Including Sustainability as Part of the Transportation Asset Management Toolbox

National TAM Conference
July 11, 2016

Discussion Points

1. **General Discussion of Sustainability**
2. **Qualitative Approached to Measuring Sustainability**
3. **Quantitative Approaches to Measuring Sustainability**
4. **Sustainability as Part of Decision Analysis**
   - **Example**
5. **Summary and Questions**

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SUP&R ITN Researchers

- **Stefanie Brodie**
  - Marie Curie Research Fellow, SUP&R ITN
- **Tony Parry**
  - Professor, University of Nottingham
- **Davide Lo Presti**
  - Senior Researcher and International Research Project Manager, University of Nottingham

Acknowledgments, Cont'd

Amec Foster Wheeler TAM Team

Jonathan Groeger, MBA

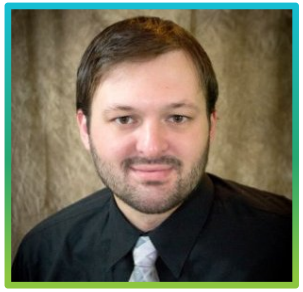
- Amec Foster Wheeler Asset Management Lead
- PM for 5 TAMPs (NY, LA, MN, NH, SC)
- PM for TAM Gap Analysis (10 States)
- Chair of TRB Committee AFD20, Pavement Monitoring and Evaluation

Richard Boadi, Ph.D.

- Lead TAM Analyst
- Lead developer of SC TAMP
- Supported NH TAMP
- Expert in risk, financial planning, and whole life management

Deepa Thandaveswara, P.E.

- Expertise in TAM, pavements, and geotech
- Co-wrote five TAM Gap Analysis reports
- Involved in SC and NH TAMPs
- Member of TRB Asset Management Committee



James Bryce, Ph.D.

- Developing the Next Generation pavement performance models for FHWA
- Expert in decision analysis
- Expert in pavement preservation and sustainability

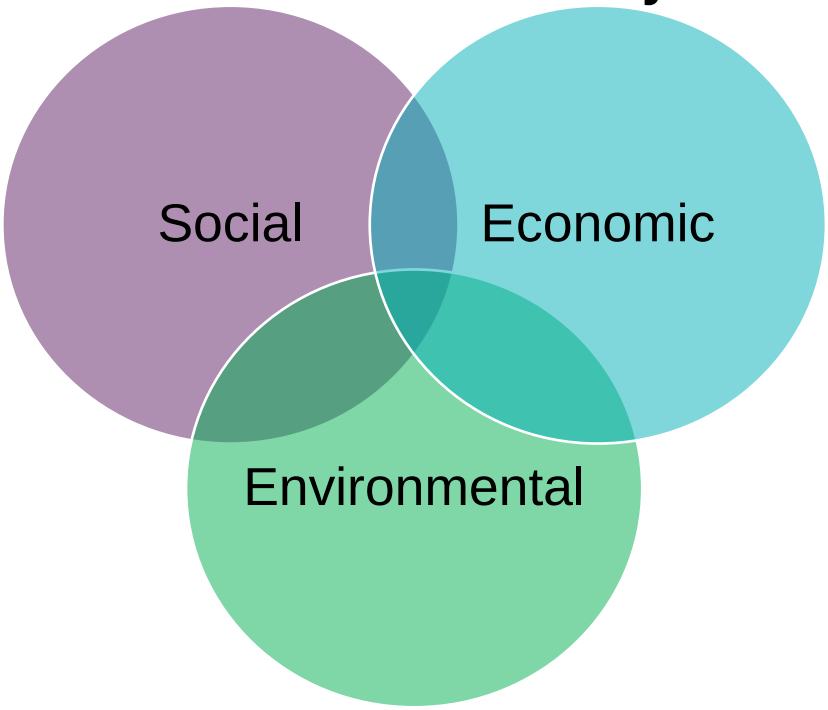
Objective

- **Present methods for incorporating sustainability into asset management decisions, both qualitatively and quantitatively.**
  - Response based versus outcome based sustainability assessment
  - Sustainability in decision analysis
  - Demonstrate tradeoff analysis for multiple objectives in a specific asset

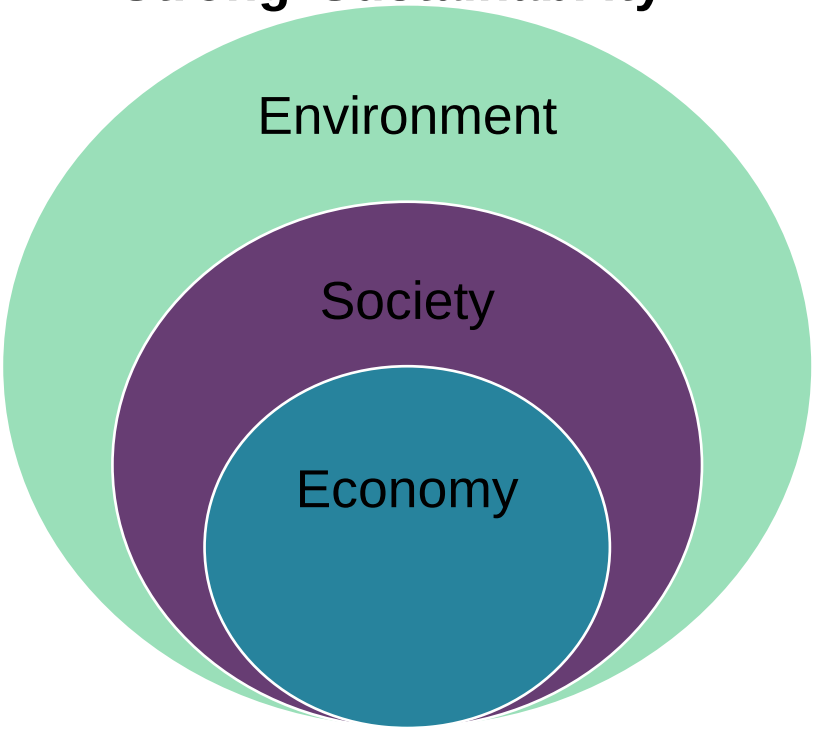
Sustainability

Meeting the needs of the current generation without compromising the ability of future generations to do so.

‘Weak’ Sustainability



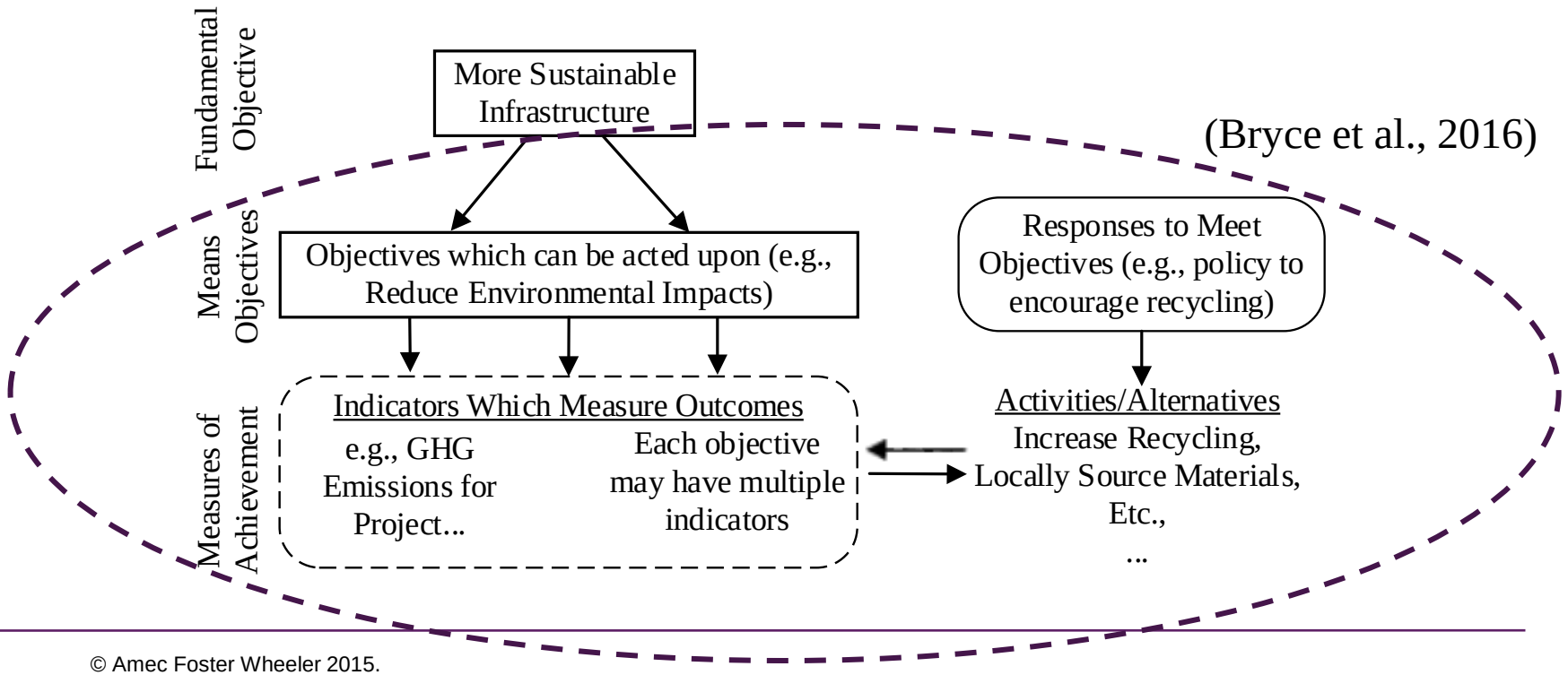
‘Strong’ Sustainability



Sustainability as a Strategic Objective

Definition of sustainability connects directly to an objectives hierarchy

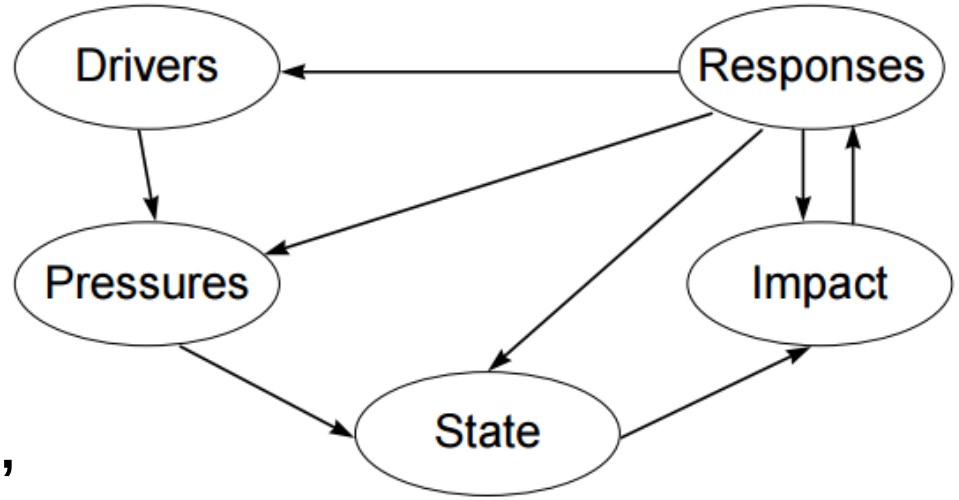
- **Should be developed when adding sustainability as an agency objective**



Assessing Sustainability

Sustainability assessment begins with a systems view of the interacting processes

- e.g., the DPSIR framework from the EEA



(Smeets and Weterings, 1999).

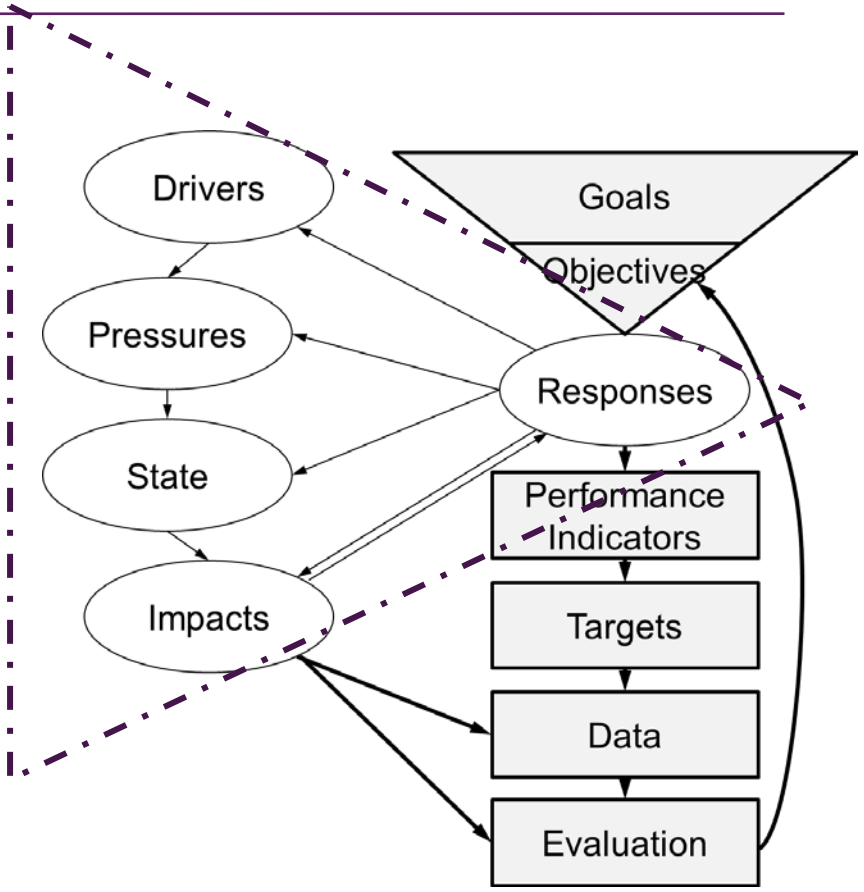
Measuring sustainability is generally done by:

1. **Measuring specific responses, generally qualitatively**
2. **Measuring outcomes from the responses, generally quantitatively.**

Sustainability Assessment in Performance Management Framework

Benefit of systematic perspective is the direct linkage with performance management.

- Responses can be derived directly from means objectives.
- Performance measures can be derived directly from responses, which directly inform performance targets.



(Bryce et al., *In Press*)

Modern Approaches to Measuring Infrastructure Sustainability

CEEQUAL
IMPROVING SUSTAINABILITY THROUGH BEST PRACTICE
Civil Engineering – Infrastructure – Landscaping – Public Spaces

INVEST
ECONOMIC • SOCIAL • ENVIRONMENTAL

Greenroads

GreenLITES Recognizing Leadership in Transportation Environmental Sustainability

Envision's critical role in infrastructure sustainability

Many agency developed methods

- Can be linked directly to an agency's goals, objectives and performance management process.

Sustainability Assessment Steps

Example: Ceequal (Civil Engineering Environmental Quality)

- **Developed in the UK by a team led by the Institution of Civil Engineers**

Journey is More Important than Score

- **Assessment is performed at end of project, 2-step process**
  1. An assessor employed by the project team determines which questions are applicable to the particular project develops a score,
  2. An independent verifier then reviews the points, along with the supporting documentation, and awards the final certification

1. Project Strategy (optional),
2. Project Management,
3. People and Communities,
4. Land Use and Landscape,
5. Historic Environment,
6. Ecology and Biodiversity,
7. Water Environment Physical Resources,
8. Transport

Example of Qualitative Response Based Sustainability Assessment

- **Many systems treat the degree of implementation of a response as a measure of sustainability.**
  - e.g., use of recycled materials in highway construction
  - *In-situ* recycling of the pavement is linked to several benefits including:
    - Reduced lifecycle costs
    - Reduced environmental impacts
    - Reduced construction time, which is expected to reduce time lost for vehicles in construction queues
    - Potentially more
- **Act of recycling, not outcomes, is reported as the measure of sustainability.**

Quantitative Approaches to Sustainability Assessment

Measure outcomes of decisions on the defined system

- Revisit recycling example
  - Conduct LCA to measure reduced environmental burdens (e.g., reduced GHG emissions, etc.)
  - Conduct LCCA to assess reduced costs
  - Model construction time effect on reduced congestion

Much more detailed analysis required:

- Tools are available

Athena Pavement LCA

CO_2e asPECT

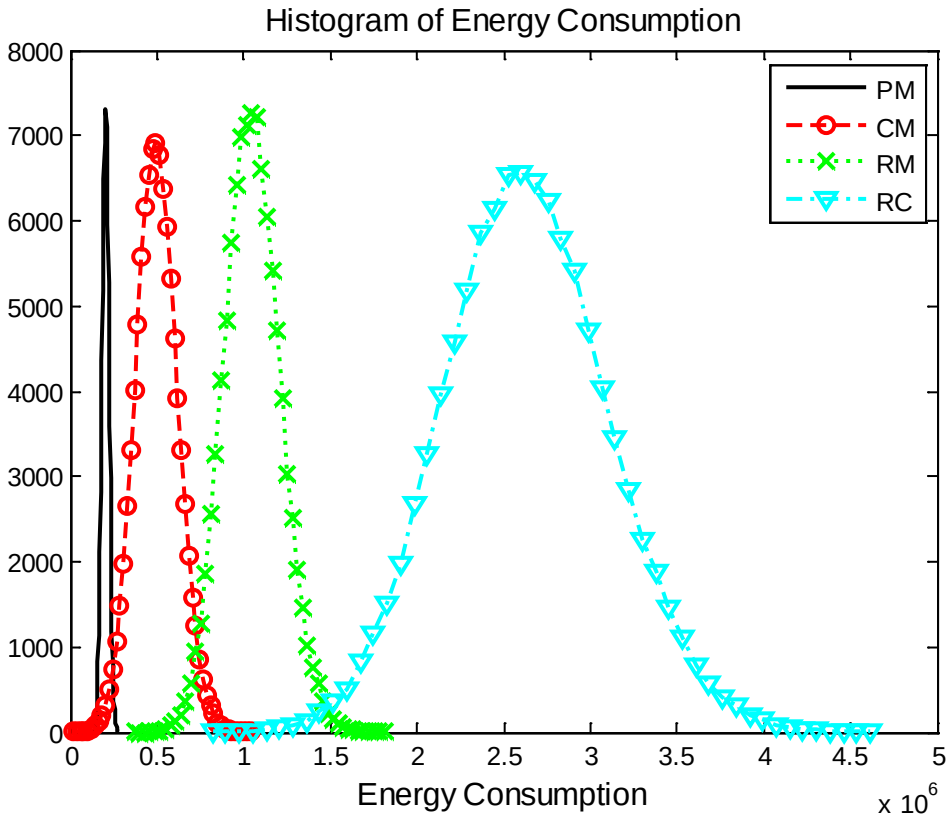
ECORCE M
ECO-comparison Road Construction and Maintenance

FHWA RealCost

Sustainability in Performance Management and Multi Criteria Decision Analysis

Like costing and risk techniques, sustainability assessment is a tool in the asset management toolbox

- Sustainable performance measures can be linked directly to an agency's goals and objectives
- Specific outcomes (using common tools) can be integrate into asset systems
  - Similar to assigning costs, each maintenance activity can be directly linked to sustainability measures



Including Quantitative Assessments in Decision Analysis: Example

Optimize M&R strategies for a small road network

- Minimize Cost and Energy Consumption, Maximize Condition (5 Year Horizon)
  - Energy consumption is a proxy for environmental measures in this example
- Develop a Pareto surface of potential outcomes based on optimization (genetic algorithms in this case).
- Assess the tradeoffs between the three objectives
  - Can be used as a decision analysis tool
  - Can be very useful as a communication tool for many stakeholders

Including Quantitative Assessments in Decision Analysis: Example

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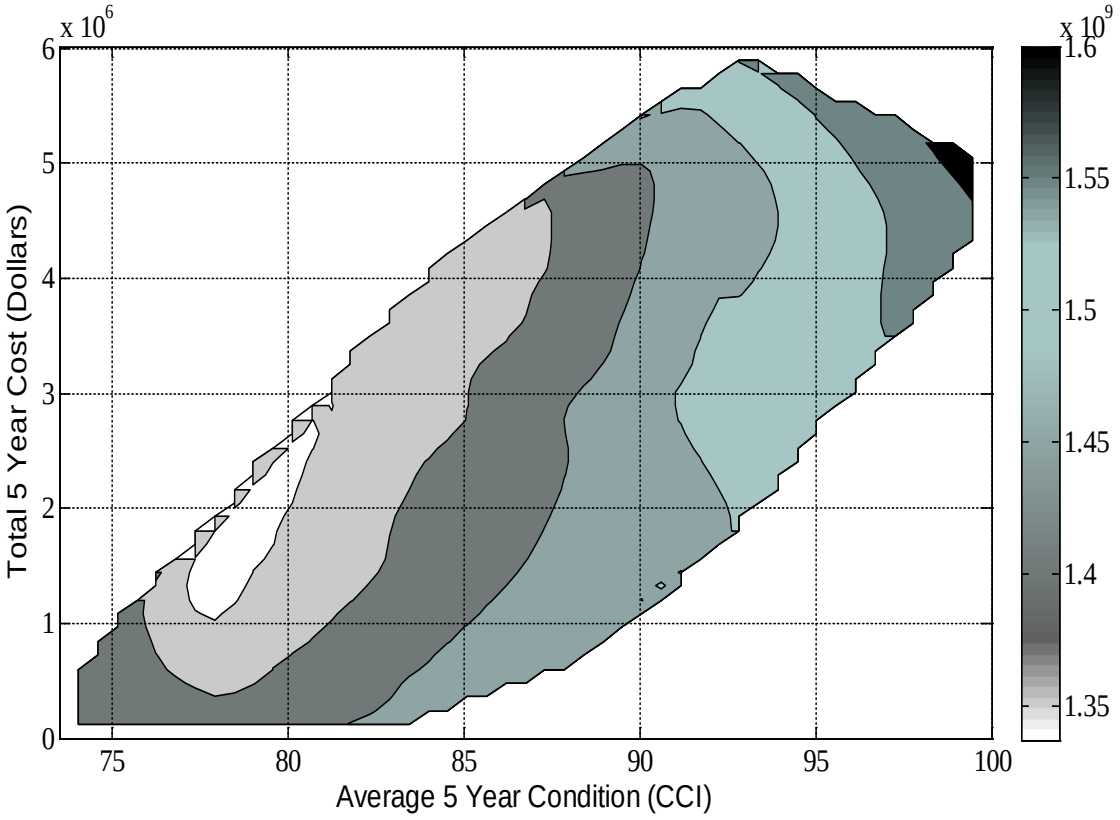
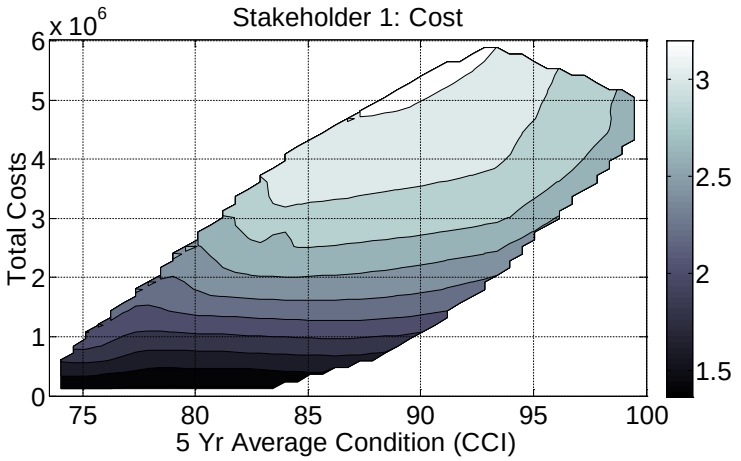


Including Quantitative Assessments in Decision Analysis: Example



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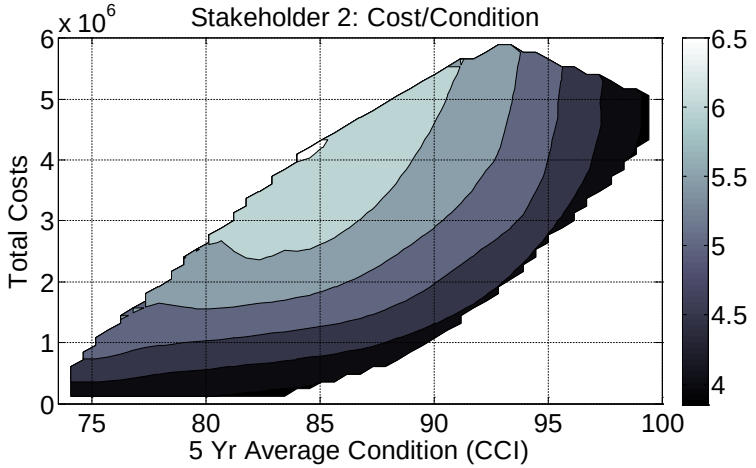

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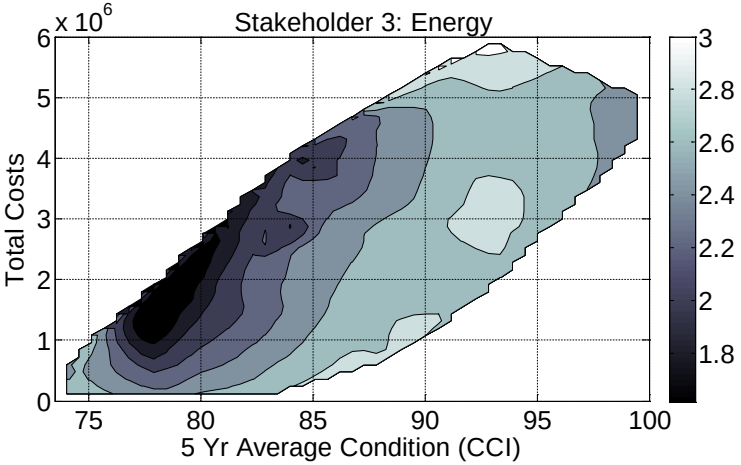

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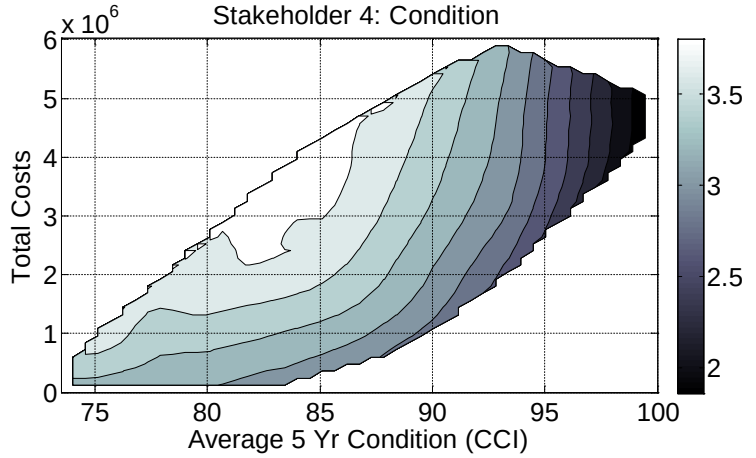

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Summary

Sustainability is driven by the tradeoffs between the cost of an asset, the value society gains from the asset, and the adverse impact on the natural environment.

- As asset management is being implemented throughout the US, sustainability related objectives should be a part of the plans
- Many tools and techniques exist to support the inclusion of the environmental aspect of sustainability into modern asset management for many asset types
- Many decision analysis techniques also exist to develop solutions for the multi criteria problem that arises from sustainability

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Thank you!!!