Solar Cooling® - the much awaited technology... and it is already here.
• ClimateWell has developed a hot water powered Air Conditioner with an integrated energy storage

• The heat pump delivers air conditioning upon demand without the need of electricity

• Hot water sources suitable for the ClimateWell units include:
  – Waste heat from electrical generators
  – Solar thermal collectors

• The ClimateWell core includes no pumps or other moving parts, is completely modular for tailored power and energy storage capacity

• The technology, called Triple State absorption for its use of dry salt, salt water and water vapor, is proprietary to ClimateWell and enables a whole new generation of thermal cooling solutions
ClimateWell – the company

- Is a Swedish company, which has developed and patented a new Solar Cooling technology
- Is an Award winner at the World Economic Forum, 2007. As a “Pioneer Technology Partner” ClimateWell’s technology, quote: “has the capacity to change human lives in the future”
- Is, among other recognitions, awarded by the Fraunhofer Institute for its groundbreaking cooling technology.
- Will shortly finalize the construction of its first production plant in Spain, first commercial market in Europe under development.
The ClimateWell technology

- A three phase absorption technology (liquid, vapour and solid states), which is patented worldwide
- Generates Solar Cooling and/or heating day and night
- Uses hot water from thermal solar panels at low and variable temperatures
- Produces 100% clean energy
- No electricity consumption, has no mechanical parts and is silent.
- Has an integrated energy storage
- The machine CW10 is completely modular

<table>
<thead>
<tr>
<th>Max Power (kW)</th>
<th>Heating</th>
<th>Cooling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage (kWh)</td>
<td>76</td>
<td>60</td>
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<tr>
<td></td>
<td>20</td>
<td>10</td>
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</table>
The ClimateWell technology 2

Triple-phase absorption heat pump system, or a "Chemical heat pump with hybrid substance"

Using a hygroscopic salt – LiCl – with an energy density of 300+ kWh/m³

Solid or Fluid Reactor Substance
• Fluid displays good energy charge and discharge power
• Fluid has very poor storage capacity
• Fluid needs continuous energy input.
• Solid has poor charge and discharge power
• Solid has good energy storage capacity

Triple-Phase: Solid and Fluid Reactor Substance in same process
• Has same charge and discharge power as Fluid
• Has same Energy storage as solid
• Allows salt solution to crystallize, thereby storing energy
How does the technology work?

• Fundamentally an absorption process, that converts heat to cold.

• This process was in fact used already in gas-fired refrigerators developed more than 100 years ago.

• ClimateWell has improved this process drastically by adding a patented energy storage solution:
  – Resulting in a de-coupling of the charging (where energy is received from the sun or the generator) from the output (where heat or cold is distributed to the house).

• The new process enables a continuous cooling/heating of the building, even with a highly volatile source of energy like the sun

  *We charge energy whenever it is available and use it when needed.*
Solar Energy

• The Sun “is the Mother of all energies”
• During one month our planet receives more solar energy than what mankind has consumed throughout all history
• The consumption/production of solar energy is less than 1% in Europe.
• The thermal solar energy is cheap to produce and little exploited.
• ClimateWell’s machine, CW10, utilizes heat from thermal solar panels and produces 100% clean energy
Solar radiation and demand for heating & cooling
Why solar cooling?

- Substitutes electricly driven compressors
- Saves energy and is energy efficient
- Does not use any toxic or harmful refrigerants (CFC).
- Considerable reductions of carbon dioxide (CO2).
- Diversification of energy resources
- Reduces the dependency on energy providers (electric utilities, gas cos.)
- Usage of an unexhaustable source, completely environmentally friendly
- Reduces energy consumption during periods of peak demand of air conditioning
- Reduces the strain on electric grids, thus avoids black-outs
- Offers optimal economical results from usage of thermal solar panels
APPLICATIONS

ENERGY EFFICIENCY

Multi family housing
Hotels
Hospitals
Offices
Public buildings, etc.

• Integrated with existing and conventional systems for improved energy efficiency.

• Optimal usage of solar energy

• Considerable reductions of energy consumption

• Maximizing the usage of hot tap water from a clean and renewable energy source

• Reductions of the CO2 emissions
Application – hospitals and geriatric centres

• The ClimateWell installation makes the hospital energy efficient and sustainable and can be integrated in an existing conventional a/c system (chillers)

• For a 200 bed hospital in Germany the savings are calculated to be:
  – 346 000 kg of CO₂
  – 26 000 Euros

• The double usage of the solar heat (heating and cooling) gives a 200% yield of the solar energy.
Applications – single homes

- Powered by thermal solar panels (appr. 30m²/machine)
- Indoor cooling and heating, hot tap water and heating of swimming pool
- Integrated storage system (24 hours/day energy delivery)
- Profitable from first day with positive cash flow
By installing ClimateWell machine(s) the building energy certificate passes from “E” to “A”

- Saves between 70% and 85% in sunny countries on cooling and heating plus domestic hot water
- Covers 100% of cooling demand
- Annual savings of about 20,000 kWh and some 13 tonnes of CO₂ per machine (South European climate conditions)

Source: Calculations from a semi-detached housing development in Madrid (las Rozas) of 185sqm.
ClimateWell’s non-solar energy applications

- The ClimateWell technology offers several further application possibilities, as:
- Transport (substituting the electric compressor for a/c).
- Energy storage from waste heat. The European (and worldwide) industry throws away unlimited amount of TWh per year.
- ClimateWell has an ongoing R&D program for the full usage of these energy application
ClimateWell’s technology recognised by Swedish Government

- Coalition leaders from the Swedish Government visited the ClimateWell head office in December 2007.

- ClimateWell is now investigating the possibility of building a 7MW system, which will take advantage of 50°C waste heat from a steel plant in Sweden in order to raise the temperature to 90°C and supply heating to the adjacent district heating net.
Example: Utilizing excess heat for cooling

High energy efficiency. Maximizing energy savings in existing and new installations.

Utilization of residual heat (cogeneration, gas turbines, …)

Considerable economical savings with positive impact on operational costs.

Increased independence from utility companies.
Example solar-gas: Micro-Trigeneration (existing).

The objective is to integrate solar cooling with micro-trigeneration in small installations (SMEs and small industrial plants).

1. Highly efficient
2. Reduction of CO2 emissions (approximately 40%).
3. Profitable from first day of operation
Example of existing installations - Bioclimatic building in Almería, Spain, - the Arfrisol project

Case study with CIEMAT and IDAE with the objective to achieve a 80 to 90% energy savings in comparison to conventional buildings.

The project consists of five buildings, each located in the different climate zones of Spain:
• Almería, Desert conditions
• Almería Coast
• Soria
• Madrid
• Oviedo
ClimateWell Show-House

Single house dwelling
Madrid, Spain

Objective: Optimize the usage of solar energy

Indoor distribution system: Radiant floor (plastic tube circuits with water)
Thermal solar panels: 34 m²
Heat sink: Swimming pools (2 x 12 m²)
Show-House Madrid – temperature chart summer 07

Total cooling area 220 m².

**Temperaturas del Showhouse**

- **Exterior**
- **Showroom**
- **Piscina**

Date Range:
- 02-jul to 09-jul
- 16-jul to 30-jul
- 06-aug to 27-aug
- 03-sep to 24-sep
The new production plant in Olvega, Soria, Spain
Current situation of the construction of the plant
The current Energy situation in Europe

- Overall lack of fossil energy sources
- Coal no long term alternative
- High dependency on energy imports
- No homogenous electric tariff system
- Insufficient electric grid network
- High crude oil prices, currently > 90USD/barrel

Prevailing downsides:
- High emissions of CO2 and other polluting gases
- High risk of accelerating the Climate Change
EU and the European Renewable Energy Council

- Heating and cooling corresponds to some 50% of all energy consumption in Europe and is now proposed by the EU Commission to be included in the overall mix of renewable energy programs in order to achieve the various 2020 targets.
- Each member state has the responsibility to develop its own energy program and, by obligation, include heating and cooling.
- By 2020, 25% of all heating and cooling consumption should come out of renewable energy sources (12% of all energy consumption in EU)
- Heating can be obtained by solar, geothermal and biomass energy.
- Solar Cooling offers economical viability year round.
ClimateWell and EU administrative institutions

• The Stern report emphasises that the fight against the ongoing Climate Change can only be achieved through collaboration between Public Institutions and private enterprises.

• Best way forward is to create stable legal framework, which guarantees increased renewable energy production and enhances (self) consumption, like:
  – Compulsory regulation for public buildings to use renewable energy.
  – Compulsory regulations for housing, offices, hotels, hospitals, etc. to use renewable energy.
  – Access to no-limit and long lasting subsidies
Examples of energy savings in numbers

<table>
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<tr>
<th>Description</th>
<th>Value</th>
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<tbody>
<tr>
<td>Average solar field per installation</td>
<td>30 m²</td>
</tr>
<tr>
<td>Annual captured solar energy (average Spain)</td>
<td>840 kWh/m²</td>
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<tr>
<td>Captured solar energy per installation</td>
<td>25 200 kWh/year</td>
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<tr>
<td>Yield of solar field</td>
<td>79%</td>
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<tr>
<td>Annual energy savings</td>
<td>20 000 kWh/year</td>
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<tr>
<td>Typical reduction of CO₂ emissions per installation</td>
<td>13 Tonnes/year</td>
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<table>
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<tr>
<th>Year</th>
<th>Forecasted # of installations of CW10</th>
<th>Forecasted sales of Solar Thermal collectors [m²]</th>
<th>Accumulated energy savings [kWh]</th>
<th>Accumulated reduction of CO₂ emissions [Tonnes/year]</th>
<th>Equivalent of Mediterranean Forest (10T CO₂/ha) [ha]</th>
<th>Reduction of power peaks [kW]</th>
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<td>300</td>
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<td>66 000 000</td>
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<td>316 000 000</td>
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</table>
Proprietary technology by ClimateWell, “3 phase absorption”, worldwide patents

- Stockholm, Sweden: Group Head Quarter
- Madrid, Spain: Commercial office
- Soria, Spain: Production plant

Partners and references

- Ciemat
- MTS Group
- Grupo Unisolar
- Vattenfall
- uponor
- UNIQUEspa
- Lansolar
- asE
- gasNatural
- general solar
- World Economic Forum
- Technology Pioneer 2007
- GES
- IMMOsolar Energy Management
- SERC