Cooperative Management for a Cluster of Residential Prosumers

Hernández, Adriana Carolina Luna; Aldana, Nelson Leonardo Diaz; Graells, Moises; Guerrero, Josep M.; Quintero, Juan Carlos Vasquez

Published in:
Proceedings of the 2016 IEEE International Conference on Consumer Electronics (ICCE)

DOI (link to publication from Publisher): 10.1109/ICCE.2016.7430742

Publication date:
2016

Document Version
Early version, also known as pre-print

Link to publication from Aalborg University

Citation for published version (APA):

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal -

Take down policy
If you believe that this document breaches copyright please contact us at vbn@aub.aau.dk providing details, and we will remove access to the work immediately and investigate your claim.
Cooperative Management for a Cluster of Residential Prosumers

Adriana C. Luna†, Nelson L. Diaz‡, Moisès Graells†, Josep M. Guerrero‡, and Juan C. Vasquez†
†Dept. Energy Technology, Aalborg University, Aalborg, Denmark, http://www.microgrids.et.aau.dk/acl@et.aau.dk, nda@et.aau.dk, joz@et.aau.dk
‡Faculty of Engineering, Universidad Distrital Francisco Jose de Caldas, Bogota, Colombia
‡Dept. Chemical Engineering, Universitat Politècnica de Catalunya (UPC), Barcelona, Spain

Abstract—This paper proposes an energy management system for coordinating distributed prosumers. The prosumers are residential microgrids which internally produce and consume energy for autonomous operation. However, better performance is achieved by cooperative operation with other prosumers neighbors. Experimental results validate the proposed strategy.

I. INTRODUCTION

A microgrid is a coordinated aggregation of distributed generators, energy storage systems (ESSs) and loads which may operate in grid-connected or island-mode. Due to the coordinated operation, the microgrid can be seen as a single controllable entity which ensures local power balance and and reliable operation of the local power grid. In this sense, small-scale microgrids based on renewable energy sources (RESs) have been widely applied in order to reduce the dependence from the power grid, mainly in residential applications. Because of this, each small-scale residential microgrid can be considered as an energy ‘prosumer’ which consumes and produces energy based on local requirements and resources.

For an optimal operation of each prosumer, it is required an energy management system (EMS) which ensures the power balance of the local power system. To be more clear, the EMS schedules the operation of the distributed energy resources (DERs) by considering load requirements, while ensuring proper ESSs performance, and maximizing the use of renewable energy resources [1]. Particularly, microgrids based on RESs require ESSs in order to smooth the variations at the power generation and increase the local consumption rate of RESs generation [2]. At this sense, ESSs based on batteries continue being the most used in islanded microgrids, since they offer good commitment between price, availability and energy density [2], [3].

However, under islanded operation, prosumers based on RESs sometimes have to disconnect the load, or waste some available energy from the primary resource in order to avoid excessive discharge and overcharge of the ESSs. Nevertheless, a better performance can be achieved when an external power system supports the operation of the system. At this sense, a prosumer can cooperate with another neighbors in order to reach a better global performance and increase the reliability of the cooperative cluster of residential microgrids [4].

In this paper, a central EMS is proposed for ensuring an optimal operation of a cluster of islanded residential prosumers.
connection and power generation for prosumer 1 (Fig. 2a) and prosumer 2 (Fig. 2b) respectively. Additionally, in Fig. 2 it is possible to see the expected behavior of the ESSs by considering a fixed load. In this figure we can see that while for the prosumer 1 the load has to be shedding for five hours, in the case of the prosumer 2 the power generation at the WT is curtailed for more than 14 hours.

B. Cooperative prosumers operation

On top of that, a central EMS can coordinate the operation of the distributed prosumers in order to improve the performance of neighborhood. This improvement can be reflected in better loads profile connections and mayor usage of the renewable resources. On top of that, collaborative behaviors such a power sharing and stored energy balance between distributed ESSs can be easily addressed by the central EMS. In this case a dedicated duplex communication channel is considered between local and central EMS as can be seen in Fig. 1. Fig. 3 shows the experimental results obtained in the Microgrid Research Laboratory of Aalborg University [6]. Fig. 3 shows the SoC profile, PV and WT generation profiles and the power shared by distributes ESSs. In this case, the SoC is equalized between distributed ESSs. In addition, it is possible to see that PV generation is not curtailed and WT generation is only curtailed for 7 hours. Also, it is possible to see how the power is equally shared between distributed ESS. What is more, in this case the loads are not disconnected in order to keep the SoC in proper levels.

III. CONCLUSION

The proposed central EMS achieves better performance of the cluster of residential microgrids, considering RESs generation, due to the cooperation between prosumers. This strategy ensures the global balance of the system, while maximizing the use of distributed generators.

REFERENCES