INTEGRATED SMART GRID CROSS-FUNCTIONAL SOLUTIONS FOR OPTIMIZED SYNERGETIC ENERGY DISTRIBUTION, UTILIZATION STORAGE TECHNOLOGIES

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Il Moggio farm: increasing efficiency and sustainability from an environmental point of view

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ABSTRACT

ASM TERNI is one of the smartest DSO in Italy and has a significant experience in research initiatives since it is partner in many EU co-funded projects. Thanks to the modern SCADA system deployed on the electricity distribution network and the smart meters installed at each customer, TERNI is able to monitor and control a real smart grid. This level of smartness is the starting point for the development and testing of a pilot in a rural area close to Terni where an off-grid microgrid is being connected to one of the TERNI's distribution substation. In InteGRIDy project, TERNI will take care of the setup of the pilot that will allow to test the collaboration between the microgrid and TERNI's Smart Grid.

Introduction

ASM TERNI will take care of the setup of the pilot that will allow to test the collaboration between the microgrid and TERNI's Smart Grid. This pilot site is a farm called "Il Moggio" located in Terni municipality; it is at present a stand-alone grid already in operation. "Il Moggio" microgrid comprises a significant amount of distributed generation: a 30 kWp rated PV plant, two 31 kVA – 25 kWt biomass Combined Heat Power (CHP) generators; in addition, electric storage consists of 50 lead batteries responsible for managing distributed generators without curtailments.

The CHP generators are a pillar of this pilot since they enable stand alone operation. They are produced and managed by All Power Labs, which is a global leader in small-scale gasification. The company produces biomass gasifier generators that are ready for everyday work, to serve real world distributed energy needs. They combine the best usability features of diesel generators, with the clean running of typical renewables, with the potential for a

carbon negative impact. With CHP generators, it is possible to generate on-demand power for 1/4 the operating cost of diesel, at 1/2 the capital cost of solar. Moreover, it is possible to shrink your carbon footprint and contribute positively to global efforts against climate change.

In this pilot, the Energy Storage pillar is focused on the optimisation of the microgrid distributed generation (PV and CHP) by means of a battery storage system. The optimisation aims both at maximising microgrid self-consumption during normal operation of the distribution grid and at supporting the grid in case of surplus of power or local congestions.

From an environmental point of view, it will be evaluated how a proper energy management can increase green energy consumption. From an economic point of view, an improvement of savings due to flexibility's supply is expected. At this level, a proper flexibility assessment will be established.

Solution implementation

ASM TERNI as a smart DSO will use its own distributed automation unit, installed in the distribution substation, to test what partially controllable energy resources of a microgrid can provide as services to the DSO. It has already been deployed a tool to monitor and control the microgrid and all the sensors necessary to monitor the cowsheds and greenhouses. This sensing, monitoring and controlling equipment is the pre-requisite to deploy an optimisation tool able to evaluate the dynamic flexibility of the microgrid and to offer proper services to the Smart Grid.

The flexibility of the microgrid will be exploited with the aim to find a trade-off between the DSO needs and the rural microgrid economic and technical constraints. By means of hardware equipment and software tools that the inteGRIDy technology providers will make available in the pilot site, it will be possible to demonstrate the application of a hybrid cooperative business model between the DSO and the microgrid's actors. Indeed, the DSO will be able to exploit the microgrid flexibility to improve

stability and reliability of the distribution network without ignoring the needs of microgrid owner in terms of business operation and energy requirements (electric and thermal needs). The pilot will demonstrate that the integrated tools will estimate both energy production and energy consumption, in compliance with local constraints imposed by production processes, a “flexibility as a service” business model will be put in place and validated.

The visualisation and optimization tool provided for the Terni pilot is the Multi-carrier hub Optimisation Engine tool that puts at disposal of the microgrid manager a GUI showing the most relevant power profiles, price trends and process parameters. This tool provides optimisation functionalities able to deal simultaneously with different objectives in order to provide optimal solutions in terms of economics and technical operations. Moreover, there is one tool puts at disposal of the DSO that is the Flexibility Optimised Management tool; this tool provides a dashboard aimed at displaying microgrid data, both historical as well as real-time ones, to the DSO. In particular, the DSO can create a power profile request at the MV connection point. The Power profile request is created selecting the KPI related to the desired grid service inside the flexibility range, which is indeed the flexibility capability of the microgrid.

Conclusions

Main savings concern microgrid resources optimisation (e.g. increasing of self-consumption, internal losses reduction), green energy consumption maximisation, network reliability and resilience improvement. Furthermore, on the distribution network, loss reduction is expected, as well as power quality improvement. ASM Terni aims at reducing SAIDI (System Average Interruption Duration Index) and SAIFI (System Average Interruption Frequency Index), reducing voltage fluctuations.

Regarding the pilot site, ASM Terni aims at increasing both efficiency and sustainability, from an environmental point of view. Environmental improvement involves CO2 emission reduction and self-consumption increase. From an economic point of view, these improvements can be considered as revenues. In actual fact, green certificates can be obtained by GSE (the energy services manager).

The pilot exploits a rural microgrid and represents a good opportunity in providing improved electric service reliability and better power quality to the end customers. Microgrid can also furnish the local utility with additional benefits by providing dispatchable power to be used in peak load conditions; moreover, there is a benefit also for the DSO related to the possibility to alleviating or postponing distribution system upgrades. Due to the increasing amount of distributed generation, many independent and private microgrids similar to the one involved in this Pilot are envisaged in the near future. Therefore, the Terni Pilot may be taken as a benchmark for the management of similar DER clusters connected to the distribution network.

About ASM TERNI, ENGINEERING and La Sapienza

ASM TERNI is Public Company fully owned by the local municipality (City of Terni). The activity of the company is related to very essential public services in the City of Terni area as: i) Production and distribution of Electric Energy, ii) Management of public street lighting, iii) Environmental Health, iv) Drinkable water distribution and water treatment plant, v) Gas distribution . As DSO, ASM Terni directly owns and operates the power distribution grid and distributes electricity from the MV-LV and HV-MV substations to the end consumers' (65.000 Smart Meters)..

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"**Sapienza" University (UNIROMA1)** participates in inteGRIDy through its Dept of Astronautics, Electrical and Energetics Engineering of the Civil and Industrial Engineering Faculty. The members of this research unit have an extensive experience in network studies related to planning, design, operation and protection of transmission and distribution networks; as well as in developing of simulation models for static and dynamic studies related to the integration of distributed generation, demand response, storage systems and EV charge systems in smart and micro grids during normal operation or fault conditions.

Information about the authors

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