

May 22, 2018

STARS Steering Committee
Association for the Advancement of Sustainability in Higher Education
2401 Walnut Street, Suite 102
Philadelphia, PA 19103

To Whom It May Concern:

I am pleased to submit this letter of affirmation that the information presented for Lehigh University's STARS Innovation Credit is complete and accurate to the best of my knowledge. This letter affirms that during the Summer of 2017 a graduate student began working on a project to map Lehigh's campus metabolism, generate conceptual models, and determine key stakeholders. The purpose of this project was to gain a comprehensive, integrated systems understanding of Lehigh's material inflows, stocks, transformations, and outflows for each of four subsystems: energy, water, food, and materials. This integrated systems thinking is called the campus metabolism approach. The idea of the campus metabolism approach is relatively new and, as such, only one other university (that we know of) is currently utilizing this approach.

This student project was part of the Lehigh Master of Engineering degree in energy, under the auspices of the Energy Systems Engineering Institute. The M. Eng. program is a ten-month, 30-credit curriculum that prepares students to assume technical leadership roles in the evolving energy field. The project is 6 credits conducted over two semesters.

The project team consisted of one graduate student and one staff mentor. As universities, like Lehigh, aim to become more sustainable, it was important to gain a comprehensive, integrated systems understanding of Lehigh's material inflows, stocks, transformations, and outflows as well as interconnections, interdependencies, and gaps within the overall campus system. By conceptually mapping the flows for each of four subsystems (water, energy, food, and materials) into, throughout, and out of each subsystem (as well as the transformations within each), the graduate student was able to create a visual model of each subsystem's structure. A systems approach, which views campus subsystems in a holistic, rather than individualized, manner, will help Lehigh to enhance efficiency, reduce waste, and meet its [Campus Sustainability Plan 2020](#) goals.

The results of this project showed how each subsystem is currently structured at Lehigh and how the subsystem structures could be improved such that the overall system better meets our campus sustainability goals. The graduate student determined that most subsystems were currently structured linearly, which results in inefficiency and a lot of waste. Recommendations

were developed that would create more semi-closed or fully-closed feedback loops for each subsystem. Closed loop feedbacks are vital for long term sustainability. The results of this project will inform future work. The data, key stakeholders, and conceptual models from this project will be used to create a data capture framework and visualization mechanism. The visualization mechanism will be a live, highly visible dashboard for each of the four subsystems on campus that shows the inputs, transformations, and outputs taking place. The future project will likely seek opportunities to target specific systems to utilize low cost and wireless sensors for more periodic measurements and accurate process control.

This project is just one example of how Lehigh students, faculty, and staff utilize the campus as a living laboratory and how multidisciplinary student research across campus generates potential solutions that positively impact the institution and the surrounding community. Through projects like this that are focused on sustainability, faculty, staff, and students help to create sustainable change on campus.

Please let me know if you have any questions.

Sincerely,

A handwritten signature in black ink that reads "Shankar". The signature is written in a cursive style and is underlined with a single horizontal line.

Rudy Shankar
Director, Energy Systems Engineering Institute
Lehigh University