



IEA SHC Task 48

Solar Thermal Heating and Cooling Systems

Best practice examples

Performance cross analysis

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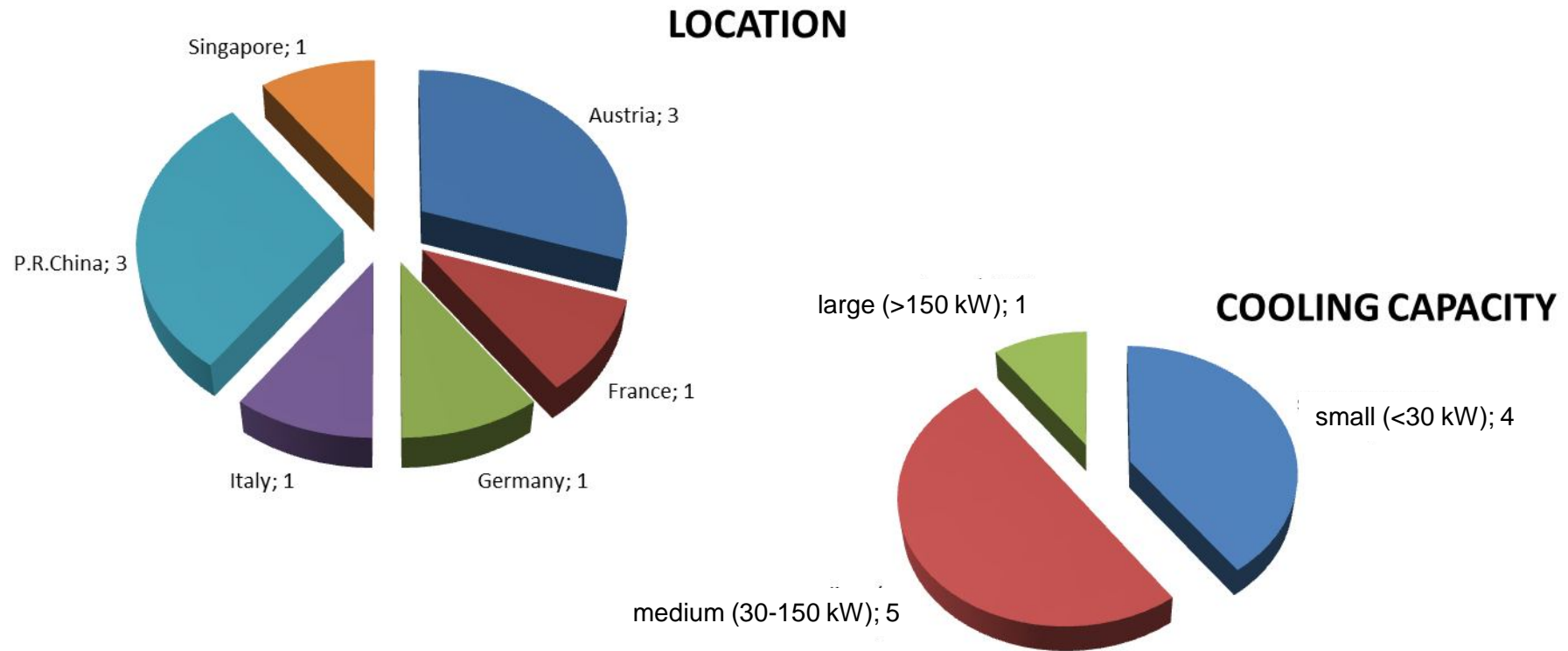


Content

- Overview
- Selected technical assessment
- Indicative economic analysis
- Conclusions



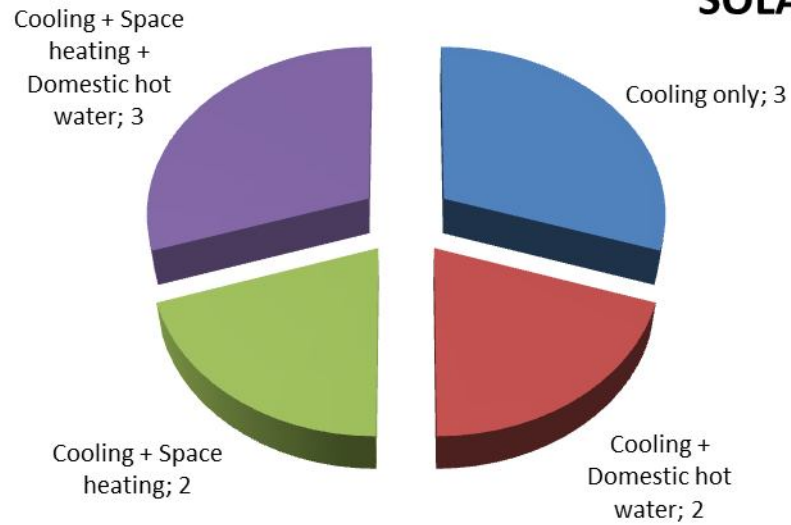
10 examples at a glance



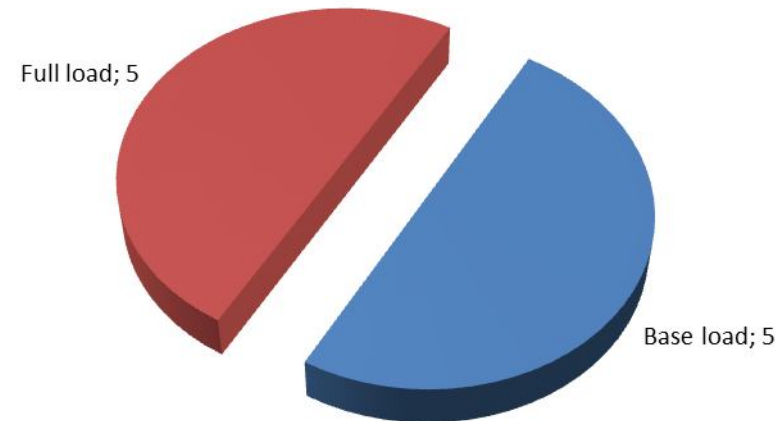


10 examples at a glance

SOLAR USE

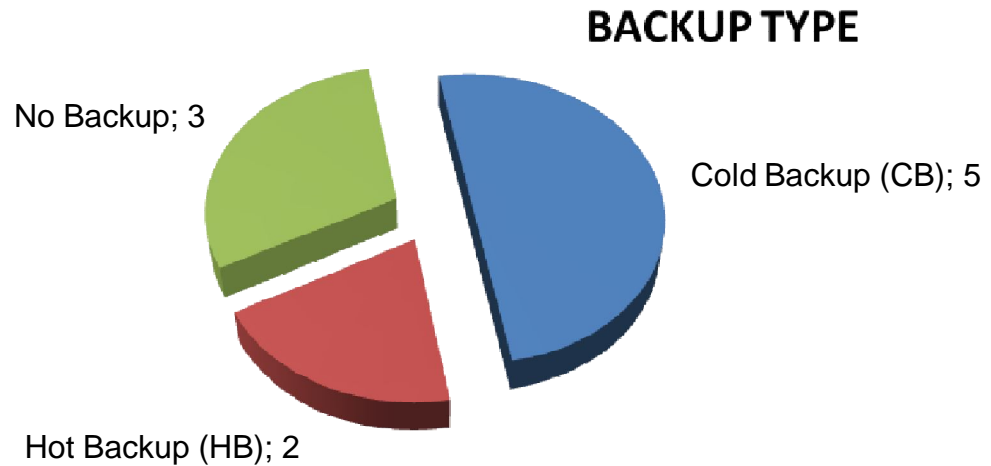
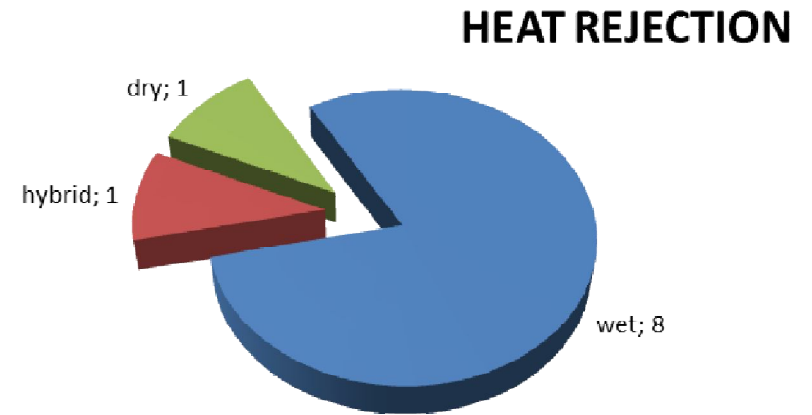
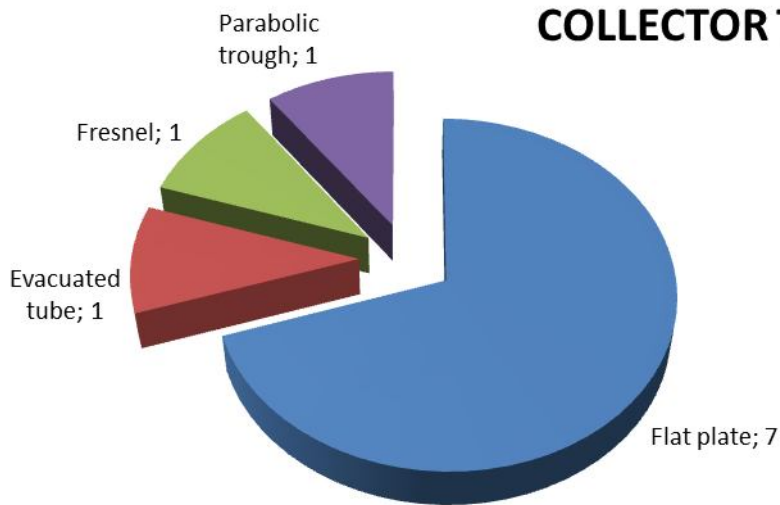


DESIGN / DIMENSIONING





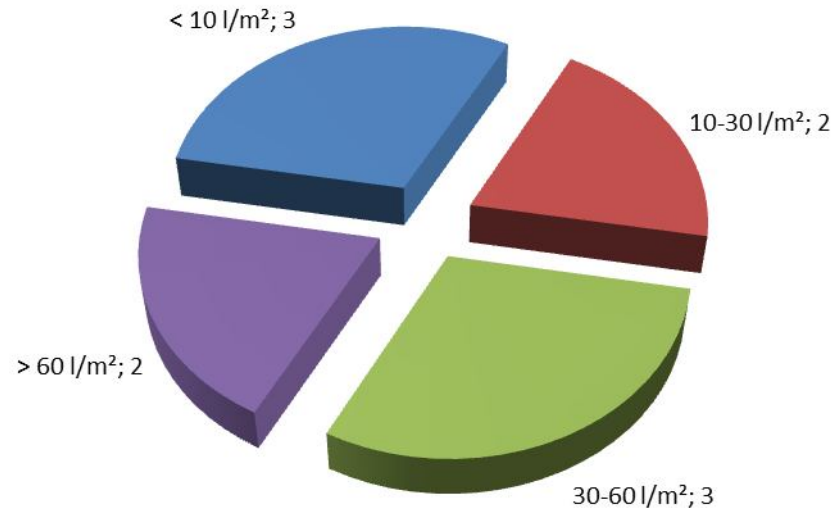
10 examples at a glance



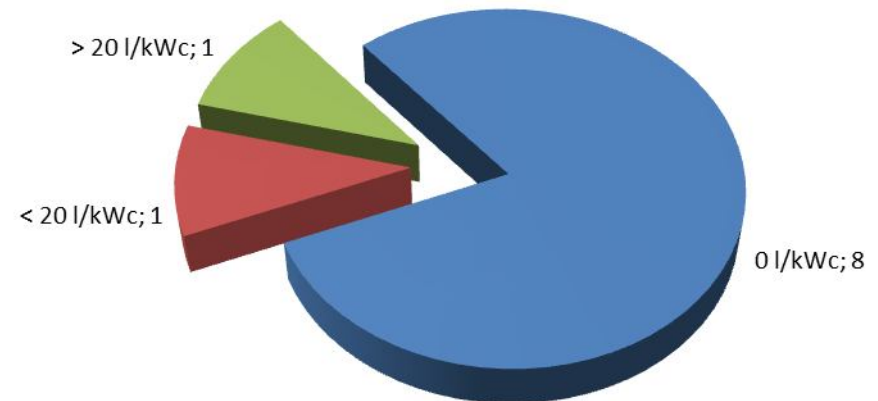


10 examples at a glance

HOT WATER TANK



COLD WATER TANK



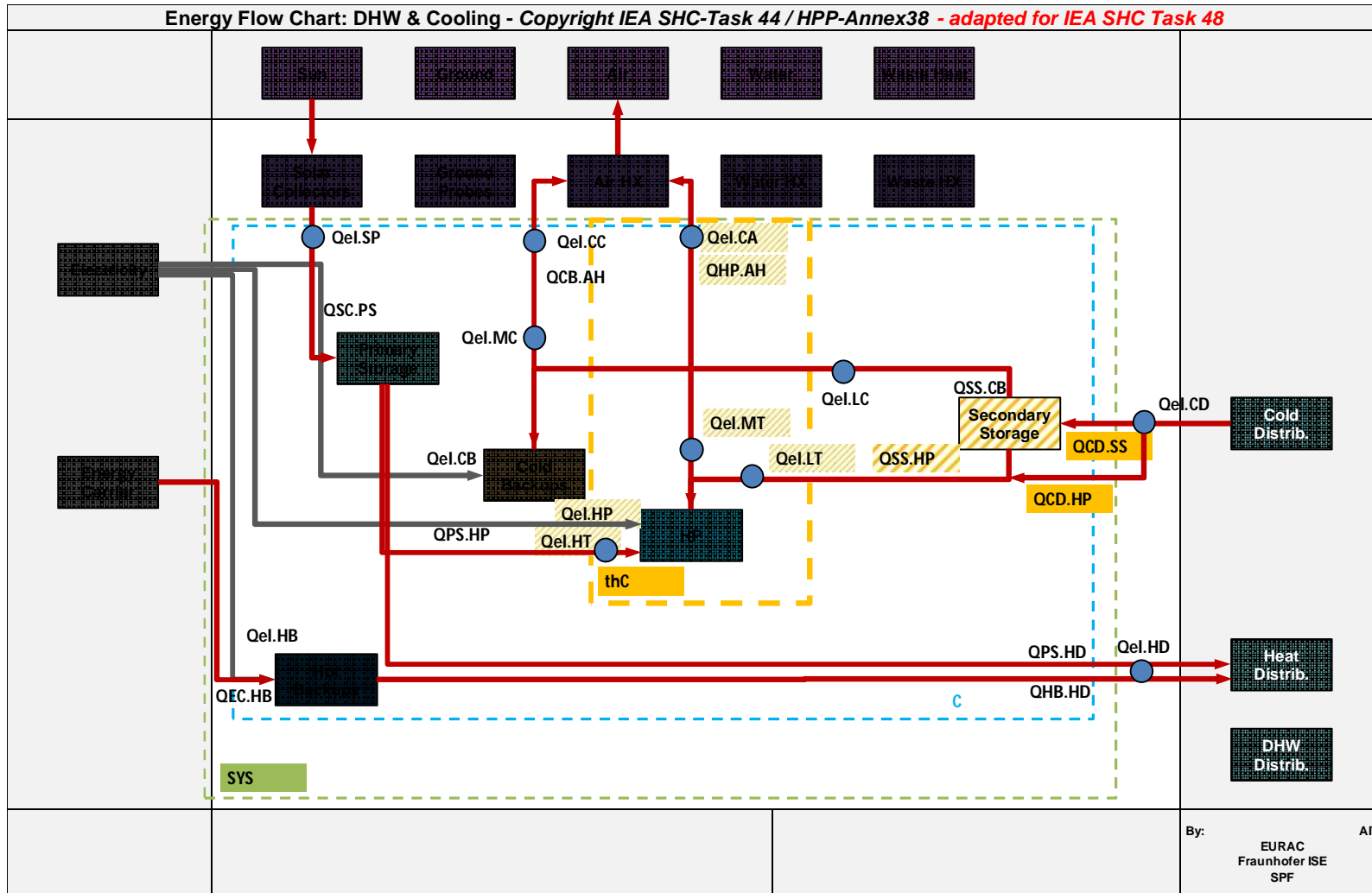
Technical assessment

- Several Key Performance Indicators (KPI)
 - Efficiency on building & component level
 - Electricity / Primary Energy / CO₂ Emissions
- Excel Tool for system evaluation
- Seasonal Performance Factor (SPF)
 - Electrical (thermal cooling only)
 - Thermal (component & system)

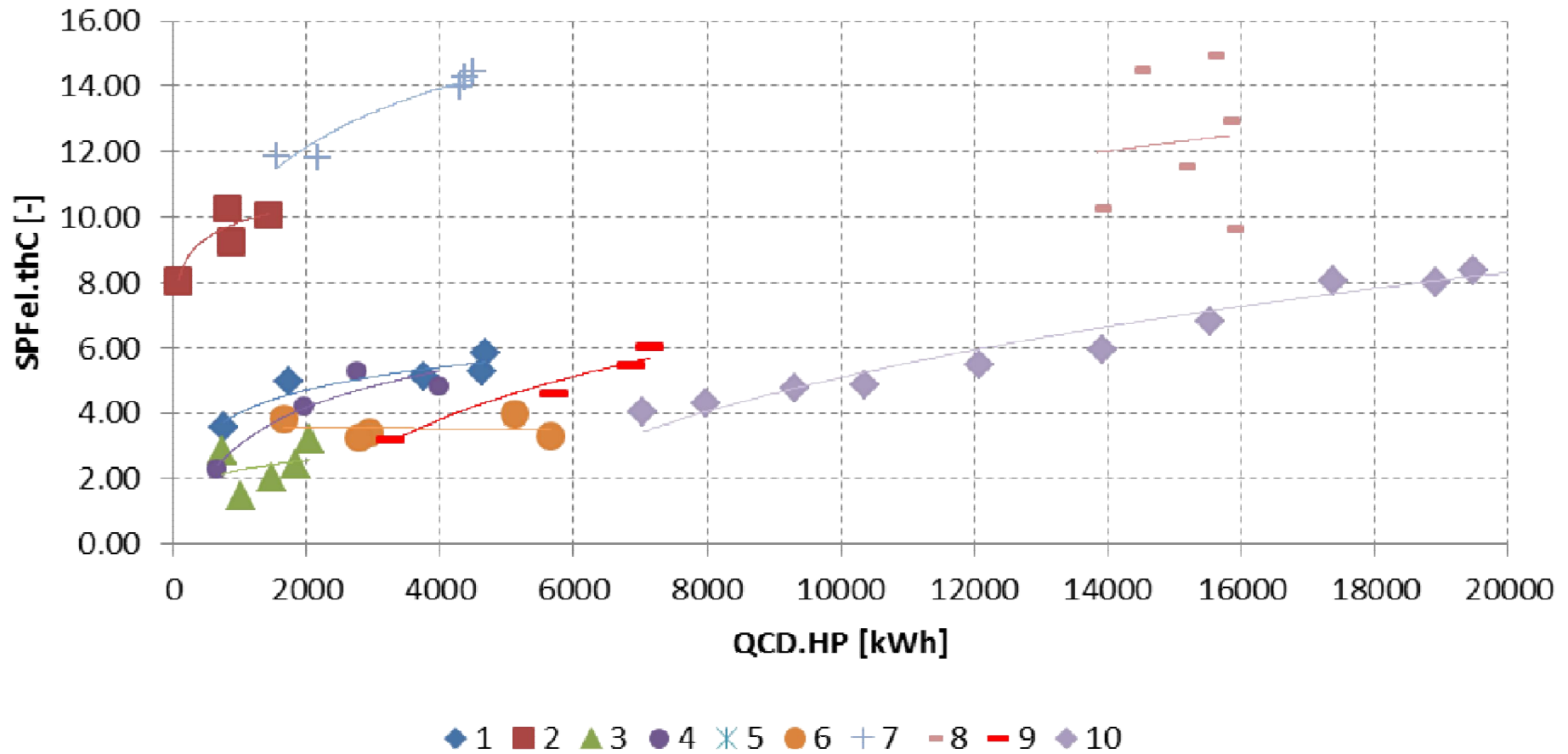
$$SPF_{el} = \frac{\sum Q_{out}}{\sum Q_{el,in}}$$

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

Technical assessment – boundary



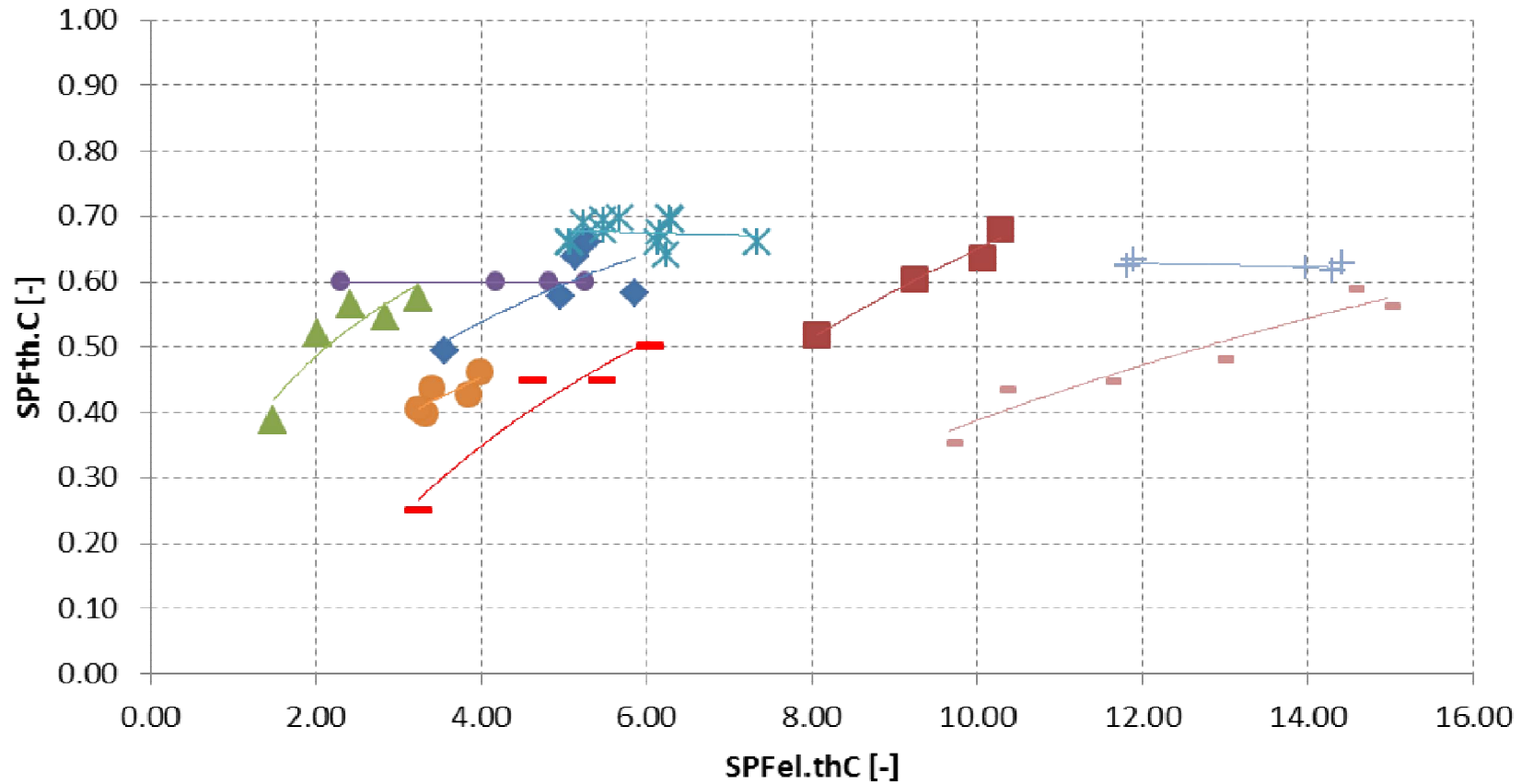
Electrical Efficiency for Thermal Cooling - $SPF_{el.thC}$ VS. Delivered Cooling Energy - $Q_{CD,HP}$



Electrical Efficiency for Thermal Cooling - $SPF_{el.thC}$

VS.

Thermal Efficiency for Thermal Cooling - $SPF_{th.C}$

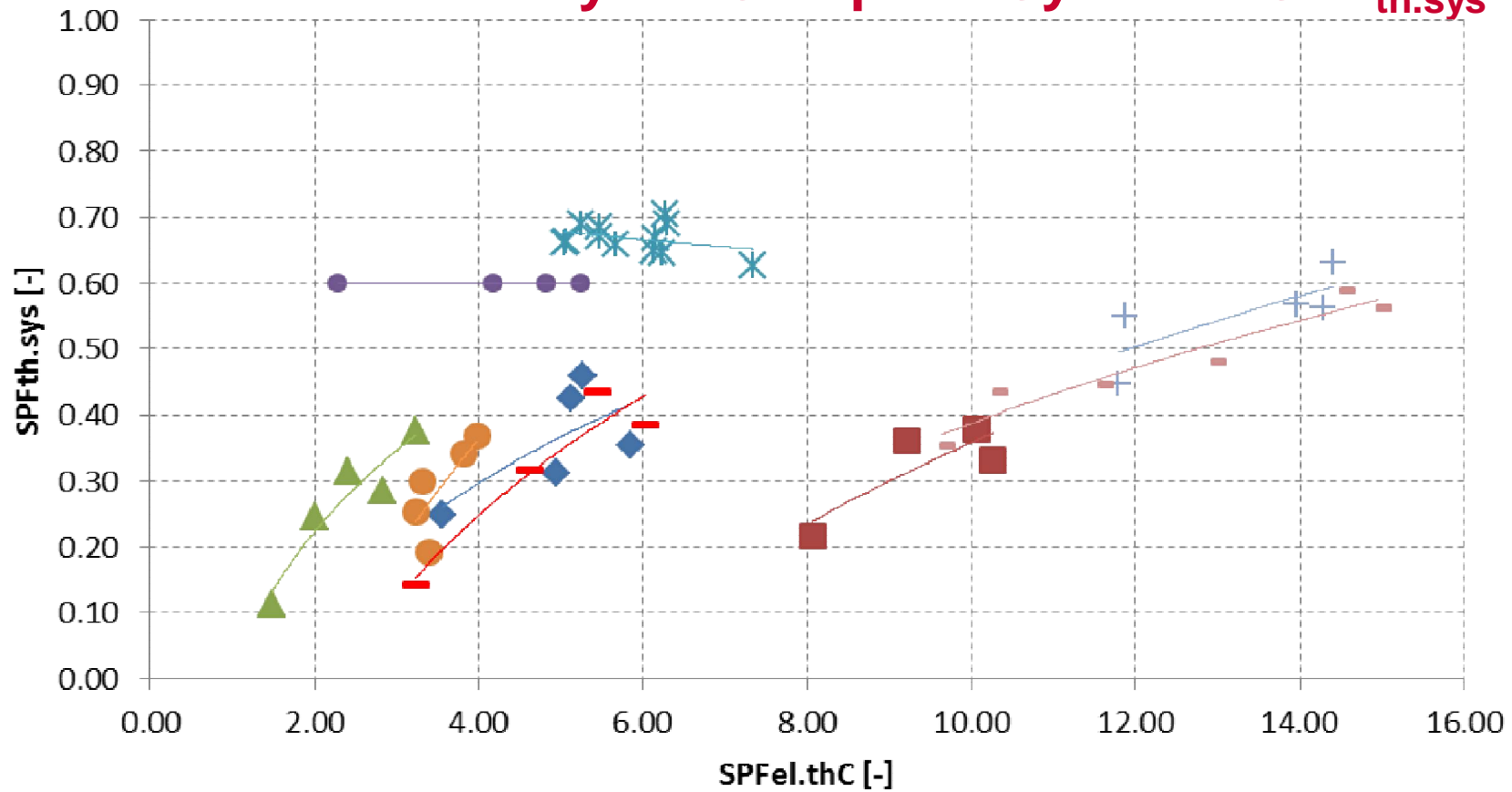


◆ 1 ■ 2 ▲ 3 ● 4 ✖ 5 ● 6 + 7 - 8 - 9 ◆ 10

Electrical Efficiency for Thermal Cooling - $SPF_{el.thC}$

VS.

Thermal Efficiency for Complete System - $SPF_{th.sys}$



◆ 1 ■ 2 ▲ 3 ● 4 * 5 ○ 6 + 7 - 8 - 9 ◆ 10

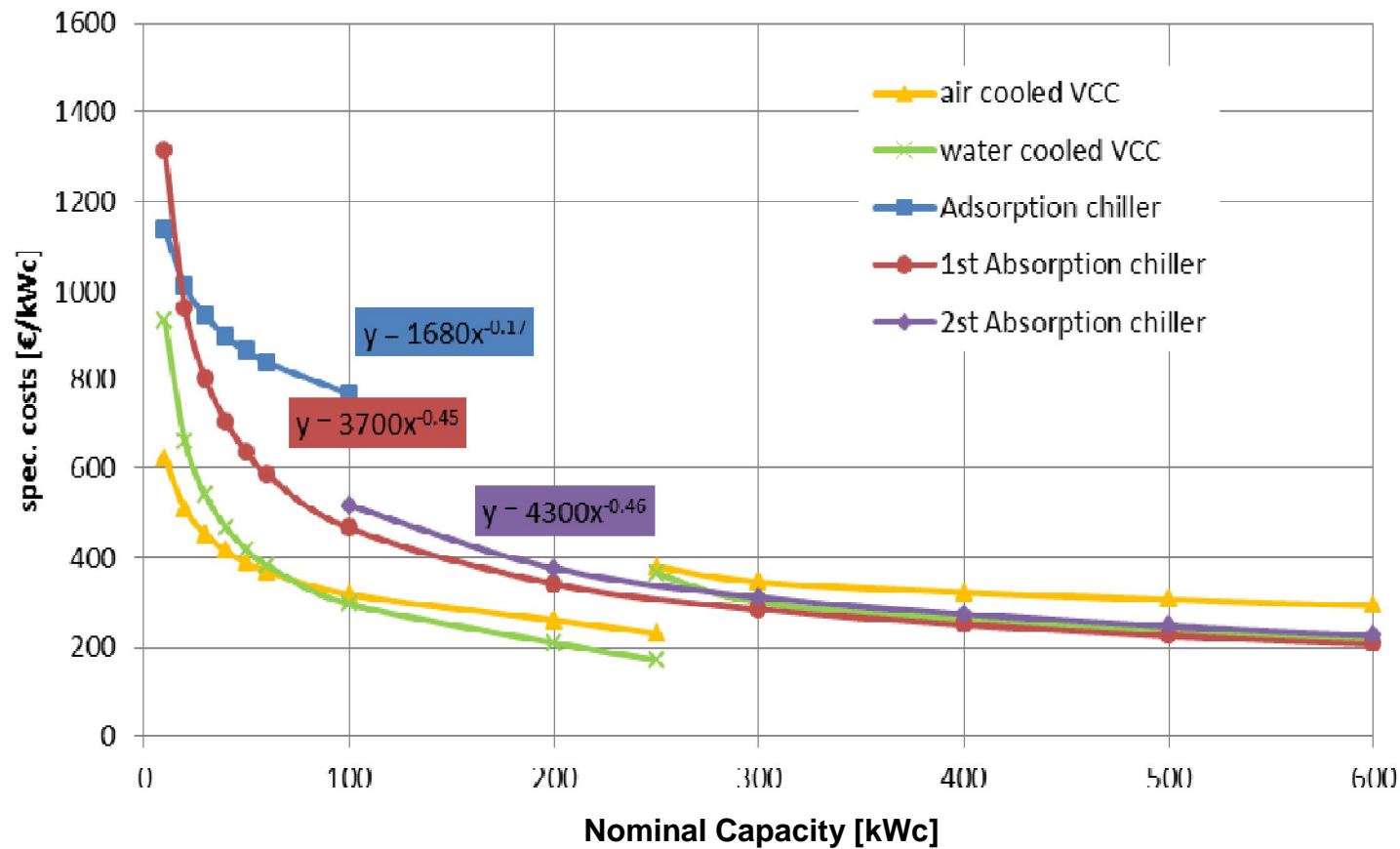


Indicative Economic Analysis

- Method & input values based on VDI 2067, EN 13798
- Annualized costs for
 - Investment
 - Replacement & residual value
 - Maintenance & service
 - Operational costs (energy, water)
- Levelized costs of energy (C+SH+DHW)
- SHC vs. REF $\text{cost ratio} = \frac{\text{levelized costs SHC}}{\text{levelized cost REF}}$

Indicative Economic Analysis

Standard costs for main components



Indicative Economic Analysis

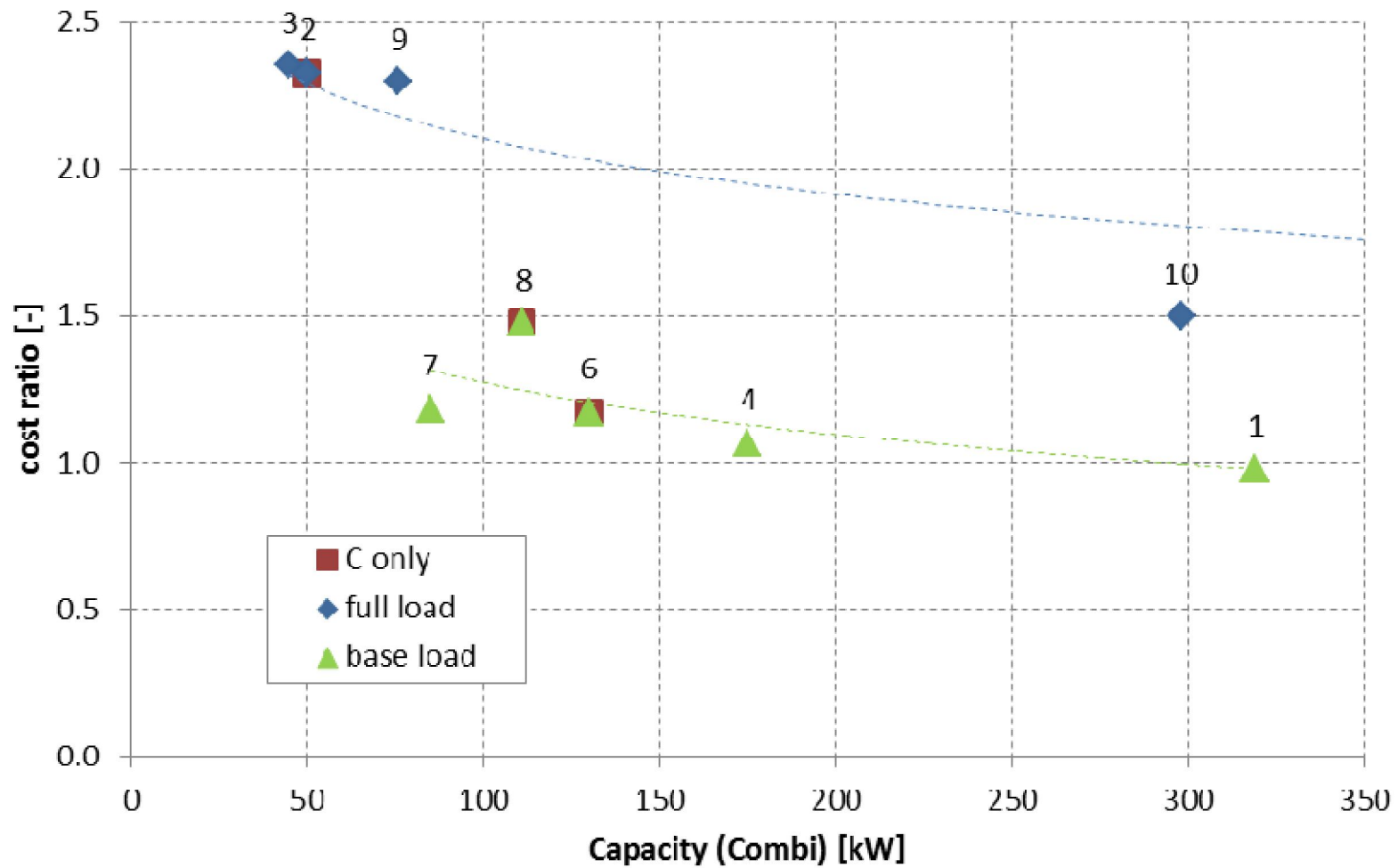
Economics

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

Result: Cost Competitiveness



Conclusions

- Electrical efficiency for thermal cooling - $SPF_{el.thC}$
 - Comparable with SEER for Vapor Compression Chillers (VCC)
 - Best practice SHC >10
- Thermal vs. electrical efficiency
 - High SPF_{th} → high SPF_{el}
 - The less energy to shift the better
- Dimension hot water tank with care
 - Cooling vs. heating/DHW
 - Charging strategy
- Cost competitiveness is possible!



More details

B7 – Key Performance Indicators

B7 – Assessment Tool

C2 – Benchmarks / Examples

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



Thank you for your attention!

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