

The General Principles of Sustainability Relative to Buildings

Dr. Adam Scouse

Forest Biomaterials Department

NC State University

Green Buildings and Sustainable Materials Project

**Supported by grant 70NANB18H277 from the National Institute of Standards
and Technology**



Presentation Outline:

- Introduce the pillars of sustainability
- Investigate the principles of each pillar of sustainability and how they apply to building applications
- Introduce some of the tools or techniques available for assessing sustainability

American Society of Testing and Materials (ASTM) Standard E2432:
Standard Guide for General Principles of Sustainability Relative to Buildings

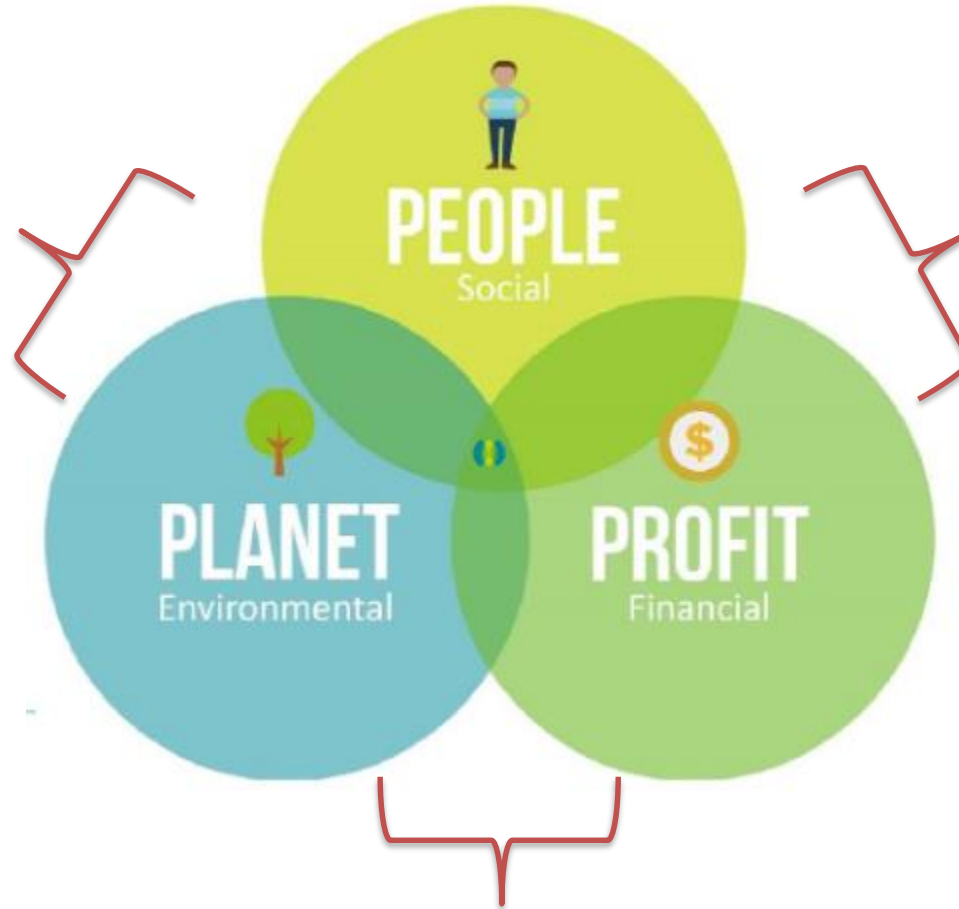


Pillars of Sustainability:

The pillars of sustainability:

- Environmental
- Economic
- Social

- Environmental regulations
- Access to clean water
- Environmental justice



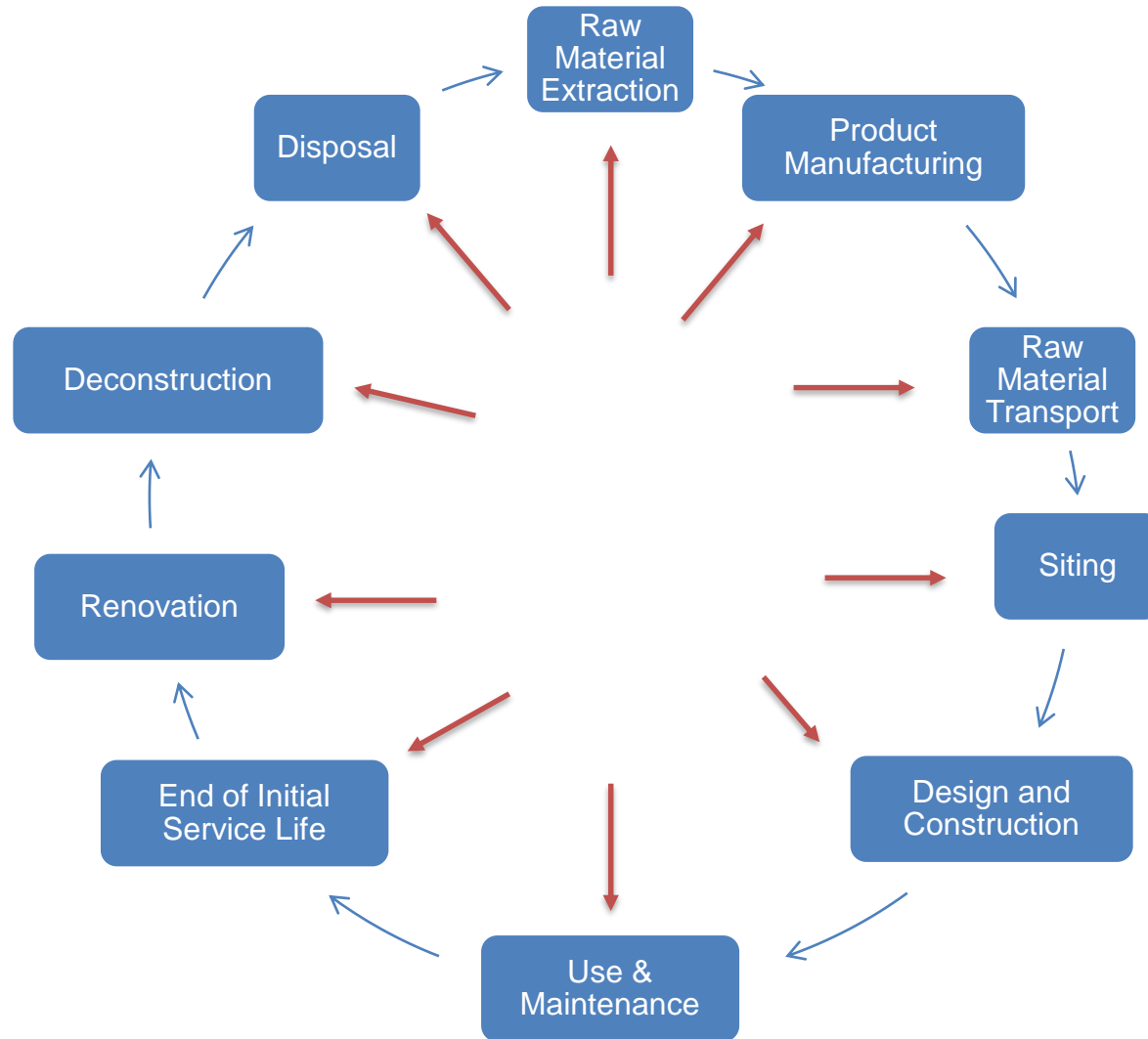
- Job creation
- Skills development
- Business ethics

- Resource efficiency
- Life cycle management
- Greener technologies



Life Cycle Stages of a Building:

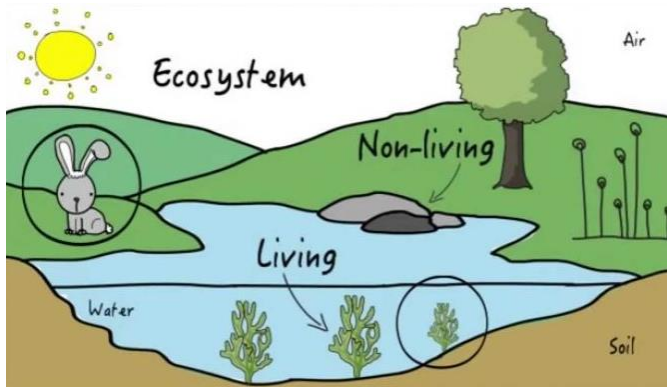
Sustainability should be considered along all life cycle stages of a building:



Environmental Pillar:

Fundamental environmental concepts defined by the standard:

- Ecosystems
- Biodiversity
- Natural Resources



*<https://qswownews.com/the-idea-of-growing-your-business-ecosystem/>

*<https://greennews.ie/national-biodiversity-week-educational-importance/>

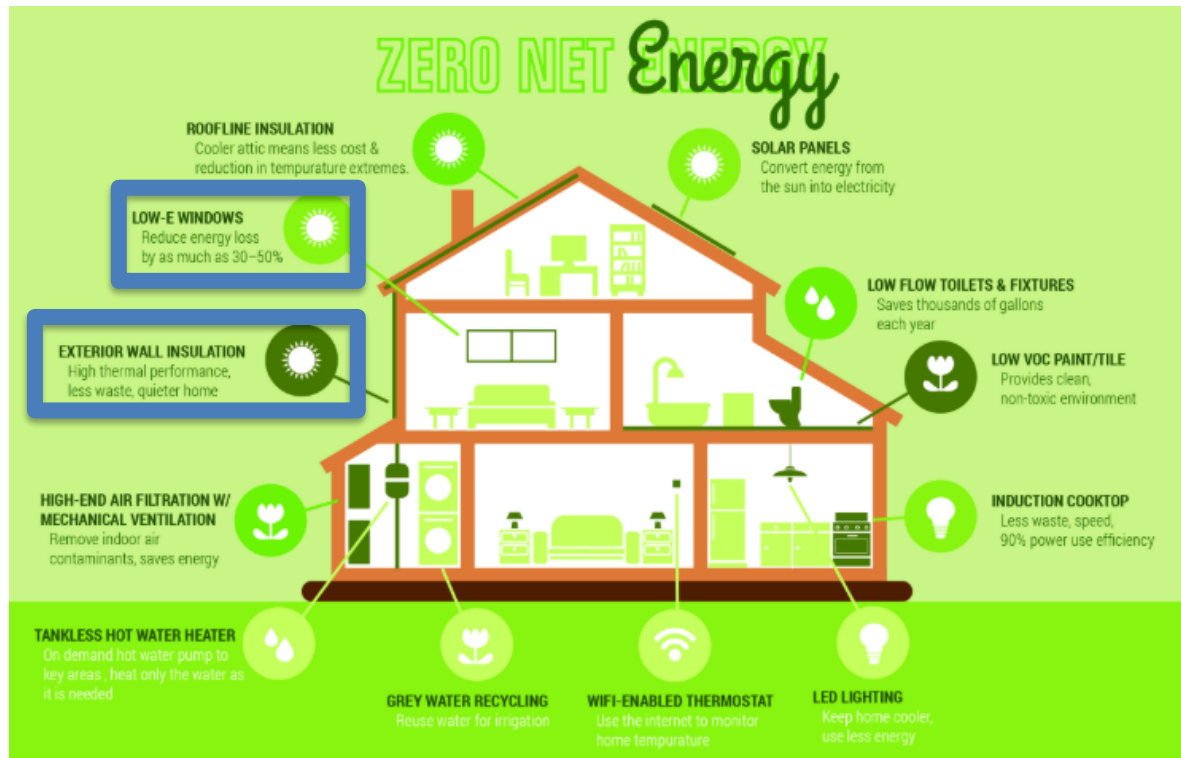
*<https://mineralseducationcoalition.org/education-database/geology-natural-resources-activity/>



Environmental Pillar:

Ecosystems

- Sustainable buildings should protect or enhance local, regional, and global ecosystems
 - Example: Energy efficient features like air sealing, properly installed insulation, and high-performance windows



Reduces:

- Carbon dioxide*
- Carbon monoxide
- Sulfur dioxide*
- Nitrogen oxides
- Particulate matter
- Heavy metals

*<https://aplogroup.com/green-building/>

*<https://www.eia.gov/tools/faqs/faq.php?id=77&t=11>

*Massetti et al. 2017. Environmental Quality and the U.S. Power Sector: Air Quality, Water Quality, Land Use and Environmental Justice.

ORNL/SPR-2016/772. Oak Ridge National Laboratory. 159 p.



Environmental Pillar:

Biodiversity

- Sustainable buildings should protect or enhance the habitats for local species
 - Example: green roof systems



Hunt Library green roof:

- Drought resistant plants
- Saves on heating/cooling costs
- Helps to control rainwater runoff
- Reduces noise pollution

*<https://sustainability.ncsu.edu/blog/2013/03/05/the-sustainable-side-of-hunt-library/>

*<https://sustainability.ncsu.edu/blog/2010/07/01/centennial-campus-at-nc-state-gets-first-green-roof/>



Environmental Pillar:

Natural Resources

- Sustainable buildings should make efficient use of the natural resources
 - Example: sustainable sourcing of wood products



Sustainable Forestry Initiative (SFI) forest certification program:

- Uses a third party auditing program to ensure that wood products are made from trees that are legally and responsibly harvested



Economic Pillar:

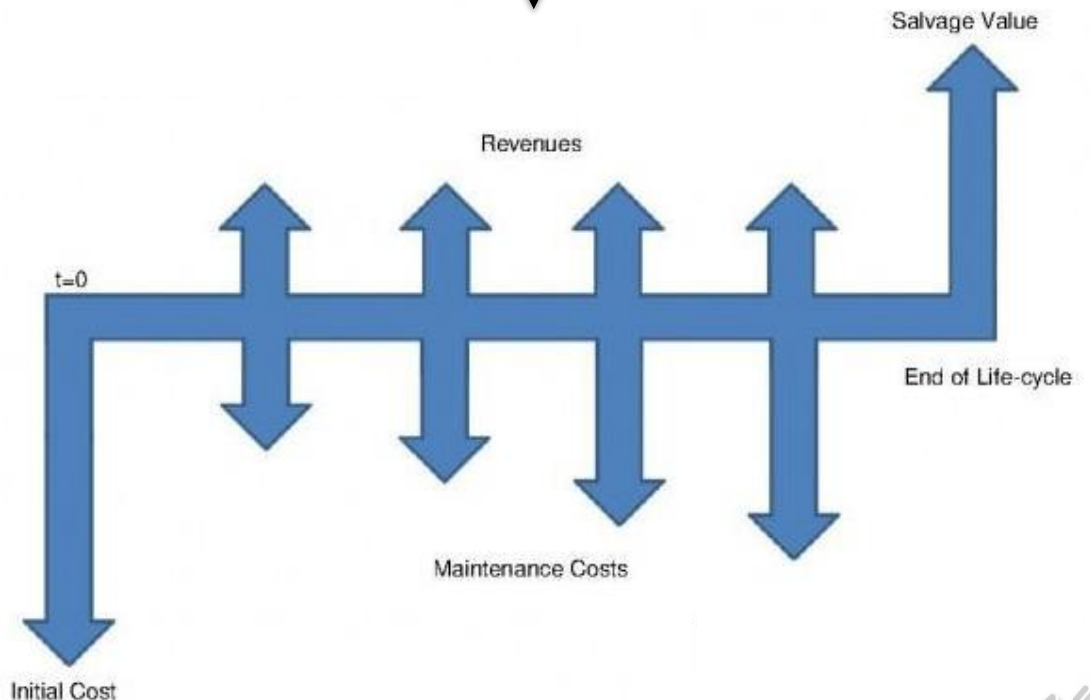
Direct costs/benefits

- First costs/benefits
- Operating costs/benefits
- End use costs/benefits

Indirect or External costs/benefits

- Social costs/benefits
- Environmental costs/benefits

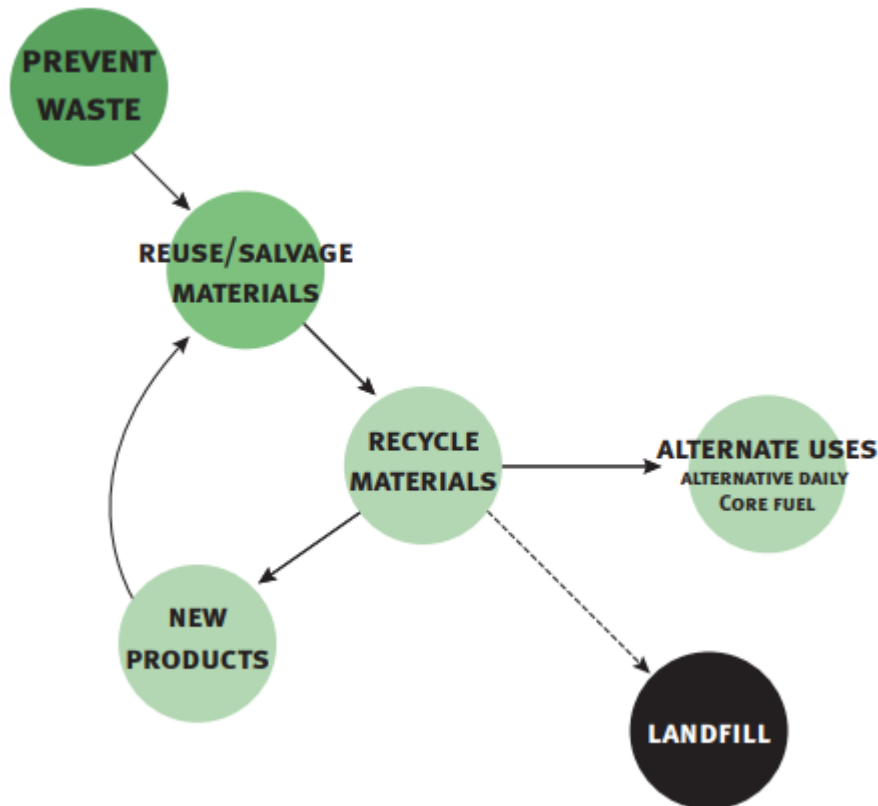
Quantified using life cycle cost analysis



Economic Pillar:

Direct or life cycle costs/benefits:

A sustainable assessment of economic costs and benefits requires considering impacts that are generated during all building life cycle stages



First costs/benefits

- Example: water-efficient indigenous plants

Operating costs/benefits

- Example: choosing durable products

End use costs/benefits

- Example: mechanical fastener construction system

Economic Pillar:

Indirect or external costs/benefits:

Impacts that pertain to the people and the environment that are indirectly associated with a building throughout its life cycle stages



Social costs/benefits

- Economic sustainability requires a diverse job market, equitable access and distribution of resources, and promoting the safety and education of workers
 - Example: avoid products which generate volatile organic compounds (VOC)



Environmental costs/benefits

- A sustainable economy thrives from functional ecosystems that provides ecosystem services which may or may not be monetized
 - Examples: crop pollination, soil stabilization, recreational value



*<https://www.behr.com/consumer/products/interior-paint-and-primer/premium-plus-interior/behr-premium-plus-semi-gloss-enamel>

*<https://www.forconstructionpros.com/sustainability/news/21045891/usgbc-names-illinois-as-top-state-for-leed-green-building>

*<https://www.hendricks.org/Updates>

Social Pillar:

Health, safety, and welfare:

- Example: building outside of floodplain, access to natural daylight*

Transparency:

- Example: communicating with building occupants during building design phase

Equity:

- Example: Buildings which offer a diversity of housing types and designate a proportion of rental/for-sale units priced for those earning less than the building area's median income



*Altomote, S. 2008. Daylight for energy savings and psycho-physiological well-being in sustainable built environments. Journal of Sustainable Development 1(3): 3-16.

*<https://leverarchitecture.com/projects/framework>

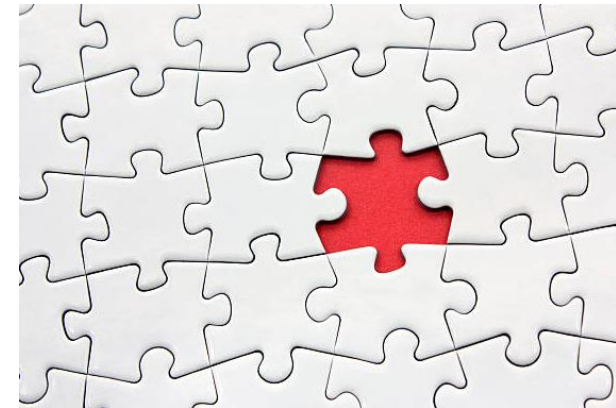
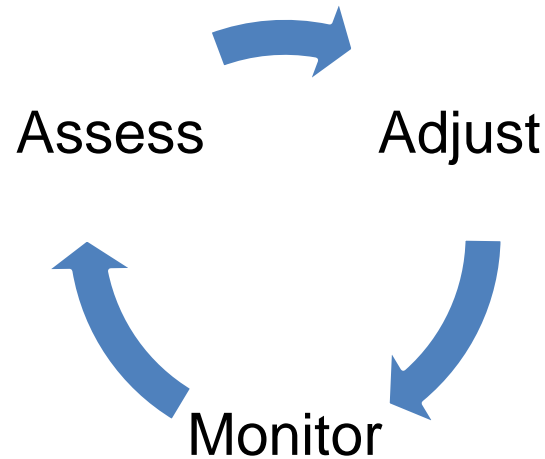
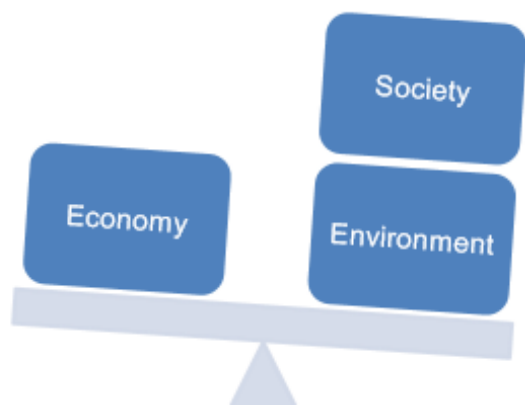
Applied Sustainability:

Caveats:

- Sustainability is an ideal
- We don't have perfect information

Strive for:

- Balance
- Continual improvement



Applied Sustainability:

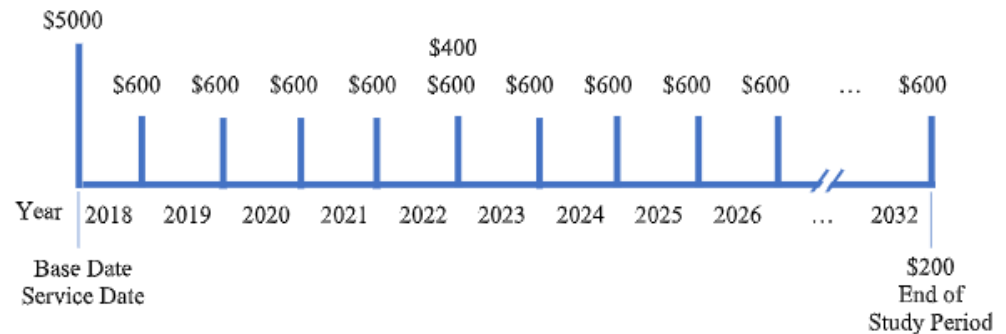
Environmental Assessment

- Example: life cycle assessment



Economic Assessment:

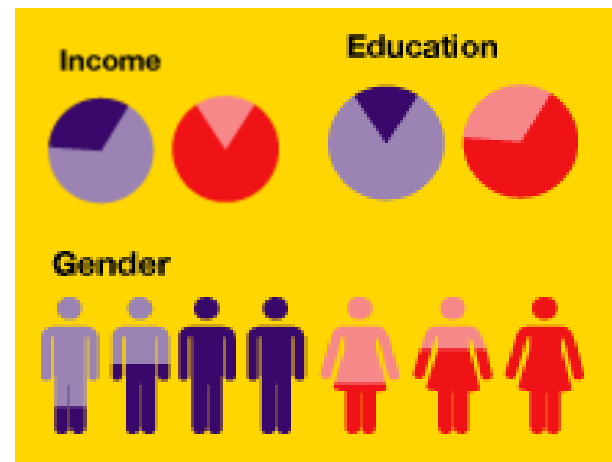
- Example: life cycle cost/benefit analysis



Social Assessment:

Examining measurable change in:

- Demographics
- Health
- Cultural and historical resources
- Distribution of power and authority
- Social well being



*<https://www.ncasi.org/technical-studies/sustainable-manufacturing/life-cycle-assessment/>

*<https://www.getbrandwise.com/branding-blog/bid/115113/Marketing-Demographics-covering-the-basics>

Visit Our Project Website

<https://faculty.cnr.ncsu.edu/yuanyao/green-buildings-and-sustainable-materials/>

This presentation and video were prepared by the project team (Yuan Yao, Stephen Kelley, Traci Rider, and Adam Scouse) at North Carolina State University using Federal funds under award 70NANB18H277 from the National Institute of Standards and Technology, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Institute of Standards and Technology or the U.S. Department of Commerce.