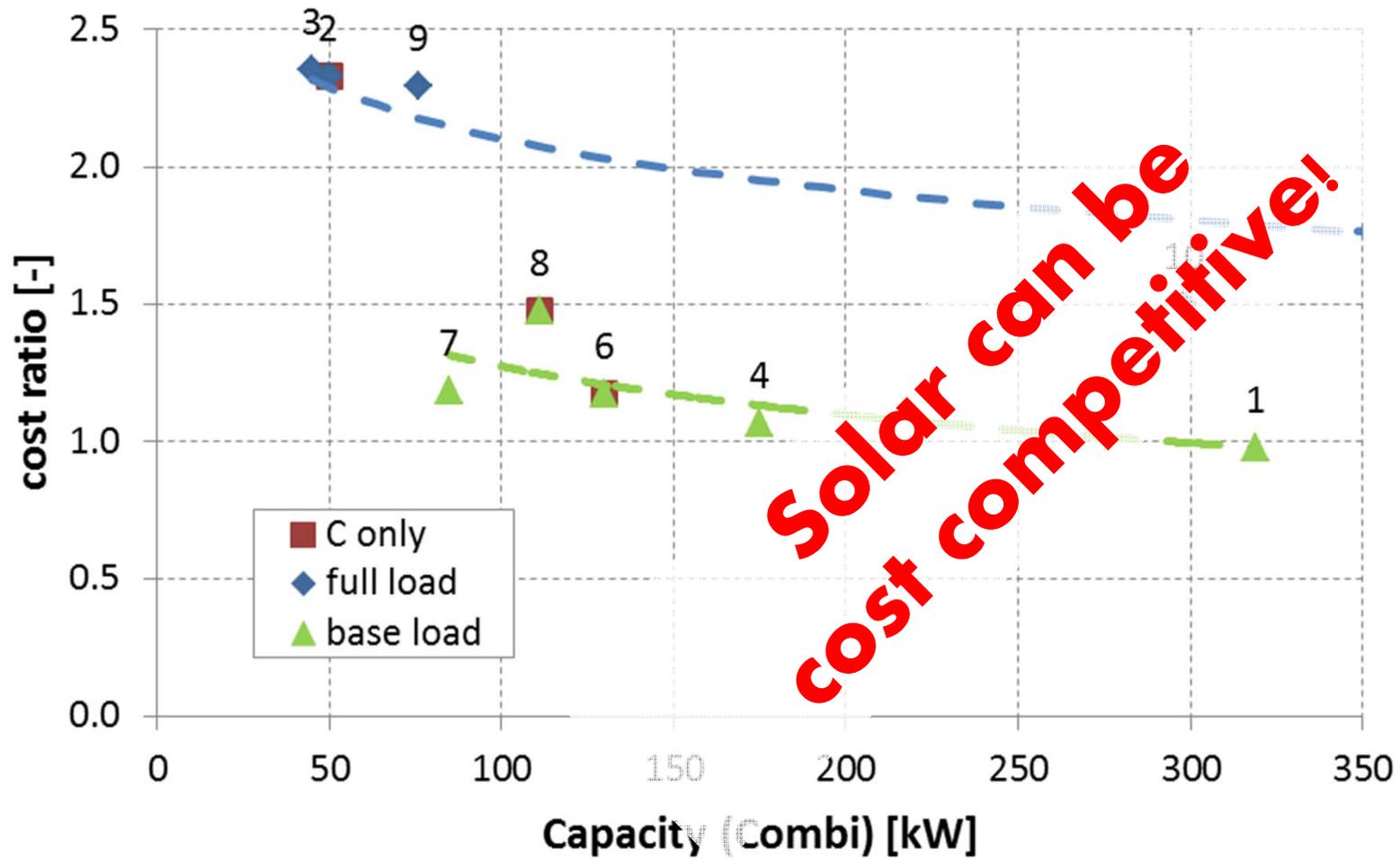
Period under consideration	25 a
Credit period	10 a
Inflation rate	3 %

Energy costs

Electricity (energy)	10 ct/kWh
Electricity (peak power)	80 €/kW.a
Natural gas	5 ct/kWh
Water	2.5 €/m ³



Cost Competitiveness!



Conclusions

- Sub-systems vs. Building performance
- Overall performance depends on
 - Component efficiency
 - System design
 - Control strategies
- Efficiency of solar cooling:
 - Electrical: $SPF_{el} > 15$
 - Primary Energy Savings $> 50\%$
- Cost competitiveness is possible!

More details already available IEA Task 48

B7 – Key Performance Indicators

B7 – Assessment Tool

C2 – Benchmarks / Examples

<http://task48.iea-shc.org/>

Updates for
IEA SHC Task 53
to follow this summer

<http://task53.iea-shc.org/>



Thank you for your attention!

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