Sustainable Action Fund Grant Program

SMALL GRANT APPLICATION

2018-19

This application is for requests from $500 up to $5,000. For detailed application instructions and further information about the program, please refer to the *Small Grant Application Toolkit* located on our website at wwu.edu/sustain/programs/SEJF/apply/.

Submit completed application by delivering a hard copy and emailing a scanned version (including signatures) to the SEJF Grant Program Manager Johnathan Riopelle at Viking Commons Room 24. Applications must be provided in both forms in order to be reviewed. Email: johnathan.riopelle@wwu.edu.

Section 1: Project Concept

a. Project Title:

Dionysus: A Personal Power station

b. Describe your proposed project

This project is a continuation of the 2018-2019 student engineering project known as the Dionysus. Previous funds went towards constructing a small working Dionysus prototype with a solar capacity of 560W, a heavy duty trailer to house batteries, and an electric bike trailer. This academic year, Dionysus, the mobile charging station, is set to provide a 120V Alternating Current (AC) outlet, a 5V Direct Current (DC) port for USB 3.0 charging, and a 24V DC port. The members of this academic year's team for 2019-2020 ask for additional funds in order to create a larger and final version of the prototype.

This will be done by purchasing more robust components such as two 40A solar charge controllers, four deep cycle batteries, 800W of solar, and a 3000W inverter (electronic device that converts Direct Current [DC] to Alternating Current [AC]). With additional funding, we intend to scale our functioning prototype by swapping low power components for higher power ones. This need for a system with a significantly higher power output came upon request by the farm so they could have concerts, movie nights, lighting, and operate cooling fans. The system will also have a USB port for charging up to three phones so visitors do not have to leave the farm

to charge their phone. This increases the time people spend at the farm making the site an even more lively and attractive place.

As the members of the committee may know, this project centers around the design and implementation of a solar powered, mobile personal power station for Western Washington University`s (WWU) Outback farm. In addition to installing a more robust Maximum Power Point Tracking (MPPT) Converter as proposed last academic year, the Dionysus will house four 12V DC marine batteries. These batteries will be recharged daily by solar panels collectively rated at 800W. The inverter will provide a set of three safe and reliable 120V AC outlets and three USB charging ports.The system is highly reliable and efficient due to the use of pre-made components which have been extensively tested on the market. The project is also highly scalable as each modular system provides up to 1600W of power.

Today's agricultural and energy productions are dominated by large investment corporations. However, there is a trend towards small and distributed production systems. Some of these benefits include increased resilience, easier access to sources of production, and easier integration of renewable energy sources. This transition is gaining momentum in both developed and developing countries, especially regions that are still facing energy and food insecurity.

While the technology for renewable energy production at large scales does exist, large mobile power systems are still cumbersome and difficult to implement. As such, Dionysus aims to facilitate and reduce the barriers for accessing clean energy by providing an all-in-one, easy to use, and low maintenance energy harvesting system. This outdoor system will harvest energy from four 200W solar panels during the day and channel that power to an energy storage unit consisting of four deep-cycle 12V DC batteries. The batteries will provide energy to the load in parallel with the solar panels or power the loads by themselves when there is no sunlight.

We are planning to purchase flooded marine batteries due to their deep cycle usage capacity. These batteries allow for prolonged idle periods and full cycling of their capacity without significant degradation. Moreover, marine batteries are readily available and easily sourced. The current prototype, shown in Figure 1, shows two of my personal "Exide 24MDP" deep cycle batteries used in accordance with an inverter and fan to show the system prototype working. Because the solar panel used is owned by the Electrical Engineering department, they cannot be used permanently in the farm and we must purchase our own. For solar panel selection, our team is looking to buy HighTec RCL-M200W solar panels. These panels are priced competitively while carrying a 25-year warranty.

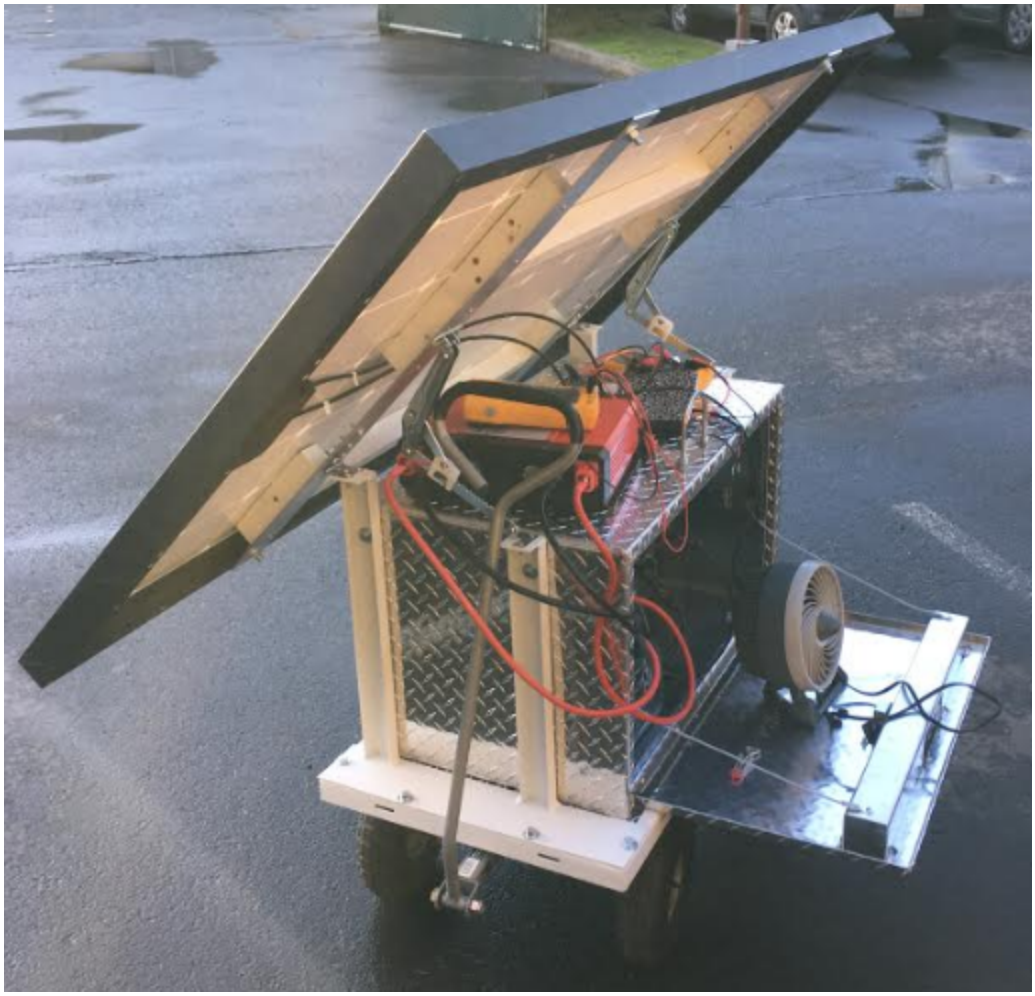

Figure 1: Small Dionysus Prototype running a fan

To see the overall system architecture of Dionysus, observe Figure 2 on the following page.

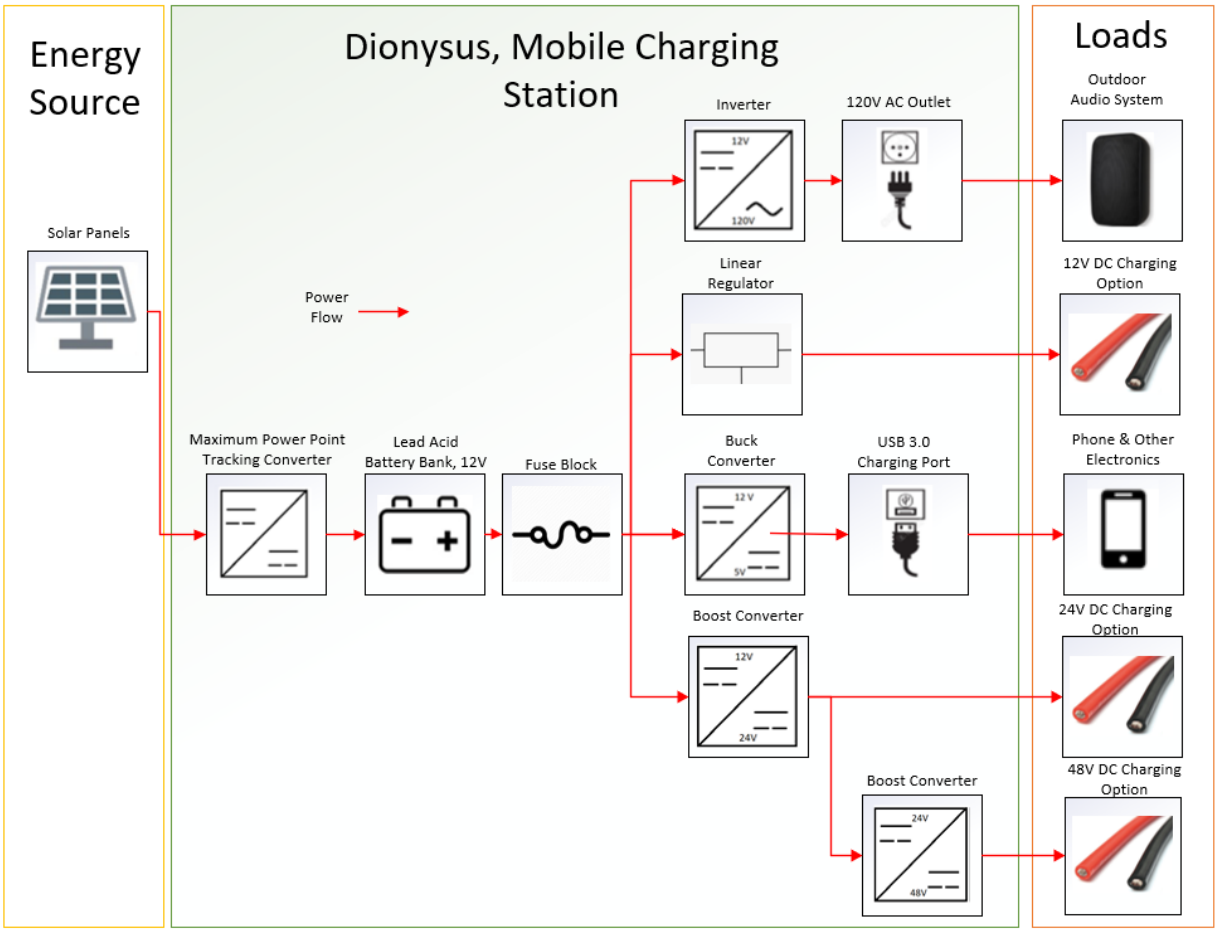

Figure 2: Overall System Flow Diagram

The integrated and intuitive design of Dionysus allows the system to be used for a wide range of purposes requiring power in isolated regions. In the case of this project, Dionysus would be implemented in several different applications complementing WWU's Sustainable Action Plan:

(1) The Outback Farm is currently trying to increase the accessibility of the farm for student volunteers and staff by operating box fans during the summer months and lighting during the night. The Dionysus can increase accessibility in both instances by offering 120 V AC outlet power for box fans cooling down student workers, and power for work lights illuminating the Outback at night.

(2) The Outback Farm has expressed desire for running power tools such as drills that require power at 120V AC to operate. As mentioned, the Dionysus will provide 120V AC outlet to charge these devices to make handiwork at the Outback Farm more efficient and less difficult.

(3) In the past, the Outback has expressed interest in operating a small irrigation pump for the spice gardens. The Dionysus offers a 24V DC option for small DC pumps such as the JABSCO pump which could irrigate one acre of land in about 2 hours with sufficient water.

(4) Dionysus will provide electrical power for aspiring music artists to plug in their audio systems in the Outback farm for outdoor concerts and television screens for outdoor theatre. The Dionysus module will give students a practical source of energy for outdoor entertainment.

c. Who is the intended audience

The primary audience is the Outback Farm staff, volunteers, and all student visitors who are seeking an outdoor area on campus to gather and socialize. Our team spoke with Terri Kempton, the farm manager, who told us that the Farm and its staff would greatly benefit from a portable energy source. Specifically, Ms. Kempton has stated she would like to be able to run fans, an audio system, and a TV in the farm where there is limited access to electricity.

Moreover, the project will serve as a model for a deployable renewable energy system which will be of interest to professors and students alike. When students volunteer at the Outback Farm or visit it during the summer months for various social gatherings, Dionysus will promote itself to the campus through the entertainment and conveniences it powers! Thus, the student population will be exposed to a great demonstration in backup solar power and be inspired to embark on similar projects.

d. How many students will be affected

Being educated about renewable energy will benefit all students. Access to clean and reliable energy in the future is something we all take for granted. Therefore, bringing awareness to these technologies is crucial for maintaining a sustainable and environmentally friendly campus. From the various departments mentioned previously in part c., we can estimate the number of students affected as follows:

Engineering Department Students: 30 x 4 = 120 students per year.

Outback Farm Rotating Staff and Visitors: 10 + 90 = 100 students per year.

Energy Department: TBD (Data to follow from Gail Cowan)

Visitors to the WWU including:

Regular Visitors: 200 people per year

Concert Goers: 200 people per year

Movie goers: 100 people per year

Total: 120+100+200+200+100+TBD = 720 and above.

Therefore, the total estimated number of people affected per year is greater than 720. It is worth noting that through promoting this product through the entertainment it powers, more people will be aware of the usefulness of this item and become involved in this project. A poll will be taken every year and with every event the farm hosts to maintain a record of how many people have attended concerts or movie nights powered by the Dionysus to verify the veracity of this estimate.

e. How long will the project last

Dionysus is designed for low maintenance, durability, and ease of use. The solar panels are covered by a 25-year warranty and all electric components within the power system will exceed that lifetime with proper operation. The car batteries we intend to purchase are covered by a 12 month warranty, have an expected lifetime of 7 years; they can also be easily replaced in case of failure. Should Dionysus need maintenance, open source project description files will allow any student with minimal engineering background to fix the issues, essentially extending the project lifetime indefinitely. This is beneficial because it gives future students at WWU the opportunity to learn about renewable energy and become competent about sustainable living.

Section 2: Project Goals

a. <u>What are the goals and desired outcomes of your project</u>

Dionysus system:

- Large Energy storage unit of four deep cycle marine batteries
- Solar panel array rated at 800 W to recharge battery bank
- Maximum Output of 1600W peak power for isolated areas
- Ability to provide the following charging options
    - 120V AC
    - USB Charging at 5V DC
    - 12V DC
    - 24V DC

Usage:

- Provide power for WWU's Outback Farm to run audio systems, fans, lights, irrigation pumps, and a TV for watching movies
- Help students and visitors visualize renewable energy systems and become educated about the usefulness of renewable energy applications

b. <u>How will your project positively impact sustainability at Western</u>

The Outback Farm has no access to electricity, limiting the use of the site in terms of enjoyment, access, and future growth of bringing more visitors to the farm. The goals of this project are to provide portable electrical power. All personnel involved at the farm will be introduced to Dionysus by the team members, raising renewable energy awareness to staff, students, and visitors. Dionysus is a model for a sustainable future at WWU and beyond. Some useful applications of Dionysus would include power to run an audio system, allowing the farm to hold concerts, movie nights, powering small irrigation pumps, running cooling fans, and several others. Concerts and movie nights at the farm will attract students monthly further raising awareness about how sustainable energy can foster a positive experience. There are a number of requests in the coming months for aspiring student artists to perform in the Outback so we hope they can use Dionysus to do just that if we are funded!

Moreover, three students work at the Outback as permanent staff members annually, as farm workers. This staff is in addition to several dedicated student volunteers. When the farm workers have a need to run a small pump to irrigate the spice gardens or other areas, our system can provide up to 1600W at 120V AC (standard U.S. outlet) or at 24VDC. This is enough to water 1 acre of land in just 2 hours. In addition, during hot summer months the farm can run box fans that will cool down students working on the farm rather than turning them away when they get tired. If the weather becomes very warm during a concert, box fans could be run

alongside the audio system to cool the concert attendees allowing them to enjoy the party longer.

Finally, power can be used to run a TV for playing movies on the farm. The Outback farm could host a movie night every month attracting more students to the farm. Along with the sound system, the students will greatly enjoy the outdoor night theatre. Because the farm lacks sufficient lighting during the night, Dionysus can power work lights so the farm can be made a safer place for students who want to gather in the outback cabin. If funded, Dionysus will greatly improve the status of the farm as being a place where students can gather anytime of the day to socialize and have fun. As the committee members can imagine, electrifying the Outback will greatly increase accessibility and enjoyability of the Outback Farm for the whole student population.

c. How does your project tie into broader campus sustainability goals or initiatives, including Western's Sustainable Action Plan?

According to the vision statement included in WWU's Sustainable Action Plan of 2017, "Western Washington University graduates will be instilled with an appreciation and understanding of the impact of human choices on people around the world and the planet itself." This project will positively foster sustainability by being an example of how the sun's energy can be harvested, stored into batteries, instead of depleting natural resources such as fossil fuels. Increasing independence from the current electricity grid, which greatly relies on fossil fuels such as natural gas and coal for power, is the key to sustainability.

As such, Dionysus not only provides a tangible energy solution for the Outback Farm, but will also raise awareness for the need of clean and deployable energy production systems. Dionysus will offer inspiration for the much-needed separation from conventional energy production through the devices it powers. WWU is engaged in the Climate Action Plan which outlines a strategy for WWU to be climate neutral (zero carbon emissions) by 2050. Because WWU joins over 660 institutions nationally to achieve this goal, by funding Dionysus other institutions would be able to see what our university accomplished and implement their own Dionysus. The spread of Dionysus would help other universities reach their own sustainable goals in the process. The university is also involved in preparing students to conduct research to address local, regional, and global environmental challenges. By implementing this system, students will have a chance to learn about our system and create one of their own to tackle environmental challenges in their own area. Students can also build their own Dionysus to take with them whenever they go camping, encouraging off-grid living. WWU also intends to increase all students sustainability-based literacy. This will be accomplished when students get to understand how Dionysus operates and can be used.

Another one of WWU goals is to have a centerpiece where students can come to and see sustainable living take place. Dionysus is just that by helping WWU create a campus environment that is habitable and a healthy community and planet through creative progressive projects. Dionysus will also be used to promote the sustainability studies minor which intends to

enroll 50 students by 2022. Sustainability studies offer students a holistic view of the relationships between society, economy, and its current negative impacts on the environment, further raising awareness of why sustainability is a great idea! Another objective of WWU is to provide sustainable content within every major by 2020. In the Electrical engineering major, there is currently none unless Dionysus is funded. It will assist faculty with including student learning outcomes that have a sustainability focus in designing better power electronics which could swap with the components we buy and showing the system works more efficiently than before. Dionysus will be a plug-and-play interface where working components could easily be swapped with power electronics students build. For example, students could build their own inverter or 40A solar charger. Because sustainability is one of WWU core values, building a cadre of faculty to engage in developing better sustainable technologies is a priority.

Lastly, the institute of energy studies has a strategic goal of using the WWU campus to build on student`s coursework and give them hands-on learning where they have a chance to make real contributions. This is sustainable action plan goal 6, objective 6.1. Some ongoing projects within the institute include students who initiated work on solar project siting, design, and permitting WWU campus as a location for a community solar program. Dionysus provides a model for the institute that meets their goals by making a contribution to the Outback farm.

Section 3: Project Participants

a. Team Information:

Name	**Department/ School Students provide major/ minor**	**Position: Faculty/staff/student Students provide expected graduation quarter/year**	**Western Email Address**
2020 Team Advisor: Dr. Xichen Jiang	Electrical Engineering	Faculty	xichen.jiang@wwu.edu
2020 Team Lead: Robert Sanborn	Electrical Engineering, Energy Concentration	Student, Graduation Spring 2020	sanborr2@wwu.edu
2020 Team Member: Amar Brar	Electrical Engineering, Energy Concentration	Student, Graduation Spring 2020	brara@wwu.edu

b. Project Stakeholders

Name	University Department and Position	Involvement in Project	Stakeholder Signature of Approval
Jack Herring	Dean of Fairhaven College	Liaison for deployment at Outback	
Amy Lazzell	Electrical Engineering, Academic Office Manager	Purchases Approval	
Reza Afshari	Electrical Engineering, Electronics Technician	Purchases Ordering	
Todd Morton	Electrical Engineering Program Director	Materials Storage	

c. Will any Associated Students clubs be involved?
No.

d. Each SEJF Project team is required to meet with their project coordinator on a regular basis. This individual will provide support and advice on your project. Communication with your project advisor is necessary for your project to proceed. Initial Below to acknowledge this agreement.

SEJF Project Coordinator	Initials	Date
Jonathan Riopelle	JR	2/18/2020
Team Lead	Initials	Date
Robert Sanborn	RS	2/18/2020

Section 4: Project Timeline

a. Describe your project's progress and promotional activity. Outline all tasks that are required to complete the projects, and all means in which you will promote the project to the campus, in the table below. Insert additional rows as necessary.

Action	Purpose	Initiation	Completion
Project Development	Provide functional final product prototype	September 2019	April 2020
Project Deployment	Provide access to energy for WWU`s Outback Farm(Host Concert, Movie night)	May 15th, 2020	June 15th, 2020
Project Development	Educate faculty on how Dionysus can be used in the classroom	May 15th, 2020	June 15th, 2020

b. Where will the project be located?

At WWU's Outback Farm.

c. Planned project completion date:

June 2020

d. Project final report due date: Project coordinator initials:

June 2020

Section 5: Project Budget

Item	Cost per Item ($)	Quantity	Cost ($)
Solar Panel HighTec RCL-M200W	160	4	640
Solar Panel Cable 160ft	79.99	1	79.99
MC4 4-to-1 Branch Connector pair	14.78	2	29.56
Inverter	149.95	1	149.95
Batteries	137.12	4	548.48
Solar Panel Mount	26.15	4	104.6
Solar Charge Controller	199	2	398
Audio System + Speakers	80.72	1	80.72
Lasko 20 in. 3 speed Box Fan	19.98	4	79.92
Renogy Adjustable Solar Panel Tilt Mount Brackets	26.15	4	104.60
Resettable Fuse 50A	11.99	1	11.99
Resettable Fuses 40A	5.00	4	20
Heavy Gauge Conductor Wire	20	1	200
Spare Parts Fund (10% of subtotal)	241.58	1	244.781
		Subtotal for Project Budget	$2447.81
		WA State sales tax (8.7%)	$212.96
		Total requested funds from SEJF	$2905.55

a. Additional funding sources: The SEJF Committee encourages the identification of additional funding sources to augment SEJF funds, and failure to secure such support may prevent approval of an application. List pending, approved, and denied applications for funding from other sources, along with the amounts requested from those sources.

   None.

b. If the project is implemented, will there be any ongoing replacement, operational, maintenance or renewal costs? If yes, has a source of funds been identified to cover those costs? This must be communicated to the appropriate stakeholder.

Ongoing Cost	Amount	Responsible Stakeholder	Signature
Maintenance	TBD	Outback Farm	
Maintenance and Further Development	N/A	N/A	

c. How will the success of the project be measured? Describe the quantitative and/or qualitative sustainability metrics you will use to measure the success of your project. A data collection plan is required for all projects.

Metric (qualitative or quantitative)	Description	Impact
Functional Product	Dionysus Complete	Clean Solar Energy Access to WWU's Outback Farm for running Irrigation pump, holding concerts, movie nights, lighting, and box fans
Educational Tool	Demonstrate the feasibility of clean energy sources	Inspire future students/faculty to invest their time and talent into clean energy projects
Promotional Tool	Complement WWU's vision for Sustainable Energy Practices	Increase WWU's prestige as a university leading in sustainability practices

d. Is there any additional information about the project that you would like to share?

I truly believe this project will help guide people towards a sustainable future and has a real life purpose in solving energy insecurity. More than an engineering project, Dionysus was designed with the hope of bringing relief where it is most needed, educating future students to renewable energy systems and the different ways in which they can be implemented.

Sustainable Action Fund Grant Program

SMALL GRANT - APPLICATION

PROPOSAL REVIEW

Once your project proposal is complete, you must print and receive hand-written signatures from the individuals listed below. After signatures are received, applications can be delivered as a hard copy to the SEJF Grant Program Manager, Johnathan Riopelle at Viking Commons Room 24 or by scanning the application and emailing it to johnathan.riopelle@wwu.edu.

Please set an appointment with the Sustainable Action Fund Grant Program Manager to review your draft proposal before submitting your application.

Sustainable Action Fund Grant Program Manager, Johnathan Riopelle

Viking Commons, Room 24

Available by appointment

Email: johnathan.riopelle@wwu.edu

Phone: (360) 650-4501

Signature: _____ Date: _____

This signature does NOT indicate that you have received funding, but it does confirm that the proposal has been received and is ready for funding review.

Comments:

Once your application is submitted, the Sustainable Action Fund Grant Program Manager and Director of Sustainability will determine funding for your SEJF Project.

Seth Vidaña, Director of Sustainability, Western Washington University

Viking Commons, Room 25

Phone: (360) 650-2491

Signature: _____ Date: _____

This signature approves funding for the project.

Comments: