THE POTENTIAL OF POSITIVE ENERGY DISTRICTS IN THE ENERGY TRANSITION ACROSS EUROPE

Axel Bruck, Instituto Tecnológico de Canarias & Energy Economics Group TU Wien, +34644601180, abruck@itccanarias.org

Overview

In order to address global warming due to greenhouse gas emissions by energy generation and high local pollution in urban areas, the European Commission initiated the "Strategic Energy Technology" (SET) Plan in 2007. In 2017, parts of the SET Plan were converted to implementation plans for further research & innovation actions, in which one area focuses on "Smart Cities and Communities". Its main target is to plan, develop or implement at least 100 "Positive Energy Districts" (PEDs) until 2025 . A PED is considered as an area with an annually accumulated net zero energy balance and a net zero carbon dioxide emission balance, while working towards an annually accumulated excess of locally generated renewable energy [1] [2]. Therefore, this work is an essential contribution towards the European goal of 100 PEDs. Since the EU is a very diverse union of member states, a "one-fits-all" approach is not promising. Thus, the main objective of this work is to evalueate the potential of a residential PED additions in different zones across Europe for existing building stock. Zones are grouped by certain indicators, such as climate conditions, demand of energy (profile and various types), settlement patterns and potentially the existing electricity grid mix. Energy includes electricity, heating and cooling. This provides an insightful overview of where and under which conditions a PED implementation would be most feasible and sensible in financial and technological terms. This is then illustrated as a PED potential map across European areas, which can help to identify areas that are most adequate for realization of Positive Energy Districts.

Methods

The optimization method used is a specifically, tailor-made linear programming (LP) model in Python using Pyomo. The model schematic is shown in Figure 1.

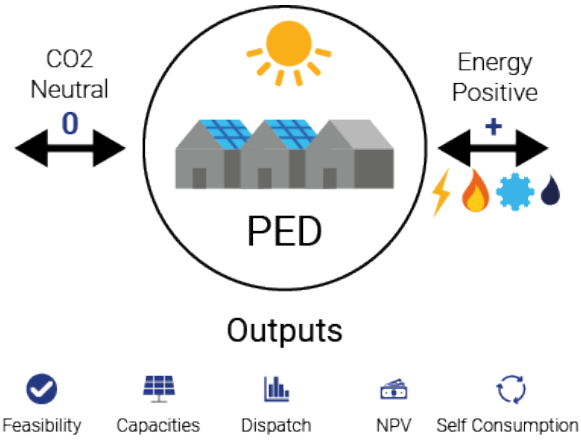

Figure 1. Schematic representation of Python Model for PED optimization

The objective of the linear programming model is the maximization of the Net Present Value (NPV) and thus the optimization of the potential PED, as well as the capacity of required multi-energy technology and high resolution energy dispatch. Main constraints are the positive energy balance with the outer scope, the net CO_2 neutrality and available space for energy generation. The model will be applied to various zones across Europe. These zones will be determined to approximately share certain indicators. A preliminary selection of those variables are as aforementioned, climate conditions, energy demand and typical settlement patterns.

Results and Conclusions

The expected results of the study are to discover the optimal areas across Europe for PED deployment, alongside the respective usage of energy generation and storage technology, as well as dispatch. These results can feed valuable information to decision and policymakers regarding which areas to focus on and what technology is most likely to yield the best results. Preliminary testing indicates that feasibility is strongly linked with settlement patterns due to the required space for energy generation over the used floor area. While in new building development the settlement pattern can be easily optimized to fit the requirements of a PED, in existing districts, this is a crucial factor.

References

[1] European Commission, SET-Plan ACTION n°3.2 -reImplementation Plan, 2018.

[2] S. Bossi, C. Gollner and S. Theierling, “Towards 100 Positive Energy Districts in Europe: Preliminary Data Analysis of 61 European Cases,” *energies,* 20 November 2020.