Market Ready Small-Scale Solar Cooling Systems

Intersolar North America Conference 2008

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SolarNext AG
• Electrically driven
• Maximum electrical consumption at peak-load period
• Refrigerant HCFCs and HFCs:
  no Ozone Depletion Potential (ODP)
  but Global Warming Potential (GWP)
• Leakages in a range of 5 – 15 % per year
Air-conditioning split-units up to 5 kW (1.4 RT):
2002: ~ 44 million units
2008: ~ 69 million units

Air-conditioning split-units: 34 billion US $  
Water cooling units: 4 billion US $  

Source: JARIA
Estimated RAC/PAC Market Size in 2006 (units: million)

- USA 16
- Europe 6.4
- China 20
- Central/Southamerica 2.5
- Middle East 2.5
- India 1.5
- Japan 8.5
- East Asia 6.5
- Africa 0.8
- Australia 0.8

World total 2006: 65.7 million units

Source: JARN
Market Potential Solar Cooling in Europe

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)
Heat Sources for Thermally Driven Cooling and Heating Systems
Schematic Cooling Processes

Recent Developments of Small Scale Water / Lithium Bromide Absorption Chillers

Water / Lithium Bromide (H$_2$O / LiBr)

**Yazaki, WFC-SC 5 & 10, Japan** (17.5 - 35 kW) (5 - 10 RT)

Source: Yazaki

**EAW, Wegracal SE 15 & 30, Germany** (15 - 30 kW) (4.3 – 8.6 RT)

Source: EAW

**Sonnenklima, suninverse 10, Germany** (10 kW) (2.9 RT)

Source: Sonnenklima

**Rotartica, Solar 045, Spain** (4.5 kW, air-cooled) (1.3 RT)

Source: rotartica
Water / Lithium Chloride ($H_2O / LiCl$)

Climatewell, CW 10, Sweden (10 kW) (2.9 RT)

Source: ClimateWell
Ammonia / Water (NH₃ / H₂O)

SolarNext, chillii® PSC12, Germany (12 kW) (3.4 RT)

chillii® PSC12

Source: Pink

chillii® Technology by SolarNext: Small Scale Ammonia / Water Absorption Chillers

Water / Silica Gel \( (\text{H}_2\text{O} / \text{SiO}_2) \)

- **SorTech ACS 15, Germany**: (15 kW) (4.3 RT)  
  Source: SorTech

- **SJTU, SWAC-10, China**: (10 kW) (2.9 RT)  
  Source: Shanghai Jiao Tong University

- **SorTech ACS 08, Germany**: (7.5 kW) (2.1 RT)  
  Source: SorTech

Recent Developments of Small Scale Water / Silica Gel Adsorption Chillers

- Residential homes
- Multi-family homes
- Office buildings
- Banks
- Hotels
- Small Super Markets
- Bakeries

- Food cooling (e.g. milk)
- Process cooling (e.g. galvanic baths)
chillii® Cooling Technology

Solar Thermal System
Solarthermische Anlage

Backup System

Heat Storage
Pufferspeicher

Chiller
Kältemaschine

Cooling Circuit
Kühlfleiss

Cold Water Storage
Kaltwasserspeicher

Biomass
Biomasse

CHP Unit
Blockheizkraftwerk

Process Heat
Prozesswärme

District Heat Network
Nah-Heizwärme

Hot Water Storage
Warmwasserspeicher

Heating Circuit
Heizkreis

Recooler
Rückkühlung
chilli® System Controller

European System Providers of Small Scale Solar Cooling Systems (≤ 30 kW)
Absorption Chiller CW 10
Water / Lithium chloride

ClimateWell Solar Cooling System (10 kW / 2.9 RT)

(2007)

H$_2$O/LiCl ClimateWell 10  
in Toledo, Spain for Space Cooling

- 32 m$^2$ Flat Plate Collectors & Back-up Boiler
- 200 l Hot Water Storage (DHW)
- 10 kW Cooling Capacity, 25 kW Recooling Capacity (Swimming Pool)

Solar Cooling System at the Residential Building, Toledo, Spain

Adsorption Chiller ACS08 (SorTech)
Water / Silica gel

CitrinSolar Solar Cooling System (7.5 kW / 2.1 RT)
(2007)

**H₂O/Silica gel chillii® STC6**

in Moosburg for Office Space Cooling

- 24 m² (total 90 m²) Flat Plate Collectors and Wood & Oil Burner Back-up
- 7,500 l Hot Water Storage and 1,000 l Cold Water Storage
- 5.5 kW Cooling Capacity, 16.5 kW Dry Cooler Capacity

CitrinSolar Solar Cooling System at the Office Building CitrinSolar, Moosburg, Germany
Absorption Chiller suninverse 10
Water / Lithium bromide

Sources: Sonnenklima
Sources: Sonnenklima

(2007)

H₂O/LiBr suninverse 10
in Uzéz, France for Space Cooling

35 m² Flat Plate Collectors
3,000 l Hot Water Storage
10 kW Cooling Capacity, 23 kW Wet Cooling Tower Capacity

Phönix Solaire Solar Cooling System at the Haribo Museum, Uzéz, France

Absorption Chiller LB 15 & LB 30
Water / Lithium bromide

Source: Schüco
(2007)

**H₂O/LiBr Schüco LB 15**

in Bielefeld, Germany for Space Cooling and Heating

- 168 m² Flat Plate Collectors
- 4,000 l Hot Water Storage, 1,000 l Cold Water Storage
- 15 kW Cooling Capacity, 35 kW Wet Cooling Tower Capacity

*Schüco Solar Cooling System at the Schüco Technology Center (STC), Bielefeld, Germany*
chillii® STC8 & STC15  
Water / Silica gel

chillii® PSC12  
Ammonia / Water

chillii® WFC18  
Water / Lithium bromide

Wegracal SE 15 & 30

SolarNext chillii® Solar Cooling Kits (7.5, 12, 15, 17.5 & 30 kW / 2.1, 3.4, 4.3, 5.0 & 8.6 RT)

(2008)

**H₂O/Silica gel chillii® STC8**

in Alzenau, Germany for Space Cooling

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

chillii® Solar Cooling Kit at Residential Building, Alzenau, Germany

NH₃/H₂O chillii® PSC10
in Gröbming, Austria for Office Space Cooling

40 m² Flat Plate Collectors and Biomass & District Heating Network Back-up
4,500 l Hot Water Storage
9 kW Cooling Capacity, 26 kW Wet Cooling Tower Capacity (& Swimming Pool)
H₂O/LiBr EAW Wegracal SE15
in Rimsting, Germany for Office Space Cooling and Heating

37 m² Flat Plate and 34 m² Vacuum Tube Collectors & Oil Burner Back-up
2,000 l Hot Water Storage and 1,000 l Cold Water Storage
15 kW Cooling Capacity, 35 kW Wet Cooling Tower Capacity
chillii® Cooling Kit 18 kW

chillii® WFC18 absorption chiller
+ chillii® System Controller w/ thermostat
+ Wet cooling tower
+ Pump (hot water circuit)
+ Pump (re-cooling circuit)
+ Mixer
+ Thermostat & timer
Adsorption Chiller SOL ACS08
Water / Silica gel

Absorption Chiller Wegracal SE 15 & 30
Water / Lithium bromide

Solution Pinguin and Alaska-Set Solar Cooling Systems (7.5, 15 & 30 kW / 2.1, 4.3 & 8.6 RT)
(2005)

**H₂O/LiBr EAW Wegracal SE15**  
in Sattledt, Austria for Office Space Cooling and Heating

- 40.5 m² Flat Plate Collectors  
- 2,000 l Hot Water Storage and 800 l Cold Water Storage  
- 15 kW Cooling Capacity, 35 kW Wet Cooling Tower Capacity

**Alaska-Set Solar Cooling System at the Office Building Solution, Sattledt, Austria (Refit)**  
Solare Kühlung

Prinzipschema

- Raumtemperatur: 22,9°C
- Aussenfühler: 15,5°C
- VI. Deckenstrahler: 33,8°C
- RL Deckenstrahler: 27,2°C
- Tagesertrag: 39,9 kWh
- Momentaneistung: 5,28 kW

Source: Solution

Stand: 26.02.2008 15:00

www.SOL-ution.com
First US System Providers of Small Scale Solar Cooling Systems ($\leq 30$ kW)

- Solarsa (Florida)
- Solaraire (California)
- Solar Panels Plus (Virginia)
- Small Capacity Absorption and Adsorption Chillers are available

- First System Providers of Small Capacity Solar Cooling Systems are on the Market

- First Operation Experiences of Small Capacity Systems are available

- Specific Costs of Solar Cooling Systems in Europe(*):
  - 5,000 to 8,000 EUR/kW (26,250 to 42,000 US$/RT(**)) in 2007
  - 4,500 EUR/kW (23,625 US$/RT(**)) in 2008
  - 3,000 EUR/kW (15,750 US$/RT(**)) are expected in the near future

(*) The solar cooling system 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.

(**) Exchange rate 1.50 US$/EUR.
Thank you.

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www.solarnext.de