TRI 1 - Optimised Integrated European net-zero emissions Energy System

Power Planning Tools, concerning the development of tools and methods to plan and operate the future integrated energy system, fostering inclusiveness, sustainability and resilience

A forecast tool for Renewable Energy Communities

Collaboration between the JRC and Magliano Alpi's Renewable Energy Community (REC) within ERIGRID Project

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Co-chair ETIP-SNET WG5

The *Renewable Energy Communities* of Magliano Alpi - I

- City of Magliano Alpi: 2,184 inhabitants, Province of Cuneo
- Since December 2020, **First** Italian **Renewable Energy Community** (**REC**), compliant with the RED-II Directive as adopted by the Italian Government (art. 42 bis, Law “Milleproroghe” 28 February 2020).
- Member of RESCOOP
- Objectives:
  - **Help Citizens and SMEs to cope with Energy Transition**
  - **Support local economic development in the post-Covid phase**
  - **Support other Cities to design and activate RECs**

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The *Renewable Energy Communities* of Magliano Alpi - II

- The **MACADO Project** (Magliano Alpi - Carrù - Dolceacqua) to create two "***Great RECs***" in compliance with the new law Dlgs 199/2021, entering into force in October 2021 (boundary: HV station).
- **Co-ordinated business plans for two RECs**: in Magliano-Carrù (up to **4 MW**) and in Dolceacqua, near Montecarlo (up to **1.5 MW**).
- The projects will apply to the **Italian Recovery and Resilience Fund** (**PNRR**, 2.2 BILLION euros for cities below 5,000 inha
- Funded by the Compagnia di San Paolo
- Partners

Magliano Alpi Carrù Dolceacqua

Technical partners

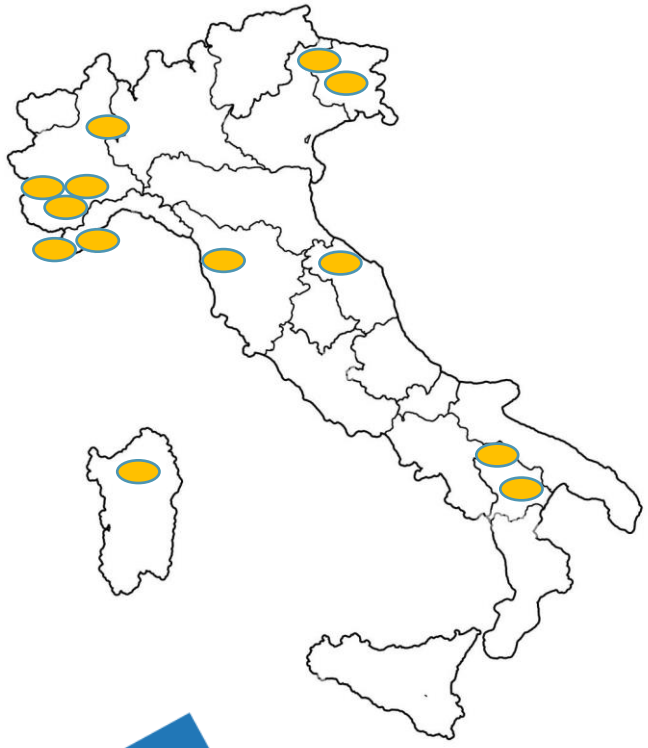
«*Magliano&Friends*» network

The **City of Magliano Alpi** is signing **official agreements with other Cities** in Italy, with the objective of speeding up the process of REC design and implementation.

A series of available RECs compliant with RED-II Directive as transposed by the Italian Law

Existing (Art. 42 bis Milleproroghe Law, MV substation area

Planned (Dlgs 199/2021, HV substation area, starting in late 2022)



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- **Comunità Collinare del Friuli**
- **Matera**
- **Ferrandina** (MT)
- **Carrù** (CN)
- **Montelabbate** (PU)
- **Granozzo con Monticello** (NO)
- **Collesalvetti** (LI)
- **San Daniele del Friuli** (UD)
- **Ceriana** (IM)
- **Rittana** (CN)
- **Benetutti** (SS)
- **Dolceacqua** (IM)
- …

The **ERIGRID Project** enabled a partnership between the **City of Magliano Alpi** and the **JRC** of the European Commission

JRC
EUROPEAN COMMISSION

erigrid 2.0
Connecting European Smart Grid Infrastructures

A forecast tool for Renewable Energy Communities

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erigrid 2.0 Connecting European Smart Grid Infrastructures

Comunità Energetica Rinnovabile Magliano Alpi

Forecast Tool for RECs

Collaboration within the Erigrid 2.0 Transnational Lab Access Program

- **Development of a software platform** to estimate techno-economic metrics of RECs
- **Forecast of the aggregate demand/generation** profiles of the REC and the **self-consumed energy**, evaluating the impact of:
  - *Seasonal trends*
  - *Weather conditions*
  - *Number and type of prosumers*
  - *Number and type of consumers*
  - *Geographical extension*

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- **Support the formulation of REC business plans, estimating the financial incentives of the REC** in a rapidly evolving regulatory framework

Step 1 – Input Data Processing

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DATA COLLECTION

The training data for the forecast tool are obtained from different sources

- Data Open Power System database
- \+
- Measurements from Magliano Alpi REC
- \+
- JRC neural network demand forecast tool

DATA CLASSIFICATION

Typical users and prosumers are identified from the data. These are used as distinct REC member types that will then populate the REC under examination

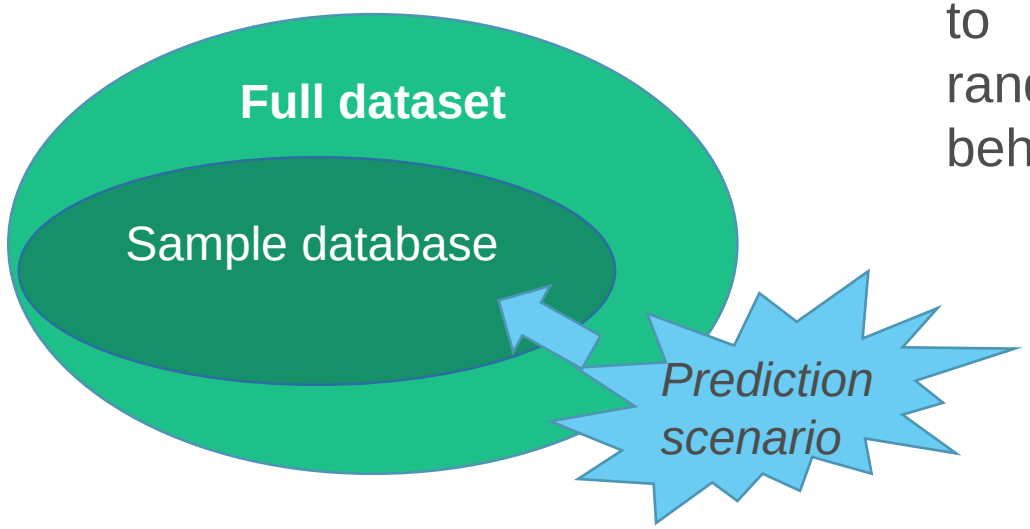
DATA FILTERING AND PROCESSING

- Data outliers and measurement errors are removed
- Energy profiles are decomposed over 24h and classified by seasons
- Interpolation to operate on the desired time step (i.e.0.25h or 1h)

Step 2 – Random Sampling Algorithm

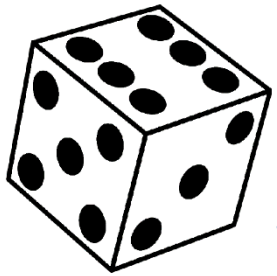
SAMPLE DATABASE DEFINITION

On the basis of the chosen prediction scenario (i.e. season, type of REC members), only the relevant samples in the dataset are selected



RANDOM SAMPLING

- A random load/generation profile is extracted from the sample database for each member of the REC under exam
- The procedure is iterated to generate multiple random instances of REC behaviour



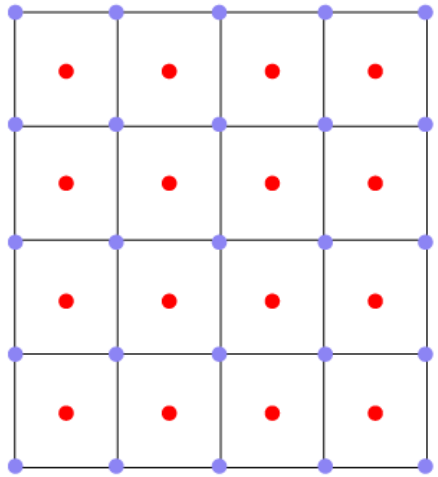
METRICS EVALUATION

The simulation outputs (aggregate load and PV generation, REC net import and export, self-consumed energy) are computed as the **average of the different simulated samples**

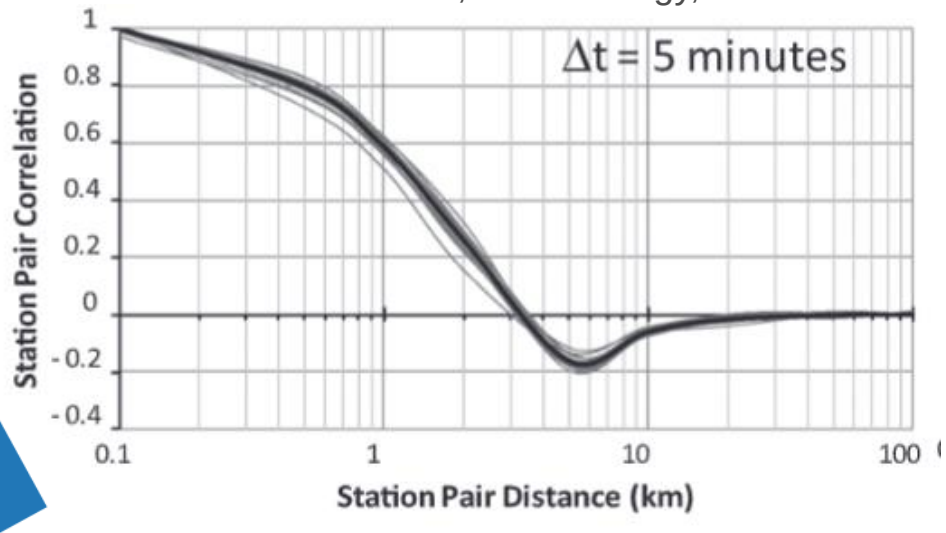
Step 2.1 – Modelling of PV correlation

SPATIAL CORRELATION

- The REC is divided in multiple sub-areas
- All REC prosumers in the same sub-area share the same PV profile



Source: Perez et al., Solar Energy, 2012



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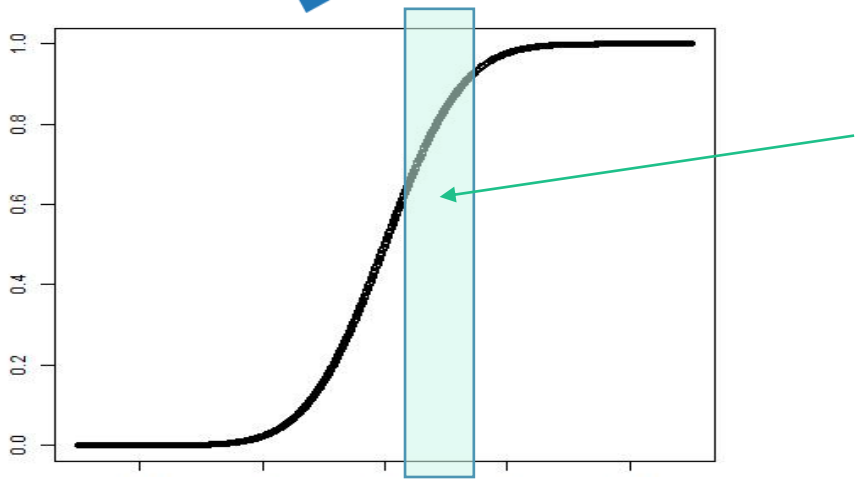
WEATHER CORRELATION

In a single sample, all profiles of PV generation are chosen within a (randomly selected) percentile interval of daily generation



Example of selected percentile interval

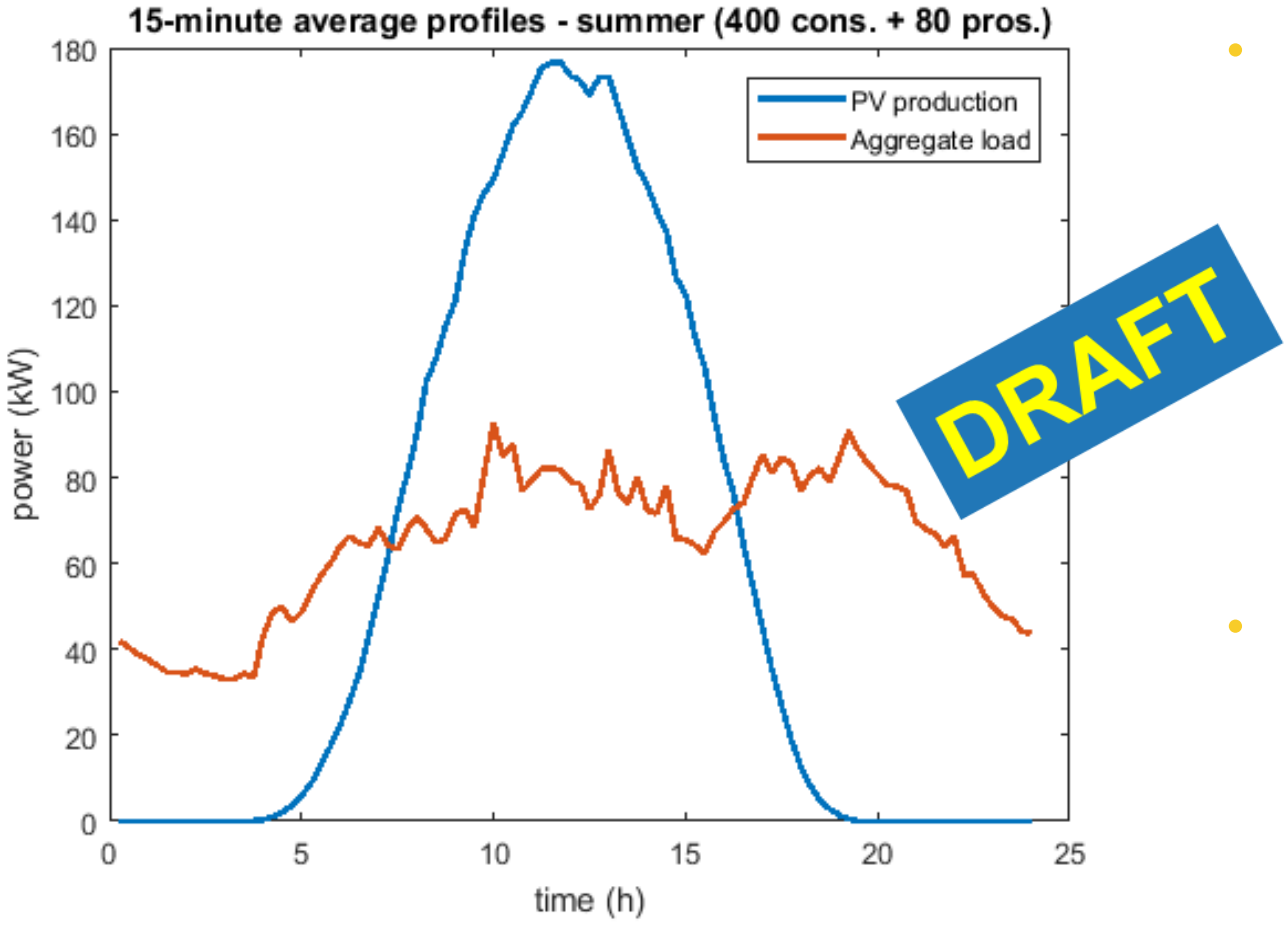
Step 3 – Elaboration of results

The forecast tool can be mainly used in two ways:

1. **Evaluation of a specific scenario** (i.e. REC with types and number of consumers/prosumers that already well defined)
2. **Sensitivity studies**: the simulations are iterated over the space of the parameters of interest, evaluating the impact of the parameters change on the output variables of interest

The ex-post evaluation of the results also allows to derive relevant economic quantities associated to the REC operation (*e.g. financial incentives in the Italian regulatory framework*)

Results – REC Energy profiles



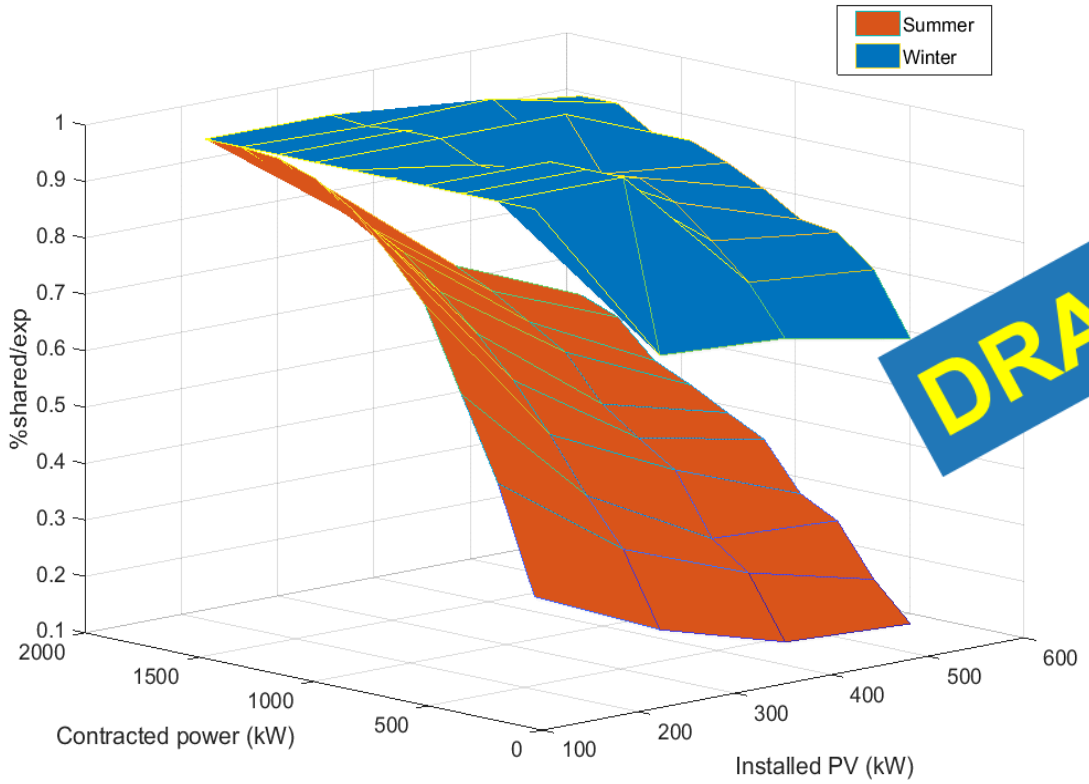
Estimated daily load/generation profiles of extended REC

- **Seasonal estimation of aggregate load and generation** profiles in the REC

The estimate of PV production accounts for **correlation** between different plants **due to geographical proximity and weather conditions**

- **REC self-consumed energy** is equal, at each time, to the minimum between red curve (load) and blue curve (PV generation)

Results – REC self-consumption



Percentage of PV generation that is self-consumed locally, as a function of contracted power and installed renewable generation

- Possibility of performing **parametric analyses on key REC metrics**

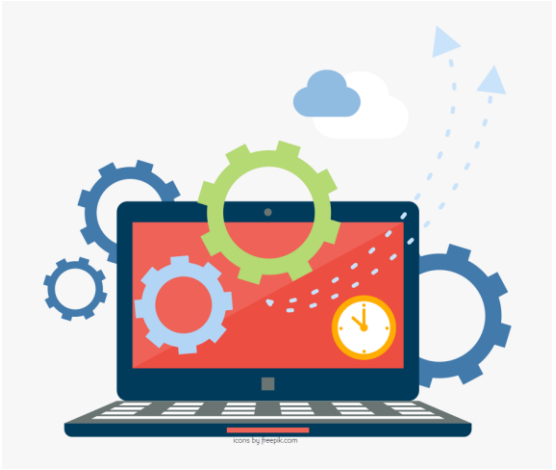
In this example: percentage of the REC exported energy that is consumed locally

- This quantity is calculated **as a function of the installed PV capacity** of the prosumers and **the total contracted power** of the consumers (in summer and winter)

Next steps

- **Refinement of forecast tool**:
  - Modelling of **spatial-temporal load correlation**
  - Use of **demand/generation forecast models** as an alternative to historical data

- Development of **open-source version of the tool**, to be made available to external practitioners, with:
  - **Graphical interface**
  - **Simplified functions for data I/O**



Contact

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