




FOUNDER

It started with recyclability



ASPHALT
100% RECYCLABLE

ASRA


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FOUNDER

There was also a focus on emissions

Total emissions from asphalt operations decreased by 97 percent from 1970 to 1999, while production of asphalt pavement material increased by 250 percent



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Wider focus in current industry information

- ⊕ Warm Mix Asphalt
- ⊕ Doubling RAP Usage
- ⊕ Perpetual Pavements
- ⊕ Porous / Open Graded




Sustainable Asphalt, Now and Tomorrow



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pavegreen.com is current outreach



BUILDING BETTER COMMUNITIES
THROUGH SUSTAINABLE PRACTICES.

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The Circle of Asphalt

Every year, about 100 million tons of pavement material is reclaimed, and about 85 percent of the total is returned to use in roads and highways. This means asphalt paved America's most recycled material.

[Read more](#)

Asphalt Topics

- What is Asphalt?
- Energy Savings
- Cleaner Water
- Pavement Safety
- Cleaner Air
- Carbon Footprint
- Noise Reduction
- Traffic Relief
- Recycled Asphalt

More Evidence
Asphalt is the gold pavement. Studies show that the noise-reducing properties of asphalt road for many years have reductions of 3 to 10 decibels are common. Hearing noise by 1 dB...

Latest News

Chesapeake Bay Bridge
Lanham, MD - asphalt pavements can be excellent tools in improving

SPECIAL SERIES: America on the Move

Take a closer look inside the Smithsonian Institution



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FOCUS AREAS

Focus areas are much the same

- ⊕ Recycled Asphalt
- ⊕ Porous Asphalt
- ⊕ Perpetual Pavements
- ⊕ Warm-Mix Asphalt
- ⊕ Green Paving Practices
- ⊕ Safe for Fishing – and for fish



ASPA

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FOCUS AREAS

Current recycling claims are impressive

Every year, about 100 million tons of pavement material is reclaimed, and about 95 percent of the total is returned to use in roads and highways.

This makes asphalt pavement America's most recycled material.

Some of the reclaimed material is recycled into shoulders and road base, but by far the lion's share is reused for its original purpose.

ASPA

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Livable communities are new focus area

- ⊕ Stimulating local economies
- ⊕ Versatility
- ⊕ Keeping it safe
- ⊕ Reducing noise
- ⊕ Better water quality

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Porous pavements show asphalt helps water quality

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Perpetual pavements






Safe, Smooth, Easy Rehabilitation



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WMA getting a large push

- ⊕ Cost effective
- ⊕ Improved performance
- ⊕ Reduced emissions
- ⊕ Portability
- ⊕ Extended paving season
- ⊕ Safety






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Green paving practices

- ⊕ **Rolling resistance**
 - 1% impact fuel consumption
- ⊕ **Pavement stiffness**
 - Minimal fuel impact
- ⊕ **Pavement smoothness**
 - 5% or greater fuel impact





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The goal of sustainability is changing

- ⊕ **Public agencies strive to be fiscally, socially, and environmentally responsible, and to be good neighbors**
- ⊕ **As a custodian of public investment, they strive to incorporate sustainability in their day-to-day operations**



Public agencies require a proactive “triple bottom line” analysis that addresses economic, environmental, and social sustainability



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Many definitions of “green”


Sustainable Development ^{LEED™}
Alternative Fuel Vehicles **Recycling**



Platinum Points **Cost-Recovery** **Green Roofs**
Global Warming ISO 14001 U.S. E.O. 13423
Environmental Management System

Best Management Practices Economic Survival

Long term planning **BALANCE** Guidance
Holistic Resource Management

Life Cycle Cost Management
Environmental STEWARDSHIP





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Why be sustainable?

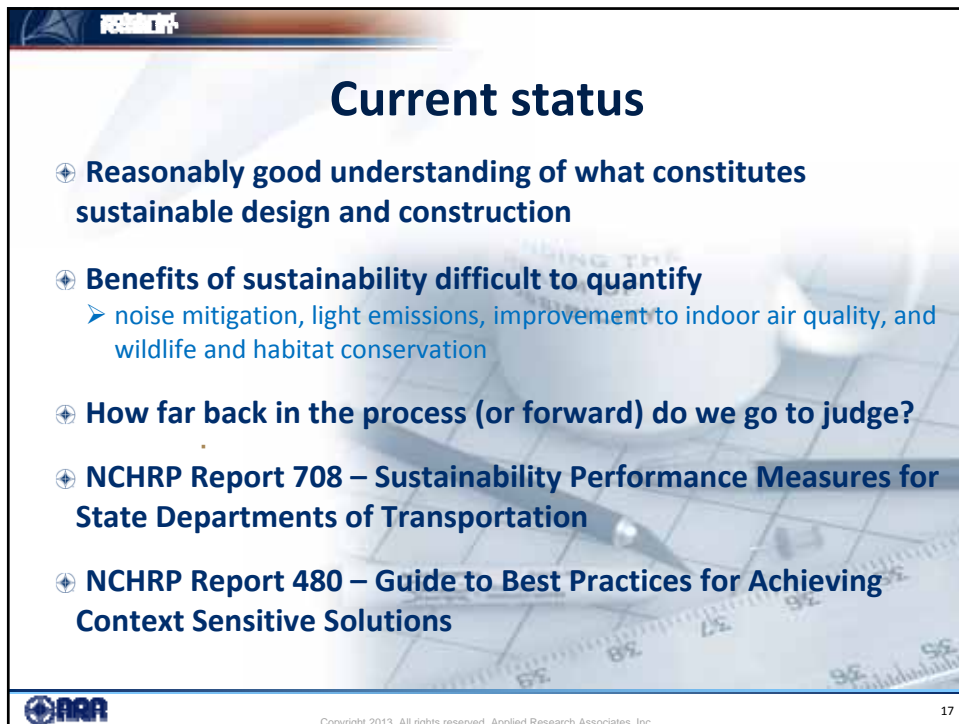
- ⊕ Take responsibility for the impact of roadway operations
- ⊕ Reduction of green house gas emissions
- ⊕ Optimize the investment in renewable infrastructure
- ⊕ Increase business value






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Current status

- ⊕ Reasonably good understanding of what constitutes sustainable design and construction
- ⊕ Benefits of sustainability difficult to quantify
 - noise mitigation, light emissions, improvement to indoor air quality, and wildlife and habitat conservation
- ⊕ How far back in the process (or forward) do we go to judge?
- ⊕ NCHRP Report 708 – Sustainability Performance Measures for State Departments of Transportation
- ⊕ NCHRP Report 480 – Guide to Best Practices for Achieving Context Sensitive Solutions

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There are many resources available






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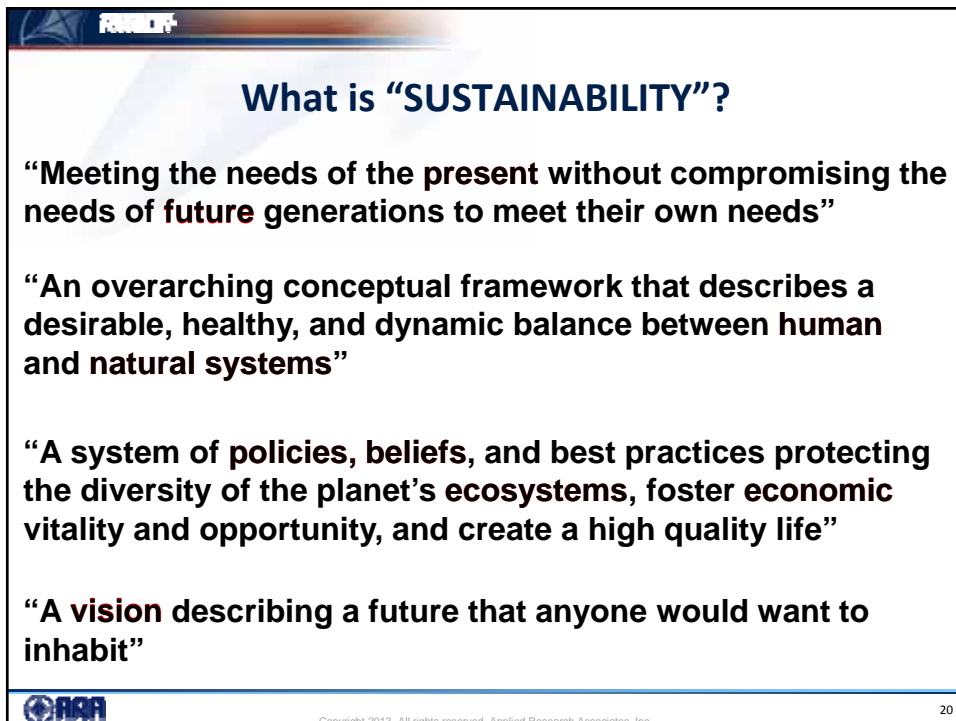


There are many tools

- ⊕ ASCE Institute for Sustainable Infrastructure (envision™) system
- ⊕ LEED, (U.S. and Canadian Green Building Councils)
- ⊕ Canadian Construction Association Guidelines
- ⊕ Washington State Greenroads Guide
- ⊕ New York State's GreenLITES System
- ⊕ Ontario Ministry of Transportation's GreenPave
- ⊕ Transportation Association of Canada's Green Guide for Roads
- ⊕ FHWA Sustainable Highways Self-Evaluation Tool
- ⊕ FHWA Green Procurement Guide
- ⊕ Saga Sustainability Database
- ⊕ Dutch Dubocalc sustainability evaluation system

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What is “SUSTAINABILITY”?

“Meeting the needs of the present without compromising the needs of **future generations to meet their own needs”**

“An overarching conceptual framework that describes a desirable, healthy, and dynamic balance between human and natural systems”

“A system of policies, beliefs, and best practices protecting the diversity of the planet’s ecosystems, foster economic vitality and opportunity, and create a high quality life”

“A **vision describing a future that anyone would want to inhabit”**

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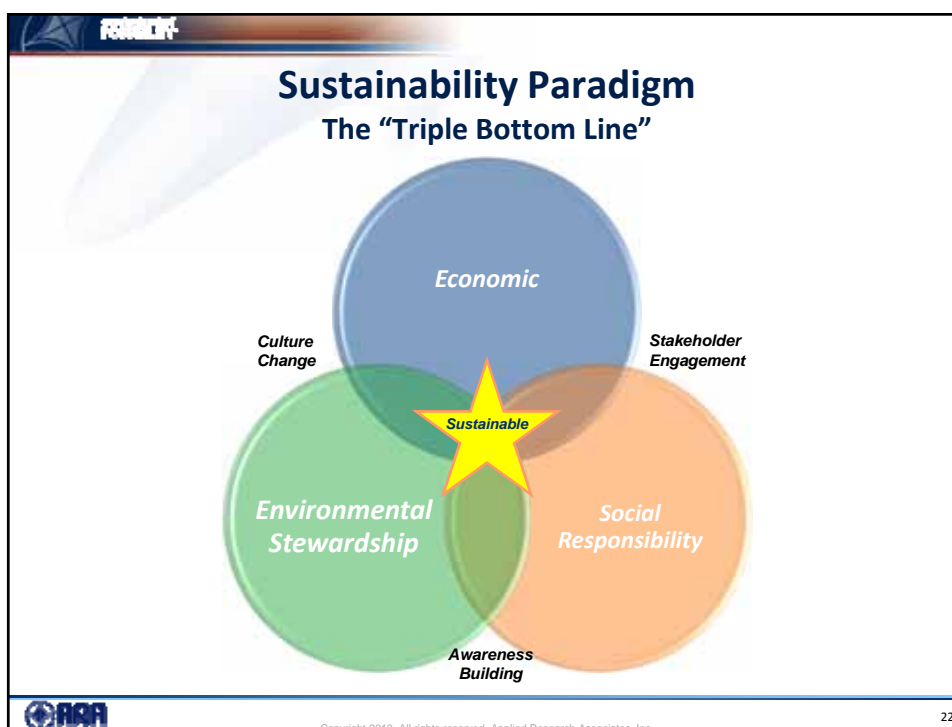
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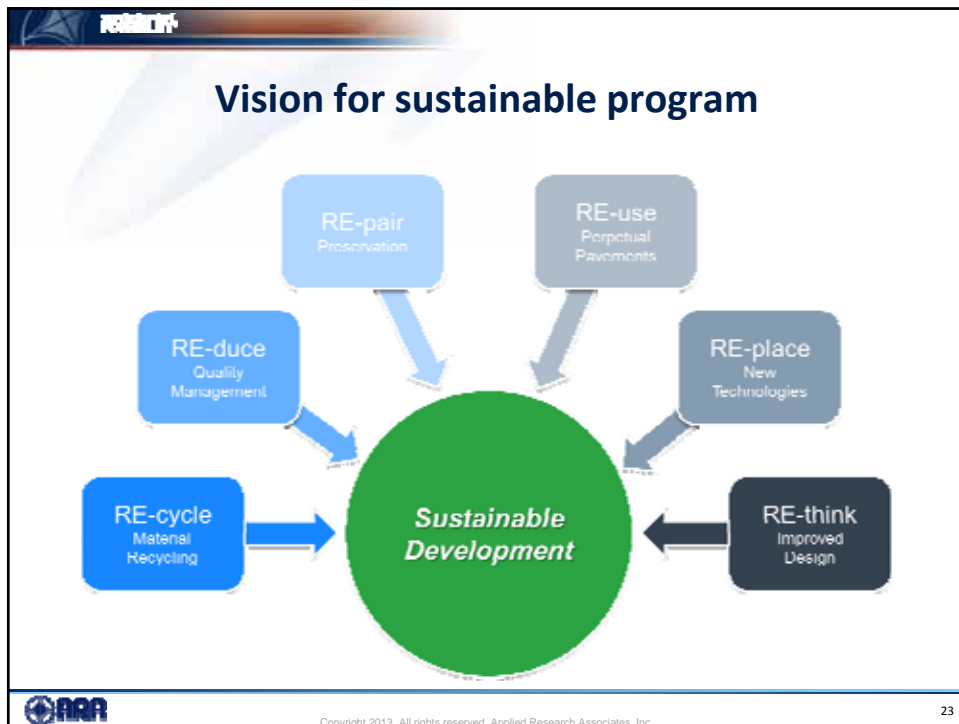
Why do we need to measure?

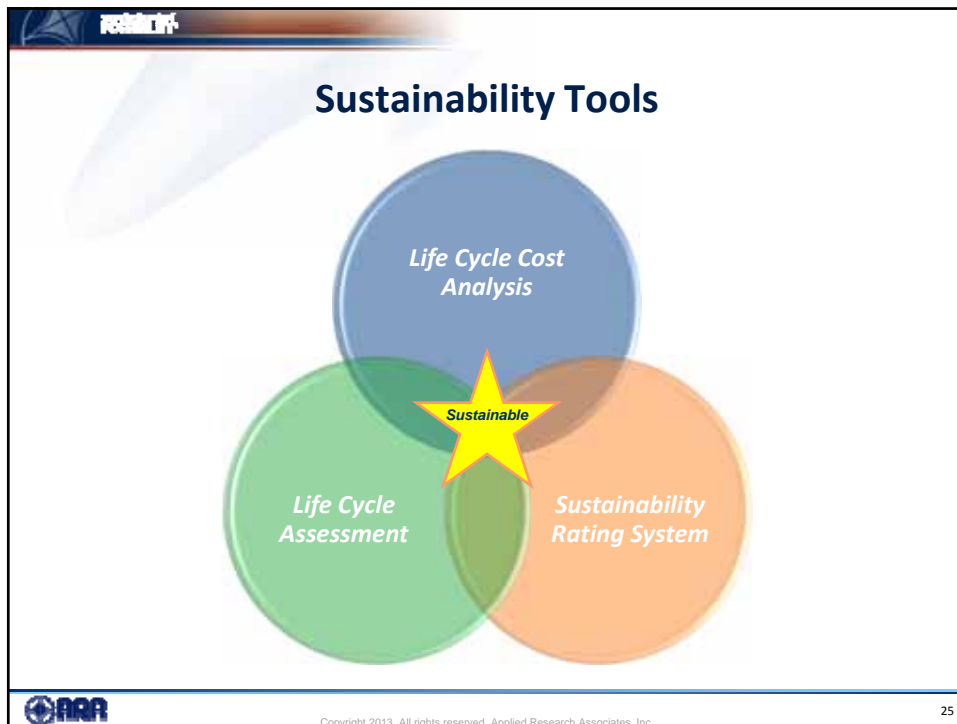
- ⊕ To evaluate our agency performance
- ⊕ To continue to develop and implement more green initiatives or best practices
- ⊕ To demonstrate to the public that environmental, economic and social benefits to improved sustainability are continually improving



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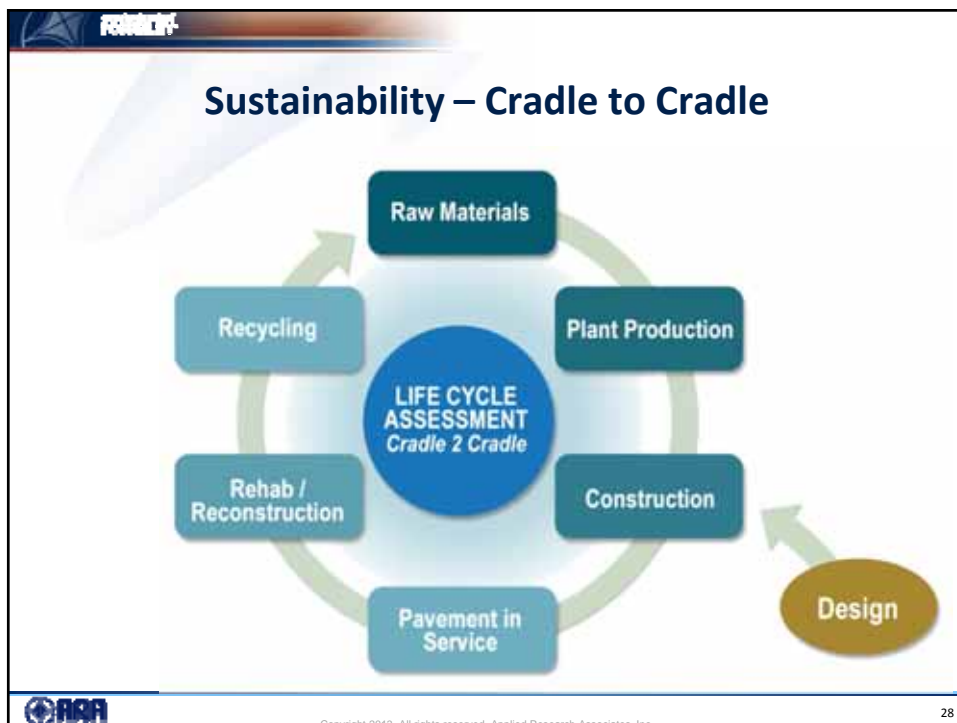
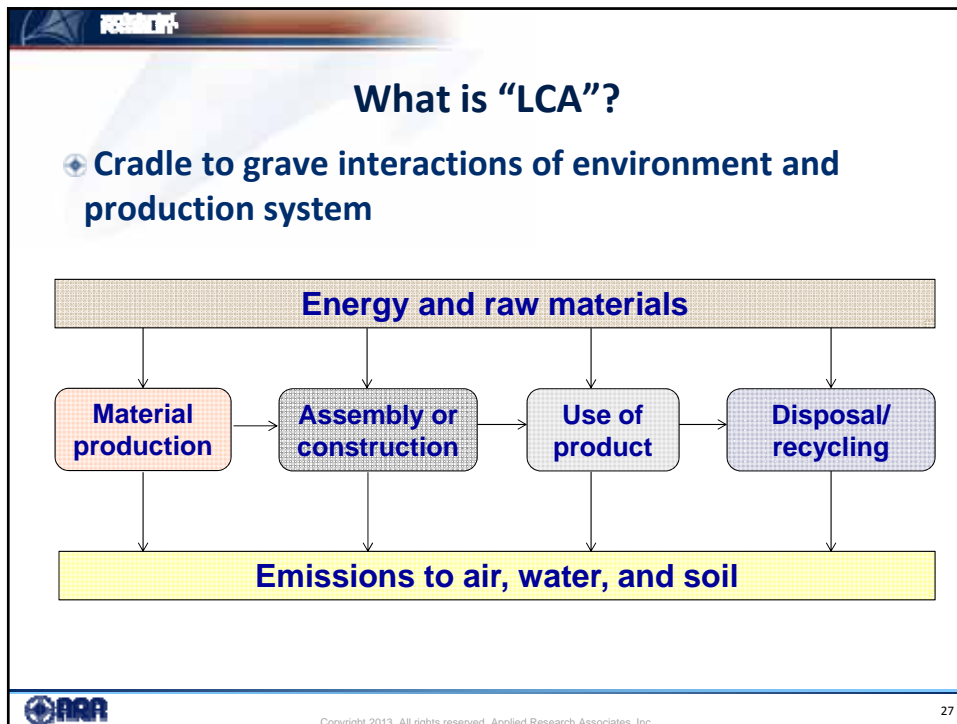



Sustainability Rating System

- ⊕ Evaluate and rate all aspects of triple bottom line
- ⊕ Objective criteria/goals
- ⊕ Points for achievement (subjective)
- ⊕ Many rating systems in the market

Name	Owner/Developer	Release
Envision	Institute for Sustainable Infrastructure	2012
GreenLITE	New York State DOT	2008
GreenPave	Ontario Ministry of Transportation	2010
Greenroads	Greenroads Foundation	2007
I-LAST	Illinois Joint Sustainability Group	2009
INVEST	FHWA	2010
LEED ND	U.S. Green Building Council	2007


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Difference between SRS and LCA

Sustainability Rating System	Life-Cycle Assessment
Qualitative	Quantitative
Incorporates social, economic, and environmental aspects	Only environmental
Usually rates a system	Typically for a specific product (eg. pavement, car, etc.)



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Let's look at INVEST

ECONOMIC • SOCIAL • ENVIRONMENTAL

- ⊕ **Considers full lifecycle of projects**
- ⊕ **Three modules with a total of 60 criteria**
 - System Planning (SP) module has 16 criteria plus one bonus criteria – Agency specific
 - Project Development (PD) module has 29 criteria– Project specific
 - Operations and Maintenance (OM) module has 14 criteria with one scorecard – Agency specific

Infrastructure Voluntary Evaluation Sustainability Tool

www.sustainablehighways.org



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INVEST – System Planning

SP-1	Integrated Planning: Economic Development and Land Use
SP-2	Integrated Planning: Natural Environment
SP-3	Integrated Planning: Social
SP-4	Integrated Planning: Bonus
SP-5	Access and Affordability
SP-6	Safety Planning
SP-7	Multimodal Transportation and Public Health
SP-8	Freight and Goods Movement
SP-9	Travel Demand Management
SP-10	Air Quality
SP-11	Energy and Fuels
SP-12	Financial Sustainability
SP-13	Analysis Methods
SP-14	Transportation Systems Management and Operations
SP-15	Linking Asset Management and Planning
SP-16	Infrastructure Resiliency
SP-17	Linking Planning and NEPA



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INVEST – Project Development

PD-1	Economic Analysis
PD-2	Life-Cycle Cost Analyses
PD-3	Context Sensitive Project Development
PD-4	Highway and Traffic Safety
PD-5	Educational Outreach
PD-6	Tracking Environmental Commitments
PD-7	Habitat Restoration
PD-8	Storm water
PD-9	Ecological Connectivity
PD-10	Pedestrian Access
PD-11	Bicycle Access
PD-12	Transit and HOV Access
PD-13	Freight Mobility
PD-14	ITS for System Operations
PD-15	Historical, Archaeological, and Cultural Preservation
PD-16	Scenic, Natural, or Recreational Qualities





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INVEST – Project Development


PD-18	Site Vegetation
PD-19	Reduce and Reuse Materials
PD-20	Recycle Materials
PD-21	Earthwork Balance
PD-22	Long-Life Pavement Design
PD-23	Reduced Energy and Emissions in Pavement Materials
PD-24	Contractor Warranty
PD-25	Construction Environmental Training
PD-26	Construction Equipment Emission Reduction
PD-27	Construction Noise Mitigation
PD-28	Construction Quality Control Plan
PD-29	Construction Waste Management



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INVEST – Operations & Maintenance


OM-1	Internal Sustainability Plan
OM-2	Electrical Energy Efficiency and Use
OM-3	Vehicle Fuel and Efficiency Use
OM-4	Reuse and Recycle
OM-5	Safety Management
OM-6	Environmental Commitments Tracking System
OM-7	Pavement Management System
OM-8	Bridge Management System
OM-9	Maintenance Management System
OM-10	Highway Infrastructure Preservation and Maintenance
OM-11	Traffic Control Infrastructure Maintenance
OM-12	Road Weather Management Program
OM-13	Transportation Management and Operations
OM-14	Work Zone Traffic Control


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PD-2: Life Cycle Cost Analyses

- ⊕ **Goal:** Reduce life-cycle costs and resource consumption through the informed use of life-cycle cost analyses of key project features during the decision-making process for the project
- ⊕ **Assigned 1 to 3 points**
 - 1 point: Perform an LCCA of all pavement structure alternatives in accordance with the method described in the FHWA's Technical bulletin for Life-Cycle Cost Analysis
 - 1 point: Perform an LCCA of all stormwater infrastructure alternatives considered
 - 1 point: Perform an LCCA of the project's major feature (bridges, tunnels, retaining walls, or other items not listed in the preceding options) for each of the alternatives considered




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PD-11: Bicycle Access

- ⊕ **Goal:** Promote bicycling in communities by providing or enhancing safe and convenient bicycling facilities within the project footprint
- ⊕ **Assigned 1 or 2 points**
 - 1 point: Implement new (or improve existing) features for existing bicycle facilities that improve safety and connectivity, or
 - 2 points: Implement features (such as those mentioned above) in the design and construction of new bicycle facilities that enhance safety, connectivity, aesthetics, comfort, and environment





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 **PD-12: Transit and HOV Access**


- ⊕ **Goal:** Promote use of public transit and carpools in communities by providing new transit and high occupancy vehicle (HOV) facilities, or by upgrading existing facilities within the project footprint
- ⊕ Assigned 1 to 5 points
 - Points are in a detailed table.

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 **PD-19: Reduce and Reuse Materials**

- ⊕ **Goal:** Reduce lifecycle impacts from extraction and production of virgin materials by recycling materials
- ⊕ Assigned up to 8 points
 - Pavement preservation: Up to 4 points
 - Reduce pavement materials: Up to 3 points
 - Bridge preservation: 2 to 4 points
 - Retrofitting bridges: 1 to 3 points
 - Repurpose pavements or bridges: 1 to 3 points
 - Reuse industrial byproduct materials: 2 to 3 points

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PD-20: Recycle Materials

- Goal:** Reduce lifecycle impacts from extraction, production, and transportation of virgin materials by recycling materials.
- Assigned up to 8 points**
 - RAP or RCA use (no points if haul off)

Recycling Method Used	Points Earned				
	1	2	3	4	5
Percent average recycled material (ARC) required for recycling in pavements	10%	20%	30%	40%	50% or more
Percent average recycled material (ARC) required for granular base course or embankments	20%	30%	40%	50%	60% or more


- In-place pavement recycling (CIP, HIP, FDR)
- Minor structural elements



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Positive Attributes of INVEST

- Objective and repeatable**
- Simple and straightforward**
 - Does not require in-depth technical knowledge
- Thoroughly documented**
- Has been vetted**
- FHWA Standard**





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Limitations of INVEST

- ⊕ **Reflect the knowledge base/experience of the developers**
 - Doesn't specifically consider local reality or practices
 - Few points for innovation
- ⊕ **The criteria considered and weighting scheme seem arbitrary**





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What is Life Cycle Assessment (LCA)

Al-Qadi


- ⊕ **Compilation and evaluation of the inputs, outputs and potential environmental impacts of a product system throughout its life-cycle** (ISO 14040, 1997)
- ⊕ **A cradle-to-grave approach for assessing industrial systems that evaluates all stages of a product's life and provides a comprehensive view of the environmental aspects of the product or process** (EPA, 2006)



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Al-Qadi

Why use LCA?

- ⊕ **Environmental impacts can be quantified**
 - e.g. CO2 emission and energy consumption
- ⊕ **Allows to determine the optimized stage of a product's influence on environment**
 - e.g. HMA material phase's energy consumption is the greatest.
- ⊕ **Allows comparing construction alternatives**
 - e.g. PCC overlay vs. HMA overlay



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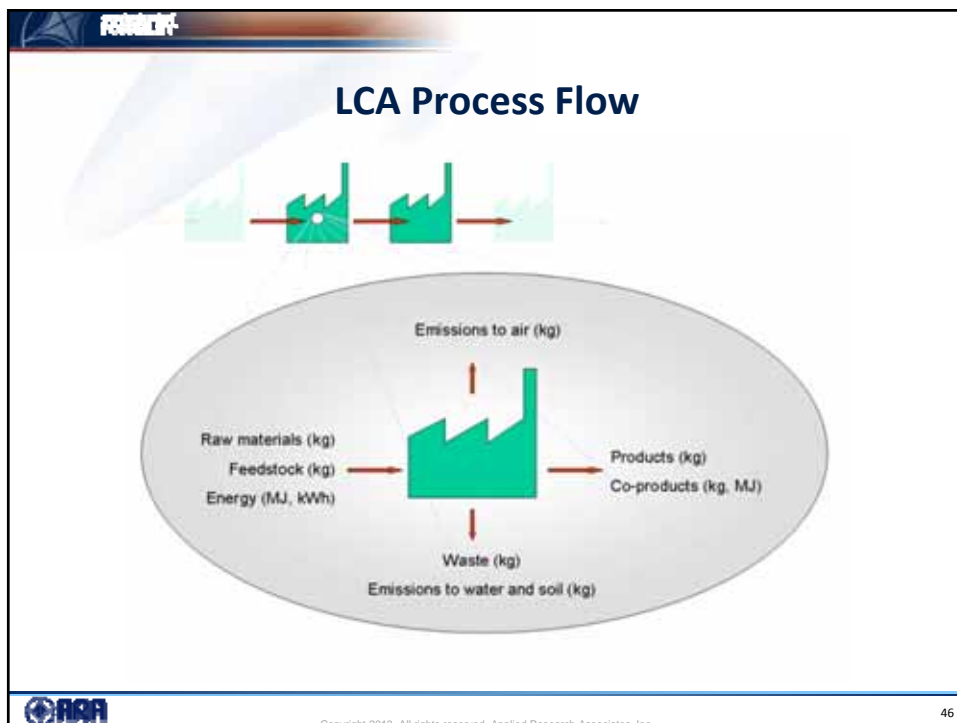
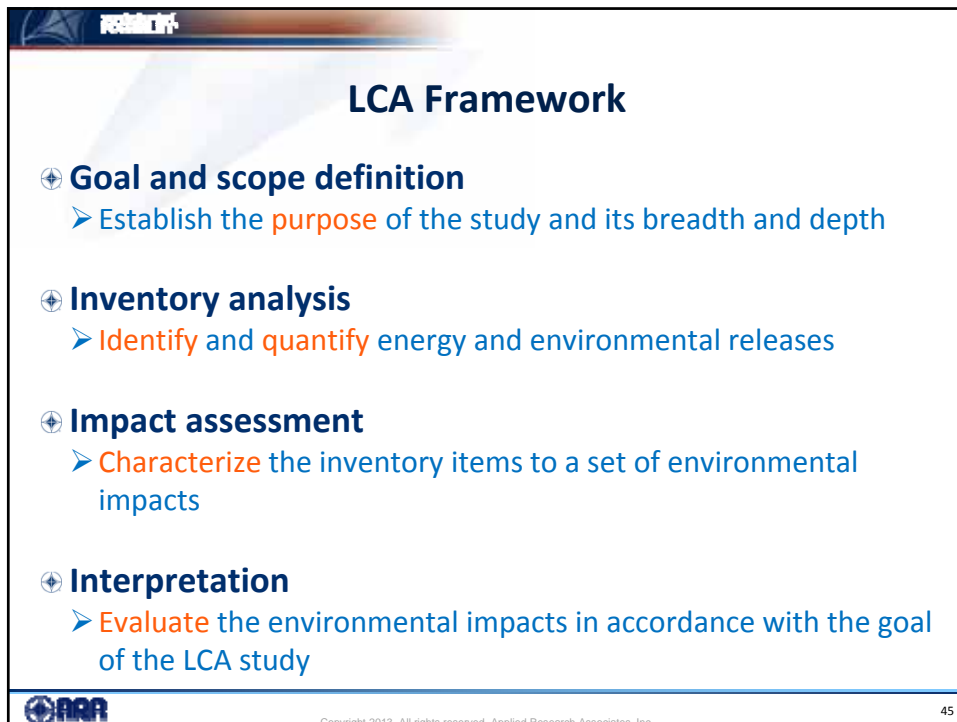
Life Cycle Assessment Quantitative Measurement of Sustainability

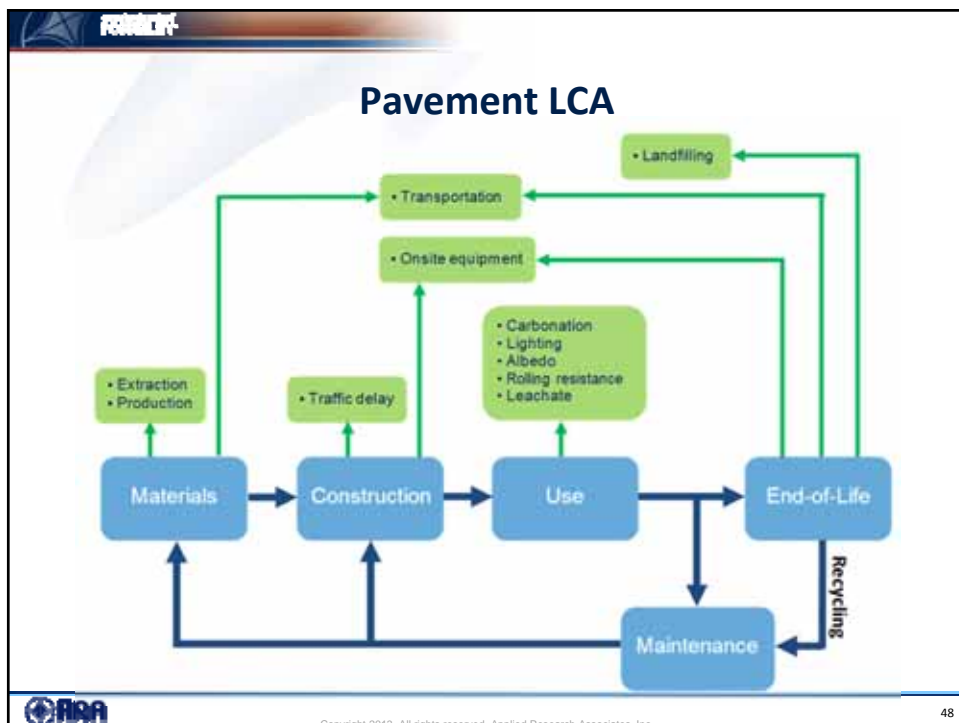
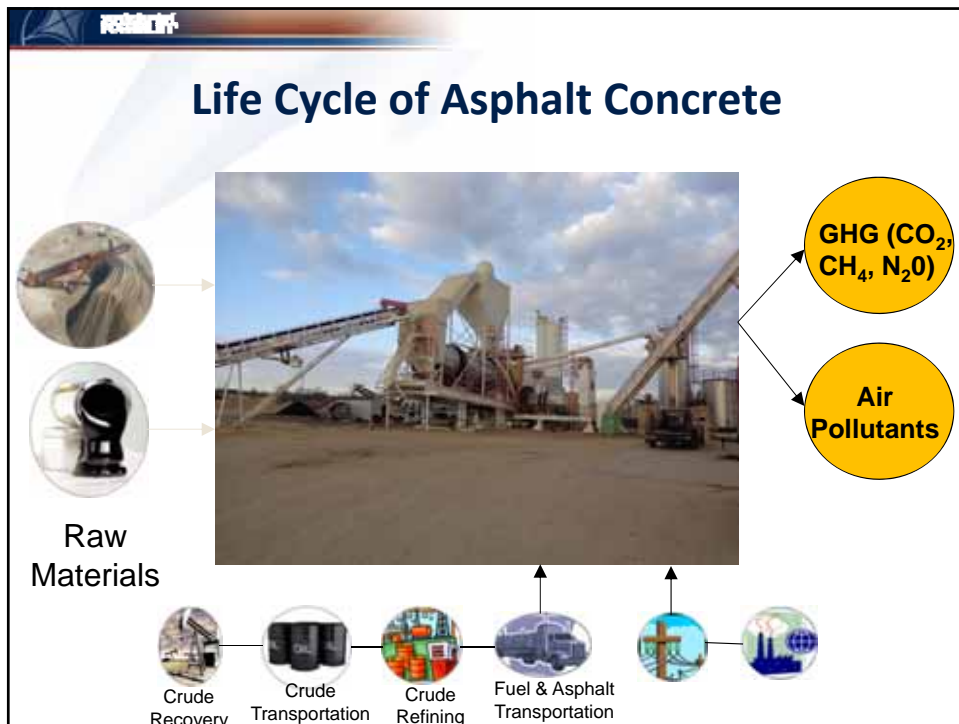
Why must we quantify?

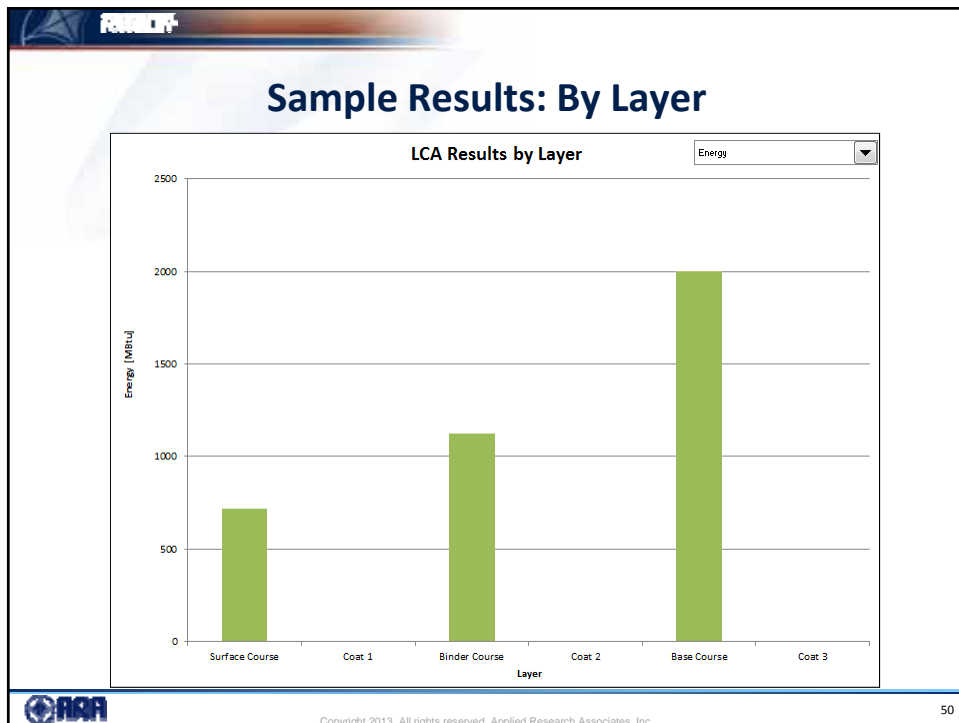
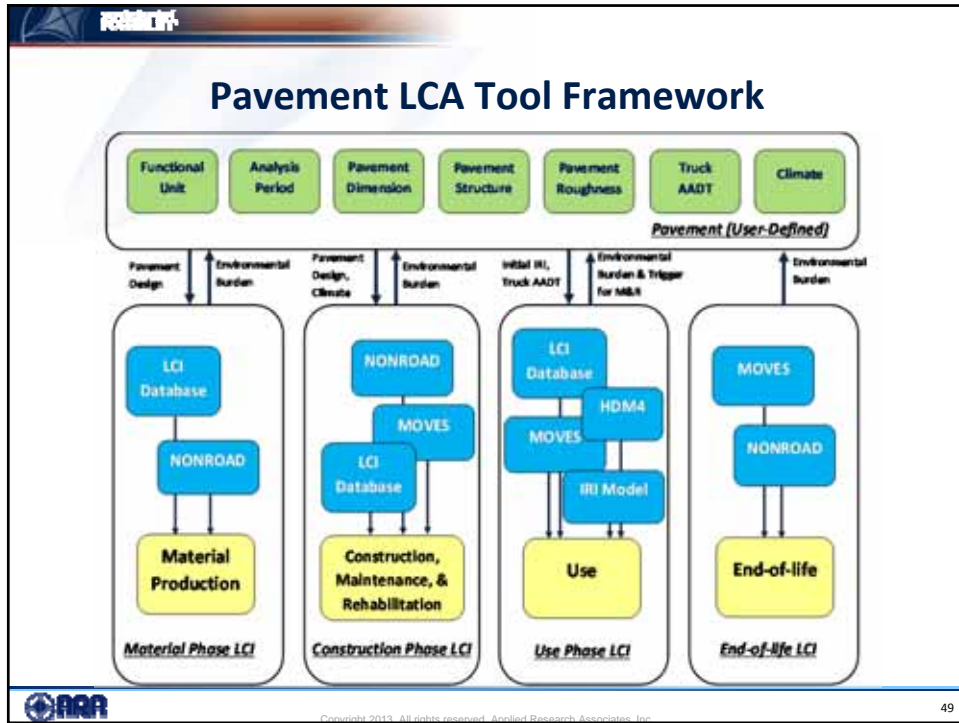
- ⊕ **If it is not quantified, it is not valued**
 - Without value, it won't get done
 - Without value, it cannot be improved upon
 - Without value, there is no incentive




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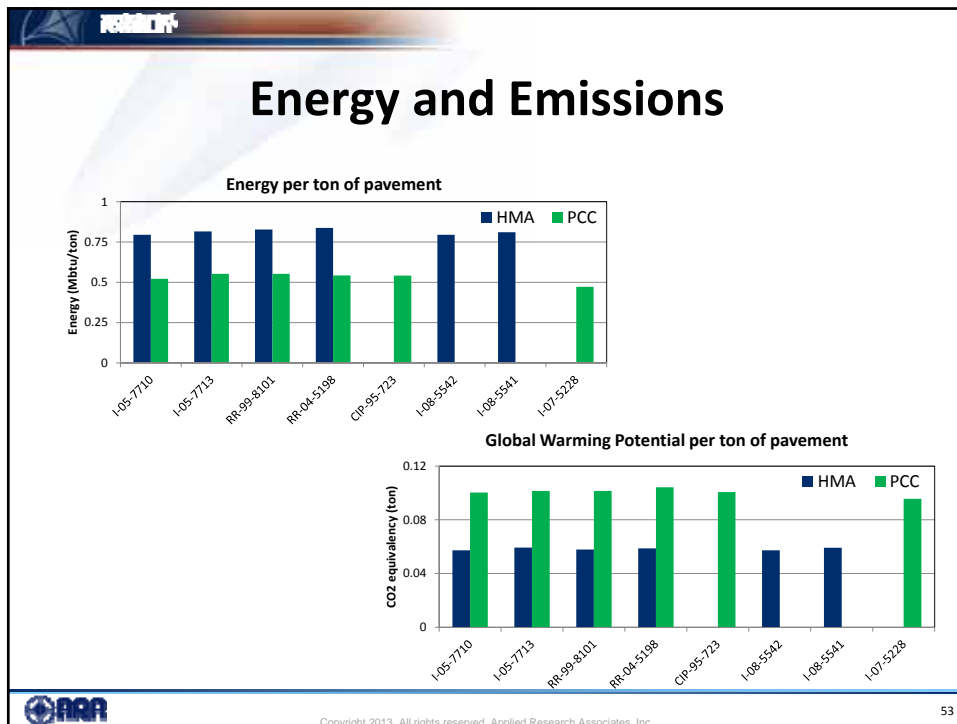




Sample Results: By Mix

Mix	Energy [MJ/t]
90B1T0845-Binder	430
90B1T0811-Binder	540
90B1T0939-SMA	630
90B1T0908-Binder	390
0	0

[illegible]



Where might it go?

- ⊕ Agency establishes sustainability goal
- ⊕ Design to sustainability goal
- ⊕ Review of design against goal
- ⊕ Construction given design standard & goal
- ⊕ Contractor runs LCA with actual materials & construction procedures – Potential bonus for sustainable construction
- ⊕ Review of construction against design standard & goal

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