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Maximizing the Impact of Investment: An update on paving competition and asset-management research

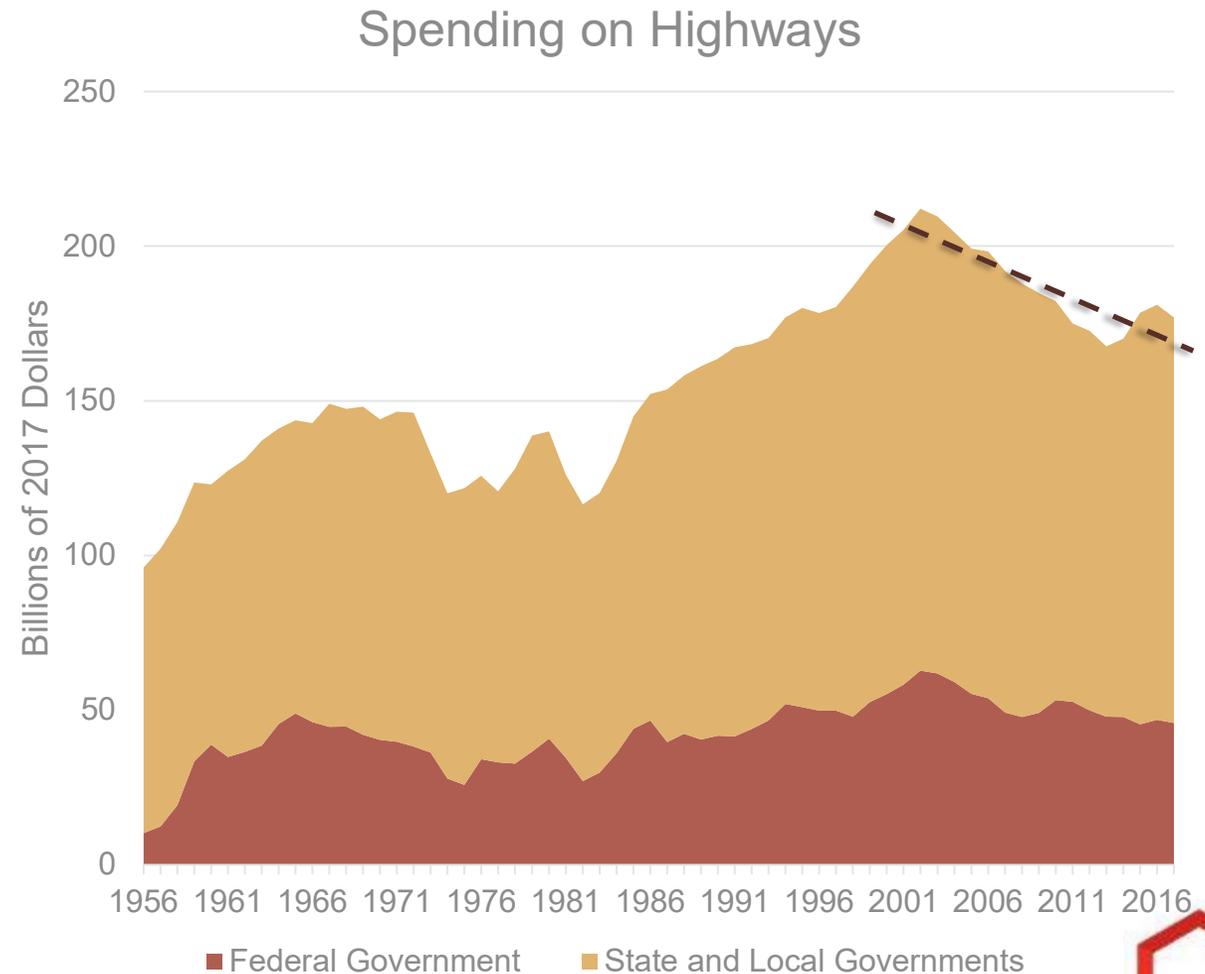
Randolph Kirchain, Co-director,
MIT Concrete Sustainability Hub

COWY Annual Concrete Pavement Workshop
March 10, 2022

Its not just about how much you spend, but how you spend it.

Building infrastructure that will last generations requires smart decisions

- IIJA provides a unique opportunity to return US infrastructure to world-class performance
- However, doing so requires smart decisions
- DOTs will still need to get the most from their infrastructure dollars



MIT CSHub has been exploring tools to maximize the impact of pavement network spending

Paving
Competition

Asset
Management



What is the question about paving competition?

Does the presence of competition between material substitutes impact pavement material prices?



VS



The pavement sector makes for an interesting case study due to the presence of two forms of competition

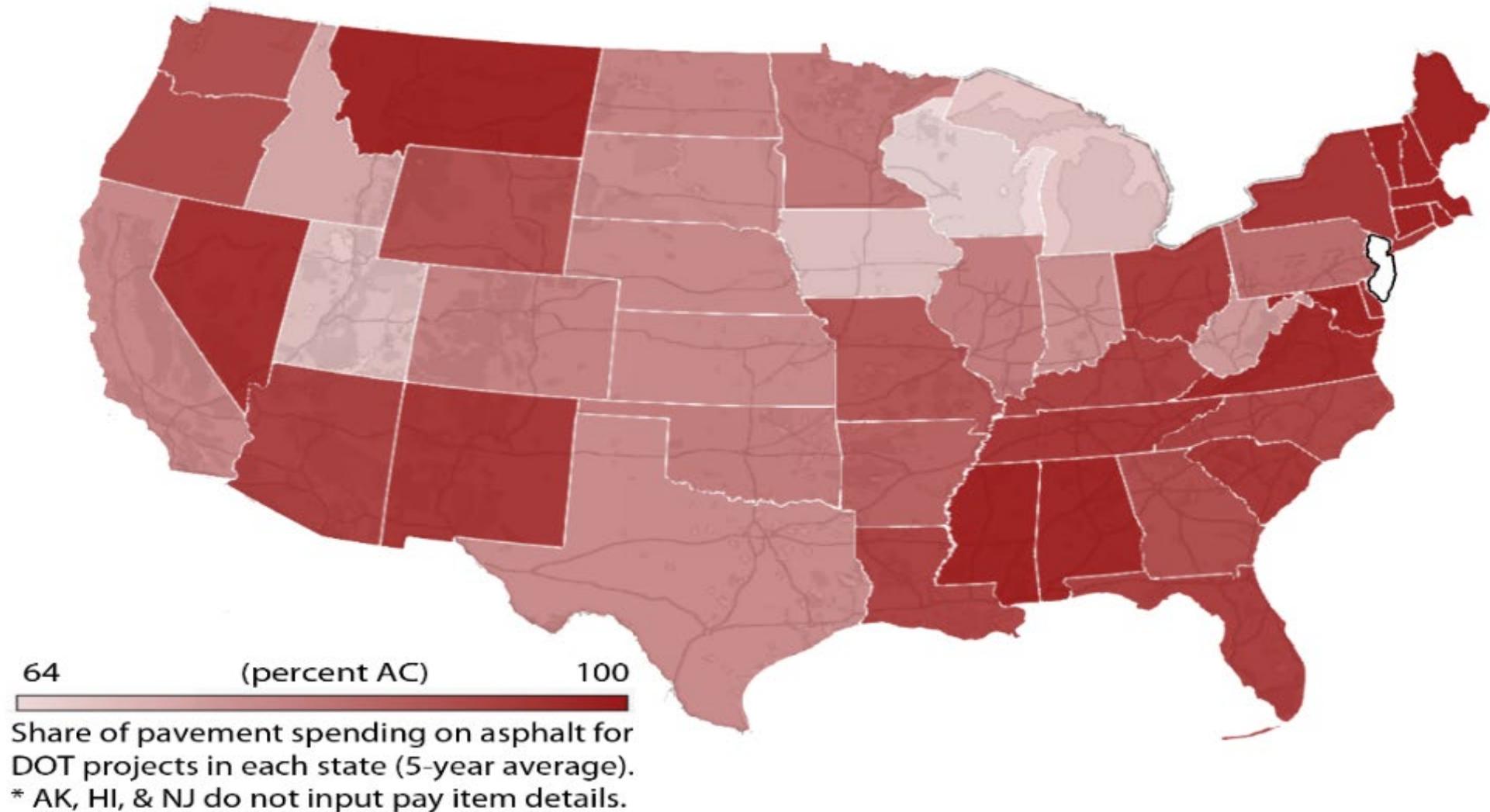
- Intra-Industry Competition: Between firms that pave with the same material
- Inter-Industry Competition: Between firms that pave with material substitutes
- Focus of this study: Characterize the effect of increased inter-industry competition in the paving sector



What did we learn?



5-year average spending on asphalt / concrete varies widely



*2005-2015, 47 states, 298k pay items, 164k jobs

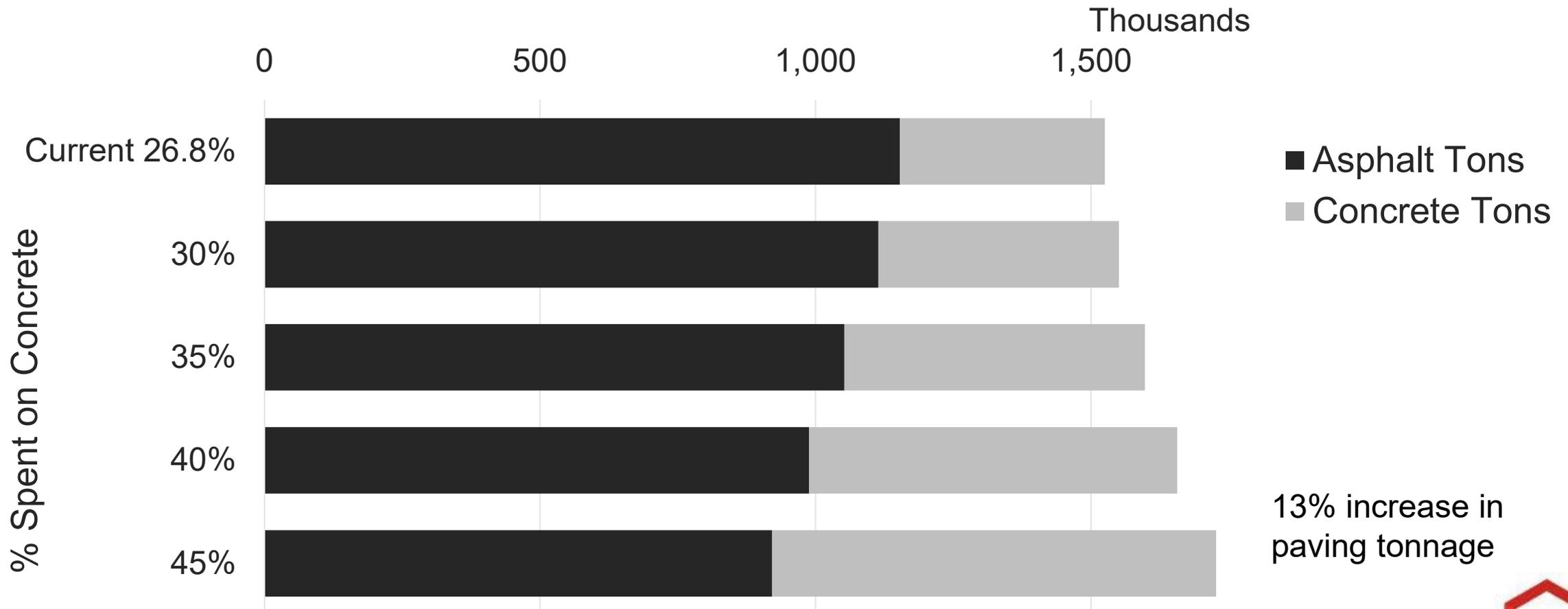
Increased competition significantly affects bid unit-prices

Significant Factors	Asphalt Jobs	Concrete Jobs
Inter-Industry Competition: percent annual spending on concrete	—	—
Intra-Industry Competition: number of bidders on a job	—	—
Project Size: quantity of material	—	—
Market Size: annual spending on paving activities	+	+
Presence of price adjustment clauses in a state: allow contractors to adjust prices after initial bid	—	N/A

+ Increase in factor *increases* prices **—** Increase in factor *decreases* prices

Increased competition could translate into more paving

Annual paving tonnage for a \$100M budget in CO



13% increase in paving tonnage

Assume asphalt price of \$64/ton and concrete price of \$145/CY



Tools for economically-efficient management of pavement networks

Paving
Competition

Asset
Management



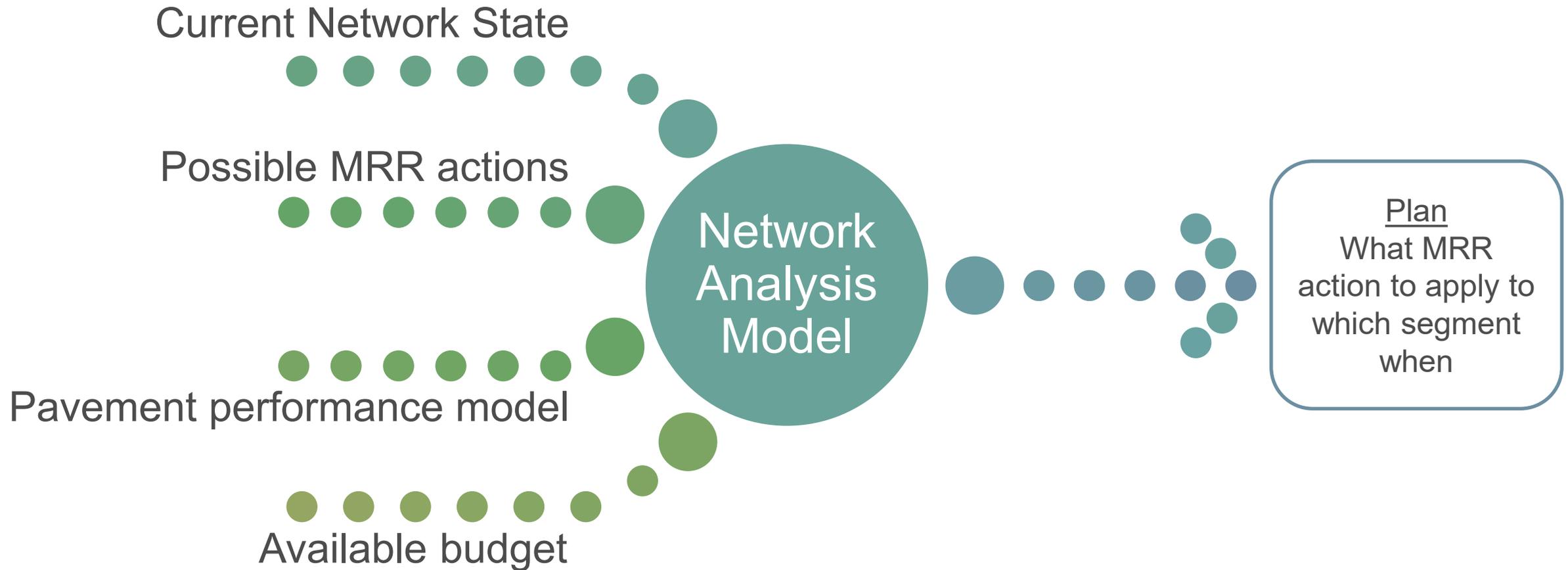
The centerpiece of pavement asset management is developing a maintenance plan



How to allocate funds to obtain best performance at lowest cost?

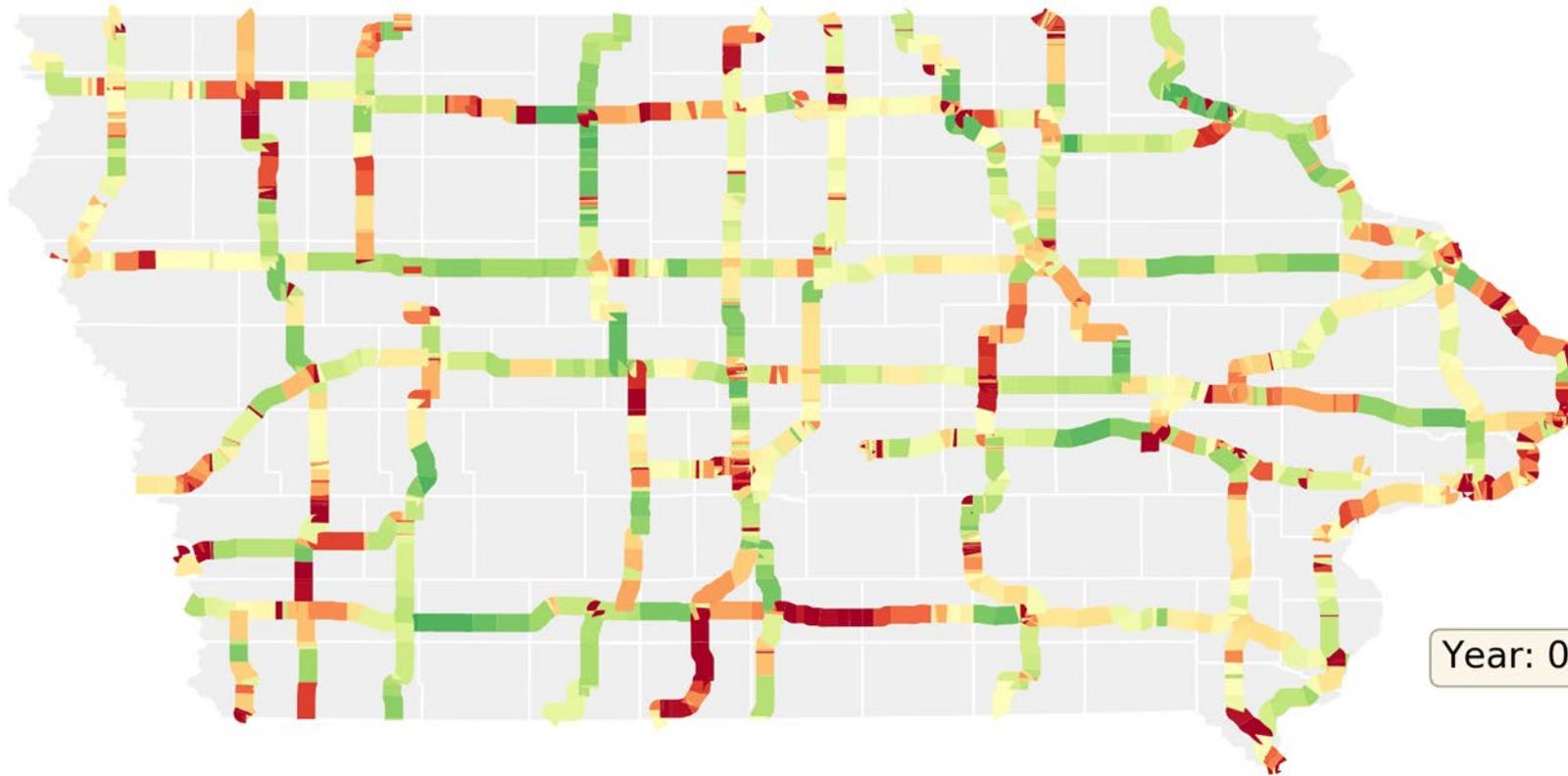


CSHub Pavement Network Asset Management Tool Considers Future Uncertainty and Risk, Allows for Flexible Strategies



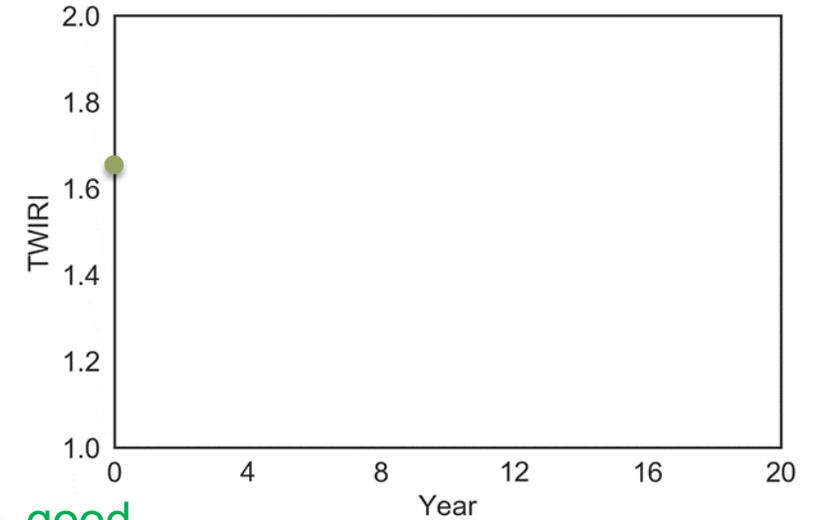
Using the CSHub Tool We Can Simulate Impact of Management Strategies on Network Performance

IRI distribution for U.S. route network in Iowa



bad

Annual TWIRI

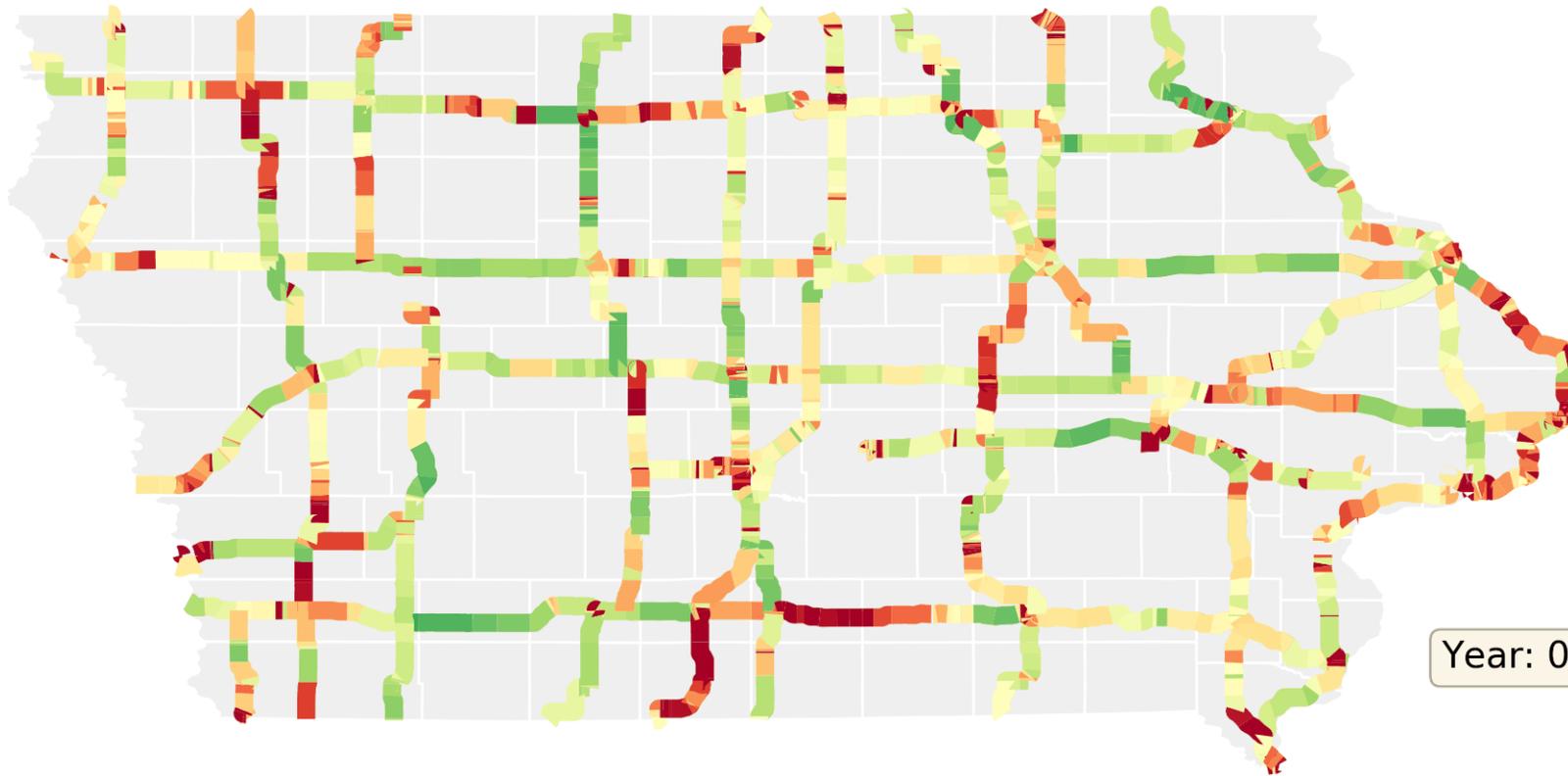


good



Using the CSHub Tool We Can Simulate Impact of Management Strategies on Network Performance

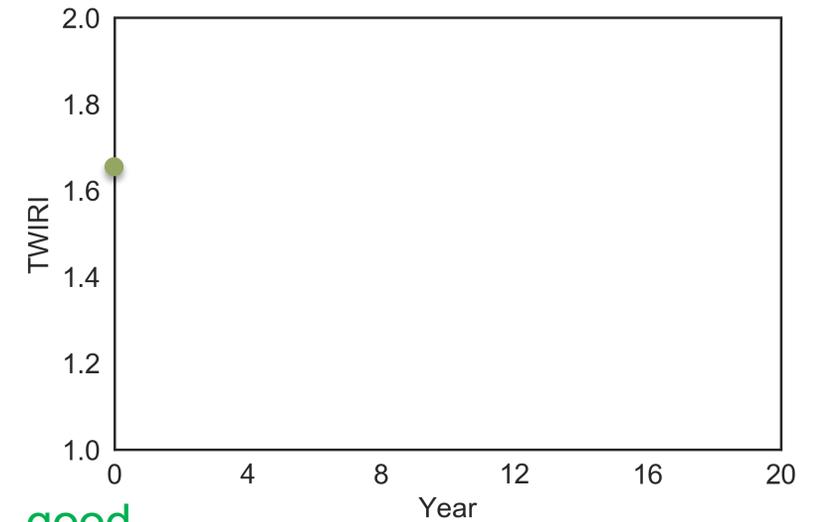
IRI distribution for U.S. route network in Iowa



Year: 0

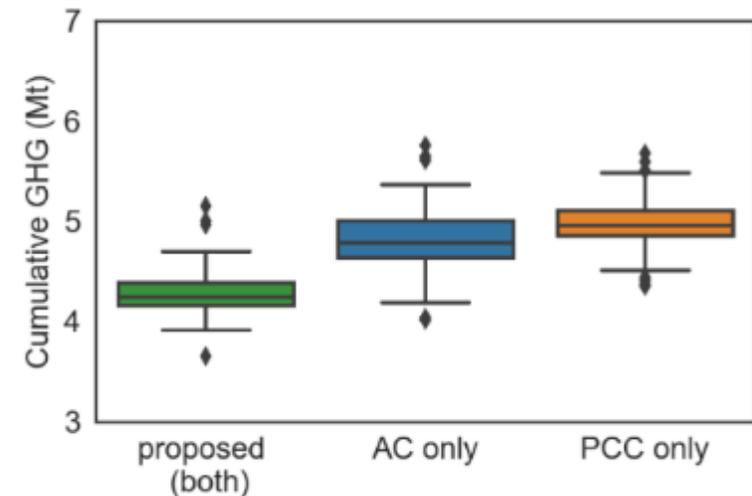
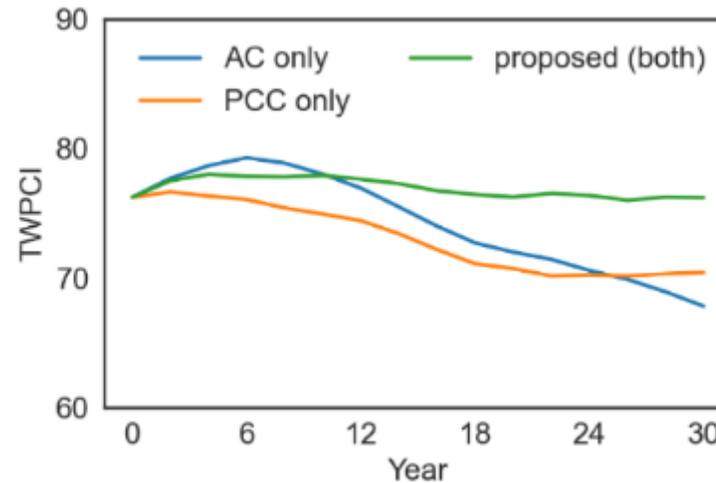
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Annual TWIRI

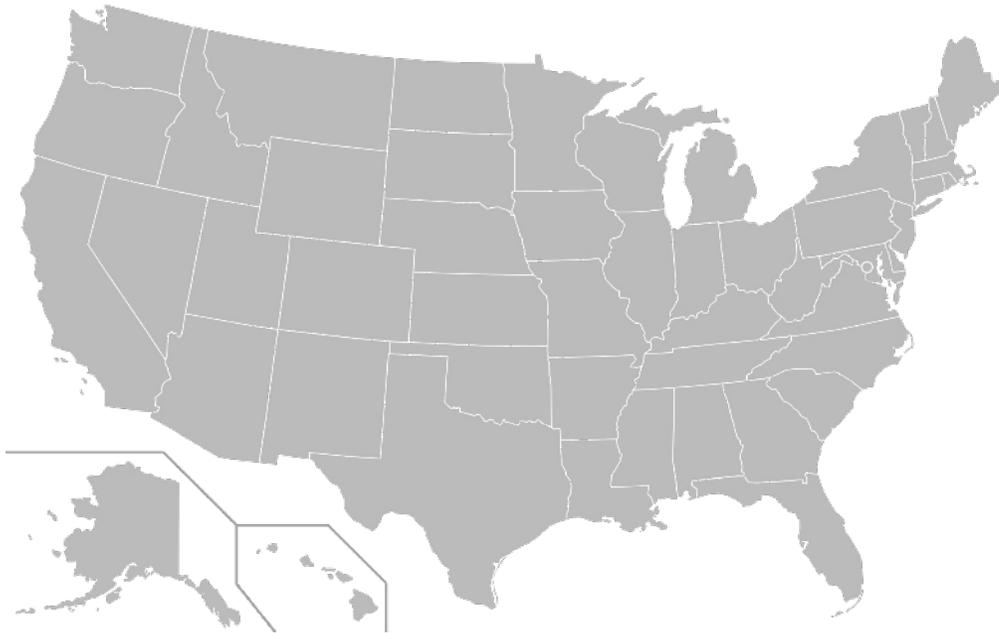


Detailed Simulations of Iowa Pavement Network Reveals Benefit of Flexibility, Long term, Diverse Materials

- Pavement networks benefit from
 - Flexible decision making
 - Long-term perspective
 - Mix of fixes
 - Multiple materials (competition)
- Achieving same result in asphalt only strategy would require spending 32% more
- Multiple materials solution generates 21% less GHG emissions



Impacts on a National Scale: How much vehicle fuel cost can be saved by changing current pavement management policies?



BAU

- FHWA road statistics
- Treatment selection:
Decision tree / treatment type
- Extra vehicle cost caused by PVI

Decision-making Flexibility

Treatment evaluation is based on the life cycle cost for an analysis period.

Includes variety of fix technologies

Long-term Planning

Evaluate life cycle cost through a long period to reflect the long-term benefits of a treatment.

Competition

The increase of competition between paving materials could decrease unit cost for both materials.

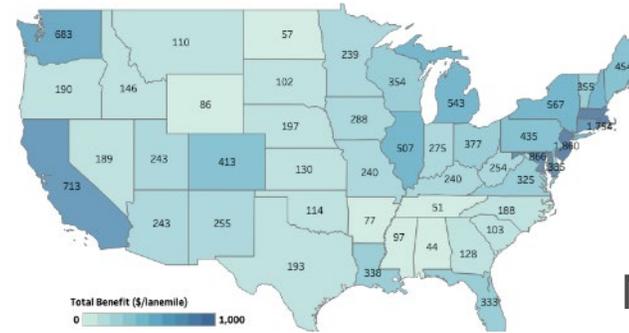
Enhanced



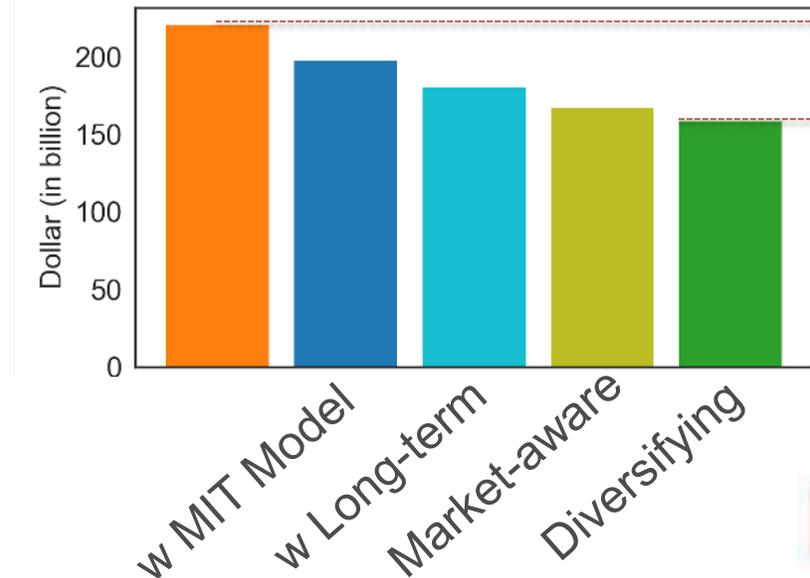
National scale analysis shows ALL states benefit from combinations of diversification & long-term thinking

- National scale analysis shows
 - ALL states benefit from combinations of diversification & long-term thinking
 - National benefit in fuel savings would exceed \$60 billion over 20 years

All States Show Benefits



National Fuel Savings
\$62 billion (28%)



Key conclusion: Leveraging four strategies will allow states to maximize the return on infrastructure investments

Flexible decision-making

Long evaluation periods

Mix of short and long-term fixes

Mix of pavement types

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Realizing these benefits locally

MIT is interested in engaging with State and Municipal DOTs

Typical engagement roadmap

1. Explore existing case studies
2. Improve data analysis
3. Develop cases analyses to identify biggest gains
4. Work on improving asset management tools





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Thank you

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