Cooling
Innovation

FAHRENHEIT

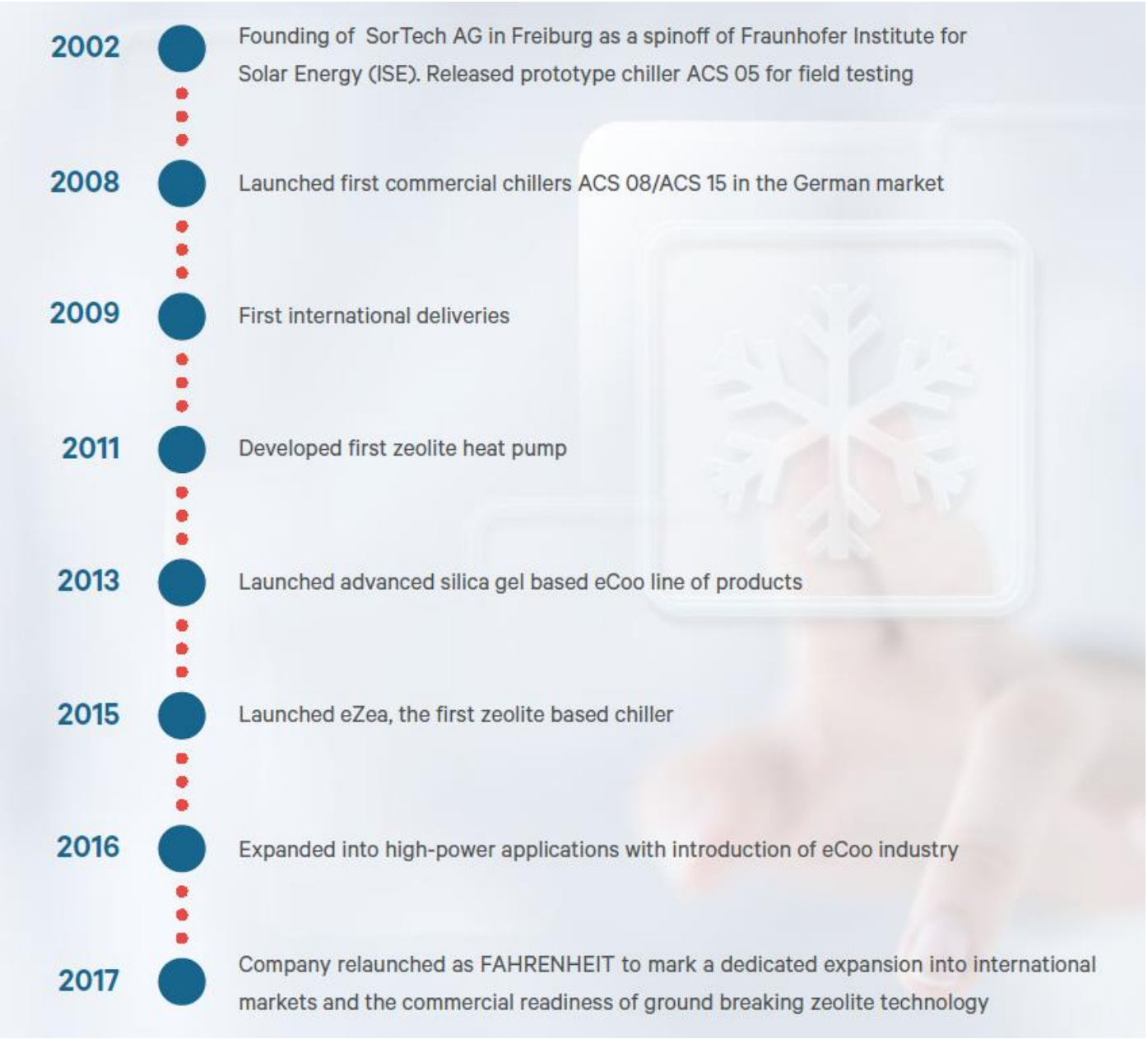
Solar Thermal Cooling with Adsorption Chillers

Experiences and Consequences for Future Projects

SHC
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Task 53 - Workshop 20th April 2017 - CNR_ITAE Messina
Eng. Gabriele Penello

From SorTech to Fahrenheit



About Projects that have already used our machine

Patent office Munich - Germany

Inlet temperature	75 °C
Cooling capacity	150 kW
Cooling temperature	14 °C
Commissioning	2011
Running time per year	1500 h

- From small and compact system of 8kW to 150-250kW cooling
- Mainly in central Europe

Fraunhofer-Institut - Solar Energy system (ISE), Freiburg

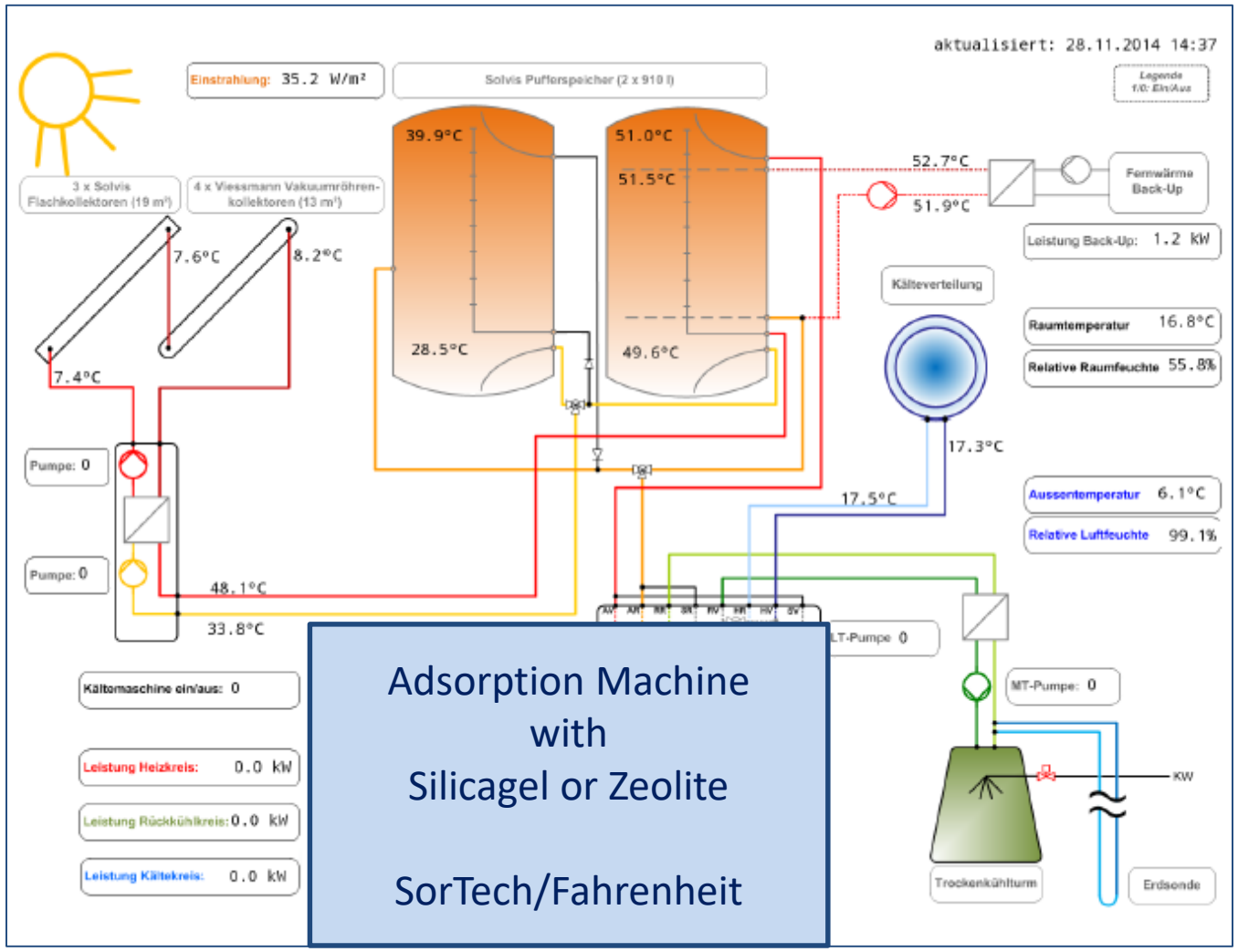
- Solar panel 20 m² and CHP as backup
- Cooling & heat pumps – ACS 08
- Recooling and cold source: Geothermie

Planning a solar cooling system with PolySun

A real case: Richard Fehrenbach Gewerbeschule - Freiburg - „Projekt SolCoolSys“

Advantages:

- Planning with different working temperature – good match between request of cooling and availability of heat.
- Different way of recooling for the best efficiency of the system.
- Standard and easy modelling, with optimization and simulation.
- Outlook and feedback about Pay Back time



Planning a solar cooling system with PolySun

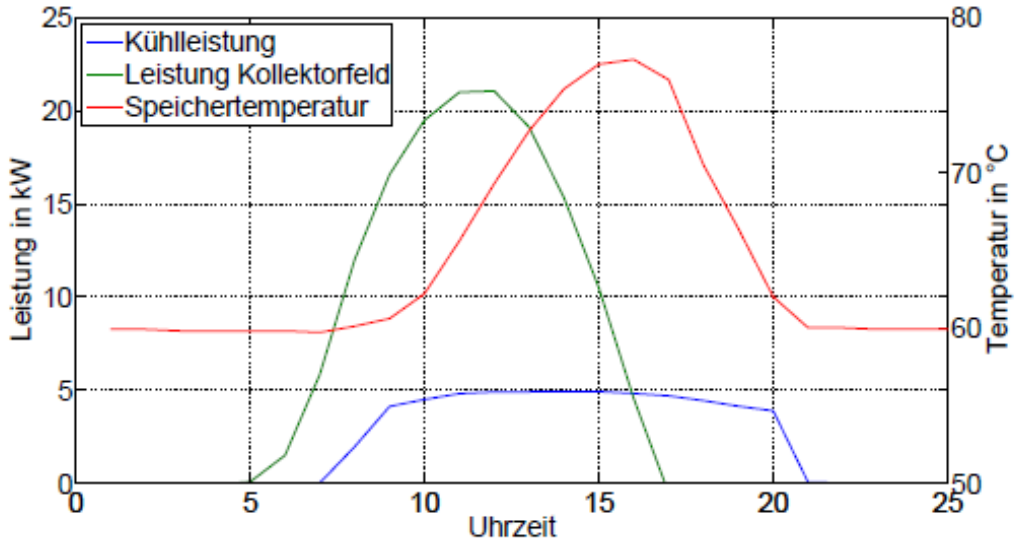
Balance between simulation with PolySun and real data of 24th June 2014 *

	Q_{HT}	Q_M	Q_{LT}	Different
Simulation	9,68 kW	-10,23 kW	4,68 kW	4,13 kW
Reality	10,49 kW	-15,09 kW	4,73 kW	0,13 kW

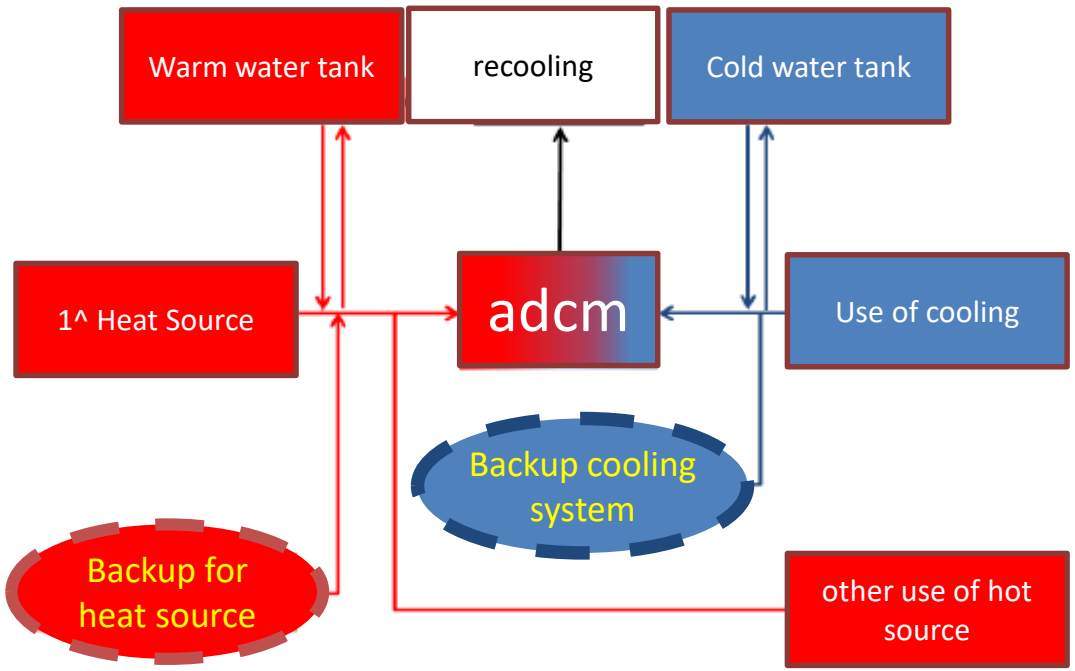
*Details from „implementierung der Adsorptionskältemachine „eCoo“ in die Softwareumgebung Polysun“. M- Dölz

Difficulties with Solar cooling system:

- Suitable for base load but hard to follow the peak load demand.
- Cooling demand and heat source (red line) should match well or… backup systems



Planning solar cooling system with PolySun



Backup of heat source as CHP, gas boiler, fuel cell… and Backup of cooling system, or a HYBRID CHILLER

Hybrid Chiller instead of two backup systems → 1Adcm + 1 electric Chiller integrated

Hybrid Chiller – HC a solution for industry and office with:

Waste heat

Solar cooling

CHP

Air compressor system

What we have already done:

- Combination of Adsorption an electrical chiller in one casing.
- Compact and efficient.
- Flexible to use with base load and peak load.
- Modular, 3 different powers and 2 different Refrigerants.

With Cold water temperature 16/19 °C
European Seasonal Energy Efficiency Ration ESEER: (electrical) 19,6
(max thermic) 0,65

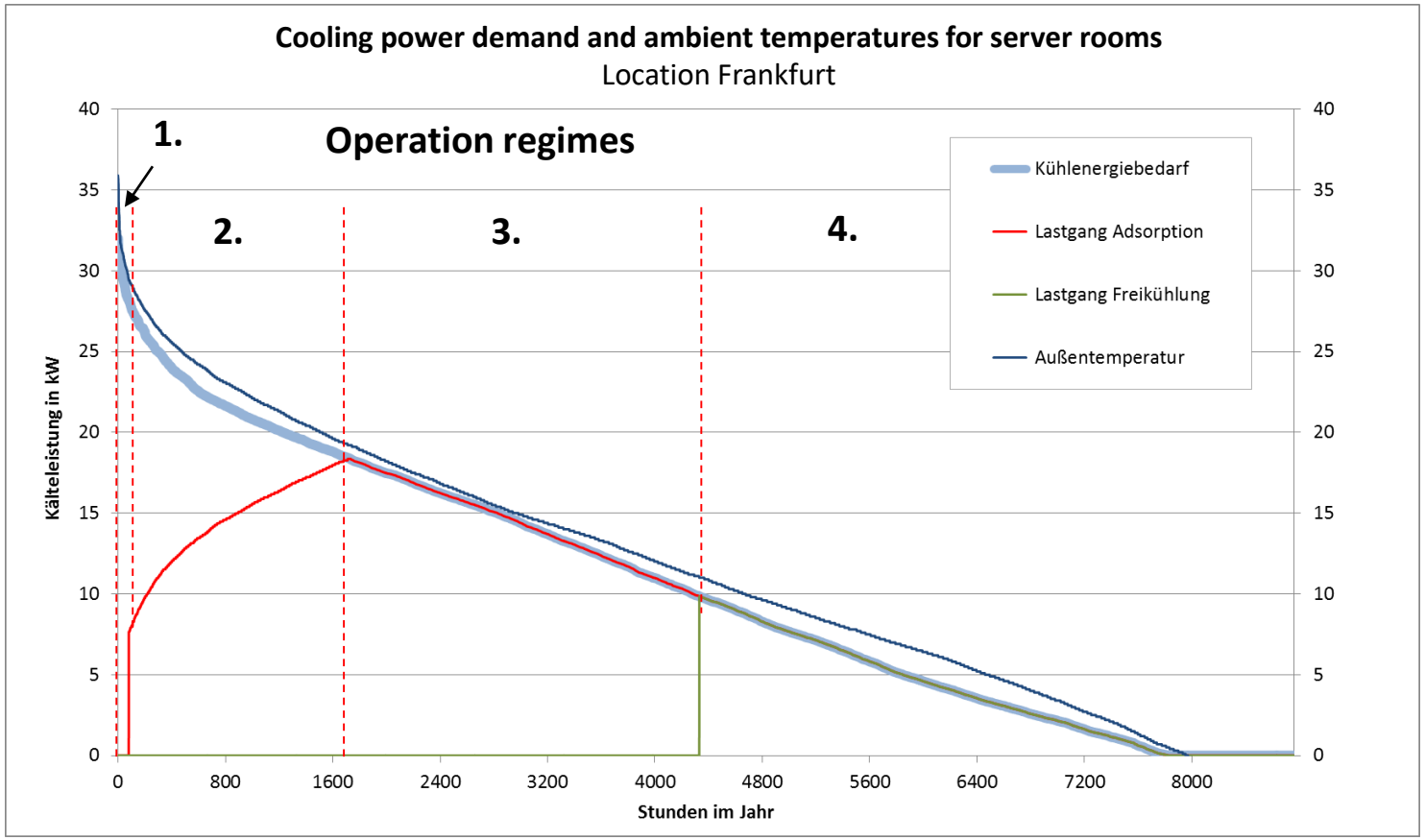
Kreisläufe	Cold water	Hot water	Re-cooling
Temperature range	8–21 °C	50-95 °C	22–40 °C

Hybrid Chiller – Calculation of the demand coverage (example)

Operation regimes

1. Monovalent compression
2. Bivalent compression and adsorption
3. Monovalent adsorption
4. Free cooling

Through direct integration system, switching between the areas is done internally.



Shares in the cooling demand coverage

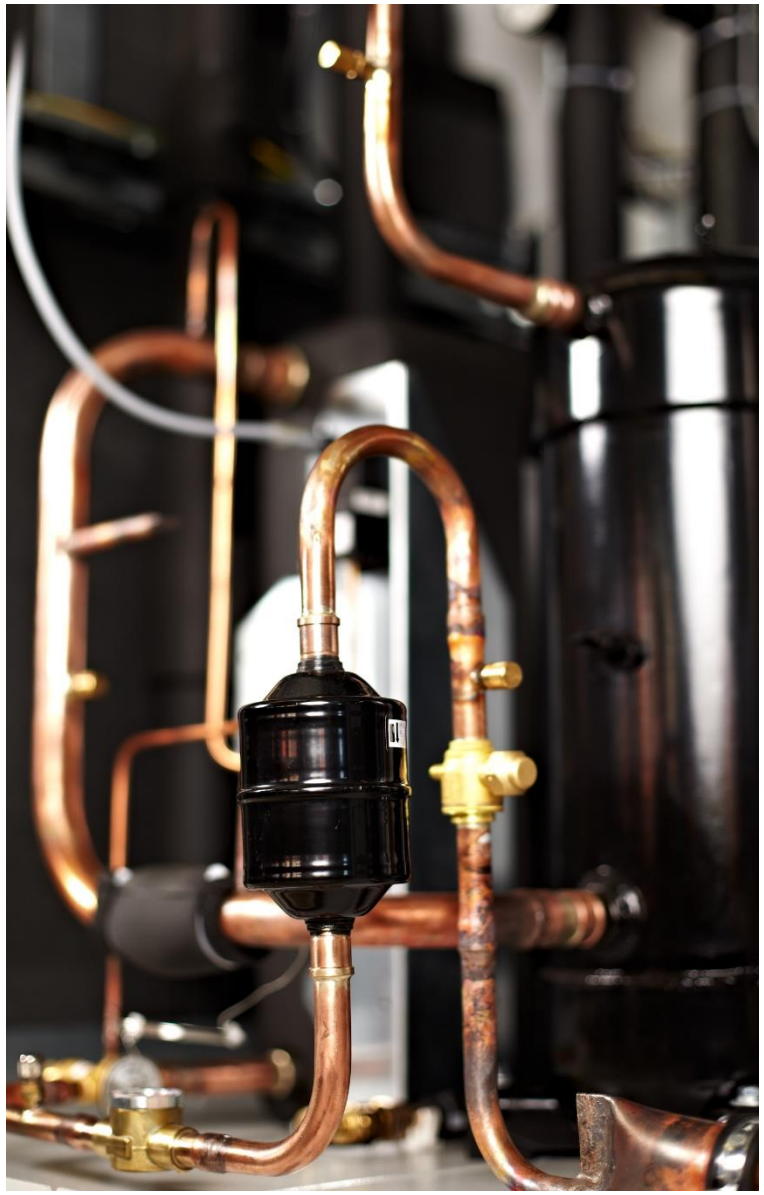
Adsorption chiller	60.974	kWh	67%
Free cooling	16.246	kWh	18%
Compression chiller	14.151	kWh	15%
In total	91.371	kWh	100%

Hybrid Chiller – HC

What are we doing now?

- „Lego-Model“ of Hybrid Chiller. Customized with different cooling capacities, peak load and base load; and different refrigerators: R134a - R404 - R290 (propan) – R600 (Butan) - R744 (CO_2) – Rxxx - ...

- Complete integrated solar cooling machine also with recooler (new European Projekt ZEOSOL + other partner and CNR/ITAE)



Economic feasibility

In the last years the Solar cooling technology was a not very successful:

- complicate and expensive system
- No „peak load“ but „base load“ of cooling
- Not a real culture and business strategy about this topic.
- No Company with „Turn Key project“

New Chances thanks to:

- decrease of the cost of Solar Panel and collector
- higher kW/m^2 for Adsorber → More compact and cheaper machine
- Subsidies: as Conto Termico 2.0 in Italy for solar cooling technology

Example - Private House - Madrid

Drive circuit: Solar thermal

Cooling circuit: Space Cooling

Recooling circuit: Wet cooling tower

- High running time per year as typically in warm regions in the South of Europe
- Subsidies as Conto Termico 2.0 for Solar Cooling
- High c€/kWh as in the industrialized Countries
- Higher kW/m^2 thanks to new technical solutions

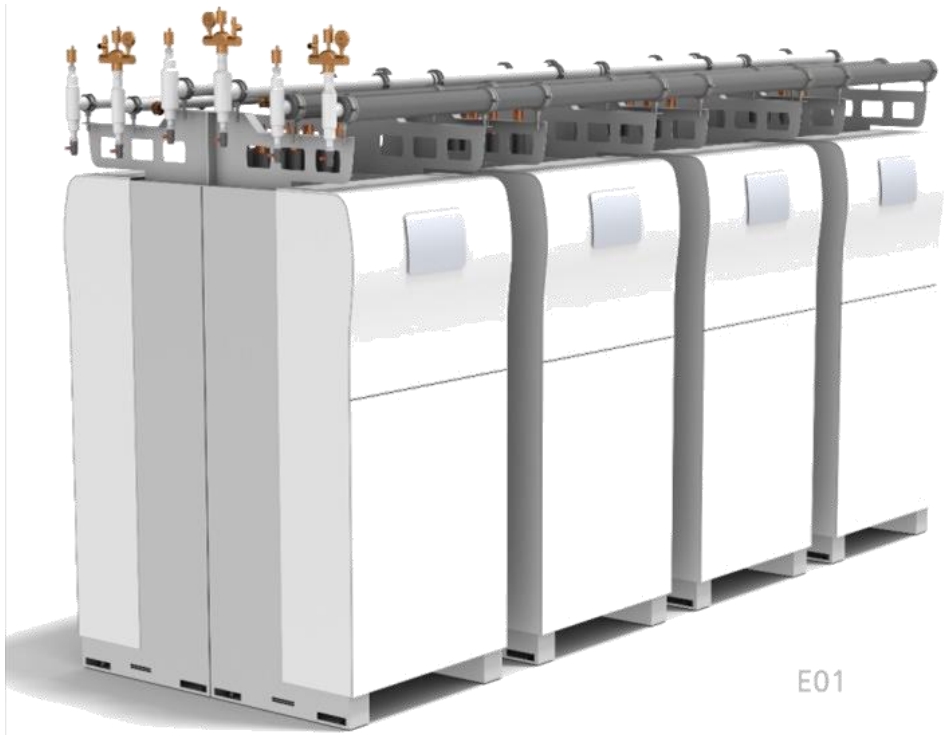
A solution with Hybrid Chiller in Solar Cooling may reach an attractive Pay Back time of 3 years.

Current Standard

Current specific cooling power

8.0 kW/m² (SorTech eCoo 2.0) to

12.0 kW/m² (SorTech eCoo Industry)

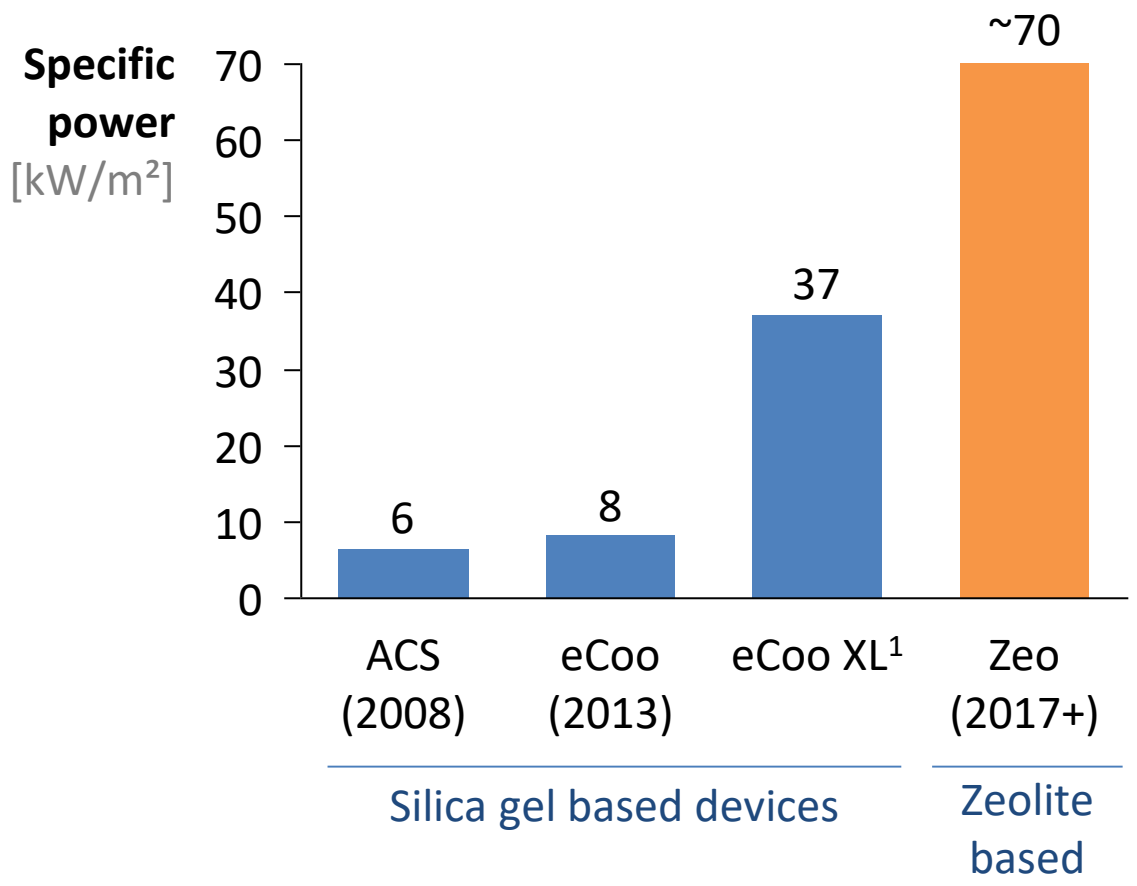


With zeolite as adsorbent, the power per area can be increased significantly

Adsorber modules are becoming smaller at identical power…

2015 **2016** **2017 …**

… allowing for increasingly more cooling power in a smaller footprint



1 Special variant for data centers: taller, and hydraulics placed above modules

We are always looking for new business partnership. **Contact us!**

Thank you!

FAHRENHEIT AG
Siegfriedstraße 19
80803 München
Deutschland
Telefon: +49 345 27 98 09-0
Email: info@fahrenheit.cool