Development of Solar Cooling Kits for the European Market

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Dr. Uli Jakob
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
Estimated RAC/PAC Market Size in 2008 (units: million)
Air-Conditioning Split-Units up to 5 kW (1.4 RT)

- USA 16
- Europe 8.6
- China 26.8
- Central/Southamerica 4.7
- Middle East 4.0
- India 3.8
- Japan 8.0
- East Asia 7.4
- Africa 1.5
- Australia 1.0

World total 2008: 82.3 million units

Source: JARN
Market Potential Solar Cooling in Europe


Total amount of installed Solar Cooling systems

<table>
<thead>
<tr>
<th>Year</th>
<th>2004</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Source: Climasol)</td>
<td>(Source: H.M. Henning)</td>
<td>(Source: Rococo)</td>
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The chart shows the increase in the total amount of installed Solar Cooling systems from 2004 to 2007.
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

Solar

[Image of solar panels] Source: Tsinghua

District Heating


CHP Unit, Biomass, Process Heat etc.

[Image of CHP unit] Source: EC-Power

[Image of ecopower unit] Source: ecopower
Climax Solar-Water Heater

Utilizing one of nature's generous forces

The Sun's heat

Gives hot water at all hours of the day and night.

No delay.
Flows instantly.
No care.
No worry.
Always charged.
Always ready.

The water at times almost boils.

Price, No. 1, $25.00

This size will supply sufficient for 3 to 5 baths.

Clarence M. Kemp, Baltimore, MD.

Advertisement for Climax Solar-Water Heater (1892), USA
Private Home with Solar Thermal Application (around 1910), Pamona Valley, USA
World Exhibition 1878 in Paris - A. Mouchot Produced the First Ice Block Through Solar Energy
chillii® STC8 & STC15
Water / Silica Gel
Source: SorTech

chillii® ISC10
Water / Zeolith
Source: InvenSor

chillii® PSC12
Ammonia / Water
Source: Pink

chillii® WFC18
Water / Lithium Bromide
Source: Yazaki
<table>
<thead>
<tr>
<th><strong>Air-Conditioning</strong></th>
<th><strong>Process Cooling</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Residential Homes</td>
<td>- Bakeries</td>
</tr>
<tr>
<td>- Multi-family Homes</td>
<td>- Butcheries</td>
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<tr>
<td>- Office Buildings</td>
<td>- Milk</td>
</tr>
<tr>
<td>- Banks</td>
<td>- Wine</td>
</tr>
<tr>
<td>- Hotels</td>
<td>- Fish</td>
</tr>
<tr>
<td>- Small Super Markets</td>
<td>- Biogas</td>
</tr>
<tr>
<td>- Bakeries</td>
<td>- Galvanic Baths</td>
</tr>
</tbody>
</table>

**Applications of Solar Cooling Kits**
chillii® Cooling Technology

Solar Thermal System

Backup System

Heat Storage

Chiller

Cold Water Storage

Cooling Circuit

Biomass

CHP Unit

Process Heat

District Heat Network

Hot Water Storage

Heating Circuit

Recooler

*Source: SolarNext*
• **Different Heat Sources**
  (e.g. Solar, CHP unit, Biomass)
• **Back-up System**
  (e.g. Oil/Gas Boiler)
• **Heat and Cold Storage Management**
• **Domestic Hot Water**
• **Chiller** (e.g. chillii® PSC12)
• **Recooler** (e.g. Dry Recooler)
• **Heating and Cooling Circuits**
chillii® Cooling Kit PSC12

chillii® PSC12 absorption chiller
+ chillii® System Controller w/ thermostat
+ Wet cooling tower
+ Pump (hot water circuit)
+ Pump (re-cooling circuit)
+ Mixing valves
+ Magnetic and swimming valve

Source: SolarNext
Realized chillii® Cooling Kit Installations: by Heat Source

- Flat Plate Collectors: 40%
- Vacuum Tube Collectors: 36%
- Parabolic Trough Collectors: 5%
- CHPC: 5%
- Waste Heat: 14%

Source: SolarNext
Realised chillii® Cooling Kit Installations: by Recooling

- Wet Cooling Tower: 47%
- Dry Recooler: 33%
- Ground Water: 10%
- Other: 10%

Source: SolarNext
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)
NH₃/H₂O chillii® PSC10
in Kalkara, Malta for Space Cooling

38 m²  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
NH$_3$/H$_2$O chillii$^\text{®}$ PSC10 (2x)
in Miesbach, Germany for Office Space Cooling

100 m$^2$ 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$^\text{®}$ Cooling Kits PSC 10 at the Raiffeisenbank Miesbach, Germany
H₂O/Silica gel chilli® 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)
H₂O/LiBr chillii® WFC18

in Newcastle, Australia for Office Space Cooling

- 60 m² Parabolic Trough Collectors
- 17.5 kW Cooling Capacity
- 43 kW Wet Cooling Tower Capacity
(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)
- Small Capacity Absorption and Adsorption Chillers are available

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

- First Operation Experiences of Small Capacity Systems are available (solar heat, biomass, CHP waste heat, process heat)

- Huge Market Potential for Solar Cooling and Refrigeration

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

(*) 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.

Dr. Uli Jakob
SolarNext AG

www.solarnext.eu