Economic Benefits of the Michigan Department of Transportation's FY 2010-2014 Highway Program

FINAL

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1 Introduction

The Five-Year Transportation Program is an integrated program that includes highways, bridges, public transit, rail, aviation, marine, and nonmotorized transportation. The objective of this study was to assess the economic benefits of the highway and bridge component of the Michigan Department of Transportation (MDOT) FY 2010-2014 Five-Year Transportation Program.

The purpose of this document is to summarize key findings regarding the economic impact of the highway and bridge program based on investment levels presented in the MDOT FY 2010-2014 Five-Year Transportation Program.

The highway portion is a rolling program; each year, a new fifth year is added and program/project adjustments are made to other years. This report will present the results of the economic impacts of the two program investment strategies presented in the FY 2010-2014 Five-Year Transportation Program. These strategies are the fully funded (match all federal-aid) program and the reduced highway program. The funding strategies were developed based on the reality that there will be insufficient state revenues available to match all of the estimated available federal funds beginning in 2011. Revenue to fund either of these strategies is supplied by gas tax and registration receipts, both of which are declining. The match all federal-aid program scenario, investment would average $1,310 million annually, while the reduced program would average $831 million. A reduced Highway Program investment strategy cutting approximately $600 million annually beginning in FY 2011 will be implemented if federal funding continues to go unmatched.[1]

Included in our assessment is the estimation of the transportation-related benefits of the program, such as travel-time savings by households and business due to the improvements of the trunkline system. The State of Michigan, as well as its individual industry sectors, benefit from MDOT's investment in transportation infrastructure. Measurement of the transportation economic benefits, or lack of benefits, can be compiled by comparing the benefits of transportation investments to fewer or no transportation investments.

Previous analysis has been provided by the University of Michigan's Institute of Labor and Industrial Relations and the Economic Development Research Group to assess the economic benefits of the highway and bridge components of MDOT's Five-Year Transportation Program. The aggregate economic impacts were measured in terms of various labor market indicators such as changes in employment, labor force, unemployment, and Gross State Product (GSP). The industry sector impacts are measured in terms of jobs. The economic effects of the program also included estimates

[1] Based on Highway and Bridge Program investment level snapshot, *Michigan Department of Transportation 2010-2014 Five-Year Transportation Program, Volume XII*, Final Draft, Michigan Department of Transportation, January 2010.

of its spin-off benefits, as generated by the Regional Economic Models, Inc. (REMI) model of the Michigan economy.[2]

For this analysis MDOT staff utilized the Michigan Benefit Estimation System for Transportation (MI BEST Tool) and MDOT's Statewide Travel Demand Model. The MI BEST Tool facilitates the analysis of the potential effects of transportation related investments on Michigan's economy. The MI BEST Tool was developed for MDOT and calculates the inputs for the REMI model for simulating the total economic impacts for the investment. The REMI Model used is REMI Policy Insight 9.5, Michigan model version 2.1.5b (herein referred to as "REMI Model").[3]

The following sections summarize the inputs into the economic model, including cost savings and transportation investments; the modeling methodology; and the results of processing the inputs through the economic model. This is the first such economic impact study utilizing MDOT's MI BEST Tool.

2 Methodology

Generally accepted methods for estimating travel efficiency gains and the resulting economic impacts of transportation projects are the basis for this impact analysis. To estimate travel efficiencies, the transportation data reported from the travel demand model serves as inputs into the economic model developed by REMI. Specifically, the travel demand model examines the transportation network, including planned improvements. Moreover, this economic impact analysis hinges on the impact of travel efficiency gains from perspective of highway users. Thus, the impact of capital projects are evaluated based on the change in vehicle hours traveled (VHT) and the vehicle miles traveled (VMT).

The MDOT Statewide Travel Demand Model (TDM) is run using the road network for the no-build and build (improved) network for the specific program years. The TDM accounts for changes in study area traffic patterns in response to the routing and distribution of trips in relation to the improved flow of the system resulting from the transportation project. Consequently, the overall changes in travel-time (VHT) and distance (VMT) reflect not only the effects of traffic benefiting from the improvements, but also the new traffic routing patterns of trips in the region. Economic impacts are then estimated by converting user benefits, such as travel time savings and vehicle operating costs (travel efficiencies) using the MI BEST Tool, into changes in economic variables, such as changes in transportation/production costs and consumer spending, which serve as inputs to the REMI model.

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[2] *Economic Benefits of the Michigan Department of Transportation's 2009-2013 Highway Program,* Final Report, Economic Development Research Group, Inc., and Institute for research on Labor, Employment, and the Economy - University of Michigan, January 2009.

[3] The Benefits Estimation System for Transportation (MI BEST Tool) was developed under contract with Wilbur Smith Associates. Appendix A provides a description of the tool and how the results compare to previous analysis conducted for the department by the University of Michigan and Economic Development Research Group, Inc.

The process starts by deriving the viable projects over the program's lifespan from a master merged file that contains data from MDOT's Sufficiency database, Administrative Customizable Reporting System (ACRS) and Statewide TDM. The resulting merged file is then manipulated to combine, delete and refine all of the remaining transportation projects that are relevant to each program year.

For each build/no-build scenario and year of the Highway Program, travel-time savings are calculated on a daily basis that is later expanded to an annual figure. Using TransCAD, a transportation network is created using the appropriate build and no-build designations for specific years. Then the appropriate travel times feed into a VMT-VHT calculator within the TransCAD program. Once these calculations are finished, the resulting VMT-VHT values for each trip purpose savings (for both the build and no-build scenarios) can be directly input into unique spreadsheet templates that are read by the MI BEST Tool.

The MI BEST Tool takes the VMT and VHT information, along with defined investment and funding costs, as inputs. The MI BEST Tool calculations include (1) conversion of impact of investment on traffic data to direct user benefits and translation of those impacts into REMI policy variables, (2) estimation of investment cost by category of spending and translation of those costs into REMI policy variables, and (3) estimation of investment funding by new revenue source and translation of those revenue sources into REMI policy variables if required.

The REMI model is run following the calculation step of the MI BEST Tool. The application passes the policy variable adjustments and investment levels into the REMI model. Construction, operations, and maintenance-related expenditures are entered into the MI BEST Tool as direct impacts which, with the underlying REMI model, compute the total state and regional economic impacts. This process is straightforward as expenditures on capital projects are entered as construction spending and non-construction related expenditures are entered into REMI as an increase in government spending. It is the REMI model that makes the calculation and assessment with regard to economic impact data, user benefits data, or more detailed sector employment benefit data.

In short, this process ultimately compares the output data of the MI BEST Tool as it reflects the results of a match all federal-aid Highway Program versus a reduced Highway Program by estimating the economic impacts associated with investment in various transportation programs over the defined years of the program.

2.1 Revenue Assumptions and Investment Levels

The Five-Year Transportation Program document identifies two Highway Program investment strategies. The first assumes that MDOT can match all federal revenues available, the full program. The second reflects a reduced Highway Program investment assuming insufficient state revenues, the reduced program. Annual investment levels for the match all federal-aid program are denoted in Figure 1F, and for the reduced funded program in Figure 1R.

Figure 1F

Match All Federal-Aid
MDOT Five-Year Highway Program[4]
FY 2010-2014 Investment Levels

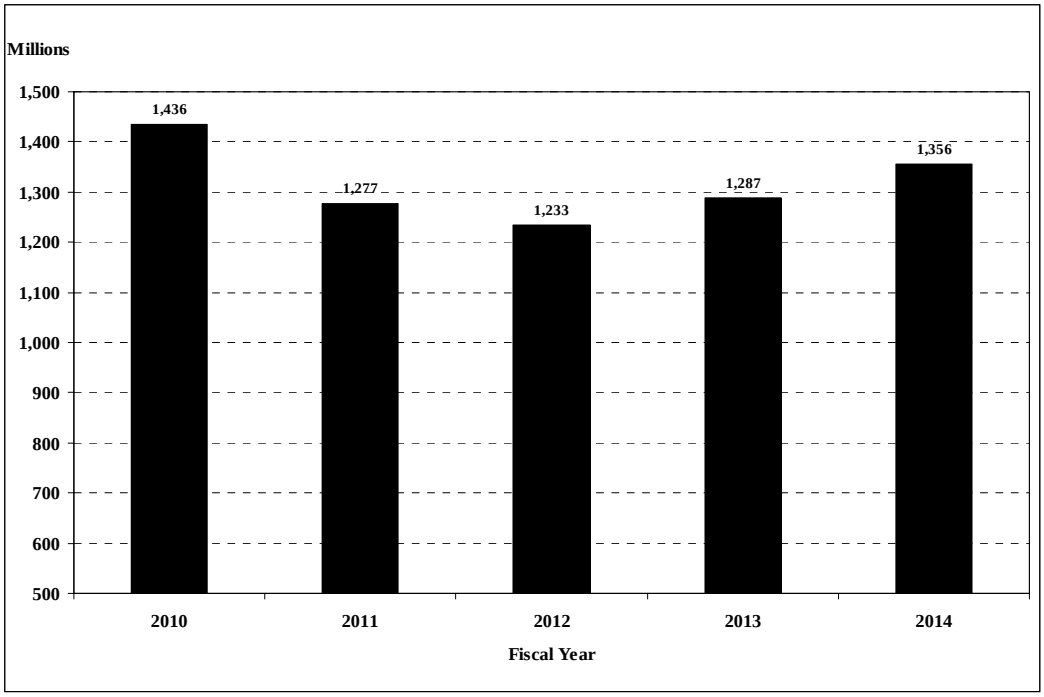
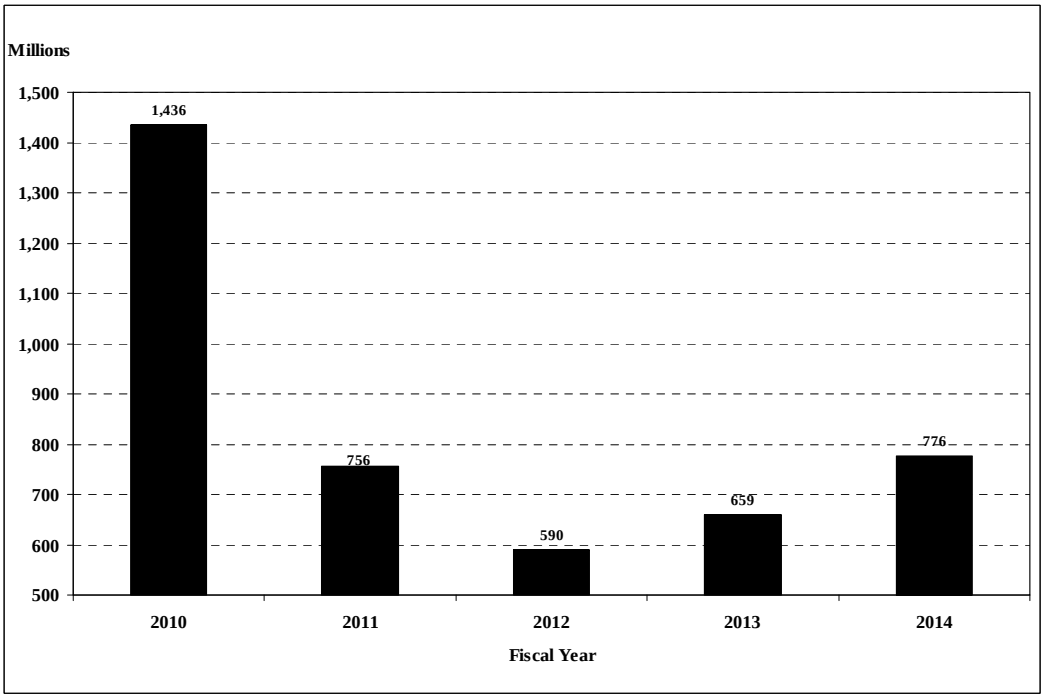


Figure 1R

Reduced Program
MDOT Five-Year Highway Program[5]
FY 2010-2014 Investment Levels



[4] MDOT Highway Capital Program investment includes routine maintenance and Blue Water Bridge
[5] Ibid.

The FY 2010-2014 federal-aid revenue estimate is based on the 2009 FHWA Notice of Apportionment assuming a 92 percent obligation ceiling. The 2009 level of funding is assumed to remain flat for two years (2010-2011) and then increase at an annual average compounded rate of 3.2 percent in 2012-2014. It is projected that $4.1 billion in federal-aid obligation authority (includes $148 million from the American Recovery and Reinvestment Act of 2009) will be made available to the Highway Capital Program for this Five-Year Transportation Program.[6]

The state revenue estimate is based on MDOT's share of the FY 2009 Michigan Transportation Fund as estimated by the Department of Treasury, Economic and Revenue Forecasting Division. Future year state revenue is forecasted using a long-range forecasting model managed by MDOT's Statewide Transportation Planning Division. It is estimated that $1.77 billion in state revenue will be available for MDOT's Capital and Maintenance Program (approximately a 1-percent increase each year). Starting in FY 2011, this estimate includes state transportation revenues from the State Trunkline Fund, and includes bond proceeds to be used to support the program, including routine maintenance and debt service payments.[7]

Additional detail is available for both the match all federal-aid and reduced programs in Table 1F and Table 1R, which denote both annual average and five-year total investment of each scenario distributed among major program categories in the MI BEST Tool. The annual average investment for the match all federal-aid program for FY 2010-2014 is $1.318 billion, which totaled $6.59 billion for the five-year period. As a comparison, investment levels of the reduced programs are only 64 percent of the match all federal-aid programs. The annual average investment for the reduced program for FY 2010-2014 is $843 million, which totals $4.22 billion of this five year period.

Annual detail on these investment data pertains to the following funding categories: repair and rebuild of existing roads, capital preventative maintenance, bridges, capacity improvements and new roads, safety programs and routine maintenance. On a percentage basis, the funding categories that would absorb the largest reductions under the reduced program would (in order) be: new road construction, congestion mitigation and air quality, repair and rebuild of existing roads, and intelligent transportation.

[6] *Michigan Department of Transportation 2010-2014 Five-Year Transportation Program, Volume XII*, Final Draft, Michigan Department of Transportation, January 2010.
[7] Ibid.

Table 1F **Match All Federal-Aid**
MDOT Five-Year Highway Program
FY 2010-2014 Investment Levels

MI BEST Tool Investment Category	Annual Average ($ million)	Five-Year Total ($ million)
Highway Expansion	**111**	**555**
New Roads/Capacity	36	180
Capacity Improvement (adding lanes)	75	375
Highway Preservation	**454**	**2,272**
Pavements Resurfacing	187	934
Pavements Reconstruction	175	876
Pavements Preventive Maintenance	92	462
Bridge	**198**	**989**
Rehabilitation and Replacement	135	676
Preventative Maintenance and Special Needs	36	181
Big Bridge (All Needs)	27	133
Highway Modernization	**99**	**497**
Operational Improvement, Safety, and ITS	99	497
Highway Other	**453**	**2,267**
Borders	11	57
Other Highway Capital	442	2,210
Multimodal Operation	**1**	**3**
Carpool/Park Lots - Preservation	1	3
Multimodal Expansion	**1**	**5**
Carpool/Park Lots - Expansion	1	5
Total Annual Average Five-Year Program	**1,318**	**6,589**

Table 1R **Reduced Program**
MDOT Five-Year Highway Program
FY 2010-2014 Investment Levels

MI BEST Tool Investment Category	Annual Average ($ million)	Five-Year Total ($ million)
Highway Expansion	**82**	**408**
New Roads/Capacity	10	52
Capacity Improvement (adding lanes)	71	356
Highway Preservation	**243**	**1,213**
Pavements Resurfacing	98	491
Pavements Reconstruction	92	461
Pavements Preventive Maintenance	52	261
Bridge	**103**	**516**
Rehabilitation and Replacement	67	333
Preventative Maintenance and Special Needs	15	73
Big Bridge (All Needs)	22	110
Highway Modernization	**58**	**289**
Operational Improvement, Safety, and ITS	58	289
Highway Other	**357**	**1,784**
Borders	11	57
Other Highway Capital	346	1,728
Multimodal Operation	**1**	**3**
Carpool/Park Lots - Preservation	1	3
Multimodal Expansion	**0**	**2**
Carpool/Park Lots - Expansion	0	2
Total Annual Average Five-Year Program	**843**	**4,217**

2.2 Travel-Time Savings Related to Program Investments

Economic impact analyses of transportation investment performed for the Five-Year Transportation Program uses outputs from the MDOT statewide TDM. These outputs denote changes in VHT and VMT, and are the necessary inputs in the computations of travel efficiency-based user benefits stemming from transportation improvement projects.

MDOT's model network is coded with different travel times for the build and no-build scenarios (based on where the various projects are built for each year of the program). This comparison is what yields the differences (i.e. user benefits) in the VHT between the scenarios.

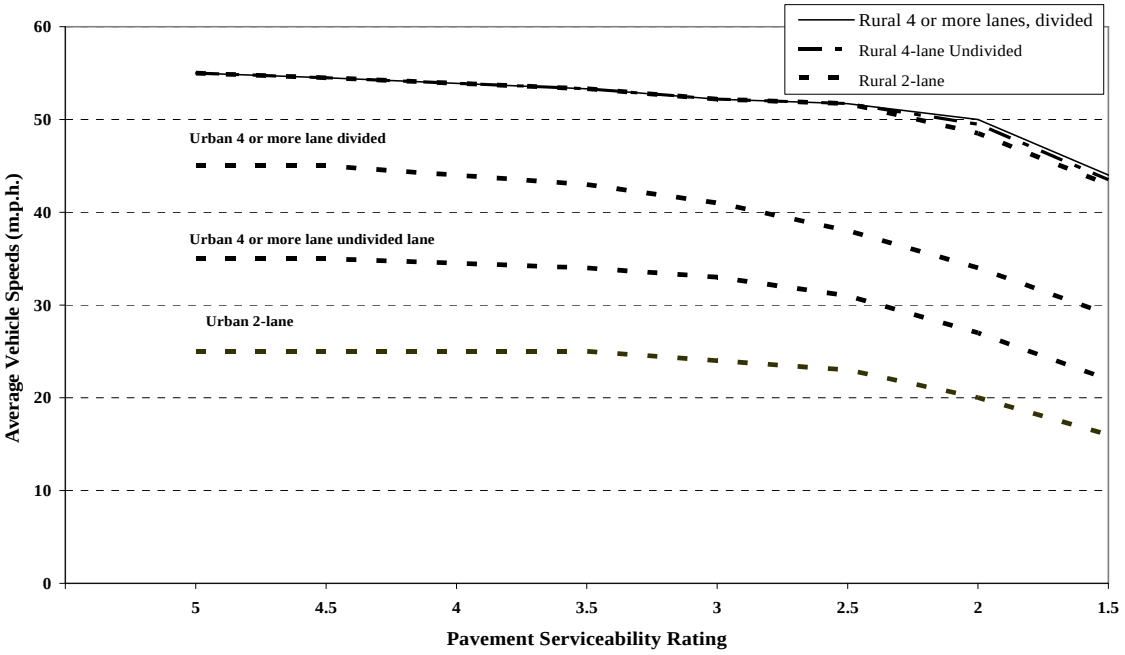
The resulting VHTs and VMTs are categorized (e.g., aggregated and/or proportioned) to correspond with the trip purposes used by the MI BEST Tool, which include commercial as well as passenger trips. Passenger trips include business, work/commuting, and non-work (e.g., social, recreational, shopping, etc.) related trips. Rationale behind the categorized different trip purposes is in the difference in the values of time, which, in turn, are the factors in estimating production cost savings and income changes.

The correlation of pavement condition and vehicle speed is a key assumption used in the assessment of travel-time savings. Limited research has shown that there is a correlation in real traffic performance with ride quality and pavement condition. Past research has generally shown that free-flow speed is reduced as ride quality declines (Zaniewski 1982). Very small speed reductions occur with slight worsening of ride quality, and speed begins to fall off noticeably as ride quality degrades to a "poor" rating. MDOT estimated that speeds on free-access roads fell by 2.5 m.p.h. on pavements with poor ride quality, and 5 m.p.h. on limited-access freeways with poor ride quality.[8]

The relationship between the change in vehicle speed and the change in pavement quality, for specific road types, is seen below in Figure 2. The change in VHT associated with the MDOT program is estimated based on this relationship.

Figure 2

Average Vehicle Speeds
By Road Type and Serviceability Rating



Source: "Life-cycle Analysis for Pavement Management Decision-making Methodology Development"
by Texas Research and Development Foundation September 1985
Adapted from McFarland and Zaniewski

[8] FHWA guidelines for assessing pavement quality are from their published recommendations (U.S. Department of Transportation, Federal Highway Administration 2004)

Calculation of the region-specific traffic compositions for 2008 (Table 2), describes the percentage of annual VMT in a region by passenger and commercial vehicles and applies to both the full and reduced programs. Cumulative annual VHT savings (Table 3) for auto and commercial were calculated from the build/no build VHT files prepared for inputs into the MI BEST Tool from the MDOT Statewide TDM.

Table 2 2008 Annual Vehicle Miles Traveled (AVMT) Composition (Match All Federal-Aid or Reduced Program)

Region	Passenger AVMT	Percent VMT	Commercial AVMT	Percent Commercial VMT
Superior	1,936,615,421	3.98	151,675,415	3.58
North	3,675,588,458	7.55	245,145,654	5.79
Grand	5,699,921,748	11.70	432,147,145	10.20
Bay	6,147,593,772	12.62	440,158,020	10.39
Southwest	5,363,902,425	11.01	882,474,920	20.84
University	8,866,183,507	18.21	1,040,410,900	24.57
Metro	17,009,776,435	34.93	1,042,925,611	24.63
State Total	48,699,581,767	100.00	4,234,937,665	100.00

Table 3 Cumulative Annual Vehicle Hours Traveled Savings, FY 2010–2014

	(Match All Federal-Aid)		(Reduced Program)	
Year	Commercial	Auto	Commercial	Auto
2010	-354,242	-3,194,500	-354,242	-3,194,500
2011	-415,892	-4,067,451	-371,693	-3,696,308
2012	-463,578	-4,951,550	-394,821	-3,910,890
2013	-563,065	-6,044,264	-443,614	-4,233,147
2014	-568,674	-6,811,205	-496,913	-4,680,480

As part of the travel-time savings process, the region-specific traffic compositions for daily vehicle hours-traveled savings expected from improved pavement conditions (full and reduced) were derived. This data is regionalized for each year and denotes a "before and after" reconstruction VHT value respective to either scenario (Tables 3F and 3R). The before values are subtracted from the after reconstruction values to arrive at the total expected regional vehicle travel-time savings.

These changes (which are annual increments, not cumulative) are shown in Table 4F for the full program and Table 4R for the reduced program, and are contrasted against each region's VHT estimates under the existing roads conditions (and the implied future deterioration). The daily VHT savings expected from improved pavement conditions under the reduced program are considerably less than the savings anticipated from the full program.

Table 4F

Match All Federal-Aid
Daily Vehicle Hours Traveled Savings Expected from Improved Pavements from Projects Within FY 2010-2014

REGION	YEAR	Daily VHT (Representative of conditions following pavement reconstruction) FY 2010-2014 Project Segments Only	Daily VHT (Representative of existing conditions) FY 2010-2014 Project Segments Only	Expected Daily VHT Savings as a Result of Improved Pavement Conditions FY 2010-2014 Project Segments Only
Bay	2010	43,545.24	45,743.20	2,197.96
Bay	2011	4,038.71	4,323.53	284.82
Bay	2012	4,496.31	4,771.25	274.94
Bay	2013	4,845.39	5,040.46	195.07
Bay	2014	4,023.92	4,310.01	286.10
		Bay Region FY 2010-2014 Cumulative Savings		**3,238.88**
Grand	2010	13,126.58	13,699.55	572.97
Grand	2011	3,601.22	3,745.44	144.22
Grand	2012	2,957.89	3,139.33	181.44
Grand	2013	6,439.62	6,698.65	259.03
Grand	2014	5,121.73	5,499.14	377.42
		Grand Region FY 2010-2014 Cumulative Savings		**1,535.07**
Metro	2010	47,078.84	49,615.19	2,536.35
Metro	2011	17,680.51	18,825.40	1,144.89
Metro	2012	13,878.05	14,781.22	903.17
Metro	2013	26,226.59	27,914.18	1,687.59
Metro	2014	16,846.76	17,968.08	1,121.32
		Metro Region FY 2010-2014 Cumulative Savings		**7,393.32**
North	2010	9,974.70	10,386.52	411.82
North	2011	4,179.45	4,320.44	140.98
North	2012	2,987.57	3,166.25	178.68
North	2013	3,211.61	3,362.28	150.67
North	2014	4,153.02	4,313.36	160.33
		North Region FY2010-2014 Cumulative Savings		**1,042.49**
Southwest	2010	16,844.67	17,742.03	897.36
Southwest	2011	6,994.51	7,308.78	314.27
Southwest	2012	4,509.19	4,772.08	262.89
Southwest	2013	2,918.60	3,079.80	161.19
Southwest	2014	3,634.85	3,815.20	180.35
		Southwest Region FY 2010-2014 Cumulative Savings		**1,816.05**
Superior	2010	11,351.56	11,736.55	384.99
Superior	2011	3,522.67	3,620.24	97.56
Superior	2012	2,313.91	2,411.43	97.52
Superior	2013	1,932.06	2,008.07	76.01
Superior	2014	1,725.85	1,771.77	45.92
		Superior Region FY 2010-2014 Cumulative Savings		**702.00**
University	2010	39,217.91	41,986.32	2,768.41
University	2011	10,588.34	11,166.80	578.46
University	2012	8,229.00	8,801.84	572.85
University	2013	6,733.82	7,185.21	451.39
University	2014	6,544.37	6,789.53	245.16
		University Region FY 2010-2014 Cumulative Savings		**4,616.26**
		Total All Region Savings		**20,344.08**

Table 4R

Reduced Program
Daily Vehicle Hours Traveled Savings Expected from Improved Pavements from Projects Within FY 2010-2014

REGION	YEAR	Daily VHT (Representative of conditions following Pavement Reconstruction) FY 2010 - 2014 Project Segments Only	Daily VHT (Representative of Existing Conditions) FY 2010 - 2014 Project Segments Only	Expected VHT Savings as a result of Improved Pavement Conditions FY 2010 - 2014 Project Segments Only
Bay	2010	43,545.24	45,743.20	2,197.97
Bay	2012	3,451.81	3,680.89	229.08
Bay	2014	3,829.57	3,884.62	55.05
		Bay Region 2010 - 2014 Cumulative Savings		**2,482.10**
Grand	2010	13,126.58	13,699.55	572.97
Grand	2011	2,010.74	2,121.30	110.55
Grand	2012	1,240.18	1,293.26	53.08
Grand	2013	981.16	1,047.90	66.74
Grand	2014	1,020.59	1,029.90	9.31
		Grand Region 2010 - 2014 Cumulative Savings		**812.66**
Metro	2010	47,078.84	49,615.19	2,536.35
Metro	2011	13,711.67	14,644.91	933.24
Metro	2012	3,166.02	3,315.30	149.29
Metro	2013	12,883.60	13,629.56	745.97
Metro	2014	11,280.64	11,326.52	45.88
		Metro Region 2010 - 2014 Cumulative Savings		**4,410.73**
North	2010	9,974.70	10,386.52	411.82
North	2011	2,845.59	2,950.15	104.57
North	2012	869.38	906.60	37.22
North	2013	1,489.78	1,526.14	36.35
North	2014	1,199.84	1,203.01	3.17
		North Region 2010 - 2014 Cumulative Savings		**593.13**
Southwest	2010	16,844.67	17,742.03	897.36
Southwest	2011	1,387.53	1,489.20	101.68
Southwest	2012	1,501.49	1,614.88	113.39
Southwest	2013	1,210.78	1,303.74	92.96
Southwest	2014	1,484.31	1,507.12	22.81
		Southwest Region 2010 - 2014 Cumulative Savings		**1,228.20**
Superior	2010	11,351.56	11,736.55	384.99
Superior	2011	725.94	752.43	26.49
Superior	2012	1,488.81	1,559.27	70.46
Superior	2013	811.69	847.08	35.39
Superior	2014	988.07	978.66	9.41
		Superior Region 2010 - 2014 Cumulative Savings		**526.74**
University	2010	39,217.91	41,986.32	2,768.41
University	2011	3,817.67	4,044.06	226.39
University	2012	743.89	758.48	14.60
University	2013	1,992.05	2,109.93	117.88
University	2014	5,016.34	5,073.65	57.31
		University Region 2010 - 2014 Cumulative Savings		**3,184.58**
		Total All Region Savings		**13,238.14**

2.3 Economic/Demographic Model and General Procedures

The following is a discussion on the methodology used by the MI BEST Tool for estimating the economic impacts of different transportation funding programs or projects for the State of Michigan.[9] The methodology described here applies to the impacts of the highway and bridge transportation programs.

The MI BEST Tool allows the analyses of the potential effects of transportation related investments on Michigan's economy. The tool prepares the necessary inputs that are passed to REMI, the underlying economic model. In general, there are three direct benefit categories that arise from transportation investments that can be quantified using the MI BEST Tool. They are:

- Travel Efficiencies: Benefits that accrue to facility users after completion.
- Construction Impacts: Impacts resulting from the expenditures on local labor and materials in constructing the facility.
- Operations and Maintenance (O&M) Impacts: Impacts resulting from the expenditures on local labor and supplies to operate and maintain the facility upon completion.

Construction and O&M-related expenditures are entered into the MI BEST Tool as direct impacts which, with the underlying REMI model, compute the total state or regional economic impacts. This process is straightforward as expenditures on capital projects are entered as construction spending and non-construction related expenditures are entered into REMI as an increase in government spending.

Estimation of economic impacts arising from travel efficiency gains requires converting output from a travel demand model, VHT and VMT for the Build/No-Build model runs, into economic variables. The travel efficiency gains arising from transportation investments included in the MI BEST Tool are:

- Travel-time savings: Transportation improvements generally improve the flow of vehicular traffic by shortening travel times and distances for system users in different ways. Travel-time savings may result in lower cost of business operations for industries transporting commodities and for business travelers, as well as in changes to personal income and quality of life for other travelers.
- Accident-cost savings: Transportation improvements may lead to reductions in accidents. Accident savings include reductions in productivity losses, property damages, and insurance costs, which, in turn, result in business cost savings, changes in income, and quality of life.
- Vehicle-operating cost savings (fuel and non-fuel): As transportation improvements reduce travel distance and time, fuel and non-fuel-related expenditures are reduced, which are monetized and represented as reductions in the cost of doing business and changes in consumption patterns.

[9] *Methodologies of Evaluating Economic Impacts*, Wilbur Smith Associates, Prepared for the Michigan Department of Transportation, March 2009.

- Emission-cost savings: Transportation improvements also can result in improvements to the air quality on an impacted area. Impacts from reduced pollution also are entered into the economic model to examine the effects on the regional economy.

Travel-efficiency impacts of transportation programs or projects are entered as inputs into REMI as direct impacts. Moreover, indirect and induced impacts can arise from the direct impacts in the model. *Indirect* impacts are the changes in inter-industry purchases of intermediate goods, as economic agents respond to changes in the output of industries attributable to changes that may result from a transportation project. *Induced* impacts represent the broader implications of a proposed change on households' income and spending patterns. These effects reflect the purchasing decisions made by the employees of industries that are both directly and indirectly affected by changes in the local economy. Indirect and induced economic impacts resulting from the direct impacts are generally referred to as multiplier effects. A summation of the direct, indirect, and induced impacts is the total impact.

Prior to running the REMI model, the REMI baseline forecasts for key economic variables such as population and employment were calibrated to ensure consistency with MDOT's recognized economic forecasts for the state. The MI BEST Tool currently uses a baseline forecast that has been calibrated by the University of Michigan for all analyses up to the year 2030. For studies extending beyond the 2030 forecast period, the REMI baseline forecast is used.[10]

The MI BEST Tool steps for analyzing MDOT's Five-Year Transportation Program include:

Step 1: Conversion of impact of investment on traffic data to direct user benefits and translation of those impacts into REMI policy variables.

Step 2: Estimation of investment cost by category of spending and translation of those costs into REMI policy variables.

Step 3: Estimation of investment funding by new revenue source(s) and translation of those revenue source(s) into REMI policy variables if required.

Once these steps are completed, the MI BEST Tool passes the information to the REMI model. The REMI output file(s) is/are generated and passed back to the MI BEST Tool.

[10] Adjusting the New Eighty-Four-Region, Seventy-Sector REMI Model to Reflect the MDOT Long-Run Forecast, George A. Fulton and Donald R. Grimes, Institute for Research on Labor, Employment, and the Economy, University of Michigan, Prepared for Bureau of Transportation Planning, Michigan Department of Transportation, October 2008.

3 Results - Economic Impacts on Michigan from MDOT's Highway and Bridge Program

The results of the economic analysis using the MI BEST Tool indicated that MDOT's Five-Year Highway & Bridge Program FY 2010-2014 contributes significantly to the Michigan economy. In all, over the course of the five-year period, planned investments are estimated to generate:

Estimated Full Program

- An average of 15,500 job-years annually.[11]
- $5.3 billion in personal income.
- $5.1 billion in GSP.
- $32.5 million (2010) to $69.3 million in travel-time savings to households.
- $29.5 million (2010) to $51.8 million (2014) Michigan business savings.

Estimated Reduced Program

- An average of 10,200 job-years annually,[12]
- $3.5 billion in personal income.
- $3.4 billion in GSP.
- $32.5 million (2010) to $47.6 million in travel-time savings to households.
- $29.5 million (2010) to $41.9 million (2014) Michigan business savings.

Business savings are calculated based on their share of the savings associated with employees' commute times, and the full amount of being on-the-clock (that is, non-home-based work-related trips). Under the full program, these are worth between $8.5 million (2010) and $18.1 million (2014) per year. The equivalent savings under the reduced program would be $8.5 million (2010) and $12.4 million (2014) per year.

In addition, Michigan businesses experience savings related to their commercial VHT savings. The standard used here is $59.40 per hour in driver wages, freight logistics cost, and vehicle operating costs. Under the full program, these savings would be between $21.0 million (2010) and $33.7 million (2014) per year. Under the reduced program, the equivalent savings would be between $21.0 million (2010) and $29.5 million (2014) per year.

In order to accurately assess the economic impacts of these investments, the annual expenditures are adjusted for inflation to reflect their value in real (constant dollar) terms. For the purposes of the impact analysis, the investment totals for each expenditure item in each year were converted (discounted) to 2010 dollars using a 3.0 percent discount rate. The MI BEST Tool calculates the spending and travel-time savings adjustments on the policy variables which are then passed over to the REMI model. REMI estimates both the direct economic effects of the initial expenditures (in terms of jobs and income) and

[11] Note that employment impacts are expressed in "job-years." One job-year is equal to one full-time job lasting one year. Thus, the job-year total shown for each year represents the total jobs either directly or indirectly generated by the Five-Year Transportation Program in that year.

[12] Ibid.

the indirect (or multiplier) effects (in additional jobs and income) of the subsequent economic activity that occurs following the initial expenditures. The output from REMI is then returned to the MI BEST Tool for reporting. For purposes of this analysis, the economic impacts are calculated to year of the expenditures.

The current highway and bridge program is forecast to support 17,500 jobs in Michigan in 2010. The effect of employment is impacted by reduced spending levels as a result of a decline in revenue beginning in FY 2011. However, it is important to note that job gains are not cumulative. That is, the number of jobs indicated for any given year represents the total number of jobs directly or indirectly generated by the given expenditures in that year and existing for the duration of that year.

Figures 3F and 3R and tables 5F and 5R on the following pages show the employment impact of the FY 2010-2014 highway and bridge program for the State of Michigan. The match all federal-aid program impacts include a reduction in the number of unemployed by 13,409 in 2010 compared to the no-build case. Under the reduced program, the number of unemployed decreases by only 2,522 in 2014 compared to 5,342 for the match all federal-aid program in the same year.[13]

[13] Source: REMI model: includes amenity effect, household time savings valued at $10.17 (approximately one-half the hourly wage rate). Changes compared with baseline forecasts.

Figure 3F

Match All Federal-Aid
Effect on Employment of MDOT's Five-Year Highway & Bridge Program
FY 2010-2014

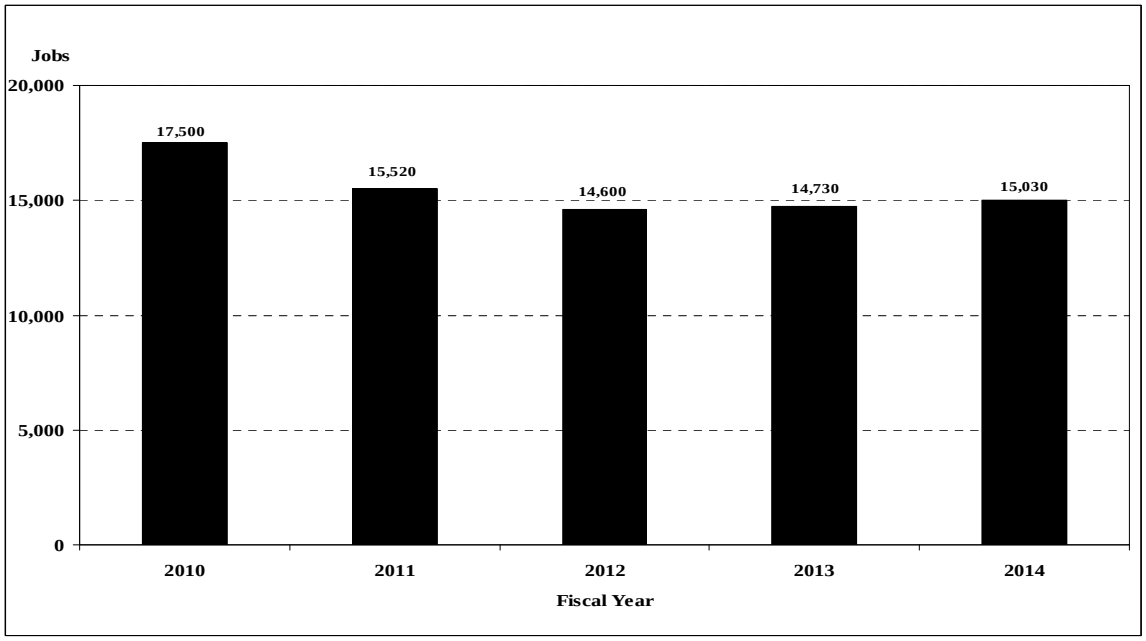


Figure 3R

Reduced Program
Effect on Employment of MDOT's Five-Year Highway & Bridge Program
FY 2010-2014

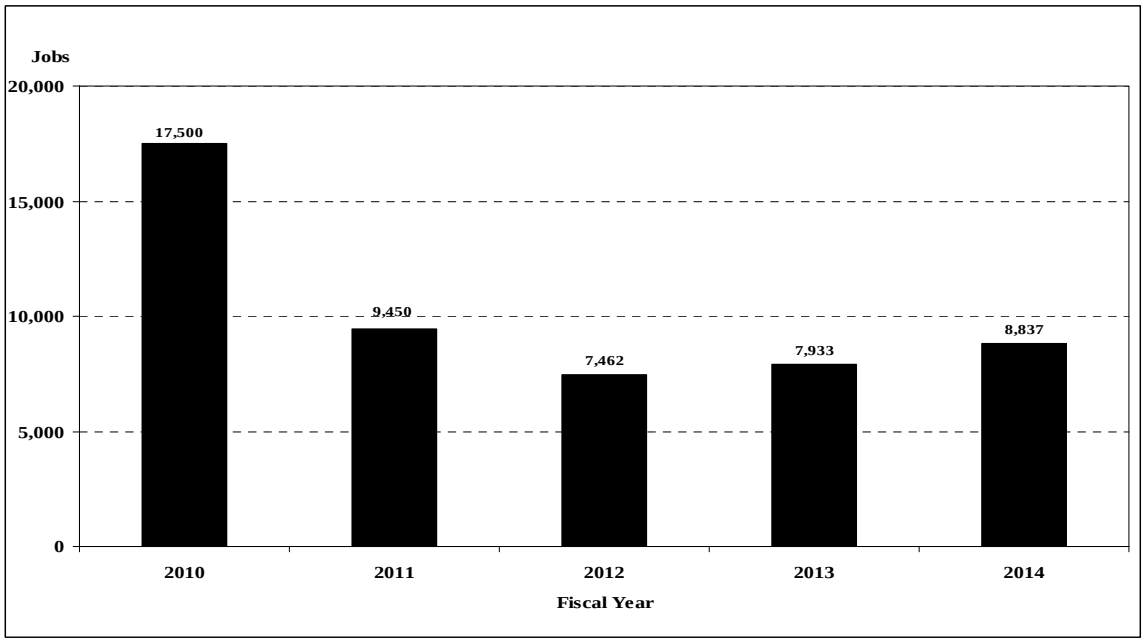


Table 5F Match All Federal-Aid Economic Benefits of MDOT's Five-Year Highway & Bridge Program FY 2010-2014[14]

	2010	2011	2012	2013	2014	Total 2010-14
Total Employment	17,500	15,520	14,600	14,730	15,030	–
Population	4,253	7,204	9,567	11,670	13,530	–
Reduction in out-migration	4,206	2,827	2,182	1,871	1,596	–
Reduction in number of unemployed	13,409	9,286	6,952	5,952	5,342	–
Labor force	4,091	6,234	7,648	8,778	9,688	–
Value of shipments ($ millions - 2010 $)	1,819	1,617	1,552	1,597	1,634	8,219
Gross State Product ($ millions - 2010$)	1,105	1,007	975	1,009	1,051	5,148
Personal income ($ million - 2010$)	1,008	1,004	1,032	1,106	1,181	5,331
Labor $ proprietors' income ($ millions)	1,004	958	951	994	1,040	4,946
Less: Social insurance taxes ($ millions)	101	98	98	104	109	510
Plus: Non-labor income ($ millions)	-90	-50	-20	2	22	-136
Equals: Total personal income ($ millions)	813	810	832	892	953	4,300

Table 5R Reduced Program Economic Benefits of MDOT's Five-Year Highway & Bridge Program FY 2010-2014[15]

	2010	2011	2012	2013	2014	Total 2010-14
Total Employment	17,500	9,450	7,462	7,933	8,837	–
Population	4,253	5,973	7,117	8,242	9,411	–
Reduction in outmigration	4,206	1,609	1,004	962.2	985.4	–
Reduction in number of unemployed	13,409	4,503	2,155	2,175	2,522	–
Labor force	4,091	4,947	5,307	5,758	6,315	–
Value of shipments ($ millions - 2010 $)	1,819	997	793	860	983	5,452
Gross State Product ($ millions - 2010$)	1,105	622	509	553	628	3,416
Personal income ($ million - 2010$)	1,008	647	565	620	708	3,548
Labor $ proprietors' income ($ millions)	1,004	599	495	534	605	3,236
Less: Social insurance taxes ($ millions)	101	61	52	56	64	333
Plus: Non-labor income ($ millions)	-90	-16	13	22	30	-41
Equals: Total personal income ($ millions)	813	522	456	500	571	2,861

[14] Employment represents the total number of private and public sector jobs, including the self-employed. Population includes all residents, civilian and military. Labor force consists of the employed and unemployed, where the unemployed are actively seeking work. Gross State Product is a state measure comparable to Gross Domestic Product for the nation. Personal income is the income of Michigan residents from all sources, after deduction of contributions to social insurance programs but before deductions of income tax and other personal taxes.

[15] Ibid.

The employment benefits by major industry division are shown in Tables 6F and 6R. Construction has the largest gains, which includes the direct employment of highway construction workers, and in professional services, reflecting the employment of engineers and other professional workers.

Table 6F Match All Federal-Aid
Employment Benefits of MDOT's Five-Year Program by Industry
FY 2010-2014

Industry	2010	2011	2012	2013	2014
Total Employment	17,500	15,520	14,600	14,730	15,030
Private Sector	15,980	13,850	13,010	13,110	13,140
Manufacturing	323	247	200	179	159
Non-manufacturing except out-of-state tourism	15,657	13,603	12,810	12,931	12,981
Construction	9,436	8,061	7,508	7,489	7,424
Retail trade	1,578	1,424	1,387	1,437	1,479
Professional services	596	515	475	472	471
Accommodation and food services	751	657	618	634	634
Other [16]	3,296	2,947	2,823	2,899	2,973
Public Sector	1,522	1,667	1,582	1,621	1,889

Table 6R Reduced Program
Employment Benefits of MDOT's Five-Year Program by Industry
FY 2010-2014

Industry	2010	2011	2012	2013	2014
Total Employment	17,500	9,450	7,462	7,933	8,837
Private Sector	15,980	8,487	6,559	6,978	7,826
Manufacturing	323	145	93	93	104
Non-manufacturing except out-of-state tourism	15,657	8,343	6,466	6,885	7,723
Construction	9,436	4,904	3,664	3,868	4,328
Retail trade	1,578	886	724	786	892
Professional services	596	314	241	254	282
Accommodation and food services	751	401	324	346	386
Other [17]	3,296	1,838	1,513	1,630	1,834
Public Sector	1,522	963.7	903.1	955.5	1,012

[16] The "Other" designation in tables 6F and 6R includes the following industry categories: (1) natural resources and mining; (2) wholesale trade, part of transportation, and utilities: (3) information; (4) financial activities except part of real estate; (5) private education and health services; (6) leisure and hospitality except accommodation and food services and part of arts, entertainment, and recreation; and (7) other services except part of personal services.

[17] Ibid.

The expenditures on highway and bridges not only impact jobs but will generate direct and indirect economic impacts for Michigan in the form of income and GSP. As shown in Figure 4F, the real cumulative impact on GSP from 2010 to 2014 is $5.1 billion for the match all federal-aid scenario. This is substantially lower in the reduced scenario, dropping to $3.4 billion.

Figure 4F **Match All Federal-Aid**
Cumulative Effect on Real Gross State Product
of MDOT's Five-Year Highway & Bridge Program FY 2010-2014

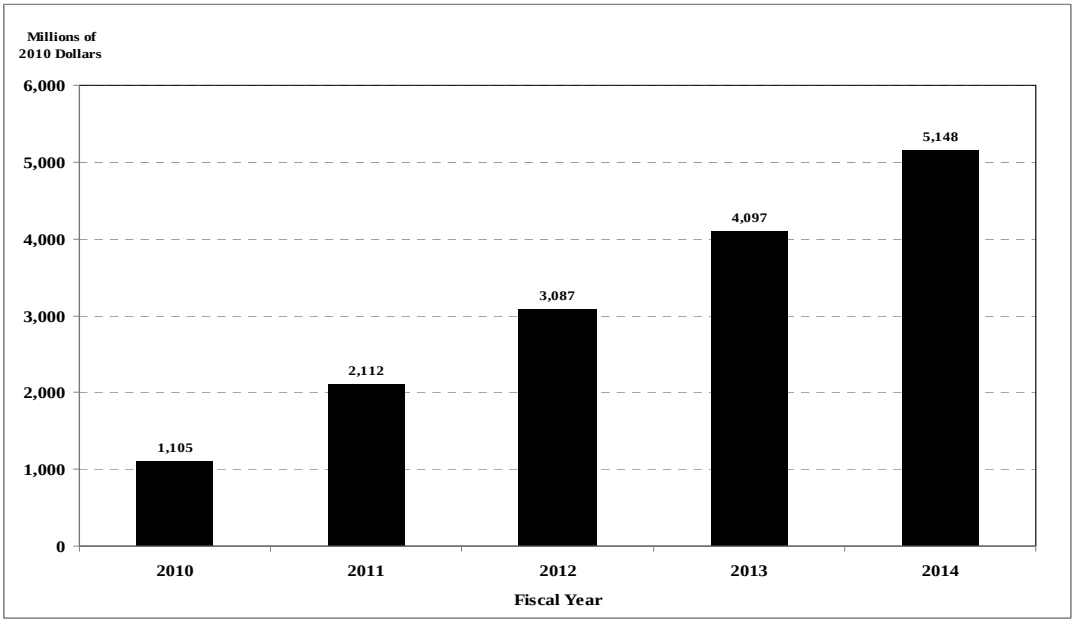
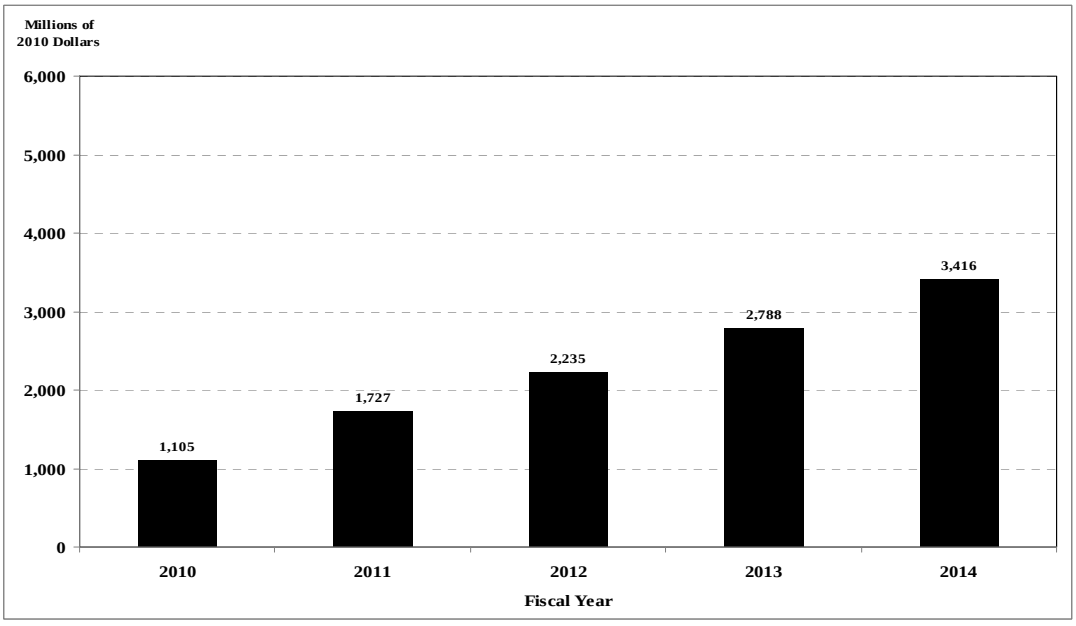


Figure 4R **Reduced Program**
Cumulative Effect on Real Gross State Product
of MDOT's Five-Year Highway & Bridge Program FY 2010-2014



Real personal income also increases for the analysis period, cumulating to $5.3 billion under the match all federal-aid scenario. However, the real income benefits under the reduced funding scenario cumulate to only $3.5 billion. Personal income figures have shown to be the biggest determinant of future consumer demand. If people have more disposable income, they will generally spend more money. A caveat is that although income still rises under the reduced funding scenario, consumer spending may not increase.

Figure 5F **Match All Federal-Aid**
Cumulative Effect on Real Income
of MDOT's Five-Year Highway & Bridge Program FY 2010-2014

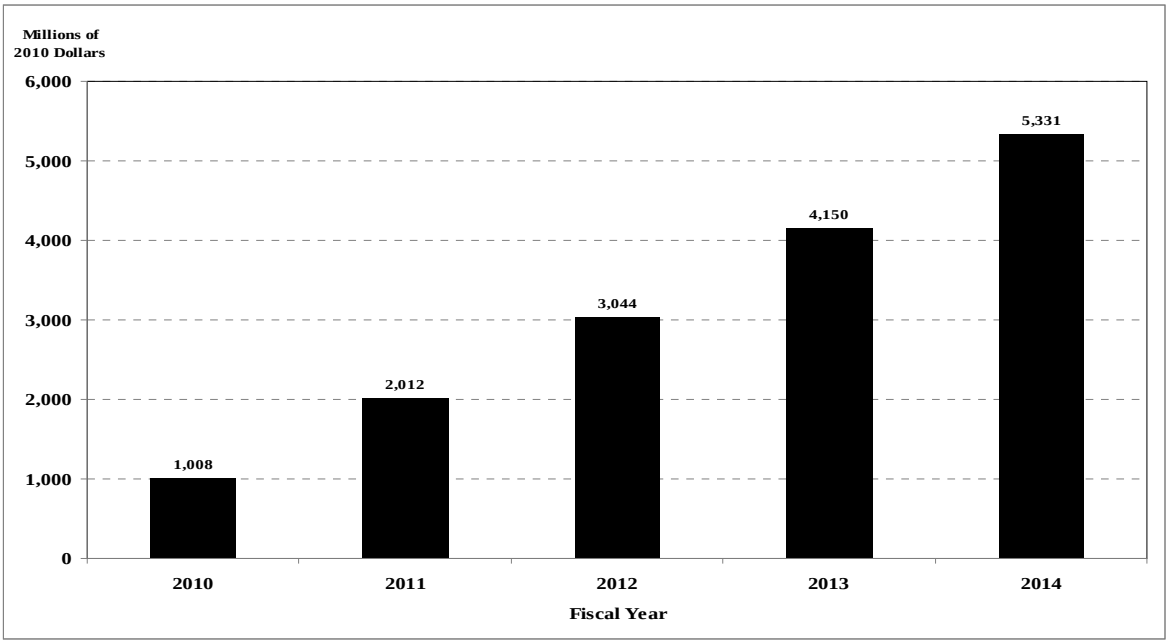
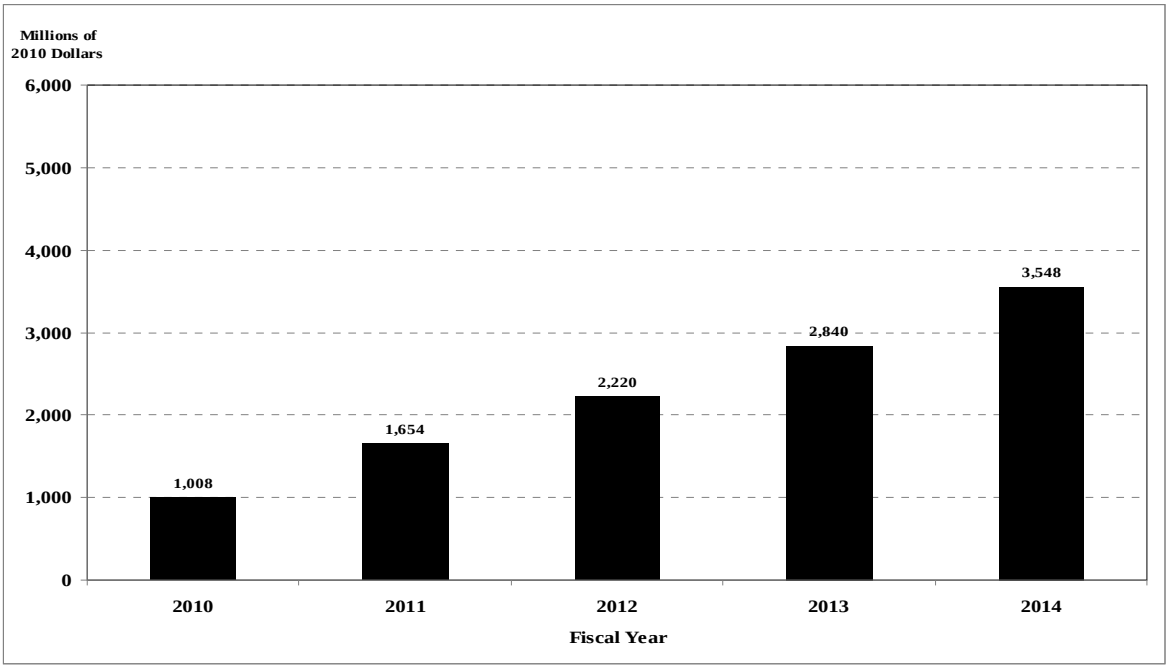


Figure 5R **Reduced Program**
Cumulative Effect on Real Income
of MDOT's Five-Year Highway & Bridge Program FY 2010-2014

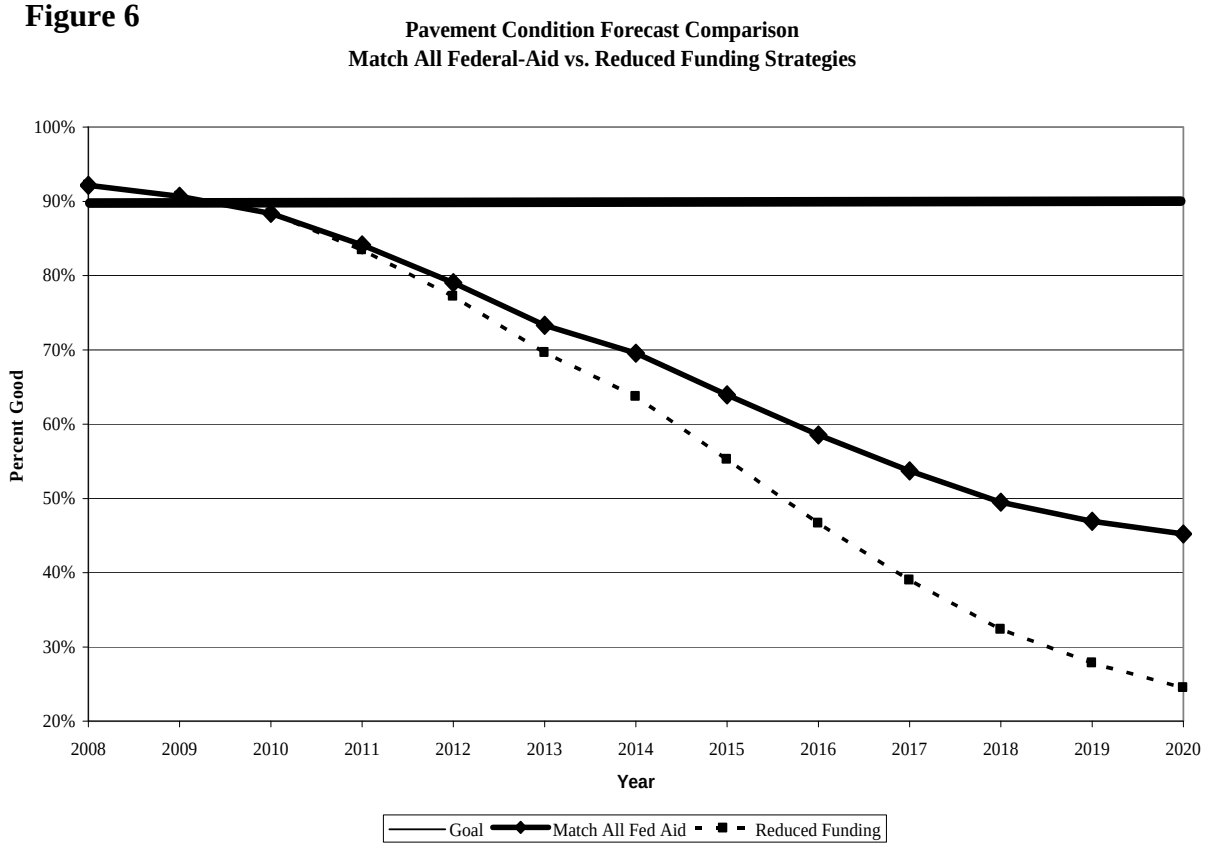


4 Conclusion

MDOT plans to spend $1,436 million in FY 2010 under the full-funding scenario. Expenditure per job in FY 2010 amounts to $82,057. This analysis finds that the expenditure per job actually increases by 2014. The ratio of job creation per dollar of investment continues to decline over time, as the buying power of the dollar is eroded by inflation in both wage levels and costs of materials. The match all federal-aid scenario will see investment declines of 26 percent for rehabilitation and reconstruction for highways and 40 percent for bridge rehabilitation and reconstruction in 2011. This results in decline in overall system condition over the program as shown in Figure 6 negating any travel time savings that might accrue to the state for maintaining pavement condition. The benefits of better roads that cumulate over time are lost.

This is only magnified in the reduced scenario. If implemented, this investment strategy would delay over 375 miles of pavement improvements, or over 100 projects, approximately a 60 percent decrease compared to the current Road Rehabilitation and Reconstruction program. The number of bridges planned for work within the Five-Year Transportation Program would be reduced by approximately 575 bridge projects, a more than 65 percent decrease compared to the current program.[18]

Figure 6



[18] *Michigan Department of Transportation 2010-2014 Five-Year Transportation Program, Volume XII*, Final Draft, Michigan Department of Transportation, January 2010.

The long-term benefit of capital investment in transportation facilities is the improvement in travel conditions which lead to economic cost savings and productivity enhancement for Michigan residents and businesses. Direct-cost savings due to reductions in travel time, enhanced safety and reliability, increased capacity and connectivity enable more jobs and business activity to take place in Michigan.

Appendix A

The Michigan Benefit Estimation System for Transportation (MI BEST Tool) was designed for estimating the economic impacts of different transportation funding programs or projects for the State of Michigan. The MI BEST Tool was developed for the department under contract with Wilbur Smith Associates as part of our long-range plan development, MI Transportation Plan. The methodology of the MI BEST Tool was first employed to assess the economic impacts of various investment packages developed as part of the MI Transportation Plan.[19] MDOT tested the MI BEST Tool on MDOT's FY 2009-2013 Highway Program. The results were compared to the results from the analysis conducted for the department by the University of Michigan and Economic Development Research Group, Inc. No significant differences between the two analysis results were found.

Job Impacts Comparison

	2009	2010	2011	2012	2013	Five-Year Average
MI BEST Tool Job Impacts	22,764	15,375	13,821	14,088	13,798	15,969
U-M Job Impacts	23,121	16,058	14,073	14,811	14,013	16,415
Difference	-357	-683	-252	-723	-215	
Percent of U-M	98.46%	95.75%	98.21%	95.12%	98.47%	97.28%

[19] The *MI Transportation Plan: Moving Michigan Forward* and all associated reports may be found on MDOT's website at: www.michigan.gov/slrp .