9th International Conference on MANAGING PAVEMENT ASSETS (ICMPA9)

A Multi-Objective Asset Management Approach to Evaluate Maintenance Strategies for Funding Allocation

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AASHTO THE VOICE OF TRANSPORTATION

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U.S. Department of Transportation Federal Highway Administration

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METROPOLITAN TRANSPORTATION COMMISSION

Outline

- **Transportation Asset Management (TAM)**
  - TAM Challenges
  - Traditional and Modern Approach
- **Metropolitan Transportation Commission in California**
  - TAM and Metropolitan Transportation Commission
- **Enhanced StreetSaver Process with Sustainability Objectives**
  - Target Objectives and Performance Measures
  - Pavement Life-Cycle
  - Estimation of CO_2 Emissions from Vehicle Use Phase
  - Social Cost of CO_2
- **Case Study**
- **Conclusions**

Transportation Asset Management (TAM)

"Strategic and **systematic process** of operating, maintaining, upgrading and expanding **physical assets** effectively throughout **their life cycle**. It **focuses on business and engineering practices for resource allocation** and utilization with the objective of better decision making based upon **quality information and well defined objectives**."

AASHTO Transportation Asset Management Guide, 2011

TAM Challenges

Physical
- Asset deterioration over time

Economic
- Funding gap

Social
- Growing population
- Increasing needs
- Maintain quality of life
- Human health
- Safety

Environmental
- Air pollution
- Depletion of non-renewable resources

Decision-Making
- Interdependency of Assets
- Multidimensional problem
- Different perspectives
- Uncertainty about future

Traditional and Modern Approach

- Performance-based
- Agency costs
  - More cost-effective to maintain pavements in good condition than to let them deteriorate (Witczak 1987)
  - Rehabilitation or reconstruction can be 6 to 10 times more expensive than timely preventive maintenance (Galehouse et al. 2006)
- Include environmental and social costs
- Environmental sustainability
  - Air
  - Natural resources
- Social sustainability
- Accommodate of all road users

Metropolitan Transportation Commission (MTC)

- Transportation planning, coordinating and financing agency
- San Francisco Bay Area, CA

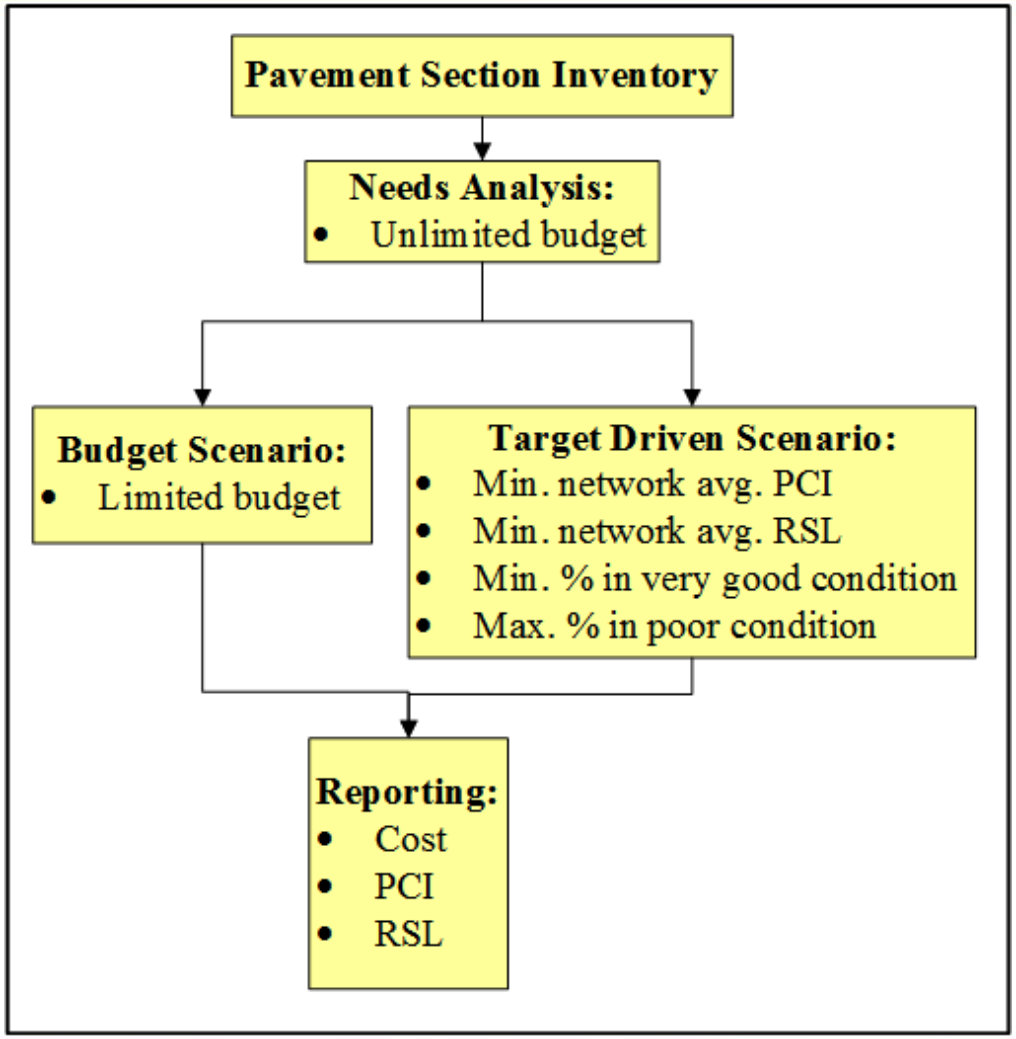
- http://mtc.ca.gov/

StreetSaver®

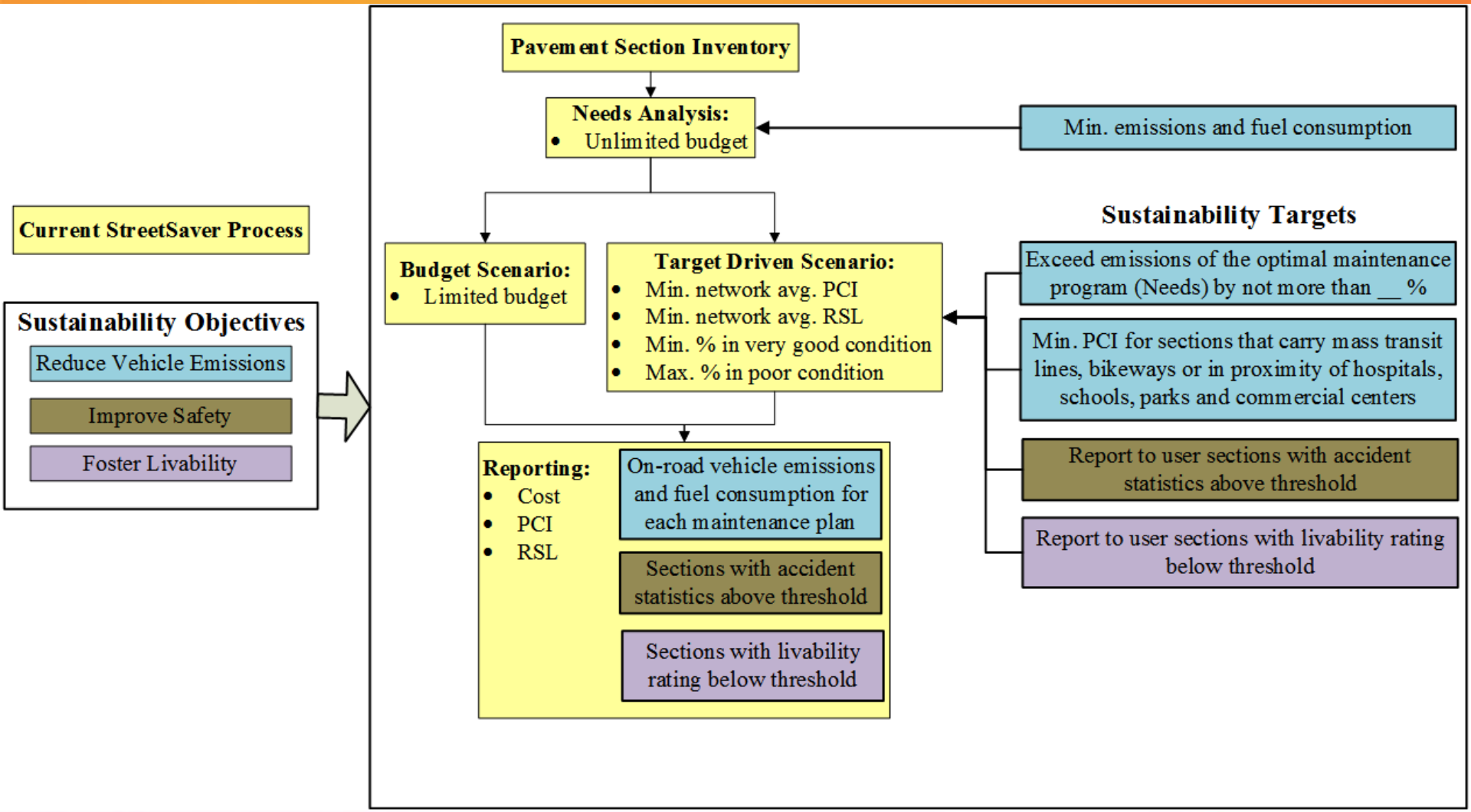
- computer-assisted decision-making program
- designed to help cities and counties prevent pavement problems through judicious maintenance and
- to diagnose and repair those that exist in a timely, cost-effective manner
- http://www.mtcpms.org/

TAM and MTC

- Pavement Section Inventory
- Needs Analysis
- Budget Scenario
- Target Driven Scenario
- Reporting



Enhanced StreetSaver Process with Sustainability Objectives



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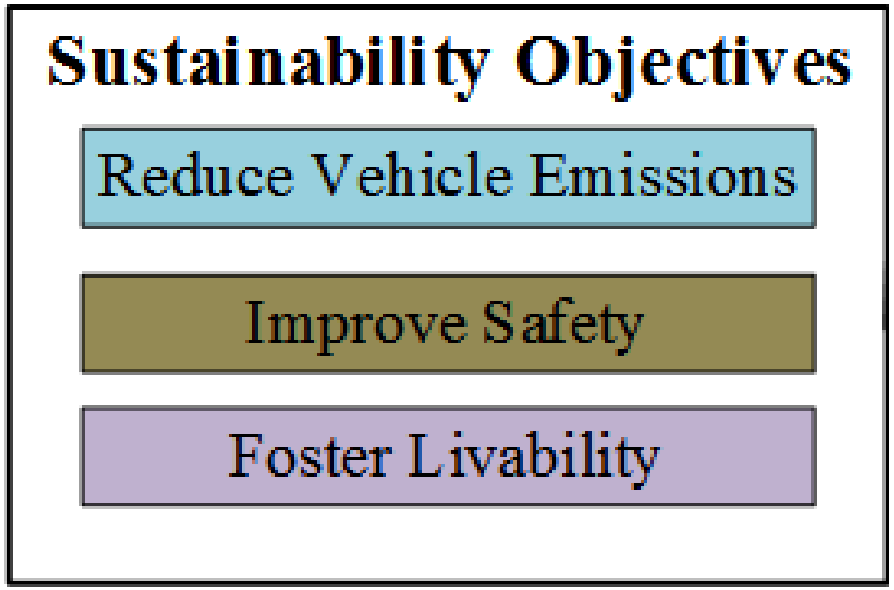


Sustainability Targets

- Exceed emissions of the optimal maintenance program (Needs) by not more than __ %
- Min. PCI for sections that carry mass transit lines, bikeways or in proximity of hospitals, schools, parks and commercial centers
- Report to user sections with accident statistics above threshold
- Report to user sections with livability rating below threshold

Target Objectives and Performance Measures

Economic

- Agency cost of pavement maintenance.

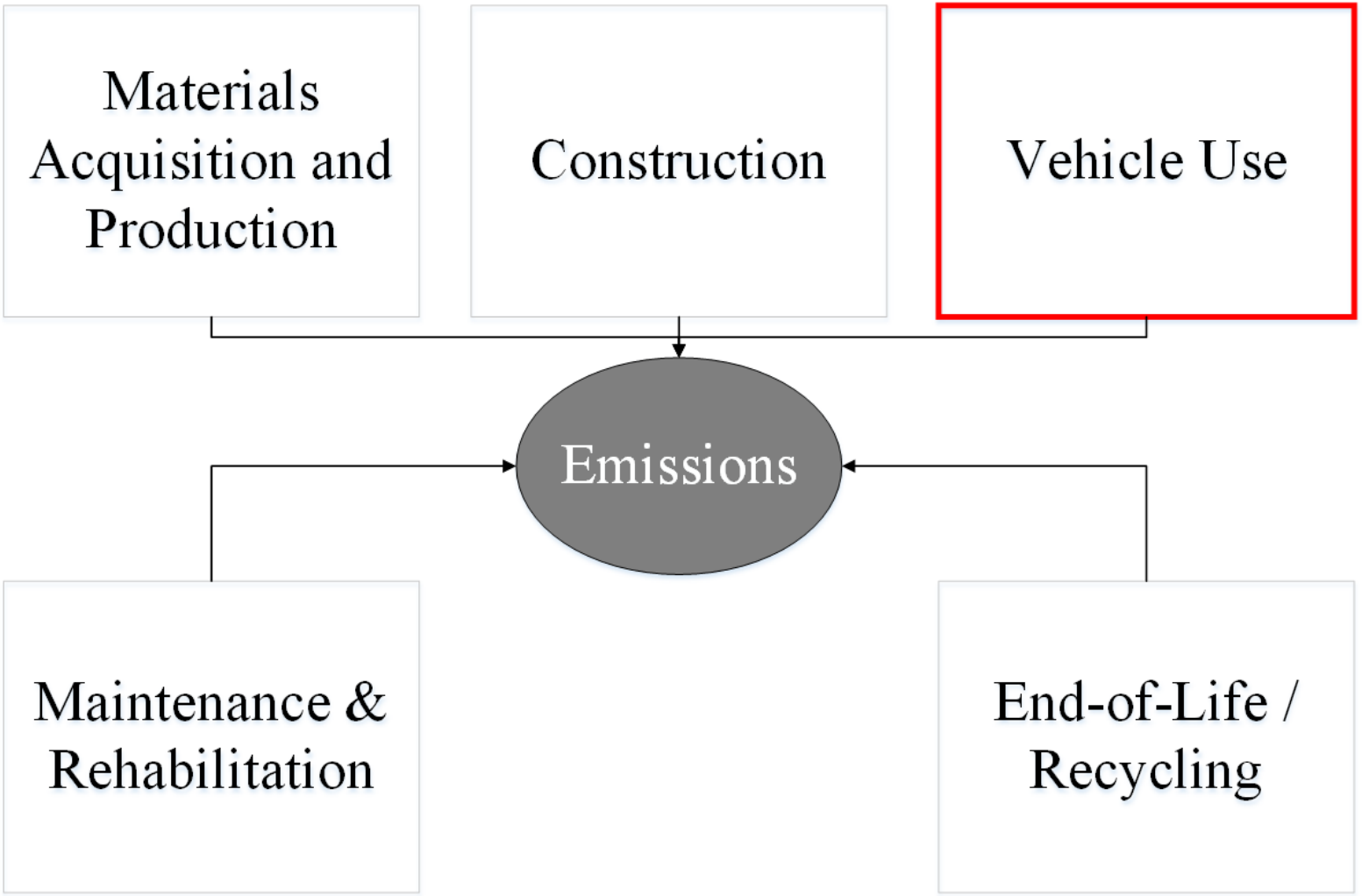
Social

- Change in condition of sections carrying mass transportation lines / bikeways.
- Social cost of CO_2

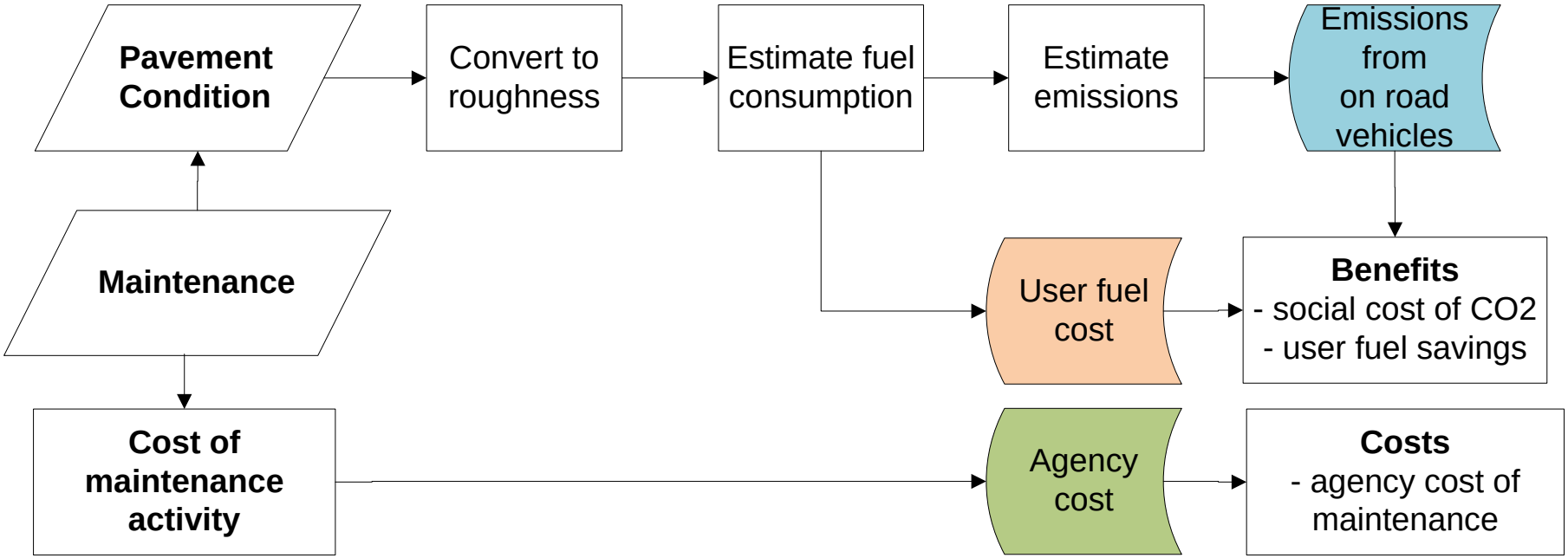
Environmental

- On-road vehicle fuel consumption estimated from pavement roughness.
- Emission (CO_2) reduction from on-road vehicles estimated from pavement.

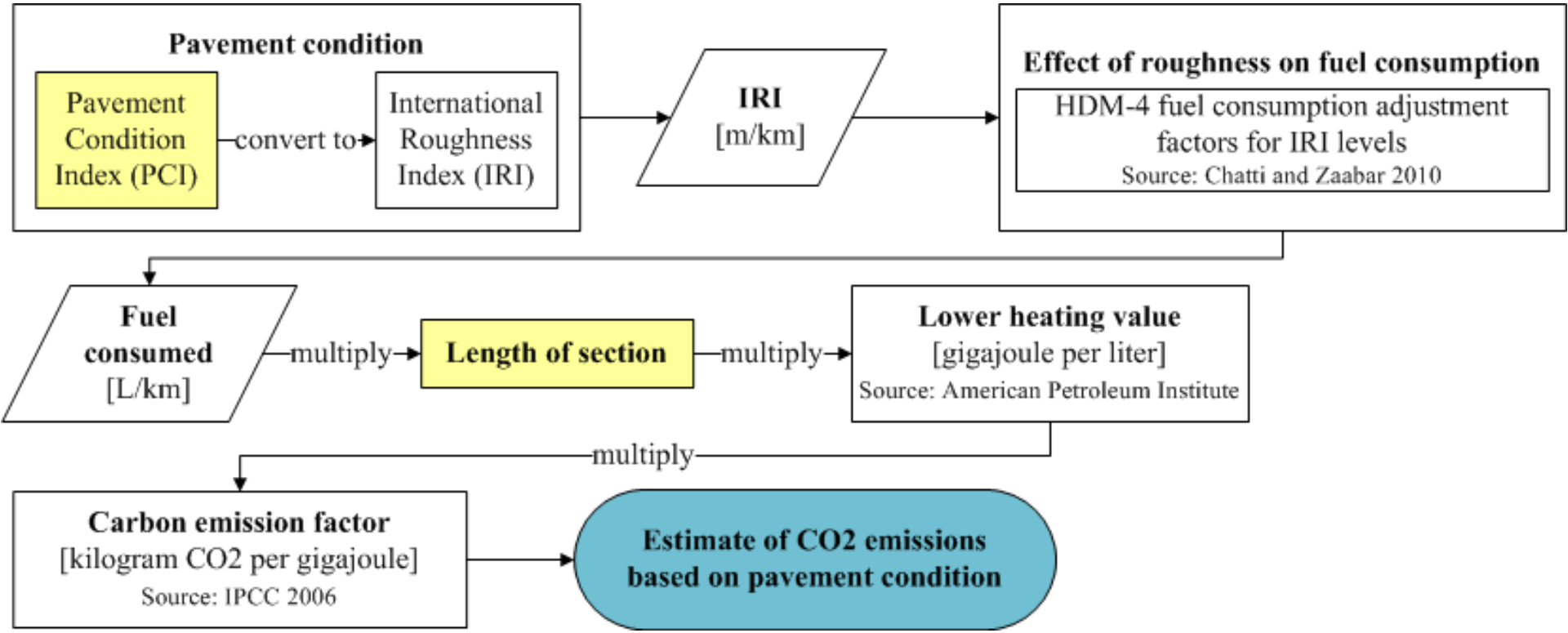
Pavement Life-Cycle



Estimation of CO_2 Emissions from Vehicle Use Phase



CO_2 Estimation using IPCC Emissions Factors



Social Cost of CO_2 Emissions

Purpose

- "To incorporate the social benefits of reducing carbon dioxide (CO2) emissions into cost-benefit analyses."

  Interagency Working Group on Social Cost of Carbon, United States Government 2013

Definition

- "An estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year"
- "Net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services due to climate change."

Case Study

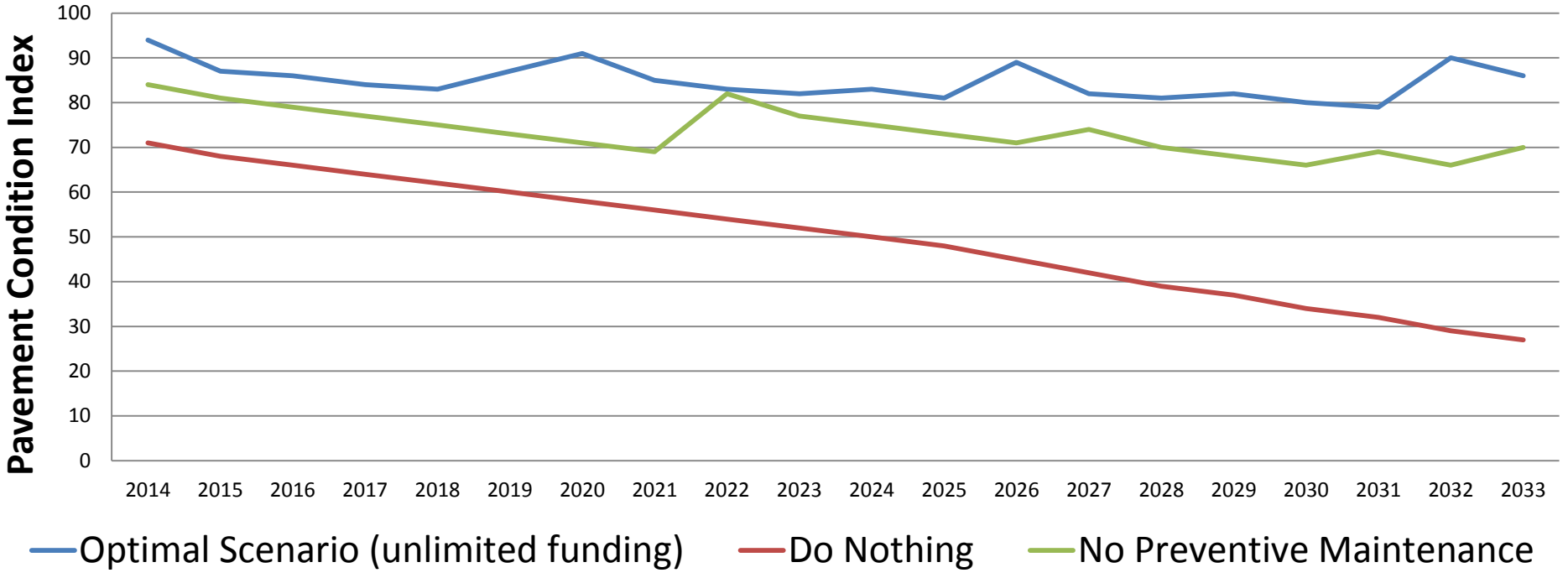
Pavement Network

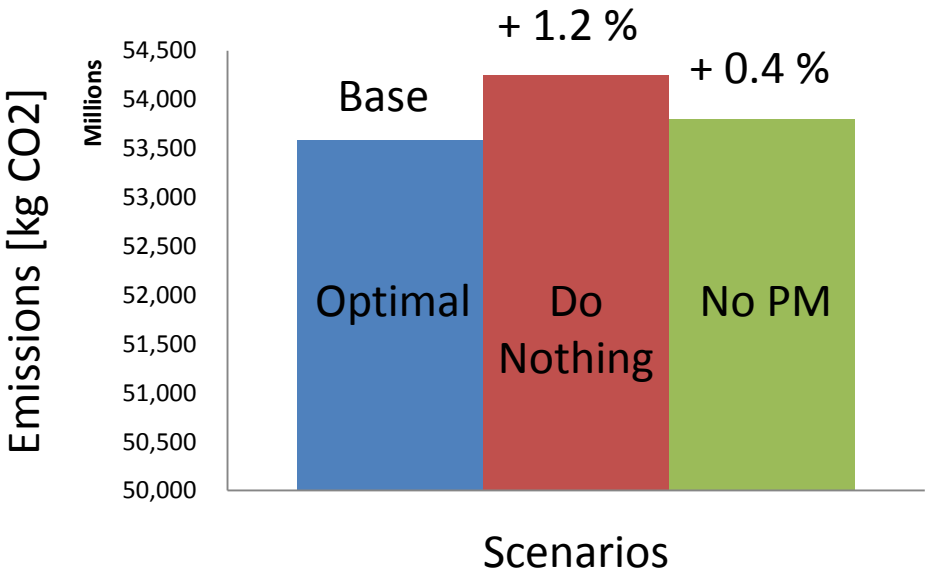
- 940 miles
- Asphalt concrete (AC)
- AADT 20,000 vehicles

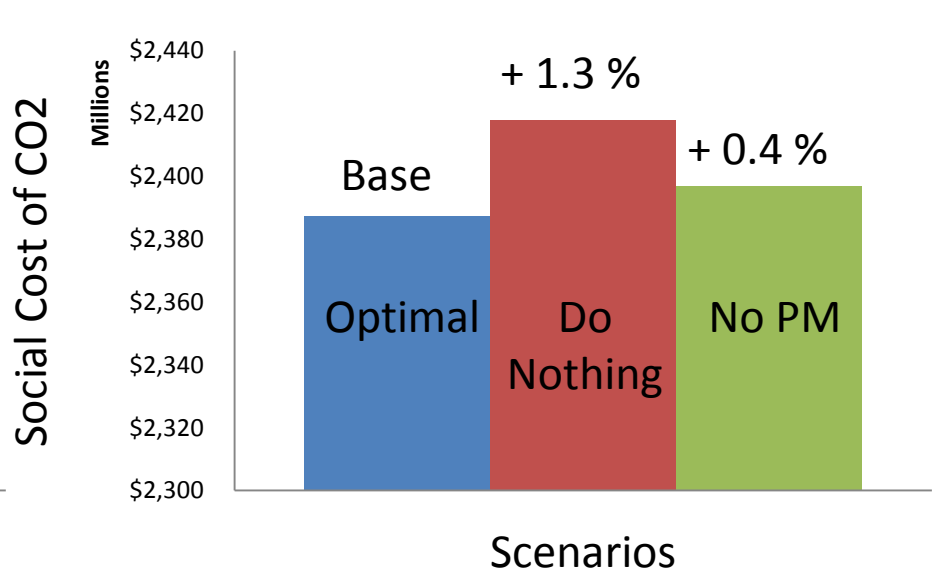
Scenarios

- Optimal Scenario (unlimited funding)
- Do-Nothing Scenario
- No Preventive Maintenance

  (PCI 99-70, IRI 0.9-1.4)


Pavement Condition Index
100
90
80
70
60
50
40
30
20
10
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
Optimal Scenario (unlimited funding)
Do Nothing
No Preventive Maintenance


Emissions [kg CO2]
Millions
54,500
54,000
53,500
53,000
52,500
52,000
51,500
51,000
50,500
50,000
+ 1.2 %
+ 0.4 %
Base
Optimal
Do Nothing
No PM
Scenarios


Social Cost of CO2
Millions
$2,440
$2,420
$2,400
$2,380
$2,360
$2,340
$2,320
$2,300
+ 1.3 %
+ 0.4 %
Base
Optimal
Do Nothing
No PM
Scenarios

Conclusions

Enhanced TAM with economic, environmental and social objectives will result in:

- Better balanced funding allocation decisions when developing maintenance strategies.
- Positive impact on air quality.
- Drivers benefit with expected fuel savings and safer roads
- Incorporate accident statistics and livability rating in the funding allocation process when prioritizing investments
- Address the needs of not only motorized vehicles but also cyclists and pedestrians.

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Thank you !!!

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