



STUDENT SUSTAINABILITY COMMITTEE

Funding Application – Step II

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: Plastic-to-Fuel Initiative to Produce Fuels for Campus Use

Total Amount Requested from SSC: \$140,000

Project Topic Areas: Land & Water Education Energy
 Transportation Food & Waste

Applicant Name: BK (Brajendra K) Sharma

Campus Affiliation (Unit/Department or RSO/Organization): Prairie Research Institute-Illinois Sustainable Technology Center

Email Address: bksharma@illinois.edu

Check one:

- This project is solely my own **OR**
 This project is proposed on behalf of (name of student org., campus dept., etc.):

Project Team Members

Name	Department	Email
Joseph M. Pickowitz	PRI-ISTC	pickowit@illinois.edu
Morgan White	Facilities & Services (F&S)	mbwhite@illinois.edu
Shantanu Pai	PRI-ISTC	spai@illinois.edu
Name	Department/Organization	Email Address

Student-Led Projects (Mandatory):

Name of Faculty or Staff Project Advisor:

Advisor's Email Address:

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

Contact Name: Margaret Morrison

Unit/Department: Prairie Research Institute-Illinois Sustainable Technology Center

Email Address: mmorrison@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.

In the past, we have demonstrated the lab and pilot scale conversion of waste plastic to plastic crude oils, that are very similar to petroleum crude oils. These plastic crude oils on distillation produce 80% fuels (gasoline and diesel) compared to 50-60% from petroleum crude oils. In this project, we propose to demonstrate a continuous catalytic pyrolysis technology capable of producing predominantly one fuel [gasoline, diesel, or non-condensable gases (ethane, propane, and butane)] from PE (#2 and #4), PP (#5), and PS (#6) collected from campus MSW. F&S has agreed to provide access to such plastic material from MSW collected by their facility and Carpool has agreed to accept the produced plastic diesel to mix into the diesel supply for truck pool (Letter of Support attached).

According to a 2012 EPA report, 251 million tons of municipal solid waste was generated in the US and the U of I generates about seventeen tons of trash per day. After MSW recovery through recycling and composting, nationally, plastic was the 2nd largest component (18%) behind food waste (21%) of the 164 million tons discarded in 2012. This means that huge quantities of plastics end up in landfills (29 million tons). Translating these numbers to the U of I campus MSW would mean that for no better reason we are conveniently sending 1.39 tons of plastic in trash to landfill everyday.

Through pyrolysis, this non-recyclable plastic waste stream on campus can be simultaneously diverted and converted into 175 gallons of fuel (assuming 60% conversion and 80% fuel yield) everyday with possible use for campus vehicles. Implementation of this technology on campus will result in waste minimization, waste conversion to fuels, reducing reliance on fossil fuels by reducing amount of petro-diesel needed on campus, the reduction of the carbon footprint of campus, extension of landfill life (equivalent to 500 tons plastic/year), and a reduction in the associated GHG emissions. In a recent report by Argonne National Lab, it has been shown that plastic-to-fuel technology helps reduce up to 14 percent in greenhouse gas emissions, up to 58 percent in water consumption, and up to 96 percent in traditional energy use when compared to ULSD from conventional crude oil, using their highly regarded Greenhouse gases, Regulated Emissions and Energy use in Transportation (GREET[®]) model. Therefore, this project will contribute towards CO₂ reduction goals set in the Illinois Climate Action Plan. Assuming replacement of 175 gallons of ULSD with plastic diesel in UIUC will prevent 543.9 lb of CO₂ emissions everyday along with reduced water consumption and traditional energy use.

The overarching goal of work that will be initiated under this project is to end landfilled plastic waste forever, by collecting, processing, and converting the plastic waste from the U of I waste transfer station MRF to a usable fuel that can be used in University vehicles. This will be achieved by demonstrating the continuous pilot scale catalytic pyrolysis system for distributed production of most desirable fuel for use in University trucks, and generating data including mass/energy balance to make a business case for commercial scale system capable of using all plastic waste produced on campus. It also involves introduction of this technology to students and involves them in conducting detailed process characterization with the aim of improving process yields and product quality and develop a student led/run initiative similar to the Illini Biodiesel Initiative.

The specific objectives of this project are:

Year 1

- i) Demonstrate the feasibility of converting waste plastic to fuels by installing a continuous catalytic pilot scale system capable of processing 200 lbs of waste plastic every day
- ii) Engage students to identify the parameters of the continuous pilot scale catalytic pyrolysis process for producing high yields of most desirable fuel (gasoline, diesel, and NC gases)
- iii) Support the education and training of students from various disciplines to study the effect of continuous operation on catalyst life

Year 2

- iv) Involve students to study the impact of feedstock quality and composition on yield and quality of fuels
- v) Evaluate and compare various fuels thus produced with petroleum fuels and demonstrate their potential as blend component in petroleum diesel
- vi) Engage students to generate mass/energy balance data
- (vii) Create awareness in the larger community by participating in outreach activities

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.

The project will be located at the Illinois Sustainable Technology Center, 1 E. Hazelwood Drive, Champaign. No special permission will be needed to enact the project on this site.

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.

In keeping with the above objectives, key stakeholders include:

- (i) U of I waste transfer station MRF: This project will help them to divert solid waste from landfills, thereby working towards iCAP goal (letter of support attached).
- (ii) The other key stakeholder is F & S. Our goal is to involve personnel from F & S (MRF) in all aspects of the pilot plant installation and testing. The goal would be to create awareness and lower uncertainty of the technology. In our experience, as key personnel in F & S become comfortable with the technology, they are more likely to consider it for future projects (letter of support attached).
- (iii) Car/Truck Pool: They will be the end user of the plastic diesel produced in this project (letter of support attached).
- (iv) Student Groups: We are aware that there are several student groups on campus with an interest in promoting renewable energy on campus, such as the biodiesel student group. We will reach out to this and other interested student groups as we progress. We also plan on offering paid internships to students in the Professional Science Master's Program offered through IBRL.
- (v) iSEE: One of missions of the iSEE is to develop and implement strategies for a sustainable campus environment, therefore iSEE would be a the key stakeholders in this project.

How will this project involve and/or benefit students?

This includes both direct and indirect impact.

- (i) **Paid internships/Undergrad/Grad students hourly employment supporting the improved design, operation, and marketing of the pilot system**
- (ii) **Outreach to student groups active in the renewable energy space, such as Biodiesel student group, IBRL, iSEE, Quad Day, Sustainability Week, Game Days, Marathons, etc.**

- (iii) Accessible facility as a resource for students to learn/advocate about this technology**
- (iv) Students will be able to conduct independent studies centered around the pilot plant. Examples of student roles would be access to data generated during pilot plant operation as input to follow-on analysis in courses offered on campus**
- (v) Students will be involved in all tasks including installation and operation of the continuous plastic-to-oil system at ISTC; record data on system operation; and collect and analyze various liquid samples. Students will calculate and assemble feedstocks to process in the correct proportions for optimum operation and energy extraction.**
- (vi) There are many facets of this project that could serve as an R&D study or thesis project across several disciplines and departments. Potential domains include: Mechanical Engineering for system integration and operation; Chemical Engineering for fuel distillation and testing; Electrical Engineering for system controls and power management; Environmental Engineering for air emissions control and sampling**

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

One of the objectives in this project is to create awareness in the larger community by participating in outreach activities. We will have a comprehensive outreach, and publicity plan to promote the project. These can be divided in to the following categories:

- Outreach to campus policy makers and operational personnel
- Outreach to general campus community through Sustainability Seminar Series, Lab tours and open houses, news releases through Daily Illini, the News Gazette etc. to spread the word in addition to featuring it on the web pages of the SSC, ISTC, PRI, iSEE and in PRI newsletter, iSEE newsletter, local media outlets
- Outreach to student groups active in the alternative fuel and sustainability space by participating in the annual iCAP meetings, Quad days, Sustainability week, Game Days, Marathons, Engineering Open House, etc.
- Present the research work on this project to Biodiesel student group, IBRL, iSEE, and in conferences on campus, (such as Undergrad Research Conference organized by ACS-ECI), and conferences focused on solid waste management and thermochemical processes
- Prepare fact sheets of key findings and industry implications for SSC, ISTC, and iSEE quarterly and annual reports to communicate to advisory board members and decision makers in the field
- Publish peer-reviewed journal publications to communicate findings to other research scientists working in the field
- Submit final project report (as per SSC guidelines) after getting draft technical report reviewed and approved by SSC staff
- Publicize Funding of Project by SSC by having a plaque by the equipment acknowledging SSC support for project. This will also be highlighted in fact sheets and media focused news.

Financial Information

In addition to the below questions, please submit the supplemental budget spreadsheet available on the Student Sustainability Committee [website](#). 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?

Yes, for following two projects:

1. Rotary Gasification for Waste to Energy in Spring 2016 (\$409,000): Not funded
2. Pilot Scale Demonstration of Plastic-to Fuel Technology to Produce Fuels for Campus Use in Spring 2018 (\$133,000): Not funded

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.

The facility will be maintained and operated by personnel from the Illinois Sustainable Technology Center. Recurrent funding for maintenance, replacement, and operation will be sought from other funding agencies, such as EREF, DOE, EPA, etc. and ISTC clients for testing their feedstock. We do not anticipate to request additional grant from SSC, and will apply for additional grant from other funding agencies.

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.

ISTC in-kind support for Operation of pilot scale plastic-to-oil unit (Personnel, feedstocks, publicity, communication, and other costs) - \$10,000

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 \(iCAP\)](#) goals?

The 2015 iCAP (Illinois Climate Action Plan) set a goal of 90% solid waste diversion from landfills by 2020. Meeting the above laudable goal requires the campus to be creative in identifying where different fractions of MSW can be used. Although food waste, a major fraction of MSW, has a possible outlet to the Anaerobic Digestors available at UCSD, there seems to be no outlet for the 1.39 tons of plastic going to landfill every day. This project provides a unique opportunity in the University setting for diversion of this non-recyclable plastic fraction from landfills, and help achieve this iCAP goal along with contributing to other goals, such as: reduction in transportation emissions, providing immersive sustainability learning opportunities to students, and indirectly to water conservation.

Plastics-to-Oil (PTO), goes beyond the iCAP goal of Waste Diversion from landfills. PTO takes it a step further; not only does it divert the plastic from the landfill, the waste plastic will also be converted into a useable fuel product that can be used to power campus vehicles. If PTO were to be implemented on Campus, plastics could be considered and reclassified as Zero Waste.

This distributed energy production model offers the opportunity to achieve greater efficiency through conversion in local areas in place of hauling the waste to a central facility. There is very little operational knowledge in the distributed energy production and utilization space, and we intend to fill this gap through this project. A successful demonstration at this scale has potential in the future to produce 175 gallons of diesel from 1.39 tons of plastic waste generated every day on this campus. The continuous plant will afford the opportunity to educate policy makers on campus, familiarize students with the technology, provide learning opportunities for students, lower the uncertainties surrounding this technology and provide a unique opportunity to bring together the various stakeholders on campus in the transition to a more informed and sustainable campus.

Furthermore, all this plastic comes from oil, so instead of handling, shipping, and landfilling the plastic off-site, it makes a lot of sense to convert it back to usable fuel on-site.

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.

Environmental impacts will be measured by comparing the reduced landfill waste, because of diversion of waste plastic material to plastic recycling from previous years to current year.

The throughput of waste plastic going to the PTO reactor and the desired output fuel exiting the reactor will be measured by mass balance to determine productivity and efficiencies.

CO2 emission reductions will be determined using ANL GREET model.

- **This is a unique opportunity to reduce landfill disposal, reduce fossil fuel consumption, and provide a novel teaching and research platform in energy.**

- The successful demonstration of this system would lead to implementation of 1-5 tons/day system capable of using all plastic waste generated on campus.

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

Our overall outreach goal is to create awareness in the larger community by participating and providing information in various outreach opportunities. More specifically, our project will afford the opportunity to familiarize students with the technology, provide learning opportunities for students, educate policy makers on campus, lower the uncertainties surrounding this technology and provide a unique opportunity to bring together the various stakeholders on campus in the transition to a more informed and sustainable campus.

- (i) We will track the number of visitors to the pilot plant.**
- (ii) We will track media and news outlet coverage.**
- (iii) We will track posters, publications, and presentations related to project.**
- (iv) We will track number of cross-campus collaboration generated as a result of this project by communicating with other departments on campus, where students from those departments could benefit from becoming part in this project.**
- (v) We will track the information disseminated to the Cities of Champaign-Urbana and the surrounding counties.**
- (vi) We will track grade and middle school visits about the technology.**

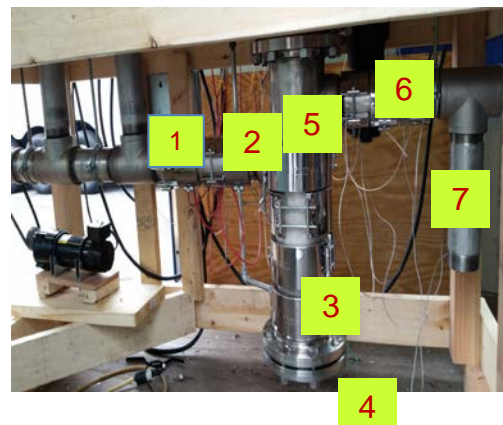
If applicable, how does this project impact environmental injustice or social injustice?

If plastic is not discarded properly, then it ends up in waterways and eventually ends up in Oceans and start accumulating in Ocean Gyres, such as Great Pacific Garbage patch. Plastic accumulated in oceans directly affect marine life. A clear example of environmental injustice on our part, if we do not take care of the waste we are generating. Social injustice part is sending this waste for further processing to countries like China and third world countries. With the help of this project, we hope that we won't have to send our plastic waste to other countries and will be able to take care of the waste we generate. Most certainly, if we can reduce the amount of plastic waste we are generating, we should do that without any question. If generation of plastic waste is unavoidable and generated plastic waste is non-recyclable, then we need to utilize this option to convert the waste plastic into useable fuel in place of letting it go in waterways, landfill, or other countries.



PTF200 with mini-fractionator attached

PTF 200/300/500 Parts Identification



Cartridge heaters

Temperature controllers and the zones they control



FACILITIES & SERVICES

Physical Plant Service Building, MC-800
1501 S. Oak St.
Champaign, IL 61820-6905

To: Student Sustainability Committee

From: Pete Varney, F&S Associate Director of Operations, Maintenance, and Alterations

Date: November 19, 2018

RE: Plastics to Oil SSC application

Hello SSC members,

The F&S Waste Management department is actively seeking methods to reduce landfilled waste from campus facilities. We currently recycle paper, cardboard, scrap metal, aluminum cans, and plastics #1 and 2. With SSC support, we are currently completing a feasibility study for a new baler to be able to continue baling the recyclables collected at the Waste Transfer Station, and also expand the collection process to include additional plastics.

Recent changes in the global recycling economy have led to uncertainty in how plastics other than #1 and 2 will be recycled. The proposal put forward by BK Sharma for converting plastics to oil is an exciting opportunity to convert used plastics into a resource for campus. F&S is prepared to provide a supply of used plastic materials for use in the plastics to oil program. We are also ready and able to accept the resulting diesel to mix into the diesel supply for the truck pool.

Thank you for your consideration of this proposal. You can contact our office at recycling@illinois.edu, if you have any questions.

Sincerely,

A handwritten signature in black ink, appearing to read 'Pete Varney', written over a light blue horizontal line.

Pete Varney

Facilities & Services