The FHWA launched the Sustainable Pavements Program in 2010 to advance the knowledge and practice of sustainability related to pavements. The overall objective is to establish a program that considers asphalt, concrete, granular, and other materials in pavement systems including new and emerging materials. A critical outcome of the program is to increase the awareness, visibility, and the body of knowledge of sustainability considerations in all the life cycle phases of pavement systems.
Presentation Objectives

What is the Sustainable Pavements Program’s Mission?

How does Life Cycle Thinking Fit into the Program?

What is the Future of Life Cycle Thinking in Pavement Design?
Sustainable Pavements Program
Vision & Mission

Advance the Knowledge and Practice of

- Designing
- Constructing
- Maintaining

More Sustainable Pavements Through

- Stakeholder Engagement
- Education
- Development of Guidance and Tools
Sustainable Pavements Technical Working Group

**Industry**
- Engineers
- LCA Professionals
- Material Manufactures
- Construction Contractors

**Academia**
- Pavement Materials
- Construction

**Agencies**
- State Department of Transportation Agencies
- Local Agencies

Initial Focus: Develop Guidelines for Sustainable Pavements
Develop Guidelines

Purpose
- Educate Practitioners
- Encourage Adoption of Sustainable Practices Throughout a Pavement’s Lifecycle

https://www.fhwa.dot.gov/pavement/sustainability/ref_doc.cfm
Sustainability in General

Common Definition

- Brundtland Report 1987
- “Development that meets the needs of present without compromising the ability of future generations to meet their own needs”
- Three Pillars of Sustainability
Sustainable Pavements

**Definition**
- No Universal Definition
- Challenge: Transportation System

**Concepts**
- achieve engineering goals
- preserve and restore surrounding ecosystems
- use financial, human, and environmental resources economically
- meet basic human needs such as health, safety, equity, employment, comfort, and happiness
# Approaches for Improving Aggregate Production for Pavement Sustainability

<table>
<thead>
<tr>
<th>Aggregate Materials Objective</th>
<th>Sustainability Improving Approach</th>
<th>Economic Impact</th>
<th>Environmental Impact</th>
<th>Societal Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce the Amount of Virgin Aggregate Used</td>
<td>Use more aggregates derived from Recycled, Co-Products and Waste Materials (RCWM) sources.</td>
<td>Can potentially reduce cost, and preserve scarce or difficult to permit virgin sources. May increase cost depending upon availability transportation, or processing required; reduce ability to recycle in the future; durability, special pollution problems (pH, toxicity, contaminants).</td>
<td>Dependent on characteristics of RCWM, considering transportation, processing, ability to recycle multiple times, special pollution problems.</td>
<td>Preserves virgin sources. Can reduce need for new sources and associated impacts. Reduces space in landfills. Potential for negative impacts depending upon transportation, processing requirements.</td>
</tr>
<tr>
<td></td>
<td>Use more durable aggregate, maximizing pavement life.</td>
<td>May increase initial cost, decrease life cycle cost.</td>
<td>Dependent upon transportation distance if not locally available.</td>
<td>Primarily dependent upon transportation.</td>
</tr>
<tr>
<td>Reduce the Impact of Virgin Aggregate Acquisition and Processing</td>
<td>Review environmental impact and remediation plans of different aggregate sources when permitting (handled via the National Environmental Policy Act (NEPA) guidelines or equivalent environmental impact review [EIR] and permit process in many states).</td>
<td>Dependent upon requirements imposed by permit. Most permit processes do not consider impacts of locating quarries outside of the jurisdictional area and importing the aggregate (transfer of impacts).</td>
<td>More sustainable features for quarry may come from permitting process.</td>
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</tr>
<tr>
<td></td>
<td>Implement processing and mining operations using less or lower impact energy sources and less water.</td>
<td>Will generally reduce environmental impact.</td>
<td>Will often reduce societal impact.</td>
<td></td>
</tr>
<tr>
<td>Reduce the Impact of Aggregate Transportation</td>
<td>Use locally available materials or those using a low impact mode for transportation (next item).</td>
<td>Will often reduce initial cost, may increase life cycle cost if there are significant differences in durability.</td>
<td>Will often reduce environmental impact.</td>
<td>May increase impact for those near local source production and transportation locations.</td>
</tr>
<tr>
<td></td>
<td>Minimize transportation impact by maximizing use of marine/barge and rail transport and minimizing truck transport.</td>
<td>Will usually reduce environmental impact.</td>
<td></td>
<td>Will usually reduce societal impact, focusing on marine and rail routes reducing noise, safety issues.</td>
</tr>
</tbody>
</table>

**Bad**  
**Break Even Point**  
**Good**
Managing change

“What you can’t measure, you cannot manage. What you can’t manage, you cannot change.”

Peter Drucker
Writer, professor and management consultant

Second Focus: Guidance for Sustainability Assessment
Sustainability Assessment

Economic Efficiency
• Life Cycle Cost Analysis
• Network and Project Level

Environmental Stewardship
• Life Cycle Assessment

Social Progress
• Social Life Cycle Assessment
Sustainability Assessment

Economic Efficiency
• Life Cycle Cost Analysis
• Network and Project Level

Environmental Stewardship
• Life Cycle Assessment

Social Progress
• Social Life Cycle Assessment
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Economic Efficiency
• Life Cycle Cost Analysis
• Network and Project Level

Environmental Stewardship
• Life Cycle Assessment

Social Progress
• Social Life Cycle Assessment

More Research Needed; Long Term Need
Sustainability Assessment

Economic Efficiency
- Life Cycle Cost Analysis
- Network and Project Level

Environmental Stewardship
- Life Cycle Assessment

Social Progress
- Social Life Cycle Assessment
Pavement LCA History

Based on Amlan Mukherjee, SPTWG Gainesville FL
FHWA Pavement LCA Framework

Educate

• Agencies on LCA methodology and application to pavements
• Practitioners on LCA principles as applied to pavements
• Documents current practices and gaps

Technical Guidance

• Implementation of pavement LCA within the U.S
• Description of viable alternatives with pros and cons

Deployment

• Encourage Progress in Pavement LCA

https://www.fhwa.dot.gov/pavement/pub_details.cfm?id=998
Oregon No. 3021

• DEQ is sponsoring EPDs for concrete

• Proposed Bill
  – DOT Create Pilot Program to assess how products procured affect CO$_2$ emissions
  – Environmental Cost
  – EPDs

California No. 262

• CO$_2$ reporting for Bidding and Awarding of Public Contract

• EPDs
EPDs are a likely vehicle to fulfil the data gaps.

Currently

End Goal

Based on Amlan Mukherjee, SPTWG Gainesville FL
LCA Needs

Includes SPTWG Feedback

• Education on LCA, EPDs, PCRs
  – Webinars, web-based videos, tech briefs, quick simple talking points

• Examples

• Technical Guidance and Tools
Sustainable Pavements Program: Immediate and Future Needs

Case Studies
- Document Environmental, Social, Economic Benefits

EPD Tech Brief
- Educate Agencies and Policy Makers
- What is EPD?
- How can EPDs be used?

LCA Tool
- Help Agencies Benchmark Impacts

Future Needs:
- Pilot study using FHWA Pavement LCA Framework
- Develop Technical Guidance on How to Incorporate EPD’s
- Develop Pavement LCA Tool
Questions
https://www.fhwa.dot.gov/pavement/sustainability/

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- **Reference Center**
  - This section provides access to the sustainable pavements reference document and other stand-alone articles from the document that cover key topics and core ideas. [Technical Articles](#), [Resources](#), [Sustainable Pavements Reference Document](#), [Pavement Life Cycle Assessment Framework](#)

- **Technology Transfer**
  - This section provides access to the Tech Briefs discussing the key concepts related to key pavement sustainability topics. Information and presentation materials on past and upcoming webinars on sustainable pavements are also provided. [Technical Briefs](#), [Webinars](#)

- **Technical Working Group**
  - The FHWA established a Sustainable Pavements Technical Working Group (SP TWG) comprised of diverse stakeholders in the pavement and materials community including individuals from State Departments of Transportation and other public agencies, industries, and academia. The focus of the SP TWG is to provide technical input on sustainability specific to pavement systems and pavement materials.