Feasibility Of Implementing Renewable Energy Power Generation Capability At BASF's Regina And Saskatoon Facilities

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Abstract

As organisations strive to meet their decarbonization commitments, emphasis is placed on the scope 2 emissions associated with the use of grid electricity. In this context, BASF Canada would like to investigate the feasibility of producing electricity onsite from a renewable source at their Regina and Saskatoon facilities. A multi criteria decision analysis was used to compare the technologies of which integrated solar was ranked the highest. A techno-feasibility analysis of this technology using System Advisor Model software revealed challenges. The low capacity factors resulting in high levelized cost of electricity for the systems rendered the projects uneconomically at this time. Additionally, the low cost of electricity from the grid diminished the incentives for onsite generation. Ongoing technological advancements and market dynamics may offer renewed opportunities for BASF in the future. Alternatively, a power purchase agreement for clean electricity can help the company meet its near-term emission reduction commitments

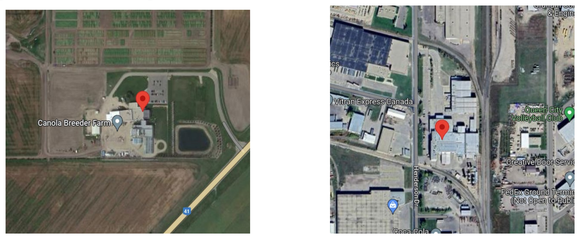
Research Question

What is the most feasible renewable energy technology available to BASF Canada to generate their own electricity (behind-the-meter system) at the Regina and Saskatoon facilities which can be implemented in the near term?

Introduction

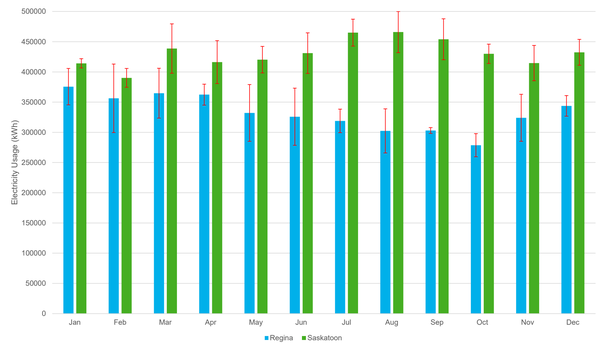
- BASF has two facilities in the province of Saskatchewan; one is in Regina and the other is in Saskatoon.
- The Regina facility is a storing, blending and packaging facility for making agricultural products while the Saskatoon facility is mainly used for growing and testing products.
- BASF has set targets to reduce their greenhouse gas (GHG) emissions in support of the Paris Agreement goal to limit global warming to below 2˚C (BASF(a), n.d.).
- Company has committed to becoming net zero by 2050 and has set an interim 2030 target to reduce its Scope 1 and 2 Greenhouse Gas Emissions (GHG) by 25% compared to 2018 levels.
- In 2018, BASF globally contributed 21.9 million metric tonnes of CO_2 equivalent (CO_2e) thus this 2030 target corresponds to reducing the Group's total emission to 16.4 million metric tonnes of CO_2e (BASF(a), n.d.).
- The company currently utilizes the Renewable Energy Credits (REC) market to offset their emissions.
- RECs are market-based instruments in which facilities that produce electricity from renewable sources and distribute the electricity into a grid, can sell emission reduction certificates in units of 1 MWh..
- BASF has developed a carbon management strategy which identifies 5 key areas in which to reduce its carbon footprint (BASF(b) n.d.). Once of the strategies is to increase deployment of renewable energy in the global power supply.
- BASF would like to investigate the opportunity of generating their own electricity for the following reasons:
  - It is alignment with the company's carbon management strategy.
  - The additional cost to the company of purchasing RECs is an opportunity cost for executing projects that can effectively reduce GHG emissions such as energy efficiency projects.
  - Even though the company has purchased RECs, the electricity it receives is from the grid and the 'real' emissions will be associated with the energy mix at the location in which the company operates
  - The purchasing and retiring of RECs does not necessarily contribute to additionality or the addition of more renewable energy power generation capacity (Gillenwater, 2008).

Figure 1: Saskatoon and Regina facilities



Note: Google Earth, 2023

Figure 2: Monthly electricity demand at Saskatoon and Regina with standard deviation between the period 2019-2022



Project Scoping

- Project Scoping involved narrow down and identify one renewable energy technology available to BASF to generate onsite electricity based on specific criteria using a multiple criteria decision analysis (MCDA).
- The criteria considered are resource availability, CAPEX, OPEX, land-use intensity of electricity (LUIE), and common practice.
- Integrated solar PVs was deemed the most suitable technology to investigate further.

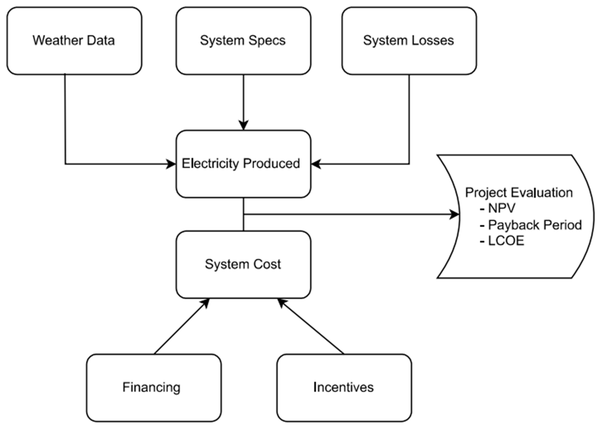
Table 1: Multi Criteria Decision Analysis for selecting Renewable Energy Technology

Criteria	Weight	Commercial Solar	Commercial Wind	Geothermal
Ease of operation	20	18	16	14
CAPEX	20	18	15	12
OPEX	15	14	13	9
LUIE	35	34	25	31
Common practice	5	5	4	2
Total Score	100	89	73	68
Rank		1st	2nd	3rd

Technoeconomic Analysis

The System Advisor Model (SAM) software was used to perform the techno-economic analysis for the proposed solar PV application.

Figure 3: Block diagram showing how renewable energy projects are evaluated.



Note: Adapted from Freeman J. (2020)

- **Base Case:** Project financing with 100% equity, REC starting at US$ 6.60 per year, REC and electricity rate increasing at the rate of inflation.
- **Case 1A:** Project financing with 80% debt for a period of 15 years, RECs price starting at US$ 6.60 per year and increasing at a rate of 10% per year until 2035 and the electricity rate increases at a rate of 1% above inflation per year for also until 2035.
- **Case 1B:** Project financing with 80% debt for a period of 15 years, RECs price starting at USD 6.60 per year and increasing at a rate of 10% per year for the duration of the project life and the electricity rate increases at a rate of 1% above inflation per year for also for the duration of the project life.
- **Case 2:** PV module with greater efficiency, reselecting applicable inverters and adjusting the cost of the system using the same assumptions as the base cases.
- **Case 3:** Decrease the load demand by 25% and use the base case assumptions to evaluate whether energy reductions can make the systems more feasible.

Results

Table 2: Summary of Results

	Base Case		Case 1 A		Case 1B		Case 2		Case 3	
Parameter	Saskatoon	Regina	Saskatoon	Regina	Saskatoon	Regina	Saskatoon	Regina	Saskatoon	Regina
Annual AC Energy (kWh)	1,381,328	2, 496,044	1,381,328	2,496,044	1,381,328	2,496,044	1,453,619	2,607,230	1,381,328	2,506,448
Capacity Factor	13.9%	12.9%	13.9%	12.9%	13.9%	12.9%	13.7%	12.8%	13.9%	12.9%
LCOE (¢/kWh)	13.37	14.10	9.55	10.06	9.43	8.71	13.63	14.25	13.36	14.09
Total Installed Cost	$2,145,224	$4,082,625	$2,145,224	$4,082,625	$2,145,224	$4,082,625	$2,301,253	$4,290,984	$2,145,224	$4,082,625
Weighted Average Cost of Capital	8.75%	8.75%	4.14%	4.14%	4.14%	4.14%	8.75%	8.75%	8.75%	8.75%
Net Bill Saving with System	$97,102	$173,116	$100,501	$179,175	$97,076	$173,116	$101,928	$181,001	$96,185	$171,777
Net Present Value	(944,661)	(1,933,990)	(345,663)	(1,118,902)	(264,165)	(327,409)	(1,037,790)	(2,060,129)	(953,779)	(1,962,527)
Simple Payback Period (years)	29	N/A	29.5	N/A	23.1	22.8	N/A	N/A	29.5	N/A
Avoided Emissions (Tonne CO_2e)	884	1,597	884	1,597	884	1,597	930	1669	884	1604

Conclusion

- The findings indicate that conventional commercial integrated solar PV technology is not economically feasible for generating onsite electricity and offsetting grid consumption or reducing the company's scope 2 emissions at the Saskatoon and Regina facilities.
- The factors which contributed the findings are the low capacity factors that are generated by the systems, the lower rate in which electricity can be purchased from the grid, and the project financing structure.
- it may be more advantageous for BASF to explore entering into a Power Purchase Agreement (PPA) with a third party to supply clean energy to these facilities rather than developing their own onsite electricity generation capabilities.
- Opting for a PPA would reduce financial risks, allow active involvement in supporting the development of new renewable energy facilities, and enable the company to concentrate on its core business operations.

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