Cost-Effective Pavement Performance Management of Indiana's Enhanced NHS through Strategic Modification of the Pavement Rehabilitation Treatment Trigger Values

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VDOT
Virginia Department of Transportation

Expansion of the National Highway System

- Because of the MAP-21 legislation, the NHS now includes all principal arterials, intermodal connectors and the STRAHNET.

- Nationally,
    - Expansion from 164,000 to 224,000 center-line miles *(1)*

Challenge of preserving the NHS

- The National Highway Performance Program was created as a dedicated funding source.

- A performance-based approach is expected to maximize the benefit of allocated funding.

Purpose for the Forthcoming Analysis

- States must explore what condition outcomes can be expected from different network preservation strategies.

- Examine the potential for leveraging treatment trigger levels to obtain better outcomes at the same funding level.

CURRENT CONDITION

Indiana's National Highway System

- **Current**:
  - Length ~ 4800 center-line miles
  - 25 billion VMT for 4-tire vehicles
  - 7.5 billion VMT for trucks

- Anticipated for the year 2029:
  - 32 billion VMT for 4-tire vehicles
  - 10 billion VMT for trucks

Current pavement condition

- **Total Network Life**: ~66,400 mile-years
  - **25th percentile**: 8.3 years
  - **50th percentile**: 14.6 years
  - **75th percentile**: 20.0 years
  - **RSL<5 years**: 16.2% miles

ANALYSIS FRAMEWORK

Problem Framework

- **Optimum Work Plan Problem:**

  - **Objective**

    Minimize User Cost due to poor network condition

  - **Constraint**

    Agency Expenditure

  - **Candidate list of projects**

    Controlled by the Treatment triggers

Outcomes

1) Remaining Service Life for the Pavement Network

2) Vehicle operating costs

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Analysis Parameters –Trigger Values

- Triggers expressed in terms of PSR condition to enable the uniform shift in trigger values for treatments of similar intensity.

- PSR has good correlation with IRI and also captures the magnitude of non-roughness distresses on a pavement section.

Analysis Parameters –Trigger Values

- The Medium Level Trigger Policy is an approximation of INDOT's current policy in identifying sections eligible to receive rehabilitation.

TABLE 1 Pavement Rehabilitation Condition Level Trigger Policies

Trigger Policy Label	Heavy Rehabilitation Trigger (PSR)	Heavy Rehabilitation Trigger (equivalent IRI in inches/mile) (3)	Moderate Rehabilitation Trigger (PSR)	Moderate Rehabilitation Trigger (equivalent IRI in inches/mile) (3)
Low	2.3	156	2.9	129
Medium	2.4	151	3.0	126
High	2.5	146	3.1	122

RESULTS
HORIZON YEAR: 2029

Total Pavement Network Service Life (mile-years)

- **Funding Effect**

  Increase in Network Life (for each additional $10 million annual investment)

Low	3179
Medium	3130
High	3181

- **Trigger Effect at low funding levels**
  - Low to Medium: +3300
  - Medium to High: +2200
  - Low to High: +5500

- **Trigger Effect at high funding levels**
  - Low to Medium: +2600
  - Medium to High: +2900
  - Low to High: +5500

25th Percentile RSL

- **Funding Effect**

  Increase in Network Life (for each additional $10 million annual investment)

Low	0.85
Medium	0.89
High	0.95

- **Trigger Effect at high funding levels**

  - Low to Medium: +0.75 year
  - Medium to High: +0.75 year
  - Low to High: +1.5 years

-**A higher trigger policy is more efficient in increasing the 25th percentile pavement RSL per unit of increased funding.**

50th Percentile RSL

- **Funding Effect**

  Increase in Network Life (for each additional $10 million annual investment)

Low	0.57
Medium	0.52
High	0.52

- **Trigger Effect at low funding levels**
  - Low to Medium: +1 year
  - Medium to High: +0.75 year
  - Low to High: +1.75 years

- **Trigger Effect at high funding levels**
  - Low to Medium: +0.5 year
  - Medium to High: +0.8 year
 - Low to High: +1.3 years

75th Percentile RSL

- **Funding Effect**

  Increase in Network Life (for each additional $10 million annual investment)

Low	0.63
Medium	0.6
High	0.59

- **Trigger Effect at low funding levels**
  - Low to Medium: +1 year
  - Medium to High: +0.75 year
  - Low to High: +1.75 years

- **Trigger Effect at high funding levels**
  - Low to Medium: +0.6 year
  - Medium to High: +0.7 year
  - Low to High: +1.3 years

Percent of Network with RSL< 5 years

- ## Funding Effect

  Increase in Network Life (for each additional $10 million annual investment)
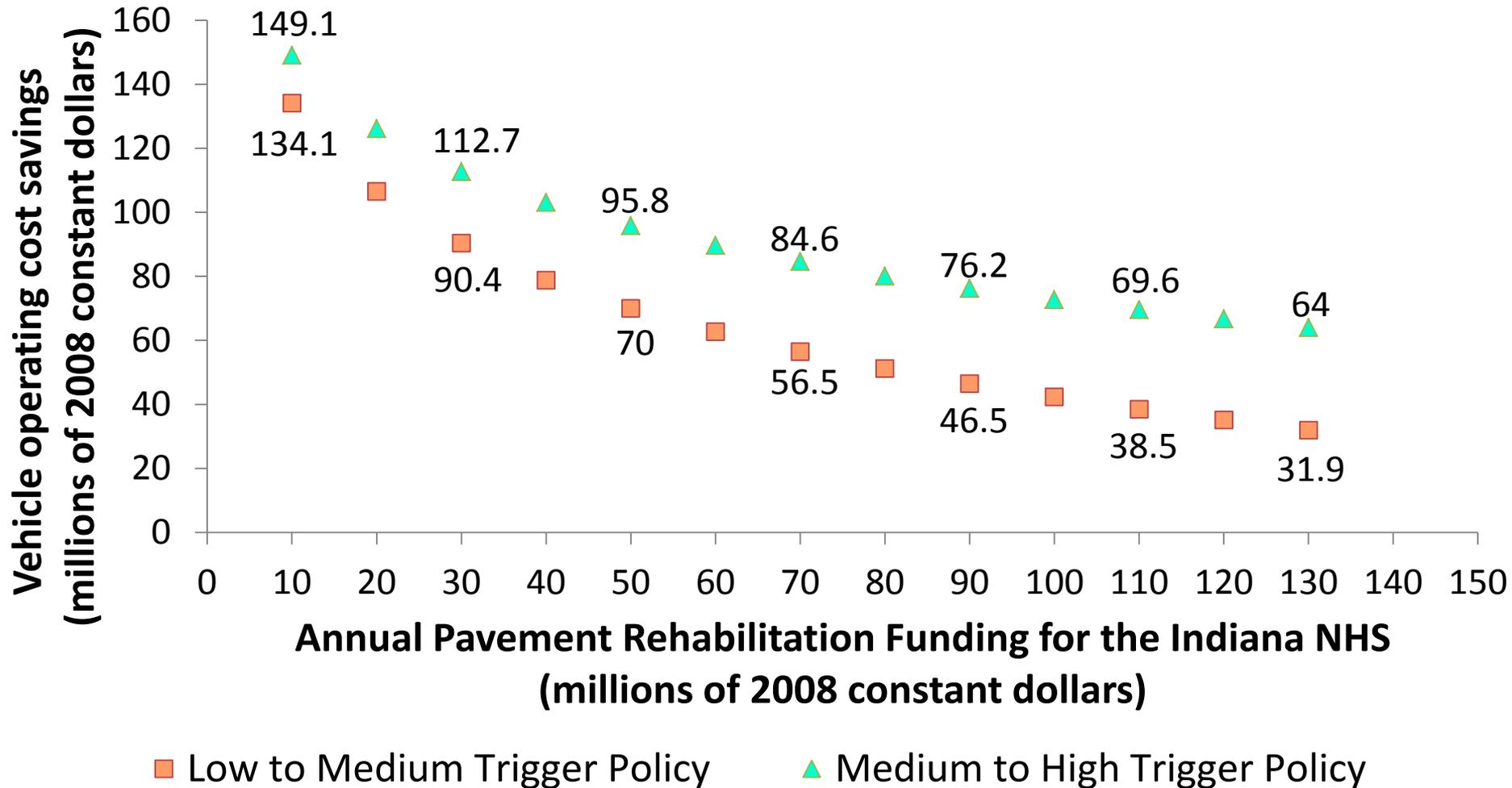
Low	3.1
Medium	2.9
High	2.7

- A lower trigger policy is slightly more efficient in reducing the percent of Indiana NHS' miles with pavement RSL< 5 years.

Vehicle Operating Cost
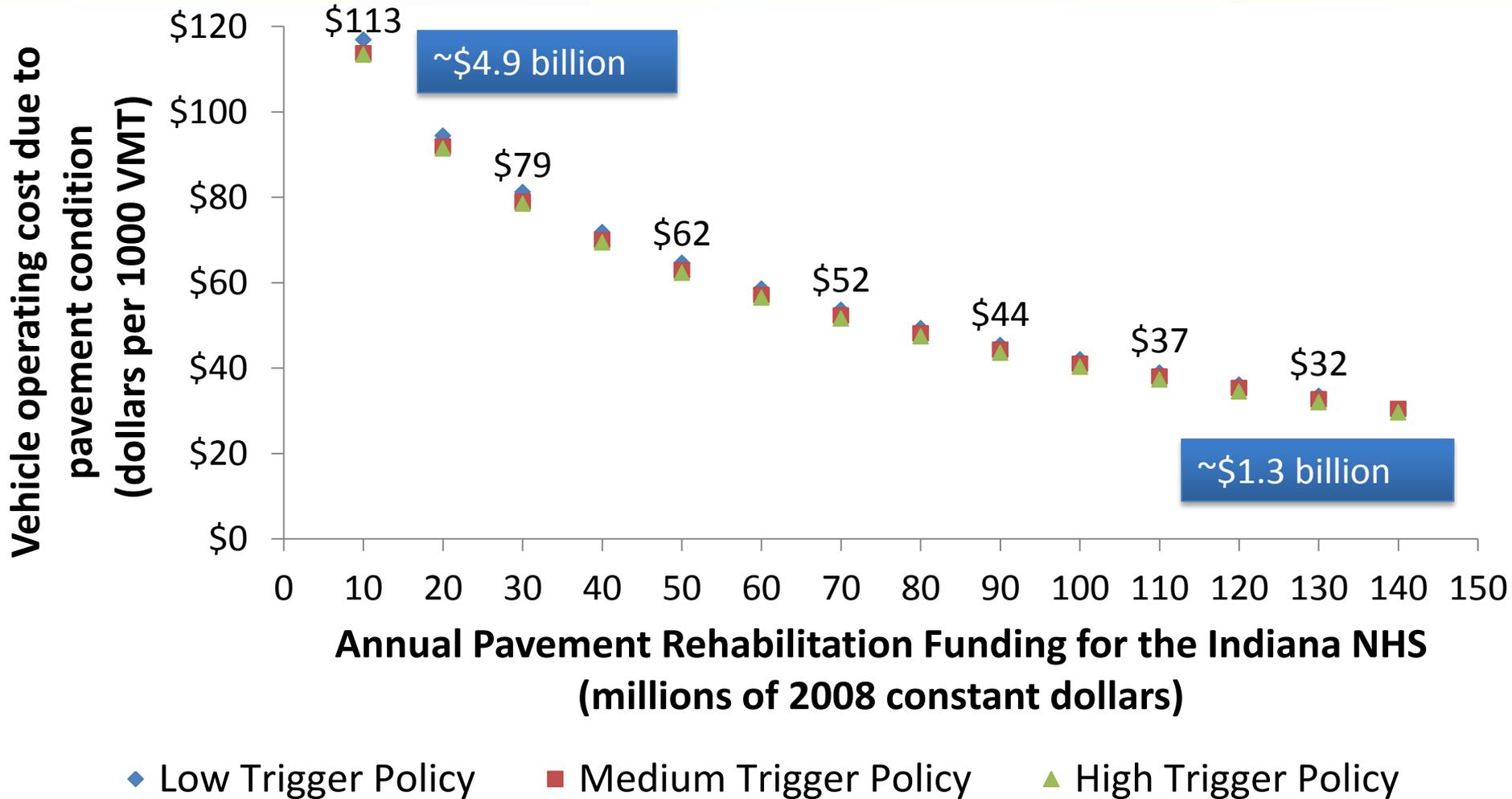
User Cost Savings due to a switch from the Low Trigger Policy to a higher trigger policy

Summary

- For the Indiana NHS system, displayed the effects of:
    - Agency Expenditure,
    - Treatment Trigger Policy

  on pavement network condition and outcomes.

- Examined the feasibility of leveraging the treatment trigger policy to improve network condition at all agency expenditure levels.

Findings for the Indiana NHS

- In the long term, a higher trigger policy increases:
  - Overall Network Condition and,
  - User Cost Savings at the network level.

- A lower trigger policy is slightly more efficient in reducing the percent of roads with RSL< 5 years.

- At both low and high agency funding levels:
  - An increase in the trigger policy results in user cost savings.

Acknowledgment

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Questions?