Example name: Solar XXI – BIPV/T Systems

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Figure 1

For installations

BISTS Location: Lisbon
9º10'39.83'' W
38º46'20.27'' N

Climate Type: Csa

Building Use: Non-residential: Office

Level of BISTS integration
Rush: Level 2
Reijenga: 5

X New Build
O Refurbishment
O Other: ……

Type of BISTS:

Hybrid

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

Building element:

X Facade
O Roof
O Other: ……..

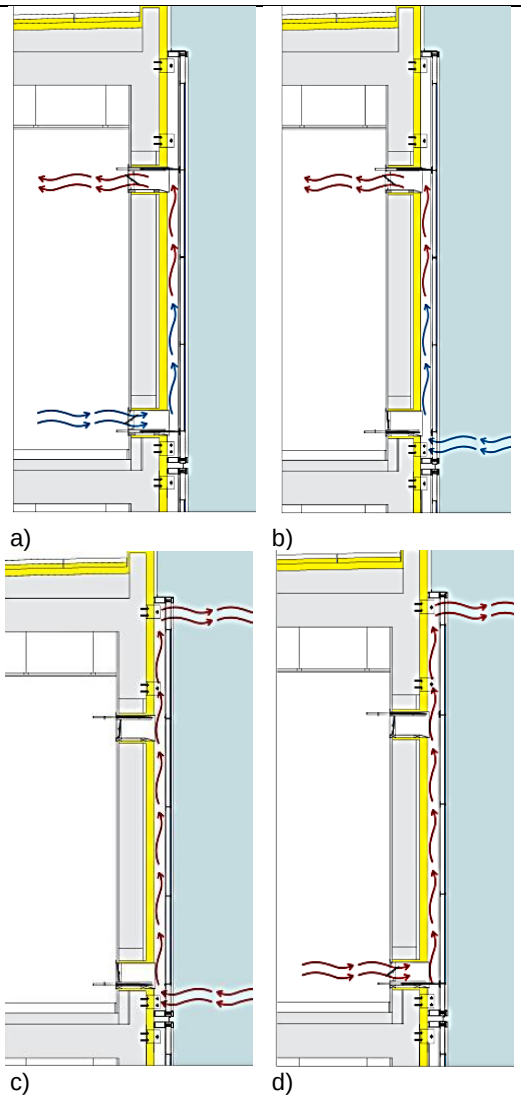


Figure 2

BISTS characteristics:

Technology: PV: Multicrystalline silicon, amorphous silicon, CIS thin-film;

Collection area: 100m^2(total), 5,26m^2 (per system)

Inclination/Orientation: 90º, fixed in the south façade

Peak power installed: 12 kW (total); 0,60 kW (per system)

Energy Produced: 31 kWh

Contribution to building load: 40%

Pre-fabrication off-site: No

Heating description: The heat released in the process of converting solar radiation into power is successfully recovered (natural convection) and insufflated into adjacent room, as a heating strategy for the improvement of the indoor climate during heating season in the day time hours (Fig.1 case a).

In the mid-season months, the system can function as a fresh air pre-heating system in which air is admitted from outside through the lower vents, which heats thereafter in the air gap of BIPV-T before insuflatted directly into the room by natural convection through the upper internal vents (Fig.2 case b).

Cooling description: During cooling season is important to extract the heat from the modules to the environment. Therefore, the most used functional situation is the extraction of the heat to outside through the two external vents (Fig.2 case c), in this situation the internal vents are closed. Another possible situation in terms of functional use, is the evacuation of the hot air from the room through the lower internal vents, and use the "chimney effect" released to the outside (Fig.2 case d).

Stage of Development: Complete **Responsible:** LNEG

O	Idea/Patent	……..
O	Prototype	……..
O	Demonstration	……..
X	Integral building element	Solar XXI
O	Commercially available	……..

BISTS description and context

Project motivation: Design a service building with low energy consumption, integrating renewable technologies (solar thermal and photovoltaic) and passive systems for heating and cooling.

Building name: Solar XXI

Function and form: Non-residential-Office, trapezoidal shape in plant

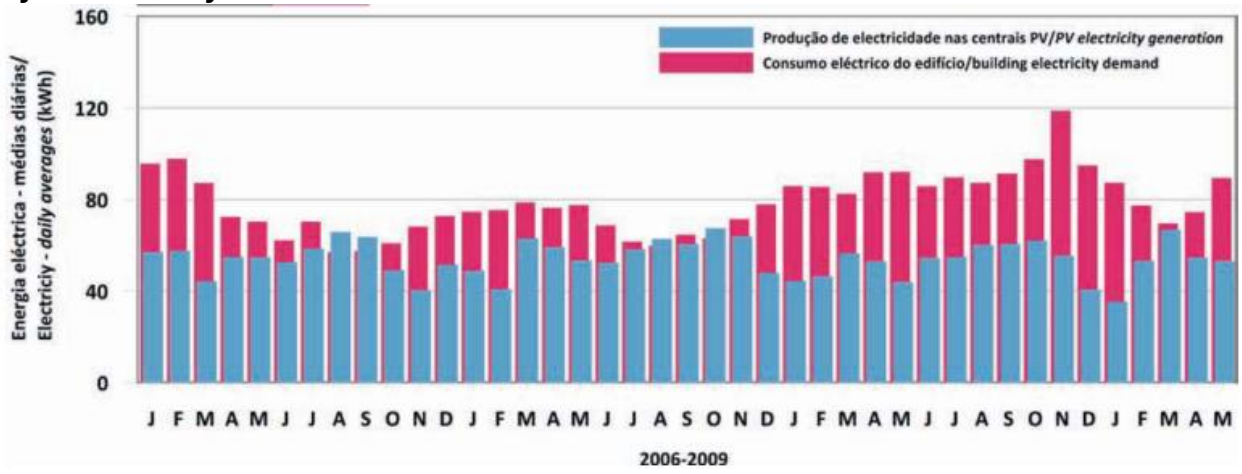
Size: 3 storeys, 1500m^2 of net floor area, 1200m^2 of conditioned floor area

Occupancy: 20 persons

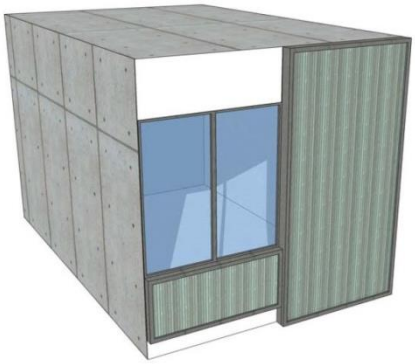
Particular features: Optimization of thermal envelope; Increase the area of solar heat gains – south solar façade, as a direct gain system for heating; External shading devices in the south oriented windows; Photovoltaic façade for electric use; Heat recovery by natural ventilation in the photovoltaic façade for indoor environmental heating; Natural ventilation.

South façade: PV/Wall ratio: 24%
Window/Wall ratio: 34%

System viability



Modelling and simulation tools developed/used



The simulation program developed by the Department of Energy (DOE) of the United States of America, EnergyPlus, has been used to study and analyse the dynamic thermal performance of the building.

BISTS Performance data

Based on:
X Estimation
X Detailed simulation EnergyPlus
X Measurement/testing
X Long-term monitoring

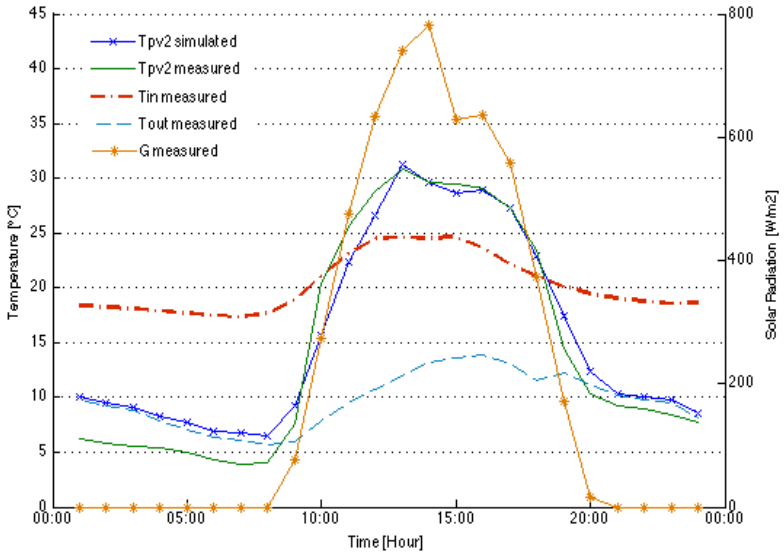
Performance parameters

For integrated systems: BIPV/T key performance indicators -

Solar savings fraction: 40 %
Light transmittance: %
Solar transmittance: %
Total solar energy transmittance: %:
Solar heat gain factor: 75 %
Building fabric U-values: 0,45 W/m^{2}K
Noise, fire, etc ratings
Other:

For separate collectors: performance rating coefficients -

Other:



Additional information:

Solar XXI building is considered a very high efficient building, with a difference in energy performance 1/10 regarding a standard Portuguese office building. From the Net ZEB goal perspective, the building, may be currently considered, a "plus (electric) Energy Building" and a "nearly Zero Energy Building" in terms of the overall building energy consumption.

Sources and references:

[1] H. Gonçalves, C. Cabrita, Solar XXI - Towards zero energy, LNEG, LNEG - Laboratório Nacional de Enrgia e Geologia, 2010. http://www.lneg.pt/download/4079/BrochuraSolarXXI_Maio2010.pdf

INSTRUCTIONS

Please fill in as much information as possible.

Tick where appropriate.

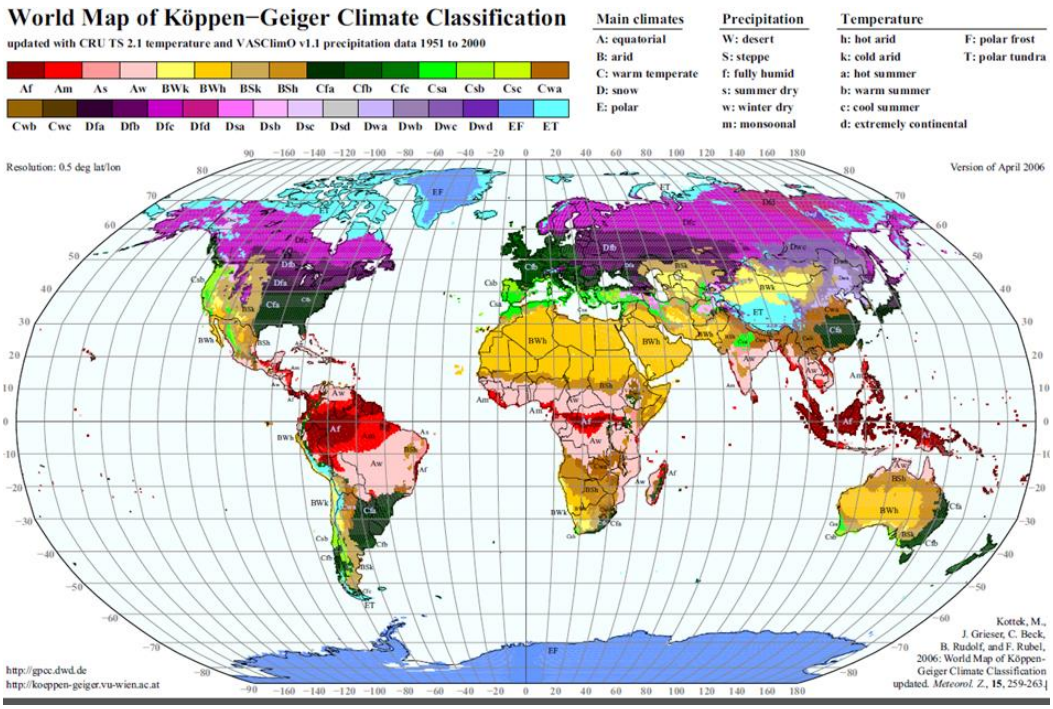
Text in red is suggested guidance. Insert information in provided space, removing red text as appropriate

If possible, use metric values.

If necessary, supply additional information on separate sheets

Reference listing

Köppen climate classification



(Kottek, M., J. Grieser, C. Beck, B. Rudolf, and F. Rubel, 2006: World Map of Köppen-Geiger Climate Classification updated. Meteorol. Z., 15, 259-263.)

Reijenga classification

The integration of PV systems in architecture can be divided into five categories:

1. Applied invisibly
2. Added to the design
3. Adding to the architectural image
4. Determining architectural image
5. Leading to new architectural concepts.

(Reijenga, TH and Kaan, HF. (2011) PV in Architecture, in Handbook of Photovoltaic Science and Engineering, Second Edition (eds A. Luque and S. Hegedus), John Wiley & Sons Ltd, Chichester, UK)

Rush classification
The architectural/visual expression of building services systems are identified as:

Level 1. Not visible, no change
Level 2. Visible, no change
Level 3. Visible, surface change
Level 4. Visible, with size or shape change
Level 5. Visible, with location or orientation change

(Rush, RD. (1986) The Building systems integration handbook Wiley, New York, USA)

Collector test standards

BS EN 12975-2 2006 ‘Thermal solar systems and components solar collectors - Part 2 test methods’
ASHRAE Standard 93-2010 ‘Methods of Testing to Determine the Thermal Performance of Solar Collectors’
ASHRAE Standard 95-1987 ‘Methods of Testing to Determine the Thermal Performance of Solar Domestic Water Heating Systems’