## Example name: Church rectory, Bocognano, Corsica, France

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**For installations**

BISTS Location: *Corsica,*
*Latitude N 42°04'50"*
*Longitude E 09°03'44"*
*Altitude 651 m*
Climate Type: *Csa*
Building Use: *residential*

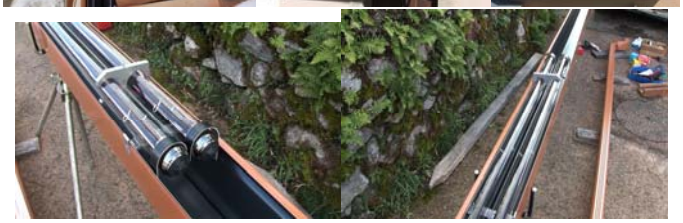
Level of BISTS
1. Applied invisibly
2. Added to the design

O New Build
⊙ Refurbishment
O Other: ……

**Type of BISTS**:

Active

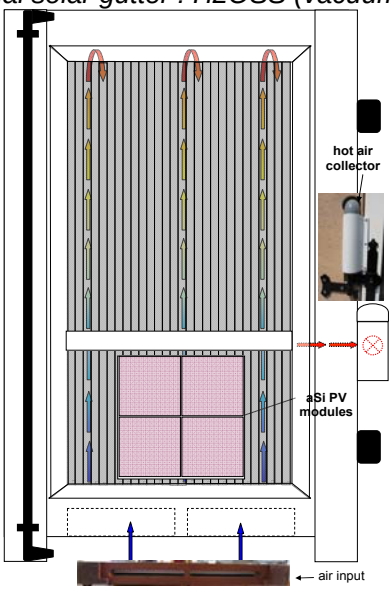
Function(s):
⊙ Air heating
⊙ Water heating
O Combi-system
O Cooling/ventilation/shading
O PV/T
O linked to another system (e.g., heat pump)
O Other: ……



*Thermal solar gutter : H2OSS (vacuum version)*

**Building element:**

O Facade
O Roof
⊙ Other: Windows (shutter), Gutters, Metal Porch roof




*Solar air shutter : Volet'air*

**BISTS characteristics**:

This residential house is composed of four small apartments. Two Integrated Solar Domestic Heat Water systems are installed in these apartments. One is integrated on a metal porch roof and one into the gutters. The area of the gutter solar collector and a part of area of the solar metal porch roof are connected to one tank for two apartments (rural tourism houses -collector area 1.80 m²). The other part of area of the solar metal porch roof is connected to another tank for the others apartments (church rectory - collector area 2.02 m²/ 43°tilted). The usages of these apartments are different: Two of them are for tourist's location, booked half the year and the other are used all the year.

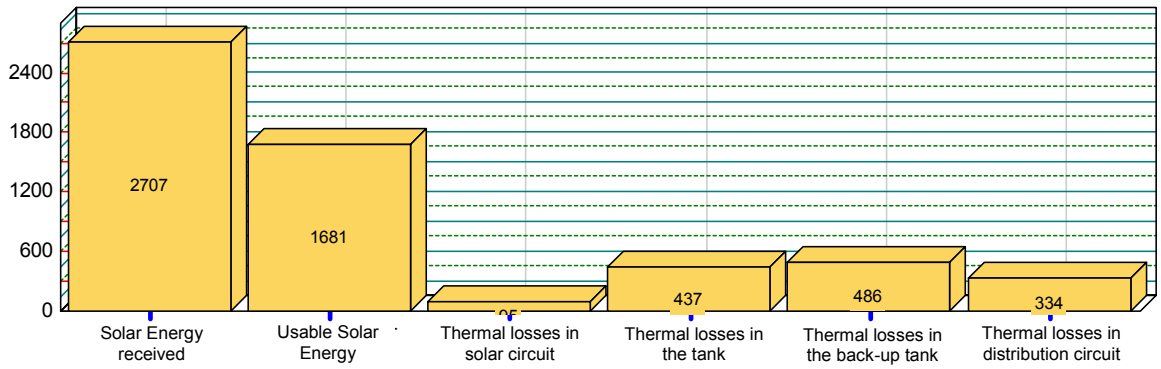
The thermal solar collector is totally invisible from the ground level thanks to the drainpipe integration; it is arranged so it can also be used on north oriented walls (being oriented south into the drainpipe). The drainpipe preserves its role of rainwater evacuation. The canalizations connecting the house to the solar collector are hidden in the vertical drainpipe. An installation consists in several connected modules. We have two versions of this solar collector:

- a solar flat plate one with from top to bottom, a thermal module is composed by a glass, an air layer, a highly selective absorber and an insulation layer. First, the cold fluid from the tank flows through the inferior insulated tube and then in the upper tube in thermal contact with the absorber. One module is about 1 m length and 0.1 m in width (individual houses).
- a vacuum solar collector into the gutter, it is this version which has been installed in the frame of this project. Vacuum tubes are in 2.0 m length in direct flow and heatpipe version. The tube diameter is 56 mm, the wall thickness of the cladding tube is 1.8 mm. The installation consists in several connected of 2 parallel vacuum solar.

Moreover, three solar air collector integrated in a shutter participate to the heating of the house and allows to maintain a healthy air in the apartments. The outside air enters into the solar collector moved by an air fan electrically supplied by a PV module, it is heated in a multi-wall polycarbonate with one transparent sheet and a black painted one; the hot air is then introduced in the apartment by a special hot air collector.

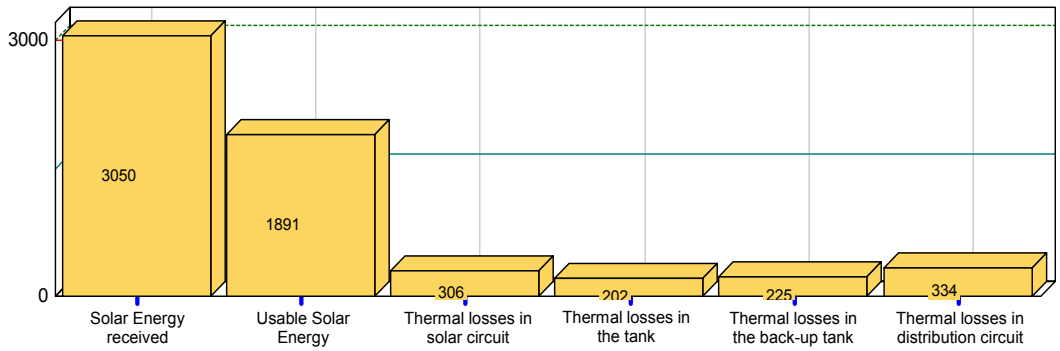
Using the vacuum version of the H2OSS solar collector, for the rural tourism houses, the energy output is estimated at 1155 kWh for collector area (tourists used -1.80 m²) and the solar fraction is 48%. For the other, the energy output is estimated at 1387 kWh for a collector area of 2.02 m² and the solar fraction is 58%.

*Thermal Water Energy Balance (Church rectory)*




*Repartition of the energy in the system*

*Thermal Water Energy Balance (Rural Tourism Houses)*




*Repartition of the energy in the system*

**Stage of Development:** **Responsible:** C Cristofari, University institute of technology

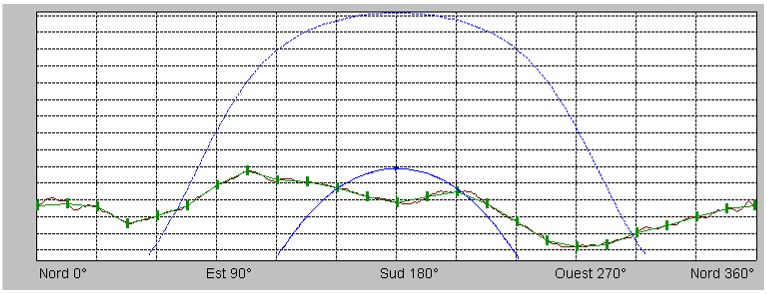
- ⊙ Idea/Patent — Patented ……..
- ⊙ Prototype — ……..
- ⊙ Demonstration — ……..
- ⊙ Integral building element — ……..
- ⊙ Commercially available — ……..

**BISTS description and context**

This project is a European project Maritimo with different Italians partners on the subject of refurbishment. The aim is the refurbishment of Mediterranean houses. This project is situated in a Corsican village near the centre of the island (see Figure below).


*Situation of the project*

The solar mask is illustrated in the following figure for summer and winter.

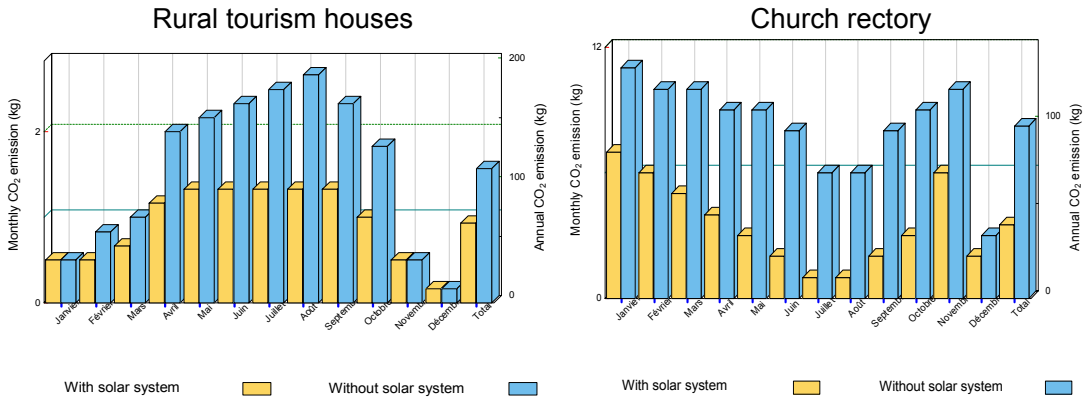



*The solar mask around the site*

**System viability**

This gutter concept uses basic solar technology (flat plate or vacuum tube) and the investment and running cost are similar to classic solar systems for the support (gutter) and the metal porch roof.

Concerning the air solar collector Volet'air, the cost of the solar shutter with the financial contribution provided by EDF and the authorities of Corsica is approximately 20% more than the cost of a conventional shutter.

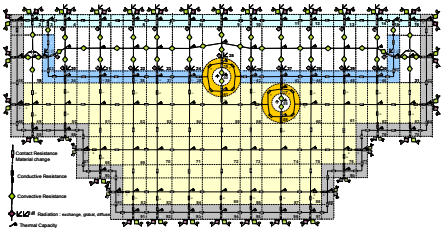



*Environmental impact - avoided $CO_2$ emissions for the vacuum solar collector H2OSS*

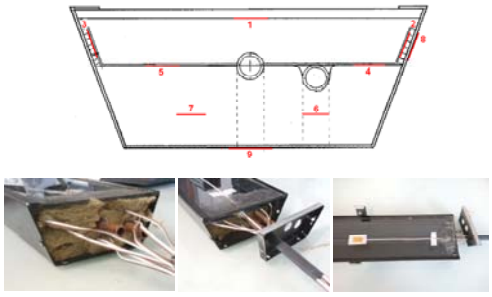
**Modelling and simulation tools developed/used**

**Thermal water solar collector H2OSS** : A pHd dissertation on the optimization of the thermal solar system H2OSS (flat plate version) was presented in December 2012. Different articles were published in international journals. We developed a two-dimensional thermal model using a finite difference method and an electrical analogy and considering 97 elementary volumes. The model was implemented and the numerical results were validated from experimental data: a thermal solar module was specially instrumented with 9 thermal sensors measuring temperatures into the solar collector and the water output and input temperatures were also recorded.

*Presentation of the flat plate solar collector into the gutter*

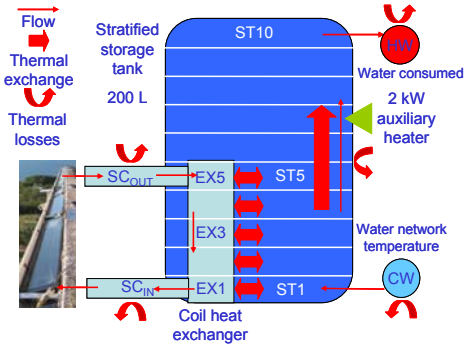


*The modeling meshing*



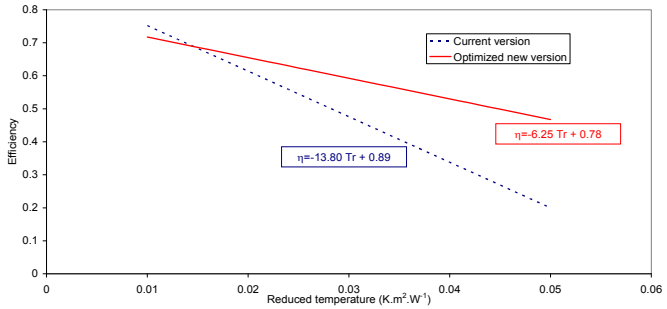
*The instrumented solar thermal module for experimental verification*

The experimental validation shows that the developed model has a good accuracy with the measured data: the nRMSE are around 5% for the water temperatures and from 4.6 % to 10% for the internal ones. The main advantage of this model is to be able to modify easily the characteristics and the form of the used materials. Then, a study on the influence of any change in material and structure on the performances of the solar collector was performed in taking into account the total water heating system.



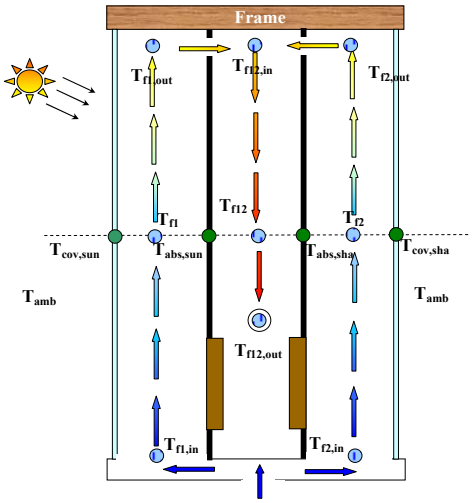

*The total thermal system used for the optimization (tank with thermal stratification)*

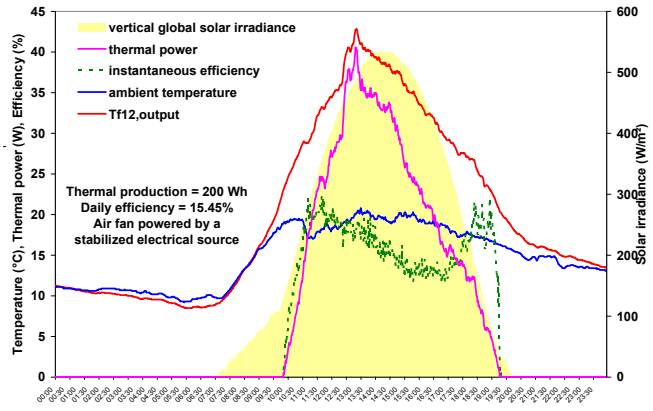
The optimized version shows very improved performances. A modelling of the vacuum version is being developed.




*The efficiency versus the reduced temperature for the first version of the flat plate solar collector and the optimized version.*

**Thermal solar air collector Volet'air**: Some experiments were realized and the implementation of a thermal simulation began.



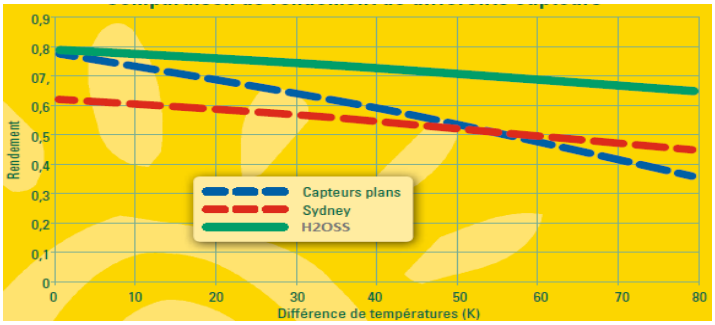




*The first step of the thermal modeling and some experimental data.*

**BISTS Performance data**

Based on:
⊙ Estimation
O Detailed simulation

⊙ Measurement/testing
O Long-term monitoring




H2OSS *vacuum solar collector efficiency compared with other solar collectors*

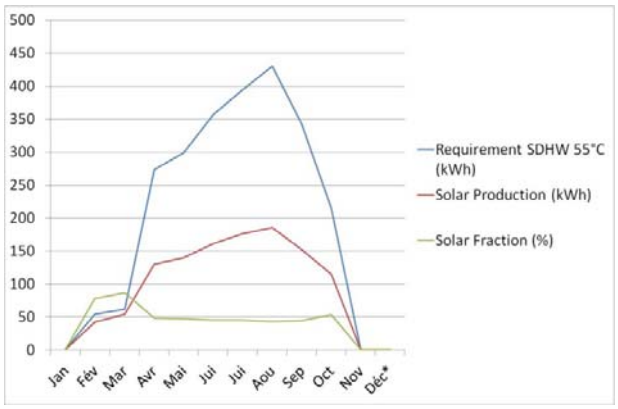
**Performance parameters**

For integrated systems:
key performance indicators -

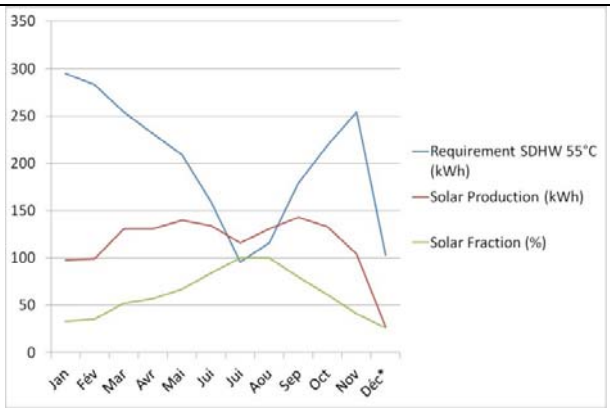
Optical efficiency : 0.781
a1 = 1.12 W/m².K
a2 = 0.004 W/m².K
Light transmittance: 96%

For separate collectors:
performance rating coefficients -
EN12-975 2, a0,a1,a2

Other:




*Energy gains - Rural tourism houses*




*Energy gains - Church rectory*

**Additional information:**

**Sources and references:**

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C.Cristofari, F.Motte, G.Notton, J.L.Canaletti (2013). A new energy concept to minimize electricity consumption in industry or buildings. Applied Mechanics and Materials, 330, 188-197.

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J.L.Canaletti, G.Notton, C.Cristofari (2008). New concept of solar air heater integrated in the building. International Scientific Journal for Alternative Energy and Ecology (ISJAEE), 5, 39-44. ISBN 1608-8298.