The impact of e-mobility in Positive Energy Districts

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Outline:

1. Introduction and background
2. Material and Methods
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   ii. Data references for electricity consumption
   iii. Simulation model
   iv. Methodology applied in the evaluation.
3. Some results and discussion
4. Conclusions
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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].
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]
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.
Material and Methods

The impact of e-mobility in Positive Energy Districts
Where is located the PED?

Setting up the first foundation stone for the synthetic PED in a simulation approach
The impact of e-mobility in Positive Energy Districts

Where is located the PED?

Where is located the PED?
Irradiance profiles along the year
How was the synthetic PED created
Material and Methods
Material and Methods

Area for new construction buildings (%)  
Area for old buildings (%)
PED archetypes

PED modelled for Bilbao based on a Bus distribution.

"Icon made by Pixel perfect from www.flaticon.com"
Building Ohm’s model for modelling the PED.
Material and Methods

"Icon made by Pixel perfect from www.flaticon.com"
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 3:** with respect to Scenario 2, it includes an ESS.  
**Scenario 4:** it adds the consumption of smart poles.  
**Scenario 5:** simulates Scenario 4 but considering that retrofitted buildings improve the label certification from C to B.  
**Scenario 6:** is obtained by adding 1 EV to Scenario 5.  
**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.

"Icon made by [Pixel perfect](http://www.flaticon.com) from www.flaticon.com"
Discussion of the results

The impact of e-mobility in Positive Energy Districts
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

The impact of e-mobility in Positive Energy Districts
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

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

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

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 864374.

## DEFINITION

The impact of e-mobility in Positive Energy Districts.

## RESULT

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<th>PV</th>
<th>ESS</th>
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</table>
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

The impact of e-mobility in Positive Energy Districts
Conclusions and task done
Main conclusions

1. We can conclude that it is possible to 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!