The impact of e-mobility in Positive Energy Districts

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   ii. Data references for electricity consumption
   iii. Simulation model
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Introduction and background

Introduction and background

This sector produces the 15% of the emissions worldwide.

This is promising solution because they can avoid the consumption of fossil fuels [3].

The inclusion of EVs has a great impact on the energy grid as they considerably increase the requirements of renewable energy generation, this has to be considered in urban planning policies [4].

A Positive Energy District (PED) is a district that produces more energy than needed to fulfil the district's demand [5]. .

PEDs "... require integration of different systems and infrastructures and interaction between buildings, the users and the regional energy, mobility and ICT systems, ..."[6].

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Introduction and background

Some studies remark that EV smart charger systems could significantly reduce distribution network costs in low carbon transition pathways [7].

EVs have a great impact on energy efficiency since they can be also be used to store energy surpluses to be used in peak hours consumption, meanwhile, this technology is easy-going to integrate into urban scenarios [8][9]

The importance of the EV for demand-side management is remarked by some authors because can increase the flexibility of microgrids [10], and also sort out the fluctuation of renewable energy [11]

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Motivation and objective

Motivation, despite the PED definition instructs to take into account the mobility system with its own share of energy needs, it does not set criteria for how much of its users' mobility energy shall be produced by the PED [14].

The aim of this research is to assess the impact that EVs might have on a test-bed PED. We want to investigate under which conditions a regular PED could afford the EVs energy requirements.

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Material and Methods

Where is located the PED?

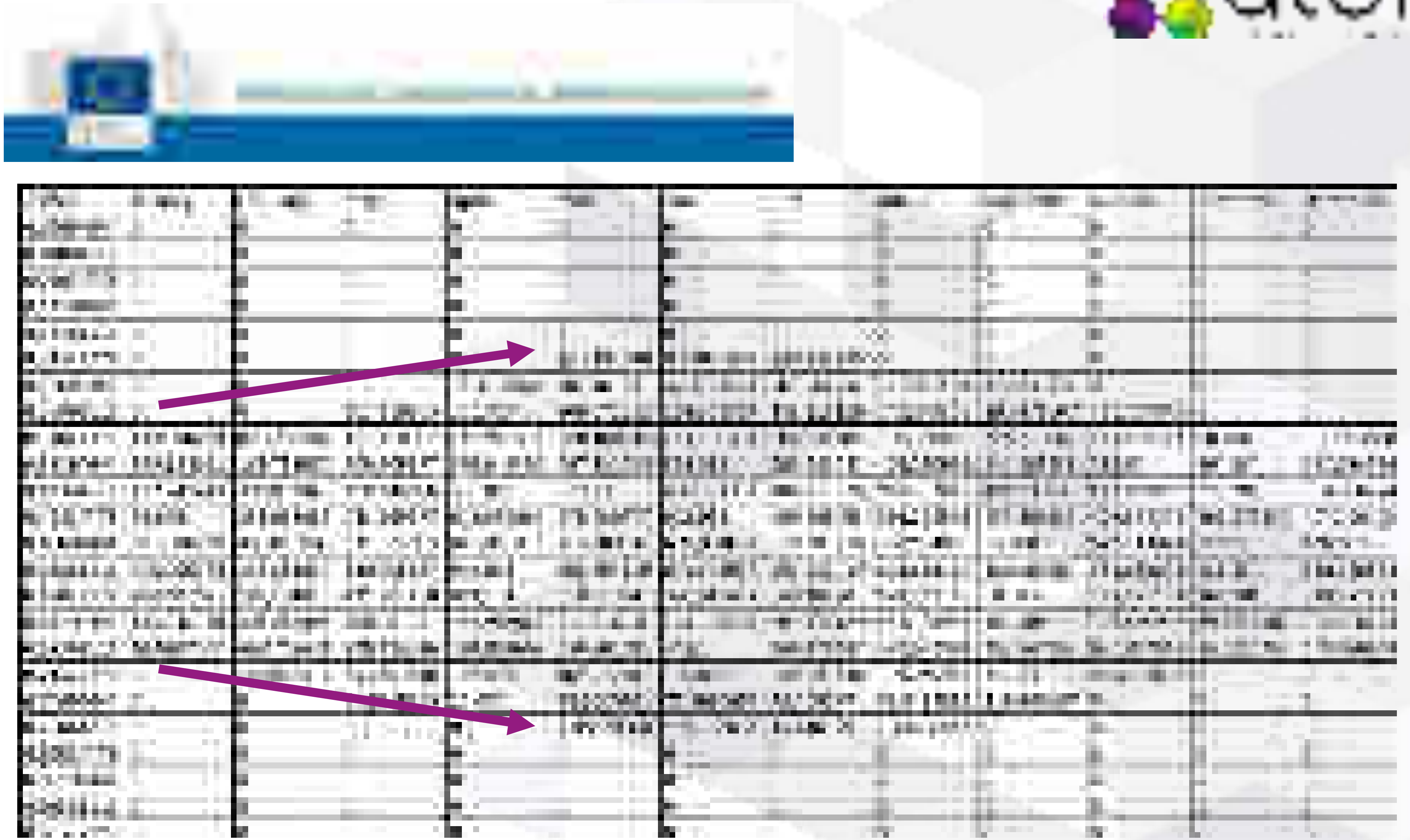
Setting up the first foundation stone for the synthetic PED in a simulation approach

Where is located the PED?

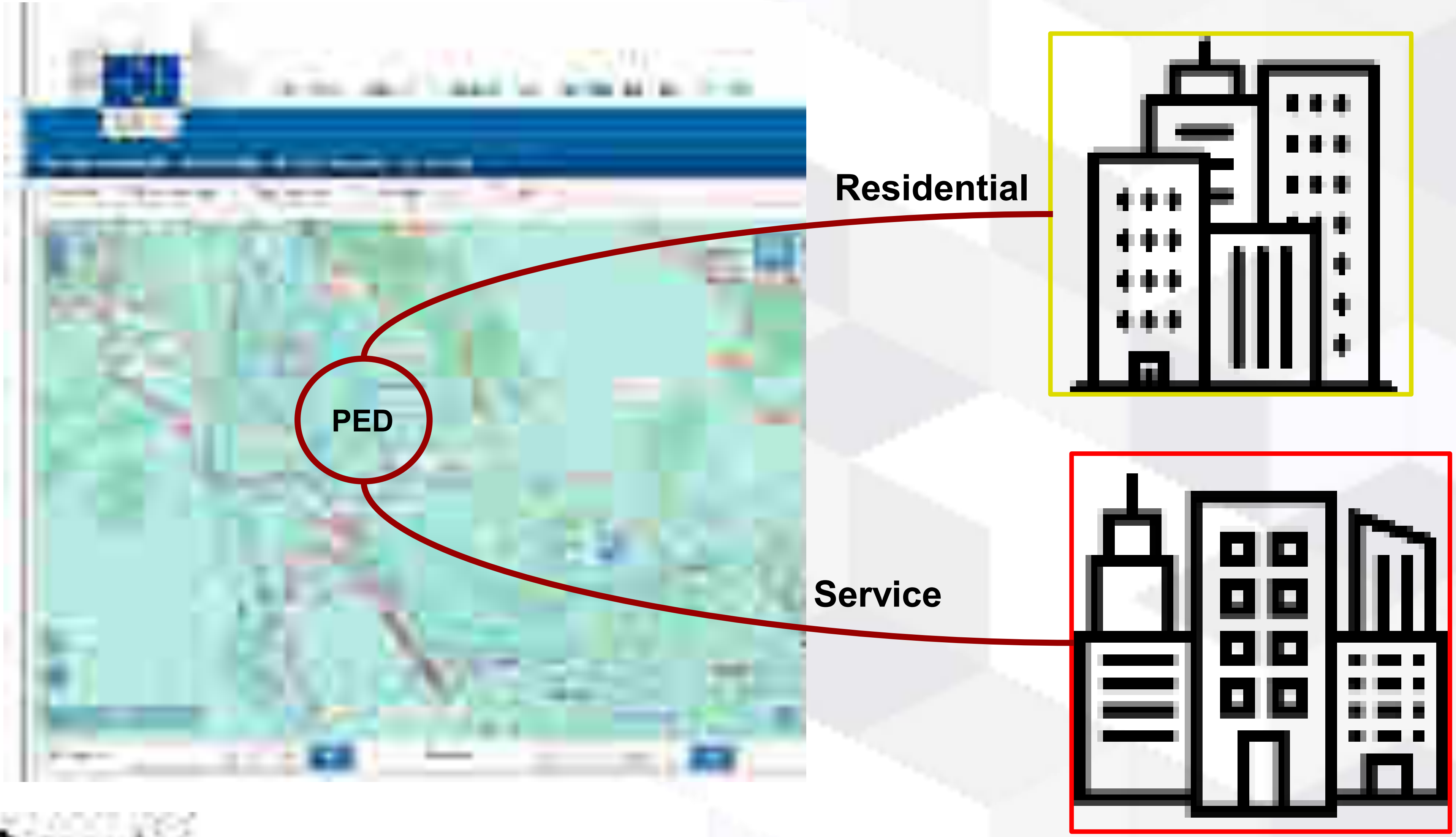
Image belongs to: https://www.zorrotzaurre.com/wp-content/uploads/2016/08/Foto-Plan-especial.jpg

Where is located the PED?

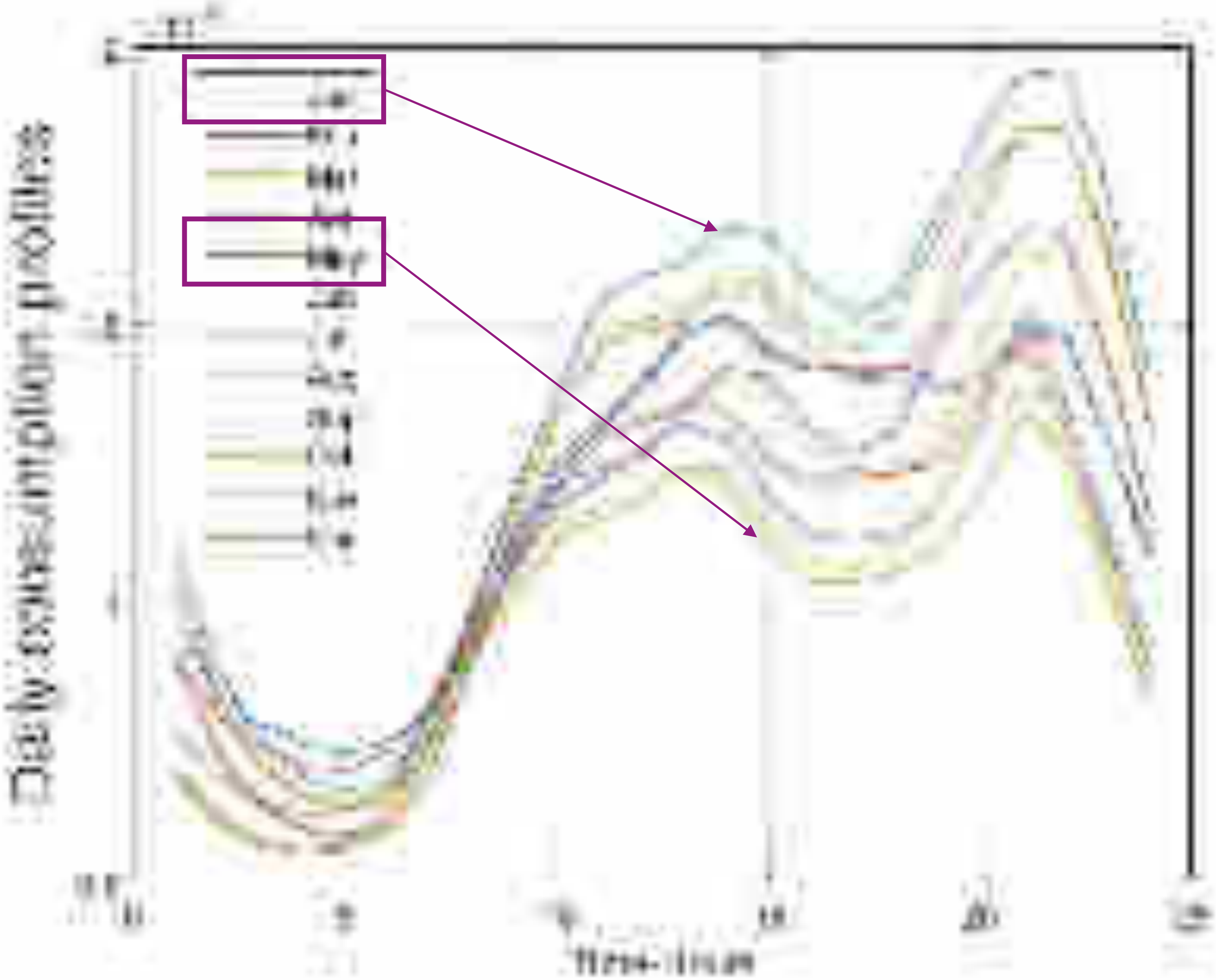
Irradiance profiles along the year



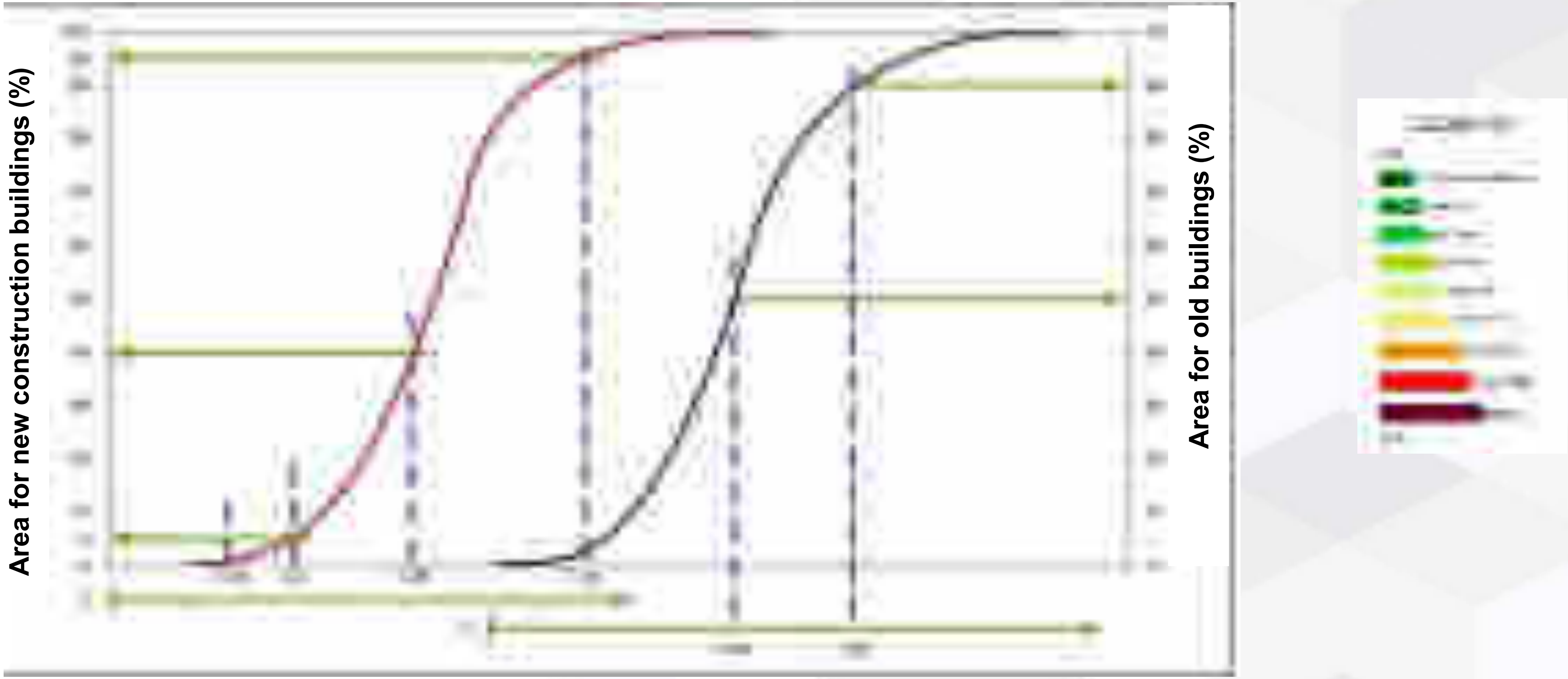
How was the synthetic PED created



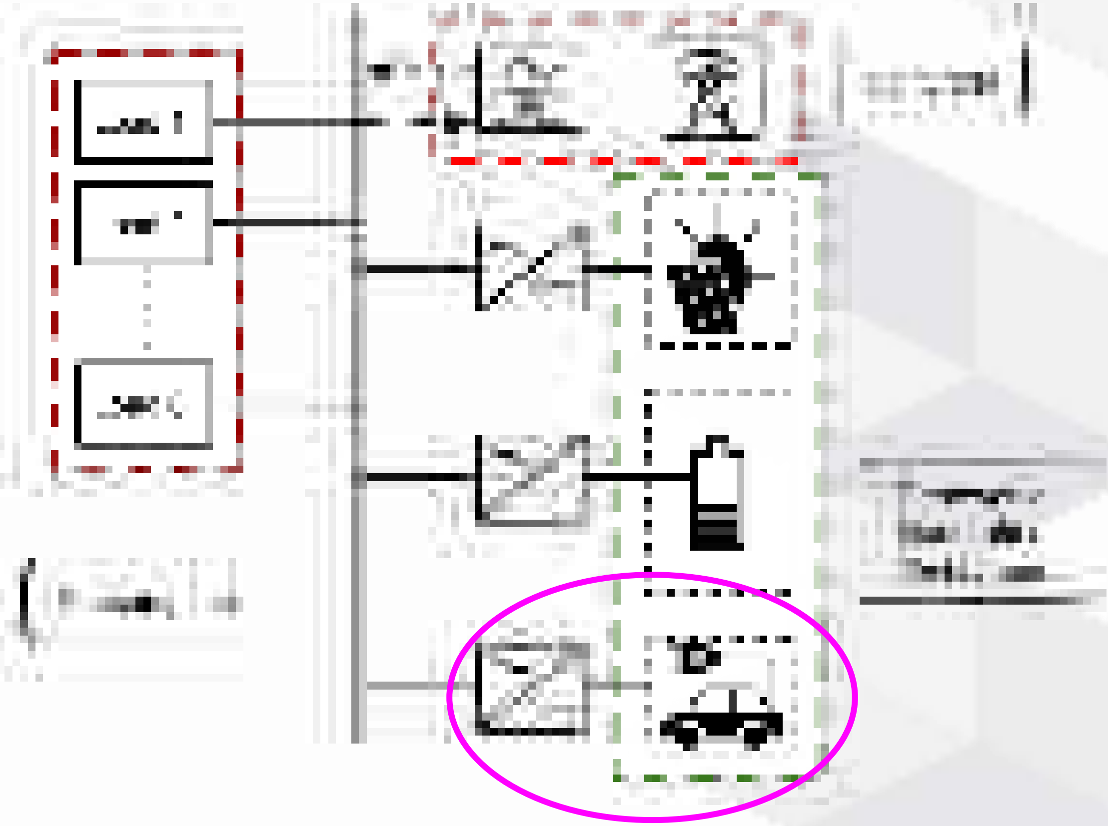
Material and Methods



Material and Methods



PED archetypes



PED modelled for Bilbao based on a Bus distribution.

$$\sum_{k=1}^{n} I = 0 \quad (1)$$

$$\sum_{k=1}^{n} I_L = I_G + I_{PV} + I_{ESS} + I_{EV} \quad (2)$$

Where:

I_L = Current consumption in buildings

I_G = Current of utility grid

I_{PV} = Photovoltaic current generation

I_{ESS} = Current of Energy Storage Systems

I_{EV} = Current of Electric Vehicle

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PED modelization and electricity

$$R_{load} = \frac{V}{P} \quad (3)$$

Where:

V: Voltage provided by the utility grid

P: Power demanded by the load/building

Building Ohm's model for modelling the PED.

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Material and Methods

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Material and Methods

Scenario 1: represents the baseline for comparison of results. The energy is only generated by the utility grid.

Scenario 2: includes RENE by PV systems.

Scenario 6: is obtained by adding 1 EV to Scenario 5.

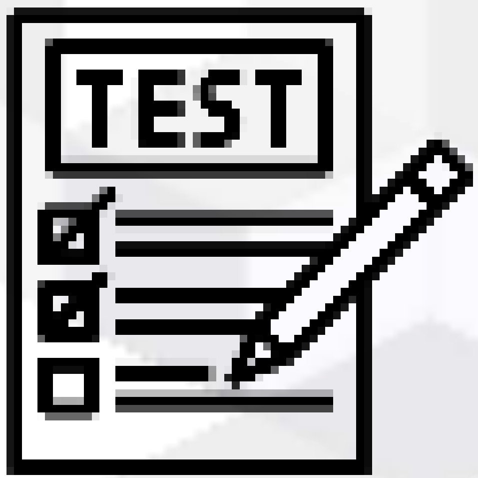
Scenario 3: with respect to Scenario 2, it includes an ESS.

Scenario 5: simulates Scenario 4 but considering that retrofitted buildings improve the label certification from C to B.

Scenario 4: it adds the consumption of smart poles.

Scenario 7: same as Scenario 6 but improving retrofitted buildings labelling from B to A and avoiding the use of EV.

Scenario 8: same as Scenario 7 but adding again the charger of the EV.



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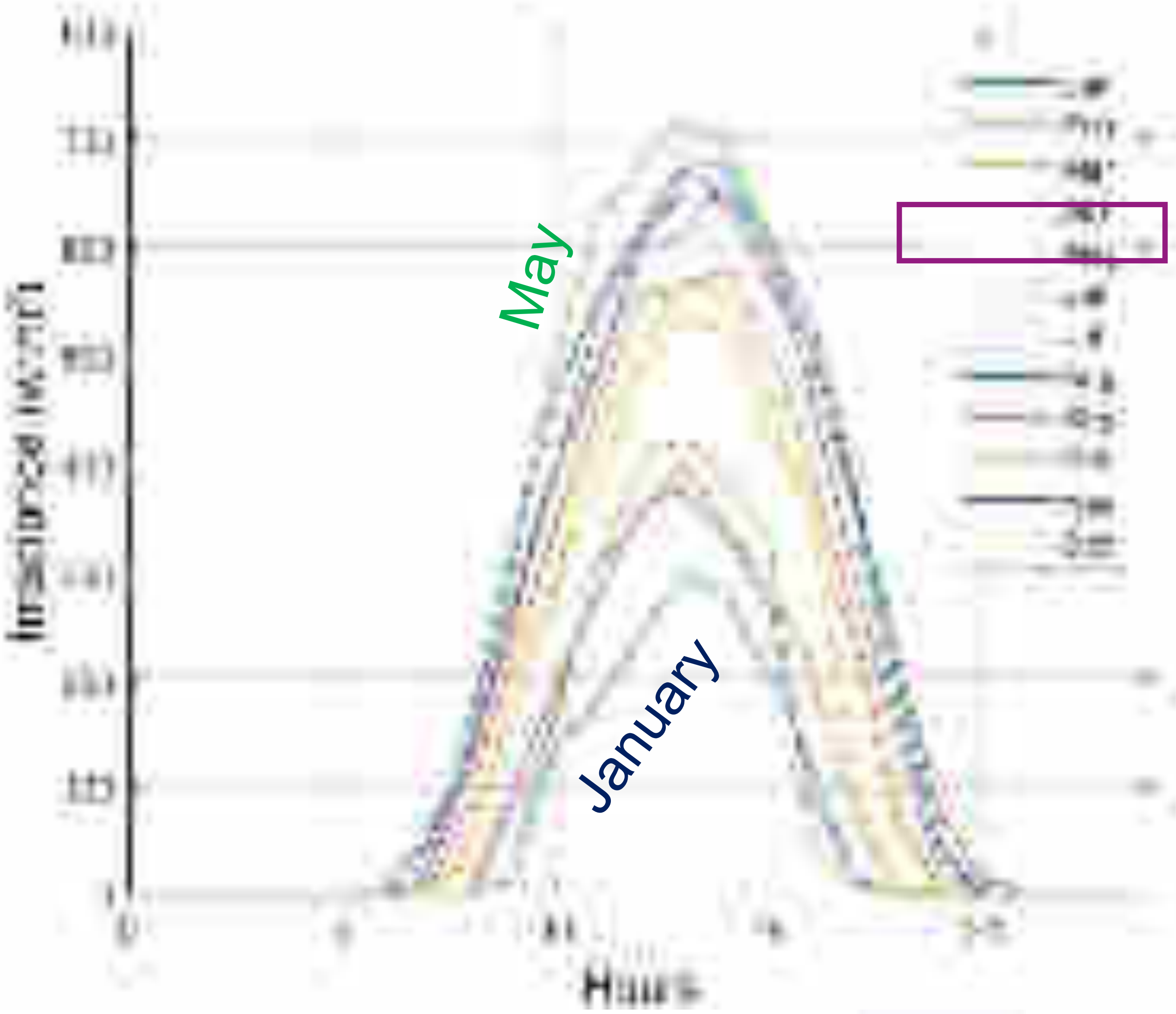
Discussion of the results

Discussion of the results

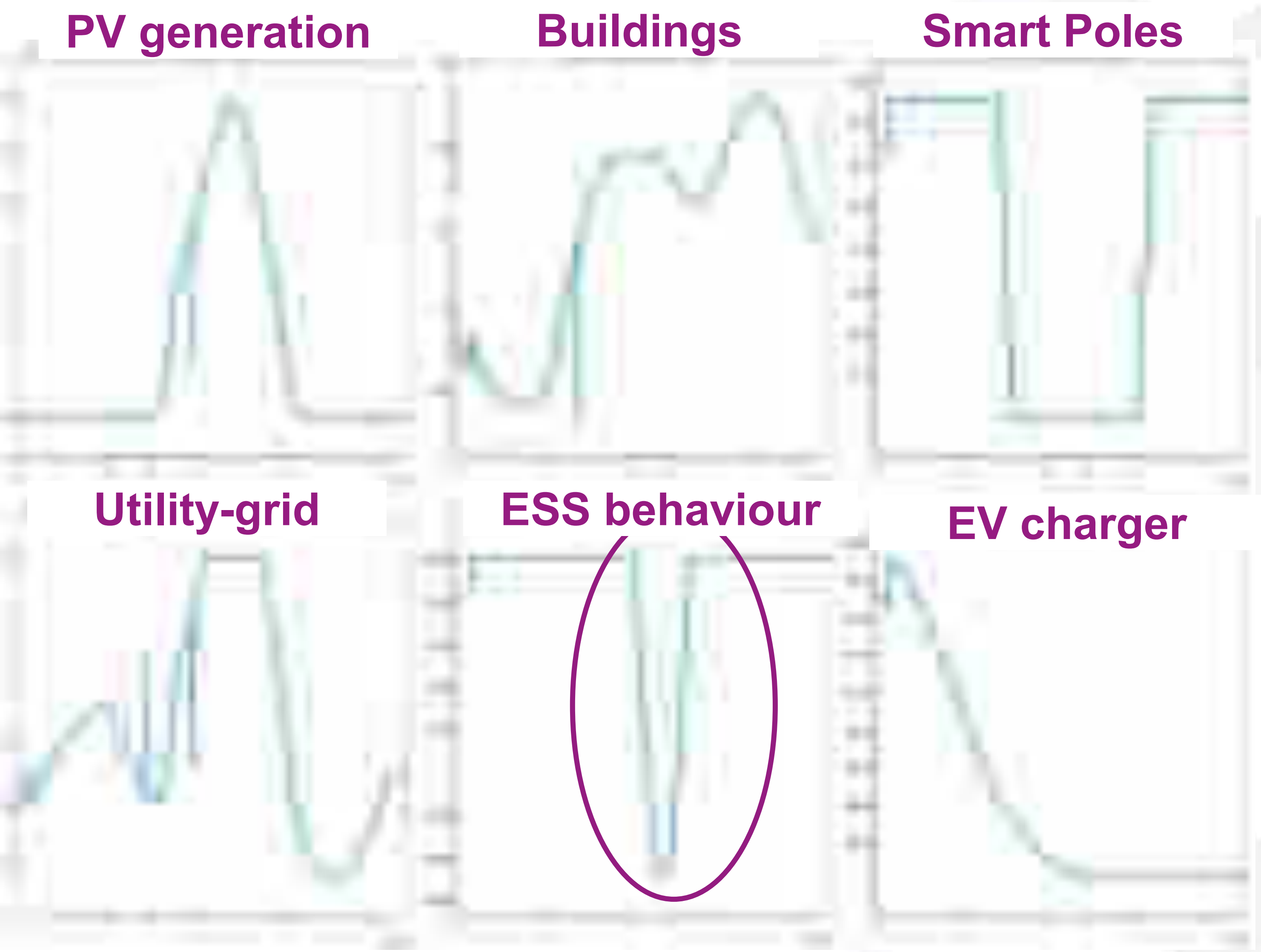


Standard Test Conditions (STC):

- Irradiance 1000 Wm2
- Temperature 25 ºC
- Air Mass 1.5

In May, we are 30% below the STCs for Irradiance

Results: 24 hours in January



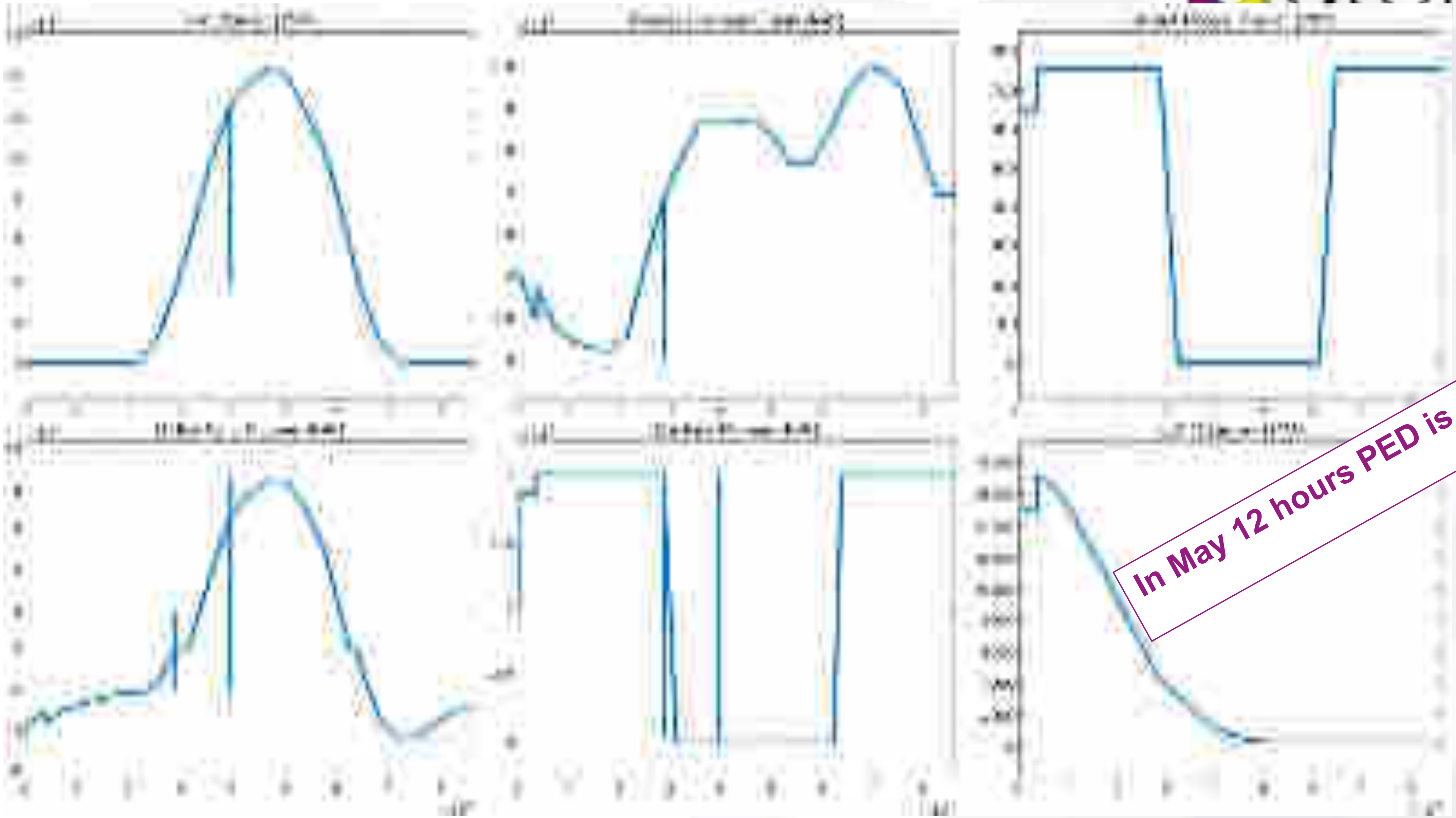
For 3 hours approximately the ESS is being charged (PED is got):

The energy generation (PV)

>

The energy consumption (buildings, lighting and EV)

Results: 24 hours in May



In May 12 hours PED is got !!

Figure 5. Simulation results in May which corresponds to highest irradiance values in the year.

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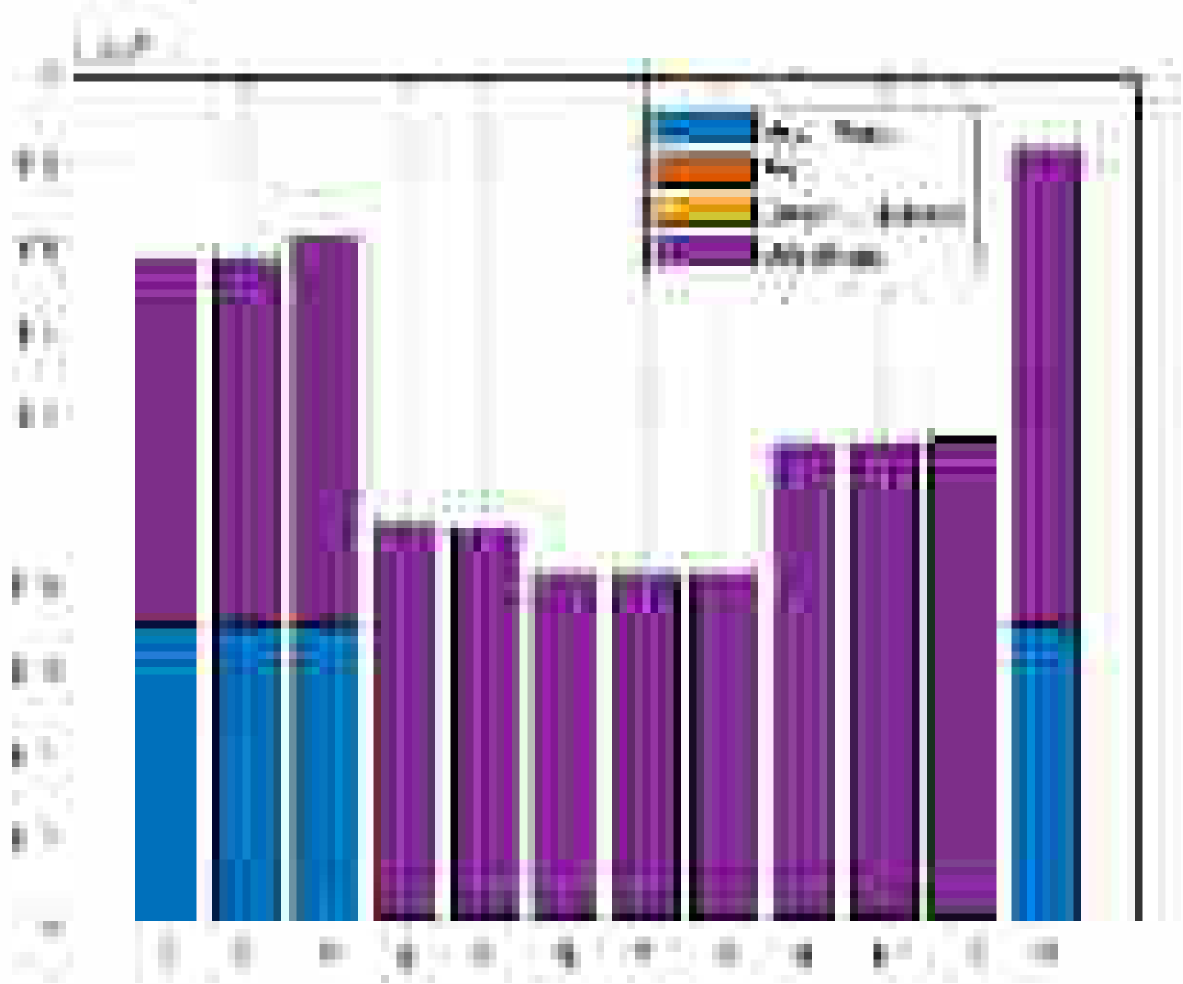
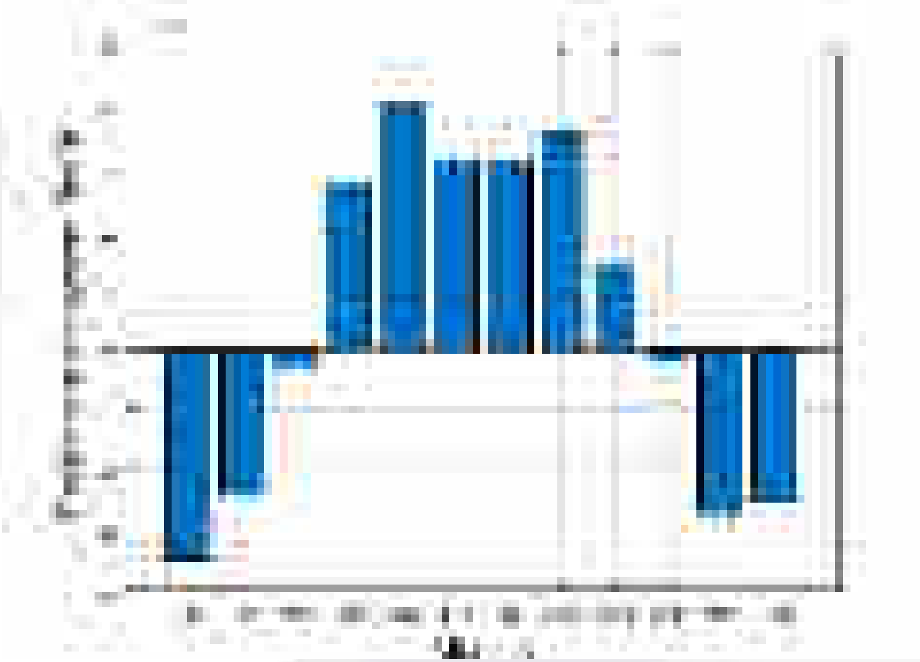
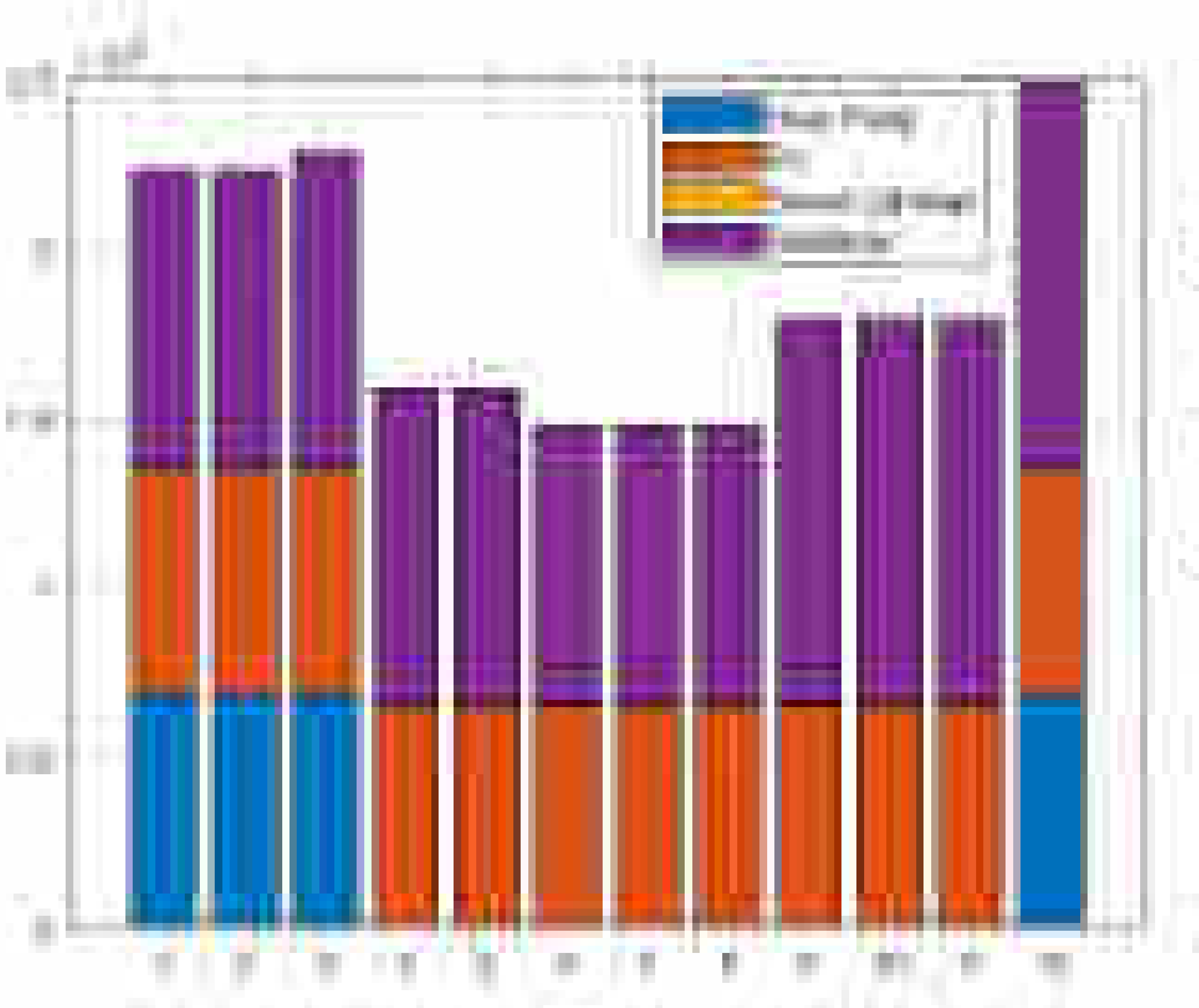
RESULTS OBTAINED

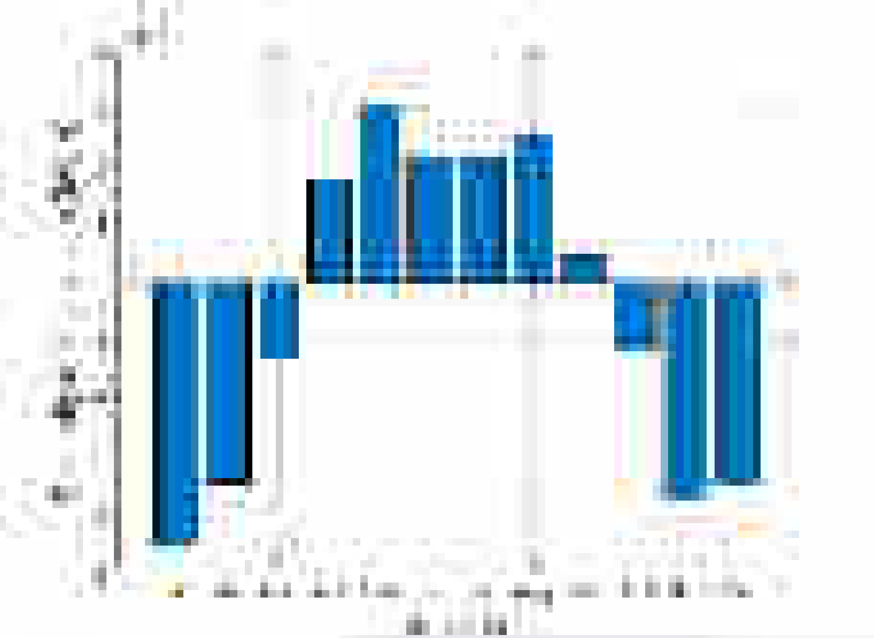




Scenario 5
- BUILDING: B
- EV: No
- LIGHTING: LED

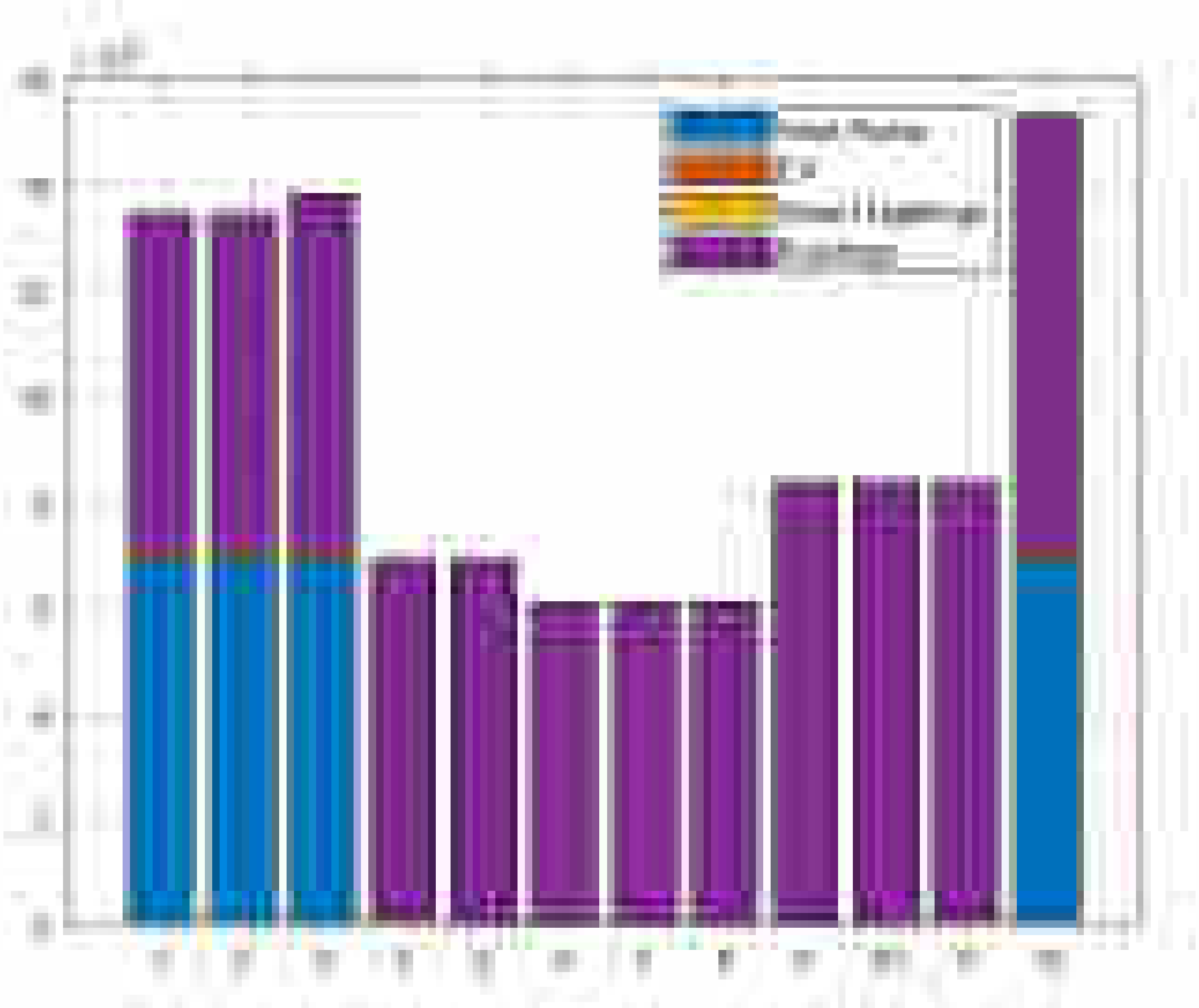
RESULTS OBTAINED

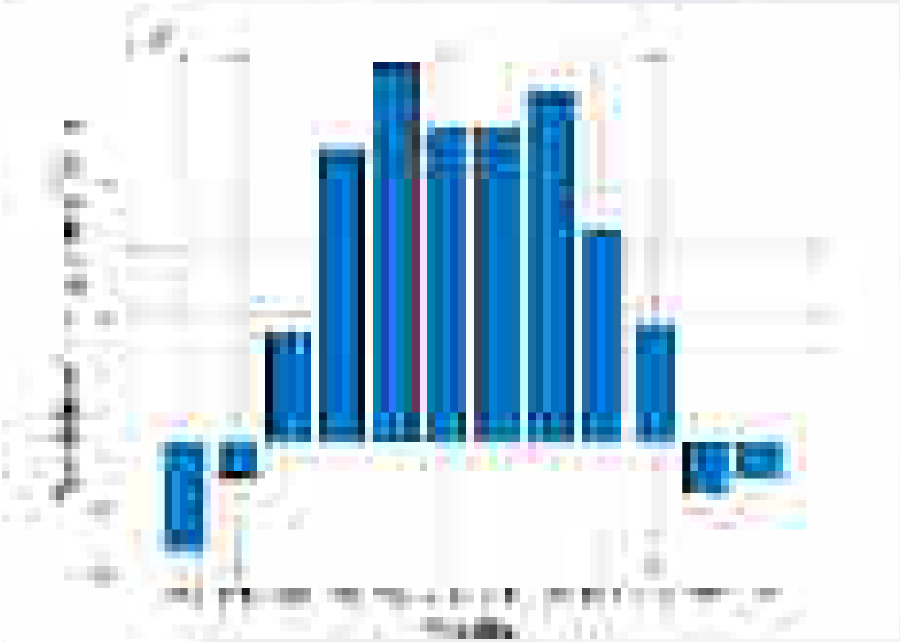




Scenario 6
- **BUILDING: B**
- **EV: Yes**
- **LIGHTING: LED**

RESULTS OBTAINED

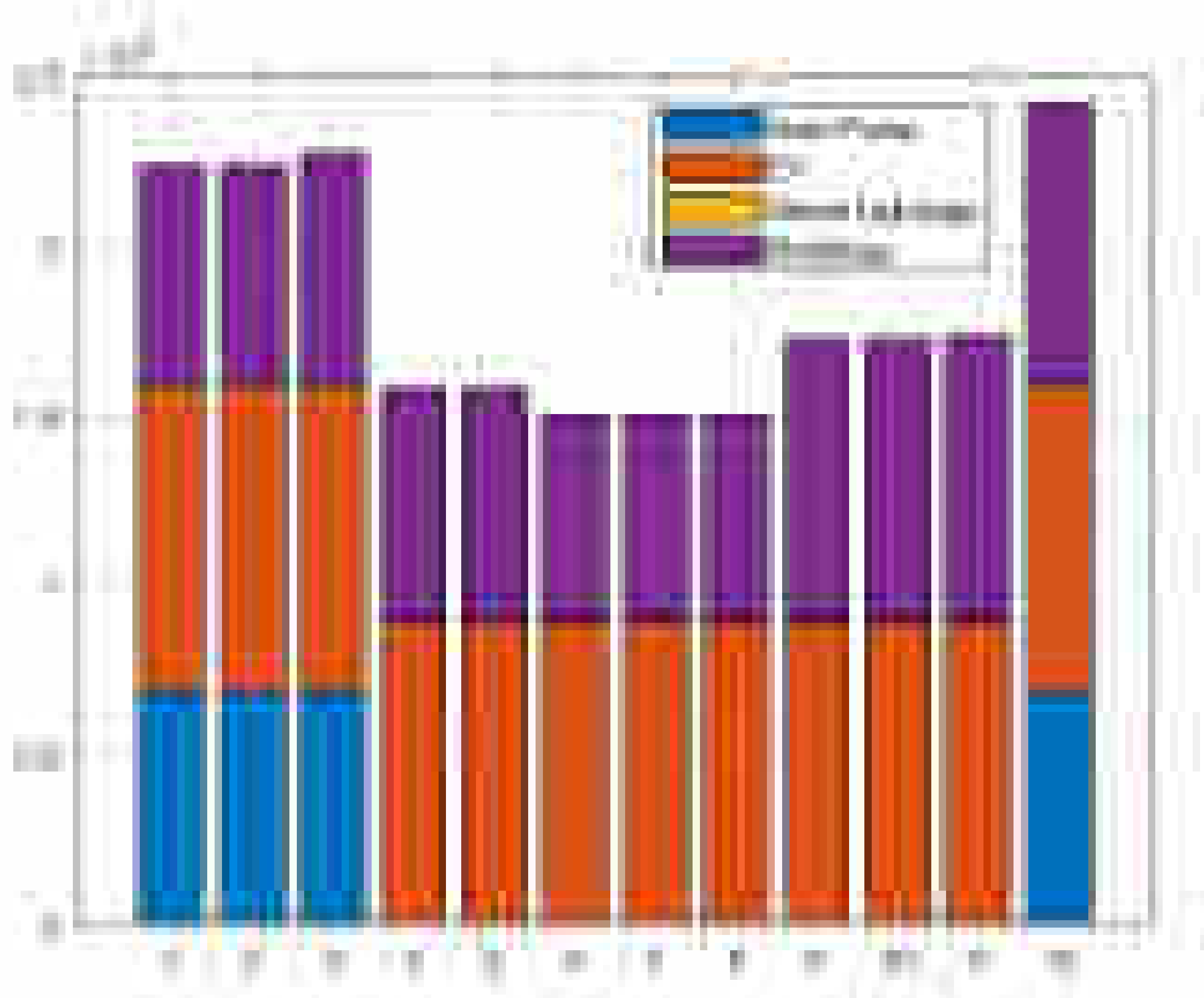


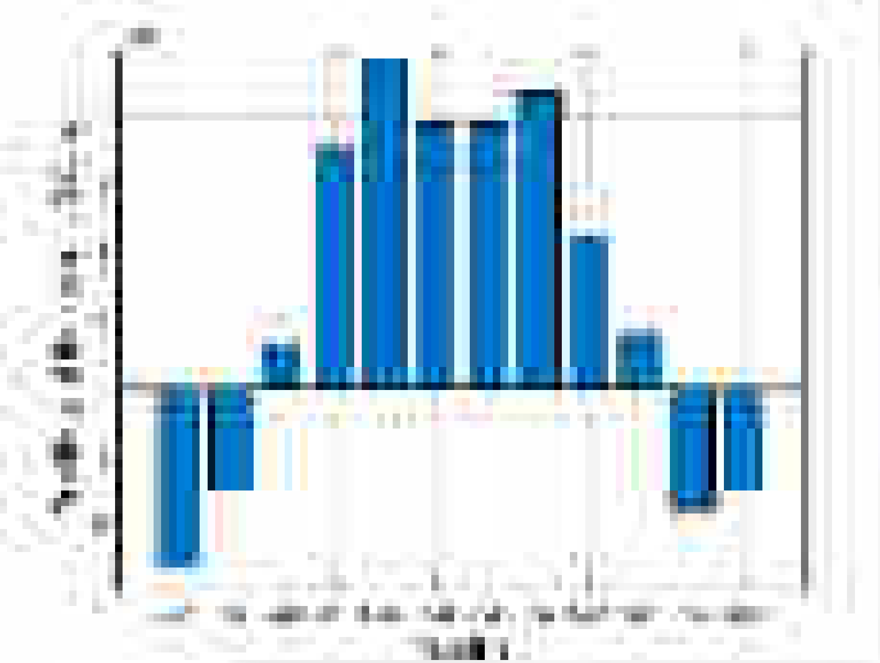


Scenario 7

- BUILDING: A
- EV: No
- LIGHTING: LED

RESULTS OBTAINED





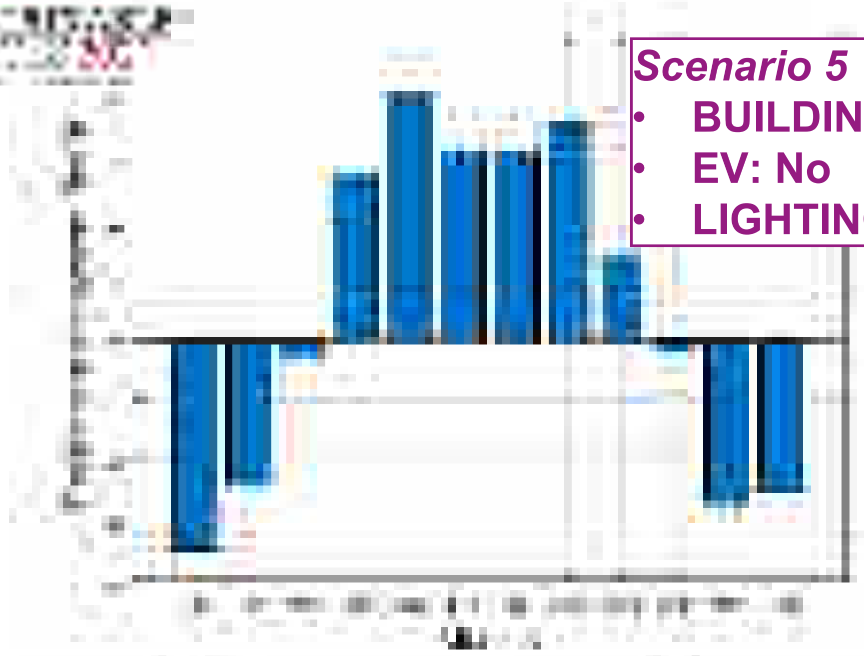
Scenario 8
- BUILDING: A
- EV: Yes
- LIGHTING: LED

RESULTS GATHERED

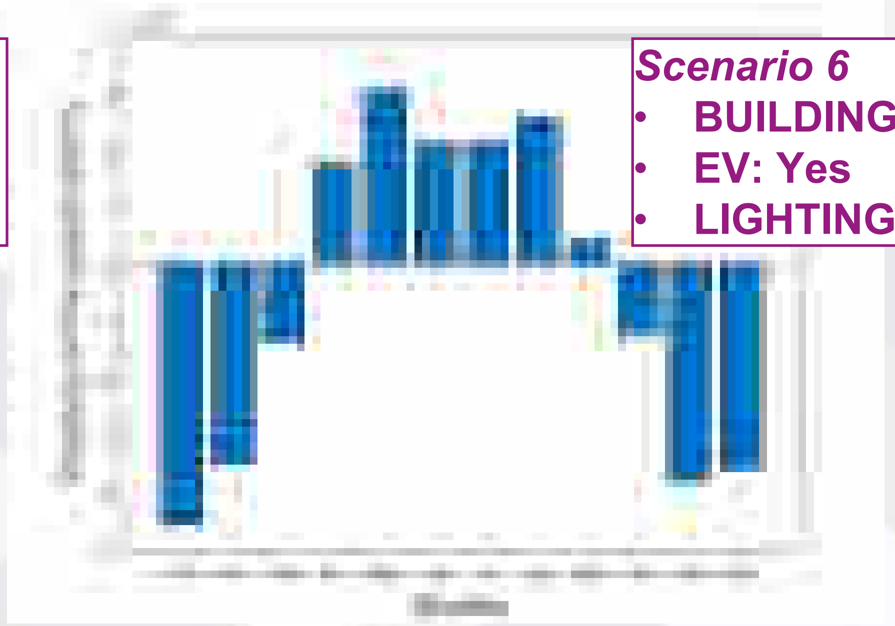
DEFINITION | RESULT

Scenario	PV	ESS	Lg	Enegy label	EE	Energy (kWh)	PED
1	**NO**	**NO**	**HALOGEN**	C	C	-12296	N
2	NO	**NO**	**HALOGEN**	C	C	-3417	N
3	YES	YES	**HALOGEN**	C	C	-2220	N
4	**YES**	**YES**	LED	C	C	-2134	N
5	**YES**	**YES**	**LED**	**B**	**B**	7899	**Y**
6	**YES**	**YES**	**LED**	**B**	**B**	87	**Y**
7	**YES**	**YES**	**LED**	**A**	**A**	10855	**Y**
8	**YES**	**YES**	**LED**	**A**	**A**	168	**Y**

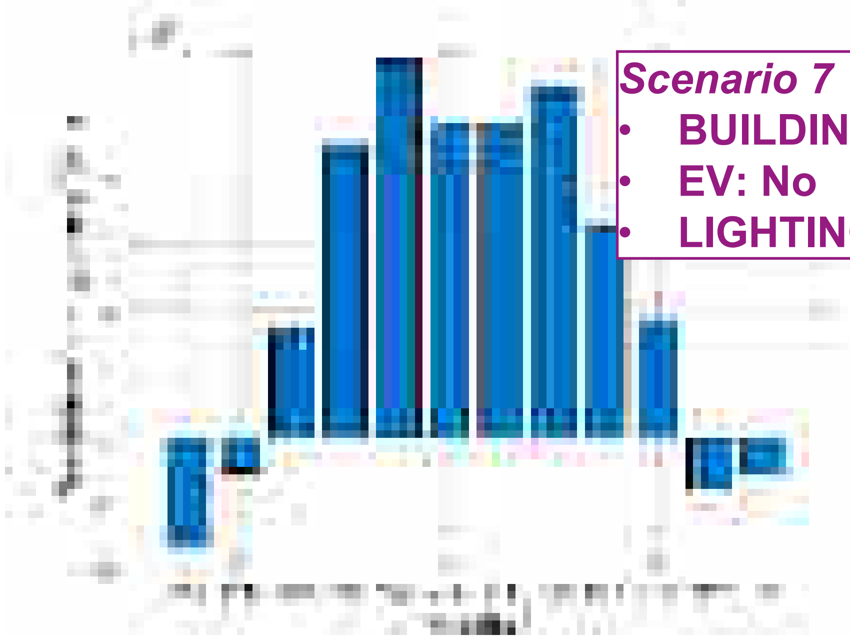
RESULTS OBTAINED



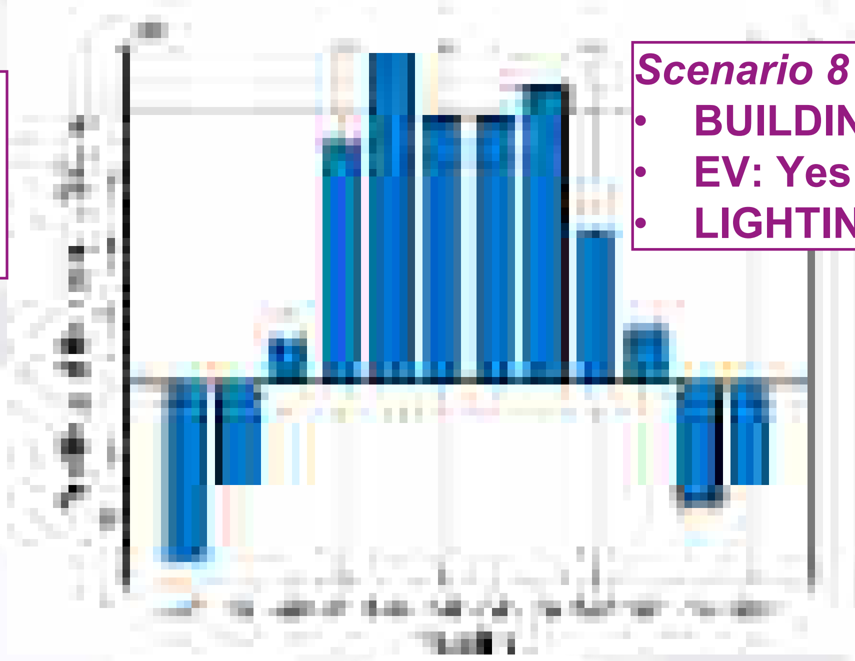
Scenario 5
- BUILDING: B
- EV: No
- LIGHTING: LED



Scenario 6
- BUILDING: B
- EV: Yes
- LIGHTING: LED



Scenario 7
- BUILDING: A
- EV: No
- LIGHTING: LED



Scenario 8
- BUILDING: A
- EV: Yes
- LIGHTING: LED

Conclusions and task done

Main conclusions

1. We can conclude that it is possible achieve the positivity of the district, and in consequence, this energy surpluses could be used to meet mobility demands of the local residents or even (under some scenarios) to EVs that would be passing by.
2. The key parameter is the energy efficiency label of buildings. It is remarkably that we achieve the positivity once we have enhanced the efficiency of the buildings unless to B.
3. In the end, the PED might provide as much as about 7 million of green kilometres, which can be turned into 545 EVs in the best scenario of the PED.

Future work

Future work

1. Optimise the energy storage systems to meet daily energy demands of the PED during the season of Winter, and Autumn seasons.
2. Use the flexibility that EVs can provide to the enlargement of ESS for smoothing the peak demands of the PED.
3. Introduce the demand side management in the model, and assess the viability to create a local energy market prosumer based.

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For your attention!

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