**Funding Criteria**

**A. General Rules**

1. Students, faculty, and staff are encouraged to submit requests for funding. Student-led projects require a faculty or staff sponsor in order to have funds awarded.
2. Funding can only go to university-affiliated projects from students, faculty, staff, and departments.
3. All SSC projects must make a substantial impact on students. This may be a direct impact or an impact through education and engagement. All SSC funding is 100% from student green fees, so the projects funded by the students must benefit them.
4. SSC encourages innovation and new technologies – creative projects are encouraged to apply.
5. Unless a type of expense is specifically listed below as having restrictions, SSC can generally fund it. The items referenced below should not be taken as comprehensive list.

**B. Things SSC Can Fund, On A Case-By-Case Basis**

1. SSC can fund feasibility studies and design work; however, it must work toward ultimately addressing a sustainability need on campus.
2. SSC can fund staff positions that are related to improving campus sustainability. Strong preference will be given to proposals receiving matching funding from departments and/or plans for maintaining continuity of the position after the end of the initial grant.
3. SSC can fund outreach events with a central theme of sustainability, provided their primary audience is the general campus community.
4. SSC discourages funding requests for food and prizes but will consider proposals on a case by case basis that prove significant reasoning.
5. SSC can fund repairs and improvements to existing building systems as long as it works toward the goal of improving campus sustainability; however, a preference is shown to projects utilizing new or innovative ideas.
6. SSC can provide departments with loans for projects with a distinct payback on a case by case base. Loans will require a separate memorandum of understanding between SSC and departmental leadership pledging to repay the award in full and detailing the payback plan.

**C. Things SSC Will Not Fund:**

1. SSC will not fund projects with a primary end goal of generating revenue for non-University entities.
2. SSC will not fund personal lodging, food, beverage, and other travel expenses.
3. SSC will not fund any travel expenses.
4. SSC will not fund tuition or other forms of personal financial assistance for students beyond standard student employee wages.

**Your Step 2 funding application should include this application, the supplemental budget form, and any letters of support.**

*Please submit this completed application and any relevant supporting documentation to* *Sustainability-Committee@Illinois.edu**. The Working Group Chairs will be in contact with you regarding any questions about the application. If you have any questions about the application process, please contact the Student Sustainability Committee at* *sustainability-committee@illinois.edu.*

**General & Contact Information**

**Project Name:** Illini Formula Electric

**Total Amount Requested from SSC:** $50,000

**Project Topic Areas:** [ ]  Land & Water [x]  Education [x]  Energy

[x]  Transportation [ ]  Food & Waste

**Applicant Name:** Henry Steenkolk

**Campus Affiliation (Unit/Department or RSO/Organization):** Illini Formula Electric

**Email Address:** steenko2@illinois.edu

**Check one:**

 [ ]  This project is solely my own ***OR***

 [x]  This project is proposed on behalf of (name of student org., campus dept., etc.): Illini Formula Electric

**Project Team Members**

|  |  |  |
| --- | --- | --- |
| **Name** | **Department** | **Email** |
| Henry Steenkolk | IFE - President | steenko2@illinois.edu |
| David Lam | IFE – Treasurer | wj6@illinois.edu |
| Chaitanya Sindagi | IFE – Electrical Advisor | Sindagi2@illinois.edu |
| Ben Schultz | IFE – Project Leader | bks4@illinois.edu |

**Student-Led Projects (Mandatory):**

Name of Faculty or Staff Project Advisor: Bruce Flachsbart
Advisor’s Email Address: mems@illinois.edu

**Financial Contact *(Must be a full-time University of Illinois staff member)***

Contact Name: Marcia Mathis

Unit/Department: Mechanical Science and Engineering

Email Address: mmmathis@illinois.edu

**Project Information**

*Please review the proposal materials and online content carefully. It is highly recommended you visit a working group meeting sometime during the proposal submission process.*

**Please provide a brief background of the project, its goals, and the desired outcomes:**

*You may copy and paste your Step 1 application answer if nothing has changed.*

IFE is a student led organization that investigates methods to improve performance, efficiency, and reliability of electric vehicles. The car is designed and manufactured to compete against teams from many universities in the international FSAE Electric competition. This year, the team will be perfecting previous year’s design through testing and data collection. We will improve battery efficiency through optimized temperature management and reduced losses in the drivetrain.

Our sight is set on developing an all-wheel drive platform where four hub-motors power the wheels independently. Doing so will require a completely new design of the entire car as the drivetrain setup, motor controllers, battery packs, suspension, and chassis will all have to be re-designed to accommodate the new layout. By developing custom motor controllers tailored for this application, we can implement many cutting-edge designs like higher switching frequencies and wide-band gap transistors which are not commercially available yet. These will enable us to utilize high fundamental frequency motors which are inherently more efficient and use less material to manufacture, while also being lighter, and thus increasing vehicle range.

The new layout will provide granular control over the vehicle dynamics which increases overall performance. It will also result in drastically lower weight in

• Motor controller due to accurate thermal margins

• Motors due to compact design and effective cooling

• Chassis due to reduced stiffness requirements

All these, along with an inherently more efficient drivetrain, result in gains in efficiency, reducing the required size of the battery as well as the environmental impact of the design.

**Where will the project be located? Are special permissions required for this project site?**

*If special permission is required for this location, please explain and submit any relevant letters of support with the application.*

We have space to design and build our vehicles in the Engineering Student Project Lab, a shared space assigned to multiple student organizations by the Engineering Design Council. We have permission to use this space to design and construct everything needed for this project.

**Other than the project team, who will have a stake in the project? Please list other individuals, groups, or departments affiliated directly or indirectly by the project. This includes any entity providing funding (immediate, future, ongoing, matching, in-kind, etc.) and any entities that benefit from this project.**

*Please attach letters of commitment or support at the end of the application.*

Our team is sponsored by many companies either in terms of monetary or in-kind donations. We are given funds by the MechSE department, Engineering Design Council, John Deere, Ford, Cummins, and Catepillar. We are given in-kind donations in terms of software licenses, products, or discounts by Altium, Ansys, General Plastics, Composite Envisions, etc.

**How will this project involve and/or benefit students?**

*This includes both direct and indirect impact.*

Our primary purpose is to give students the opportunity to design and build an electric vehicle from scratch. Many of our members are mechanical, aerospace, and electrical engineering students with interests in EV technology. Exposure to these technologies give our members a better standing in the job market when they graduate. Moreover, through our close partnership with companies that are moving towards electrification such as Ford, Caterpillar, Cummins, GM, and Tesla, our team members gain direct access into the industry where they can make the most difference.

Throughout the design process, our members are introduced to 3D-modeling software such as Solidworks and utilize simulation techniques including Finite Element Analysis and Computational Fluid Dynamics. These skills are extremely helpful to our members in pursuing a career in all forms of engineering as they are widely utilized in the industry. After the design process, we will manufacture and assemble every component on the car, giving our members great experience with a real-world manufacturing process. The hands-on building experience will reinforce the concept of designing for manufacturability, keeping cost and material waste in mind.

While our mechanical subsystems work to integrate the electric motor into a performance oriented chassis, suspension, and drivetrain, our electric subsystems focus on improving the reliability and efficiency of our vehicle. Members on our electrical subsystems would be tasked with creating a control system for the motor, accumulator (battery pack), as well as other low-voltage components required for operation and safety. Constant testing and tuning is required to perfect driving dynamics and ensure long-term reliability. The batteries in an electric vehicle may be the biggest limitation of its performance and range. Thus, batteries are the top research topic amongst the best electric vehicle manufacturers. Our members will research into battery engineering and thermal cell characterization to design a reliable, high capacity, and light weight battery pack. With a major redesign upcoming, our team will provide more learning opportunities for our members through projects such as custom battery packs and motor controller. Students will draw from various aspects of electrical, computer, and mechanical engineering fields to research and develop one of the highest performance motor drives amongst the competition.

Because of the electric nature of our team, we are also contributing to the adaptation of electricity as an alternative energy for transportation in a wider sense. As the FSAE electric competition becomes more popular, the concept of powering transportation with electricity would be proven not as a viable option but also one capable of high-performance to the mass public.

**How will you bring awareness and publicize the project on campus? In addition to SSC, where will information about this project be reported?**

Each year, we attend multiple social events such as Quad Day (general and engineering), Engineering Open House, and Homecoming Parade. These events draw a considerable amount of attention as it is rather uncommon to see a racecar everyday. Students are generally further awed when they learn that our vehicle is powered by electricity. We also gather not only attention of the students on campus but also of the public. By attending the competition and community events such as the Urbana Drive Electric Fair, we are spreading the EV culture, proving that electricity could be a viable and practical replacement to traditional power sources for transportation.

# Financial Information

*In addition to the below questions, please submit the supplemental budget spreadsheet available on the Student Sustainability Committee* [*website*](http://ssc.sustainability.illinois.edu/?page_id=2087)*. Submission of both documents by the submission deadline is required for consideration of your project.*

**Have you applied for funding from SSC before? If so, for what project?**

We applied in 2017 for funds needed throughout 2017-2019 to construct a completely redesigned RWD construction in 2019. The $24,750 we received in 2017 had allowed us to purchase new motor, motor controller, and batteries throughout the three years which resulted in the 2019 car being the most powerful car we've ever built while still maintaining high efficiency. These drastic changes were only possible because of the support received from SSC which allowed the team's great ambitions to become a reality.

**If this project is implemented, will you require any ongoing funding required? What is the strategy for supporting the project in order to cover replacement, operation, or renewal costs?***Please note that SSC provides funding on a case by case basis annually and should not be considered as an ongoing source of funding.*

We will not be requiring any ongoing funding. With major upcoming design changes as we are switching from rear-wheel drive to all-wheel drive, expenses will be funneled towards the purchasing of critical driving components of the car such as custom motors, motor controllers, and other materials for 4WD system construction. These components are generally the most expensive components of the vehicle. As each new car is an improvement of the previous, there will be ongoing changes to our designs perfecting the previous iteration. However, major expenses would occur as a one-time purchase reused throughout multiple years instead of an annual purchase. The small-scale changes each year will instead be funded by sponsorships we acquire and funding from other on-campus sources.

**Please include any other obtained sources of funding. Have you applied for funding elsewhere?**

*Please attach any relevant letters of support as needed in a separate document.*

The team receives direct financial support each year from multiple other on-campus sources including the Engineering Design Council and the Mechanical Science and Engineering Department. We receive some financial and in-kind support from other sponsors, as listed above. However, the funding from these sources is only enough to cover required yearly expenses that the team occurs on a regular basis, requiring reuse of all major system components from year-to-year. In this project, we are applying for funding to take our project to the next level - the development of a 4WD electric vehicle, allowing us to push the engineering limits of performance and efficiency.

# Environmental, Economic, and Awareness Impacts

**How will the project improve environmental sustainability at the Urbana-Champaign campus? If applicable, how does this project fit within any of the** [**Illinois Climate Action Plan**](https://icap.sustainability.illinois.edu/) **(iCAP) goals?**

Our main source of impact would come in the form of Education and Outreach. By building an all-electric car, we promote environmental sustainability not only within the club but throughout the university as well. Our presence on campus and in the competition is serving as an example of how transportation is steadily becoming powered by electric vehicles and alternative energy. By implementing new design goals such as all-wheel drive and custom motor controllers, we are pushing the limits of these technologies, helping electric vehicles down the path they need for mainstream adoption. Additionally, through this project, we open up new opportunities for our members to research and get educated on new EV technologies, including cutting-edge MOSFET design practices and the highest energy density battery technologies. Our members are likely join a career related to electric-vehicle automotive engineering, thus taking the knowledge they learn from designing electric vehicles here to creating more advanced and efficient electric vehicles for the mass public.

**How will you monitor and evaluate the project’s progress and environmental outcomes? What short-term and long-term environmental impacts do you expect?**

*Some examples include carbon emissions, water conservation, green behavior, and reduced landfill waste.*

By building an all-electric car, we drastically reduce carbon emissions compared to a combustion racing team. Furthermore, we design with the manufacturability of the vehicle in mind. All components are designed to utilize the minimum amount of material needed, and are designed to be easily manufacturable. We make sure to maximize our resources, and not to waste any of our materials. If there are ever any extra resources we either dispose of them properly or use them for our car the following year. Our work progress is monitored by a weekly update on completed and planned tasks. We also have specific deadlines for completion of various stages of the design and manufacturing processes such as design freeze, welded chassis, rolling car, etc. Our vehicle houses many sensors and data loggers which read information about temperature, power, energy usage, and much more data. From these data we are able to better understand the vehicle and how we can improve performance and efficiency. In the long-term we are helping create a more sustainable enviornment by familiarizing students and the community with industry-leading electric vehicle technology. Not only are more electric vehicles likely to be adopted by the public, our members that involve themselves with the industry after they graduate are likely to build more efficient vehicles.

**What are your specific outreach goals? How will this project inspire change at UIUC?**

Each year we recruit students through Quad Day (general and engineering), Engineering Open House and as many events as we can possibly attend. We also utilize social media to constantly update our work progress, promote social events, and present gratitude towards sponsors. This year we've recruited around 100 new members to the team. Every member that is involved with us will get hands-on experience with the construction of the car and learn about the engineering that goes behind an electric vehicle. By building a competitive racecar each year that not only can amaze crowds during parades but also win at an international competition would prove the capability of electric vehicles not just at UIUC, but to the entire world.

**If applicable, how does this project impact environmental injustice or social injustice?**

At our team, we want to maximize the knowledge and experience that members get, no matter their race or gender. Traditionally, the ratio between male and female members in car teams have always been biased towards the male members. We are actively welcoming and recruiting female members to join. We also welcome students from any field of study to participate and learn. Though our members are primarily engineering students, we have several members from the college of business, and will be collaborating with students from art and industrial design.