



NAU Green Fund

Research Grant Application

Student Research Grant Application

Green Fund Mission Statement: “The NAU Green Fund promotes student participation in and provides funding for projects that reduce NAU’s negative impact on the environment and create a culture of sustainability on-campus.”

In support of the Green Fund’s Mission Statement and its ability to improve sustainability on campus, the Green Fund will be accepting proposals for research projects that help to understand and reduce NAU’s environmental impact, with the goal that this research funding could act as seed funding for Green Fund project proposals.

Grants will be awarded using rolling deadlines and the Committee will enforce a priority date with a soft close during week 12 of the semester. Due to limited time and a reduction in weekly meetings at the end of the semester, the Committee may not review applications submitted after.

Submit completed application packages to: GreenFund@nau.edu

Application Details

All applications **must** meet the following requirements to be considered for funding:

1. Research must be primarily conducted by either an **undergraduate or graduate student** who is currently enrolled full-time at NAU.
2. Research must be conducted under the guidance and approval of a full-time NAU faculty member.
3. Research design and goals must focus on improving sustainability on NAU's campus.

Only a **complete application package** will be considered for funding. A complete package includes:

- **Abstract** of the project's goals, expected results, and broader impacts to the NAU campus community (200–300 words).
- **Detailed project proposal** with specific information about current literature, research goals, methods, data collection and dissemination, and how this research will improve sustainability at NAU (1–2 pages).
- **Questionnaire** (filled out using the provided template).
- **Project budget** (filled out using the provided template).
- **Project timeline** (filled out using the provided template).
- **Letter of recommendation** from the faculty supervisor addressing the student's ability to conduct and complete the research (may be submitted separately, but must be received by the deadline).
- **Signed student commitment** to present a status update of their research in both an oral presentation to the Green Fund Committee and a poster/exhibit presentation at the Undergraduate or Graduate Symposium, within one year of receiving funding.

Additional Requirements and Rules

- Funding provided by the Green Fund **may not be used** in any way for faculty salary.

- Funding **may allow for student wages** depending on project specifics and explicit Green Fund approval. The Green Fund recognizes that some projects require significant time and labor, not just materials.
- If funding is used for student wages, the applicant **must coordinate payment** through the department of the project advisor. The Green Fund does not coordinate student positions.
- Funding is limited to **one proposal per student per year**, but applicants may apply across multiple years.

A student who has previously received a Green Fund Student Research Grant is **neither more nor less likely** to receive funding again.

- Recipients of the Student Research Grant are determined **at the sole discretion of the Green Fund Committee**, based on merit and goals-based review of all complete applications.

Application Availability and Deadlines

The Student Research Grant application portal and associated documents will remain open throughout the year.

- Funds will be **encumbered at the beginning of each semester** to cover expected costs.
- Grants will be awarded on a **rolling deadline basis** to increase student participation.
- The Committee will enforce a **priority date with a soft close during week 12** of the semester.
- Applications submitted after this time **may not be reviewed** due to limited availability and reduced weekly meetings at the end of the semester.

Project Coordination and Funding Distribution

- Applicants are responsible for contacting other university entities if the research involves **space use or alteration of existing infrastructure**.
- Upon approval, **funding will be disbursed** to the department of the project advisor or designated sponsoring department.

- Any **unused or remaining funds** must be returned to the Green Fund after the research project is completed.

Student Wage Guidelines


- **Students** may budget **\$15.50/hour for up to 200 hours maximum**.
- Any increase or decrease in wage values is **at the discretion of the Committee**.

We highly recommend meeting with a Green Fund Committee member prior to submitting the application. The Green Fund Committee member will assist you with the Project Application writing process, if needed. Please reach out to GreenFund@nau.edu for assistance.

Contact Information

Contact Information	
Project Leader Name:	Justin Patterson
Phone:	520-528-2758
NAU Email:	jip66@nau.edu
Date:	1/21/2026
Expected Graduation Date:	May 2026
Project Name:	Experimental 3D Printer for Vacuum Moisture Swing

Department / Advisor Information	
Project Advisor Name:	Jennifer Wade
Project Advisor Department:	Mechanical Engineering
Phone:	928-523-152
NAU Email:	jennifer.wade@nau.edu
Title:	Professor

Funding Information for Transfer	
Local Speedchart:	 20381
Financial Contact:	David Willy

Abstract

As atmospheric CO₂ continues to rise, it becomes increasingly important to reduce carbon emissions to prevent further environmental impacts. To assist in this effort, NAU has committed to the goal of carbon neutrality by 2030 with the particular focus of reducing scope one and scope two emissions. The largest source of these emissions is the NAU heating plants, power plants used for NAUs purchased power, and emissions generated by NAUs fleet. Point source absorbers such as carbon capture technology are particularly promising solutions for these applications and can be implemented into existing systems. By utilizing a vacuum moisture swing process, these systems may be further optimized to capture carbon emissions at minimal energy costs. To begin evaluating the feasibility and cost of carbon capture for NAU, further practical tests are required. To this end, we are developing a pilot plant and test bed to assist multiple researchers in verifying the feasibility of carbon capture sorbents which they have been developing. Funds from the Green fund would allow us to perform additional experiments with structured sorbents 3D printed from inexpensive powders. Recent studies have shown that these structures can improve efficiency, reduce power consumption, and improve the ease of implementation to point source systems similar to those present at NAU. If these sorbents prove practical and cost-effective, testing on 3d printed structured sorbents would assist in any future feasibility study on carbon capture at NAU directly or in regional communities and would improve the applicability of carbon capture systems to any future NAU projects further aligning the project with NAUs goals.

Project Proposal

The goal of the vacuum moisture swing capstone project is to design and build a direct air capture device that utilizes a vacuum moisture swing process to separate CO₂ from ambient air. This process utilizes common sorbent materials to bind to CO₂ as air passes through them, and then it leverages a process in which moisture unbinds the CO₂ from the sorbents. The intent is to have a scalable design which will be practical and energy-efficient for large-scale applications such as on the NAU campus. The project is being completed under the requirements of the Mechanical Engineering capstone class under supervision of David Willy. The project's client and advisor is Jennifer Wade, who has been exploring the vacuum moisture process in NAU's Climate Solutions Lab. It is sponsored by SRP, who provided funding to build the lab scale DAC apparatus.

The project has two primary goals: to design a structured sorbent bed that will be more energy efficient than the standard packed bed, and to build a functioning, lab-scale device which will perform the vacuum moisture swing process for this sorbent bed. Sorbent beds will be designed as CAD models and run through CFD simulations to optimize their shape for maximum reaction with minimal obstruction which will lead to higher performance at a lower energy cost. By using a Unique ceramic 3D printer these structures can be easily manufactured for physically testing in our device. The resulting data can then be scaled up to determine the approximate energy requirements to capture CO₂ on a full scale.

Once completed this system will theoretically remove CO₂ directly from the atmosphere for a small portion of the energy required by existing systems. The energy requirements for such a system can then be determined for application on our NAU campus. With the increased performance due to the vacuum moisture swing and complex sorbent structures, carbon neutrality will become a much more realistic goal for NAU and many other high emission facilities.

Throughout the fall 2025 semester this device has been designed, and various sorbent structures have been theoretically tested for the final design. In the next few weeks all parts will be ordered, and the lab scale test rig will be assembled. If this printer is funded, we will be allowed to begin printing complex sorbent structures as soon as the device is ready to allow maximum time to physically optimize our system.


Project Overview

Please answer the following questions to the best of your ability, for questions that are not applicable, please list N/A.

Please select the focus of your research project.

- Renewable energy/Energy efficiency
- Emissions reduction
- Environmental justice/ Intersectionality
- Waste Minimization
- Understanding sustainability behavior/ perspecting of NAU students
- Transportation
- Other: _____

1. How will your research promote the purpose of the Green Fund and further sustainability on NAU's campus?

Nau's office of sustainability has a goal to reach complete carbon neutrality here on campus by 2030. Due to the heating and transportation required on this snowy mountain campus it is very Unlikely for Nau to reach these goals in the next 4 years. Carbon capture technology such as point source absorbers could eliminate these emissions however, they require great amounts of energy. By utilizing a vacuum moisture swing process the energy requirement for these systems could be greatly reduced, allowing NAU's sustainability goals to be met. By developing and testing this process here on campus NAU, can be of the first major institutions to integrate carbon capture technology of such  efficiency.

2. Will your research require the utilization of any spaces or infrastructure on campus? If so, identify the specific locations and/or infrastructure, how much of the space you require, and what each space will be used for. Please refer to the [Space Committee Approval Process](#) document to know if your research will

require approval through the space committee.

Project advisor Jennifer Wade will provide space inside one of her labs.

3. Will other departments on campus be needed to assist in this project (i.e. Facility Services, Campus Transit)? If so, identify department partnerships.

No assistance will be needed from any on campus departments.

4. How will you monitor the impact of your research after completion? What do you plan to do with the results of your research?

The direct result of this funding would be complex sorbent structures, designed to maximize absorption while minimizing obstruction. These structures will then be tested in our lab scale system to determine the optimal shape and its expected performance. Once this has been optimized data will be adjusted for a larger scale and compared to existing DAC systems. The design may then be scaled up for campus or commercial implementation.

Research Budget

Please respond to the following funding question, and complete a thorough breakdown of all projects in the provided Line Item Budget below. Include a 5% line item for contingency of the overall cost.

Does this research have any other sources of funding, and/or have you applied for other sources of funding? If so, list all additional sources of funding, both confirmed and potential, outside of the funds being requested from the Green Fund.

Line Item Budget:

Item	Item Justification	Quantity	Price per Unit
Eazao Bio Ceramic 3D Printer https://www.eazao.com/product/eazao-bio/	Ceramic 3D printer used to print complex sorbent structures	1	\$899
Air Control Box for Eazao Bio https://www.eazao.com/product/air-control-box/	Allows non continuous (more complex) prints	1	\$500
Additional 30mL Cartridges for Eazao Bio https://www.eazao.com/product/30ml-cartridge/	Less prep time between prints, may deteriorate over time.	2	\$8
Additional 55mL Cartridges for Eazao Bio https://www.eazao.com/product/55ml-cartridge/	Less prep time between prints, may deteriorate over time.	3	\$12

<p>Print Release Film for Eazao Bio</p> <p>https://www.eazao.com/product/print-release-film/</p>	<p>Less prep time between prints, may break over time</p>	5	\$5
<p>Eazao nozzles 4pk</p> <p>https://www.eazao.com/product/nozzles/</p>	<p>Additional sizes, may break over time</p>	2	\$5
<p>Eazao Nozzle adapter</p> <p>https://www.eazao.com/product/nozzle-adapter/</p>	<p>Used to fit Eazao nozzles, may break over time</p>	2	\$5
<p>US freight from Eazao and tax</p>	<p>Tax and shipping</p>	1	\$189.38
<p>California Air Tools 1.0 Gal. Light and Quiet Steel Tank Electric Portable Air Compressor</p> <p>https://www.homedepot.com/p/California-Air-Tools-1-0-Gal-Light-and-Quiet-Steel-Tank-Electric-Portable-Air-Compressor-1P1060S/300500747</p>	<p>Required to feed printer</p>	1	\$149
<p>Husky 25 ft. Recoil Nylon Air Hose Kit 15-Piece</p> <p>https://www.homedepot.com/p/Husky-25-ft-Recoil-Nylon-Air-</p>	<p>Connects compressor to printer</p>	1	\$20.98

Hose-Kit-15-Piece-UAAK-15F-2/320249023			
Husky 1/4 in. Air Compressor Filter https://www.homedepot.com/p/Husky-1-4-in-Air-Compressor-Filter-HDA70403AV/100027474#overlay	Keeps moisture from going to printer	1	\$16.48
Harvey 1/2 in. x 260 in. Thread Sealing PTFE Plumber's Tape https://www.homedepot.com/p/Harvey-1-2-in-x-260-in-Thread-Sealing-PTFE-Plumber-s-Tape-178503/202280370	Seal all connections	1	\$0.98
Home Depot sales tax	Tax	1	\$18.94
DigiKey QS-1/4-6 adapter (tax and shipping included) https://www.digikey.com/en/products/detail/festo-corporation/QS-1-4-6/13977142?gclid=CjwKCAjwpOfHBhAxEiwAm1SwEkVQoXRPCC	Necessary adapter, may lose seal over time	3	\$14.83

Nri4bNjvUkmUvA6hUKXKNYC urQpiY4YA_bWYXmd0TrPBo CNg0QAvD_BwE			
Laguna 5lb c&c ball clay (tax and shipping included) <a href="https://www.lagunaclay.com/products/c-c-ball-clay?mvact=addedtocart&mva
ct=addedtocart">https://www.lagunaclay.com/pr oducts/c-c-ball- clay?mvact=addedtocart&mva ct=addedtocart	Clay to begin testing printer	1	\$26.69
Creality MK8 Nozzle Kit 24pc (tax and shipping includes) <a href="https://store.creality.com/produ
cts/mk8-nozzles-kit-24-pcs">https://store.creality.com/produ cts/mk8-nozzles-kit-24-pcs	Extra sizes, may break over time	1	\$18.77

5% Contingency (5% of total project cost)	\$97.60
Total Research Cost	\$2049.65

Total Funding Requested: \$2049.65

Research Timeline

Please provide an expected timeline for your research in the template below. Green Fund recognizes that complex research of this nature should have flexible, adaptable schedules, and the timeline provided will be treated as such. However, it is expected that you strive to adhere to this schedule as much as possible. **Please be as specific as possible.**

Expected Timeline:

Action	Parties Involved	Completion Month & Year
Unbox, assemble and setup all components, to begin commissioning printer	Capstone Team	Early February 2026
Optimize sorbent slurry for printing of structures	Capstone Team	Late February 2026
Begin to print wide range of structures that have performed well in theoretical simulations	Capstone Team	Early March 2026
Physically test structures, compare results between structures and with theoretical data	Capstone Team	Late March 2026
Select optimal structure and record all relevant data. Scale data up and compare to existing systems	Capstone Team	Early April 2026

Compile all findings for poster and presentation at undergrad symposium	Capstone Team	Late April 2026
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Expected Project Completion Date: April 20th, 2026

Sponsorship Form Completion Checklist

Please complete all of the following items before submitting an application.

- Contact Information
- Project Overview
- Project Budget
- Project Timeline
- Obtain **ALL** necessary letters of support for reimbursement, ongoing maintenance, student wages, etc. Attach the letters of support to the completed application.
- Submit the completed application to GreenFund@nau.edu

Commitment to Present Research

If selected as a recipient of the Green Fund Student Research Grant, regardless of the outcome of my research project, I Branden Welker commit to presenting the status of the research as described in this application in the form of an oral presentation to the Green Fund Committee or a poster exhibit presentation at the Undergraduate or Graduate Research Symposium, no more than 1 year after receiving notification of funding.

The oral presentation to the Green Fund Committee will consist of an approximately 10 minute long PowerPoint that includes the following aspects of your project; original goal and purpose of research, conflicts or changes to the original purpose, results/conclusion; all relevant graphical displays of data

Student Signature: 

Thank you for your submission. We deeply appreciate your commitment to sustainability at NAU, and we look forward to reviewing your application. Please direct any further questions to GreenFund@nau.edu.