SUSTAINABLE PLACES 2021

Sep. 28 - Oct. 1, 2021 | Rome, Italy

Distribution grid energy flexibility:

the Ebalance-Plus technologies developed for the University of Calabria Demo Site

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Energy Flexibility

Increase of renewable generation and distributed energy resources
Decrease of dispatchable plants

The distribution networks are facing new operational challenges due to RES intermittent characteristics and increased network utilization so new regulation and balancing resources have to be deployed

Various frameworks have been defined to ease the **energy flexibility** and in particular the associated **market flexibility**

Opportunities for distribution system operators to cope with these challenges to *exploit the flexibility of distributed energy resources (DERs) and end-users using different market mechanisms in the power system*

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The aim is to increase network flexibility and resilience by creating and integrating smart energy technologies into an energy balancing platform proposing a local energy flexibility market model

Objectives:

- **increase the energy flexibility of distribution grids;**
- **predict the available flexibility;**
- **increase the distribution electricity grid resilience;**
- **design and test new ancillary models to promote new local markets based on energy flexibility;**
- **test a variety of ebalanceplus technological solutions (electric smart-storage at building and district level, V2G systems with local DC networks and SiC power inverters, power to heat, management of PV power inverters, regulation of CHP and management of appliances/devices with IoT-based systems) at four real demonstration sites located in Spain, Italy, France and Denmark. Additional laboratory testing will address safety issues.**

Another special feature of ebalanceplus is its social and market orientation.

The project work plan covers a 4-year period and involves 15 partners from 10 countries. All project activities and results are divided into 9 work packages, dealing with research, analysis, evaluation and exploitation to achieve future replicability.

Partners

cemosa Ingeniería y Control, DTU, Università della Calabria, Universidad de Málaga, SoftCrits Software for Critical Systems, JUNIA Grande école d'ingénieurs, MTECH Excel Micro Technologies, reengen, ihp, National Information Processing Institute, ESCI European Science Communication Institute, ENFOR Delivering the Future, tps Turbo Power Systems, Ampere Energy, Magnum Cap Electrical Power Solutions

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Different ways to provide energy flexibility

Using ESSs allows one to modify both the load and generation profile

Demand Response program, which requires active user interaction, or in any case requires schedulable and interruptible loads.

Reduction of the maximum power absorbed by the network, reducing power peaks, moving the electrical load in the hours in which there is surplus of power, providing frequency and voltage regulation service, facing network congestion and so on.

The structure of the **UNC demo site** has been implemented in order to be able to implement and observe what has been described and theoretically defined in terms of flexibility resources and services.

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The University of Calabria campus

- Variety of buildings: laboratories and classrooms, administrative offices, library, and student residence that represent both electric and thermal passive loads.
- MV substation with a ring distribution grid in MV (contracted power of 8 MW)
- Several renewable energy generation plants are operating.
- Some buildings and plants have been equipped with monitoring and control systems.
- Considered as an aggregation of consumers, prosumers and producers

Facilities integrated in the UNC demo site

A: Cubo 18B
B: Monaci
C: Cubo 31B
D: Chiods2
E: Megacentrale
F: Cube 41B
G: Cubo 44B

PV1:
- Library Area photovoltaic generator;
- Monaci photovoltaic generator.

SC: Two solar concentration plants for the generation of thermal energy

PV2: on the rooftop of 14 office buildings (hereinafter "Cubes")
HCPV: Heat concentrator photovoltaic plant generator
GEO: Geothermal plant with a PV plant

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How to provide Flexibility services in the UNC demo site

The UNC demo site objectives are:

1. Increasing the energy flexibility of buildings both in terms of consumption (IoT devices and smart appliance to enable DR program) and generation (PV power modulation);
2. Deploying resilience services and increase the grid reliability, supporting DSO/TSO services;
3. Simulating and testing the benefits of demand response services to manage the energy flexibility;
4. Testing smart-grid automation and control technologies to unlock the available flexibility;

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How to provide Flexibility services in the UNC demo site

The main objectives of the devices/upgrades that would be deployed are:

- Improve the control, automation and communication (with the DSO/Aggregators) of primary substations;
- Improve the control, automation and communication of secondary substations;
- Enable and improve the management of flexibility resources (m-chp unit, PV plants and electric and thermal storage);
- Test demand response program and evaluate the responsiveness of the end-users using IoT devices and small smart storage units;
- Integrate the energy management system and flexible resources in the project platform;
- Increase the office building flexibility, using smart storage systems.

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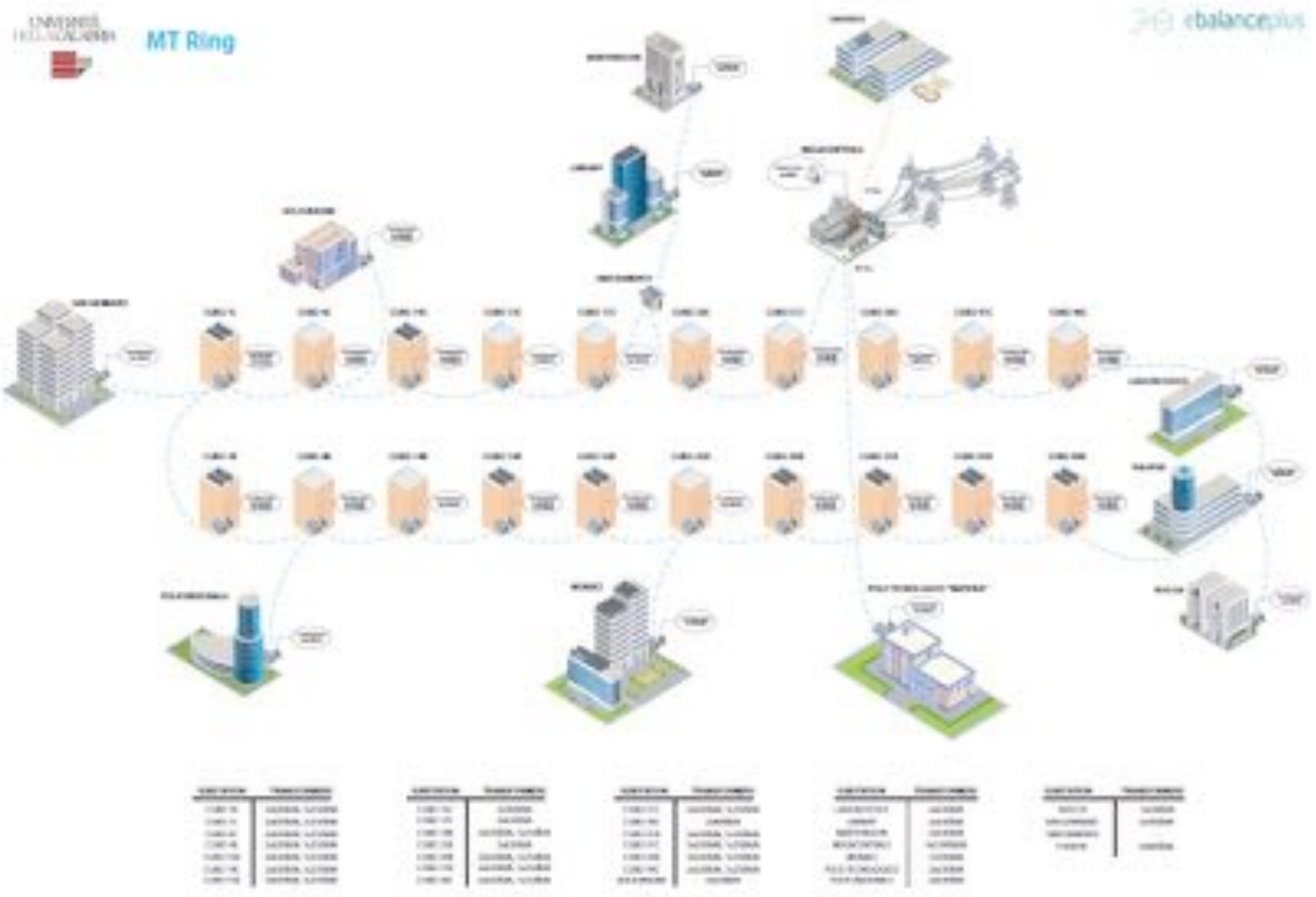
UNC Demo site Configuration

1. MV/MV primary substation “**MegaCentrale**”;
2. Four office buildings “**Cubo**”;
3. Four **MV/LV substation**s;
4. Five apartments of **Monaci** residential;
5. An experimental microgrid of **Chiodo2** residential building (experimental AC/DC Microgrid is present, has been chosen. where a hybrid AC/DC microgrid has been deployed. It consists of three nano-grids installed and connected to a common DC bus operating as a unique hybrid AC/DC microgrid. This microgrid integrates two PV plants, one stirling –engine mCHP, a lithium battery energy storage, several electric loads, and some controllable loads. Moreover, one heat pump with thermal storage is installed).



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UNC Demo Site

MegaCentrale and MV/LV substations

MVGMU and sensor to evaluate the quality of the voltage of the grid where it is applied, optimize the voltage and reactive power on the distribution grid to increase the RES generation and monitor the status of Transformers

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UNC Demo Site

Office buildings

DERMU, smart meter and smart storage systems to implement DR program and for the optimal control of DER at Virtual power plant level to reduce energy price and CO_2 emission

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University of Calabria Demo Site

Smart meters

MV/LV Substations and Office Buildings

Smart Grid Management Units

Smart Storage Systems

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UNC Demo Site

Monaci

DERMU, smart meter, smart storage systems, IoT devices and smart appliances to implement DR program and for the optimal control of DER at Virtual power plant level to reduce energy price and CO_2 emission

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University of Calabria Demo Site

Residential Buildings

Smart Storage Systems

Smart Meter Installation

Smart Appliances and IoT devices

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UNC Demo Site

Chiodo 2

Smart meter, nanogrids, smart storage systems to opportunely enable the flexibility resources based on the output of the implemented algorithm (flexibility management, PV and load prediction, CO2 and energy price optimization) and so the specific control signals will be sent by the Ebalanceplus platform

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Future steps

Connecting with the ebalanceplus platform

Testing management algorithms

Connect – Share - Learn

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Thank you for the attention

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