VOITURE SOLAIRE
ESTEBAN 10

ESTEBAN PROJECT

SOLAR CAR

2022- 2023

DRIVING ON SUNSHINE

Since its inception, the Esteban project has combined creativity and perseverance to achieve an ambitious goal: to develop a car powered entirely by solar energy that is as efficient as possible. Each year, the team must compete in ingenuity to find innovative solutions to build increasingly efficient prototypes and thus contribute in its own way to the development of sustainable energy. Today, the Esteban project is proud to present Polytechnique Montréal's latest solar car prototype: Esteban 10.

It goes without saying that we could not achieve these objectives without the valuable contribution of our partners, who share our passion and our vision. Our partners not only support a technological innovation initiative, but also contribute with us to promote science and technology both on the Quebec scene and internationally. We believe it is our duty to encourage science education and sustainable engineering in our community

« Esteban is a unique environment where students can gain experience, deepen the areas that interest them, while learning from more experienced students. »

This year, the team is thinking big. Our newest prototype, Esteban 10, has proven itself in the multi-occupant category by winning 1st place at the Formula Sun Grand Prix (FSGP) and third place in the American Solar Challenge (ASC) 2022. This prototype will return to the FSGP in the summer of 2023 to once again carve out a size on the catwalk. At the same time, throughout 2022-2023, the team will begin manufacturing its new prototype: Esteban 11, the second multi-occupant vehicle manufactured by the team.

The team will have to be innovative, because several changes concerning the technical regulations of competitions push us to review the design of our prototypes.

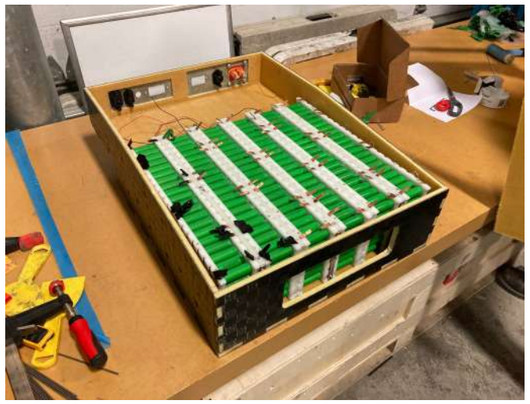
Supporting the Esteban project is nothing less than an investment in the know-how of 40 students eager for performance and innovation and convinced that it is possible to build a greener future. It is for this reason that we invite you to join our team of partners, to live this adventure with us and to help future engineers meet the major challenges of today and tomorrow.

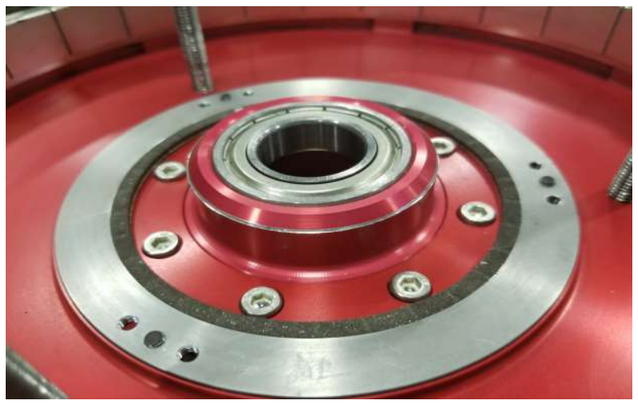
AT THE HEART OF THE PROJECT: INNOVATION

Due to the change of category between Esteban 9 and Esteban 10, the team had to rethink its design in order to adapt to the different constraints related to a multi-passenger vehicle. Indeed, during the competition, points are awarded for the practical side of the vehicle. So the team had to make sure to include features you would find in an everyday vehicle. From cup holders to phone chargers, committee members had to use their creativity. Weight constraints were also considered. The addition of a second passenger significantly increasing the total weight of the vehicle, the team had the task of redesigning its mechanical and electrical systems.

Comparative technical sheet of Esteban 9 and 10

Vehicle	Esteban 9	Esteban 10
Dimensions	3.3 m x 1.84 m x 1 m	4.9 m x 1.85 m x 1.25 m
Weight	198 kg	300 kg
Peak speed	115 km/h	115 km/h
Cruising speed	70 km/h	65 km/h
Battery pack	5 kWH (Li-Ion)	9.2 kWH (Li-Ion)
Power	0.86 kW (1.1 HP of Solar Energy) 5kW (6.7 HP Motors)	1.3 kW (1.74 HP of Solar Energy) 10 kW (13.4 HP Motors)
Engine Layout	Front Wheel Drive	Front Wheel Drive
Autonomy	350 km	400 km





Esteban 10: A prototype integrating advanced technologies

ELECTRICAL
Three-phase synchronous **in-wheel electric motor** with regenerative braking
Solar panels with monocrystalline silicon cells
Automotive standard Modular **CAN network**
Battery management and protection system (BPS) ensuring the safety of the car
Control system optimizing efficiency and performance
Intelligent dashboard and **telemetry** for real-time data analysis

MECHANICAL
Monocoque **carbon fiber** frame optimized by **finite element** methods
Composite structure manufactured by vacuum infusion and prepreg
Digital model developed by CAD
Four-wheel **hydraulic braking** system
Custom suspension with ajustable
Supports for electrical components manufactured in **3D printing**

The integration of new features into the car prompted the team to optimize the performance of the car's electrical systems, in order to meet competition criteria and improve the practicality of the car.

THE TEAM

Our technical society makes a point of bringing together students from a variety of engineering programs. To this end, we have members in the field of mechanical engineering, electrical engineering, software engineering, industrial engineering, physical engineering, biomedical engineering and civil engineering who all participate actively in the project by helping to promote, project management, design, manufacturing, and fundraising.

Supporting the project also means investing in the training of these future engineers in search of innovation and aware of environmental issues. This is a unique opportunity to forge ties with student entrepreneurs who are developing very relevant work experience by participating in this concrete and large-scale project.

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PROMOTING THE PLACE OF WOMEN IN ENGINEERING

The Esteban technical society is proud to see its proportion of female students increase year after year. The women in this project are key to its success. We make it our duty to showcase their dedication. Moreover, during the 2021-2022 cycle, the project's board of directors was composed mostly of female students and, at its head, a female director general.

During the following year, the team will pursue its mission of promoting the place of women in engineering, both at Polytechnique and on our various platforms. We encourage young girls to pursue the engineering profession through school presentations in elementary, high school and CEGEP.

COMPETITIONS : A MAJOR CHALLENGE

One of the most demanding objectives of the Esteban Project is to measure itself against the prototypes of the most prestigious universities. To do this, we have to build a car that complies with American traffic laws since the competitions take place on conventional roads!

A journey of nearly 3000 km aboard a solar car is the challenge offered by the American Solar Challenge, a competition that takes place every two years in the United States. From Omaha in Nebraska to Bend in Oregon, via the Rockies, Esteban was able to clinch the third position during his last participation in 2022. In addition, the team achieved an excellent performance during the Formula Sun Grand Prix competition in 2022, where it won first place. The team also distinguished itself by winning the "Aesthetics award", the "MOV efficiency award" and stage 4 of the competition. In addition, Esteban 10 was the first multi-occupent vehicle to have recharged only with solar energy at the FSGP.

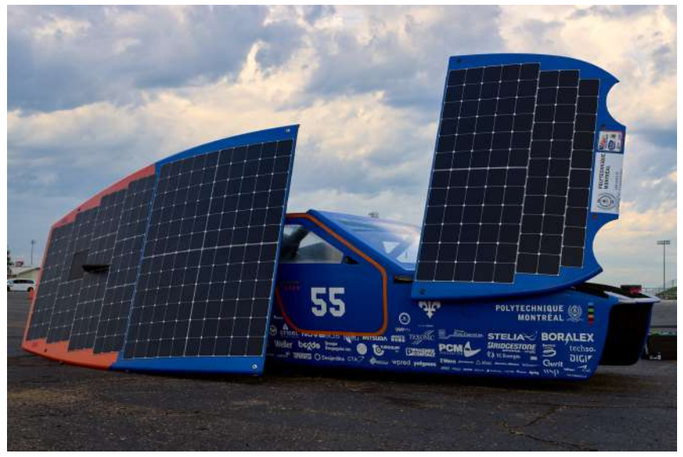
THE CONTINUATION OF THE ADVENTURE

Formula Sun Grand Prix (FSGP) 2023 with Esteban 10

In 2023, the "Formula Sun Grand Prix" will take place in Topeka, Kansas, the city in which the competition was first held in 2000! After a first place at the FSGP 2022, the team is confident of obtaining the same results in 2023 with Esteban 10. The vehicle will have to be adjusted in order to comply with the new rules of the competition and ensure a place on the podium.

Manufacture of the new prototype: Esteban 11

Proud of the results obtained with its tenth prototype, the team is starting to manufacture its eleventh iteration: Esteban 11. Throughout 2022-2023, the team will have to demonstrate ingenuity and perseverance in order to see the birth of its most ambitious designs: monocoque chassis, battery divided into two units and programming of an entirely new code. Seeing always bigger, the team is committed to taking up a major challenge: adjusting the design of its new prototype so that it also respects the rules of the **World Solar Challenge (WSC) 2025**: a competition of solar cars bringing together best universities around the world.



Fall 2023 Rally with Esteban 11

Following the great success of the Montreal-Quebec events in 2017 and Montreal-Gaspé in 2021, the team wanted to repeat the experience by organizing a rally on the roads of Quebec in the fall of 2023. This aims to reproduce conditions similar to those the team faces during the American Solar Challenge. The last high-profile rally, which took place in the summer of 2021, allowed our partners to shine and gave our new recruits a taste of what the competitions in which we participate look like.

In addition, the rally will be an opportunity to test our new vehicle in order to target certain improvements to be made before the competitions in the summer of 2024. The car will be pushed to its maximum capacity during the rally, so this will also allow us to evaluate the points to be improved during the next design. This project will promote sustainability to everyone who sees the car drive by or hears about the rally in the media.

American Solar Challenge (ASC) 2024 with Esteban 11

It is with a completely redesigned prototype that Esteban plans to arrive at the starting line of the American Solar Challenge 2024. The team will have the challenge of traveling the Oregon National Historic Trail. Innovation being the watchword for this eleventh edition, several new features will be included on the new prototype. With its best results so far, the team is confident of achieving a vehicle that is both efficient and practical, which will achieve results on par with those achieved in recent years.

BECOMING A PARTNER

Esteban is proud to wear the colors of his partners during his numerous and varied appearances. By supporting the project, our sponsors are entitled to the following privileges:

Contribution value	- 1000 $	1 000 $ and +	2 500 $ and +	5 000 $ and +	10 000 $ and +
Display in our media (website, Facebook, posters, etc.)					
Exclusive information on the progress of the project					
Access to our candidate database					
Invitation to events					
Display on the team t-shirt and on the car					
Promoting your job offers to the team					
Personalized publication on our networks					
Presentation of your company to the team					
Presentation of the vehicle in your company					
Personalized demonstration					
Negotiable exclusive visibility					
Display size on vehicle and t-shirt					
Small size					
Medium size					
Big size					
Very big size					

VISIBILITY

Esteban participates in several events during the year. Whether at public events, corporate exhibitions, visits to schools or international competitions, our team proudly displays its partners. Thus, the logos of our partners are present on the car, the team uniform, the website, as well as in the promotional documents.

Energy will be a key issue of the 21st century and Esteban is an exceptional tool to stimulate public interest in the technologies of the future, as well as in the unique possibilities offered by the professions of engineering and science.

The sponsors of the Esteban project enjoy high visibility among students at Polytechnique Montréal and other project partners.

In recent years, the project has also been the subject of reports in the following media:

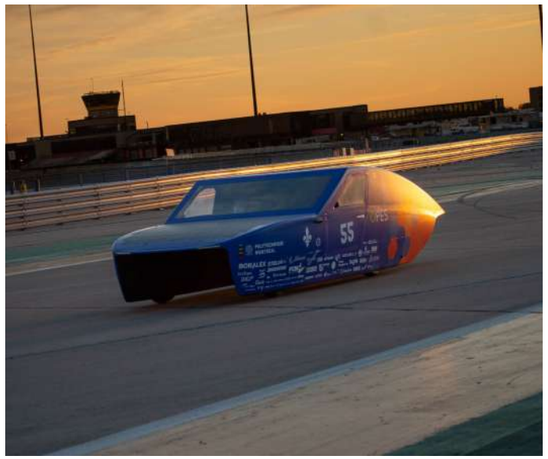
- **Radio-Canada (telejournal, radio, Internet)**
- **TVA Nouvelles**
- **CTV (television, internet)**
- **Journal de Montréal, Journal de Québec, Canoë**
- **98,5 FM**
- **Journal Métro**
- **Les affaires**
- **PLAN (Journal of the Order of Engineers of Quebec)**
- **CBC**
- **La Presse**

BUDGET

Each year, Esteban relies on both its long-standing sponsors and its constant search for new partners. Here are the estimated costs for the 2022-2023 cycle of the project.

Expenses forecast	
Expenses linked to completing the Esteban 11 protoype	
Mechanical systems	66 660 $
Aerodynamic shell	11 800 $
Structural chassis	13 150 $
Ergonomics	7 100 $
Hardware	3 550 $
Motors and controllers	500 $
Battery	4 000 $
Low-power systems	3 000 $
Solar panels	77 000$
Electrical connections	2 500 $
Subtotal	189 260 $
Administration	
Truck	2 000 $
Registration of the vehicule	750 $
Organization of the workshop	400 $
Safety and security	350 $
Carboneutrality	2000 $
Emergency fund	3 000 $
Subtotal	8 500 $

Expenses forecast (continued)	
Competitions and events	
FSGP 2023	19 500 $
Vehicule shows	500 $
Small events	500 $
Road tests	6000 $
Subtotal	26 500 $
Total	224 260 $



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