Pavement Research Roadmap
Life Cycle Assessment (LCA)

Goal

To understand how pavement practices can reduce greenhouse gas emissions and energy use on the state highway network.

Scoping | Development | Application | Implementation

1.
Establish guidelines for application of LCA to pavement and approaches relevant to California, considering ISO standards and results of workshop.
— 100% —

- **Tasks:** a. Develop draft guidelines
  b. Hold international workshop to review guidelines and approaches for California
  c. Document results
  d. Disseminate results
- **Documentation:** a. and b. www.ucprc.ucdavis.edu/p-lca
  c. UCPRC tech memo for Caltrans "Pavement Life Cycle Assessment Workshop: Discussion Summary and Guidelines
  d. Presentations for TRB (3 total in 2011 and 2012), FHWA Sustainable Pavement ETG
- **Status:** Completed, update as necessary

2.
Develop initial models and obtain expert review, and do initial case studies to provide preliminary results regarding effects of maintenance timing and smoothness.
— 100% —

- **Tasks:** a. Develop models
  b. Perform case studies
  c. Report
  d. Discuss with Caltrans, industry and others and revise report.
- **Documentation:** a. – d. UCPRC tech memo for Caltrans "Pavement Life Cycle Assessment: Workplan to Use Environmental LCA to Develop Tools and Recommend Practices to Reduce Environmental Impact"
- **Status:** Complete

3.
Expand the LCA model to cover more variables in the pavement life cycle.
— 90% —

- **Tasks:** a. Add models for concrete lane reconstruction, congested and stop-start traffic, highway geometry
- **Documentation:** a. Report documenting the models
- **Status:** Analyses complete, draft report being edited.

4.
Validate Traffic Speed Assumptions
— 90% —

- **Tasks:** a. Validate effects of smoother pavements on traffic speeds
- **Documentation:** Report documenting the investigation
- **Status:** Analyses complete, draft report being edited.

5.
Apply the LCA model to the state network and analyze effects of smoother pavement on GHG emissions and energy use.
— 90% —

- **Tasks:** a. Complete the factorial of case studies to cover major types of segment on the network for CAPM and lane replacement.
  b. Using PMS (PaveM) data and LCA models investigate IRI maintenance trigger levels for different types of segment in the network to optimize GHG emissions and energy use reduction.
  c. Evaluate effects of smoother pavement on traffic speeds, which might negate GHG benefit.
  d. Compare cost/benefit for different scenarios with those of other strategies being implemented by the state.
- **Documentation:** a. – d. Report detailing results and recommendations regarding targeting of projects and optimized IRI trigger values.
- **Status:** Analyses complete, draft report being completed (same report as Objective 3).

6.
Expand the LCA model to consider various types of recycling, traffic closures and visco-elastic energy dissipation.
— 35% —

- **Tasks:** Add models for:
  a. various types of recycling used in pavement maintenance and reconstruction,
  b. traffic closures and effects on vehicle emissions
  c. visco-elastic energy dissipation by vehicles.
- **Documentation:** Internal technical memos documenting the models.
- **Status:** a. just beginning
  b. about 40% done
  c. about 60% done
  Expect to have a. and c. done by mid-summer,
  b. by June 2014.

7.
Validate Viscoelastic energy dissapation by vehicles.
— 0% —

- **Tasks:** a. Compare results from different models
  b. Field validation
- **Documentation:** a. Tech memo and experiment plan for b.
  b. Report
- **Status:** Not started

8.
Apply the LCA model to various recycling scenarios, traffic closure strategies and visco-elastic energy dissipation and analyze effects of on GHG emissions and energy use.
— 0% —

- **Tasks:** a. Develop factorial of important variables for different types of projects that might use recycling. Analyze case studies.
  b. Develop factorials for traffic closure strategy scenarios. Analyze case studies
  c. Develop factorials for visco-elastic energy dissipation scenarios. Analyze case studies
- **Documentation:** a. Report detailing models and results and recommendations regarding where recycling has most and least benefit.
  b. Report detailing models and results regarding relative effects of traffic closures and where attention to them has most and least benefit.
  c. Report detailing models and results and recommendations regarding where attention to viscoelastic dissipation has most and least benefit.
- **Status:** Not started

9.
Consideration of category pollutants, in addition to GHG emissions and energy use.
— 0% —

- **Tasks:** a. Expand models to consider water, air and land pollutants.
  b. Evaluate previous work to include expanded impact assessment.
- **Documentation:** a. Work plan for questions to address.
  b. Results
  c. Report(s)
- **Status:** Not started

10.
Address additional materials design and policy questions developed by Caltrans.
— 5% —

- **Tasks:** a. Use LCA models combined with climate and energy use models from LBNL to evaluate where cool pavements have benefit and how much. Sponsored by ARB.
  b. TBD
- **Documentation:** a. LBNL report for ARB
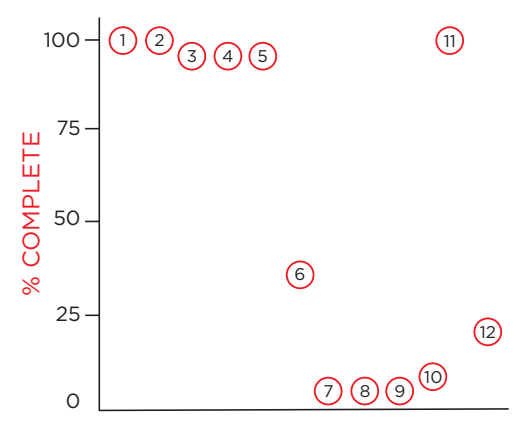- **Status:** a. early 2015

11.
Incorporate simplified LCA GHG calculations into PaveM pavement management software.
— 100% —

- **Tasks:** a. Develop simplified algorithms and data tables.
  b. Give to AgileAssets to code.
  c. Check that working correctly in PaveM.
  d. Include in Benefits reports
- **Documentation:** Working PaveM code.
- **Status:** Completed March, 2013

12.
Develop project-level LCA software using models developed.
— 20% —

- **Tasks:** a. Develop research grade software.
  b. Develop documentation and guidance for use.
  c. Develop commercial grade code and documentation.
- **Documentation:** a. Research grade software
  b. documentation and guidance
  c. Commercial grade code
- **Status:** a. Currently in spreadsheets, some work on architecture done.
  b. Some initial documentation begun.
  c. Met with CT IT. Cannot be done with DRI funds. Needs FSR.

— Status At-A-Glance —

% COMPLETE chart showing items 1, 2 at 100; 3, 4, 5 and 11 near 100; 6 near 35; 12 near 20; 7, 8, 9, 10 near 0.