

Four Priority Low-Carbon Concrete Initiatives for FHWA LCTM Applications

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FHWA's Low-Carbon Transportation Materials Grants Program Is LIVE!

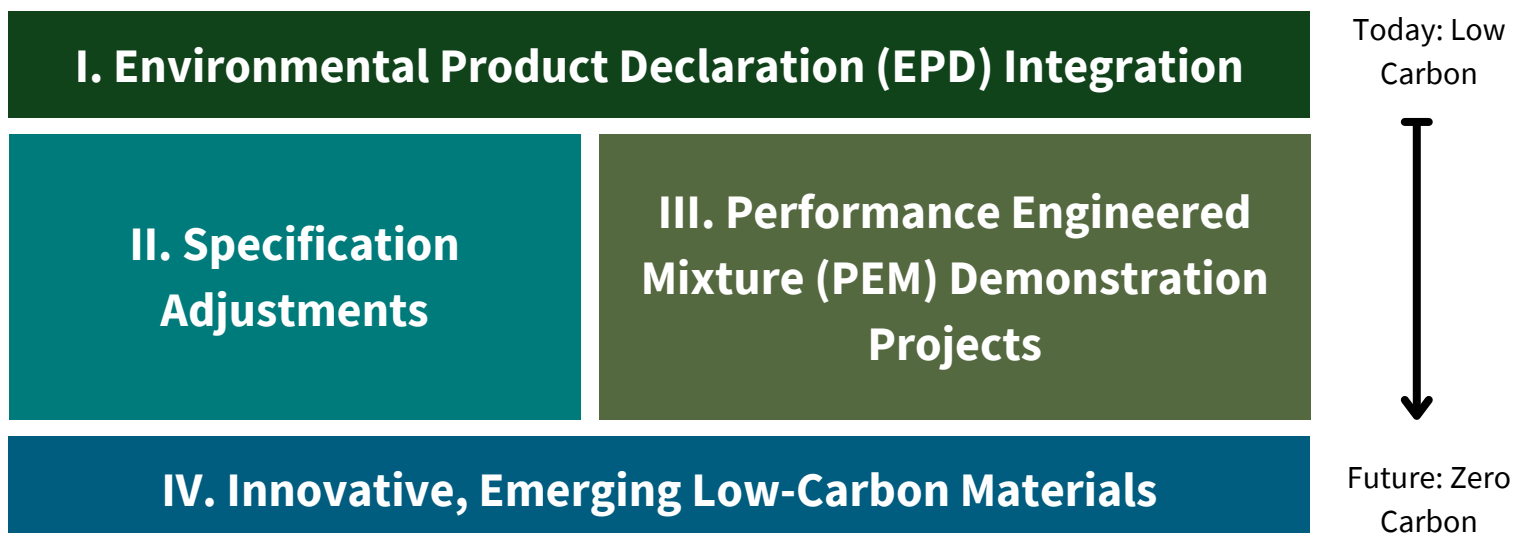
We've developed **an easily deployable toolkit of project ideas that state DOTs can use to inform their applications to the [FHWA LCTM program](#)**, specifically related to procurement of low-carbon concrete materials. Our recommendations build off efforts currently underway at many state DOTs. Our hope is to make it easy for DOTs to develop a cohesive approach to **improving the durability** and **reducing the environmental impact** of concrete. Note that the LCTM Program is designed to cover a broader set of building materials, and state DOTs should pursue projects to address these materials as well.

We encourage agency staff to use program approaches and ideas from this document. We also want to point you toward the **[Reduced-Carbon Concrete Consortium \(RC3\)](#)**, which can support qualifying entities in developing their applications!

Four Priority Low-Carbon Concrete Initiatives

We've provided a list of recommended initiatives and project ideas that will unlock state DOTs' ability to procure low-carbon concrete materials. The recommendations are organized into four initiatives that build up to comprise a **well-rounded low-carbon concrete program for a state DOT**. Deployed together, these initiatives will facilitate widespread use of today's best, market-ready, low-carbon concrete mixes, while getting DOTs started with unlocking deeper reductions through innovative, high-performance mixes.

These initiatives cover both eligible "process development" items — activities that setup DOTs to procure materials with substantially lower embodied carbon — as well as initiatives to deploy eligible materials on construction projects. The four priority initiatives are summarized in the graphic below:



I. Environmental Product Declaration (EPD) Integration

The objective of this initiative is to build capacity for public transportation agencies, their contractors, and material suppliers to incorporate [EPDs](#) into their material procurement process. Although this strategy is broader than concrete, focused attention to study and expand EPD availability at the state level is critical for concrete to account for regional variations in the ready-mix concrete supply chain.

Initiative Concept:

Pilot or expand the use of EPDs in the procurement process, ensuring that environmental impacts are a key consideration in material selection

Recommended Project Opportunities:

1. **Develop an EPD submission protocol** for collecting, processing, and verifying EPDs during the project bid phase.
2. **Conduct regional market outreach** to survey locally available EPDs and engage concrete producers and contractors about using EPDs for procurement.
3. **Collect global warming potential (GWP) data** from surveyed EPDs and **establish regionally appropriate GWP benchmarks** in alignment with LCTM program guidelines.
4. **Deploy procurement processes incorporating GWP limits** to qualify materials in accordance with LCTM program guidelines.
5. **Deliver performance bonuses or incentives to contractors** that outperform GWP limits.

Desired outcomes

- Enable information gathering and benchmarking processes to reduce the environmental impact of concrete infrastructure projects.
- [Increased understanding of EPDs for agency staff](#) across departments, contractors, and suppliers.
- Incentivize the use of EPDs and GWP optimization in procurement processes.

II. Specification Adjustments

The objective of the near-term specification adjustments initiative is to reduce the environmental footprint of concrete by altering material specifications to align with industry best practices.

Initiative Concept:

Establish specification update directive to make near-term specification changes to reduce emissions in concrete

Recommended Project Opportunities:

1. **Review, revise, and/or eliminate portland cement minimum limits.**
2. **Adjust maximum SCM usage limits** to enable significantly higher (50%–80%) replacement where appropriate.
3. **Revise approved material lists** to enable wider use of AASHTO M 295 (ASTM C595), including Type IT ternary blended cements and low-carbon ASTM C1157 performance hydraulic cements.

Desired outcomes

- Increased use of AASHTO M 295 (ASTM C595) blended cements, including Type IT and ASTM C1157 performance hydraulic cements.
- Increased SCM content in concrete mixtures used for transportation projects.

III. Performance Engineered Mixture Demonstration Projects

The objective of this initiative is to establish and demonstrate performance-engineered mixes for low-carbon concrete, focusing on durability, strength, schedule, and environmental impact. Once DOTs have setup protocols for the use of EPDs allowing them to procure low-carbon materials, PEM design can be utilized to achieve a new level of reductions by unlocking innovation by engineers and contractors.

Initiative Concept:

Develop demonstration projects utilizing performance engineered mixture (PEM) design for low-risk concrete applications

Recommended Project Opportunities:

1. **Reference [established performance standards](#)** for concrete transportation projects.
2. **Develop performance requirements** for concrete used in transportation projects. Build off existing US-based PEM research and demonstration initiatives, such as those conducted at the [National Concrete Pavement Technology Center](#) and at FHWA's Turner-Fairbank Highway Research Center.
3. **Establish ambitious GWP targets** for concrete used in PEM design demonstrations in collaboration with ready-mix concrete suppliers and contractors.
4. **Leverage EPD procurement processes** to ensure that low-carbon outcomes are validated.
5. **Deliver performance bonuses or incentives** to contractors that achieve ambitious GWP targets.
6. **Coordinate with other DOTs and FHWA to develop a consistent performance reporting framework** across all states, enabling comparative analysis and shared learning from demonstration projects.
7. **Develop in-place performance assessment protocol** for concrete transportation projects to focus on long-term performance of low-carbon materials.
8. **Pilot alternative contracting methods focused on risk management**, with accountability and risk appropriately allocated across stakeholders.
9. **Pilot alternative contracting methods** that focus on lifecycle costs and environmental impacts that incentivize the use of materials with low-embodied carbon as well as offer significant carbon reduction over all life cycle stages.

Desired outcomes

- Develop a set of performance criteria that incorporate embodied carbon while maintaining structural integrity.
- Enable flexibility in mixture designs to foster innovation in low-carbon concrete solutions.
- Pilot alternative contracting methods that focus on sharing the risk of implementing low-carbon concrete.

IV. Innovative, Emerging Low-Carbon Materials

The objective of this initiative is to explore and validate the effectiveness of innovative materials in reducing carbon emissions. Leveraging the FHWA program funding is contingent on the availability of EPDs for each product; we believe that many of the technologies listed here will be available on the market with EPDs within the eligible time window for the LCTM program.

Initiative Concept:

Develop demonstration projects of emerging low-carbon concrete technologies, including near-zero or zero emissions concrete innovations

Recommended Project Opportunities:

1. **Develop concrete mixture approval process that is performance-based and applicable to all concrete materials** for use in a set of concrete innovation demonstration projects.
2. **Develop laboratory and site demonstration placements** to evaluate the constructability and performance of key emerging low-carbon concrete solutions, including:
 - a. Alternative SCMs (e.g., calcined clay, concrete fines, reactive silica from mine tailings, and new or synthetic fly ash, slag or limestone)
 - b. Emerging blended cements (e.g., limestone calcined clay or LC3)
 - c. Optimized aggregate grading
 - d. Low-paste volume mixture designs
 - e. Alternative cements (belite-rich cement, calcium sulfoaluminate, alkali-activated materials, bio-based cement)
3. **Set near-zero or zero GWP thresholds without prescriptive material specification** for a portion of demonstration projects. This will enable a streamlined, competitive process to assess emerging near-zero or zero emissions concrete innovations.
4. **Leverage EPD procurement processes** to ensure that low-carbon outcomes are validated.
5. **Coordinate with other DOTs and FHWA to develop a consistent data reporting framework** across all states, enabling comparative analysis and shared learning.

Desired outcomes

- Adopt a consistent testing methodology to evaluate and approve emerging low-carbon concrete materials.
- Develop capacity to demonstrate and assess near-zero or zero emissions concrete innovations.
- Accelerate the market uptake of emerging low-carbon concrete products and solutions.

Conclusion

FHWA's Low-Carbon Transportation Materials (LCTM) Program presents a once-in-a-generation opportunity for DOTs to reduce the environmental impact of concrete materials used in their projects. DOTs leveraging this funding will build capacity to procure and install low-carbon construction materials, transforming the way US infrastructure is constructed. As agencies develop proposals for the FHWA LCTM, the RMI team and others, including the [RC3 group](#), are available to advise DOTs and review aspects of the project applications.

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