



# Where does Solar Cooling stand today?

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**SOLEM**  
CONSULTING

# Introduction

## Heat sources for thermal cooling

### Solar



Source: Tsinghua



Source: Citrin Solar

### District Heating



Source: wikipedia

### Cogeneration Units, Biomass, Process Heat etc.



Source: EC-Power

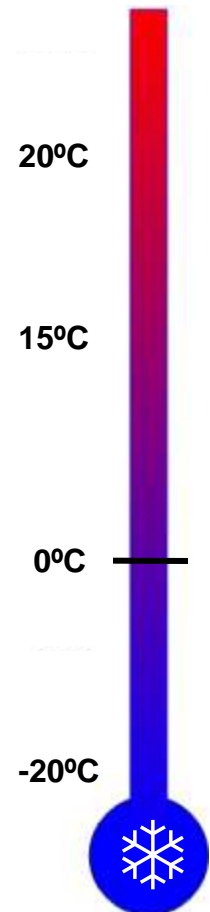


Source: GE Jenbacher

# Introduction

## Collector technologies – Application for solar cooling

Solar thermal collector	Heat transfer medium	Collector temperature	Application for cooling
Air collector 	Air	40-60°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



# 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

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**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

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### SolarNext chillii® Cooling Kit ISC18



Source: SolarNext

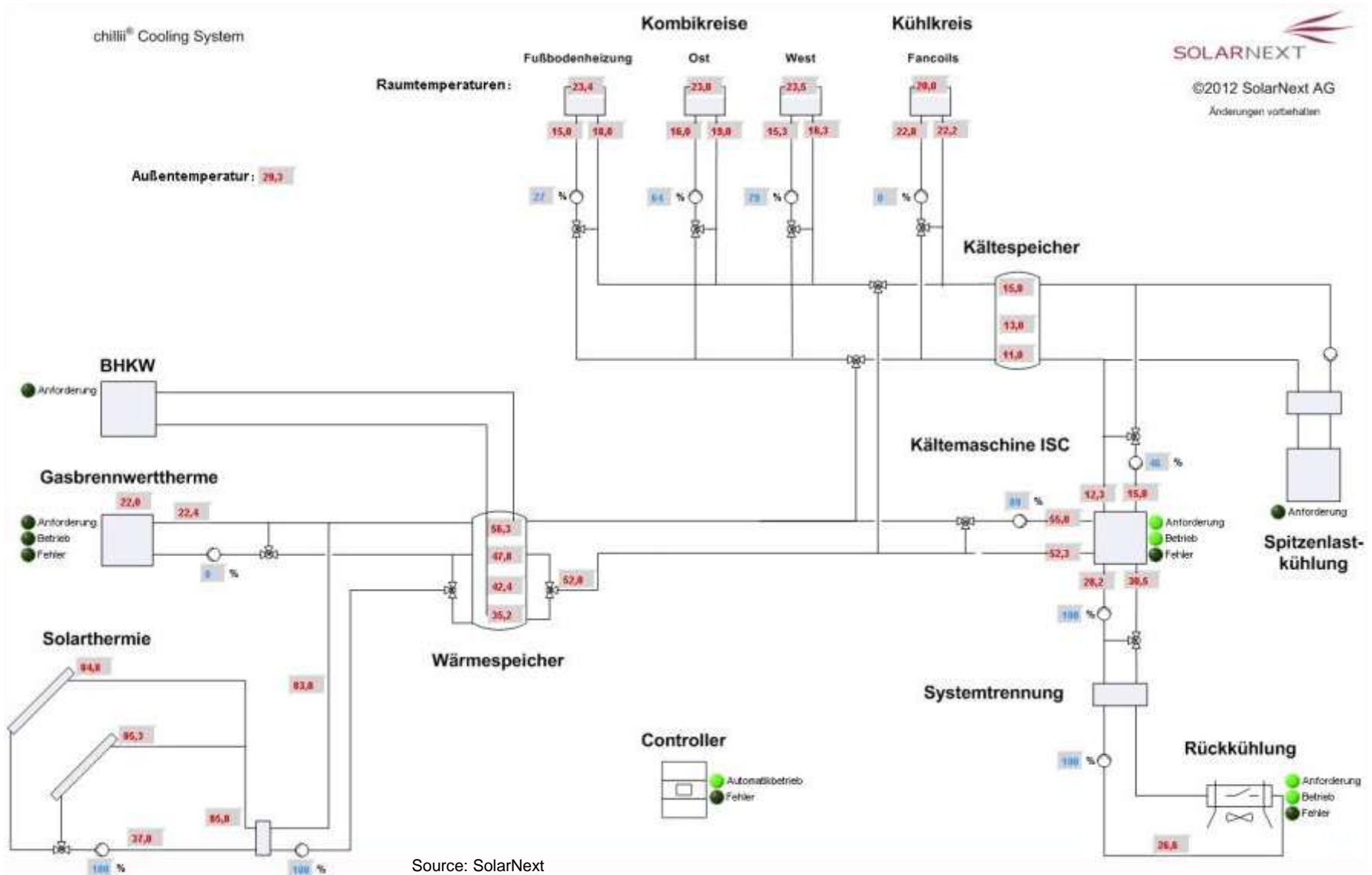
### Schüco LB15 System Package



Source: Schüco

# Standardized systems

## System controller with visualisation (Modbus TCP / VPN)





### Pre-designed pump group



Source: SorTech

### Recooler



Source: SorTech

# Standardized systems

## Recent solar cooling kit supplier

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**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

# Costume-made systems

Supplier of costume-made solar cooling systems



**(Middle East, North Africa)**



**(Europe, North Africa, Middle East)**



**(USA)**



**(Middle East, Spain, USA)**



**(Europe, USA, Caribbean, Asia)**



**(Europe, Middle East)**



**(China, Europe, USA, Middle East)**

# Latest developments

## New system supplier from India (2010)

A typical solar installation



### The Thermax edge – parabolic concentrators

#### Operating characteristics

- Based on Scheffler design
- Dish area of 16m<sup>2</sup> 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

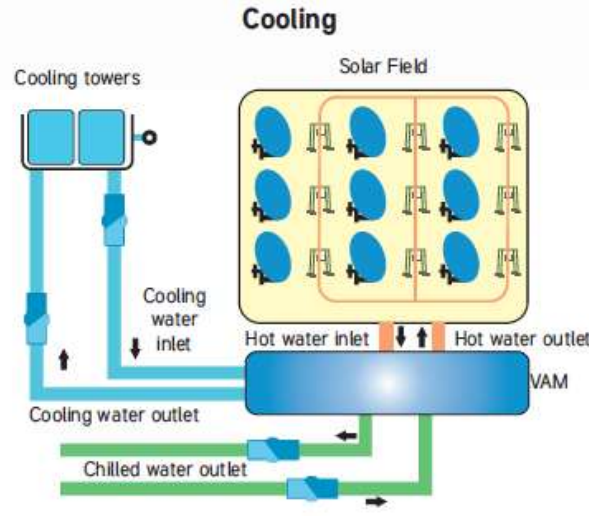
- Each dish generates an average of 4.5 to 5.5 kWh
- Attractive payback period
- Financial incentive available from MNRE, Government of India
- Depreciation benefit up to 80% in the first year

#### 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 m<sup>2</sup> for one module)
- Low morning heat up time due to lower system losses
- Dual axis tracking system



For further enquiries, email: [solar@thermaxindia.com](mailto:solar@thermaxindia.com)



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#### Thermax Business Portfolio

- Boilers & Heaters
- Water & Waste Solutions
- Air Pollution Control
- Chemicals
- Absorption Cooling
- Captive Power

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

The power of the sun,  
harnessed by Thermax



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

## News Release

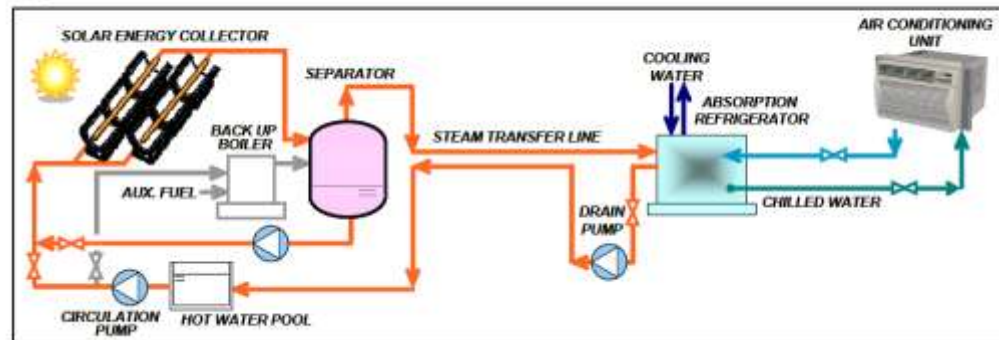
**HITACHI**  
Inspire the Next

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



# SAKURA<sup>®</sup>

Air Conditioner



# Latest developments

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

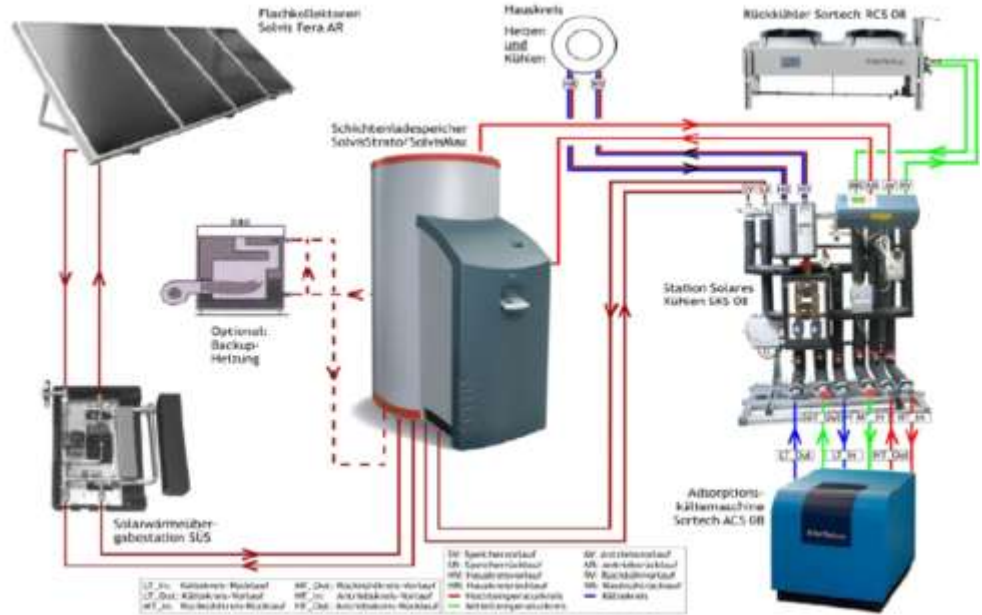


Source: Jiangsu Huineng

### Solar Cooling Kit

Heating, DHW, Cooling

System development & field test



Source : Fraunhofer ISE



Solar collection  
Hydraulics  
System integration



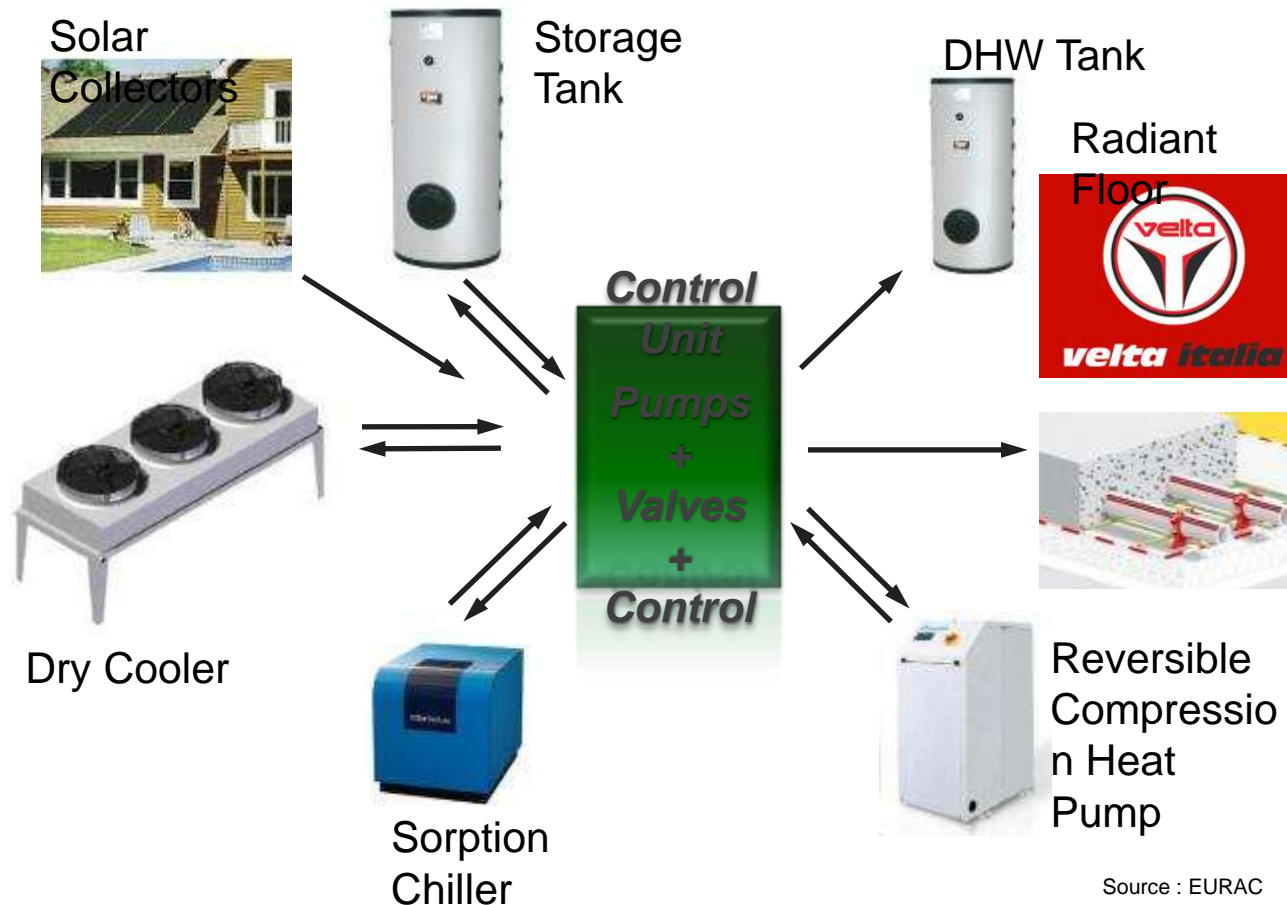
Chiller  
Heat rejection  
Hydraulics



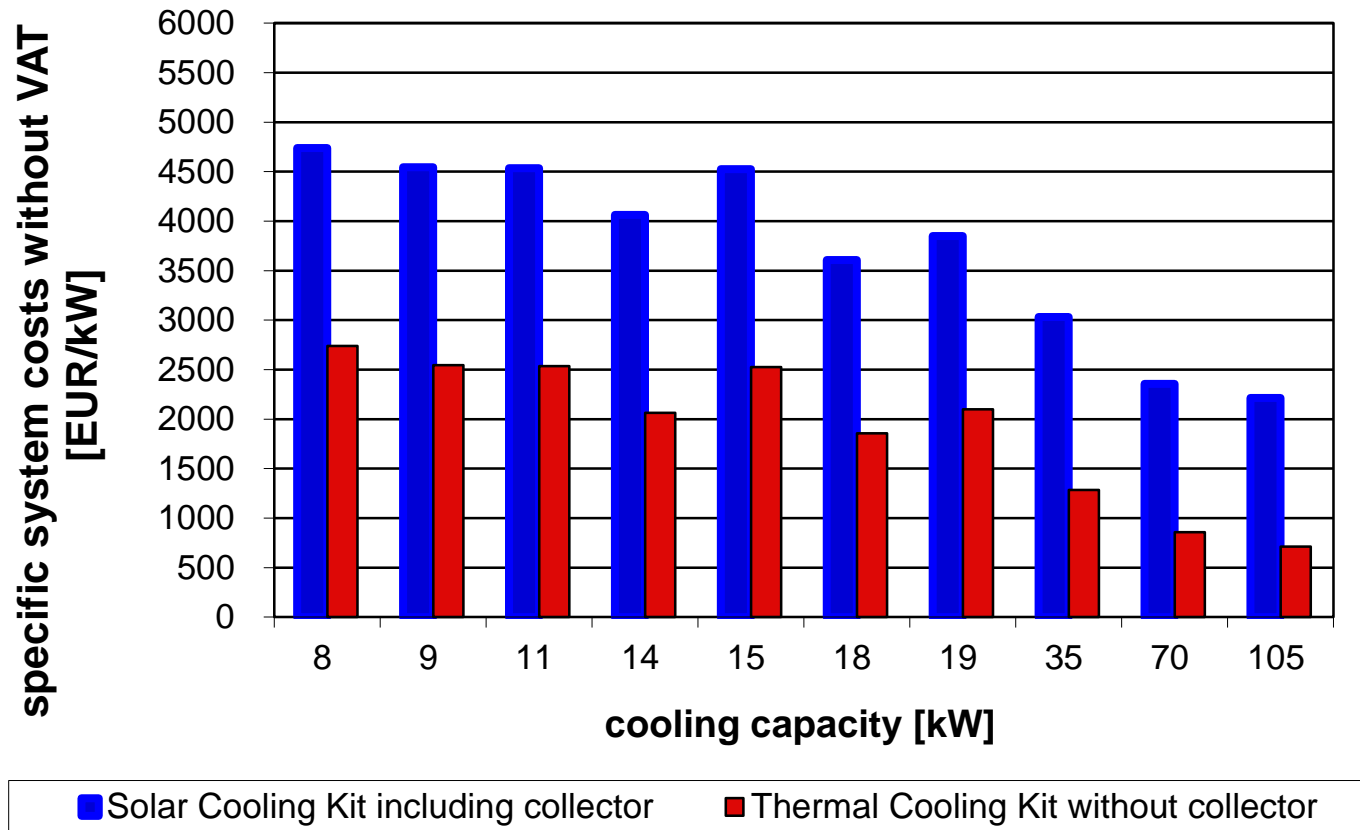
Tests, optimisation,  
evaluation

### Solar combi+ system

Commercial development – Velta Italia with EURAC



Source : EURAC



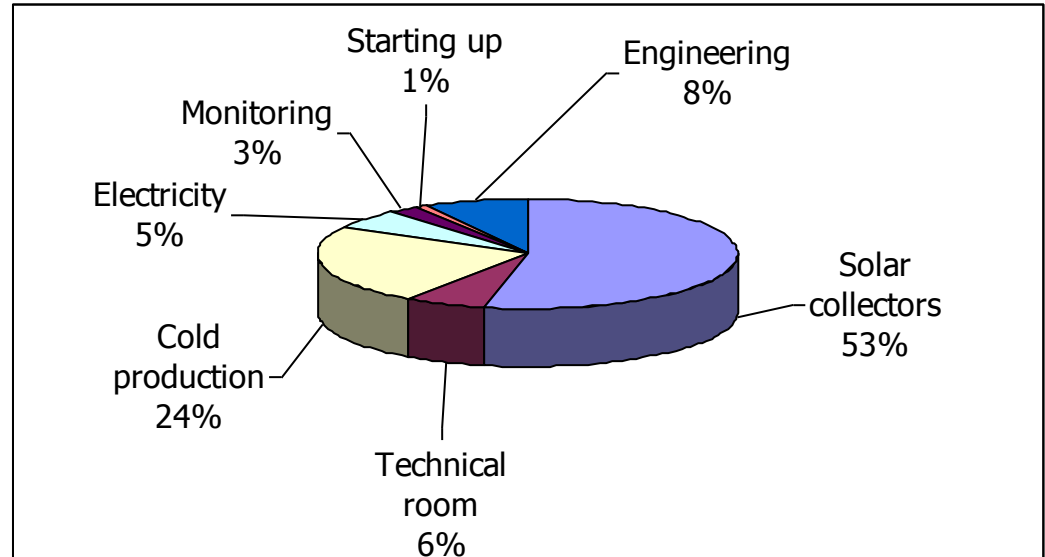
Source: SolarNext

**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
<b>TOTAL</b>	<b>243 230</b>
\$/ton	24 323

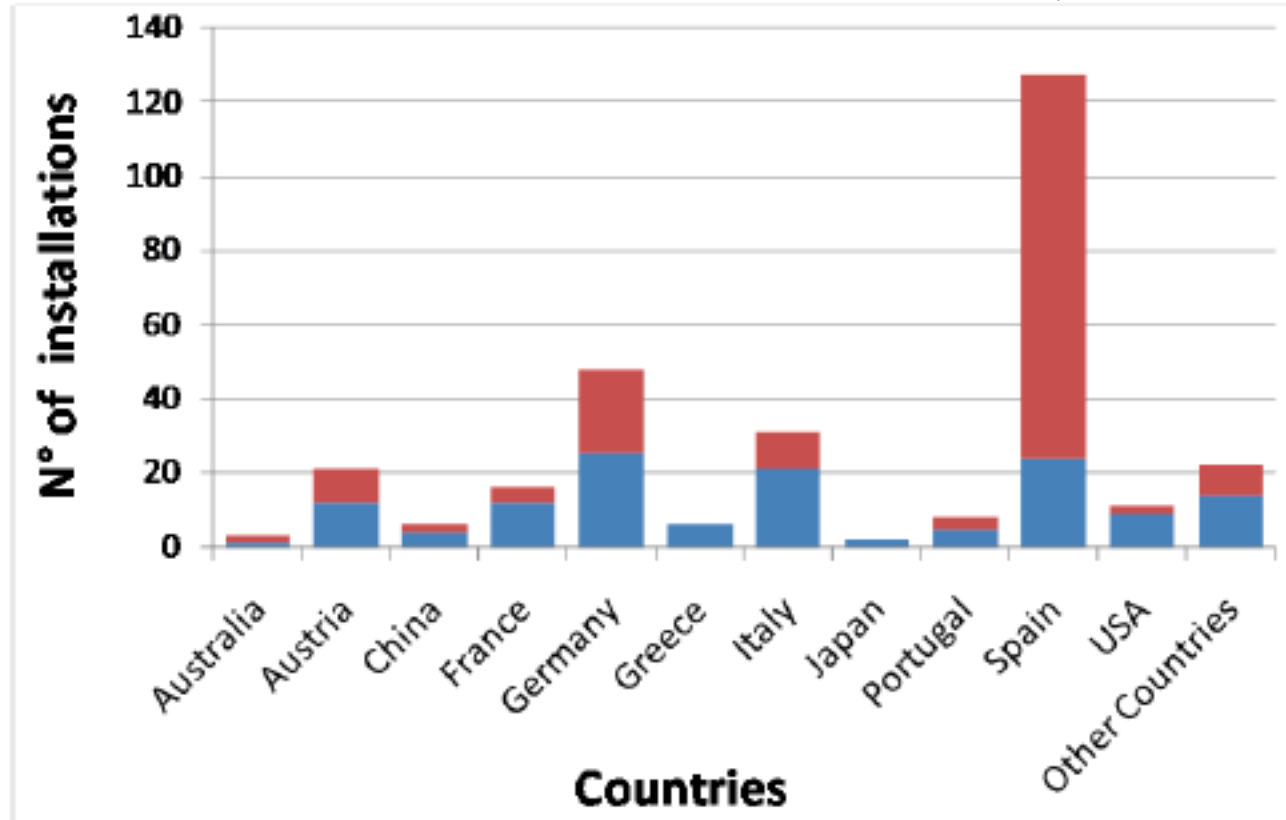


Sources: Tecsol



about 5,500 EUR/kW

Source: Sparber, IEA-SHC Task 38



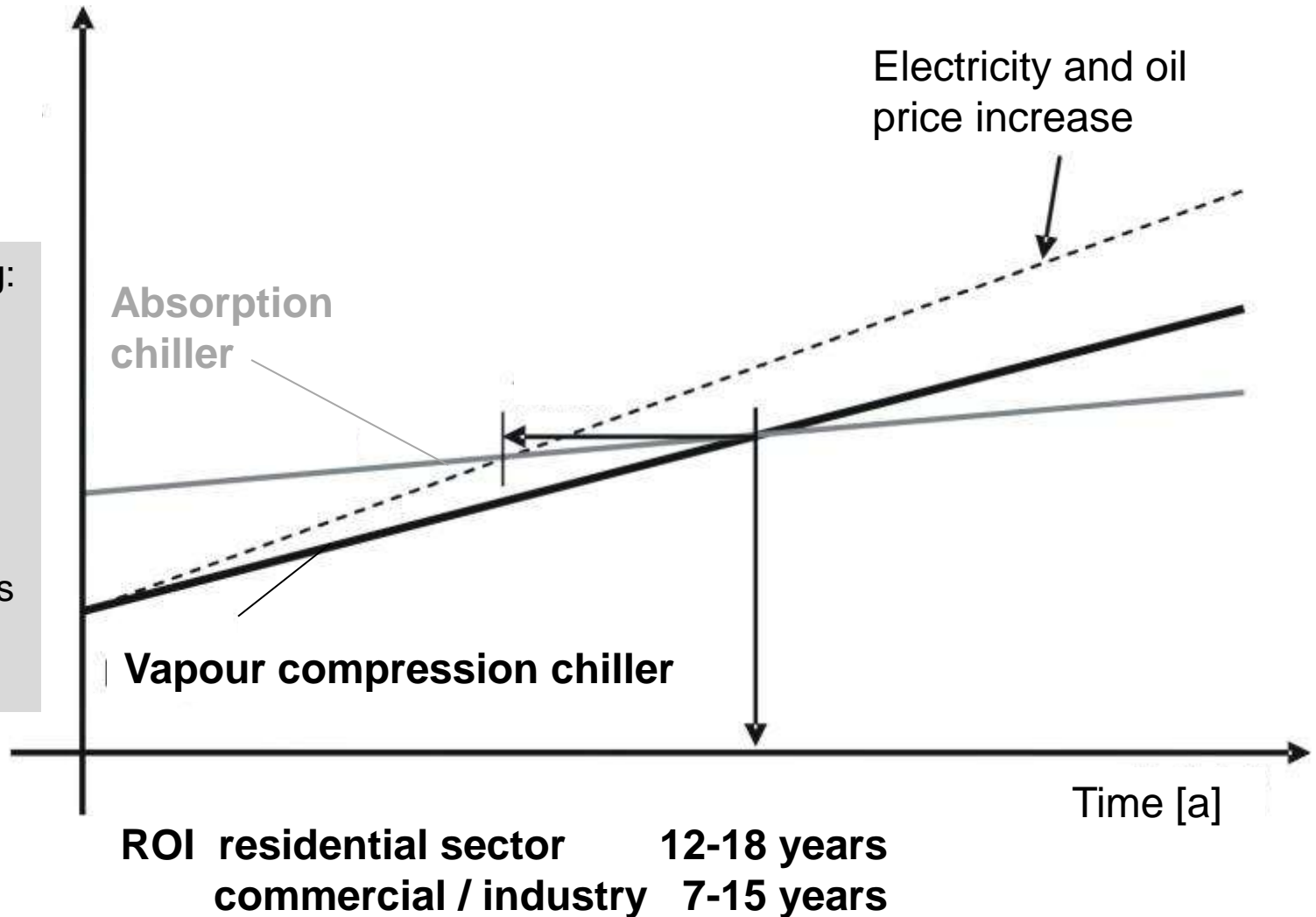
135 large-scale installations (blue column)

166 small/medium-scale installations (red column)

Investment and O&M cost

### Solar cooling:

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



# Design tools

## Check-list method (IEA-SHC Task 38)

The screenshot shows a web browser window with the URL <http://www.tecsol.fr/RafrSol2/index.htm>. The page title is "Climatisation/Chauffage Solaire". The main content area is titled "CHECK-LIST METHOD FOR THE SELECTION AND THE SUCCESS IN THE INTEGRATION OF A SOLAR COOLING SYSTEM IN BUILDINGS". It features a "Technical Feasibility" section with a "Building" sub-section containing several questions with dropdown menus and help icons. A "Load" sub-section also contains questions with dropdown menus. A "Next" button is visible at the bottom right of the form. On the right side, there is a vertical navigation menu with options: Project, Technical Feasibility, Economical Feasibility, Organisational Feasibility, and Result. The left side of the page has a sidebar with various navigation links.

**TECSOL** Climatisation/Chauffage Solaire

**SHC** SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY

**Technical Feasibility**

To build-in a check list, the first topic is naturally the building, which is the target of the solar cooling system and its technical features.

Please select an answer in the list for each question. If you do not know, let the answer empty.

**Building**

Climate of the location  ?

Area for solar collectors  ? (R = building surface/available solar surface)

Space available for the technical premises  ?

Heating and cooling distribution network adapted  ?

Existing or planned adapted conventional heating/cooling material  ?

Bio-climatic cooling solutions planned or installed.  ?

Are you planning to call for an installer and a engineering office with good solar cooling experience?  ?

**Load**

Correlation between daily production and thermal load  ?

Correlation between yearly production and thermal load  ?

Energy needs (cooling, hot water and heating) all year long  ?

If airconditioning is planned : is the solar system assisted with a back up?  ?

[Next](#)

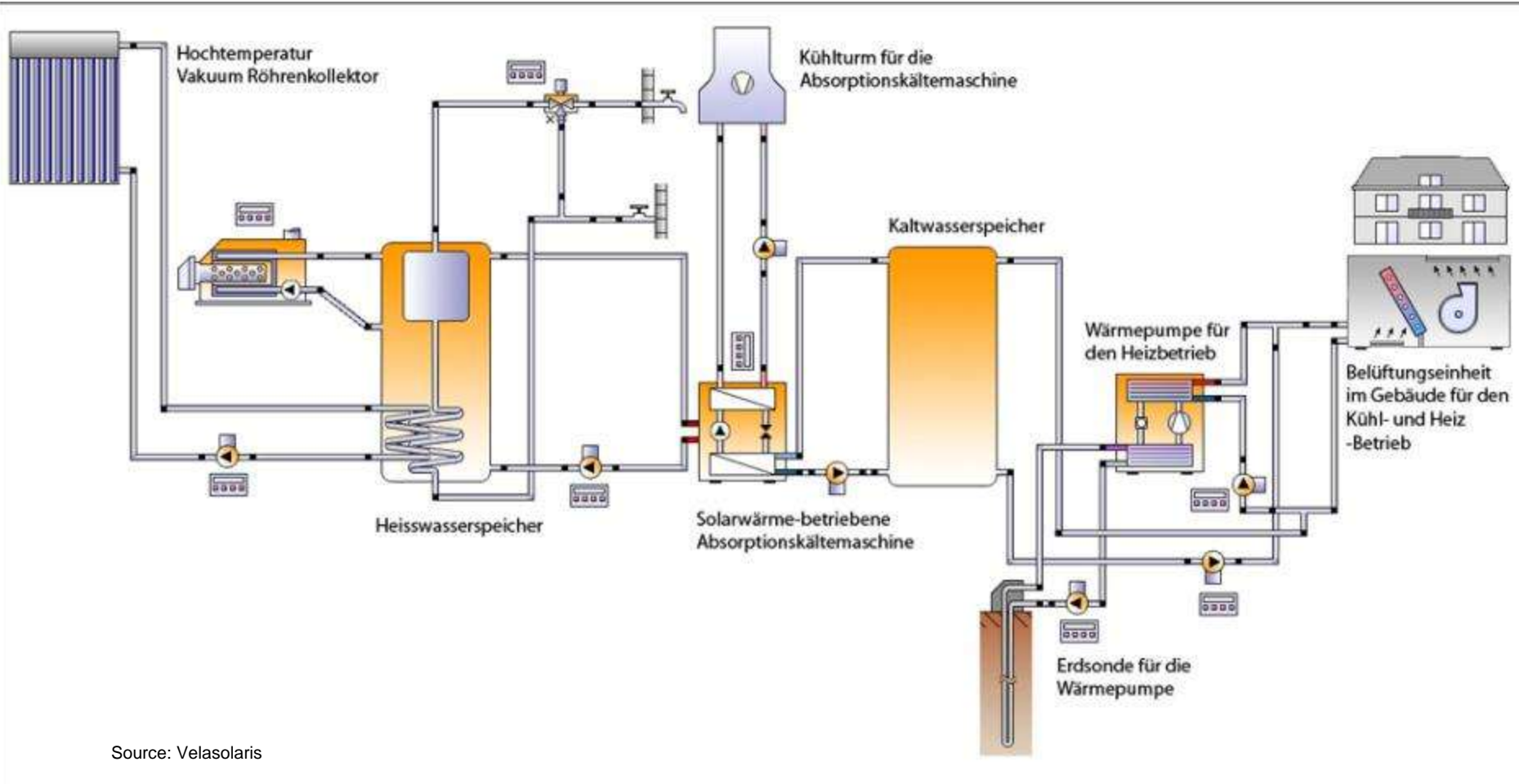
Project  
Technical Feasibility  
Economical Feasibility  
Organisational Feasibility  
Result

Introduction  
Technologie  
Généralités  
Absorption  
Adsorption  
DEC  
Outils et méthode  
Etat des lieux  
Bonnes pratiques  
Banyuls  
Maclas  
Projets européens  
Téléchargements

Source: Tecsol

# Design tools

## Example simulation software (Polysun)



Source: Velasolaris



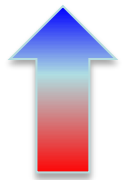
- HIGH-COMBI (2007-2011, FP6)
- SOLAR COMBI+ (2007-2010, Intelligent Energy Europe)
- SAHC (2007-2010, Intelligent Energy Europe)
- KeepCool II (2007-2010, Intelligent Energy Europe)
- SOLAIR (2007-2009, Intelligent Energy Europe)
- SOLCO (2007-2008, Intelligent Energy Europe)
- MEDISCO (2006-2009, FP6)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



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



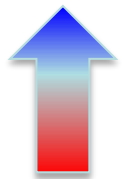
**Market**



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



**Demo**



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



**Science**



- 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





- 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







- 
- Several new small-scale and medium-scale Absorption and Adsorption chillers were developed worldwide in the last few years
  - Standardized Solar Cooling 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](http://www.iea-shc.org))

A bright sunburst effect in a blue sky with scattered white clouds, serving as the background for the top half of the slide.

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