



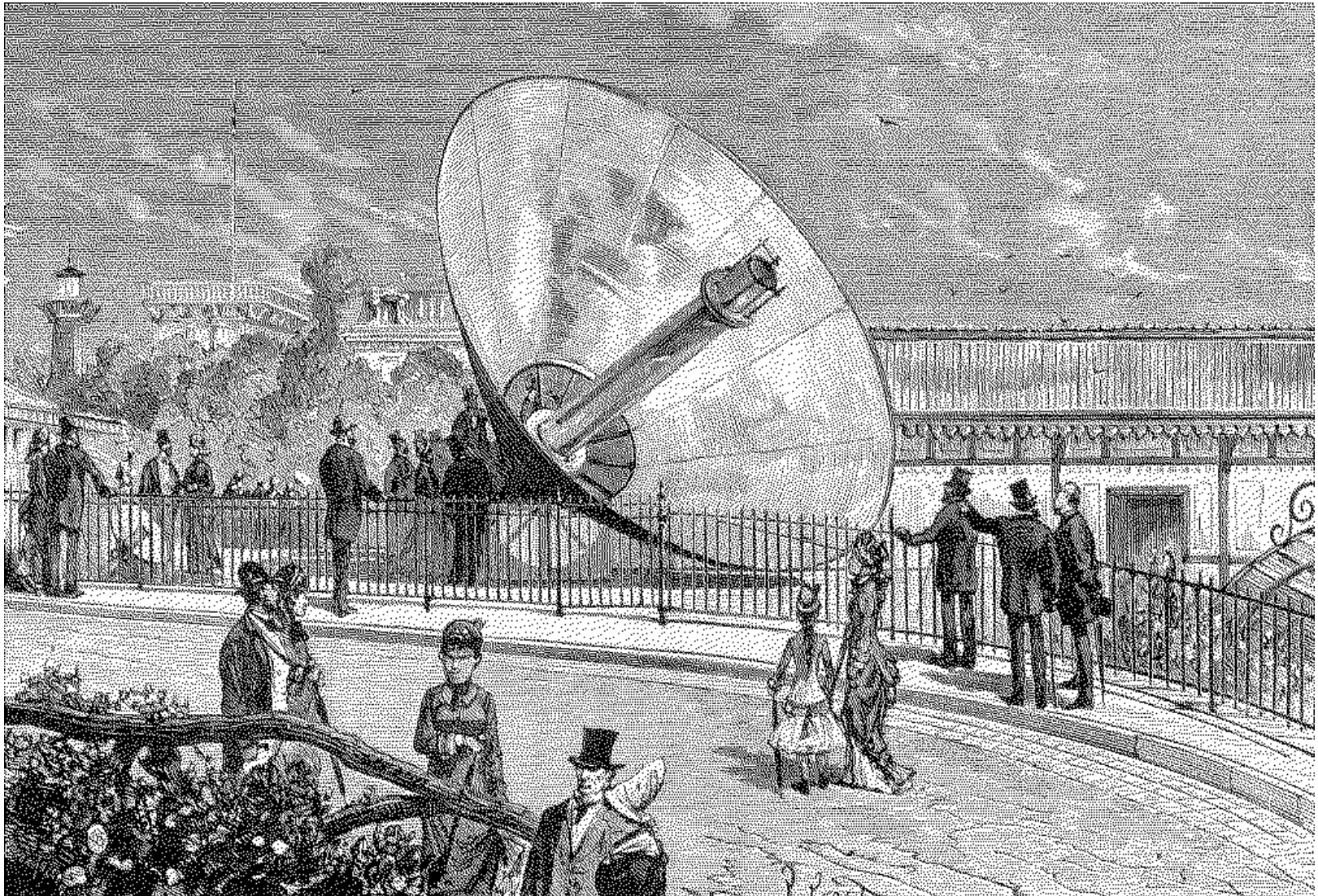
Status and perspective of solar cooling in Europe

Australian Solar Cooling 2013 Conference,
CSIRO Riverside Life Sciences Centre, Sydney, Australia, 12.04.2013

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 (8 - 200 kW)
- Lobbying of Sorption Cooling Technologies
- Promoting and Developing of the Solar and Thermal Cooling Market on European Level



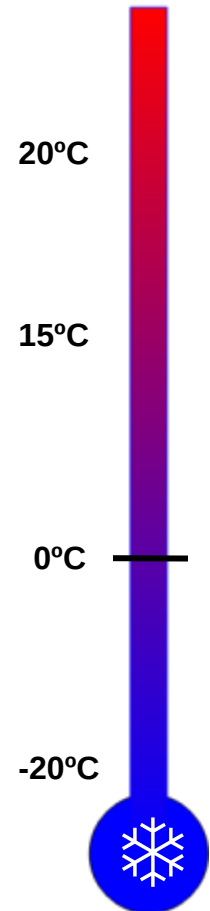


Source: Olynthus Verlag

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

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Solar thermal collector		Heat transfer medium	Collector temperature	Application for cooling
Air collector		Air	40-60°C	Air-conditioning
Flat plate collector		Water, Water-Glycol	70-90°C	Air-conditioning, slab cooling
Evacuated tube collector		Water, Water-Glycol	90-120°C	Air-conditioning, slab cooling
Parabolic trough / Fresnel collector		Thermal oil, Water	120-250°C	Refrigeration, air-conditioning, slab cooling



Solar thermal collector technologies – Application for solar cooling

SorTech (DE)
8 & 15 kW
Water / Silica Gel



Source: SorTech

InvenSor (DE)
10 & 18 kW
Water / Zeolithe



Source: InvenSor

Pink (AT)
19 kW
Ammonia / Water



Source: Pink

Tranter Solarice (DE)
30 & 50 kW
Ammonia / Water



Source:
Tranter
Solarice

Sakura (JP)
10.5 – 35 kW
Water / LiBr



Source: Sakura

EAW (DE)
15 & 30 kW
Water / LiBr



Source: EAW

Yazaki (JP)
17.5 & 35 kW
Water / LiBr



Source: Yazaki

Thermax (IN)
35 kW
Water / LiBr



Source: CISRO

no claim on completeness

Small-scale capacity absorption and adsorption chillers

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EAW (DE)
50 – 200 kW
Water / LiBr



Source: EAW

Yazaki (JP)
70 – 175 kW
Water / LiBr



Source: Yazaki

Thermax (IN)
70 – 352 kW
Water / LiBr



Source: Thermax

Mayekawa (JP)
105 – 430 kW
Water / Zeolite



Source: Mayekawa

HIJC (US, former Nishiyodo)
220 – 350 kW
Water / Silica gel



Source: HIJC

AGO (DE)
50 – 500 kW
Ammonia / Water



Source: AGO

no claim on completeness

Medium-scale capacity absorption and adsorption chillers

Makatec (DE)
5 – 100 kW
Ammonia / Water



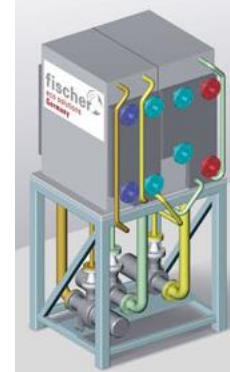
Source: Makatec

Köhler Industries (DE)
40 kW & 250 kW
Ammonia / Water



Source: Köhler Industries

Fischer Eco Solutions (DE)
15 kW – 1.2 MW
Water / Lithium bromide



Sources: Fischer Eco Group



Latest developments of resorption and absorption chillers

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SolabCool (NE)
5 kW
Water / Silica gel



Source: SolabCool

Mitsubishi Plastics (JP)
10 kW
Water / Zeolite



Source: Mitsubishi Plastics

Jiangsu Huineng (CN)
11 – 350 kW
Water / LiBr



Source: Jiangsu Huineng

Latest developments with integrated heat rejection

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Pre-designed pump group



Source: SorTech

Recooler



Source: SorTech

Sub-systems of sorption chiller manufactures

Integrated hydraulic unit
including pumps, mixers
and valves



Source: InvenSor

Integrated hydraulic unit for comfortable system integration

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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



LB Cooling System,
15 and 30 kW



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



Alaska-Set,
8, 15, 30 and 54 KW

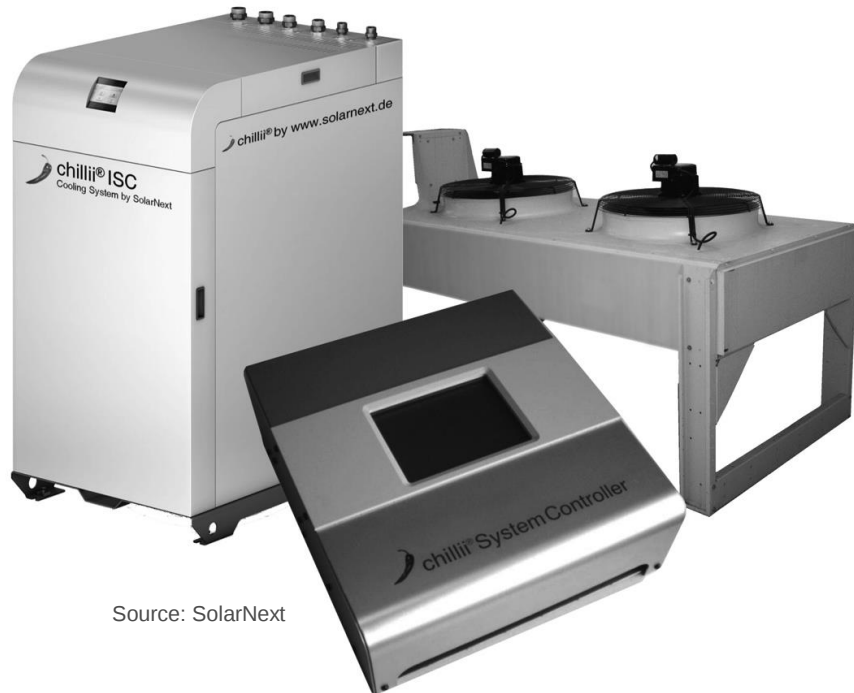
no claim on completeness



Recent solar cooling kit suppliers in Europe



chillii® Cooling Kit ISC18



Source: SolarNext



chillii® Cooling Kit WFC175



Source: SolarNext

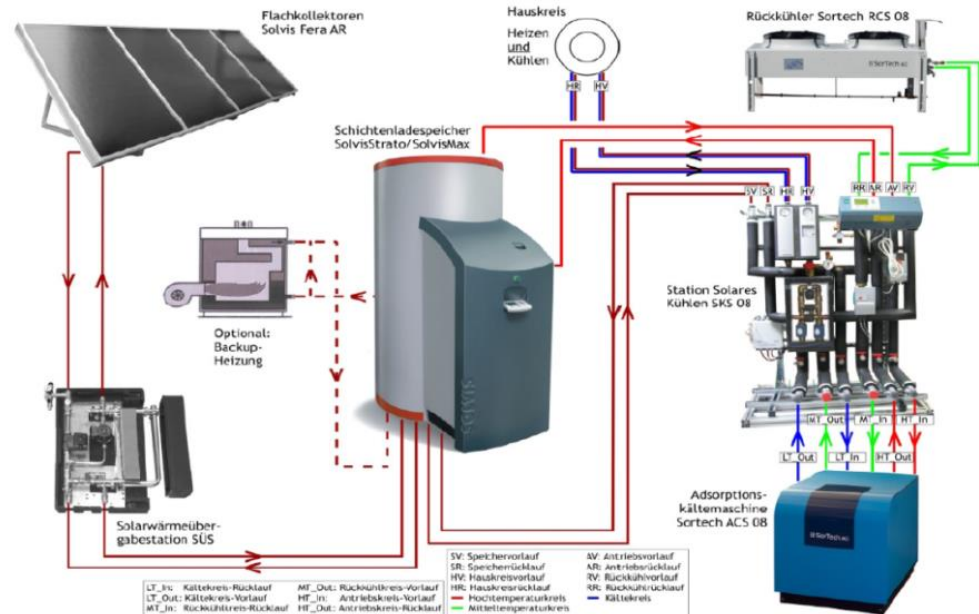
Solar / thermal cooling kits (small and medium-scale capacity)

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Solar Cooling Kit

Heating, DHW, Cooling

System development
& field test



Source : Fraunhofer ISE



Solar collection
Hydraulics
System integration



Tests, optimisation,
evaluation



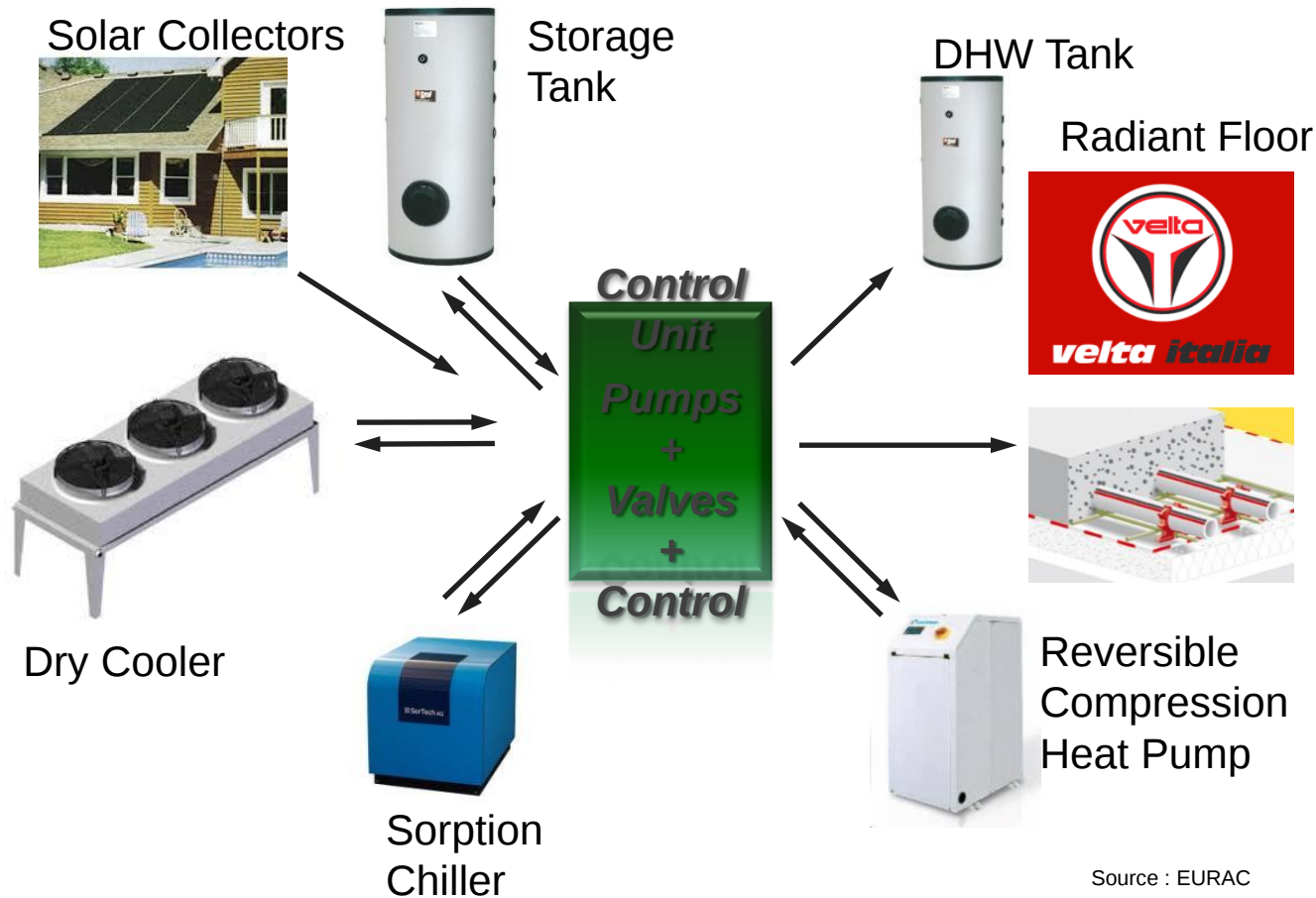
Chiller
Heat rejection
Hydraulics



Latest developments of solar cooling kits / example #1

Solar combi+ system

Commercial development – Velta Italia with EURAC



Source : EURAC

Latest developments of solar cooling kits / example #2

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(Middle East, North Africa)



(USA)



(Middle East, Spain, USA)



(Europe, USA, Caribbean, Asia)



(Europe, Middle East)



(China, Europe, USA, Middle East)

no claim on completeness

Worldwide suppliers of costume-made solar cooling systems

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A typical solar installation



The Thermax edge - parabolic concentrators

Operating characteristics

- Based on Scheffler design
- Dish area of 16m² and more
- A parabolic dish concentrates sunlight on to the receiver
- Fixed focus design
- Converts ambient water into hot water/ steam through a natural circulation system
- Converted energy can be stored in insulated header pipe

Energy output & key financials

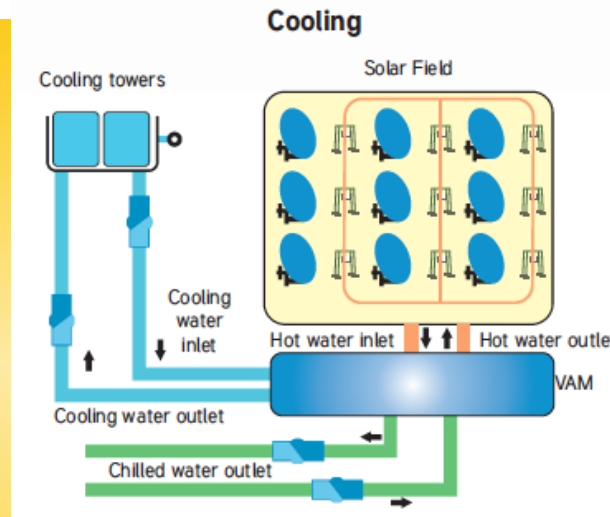
- Each dish generates an average of 4.5 to 5.5 kWh
- Attractive payback period
- Financial incentive available from MNRE, Government of India
- Depreciation benefit up to 80% in the first year

Tracking system

The parabolic dish operates on a two axis tracking system which utilizes the energy generated from the PV cells attached to the dish. Thus, the tracking system is automated without electricity being required.

Rich in features

- Virtually zero operating cost
- Robust technology, proven over the last 15 years
- Can work for 250 to 300 days in a year
- Modular design for easy and safe operation and maintenance
- Can be easily integrated with existing back up system
- Space saving design - can be installed on rooftops (requires only 35 m² for one module)
- Low morning heat up time due to lower system losses
- Dual axis tracking system



For further enquiries, email: solar@thermaxindia.com



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Thermax Business Portfolio

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Water & Waste Solutions

Air Pollution Control

Chemicals

Absorption Cooling

Captive Power

In view of our constant endeavour to improve the quality of our products, we reserve the right to alter or change specifications without prior notice. All photographs shown in this brochure are representative in nature and to be used for reference only. For actual details and specifications, please refer to Thermax data document.



THERMAX

The power of the sun,
harnessed by Thermax



- Scheffler-Mirror and parabolic trough collectors with LiBr Absorber (SE, DE, new TR)

Latest system supplier from India (2010)

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VERBAND FÜR SORPTIONSKÄLTE E.V.

News Release

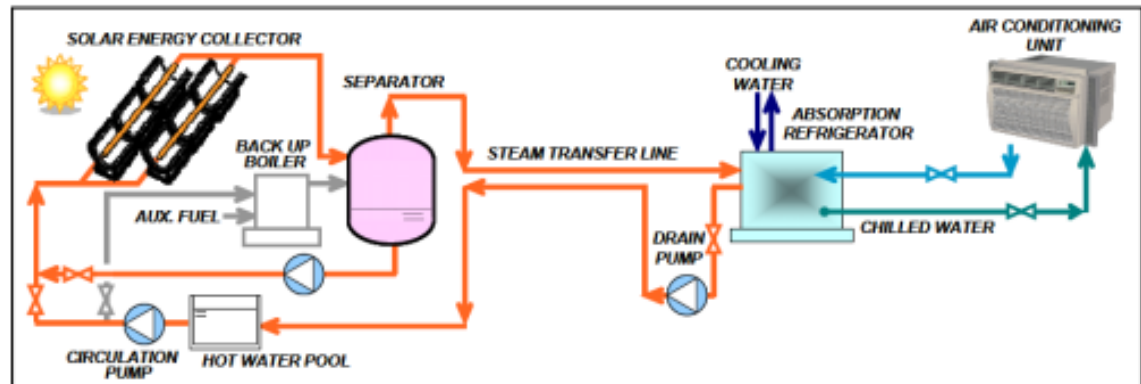
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Inspire the Next

FOR IMMEDIATE RELEASE

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■ System flow

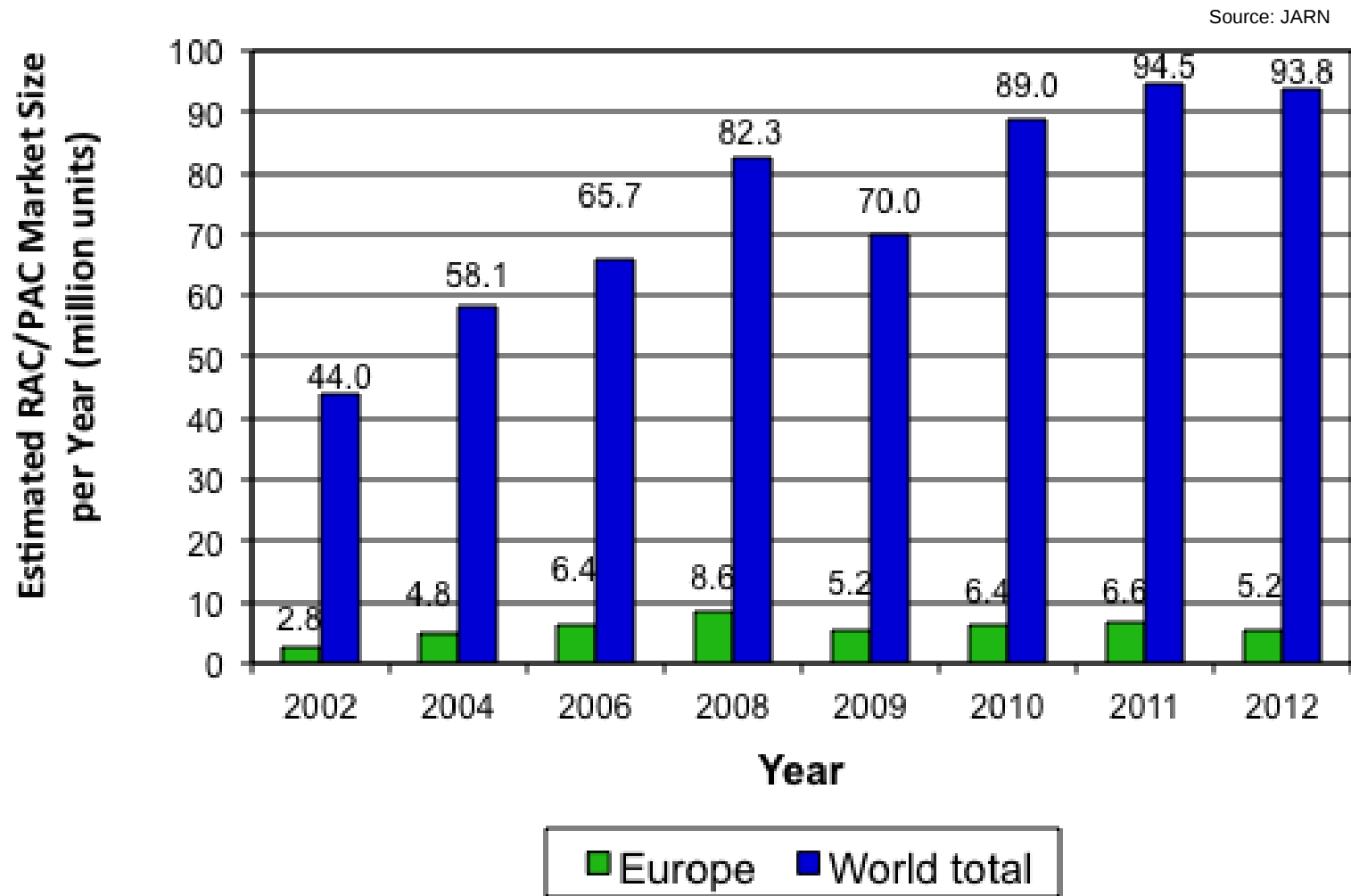


Hitachi Plant Technologies Develops a Solar Activated Air Conditioning System

Use of a high-efficiency solar energy collector developed by Hitachi Plant Technologies reduces consumption of fossil fuels and carbon dioxide emissions

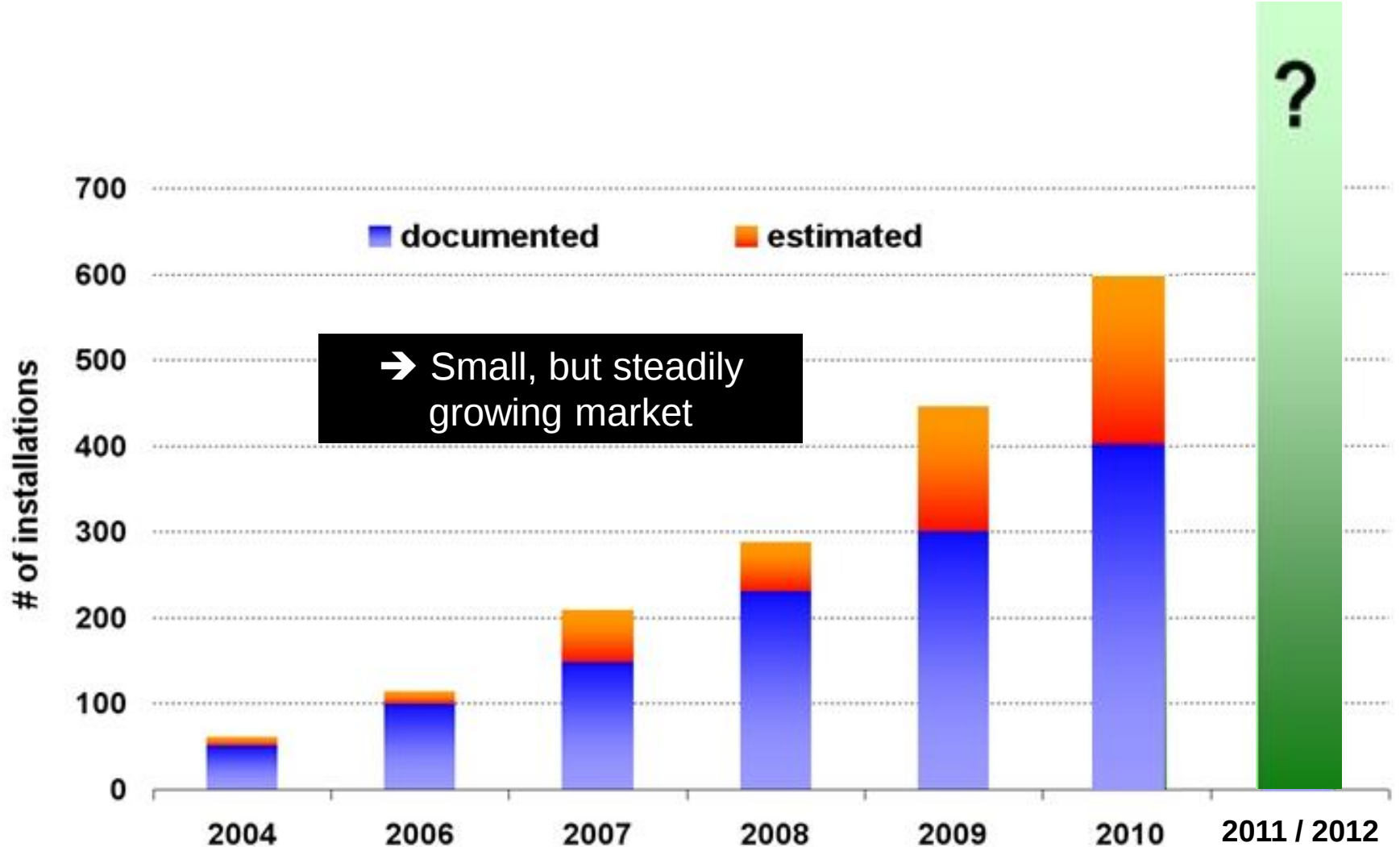
- Planned turn-over of 44 million EUR till 2015

Latest system supplier from Japan (2011)



- Refrigerants (HCFC and HFC) with global warming potential (GWP)
- Leakage rate approx. 5 – 15 % per year!

Market situation of conventional air-conditioning up to 5 kW (1.4 RT)

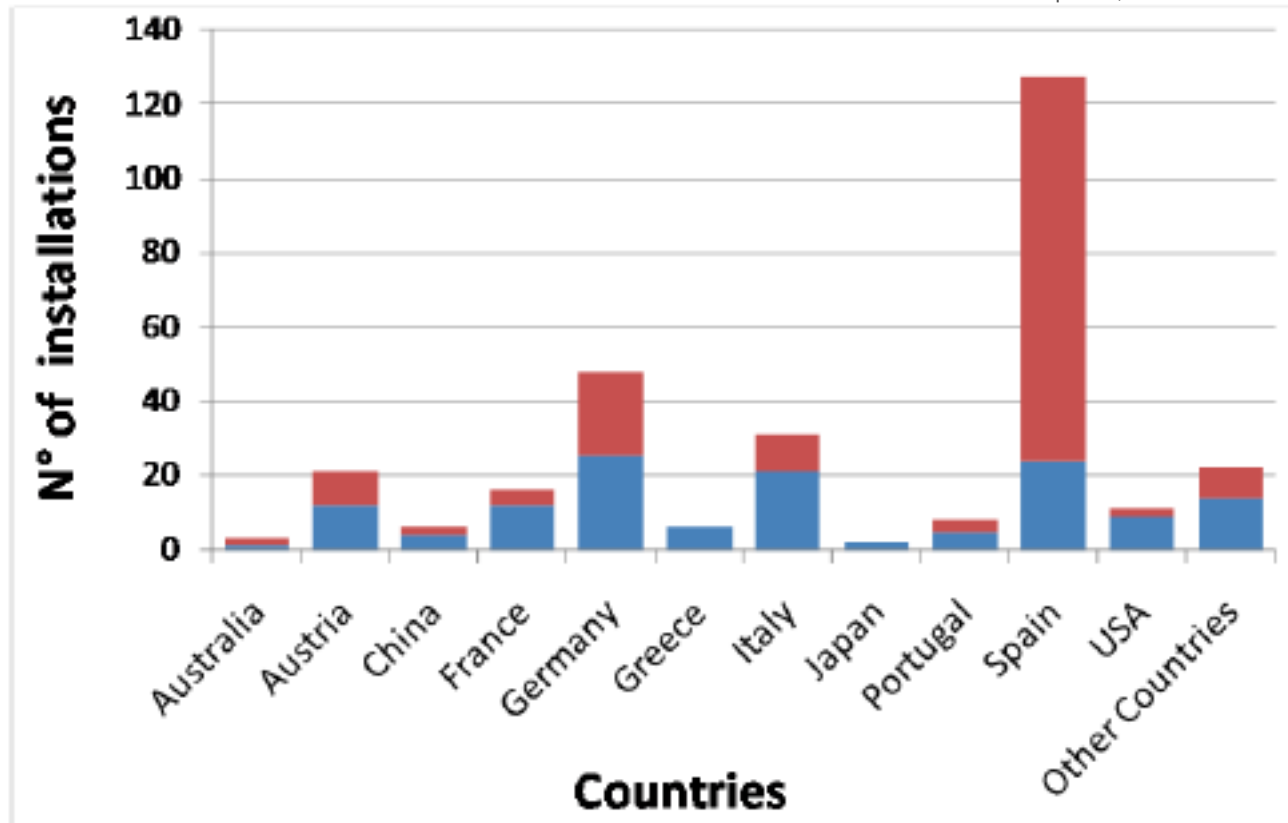


Source : TECSOL / Solem Consulting

- About > 1,000 systems installed worldwide (2012)

Market development of solar cooling

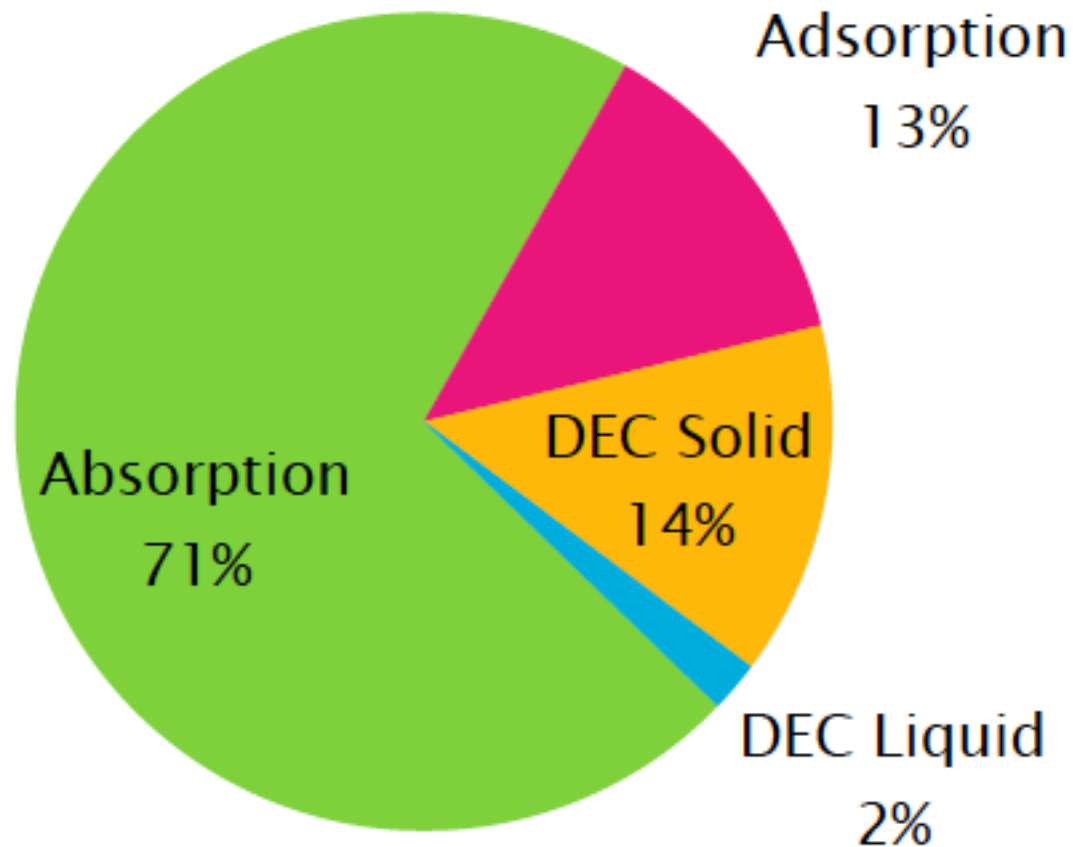
Source: Sparber, IEA-SHC Task 38



135 large-scale installations (blue column)

166 small/medium-scale installations (red column)

Documented solar cooling installations (2009)

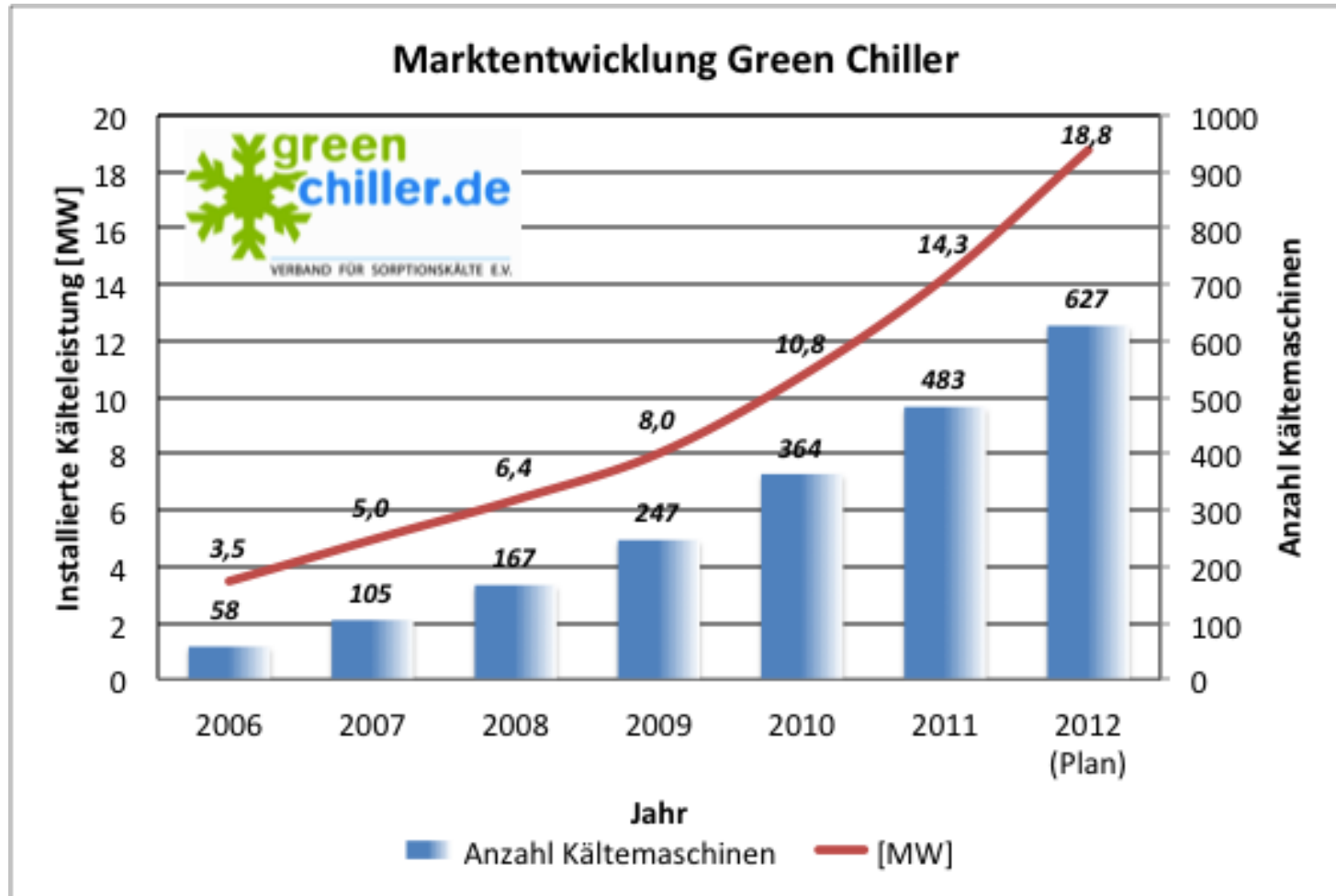


Sources: EURAC, Tecsol

Market share of solar driven sorption chillers (2009)

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Installed Cooling Capacity [MW]



Anzahl Kältemaschinen

Number of Chillers

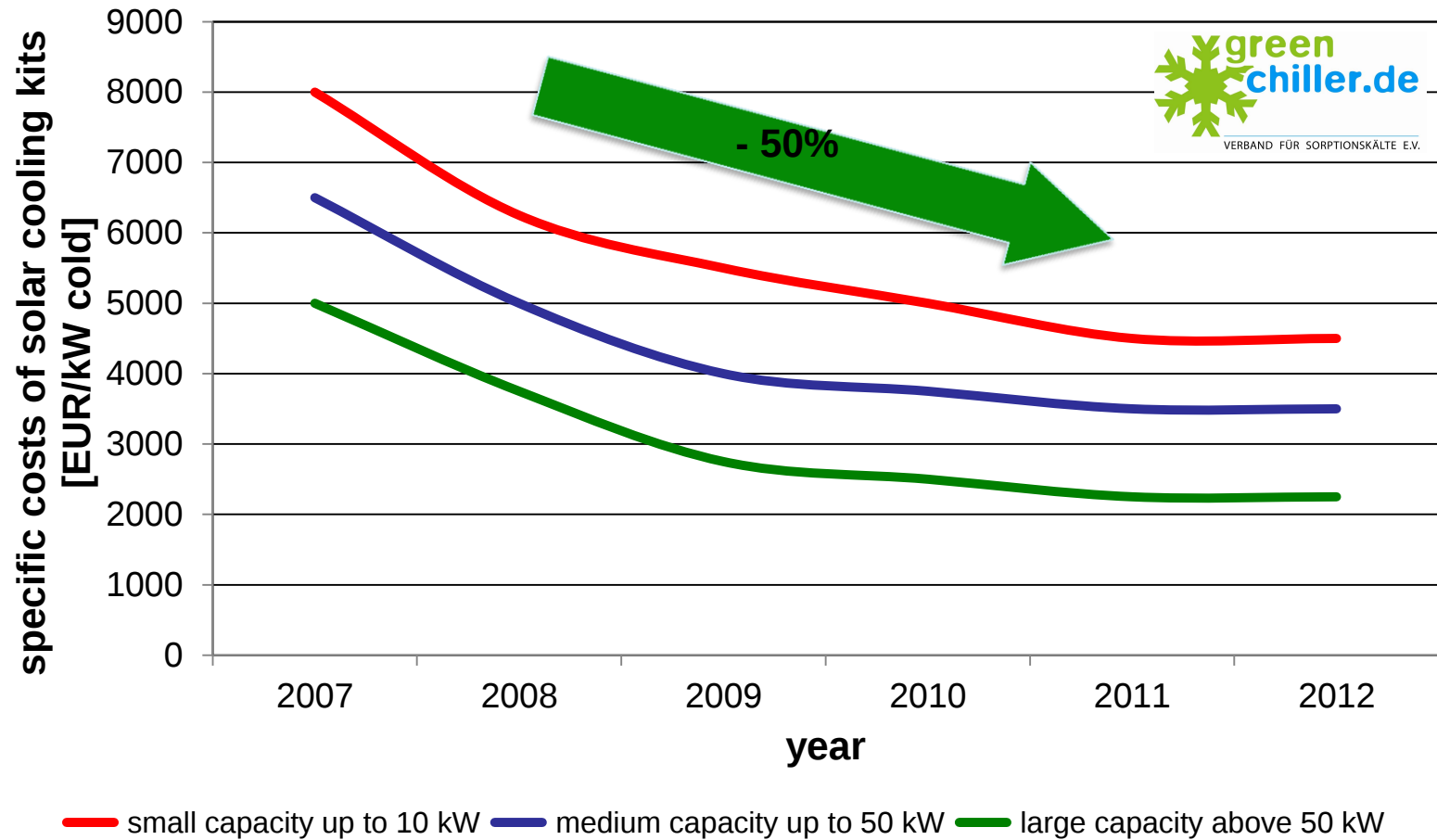
ca. 34% Solar Cooling

ca. 44% CHPC

ca. 8% District Heating

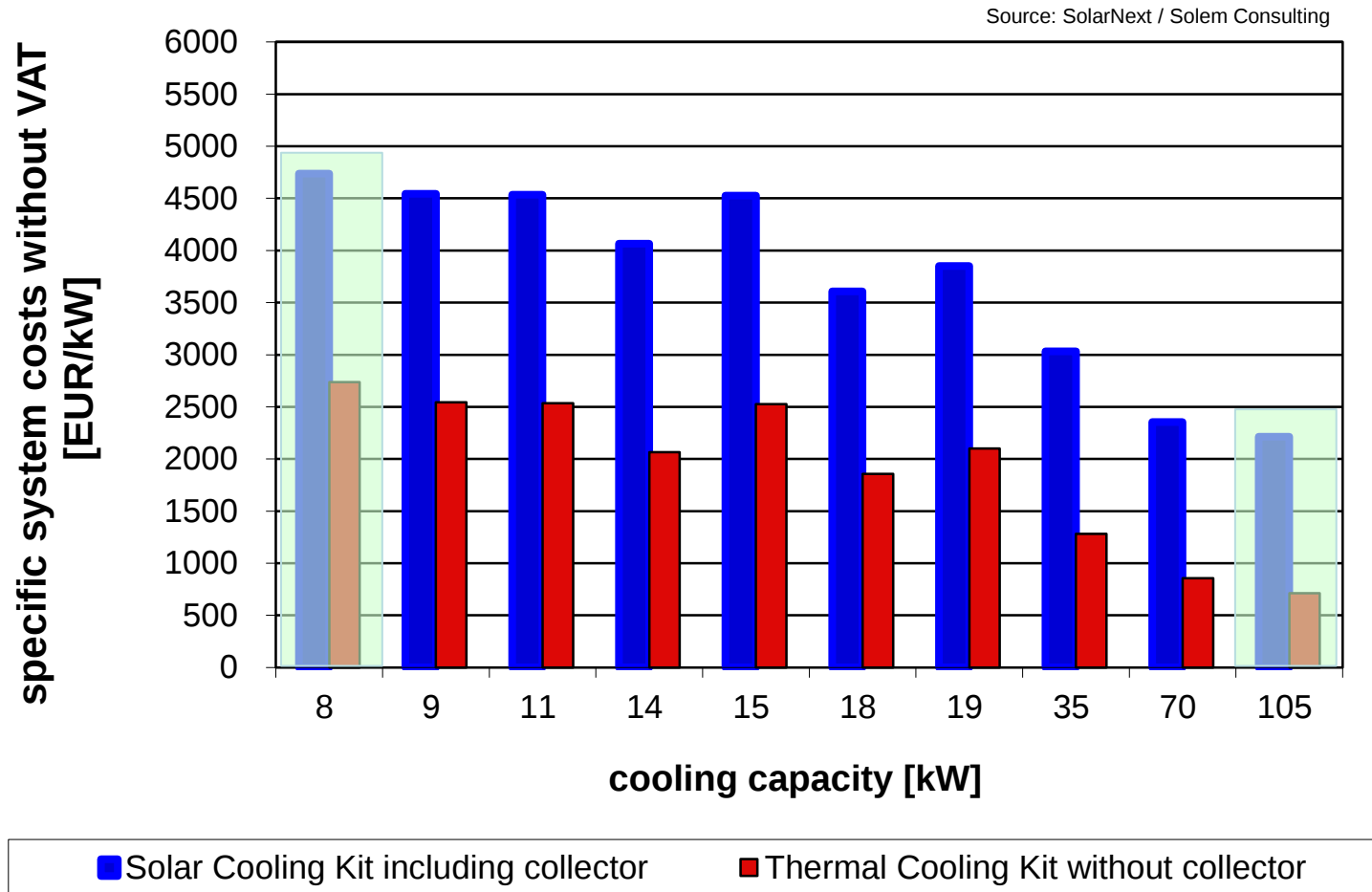
ca. 14% Waste Heat

Sales numbers of Green Chiller manufacturer (2006-2011)



- Cost reduction of 45-55% within last 5 years!

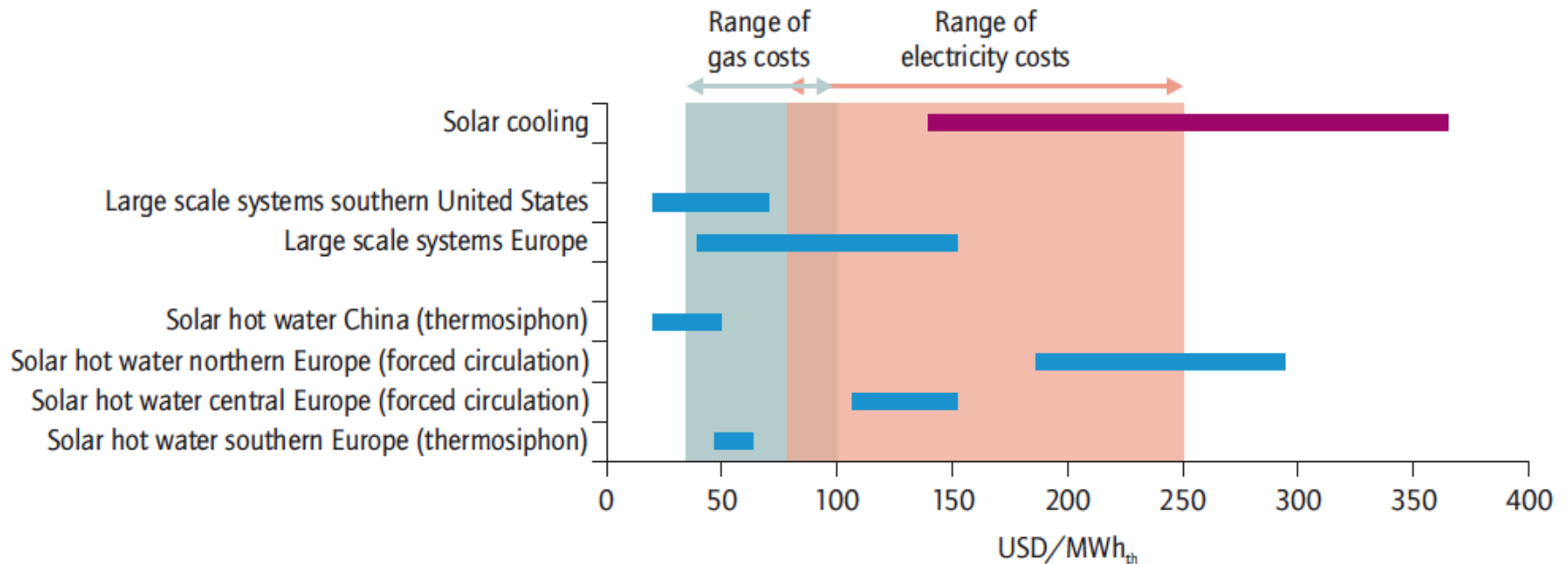
Cost development of solar cooling Kits (2007-2012)



- Solar collectors cost share at low cooling capacity at about 45% and at larger cooling capacity about 65%!

Specific total costs of thermal and solar cooling kits (2011)

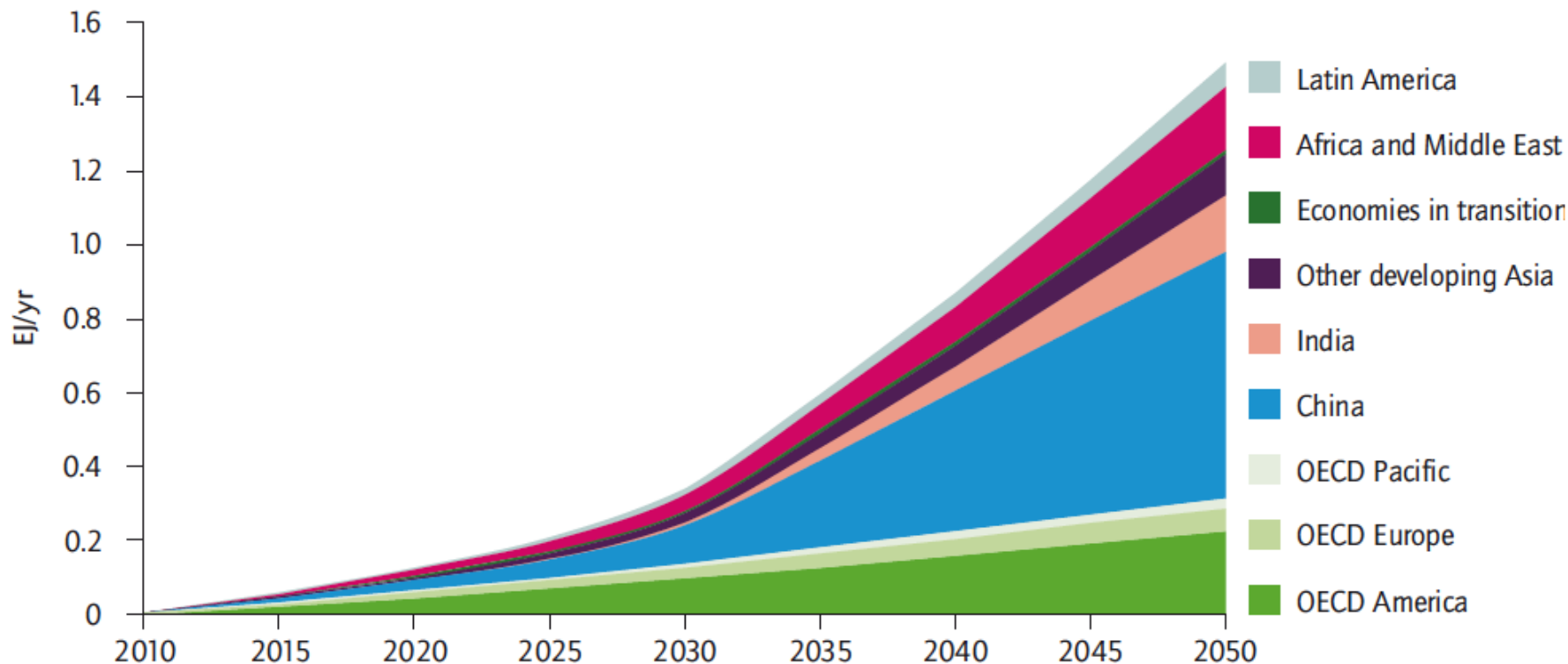
Figure 9: Costs of solar heating and cooling (USD/MWh_{th})



Note: Costs of solar cooling: USD/MWh_{cooling}.

Source: IEA Technology Roadmap Solar Heating and Cooling, 2012

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

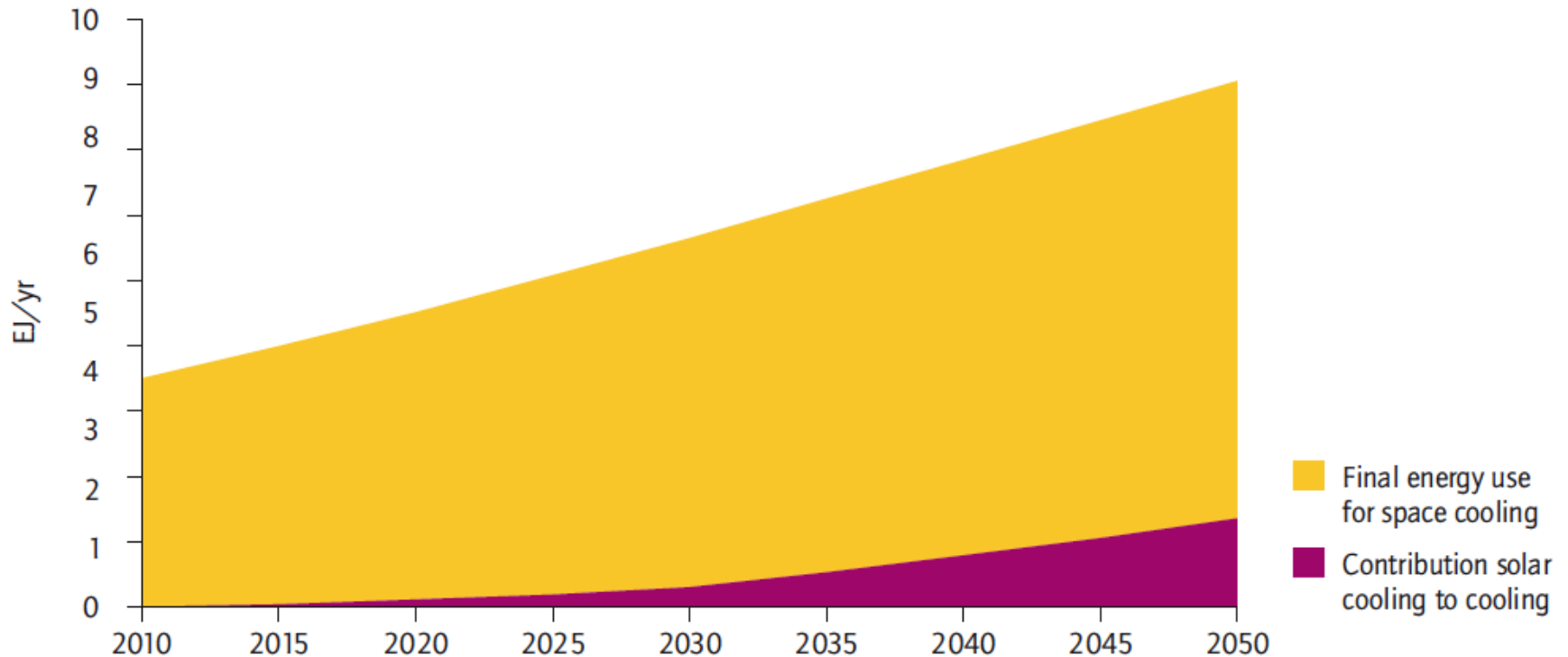


Source: IEA Technology Roadmap Solar Heating and Cooling, 2012

- $1.5 \times 10^{18} \text{ J/a} = 416.7 \text{ TWh/a}$ Solar Cooling by 2050
- Systems could enter the market between 2015 and 2020

IEA Technology Roadmap SHC – Market potential by 2050

Figure 17: Roadmap vision for solar cooling in relation to total final energy use for cooling (Exajoule/yr)



Source: IEA Technology Roadmap Solar Heating and Cooling, 2012

- Solar Cooling nearly 17% of total energy use for cooling!

**Contribution of Renewable Cooling to
the Renewable Energy Target of the EU**
Policy Report

On behalf of NL Agency of the
Netherlands
Lex Bosselaar (Lex.Bosselaar@AgentschapNL.nl)

Freiburg /
June 12th 2012

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- Total cooling demand in 2050 will reach 733 TWh/a in the EU
- At least 50% of the cooling demand could be covered by renewable energy by 2050 (about 370 TWh/a)
- 50% of this cooling demand could be met by solar thermal cooling alone (RDP-scenario, 185 TWh/a)!
- Total collector area of 3,880 million m² (8 m² per EU inhabitant)!

- About 1,000 solar cooling systems installed worldwide (2012)
- Several new small and medium-scale Absorption and Adsorption chillers were developed worldwide in the last few years, especially in Europe
- Standardized Solar Cooling Kits available to bring down the costs
- Standards/Norms needed (CEN, DIN, etc.) to develop the markets
- Incentive schemes available, e.g. in Germany (KfW) up to 50% repayment bonus of net investment costs!
- Solar heat is particularly of interest if a solar thermal system is used for other heat needs, too (e.g. heating, DHW)

Conclusion



VERBAND FÜR SORPTIONSKÄLTE E.V.

Thank you.

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

www.greenchiller.eu