Renewable Energy Analysis and Implementation in Klamath Falls, Oregon

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ENGR 101 - H04
Fall 2019
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Introduction

- Providing sustainable, clean energy in important, and one can do this by analyzing weather patterns and developing prototypes

Background

- Solar panels can produce energy without taking up as much space (GreenMatch)
- Wind power is more efficient, but depends on wind patterns ("How Wind Energy Works")

Problem Statement

- A 200 household residential complex must be constructed in Klamath Falls, Oregon which is powered entirely by renewable energy

Methods and Materials

- Weather calculations performed in Excel with AVERAGE, STDEV, MAX, and SUM functions

$$E = 0.75pt \quad \textbf{(Equation 1)}$$

$$P=(0.5)(p)(A)(Cp)(V3)(Ng)(Nb) \quad \textbf{(Equation 2)}$$

- **Equation 1** ("How to Measure Solar Panel Output") and **Equation 2** (Sarkar and Behera 3) were used to calculate for solar and wind power respectively
- The figures below show the models that were used as units for each of the two power systems

Figure 1. The LG Solar 400 Watt NeON BiFacial Commercial Mono Solar Panel

Figure 2. A Siemens Gamesa 2.X 114 m diameter wind turbine

Results

- The cost for an individual solar panel was found to be about $2.99 per Watt (Matasci)
- The cost for a wind turbine was found to be about $1.75 million per MegaWatt ("How Much do Wind Turbines Cost?")
- Average 2-minute wind speed was 18.21 mph
- Average 5-minute wind speed was 22.84 mph
- Wind direction changed in a fairly predictable pattern over periods of a few days

Weather Tables

Table 1. Amounts of precipitation and fog in Klamath Falls for the year

Total Annual Precipitation	Days without Precipitation	Days with Fog	Days with Heavy Fog
9.10 in	77.53%	43.56%	9.31%

Table 2. Average wind speed for the year and the frequency of days with certain amounts of wind

Average Wind Speed	Days Over 10 mph Avg	Days Over 15 mph Avg
5.95 mph	11.23%	1.37%

Energy System Tables

Table 3. Power output per single unit of each system and total amount of energy consumed

Solar Power Generated	Wind Power Generated	Power Consumed
108 kWh	61,357.203 kWh	182,800 kWh

Table 4. Estimated costs for each collective system

	Number Units in System	Cost for All Units ($)
Solar System	2,000	2,392,000
Wind System	3	11,025,000

Discussion

According to **Table 1**, there is was not a significant amount of precipitation in Klamath Falls, but there was a lot of fog. The average wind speed was exceptionally low, as seen in **Table 2**, making wind energy unrealistic. Because much larger units of wind energy were used, they were more powerful, but also much more expensive than the solar panels, as seen in **Table 3** and **Table 4**.

Conclusions

- Wind energy was incredibly expensive and not ideal for the location, so solar energy was chosen
- The goal of creating a cost-effective renewable energy system was successfully met

Future Work

- Work could be done to optimize the efficiency of the solar system for the climate
- Other types of clean energy could be researched

References

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