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Measuring the Sustainability of Infrastructure Systems:
Information Requirements and Desiderata

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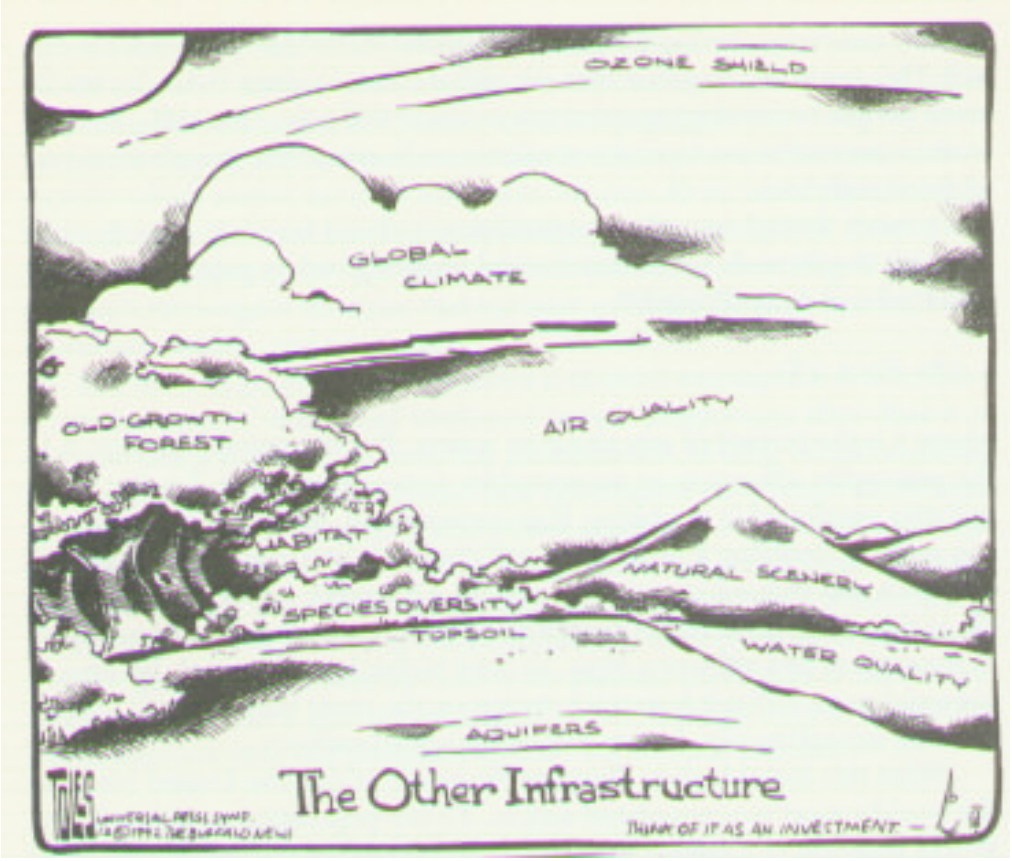
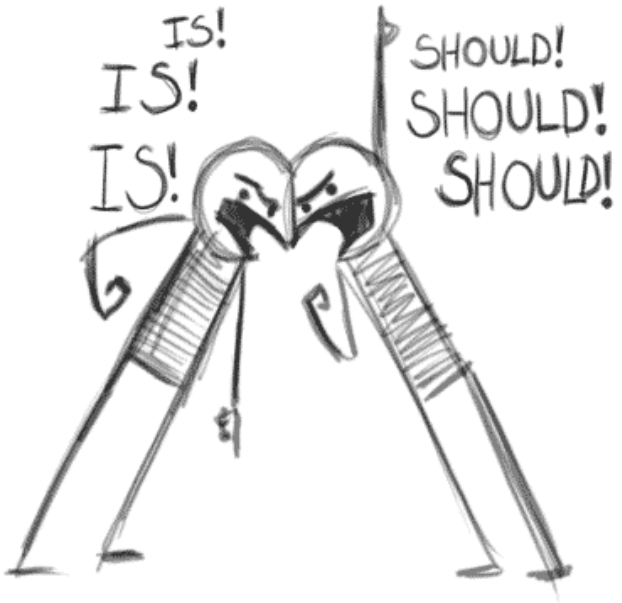
Overview

- Three measurement approaches for CIS
- Comparative utility for various purposes
- Lessons learned from vertical construction
- CIS measurement as an innovation



Prescriptive Measurement

- Set of heuristic or theory-based "shoulds"
- Either a few overdesigned or many situation-specific items
- Based on current technology
- Measurement = did you do it or not?



"Use pervious pavement for parking"

(http://tomjech.com/)

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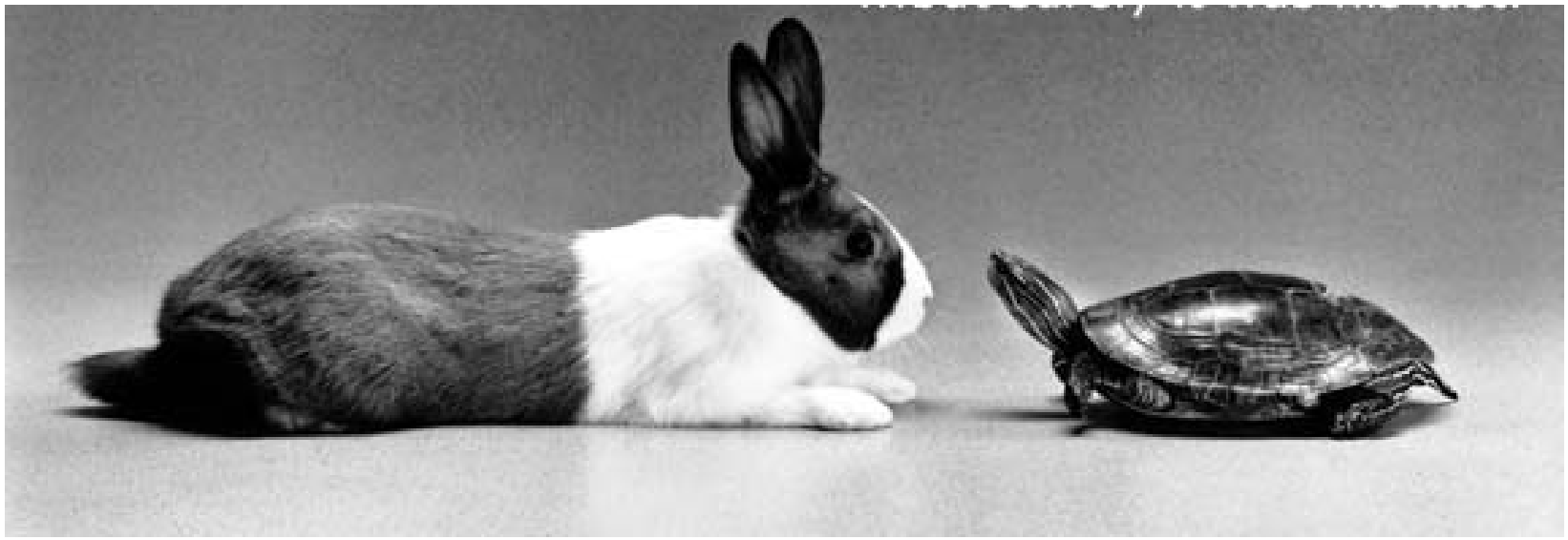
Performance-based Measurement

- Minimum threshold on a performance continuum
- The *how* is up to the designer. Framing is key!

"Reduce runoff from paved areas to predevelopment equivalent."



(http://newmedia.kvcc.edu/)

Systems-based Measurement

- Whole solution performance-based measurement
- Captures synergies and opportunities bigger than individual project features

"Allow no stormwater runoff to cross site boundaries."

(AFRC/Homestead ARB/Cadle)

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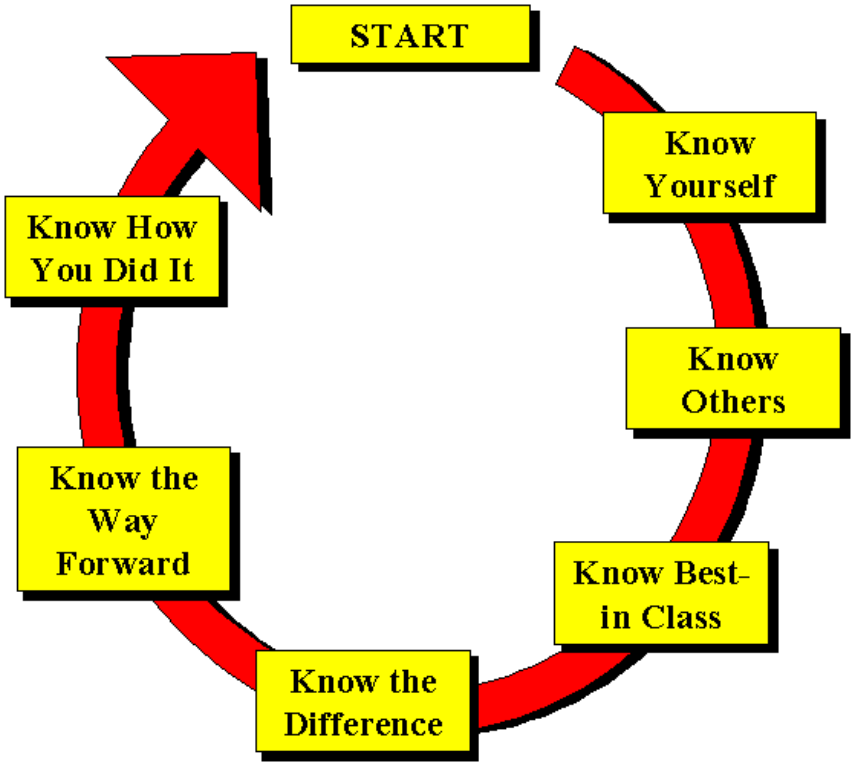
Purposes of Measurement

- Baselining
- Benchmarking
- Prioritization, decision support, and selection
- Documentation



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Approach vs. Purpose

	Prescriptive	Performance-based	Systems-based
Baselining			
Benchmarking			
Prioritization			
Documentation			
Useful whenÉ	• Coarse resolution is enough • Best practices are well-established and do not change	• Good performance simulation models exist • System behavior is predictable	• Facilities are perceived within larger context • Ongoing changes to the system are possible to optimize performance

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Scales of Assessment

Scale	Threshold Systems	Profile Systems
Raw Material	• Forest Stewardship Council Certification	• BEES
Product or Assembly	• GreenSeal • GreenLabel Plus	• Athena
Building	• LEED • GreenGlobes	• GBTool
Development, City, or Region	• LEED-ND • Ecological Footprint Carbon Footprint	• ICLEI Profile
Enterprise	• Ranking in Dow Jones Sustainability Index • Carbon Footprint	• GRI® Triple Bottom Line • SAM Corporate Sustainability Assessment

Threshold vs. Profile

Carbon Facts

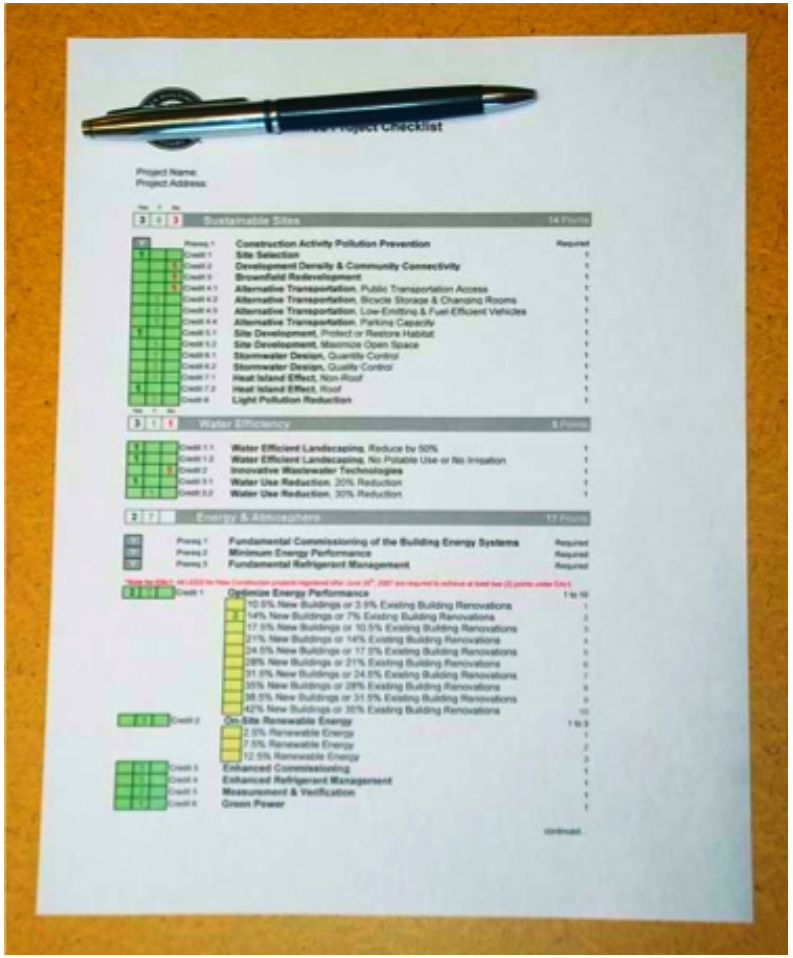
Product Size 1 Cheeseburger (130g)

Amount Per Serving	
Kilograms CO_2 Equivalent 3.08	
Kilograms CO_2 .243	Kilograms CH_4 .123
Total C: Energy Sources	243g
Transportation	
Fossil Fuel (Diesel)	120g
Fossil Fuel (Gasoline)	48g
Electricity Production	
Fossil Fuel (Natural Gas)	75g
Fossil Fuel (Coal)	0g
Other	
Total C: Non-Energy Sources	2840gCO_2E
Enteric Fermentation	81.0g (1864gCO_2E)
Manure	25.8g (656gCO_2E)
Other	5.2g (120gCO_2E)
Carbon/Product Ratio	23.7
Localism Rating	C+
Sustainable Production Rating	D+

overall carbon code: orange

Lessons from Vertical Construction

- Scope and boundary of analysis
- Amalgamation and scale validity
- Context specificity
- Mutual exclusivity and collective exhaustiveness
- Utility to target audiences



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Lessons from Vertical Construction

- Meaningful results vs. level of effort
- Distinction among alternatives
- Projected vs. actual performance
- Obtaining uniform data

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Attributes of Innovations Affecting their Adoption

- Relative advantage vs. competitors/ status quo
- Compatibility/ fit with context
- Complexity/prior knowledge required
- Trialability/level of commitment
- Observability of results

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Prescriptive Measurement

- Required info:
  - Presence/absence of design features
- Validation:
  - Direct inspection
  - Observation/ documentation
- Outcomes:
  - Problems can be corrected as you go
  - Potential overdesign

- Relative Advantage: Low precision, low investment
- Compatibility: Good fit with practice
- Complexity: Limited training required
- Trialability: Low initial commitment by owners
- Observability: Features are observable, but real performance may not correlate

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Performance-based Measurement

- Required info:
  - Ability of sub-systems to meet performance thresholds
- Validation:
  - Performance testing
  - Simulation models
  - Design heuristics
- Outcomes:
  - May be too late to fix problems after the fact
  - Design to fit

- Relative Advantage: Better precision, medium investment
- Compatibility: May require new services/tools
- Complexity: May require modeling expertise
- Trialability: Medium owner commitment; large design/const commitment
- Observability: Correlates well with performance indicators

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Systems-based Measurement

- Required info:
  - Inputs and outputs
  - Sources and sinks
- Validation:
  - Simulation models
  - Real-time tracking
- Outcomes:
  - Isolating and fixing problems can be tough
  - Subsystem synergies can improve overall performance

- Relative Advantage: High utility for custom systems/ variable investment
- Compatibility: Requires additional tracking
- Complexity: May require new data sources
- Trialability: High commitment and cooperation required
- Observability: May or may not correlate well with public indicators

Conclusions

- Simpler approaches can ultimately be counterproductive
- Measurement approach should be matched to desired use of results
- More complex approaches can be customized to fit client needs
- Future work:
  - Human/organizational context of decisions
  - Defining new types of failure modes for CIS

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Questions?

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