

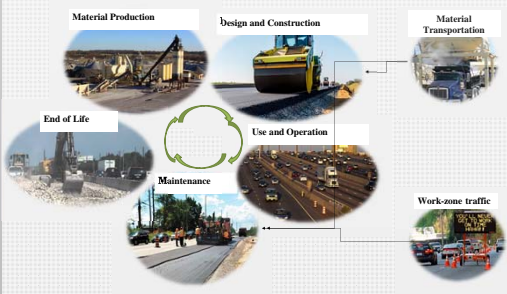
Towards Developing Environmental Sustainability Performance Measures for Pavement Asset Management Practice

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INTRODUCTION

- Improved lifecycle environmental performance of pavements, reduced climate change impacts and human health effect underscore the need to incorporating environmental sustainability into pavement management practice
- Reducing virgin material consumption and air pollution throughout the lifecycle of a road pavement facilitates improved productivity in the optimal allocation of resources and reduced road user cost.



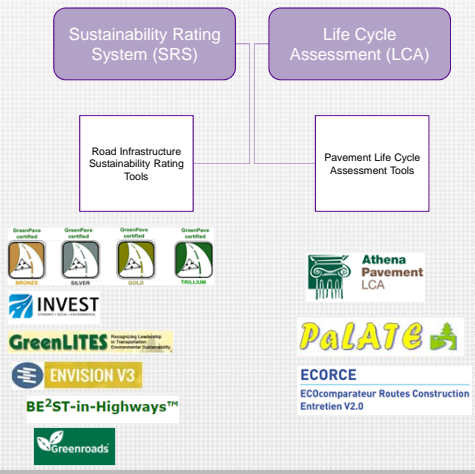
Pavement Lifecycle Phases

- However current paradigm of asset management decisions made within pavement management systems only prioritizes resource allocation policies that maximizes the technical performance of the road network with no consideration of the environmental sustainability.

OBJECTIVE

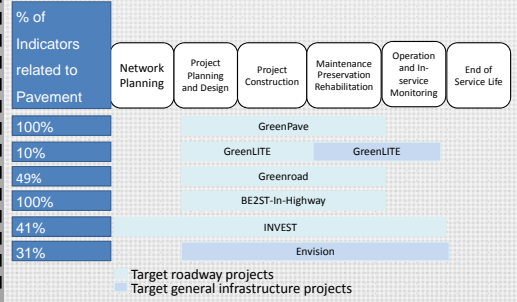
- Unveil the challenges in environmental performance assessment of innovative pavement technologies
- Define relevant environmental performance measures
- Develop a framework to incorporate the relevant environmental performance measures into network-level pavement management

APPROACHES FOR QUANTIFYING ENVIRONMENTAL SUSTAINABILITY



SRS TOOLS

Application of SRS to Road Pavement Management:
Reveal challenges to adopting available tools to the pavement management



LCA TOOLS

Application of LCA to innovative Hot Mix Asphalt (HMA) mixes:

- Evaluate the environmental performance of six HMA design mix produced with different proportions of coarse recycled Concrete Aggregates (CRCA)
- A cradle to construction gate LCA approach and functional unit is 1 km two lane road

Material Content of HMA mixes

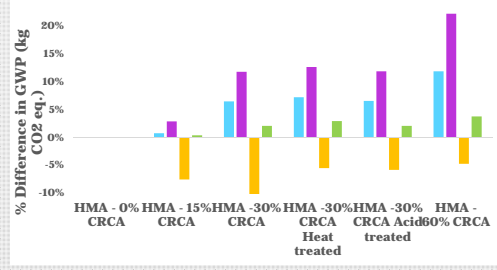
Materials\HMA Mixes	0% CRCA	15% CRCA	30% CRCA	30% CRCA (Heating treated)	30% CRCA (Acid Treated)	60% CRCA
Asphalt binder (%)	4.83	4.9	5.31	5.31	5.31	5.71
Natural Course Aggregate (NCA) (%)	95.17	87.5	79.54	79.54	79.54	64.1
Coarse Recycled Concrete Aggregate (CRCA) (%)	0	7.6	15.15	15.15	15.15	30.2

Life Cycle Inventory and Impact Assessment: Environmental performance modelling with three pavement LCA tools:

- PaLATE,
- Athena Highway Impact Estimator
- ECORCE M

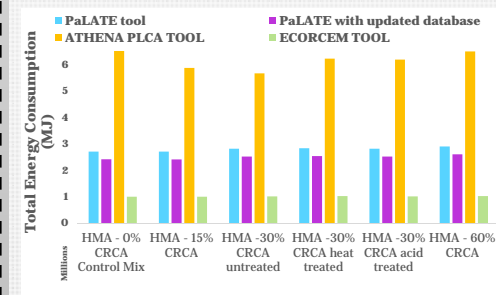
RESULTS

Climate Change Impact – Global Warming Potential (GWP): In comparison to control mix, GWP values of mixes containing CRCA ranges from -10% to 23%. Only Athena tool showed environmental benefits for using CRCA



RESULTS (CONT.)

Energy Consumption: The impacts for each mix differ largely among the tools. The results from Athena are much higher compare to PaLATE and ECORCEM, for example HMA - 60% CRCA show up approx. 250% and 600% higher respectively



CONCLUSION AND FUTURE WORK

- The limitations in the available approaches for quantifying environmental sustainability makes it challenging to incorporate environmental performance into pavement management systems
- Environmental performance evaluation of HMA design mixes with CRCA with three pavement LCA tools reveals the following challenges and opportunities:
 - Variability in the environmental impacts results reflects the influence of inconsistent modelling approaches and discrepancies in data adopted in these tools
 - Few impact category and lifecycle phase are considered/assessed by the available LCA tools
 - There is need to enhance the quality of data based on regional practice to better understanding of impacts
- Future work includes developing a core set of environmental performance measures and sustainability assessment framework considering all aspects of the pavement lifecycle

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