# Performance assessment of a small-scale adsorption chiller integrated to an already existing solar heating system


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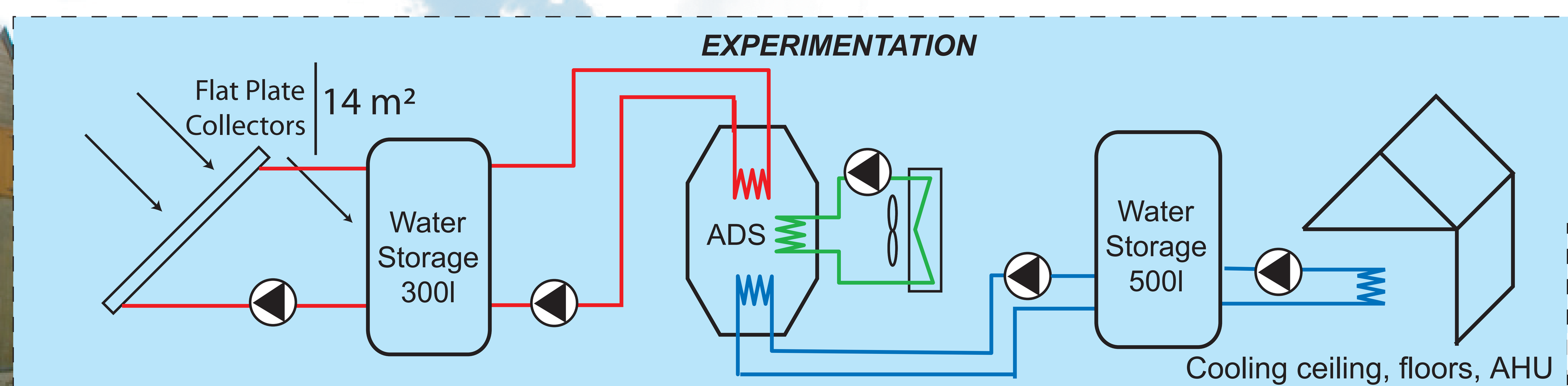
*Objective :* To measure the thermal and electrical energy performance of a small scale air-conditioning system

## Solar air-conditioning system components

A small-scale adsorption chiller was installed in April 2011 in a laboratory building. This building was previously equipped with a fully monitored heat and cold production and distribution system. A solar collector field (14m²) used for building heating and domestic hot water production exists. The heart of the system contains an adsorption chiller INVENSOR LTC09 (9kWcold) nominal power, a dry cooling tower and a hydronic module including pumps.

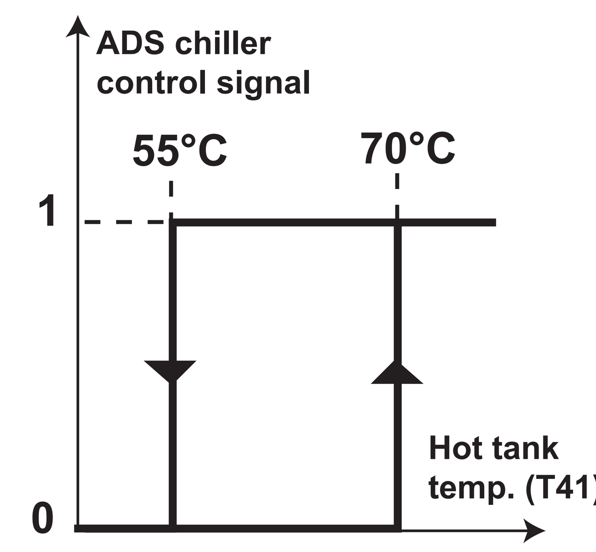



## Control strategy

The main assumption deals with the cooling load. A building with infinite cooling load is considered. In this way the total cold water produced is used to cool the building. This assumption allows to evaluate the chiller performance with a fixed cold water temperature (15-18°C).

Due to the small collector field compared to the adsorption nominal power, the system cycles during the day.

Longest operating period : 3h30min




Solar loop is made of 14 m² flat plate collectors, a draining system and a 300 l hot water storage. Cold water is stored in a 500 l tank and distributed in the laboratory with the air handling unit, a cooling ceiling and cooling floors.

## Monitoring

**Thermal performance measurements :**

temperatures
massflows

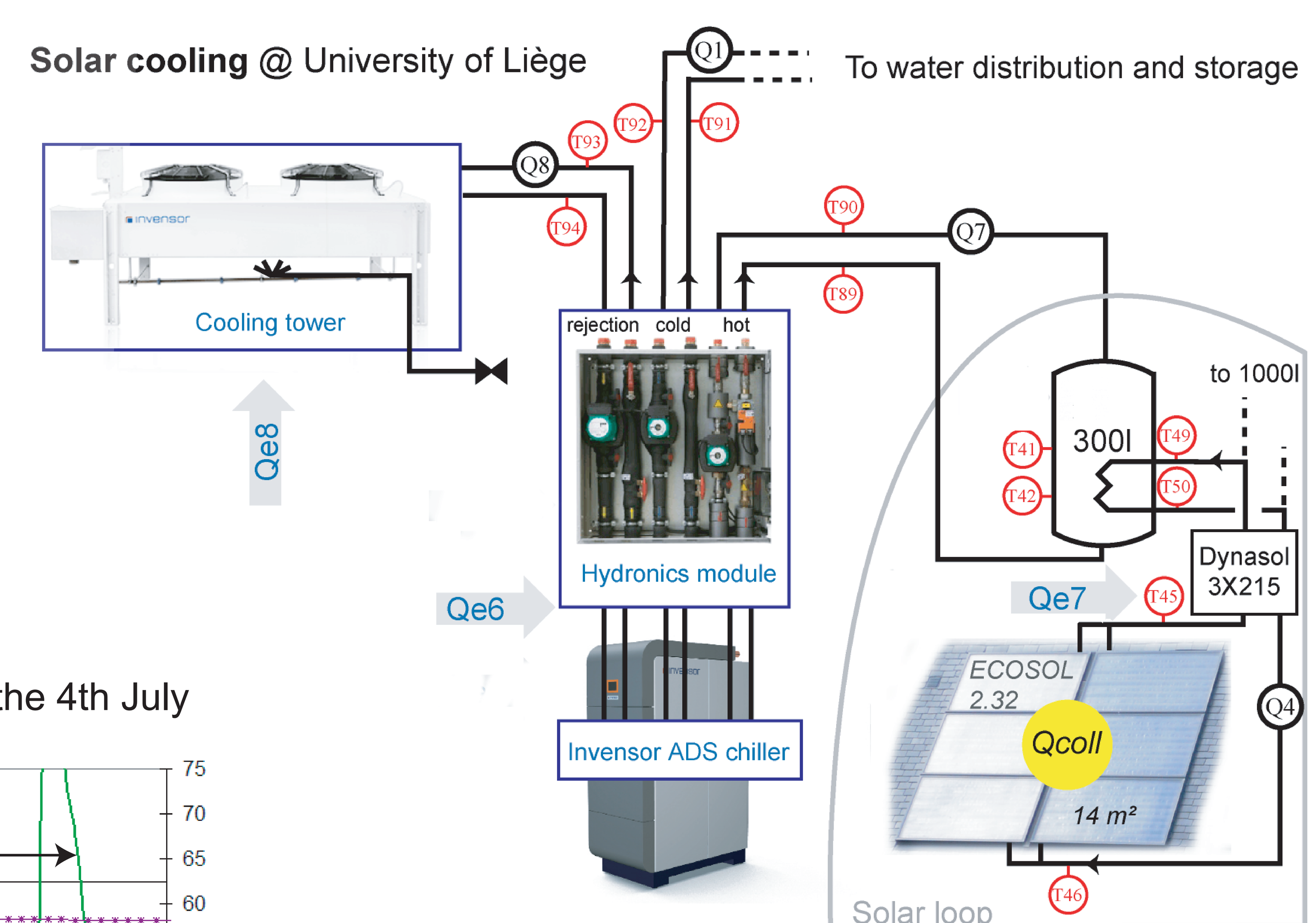
**Electrical performance**

powers Qe6

energy flows COPs

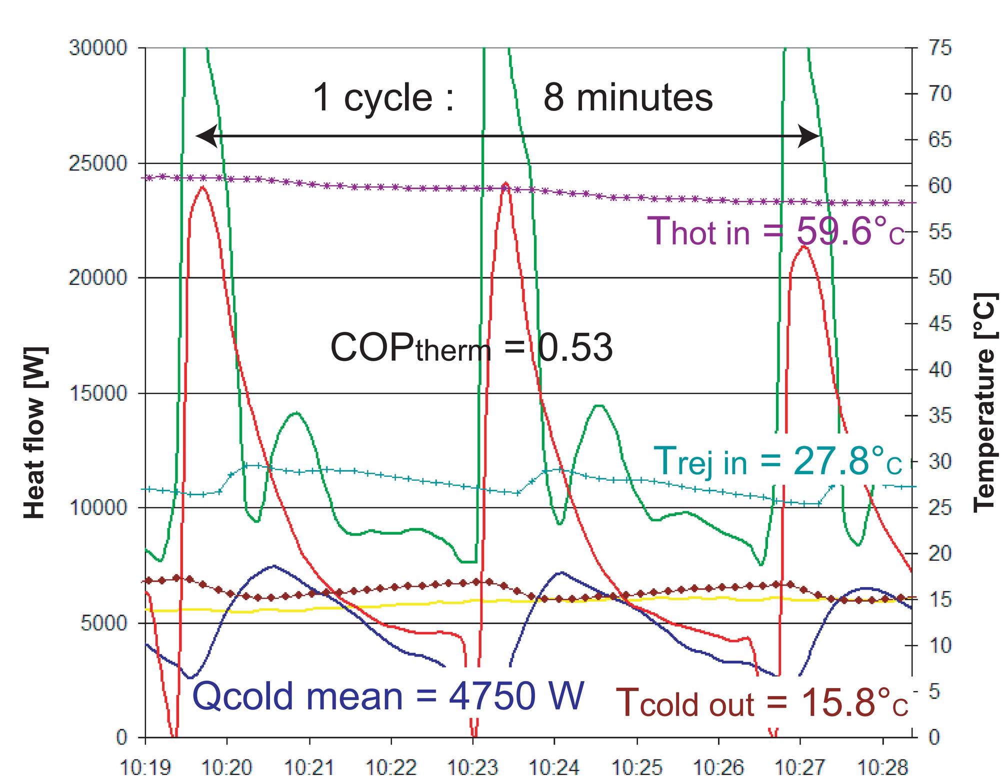
**Meteorological data measurements**

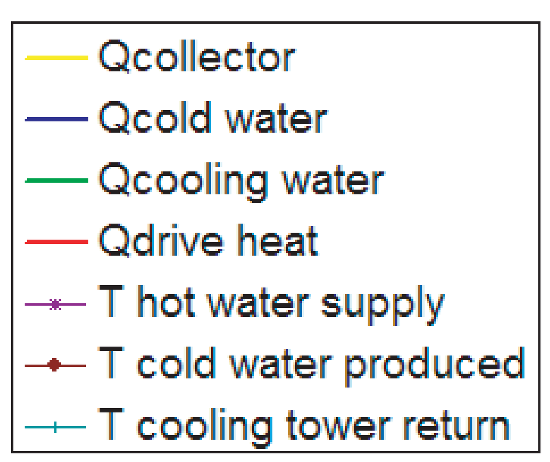
temperature, humidity and solar radiation

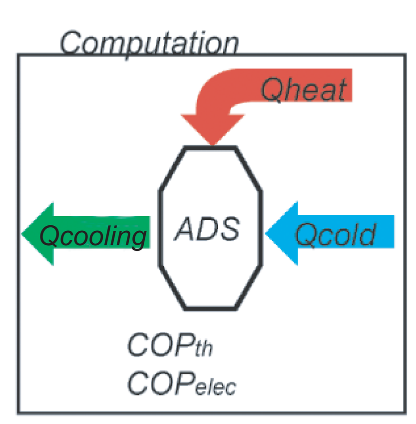



## Typical cycle results

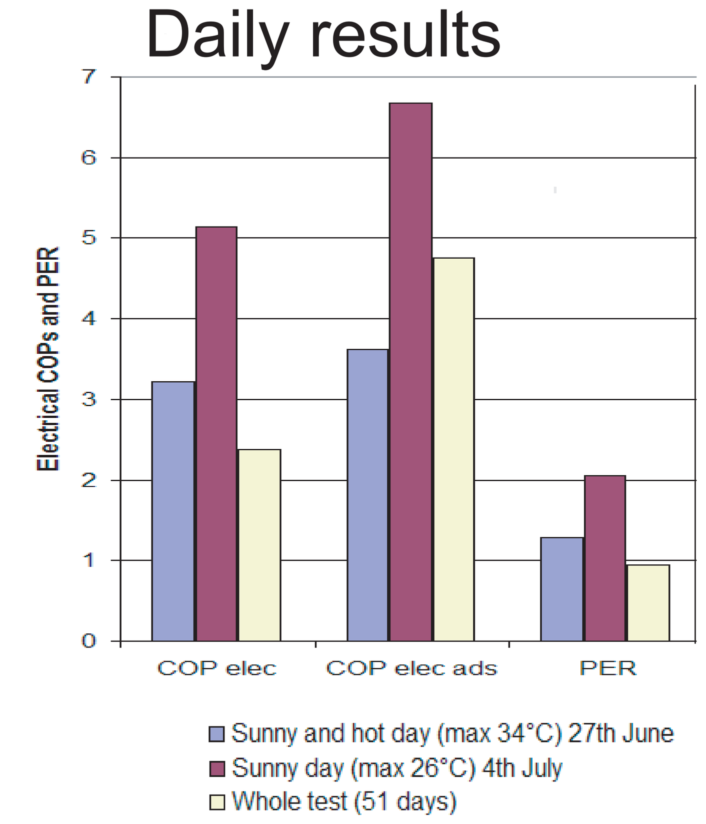
Heat flows of an adsorption cycle on the 4th July

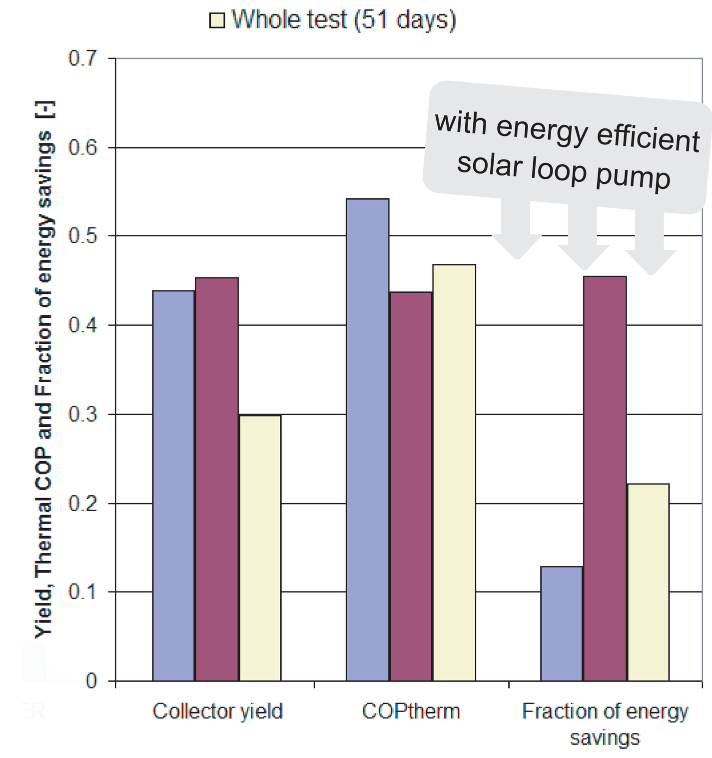



## Daily results




## Results summary

| | Units | Mean value for 51 days | Sunny and hot day 27th June 2011 |
|---|---|---|---|
| Collected solar energy | [kWh/day] | 22.1 | 45.8 |
| Cold energy produced | [kWh/day] | 8.2 | 21.3 |
| Electricity consumed (fans, 4 pumps, ADS chiller) | [kWh/day] | 3.4 | 6.6 |
| Electricity cons. standby | [kWh/day] | 0.61 | 0.56 |
| Thermal COP | [-] | 0.47 | 0.54 |
| Electrical COP | [-] | 2.38 | 3.21 |
| Electrical COPADS only | [-] | 4.71 | 3.62 |
| Collector yield | [-] | 0.3 | 0.44 |
| Primary Energy ratio | [-] | 0.95 | 1.29 |

## Conclusion

**Measurements of the solar cooling systems provide performance indicators. On a thermally point of view, a good COPtherm is achieved (around 0.5). Some enhancements will be done to increase this value.**

**After preliminary tests, a more energy efficient solar pump was installed during the tests. The total electricity consumption remains high and the complete system does not reach high COPelec (5.1 maximum). A spraying kit will be installed ; it will certainly raise this performance indicator.**