Dundonald Avenue Solar Farm

STANTEC FEASIBILITY STUDY EXECUTIVE SUMMARY

The City of Saskatoon (City) has been actively seeking options for the installation of a solar photovoltaic (PV) system in the area south of 11th Street West, between Circle Drive South and the railway tracks that run parallel to Dundonald Avenue. The City has hired Stantec Consulting Ltd. (SCL) to perform a feasibility analysis which includes technical and financial analysis, and limited stakeholder engagement support.

The study provides a conceptual layout and equipment specification as a basis for technical and financial analysis. The technical portion of the study included review, analysis, and recommendations from each of the solar, electrical, civil, landscape, and environmental services perspectives.

Solar generation design and simulations using PVsyst software resulted in a site-optimized 2.2 MW_{dc} system using fixed 35-degree tilt racks spaced 15 metres apart. The PV modules were portrait oriented and 2 modules high and 12 modules across. This arrangement was selected to minimize shading, reduce snow build-up, and maximize the available land area used. The detailed design stage and future nearby developments may change the space available for panels.

	Horizontal Global Irradiance	Horizontal Diffuse Irradiation	Ambient Temperature	Global Irradiance on Collector Plane	Gross Energy Injected into Inverters (P50)	Net Energy Injected into Grid (P50)
	kWh/m²	kWh/m²	ºC	kWh/m²	kWh	kWh
January	34.9	13.95	-14.21	86.0	196,297	189,014
February	59.8	19.14	-13.45	118.4	283,858	273,697
March	104.9	39.77	-6.53	156.4	357,473	344,884
April	136.1	39.77	-6.53	163.4	348,049	335,828
May	177.7	70.49	10.88	184.5	382,911	369,877
June	190.0	72.05	15.11	188.3	390,132	359,593
July	209.6	66.23	19.00	214.4	434,723	420,037
August	166.6	63.77	17.22	191.6	390,689	362,138
September	115.2	42.5	11.73	154.8	321,006	310,053
October	71.4	26.79	3.40	119.9	260,019	250,909
November	36.7	17.22	-4.13	78.3	176,646	164,927
December	26.7	11.51	-13.00	69.2	155,308	149,299
Annual/ Average	**1329.7**	**495.08**	**2.59**	**1725.3**	**3,697,111**	**3,530,256**

Table 1 PVsyst First Year Results

The system anticipated annual capacity factor is summarized in the following table:

Inverter Output (kWh) Ran 100% of year	Energy to Grid (kWh)		Annual Capacity Factor		
	Gross	Net	Before Losses (Average)	After Losses (Average)	Difference (Average)
3,922,807	3,697,111	3,530,256	5.8%	10.0%	4.2%

Table 2 Annual Capacity Factor Results

Inter-connection with the utility-grid was reviewed and deemed to be relatively straight-forward. There is a 15kV-750MCM underground distribution feeder running through the north end of the site with concrete pull-vault. Power can be run from this location parallel to the service road to the solar equipment near the access gate.

High-level analysis was performed on a potential Battery Energy Storage System (BESS). While it is a promising technology experiencing increased adoption across North America, it was recognized that a nearly doubling in capital expenditure of the project, negative impact to Levelized Cost of Energy (LCOE), calculated negative life-cycle cost, and lack of vendor/product certainty and standardization was not desirable. However, it was noted that it would be worth monitoring system costs over the next 3 to 5 years and performing deeper study as key technology advancements are realized, system designs become more standardized, systems become more prevalent, costs stabilize, and energy/demand costs rise.

To consider potential glare impacts to neighboring residential and commercial buildings, a Glare Study was performed to assess light reflection impacts on roadways, and overhead flight paths. Overall, the analysis demonstrated that glare levels were found to be within acceptable limits and would not pose any nuisances.

Stantec provided a high-level review of the acoustical impacts in the immediate area. This review showed no notable acoustical concerns to the neighboring residential community.

Civil, landscape, and environmental aspects of the site were reviewed with the City. Analysis resulted in earthworks, site access, service road, equipment area, drainage, landscape, and environmental study recommendations.

Earthworks is anticipated to be minimal for the project. While the sloping of the site presents challenges, earthworks comes with significant cost, so it is preferential from a financially perspective to work with the site topography as opposed to re-shape it. As a result, drainage patterns and run-off rates will remain substantially the same as it is currently. Some site clearing will be required as there are some older ill-maintained trees, which will compromise system performance, and obsolete railway telegraphy poles which present challenges for the site layout. There are other fixed site features

which will be worked around, such as active registered easements for underground cabling/piping and above-ground power/telecom pedestals and a major water valve.

Primary site access was provided through a gate on the west edge of the site at an abandoned rail-crossing, with emergency access gates provided on the north and east perimeters. A service road is recommended from the primary access gate in the west, running along the west perimeter of the site up to the north end of the site, and from the access gate across the site to the east side and down to the south end. Equipment will be located between the north and south sections of the site and is anticipated to include a step-up transformer, Saskatoon Light & Power switch, and possibly a small trailer/building to house monitoring/controls equipment.

Landscaping was discussed at length; considerations included how to improve the aesthetics of the site, and how to increase utility of the site from a sustainability perspective. Recommendations include modifying the existing seed-mix to one which attracts pollinating insects. Implementation of more extreme concepts such as introducing on-site beehives or sheep grazing were not studied in-depth due to anticipated operational complexities and costs. It should be noted that careful selection of grasses and plants that do not grow higher than the leading edge of the solar PV array to prevent any shading issues.

The environmental services team reviewed the project circumstances and recommended a desktop study be performed primary due to the impact of missing available study seasons if further study required. For example, if a desktop study determines that a particular species/environment study is required, it is possible that the study can only occur during a certain time of year, which could delay a project until such study can be performed. Based on the information available, the City felt confident that further study would not be required and elected to not have a desktop study performed.

The City is an organization which highly values proactive engagement with project stakeholders. It is anticipated that the project will garner heightened levels of public interest. Accordingly, it was requested that Stantec provide technical and financial data, along with photo-realistic rendering to assist with engagement activities.

As part of the financial analysis, an Opinion of Probable Cost (OPC) for capital cost and operation and maintenance costs was developed using industry data with verification by Canadian-based wholesalers and contractors. The OPC projected that the capital costs of the system to be approximately $4.25 million or approximately $1.88/Wdc. Operation and Maintenance (O&M) costs are projected to be approximately $27,500/year or $12.50/kW per year.

The developed CAPEX and OPEX figures were the basis of in-depth financial analysis. Four project implementation cases were studied. Each of the cases included a variation in financing, ownership, and power usage assumptions. Each of the cases, with assumptions, analysis, and commentary are included in the report. The most beneficial case was deemed to be Case 1 where Saskatoon Light & Power finances and builds the solar power plant, and retains the electricity for retail and Demand Charge savings and Carbon Credits are retained. In this case it was determined that the system should

pay itself back in 15 years of operation, or just over 7 years with the receipt of a government grant.

In summary, an acceptable technical solution appears to be feasible given the target design criteria, site conditions, and supporting physical infrastructure. From a financial perspective, analysis indicates that the project is expected to be very beneficial in one case, and moderately beneficial in one other case. Finally, the environmental, glare, and acoustical impacts on the immediate and surrounding areas appear to be acceptable. Overall, the project appears to be technically feasible, meets financial expectations, and is environmentally and socially sustainable.

It should be noted that as the technology continues to improve, newer modules on the market will potentially change the dynamic of which the solar farm is developed. Hardware and costs considered for this assessment should be viewed as a snapshot of the time this report was developed. Newer technology can and will change the assumptions used to develop this assessment and will only continue to become significant the further away from this analysis the project takes to materialize.