



Industrial Cooling through Hybrid system based on solar heat

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Consortium

Veolia Serveis Catalunya

IDP Ingeniería y Arquitectura Iberia S.L.U.

Bo de Debò

Consiglio Nazionale delle Ricerche

Comet Technology

Fahrenheit AG

R2M Solution SRL

Empa

CiaoTech S.r.l

Ecotherm (takeover of Frexnex)

Austrian Institute of Technology

Givaudan

Ekodenge

Dr. Jakob energy research GmbH & Co. KG

Asociación Española de Normalización



Key objectives

HyCool Project Mission is increasing the current use of Solar Heat in Industry Processes, and to do so the project proposes the coupling of a new Fresnel CSP **Solar thermal collectors (FCSP) system with specially build Hybrid Heat Pumps (HHP)** for a wider output temperature range to increase the potential implementation in industry.

1. **Improve industrial integration** of current Solar Heating Systems;
2. **Achieve a TOTEX cost effective solution;**
3. **Generate trust in the solution** proposed (Chemical and Food Industry).

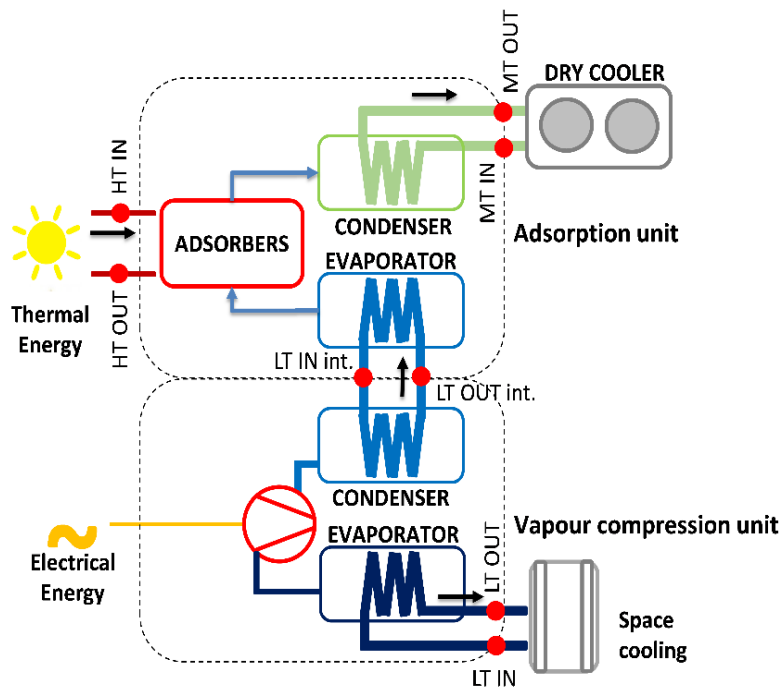


Energy consumption reduction **up to 75 %**

HHP electrical EER of 6

The efficiency increase up to 25%.

Key equipment

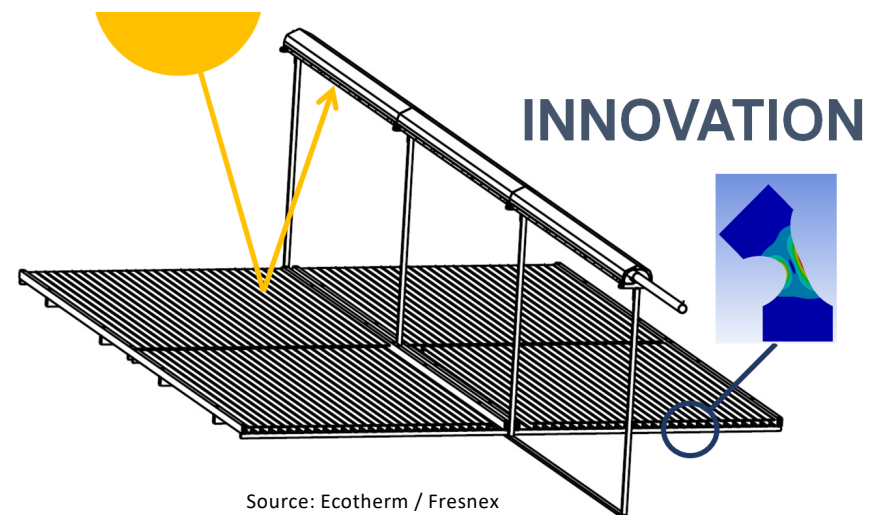


Source: Fahrenheit

Solar steam generation (Concentrating solar collectors)

Hybrid sorption/compression system

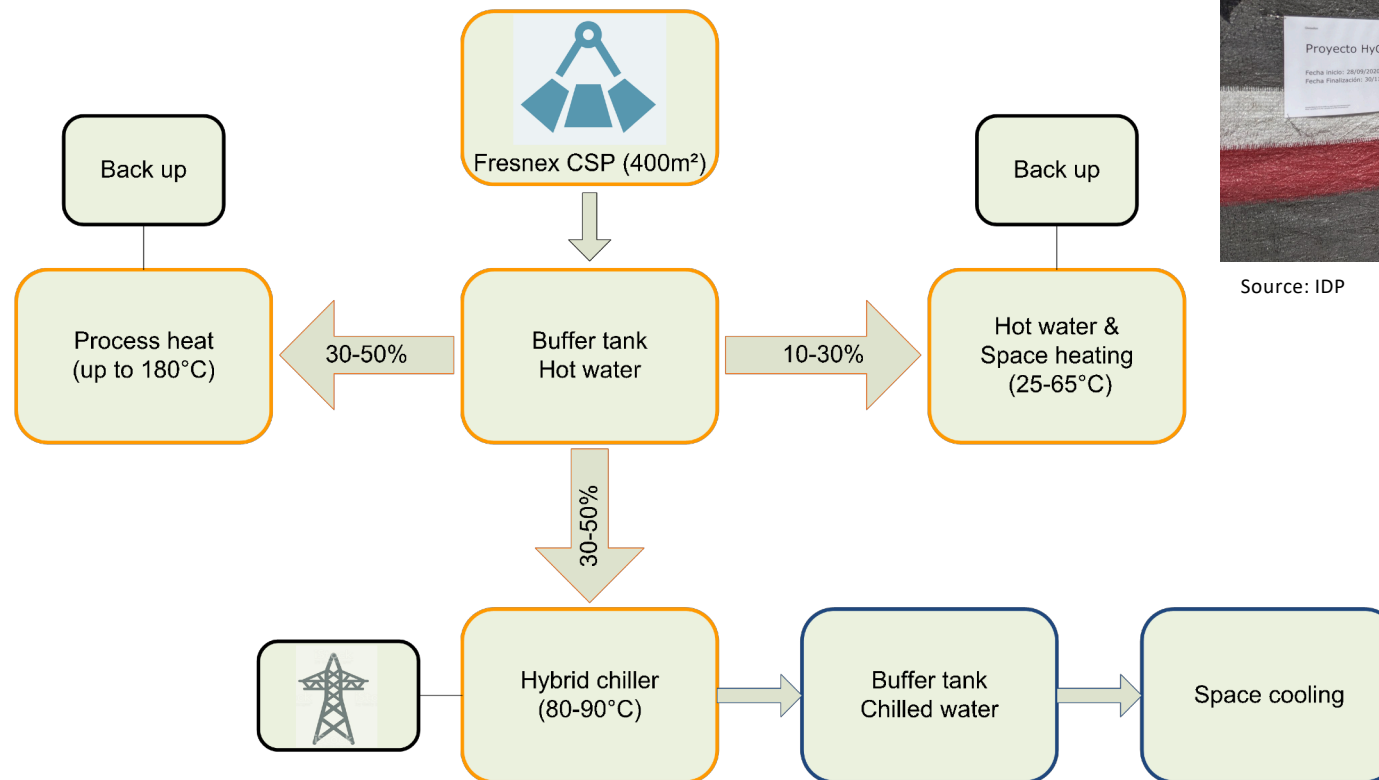
A sorption module, whose evaporator cools down the condenser of a vapor compression chiller (increased electrical EER)



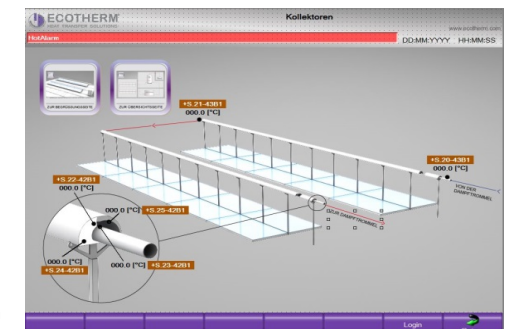
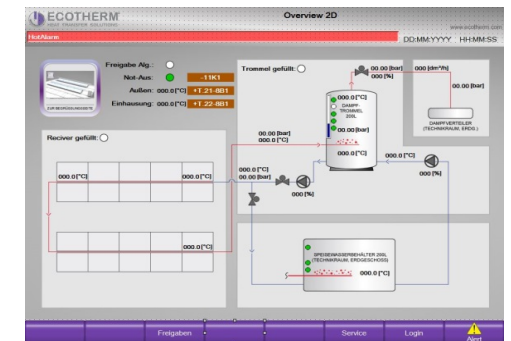
Source: Ecotherm / Fresnex

Integration measures on pilot sites

System integration of solar heat



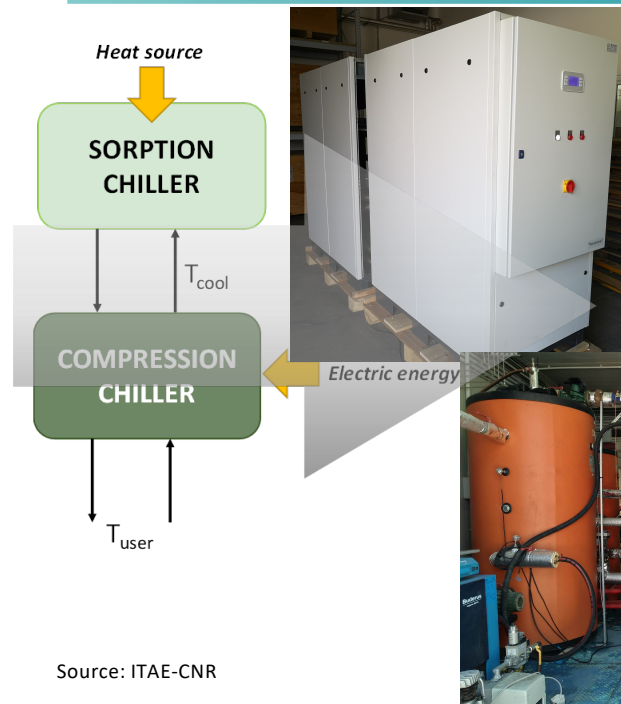
Source: IDP



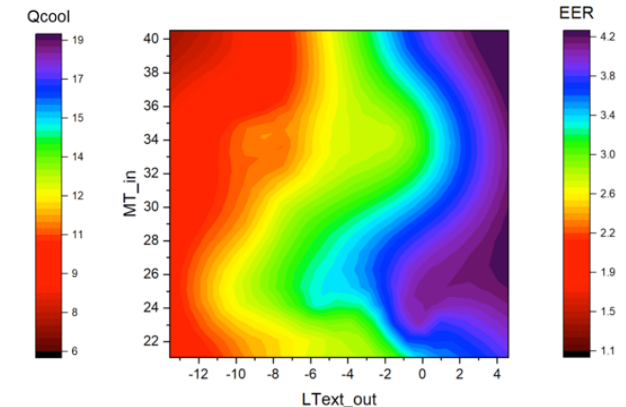
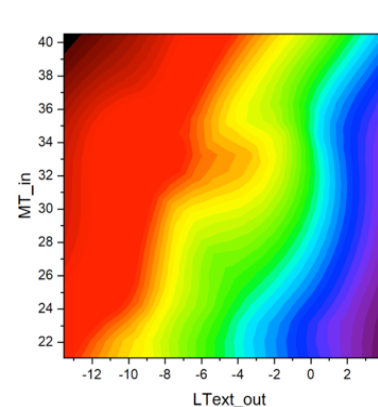
Source: Ecotherm

Monitoring system

Testing of HyCool - solution components



- ➞ Full performance map
- ➞ Definition of reduced models for energy management system implementation
- ➞ Evaluation of achievable savings




TESTING RESULTS IN A NUTSHELL

- ➞ Cooling capacity between 6 kW and 20 kW according to operating conditions. For standard process cooling operation ($T_{amb}=30^{\circ}\text{C}$, $T_{user}=4^{\circ}\text{C}$), cooling capacity is 17 kW, for refrigeration ($T_{amb}=30^{\circ}\text{C}$, $T_{user}=-8^{\circ}\text{C}$) cooling capacity is 11 kW.
- ➞ EER(=cooling output/electricity input) between 1.5 and 4.2. For standard process cooling operation ($T_{amb}=30^{\circ}\text{C}$, $T_{user}=4^{\circ}\text{C}$), EER is 4, for refrigeration ($T_{amb}=30^{\circ}\text{C}$, $T_{user}=-8^{\circ}\text{C}$) EER is 3. Gaining compared to standard compression chillers between **+15% and +25%**.

See also <https://hycool-project.eu/download/experimental-evaluation-of-a-hybrid-adsorption-compression-cascade-chiller-for-solar-cooling-applications-in-industrial-processes/>
<https://hycool-project.eu/download/poster-on-experimental-evaluation-of-a-hybrid-adsorption-compression-cascade-chiller-for-solar-cooling-applications-in-industrial-processes/>

HyCool Pre-feasibility Simulator tool



Project
Consortium
Pilot

HyCool Pre-feasibility Simulator

Dear user, the HyCool team is glad to offer this pre-feasibility evaluation tool designed fo

The tools enables users to evaluate whether or not HyCool technology is suitable for a giv characteristics:

1. Direct Solar Irradiation (DNI) on site
2. Yearly average ambient temperature on site
3. Required cooling process temperature
4. Electricity price: price per kWh of electricity you use for running the chillers on site
5. Yearly full-load operation hours

Once you have entered those values based on suggested intervals, the tool will assess the

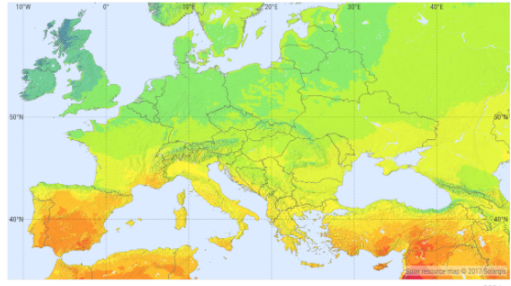
It is important to clarify that the output of this report is a pre-feasibility evaluation. A possible good investment. As a matter of fact, in order to assess the feasibility in a detailed management.

This tool is based on HyCool report D2.1 "Requirements: context of application and industrial (http://hycool-project.eu). You will find all scientific explanations and sources there.

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Industry Sector
Chemicals

DIRECT NORMAL IRRADIATION EUROPE



Average annual sum of DNI period 1994-2016

400 800 1200 1600 2000 2400 kWh/m²

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Solar resource map © 2019 Solargis

Solar irradiation (kWh/m² y)

DNI ≥ 2160

Please enter the yearly solar direct irradiation (DNI) in your location. You can get this information on the image.

Yearly average ambient temperature (°C)

T ≥ 19,2

Please enter the yearly average temperature in your location. A possible source for yearly average ambient temperature is the "Global Solar Atlas".

Industrial process temperature (°C)

T ≥ 16

Please enter the required cooling-process temperature.

Electricity price (€/kWh)

P ≥ 0,14

Please enter the electricity price.

Full load operation hours (h/y)

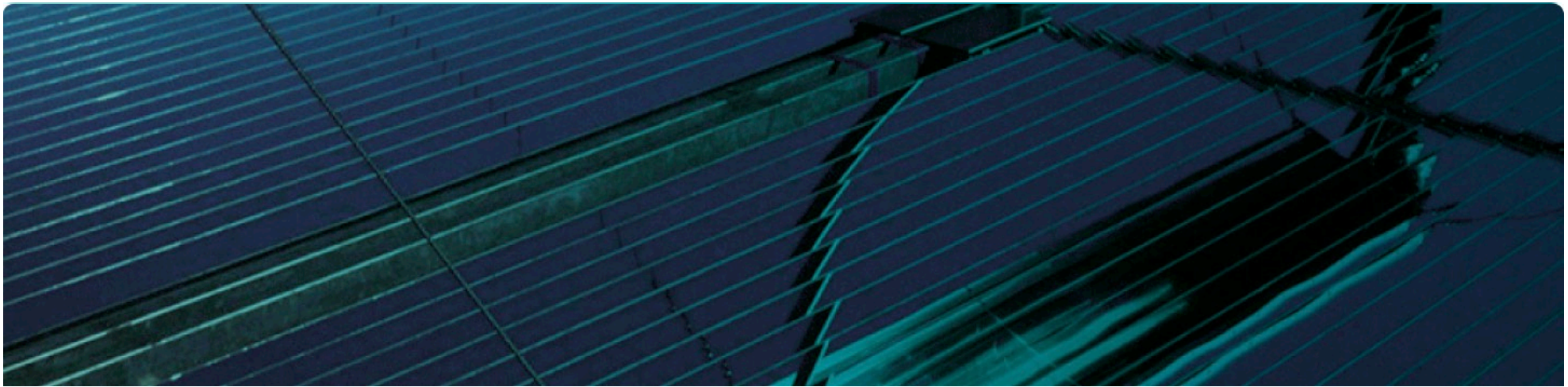
8200 ≤ N < 8760

Please enter the number of yearly full-load operation hours of the cooling process.

☐ I have read and agree to the Privacy Policy

SUBMIT

Exploitation / e-learning



Thank you for your attention

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