

Optimization of Renewable Energy Communities for flexibility services

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Abstract

The research activity carried out tries to bridge the gap between users of a renewable energy community (REC) and flexibility tools that are available to aggregates users. EnGreen's work has stimulated the creation of about 20 RECs in Italy. Technologies such as smart-metering, heat pumps, photovoltaic panels, and batteries could be able to shift nighttime loads during core hours, increasing self-consumption and shared energy. The open-source models developed *ECModel* and *pypsa-distribution* are trying to help practitioner and researcher to understand the potential or REC in Italy and Europe.

Objectives

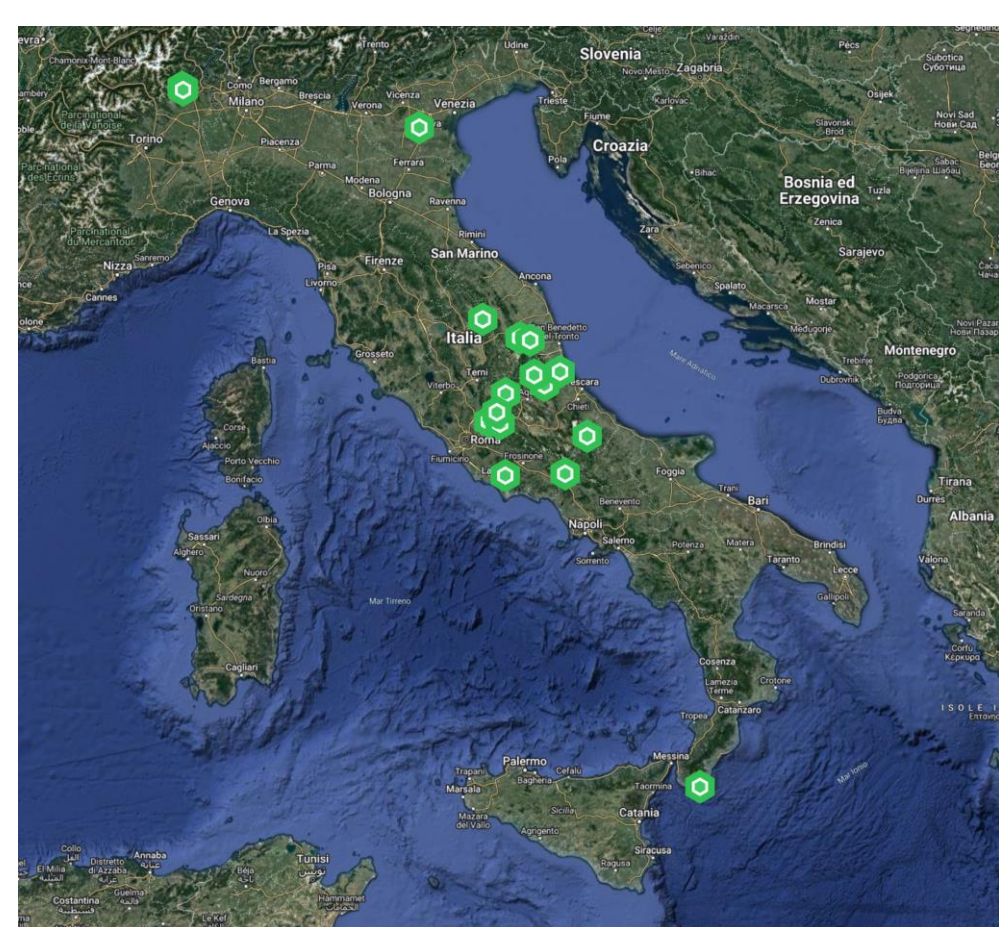
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- Comprehensive design for fair renewable energy community, from the technical-economic design to the social dimension
 - ❑ Identification of methods of economic allocation among members of RECs
 - ❑ Design and optimization of assets in RECs
 - ❑ Development of aggregate user solutions for network ancillary services

Introduction

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- 35 RECs active in Italy, 41 almost established, 24 under development
- 18 REC under development and 2 active on Italian territory with to EnGreen



Location of EnGreen RECs

First year activities

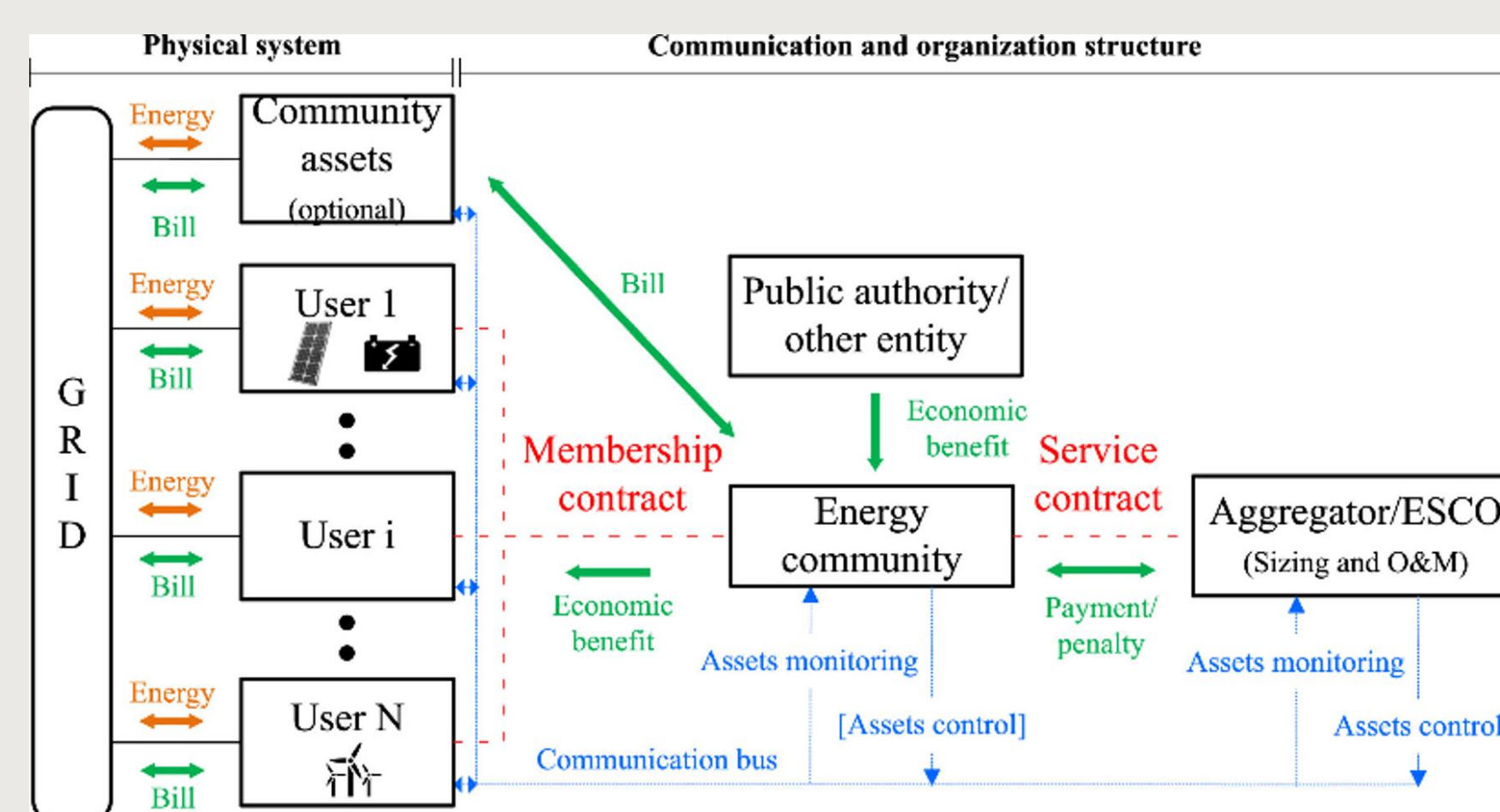
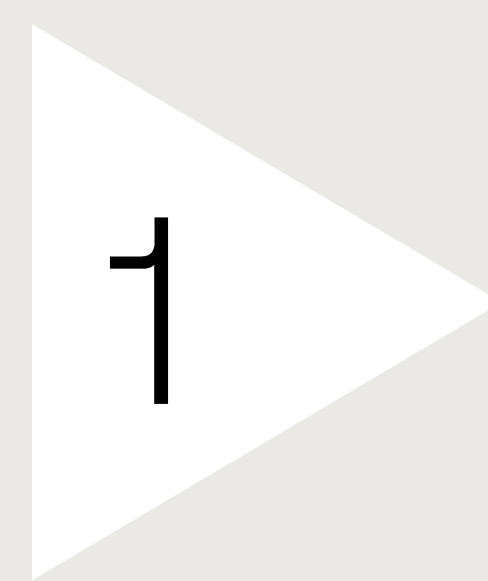
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- Conferences: 3 in presence attendance, 2 online attendance
- PhD seminar organization "Renewable Energy Communities: Italian case studies and EU regulatory framework", 12 speakers and 10 hours event
- Publication: 3 conference proceeding, 2 journal publication under process
- Research PhD seminar: English for research purposes, CLI and multiple webinar

Materials and Methods

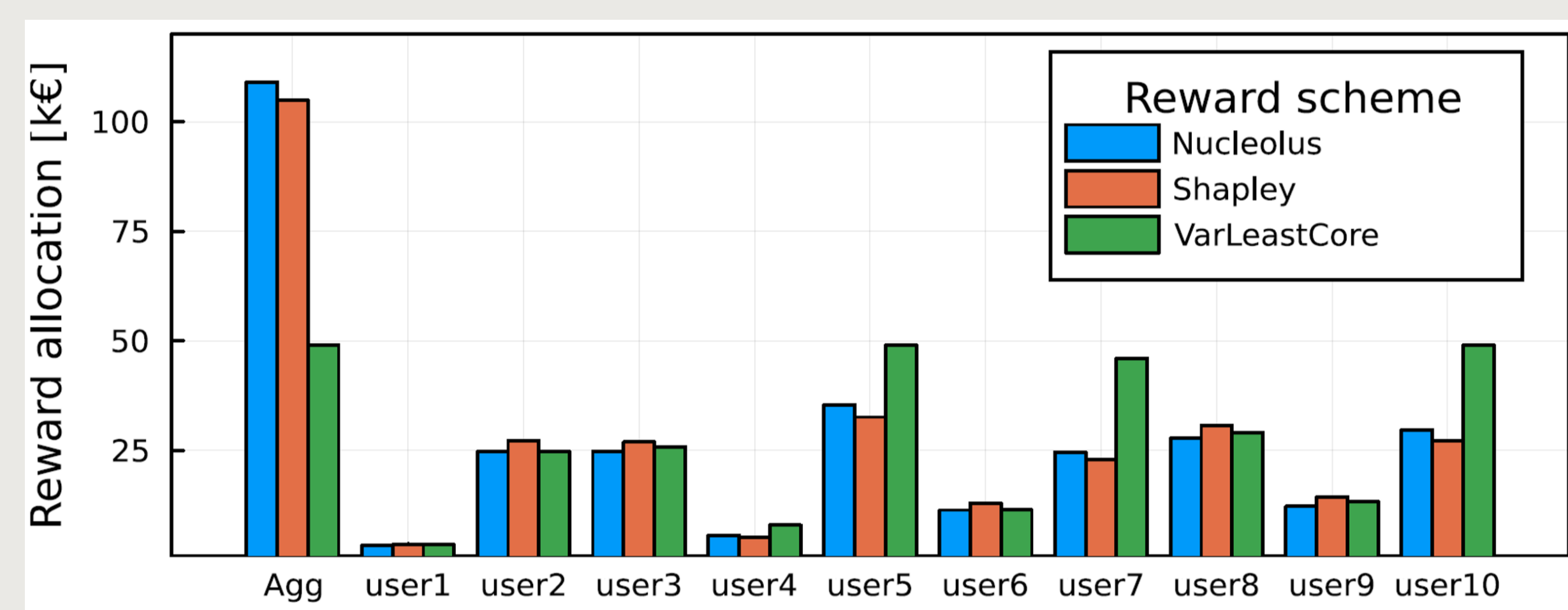
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Analysis of the various tools and models available and missing features in the Italian landscape [1] and development of RECs with EnGreen



REC physical and organization structure

- In person data collection in Lazio and Piedmont
- Data analysis
- Meeting with residents, enterprises and public institutions



Reward allocation of ECModel [3]

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Study of allocation mechanisms and ways to distribute the incentive [2] RECs can provide flexibility mechanisms to the grid [3]

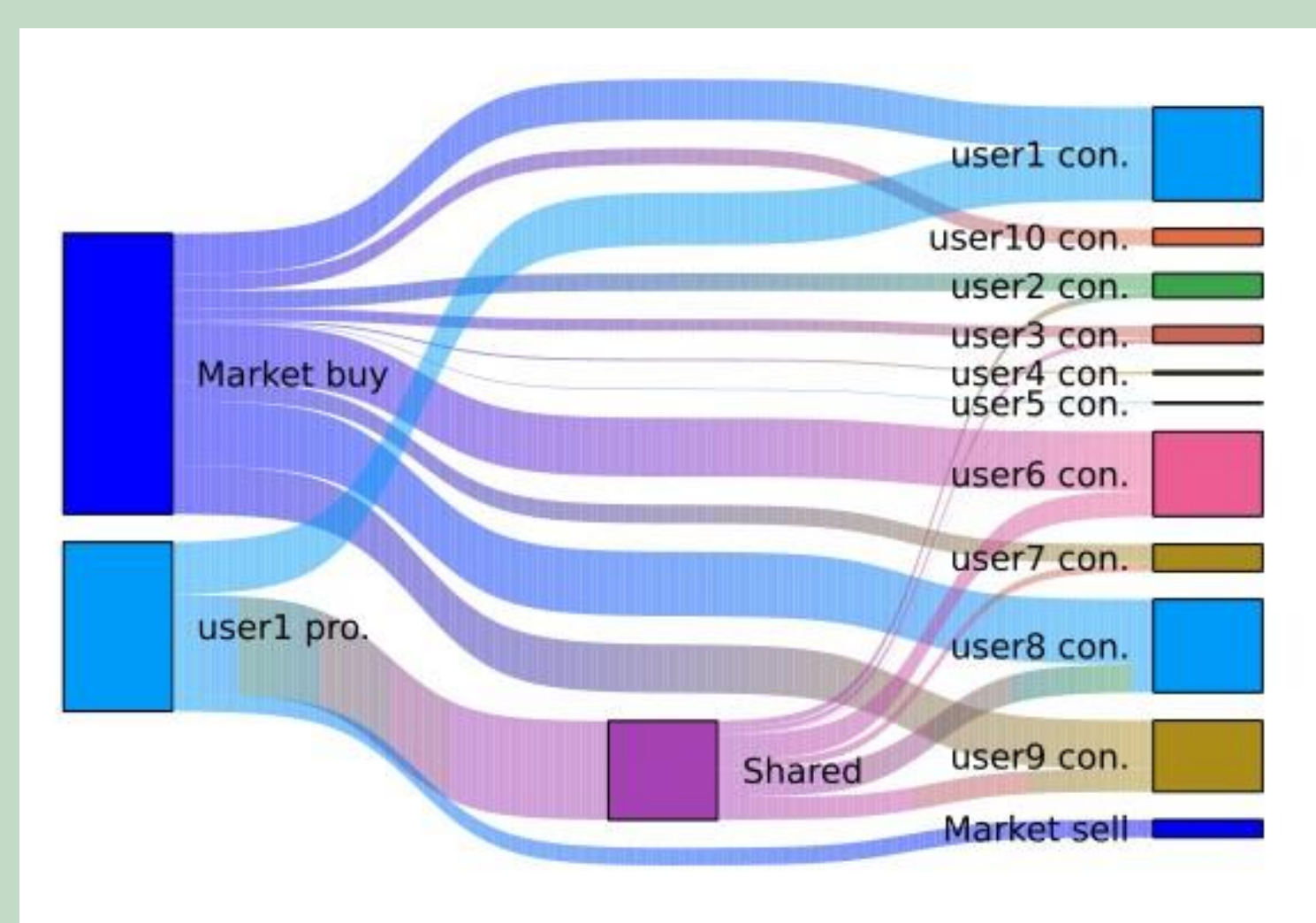


REC kick-off meeting with municipality and citizens

Preliminary findings

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- EnergyCommunity.jl & TheoryOfGames.jl: useful tools for REC, addressing the identification phase with a linear optimization model and different reward schemes



Energy fluxes from ECModel [1]

- Current regulatory status prevents the development of consistent projects with the market insecurity of the incentive system

Continuation plan for subsequent years

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Activity	Q1 Y1	Q2 Y1	Q3 Y1	Q4 Y1	Q1 Y2	Q2 Y2	Q3 Y2	Q4 Y2	Q1 Y3	Q2 Y3	Q3 Y3	Q4 Y3
Literature												
RECs creation												
Fairness in RECs												
IREC visiting												
Flexibility cases												
Thesis work												

Publications

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- [1] D. Piserà, T. Ferrucci, D. Fioriti, D. Poli, F. Silvestro, Freeware Digital Platforms for Designing Renewable Energy Communities in Italy: An Overview, AEIT23, under publication
- [2] D. Fioriti, T. Ferrucci, and D. Poli, 'Fairness and reward in Energy Communities: game-theory versus simplified approaches', IEEE ICPS Europe, Jun. 2023, pp. 1-6. doi: 10.1109/IEEEIC/ICPSEurope57605.2023.10194696.
- [3] T. Ferrucci et al., 'Battery energy storage systems for ancillary services in Renewable energy communities', E3S Web Conf., vol. 414, p. 03011, 2023, doi: 10.1051/e3sconf/202341403011.