Industry Perspectives: Sustainable Asphalt Technologies
• What does it mean to be “Sustainable”?  

• What asphalt technologies are considered “Green” and why?  

• Why do we need to quantify our impact?  

• What tools are available for quantification?  

• What is NAPA’s role?
Sustainable

“Meets the needs of the present without compromising the ability of future generations to meet their own”\(^1\)

Sustainable Pavements?

No universal definition

“Triple Bottom Line”

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1 UN World Commission on Environment and Development
Sustainable Asphalt Pavements

- Societal
  - Safe
  - Quiet
  - Smooth Ride Quality
  - Minimizes User Delay
  - Natural Resource Conservation

- Economic
  - Virgin Material Reuse/Replacement
  - Reduced Fuel
  - Improved Durability
  - Long Life

- Environmental
  - Storm Water Runoff
  - Water Treatment
  - Reduce Emissions
  - Reduce Landfill
How Sustainable are Asphalt Pavements?

- Porous Asphalt
- Warm Mix Asphalt (WMA)
- Reclaimed Asphalt Pavement (RAP)
- Ground Tire Rubber (GTR)
- Recycled Asphalt Shingles (RAS)
- Perpetual Asphalt Pavement
• Porous pavements manage stormwater
• Not just for parking lots
Porous Asphalt Pavements

- Societal
  - Cool Pavement
  - Reduced Noise
  - Improved Safety

- Economic
  - Cost Effective

- Environmental
  - Storm Water Runoff
  - Water Treatment
  - Ground Water Recharge
Warm Mix Asphalt

![Graph showing Warm Mix Asphalt Use]

**Warm Mix Asphalt Use**

- **2009**: 5%
- **2010**: 11%
- **2011**: 19%
- **2012**: 24%

**Categories:**
- DOT
- Other Agency
- Commercial & Residential
Warm Mix Asphalt

Societal
- Worker Comfort
- Improved Ride Quality
- Lower User Delay

Economic
- Reduced Fuel
- Allows higher percent RAP
- Extension of Paving Season

Environmental
- Reduced Emissions
How Many Tons of RAS is Used in Asphalt Mixes?

~ 1.9 million tons RAS recycled into pavement
Recycled Asphalt Shingles (RAS)

Societal
- Natural Resource Conservation

Economic
- Material Replacement

Environmental
- Reduced landfill space
Ground Tire Rubber

- Millions of new tires produced annually
- > 60 million are stockpiled
- Asphalt-Rubber uses over 2,000 TIRES per lane-mile on a typical 2” overlay.\(^2\)
- 26,328 Tons GTR Reported Used in 2012 (this value is likely much higher since not all states reported GTR)

2. Rubber Manufacturers Association, 2003
Ground Tire Rubber

Societal
• Reduction Traffic noise

Economic
• Improved Durability

Environmental
• Reduced landfill space
• Substitute for TDF (tire derived fuel)
How much RAP is Being Used?

- >60 Million Tons RA Used in Asphalt
- 2009: Blue
- 2010: Red
- 2011: Green
- 2012: Purple

- Used in HMA/WMA
- Used in Aggregate
- Used in Cold Mix
- Used in Other
- Landfilled

<1% RAP is landfilled
Reclaimed Asphalt Pavement (RAP)

Societal
- Natural Resource Conservation

Economic
- Reuse Aggregate and Asphalt Binder

Environmental
- Reduced Emissions
- Reduced landfill space
- Closes Life Cycle Circle
Need to Quantify Green Pavement Benefits

• Increased awareness of Environmental Impacts
  • Growing Interest in Sustainability Principles
  • >1/2 of DOTs have adopted Sustainability Principles
• Environmental and Social Benefits could be part of pavement selection process
• Increasing bottom line through green practices
• Helps with Environmental Benchmarking
Measuring Sustainability – Life Cycle Analysis

Recycle/Reuse

Raw Material
- Aggregates
- Admixtures
- Asphalt Binder
- Transport

Production
- Fuel
- Water
- Equipment

Construction
- Transport
- Paving

Use
- Vehicle Operation
- UHI
- Stormwater Runoff
- Maintenance/Workzone congestion

End of Life
- Landfill
- Recycle/Reuse

Use
- Landfill
- Recycle/Reuse
Measuring Sustainability – Life Cycle Analysis

www.asphaltpavement.org/GHGC

NAPA’s GHG Calc.
Measuring Sustainability – Life Cycle Analysis
# Environmental Product Declarations (EPDs)

Standardized Life Cycle Assessment defined by the Product Category Rules (PCRs)

- Goal and Scope
- Acceptable Inventory Data
- Impact Categories

## Environmental Product Declarations (EPDs)

- **Functional unit:** 1 metric ton of asphalt concrete
- **Primary Energy Demand [MJ]:** 3.9x10³
- **Renewable [MJ]:** 3.9x10³
- **Non-Renewable [MJ]:** 3.5x10²
- **Global Warming Potential [kg CO₂-eq]:** 79
- **Acidification Potential [kg SO₂-eq]:** 0.23
- **Eutrophication Potential [kg N-eq]:** 0.012
- **Ozone Depletion Potential [kg CFC-11-eq]:** 7.3x10⁻⁹
- **Smog Potential [kg O₃-eq]:** 4.4

**Boundaries:** Cradle-to-Gate
**Company:** XYZ Asphalt
**RAP:** 10%

Source: PE International

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## Life Cycle Inventory (LCIs)

- Energy Use
- Raw Material Use
- Emissions/Waste

## Product Category Rules (PCRs)

Defines LCA

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**Image Source:** Turbosquid.com
• Rating Tools
  – Best practices
  – Earn Credits
  – Indicator of sustainability

• Move Towards Transparency
• Over 1,000 Members; many family-owned businesses
• NAPA’s mission includes:
  • Pavement economics & sustainability
  • Public and Gov’t agencies demand sustainability
• NAPA continues to focus on sustainability demands
  • Recycled materials (RAP, RAS, tire rubber)
  • Sustainable technologies (WMA, porous, alt. binders)
  • Quantifying Sustainability Asphalt (rating systems, LCA)
• Research indicates smooth pavements save fuel
  • Trip Rpt: rough roads costing $400 million annually
  • WesTrack: 4 – 4.5% fuel savings

• How does this fit into LCA?
LTPP IRI vs. time: pavement differences

IRI (m/km)

Time (year)
• Perception that dark-colored pavements cause UHI
• Lawrence Berkeley Nat’l Lab (LBNL) research
  • Originally for buildings; modeled for pavements
  • Driving public policy / legislation / building codes
• Other research starting to contradict
  • ASU: no difference in air temperatures above pvmt.
  • Stanford / UC-SD: reflected radiation heats up atmos.
  • Reflected radiation may heat-up adjacent buildings
Pavement color: something to think about

• Researchers reporting impacts of reflected radiation
• Increased atmospheric heating
• Decreased rainfall
• Increased heating of adjacent walls
• Air temperature above pavement is the same
• Unintended consequences published by ASU

http://ncesmart.asu.edu/news/unintended-consequences
• Asphalt Industry has well established green paving technologies

• New Movement in Sustainability
  • Quantify environmental and social impacts

• Asphalt Industry is taking a leading role
Questions and Thank-you