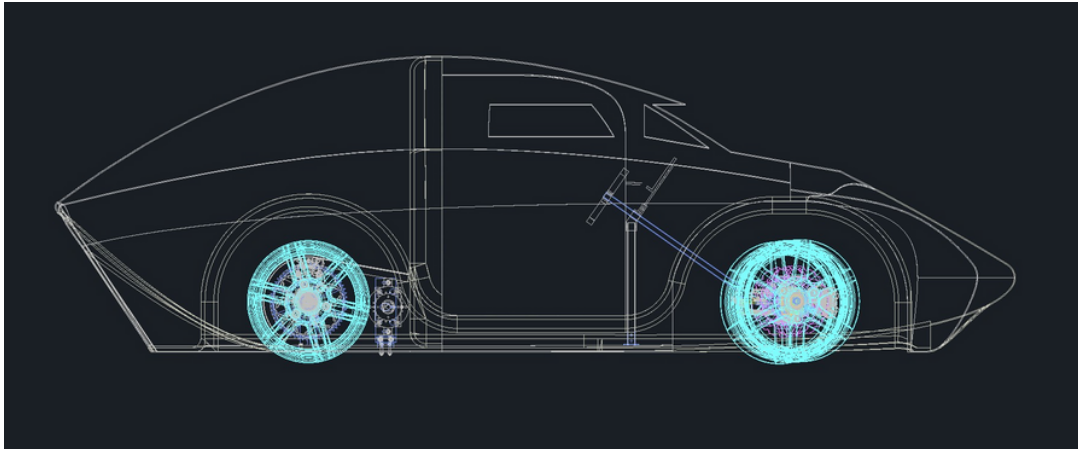


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# CORNELL ELECTRIC VEHICLES

SPONSORSHIP PACKET  
2023-2024



**Ithaca, NY**

**[cornellelectricvehicles.org](http://cornellelectricvehicles.org)**

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**[@cornellelectricvehicles](#)**

# OUR TEAM

**CORNELL UNIVERSITY'S  
FOREMOST PROJECT TEAM DEDICATED TO  
BUILDING AUTONOMOUS HYPER-EFFICIENT  
ELECTRIC VEHICLES**

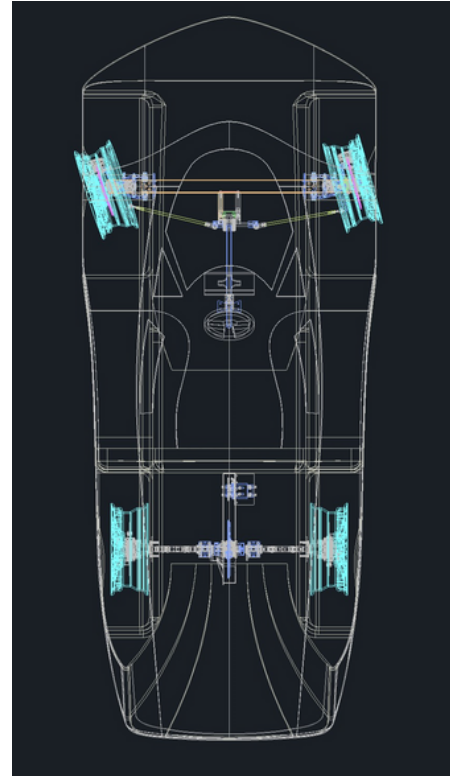


Cornell Electric Vehicles is the foremost team at Cornell University dedicated to building autonomous, hyper-efficient electric cars. From our inception in 2014, pre-empting the electrification of the automotive space, and tackling autonomy targets at the magnitude of research and industry initiatives, we consciously lead Cornell's charge towards tomorrow's smart, green transport solutions.

Our deeply knowledgeable 60+ person organization spans every degree level, and operates at the pace of a startup. Determined to endow our members with deeply employable skills, we have repeatedly produced industry-grade vehicles, using industry design and manufacturing methodologies. Having placed highly at Shell Eco-Marathon, the premier global energy efficiency competition, we are a respected team operating at the limits of emergent technologies. Endeavoring to achieve level two autonomy in our vehicles reflects our determination to continue forging at the leading edge of innovation.

# MECHANICAL

The Mechanical subteam is focused on designing the most efficient car possible. This comes from a variety of considerations, including weight optimization, aerodynamic chassis design, material considerations, and minimizing slop. We are now taking an additional step beyond this to make the car both efficient and safely autonomous, simultaneously allowing for self-driving as well as manual controls. This year, the team is focused on making our 2022 prototype vehicle autonomy ready, testing our 2023 vehicle, and using this knowledge to design our next car projected for 2025. The team is further split into four sub-systems:

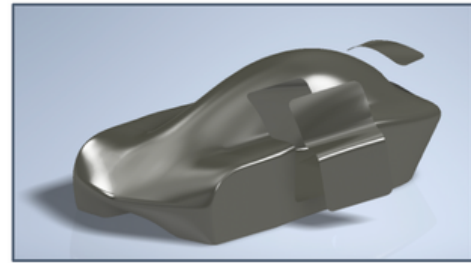


## **MECHANICAL AUTONOMY**

The mechanical autonomy subteam focuses on enabling autonomous driving from a mechanical perspective. This group is focused on simultaneously designing for human and autonomous control, taking into consideration both safety and efficient design practices. Current projects include retrofitting our old vehicles for autonomous steering and braking capabilities, as well as handling all electromechanical integration. The goal of this team for the future is to allow all upcoming vehicles to be designed for autonomy from the start.

## CHASSIS

- Working to design the most **aerodynamic** shape possible while also **optimizing weight**
- Working heavily with **composites and carbon fiber**, this team is well versed in layup procedures
- Working to improve both our designs and our **manufacturing process** in order to make the car as strong and light as possible.



## DRIVETRAIN

- Design the most **efficient power transmission** possible for our rear-wheel drive vehicle
- Balance **power output** from the motor, selected for optimal efficiency, with build-in mechanical advantage to **increase torque** output.
- Implement the team's very first **differential design** to increase the efficiency of the system as a whole to above 80%.



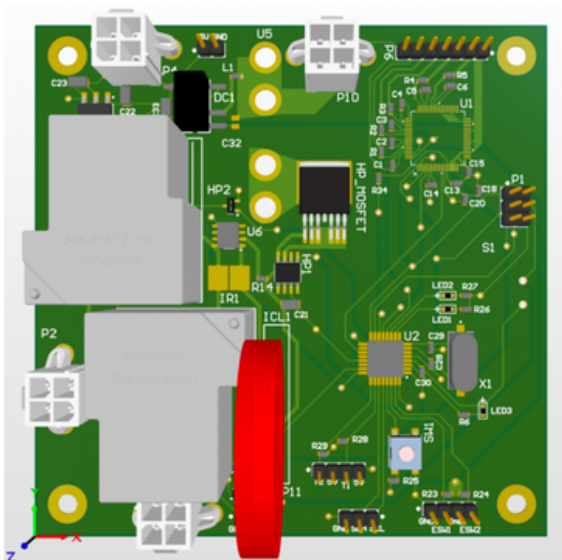
## STEERING

- Allow for **precise and accurate control** of the car, from turning to brakes and suspension.
- Front assembly is crucial towards the overall performance, efficiency, and safety of the car. Precise steering allows for quick decisions to be made by the driver and autonomous systems, while brakes serve as **our most robust safety system**.
- Last year, this team implemented our **very first suspension design** for absorbing shocks in the road, and is working towards developing our next steering system.

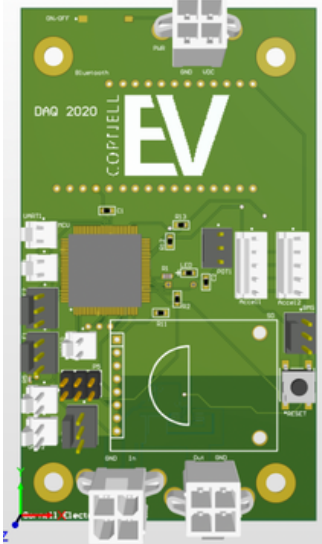
# ELECTRICAL

Taking a more “under the hood” role, the electrical subteam supplements the brawn of our mechanical build with the brains of our electrical systems. Our subteam designs the printed circuit boards onboard our vehicle, and implements the medley of sensors and electrical equipment necessary to meet the car’s functional requirements, as well as meet the team’s automation and efficiency goals. This year, we’re aiming to optimize our existing competition-critical systems, and redesign some of our older systems such as Data Acquisition (DAQ) and Battery Management (BMS). Additionally, unlike in previous years, we’re working to integrate all of our systems onto a common CAN bus. This will allow for clean, harmonized communication between all the PCBs and sensors onboard our vehicle, while following industry-grade standards. The following are the series of projects our members are taking on this semester:

## BATTERY MANAGEMENT SYSTEM (BMS)

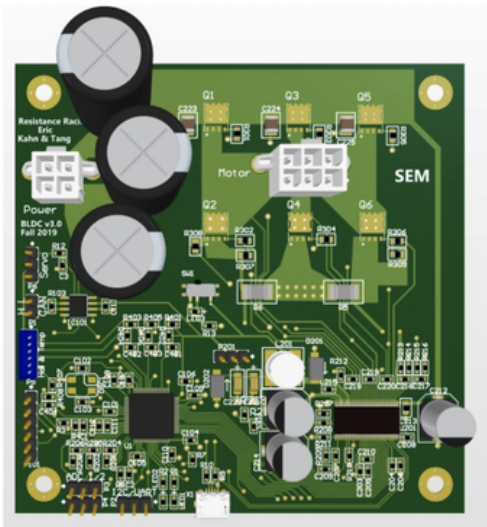


The BMS is the caretaker to our 24V LiPo Battery. It monitors the status of the battery’s cells, implements overcurrent, overvoltage, and overtemperature protection, as well as maintains its healthy and efficient function through active cell-balancing. The monitoring and protective relay actuation is orchestrated via an RP2040 microcontroller, and the board is expected to communicate both through CAN and Wifi. All in all, this project provides our members with valuable power electronics experience.



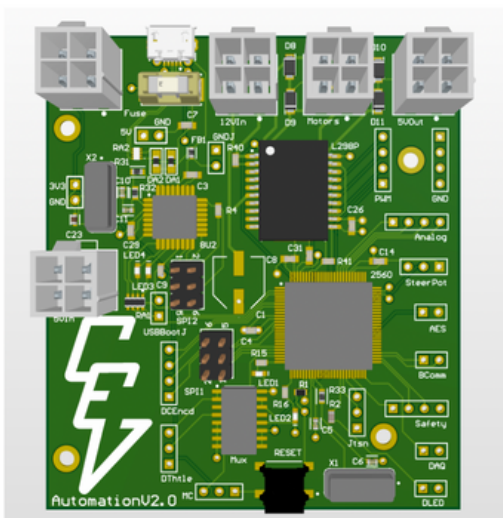
## DATA ACQUISITION SYSTEM (DAQ)

The nervous system to our car. DAQ implements all the sensors necessary to gauge our mechanical performance. It also manages the equipment our software team requires to implement autonomous driving.



## MOTOR CONTROLLER

The motor controller leverages high-efficiency control algorithms to manage motor drive effectively. The controller also implements sinusoidal hybrid control and field oriented control.



## AUTOMATION

The automation board converts software autonomy outputs to signals for mechanical actuation, and simultaneously enables vehicle control via remote control.

# SOFTWARE

## DATA APPS & ANALYSIS

The Data Apps and Analysis subteam develops web and mobile applications to visualize and analyze data collected by the data acquisition board developed by the electrical subteam.

In addition to real-time dashboards, the data apps and analysis subteam manages a database and historical dashboard, which the electrical and mechanical subteams use to gain insights and plan their next iterations. Subteam projects include: a Driver Dashboard, a Live Timing Dashboard, and a Historical Dashboard.



The Data Apps and Analysis subteam is also developing an AR Windshield, which entails displaying live information about the vehicle using a heads-up display that is projected onto the windshield. This project aims to also integrate with all subteams' autonomy divisions, so that features including displaying the car's optimal path on the windshield can also be added in the future.

# SOFTWARE AUTONOMY

Our Software Autonomy subteam is working to support our goal of making all of our vehicles fully autonomous in the future. The features that this team plans to add to the vehicle are perception and localization capabilities, as well as autonomous motion planning in order to physically move the vehicle.

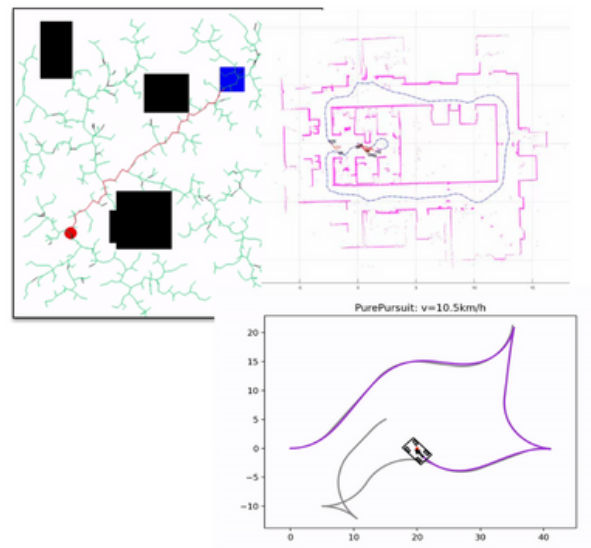
## PERCEPTION

- Real-time, low-power environmental perception and obstacle identification.
- Detect obstacles, roads/sidewalks, and environmental cues like stop signs and traffic lights.
- Technologies: Machine learning and computer vision, LiDAR and stereo camera data processing, multi-modal 3D object detection, point cloud segmentation



## LOCALIZATION AND MOTION PLANNING

- Produce mapping and obstacle data, determine the cars location and where it should go next.
- Technologies: Robotics algorithms, statistical algorithm design, vehicle modeling and control theory, latency critical computation





# OPERATIONS

The Operations subteam is a multifaceted team that spans the entire spectrum of business operations that helps to ensure the seamless execution of CEV's mission. We focus on maintaining the website, forming sponsor and public relations, tracking our finances, and designing graphics.

We've undergone a complete transformation of our website, and the results are truly impressive. Not only does it highlight our future goals and vision, but it also adds an element of fun with captivating effects and engaging graphics that truly elevate the user experience.

A Breakdown of Our Operations:

## Sponsor Relations

- Collaborates with external organizations, building and maintaining partnerships that support our endeavors. This teamwork ensures we have the resources needed to make our projects successful.

## Finance

- Manages budgets, tracks expenses, and makes sure our finances are in order, ensuring we can allocate resources efficiently to advance our mission.

## Graphic Design

- Uses a variety of tools to design everything from the merchandise to visually appealing infographics.

# COMPETITION

Cornell Electric Vehicles competes annually in the Shell Eco-Marathon, one of the world's top energy efficiency competitions with over 700 universities from 52 countries participating, to create the most efficient vehicle.

In the past, we have traveled to the Indianapolis Motor Speedway and competed in the Electric Prototype Category, placing 3rd in 2019 and 5th in 2018. Starting in 2022, we switched to the Electric Urban Concept Category, which is modeled after passenger cars, to better align with industry standards and allow us to pioneer the future of high-efficiency electric cars.

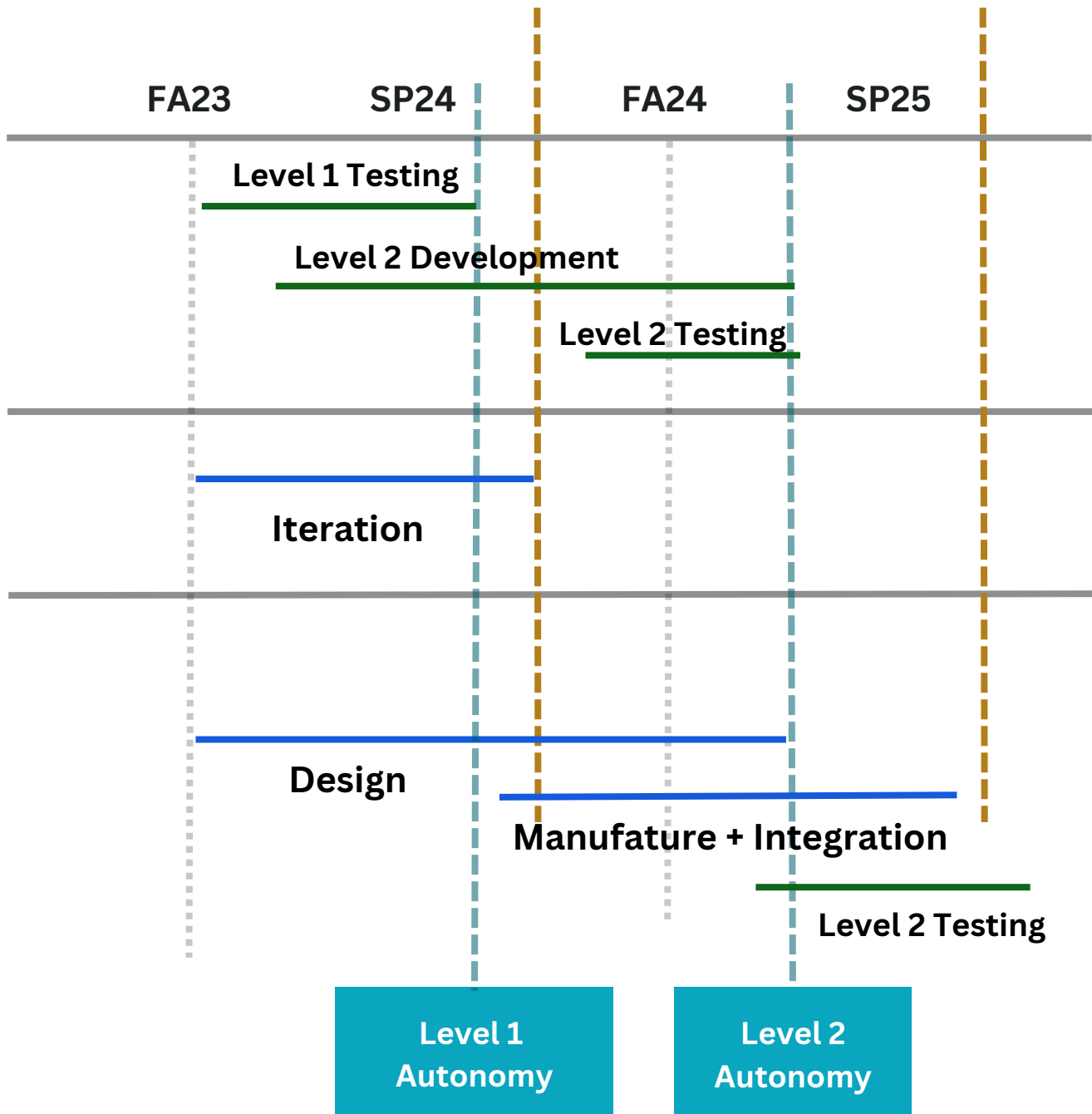
We recognize that the future of the automotive industry lies in autonomous vehicles and policy pushes for sustainability only cements the importance of autonomous electric vehicles, so this year we are developing and integrating Level 2 autonomy into our competition vehicles for the upcoming 2024 Shell Eco-Marathon.



# OUR FUTURE

SHELL ECO  
MARATHON  
2024

SHELL ECO  
MARATHON  
2025



# SPONSORSHIP TIERS

| Sponsorship Benefits                        | TERAWATT<br>\$4000+   | GIGAWATT<br>\$2000-\$3999 | MEGAWATT<br>\$1000-\$1999 | KILOWATT<br>\$500-\$999 | WATT<br>\$100-\$499 |
|---|-----------------------|---------------------------|---------------------------|-------------------------|---------------------|
| Graphic Decals on Car                       | 3x Max Size (20x20cm) | 2x Large Size             | 2x Small Text Decal       | 2x Small Text Decal     |                     |
| Recruitment Guidance and Information        | ●                     | ●                         |                           |                         |                     |
| Logo on Banner in Team Office               | ●                     | ●                         | ●                         |                         |                     |
| Thank You Plaque                            | ●                     | ●                         | ●                         |                         |                     |
| Resume Book                                 | ●                     | ●                         | ●                         |                         |                     |
| Logo on all CEV Publications                | ●                     | ●                         | ●                         |                         |                     |
| Info Session open to Cornell Community      | ●                     | ●                         | ●                         |                         |                     |
| Social Media Spotlight                      | ●                     | ●                         | ●                         | ●                       |                     |
| Company Name listed in all CEV Publications | ●                     | ●                         | ●                         | ●                       | ●                   |
| Company Logo on CEV Website                 | ●                     | ●                         | ●                         | ●                       | ●                   |
| Thank You Letter                            | ●                     | ●                         | ●                         | ●                       | ●                   |

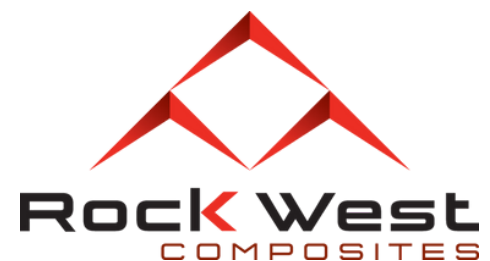
# CURRENT SPONSORS



**NVIDIA**



*Altium*



# CONTACT US

## FULL TEAM LEADS



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# THANK YOU FOR YOUR CONSIDERATION!

