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

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Becoming energy self-sufficient using sustainable energy sources

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ARTICLE INFORMATION	ABSTRACT
Published 5th July 2019. Keywords: Smart, Energy, demand-side management, efficient solution, efficiency, BEMS.	The University of Cyprus (UCY) has set the goal of becoming energy self-sufficient using energy produced from sustainable energy sources. To achieve that 10 MWp of PV, 7.5 MWhr of electrochemical storage, solar thermal units and heat pumps will be engaged (own funding). An energy management system will evaluate and demand-side management strategies, such as peak load shifting and shedding of non-critical loads, to reduce energy cost. This energy management system will be capable of identifying costly variations in electrical load profiles by determining if and when peak demand usage occurs in the facility, while the optimum use of resources all year-round will be offered through a planned micro-grid architecture. UCY as a pioneer in the research field will utilize the cross-functional platform provided within inteGRIDy to increase the energy efficiency within the university campus.

Introduction

The Cyprus pilot tests two different use cases. The first use case is related to the operation of a grid-connected **microgrid** within the campus of University of Cyprus (UCY) in Nicosia city, while the second one is focused on **dispersed prosumers** within Cyprus island, enabling the DSO of Cyprus to harness the benefits of demand-side flexibility. The selected prosumers have a photovoltaic (PV) installation with two separate smart metering infrastructures, to have access both to production and consumption data. These prosumers are dispersed within Nicosia and Larnaca regions. These two different sites have been proposed for reasons of having different weather conditions, while being located near UCY. Furthermore, the selected prosumers are not supplied by the same distribution feeder. The impact of the proposed solutions to a single feeder of the electrical grid will be examined within the university microgrid test case.

The University of Cyprus is selected as a pilot site, since it is in the transformation phase to become a “living lab”. Currently, more than 400 kWp PV are installed both on rooftops and in terrain. Furthermore, many buildings within the university campus have Building Energy Management Systems (BEMS) for controlling the heating/cooling needs. A large PV park (10 MWp) and a battery storage bank (7.5 MWh) are in the design stage to be installed within the university campus, enabling the microgrid operation. The monitoring of the microgrid will be carried out through sensors and advanced smart metering infrastructure, placed in several nodes within the campus. A single point of collecting the measurements and take the respective control decisions is included in the solution.

In short, the challenge is the optimal use of local resources, leading to the minimization of energy cost. Both use cases of the Cyprus pilot address problems of energy communities. The planned solutions maximise the use of local resources and allow sharing between the members of community, through the best utilisation of the embedded synergies.

Solution implementation

The Energy Community Build & Operate Solution is being implemented in the university campus and distributed through aggregated practices that can be extended to flexible portfolio for managing the flexibilities of Demand Response.

The solution includes the Central Energy Management System within the university campus linked with the storage management system, both interfaced via open protocols with the Demand Response Optimization Engine. The final solution also incorporates all the required components: smart sensors, real-time communications and PV forecasting tool.

The Energy Community Build & Operate Solution helps energy communities (i.e. commercial entities, industrial zones, local communities) to minimize energy costs by utilizing local energy resources & benefits of synergies. Furthermore, it can generate flexibility as an add on trading commodity.

UCY as a pioneer in the research field will utilize the cross-functional platform provided within inteGRIDy to increase the energy efficiency within the university campus. By activating the identified control points within the campus, the microgrid concept will be implemented. The target is to transform the University of Cyprus into a “living laboratory”, which will use its own RES production to cover the electricity needs. The architecture so developed is applicable as an Energy Community in all commercial and industrial controlled areas.

DSO can take advantage of the controllable microgrid and the controllable prosumers within Cyprus to solve grid issues (such as violations of the voltage profile, grid congestion issues, power quality deterioration, etc.).

The cross-functional platform of inteGRIDy will be utilized to combine all the information provided by the smart metering infrastructure (for RES production, energy storage and energy consumption) and installed sensor systems within the university campus microgrid with the forecasted energy. The target is to increase the controllability and energy flow efficiency of the microgrid.

The platform provided by inteGRIDy will be utilized by the dispersed prosumers to offer ancillary services to the DSO through controllable demand response. The DSO will use the controllability of both the microgrid and the dispersed prosumers to resolve the above referred grid issues.

As a result, the highly valuable benefits can be summed up as follows:

1. World-class learning environment from teaching and research
2. Deep sustainable energy expertise and capabilities
3. Dedicated facility for energy research and development

Conclusions

Cyprus’ pilot cases demonstrate how the Energy Community Build & Operate Solution helps energy communities (i.e. commercial entities, industrial zones, local communities) to minimize energy costs by utilizing local energy resources & the benefits of synergies, which will bring the following benefits:

- Sustainable Energy research and development
- Cultural, social and economic development to Cyprus
- Establishment of facilities for transforming the university into a green campus with microgrid controls for generating flexibilities for use by the grid operators, effective energy and demand side management.

About the University of Cyprus

The University of Cyprus, established in 1989, aims to establish itself as a Pioneer Research Institution achieving International Scientific Recognition in European Higher Education, offering Competitive Programmes and to become a Centre of Excellence in the wider Euro - Mediterranean Region. More specifically, the Research Centre for Sustainable Energy (FOSS) was created in order to play a key role in research and technological development activities in the field of sustainable energy within Cyprus and at international level with the aim of contributing to the achievement of the relevant energy and environment objectives set out by Europe.

Information about the authors

Dr Venizelos Efthymiou (UCY) is a holder of the UMIST university degrees: BSc in Electrical Engineering and Electronics, Master of Science (MSc) in Power Systems and Doctor of Philosophy (PhD). He is a member of the Governing Board of the Smart Networks for the Energy Transition and Photovoltaics ETIPs active member of EURELECTRIC, and chairman of FOSS Research Centre for Sustainable Energy of the University of Cyprus.

George E. Georgiou is a Professor and the Director of FOSS Research Centre for Sustainable Energy, University of Cyprus. Having graduated from the University of Cambridge with a BA, MEng, MA all with distinction and a PhD, Dr Georghiou continued his work at the University of Cambridge in the capacity of a Research Fellow (1999-2002). Prof. Georghiou is currently a member of the CENELEC and IEC committees on PV and is acting as an expert evaluator for Horizon 2020 energy proposals as well as being a member of CIGRE and the European Solar Energy Industrial Initiative. He also represents Cyprus on the SET plan steering committee.

Acknowledgement

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731268.