Solar Cooling in Buildings – scalable technology for India

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Average Annual Global Irradiation for the World [kWh/m²a]

(Source: Meteonorm (Data), Friedemann Jung)
• Annual Global Radiation Varies from 1,600 to 2,200 kWh/m²a

(Source: TERI)
• 350 MW Solar Thermal Capacity Correspond to 500,000 m² Collector Area
• Total Installed Area in India up to 2007 is 2.15 million m² (1.5 GW)

Annual Rate of Installed Solar Thermal Capacity in India
Solar Cooling – Simultaneity of Solar Radiation and Cooling Demand

1. Global radiation
2. Cooling load
3. Heating load

Simultaneity

Solar surplus supply in summer
SolarNext Technology -
Clean Energy for Air-Conditioning

• Solar Cooling
• Solar Heating
• Solar Domestic Hot Water (DHW)
• Solar Pool Heating

All in one System!

The Application of Solar Cooling in a Building (Installation Principle)

**Schematic Cooling Processes**

Electrically Driven Compression Chiller

- **Electrical input** \( P_{el} \)
- **Cooling capacity** \( Q_O \)
  - (fan coils / cold ceilings)
- **Re-cooling capacity** \( Q_C \)
  - (cooling tower)

Thermally Driven Absorption or Adsorption Chiller

- **Heating capacity** \( Q_H \)
  - (solar collector)
- **Re-cooling capacity** \( Q_C \)
  - (cooling tower)
- **Cooling capacity** \( Q_O \)
  - (fan coils / cold ceilings)
Estimated RAC/PAC Market Size in 2008 (units: million)
Air-Conditioning Split-Units up to 5 kW (1.4 RT)

Source: JARN

World total 2008: 82.3 million units
Market Potential Solar Cooling in Europe

Air-Conditioning
- Residential Homes
- Multi-family Homes
- Office Buildings
- Banks
- Hotels
- Small Super Markets
- Bakeries

Process Cooling
- Bakeries
- Butcheries
- Milk
- Wine
- Fish
- Biogas
- Galvanic Baths
Large-Scale Water / Lithium Bromide Absorption Chillers


clean energy for you
SolarNext chillii® Solar Cooling Systems (15 - 500 kW)

Yazaki WFC 10 - 30
Water / Lithium Bromide

chillii® ESC15 - 200

chillii® ACC50 - 500
Ammonia / Water

chillii® ESC15, 30, 54, 150, 200

chillii® ACC50, 100, 200, 500

Source: Yazaki

Source: EAW

Source: AGO

Source: AGO
Mayekawa, Japan (50-350 kW)

Source: Albring

Nishiyodo, Japan (70-500 kW)

Source: Fraunhofer ISE
(1999)

H₂O/Silica Gel Nishiyodo NAK 100/350
in Augsburg, Germany for Space Cooling and Cold Production for the Laboratories

2,000 m² Flat Plate Collectors and District Heating Network Back-up
6,000 m³ Gravel-Water Aquifer Storage
247 kW Cooling Capacity
686 kW Wet Cooling Tower Capacity

Solar Cooling System at Bayrisches Landesamt für Umweltschutz, Augsburg, Germany

(1991)

**H₂O/LiBr Yazaki WFC-SC 15**

in Banyuls for Wine Cooling

- 130 m² Vacuum Tube Collectors
- 1.000 l Hot Water Storage
- 52 kW Cooling Capacity
- 180 kW Wet Cooling Tower Capacity

**Solar Cooling of a Winery, Banyuls, France**

chillii® STC8 & STC15
Water / Silica Gel

chillii® ISC7 & ISC10
Water / Zeolith

chillii® PSC12
Ammonia / Water

chillii® WFC18
Water / Lithium Bromide

Source: SorTech
Source: InvenSor
Source: Pink
Source: Yazaki

SolarNext chillii® Thermal/ Solar Cooling Kits (7, 7.5, 10, 12, 15, 17.5 kW)

chillii® Cooling Technology

Heat source 1 → Heat storage tank → Heating circuits
Heat source 2 → Heat storage tank → Cooling circuits
Solar system → Heat storage tank

Sorption chiller
Cold water storage tank
Electrical chiller

Pool → Recooler

Source: SolarNext

chillii® System Controller Development
chillii® Cooling Kit PSC12

- chillii® PSC12 absorption chiller
- chillii® System Controller HC
- Wet cooling tower
- Hot water pump with IF-Module
- Recooling pump with IF-Module
- Mixing valve with actuators
- Frequency converter
- Magnetic valves and swimming valve
chillii® Cooling Kit ISC10

- chillii® ISC10 Adsorption chiller
- chillii® System Controller HC
- Dry cooling tower (with sprinkling system)
- Hot water pump with IF-Module
- Recooling pump with IF-Module
- Mixing valve with actuators
- Expansion tank
- Security valve with manometer
H₂O/Silica gel chillii® STC8
in Wiesloch, Germany for Space Cooling

40 m² Flat Plate Collectors and Oil Burner Back-up
2,000 l Hot Water Storage
7.5 kW Cooling Capacity
22 kW Dry Cooler Capacity (with Water Spraying)
(2008)

NH$_3$/H$_2$O chillii® PSC10
in Kalkara, Malta for Space Cooling

38 m$^2$ Flat Plate Collectors
1,000 l Hot Water Storage and 1,000 l Cold Water Storage
10 kW Cooling Capacity
27 kW Ground Water Cooling Capacity (ca. 21 °C), sweet/salt water
(2008)

**NH₃/H₂O chillii® PSC10 (2x)**

in Miesbach, Germany for Office Space Cooling

- 100 m² Flat Plate Collectors & Gas Burner Back-up
- 7,500 l Hot Water Storage and 2,000 l Cold Water Storage
- 20 kW Cooling Capacity
- 48 kW Wet Cooling Tower Capacity

**chillii® Cooling Kits PSC 10 at the Raiffeisenbank Miesbach, Germany**

(2008)

H₂O/Silica gel chillii® STC8 (2x)
in Schörfling a.A., Austria for Office space Cooling

162 m² Façade Collectors and Gas Burner Back-up
15,000 l Hot Water Storage and 1,500 l Cold Water Storage
15 kW Cooling Capacity
45 kW Dry Cooler Capacity (with Water Spraying)

(2009)

**H₂O/Zeolith chillii® ISC10**  
in Wyong, Australia for Space Cooling (Coffee Shop)

- 34.8 m² Vacuum Tube Collectors
- 1,500 l Hot Water Storage and 500 l Cold Water Storage
- 10 kW Cooling Capacity
- 30 kW Dry Cooler Capacity (with Water Spraying)

*chillii® Cooling Kit ISC10 at the Milk Factory, Wyong, Australia*

(2008)

**H₂O/Silica gel chillii® STC8**

in Pescia, Italy for Cooling of a Greenhouse

- 19 m² Vacuum Tube Collectors
- 1,500 l Hot Water Storage, 1,000 l Cold Water Storage
- 7.5 kW Cooling Capacity
- 22 kW Dry Cooler Capacity (with Water Spraying)

**chillii® Cooling Kit STC8 at Greenhouse, Pescia, Italy**

Specific Costs of Low Capacity Solar Cooling Systems

![Graph showing specific costs of chillii® Cooling Kits and Solar Cooling Kits](Source: SolarNext)

**Without Installation Costs and Cold Distribution**
- Large and Medium-Scale Absorption and Adsorption Chillers are available since several years and used for Custom-Made Systems

- First Small-Scale Thermal/ Solar Cooling Kits are on the Market

- First Solar/ Thermal Cooling Associations Founded (Green Chiller, ausSCIG)

- Specific Collector Surface of the chillii® Solar Cooling Kits is 4.5 m²/kW (Average Value of Market Available Solar Cooling Kits in Europe is 4.2 m²/kW)

- Specific Costs of Solar Cooling Kits in Europe(*):
  - 5,000 to 8,000 EUR/kW in 2007
  - 4,000 to 4,500 EUR/kW in 2008
  - 3,500 to 4,500 EUR/kW in 2009

(*) The solar cooling Kit consist of solar thermal collectors, hot water storage, pump-set, chiller, re-cooler, partly cold water storage and system controller. The specific costs are without cold distribution and installation costs.

Conclusion
Thank you.

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www.solarnext.de
www.greenchiller.de