

Campus Sustainability Fund Spring 2022 Annual Grant Proposal Application

Thank you for your interest in the new Campus Sustainability Fund! This application form may be used to apply for Spring 2022 Annual Grant funding in amounts from \$5,001 - \$100,000 through 5 PM on March 31st, 2022. Only applications that include thorough and thoughtful responses will be considered. Incomplete proposals will not be reviewed.

Please review our Spring 2022 grant information, including our eligibility and evaluation criteria here: sustainability.arizona.edu/csf

Please have a completed budget sheet ready to submit before starting this application. The template can be found here: <https://arizona.box.com/s/23d2mtihkkrx95c42luhk4k5omtqrwt>. After opening the link, click "Download" at the top right corner and it will download as an Excel Sheet.

All character limitations within this proposal include spaces.

For approved projects to receive funding, the project's department must have a STDFEE account as CSF funding can only be transferred to another STDFEE account. If your project's department does not have a STDFEE account set up, we recommend that it be a 265XXXX account. Although not required, we encourage you to use the same range to match the Sustainability Fee account: 2657605. Approved proposals will also be required to complete the Campus Sustainability Fund's Letter of Agreement before funding is dispersed where more details on this will be provided to the Fiscal Officer.

All funding must be used by the end of fiscal year 2023 (June 30, 2023). Unused funding as of this date will be returned to the Fund for reallocation for future funding opportunities.

** Please contact emilyhaworth@arizona.edu for questions, help in completing the budget template, or any other issues. **

Email *

jadamsb2@email.arizona.edu

Contact Information

Each project proposal requires a primary and secondary project manager as well as a fiscal officer. If the primary project manager is a student who graduates in May 2023, the secondary project manager must be a staff or faculty member OR a student who graduates AFTER May 2023.

Projects where the primary and secondary project manager are both students require the involvement of a staff or faculty member within the applicable department.

Primary Project Manager Name *

The primary project manager is responsible for completing this application, answering questions posed by the Campus Sustainability Fund's Committee, and completing all required reporting on project progress and outcomes.

John Adams

Primary Project Manager Status *

Student

Staff

Faculty

Other:

Primary Project Manager Email *

jadamsb2@email.arizona.edu

Primary Project Manager Department Name *

Biosphere 2

Secondary Project Manager Name *

The secondary project manager is responsible the back-up for the primary project manager if they are unable to complete any of the requirements of the Campus Sustainability Fund, particularly completing required reporting on project outcomes.

Jason Deleeuw

Secondary Project Manager Status *

Student

Staff

Faculty

Other:

Secondary Project Manager Email *

deleeuw@arizona.edu

Secondary Project Manager Department Name *

Biosphere 2

Departmental Employee Contact Name *

Projects where the primary and secondary project manager are both students require the involvement of a staff or faculty member within the applicable department. The departmental employee contact must be a staff or faculty member within your department who is responsible for monitoring the project's budget and reporting if both project managers are unavailable. If this does not apply to you, type N/A for these responses.

N/A

Departmental Employee Contact Email *

N/A

Departmental Employee Contact Department Name *

N/A

Fiscal Officer *

The fiscal officer is a staff member within your department who is responsible for financial transactions and who will support reporting by pulling requested expenses against awarded funding and ensuring that funding is spent within awarded categories.

Julie Stringer

Fiscal Officer Email *

jas31@email.arizona.edu

Fiscal Officer Department Name *

Biosphere 2

Tell Us About Your Project

Official Project Name *

Please be specific but concise as this name will appear on reports and our website. Creativity is encouraged!

Feeding the Future: student-led design at the nexus of food, energy, and water

Requested Funding Amount *

Please enter this amount after completing the budget sheet and populate the total amount here. If you are requesting multi-year funding, please format it as the following: \$67,800 (FY23), \$60,200 (FY24), \$50,400 (FY25)

\$85,700

Primary Project Category *

Please select one category that best encompasses the nature of your project.

- Water
- Energy
- Waste
- Transportation
- Food
- Social Sustainability (including Social/ Environmental Justice)
- Natural Environment
- Campus Life (Health & Wellbeing, Behavior Change)
- Research and Academics
- Carbon Reduction
- Art
- Built Environment
- Policy

Secondary Project Category *

Please select a secondary project category. If not applicable, select the same category again.

- Water
- Energy
- Waste
- Transportation
- Food
- Social Sustainability (including Social/ Environmental Justice)
- Natural Environment
- Campus Life (Health & Wellbeing, Behavior Change)
- Research and Academics
- Carbon Reduction
- Art
- Built Environment
- Policy

Background and Context *

Please provide any relevant background about your organization/team including your mission and/or expertise. Please also lay out the rationale for the proposed project such as context on the issue that your project would address. This section is meant to give us more information about you, while also giving you more space below to talk toward your proposed project. Responses are limited to 3,000 characters including spaces.

Biosphere 2 is the eminent location for research, education, and outreach surrounding issues of the environment, food safety and security, fit-for-purpose water and access, energy production and security, and their nexuses. Biosphere 2 seeks \$85,700 for purchase of a Freight Farm Greenery S, the latest generation modular container farm, to complement and expand Biosphere 2 (B2) research infrastructure to address a fundamental challenge facing society – food safety and security.

The University of Arizona (UA) established Biosphere 2 as a multidisciplinary hub for cutting edge environmental change research that produces global impact on our understanding of the world, practices to better manage its natural resources, and policies to protect our fragile ecosystems. Biosphere 2's unique spatial scale enables researchers to do controlled experimentation at an unprecedented systems-level of analysis: mesoscale research. Biosphere 2 provides the missing link between the laboratory and the real world and integrates these levels of analysis for forecasting, scenario evaluation, and science-based policy making.

As the world population nears 8 billion, with 11 billion looming ahead by the end of this century, the inextricable linkages between food, energy, and water security, show that seemingly simple changes in one area may have vast consequences in another. From water use in energy production, including traditional hydropower, to agricultural land-use for growing biofuels, to traditional agricultural production (an estimated 70% of freshwater use is for agriculture), these interdependencies have consequences for both the developed and the developing worlds. Industrious stewardship of food, energy, and water resources lead to questions related to situational scarcity, innovation of new materials, and smart-data driven decision making. This, coupled with the social science questions of access to resources and related public policy formulation, is central to a future of sustainable and resilient food, energy, and water systems.

The agricultural industry is breaking the boundaries of food production, increasing food safety and security by growing crops hydroponically inside shipping containers. A multi-pronged approach is necessary if we are going to reduce the carbon emission of agricultural production and its transport, improve the nutritional value of the crops, and increase the accessibility of the food to communities. Container grow environments provide a highly efficient and portable grow space that can be placed almost anywhere. Our goal is to create “circular economic” structures, leveraging and integrating this new facility into existing programming to enhance student/community engagement, alternative curriculum, and research & development. Biosphere 2, with its one-of-a-kind mesoscale structure, surpasses traditional laboratories in providing a place that enables this research

Project Description *

Please provide a description of your project. Please include information on the need your project fills and how it does so. Include objectives, an anticipated timeline, and expected impact(s). Responses are limited to 3,000 characters including spaces.

The science, education, and outreach programs associated with this modular container farm are transformational. The UAB2 will tackle the problem of sustainable agriculture while focusing on three grand challenges in science: integrating multiple disciplines (e.g., crop science, social justice, bioregenerative life support systems), applying instrumental calibration to adaptable biological systems (SIMOC), and developing an understanding of how this type of system can be integrated with renewable technologies to realize net zero production.

Initially, Biosphere 2 will set up one container grow environment on location. We envision research opportunities in the areas of new crop cultivation, crop commercial viability, and how this type of grow environment can potentially be a solution to food insecurity and injustices.

The Freight Farm Greenery S is the latest generation modular container farm that brings agriculture to a new dimension by growing and harvesting produce that is herbicide and pesticide free, utilizing non-genetically modified seeds, in a controlled environment without the use of sunlight in the grow process. Its container provides a sustainable, fully traceable, supply-chain-independent source of produce that is independent of soil or climate and uses minimal water. This makes it possible to bring fresh food to an area where it might otherwise be impossible to grow. They also help to significantly reduce the distance between where food is grown and where it is consumed. It would be possible, once proof of concept is completed, that such units could be located on the UArizona campus and be the primary supplier of greens to the UArizona campus.

Project Summary Snapshot *

Please provide a short summary of your project. This summary will be used on our new website and other Office of Sustainability materials, if approved. Think of this as a hyper-concentrated summary limited to just a few sentences. Responses are limited to 800 characters (~60-100 words).

A multi-pronged approach is necessary if we are going to reduce the carbon emissions from agricultural production and its transport, improve the nutritional value of the crops, and increase the accessibility of the food to communities. Container grow environments provide a highly efficient and portable grow space that can be placed almost anywhere. The goal is to create “circular economic” structures, leveraging and integrating this new facility into existing programming to student/community engagement, alternative curriculum, and research & development. Biosphere 2, with its one-of-a-kind mesoscale structure, surpasses traditional laboratories in providing a place that enables this research.

Project Feasibility & Logistics *

Please provide a description of the work that has been completed so far to make this project feasible. Have all relevant partners been contacted/coordinated with? Please identify them in your response. Have you received reasonable quotes for supplies? What research has been completed to lay the foundation for this project? Proposals that have not thoroughly pre-planned may be rejected outright. Responses are limited to 3,000 characters including spaces.

The Biosphere 2 team researched several options for container grow environments and through our evaluation of the integration of software, hardware, and the grow environment ranked Freight Farms as our top choice. Freight Farms' patented technology is proven globally and should be considered as the platform to address issues around sustainability, food security, and economic mobility. Freight Farms is the only company that provides a growing container, as described above, that meets the following criteria:

1. Freight Farms holds multiple patents on the vertical grow system hardware and software as part of an extensive intellectual property portfolio.
2. Freight Farms has submitted over 15 patents pending on various elements of hardware, software, and plant production unique to the industry. These patents cover advanced software and data processing capabilities, as well as automation and remote control.
3. Freight Farms operates the largest network of IoT-connected farms in the world, spanning 45 U.S. states and 26 countries. This network provides a continuous source of learning and advancement that can be leveraged across the entire network.

Freight Farms created this category within the industry and is the leader in research, including a contract with NASA to research growing in extreme climates and a farm at the University of California at Davis – the world's leading plant and animal science university – that will be leveraged across several vertical farming research projects.

The Biosphere 2 team has communicated on several occasions with Freight Farms' senior management team to present our interest in their product and the integration of it into our existing outreach, research, and student engagement programs. Freight Farms has supplied Biosphere 2 with a quote. Once the purchase order is executed the estimated delivery is 3-4 months. Biosphere 2 has identified a site location requiring minimal site prep and infrastructure upgrades.

The total cost for this project is estimated to be \$ 186,092.49 with the Total Annual Grant Funding request being \$85,700. Biosphere 2 has secured \$70,000 to assist with the purchase of the Freight Farm Greenery S container and will be providing an additional \$30,392.49 in funding sources for the project.

John Adams, Biosphere 2's Deputy Director and Chief Operating Officer, will oversee and direct all aspects of the project. Jason DeLeeuw, Biosphere 2's Lead Terrestrial Research Specialist and Chief Horticulturalist, will oversee the day-to-day operation and students/interns working in and around the container. The electrical wiring design and installation will be supported by Biosphere 2's Electrical Engineer, Wei Ren Ng and Biosphere 2's Electrician Kevin Brandt.

Environmental Sustainability Outcomes *

Please provide a brief description of how you expect your project to advance environmental sustainability on campus. Responses are limited to 3,000 characters including spaces. A definition of environmental sustainability is provided in our Spring 2022 Information.

At Biosphere 2 we are investigating agrivoltaics, the introduction of crop vegetation into the typical solar power plant installation in desert drylands. This novel approach leads to increased renewable energy production, increased food production, and reduced water use. Larger solar installations create a heat island effect which also reduces photovoltaic efficiency - as panel temperatures increase electricity production decreases. Water given off by the crops under the panels helps to cool them increasing the overall efficiency of the system. The shade from panels creates a more favorable growing environment for the plants leading to a significant increase in both crop productivity and water-use efficiency. However, crops are still grown out-of-doors and subject to extreme weather, pests, and limited growing seasons.

The Greenery S is a hydroponic system that grows plants in nutrient-rich water instead of soil, packing commercial-scale production into a 320 square-foot space, which can grow the equivalent of 2.5 acres of traditional farmland. IoT sensors constantly transfer Greenery S data to the proprietary Farmhand app for maximum control and transparency. The farm's built-in dehumidifier enables water recapture and recycling, contributing to the 99% reduction in water use versus traditional agriculture. At the same time, optimized watering schedules, lights, and climate conditions ensure that over 95% of the produce is sellable. Lastly, these farms can be distributed to any location globally and given their modular nature can be relocated in as little as one day.

It is our intention through student-led design teams to integrate agrivoltaics and the container farm into a system. By doing so, all the power needs of the container will be provided by a photovoltaics system which will also encourage a more favorable grow environment in the shade of the panels for taller varieties that cannot be grown inside the container. Within the container environmentally sensitive crops can be grown in a highly controlled and productive environment. This will be the first integration of traditional agricultural practices, photovoltaics, energy storage, and an indoor vertical farm.

Social Sustainability Outcomes *

Please provide a brief description of how you expect your project to advance social sustainability on campus. Responses are limited to 3,000 characters including spaces. A definition of social sustainability is provided in our Spring 2022 Information.

Our food system is largely centralized. Not only here in the US, but also worldwide, we are seeing a decrease in farms as our population and the need for nutritional food is increasing. The amount of U.S. farms has dropped by roughly 70% since the 1930s. It was recently reported by CUESA that the average meal in the United States travels about 1,500 miles from farm to plate.

Studies show that only about one-third of small farms have a designated successor in the family, in part because many young people are unwilling to make the significant financial investment in an industry that requires them to dedicate long hours and significant physical effort for meager rewards. There is a need for a new generation of farmers to provide that local food.

Beyond this, a centralized food system poses concrete risks: widespread foodborne illness outbreaks; shipping interruptions caused by natural disasters that cause food spoilage in one part of the world while people on the other side are cut off from their food source; and depletion of our land and natural resources. Decentralizing our food production has the power to mitigate these risks.

A container farm is more than just a cool piece of technology and a solution for the future, it is a platform for a viable business plan. A single vertical container farm can grow the equivalent of 2.5 acres of produce annually, a lucrative prospect. Furthermore, according to Freight Farms, a single farmer can comfortably operate up to 3 shipping containers. A modular and stackable design that conserves space and can be placed almost anywhere makes it easier to scale a vertical farming business compared to traditional farming methods.

Container farming works well in both urban and rural settings and can function as a standalone business or as an accessory to an existing farm or restaurant. Beyond food production, a container farm is an asset for small businesses and organizations, an easy way to incorporate sustainable practices, educational curriculum, community engagement, or job training into their programming, and a huge positive differentiator for their business.

Providing the opportunity for UArizona students to operate this new and innovative system will give them invaluable experiences in sustainable farming.

Student Leadership & Involvement *

Please provide a brief description of how you expect your project to benefit students on campus regarding the creation of leadership opportunities or student engagement. What leadership opportunities exist within your proposal? If you plan to hire/ or involve students, please describe in what capacity. For example, if you plan to hire students, create an internship, or seek student involvement, please describe relevant details thoroughly (wages, responsibilities, duration of job, extent of involvement, how you will solicit/ market these opportunities etc.). Responses are limited to 3,000 characters including spaces.

Initially Biosphere 2 and Freight Farms will sponsor a University of Arizona ENGR 489 A/B Interdisciplinary Capstone Design team to design an integrated photovoltaics system that will support all the electrical needs of the container and provide a shaded grow environment for taller stature crops outside. The objective of this design would be to combine these technologies into a system that could be placed in regions and communities where electrical connectivity is unavailable and the harshness of the environment limits agricultural practices. Additionally, Biosphere 2 and CEAC will provide internships for up to 4 students per semester to maintain and cultivate a variety of crops inside the container using, when possible, seeds from the Arizona Seed Bank. We have also partnered with the College of Engineering, College of Agricultural and Life Science, Honors College, the Controlled Environment and Agricultural Center and the Arizona Seed Bank to develop undergraduate and graduate research and experiential learning opportunities, work force development, and public engagement.

UArizona is an award-winning Hispanic Serving Institution (HSI), one of the top producers of Indigenous PhD graduates in the US, the state's land-grant institution – with Extension offices in all 15 AZ counties and a large tribal extension program and serves a demographic group and geographic region that will be well-served by training and preparation for careers in innovative sectors. These sectors - including STEM, sustainable energy, water conservation, urban agriculture, and the future of food - align with the UA mission, can improve personal and community earning potential, and provide economic development pathways that will continue serve our communities even as climate changes. The diverse student cohorts that can be convened in these types of project-based learning improve creative problem-solving abilities, generate more innovative products, and provide students with real-world experiences and skills that employers seek.

Education, Outreach, & Behavior Change *

Please provide a brief description of how you expect your project will communicate its impacts to the campus community. How will your project educate the campus community and/or incorporate outreach and behavior change? How are you reaching beyond the "sustainability choir?". Responses are limited to 3,000 characters including spaces.

Annually approximately 100,000 people visit Biosphere 2 and of those nearly 6000 are K-12 students and teachers. The container farm will be incorporated into the visitor experience by including it as a new stop featured in the Biosphere 2 experience app. Biosphere 2 Researchers and UArizona students' interviews will be incorporated at part of the app stop and these will be regularly updated as new cultivars are added and experiments completed. The container farm will also be regularly featured on all Biosphere 2 Social media platforms. The Biosphere 2 Facebook page has over 32,000 followers, Instagram has over 13,000 followers, and Twitter has nearly 5,000 followers. Additionally, we will create a video highlighting the importance and sustainable technologies of the container farms, how it is being used by UArizona students and researchers, and how such technologies have been incorporated in other communities to reduce the carbon emission of agricultural production, increase food safety and security, and increase the accessibility of the food to communities. Dr. Kevin Bonine, Biosphere 2's director of education and outreach will facilitate connections with UA Main campus through undergraduate/graduate engagement.

Project Budget *

Please provide a completed project budget using our Budget Template. The template can be found here:

<https://arizona.box.com/s/23d2mtihkakrx95c42luhk4k5omtqrwt>

Using the link, click "Download" at the top right corner and it will download as an Excel Sheet. You will need to sign into Box if you haven't used it prior. Please save your Excel sheet as: Project Name_Budget Template



Feeding the Futu...

Supporting Document

Not required, but please upload any relevant documents here, including annual reports, FM budget quotes, maps, images of the product or equipment to be purchased, etc.



Sustainability Fre...

This form was created inside of University of Arizona.

Google Forms