Assessing the Options for Sustainable Energy Solutions for the Okanese First Nation as a Means of Economic Empowerment

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RESEARCH QUESTION

How can renewable energy technologies be most effectively used to support the Okanese First Nation in Saskatchewan in achieving sustainable economic, environmental, and social well-being?

INTRODUCTION

This research explores options for integrating renewable energy solutions within the Okanese First Nation.

Inspired by the experience and the success of renewable energy initiatives implemented by other First Nations, which showcased the potential for significant community benefits.

This study evaluates the potential for renewable energy systems such as solar, wind, and biomass to serve as a pathway for generating sustainable energy, fostering economic growth, and delivering environmental benefits.

The methodology involved reviewing secondary data, analyzing case studies of similar projects, and applying multi-criteria decision analysis (MCDA) to evaluate each renewable energy technology on technical, economic, and social factors.

A hybrid 5 MW wind turbine and 5 MW solar photovoltaic system was recommended as an optimal energy solution capable of powering over 2,400 homes annually, generating jobs, and preventing approximately 24,000 tonnes of CO2e emissions each year.

The study advocates for Indigenous ownership models, capacity-building opportunities, environmental stewardship, and access to federal funding programs to support implementation.

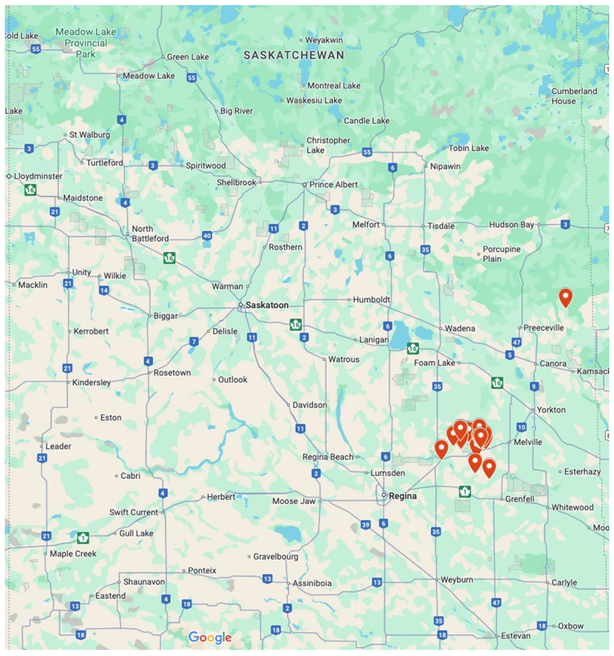
BACKGROUND

Okanese First Nation is a Treaty 4 signatory and a member of the File Hills Qu'Appelle Tribal Council.

It is situated northeast of Regina, Saskatchewan.

It has a population of approximately 800 members, with most of the members living off reserve.

According to Statistics Canada (2023), as of the 2021 census, around 213 residents lived on the reserve in 60 single-detached dwellings.



Adapted from Google Maps (n.d.). https://www.google.com/maps

The First Nation faces the challenge of limited economic development opportunities and aspires to revitalize its culture, preserve its natural resources, and create long-term opportunities.

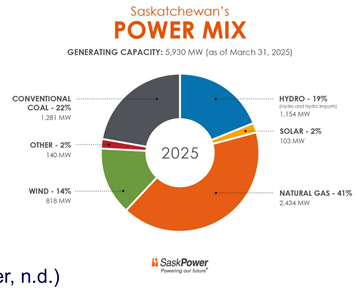
They have also observed the success of renewable energy projects such as the Pesâkâstêw 10 MW Solar Project and Cowessess First Nations Awasis 10 MW Solar Project, which have a 20-year Power Purchase Agreement (PPA) with Saskatchewan Power (SaskPower).

These projects show the transformative potential of Indigenous-led renewable energy initiatives in environmental, social, and economic dimensions.

The First Nation holds rights to over 10,000 hectares of reserve land, providing flexibility and strategic options for sustainable energy development projects.

OPPORTUNITY

Saskatchewan's power mix includes about 22% of its electricity generated from conventional coal. SaskPower's aims to cut GHG emissions by 50% below 2005 levels by 2030, which creates policy openings for Indigenous-led projects.



(SaskPower, n.d.)

DECISION-MAKING FRAMEWORK

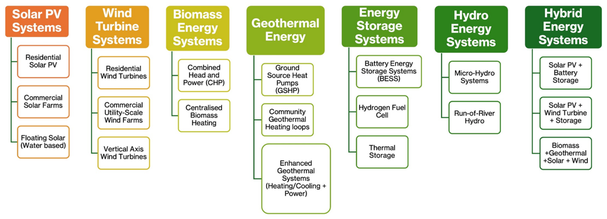
Profit
Revenue Generation

People
Capacity Building
Local Employment
Support underfunded community programs

Planet
Low GHG Emissioons
Circular Resource Use
Climate adaptability

Purpose
Cultural Match
Community Ownership
Autonomy and Control

WHAT IS POSSIBLE?



BUSINESS MODEL

Revenue generation is through a power purchase agreement (PPA) similar to Cowessess' First Nations' 20-year PPA with SaskPower, which guarantees stable cash flow.

Alternatively, the SaskPower Renewable Access Service (RAS) can be leveraged to allow selling renewable electricity to large customers using SaskPower's grid infrastructure.

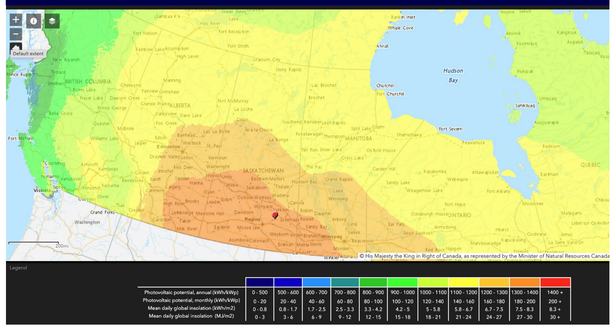
CASE STUDY: AWASIS SOLAR PROJECT

The Awasis Solar Project is a 10 MW solar PV facility developed through a limited partnership between Cowessess First Nation, holding 95%, and Elemental Energy, with 5%. Featuring 33,000 solar panels, it was commissioned in 2022 on reserve land (Elemental Energy, 2023).

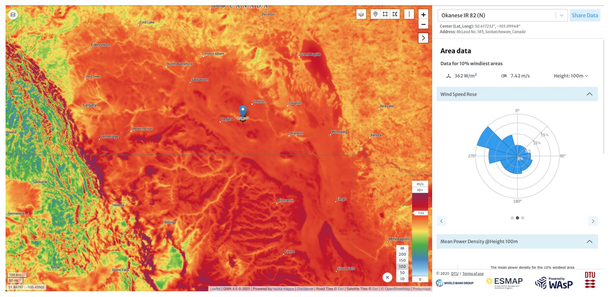
The project received $18.5 million in federal funding: $13.7 million from Natural Resources Canada's Smart Renewables and Electrification Pathways program, $3.5 million from Infrastructure Canada's Investing in Canada Plan Green Infrastructure stream, and $1.25 million from PrairiesCan (Natural Resources Canada, 2022).

Revenue is generated via a 20-year Power Purchase Agreement with SaskPower. Since 2022, the $21 million project has been operational, supplying about 2500 homes. The revenue supports sustainability initiatives and underfunded programs promoting community and cultural renewal. This Solar Project exemplifies how renewable energy can contribute to economic reconciliation and fund community-led sustainability efforts.

RESOURCE POTENTIAL AT LOCATION



(Natural Resources Canada, n.d.)
Solar Photovoltaic Potential up to 1300 -1400 kWh/kWp/year

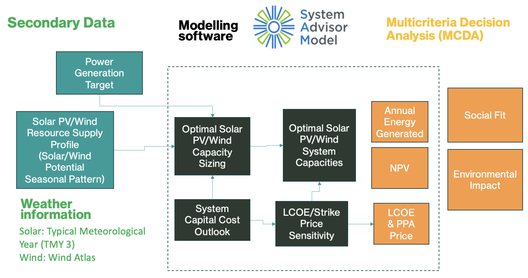


(Global Wind Atlas, n.d.)

The data from the Global Wind Atlas indicates that the Okanese region has wind speeds suitable for commercial-scale power generation, with wind power density reaching as high as 362 W/m² in Okanese Indian Reserve No.82

METHODOLOGY

A multidimensional approach involving secondary data analysis, technology systems modelling with System Advisor Model (SAM), case study reviews, and multi-criteria decision analysis.



Energy Systems Modelled

Case	System Type and Capacity (MW)
1	Solar PV- 5 MW
2	Solar PV- 10 MW
3	Wind Turbine – 5 MW
4	Wind Turbine – 10 MW
5	Hybrid (5 MW Solar PV and 5 MW Wind Turbine)

These system choices are guided by technical and contextual factors relevant to the Okanese First Nation. These capacities match the scale of Indigenous-led projects carried out in Saskatchewan and other First Nations, making them feasible and fundable options.

Parameters	Data (5 MW)	Data (10 MW)
No of modules	9,600 (CS7N-700TB-AG) (Bifacial)	18,600 (CS7N-700TB-AG) (Bifacial)
No of inverters	2 (Sungrow SC2500U (550V))	2 (Sungrow SC2500U (550V))
Name Plate DC Capacity	6,723.8 kW (6.728 MW)	13,027 kW (13.027 MW)
Total AC Capacity	5,085 kW (5MW)	10,000 kW (10MW)
DC to AC Ratio	1.34	1.3
No of Sub-Arrays	2	4
Sub-Array Configuration	20 modules per string x 120 Strings in Parallel = 2400	25 modules per string x 186 Strings in Parallel = 4650
Tilt Angle (fixed)	43	43
Shading	No self-shading	No self-shading
DC Degradation rate	0.5 %/yr	0.5 %/yr
Total Land Area	23.96 Acres	46.42 Acres

Wind Turbine System Design

Turbine model: Custom-designed turbine with parameters aligned to the Siemens Gamesa SG 5.0-145 (2.0). It offers a strong power output, proven reliability, and utility-scale capacity for off-grid energy generation.

It has a rated capacity of 5 MW and features a 145-meter diameter rotor, providing a larger sweep area for improved energy capture in areas with lower wind speeds.

The blades are 71 meters long and are designed to balance high energy production with reduced noise levels. Key inputs for the simulation include a cut-in wind speed of 2.5 m/s, a rated power output plateau at wind speeds between 10.8 m/s and 26 m/s, and a cut-out wind speed of 27 m/s.

RESULTS

Techno-Economic and Environmental Performance Summary

System	Annual Energy (kWh)	Capacity Factor (%)	Homes Powered	LCOE (¢/kWh)	Capital Cost ($)	NPV ($)	IRR (%)	PPA (¢/kWh)	Avoided CO_2 (tCO_2e/yr)	Land Required (acres)
5 MW Solar PV	10,239,300	23.4	1,078	6.66	8,162,170	83,532	3.17	7.5	10,239.30	23.9
10 MW Solar PV	20,136,800	23	2,120	6.56	15,828,900	451,220	3.83	7.5	20,136.80	46.42
5 MW Wind	14,967,000	34.2	1,575	4.69	8,716,510	2,323,819	17.7	6.5	14,967.00	4.1
10 MW Wind	29,933,900	34.2	3,151	4.69	17,433,000	4,647,638	17.77	6.5	29,933.90	27
10 MW Hybrid (5+5)	23,625,500	27	2,487	6.08	15,896,100	3,949,479	13.06	7.5	23,625.50	28

MCDA Outcome

Criteria	Weight (%)	5 MW Solar	10 MW Solar	5 MW Wind	10 MW Wind	Hybrid 5+5 MW
Capacity Factor	5	0.3	0.3	0.45	0.45	0.4
Seasonal Balancing	15	0.6	0.6	1.2	1.2	1.35
Homes Powered	10	0.4	0.6	0.5	0.9	0.8
Net Capital Cost	5	0.45	0.3	0.4	0.2	0.25
Avoided Emissions	10	0.4	0.6	0.6	1	0.9
NPV	5	0.1	0.15	0.4	0.5	0.45
IRR	5	0.1	0.15	0.5	0.5	0.35
Land Required	5	0.35	0.25	0.45	0.4	0.4
Jobs Created	15	1.05	1.05	1.05	1.05	1.2
Cultural Alignment	10	0.8	0.8	0.8	0.8	0.8
Low Entry Skill	15	1.2	1.2	0.75	0.75	1.05
Total Weighted Score	**100**	**5.75**	**6**	**7.1**	**7.75**	**7.95**

CONCLUSION

SDG 7 - Affordable and Clean Energy

A 10 MW hybrid energy system combining 5 MW of solar PV and 5 MW of wind offers the most balanced, efficient, and community-aligned solution for the Okanese First Nation. The system can generate over 23.6 GWh/year, supplying electricity to more than 2,400 homes, while achieving a higher capacity factor than solar alone by leveraging complementary wind generation.

SDG 8 – Decent Work and Economic Growth

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SDG 13- Climate Action

The hybrid system is viable with a net capital cost of $16M USD, LCOE of 6.08 ¢/kWh, and a positive NPV of $4M USD under a PPA rate of 7.5 ¢/kWh. It offers a pathway to energy sovereignty, long-term cost savings, and climate resilience for the Okanese First Nation.

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