

# Progress Report - Campus Sustainability Fund

March 2023 – Feeding the Future: student-led design at the nexus of food, energy, and water

## Email:

jadamsb2@arizona.edu

## Project Manager Name:

*who is submitting this project?*

John Adams

## Project Name:

Feeding the Future Freight Farm student lead

## Project Subaccount Number:

2234751 - 23.52

## Project Summary Snapshot:

*Please copy and paste the "Summary Snapshot" you provided in your project application.*

### Response

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.

## Requested Metrics:

*Please report your project's metrics and their most recent number or response in a list format.*

### Response

# of crop varieties being planted 36

# of lbs produced monthly 291 lbs/ month

# of pounds donated to the Campus Pantry and local Food Bank 1861.20 lbs

# of students involved in the Capstone project--6

# of student positions created--3

# of people in the core project team involved in planning and execution of the project (if they're a student/ staff/ faculty etc)-6

# of hours spent on this project (broken up by students/ staff) Students average approximately a total of 20-22 hours/week Staff Hours--Total of 24 hours per week

We have hosted over 20 private groups (>150 people) where we have showcased the Freight Farm highlighting the importance and sustainable technologies of the farms, how it is being used by UArizona students and researchers to improve agricultural practices.

## Project Accomplishments :

*Please describe what aspects of the project have been accomplished. Be as descriptive and specific as possible. Examples of accomplishments could include: Held 4 public meetings totaling 130 attendees; Transitioned 300 square feet of dirt into usable garden space and signed on 14 community garden volunteers. Other examples of accomplishments could include sharing a confirmed schedule of events, the connections/contacts that have been established, etc.*

## Response

We have successfully developed partnerships with the University of Arizona Campus Pantry and Impact of Southern Arizona. On a nearly weekly basis Biosphere 2 can provide fresh greens, harvested from the Greenery S Freight Farm to both organizations. To date we have delivered over 2000 lbs of fresh produce. Although we have not received exact numbers of either organization, the produce provided has been included in well over 5,000 meals to the pantry's respective clients.

We have been a case study for several communities as we evaluate the integration of such technology into their respective programs for provide hands on educational opportunities as well as providing fresh produce.

- Cayman Island—we had a discussion with Codi Whittaker from Primitive Green to look at how local government could purchase and donate a farm to a local school to facilitate hands on engagement, work force development and grow fresh produce.
- Cochise County—we met with Cheyenne MacMasters from the Cochise County Cooperative Extension and her team to discuss ways in which they could begin a pilot program that would bring several Freight Farms to Cochise County. The stated purpose of their farms would be threefold: (1) to provide fresh, nutrient-dense leafy greens to local food pantries and sell any surplus to local restaurants and hospitals; (2) to educate people about how to use hydroponic farming effectively; and (3) to reduce local water consumption. Later in March their team will come to Biosphere 2 to see the Freight Farm firsthand and learn more about it up close.

Biosphere 2 sponsor a University of Arizona ENGR 489 A/B Interdisciplinary Capstone Design team to design an integrated photovoltaics system that will support the electrical needs of the container and provide a shaded grow environment for taller stature crops outside. For the past two semesters we have been mentoring Students completing the course requirements for ENG 498 Interdisciplinary Cap stone project, they have made great progress and recently presenting their progress at their ISR presentation. They will be presenting the final design at Design Day in early May. All presentation can be found in the box folder <https://arizona.box.com/s/79sz5f0se0pefnzyeii85765p8plnvxt>

The objective of the design is to combine technologies into a system that could be placed in regions and communities where electrical connectivity is unavailable and harshness of the environment limits agricultural practices. Initial design by the students will be completed by May 2023. The students are:

- Brooke Bykowski, [bykowski@arizona.edu](mailto:bykowski@arizona.edu)
- Stephanie Orchard, [stephanieorchard@arizona.edu](mailto:stephanieorchard@arizona.edu)
- Alejandro Quijada, [quijada52@arizona.edu](mailto:quijada52@arizona.edu)
- Katelynn Carroll, [katielynn@arizona.edu](mailto:katielynn@arizona.edu)
- Logan Eaton, [loganeaton@arizona.edu](mailto:loganeaton@arizona.edu)
- Hailey Schleining, [haileyschleining@arizona.edu](mailto:haileyschleining@arizona.edu)

Biosphere 2 have provided internships for 3 students to maintain and cultivate a variety of crops inside the container. This provide real-world hands-on experience with a system they will likely work with once they are in the workforce. These students are:

- Jordan Collins, [jcollins@arizona.edu](mailto:jcollins@arizona.edu)
- Alex Cantor, [alexcantor@arizona.edu](mailto:alexcantor@arizona.edu)
- Paiton Stith, [pstith@arizona.edu](mailto:pstith@arizona.edu)

Hosted Dr. Triston Hooks, CEAC Faculty Biosystems Engineering Integrated Freight Farm into BE 217, BE 350 Advanced Hydroponic Crop Production, BE 497 Integrated Pest Management for CEA. This fall BE 217: Intro to Hydroponics; 14 students plus Triston visited Freight Farms.

Dr. Gene Giacomelli and his Controlled Environment Systems BE & PLS 483/583 visited with 16 students.

We also had a meeting with Source One water, a phoenix based company using proprietary technology to harvest water from the air. Looking at integration of this technology to support Freight Farm's water needs.

To date the Freight Farm has produced 2032.68 pounds of produce that have been delivered to the Campus Pantry, Impact of Southern Arizona, and to Biosphere 2.

- 20,148 plants have been grown and harvested.
- Production includes the following species with respective number of cultivars:
  - Lettuce (22 cultivars)
  - Mustard greens (6 cultivars)
  - Kale (4 cultivars)
  - Basil (3 cultivars)
  - Arugula (1 cultivar)
  - Bok Choi (1 cultivar)
  - Collard greens (1 cultivar)
  - Radicchio (1 cultivar)
  - Swiss chard (1 cultivar)
  - Sorrel (1 cultivar)
  - Spinach (1 cultivar)
  - Watercress (1 cultivar)
  - Upland cress (1 cultivar)

## Next Steps:

### Response

- 1.) Hire 2-3 additional students for summer support of the Freight Farms
- 2.) Working with CEAC development several research questions that can be addressed using the Freight Frame and lead by UA students
- 3.) Work towards finalizing the engineering student design into construction documents
- 4.) development a solid cost estimate for integration of Agrivoltaics and Freight farms
- 5.) installing Source One air water harvesting technology to Freight Farms to supply all necessary water

## Challenges Faced:

*Please identify and describe any obstacles/roadblocks you or your team have experienced, and detail how you've managed them/ will manage them. Should your project already be completed, please note what challenges you faced and what you would do differently.*

### Response:

Probably the biggest challenge with running the Freight Farm has been the learning curve. There was a lot to learn about the farm and we had to learn it on the fly to get the farm up and running as quickly as possible. We have addressed this challenge by relying on our general knowledge of hydroponics systems and by using the Freight Farm Academy, an online course available to Freight Farm users. We have come a long way; even now, though, after six months, we are still learning different ways to run the farm more efficiently. A major challenge we faced after the farm was set up was maintaining internet connection to the farm. When the power to the farm was interrupted, during a storm during the summer, for example, the internet connection to B2 would frequently be knocked offline. If this happened, the entire farm would shut down because the farm's control is completely dependent upon the internet. We solved this challenge by installing new, more powerful antennas to the Freight Farm and to B2, which eliminated the problem. We still have daily challenges, of course, such as clogged emitters, bacterial and algal outbreaks in the tanks, and pH imbalances in the nutrient solution, but we strive to be resilient and resourceful in addressing these problems. When we have been unable solve a problem by ourselves, we consult Freight Farms or the UA CEAC for support.

## Project Support:

*Can the CSF support you in addressing any roadblocks you've encountered? How else can the CSF support your project?*

**Response:**

We would like to develop additional connections to Food Banks other than the two we are working with now to ensure all produce grown in the farms is fully utilized.

**Photo Upload:**

*Please upload or provide links (below) to relevant photos.*

**Response:**

\* IMG\_3864.JPG [https://sustainability.arizona.edu/system/files/webform/csf\_progress\_report/286/IMG\_3864.JPG] \* IMG\_3650.JPG [https://sustainability.arizona.edu/system/files/webform/csf\_progress\_report/286/IMG\_3650.JPG] \* IMG\_3573.JPG [https://sustainability.arizona.edu/system/files/webform/csf\_progress\_report/286/IMG\_3573.JPG] \* IMG\_3776 3.JPG [https://sustainability.arizona.edu/system/files/webform/csf\_progress\_report/286/IMG\_3776%203.JPG] \* FF\_1.6.1.jpg [https://sustainability.arizona.edu/system/files/webform/csf\_progress\_report/286/FF\_1.6.1.jpg] \* IMG\_3629.JPG [https://sustainability.arizona.edu/system/files/webform/csf\_progress\_report/286/IMG\_3629.JPG] Photo Link <https://arizona.box.com/s/79sz5f0se0pefnzyej85765p8plnvxt> This box folder contains additional photos, videos, presentations and support materials

**Photo Link:**

*Please copy hyperlinks to photos here should you not be able to individually upload photos.*

**Response:**

<https://arizona.box.com/s/79sz5f0se0pefnzyej85765p8plnvxt> This box folder contains additional photos, videos, presentations and support materials

**Media/Links:**

*Please include links to any media coverage or events information (e.g. news, social media, websites, interviews, etc.)*

**Response:**

We did not have any new media coverage since our last report but the Freight Farm is now one of the app stops visitors have access to. It is stop 112 and this video is included in the box folder for your viewing, <https://arizona.box.com/s/79sz5f0se0pefnzyej85765p8plnvxt>

- UA News Release: <https://news.arizona.edu/press-release/feeding-future-biosphere-2-delivers-first-lettuce-crop-campus-pantry-food-bank>
- Story KVOA : [https://www.kvoa.com/video/1st-crop-of-lettuce-grown-in-container-farm-delivered-to-uarizona-campus-pantry/video\\_e143bb68-1409-5675-8a63-e9e391e65a17.html](https://www.kvoa.com/video/1st-crop-of-lettuce-grown-in-container-farm-delivered-to-uarizona-campus-pantry/video_e143bb68-1409-5675-8a63-e9e391e65a17.html)
- Tweet From President Robbins: <https://twitter.com/UArizonaPres/status/1559627188185583616>
- KOLD News 13(Biosphere 2's Freight Farm, UA Students Find New ways to Grow Food): <https://www.kold.com/2022/11/15/shipping-container-green-machine-uas-biosphere-2-finds-new-ways-grow-food/>
- Biosphere 2 YouTube Channel: <https://www.youtube.com/watch?v=b-k8xtCMAb0>
- Featured in Arizona Institute for Resilient Environments and Societies Newsletter *The Dirt*
- Featured in Biosphere 2's Newsletter: Inside the Impact, October 2022 Issue
- Featured in Freight Farm's recent Newsletter, went out to 37,000 subscribers