

City of Saskatoon

Solar Photovoltaic Feasibility Study for Municipal Buildings

1.0 Executive Summary

The City of Saskatoon's Low Emissions Community Plan sets targets to install 24 MW of rooftop solar on municipal buildings by 2026 and 20 MW of utility-scale solar photovoltaic (PV) facilities by 2030. In an effort to achieve these targets, the City of Saskatoon is developing a Renewable Energy Strategy and retained J.L. Richards & Associates Limited (JLR) to complete a comprehensive Solar Feasibility Study on eight municipal facilities.

1.1 PV Assessments Results

For each facility a PV Assessment was completed, which included a solar site assessment and a proposed design option. The solar site assessment included a review of the building's structure and electrical systems, estimated roof replacement schedule, and utility interconnection programs for suitability of a solar PV system. Based on the site conditions, a design option was proposed with estimated annual energy production (and associated greenhouse gas emission reductions), opinion of probable construction costs, and economic analysis. A summary of the results from these PV Assessments can be found in Table 1. A colour scale has been added for clarity to easily compare projects against one another for a given metric. Red highlights the worst performers (e.g., longest payback, highest costs, upgrades anticipated), and green highlights the best performers (e.g., shortest payback, lowest costs, no upgrades expected).

For the rooftop systems, a total of 2.3 MW DC of solar capacity was identified, resulting in approximately 2,500 MWh per year of clean electricity generation and over 500 tonnes CO₂eq of greenhouse gas emission reductions. The total budgetary rough order of magnitude opinion of probable construction costs for these systems is \$3.8 million and the estimated total annual electricity bill savings are over \$224,000 for all buildings combined.

The possibility of a ground mount system at the wastewater treatment plant was assessed at a size of 17 MW DC, which results in approximately 22,000 MWh of clean electricity generation and over 4,000 tonnes CO₂eq of greenhouse gas emission reductions. The total budgetary rough order of magnitude opinion of probable construction costs for this system is \$18.6 million and the estimated average annual electricity generation revenue is \$1.4 million, assuming SaskPower will provide a Power Purchase Agreement.

The estimates above are an "opinion of probable construction cost" based on historic construction data, and do not include COVID-19 cost impacts related to labour, material, equipment, manufacturing, supply, transportation, or any other element. To achieve the targets set in the Low Emissions Community Plan additional PV Assessments could be completed for other buildings in the City's portfolio.

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Table 1: Summary Table of PV Assessment Results

Site	Energy Generation (kWh)	GHG Reductions (tonnes CO2eq)	Electrical Review	Structural Review	Roof Replacement Due	Interconnection Review	Payback (years)	\$/W DC	LCOE (\$/kWh)	Lifetime Carbon Cost Effectiveness (\$/tonne CO2eq)
Arena	421,418	83	Study Required	No Upgrades	2037	SL&P	23	\$1.39	\$0.1244	\$247
CH	184,900	37	No Upgrades	Study Required	2034	SL&P	24	\$1.56	\$0.1457	\$302
FH3	39,010	8	Study Required	Upgrades Likely	2043	SL&P <100 kW	26	\$2.59	\$0.2244	\$509
LCC	114,600	23	No Upgrades	No Upgrades	2039	SaskPower Limited	26	\$1.98	\$0.1532	\$350
PHQ	566,900	112	No Upgrades	Upgrades Likely	2040	SL&P	26	\$1.63	\$0.1630	\$317
SFH	703,300	139	Upgrades Likely	No Upgrades	2020	SL&P	14	\$1.34	\$0.0937	\$236
CSE	117,070	23	No Upgrades	No Upgrades	2021	SL&P	22	\$1.90	\$0.1311	\$358
WWTP – RT	390,200	77	Study Required	Upgrades Likely	Unknown	Load Displacement	26	\$2.16	\$0.1836	\$398
WWTP – SGM	2,175,300	431	Study Required	N/A	N/A	Load Displacement	16	\$1.56	\$0.0836	\$229
WWTP - LGM	22,000,000	4,331	Study Required	N/A	N/A	Revenue System	13	\$1.10	\$0.0637	\$172

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1.2 Deployment Strategy

Based on the findings of the PV Assessments and input from the City of Saskatoon each project was ranked in priority and a potential multi-year phased implementation approach was prepared (Table 2). The estimated roof replacement dates were the primary factor used in prioritizing projects follow by which site would require the least amount of structural and/or electrical upgrades.

Table 2: Priority List and Proposed Implementation Plan

Rank	Project	Address	Deployment Year
1	Civic Square East	202 4 th Avenue North	2023
2	Saskatoon Field House	2020 College Drive	2023
3	WWTP – Small Ground Mount	470 Whiteswan Drive	2025
4	Fire Station No. 3	2613 Clarence Avenue South	2023
5	Lawson Civic Centre	225 Primrose Drive	2024
6	ACT Arena	107 105 Street East	2024
7	City Hall	222 3 rd Avenue North	2026
8	New Police HQ	76 25 Street East	2026
9	WWTP – Large Ground Mount	470 Whiteswan Drive	2030
10	WWTP – Rooftop	470 Whiteswan Drive	2026

1.3 Grants, Incentives and Financing Programs

Three federal programs were identified that provide direct funding for solar PV projects or funding for projects that a solar PV array can be a portion of.

The Green Municipal Fund provides low interests loans up to \$10 million to cover up to 80% of eligible costs. This program can fund retrofits to municipal facilities that improve energy efficiency by at least 30% where 10% can be provided by on-site renewable energy. As well, it provides funding for projects that are looking to generate renewable energy on a brownfield site. This program will also cover up to 50% of the costs for supporting feasibility studies, including front end engineering and design.

The Green and Inclusive Community Buildings program funds up to 80% of project costs (60% for projects greater than \$10 million) to a maximum of \$25 million. This program will fund retrofits to community buildings to make them more energy efficient and lower their carbon emissions over the lifetime of the project such as installing a rooftop solar PV system.

The Low Carbon Economy Challenge provides up to \$25 million in funding and up to 40% of total project costs. The program funds greenhouse gas emissions reducing projects such as generating electricity from renewable sources for self consumption.

Aside from Government grants, the Saskatchewan Environmental Society Solar Co-operative Ltd. installs solar arrays at no cost to the building owner and leases the array over a 25-year period. The solar assets are collectively owned by co-op members.

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1.4 PV Assessment Methodology

The energy production estimates are based on a typical meteorological year for Saskatoon International Airport using the 2020 Canadian Weather Year for Energy Calculation dataset from Environment and Climate Change Canada. The production estimate accounted all forms of system losses such as module mismatch, wiring, clipping, inverter, AC system, reflection, shading and soiling. The greenhouse gas emission reductions were estimated using SaskPower's forecasted net emission intensity factors to 2030.

For each building a review of the existing electrical infrastructure and available structural information was completed to assess the high-level feasibility of installing a solar PV system. Roof replacements have a major impact on the economic analysis for solar rooftop PV systems, a review of building condition assessment reports was conducted to determine when the next roof replacement was anticipated for each facility.

SaskPower's current net metering program limits the size of solar PV projects to 100 kW DC. Saskatoon Light & Power's net metering program is currently limited to 100 kW DC as well. However, this program is governed by the City of Saskatoon's Administrative Policy A07-022 – Power Producer Policy. Updates to this policy can be recommended by the General Manager, Transportation and Utilities and approved by the City Manager.

An economic analysis of each system was conducted through a custom developed lifecycle cost analysis tool that was provided in an Excel workbook format to the City of Saskatoon and included calculations for net present value, levelized cost of energy (LCOE), and carbon cost effectiveness. LCOE represents the net present value of building and operating the PV system per unit of total electricity generated over a 25-year life of project. Carbon cost effectiveness represents the initial capital costs per tonne of greenhouse gas emission reductions measured over the lifetime of the project, this is commonly requested on funding applications.