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 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:

Dyonisos: An Integrated Energy Management System.

b. Describe your proposed project:

This project involves the design, construction and implementation of an integrated energy management system for Western Washington University's Outback Farm. Specifically, Dyonisos will harvest energy from solar panels, store the energy in car batteries and power DC electric appliances such as irrigation pumps, motors, computers, and chargers. This project is highly scalable as each modular system deployed can provide up to 1000 W of power and is highly efficient due to its all-in-one design.

Today's agricultural and energy productions are dominated by large single entities but there is a trend towards small and distributed production systems. Some of the benefits this alternative structure includes are increased resilience, easier access to sources of production and easier integration of renewable energy sources. This transition is both gaining momentum in developed countries and in regions of the world that are still facing energy and food insecurity.

While there exists technology for all the necessary components of renewable energy production, large, mobile, power systems are still cumbersome and difficult to implement. As such, Dyonisos aims to facilitate and to 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 280 W solar panels during the day, channeling that power to loads or to 12V car batteries for storage. The batteries can also provide energy to the load in parallel along with the solar panels when discharging or power the loads by themselves when there is no sunlight.

We have selected lead-acid car batteries due to their deep cycle usage capacity; these batteries allow for prolonged idle periods and full cycling of their capacity without significant degradation. Furthermore, lead-acid car batteries are readily available and easily sourced. The Itek 280-HE solar panels chosen for this project are locally manufactured and priced competitively while carrying a 25-year warranty. Itek has already donated 5 of these panels to the electrical engineering and additional panel donations may be obtained in

the future. The program has also acquired two "Ever Start Plus 35-3" lead-acid batteries for student projects that can be used for initial design prototyping.

An integrated user interface will allow for the selection of different modes of operation on Dyonisos, such as scheduled power delivery to loads, priority energy backup to the battery bank, or maximum combined power delivery from the solar panels and the batteries to the load. Figure 1 shows the internal architecture of Dyonisos and its integration with the aforementioned components. Figure 2 shows the physical concept of Dyonisos; a 3D printed enclosure that will be weather proofed.

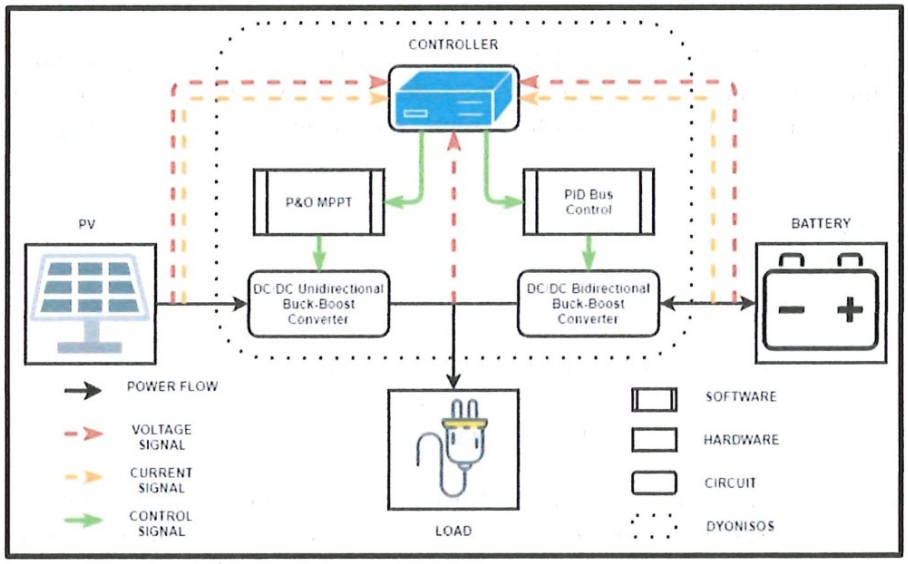

Figure 1 - Dyonisos Functional Schematic

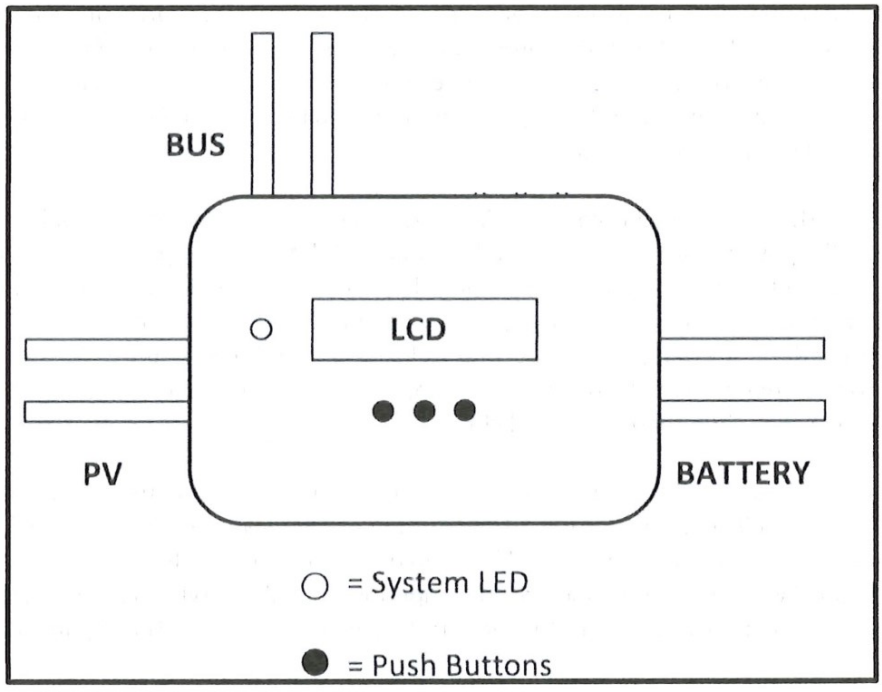

Figure 2 – Dyonisos Physical Concept

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

(1) Dyonisos will provide power for the outdoor cabin at the Outback Farm, allowing for a greater range of activities to be held on site (e.g., outdoor concerts, classes) and providing power needs for agricultural purposes. The Outback Farm is currently trying to increase the efficiency of their irrigation system and Dyonisos can provide the energy required to run water pumps. The implementation at the farm will be done through the creation of a mobile energy trailer; a self-contained solar energy harvester and storage system with Dyonisos at its core. Figure 3 shows a schematic of the possible realization of this first project.

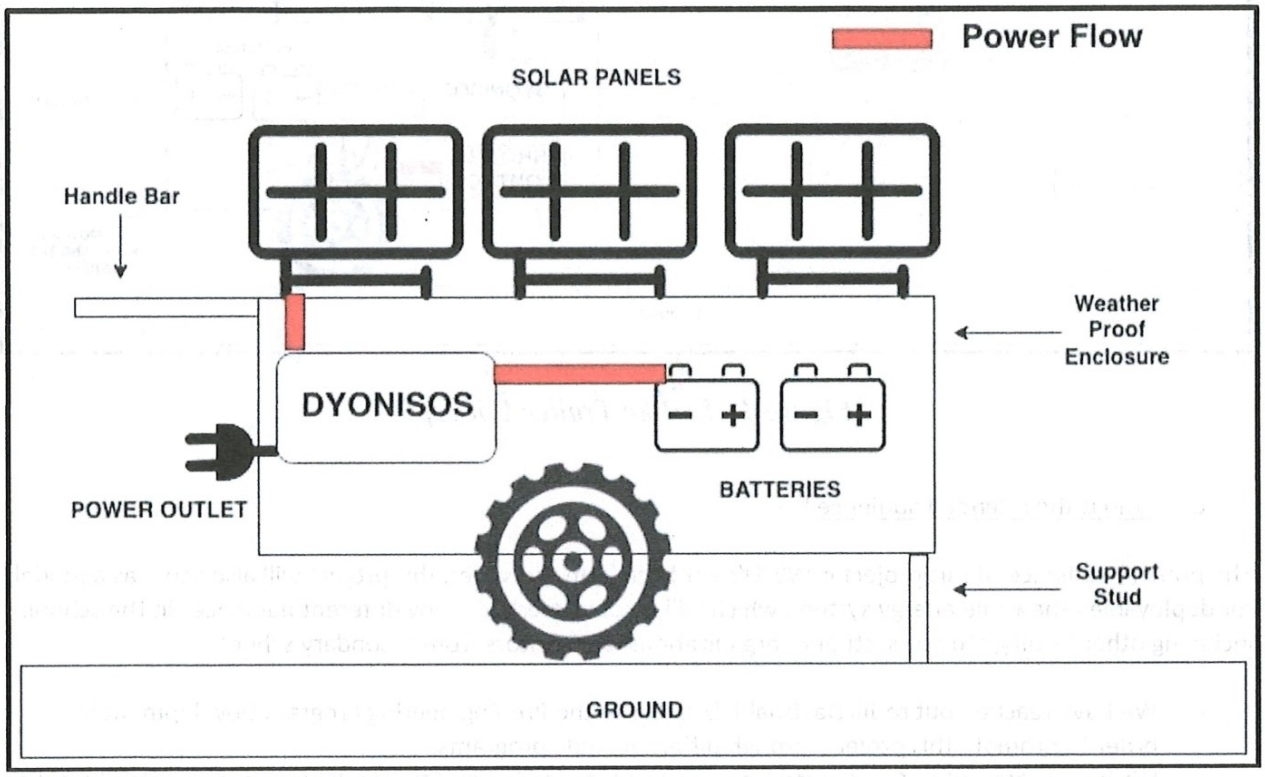

Figure 3 - Energy Trailer Concept

(2) Dyonisos will serve as the energy managing system for a student constructed Electric Bike Trailer. This solar powered trailer can be attached to any existing bicycle to make it into an electric bike. Once again, it will rely on solar panels and lead-acid batteries, interfacing those elements through Dyonisos. This will provide advertising for WWU and Dyonisos, raising awareness on alternatives ways of transport and hopefully inspiring future students regarding renewable systems. Figure 4 illustrates this project.

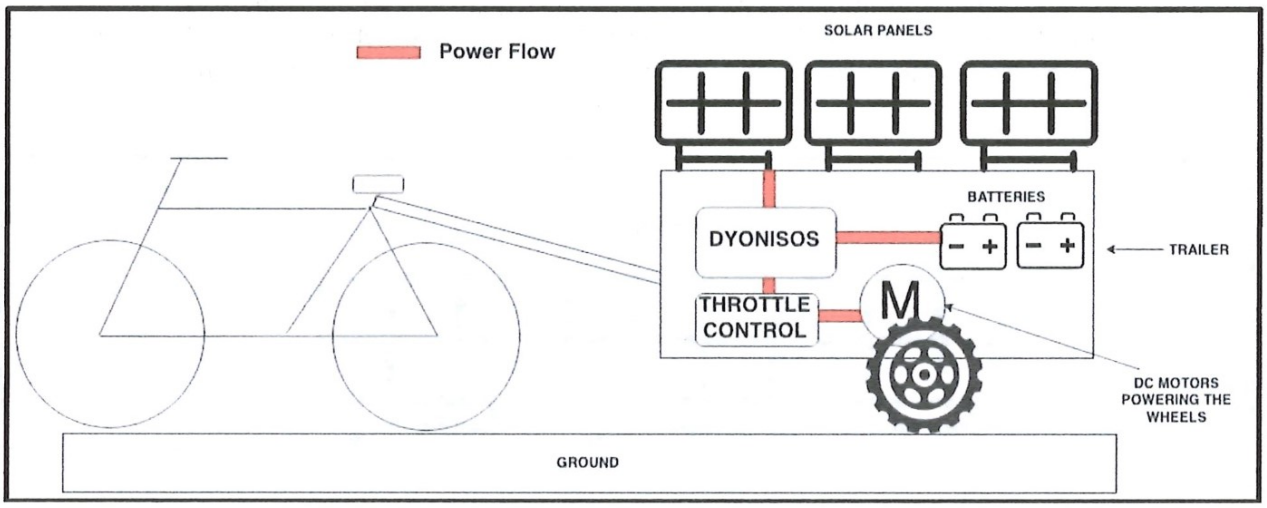

Figure 4 - E-Bike Trailer Concept

c. Who is the intended audience?

The primary audience of this project is WWU's Outback farm. However, this project will also serve as a model for deployable renewable energy system, which will be of interest to many different audiences in the school, including other faculty, students, student organizations, and visitors from secondary schools.

- We have reached out to Jill Davishahl, Director of the Pre-Engineering Program Development in order to promote this project through different study programs.
- We have reach out to Gail Cowan from the Institute for Energy Studies (IES) in order to introduce the program and its students to this project.
- We have reached out to Jason Lind, a communication teacher, to promote Dyonisos. Following a discussion with him, we intend to present Dyonisos in COMM 350, 224 and 318 during Spring quarter, as a project students of those classes will promote through digital media.
- Dyonisos will be presented to all teachers of the engineering department in June 2019, as well as students attending the engineering open house. Additionally, many students already expressed interest in taking over this project in the following years.
- The Outback will inform and train their staff and students on the use of Dyonisos as part of a solar generation system, educating people on renewable technologies.
- The Outback Farm partners with WWU associated students, Fairhaven college, L.E.A.D, and the office of sustainability, all of which will become aware of this project and its impact.

d. How many students will be affected?

All students will benefit from education of renewable power systems. The access to reliable and clean energy should not be taken for granted, so educating students and bringing awareness to these technologies is crucial for maintain a sustainable and environmentally energy network of the future. 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: 500 people per year.
Total: 120+100+500+TBD = 720 and above.

Therefore, the total estimated number of people affected per year is greater than 720. It is worth noting that through active publicity generation, more people will be aware and become involved in this project.

e. How long will the project last?

Dyonisos 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 should exceed that lifetime with proper operation. The car batteries we are intending on using are covered by a 2-year warranty, have an expected lifetime of 10 year; they can also be easily be replaced in case of failure. Should Dyonisos need maintenance, thorough open source documentation and project description files will allow any student with minimal engineering background to fix the issues, essentially extending the project lifetime indefinitely.

SECTION 2: Project Goals.

a. What are the goals and desired outcomes of your project?

Dyonisos system:

- Interface readily available lead-acid car batteries and solar panels to provide a common DC electric output of 1 kW peak power in isolated regions
- Ability to charge readily available car batteries
- Ability to provide 12, 24, and 48 V at its output
- Intuitive user Interface

Usage:

- Provide power for WWU's Outback Farm
- Educate students and visitors on renewable energy systems and their applications
- Create an electric bike trailer propelling the bike it is attached to

b. How will your project positively impact sustainability at Western?

The Outback Farm currently has no access to electricity, limiting the use of the site. By implementing a solar energy trailer using Dyonisos, the farm will be able to better water its crops through improved irrigation and plow the fields with electric agricultural tools. The presence of a power source also will allow for social events such as outdoor concerts, classes, and community activities. Furthermore, all personnel involved at the farm will be introduced to Dyonisos, raising renewable energy awareness to staff, students, and visitors. Dyonisos is a model for a sustainable future at WWU and beyond.

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." As such, Dyonisos 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. Furthermore, this project will offer inspiration for the much-needed separation from conventional energy production.

SECTION 3: Project Participants.

a. Team Information: A team should consist of two to five individuals, including the advisor.

Project Advisor Information (Faculty or Staff) Student proposals must include a staff or faculty advisor. The role of the advisor is to provide assistance and guidance to the team during the development, implementation, and post-implementation stages of the proposal process.

Project Lead: There must be at least one team lead designated for the project. This individual is expected to serve as the communication liaison for the project.

Name	Department/School Students provide major/minor	Position: Faculty/staff/student Students provide expected graduation quarter/year	Western email address
2019 Team Advisor: Dr. Xichen Jiang	Electrical Engineering	Faculty	xichen.jiang@wwu.edu
2019 Team Lead: Arthur Maréchal	Electrical Engineering Energy Concentration	Student, Graduation Spring 2019	marecha@wwu.edu
2019 Team Member: Troy Thornton	Electrical Engineering Energy Concentration	Student, Graduation Spring 2019	thorntt4@wwu.edu
2020 Team Member: Arick Grootveld	Electrical Engineering Electronic Concentration	Student, Graduation Spring 2020	grootva@wwu.edu
2020 Team Member: Amar Brar	Electrical Engineering Energy Concentration	Student, Graduation Spring 2020	brara@wwu.edu

b. Project Stakeholders

Does your project involve labor, include involvement, or require permission from organizations, departments, or individuals on campus or in the community? These project partners are your stakeholders; list them below. Each stakeholder must provide a signature of approval for this project. Insert additional rows as necessary. More than two stakeholders may move your application into the medium grant process. For more information, please refer to the Small Grant Toolkit.

Name	University Department and Position	Involvement in Project	Stakeholder signature of approval
Terri Kempton	Environmental Science, Instructor and Outback Farm Manager	Liaison for deployment at Outback	
Max Schneider Amar Brar	Electrical Engineering, Students	Bike Trailer Production	
Joseph Morgan Taylor Rogers	Electrical Engineering, Students	Energy Trailer Production	
~~TBD~~ Nathan Book	Electrical Engineering, Student	Coordinator of Production Teams	
Amy Lazzell	Academic Office Manager, EE Department	Purchases Approval	
Reza Afshari	Electronics Technician, EE Department	Purchases Ordering	
~~TBD~~ Todd Morton	~~TBD~~ Director EE	Bike Trailer Storage	

If your project team is proposing a temporary or permanent facility or property modification, then a Project Owner Form must be submitted with the application. Form can be found on SEJF website: wwu.edu/sustain/programs/SEJF/apply

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 advisement 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
Team Lead	**Initials**	**Date**
Arthur Maréchal	AM	

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 product prototype	September 2018	May 15th 2019
Project Deployment	Provide access to energy for WWU's Outback Farm	May 15th 2019	June 15th 2019
Project Deployment	Electric Bike Trailer Showcase Capitalization consistency issue here again	May 15th 2019	June 15th 2019
Project Promotion	Educate and promote this renewable energy system	May 15th 2019	June 15th 2019

b. Where will the project be located?

At WWU's Outback Farm and on an electric bike available on campus.

c. Planned project completion date:

June 2019

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

June 2019

SECTION 5: Project Budget.

Item	Cost per Item ($)	Quantity	Cost ($)
Dyonisos Hardware			
Inductors	150	2	300
Capacitors	50	4	200
Printed Circuit Board (PCB)	50	2	100
MOSFET Switches	5	6	30
Arduino Uno Rev 3	23	2	46
Wires	20	1	20
MC4 Connectors	7	8	56
Gate Drivers	6	4	24
Resistors	1	20	20
Current Sensors	6	5	30
Liquid Crystal Display (LCD) and push buttons	20	2	40
Enclosure Material	20	2	40
Screws	10	1	10
Heat Sink	50	2	100
Lead-Acid Deep Cycle Batteries (Ever Start Plus 35-3)	110	2	220
Solar Panels (Model iT-280-HE)	350	2	700
Trailers Hardware			
Wheels	25	4	100
Axle	20	4	80
Mounting Hardware	100	2	200
Wood for frame	100	2	200
24V DC Motor	70	4	280
Motor Mount	30	4	120
ETC Controller	30	1	30
Throttle Grip	30	1	30
Labor			
Amar Brar	12 / hour	25	300
Max Schneider	12 / hour	25	300
Troy Thornton	12 / hour	25	300
Arthur Maréchal	12 / hour	25	300
Joseph Morgan	12 / hour	25	300
Taylor Rogers	12 / hour	25	300
~~TBD~~ Nathan Bock	12 / hour	25	300
		Total project budget	**$~~Finish?~~ 5000**
		Total of all other funding sources, listed below	**$ 0**
		Total requested funds from SEJF	***$5000***

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 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	Unknown	Outback Farm	
Maintenance and Further Development	Unknown	Arick Grootveld Amar Brab	

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	Dyonisos Complete	Clean Energy Access for WWU's Outback Farm and Electric Bike Trailer
Educational Tool	Inspire future students to pursue clean energy implementation	Inspire and empower students to bring change in their generation
Promotional Tool	This would complement WWU's image	Environmentally responsible school supporting student initiative

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

I strongly believe this project has real life purposes and could be deployed in farms of a similar scale. An estimated 500 million farms of less than 2 hectares are responsible for 80% of the food consumed in rising countries and all of them could benefit from this type of system. More than an engineering project, Dyonisos 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: