IEA SHC Task 52 “SolarUrban”

Solar Heat & Energy Economics in Urban Environments

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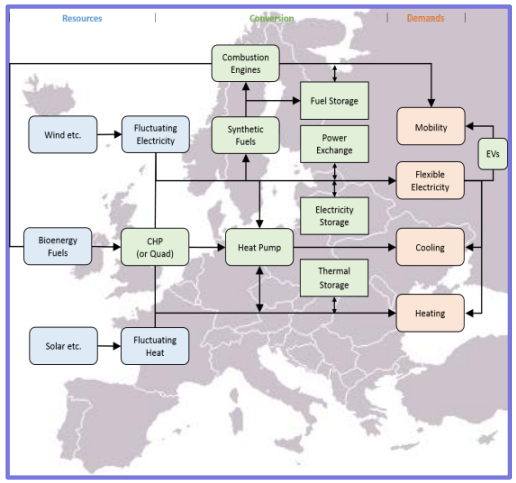
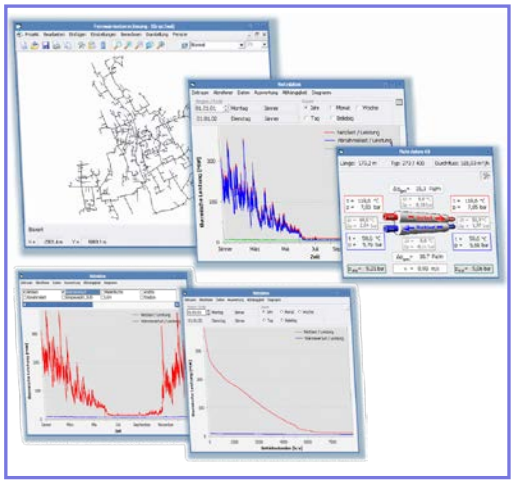
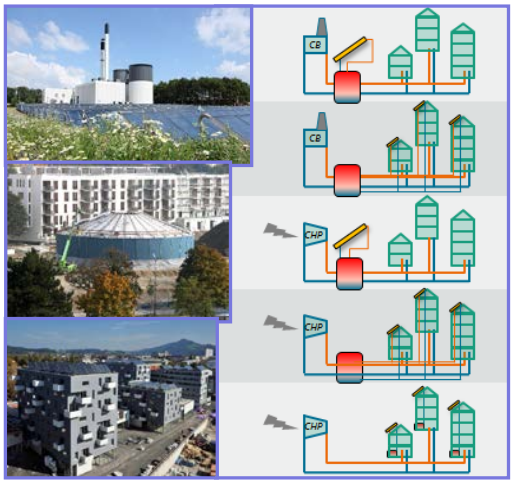
Task Overview

- IEA SHC Task 52 “SolarUrban”
  - OA: Sebastian Herkel, Fraunhofer ISE, DE
  - Duration: 01/2014 – 12/2017

Task 52
Solar Heat and Energy Economics in Urban Environments







- Subtask A
  - Energy Scenarios

  Lead: Brian V. Mathiesen, AAU, DK
- Subtask B
  - Methods, Tools, Case studies

  Lead: Paul Bourdoukan, Sorane SA, CH
- Subtask C
  - Best-practice analysis

  Lead: Franz Mauthner, AEE INTEC, AT

Subtask A - Results

- Subtask A: Energy Scenarios
  - RQ: What can be the role of solar thermal in future high-renewable energy systems?

- Conclusions:
  - Technical solar thermal potential (AT): 4-12% of the low-temperature heat demand (or 2-7 TWh/year resp. 5–20 million m²)

PRO

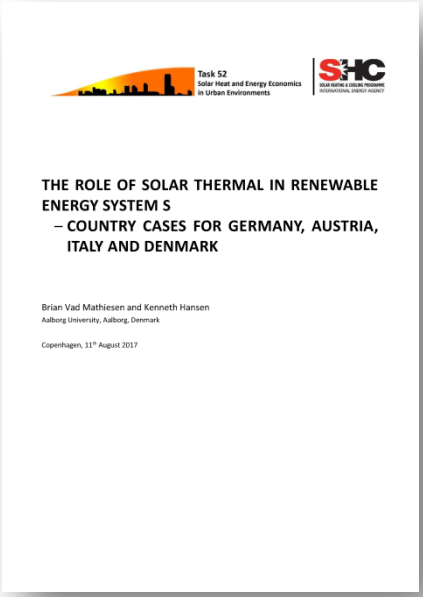
+ ST could ease pressure on biomass

+ ST could supply renewable heat were no alternative heating sources are available

- ST could lead to higher energy system socio-economic costs

- Benefits of ST today decrease in a high-RE system

CONTRA



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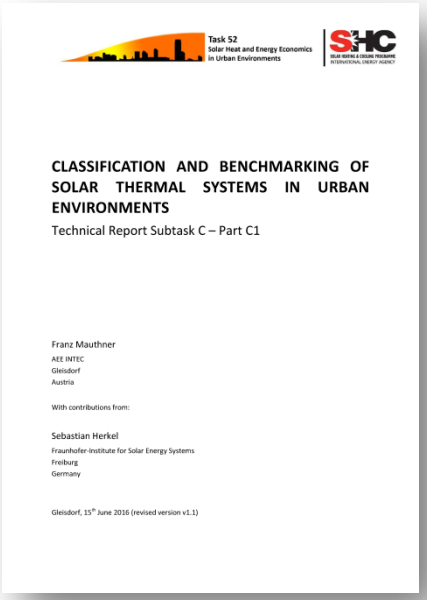
Subtask C – Results (C1)

- Subtask C: Best-practice analysis
  - ST-C1: Classification and benchmarking of solar thermal systems in urban environments
- Results
  - Database of techno-economic benchmarks for different solar thermal system categories

Solar thermal system category	DHW-SFH Solar domestic hot water systems in single family homes	CS-SFH Solar-combi systems in single family homes	CS-MFH Solar-combi systems in multi-family homes
All systems of this category are **roof mounted** All systems of this category are equipped **with short-term (diurnal) storages**			
Energy/technical data			
Kind of solar thermal collector used *optional*	**FPC** *ETC*	**FPC** *ETC*	**FPC** *ETC*
Kind of solar energy storage used	**DHW-tank**	**TTES (pressurized)**	**TTES (pressurized)**
Typical size per unit [m^2_{gross}] *- range (from - to)*	**7** *5 – 10*	**18** *12 – 24*	**100** *30 – 300*
Typical thermal peak capacity per unit [kW] *- range (from - to)*	**5** *4 – 7*	**13** *8 – 17*	**70** *21 – 210*
Typical storage volume per unit [ltr.]	**400**	**1,500**	**9,000**
Typical annual production per unit [kWh/a]	**2,625**	**5,940**	**39,500**
***Specific* storage volume per unit** [ltr./m^2_{gross}] *- range (from - to)*	**65** *50 - 80*	**85** *60 - 110*	**95** *70 - 120*
Typical solar energy yield *SE* [kWh/m^2_{gross}/a] *- range (from - to)*	**380** *330 – 430*	**330** *310 – 350*	**400** *355 - 450*
Typical solar fraction *sf* [-] *- range (from - to)*	**68%** *60 – 75%* (domestic hot water only)	**20%** *15 – 40%* (DHW + space heating)	**15%** *10 – 25%* (DHW + space heating)
Technical life time [years]	25	25	25
Financial data			
Specific cost ready installed [1,000€/m^2_{gross}] (excl. VAT, excl. subsidies)	**0.93** (+/- 13%) *(0.81 – 1.05)*	**0.76** (+/- 13%) *(0.67 – 0.86)*	**0.66** (+/- 21%) *(0.52 – 0.80)*
Specific cost (material only) [1,000€/m^2_{gross}] (excl. VAT, excl. subsidies)	**0.70** (+/- 6%) *(0.66 – 0.74)*	**0.61** (+/- 8%) *(0.57 – 0.66)*	**0.55** (+/- 20%) *(0.44 – 0.66)*
Labor required [hrs.] Labor cost [€/hr.] (excl. VAT)	18 (+/- 6hrs) 90 (reference: AT)	30 (+/- 10hrs) 90 (reference: AT)	120 (+/- 30hrs) 90 (reference: AT)
Investment per unit ready installed [1,000€/unit] (excl. VAT, excl. subsidies)	**6.5** (+/-13%) *(5.7 – 7.3)*	**13.8** (+/-13%) *(12.0 – 15.5)*	**65.8** (+/-21%) *(52.1 – 79.5)*
Fixed O&M per unit [€/m^2_{gross}/a]*	7.0	6.1	5.5
Variable O&M per unit [€/m^2_{gross}/a]**	1.4	1.2	1.4
Levelized cost of heat *LCOH* [€-ct/kWh] *- range (from - to)*	**16.2** (+/- 12%) *(14.3 – 18.1)*	**15.5** (+/- 12%) *(13.7 – 17.4)*	**11.2** (+/- 20%) *(8.9 – 13.4)*

Solar thermal system category	SDH: Solar district heating Solar assisted district heating (ground mounted collector field)	
All systems of this category are **ground-mounted** and may be equipped with either - short-term (diurnal) storages **(A)** or - long-term (seasonal) storages **(B)**		
Energy/technical data	**A) with diurnal storage**	**B) with seasonal storage**
Kind of solar thermal collector used *optional*	**FPC**	**FPC**
Kind of solar energy storage used *optional*	Non-pressurized TTES *pressurized TTES*	PTES *BTES, (ATES)*
Typical size per unit [m^2_{gross}] *- range (from - to)*	**10,000** *5,000 – 20,000 (up to 150,000)*	**50,000** *20,000 – 70,000*
Typical thermal peak capacity per unit [kW] *- range (from - to)*	**7,000** *3,500 – 14,000*	**35,000** *14,000 – 140,000*
Typical storage volume per unit [m^3_{water}]	**1,200**	**125,000**
Typical annual production per unit [MWh/a]	**4,100**	**17,500**
***Specific* storage volume per unit** [ltr./m^2_{gross}] *- range (from - to)*	**120** *90 – 150*	**2,500** *1,500 – 3,500*
Typical solar energy yield *SE* [kWh/m^2_{gross}/a] *- range (from - to)*	**410** *380 – 460*	**365** *340 – 390*
Typical solar fraction *sf* [-] *- range (from - to)*	**12%** *5 – 20%*	**50%** *40 – 60%*
Technical life time [years]	25	25
Financial data	**A) with diurnal storage**	**B) with seasonal storage**
Specific cost ready installed [1,000€/m^2_{gross}] (excl. VAT, excl. subsidies)	**0.24** (+/- 12%) *(0.21 – 0.27)*	**0.29** (+/- 15%) *(0.25 – 0.33)*
Specific cost (material only) [1,000€/m^2_{gross}] (excl. VAT, excl. subsidies)	**0.22** (+/- 12%) *(0.19 – 0.25)*	**0.27** (+/- 15%) *(0.23 – 0.31)*
Specific cost (labor only) [1,000€/m^2_{gross}] (excl. VAT, excl. subsidies)	**0.02** *(0.02 – 0.02)*	**0.02** *(0.01 – 0.02)*
Investment per unit ready installed [1,000€/unit] (excl. VAT, excl. subsidies)	**2,400** (+/-12%) *(2,100 – 2,700)*	**14,500** (+/-15%) *(12,325 – 16,675)*
Fixed O&M per unit [€/m^2_{gross}/a]*	1.7	2.0
Variable O&M per unit [€/m^2_{gross}/a]*	1.5	1.3
Levelized cost of heat *LCOH* [€-ct/kWh] *- range (from - to)*	**4.1** (+/- 11%) *3.7 – 4.6*	**5.5** (+/- 14%) *4.7 – 6.3*



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Subtask C – Results (C2)

- Subtask C: Best-practice analysis
  - ST-C2: In-depth analysis (technical details, lessons learned, success factors, barriers) of selected solar thermal applications

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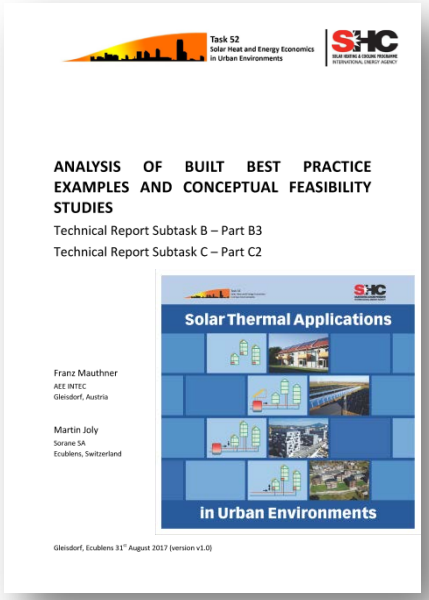

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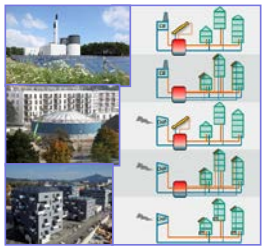
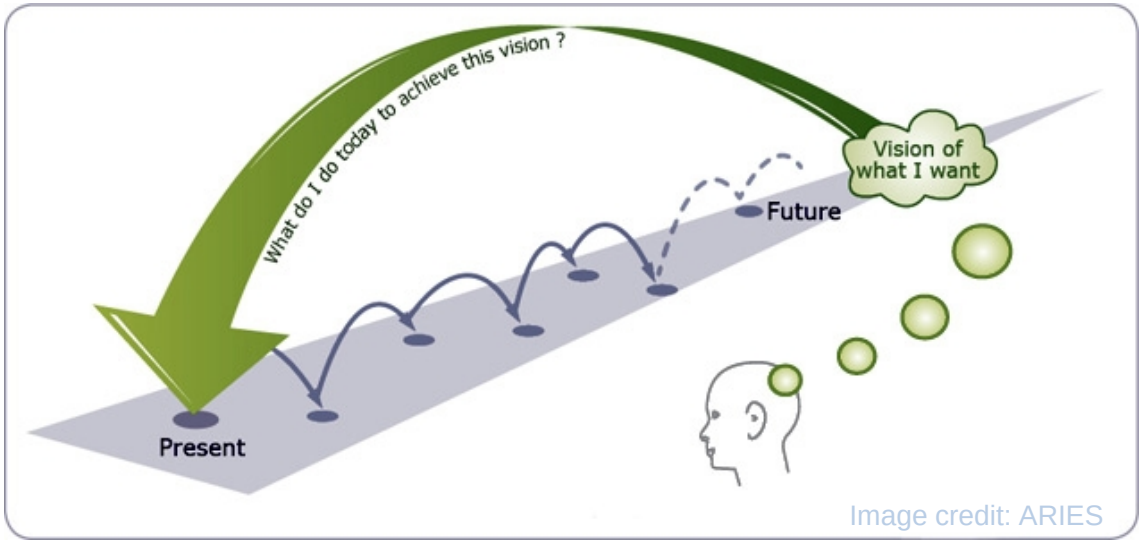
Die Transformation des Energiesystems als sozial-ökologische Aufgabe

- Wie gelingt es, die Perspektive der AnwenderInnen in die Forschung zu integrieren?
  - 1) Kenntnis über den Status quo und Erarbeitung langfristiger Visionen sowie
  - 2) *Backcasting* zur Ermittlung der Forschungsbedarfe unter Einbeziehung der relevanten AnwenderInnen





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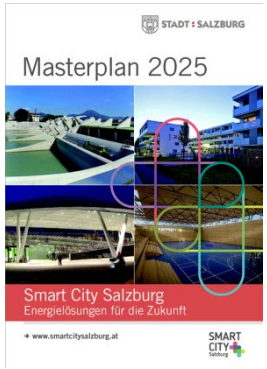

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IDEA TO ACTION

Thank you
for your Attention