

Special EEE Research Seminar

Date: Thursday, April 24, 2025, at 10:30AM

Location: STEW 310

Melissa Bilec, Ph.D.**George M. and Eva M. Bevier Professor, Co-director
of the Mascaro Center for Sustainable Innovation**
University of Pittsburgh**A Tale of Two Sectors. How can we make systemic sustainability progress in two tricky sectors – buildings and healthcare?****Abstract**

Dr. Bilec's research focuses on developing sustainable solutions for the built environment and healthcare. As a leading expert in life cycle assessment (LCA), she evaluates the environmental impacts of these sectors, which consume substantial resources and contribute significantly to greenhouse gas emissions. She applies LCA to gain a comprehensive understanding across all stages. Her work also includes urban-level modeling, energy modeling, indoor air quality assessments, and the development of circular economy principles. In this seminar, she will discuss two recent projects.

First, concerning the built environment, Dr. Bilec will explore how emerging tools, like digital twins, can add in sustainable decision-making. Specifically, she will examine the link between systems-level analysis and digital twin technologies to enhance sustainable engineering. A pilot digital twin was created for an existing building and its surrounding streetscape. A building information model (BIM) was developed using two-dimensional drawings, architectural renderings, specifications, and terrestrial laser scanning. Material estimates and replacements from the BIM provided insights into the building's urban metabolism and material flows. The digital twin, built in Unreal Engine, incorporated real-time data on weather, indoor environmental quality (PM, VOCs, humidity, temperature, lighting), electricity use, steam flow, and water consumption. This study represents an initial step toward integrating diverse sustainability data streams through digital twin technologies, enabling dynamic and spatial visualization.

Second, the healthcare sector contributes significantly to carbon emissions—accounting for 8.5% of U.S. greenhouse gas emissions. Currently, it operates within a linear economy of take, make, and waste, depleting resources and losing embodied energy and carbon through material disposal. A circular healthcare economy aims to restore value by reusing, repairing, reprocessing, repurposing, and recycling medical products. In collaboration with physicians from multiple organizations, her team conducted LCAs comparing the environmental impacts of reusable and disposable devices, including pulse oximeters, uterine manipulators, stethoscopes, specula, and surgical table covers. Overall, reusable devices showed lower environmental impacts—particularly in global warming potential—though results varied based on usage frequency and sterilization methods. Disposable devices tended to have higher impacts during raw material extraction and use, but lower end-of-life impacts.

These findings underscore the importance of integrating sustainability into healthcare practices. With optimized sterilization and usage, reusable devices offer substantial environmental benefits. By transitioning to circular models, hospitals can lead the way in reducing emissions, lowering costs, and contributing to sustainability.

Bio

Dr. Melissa Bilec is a prominent voice in sustainable engineering. She is the Bevier Professor in Civil and Environmental Engineering and co-directs the Mascaro Center for Sustainable Innovation, a center advancing sustainable research and education at the University of Pittsburgh. She serves as the Special Assistant to the Provost for Sustainability. Dr. Bilec's research is dedicated to developing sustainable solutions for buildings and healthcare. At the University of Pittsburgh, Dr. Bilec has led greenhouse gas inventories since 2008 and serves on the Chancellor's Sustainability Council to guide the University's climate strategy. She has published over 150 peer-reviewed articles and secured over \$22 million in funding. Her educational contributions include creating an M.S. in Sustainable Engineering degree, co-developing a university-wide undergraduate certificate in sustainability, and establishing the PhD Circular Economy Program. Her earlier work focused on community-based infrastructure projects, including transforming a century-old hot metal bridge into a pedestrian bridge. Dr. Bilec enjoys yoga, travel, hiking, and spending time with her family.