E4 - SOLAR EARTH CIVIL CAPSTONE PROJECT

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SOLAR EARTH
World's toughest solar

ABSTRACT

- **In this capstone project, we looked at how the solar paver product from Solar Earth Technologies could be implemented on the University of Calgary campus to offer renewable energy production and reduce non-renewable energy usage.**
- **Project Deliverables:**
  - **Life Cycle Assessment**
  - **Location Analysis**
  - **Conceptual Design**
  - **Energy Analysis**
  - **Product Comparison**
  - **Product Testing**
  - **Installation Plan**

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INTRODUCTION

In 2019, the University of Calgary created a Climate Action Plan that set goals for 50% carbon reduction on campus by 2030 and creating a completely carbon neutral campus by 2050. This plan took into consideration the Sustainable Development Goals set by the United Nations in 2015. The University's plan focuses on solutions for cleaner energy supplies as well as a reduction in energy demand.

Today, the University is exploring options for new products and technologies that could help it reach this goal. One such product is solar pavers developed by Solar Earth. This project is a collaboration between the University of Calgary and Solar Earth. The purpose of this project is to investigate the feasibility of using these solar pavers on campus.

For the purposes of this project, we evaluated the solar pavers under the goal of 50% carbon reduction by 2030.

METHODS AND MATERIALS

Life Cycle Analysis
- Used to analyze the life cycle carbon emissions of Solar Earth's Solar Pavers, including the stages of material extraction and processing, manufacturing, distribution, usage, and recycling.

Product Testing
- Describes the testing procedures used to evaluate the performance of Solar Earth's Solar Pavers, including load testing, melting salts testing, freeze-thaw testing, and abrasion testing.

Product Comparison
- Compares the performance of Solar Earth's Solar Pavers to regular solar panels, highlighting the differences in appearance, installation, cost, durability, and energy output.

Install Plan
- Describes the installation process for Solar Earth's Solar Pavers, including the equipment and methods used to install them, which is generally simpler than installing regular solar panels.

TESTING RESULTS

Point Load Test
- Solar Earth Technologies provided information based off of their extensive load testing. They assure that their solar paver product can withstand static loads up to 5000 kg and point loads up to 1.3 MPa. Our teams load tests determined that the solar cell would be the main concern when it comes to loading, as opposed to the traction top plane. Advertised value (190 psi) takes into account solar cell which will be a lot less durable, we tested the stronger quartz traction plane instead with the result of 26991 psi.

Melting Salts Test
- Based off our teams test, we determined that melting salts causing snow to melt on top of the solar paver increases the output voltage. We believe this is due to the water allowing for less refraction within the quartz traction layer. We recorded values 5.9V and 5.67V on average with and without melting salts respectively.

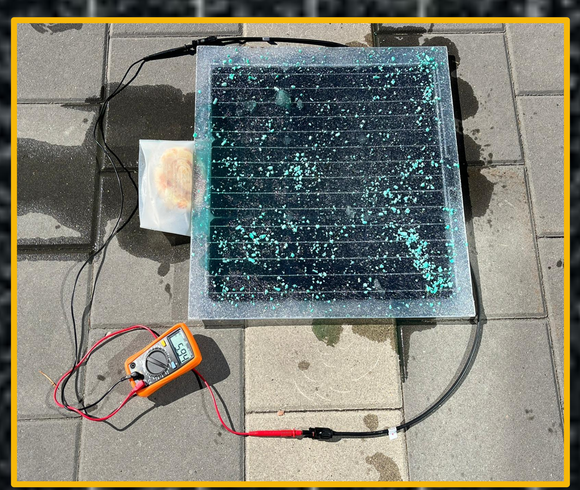

Figure 1. Melting Salts Test Setup

Figure 2. Point Load Test Setup

Lifetime Energy	kWh	897
Lifetime CO2 Emissions	kg	114
CO2 Emissions from Solar Earth's Solar Paver	kg CO2/kWh	0.127
CO2 Emissions from electricity used at the University of Calgary	kg CO2/kWh	0.59
Reduction of Emissions	%	78%

***Figure 3.** Final Conceptual Design at Mac Hall*

Figure 4. Solar Earth Capstone Team

CONCLUSIONS

After research, surveys, and testing, our team decided that the best location for the solar pavers was the south entrance of MacEwan Hall. This decision was based on solar exposure, stakeholder preference, and traffic volume.

We developed our final conceptual design for this location. The application chosen for this location included automatic doors, lighting, and de-icing technology.