RAINHOUSE
NEWSLETTER

WHAT'S INSIDE

B.C. Supply Chain Resiliency Grant program.

Partners involved in the project: CanEV & UVic Clean Transportation Research Team.

The project: achievements, setbacks and outcome

FEATURING

SUPPLY CHAIN RESILIENSY GRANT

MAY 2022

Rainhouse and Canadian Electric Vehicles (CanEV) partnered to work on addressing a supply chain issue - the lack of local battery manufacturing capacity in BC. They created a battery manufacturing project that allowed both companies to combine their expertise. CanEv's knowledge in electric vehicles and battery formation with Rainhouse's manufacturing and assembly experience are the perfect combination to achieve great results. This project would not have been possible without the support from the Government of British Columbia. Thanks to this partnership, we were awarded the Supply Chain Resiliency grant valued at $200,000 to help with the costs of a project this magnitude.

CanEv is a global business with over 20 years of experience supplying kits, components, and services for EV conversion projects and building a commercial line of specialty utility vehicles and equipment. They have a wide range of electric vehicle offerings, from heavy-duty tug trucks used at airports and other institutions to heavy-duty off-road trucks used at resorts, parks, and airports. They have also developed conversion packages for industrial vehicles such as ice resurfacing machines, construction equipment, and custom commercial vehicle projects.

CanEV joined Rainhouse in this adventure to tackle a common goal, developing a battery pack

CanEv's president, Todd Maliteare, acquired the company back in 2016 to fulfill his long-life dream of moving to Western Canada. Originally from Manitoba, Todd is no stranger to moving around and experiencing living in different parts of Canada. After high school, he moved to Saskatchewan to pursue his engineering degree. Upon completion and on the hunt for new job opportunities, he decided to move to Edmonton, where he spent most of his adult life and built his expertise as an electrical engineer. When the possibility of buying CanEv came up, it was a no-brainer since it was finally the opportunity to fulfill his long-time dream of living and settling on the West Coast. He is thrilled to work doing what he loves and lives in a wonderful and scenic area known as "the harbor city" or Nanaimo.

Todd Maliteare-CanEv's president.

THE PROJECT

The goal of this project was to create a battery pack for CanEV's new electric medium-duty truck (e-MDT). Rainhouse has the project management, procurement and assembly experience but needed assistance with testing and modelling. Therefore, UVic's Clean Transportation Research Team of the University of Victoria led by professor Zuomin Dong was contracted.

To get started, we identified several battery suppliers to make an informed selection. For the electric medium-duty truck, we reviewed EcoPower/ETC, a company that provides small quantities and lower cost LFP modules for EV applications, and REPT, a well-established EV supplier with certified and mature EV battery modules provides small quantities at a reasonable cost.

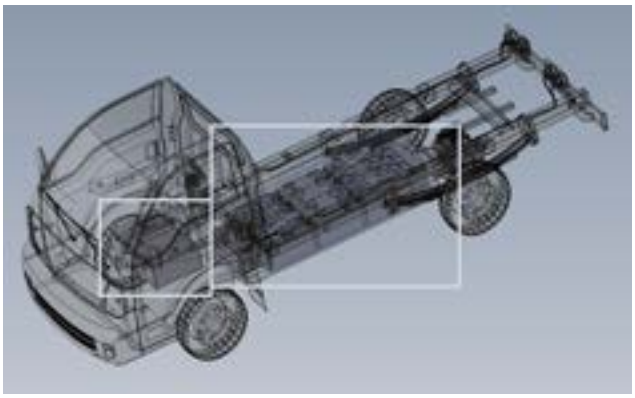
The UVic PRIMED battery facility tested cells from both companies to confirm the 'technical specification' and obtained data from the DP battery performance and thermal behavior models. Although there were no significant differences, CanEv decided EcoPower EP-LPF a77Ah 1P12S power modules were the most suitable. The electric propulsion and battery Energy Storage System (ESS) of the e-MDT were modeled at UVic, and we used the results to support the battery ESS pack design.

We continued our research, but this time to create an extensive list of relevant standards based on similar battery projects and products. These standards showed us ESS pack requirements are based on their application and performance.

After analyzing EV battery selection and the preliminary design, it was time to order the battery modules to later assemble and test the battery pack. Thus, we ordered ten 277Ah 1P12S modules of EP-LPF from EcoPower. These modules were set to arrive in April 2022 and would then allow us to move forward in assembling a prototype pack.

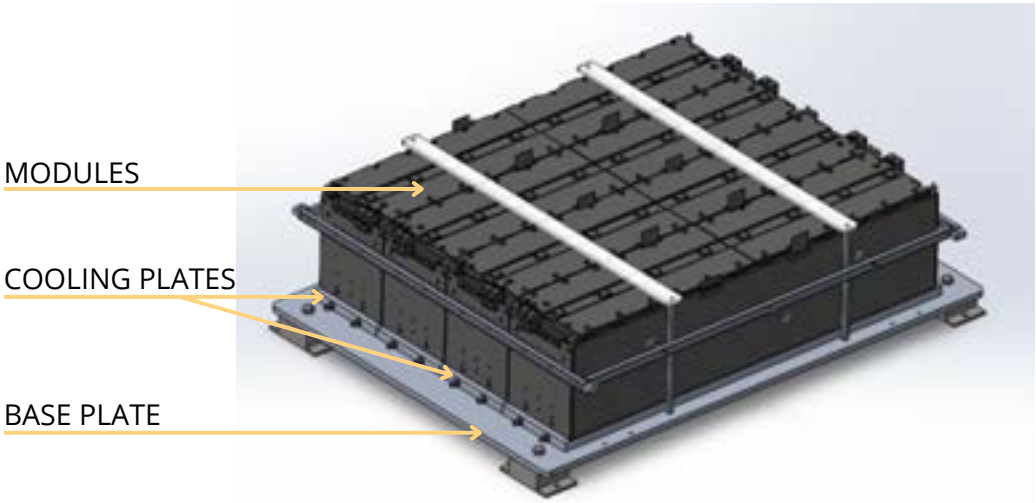
277Ah 1P12S modules of EP-LPF from EcoPower

We carried out a study on various medium-duty trucks (MDTs) to identify the typical design and dimensions of the ladder frame of the truck's chassis. The powertrain system model of CanEV e-MDT was built to access its performance and range using different numbers of LFP battery modules and pack designs. The battery pack consists of 8 EcoPower EP-LFP 277Ah 1P12S battery modules that provide a total of 309V nominal voltage with 81.7kWh and can be mounted and safely protected between the truck's ladder frames. Two additional modules can be mounted under the cab.



Battery pack location rendering.

The pack design places 4 x 2 modules on the cooling plates mounted on top of the pack's base plate. All elements are attached to the solid base plate with a battery pack enclosure mounted on top to provide additional structural stability. We developed four different cooling plate designs and analyzed them using FEA and CFD to ensure structural integrity and heat removal capability.



e-MDT Battery Pack Rendering

Additionally, we investigated three different manufacturing methods, including friction-stir welding, conventional welding, and copper pipe embedding. A two-piece design with an O-ring seal was selected, and we produced a single cooling plate prototype to be used with two EcoPower battery modules. The expectation from this step of the process was to use this design and manufacturing method in the prototype e-MDT pack, and after obtaining sufficient results during testing, use it to create the production version of the battery pack.

Similarly, we examined the battery-pack enclosure using FEA static analysis or transient collision simulations for safety validation. The simulation results showed that the enclosure would be able to handle 20G acceleration horizontally and 8G acceleration vertically.

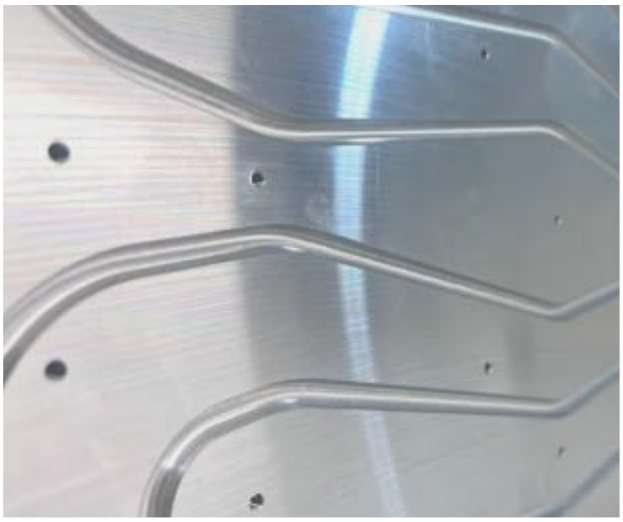
CERTIFICATION

EV battery packs are no exceptions to certification requirements. Throughout this project, we reviewed Transport Canada requirements for lithium battery packs used on vehicles over 10,000 GVW. We found that TSD 305- Electrolyte Spillage and Electrical Shock Protection defines the requirements. For our project, TSD305 is not applicable, it is only required for vehicles with GVWR below 4536 kg, and the CanEV e-MDT is heavier than the threshold weight.

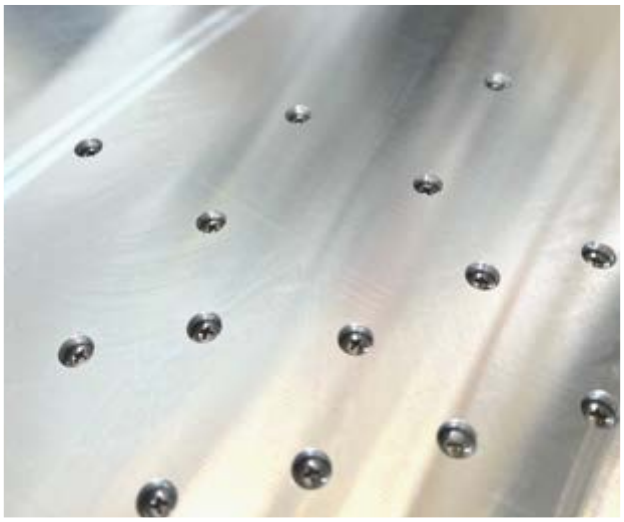
UN38.3 is the certification requirement for batteries to be shipped. Although UN38.3 does not apply to new vehicle production, it is required to transport replacement battery packs. This requirement creates a significant obstacle to shipping any replacement battery packs during the vehicle's lifecycle.

SETBACKS

Shipping delays pushed the arrival of the EcoPower modules and hindered the project team's ability to assemble a prototype battery before the end of the project. In efforts to make the most out of the project, the team agreed to designing the battery pack's cooling plate, which prevents overheating, with the time that was allocated to assembling and testing the prototype pack.



Cooling Plate - Interior



Cooling Plate Exterior and Fasteners.

OUTCOME

Even though a fully assembled battery pack was not the result of the project; CanEV, UVic CTRT, and Rainhouse all gained valuable insight and experience into the battery market. We all learned about new and used batteries, certification requirements, and the technical and market challenges associated with battery manufacturing for different applications. Through modeling, testing and prototyping, all parties made meaningful progress towards bringing locally manufactured battery packs to market.

This project proved why it is important to develop this ability locally. The supply chain issues we faced with producing one prototype battery pack clearly show why we need to grow this market in Canada, and more specifically in BC. All possible suppliers we found in our research are located in Asia, and currently, there is no battery manufacturing facility that deals with developing the chemistry and battery assembly anywhere in North America.

We are honored to see the provincial government's commitment to innovation and technology development on the West Coast and appreciate having the opportunity to explore and grow our knowledge and experience in battery manufacturing thanks to their funding initiatives.

BRITISH COLUMBIA