Control strategies study of a complete solar assisted air conditioning system in an office building using TRNSYS.



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Objective: Evaluate energy savings of Solar-air conditioning in an office building

Meteorological data layer

Building layer

Solar gains

Solar protections

Appliances gains

Building enveloppe

Emission

Pipes

Pump

FCU

Distribution

Zones

Distribution &

Emission layer

Occupation schedules

People heat gains

Ventilation

H&C Set points

Emission

FCU

Pump

Distribution

Methodology

The development of solar air conditioning (SAC) technology is closely linked to its economical profitability. To check what are the real benefits of SAC installation, it is important to compute the energy savings as well as their essential parameters.

Creation of complete simulation environment let us discover interactions between all sub-parts of the system and gives the possibility to vary many parameters and check their influence on energy consumption for heating and cooling.

These strategies concern following devices operation:

- Solar thermal field
- mass flow variation
 Heat storage
- utilization of heat for building heating or not
- Absorption chiller

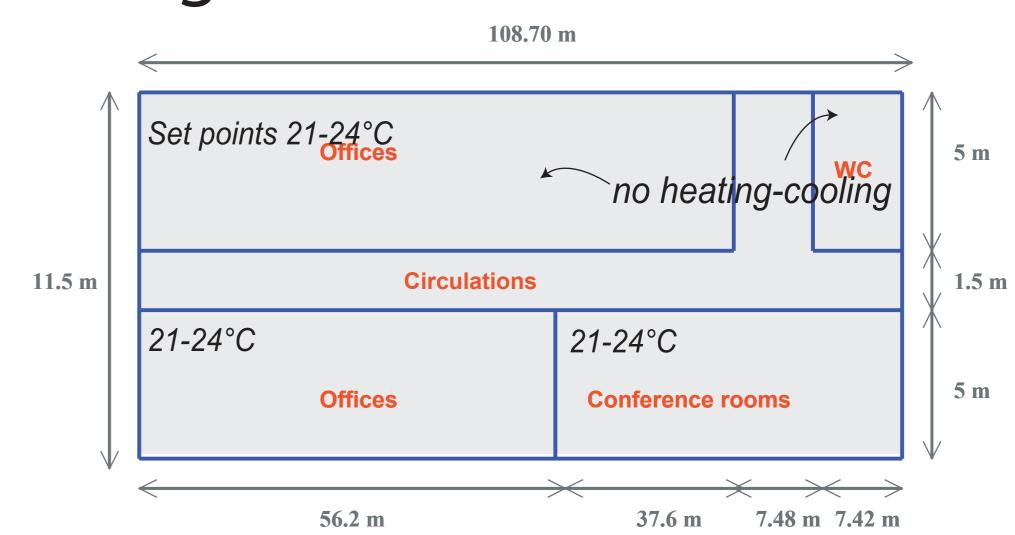
 hot water temperature variation
- Emission devices

 cooling set point variation

Sub-system implementation

Production and storage layer Cooling Boiler Heat ABS tower field Storage chiller **Production & Storage** Boiler ETC Type 71 Type 700 Heat distribution **Emission** network Storage & Distribution Type 534 Pipes 2X Type 34 **Key figures** Heat. coil (OFF1) VCC Absorption Storage tank PI controller H&C Type 655 3X Type 23 chiller 7 m^3 Heat. coil (OFF2) production Type 255 storage Heat. coil (MEE) Absorption chiller Pipes 2X Type 34 **105 kW**c COPnom 0.695 Building Cold Cool. coil (OFF1) PI controller Cooling Backup chiller distribution 3X Type 23 Cool. coil (OFF2) 105 kWc tower network COPnom 3.5 Type 510 Implemented in Cool. coil (MEE) TRNSYS 16 Evacuated tube collector 200 m²

Building characteristics



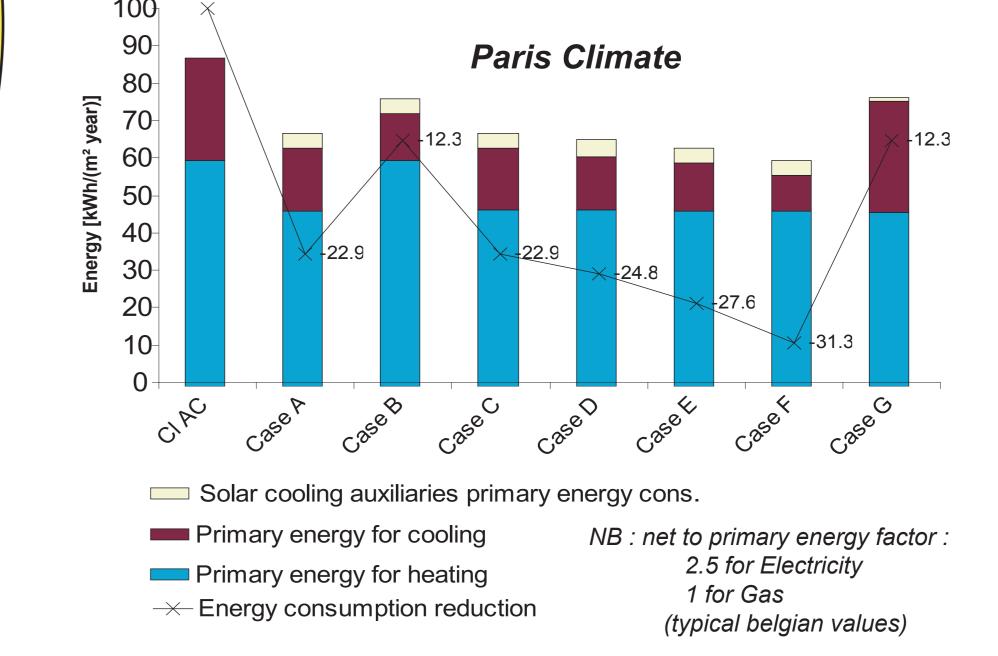
Important features:

- Typical European office building (Case study IEA ECBCS 48)
- 1250m² floor (one floor of 12 floor building)
 - High internal loads (appliances 15 W/m²; light 6-18 W/m²)
 - North-South largely glazed
 - U value of walls = 0.80 W/(m².K);

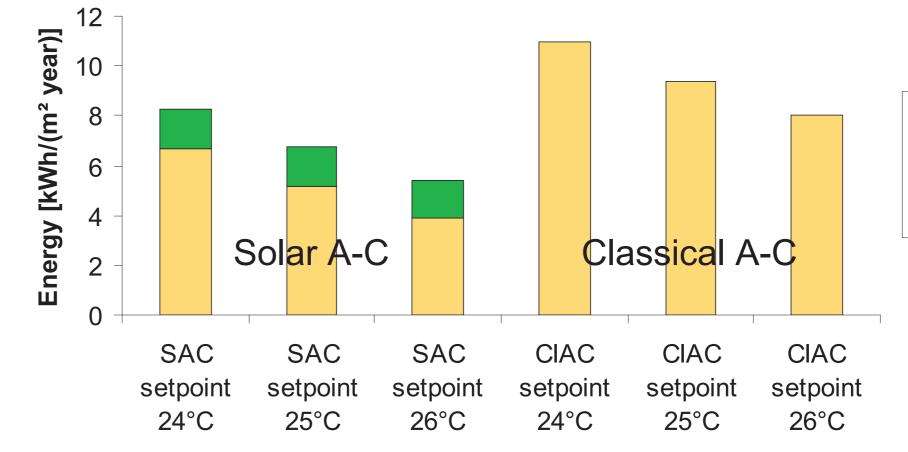
U windows = $2.95 \text{ W/(m}^2 \text{ K)}$

Results

Primary energy for heating and cooling



Net energy for cooling



Auxiliaries net energy consumption
 VCC Chiller net energy consumption

Paris Climate

Paris Climat

Test cases

Case	Features	Primary energy H&C
CIAC	Classical Air-conditioning (Boiler for heating	87.9
	; Vapour compression chiller for cooling)	
A	Base case	67.7
	Cooling setpoint 24°C – 60% RH	
	hour)	[kWh/(m² year)]
	Absorption chiller is switched on when top	[, [,] = 5,]
	tank temperature >83°C	
В	Solar energy not used for heating building	77.1
С	Collector mass flow variation : linear value	67.7
	between 0 and 30 kg/(m ² coll hour)	
	depending on output collector temperature	
D	Absorption chiller can be fed with water from	
	70 to 83°C depending on the cooling load	66.1
Е	Set point is 25°C – 60% RH	63.7
F	Set point is 26°C – 60% RH	60.4
G	Solar energy only used for heating building	77.1

Conclusion

Different scenarios are defined and revealed impact of control on energy consumption. Compared to classical air conditioning, energy savings reach 20 to 30% using solar air-conditioning. Room temperature set point has also great impact.

Other investigations about control can be done in further work. For example, cooling circuit flow and cooling set point variations seems to be crucial for energy savings.