SOLAR PANELS IN ALBERTA AND GREENHOUSE GAS (GHG) EMISSIONS

OSSAMA PERVEZ

ACADEMIC SUPERVISOR: DR. MUJTABA SHAREEF
INDUSTRY PARTNER: EMISSIONS REDUCTION ALBERTA
INDUSTRY SUPERVISOR: GRACE MEIKLE

Research Question

What are the GHG emissions produced during the upstream manufacturing of solar panels?

The research is further divided into two parts:

- The project quantifies reduced GHG emissions in Alberta if 25% of total energy generated from natural gas and coal is replaced with solar panels.
- How to improve sustainability for the upstream value chain.

Background

According to Alberta Electric System Operator (2023), “For the first time, renewable generation, at 12.6 percent of total generation, provided more electricity than coal”.

In Alberta, solar provided just 1.4% (16.65 MW) out of total renewable electricity as of December 1, 2022

No.	Source	Electricity Generation (MW)	Percentage (%)
1	Natural Gas	6921.83	73
2	Coal	1108.75	12
3	Renewables	1189.5	12.6
4	Others	236.83	2.4
5	Total	9456.91	100

Importance of Research

As Canada is committed to reaching net-zero emissions by 2050 (Government of Canada, 2023), the research promotes the development of solar projects in Alberta.

It promotes the manufacturing of solar panels ethically.

It compares the emissions of solar panels with other fossil fuels and suggests solar panels become carbon neutral after a few years of operation.

Methodology

Emissions data for raw materials was studied from publicly available data.

Life cycle assessments (LCAs) were studied to identify how much emissions a typical solar panel produces during its lifecycle.

System Advisor Model (SAM), was used to calculate the annual generation from solar panels, and based on the emission factor found in the literature review, the environmental payback time of solar panels was calculated.

One-on-one interviews were conducted with major solar providers/projects in Alberta on which Emissions Reduction Alberta (ERA) has directly worked in the past.

Market research was done to provide suggestions on how the sustainability and overall manufacturing emissions can be reduced for solar panels.

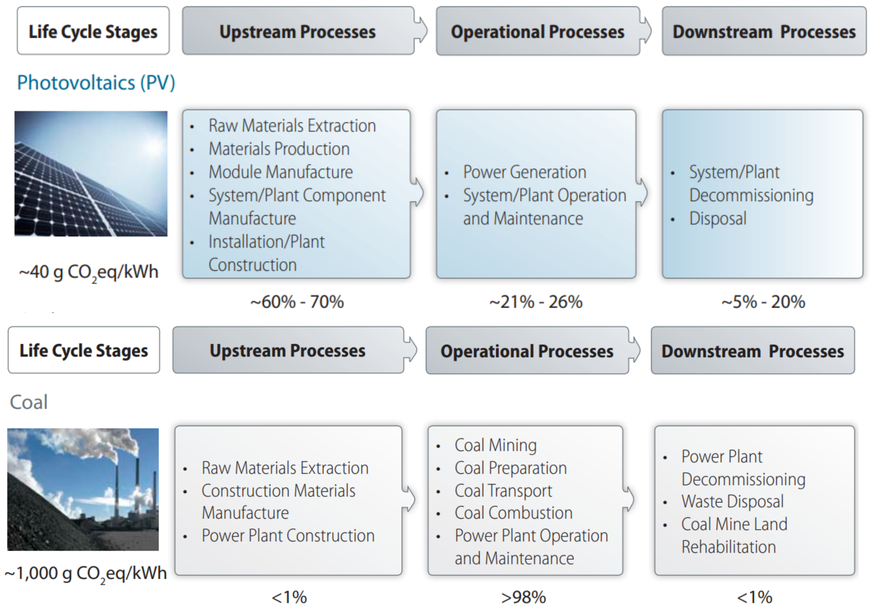
Project Linked with SDG

SDG13 - Climate Action

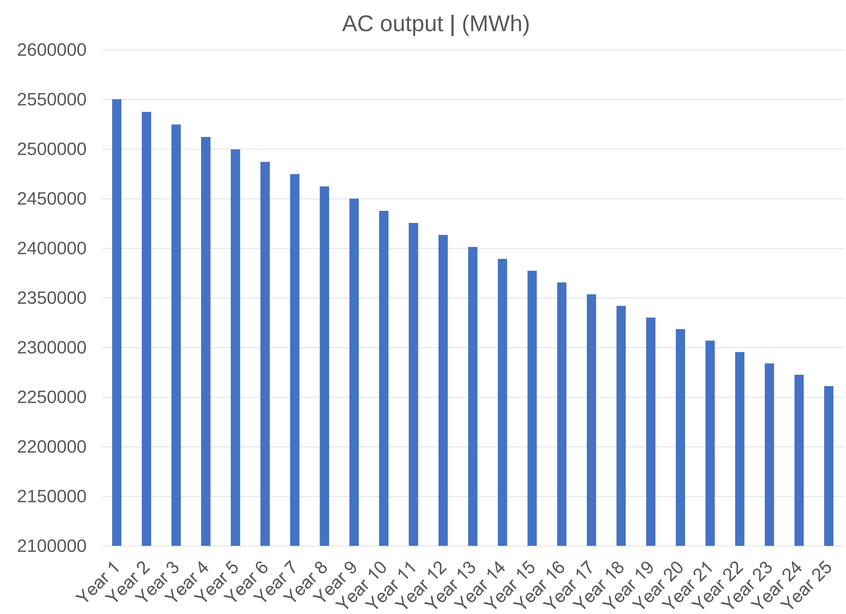
SDG9 – Industry, Innovation, and Infrastructure

SDG11 - Sustainable Cities and Communities

National Renewable Energy Laboratory LCA (NREL, 2012)



Reduced GHG emissions in Alberta if 25% of total energy generated from natural gas and coal is replaced with solar panels



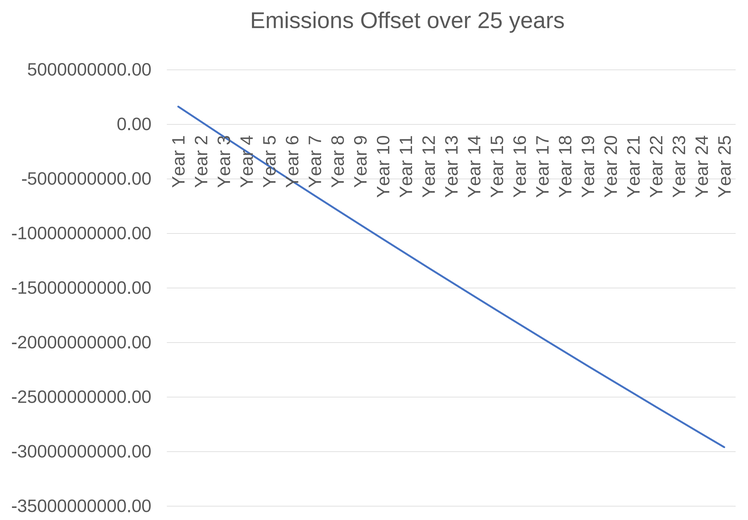
2007.65 MW Proposed Solar Project

Calculating the environmental payback time for 2007.65 MW solar panels

$$Tpayback1 = EmissionsPV25 - Eannual1 \cdot 1000 \cdot (EFMix - EFPV)$$

$$Tpayback\ (n) = Tpayback\ (n-1) - Eannual\ (n-1) \cdot 1000 \cdot (EFMix - EFPV)$$

Applying this equation shows that solar panels will be carbon neutral after 2 years of operation. Whereas over 25 years of operation, 29.59 Mt CO2-eq is avoided compared to consuming electricity from the grid.



Key Findings

- Alberta is the oil and gas hub, so ideally, the solar industry will not completely disrupt the oil and gas market. It will take time.
- The selection of a brand is based on economics, availability, levelized cost of energy (LCOE), and whether the specific brand complies with the specifications. The selection is not based on manufacturing emissions.
- Only top-of-the-line solar panel brands with the Canadian Standards Association (CSA) certification are considered.
- Manufacturing and transporting emissions are considered. One company said they buy offsets while the other four companies said the solar panels automatically offset their emissions during operation
- Forced/child labor is the biggest supply chain issue in the manufacturing of solar panels.
- North American manufactured panels are more expensive than China, as they are fully complying with sustainability regarding social aspects.

Conclusion

Solar Panels have manufacturing emissions but clear their carbon debt within a few years of operation.

From the research, the social aspect of sustainability needs to be checked in the supply chain of solar panels. Bill S-211 should solve this problem by enforcing that products imported to Canada must report it has no forced/child labor content.

Provincial and federal incentives motivate the public to install solar energy. Solar panels not only bring economic advantages to consumers but also environmental advantages for the province/country.

As Canada is committed to reaching net-zero emissions by 2050 (Government of Canada, 2023), market research and interview participants all agreed that generating electricity via solar energy will play a vital role in achieving this target.