ICBMB
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Bioclimatic Materials & Buildings
Energy efficiency and global industry value chain

ECOLE SUPERIEURE
POLYTECHNIQUE

Thermal behavior and energy evaluation of an ecological building located in Dakar, Senegal

Par

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Introduction

Building sector consume a lot of electrical energy

It is a major emitter of greenhouse gases

This sector is therefore one of the responsible for the climate changes

Contribution to climate changes of States like Senegal remains low

These countries support negative effects of climate changes.

They have to develop adaptation strategies .

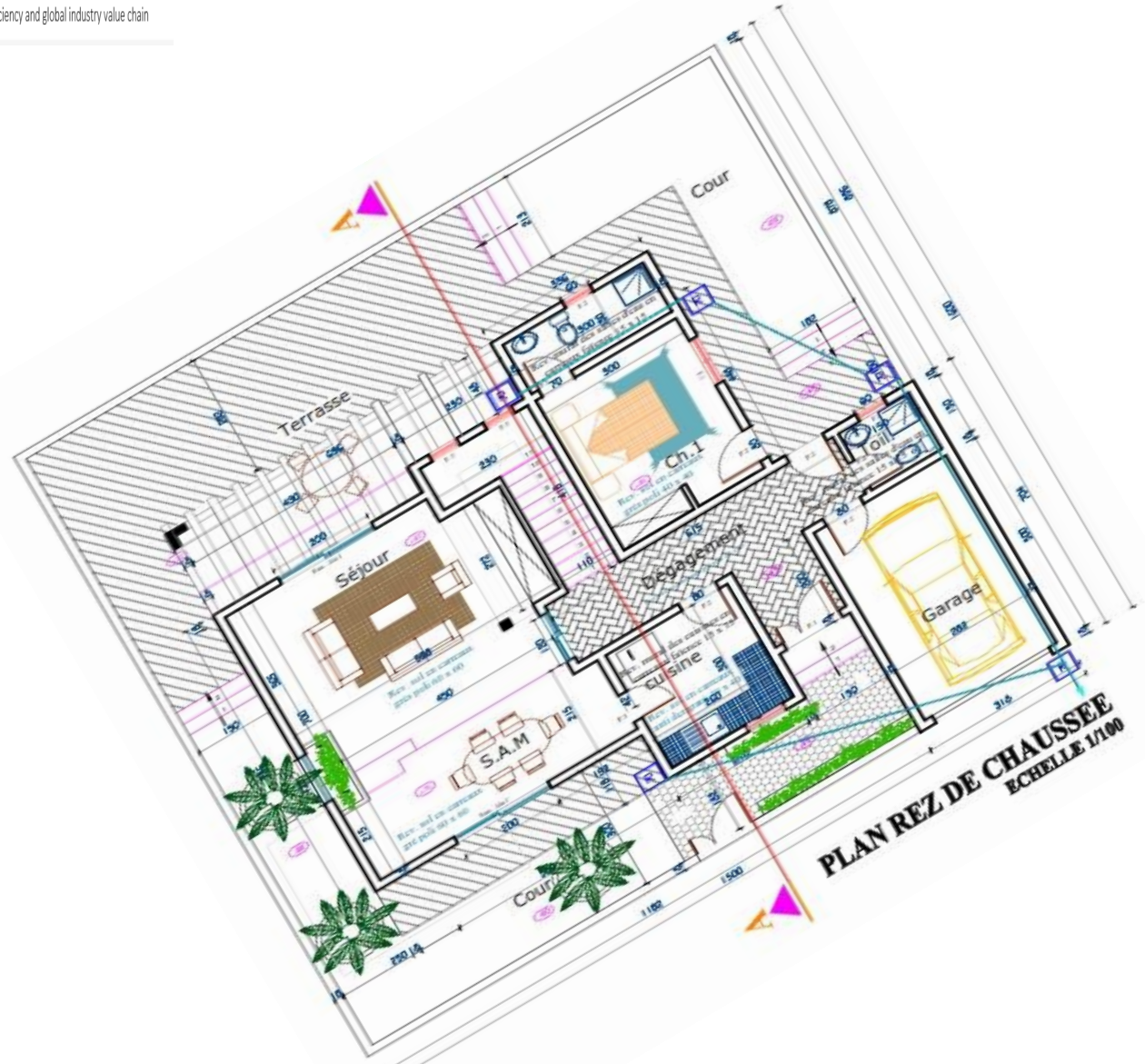
Among these strategies, construction of bioclimatic buildings

Objectives of this study

First evaluation of thermal behavior and PV production and electrical consumption of the building during the last three months (December, January and February).

- Assessment of bioclimatic behavior of a thermal zone
- Determination of time lag and decrement factor
- Evaluation of PV production and electrical consumption

Architecture of the building studied



- Building with very little joint ownership
- Presence of openings that face each other to promote air circulation
- Facades SE and SW

Features of the building

- Exterior walls made with hollow bricks

- Interior partitions made with compressed stabilized earth bricks

- Roof terrace is a hollow body floor with 5 cm expanded polystyrene insulation.

- This villa also has a 1.5 kWp photovoltaic generator and a 300 L solar water heater

Features of the building

- hollow bricks

- compressed stabilized earth bricks

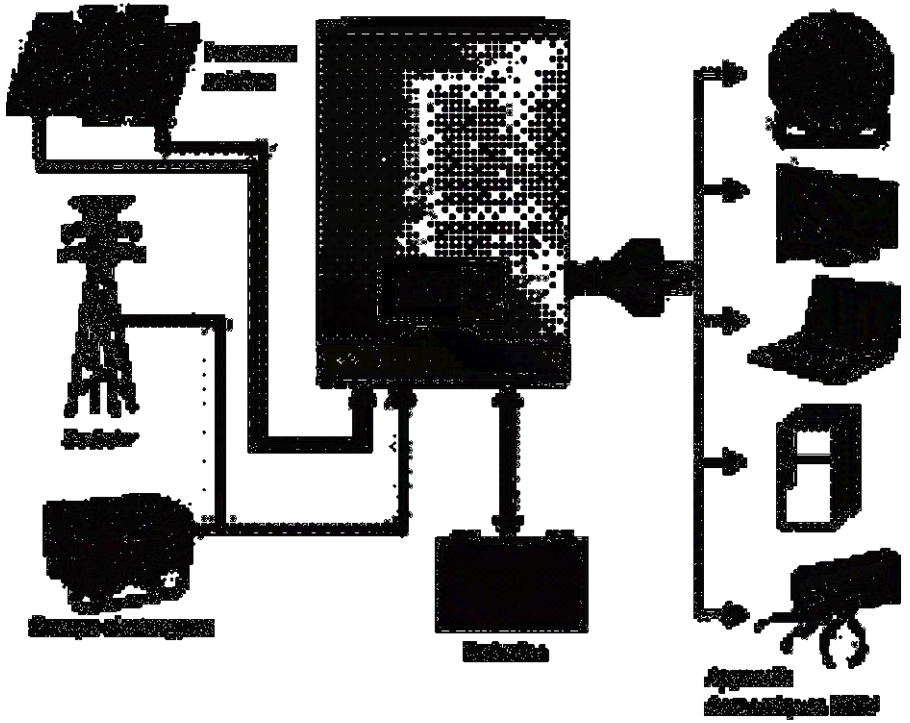
Features of the building

1.5 kWp photovoltaic

Methodology

Exterior conditions are measured with a Tahmo station

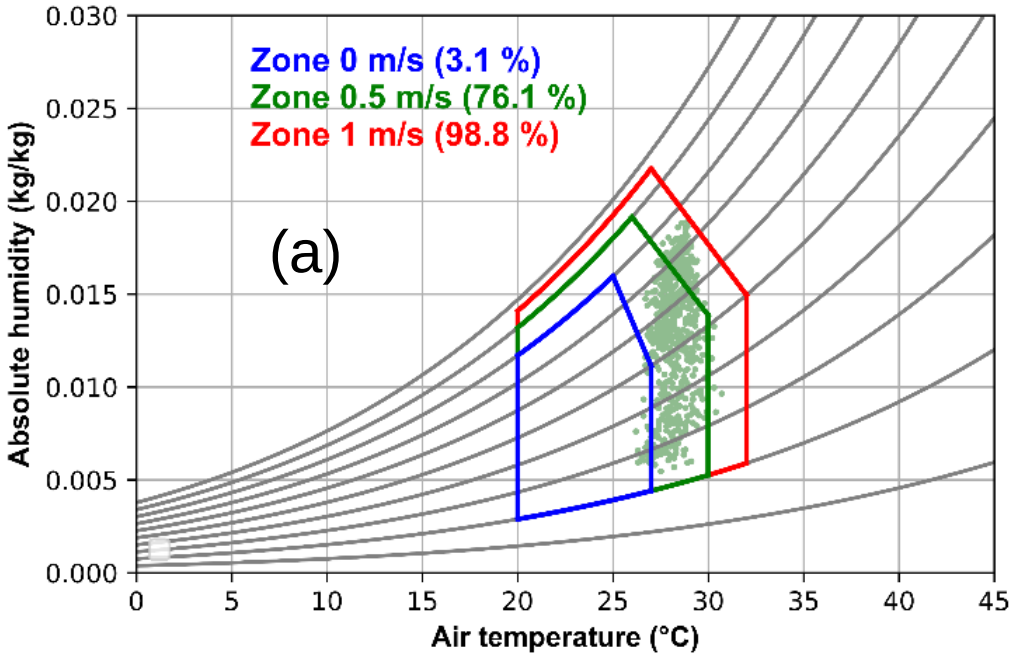
Interior conditions are measured with a Thermohygrometer



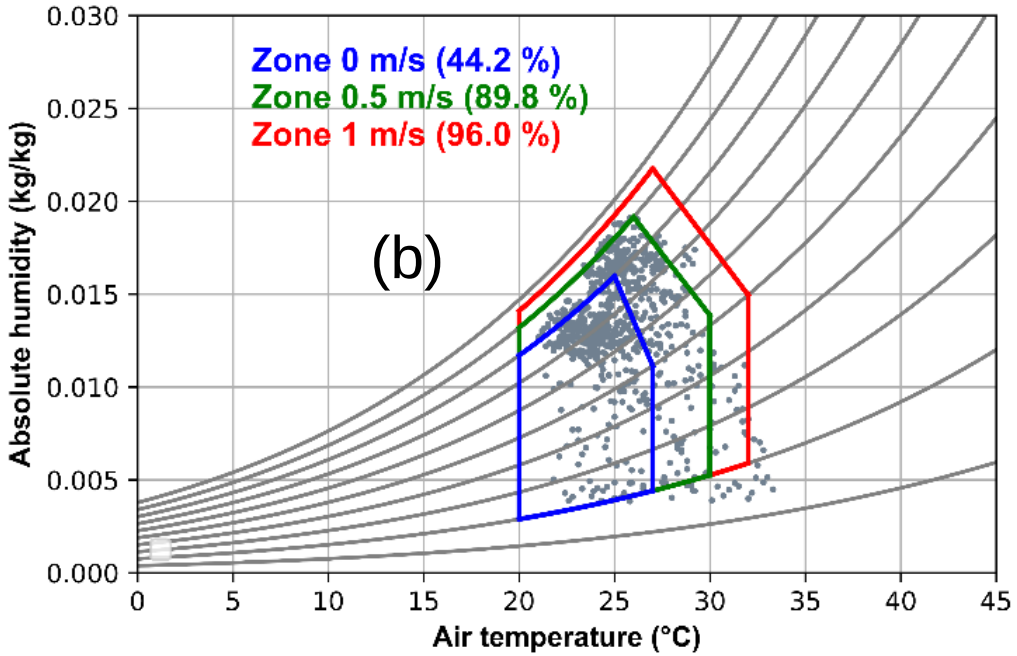
Hybrid invertor connected to a computer via WatchPower software for electrical measurements

Results: Thermal Comfort

Givoni diagram chart for December



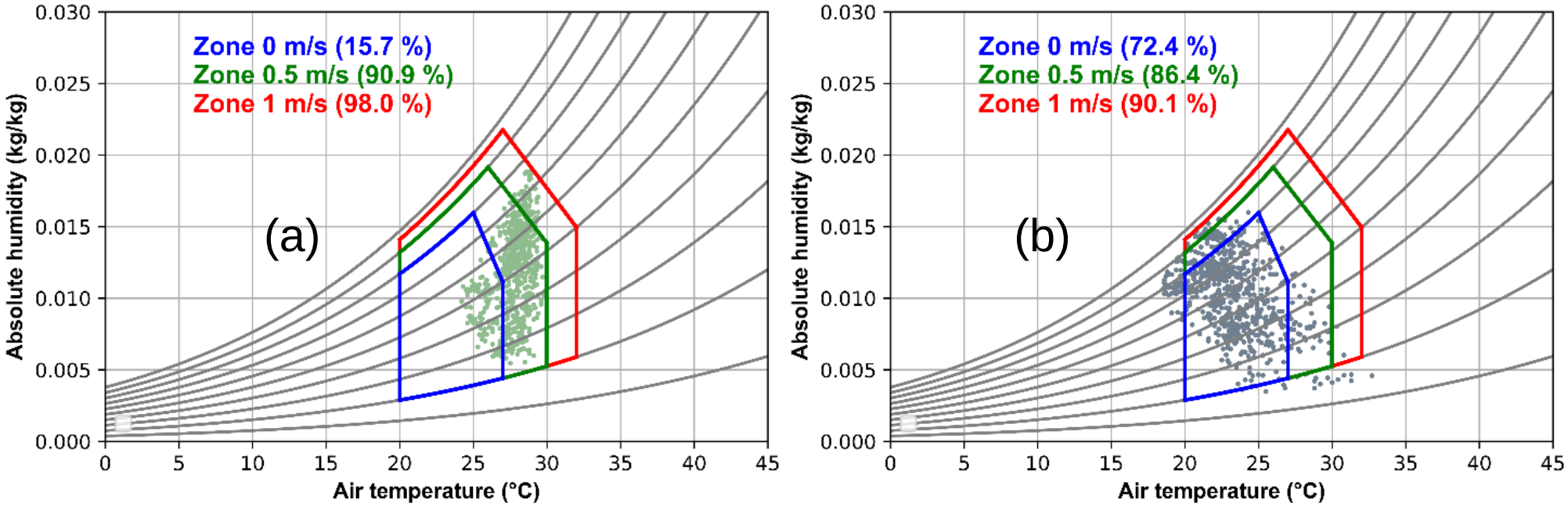
(a): Indoor conditions



(b): Outdoors conditions

Results: Thermal Comfort

Givoni diagram chart for January

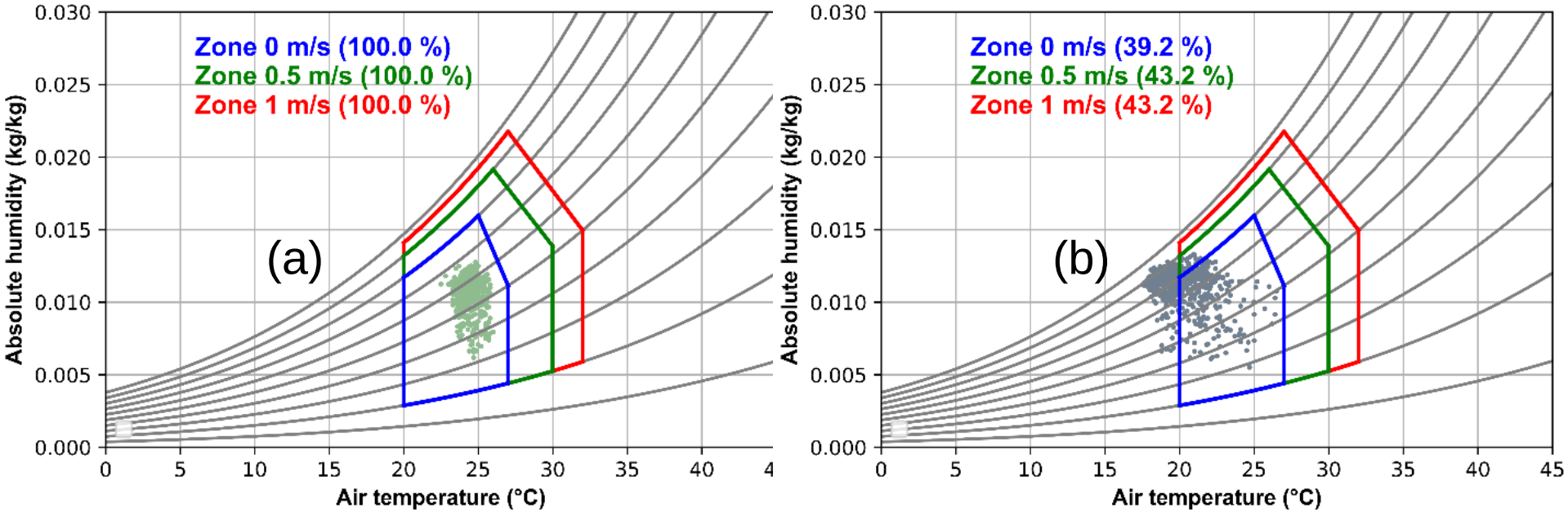


(a): Indoor conditions

(b): Outdoors conditions

Results: Thermal Comfort

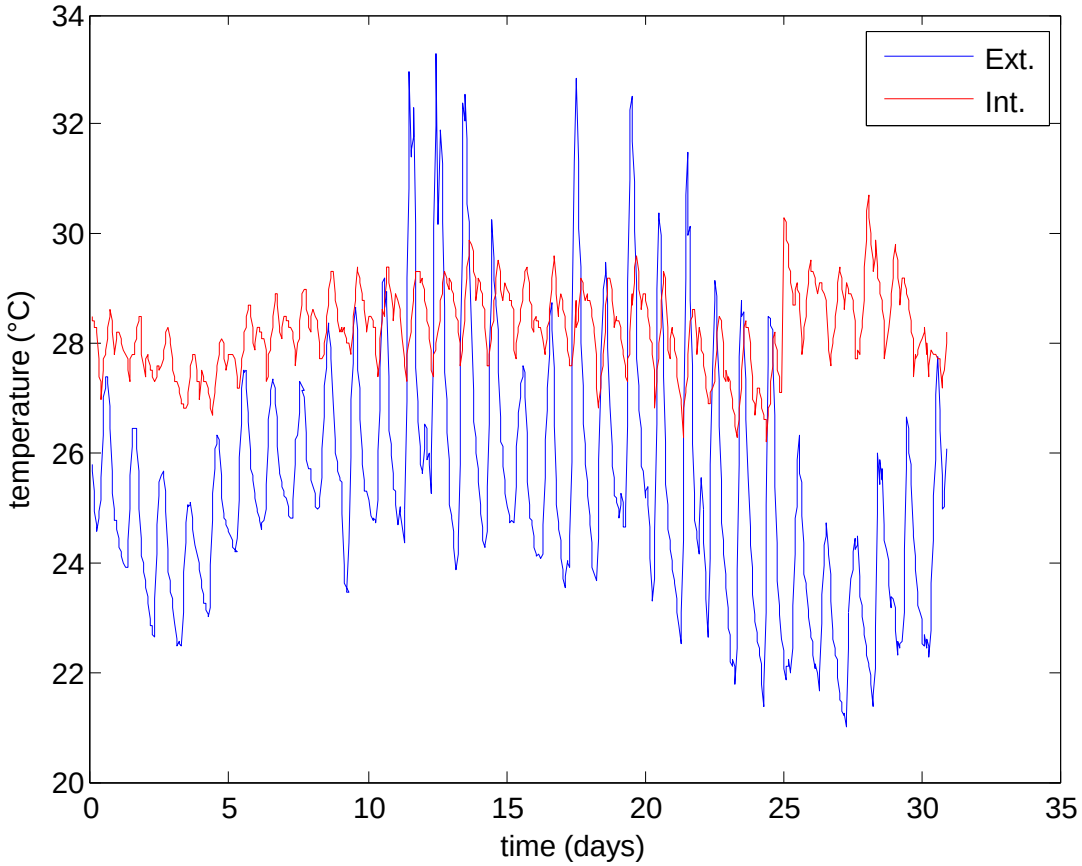
Givoni diagram chart for February



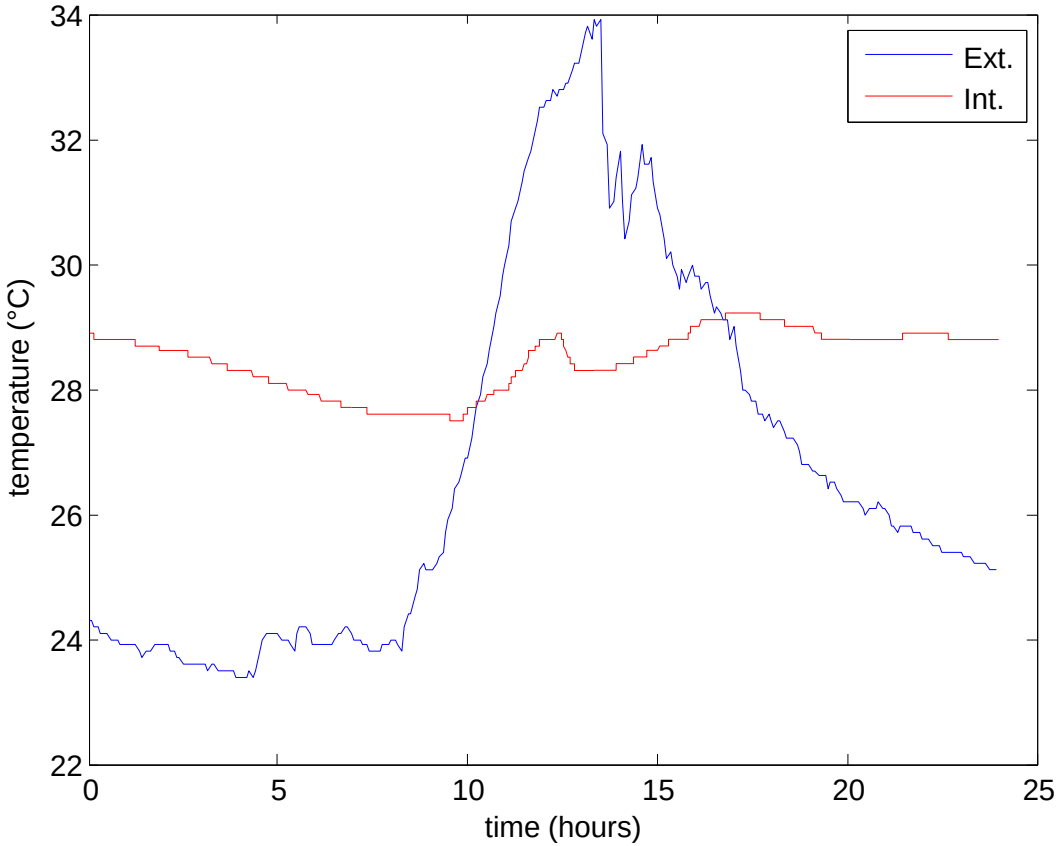
(a): Indoor conditions

(b): Outdoors conditions

Results : thermal behavior

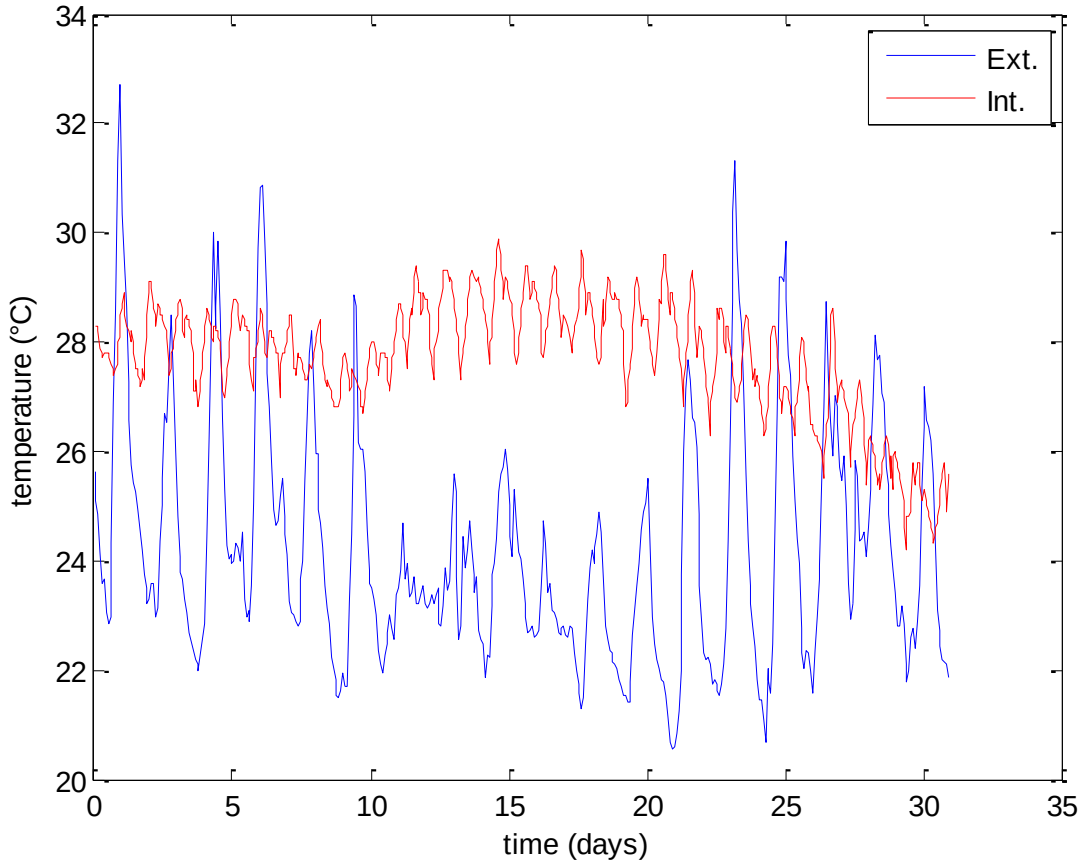


Temperature variation for December

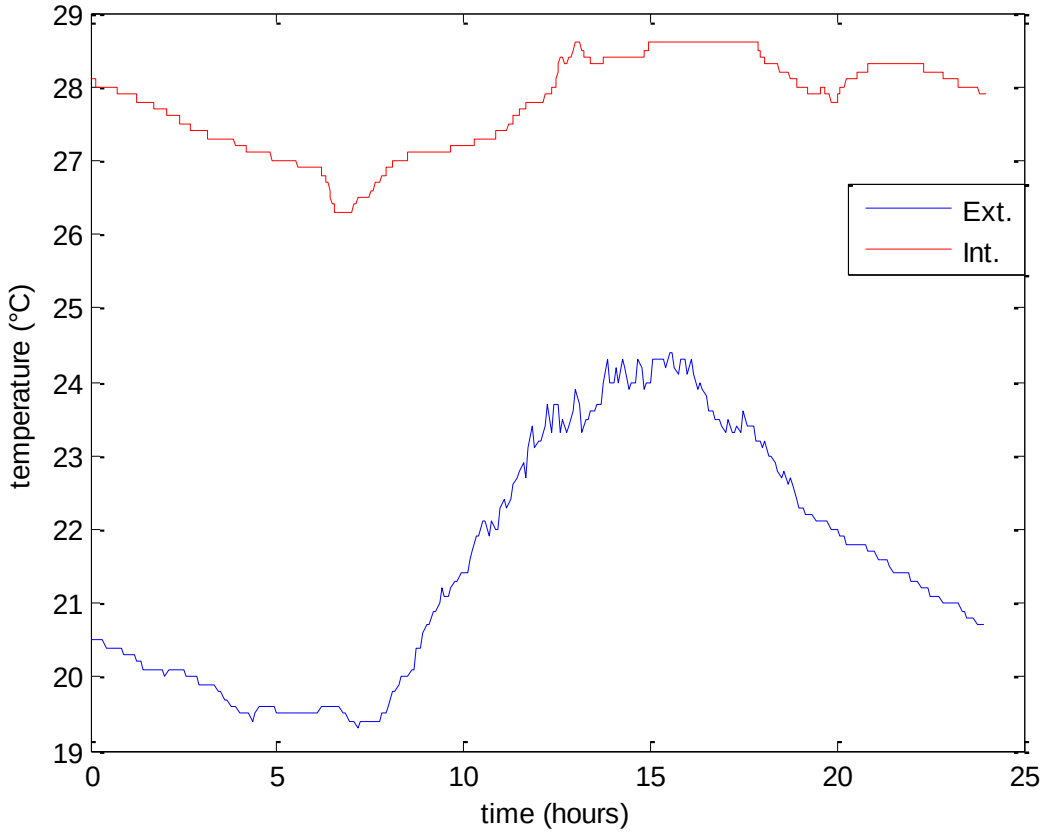


December 18

Results: thermal behavior

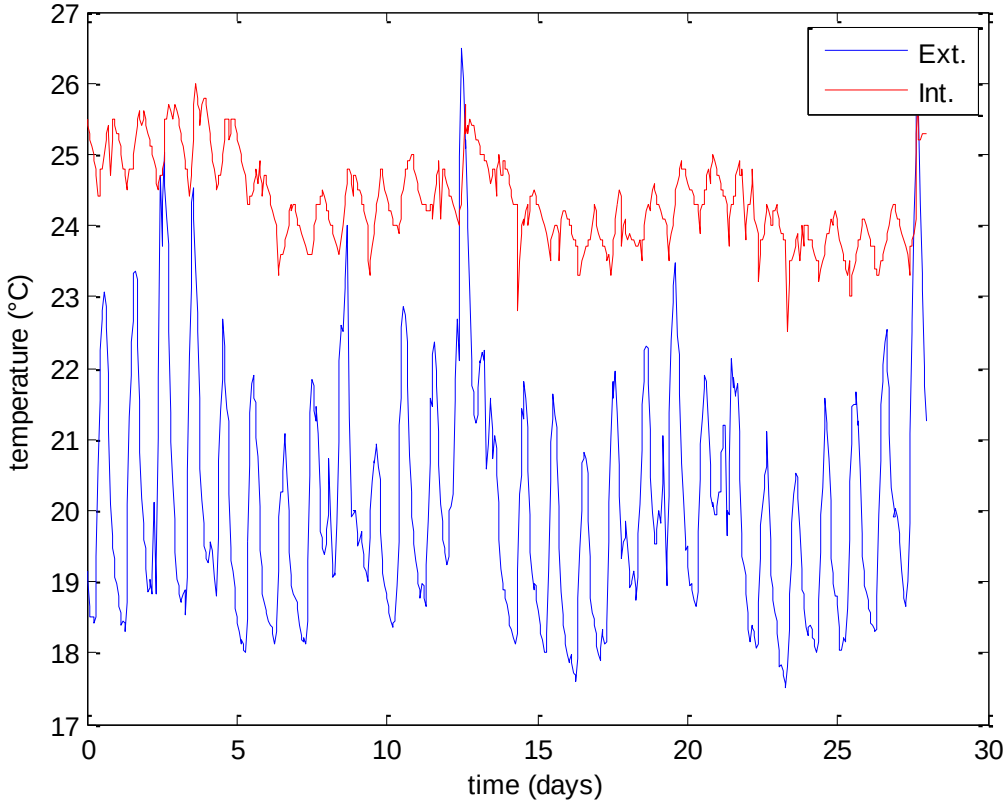


Temperature Variation for January

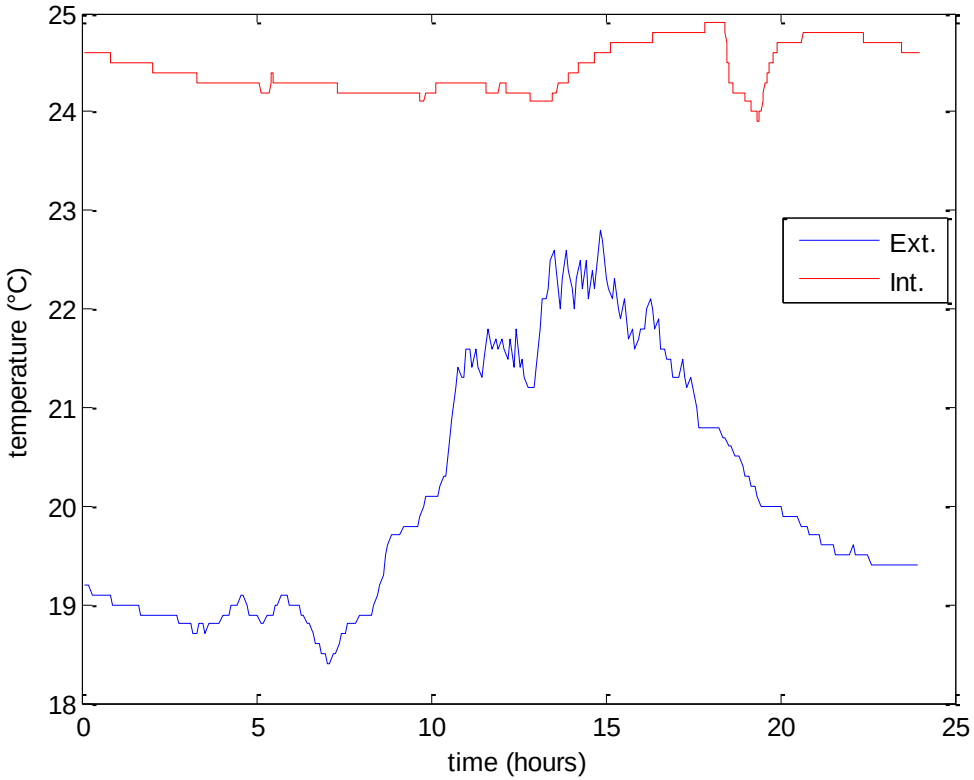


January 18

Results: thermal behavior

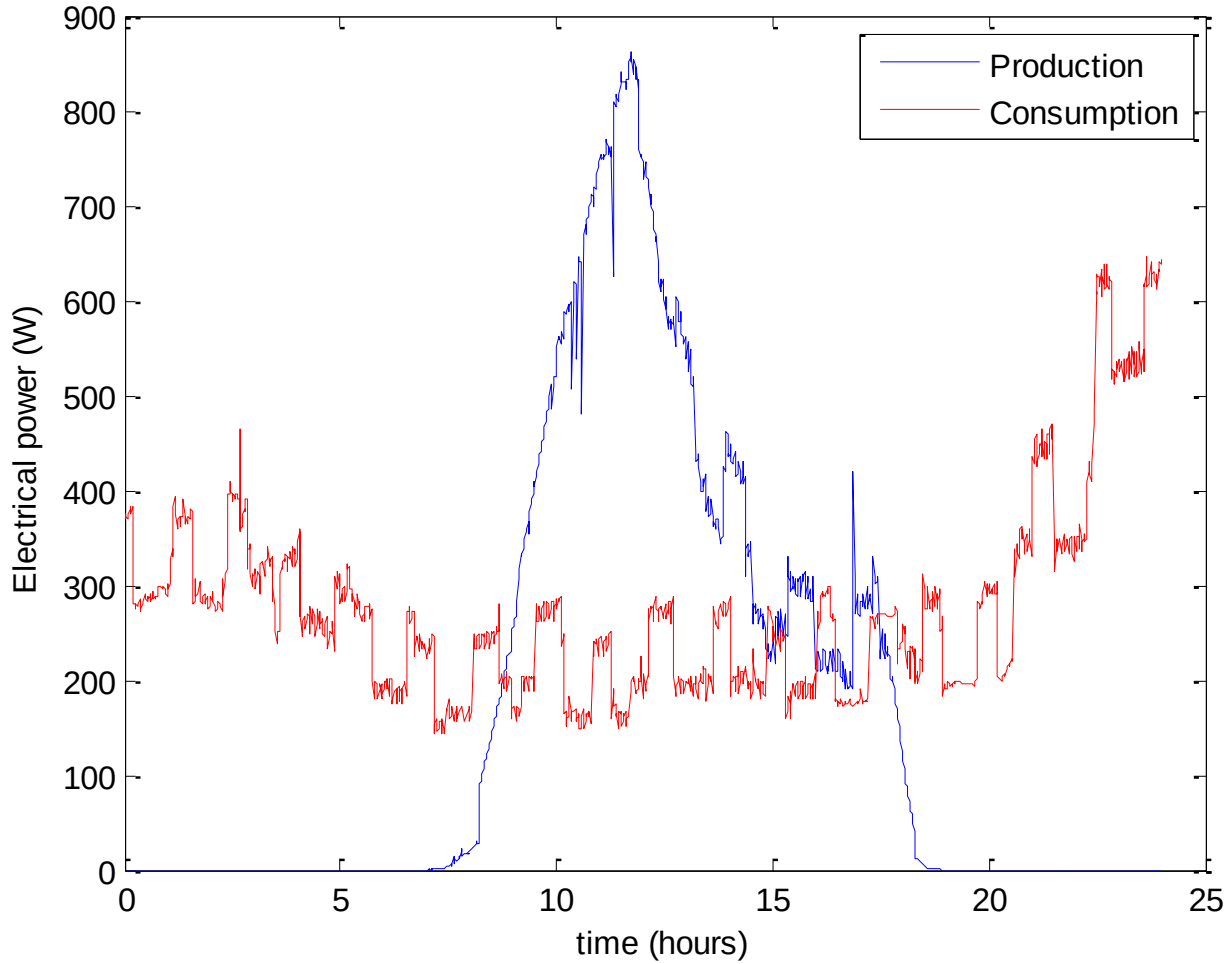


Temperature variation for February



February 12

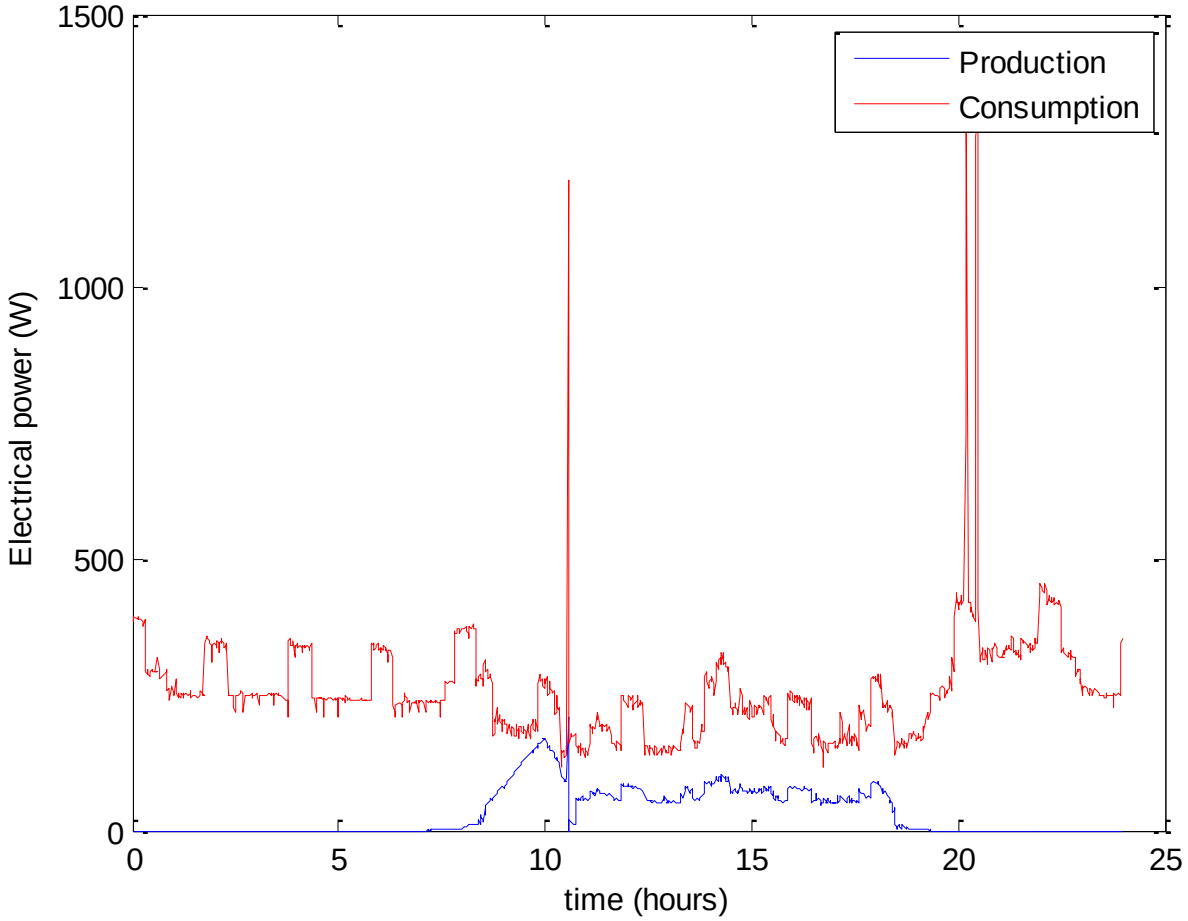
Results: electrical power



- Peak of PV production about 850 W
- Peak of Power Consumption less than 650 W
- Building consumption remains low (6.6 kWh)
- PV Energy 4.1 kWh
- Building autonomy: 62%

Electrical power variation for December 23

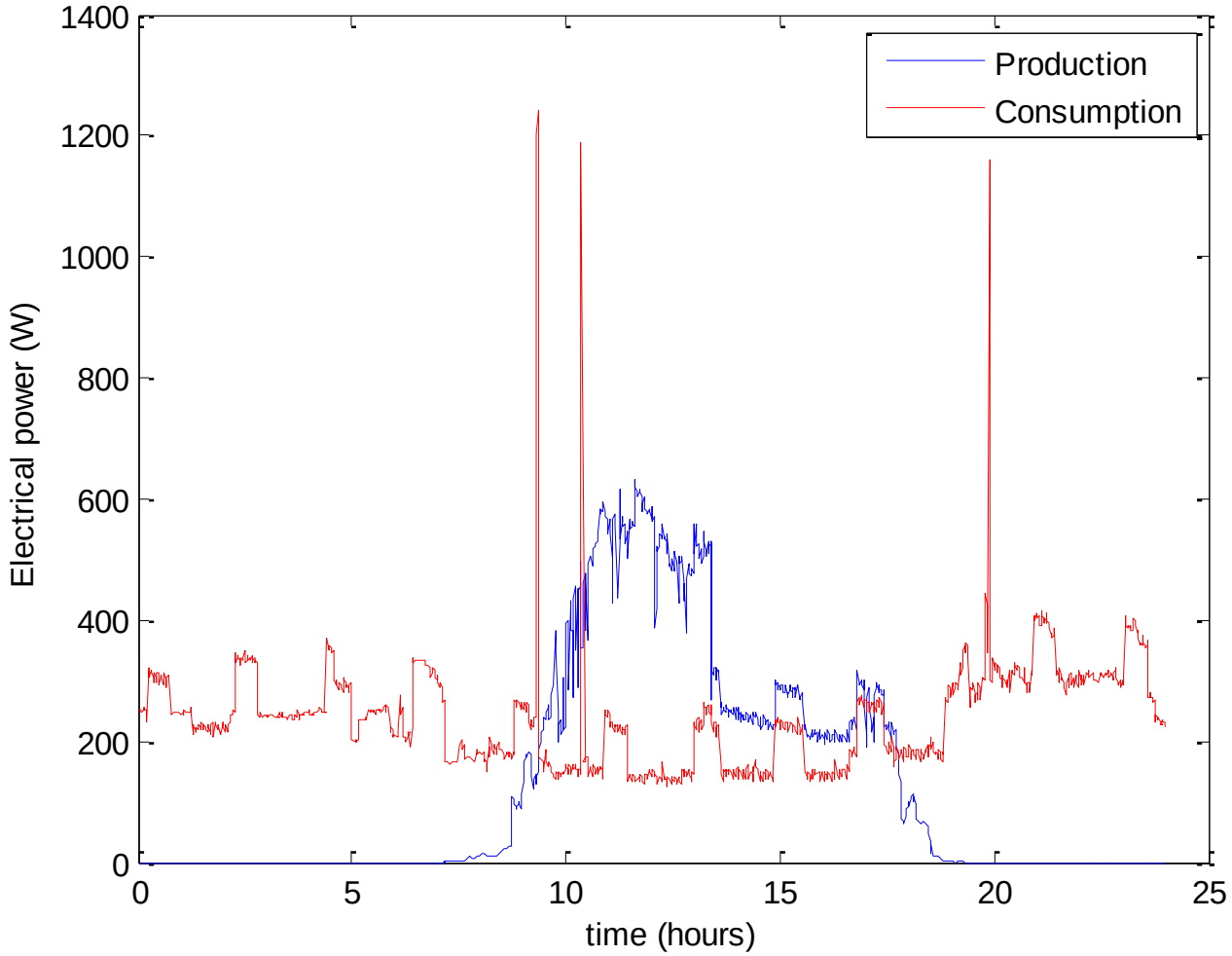
Results: electrical power



Electrical power variation for January 29

- Building consumption remains low (6.2 kWh)
- PV Energy very low 0.8 kWh
- Building autonomy: 12%

Results: electrical power



Electrical power variation for February 12

- Building consumption remains low (6.1 kWh)
- PV Energy very low 3.1 kWh
- Building autonomy: 52%

Conclusion

- Givoni digramm charts show that the thermal zone of the ecological building is comfortable for the three months.
- The points are less scattered inside than outside the building.
- The interior temperature has smaller amplitudes than the exterior ones and time lag can reach 3 hours.
- We can assess that the building has a bioclimatic behavior.

Conclusion

- For January and February, interior temperature is always above the exterior temperature. This is due to solar radiation.
- The PV production is less than electrical consumption for selected days. All the potential of PV production is not used due to the low battery capacity installed.

Perspectives

- This study will be extended for at least one year to assess the thermal behavior of building during the summer.
- The main facades are oriented towards the South-East and the South-West. To protect them from the radiation, we are planning to make a vegetation of the of the fence wall.

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