EXAMINING THE VIABILITY OF INTRODUCING RENEWABLE ENERGY SOLUTIONS IN THE PHILIPPINES

Reducing the emissions of greenhouse gases in developing countries while simultaneously raising the living standard is one of the major challenges that our global society is faced with today. A Swedish project called 'Power to the Philippines' with the intention of addressing this situation by providing renewable off-grid energy solutions to rural areas in the Philippines, where diesel generators are commonly used today. This article presents an analysis comparing the intended project to the current energy system, focusing on energy security as well as environmental and economical factors.

The Philippines is an island nation in South East Asia consisting of more than 7 000 separate islands. The Philippines is the country in the world that is most often struck by tropical storm; every year between 6 and 9 typhoons hit land in the Philippines. In November 2013 the super typhoon Haiyan hit the nation, killing 10 000 people and causing massive destruction to parts of the infrastructure with an estimated worth of 14.5 billion USD.

Especially in the first months following a disaster of this magnitude it is crucial for a successful disaster recovery to give the people access to electricity to enable refrigeration, clean water generation, telecommunication and lighting. Large portions of the Philippine people living in rural areas are left without access to the national grid, and are mostly relying on diesel generators for power generation.

The Swedish company InnoVentum has initiated a project called "Power to the Philippines" which intends to provide humanitarian aid villages run by the Children's mission that are active in the Philippines with renewable energy by incorporating their power generation solution, the "Dali Powertower", into the local energy system. The Dali Powertower is a renewable hybrid power generation system combining a wind turbine with a rated power of 3 kW and 6 solar panels with a total rated power of 1.5 kWp. This renewable solution will be compared to the diesel generators that are used in these villages today, as well as a hybrid of these two energy supply systems.

This article presents the results from a master thesis project which was carried out at Lund University, department of engineering, which investigates InnoVentums project "Power to the Philippines" if realized in its full-scale form - being able to completely power a humanitarian aid village with renewable energy to meet its basic needs, and compares it to the two other energy supply systems. This comparison focuses on the factors environmental impact, economic viability and energy security.

The energy demand pattern of a humanitarian aid village in the Philippines was modelled after a local village known as the 'Scandiavian village', which is located in Tacloban and run by the Children's mission. By modelling the hourly fluctuation of energy demand in a day the total annual energy load can be calculated. The three energy supply systems were dimensioned so as to be able to supply the load 95 % of the time, which resulted in the following dimensioning;

- 13 Dali PowerTowers
- One 7 kW diesel generator consuming 12 700 liters of diesel/year
- 5 Dali PowerTowers, 1 diesel generator consuming 4 780 liters of diesel/year.

In the case of the purely renewable energy system, as well as the hybrid system, there was a need for over-dimensioning the systems in order to be able to meet the load more than 95 % of the time. By conducting a cradle-to-gate life cycle assessment study (including the diesel consumption) the environmental impact of these three energy supply systems could be calculated.

An economic analysis using the equivalent annual cost method was also carried out in order to assess the economic viability of the different energy supply systems. The economic analysis is conducted for 3 discount rates (3, 8 and 13 %), and results in the cost per used kWh.

The results of the LCA study showed that the Dali Powertower system has the least amount of environmental impact per kWh of used energy out of the studied systems, both regarding GWP (89 gCO2/kWh) and primary energy demand (0.33 kWh/kWh).

The diesel generator is the system with the highest amount of environmental impact, having about 21 times higher environmental impact (both regarding global warming potential and primary energy demand) than the Dali Powertower system.

The renewable/diesel hybrid system had the second lowest environmental impact, with about 6 times higher environmental impact (both regarding global warming potential and primary energy demand) than the Dali Powertower system.

The results from the economic analysis show that when the all the electricity is utilized, the Dali Powertower system produces the cheapest electricity at a low and medium discount-rate (0.31 and 0.44 $/kWh respectively) while the diesel generator system (flat-rate diesel price) produces the cheapest electricity at a high discount-rate (0.57 $/kWh).

However, if only the electricity used by the humanitarian aid village is considered, the hybrid system becomes the cheapest alternative, costing 0.56 $/kWh compared to the 0.75 $/kWh of the Dali Powertower system.

At the medium discount-rate the diesel generator system produces the cheapest energy (0.53 $/kWh), closely followed by the Dali Powertower and hybrid system costing about 10 cents more per kWh. At the high discount-rate the diesel generator system becomes even cheaper (0.57 $/kWh) compared to its competitors while the leap to the competitors simultaneously becomes larger.

The conclusion is that the hybrid system is the best alternative for the humanitarian aid village, as it can provide cheap energy with high energy security at a relatively low environmental impact. Therefore, the “Power to the Philippines” project can be deemed to be of interest to humanitarian aid villages, as long as the energy load of the humanitarian aid village is not solely provided by Dali Powertowers. A hybridization of Dali Powertowers with the existing diesel generators can help lower the environmental impact of the existing energy system, while simultaneously lowering the cost of electricity.

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