Tufts University Green Fund Initial Idea Submission

Applicant Information:

Name:

Michael Saad

Role at Tufts (e.g. Undergraduate Student, Graduate Student, Faculty, Staff):

Graduate Student

Email and Phone # of Lead Submitter:

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Campus:

Medford

Project Title:

SciTech Autoclave

One Sentence Description *(This is how your project will be described on the Green Fund website):*

As an alternative to the large capacity autoclave in SciTech, a smaller capacity autoclave will allow users a sterilization option that will save water and energy.

General Application Questions:

1. **What project would you like to fund with a grant from the Green Fund?**

The Biomedical Engineering (BME) and Chemical and Biological Engineering (CHBE) Departments at Tufts University would like to purchase a small autoclave to reduce energy and water consumption in our laboratories. Our departments currently have one large autoclave for sterilizing equipment. As sterilization of equipment is vital to a functioning lab, the large autoclave is often used for singular smaller items when work necessitates it. The large autoclave uses 10 gallons of water and 8 kWh during a 30-minute gravity cycle at 121°C and an additional 2 gallons of water and 3 kWh during each hour of idle time. The smaller autoclaves we wish to purchase uses only 1.72 gallons through multiples cycles and about 1.15kWh during a 30-minute cycle. Additionally, the smaller autoclave would not use any additional water when not in use. We have the potential to reduce energy consumption by about 1600% and water consumption by about 4000% assuming 5 hours of usage daily. We have spoken with our department administrators who have agreed to support ongoing usage and maintenance. Therefore, we are looking to fund the initial purchase of a smaller autoclave in hopes of saving energy and water within our labs.

2. **Who would you work with on this project? Who would need to be involved?** *(For example: are there departments you would need to reach out to for help implementing or facilitating your project? If you are hosting an event, you might need someone to help you set up and help clean up afterwards. Do you need permission from anyone to complete your project?* **Include their role** *(collaborator, advisor, vendor, resource)* **and whether they have been confirmed their involvement in the specified role. Undergraduate students must have a faculty/staff advisor submit a letter of support for their project which indicates their willingness to mentor the proposed project.**

Name and Title	Role	Status
Sawnaz Shaidani, PhD student	Co-applicant	Confirmed
Sara Rudolph, PhD student	Co-applicant	Confirmed
Sophia Letcher, PhD Student	Co-applicant	Confirmed
Olivia Foster, PhD Student	Co-applicant	Confirmed
John Yuen, PhD Student	Co-applicant	Confirmed
Carmen Preda, BME Lab Coordinator	Advisor	Confirmed
Emily Edwards, CHBE Lab Coordinator	Advisor	Confirmed
Laura Place, BME Engineering Lab Coordinator	Advisor	Confirmed
Kyle Carbutt, ThermoFisher Representative	Vendor	Confirmed

3. **What costs would be involved in your proposal? Please provide a rough budget.**

The quote for the autoclave (Heidolph Tuttnauer Sterilizer 2840ELP Benchtop) is listed at $11,830.77 from ThermoFisher. As the BME and CHBE departments have agreed to support maintenance and repairs, we are asking for the funds to simply purchase the instrument. The departments will handle other associated fees. Since the autoclave is compact, there will be no installation costs. While the autoclave is a rather expensive purchase, the instrument should las the departments at minimum 10-15 years.

4. **What steps would you take to accomplish this project?**

We envision multiple potential benefits of funding our proposal for the Tufts community. Primarily, allowing the purchase of a more efficient autoclave system will (1) create energy savings for the university, (2) create a more accessible sterilization system, and (3) create momentum for future sustainable initiatives in the Biomedical Engineering (BME) and the Chemical and Biological Engineering (CHBE) Departments and beyond.

As mentioned above, current autoclave methods used in the BME/CHBE departments are oftentimes wasteful and inefficient. Continued use of large autoclaves not only contributes to university-produced waste, but also incurs unnecessary energy costs. Large autoclaves that are seen in most non-medical departments at Tufts have been optimized for medical applications that demand exceedingly high-throughput sterilization and shorter cycle times, and resultantly they are designed for quickly processing trays of medical devices for several hours daily. Non-medical laboratories that use these larger autoclaves are wasting water and energy on the much smaller cycles that need to be run in these settings, as high-throughput sterilization is often a trade-off for energy efficiency. Optimizing sterilization methods via smaller autoclaves will increase campus sustainability and save money that can then be diverted into other initiatives on campus.

Additionally, it would be beneficial for students to understand the purpose of the smaller autoclave vs. the larger autoclave with respect to sustainability. Along with posting signage near the smaller autoclave to explain its sustainability purposes, trainings on how to use the autoclave will also include this information. This educational experience will highlight the goals of the Office of Sustainability, which are to “be leaders in the responsible stewardship of the physical environment by cultivating knowledge in our students and faculty of sustainable issues and solutions” and to integrate sustainability into research and scholarship.

On the same note, allowing the BME/CHBE departments to pioneer energy-saving sterilization methods will create a precedent in the Tufts scientific and medical community. As

autoclaves are among the most energy-consuming medical equipment in hospitals, modeling and supporting the uses of smaller autoclaves in a Tufts laboratory setting may motivate not only other laboratories at Tufts, but also the Tufts medical community to do the same when possible (Kamal et al., 2021). Beyond the energy saving itself, we hope funding the BME/CHBE departments alongside other Tufts departments will encourage the use of more user-friendly equipment that serve as learning tools for students and enhance Tufts' reputation as a leader.

Kamal, J., Hmidat, A., & Abdallah, S. (2021). Energy Saving Analysis of Medical Steam Sterilizer. *AMT2020: THE 6TH INTERNATIONAL CONGRESS ON THERMAL SCIENCES*. https://doi.org/10.1063/5.0049410

5. **How would your project help or benefit the Tufts community?**

Water and Energy Consumption Logistics

The large capacity autoclave is currently used about 20 hours per week for various run cycles. On average, a run cycle uses 10 gallons of water per hour, totaling to around 200 gallons of water usage per week. The cycles also use around 8 Kilowatt hours (kWh) of power, or about 160 kW per week. When the large capacity autoclave is not being run, it is left in its idling state, except for a 12-hour shut down that occurs once per week. During the idling time, the autoclave uses about 2 gallons of water per hour, totaling to around 272 gallons per week. While idling, the machine uses about 408 kW per week. The large capacity autoclave presents significant water usage and energy usage burdens.

The small capacity autoclave uses much less water and energy, both while running a cycle and while idling. When in use, the small autoclave uses about 950 mL of water and 1.15 kWh per cycle. In idling state, the smaller autoclave does not use water. Although we do not have energy consumption values for idling state of the small incubator, assuming a similar ratio as the large autoclave, the small would require 0.43 kWh while not in use. With a smaller machine, it may be feasible to shut down the autoclave fully between cycles, depending on start-up time, allowing for further water and energy savings while not in use.

With the small capacity autoclave available, we can monitor use of both the small and large autoclaves to see how they are both utilized to evaluate further options for water and energy savings. Many autoclave cycles that are currently run each week are small batches that could likely transition to use the smaller machine. If the larger autoclave is used less, we may be able to schedule more frequent shut-downs of the large autoclave, saving more water and energy that would be used during overnight idling states. That would save 24 gallons of water and 36 kW per 12 hour shut down, and 2-3 additional overnight shut-downs per week could result in savings of 72 gallons of water and 108 kWh of energy per week.

	Cycle Run		Idling	
	Water Consumption/Hour	**Energy Consumption/Hour**	**Water Consumption/Hour**	**Energy Consumption/Hour**
Large Capacity Autoclave	37.9 L	8 kWh	7.57 L	3 kWh
Small Capacity Autoclave	950 mL	1.15 kWh	0 mL	0.43 kWh

Education, Training, and Outreach

If we do receive the smaller capacity autoclave, we will design trainings that not only detail how to use the instrument but also focus on sustainable practices and considerations. We will outline the difference in water and energy consumption between the two autoclaves, encourage shared use of the autoclave (autoclave "carpooling") to conserve resources, and of course safety considerations.

To track and quantify success, we will organize and maintain google calendars to track the use of both instruments. The large capacity autoclave will still be used for sterilization of large equipment such as bioreactors and biohazard waste. Thus, we will quantify the amount of time both autoclaves are in use or on. We will then use those values to calculate the water and energy consumption. To compare to what would have been used previously, we will assume the alternative scenario where the large capacity was left on or in use for the entirety of the time the small capacity autoclave is on or in use. Thus, we will be able to estimate the resource savings.

Furthermore, if the program is successful, we will present these savings to other departments. Within the BME/CHBE departments, we will investigate the potential for a similar small and large autoclave system for the Science and Engineering Complex labs. We would also be interested in writing a report or generating figures on resource savings that the Tufts Office of Sustainability could share with the broader Tufts community. Our hope is that this two-autoclave model could be implemented at more Tufts-affiliated labs.

What can I expect next?

The Green Fund committee will meet in early October and decide which projects will advance to the next round. These projects will be asked clarifying questions about details specified in this application. The committee will meet again and review the responses to its questions and vote to advance proposals based on those answers. Projects that advance past the clarifying questions stage will then be asked to fill out a more complete application (which can be found at go.tufts.edu/GreenFund) including a budget and a Gantt chart with accompanying letters of support from necessary collaborating entities at Tufts.

When finished with this initial idea submission, please save as a PDF and email to GreenFund@tufts.edu. Thank you!