



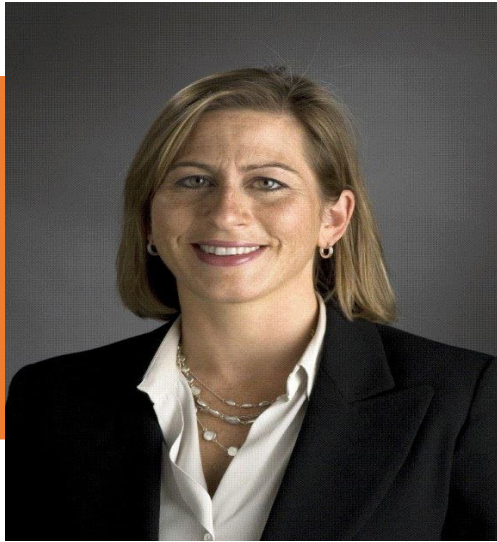
Standards Education for Infrastructure Improvement & Resilience

RIT | Rochester Institute of Technology

September 10, 2025
NIST SSCD Awardee Meeting

Lisa Greenwood, PhD
Associate Professor
Civil Engineering Technology, Environmental Management & Safety

Our Core Team



Lisa Greenwood, Ph.D.

***Associate Professor,
Environmental
Sustainability, Health
& Safety***



Yewande Abraham, Ph.D.

***Associate Professor,
Texas A&M University
(formerly at RIT in Smart
Cities and Construction
Management)***



Sumita Mishra, Ph.D.

***Professor,
Computing Security***



**Jennifer Schneider
Sc.D., CIH**

***Senior Director of
Integrated Curriculum,
Office of the Provost***

***Principal, Collaboratory
for Resiliency &
Recovery @RIT***

Award Title:

Standards Education for Infrastructure Improvement and Resilience

Award Date:

FY 2022

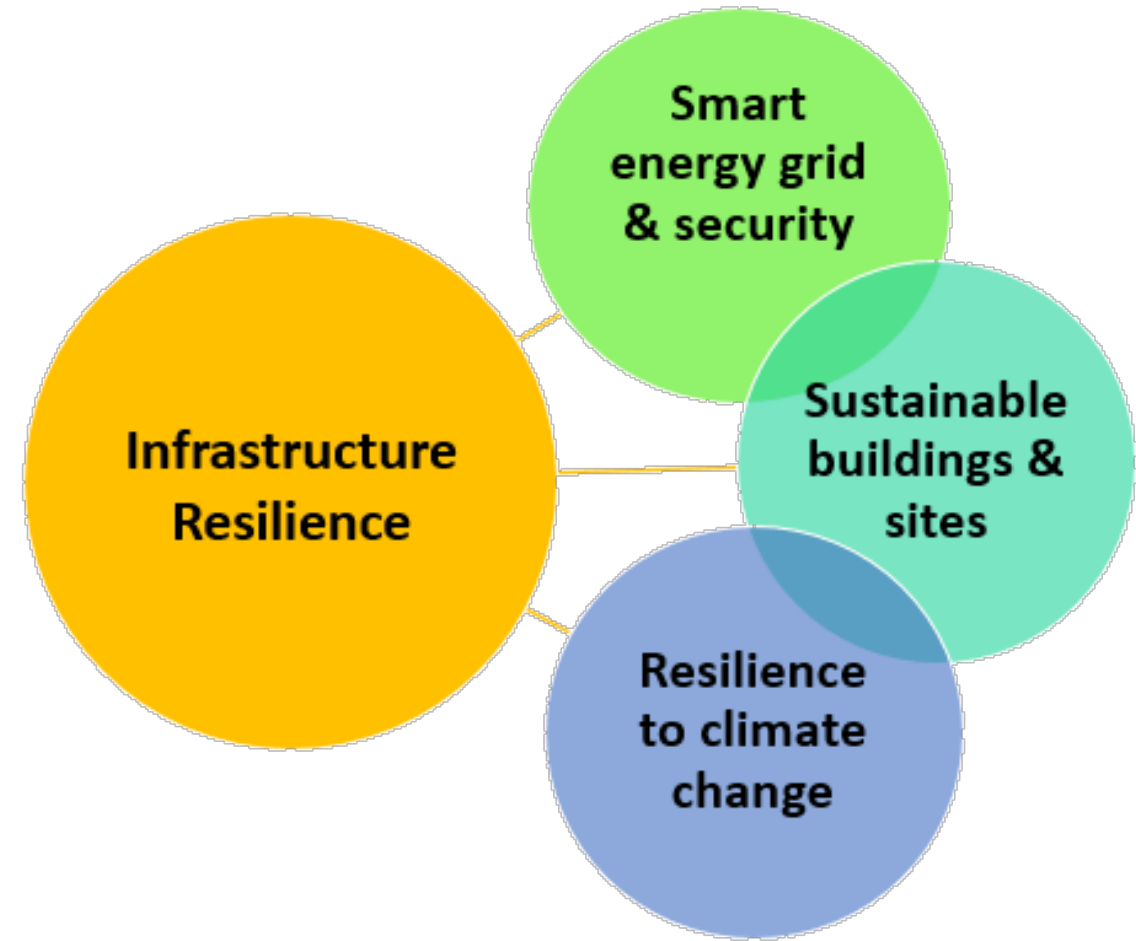
Project Goal:

To develop a set of reusable and **customizable course modules related to infrastructure resilience and environmental sustainability** to provide opportunities for active learning while applying relevant standards in different contexts and scenarios

Course formats include traditional classroom learning as well as blended and online instruction

Project Focus:

1. **Resilient power infrastructure** – smart grid security and privacy
2. **Sustainable buildings and sites** – legacy pollution, “green” BD&C
3. **Infrastructure resilience to climate change and other disruptions**



Module Elements

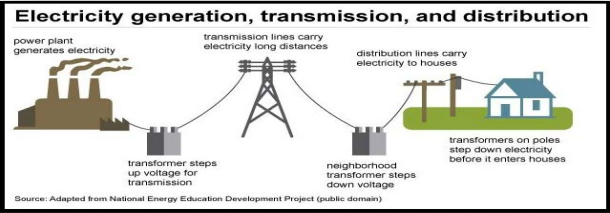
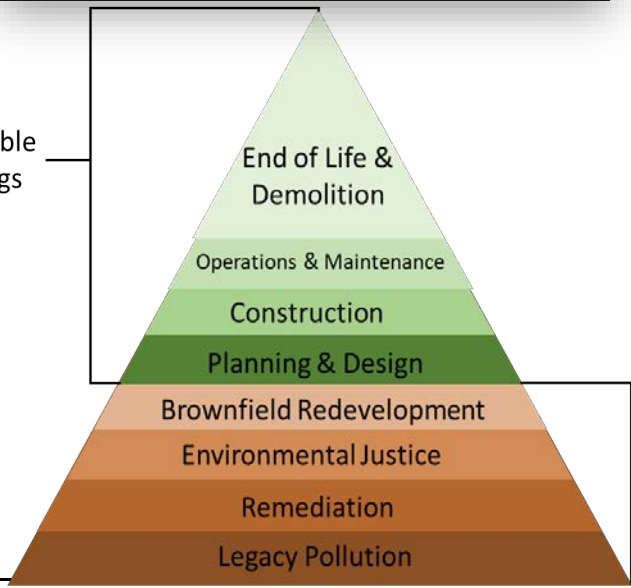
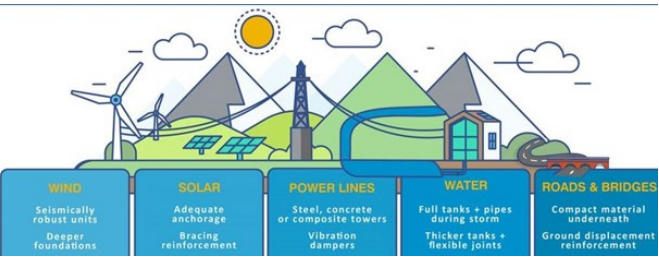
Module	Element	
Power Infrastructure	a. Infrastructure Basics and Smart Energy Grid b. Smart Energy Grid Cybersecurity c. Privacy Threats to the Smart Energy Grid	 Electricity generation, transmission, and distribution power plant generates electricity transmission lines carry electricity long distances distribution lines carry electricity to houses transformer steps up voltage for transmission transformers on poles step down electricity before it enters houses neighborhood transformer steps down voltage Source: Adapted from National Energy Education Development Project (public domain) Image Source: https://www.powerelectronicsnews.com/wp-content/uploads/sites/3/2017/05/NDavis1.png
Sustainable Buildings & Sites	a. Introduction to Sustainable Sites b. Legacy Pollution - Background c. Legacy Pollution – Remediation & Brownfields Redevelopment d. Environmental Justice e. Sustainable Buildings - Background f. Sustainable Buildings – Planning & Design g. Sustainable Buildings – Construction h. Sustainable Buildings – Operations and Maintenance i. Sustainable Buildings – End of Life	 Sustainable Buildings End of Life & Demolition Operations & Maintenance Construction Planning & Design Brownfield Redevelopment Environmental Justice Remediation Legacy Pollution Clean Up of Legacy Pollution and Sustainable Sites
Infrastructure Resilience to Climate Change & Other Disruption	a. Introduction to Infrastructure Resilience & Disruption b. Resilience to Impacts of Climate change – Mitigation c. Resilience to Impacts of Climate change – Adaptation d. Resilience to Natural Disasters e. Resilience to Man-made Disruption	 WIND Seismically robust units Deeper foundations SOLAR Adequate anchorage Bracing reinforcement POWER LINES Steel, concrete or composite towers Vibration dampers WATER Full tanks + pipes during storm Thicker tanks + flexible joints ROADS & BRIDGES Compact material underneath Ground displacement reinforcement

Image source; <https://miyamotointernational.com/how-cities-can-use-infrastructure-to-pave-the-way-to-climate-resilience/>

Module Structure

Component	Description
Module Overview & Description	- Executive summary with introduction and overview of the module - Module learning outcomes, description, and rationale - Summary of key standards included in the module
Educational Content	- Slides and notes for lectures with guided activities and exercises - Supplementary resources, e.g., readings, links to materials and tools - Example discussion questions and exercises
Module Assessment	- Example assignments - Assessment tools and methods to measure module effectiveness

Standards Domain	Standards - Select Examples
Energy/power infrastructure and cybersecurity	NIST SP 800-53 for security and privacy controls, NIST SP 800-30 for risk assessment and management, and ISO/IEC 27001 for information security management
Sustainable buildings	National Green Building Standard (NGBS), US Green Building Council's LEED standard, ANSI/GBI Green Globes, Living Building Challenge, ASCE/SEI 7, ASHRAE 189.1- Design of High-Performance Green Buildings
Sustainable sites/legacy pollution	National Oil and Hazardous Substances Pollution Contingency Plan (NCP) - 40 CFR Parts 300-311, 355, and 373; National Emission Standards for Hazardous Air Pollutants (NESHAP) - 40 CFR Part 63; Superfund Climate Resilience Framework
Resilient infrastructure	ISO 14090, ISO 37101, USGBC RELI, Stafford Act (Hazard Mitigation Planning & standards)

Results & Key Learnings –

- **17 sub-modules** developed under the 3 core modules
 - Instructor materials, educational content, exercises, resources
- **2 case studies** developed for scenario-based simulation exercises
 - (1) sustainable sites
 - (2) smart grid security
- **200+ students** interacted with the content across **6 courses** in **5 degree programs in 2 Colleges** – 3 undergraduate and 2 graduate programs in engineering and computing colleges (to date)
- Content and resources shared with instructors at Penn State and George Washington University

Results & Key Learnings

- Feedback from instructors highlighted **successful student grasp of concepts and engagement with content** - but in some cases, limited confidence with standards-based content (mentoring helped!)
- The use of formative assignments followed by a project or scenario-based exercise helped to provide **a foundation for students to apply the standards** they learned about
- Scenarios and case-based assignments promoted **active learning and relatability**
- **90%** of students **achieved a B or better** on standards-related work
- Alumni survey feedback suggests that use of standards in the curriculum has **strong value for students as they enter the workforce**

Results & Key Learnings – Alumni Survey

- Alumni commented that **incorporation of standards** in the curriculum provided a “well-rounded knowledge base” that **gave them an edge in their field**:
 - *“The curriculum prepared me better than other EHS professionals. I feel this is the key to my successful career working for one of the largest pharmaceutical companies in the world leading their EHS programs.”*
 - *The curriculum helped me to “learn to navigate and interpret regulations much faster than most of me [sic] peers.”*
- Others appreciated the **skills** they **gained** in relation to **standards literacy, leadership, and critical thinking**:
 - *“My education ... provided the leadership skills I needed to implement standards.”*
 - *“My education ... gave me a good overview of the standards and how they should be used and applied. This is helpful in my career because you can’t remember everything so you need to know where and how to find the information.”*

Results & Key Learnings – course outcomes

Course	Module	No. of Students	Assessment Method	% B or Better	
ESHS 720 - EHS Management (Graduate, Online)	Sustainable Sites Infrastructure Resilience	29	Formative: based on application of module concepts and content within two assignments. Summative: based on comprehensive case-based term project.	Unit 3: 90% Unit 4: 86% Term project: 100%	
ESHS 150 - Principles of ESHS (Undergraduate, On Campus)	Sustainable Sites Infrastructure Resilience	29	Formative: based on application of module concepts and content within two assignments. Summative: based on comprehensive case-based term project.	Unit A/Quiz 4: 83% Unit B/Quiz 7: 86% Term project: 93%	
ESHS 755 – Corporate Social Responsibility (Graduate, Online)	Sustainable Sites	35	Formative: based on application of module concepts and content on Units 2 and 3 assignments. Summative: based on comprehensive case-based term project.	Unit 2 100% Unit 3 94% Term project: 100%	
CONM 690 – Sustainable Building Design and Construction (Graduate, Online)	Sustainable Sites Infrastructure Resilience	5	Formative: based on application of module concepts and content within a group assignment. Summative: comprehensive term project	Group assignment: 100% Term Project: 100%	
CVET 180 – Introduction to Civil Engineering (Undergraduate, On Campus)	Sustainable Sites	44	Formative: based on application of module concepts and content within one assignment.	Assignment A: 98%	
CSEC-461 – Computer System Security (Undergraduate, On Campus)	Infrastructure Resilience	59	Formative: based on applying module concepts and content on Unit 3, 4, and 7 assignments. Summative: based on unit quizzes	Assignments Unit 3: 81% Unit 4: 90% Unit 7: 91%	Quizzes Unit 3 81% Unit 4 90% Unit 7 90%

Results & Key Learnings - Dissemination

Dissemination across the project included 6 conference and workshop presentations, 1 published conference paper, 1 published journal paper, and 1 graduate student project/thesis

Date	Venues	Audience	Details
December 2022 Virtual	NIST Workshop on Standards Education	Academic faculty NIST personnel	Presentation Workshop for awardees
April 2024 Montreal, QC	ASEE St. Lawrence Annual Conference	Academic Faculty	Presentation & Conference Paper Conference Proceedings ¹
May 2024 San Diego, CA	World Conference on Quality and Improvement	Business professionals Academe	Presentation & Panel Session
August 2024 Washington, DC	TAG 207 Fall Conference	Business professionals Government Academe	Presentation
October 2024 Chicago, IL/Virtual	International Conference of Social and Education Sciences (IConSES)	Academic faculty Graduate students	Presentation & Conference Paper Journal publication ²
November 2024	International Journal of Education Sciences	Academe	Publication – Journal publication in early 2025 ²
March 2025 Golden, CO	UL Standards Education Summit	Academic Faculty SDOs	Presentation Summit/Workshop for standards educators - Findings and Lessons Learned

- Graduate Assistant M. Hargrave project/thesis: *Standards Literacy and Career Success: Exploring the Effects of Standards Integration in ESHS Curriculum at RIT (2023)*.
- *Published papers:*
 - Greenwood, L. L., Hargrave, M., Abraham, Y. S., Mishra, S., & Schneider, J. L. (2024, August). Preparing the Engineers of Tomorrow: Standards Education for Infrastructure Improvement and Resilience. In *2024 ASEE St. Lawrence Section Annual Conference*. DOI 10.18260/1-2-370.1114.1143-48573.
<https://peer.asee.org/48573>
 - Greenwood, L. L., Schneider, J., Mishra, S., Abraham, Y. S., & Pandian, S. K. S. (2025). Integrating Standards for Infrastructure Improvement and Resilience in University Curricula. *International Journal of Education Science*, 2(1), 75-90.

Conclusions

Results suggest:

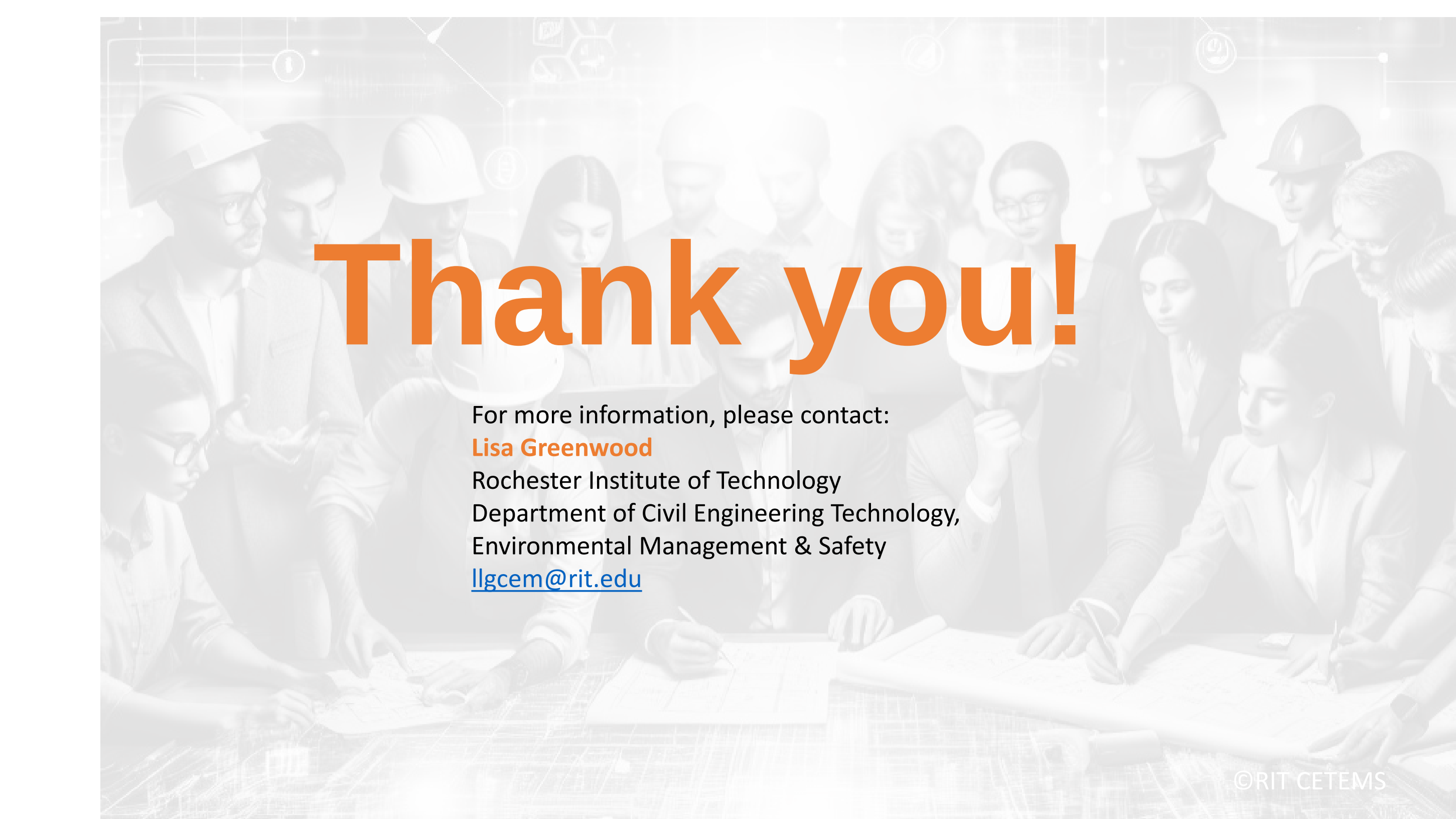
- Instructors benefit from flexible, modular approach
 - Content can be mixed/matched and **adapted to suit a range of courses** and programs
 - Modules include **supporting resources** and examples for instructors
 - **Mentoring** helps build instructor confidence with standards
- Students benefit from learning about standardization and standards related to their field
 - Combination of **active learning and formative and summative assignments** provides a foundation for students to apply the standards
 - **standards literacy enhances their skillset and preparedness** for entering professional practice
 - Standards literacy can give students **an advantage over others** in their field

Acknowledgements

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Thank you!

For more information, please contact:

Lisa Greenwood

Rochester Institute of Technology

Department of Civil Engineering Technology,

Environmental Management & Safety

llgcem@rit.edu