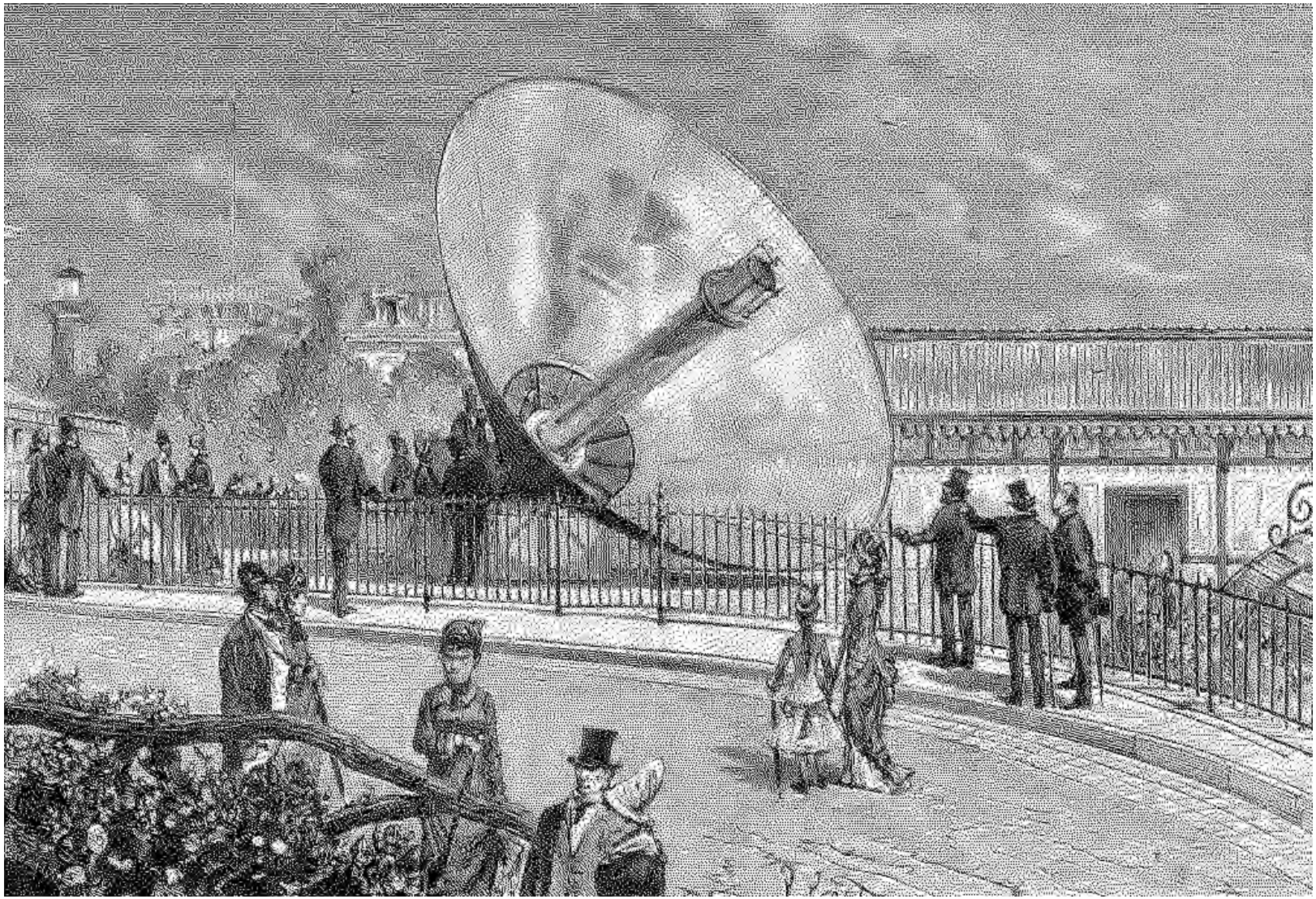
Solar Air-Conditioning in Europe

Chinese Solar Cooling Conference,
Shanghai Jiao Tong University, China, 27.03.2015

Dr. Uli Jakob
Green Chiller – Association for Sorption Cooling e.V.

- **Formed in March 2009**
  as Industry Association
  (today 10 Companies,
  11 Institutes, 1 Association)
- **Located in Berlin, Germany**
- Representing around 60% of all European manufacturers of thermally driven sorption chillers in the small and medium-scale cooling capacity range (5 - 200 kW)

- **Lobbying of Sorption Cooling Technologies**
- Promoting and Developing of the Solar and Thermal Cooling Market on European Level



Source: Olynthus Verlag

World exhibition in Paris – First ice block through solar energy (1878)

green chiller.de
VERBAND FÜR SORPTIONSKÄLTE E.V.

SolabCool
SolabChiller
Water / Silica gel

Source: SolabCool

SorTech
eCoo 2.0
Water / Silica gel

Source: SorTech

- Cooling capacity range: 4.5 kW to 10 kW
- Heating temperatures: 60 – 95°C / 50 – 95°C
- Cold water temperatures: 15°C
- COP: 0.6 – 0.65

New small-scale capacity water/silica gel adsorption chillers

SorTech
eZea
Water / Zolithe

Source: SorTech

InvenSor
LTC10 & LTC10e & HTC18
Water / Zolithe

Source: InvenSor

InvenSor
LTC30e
Water / Zolithe

Source: InvenSor

- Cooling capacity range: 10 kW to 30 kW
- Heating temperatures: 75 – 95°C / 60 – 95°C
- Cold water temperatures: 15°C
- COP: 0.53 / 0.6 – 0.65 (0.7*)

* High Efficiency Modus

New small-scale capacity water/zeolite adsorption chillers

EAW
SE15
Water / Lithium bromide

Source: EAW

Pink
PC19
Ammonia / Water

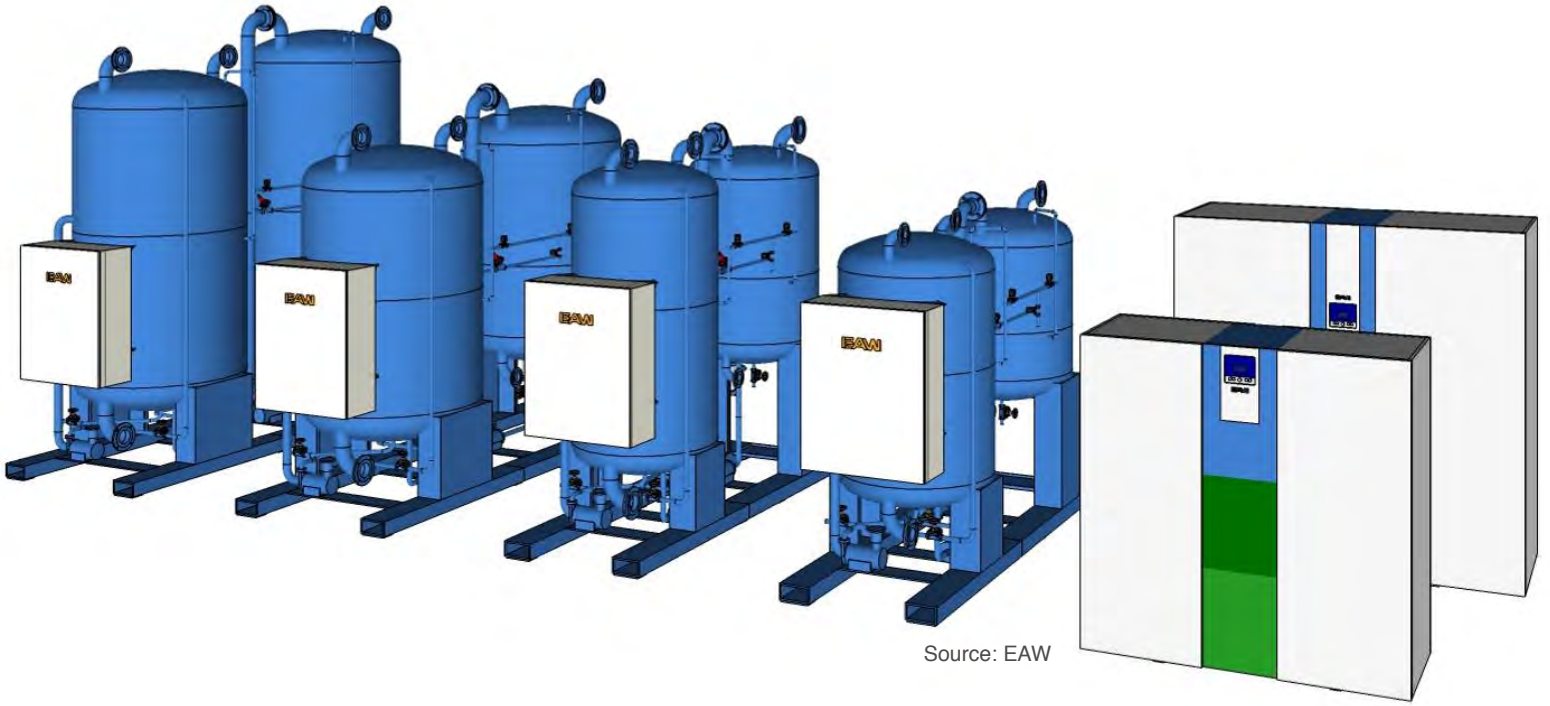
Source: Pink

- Cooling capacity range: 15 kW to 19 kW
- Heating temperatures: 65 – 95°C
- Cold water temperatures: 6 – 7°C (NH_3 -5°C)
- COP: 0.65 – 0.75 (0.5)

no claim on completeness

Small-scale capacity water/LiBr and NH_3/water absorption chillers

EAW
Wegracal SE 30 - 200
Water / Lithium bromide

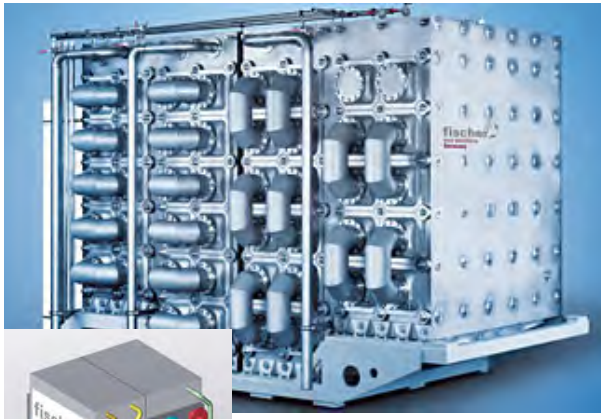


Source: EAW

- Cooling capacity range: 30 kW to 200 kW
- Heating temperatures: 70 – 95°C
- Cold water temperatures: 6 – 7°C
- COP: 0.7 – 0.75

Medium-scale capacity water/LiBr absorption chillers

Fischer Eco Solutions
fischer ARU 15 – 5000
Water / Lithium bromide



Sources: Fischer Eco Group

Baelz
Biene 50 & Hummel 160
Water / Lithium bromide

Source: Baelz

- Cooling capacity range: 15 kW to 5,000 kW
- Heating temperatures: 55 – 95°C
- Cold water temperatures: 6 – 7°C (16°C)
- COP: 0.6 – 0.7 (0.8)

no claim on completeness

New medium-scale capacity water/LiBr absorption chillers

green chiller.de
VERBAND FÜR SORPTIONSKÄLTE E.V.

AGO
congelo50 - 1000
Ammonia / Water

Source: AGO

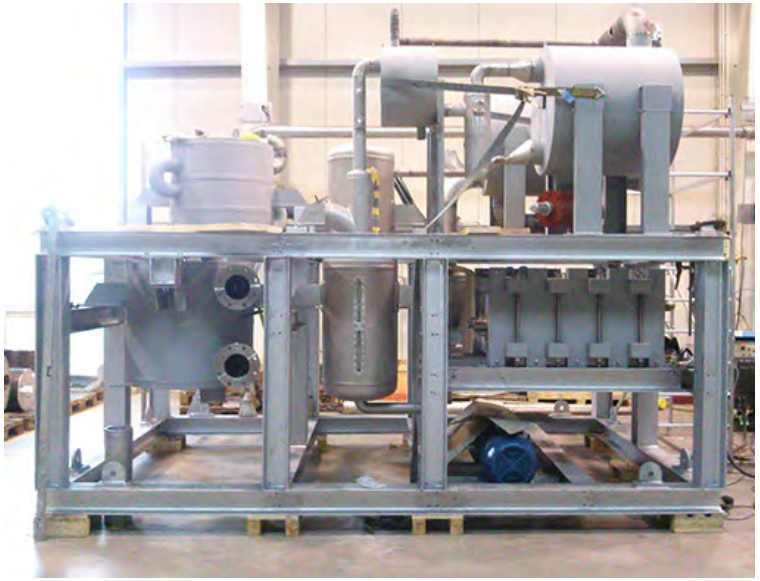
Tranter Solarice
XS30 & XS50
Ammonia / Water

Source: Tranter Solarice

- Cooling capacity range: 25 kW to 1,000 kW
- Heating temperatures: 80 – 105°C
- Brine temperatures: -5 – -10°C
- COP: 0.5

Medium-scale capacity NH_3/water absorption chillers

En-Save
En-Save Cold® XS30 – XXL100
Ammonia / Water



Source: en-save

Köhler Industries
EcoFreez50 & 300
Ammonia / Water

Source: Köhler Industries

- Cooling capacity range: 30 kW to 250 kW
- Heating temperatures: 80 – 135°C (170°C)
- Brine temperatures: 0 – -10°C (-30°C)
- COP: 0.5

New medium-scale capacity NH_3/water absorption chillers

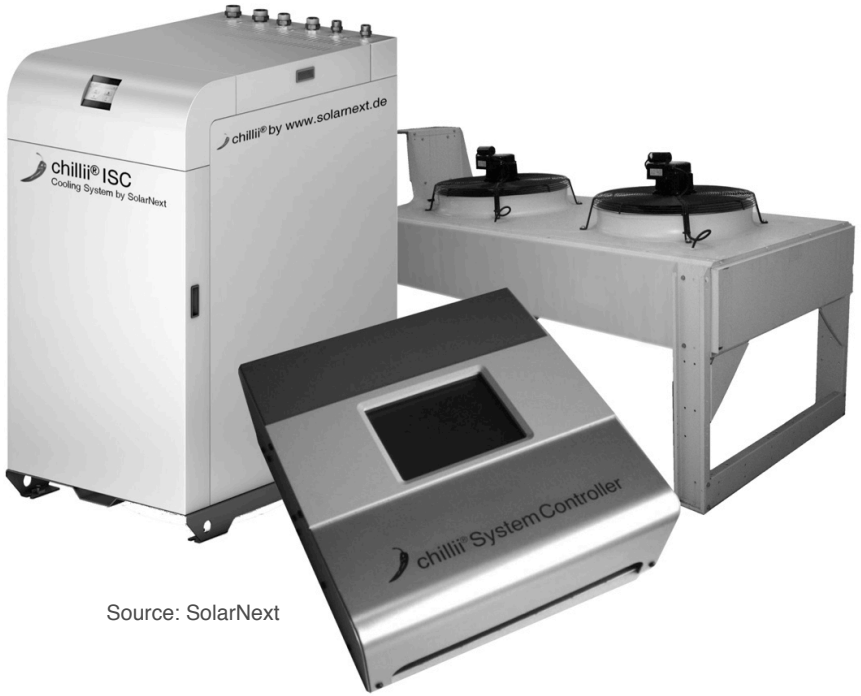
Source: InvenSor

Source: SorTech

Integrated hydraulic unit for comfortable system integration

green chiller.de
VERBAND FÜR SORPTIONSKÄLTE E.V.

chillii® Cooling Kit ISC18



Source: SolarNext

chillii® Cooling Kit WFC175

Source: SolarNext

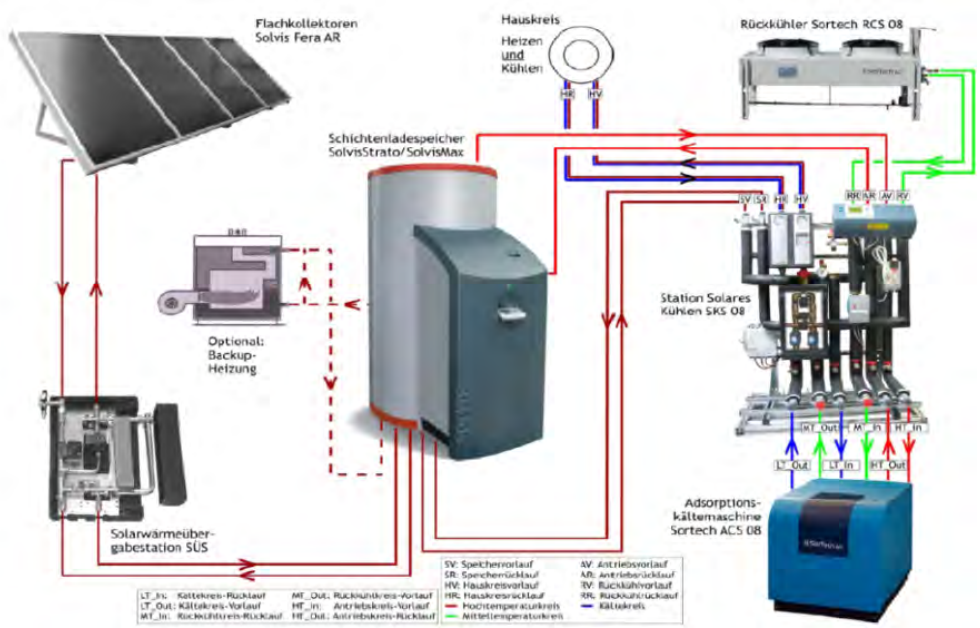
Solar / thermal cooling kits (small and medium-scale capacity)

green chiller.de
VERBAND FÜR SORPTIONSKÄLTE E.V.

Solar Cooling Kit

Heating, DHW, Cooling

System development
& field test



Source : Fraunhofer ISE

SOLVIS

Solar collection
Hydraulics
System integration

SorTech AG

Chiller
Heat rejection
Hydraulics

Fraunhofer ISE

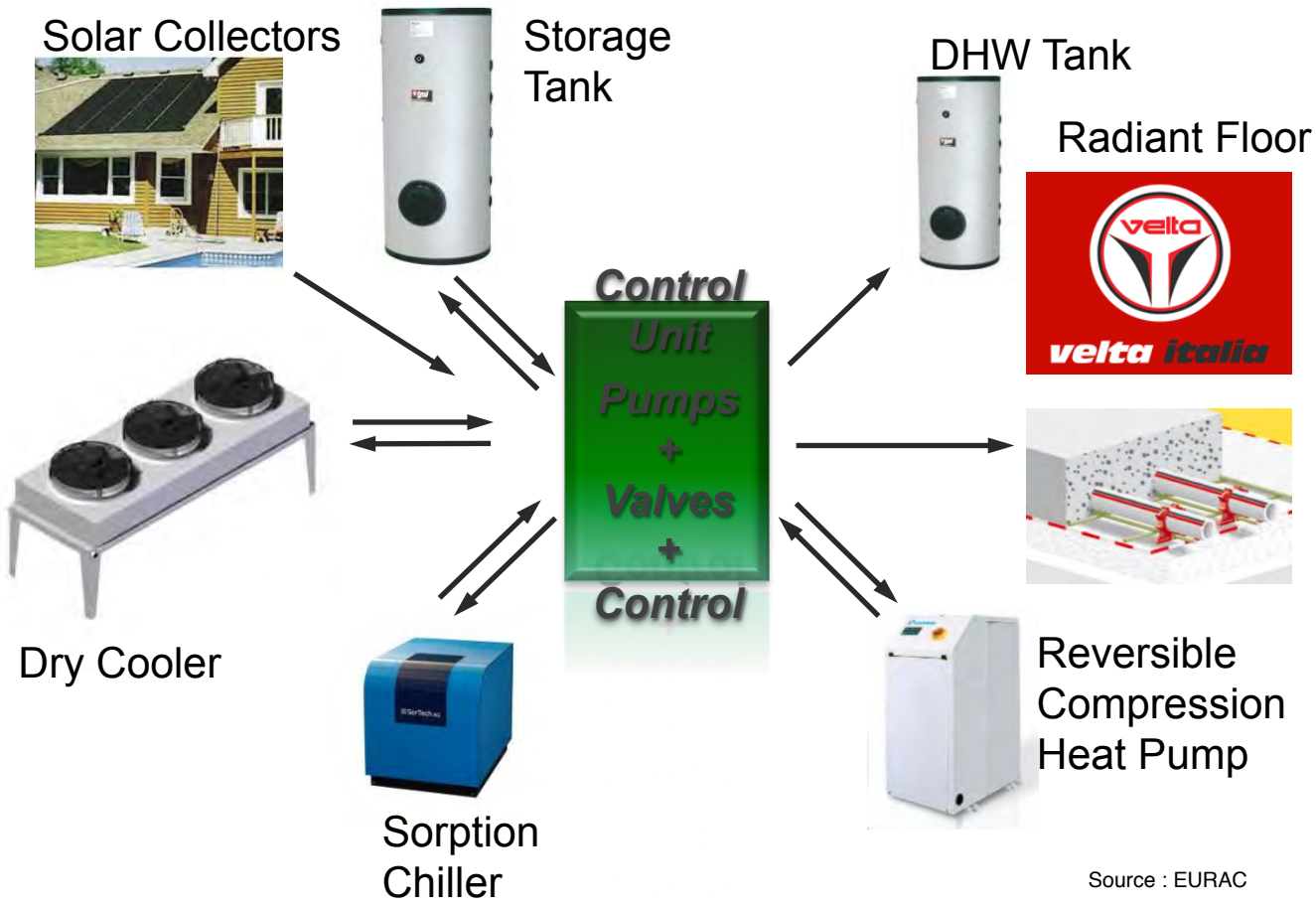
Tests, optimisation,
evaluation

Latest developments of solar cooling kits / example #1

green chiller.de
VERBAND FÜR SORPTIONSKÄLTE E.V.

Solar combi+ system

Commercial development – Velta Italia with EURAC



Source : EURAC

Latest developments of solar cooling kits / example #2

coolySun,
8, 15, 30, 54, 83, 150 and 200 kW

SOLARTIK,
17.5, 35, 70 and 105 KW

Package System,
17.5, 35, 70, 105, 140 and 210 KW

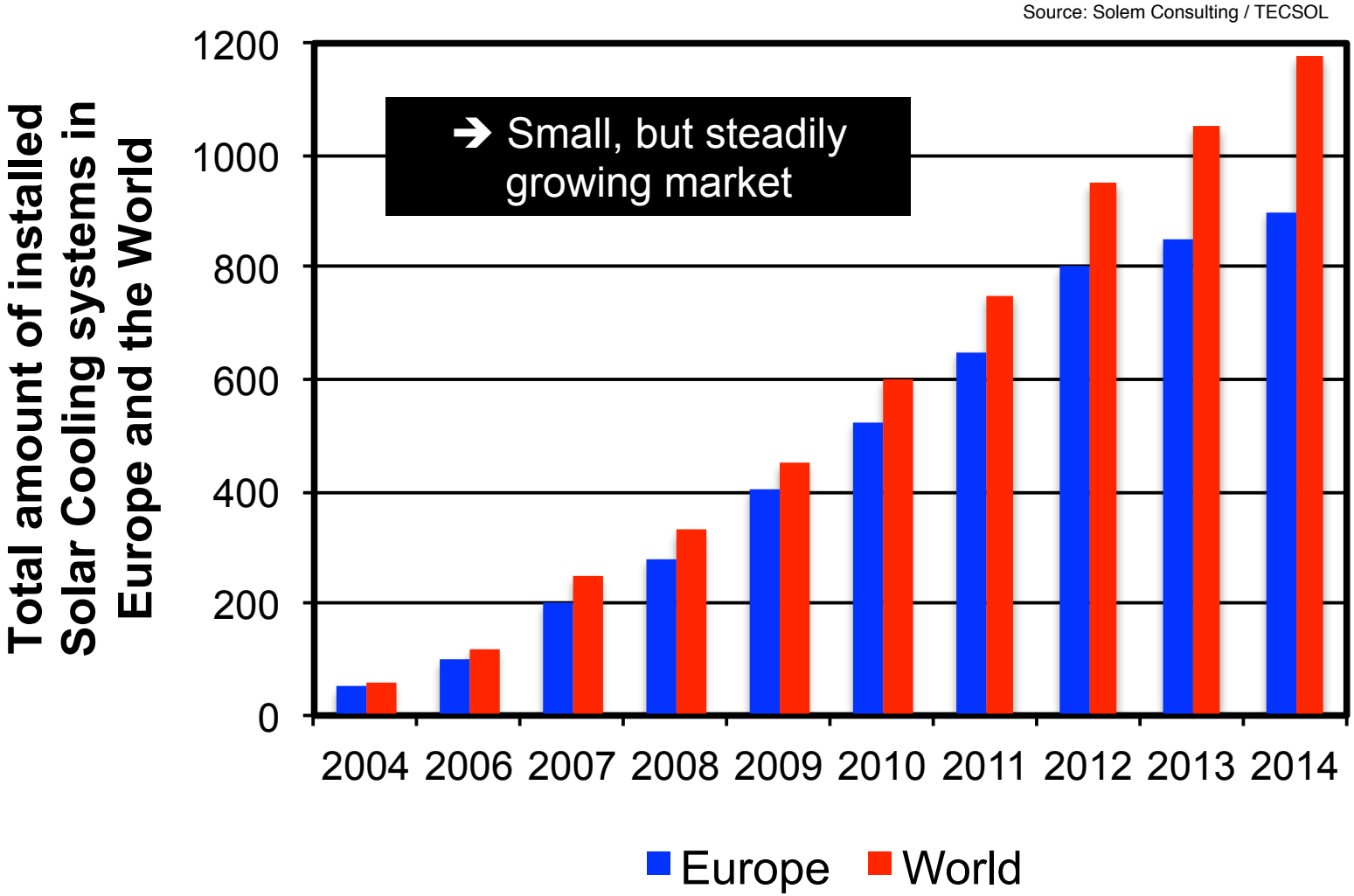
chillii® Cooling Kit,
8, 10, 15, 17.5, 18, 19, 30, 35, 50, 70, 105 and 175 kW

no claim on completeness

Recent solar cooling kit suppliers in Europe

VERBAND FÜR SORPTIONSKÄLTE E.V.

Source: Solem Consulting / TECSOL



- **About > 1,200 systems** installed worldwide (2014)

Market development of solar cooling

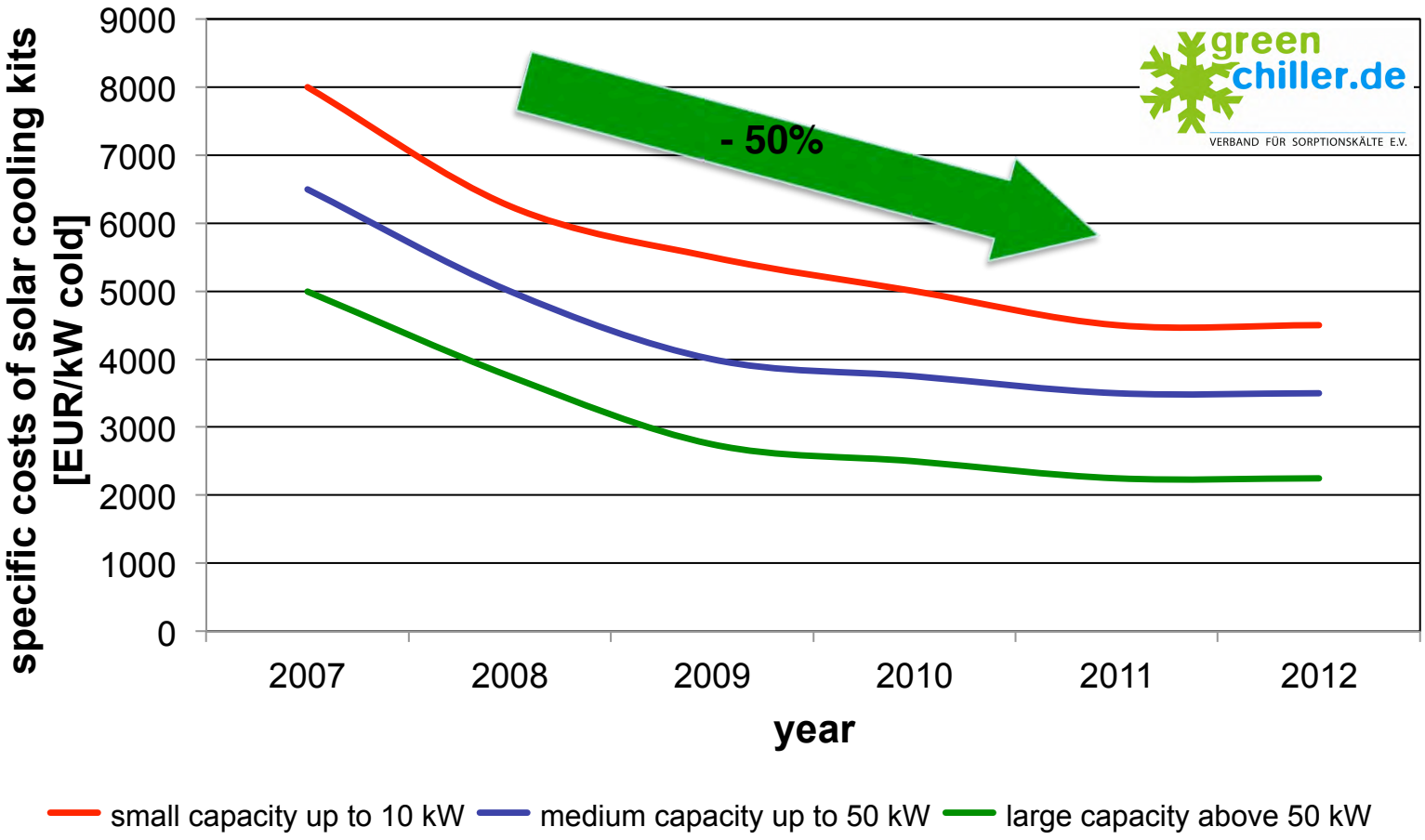
green chiller.de
VERBAND FÜR SORPTIONSKÄLTE E.V.

Source: Green Chiller

Sales numbers Green Chiller manufactures (2006-2013)

green chiller.de
VERBAND FÜR SORPTIONSKÄLTE E.V.

Source: Solem Consulting / Green Chiller

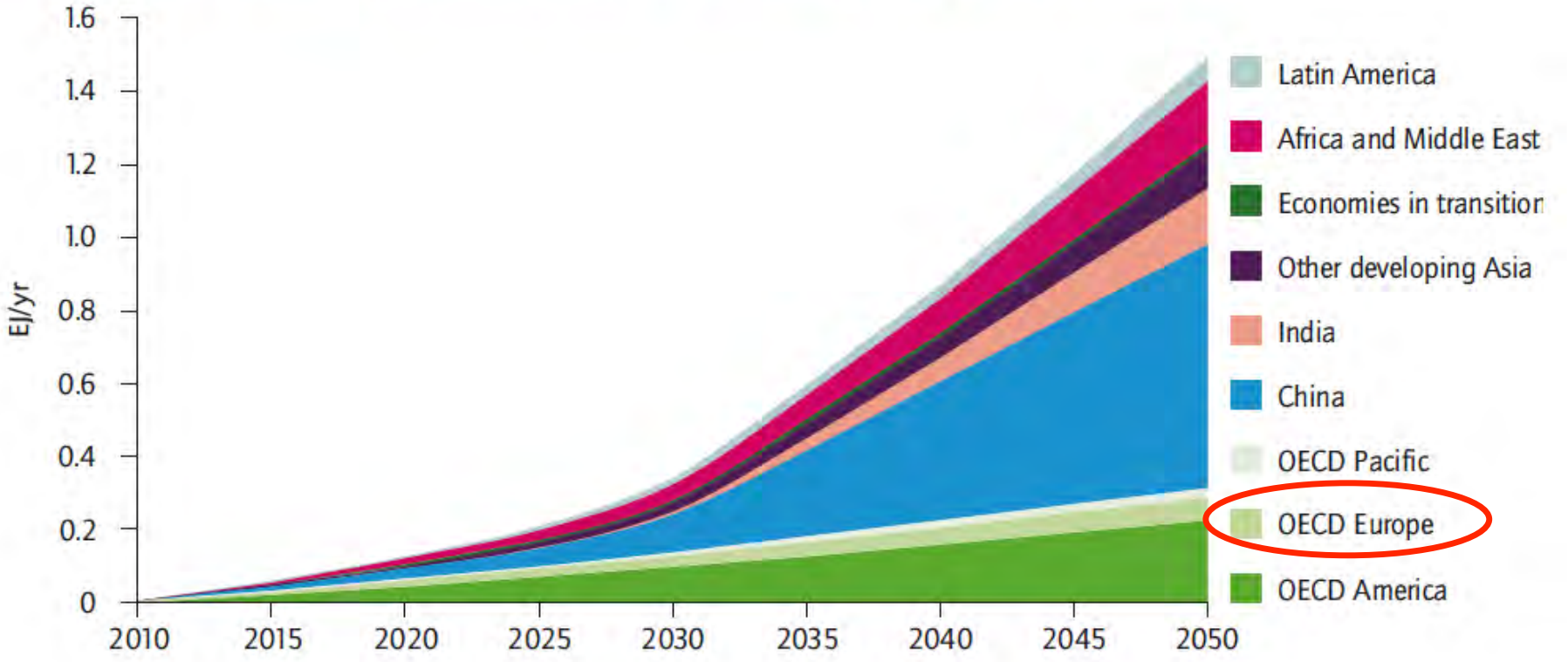


- **Cost reduction of 45-55%** within last years!

Cost development of solar cooling Kits in Europe (2007-2012)

green chiller.de
VERBAND FÜR SORPTIONSKÄLTE E.V.

Figure 16: Roadmap vision for solar cooling (Exajoule/yr)



Source: IEA Technology Roadmap Solar Heating and Cooling, 2012

- 1.5 x 10^{18} J/a = 416.7 TWh/a Solar Cooling by 2050
- Solar Cooling nearly 17% of total energy use for cooling!

IEA Technology Roadmap SHC – Market potential by 2050

green chiller.de
VERBAND FÜR SORPTIONSKÄLTE E.V.

- **MAP (market incentive program)**: BAFA offers **200 EUR/m²** for collector areas between 20 m² and 100 m² for solar thermal cooling at existing buildings, now also for new buildings **150 EUR/m²** **(NEW 1.4.2015)**.

- **MAP**: BAFA offers also an annual solar energy yield based subsidy for solar cooling of **0.45 EUR per kWh/a/collector** (Solar Keymark) for collector areas between 20 m² and 100 m² **(NEW 1.4.2015)**.

- **BAFA** has opened the program for promotion of efficient cooling systems in industry for sorption technology/solar cooling between 5 – 500 kW cooling capacity **25% of net investment** (**since 1.1.2014**).

Source: SolarNext

- About 1,200 solar cooling systems installed worldwide (2014)
- Several new small and medium-scale Absorption and Adsorption chillers were developed in Europe
- Standardized Solar Cooling Kits available to bring down the costs
- Incentive schemes available, e.g. in Germany (BAFA) up to 200 EUR/m^2 collector area and 25% repayment bonus of net investment costs for sorption chiller systems!
- Solar heat is particularly of interest if a solar thermal system is used for other heat needs, too (e.g. heating, DHW)

Conclusion

Thank you.

Dr. Uli Jakob
Green Chiller – Association for Sorption Cooling e.V.

www.greenchiller.eu