



# ESTEBAN PROJECT

## SOLAR CAR TEAM

2020 - 2021

# DRIVING ON SUNSHINE

The Esteban Project combines both creativity and perseverance toward an ambitious objective since its inception: developing the most competitive electric car powered entirely by the sun. Every year, our team must ingeniously surpass itself to build an ever more performing prototype, thus adding its contribution to the development of sustainable energy sources. Today, the Esteban Project is proud to introduce Polytechnique Montreal's latest solar car prototype: Esteban 10.

Needless to say, we could never reach our goals without the precious contribution of our sponsors, sharing our passion and our vision. Not only do our partners support an innovative technological initiative, but they also contribute to promoting science and technology both in Quebec and around the world. We believe it is our responsibility to use our project to popularize science and sustainable engineering within our community.

« The knowledge transfer and the experience acquired during the manufacturing of the last prototypes make us confident as for the realization of this large-scale project. »

This year, the team is thinking big. Our new prototype, Esteban 10, will compete in another category of solar vehicles, commonly called cruisers. These multi-passenger vehicles combine speed and convenience. Now the team will be awarded points if the car has amenities such as those found in everyday vehicles. The team had to be innovative, as several changes to the design of the prototype were expected.

Supporting the Esteban Project is nothing less than an investment in the training of 40 students eager to innovate, and who are convinced it is possible to build a greener future. This is the reason we invite you to join our team and live this great adventure by encouraging future engineers to tackle the energy challenges of tomorrow.

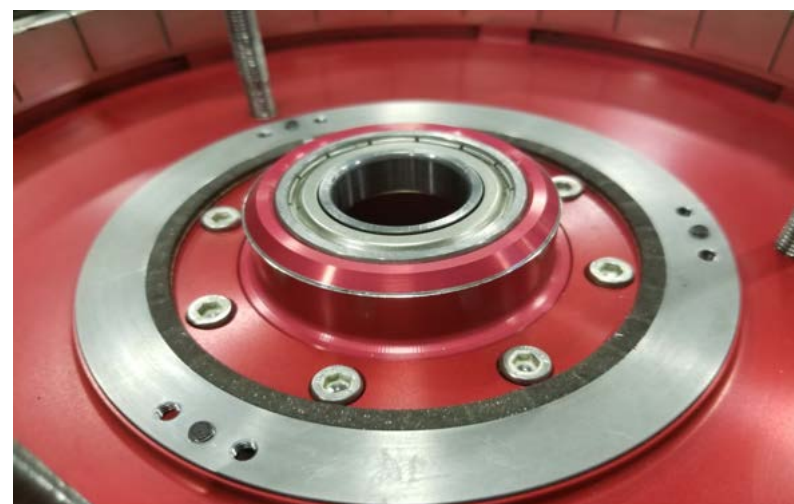


# INSIDE THE PROJECT : INNOVATION

## Comparative Technical Data 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

Due to the change of category, the team had to rethink its design in order to adapt to the different challenges associated with a multi-passenger vehicle. As a matter of fact, during the competition, points will be awarded to the practical side of the vehicle. The team therefore had to make sure to include features that would be found in an everyday vehicle. From the cup holder to the phone charger, the committee members had to call upon 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 rethinking its mechanical and electrical systems.



## 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 adjustable

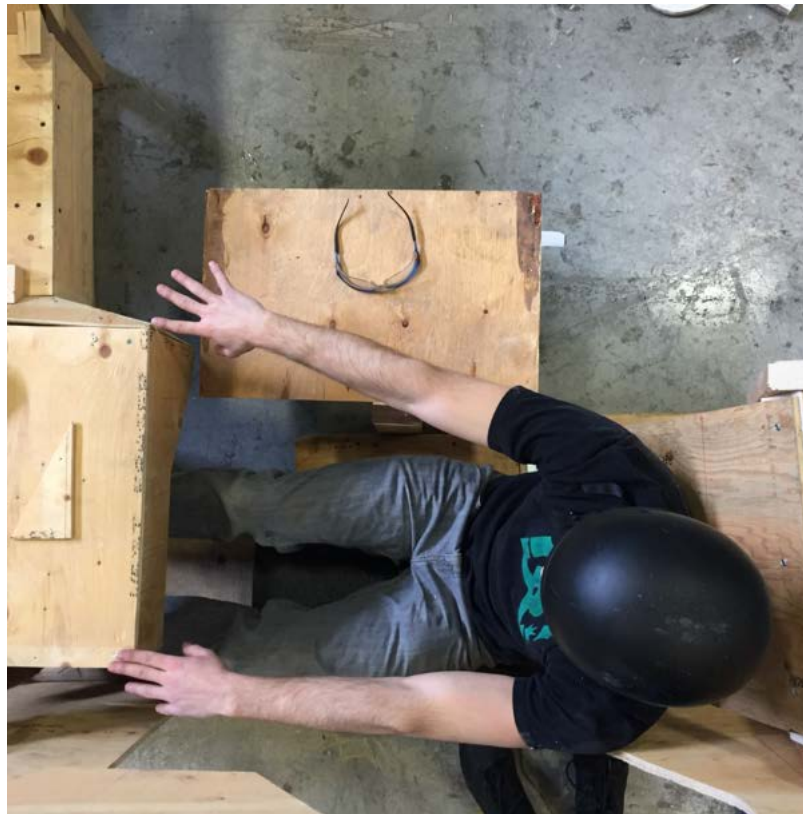
Supports for electrical components manufactured in **3D printing**

The electrical network constitutes the brain of the car and Esteban 10's team aim to build the entirety of the embedded systems of the prototype. This new vehicle will therefore be more efficient as well as more reliable and will allow a better analysis in real time of the performances during our competitions.

The implementation of new features in the car will encourage the team to optimize the performance of the electrical systems in order to satisfy the competition criteria and improve the practical aspect of the car.

# RESEARCH AND DEVELOPMENT

## Test vehicle



For the year 2020-2021, the Esteban team is embarking on a brand new project, namely the design and manufacture of our very first test vehicle. This vehicle will notably enable design teams to manufacture parts and test them in a realistic context in order to be able to integrate them into future prototypes.

This project will also allow Esteban's team to develop new ideas and more innovative designs from a research and development point of view. This new concept will be useful over the next few years and will allow new members to integrate into the team at their own pace, having the freedom to experiment and come up with new ideas.

# THE TEAM

Our team makes a point of bringing together students from a variety of backgrounds. To that end, we have members in the fields of mechanical engineering, electrical engineering, software engineering, industrial engineering, physical engineering, chemical engineering, civil engineering and aerospace engineering who all actively participate in the project by assisting in promotion, project management, design, manufacture, as well as fundraising.

Supporting the project also means investing in the training of these future engineers who are aware of environmental issues. This is a unique opportunity to connect with student entrepreneurs who are developing highly relevant work experience by participating in this concrete and prestigious project.



## COMPETITIONS : A MAJOR CHALLENGE

One of the most challenging objectives of the Esteban Project is to compete against the prototypes of the most prestigious universities. To do this, the team must build a solar car that complies with the American Highway Code, since competitions are held on conventional roads!



A journey of nearly 3,000 km in a solar car is the challenge provided 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, passing through the Rockies, Esteban was able to clinch the fourth position in the last event in 2018. In addition, the team had an excellent performance in the Formula Sun Grand Prix in 2019, where they won first place. The team also stood out by winning the "Dynamics Award" and the "Best Electrical System Design Award".

# THE PURSUIT OF THE ADVENTURE

## Formula Sun Grand Prix (FSGP) 2021

In 2021, the “Formula Sun Grand Prix” will take place in Topeka, Kansas, the city in which the competition first took place in the year 2000! After a first place at the FSGP 2019, the team is confident in its ability to obtain the same results in 2021. Esteban 10 will thus be optimized, in order to pass the qualifying rounds quickly and to secure a place on the podium.



## American Solar Challenge (ASC) 2021



It's with a completely redesigned prototype that Esteban plans to arrive at the start line of the American Solar Challenge 2021. The team will have the challenge of covering the Santa Fe Trail. Innovation being the guiding principle for this tenth edition, several new features have been included on the new prototype. With its best results so far, the team is confident in the realization of a vehicle that is both efficient and practical, which will achieve results to match those from recent years.

## Gatineau-Gaspé Rally 2021

Following the great success of the Montreal-Quebec event in 2017, the team wanted to repeat the feat by organizing a rally between the cities of Gatineau and Gaspé in order to recreate conditions similar to those faced in the American Solar Challenge. This highly publicized event, held in May or June 2021, will aim to promote our partners and give our new recruits a taste of what the competitions in which we take part look like.

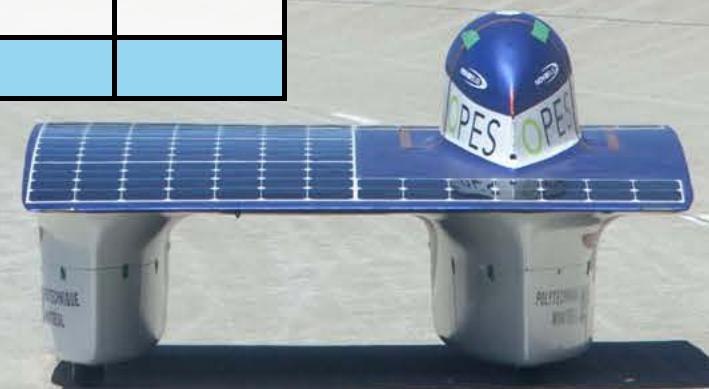
In addition, the rally will be an opportunity to test our vehicle in order to identify certain improvements to be made before the competitions. The car will be pushed to its maximum capacity during the rally, so this will also allow us to assess the points to be improved during the next design. This project will also promote sustainability to everyone that sees the car pass or hears about it in the media.



# BECOMING A PARTNER

Esteban is proud to wear the colours of its partners during its numerous and diversified appearances. By supporting the project, our sponsors are granted the following benefits:

Sponsorship value	1 000 \$ and -	1 000 \$ and +	2 500 \$ and +	5 000 \$ and +	10 000 \$ and +
Display on our official web page and social network					
Access to our recruiting database					
Invitation to special events					
Display on our racing trailer and on team t-shirt					
Custom information/recruiting session at Polytechnique					
Personalized thank-you gift					
Private vehicle demonstration in your company's headquarters					
Custom demonstration and road tests					
Exclusive naming and negotiable visibility					
<b>Display size on vehicle</b>					
Small size					
Medium size					
Large size					





Esteban participates in several events throughout the year. Whether it is at public events, corporate exhibitions, school visits or international competitions, our team proudly displays its partners. Thus, our partners' logos 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 raise public interest on the technologies of the future, as well as on the unique opportunities offered by the engineering and science professions.

The sponsors of the Esteban project benefit from great visibility among the students of Polytechnique Montréal and the other partners of the project.

During the last years, the project has also been the subject of reports in the major following media:

- Radio-Canada (newscast, radio, Internet)
- TVA Nouvelles
- CTV (television, internet)
- Journal de Montréal, Journal de Québec, Canoë
- 98,5 FM
- Journal Métro
- Les affaires
- PLAN magazine (Ordre des Ingénieurs du Québec)
- CBC
- La Presse
- The Gazette

\* note : Press review is available on demand.

Every year, Esteban trusts in its long-term sponsors and its constant search for new partners. Here are the estimated costs for the 2020-2021 cycle of the project.

## Expenses forecast

### Expenses linked to completing the Esteban 10 prototype and to the conception of the test vehicle

Mechanical systems	12 360 \$
Aerodynamic shell	2 500 \$
Structural chassis	5 500 \$
Ergonomics	1 480 \$
Hardware	3 690 \$
Motors and controllers	1 000 \$
Battery	4 500 \$
Low-power systems	2 450 \$
Solar panels	1 600 \$
Electrical connections	250 \$
Other mechanical spendings	6 000 \$
Other electrical spendings	2 700 \$

**Subtotal 44 030 \$**

### Administration

Truck	2 000 \$
Registration of the vehicle	1 350 \$
Avertising and marketing	800 \$
Emergency Fund	2 500 \$

**Subtotal 6 650 \$**

## Expenses forecast (cont.)

### Competitions and events

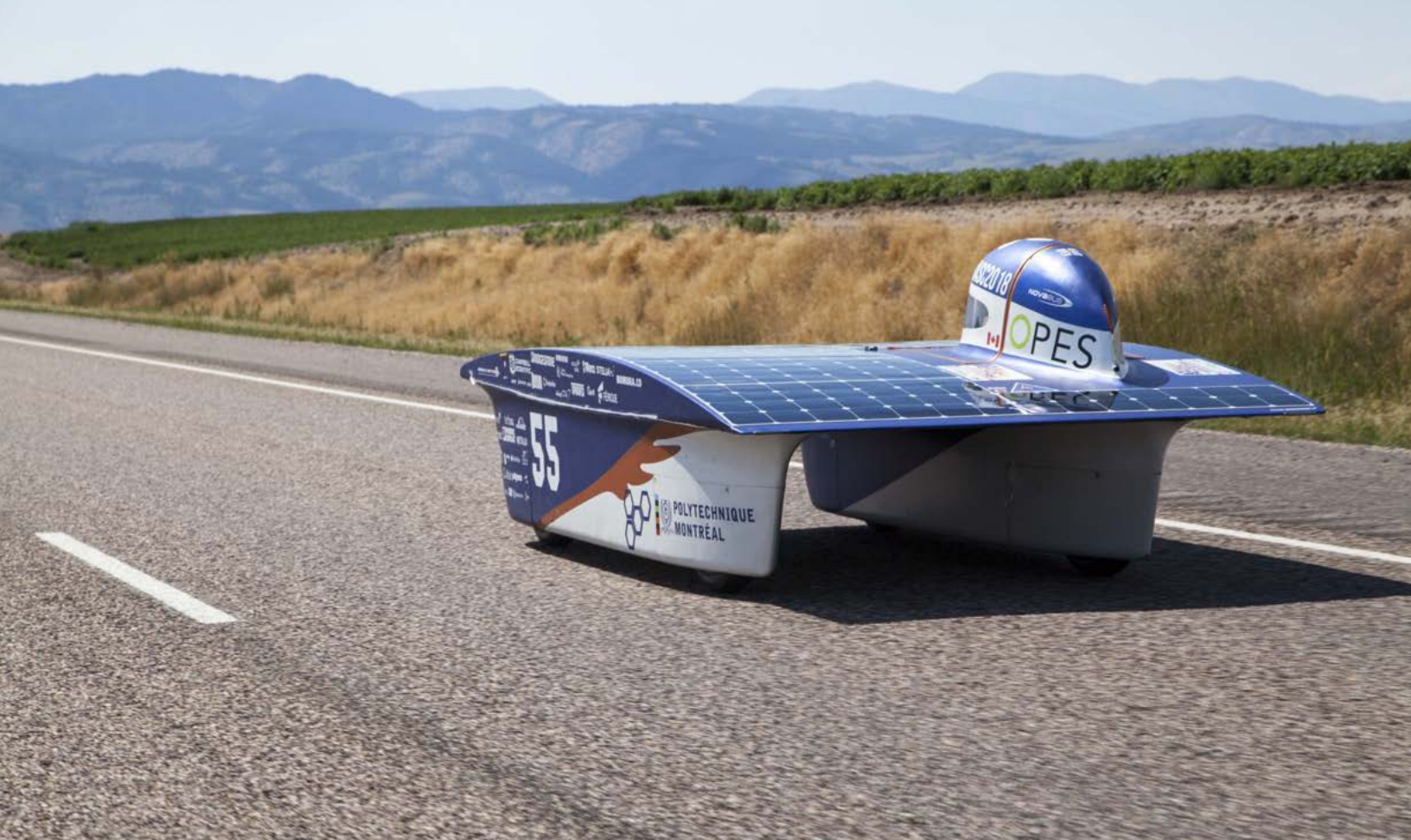
ASC and FSGP 2021	19 855 \$
Unveiling of Esteban 10	1 750 \$
Gatineau-Gaspé event	4 850 \$
Small events	500 \$
Road tests	700 \$

**Subtotal 27 655 \$**

**Total 78 335 \$**







# CONTACT

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