# Rethimno Village Hotel

## Summary:

| | | | |
|---|---|---|---|
| **Country** | *GREECE* | **Collector area** | *Total: 647 m², 448 m² for solar cooling* |
| **Location** | *CRETE RETHIMNO* | **Collector type** | *Flat plate solar collectors-selective surfaces* |
| **Building** | *HOTEL* | **Cooling capacity**<br>**Heating capacity** | *105 kW*<br>*210 kW* |
| **Technology** | *ABSORPTION* | | |

**Main positive points :**

Commercial Installation, 1st hotel in the world using solar cooling.
Contribution to the environment.
Contribution to the company.
Contribution to the National energy balance sheet.

## Building description:

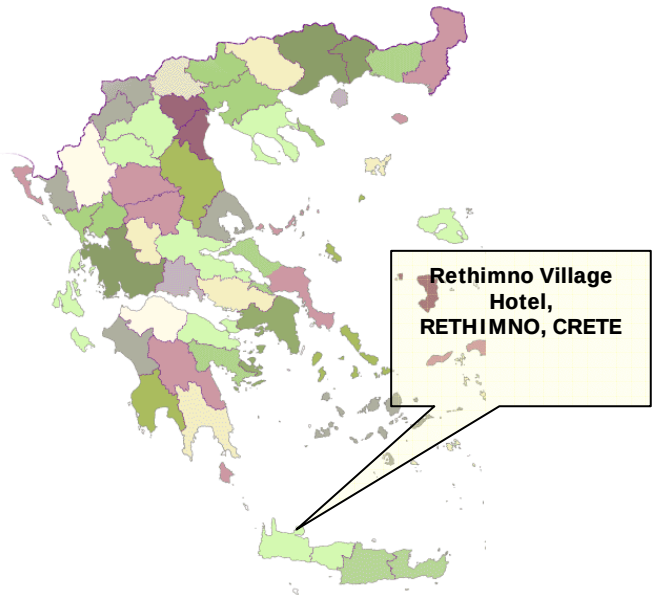
The “Rethimno Village” hotel is located in Rethimno Crete, in southern Greece. It caters mainly for tourism; with a bed capacity of 170 beds, and it has a 100% occupancy rate in the summer and a 45% occupancy rate in the winter.

This installation uses flat plate collectors (selective surfaces, 448 $m^2$) for central air conditioning (cooling and heating) and also 199 $m^2$ polypropylene collectors provide hot water for the heating of the swimming pool.

The design, supply and installation of this system was done by SOLE S.A.

Total air conditioned area: 3.000 $m^2$

Commencement of operation: 11/09/2000



**Picture 1 :** The solar collectors (647 $m^2$) of Rethimno Village hotel, located on the roof of the hotel.

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**Picture 2:** View of the installed solar collects of Rethimno Village hotel

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**Picture 3:** Different view of the installation, Rethimno Village hotel

# *Cooling requirements:*

Informations about: local climate, thermal loads….

Latitude: 35 21 N
Longitude: 24 31 E

| Sunshine duration (h) | Average air temperature | Net Maximum Temperature | Net minimum Temperature | Relative humidity | Average cloudiness | rainfall | Wind direction |
|---|---|---|---|---|---|---|---|
| h | oC | oC | oC | % | 8 | mm | |
| 110,8 | 12,9 | 24,9 | 0,8 | 69 | 5,6 | 153,5 | S |
| 132,2 | 13,1 | 25,4 | 2 | 67 | 5,3 | 88,9 | N |
| 157 | 14,4 | 28,5 | 3 | 65 | 4,6 | 69,7 | N |
| 218 | 17 | 33,2 | 5,4 | 64 | s3,8 | 38,1 | N |
| 309 | 20,7 | 37 | 9,6 | 64 | 2,7 | 8,7 | N |
| 335 | 24,9 | 37,5 | 13,6 | 61 | 1,6 | 5,3 | N |
| 373,1 | 26,8 | 41,4 | 15 | 60 | 0,9 | 0,1 | N |
| 350,2 | 26,9 | 39,3 | 16,4 | 61 | 1 | | N |
| 263,7 | 24,3 | 38 | 13,6 | 64 | 2,4 | 19 | N |
| 166,1 | 20,9 | 35 | 8,8 | 67 | 4,1 | 104,9 | N |
| 165,8 | 17,9 | 30,5 | 6,9 | 68 | 4,3 | 49,7 | N |
| 112,9 | 14,9 | 28 | 2,4 | 67 | 5,3 | 104,5 | S |
| 2694 | | | | | | | |
| 1968-72/π | | | | | | | |

ΠΙΝΑΚΑΣ 1: **Cooling – heating and hot water needs.**

| ΜΗΝΑΣ | COOLING | HEATING | HOT WATER | TOTAL |
|---|---|---|---|---|
| Ιανουάριος | - | 42.408 | 8.010 | 50.418 |
| Φεβρουάριος | - | 51.072 | 9.760 | 60.832 |
| Μάρτιος | - | 63.612 | 13.480 | 77.092 |
| Απρίλιος | - | 61.560 | 19.580 | 81.140 |
| Μάιος | 73.153 | - | 24.290 | 97.443 |
| Ιούνιος | 125.856 | - | 26.130 | 151.986 |
| Ιούλιος | 162.564 | - | 27.000 | 189.564 |
| Αύγουστος | 162.564 | - | 27.000 | 189.564 |
| Σεπτέμβριος | 125.856 | - | 26.130 | 151.986 |
| Οκτώβριος | 78.030 | - | 21.600 | 99.630 |
| Νοέμβριος | - | 41.040 | 13.070 | 54.110 |
| Δεκέμβριος | - | 38.167 | 8.010 | 46.177 |
| **TOTAL (KWh)** | **728.023** | **297.859** | **224.060** | **1.249.942** |

The swimming pool needs between February and November are 248.305 KWh according to the chart below; they are equal to the total collectors output since there is no back up system available.

ΠΙΝΑΚΑΣ 2: **Collector output equal to the total swimming pool load.**

| Μήνας | Φορτίο (KWh) |
|---|---|
| 2 | 10.690 |
| 3 | 17.830 |
| 4 | 24.140 |
| 5 | 32.470 |
| 6 | 35.160 |
| 7 | 38.020 |
| 8 | 34.250 |
| 9 | 26.330 |
| 10 | 17.527 |
| 11 | 11.888 |
| **ΣΥΝΟΛΟ (KWh)** | **248.305** |

# *Air conditioning system description:*

The solar collectors supply an absorption chiller with hot water of temperature 70-75 °C which operates with a coefficient performance of 60%.

The absorption chiller, uses the hot water as source of energy and produces cool water of temperature 8-10 °C. The cooling medium is also water (instead of Freon or Ammonia).

This is achieved within the condensation and evaporation of the coolant (water) in vacuum. The absorption chiller doesn't consist of movable parts and use minimum electric energy for the operation of the vacuum pump (0.5 kW).

The useful power is 105 kW. Also a boiler of 600 kW substitutes the collectors field when there is cloudiness or whenever there is need for air-conditioning during the night.

During the winter period the solar collectors produce hot water of 55 °C, which is circulated directly to the fan coil units in the building. The same boiler replace the collector field in case of overcast. The cold water (during the summer period) and the hot water (during the winter period) is directed to the local air-conditioning units where they cool or heat respectively the ambient air within physical procedures.

**Figure 1:** General diagram of the system

**Picture 4 :** Absorption chiller

**Picture 5:** Flat plate selective solar collectors

**Picture 6:** Solar polypropylene collectors for swimming pool heating

# Technical results:

Annual results
Solar Energy output: 650.743 KWh
Total Energy load: 1.498.247 KWh
Solar coverage: 43%

# Financial aspects:

Investments costs, subsidies, financing method, operation costs, financial savings

Total cost of investment: 264.123 €
The project was subsidized up to 50 % by National Operational Programme for Energy (of the Greek Ministry of Development)

# Environment:

Environmental savings, primary energy savings…

Primary Energy Savings: 650.743 kWh/year

Environmental Savings: Emissions Reduction

| | |
|---|---|
| **$CO_2$** | **1.094.972 kg/year** |
| **$SO_2$** | **17.919 kg/year** |
| **$CO_2$** | **187 kg/year** |
| **$NO_X$** | **1.463 kg/year** |
| **HC** | **53 kg/year** |
| **Particulars** | **923 kg/year** |

# Opinions:

The owners of the building are really very satisfied by all aspects of their investment, i.e. financial, environmental, etc., They also believe that the whole project contributes to the ecological image of their company to their clients, employees, the government and the public. The project has been awarded by CRES in Greece (Center of renewable energy sources) as the best investment in Greece for the year 2000.

# Contact:

Address, e-mail or web-site for more information

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# Conclusion:

Summary of the major positive points of this installation (to give convincing arguments to go for solar air conditioning)