Power Preliminary Engineering Technical Memorandum

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The deliverable for this task is to be a technical memorandum that summarizes the investigative processes used, conclusions reached, and recommendations made, together with the justification for said recommendations. The memorandum is to be of a professional quality with appropriate footnotes, bibliography, and supplemented with graphs, tables, and exhibits as appropriate. The technical memorandum will be included as part of the final project design report.

Preliminary Investigation:

With one of the purposes of REAP's greenhouse being sustainability, the client made the criteria that the greenhouse had to be as self-sufficient as possible, in terms of energy. With this in mind the power team set off to collect data concerning clean, renewable, and accessible sources of electrical energy. As a result, three sources of power were considered: wind, solar, and a battery bank for backup.

Wind:

Within a very short period of time it was concluded that wind at the project site would not conform to technical or financial constraints. Through an exhaustive search on available wind generators it was discovered that not all wind power generators are created to work at all wind speeds. Instead wind power is designed to work at a very narrow band of wind speeds as to more efficient at extracting the power from those speeds. This created a problem as it was also researched, and later confirmed on site, that the area around the project site has drastic shifts in wind speeds, with a possible max in excess of 100 mph. If wind were to used one of a few scenarios would have developed. 1, a generator capable of providing power at low wind voltages would be able to produce power at said speeds but would then need some form of safety mechanism to prevent implosion at high speeds. 2, a system capable of producing at high speeds would stand idle at low speeds but then provide power at high speeds. 3, both systems would be employed to provide power at all wind ranges but would financially restrain other aspects of the project. It was therefore concluded that wind simply was not a practical form of energy production for the site and is **not recommended**.

Batteries:

Pre-site visit, a battery bank for running the entire operation off grid was considered to be a very real possibility. However, after the site visit took place there were a few criteria that disqualified this option. These included the complexity that it would not only add to the circuit to be designed and installed but also added complexity for the built environment that would need to house the battery bank, as it is not recommended that it be exposed to the outdoor environment. These two factors alone would mean that the costs for our design would increase. In addition, since deep cycle lead acid batteries would be utilized, there would be an additional costs when all batteries would need to be replaced. This then in turn would inhibit reliability of the system as all power would need to be cut whilst replacement would be taking place. Considering the site's placement and orientation with respect to obtaining these assets a battery bank is **not recommended**.

Solar:

With the site's access to clear skies, free from pollution and obstructing structures, multiple options of vendors and DIY kits for construction; solar was concluded to be the sole producer of energy for the project and **is recommended**. Due to the fact that there will not be any additional supplemental energy infrastructure for the greenhouse it is therefore also recommended that the installed photovoltaic (PV) system, is grid tied. This not only, once again decreases complexity, but also decreases implementation costs as available kits and components for grid tied PV cost less than off-grid systems (1). While on site it was also discussed that to decrease costs that it would be beneficial to tap into the infrastructure of the current solar array.

In conjunction with other teams associated with the project it has been confirmed that the only elements of the greenhouse that will be utilizing power are pumps for the individual towers. With each pump requiring ~24 watts and there being an undetermined amount of pumps, ranging between 20-100) the energy required is an approximate 0.48 KW - 2.4 KW. This, unfortunately, does not take into account losses in the solar panel, inverters, or the broader range of losses in the general circuitry. It can therefore be said that a larger system would not only be beneficial for reliability due to these losses but also add the capability to upgrade and expand if the need arises. At the time of this writing a reasonable 2KW system purchased with required mounting gear for a typical house would cost $3,855.60 or $1.89/watt (2). This figure should be taken with a "grain of salt" as prices for PV systems are still continuing to drop and the recent extension for government spending on renewable energy sources is set to help those prices to continue to drop. As such a particular system cannot be recommended until the time of procurement.

Future Tasks:

While the general decision about energy sources and requirements have been established much is still to be done, below is a list of future tasks to be completed

- Design of utility-tied circuit
- Finalization of energy requirement as pertains to budget
- Mounting options (directly on the greenhouse or free standing)

References

(1) Mayfield, R.; Mayfield, R. *Photovoltaic Design And Installation For Dummies*; Wiley: Somerset, 2010.
(2) Gogreensolar.com,. 2kW Solar Panel Installation Kit - 2000 Watt Solar PV System for Homes Complete Grid Tie Systems http://www.gogreensolar.com/products/2kw-diy-solar-panel-kit-microinverter (accessed Dec 21, 2015).