Solar PV Options to Reduce Emissions from Drilling, Completions, and Production Operations

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01 Abstract

This research assesses options for the oil and gas sector in Canada to reduce scope 1 and 2 GHG emissions from their drilling and completions operations. This sector accounts for 26% of national GHG emissions in Canada. Drilling and completions operations contribute to a significant portion of greenhouse gas emissions which can be reduced by various options. This paper explores the techno-economic feasibility of implementing different solar photovoltaic options to offset the carbon emissions for a specific organization. Using organizational and historical data coupled with SAM simulation software, the research finds that bi-facial panel systems with single-axis tracking offer the most cost-effective solution with the lowest Levelized Costs Of Electricity (LCOEs) when compared to their mono-facial, fixed mounted counterparts. Carbon offset credits produced by the system can be used to meet the organization's emissions compliance obligations.

02 Objective

The objective of this research is:

- Determine what the optimal design and cost for a solar PV system would be for the organization.
- Determine the amount of GHGs reduced from the implementation of the solar farm as it would contribute to the organizations goal of reducing their scope 1 and 2 emissions.
- Utilizing a modeling program (SAM) and publicly available weather datasets to calculate the energy production of a solar PV farm.
- Completing a financial analysis by calculating indicators like the Levelized Cost of Electricity (LCOE) and payback periods.
- Reviewing the literature to enable the assessment of the landscape to determine appropriate carbon pricing scenarios that would affect the project economics.

References

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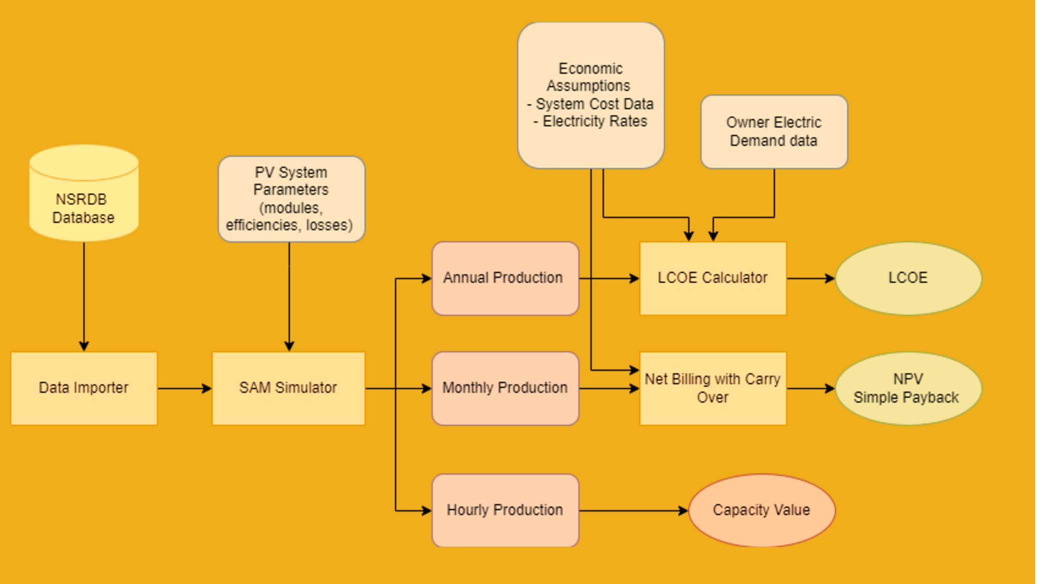
03 Methodology

To develop an optimal solar farm that can be implemented, various design options were investigated. The System Advisor Model (SAM) was used to analyze the energy production potential and economic feasibility of each design. A reference case was designed using SAM. Solar irradiance and ambient weather data were imported from the National Solar Radiation Database (NSRDB) dataset which was also developed by NREL.



SAM Framework

As renewable energy projects can generate offsets, RECs, or EPCs, the value of these was calculated. Using current carbon pricing identified from current policies the value of offsets that could be generated from the project was calculated. Other potential carbon pricing scenarios were developed based on the literature and current political stances on the carbon tax. The value of offsets was determined for each carbon pricing scenario using the energy output from SAM, offset quantification protocols in Alberta, and Excel.

Equation 1:

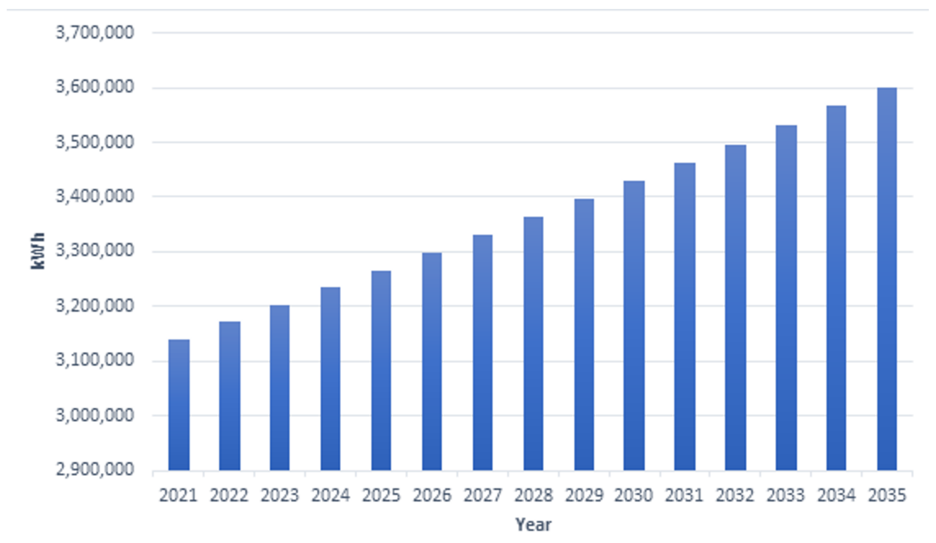
Electricity Generation = Emissions $_{\text{Electricity Generation}}$ = **Electricity x Electric Factor** $_{\text{Elec}}$

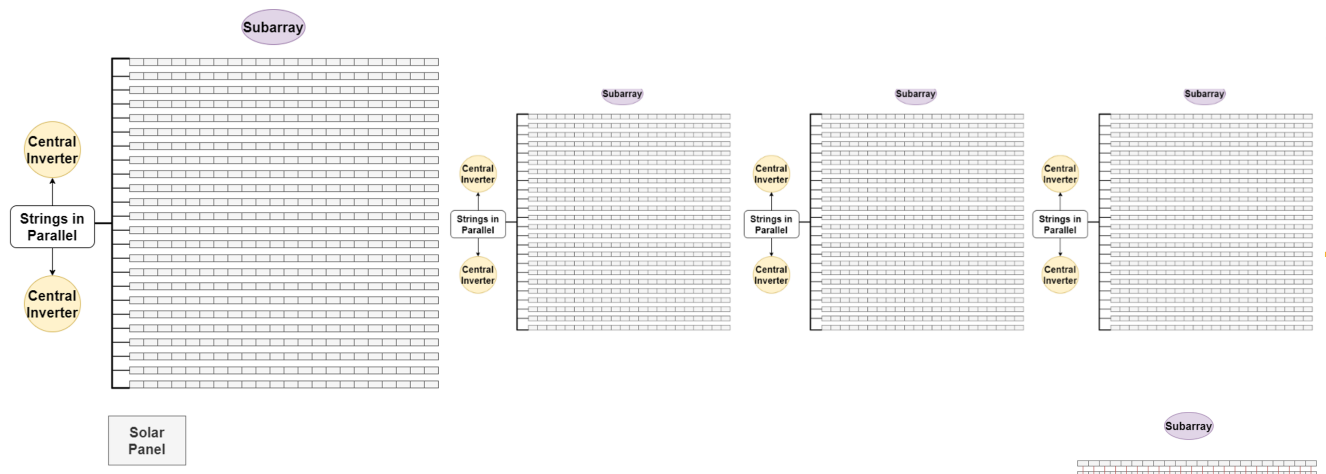
For the economic analysis, SAMs financial model was used. A mix of actual costs from suppliers and literature was obtained to determine the various system component costs. Five scenarios were analyzed with one having no carbon pricing.

1. Carbon pricing will follow the federal plan which is currently $50/tonne increasing by $15/year up to 2030. It will then remain at $170/tonne.
2. Carbon pricing will follow the federal plan but continue to increase by $15/year until the end of the life of the project. This will reach $245/tonne in 2035.
3. Carbon pricing will remain at the current TIER price of $50/tonne.
4. Carbon pricing will follow the federal plan until 2030 and then increase by 2% annually.
5. No carbon pricing will be in effect.

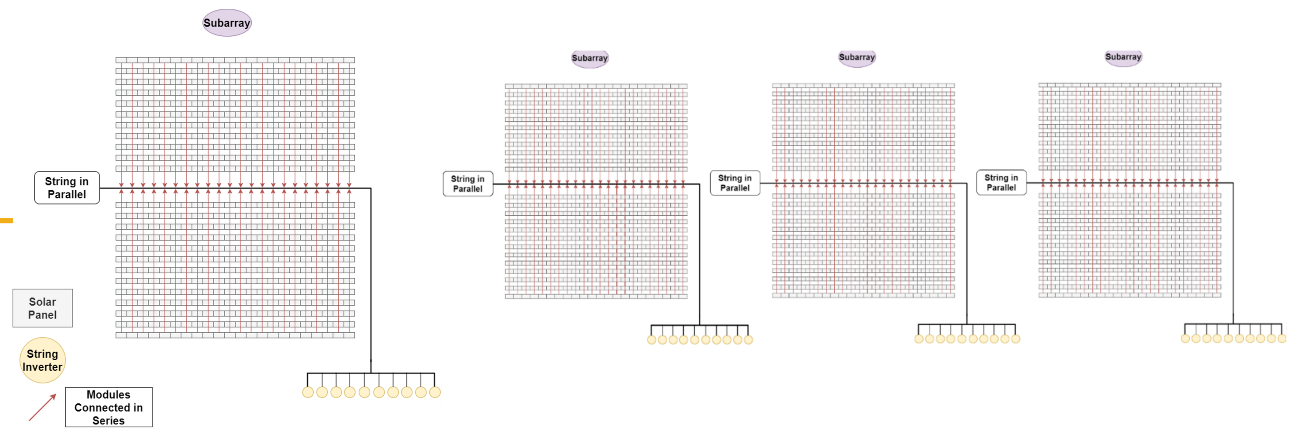
04 Results

Total Combined Predicted Electricity Consumption





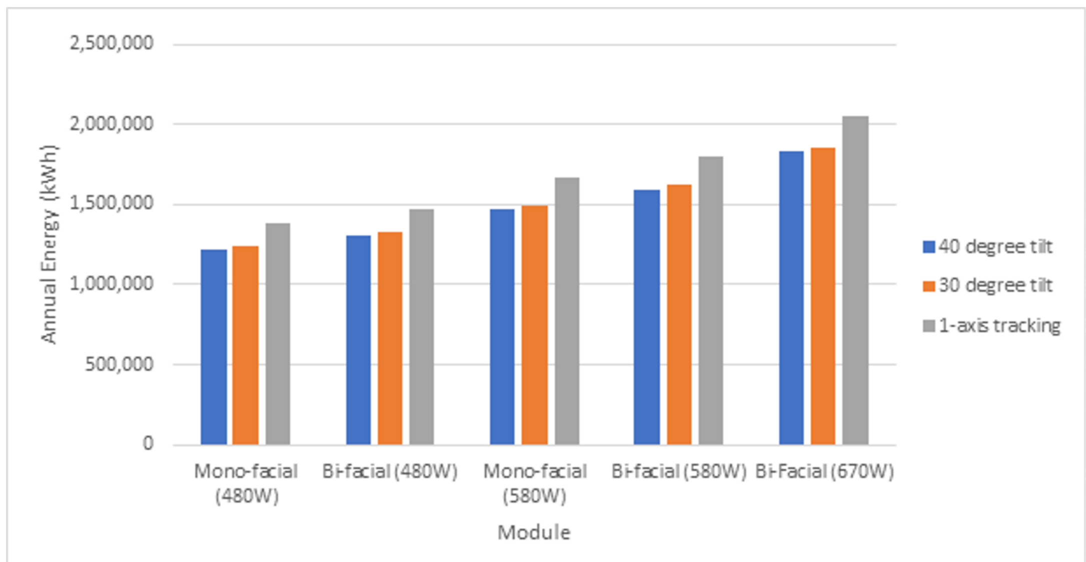
Central Inverter Layout



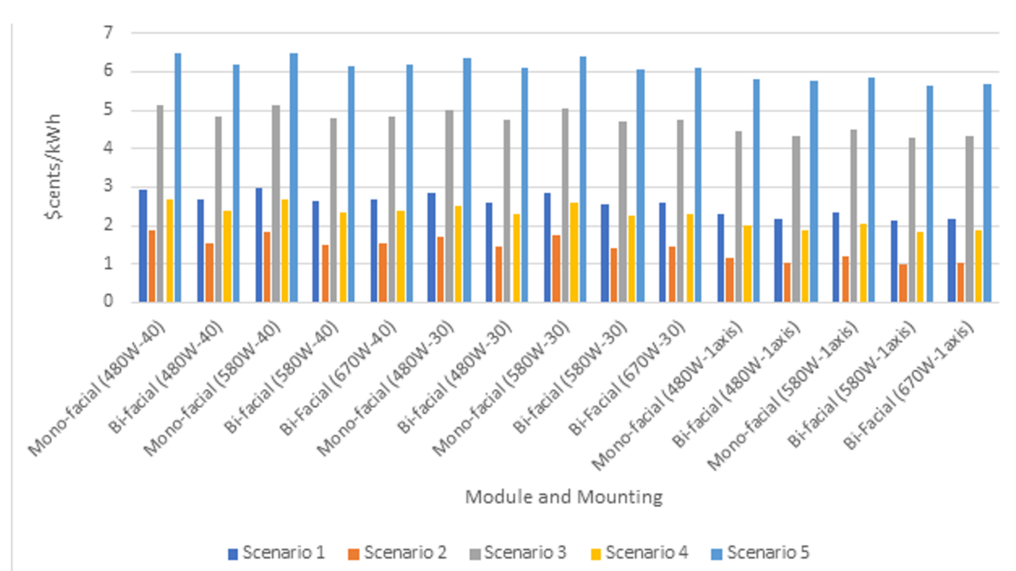
String Inverter Layout

05 Findings

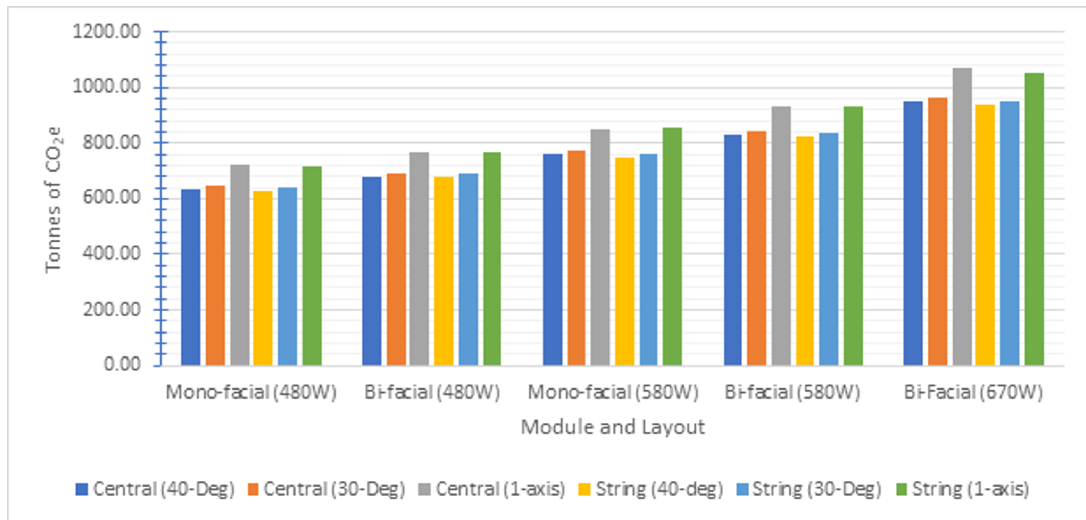
Energy Output Variation based on Panel Type and Mounting System for Central Inverter Layouts



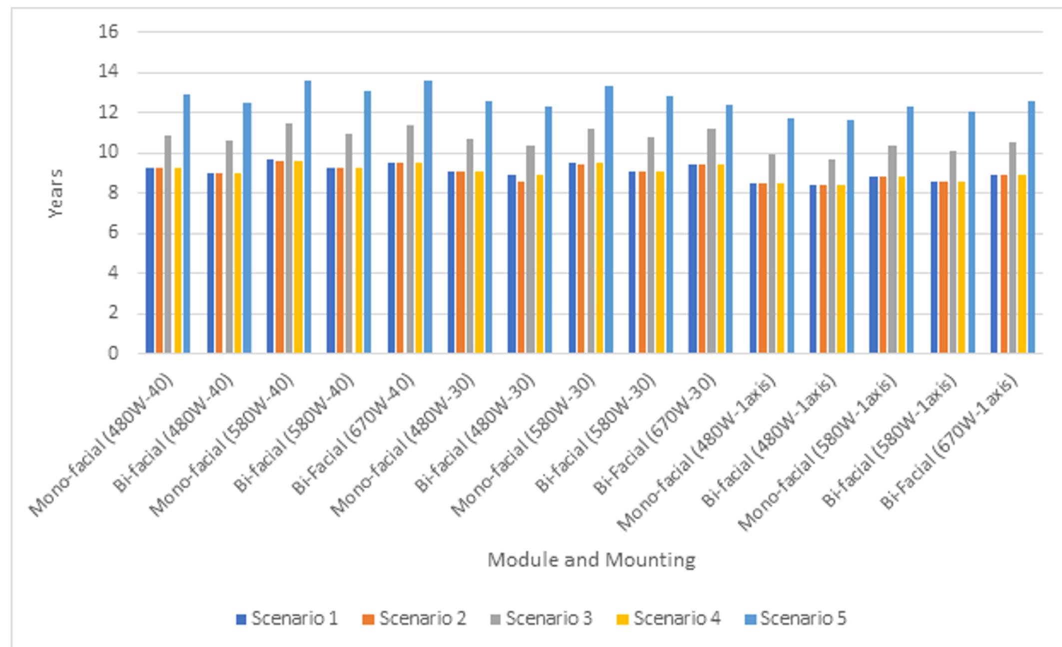
LCOE of each Central Inverter System Design based on the Carbon Pricing Scenario at a 5% Discount Rate



GHG Reductions in Year 1



Discounted Payback Period of each Central Inverter System Design based on the Carbon Pricing Scenario at a 5% Discount Rate



06 Conclusion

A 580W, bi-facial, one-axis tracking layout with central inverters. This has the lowest LCOE and payback period of $5.64 cents/kWh and 12.1 years respectively at a discount rate of 5% with no carbon pricing. The optimal solar farm will have an estimated installation cost $2,906,805 and an LCOE of $5.64 cents/kWh with a payback period of 12.1. years at a discount rate of 5% and no carbon pricing.