NEAR ZERO ENERGY BUILDINGS ENTROPY PERFORMANCE

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INTRODUCTION

- Energy efficiency is a key point to fight climate change.
- Buildings consume around 30 % of final global energy.
- New paradigms of energy design are being established:
  - Near-Zero Energy Buildings: buildings with low energy budget and high efficiency.
  - Net-Zero Energy Buildings: buildings that have an efficient management of energy generation to power the building.

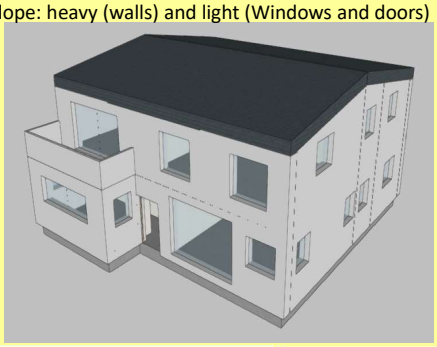
AIM

To characterise energy efficiency performance in terms of entropy .

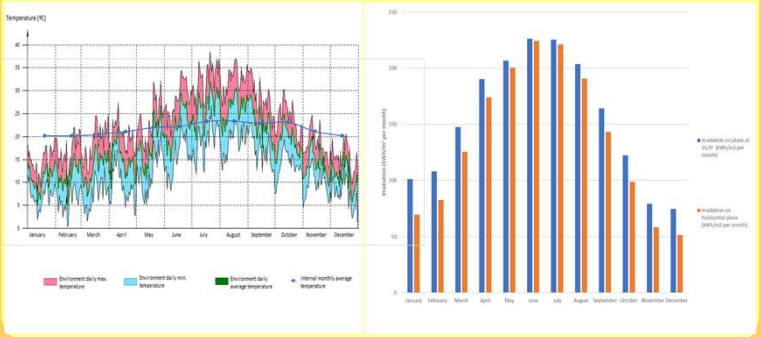
METHODOLOGY

We have simulated the house below designed under nZEB and NZEB criteria, considering low efficiency consumption according to Spanish regulations. It is located in la Roca del Vallès, Barcelona (GPS: 41.5836, 2.3275)

We considered the energy impacts related to:
- Climatization: cooling and heating.
- Illumination
- Occupancy
- Irradiance
- Ventilation
- Envelope: heavy (walls) and light (Windows and doors)



Simulated House



Outside average temperatures, internal confort temperature and irradiation profile at the location.

ENERGY AND ENTROPY ANALYSIS

Entropy balance of the building $dS = dS_e + dS_i$

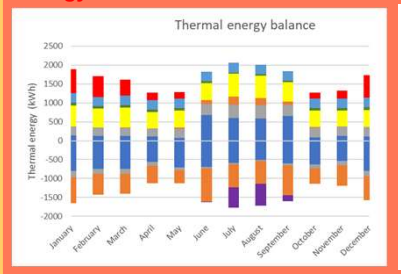
Entropy generation due to heat exchage Q between to bodys at T_{cold} and T_{hot}. $S_i = \left(\frac{Q}{T_{cold}} - \frac{Q}{T_{hot}}\right) = Q \cdot \left(\frac{1}{T_{cold}} - \frac{1}{T_{hot}}\right)$

Entropy flow of a system at temperature T and exchanging heat Q $S_e = \frac{Q}{T}$

Gouy Stodola Theorem: lost work results in entropy generation at the thermal source

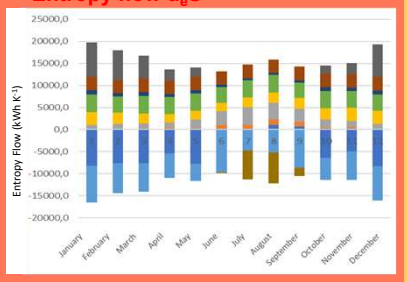
SIMULATION RESULTS

Energy Balance



The input-output energy balance of the building is zero in average.

Entropy flow d_eS

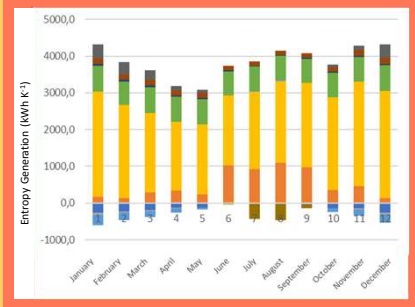


The input-output entropy flow balance of the building is zero in average.

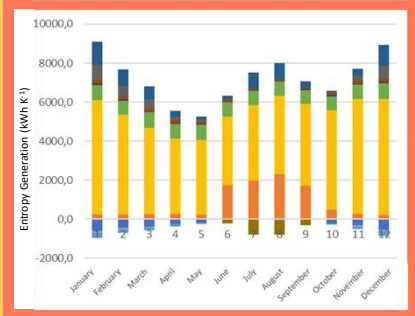
This is a consequence of energy conservation

Entropy generation d_iS

Entropy generation at the building is mainly due to solar irradiance. It is mostly generated towards the buidling. The negative sign means generated towads the environement.



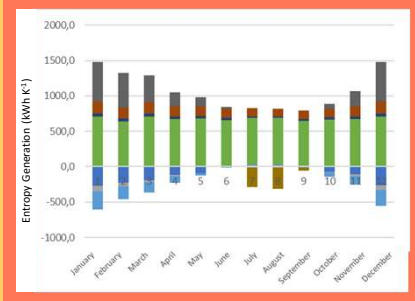
nZEB building simulated with irradiance



Simulation with lower appliances efficiency and higher envelope transmitance.

Figures Legend

- Qcooling
- Qheating
- Qocupation
- Qilumination
- Qappliances
- Qventilation
- Qwindows+do
- Qenvelope



nZEB simulation without radiation (shadowed building). Entropy clearly decreases

Damage induced in the bedcover inside the building due to irradiation.

Energy transformations and entropy generation might connect energy efficiency with life cycle analysis through entropy calculations.

CONCLUSIONS

- Simulation of energy performance of nZEB
- Entropy balance and evaluation of entropy generation sources.
- Irradiance plays a key role in entropy generation.
- Entropy generation leads to buildind degradation.

ACKNOWLEDGEMENTS

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