Solar Cooling Design Guide

Results of an expert survey

Daniel NEYER, Daniel MUGNIER, Stephen WHITE

INTRODUCTION

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- Task 48
- Lack of
    - efficient,
    - reliable and
    - cost competitive SHC solutions

- Summary of experiences / lesson's learned
    - General findings → 10 key principles
    - Specific outcomes → 3 examples
- The Solar Cooling Design Guide, Case Studies of Successful Solar Air Conditioning Design

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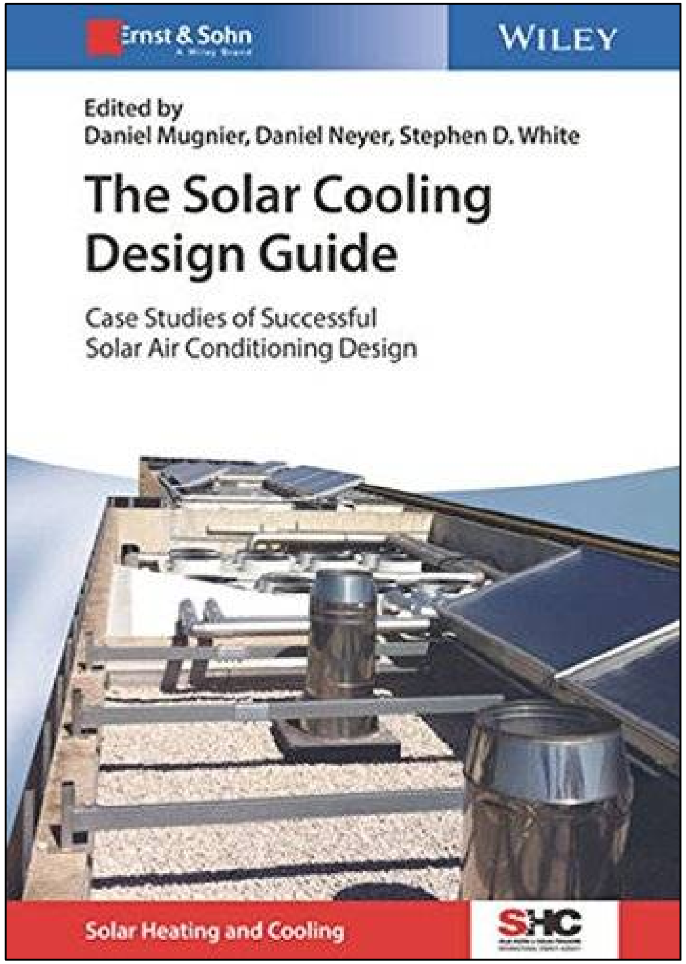
- As companion to Solar Cooling handbook
- Specific description of design for already built and successful SHC examples.
- Promoting of solar cooling!?



- https://www.amazon.de/Solar-Cooling-Design-Guide-Conditioning/dp/3433031258/ref=sr_1_1?ie=UTF8&qid=1523335059&sr=8-1&keywords=solar+cooling+design+guide

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- Solar Energy Paper, Special Issue: Solar Cooling
- Scientific background
  - Literature in context of Task48
  - Recent literature review
  - expert survey
- Expert Survey
  - About the 10 key principles
  - Assessment of importance
  - elucidate of expert experiences

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10 key principles for successful solar air conditioning design – A compendium of IEA SHC Task 48 experiences

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ABSTRACT

The results of past and ongoing activities, in successive IEA SHC (solar heating and cooling) Tasks, suggest enormous potential for solar cooling technologies to reduce greenhouse gas emissions. However, solar thermal cooling still faces barriers to emerge as an economically competitive solution. IEA SHC Task 48 was introduced to gather learnings from existing installations, and to find technological and market solutions, which could enable industry to deliver solar thermal driven heating and cooling systems that are efficient, reliable and cost competitive.

The selected experiences of these research activities were clustered into 10 qualitative key principles for successful design and operation of SHC systems. Three existing systems are fully discussed in a solar cooling design guide (Mugnier et al., 2017). This paper aims to introduce these key principles in its general format. The background to the qualitative statements is explained, supplemented with examples from the context of Task 48 and compared with recent literature. Furthermore, a survey was conducted among SHC experts, who provide an assessment of the importance of the principles.

The result shows that all principles have their eligibility. However, it turns out that there are three main categories of principles: (i) essential, (ii) important and (iii) controversial. Following the key principles is not a guarantee, but they can support researchers, designers and contractors to implement solar heating and cooling systems successfully.

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- Thanks to all supporter’s of our book and paper!!

10 key principles

- Principle 0: Reduce energy demand before applying renewables
- Principle 1: Choose applications where high annual solar utilization can be achieved
- Principle 2: Avoid using fossil fuels as a backup for single effect ab-/adsorption chillers
- Principle 3: Design the ab-/adsorption chiller for relatively constant operation at near full load
- Principle 4: Use wet (or hybrid) cooling towers whenever possible
- Principle 5: Design the solar collectors for operation at average (not peak) solar radiation levels

10 key principles

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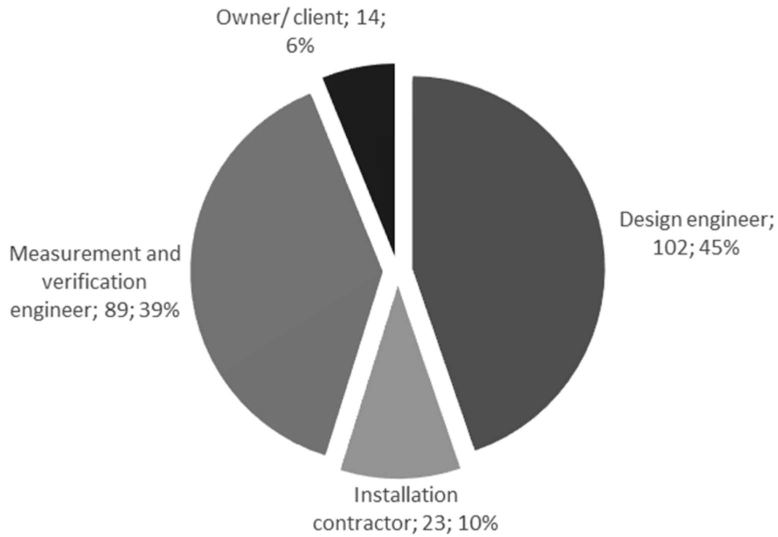
- Principle 6: Keep the process flowsheet simple and compact
- Principle 7: Provide thermal storage capacity and hydraulics in a form that matches the thermal requirements of each application
- Principle 8: Minimise parasitic power
- Principle 9: Minimise heat losses
- Principle 10: Apply appropriate resources to designing, monitoring and commissioning

→ Importance and significance of 10 key principles?

→ Survey under solar cooling experts

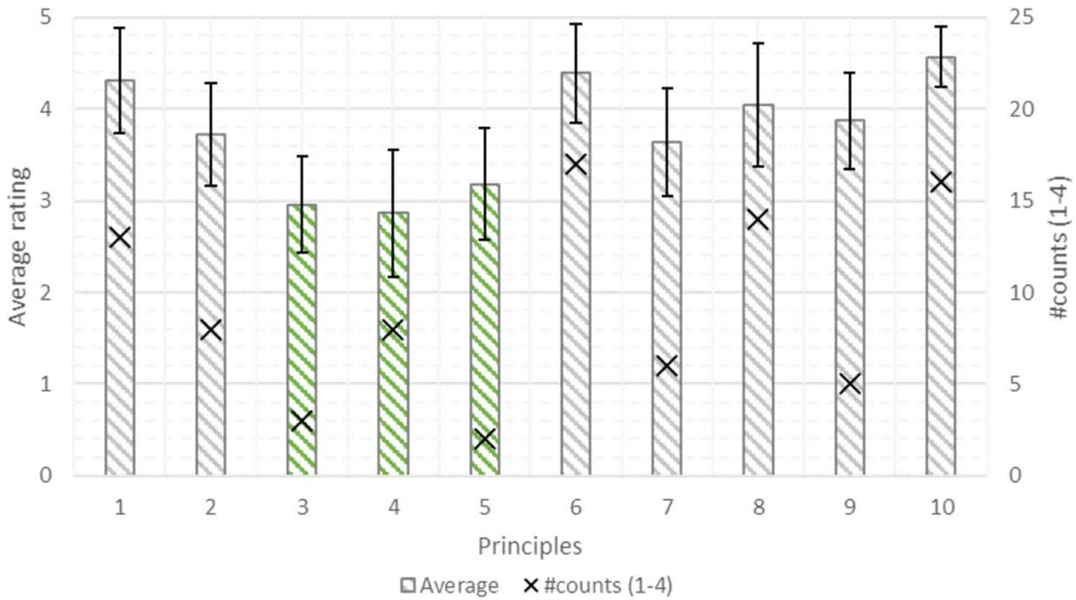
Expert survey

- 5 questions, open- and closed ended
- 27 Experts provided feedback (20 of IEA Task 53)
- 230 SHC plants
- Different net samples
  - Origin (south/north)
  - Profession (scientist, consultant, company)



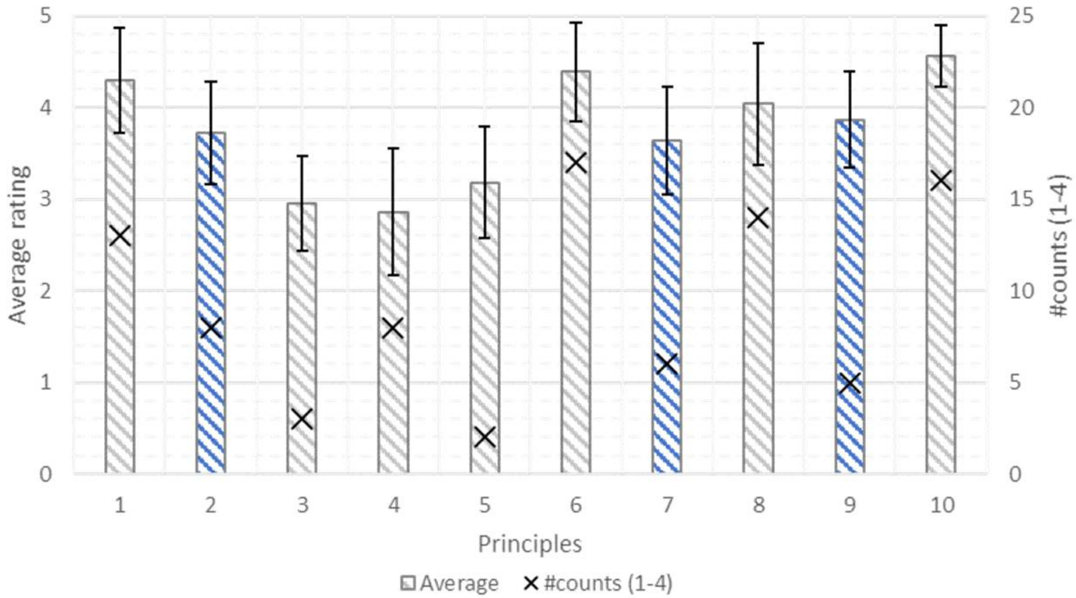
Rating

- “Controversial”
  - **Principle 3:** Design the ab-/adsorption chiller for relatively constant operation at near full load
  - **Principle 4:** Use wet (or hybrid) cooling towers whenever possible
  - **Principle 5:** Design the solar collectors for operation at average (not peak) solar radiation levels



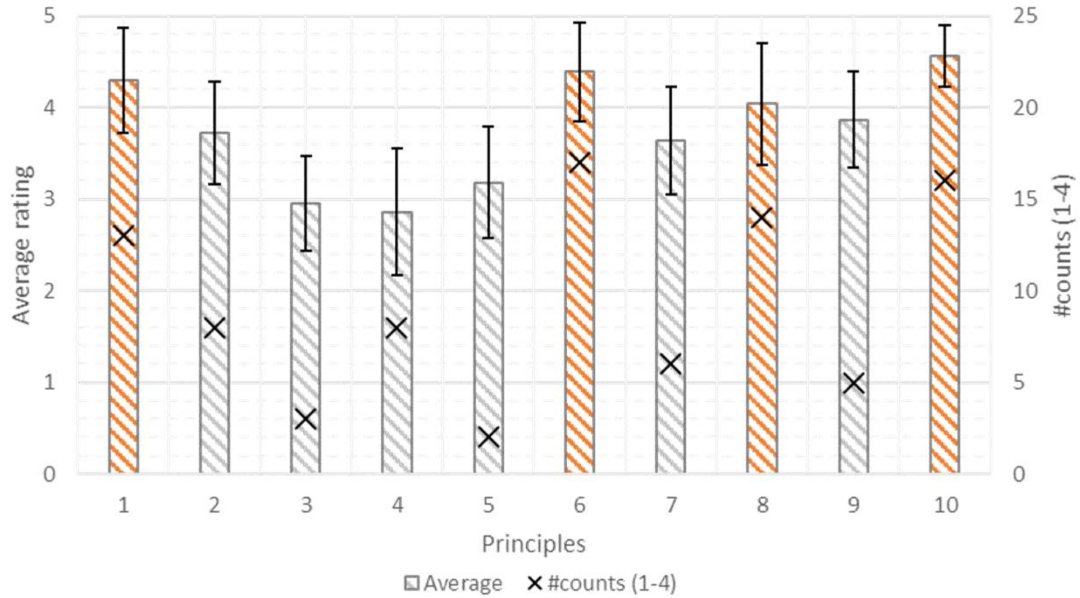
Rating

- „Important“
  - **Principle 2:** Avoid using fossil fuels as a backup for single effect ab-/adsorption chillers
  - **Principle 7:** Provide thermal storage capacity and hydraulics in a form that matches the thermal requirements of each application
  - **Principle 9:** Minimise heat losses



Rating

- „Essential“
  - **Principle 1:** Choose applications where high annual solar utilization can be achieved
  - **Principle 6:** Keep the process flowsheet simple and compact
  - **Principle 8:** Minimise parasitic power
  - **Principle 10:** Apply appropriate resources to designing, monitoring and commissioning



Summary

- 10 key principles support successful design
- Three categories were found
  - Essentials: undisputed
  - Important: from second attention
  - Controversial: different solutions possible
- Further work in Task 53
  - Include operation
  - Include new generation – ST & PV
  - ….

- Thank you for your support of the survey!

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Thank you for your attention!

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