David Garcia

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Electrical Engineering

A Sustainable and Reliable Hybrid Microgrid System for Rapidly Deployed Military and Isolated Town Environments

Mentor: Dr. Junhui Zhao

The question which began the research was, "How can we provide renewable energies to hard to reach areas in the world, which would otherwise not have electricity or have difficulty fueling their electricity grids?". The immediate answer arrived with, finding a buyer of a system which could use the same proposed requirements for electricity, so the system can be distributed and researched for future acquisition. The military has a need for mobile systems to provide electricity to temporary outposts. The methodology included defining an electricity-need requirement for over 1,000 troops and defining the living conditions/operations conditions. Likewise, the need was defined for hard to reach towns and their 1,000 inhabitants. The programming utility used was MATLAB, as well as using add-ons for the adjustable renewable energy devices and power conditioning required for such a network. The research phase included effective ways to incorporate signal conditioning from renewable resources, which renewable resources would return the largest electricity yield in a environment, discovering the best controllers to use for types of renewables, and lastly, what type of concessions would need to be made to produce a hybrid solution to power both environments. The University of New Haven library, as well as the resources from MATLAB and IEEE were instrumental in the success of designing such a system that met all requirements.

The results of the research concluded with answered questions and revealed some unanswered possibilities for adequately meeting both needs of those environments. Of the answered questions, the first was, "Is there such a system which would satisfy the needs of both environments?". The answer is, yes, there is a system which would use 480 gallons of diesel fuel less over the course of a month and allow for just under 3,000lbs of fuel transportation alleviated with using this system. The system included three 17m wind turbines that operated at approximately 75kWh and incorporating 400 square meter of solar panels across housing roofs and municipal areas. The questions which arose during research would include, "what level of maintenance would be required for upkeep?". The answer to that question will be further reviewed once the manufacturers return further logistic requirements and warranty information. Another question arose when the loss of benefit from all of the renewable energies went dark or windless. The answer was incorporating a hierarchy amongst the finer components of the system. For the military applications, this led to prioritizing a operations center over the laundry facility, likewise the civilian application limited the amount of electricity used on municipalities and kept a community water filtration system operational. Further accommodations would need to be finetuned with appropriate city officials. Lastly, the future of this research would include the efficiencies of existing systems and size of the batteries currently available. The knowledge acquired in this research will be used in a consulting capacity for a 2019 Electrical Engineering Senior Design project as well, involving improving efficiencies in the solar cells.

References:

Yashwant S., S.C. Gupta and Aashish Kumar B. *PV-wind hybrid system: A review with case study*
Sawle et al., *Cogent Engineering* (2016)