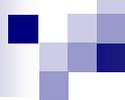


Transportation Infrastructure & Economic Development

A Report to the North Dakota Legislative Council
by the
Upper Great Plains Transportation Institute
North Dakota State University



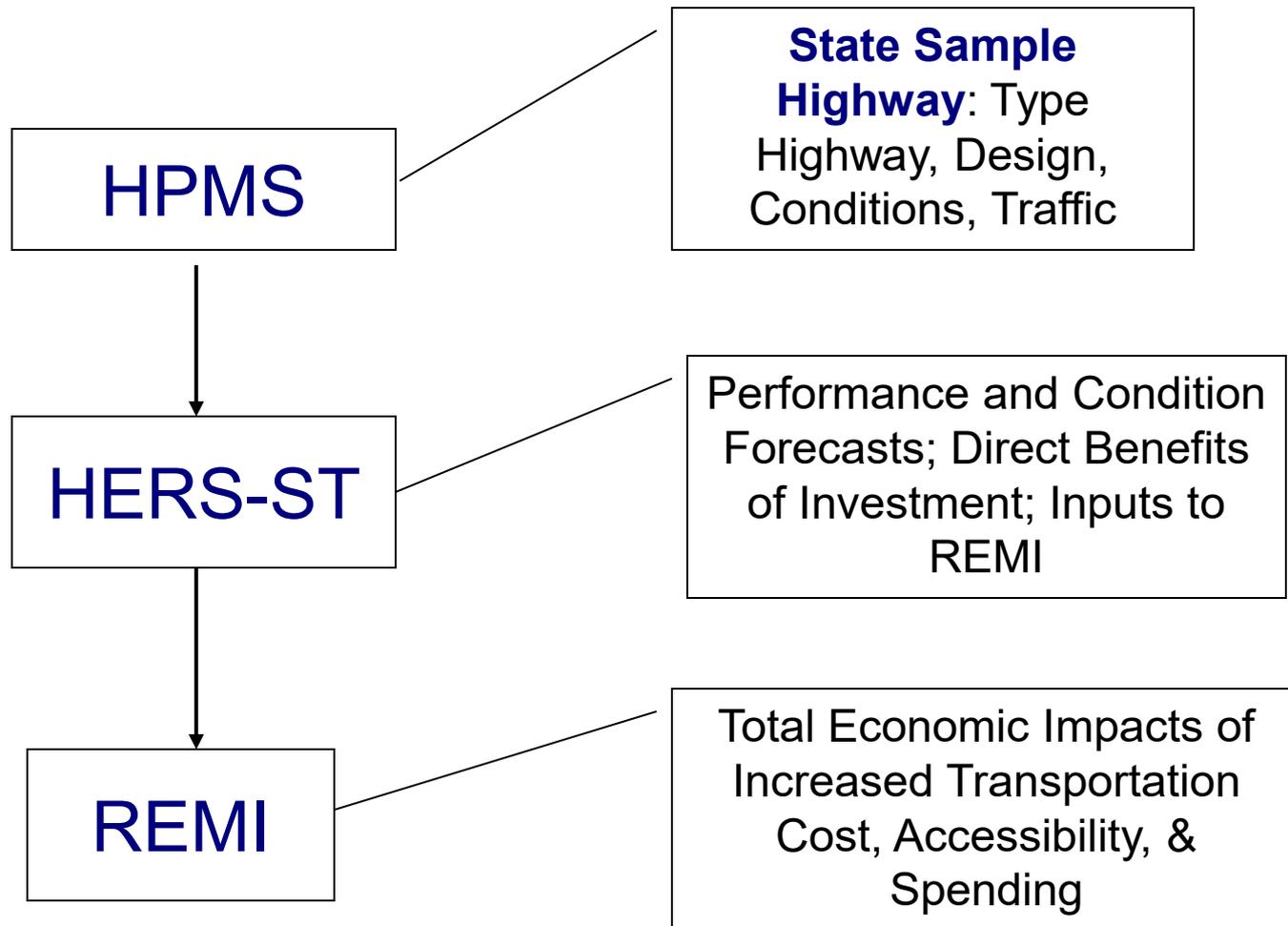
General Objectives

1. Determine how improvements to the state's transportation infrastructure might enhance the business climate of North Dakota and the state's competitive position in economic development, “with a focus on the potential to expand the sale of goods to markets outside the state by strengthening the state's transportation infrastructure”
2. Provide recommendations on “how to enhance the state's transportation infrastructure”
3. Identify “proposed legislative changes necessary to implement any recommended changes”

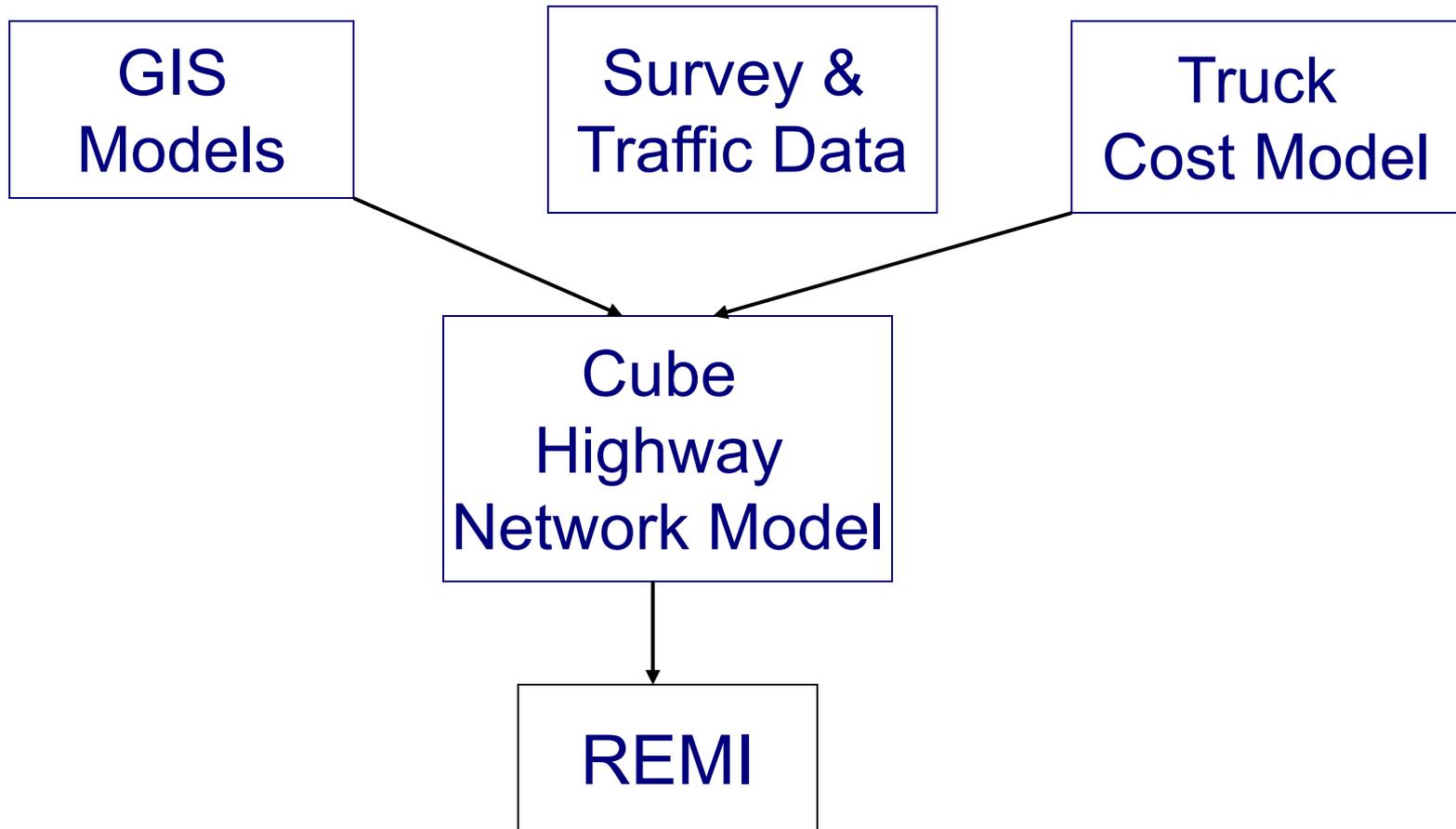
Specific Topics

- Raising highway load limits
 - Spring limits
- Rail service
 - Decline in service
 - Potential incentives to expand service
- Air service – specially-situated airports
- Recommended infrastructure enhancements
- Economic development benefits

Highway Analysis Process



Load Limit Analysis Process



HERS-ST: Background

- Enhanced version of national HERS model used by USDOT
 - Info. submitted to Congress in C&P report
 - Investment required to maintain or improve the highway system
 - Benefits of investments (B/C ratios)
 - Highway system performance measures
- HERS-ST & HERS use same analytical engine
- Both use the HPMS sample

What Benefits Are Considered?

| | User Benefit | Agency Cost | Externality |
|---|---------------------|--------------------|--------------------|
| Benefits | | | |
| Vehicle Operating Cost Savings | X | | |
| Safety Cost Savings | X | | |
| Travel Time Cost Savings | X | | |
| Benefits to New Travelers | X | | |
| Highway Maintenance Cost Savings | | X | |
| Residual Value of Investment | | X | |
| Emissions Reductions | | | X |
| Costs | | | |
| Initial Improvement Cost | | X | |

Benefit-Cost Logic

- Base Case (No improvement)
 - Conditions deteriorate → user and maintenance costs increase
 - Terminal condition is reached (e.g., PSR of 1.0 → conversion from paved to unpaved road)
- Improvement Case
- Benefits = difference
- Induced demand affects benefits over time
 - Baseline traffic growth (Future AADT / AADT) adjusted for generalized price of travel

HERS-ST Results

| Forecasted Improvements to Highway Pavements in North Dakota: 2005-2024 | | | |
|---|---------------------|------------------------------|--------------------|
| Improvement Type | Lane-Miles Improved | Cost of Improvements (\$000) | Benefit/Cost Ratio |
| Reconstruction due to Pavement Condition | 44 | 36,342 | 3.50 |
| Major Widening with Avg. Cost Lanes | 76 | 58,597 | 7.78 |
| Resurfacing with Minor Widening | - | 780 | - |
| Resurfacing with Shoulder Imps. | 1,491 | 368,652 | 1.78 |
| Resurfacing and Realignment | 14,626 | 2,676,805 | 5.20 |
| All | 16,263 | 3,145,014 | 4.89 |

HERS-ST Results

| Forecasts of Highway User Costs in North Dakota (\$/1,000 vehicle-miles) from 2004 to 2024 | | |
|---|-----------------|-----------------|
| Highway User Costs | 2004 | 2024 |
| Travel Time Costs | \$342.85 | \$340.43 |
| Vehicle Operating Costs: | | |
| 4-Tire Vehicles | \$250.90 | \$241.54 |
| Trucks | \$828.43 | \$820.12 |
| All Vehicles | \$353.79 | \$345.77 |
| Crash Costs | \$111.91 | \$110.21 |
| Total User Costs | \$809.49 | \$797.63 |



Budget Constrained Scenarios

- Three Scenarios were estimated:
- 75% of baseline funding
- 50% of baseline funding
- 25% of baseline funding

Budget Constrained Scenarios

Changes in Lane-Miles Improved, Improvement Costs, and Routine Maintenance Costs as a Result of Hypothetical Budget Constraints

| Funding Level (Percent of Baseline) | Lane Miles Improved: 2005-2024 | Capital Improvement Cost (Million \$): 2005-2024 | Maint. Cost (Million \$): 2005-2024 |
|--|---|---|--|
| 100% | 16,263 | \$3,145.01 | \$ 166.39 |
| 75% | 12,658 | \$2,358.76 | \$ 180.29 |
| 50% | 8,469 | \$1,468.33 | \$ 200.73 |
| 25% | 4,309 | \$786.25 | \$ 228.69 |

Budget Constrained Scenarios

Table 5. Changes in Highway System Performance as a Result of Hypothetical Budget Constraints

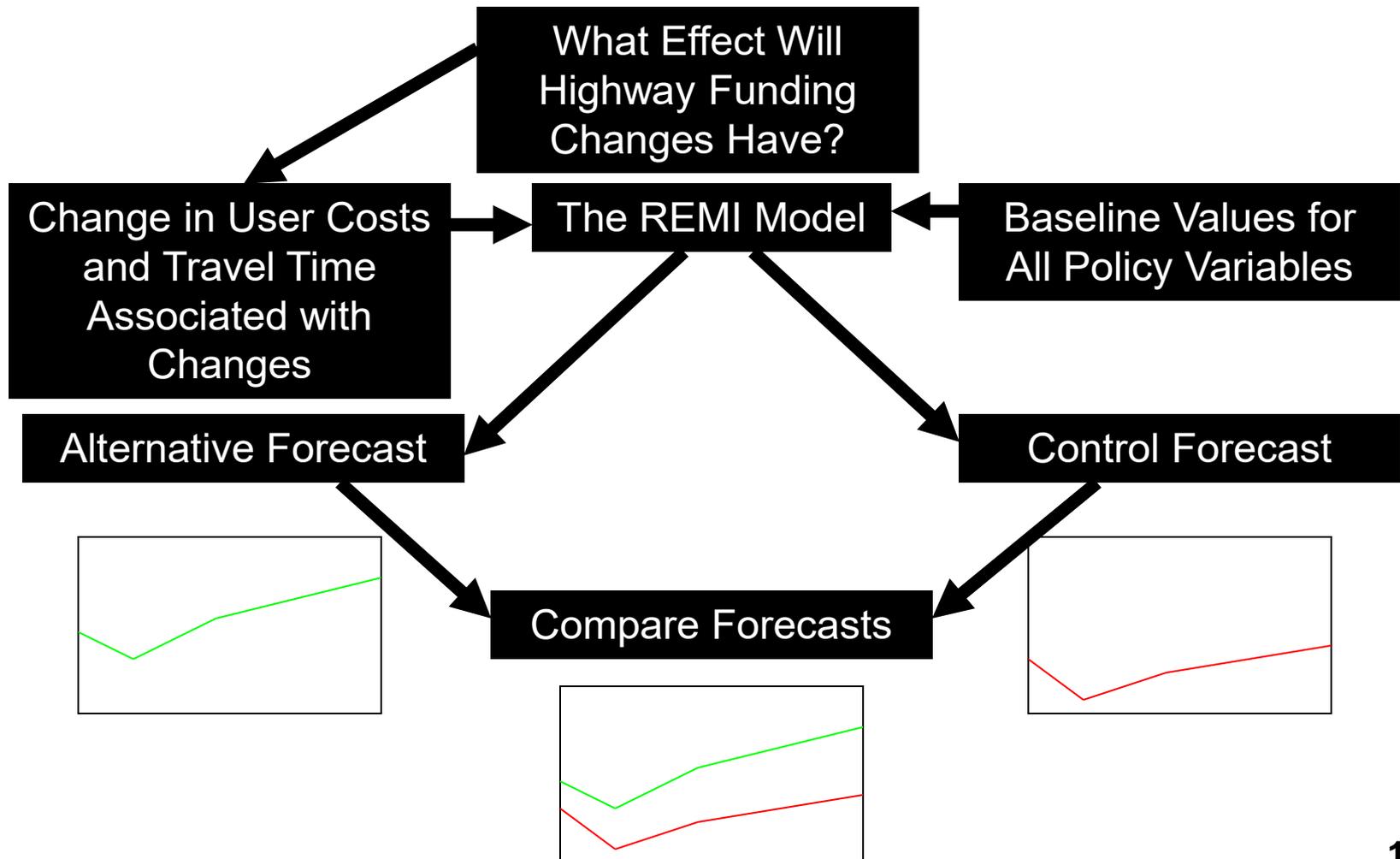
| Funding Level (Percent of Baseline) | Predicted Values for 2024 | | |
|---|---------------------------|-------------------------------|------------------------|
| | VMT (billions) | Avg. Travel Speed (mph) | Average IRI (in/mi) |
| 100% | 6.80 | 67.4 | 108 |
| 75% | 6.73 | 66.1 | 122 |
| 50% | 6.57 | 62.8 | 146 |
| 25% | 6.35 | 56.9 | 184 |

Budget Constrained Scenarios

Table 6. Changes in Highway User Costs as a Result of Hypothetical Budget Constraints

| Projected User Costs per 1,000 Vehicle-Miles in 2024 | | |
|---|--------------------|------------------------------|
| Funding Level (Percent of Baseline) | Travel Time | Vehicle Operating |
| 100% | \$340 | \$346 |
| 75% | \$348 | \$350 |
| 50% | \$369 | \$354 |
| 25% | \$404 | \$358 |

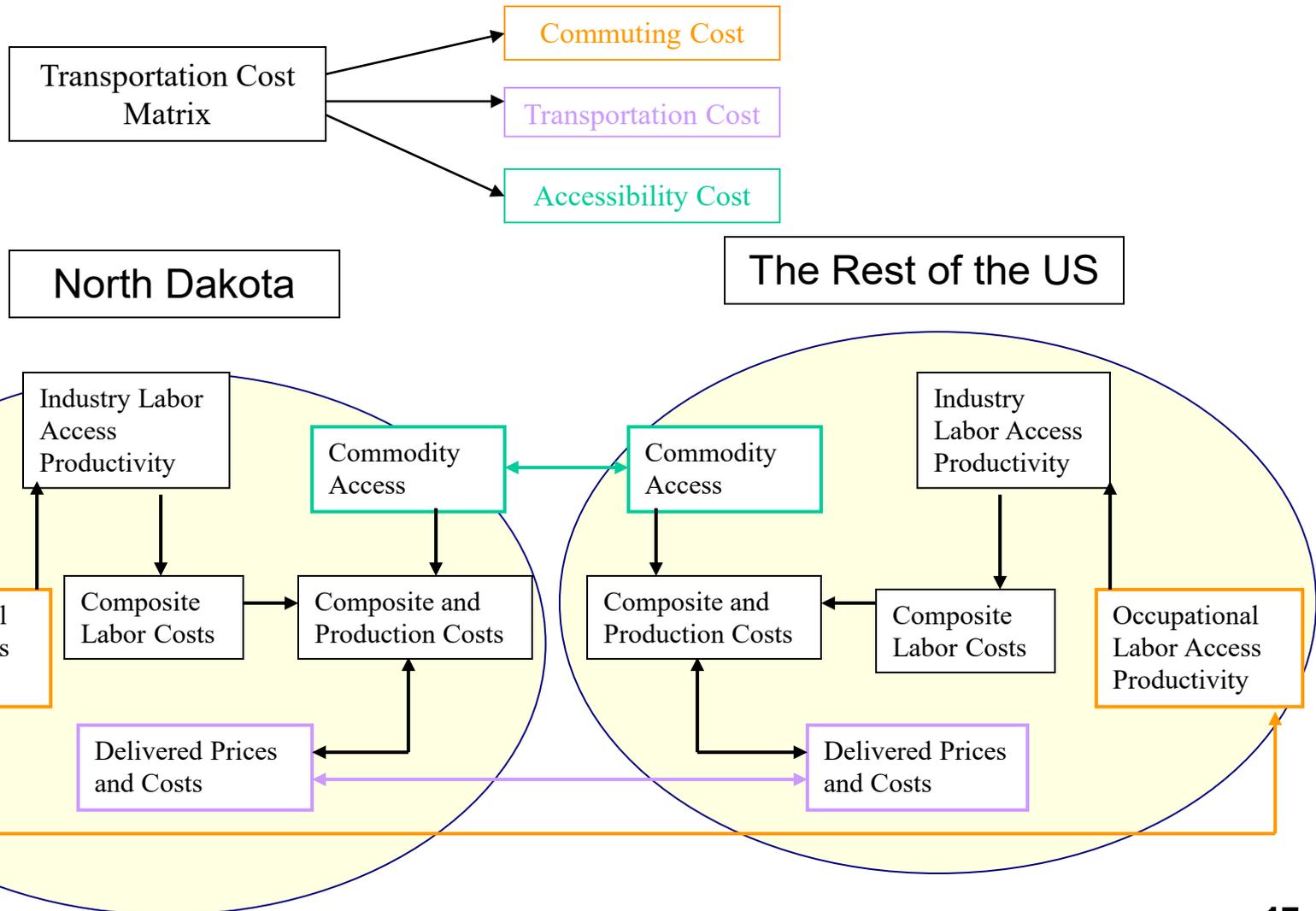
REMI Analysis Process



HERS-ST Output to REMI

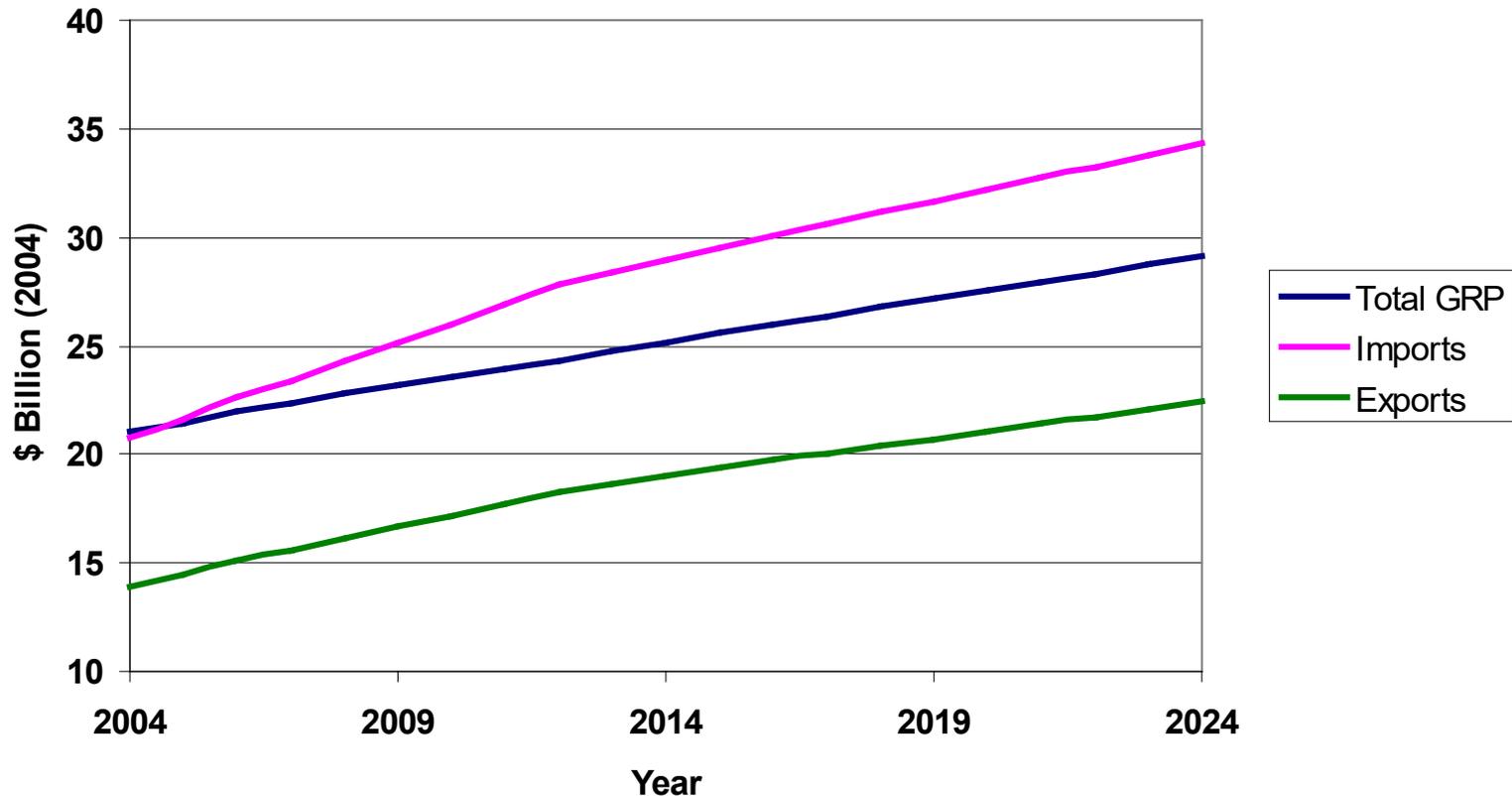
- User Costs
 - Operating Costs
 - Safety Costs
 - Emissions Costs
- Agency Expenditures
 - Construction/Maintenance Costs
 - Funding Mechanism
- Effective Distance
 - Commuting Cost
 - Transportation Cost
 - Accessibility Cost

Dual-Regional Price and Wage Linkages



Baseline Forecast

Forecasted GRP, Imports, and Exports Under Current Highway Conditions
2004-2024



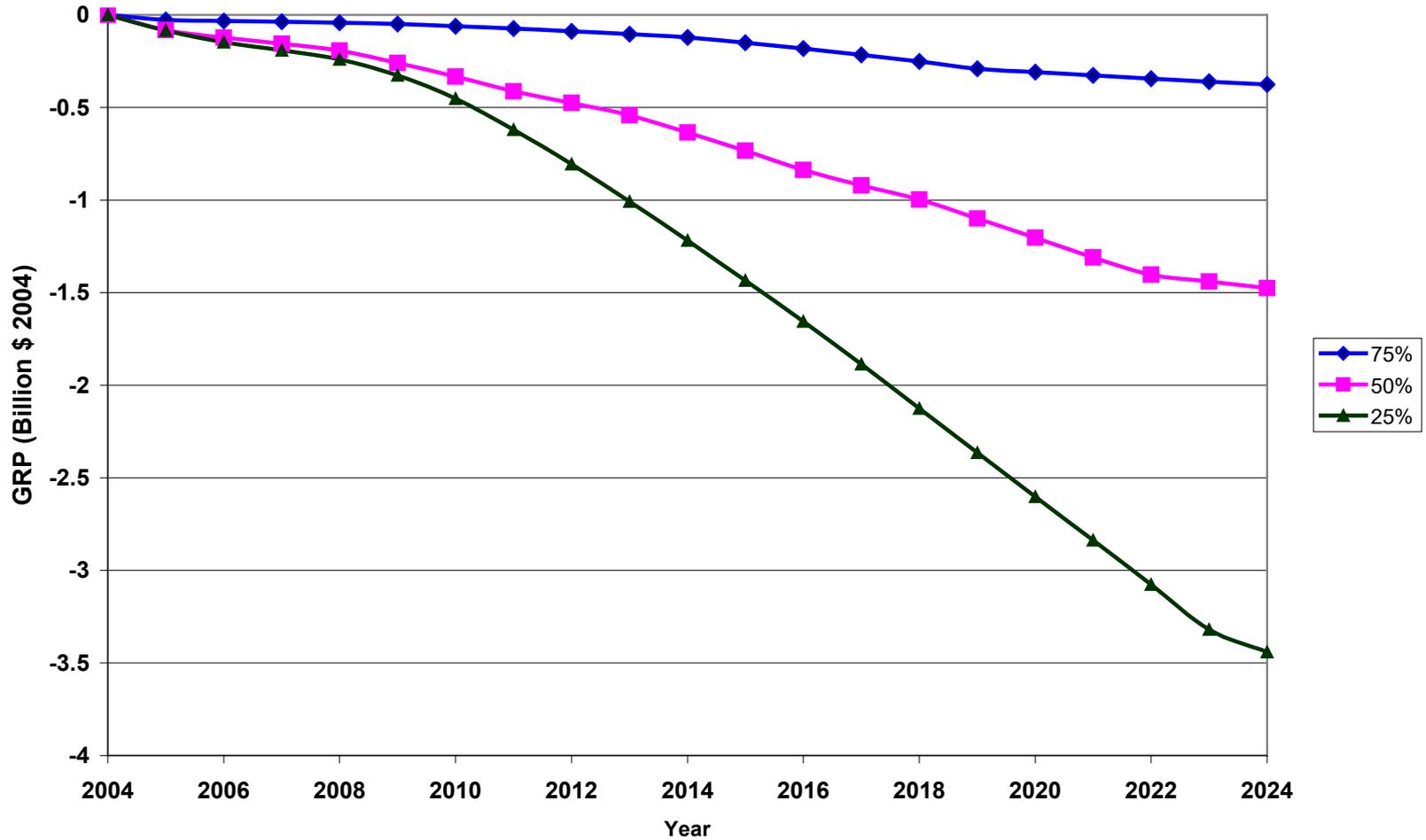
Budget Constrained Scenarios

| Change in 2024 North Dakota Employment and Gross Regional Product Estimates Under Different Highway Funding Scenarios | | | |
|--|------------------------------------|------------|------------|
| | Percent of Baseline Funding | | |
| | 75% | 50% | 25% |
| Total Employment (Thousand) | -7.20 | -23.96 | -66.37 |
| Labor Force (Thousand) | -6.28 | -24.84 | -56.26 |
| GRP (2004 Billion \$) | -0.41 | -1.35 | -3.91 |

Budget Constrained Scenarios

| Percentage Changes From 2024 Baseline Forecast Under Different Highway Funding Scenarios | | | |
|---|------------------------------------|------------|------------|
| | Percent of Baseline Funding | | |
| | 75% | 50% | 25% |
| Total Employment | -1.45% | -4.82% | -13.35% |
| Labor Force | -1.67% | -6.60% | -14.95% |
| GRP | -1.41% | -4.65% | -13.41% |

Changes in GRP Growth Under Different Highway Funding Scenarios



Budget Constrained Scenarios

| Percentage Change in Imports and Exports Under Different Highway Funding Scenarios | | | |
|---|------------|------------|------------|
| | 75% | 50% | 25% |
| Imports from Rest of Nation | -1.25% | -4.04% | -11.33% |
| Exports to Rest of Nation | -1.90% | -5.52% | -19.33% |
| Relative Cost of Production | 0.53% | 2.29% | 5.87% |
| Relative Delivered Price | 0.21% | 0.88% | 2.36% |

Spring Load Restrictions

| Spring Load Restrictions on State Highways in North Dakota | | | | |
|---|--------------------|--------------------|----------------|-----------------------------|
| Class | Single Axle | Tandem Axle | 3 Axles | Gross Vehicle Weight |
| Legal Weights | 20,000 lb | 34,000 lb | 48,000 lb | 105,500 lb |
| 8-ton | 16,000 lb | 32,000 lb | 42,000 lb | 105,500 lb |
| 7-ton | 14,000 lb | 28,000 lb | 36,000 lb | 105,500 lb |
| 6-ton | 12,000 lb | 24,000 lb | 30,000 lb | 80,000 lb |
| 5-ton | 10,000 lb | 20,000 lb | 30,000 lb | 80,000 lb |

Improvement Costs

| Costs to Eliminate Some or All Spring Load Restrictions on State Highways | | | |
|--|--|----------------------|---------------------|
| | The Costs to Raise All State Highway Segments to: | | |
| HPCS | Legal Weight | 8-Ton | 7-Ton |
| Interregional | \$23,000,000 | | |
| State Corridor | \$27,100,000 | | |
| District Corridor | \$122,000,000 | \$62,575,000 | \$6,600,000 |
| District Collector | \$120,000,000 | \$78,725,000 | \$32,625,000 |
| Total | \$292,100,000 | \$141,300,000 | \$39,225,000 |

Impacts of Spring Limits on Grain Shipments

Percent of Crops Marketed by Month

| Crop | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Wheat | 11 | 9 | 9 | 5 | 3 | 3 | 9 | 14 | 11 | 7 | 8 | 11 |
| Barley | 8 | 8 | 9 | 4 | 2 | 11 | 5 | 18 | 11 | 8 | 7 | 9 |
| Oats | 13 | 3 | 10 | 15 | 3 | 4 | 6 | 11 | 10 | 8 | 7 | 10 |
| Corn | 15 | 11 | 9 | 7 | 5 | 6 | 6 | 6 | 2 | 9 | 13 | 11 |
| Sunflowers | 10 | 8 | 11 | 5 | 2 | 4 | 5 | 2 | 3 | 29 | 11 | 10 |
| Beans | 10 | 9 | 9 | 7 | 6 | 4 | 6 | 3 | 17 | 13 | 4 | 12 |
| Soybeans | 15 | 6 | 3 | 2 | 1 | 1 | 2 | 1 | 6 | 40 | 14 | 9 |

North Dakota Agricultural Statistics 2005. North Dakota Agricultural Statistics Service, ND-NASS, Fargo, N.D., 2005.

Agricultural Impacts

| Annual Impacts of Seasonal Highway Load Limits on Grain Transportation Cost | |
|--|---------------------|
| Impact Factor | Annual Value |
| Incremental Vehicle-Miles of Travel | 570,734 |
| Incremental Vehicle-Hours | 8,786 |
| Incremental Cost | \$1,227,599 |

Manufacturing Impacts

Annual Impacts of Seasonal Highway Load Limits on the Transportation Cost of Manufactured and Processed Goods

| Impact Factor | Annual Value |
|-------------------------------------|---------------------|
| Incremental Vehicle-Miles of Travel | 1,733,224 |
| Incremental Vehicle-Hours | 29,242 |
| Incremental Cost | \$1,288,634 |

Load Limit Analysis

- Partial analysis-excludes oil, beets, potatoes, and other crops
- It is not cost effective to remove spring load limits from all state highways.
- Removing limits on key highways may be cost effective.
- UGPTI should work with NDDOT to conduct individual analyses of key highways and determine if these highways should be improved to eliminate spring load restrictions.



Highway Recommendations

- The NDDOT is focused on a preservation program that keeps pavements in good condition.
- These programs generate substantial economic benefits and should be continued.



Highway Recommendations

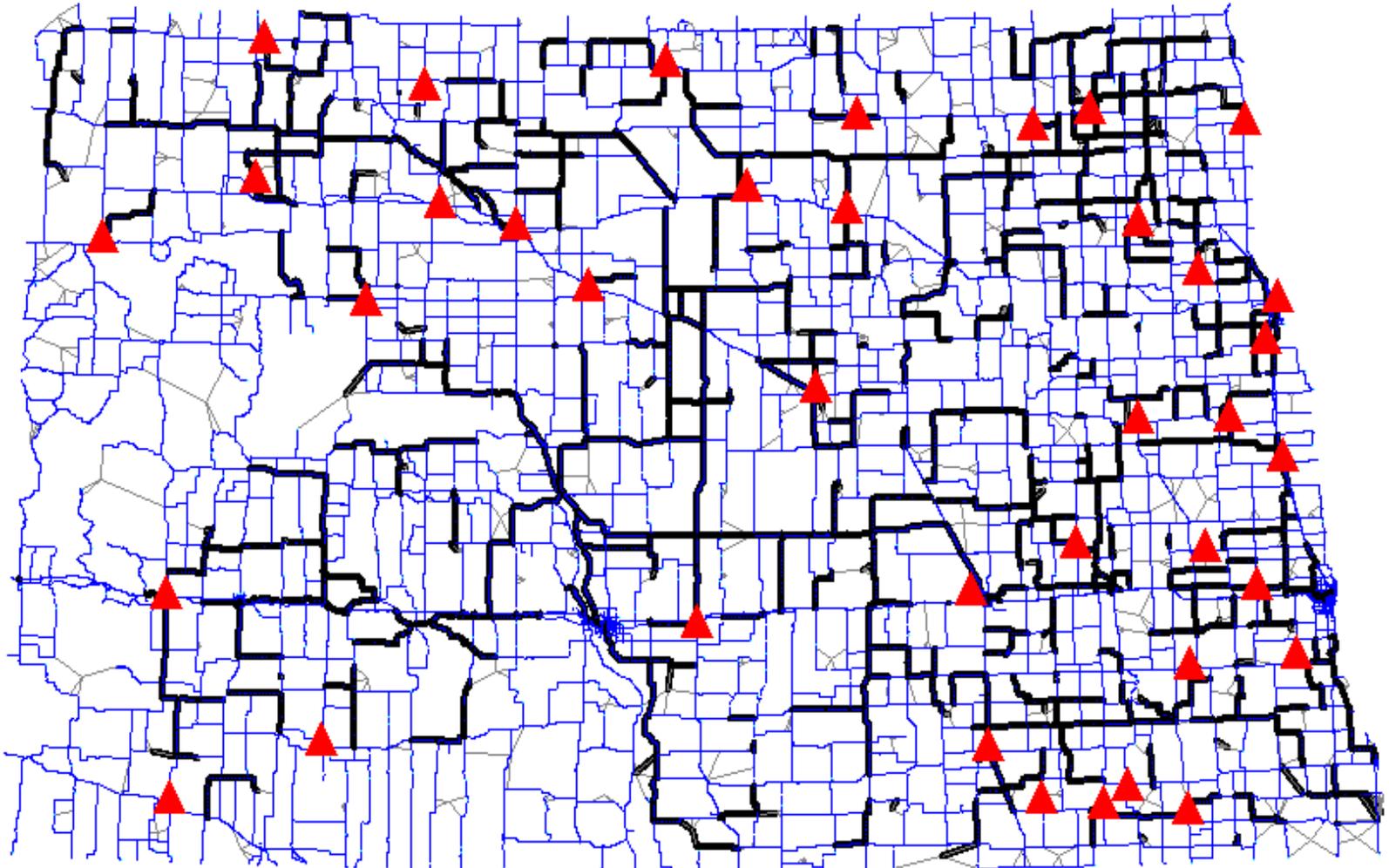
- Access to key industrial and agricultural facilities should be analyzed on a case-by-case basis.
- These facilities include shuttle-train elevators, processing plants, current and future ethanol plants and other key industrial facilities.



Highway Recommendations

- The benefits and costs of eliminating or mitigating spring load limits on key highway segments should be analyzed on a case-by-case basis.
- Load limit elimination on highway segments serving key agricultural and manufacturing locations may be cost effective.

Load Limited Segments and Shuttle Elevators



Highway Recommendations

- New mechanistic pavement analysis techniques offer potential for improved forecasting of pavement lives
- May make it possible to shorten the durations of spring load restrictions in some cases, and identify more cost-effective designs.
- Thus, it is important to develop data and inputs to fully utilize these advanced procedures.



Highway Recommendations

- Selective case studies should be undertaken of highway load limits in counties.
- A great deal of information must be developed in order to assess the benefits and costs of uniform county load limits.
- A cost-effective analysis plan must be developed that includes representative counties throughout the state.

Branch Line Analysis

- Scenario 1: All branch lines and regional railroads are abandoned, grain at branch line elevators is trucked to the nearest mainline elevator.
- Scenario 2. All branch lines and regional railroads are abandoned, grain travels directly from field to the nearest mainline elevator.

Branch Line Analysis

| Direct and Secondary Costs Associated with Transshipment Scenario in 2024 (Stated in 2004 Dollars) | |
|---|---------------------|
| Variable Trucking Cost | \$7,082,039 |
| Handling Cost | \$10,838,432 |
| Highway Improvement Costs | \$8,883,165 |
| Secondary Impact of Production Cost Increase | \$4,526,587 |
| Total Cost | \$31,330,224 |
| Special Fuel Tax Receipts | \$332,286 |
| Net Impact | \$30,997,938 |

Branch Line Analysis

| Direct and Secondary Costs Associated with Farm to Mainline Scenario in 2024: (Stated in 2004 Dollars) | |
|---|---------------------|
| Variable Trucking Cost | \$7,535,229 |
| Handling Cost | \$0 |
| Highway Improvement Costs | \$10,034,828 |
| Secondary Impact of Production Cost Increase | \$3,087,124 |
| Total Cost | \$20,657,181 |
| Special Fuel Tax Receipts | \$375,366 |
| Net Impact | \$20,281,815 |



ND Rail Investment Programs

- Local Freight Rail Assistance
- Reduced Interest Loans
- Freight Rail Improvement Program

Rail Recommendations

- NDDOT should continue its rail assistance programs.
- Focus on increasing axle loads, travel speed, and efficiency make the state more attractive to businesses.
- Additional funds are needed for rail assistance programs.

Air Services Analysis

| Aviation-Related Expenditures and Employment in North Dakota: 2004 | | | | | | |
|---|--|------------------|--------------------|------------------------|----------------|---------------|
| | 2004 Expenditures (Thousand \$) | | | 2004 Employment | | |
| | Direct | Induced | Total | Direct | Induced | Total |
| Commercial Tenants | | | | | | |
| Commercial Tenants | \$106,092 | \$159,138 | \$265,230 | 2,622 | 2,622 | 5,244 |
| GA Tenants | \$66,910 | \$100,365 | \$167,275 | 1,859 | 1,859 | 3,718 |
| Services | \$216,778 | \$325,168 | \$541,942 | 1,145 | 1,145 | 2,290 |
| Visitor Expenditures | \$193,430 | \$290,145 | \$438,575 | | | |
| Total Impacts | \$403,209 | \$604,813 | \$1,008,023 | 5,626 | 5,626 | 11,252 |



Air Service Trends

- Growth of Air Cargo
- Growth of Commercial Carriers and Regional Jets
- Growth in Use of General Aviation Airports

Current and Future Airport Needs

- Large commercial airports are situated to participate in growth of air cargo and regional jet services
- Local airports near energy and processing facilities are situated to provide business accessibility.
(Hazen, Washburn, potential ethanol sites)
- Physical constraints hinder airport expansion.
(Bowman)
- Many small airports would like automated weather services, but do not meet minimum criteria.
- Improvements to GA terminals are needed to enhance business access.



Air Service Recommendations

- Infrastructure and capacity constraints that limit growth and expansion to accommodate increased demand.
- Encroachment of incompatible land development with concerns over aircraft noise and safety.
- Funding will be a greater problem in the future as limited local, state and federal dollars are dedicated to other priorities.