需要側管理を考慮したマイクログリッドの多目的最適容量と電力計画

Thesis title: Multi-Objective Optimal Sizing and Power Scheduling of Microgrids Considering Demand Side Management.

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ABSTRACT

Microgrid is the brightest solution to overcome the energy problems of the newly constructed areas. Multi-objective optimal microgrid sizing plays a technical-economical-environmental role in designing sustainable and reliable power systems. In order to reduce CO2 emissions, depending on renewable power sources is the best option to reach this target. Hybrid renewable sources with storage facilities help in reducing renewable sources' uncertainties. Connecting the microgrid to the public ensures the full system reliability and increases the system productivity by selling extra power back to the utility. System productivity can be increased by selling extra power to the grid, integrating electric vehicles or using excess power in other ways like seawater electrolysis. For any practical microgrid, energy management strategies are crucial for a feasible design. Demand response programs offer an energy management technique for managing electrical consumption. It is one of the load-side management schemes that assists in rearranging the load by transferring a portion of it from peak to off-peak periods. The integration of electric vehicles into microgrids also provides an effective means of energy management. Moreover, replacing ICE cars with electric vehicles reduces emissions, especially if they are charged from renewable sources. The incorporation of EVs into microgrids via vehicle-to-grid strategies has a significant impact on reshaping the load, increasing revenues, and supplying power in the case of outages or a lack of generation. This research introduces a study of optimal power scheduling and energy management of hybrid residential microgrids. It discusses different scenarios of the system with different configurations and renewable technologies, considering renewable sources' uncertainty. Moreover, different generation and storage systems are considered, like PV, WG, biomass, fuel cells, seawater electrolysers, BESS, public grid, and EVs. Different multi-objective optimization techniques are introduced to satisfy the optimum system cost with minimum emissions and loss of power supply. Furthermore, a comparison between different EVs integration and V2G techniques is explained. By managing charging and discharging of EVs, both microgrid and car owners can make reasonable revenues. Besides that, it provides the ability to change the demand patterns to satisfy the other microgrid's objectives. Time-of-use demand response is also applied as it has an effective role in load reshaping to maximize use of renewable sources, reduce the peak load, and lessen the grid's emissions. The obtained results verified that load reshaping techniques provide an effective control option for power networks to economize total cost, increase revenues, and reduce emissions. This can be done effectively by using V2G and DR techniques with the help of renewable energy sources. It also confirms the effectiveness of biomass to ensure system reliability and reduce grid emissions.