Energy Communities and Consumer engagement – The JRC Experience

Roundtable of Future Market Platform - Enable flexibility potentials of consumer groups

Antonio De Paola

Berlin, 3rd June 2024

Renewable Energy Communities (RECs)

A group of consumers and/or prosumers, that together share energy generation units and electricity storage

- Key tool for the **energy system decarbonisation**
- **Direct benefits to local consumers** (higher efficiency, lower costs)
- **Increased public acceptance** of renewable projects
- **Facilitate private investments** in the energy transition
- **Distributed and scalable solution** to support grid operation and facilitate penetration of renewables

Can Energy Communities **enable and enhance the flexibility** of their members?

Energy Communities in Italy and Europe

2018 — Dir. 2018/2001 (RED II)

- Introduction of **Renewable Energy Communities** (RECs)
- **Main objective**: provide **environmental, economical and social benefits** to their members and local communities

2019 — DL 162/2019 + Legge 8/2020

- First **preliminary implementation**
- Aggregation area limited by **connection to the same secondary substation** (MV/LV)
- **Maximum size** of single plant: **200kW**

2021 — DL 199/2021

- **Final implementation**
- Aggregation area limited by **connection to the same primary substation** (HV/MV)
- **Maximum size** of single plant: **1000kW**

2022 — TIAD + Consultation + Decreto MASE

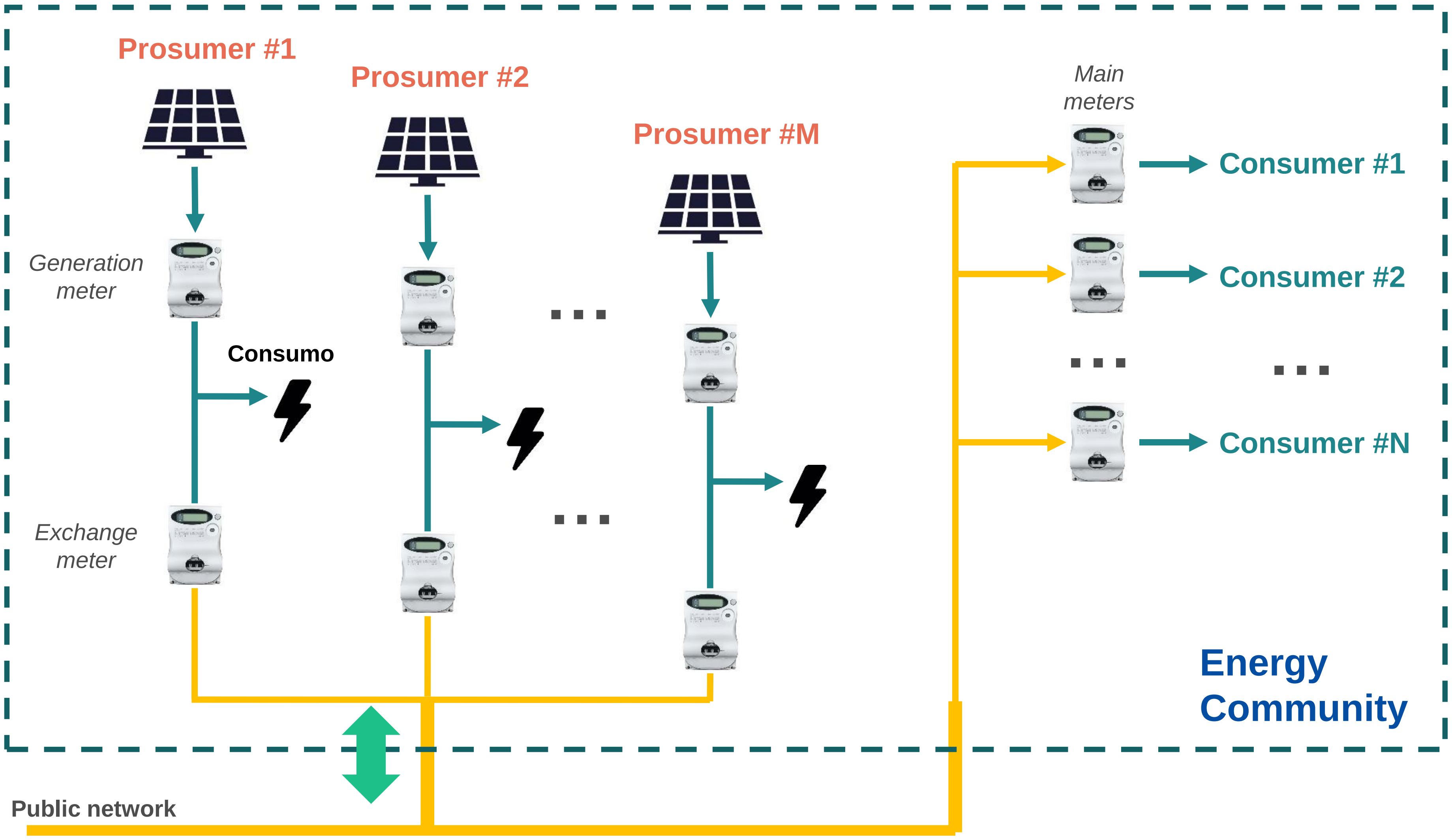
- **Refinement of technical details**
- Mapping of primary substations
- Clarification of the different roles and procedures for the access to the economical incentives

2018 — 2019 — 2020 — 2021 — 2022 — 2023

Economic incentives on REC self-consumed energy (2019–2023)

Virtual scheme for energy sharing and self-consumption (2019–2023)

«Virtual» Energy Sharing



- **Ex-post evaluation of the self-consumed energy,** on the basis of the net hourly energy exchange with the network
- **No change in the existing infrastructure**
- Each REC memebr maintains its right to keep/change the energy retailer

Step 1: Engagement with stakeholders

Comune di Magliano Alpi

Comunità Energetica Rinnovabile Magliano Alpi

Politecnico di Torino
1859

ENERGY CENTER

- **First Renewable Energy Community in Italy**, developed with the support of local institutions and universities (Politecnico di Torino)
- **Initial project was quite small**: 1 residential consumer + 3 shops + 4 rooftop photovoltaic plants
- **Willing to expand:** what are the implication for the REC self-consumption and the associated economic incentives?
- **Flexibility:** can we use it to improve the self-consumed energy of the REC and maximize the incentives?

Step 2: development of new scientific project

OBJECTIVE: alignment of demand and renewable generation within the energy community

- **Reduced costs and emissions**
- **Increased efficiency of the power system**

IMPACT FACTORS

- Flexibility of REC energy consumption
- Number/types of consumers
- Number/types of prosumers
- Geographical position and extension

UNCERTAINTIES

?

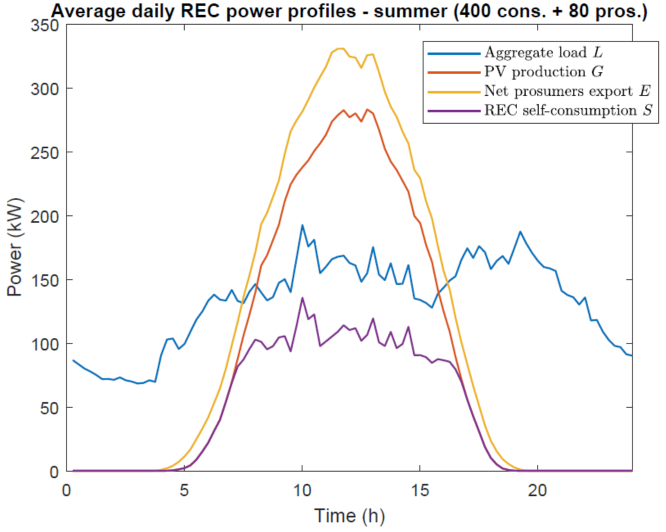
- Behaviour/consumption of consumers
- Weather conditions

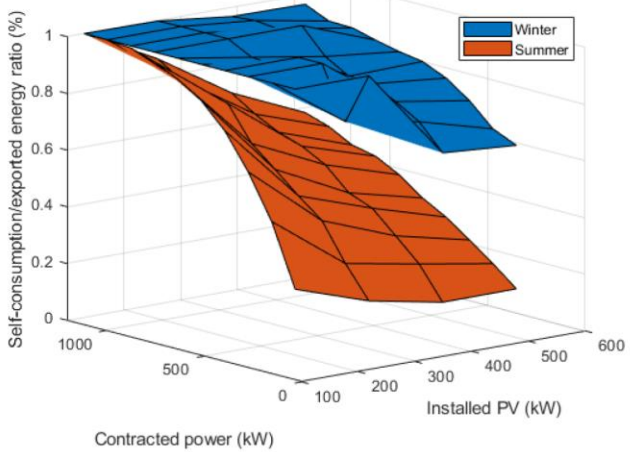
Necessary to develop new tools to
- **Support the planning and design of new RECs**
- Provide quantitative evidence for the preparation of **adequate business plans**

New forecast and analysis tool for RECs

- Development of a new software tool that relies on historical data and statistical models **to forecast behaviours and performance of energy communities**

- Forecast of the aggregate generation and demand profiles of the REC
- Estimation of current and future **economical incentives**
- **Sensitivity studies** on size and composition of the communities





A. De Paola et al., *A Predictive Tool for Techno-Economical Analyses of Renewable Energy Communities*, 2023 IEEE International Conference on Environment and Electrical Engineering (EEEIC)

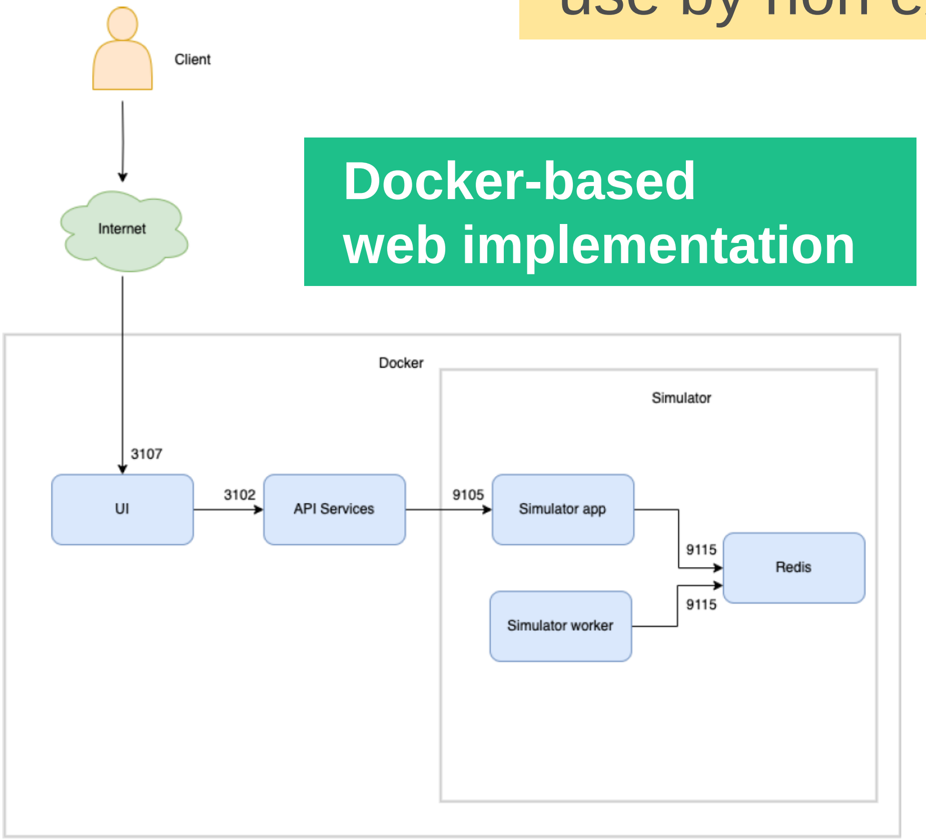
ERIGrid 2.0 Connecting European Smart Grid Infrastructures

pean mission

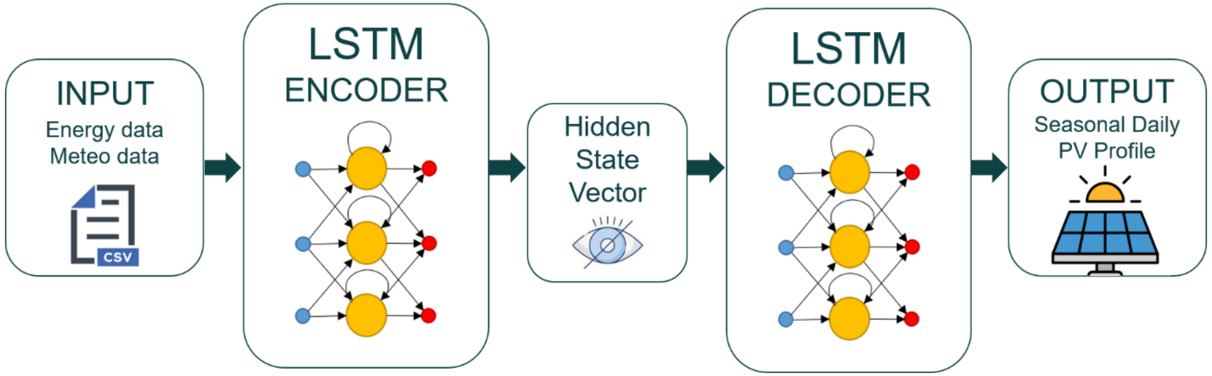
Step 3: Open-access implementation of the tool

Transformation of the scientific tool (MATLAB based, difficult to use by non experts) into an **open access web-based resource**

Docker-based web implementation



Improved forecast accuracy with neural networks



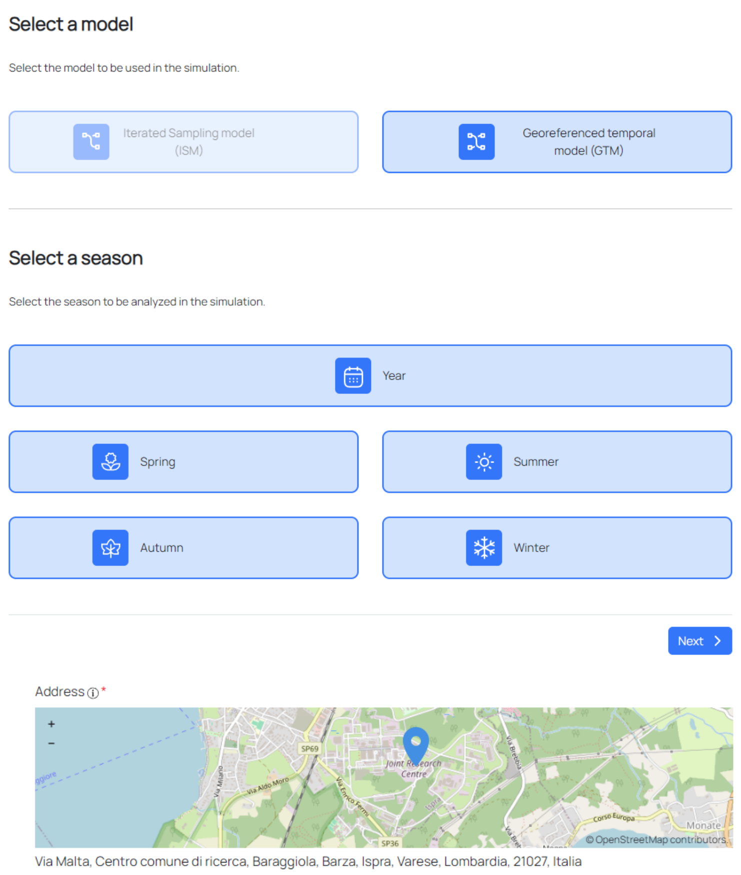
A. De Paola et al., *Open-source software tool for techno-economic analyses of Renewable Energy Communities*, in preparation.

fabbricadigitale

European Commission

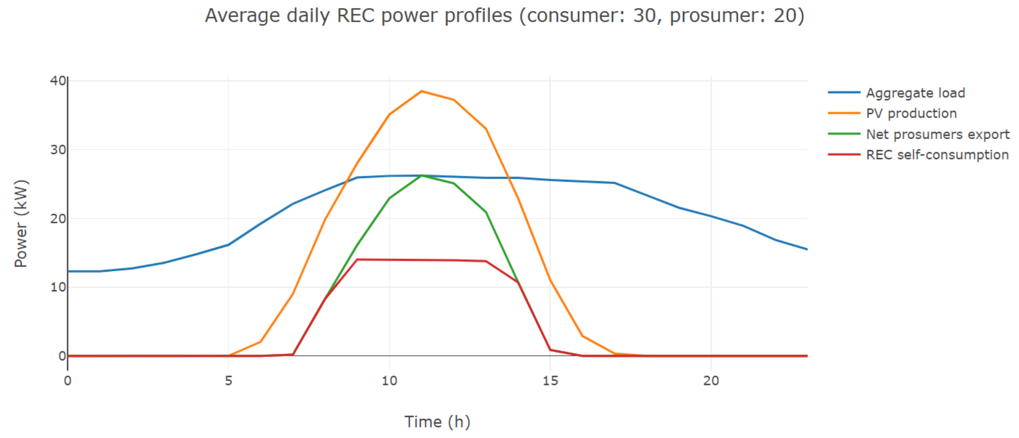
Step 3: Open-access implementation of the tool

Easy-to-use graphical interface + **Compact output of main REC metrics**



Total produced energy	Total used energy	Total shared energy
137.705,37 kWh	171.579,66 kWh	38.716,61 kWh
Peak power REC	**Consumer contracted power**	**Prosumer contracted power**
520,00 kWp	480,00 kWh	440,00 kWh

Spring | Summer | Autumn | Winter



Step 4: Inclusion of socio-economic metrics

IDEAL

AMPds the Almanac of Minutely Power dataset

COMBED

Commercial Building Energy Dataset

FINESCE

HIPE Data Set

- **Data-driven forecast model** that predicts REC behaviour on the basis of the **socio-economic parameters** of its members (income, family size, age, energy awareness)
- Apply load disaggregration techniques and optimization methods to assess **upper bound on flexibility benefits** (self-consumption)
- **Planning tool for optimal composition of RECs**, with estimations on potential value of flexibility-enabling actions

fabbricadigitale

European Commission

Lessons learned

- **Enabling flexibility** and engaging customers requires the **active involvement of multiple stakeholders** (academia, public entities, industry, …)
- Still a **large gap between theoretical assessment** and **practical deployment** of flexibility
- **Wide range of expertise** (engineering, IT, social sciences, policy experts) **needed** to scope problems and produce impactful solutions
- **Great importance of datasets,** both in terms of physical measurements and surveys

Thank you. Any questions?

Contact: antonio.de-paola@ec.europa.eu

European Commission