DEVELOPMENT OF AN AIR BASED SORPTION COLLECTOR

within the EU project INSPIRE

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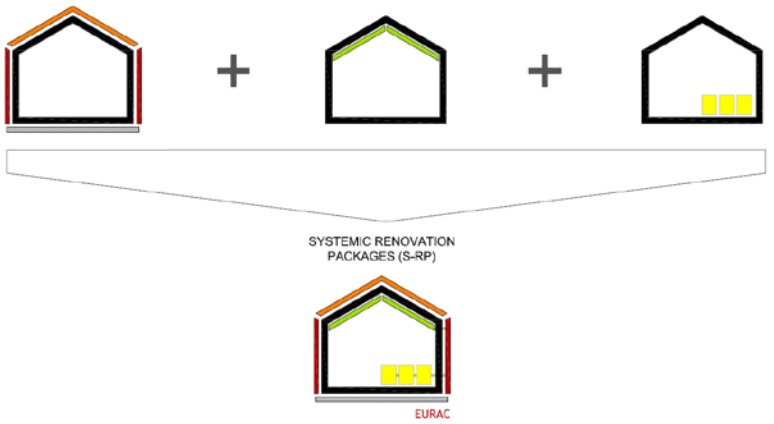
AGENDA

- The inspire project
- Sorption collectors
- Design of an air-based sorption collector for façade application
- Measurements of a prototype
- Simulation results

Inspire project

- Development of “renovation packages” to reduce energy consumption of existing buildings to <50kWh/m²/yr
  - building envelope: 4 façade kits, 2 roof kits
  - energy distribution: chilled/heated ceilings
  - Normative measures, dissemination, …

- 24 project partners (coordinated by EURAC)
- 4 years
- …



Sorption collector – why that?

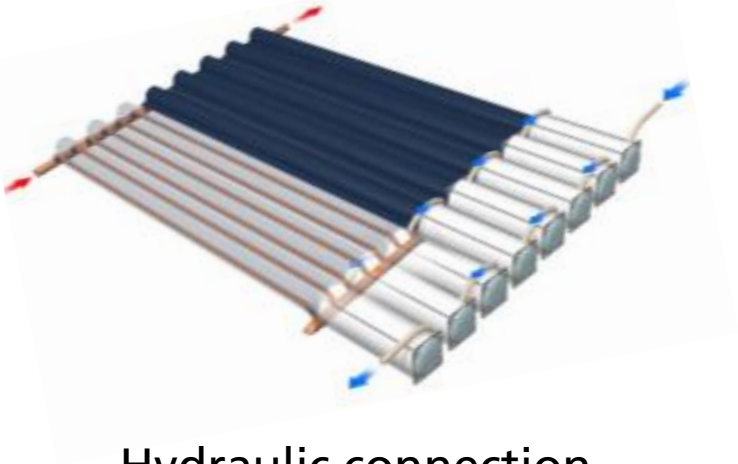
- Why integrate sorption tubes into solar collectors
  - Simplified installation
  - No high temperature circuit required

- Resulting peculiarities
  - Regeneration during times of insolation, ad/bsorption during times without insolation → daily cycle
  - !!! Cold production during non-insolation hours !!!
  - Heat rejection partly shifted non-insolation times (→ low ambient temperature)

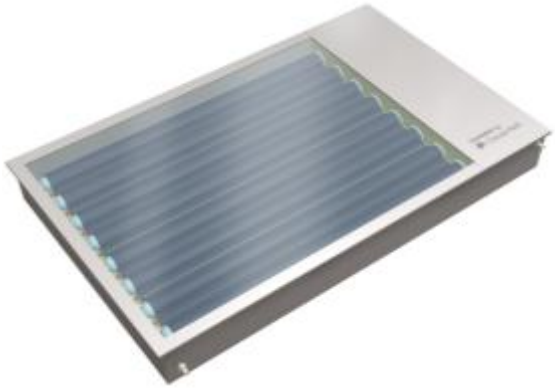
Basic design options – water based flat plate collector

Sorption tube

Integration with heat exchangers



Hydraulic connection



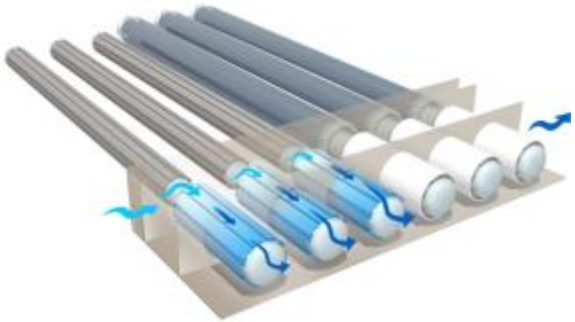
Collector integration

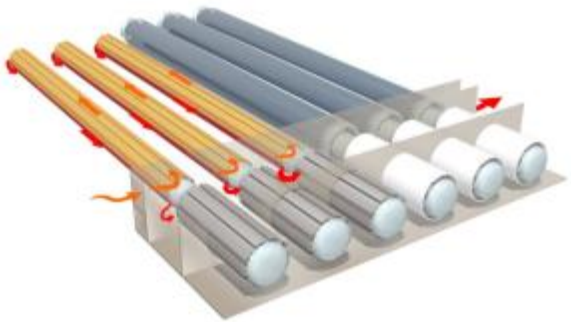
Source: CCT

Basic design options – air based vacuum tube collector

Sorption tube

Integration with
heat exchangers

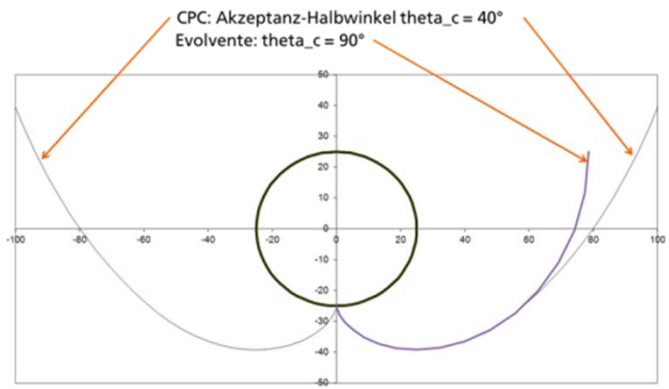




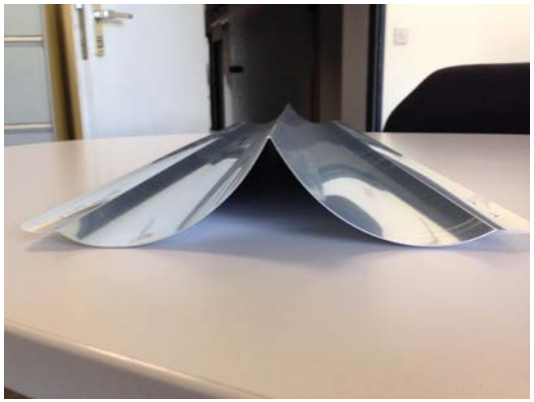
Air flow and integration

Source: CCT

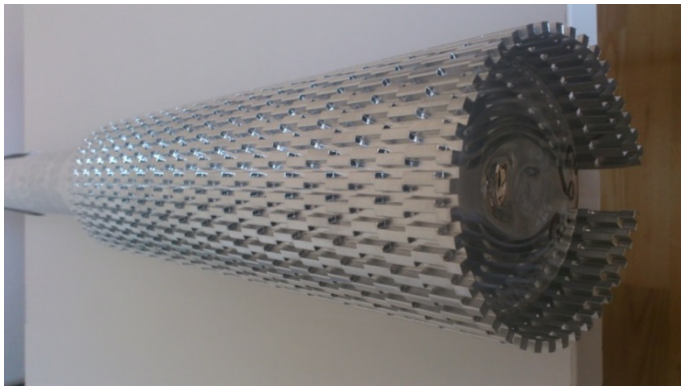
Air based vaccuum tube collector –design details



Reflector



Reactor HX

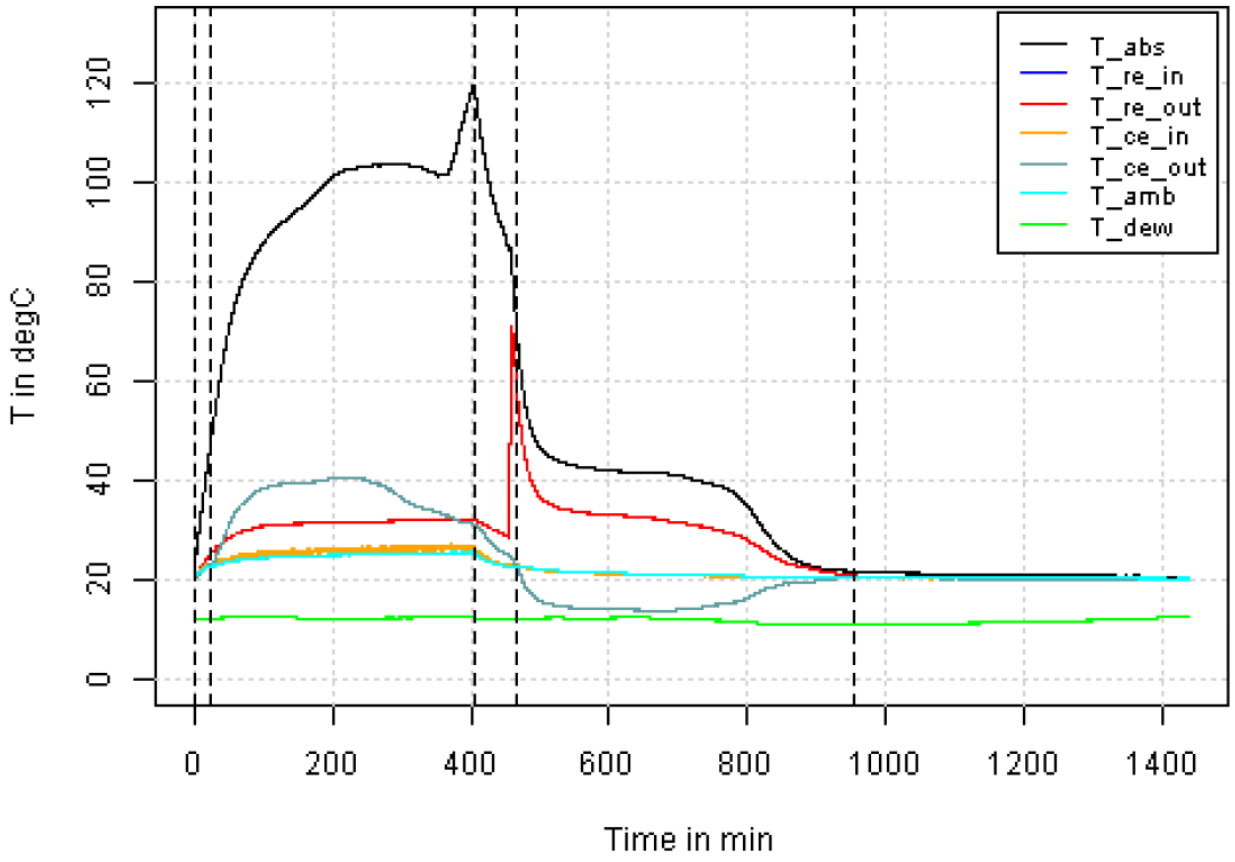


Evaporator/Condenser HX

Source: Fraunhofer ISE

Fraunhofer ISE

Collector measurements - temperatures

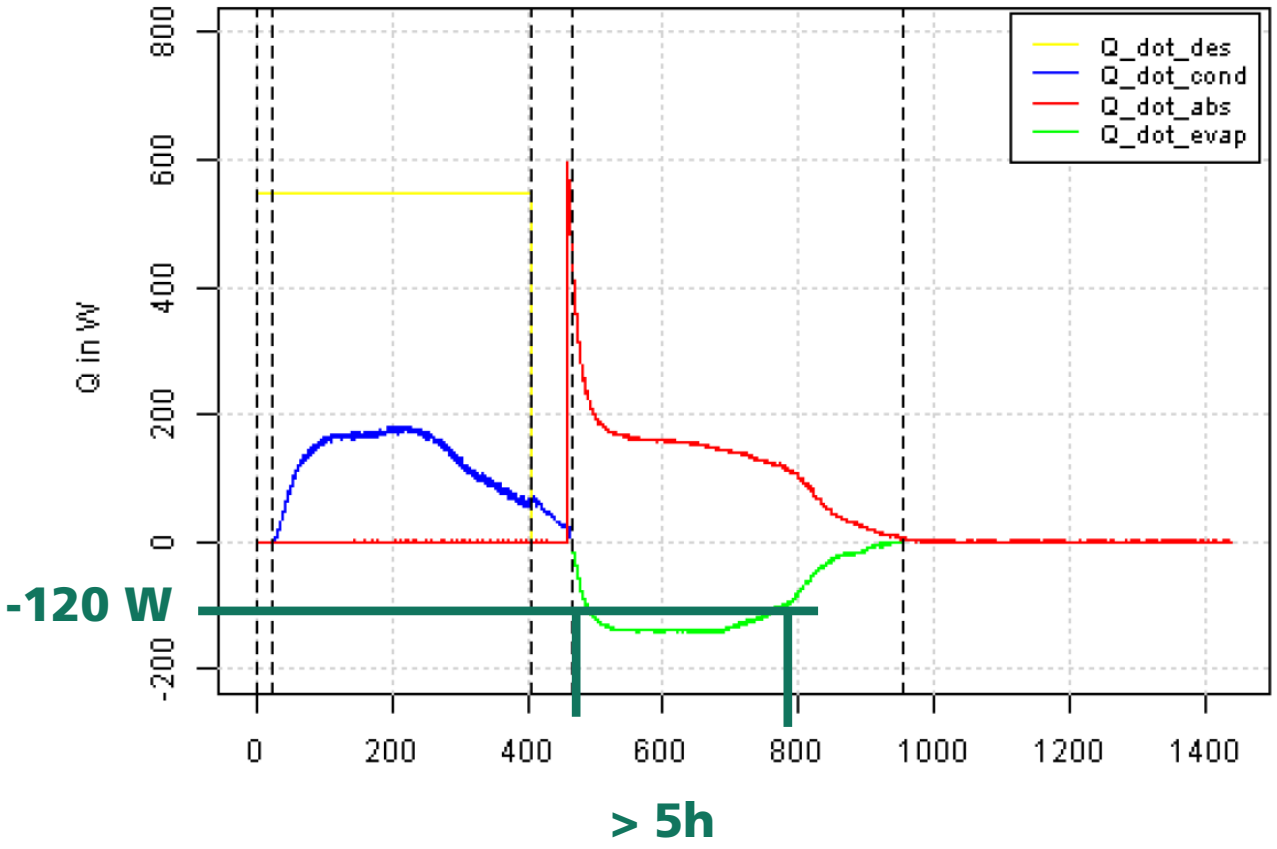


1 collector consists of 4 reactor tubes, 0.89m² aperture area

Source: Fraunhofer ISE

Fraunhofer ISE

Collector measurements - Power



Source: Fraunhofer ISE

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Simulation results – 20m² office room, 2.7 m² aperture area in the facade

		SFcool
		[%]
Stockholm	East	**40**
	South	32
	West	31
Stuttgart	East	**33**
	South	23
	West	28
Rome	East	**27**
	South	21
	West	27

$$SF_{cool} = \int \dot{Q}_{SC\_cool} \Big/ \int \dot{Q}_{cooldem}$$

Simulation results – 20m² office room, 2.7 m² aperture area in the facade

		SFcool	SEERcool
		[%]	[-]
Stockholm	East	40	6.9
	South	32	5.6
	West	31	6.4
Stuttgart	East	33	6.4
	South	23	5.1
	West	28	6.9
Rome	East	27	6.8
	South	21	6.0
	West	27	7.9

$$SF_{cool} = \int \dot{Q}_{SC\_cool} \Big/ \int \dot{Q}_{cooldem} \qquad EER_{cool} = \int \dot{Q}_{SC\_cool} \Big/ \int \dot{Q}_{SC\_electric}$$

Simulation results – 20m² office room, 2.7 m² aperture area in the facade

		SFcool	SEERcool	η_{cool}
		[%]	[-]	[%]
Stockholm	East	40	6.9	19
	South	32	5.6	11
	West	31	6.4	14
Stuttgart	East	33	6.4	20
	South	23	5.1	11
	West	28	6.9	16
Rome	East	27	6.8	18
	South	21	6.0	12
	West	27	7.9	20

$$SF_{cool} = \int \dot{Q}_{SC\_cool} \Big/ \int \dot{Q}_{cooldem} \qquad EER_{cool} = \int \dot{Q}_{SC\_cool} \Big/ \int \dot{Q}_{SC\_electric} \qquad \eta_{cool} = \int \dot{Q}_{SC\_cool} \Big/ \int \dot{Q}_{SC\_solar}$$

Conclusions

- Systems with vacuum tubes are advantageous over flat plate collector
- Air based system reduces number of components (no drainback system, no dry cooler)
- Improvement of electric efficiency required → reduction of pressure drop in condensor/evaporator part
- Orientation of sorption collector needs to fit load
- Promising results in terms of thermal performance

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www.inspirefp7.eu

Thank you for your attention!

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