SOLAR-POWERED COOLING, DEHUMIDIFICATION AND AIR CONDITIONING

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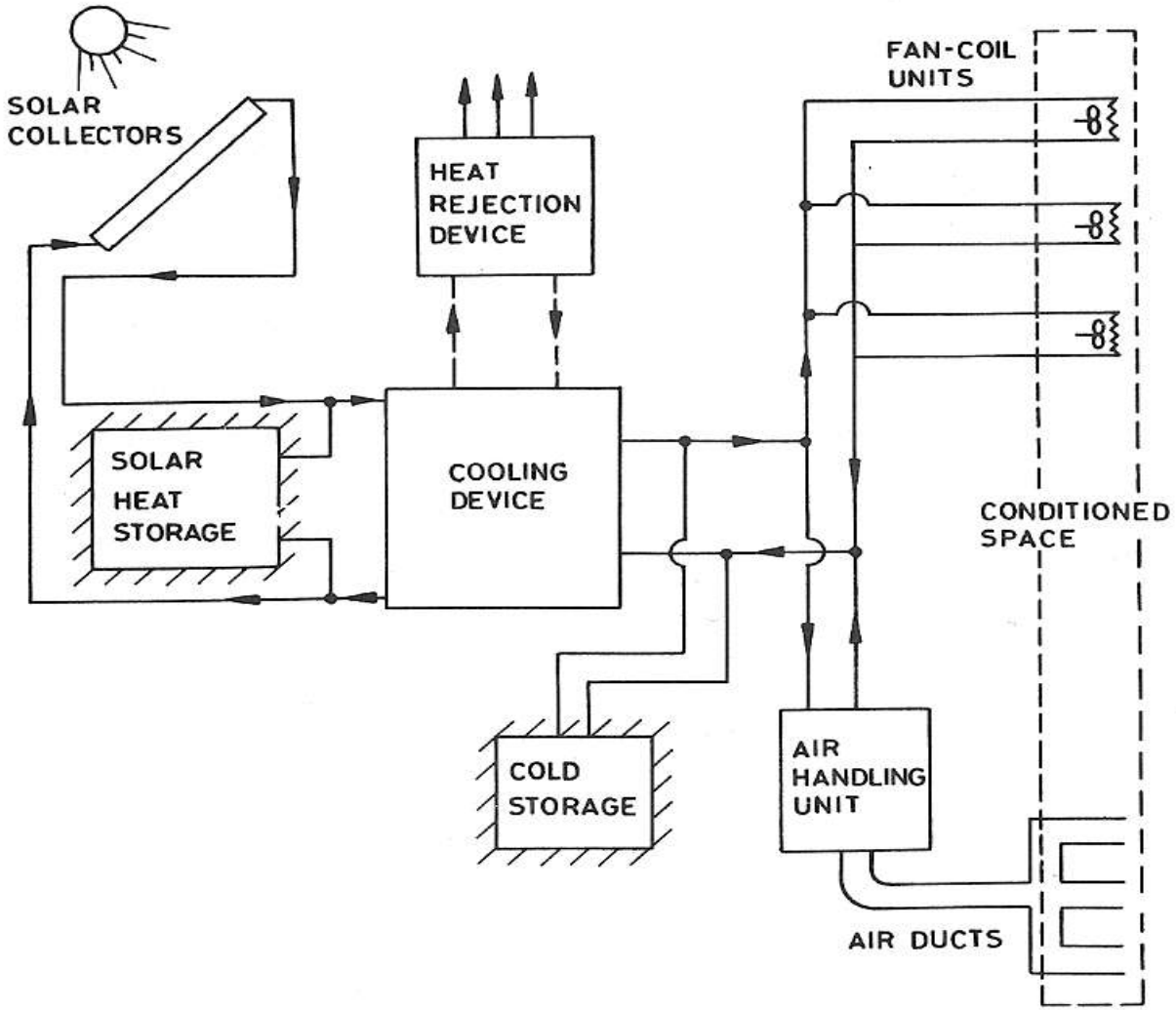
Demand for Air Conditioning in the World is on the rise…

- Climate change and Global Warming
- Increased standard of living
- Demand for comfort
- European countries with no A/C tradition: “12 participants (national energy agencies, manufacturing experts, university labs, electric utilities) from 8 countries including the EU manufacturer’s association EUROVENT gathered to identify suitable measures to transform the Central Air Conditioning market in the direction of Energy Efficiency” (EU Report, 2003)

Demand for A/C associated with increased demand for primary energy…

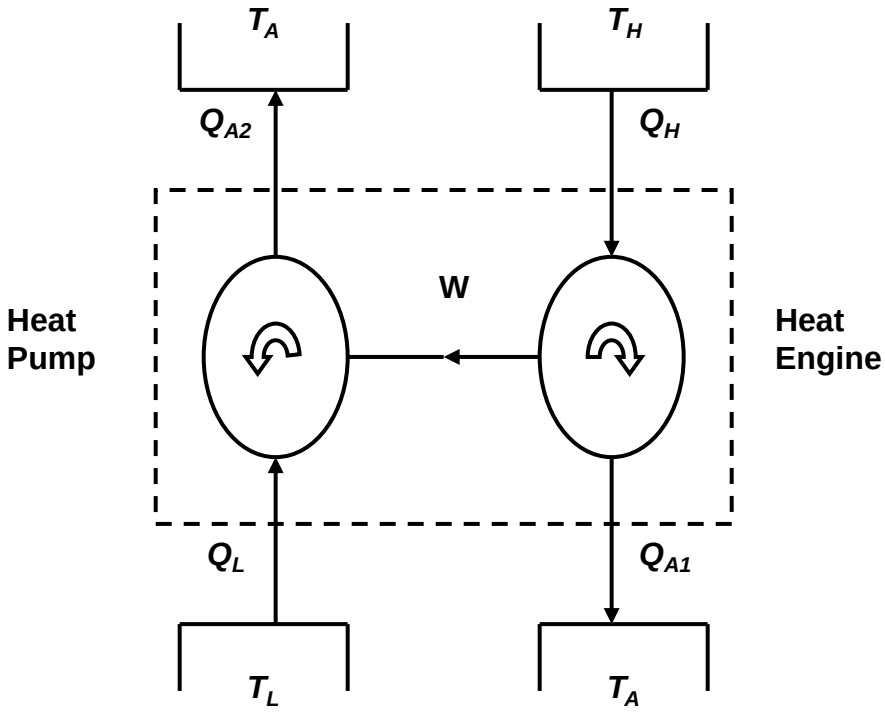
- Solar Cooling can Alleviate the Problem
- Closed-cycle systems: Absorption, Adsorption, Jet-cooling….
- Open-cycle systems: Liquid desiccant, Solid sorption

Solar Cooling System

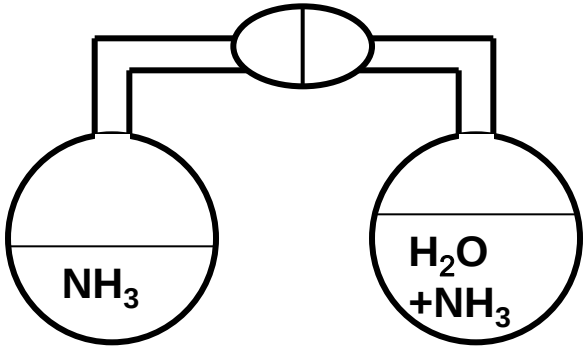


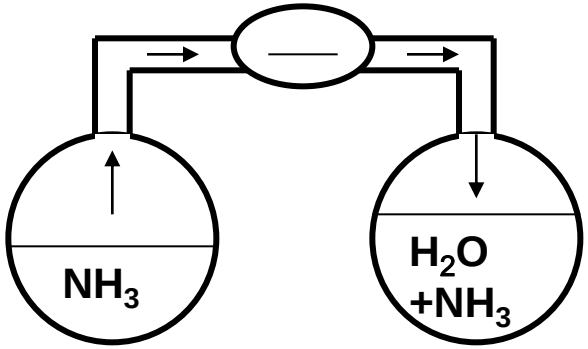
Solar Cooling/ Air Conditioning

- Heat Pump driven by Heat Engine
- Absorption/Adsorption Heat Pump



Chemical Heat Pump Principle



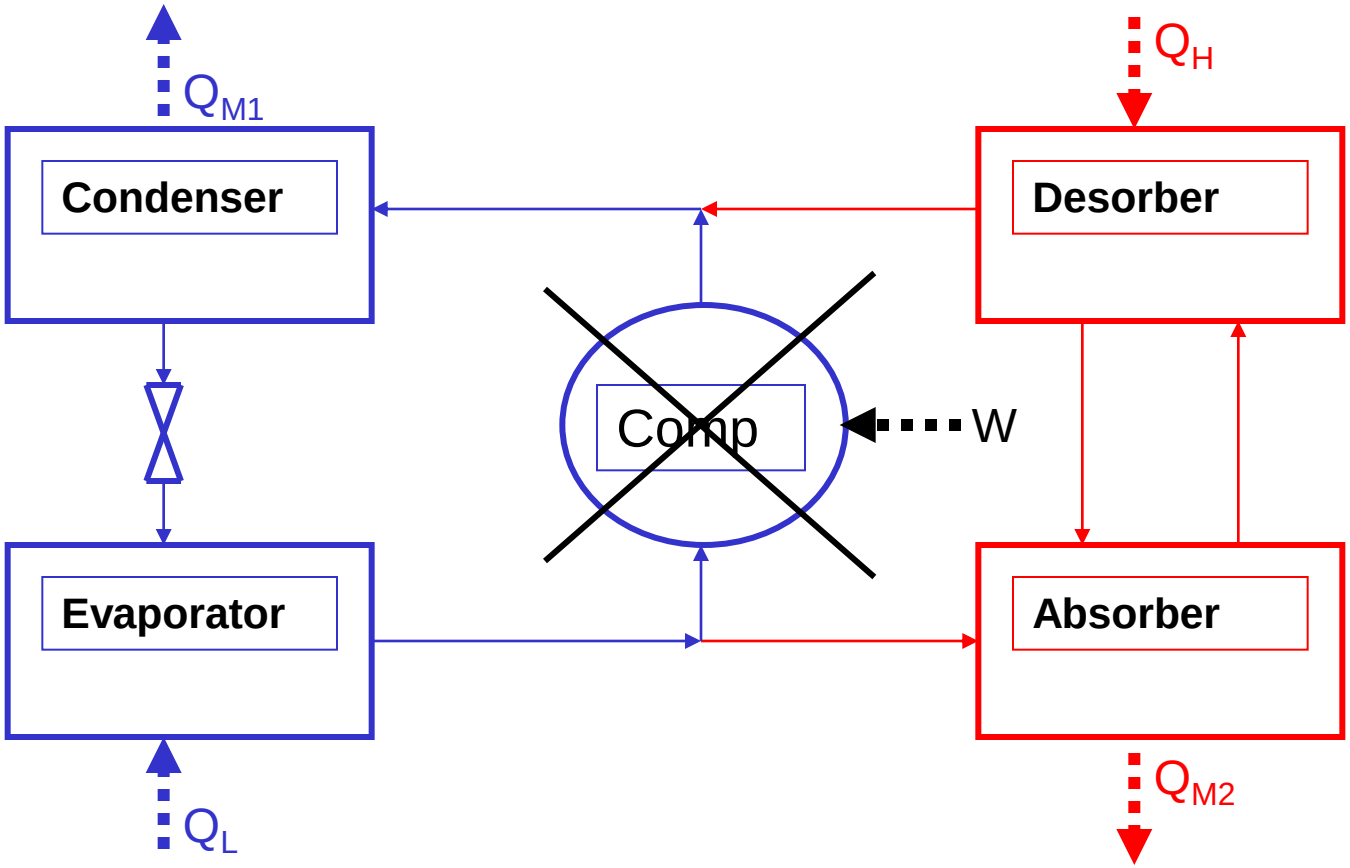


$T_{pure} = T_{solution}$
$P_{pure} > P_{solution}$

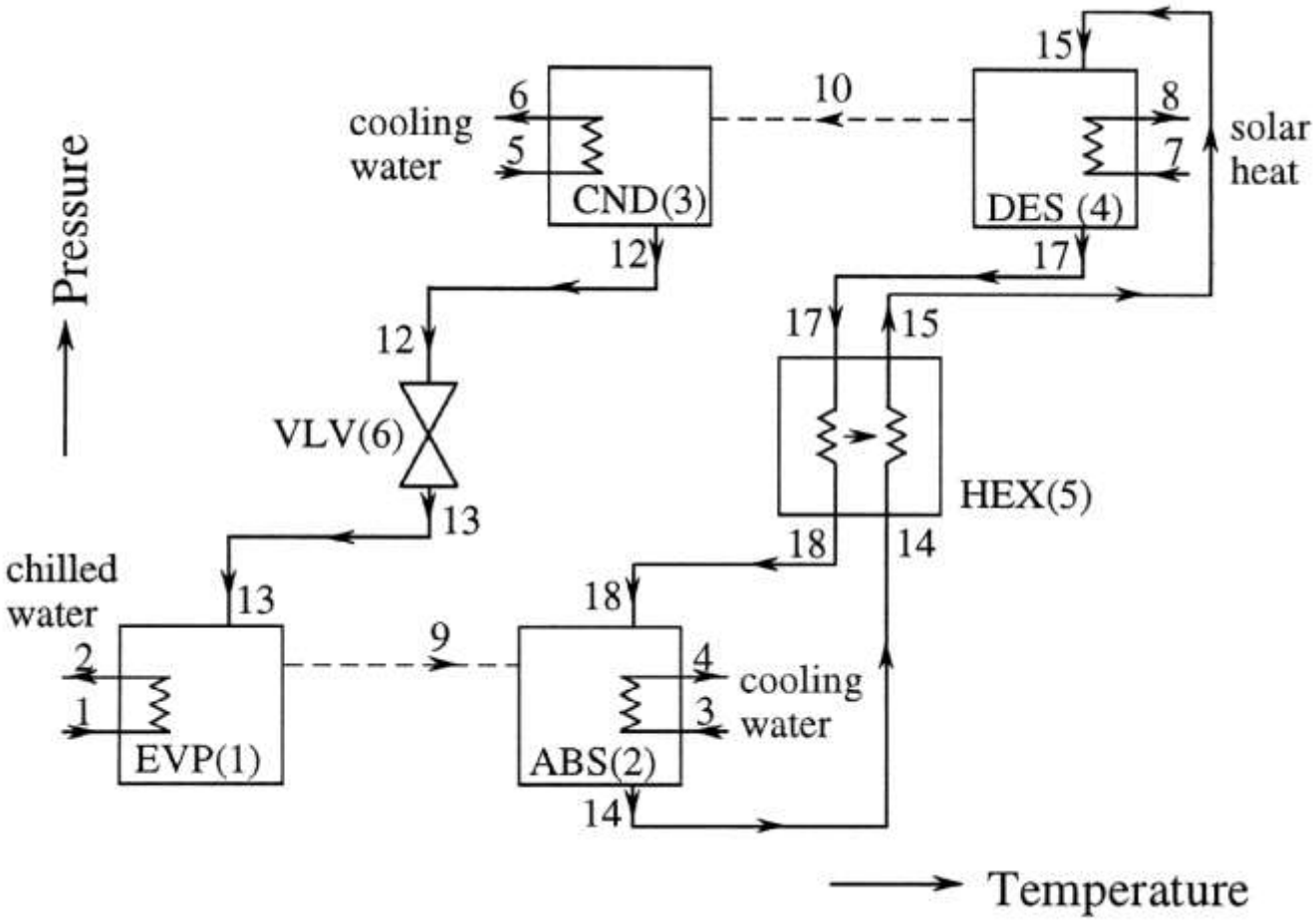
$T_{pure} < T_{solution}$
$P_{pure} = P_{solution}$

$T_{solution}-T_{pure}$=Temperature Lift

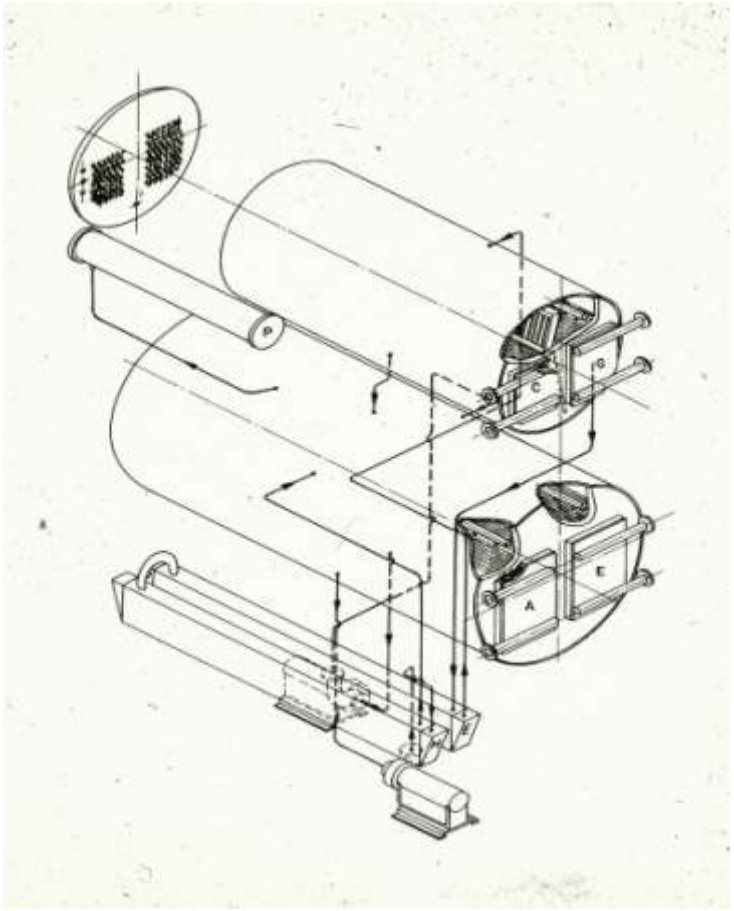
Absorption Heat Pump Principle

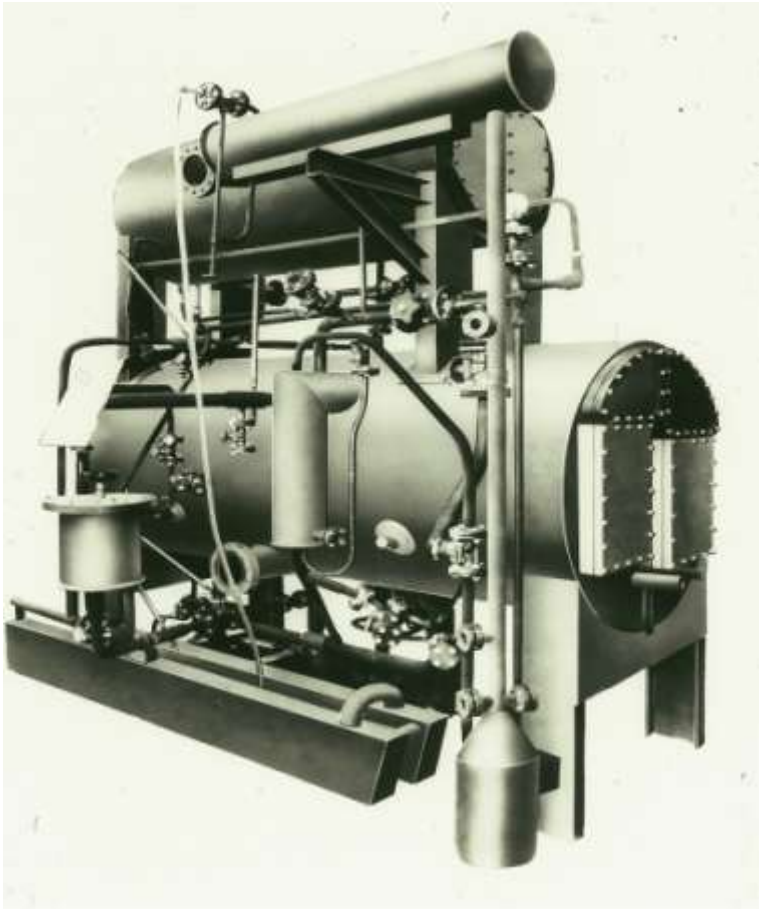


Single-Effect LiBr-H_2O Absorption Chiller



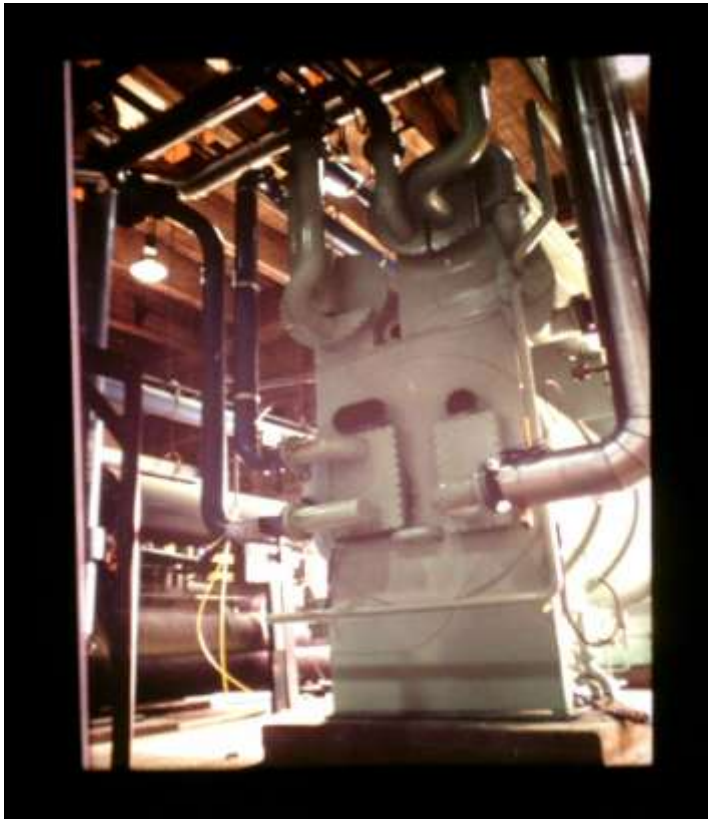
Prototype 50 TR (175 kW) Solar Absorption Cooling System, Tadiran ASD





Tadiran ASD Solar Cooling Project

200 TR (700 kW) Solar Absorption Cooling System at Tel-Hashomer Hospital, Israel



Absorption Working Fluid Pairs

- NH_3-H_2O
- H_2O-LiBr
- Other absorbents for NH_3 and H_2O
- Organic absorbents for CFC/HCFC
- Ternary mixtures

- Additives – anti-corrosion, enhanced heat transfer

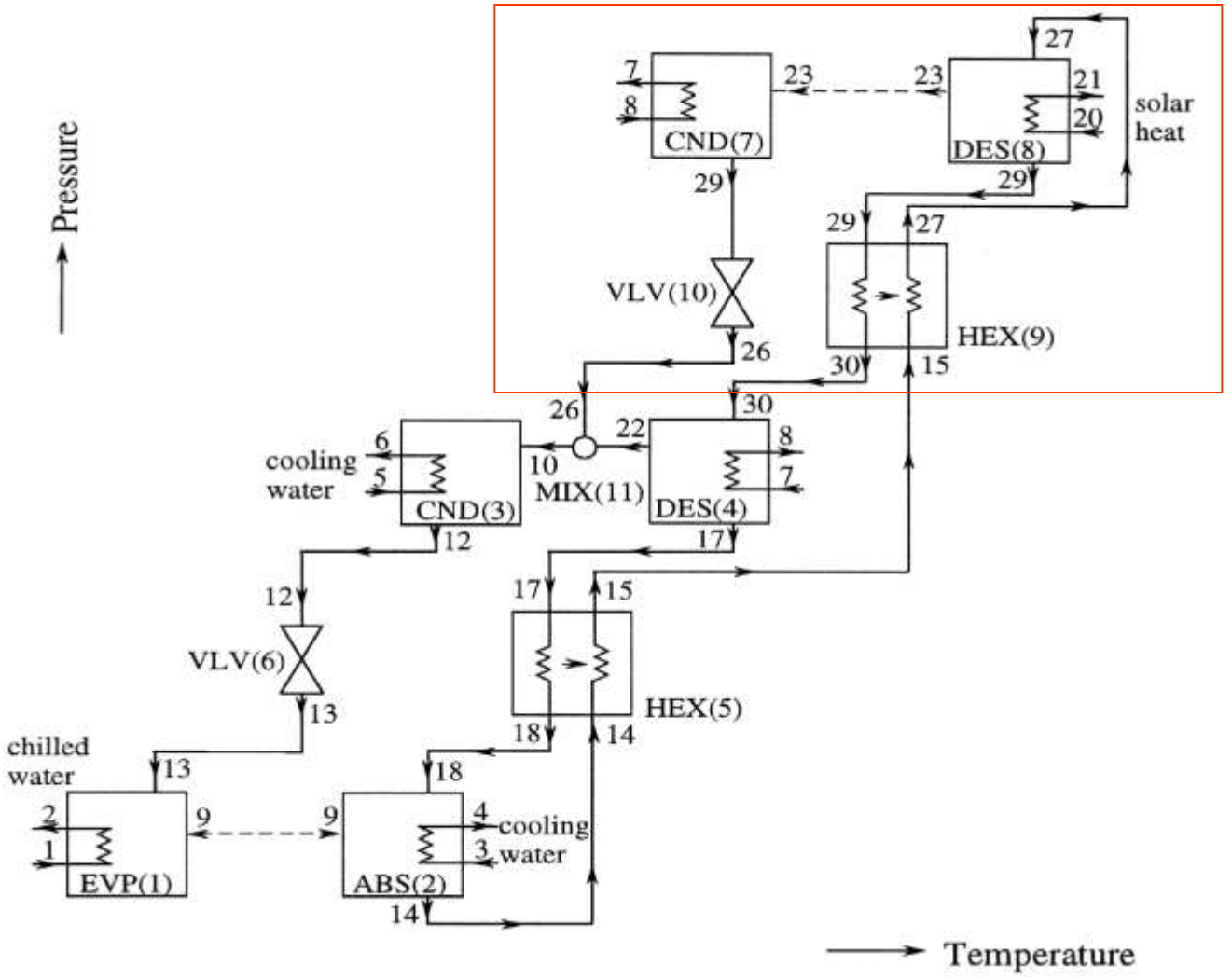
Absorption Systems – first cooling machines in History

- Chemical Heat Pumps – as early as 18th century
- First continuously operating refrigerators – Edmond and Ferdinand Carrè ~1860
- Gas-fired NH_3-H_2O domestic refrigerators up till ww2
- Large-scale H_2O-LiBr chillers powered by waste heat and solar
- Multi-effect gas-fired chillers for A/C ~1980's and on
- Domestic NH_3-H_2O heat pump development

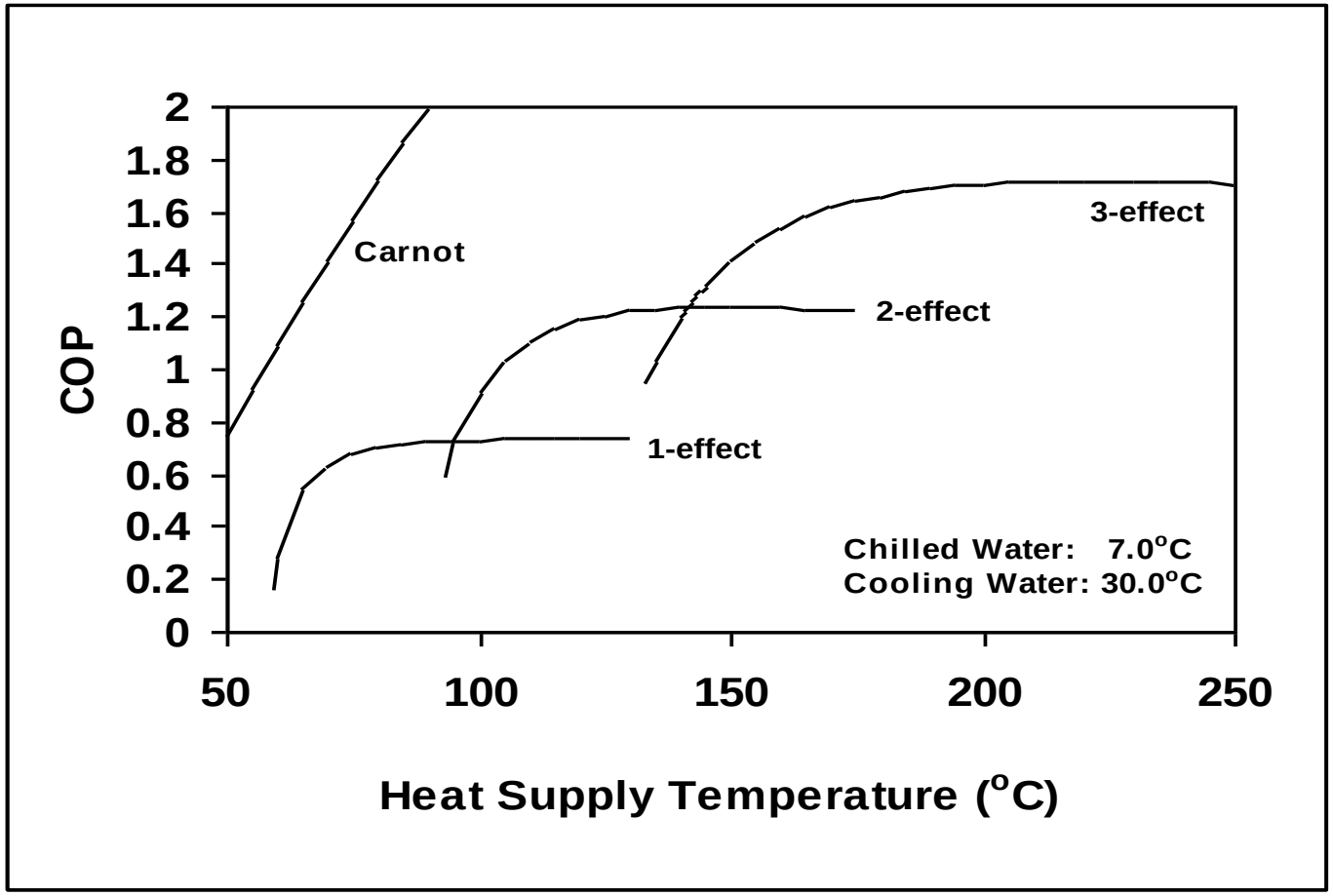
Absorption Multi-Staging

- Staging required to benefit from hi-temp heat source

- Double-effect chillers: Series and parallel connections
- Triple-effect systems
- Cascading



Multi-Staging allows improved performance with high heat source temperatures



Research Needs

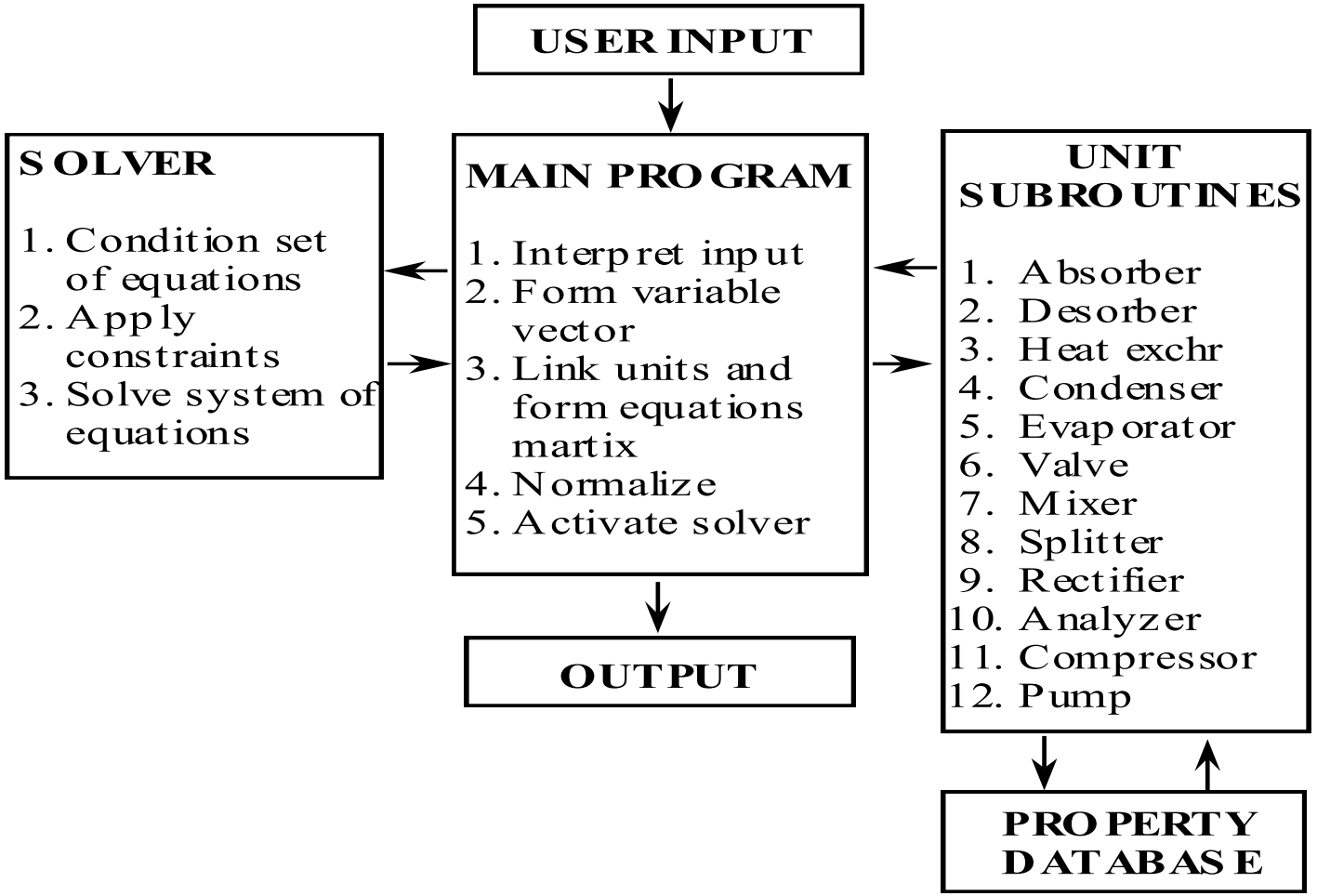
- Advanced cycles
- Advanced fluids
- Heat and mass transfer in absorption/desorption
- System simulation

ABSIM

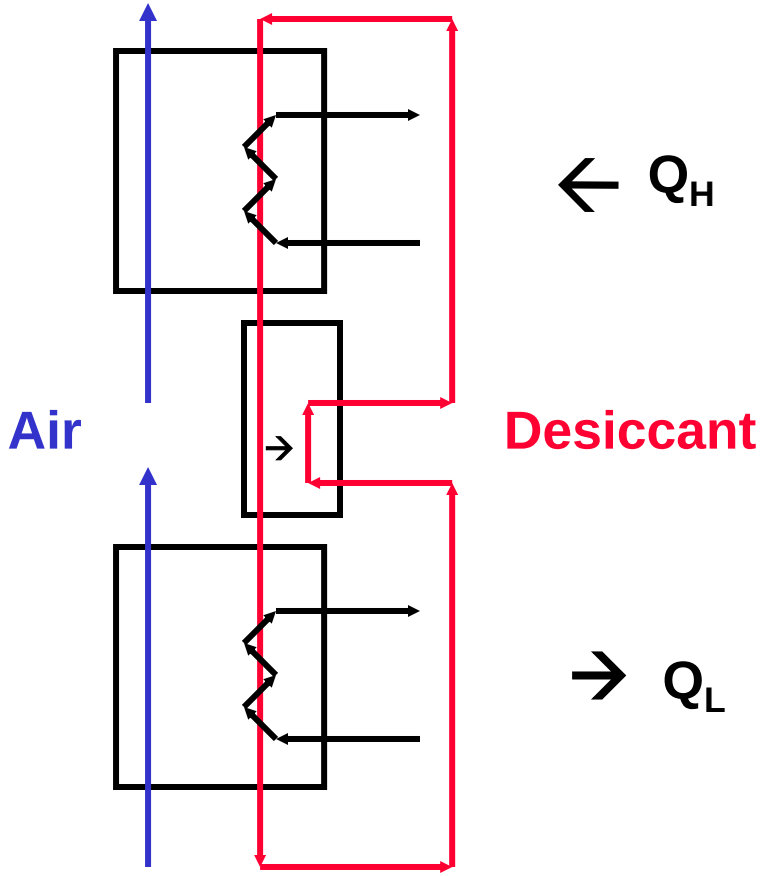
Modular Simulation Tool for Absorption and other Thermal Systems

- User-oriented, modular and flexible
- Evaluate different cycle configurations and working fluids
- Evaluate system performance in off-design conditions
- Perform preliminary design optimization
- Check control strategies

ABSIM - Program Structure



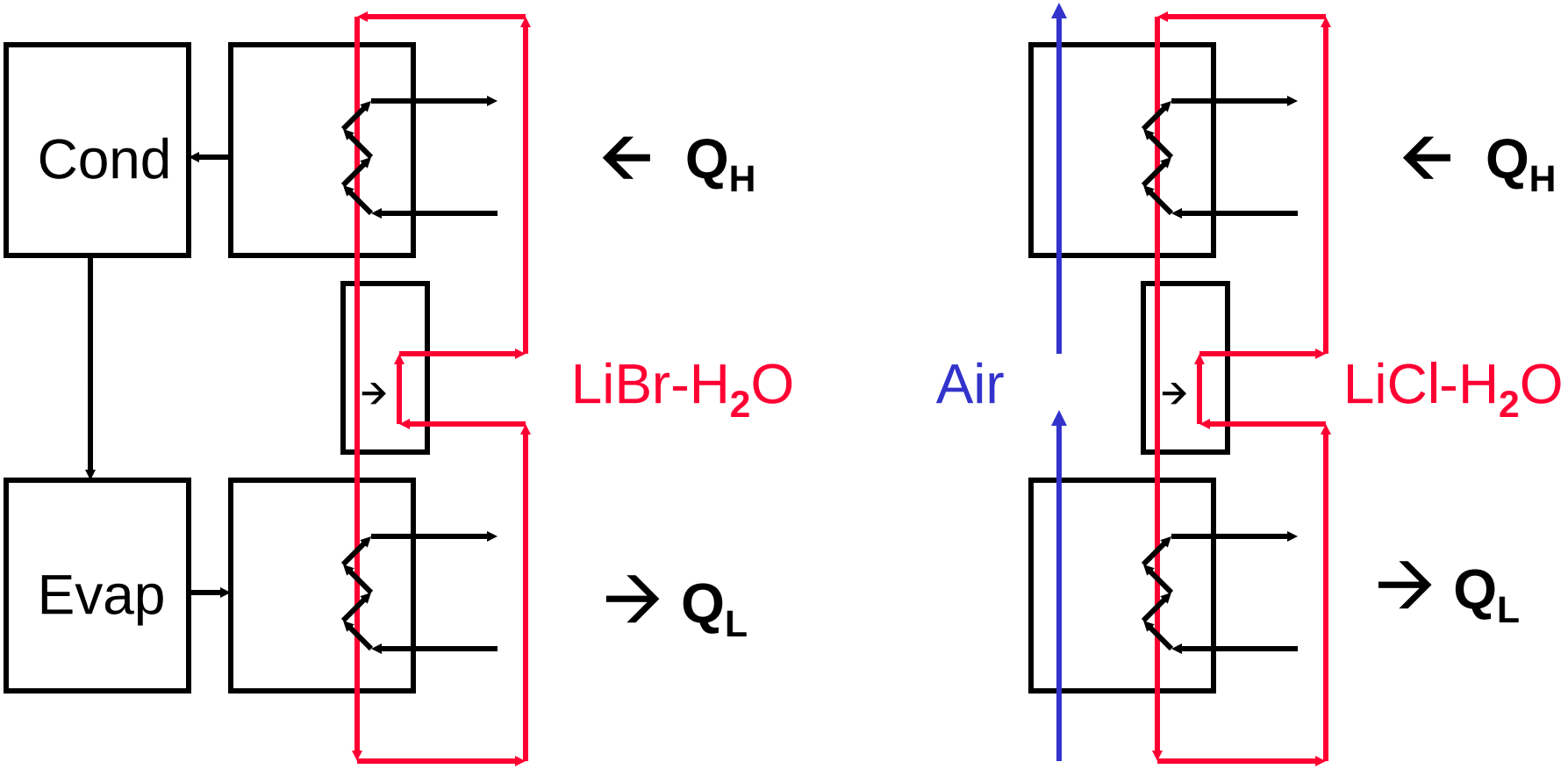
Desiccant System Principle



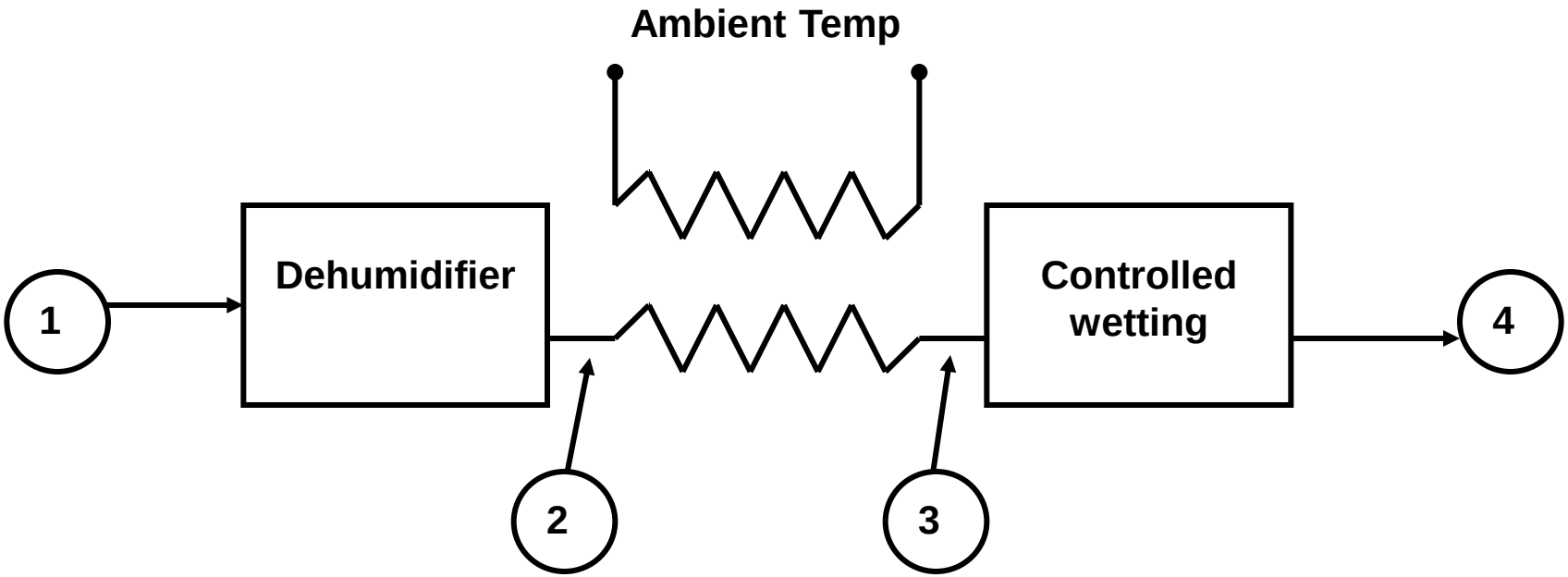
Two types of Desiccants

- Adsorbent
- Absorbent

Liquid Desiccant vs. Absorption



Cooling by controlled drying and wetting



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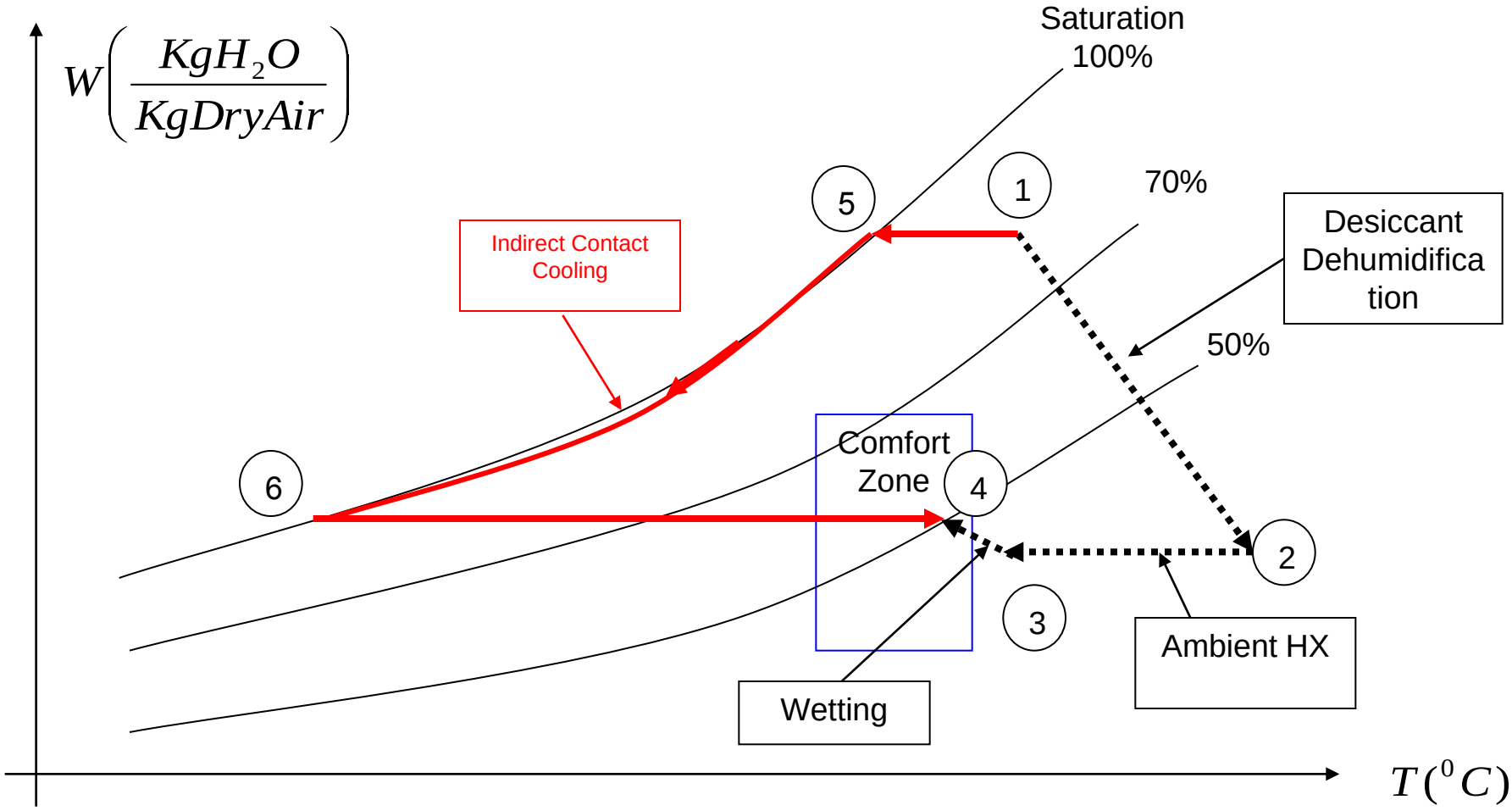
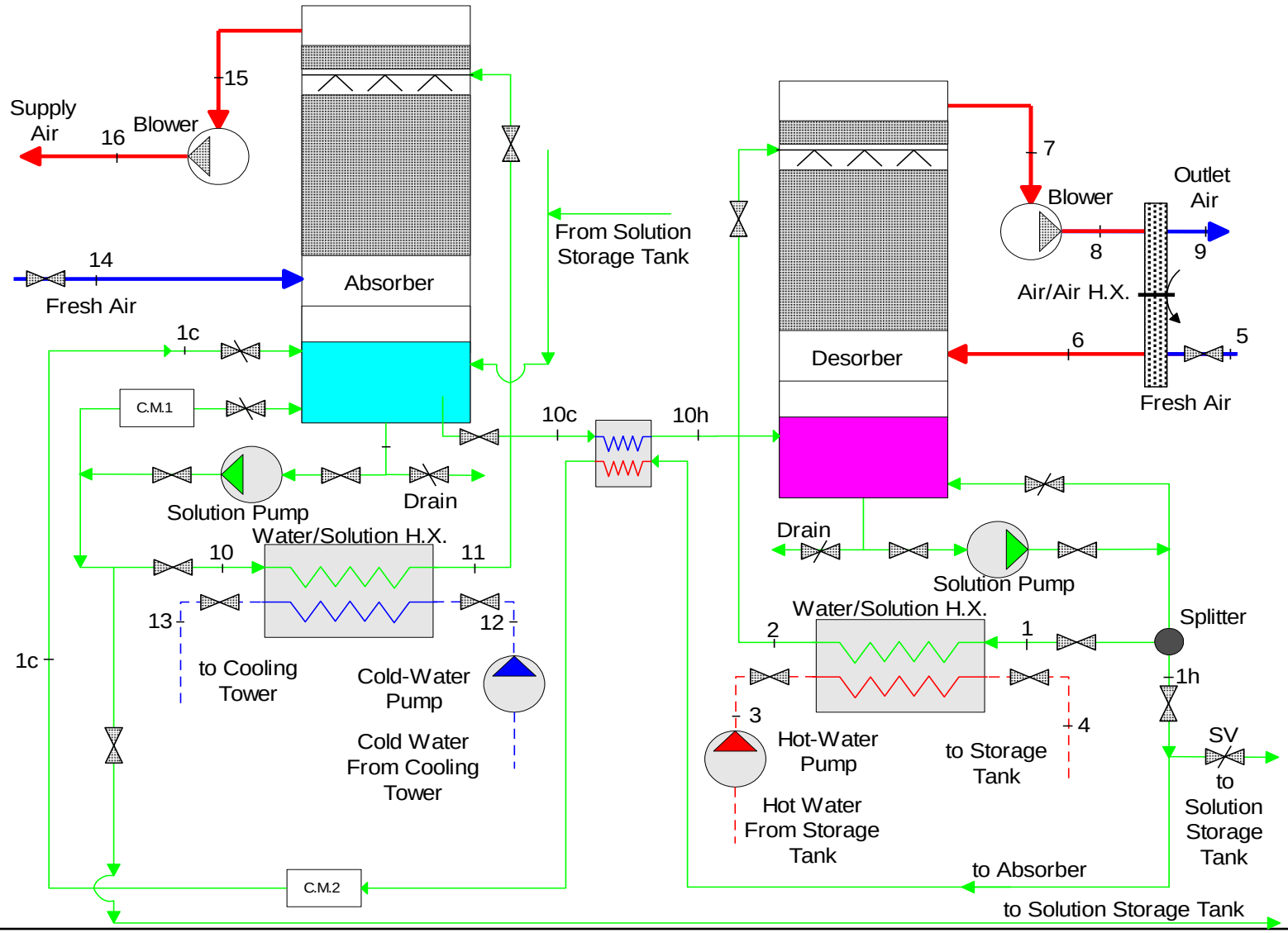
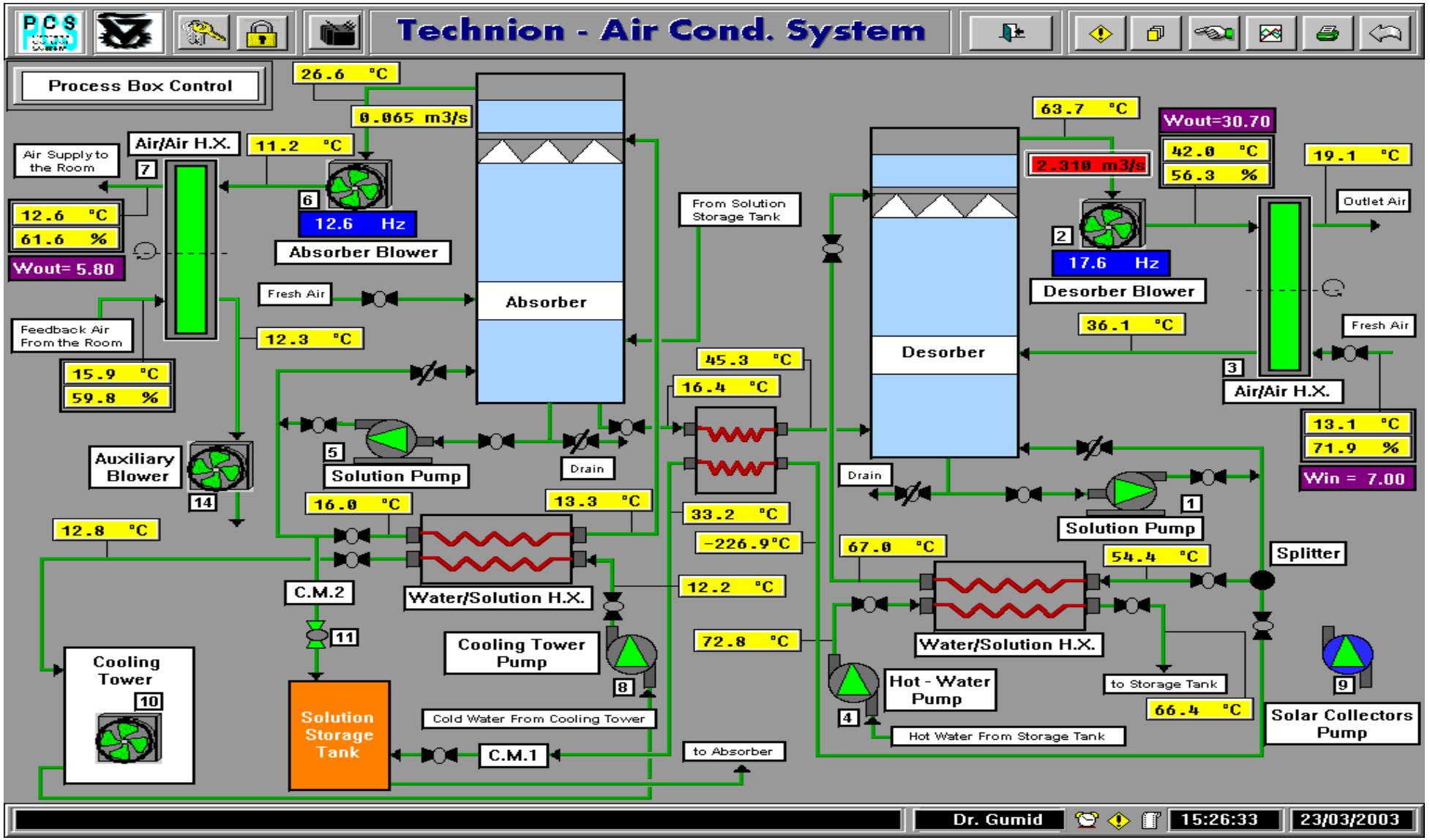


Schematic Description of Desiccant System

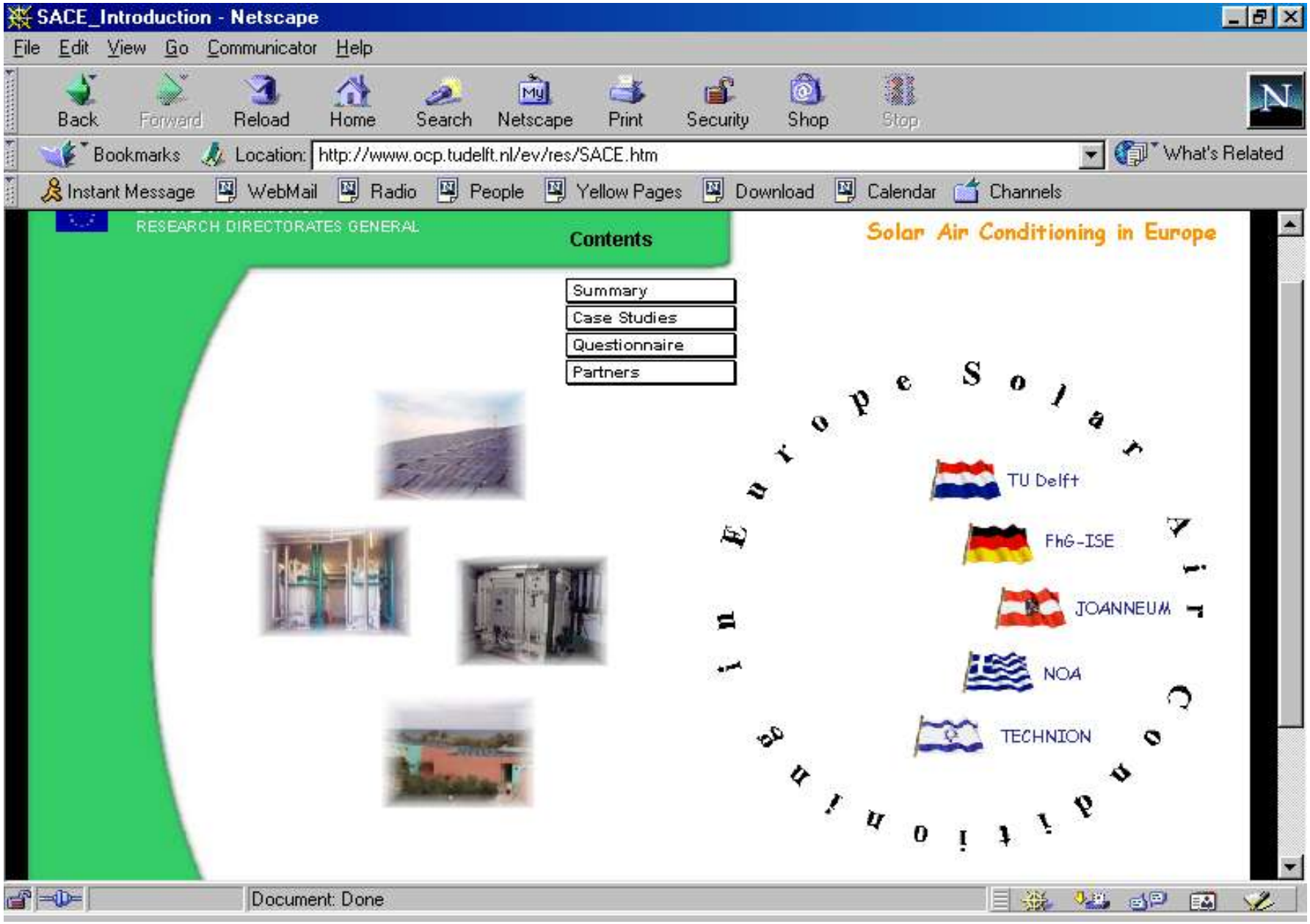


20-kW Solar Liquid Desiccant System at Technion, Haifa, Israel

Control Unit - View of Computer Screen



Solar Collector Field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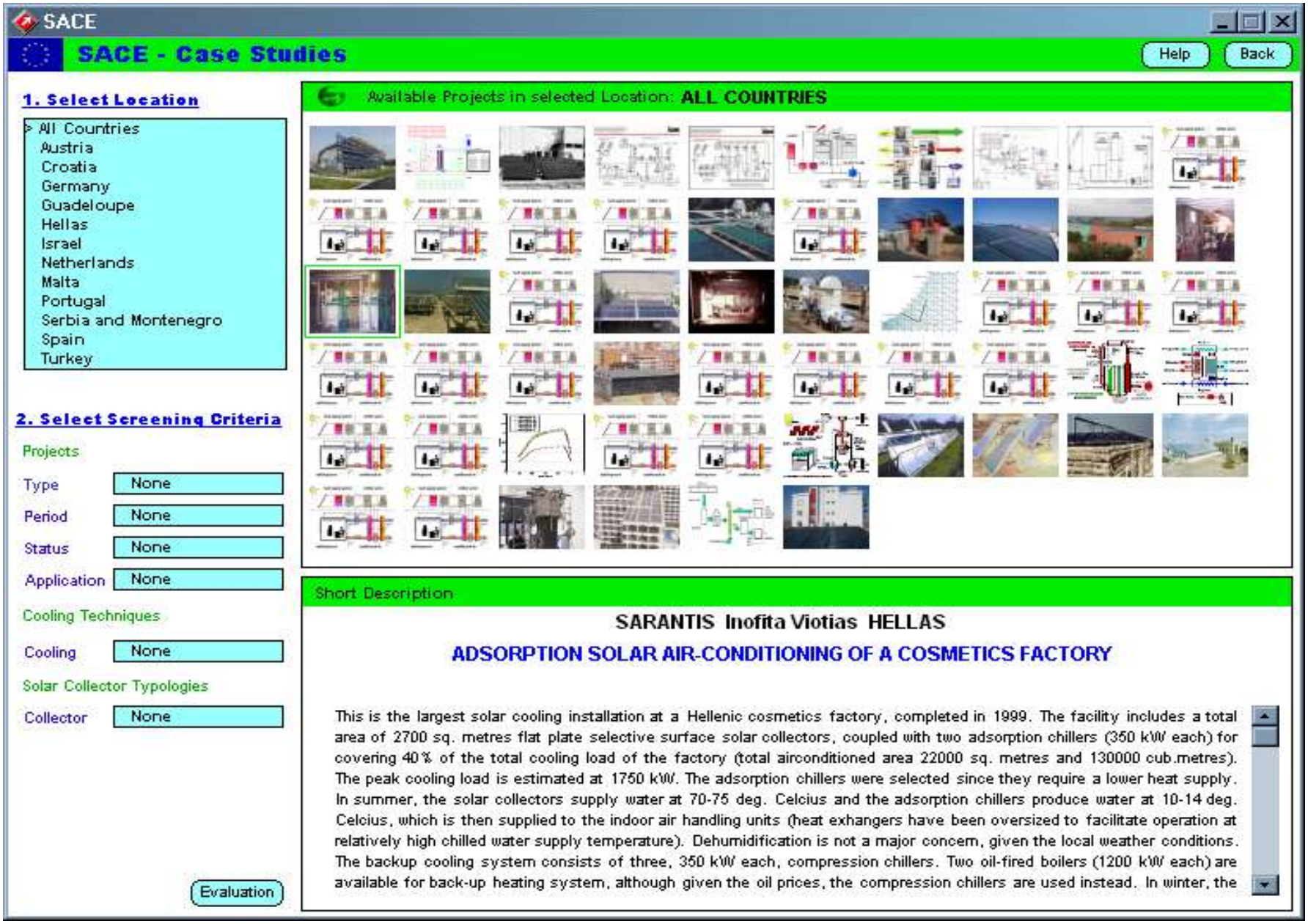
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Short Description
SARANTIS Inofita Viotias HELLAS
ADSORPTION SOLAR AIR-CONDITIONING OF A COSMETICS FACTORY
This is the largest solar cooling installation at a Hellenic cosmetics factory, completed in 1999. The facility includes a total area of 2700 sq. metres flat plate selective surface solar collectors, coupled with two adsorption chillers (350 kW each) for covering 40% of the total cooling load of the factory (total airconditioned area 22000 sq. metres and 130000 cub.metres). The peak cooling load is estimated at 1750 kW. The adsorption chillers were selected since they require a lower heat supply. In summer, the solar collectors supply water at 70-75 deg. Celcius and the adsorption chillers produce water at 10-14 deg. Celcius, which is then supplied to the indoor air handling units (heat exhangers have been oversized to facilitate operation at relatively high chilled water supply temperature). Dehumidification is not a major concern, given the local weather conditions. The backup cooling system consists of three, 350 kW each, compression chillers. Two oil-fired boilers (1200 kW each) are available for back-up heating system, although given the oil prices, the compression chillers are used instead. In winter, the

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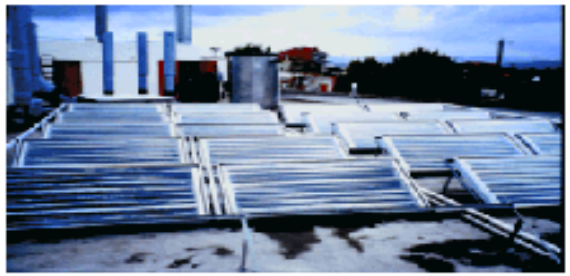

Objectives

The main objective of Task 25 is to improve the conditions for the market entry of solar assisted cooling systems in order to promote a reduction of primary energy consumption and electricity peak loads due to cooling.

Therefore the project aims are:

- The definition of performance criteria of solar assisted cooling systems considering both energy-relevant as well as economic performance
- The identification and further development of promising solar assisted cooling technologies
- An optimized integration of solar assisted cooling systems into the building and the HVAC-system focusing on an optimized primary energy saving - cost performance
- The creation of design tools and design concepts for architects, planners and civil engineers

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TASK 38

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Objectives
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Task 38 - Solar Air-Conditioning and Refrigeration

OVERVIEW

This web site is the official web site of IEA SHC Task 38 "Solar Air-Conditioning and Refrigeration" - a four-year task initiated by IEA Solar Heating and Cooling Programme Implementing Agreement.

Task Information

Duration
1 September 2006 through to 31 August, 2009

Operating Agent
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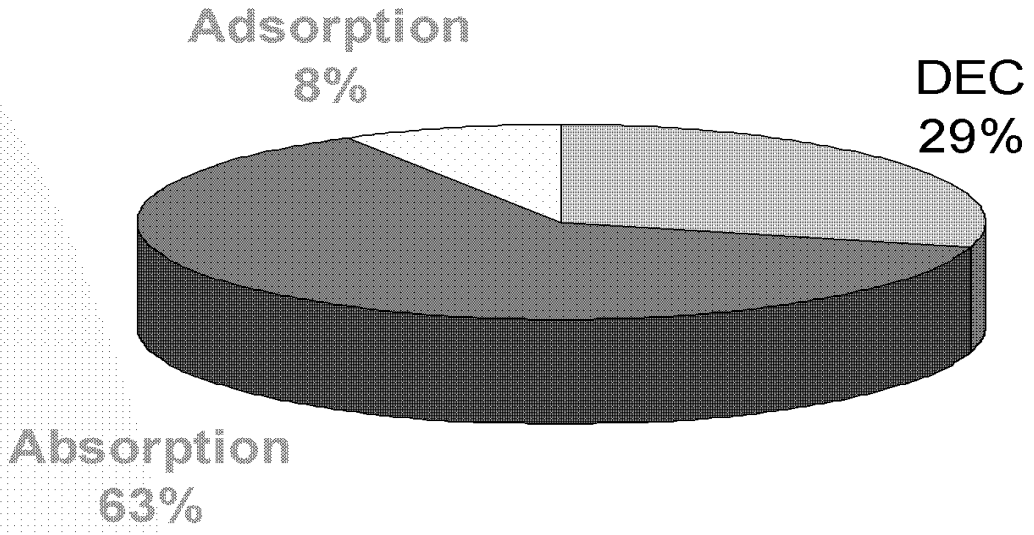
Internet 100%

Market situation

Task 38
Solar Air-Conditioning
and Refrigeration



Thermally driven chiller share : 71%

Source : Task 38 survey ; 75 existing installations with detailed informations (chiller manuf.)

The End

Thank You for Your Attention!