Where does Solar Cooling stand today?

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SOLEM CONSULTING

Heat sources for thermal cooling

Solar

Source: Tsinghua

Source: Citrin Solar

District Heating

Source: wikipedia

Cogeneration Units,
Biomass,
Process Heat
etc.

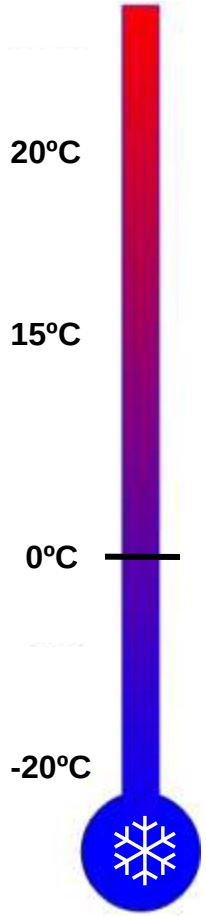
Source: EC-Power

Source: GE Jenbacher

Introduction

Collector technologies – Application for solar cooling

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



Chiller technologies

Many low power systems available

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

Source: SorTech

InvenSor (DE)
10 & 18 kW
Water / Zeolithe

Source: InvenSor

Pink (AT)
14 & 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

Chiller technologies

Medium-scale absorption and adsorption chillers

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 / Zeolithe

Source: Mayekawa

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

Source: GBU

AGO (DE)
50 – 500 kW
Ammonia / Water

Source: AGO

no claim on completeness

Chiller technologies

Focus last years - integration of heat rejection

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

Source: Jiangsu Huineng

Mitsubishi Plastics (JP)
10 kW
Water / Zeolithe

Source: Mitsubishi Plastics

Standardized systems
Solar cooling kits

SolarNext
chillii® Cooling Kit ISC18

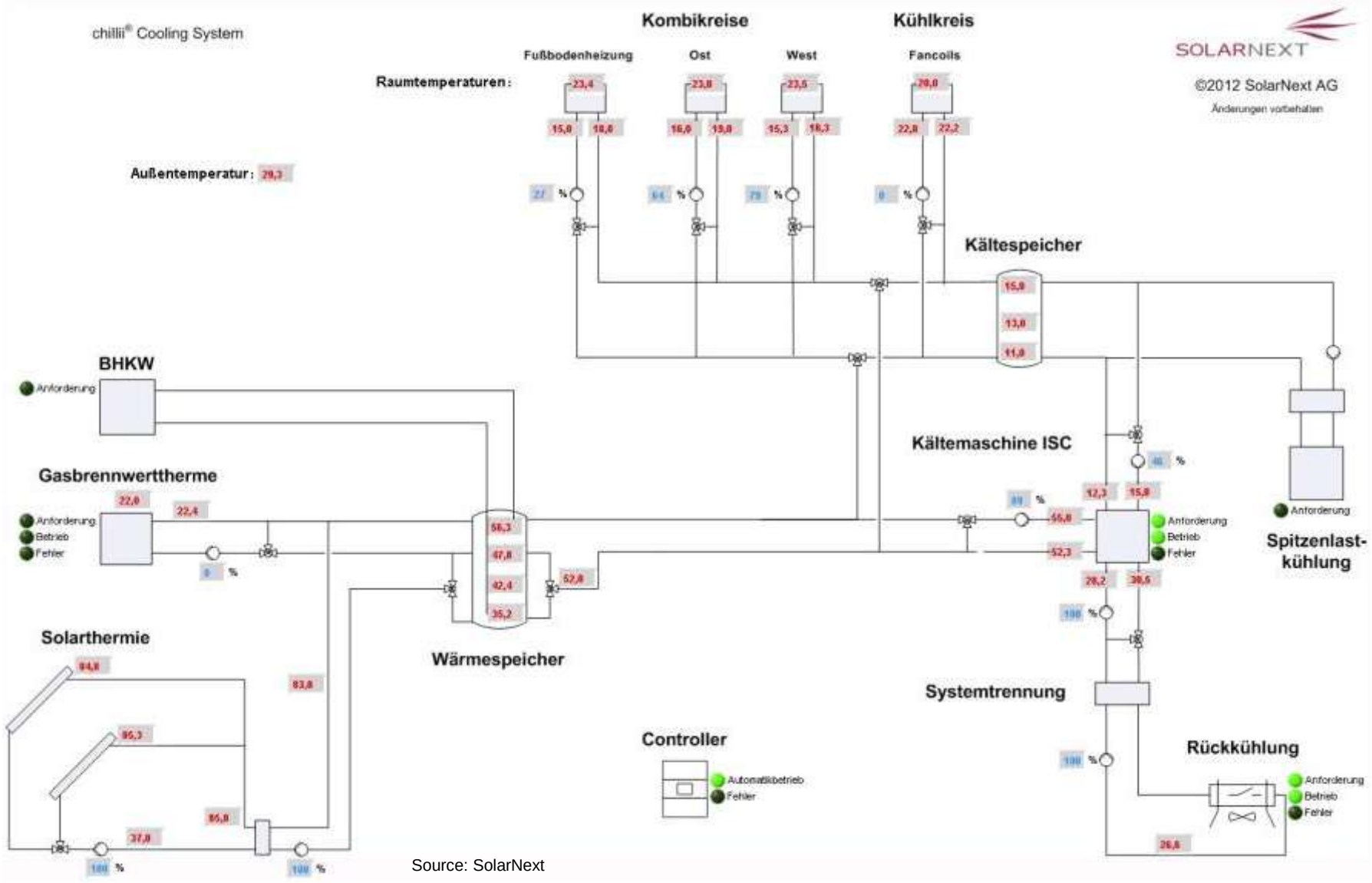
Source: SolarNext

Schüco
LB15 System Package

Source: Schüco

Standardized systems

System controller with visualisation (Modbus TCP / VPN)



Source: SolarNext

Standardized systems
Sub-systems of sorption chiller manufactures

Pre-designed pump group

Source: SorTech

Recooler

Source: SorTech

Standardized systems
Recent solar cooling kit supplier

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

Kingspan Climate System,
10 and 20 kW

SOLARTIK,
17.5, 35, 70 and 105 KW

LB Cooling System,
15 and 30 kW

chillii® Cooling Kit,
8, 10, 14, 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

Costume-made systems

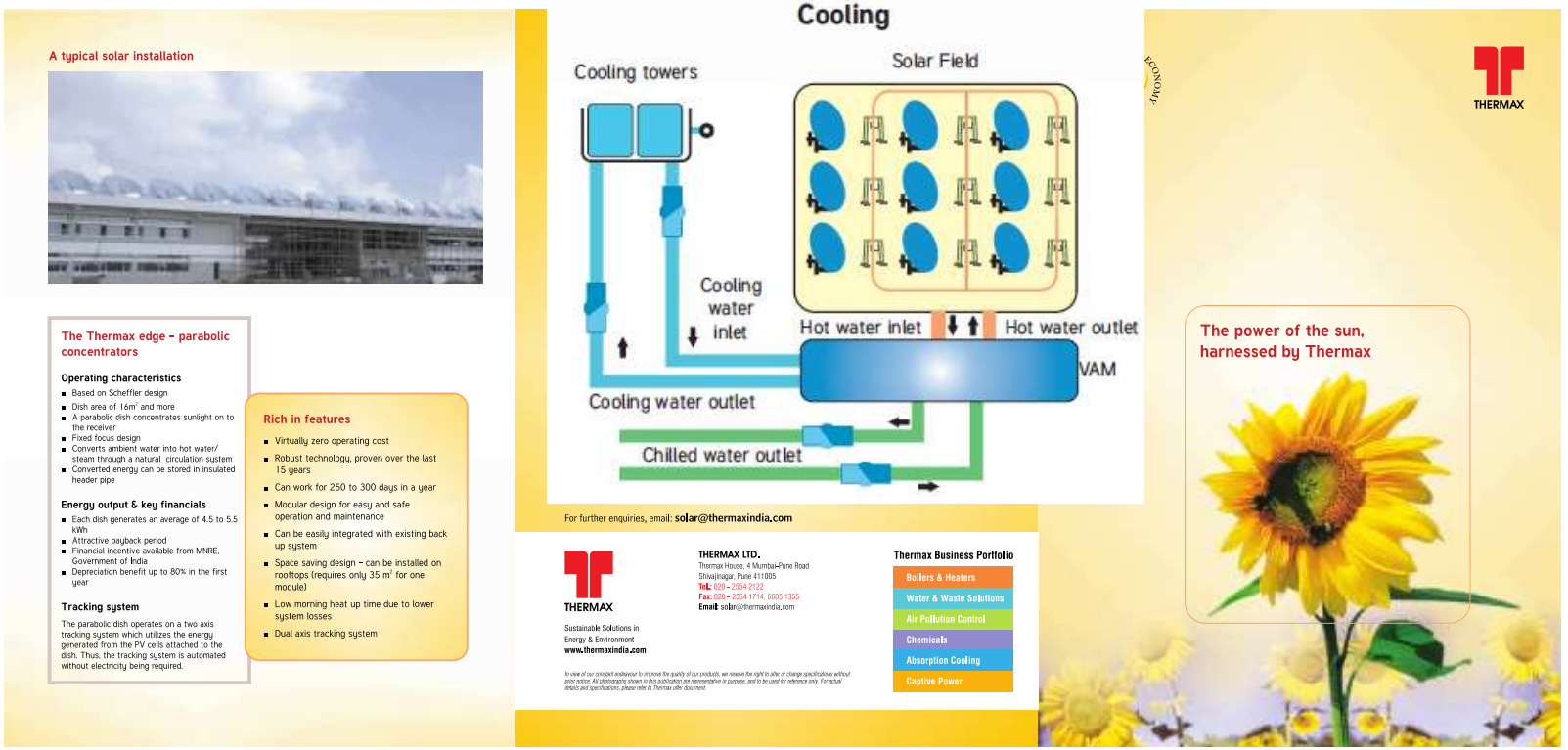
Supplier of costume-made solar cooling systems

MILLENNIUM ENERGY INDUSTRIES	**(Middle East, North Africa)**
Optimal Solutions GROUPE EDF	**(Europe, North Africa, Middle East)**
SOLAR PANELS PLUS	**(USA)**
SOLEL	**(Middle East, Spain, USA)**
SOLID solarinstallation+design	**(Europe, USA, Caribbean, Asia)**
	(Europe, Middle East)
VICOT 启威特	**(China, Europe, USA, Middle East)**

no claim on completeness

Latest developments

New system supplier from India (2010)



- Scheffler-Mirror with LiBr Absorber (SE, DE, new TR)

Latest developments

New system supplier from Japan (2011)

News Release

HITACHI
Inspire the Next

FOR IMMEDIATE RELEASE

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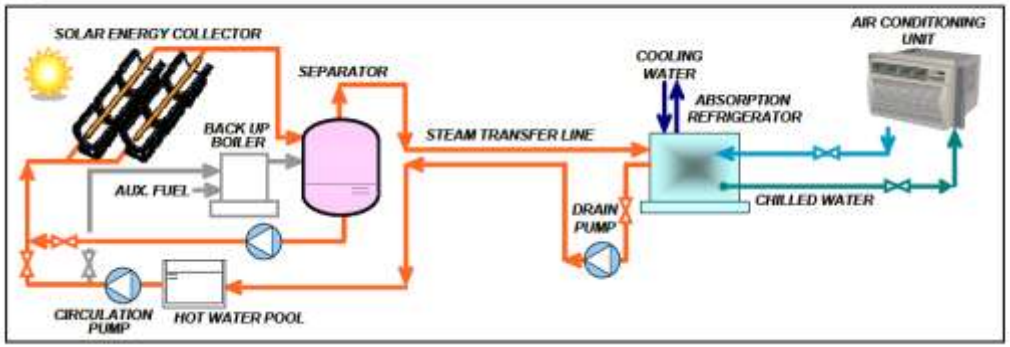
■ System flow



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 developments

New system supplier from Japan (2012)

SAKURA® Air Conditioner

Latest developments

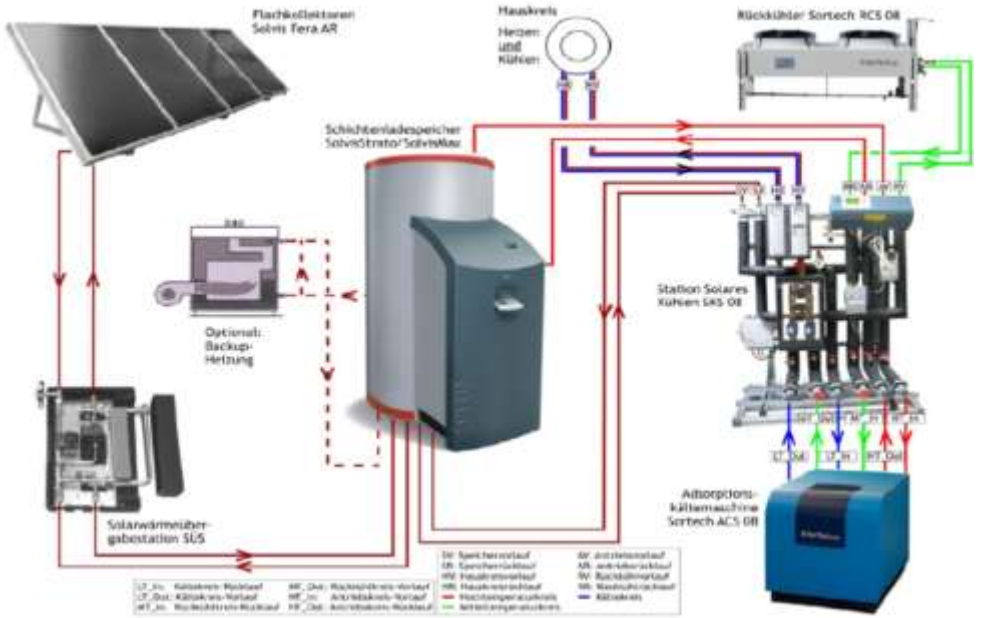
Small-scale Solar Cooling Kit supplier from China (2012)

Source: Jiangsu Huineng

Solar Cooling Kit

Heating, DHW, Cooling

System development
& field test



Source : Fraunhofer ISE

SOLVIS

Solar collection
Hydraulics
System integration

SorTech AG

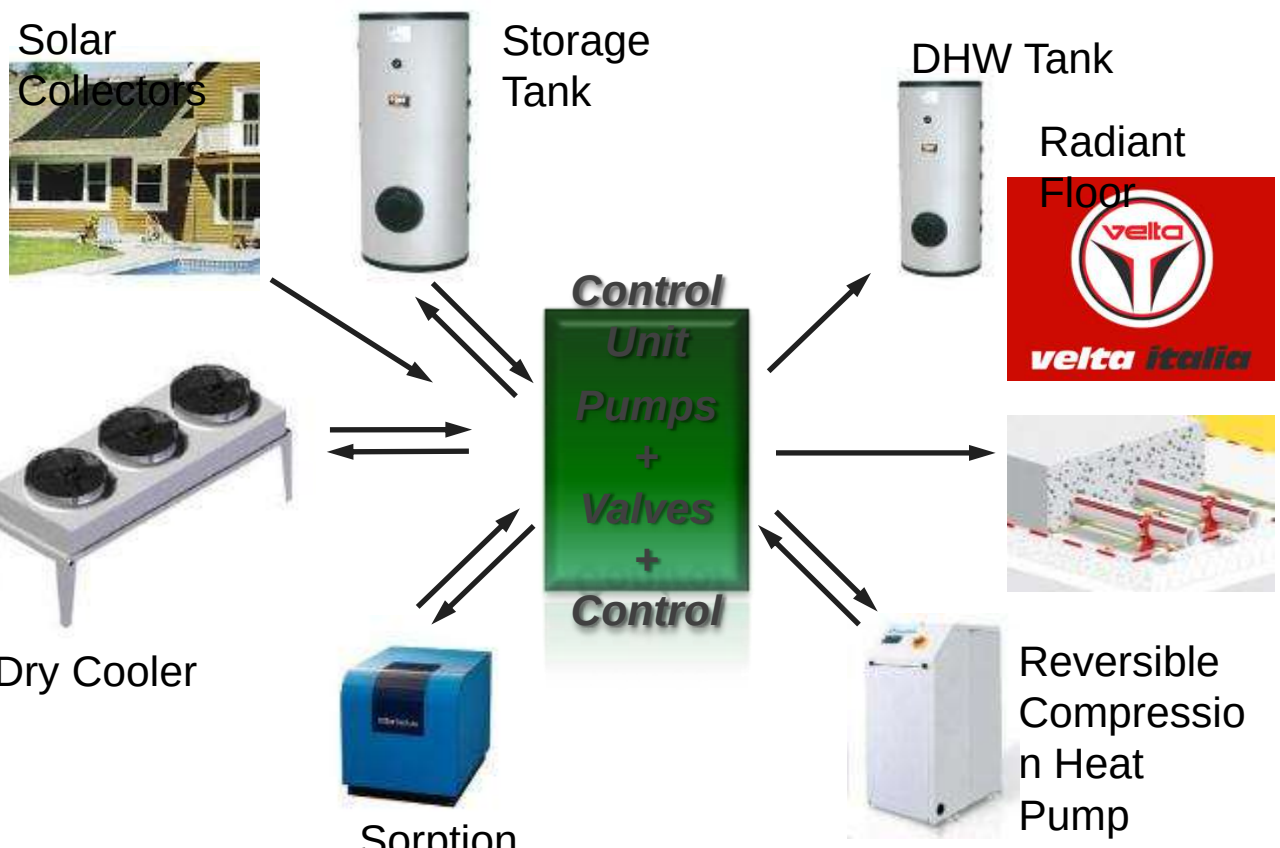
Chiller
Heat rejection
Hydraulics

Fraunhofer ISE

Tests, optimisation,
evaluation

Solar combi+ system

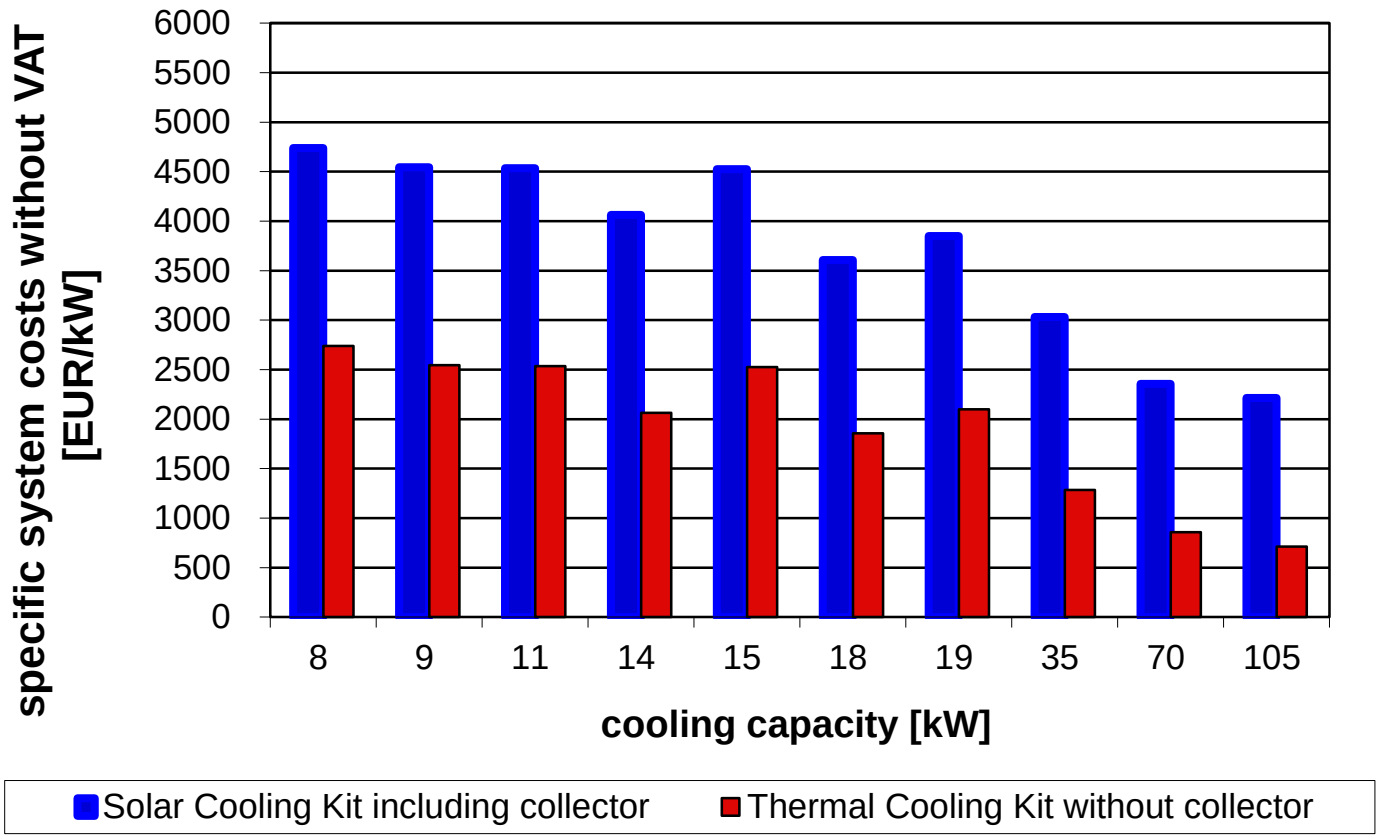
Commercial development – Velta Italia with EURAC



Source : EURAC

Costs and market development

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

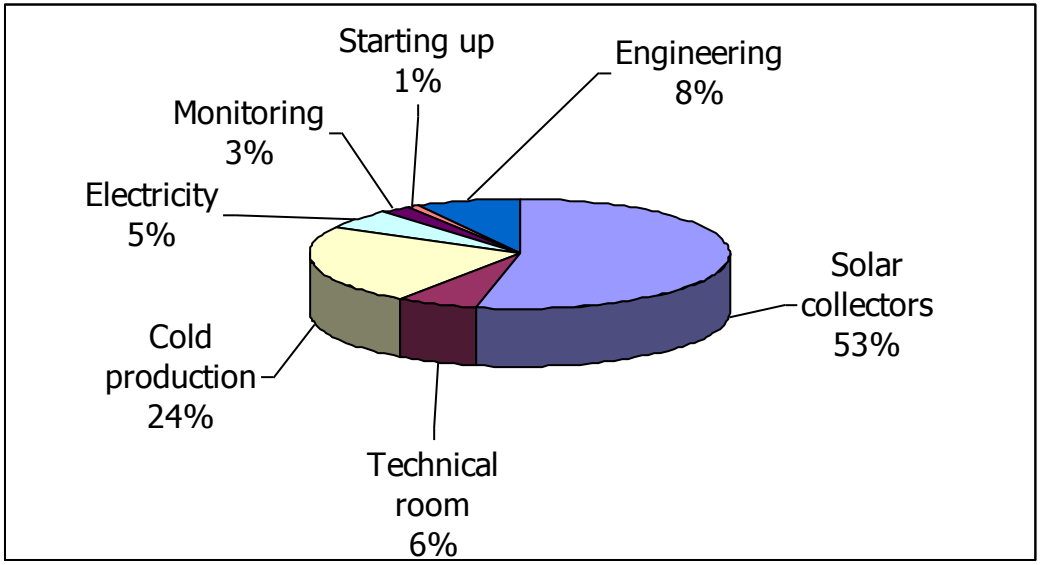


Source: SolarNext

Cost reduction of 20% within 2 years (2009-2011)!

Solar cooling installation – 10 RT (35 kW) Absorption in France (2009)

	$ (w/o tax)
Solar collectors	130 000
Technical room	15 080
Cold production	57 200
Electricity	13 000
Monitoring	6 500
Starting up	1 950
Engineering	19 500
TOTAL	**243 230**
$/ton	24 323



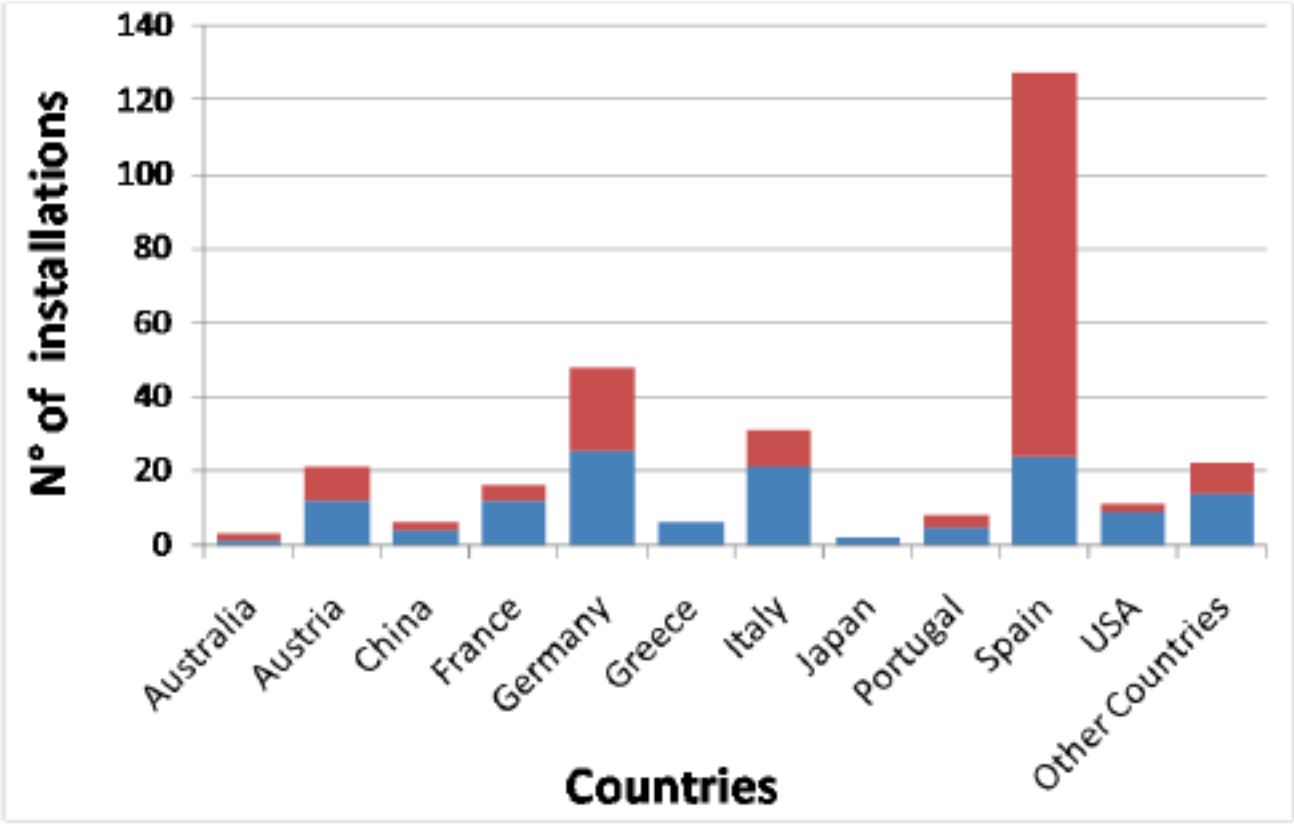
Sources: Tecsol

about 5,500 EUR/kW

Costs and market development

Documented solar cooling installations (2009)

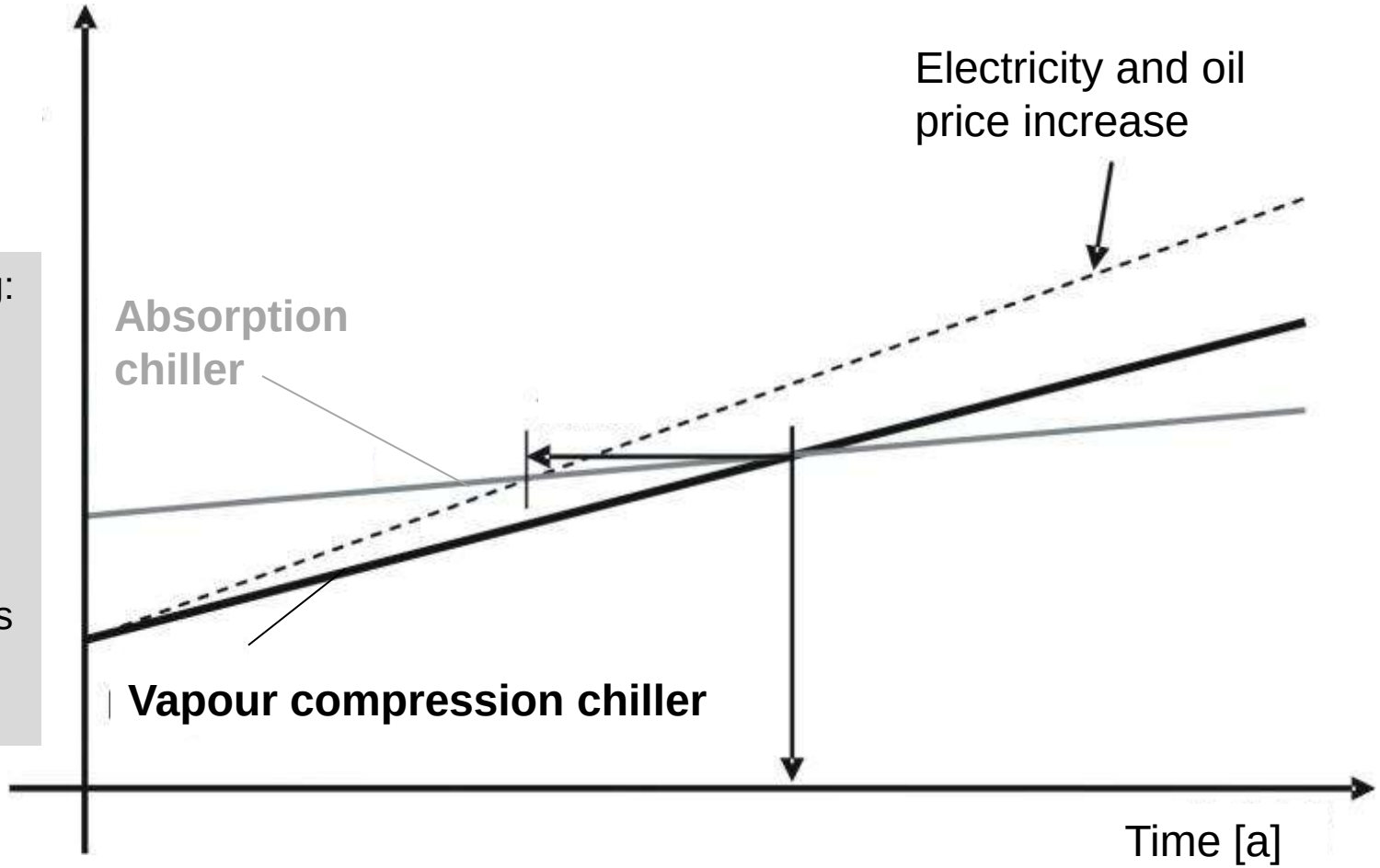
Source: Sparber, IEA-SHC Task 38



135 large-scale installations (blue column)

166 small/medium-sclae installatios (red column)

Economics of solar cooling systems



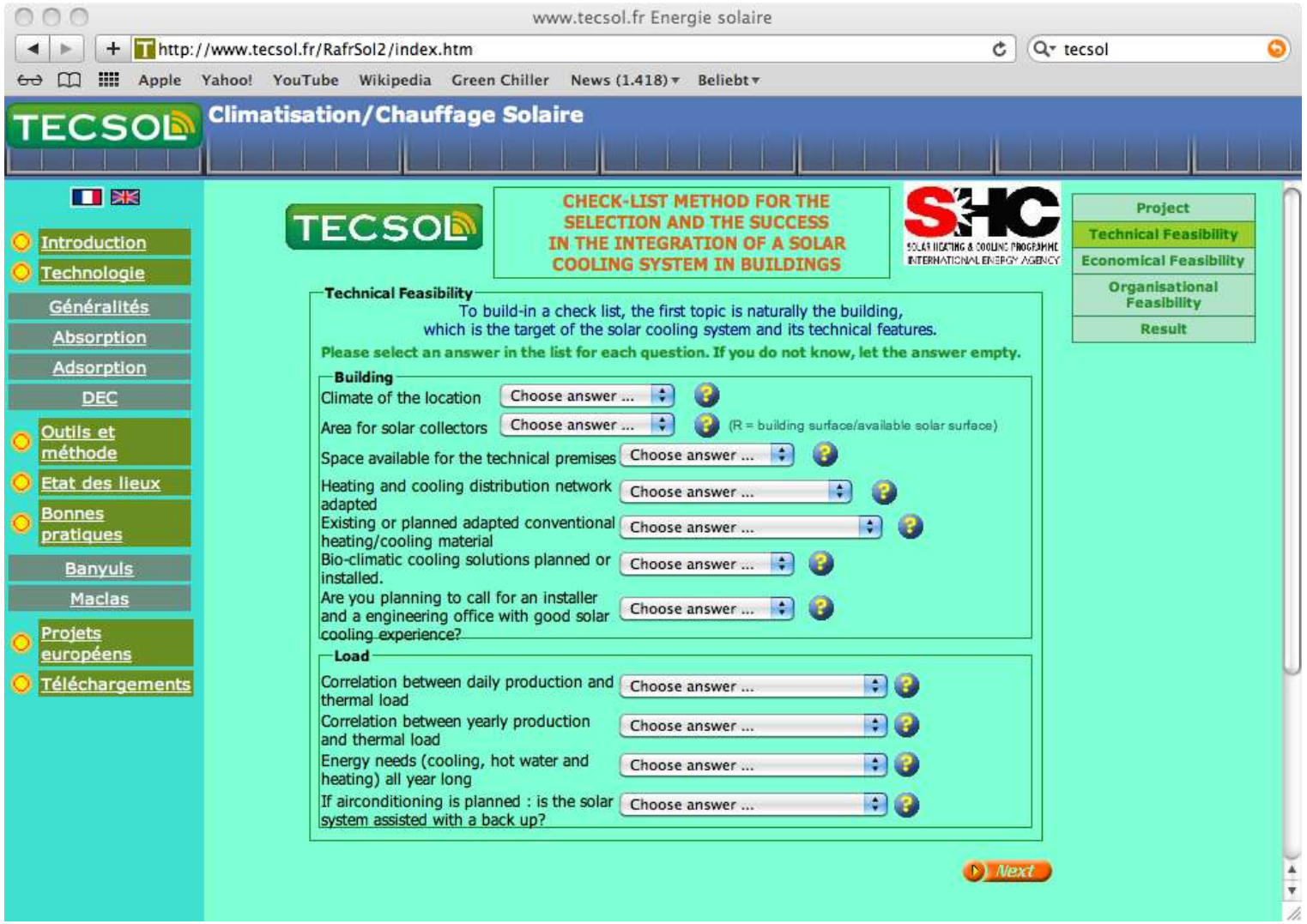
Solar cooling:

- higher investment cost upfront
- lower O&M cost lifetime
- ROI depends on fossil fuel cost

ROI residential sector 12-18 years
commercial / industry 7-15 years

Design tools

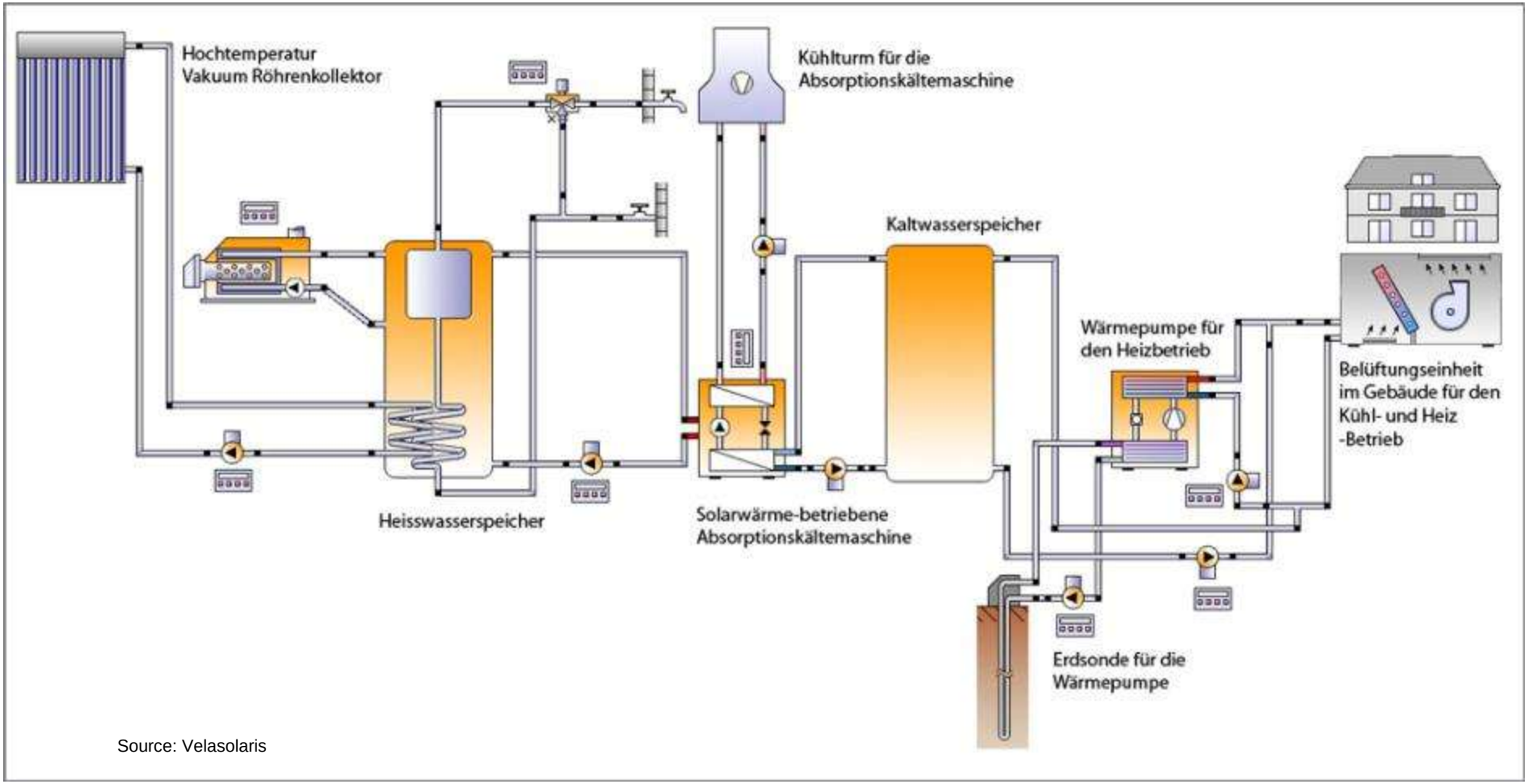
Check-list method (IEA-SHC Task 38)



Source: Tecsol

Design tools

Example simulation software (Polysun)



Source: Velasolaris

R&D / Networks / Associations

EU research projects related to solar cooling

- HIGH-COMBI (2007-2011, FP6)
- SOLAR COMBI+ (2007-2010, Intelligent Energy Europe)
- SAHC (2007-2010, Intelligent Energy Europe)
- KeepCool II (2007-2010, Intelligent Energy Europe)
- SOLAIR (2007-2009, Intelligent Energy Europe)
- SOLCO (2007-2008, Intelligent Energy Europe)
- MEDISCO (2006-2009, FP6)
- REACT (2006-2008, FP6)
- ROCOCO (2005-2008, FP6)
- KeepCool (2004-2007, Intelligent Energy Europe)
- CLIMASOL (2003-2005, ALTENER)
- SACE (2002-2003, FP5)

R&D / Networks / Associations
International Energy Agency (IEA)

- IEA SHC Task 48 „Quality Assurance and Support Measures for Solar Cooling“ (2011-2015)

- IEA SHC Task 38 „Solar Air-Conditioning and Refrigeration“ (2006-2010)

Task 38
Solar Air-Conditioning
and Refrigeration

- IEA SHC Task 25 „Solar Assisted Air Conditioning of Buildings“ (1999-2004)

International Energy Agency
Solar Heating & Cooling Programme

TASK 25
Solar Assisted
Air Conditioning
of Buildings

Market

Demo

Science

Green Chiller – Association for sorption cooling

- Formed in March 2009
  as German industry association
  (today 10 companies, 10 institutes)
- 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
- **Lobbying of sorption cooling technologies** in general but especially in the politics (small and medium cooling capacity range)
- Promoting and developing of the solar and thermal cooling market on European level

R&D / Networks / Associations

Green Chiller – Website

R&D / Networks / Associations

ausSCIG – Australian Solar Cooling Interest Group

- Formed in January 2008
  as Australian interest group
- Located at CISRO in Newcastle, Australia
- At present over 200 members
- Working groups:
  1. Technology Roadmap and Barrier Assessment;
  2. **Standard Development**;
  3. Demonstration, Funding and Research and
  4. Education, Training and Communication
- ausSCIG Chairmann Dr. Stephen White
  and ausSCIG Secretary Daniel Rowe

R&D / Networks / Associations
ausSCIG – Website

Conclusion / Outlook

- Several new small-scale and medium-scale Absorption and Adsorption chillers were developed worldwide in the last few years
- Standardized Solar Cooing Kits available to bring down the costs
- Standards/Norms needed (CEN, DIN, etc.) to develop the markets
- Solar heat is particularly of interest if a solar thermal system is used for other heat needs, too (e.g. heating, DHW)
- Solar cooling position paper prepared in Task 38 "Solar Air-Conditioning and Refrigeration" of the IEA Solar Heating and Cooling Programme (www.iea-shc.org)

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