2026 Science Fair Project Design Logbook

Project Title: InfraSolar

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School: Queen Elizabeth High School

Supervisor (if applicable): Bobby Lahoda

Start Date: Dec 9th first evident based formal documenting started brainstorming for months before this

November

This is the start of my project!

At first, I was very interested in electrical infrastructure. So I began by researching transmission lines because I always see them stretching across highways and rural land. I started wondering how electricity could travel such long distances without major losses. That curiosity led me into researching the power grid as a whole.

As I learned more, I realized that transformers are one of the most important components in the entire electrical system. They regulate voltage so electricity can travel efficiently across long distances and then safely power homes, hospitals, schools, and businesses.

While researching transformers, I discovered that they are exposed to extreme weather conditions year-round. In Canada especially, winter temperatures can drop drastically. I began asking myself:

How do transformers survive harsh winters?

What happens to transformer oil in extreme cold?

Can environmental exposure shorten their lifespan?

This is where the inspiration for my project truly began.

My project question became:

How can a solar-powered, insulated cover maintain safe operating temperatures for transformers?

Initial Research Phase

This period was focused entirely on research and understanding the problem.

First, I needed to understand exactly how transformers work. Here are some of my findings:

Transformers regulate voltage levels in the power grid.

They step voltage up for transmission and step voltage down before it reaches buildings.

Transformer oil is used for insulation and cooling.

Oil viscosity increases in cold temperatures, which can affect efficiency.

Environmental exposure (snow, hail, wind, debris) contributes to long-term wear.

I also researched the economic impact of power grid failures. I found that power outages cost billions annually in Canada and the United States. Since transformers are critical components, improving their protection could increase grid resilience.

This research phase taught me how to read articles, infrastructure reports, and engineering material. I learned how to extract relevant data instead of just reading surface-level information.

Exploring Possible Solutions

At first, I was unsure what energy source I should use. I considered:

Oil-based heating

Too common hard to differentiate

Electric grid-powered heating

Too common hard to differentiate

Passive insulation only

Only briefly explored this but found it too implausible

Solar-powered heating

My decision was made to choose this based on the Rebecca Young invention for the solar powered sleeping bag. Which one several awards

I researched solar energy systems and learned about:

Peak Sun Hours in Alberta

Solar panel tilt optimization

Battery storage systems

Charge controllers

Energy conversion efficiency

I looked into what makes systems work and into countless types of solar powered projects and took inspiration from a lot.

Objectives Created

After all my research, I created three main objectives:

1. Durability

   The structure must withstand wind, hail, snow, and debris. This was my main objective as I was set on making a system that wouldn't fail due to Canada's climate

2. Energy Independence

   The heating system must function without relying on the main power grid. This was also really important for me as I thought for mine to be different and to be even worth looking at I needed to hit an unapproached angle.

3. Environmental Impact Reduction

   The system must reduce reliance on oil-based heating and lower carbon emissions. This was a benefit of my renewable energy source AKA solar panels but not a main priority I focused on during my research

I also had secondary goals of cost-effectiveness and scalability, but my main focus remained durability and energy independence.

November – December 2025

This month was focused on design and asking for tips from friends and understanding

science fair

I realized that a square base would be best because it matches the shape of the transformer. Then I realized that solar panels need to be at an angle for maximum efficiency. So I came up with the box but with a 30 degree angle roofing.

Eventually, I finalized this structure design

Square polycarbonate base for structural shielding

Triangular roof

Solar panels mounted at 30° angle

I chose polycarbonate instead of acrylic or glass because:

It has higher impact resistance

It performs better in cold temperatures

It is literally made for outdoor use

During this phase, I also researched charge controllers that could be plausible and efficient for a system like mine. I learned that an MPPT (Maximum Power Point Tracking) charge controller would optimize energy transfer from the solar panels to the battery while preventing overcharging.

December 2025 – January 2026

This month focused on engineering calculations and feasibility.

I calculated:

Daily energy needs for a 100W heater

Required solar panel wattage

Battery capacity requirements

I discovered that:

A 100W heater running continuously requires ~2.4 kWh per day.

Alberta averages approximately 4.2 -- 4.4 winter Peak Sun Hours.

A 1400W solar panel could theoretically generate enough daily energy under average

conditions.

January – February 2026

This month was about refinement of ideas and help from friends

I refined ideas, improved margins and discovered new critical information.

Overall conclusion this system is likely to be able to replace existing solutions and lower overall consumer price. Whilst maintaining efficiency and being environmentally friendly.

The overall majority of deep theoretical knowledge and claims are backed up by my information within my CYSF shelf.

Future plans

At CYSF I will be bringing a partial prototype with data and tests that will prove certain claims.

Thank you

Any questions email me at : milop6@educbe.ca