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13 March 2020

F1909 Solar District Cup

Construction Loan for Solar Development Near Geothermal Substation

ME486C - 006

The Solar District Cup is a completely analytical competition aimed at designing, financially analyzing, and optimizing a solar powered campus or district. The NAU team has been assigned to New Mexico State University and has been given a large empty dirt lot away from campus near the Geothermal Substation as a primary location for panel placement. While the team has already determined the type of panels, amount, and location of placement, a key component missing for the financial analysis are the aspects revolving around the construction loan that must be taken out to initially fund the installation.

In total, there will be 25,800 panels (pan) and 10 inverters (inv) in use for this design. The panels cost $1.06/W and provide 300 Wdc/pan. The inverters cost $888 each. The total cost for equipment is:

$$25,800\ pan \times 300\ \frac{Wdc}{pan} \times 1.06 \frac{\$}{W} + 10\ inv \times 888 \frac{\$}{inv} = \$8,213,280 \tag{1}$$

In addition to equipment, the construction loan needs to account for labor of installation. According to the National Renewable Energy Laboratory, electricians cost on average $29.35/hr and general laborers cost $19.23/hr [1]. The team is assuming 10 electricians (elect) for installation, and 100 manual laborers (man) until further information is provided from the competition. An assumption provided by the competition is that construction will take exactly 6 months. While this is a very inaccurate assumption to make, it simplifies financial projections substantially.

Going with the assumption of 6 months for construction completion, electricians and general laborers will be working roughly 8 hours a day, 5 days a week, for 26 weeks. The total cost for the electricians is determined as:

$$10\ elect\ [(8 \frac{hr}{day} \times 5 \frac{day}{week} \times 26\ weeks) \times 29.35 \frac{\$}{hr}] = \$305,240 \tag{2}$$

The total cost for manual laborers is determined to be:

$$100\ man\ [(8 \frac{hr}{day} \times 5 \frac{day}{week} \times 26\ weeks) \times 19.23 \frac{\$}{hr}] = \$1,999,920 \tag{3}$$

In total it is expected to cost $2,305,160 for installation labor.

The construction loan is the sum of both the equipment costs and installation labor, bringing the total to be taken out for the loan to be $10,518,440. In order to account for any unpredictable circumstances, a 3% contingency will be added to this amount to ensure that if something goes wrong there are additional funds to help cover it. This brings the final total for the loan up to:

$$\$10,518,440 \times 1.03 = \$10,833,993.20 \tag{4}$$

When taking out the loan, there will be a fee of 1% of the total loan cost that will go directly to the loan provider. This amount will be:

$$\$10,833,993.20 * 0.01 = \$108,339.93 \quad (5)$$

Using data provided by the National Renewable Energy Laboratory, the average interest rate on a construction loan for solar installation ranges from 3%-5% [2]. The team has chosen 4.5% as a more conservative measure in the financial model. Using the assumption that the loan will accrue interest during the 6 months of construction, the total amount due after 6 months is tabulated in Table 1.

Table 1: Total amount due on construction loan after 6 months

Month	Loan Amount	Interest	Total Due
1	$10,833,993.20	$487,529.69	$11,321,522.89
2	$11,321,522.89	$509,468.53	$11,830,991.42
3	$11,830,991.42	$532,394.61	$12,363,386.04
4	$12,363,386.04	$556,352.37	$12,919,738.41
5	$12,919,738.41	$581,388.23	$13,501,126.64
6	$13,501,126.64	$607,550.70	$14,108,677.34

In total after 6 months, the installation of panels and panels themselves will cost $14,108,677.34. The team is still determining the payoff period for the loan meaning the total price paid for the construction loan is likely to increase relatively substantially by the time it is paid off in full.

To illustrate the physical model of the panels in the empty lot, Figure 1 is provided below.

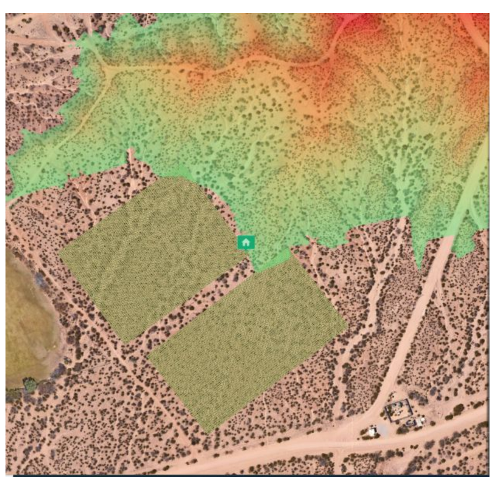

Figure 1: Design of panel placement in dirt lot near Geothermal Substation with lidar to show effects of elevation

This final value for the impact of the construction loan shows just how expensive this design is. While 14 million dollars is very high, it is important to keep in mind that this number will change once final values are determined for the exact number of laborers and electricians, as well as how long it will take the loan to be paid off.

Overall, determining a value for the predicted construction loan is very useful to the project as it provides a ballpark value for the total cost of the proposed design. This value will be compared against final production values of the design to determine the financial viability, and then will be compared to the University's current annual cost for electricity. These are the next steps in finishing the financial model and are expected to be completed by the end of spring break, March 22.

References

[1] R. Fu, D. Feldman, and R. Margolis, *U.S. Solar Photovoltaic System Cost Benchmark: Q1 2018.* "PDF." Nov-2018.

[2] David Feldman and Paul Schwabe, *Terms, Trends, and Insights on PV Project Finance in the United States, 2018.* "PDF." Nov-2018.