Economic Benefits of the Michigan Department of Transportation's FY 2011-2015 Highway Program

Final Report

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1 Executive Summary

The Michigan Department of Transportation (MDOT) has estimated the economic impacts of its FY 2011-2015 Five-Year Transportation Program. This analysis covers its highway and bridge component. For this analysis, MDOT staff utilized the Michigan Benefit Estimation System for Transportation (MI BEST Tool) and MDOT's Statewide Travel Demand Model (TDM).

The results of the economic analysis using the MI BEST Tool indicated that MDOT's FY 2011-2015 Five-Year Highway & Bridge Program contributes significantly to the Michigan economy. Economic impacts include increases in employment, business output, value-added (as measured by gross state product) and personal income. In all, over the course of the five-year period, planned investments are estimated to generate:

Estimated Match All Federal-Aid Program (2011 dollars)

- 16,900 job-years in 2011.
- An average of 16,383 job-years annually for 2012-2015.
- $6.0 billion in real personal income over five-year period.
- $5.9 billion in GSP over five-year period.
- $37.9 million (2011) to $93.1 million (2015) in travel-time savings to households.
- $96.1 million (2011) to $237.3 million (2015) Michigan business savings.

Estimated Current Program (2011 dollars)

- 16,900 job-years in 2011.
- An average of 7,955 job-years annually for 2012-2015.
- $3.6 billion in real personal income over five-year period.
- $3.4 billion in GSP over five-year period.
- $37.9 million (2011) to $76.1 million (2015) in travel-time savings to households.
- $96.1 million (2011) to $125.5 million (2015) Michigan business savings.

2 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 2011-2015 Five-Year Transportation Program.

The highway and bridge portion is a rolling program; each year, a new fifth year is added and program/project adjustments are made to other years. Every reasonable effort has been made to ensure the data analyzed in this study are accurate. Program investment levels and programmed projects are those provided by MDOT's Statewide Systems Management Section, Bureau of Transportation Planning as of February 4, 2011, reflecting two program investment strategies: Current Program and Match All Federal-Aid.

The Current Highway Program presents the anticipated shortfall in state revenues used for matching federal aid funds in the years 2012 - 2015 and the program reductions that would need to take place if funding is not identified. Since that section was written in November 2010, MDOT has continued to look for ways to match all available federal aid and has identified several options allowing us to move forward. They include: 1) A programmatic agreement with the Federal Highway Administration to allow the New International Trade Crossing (NITC) expenditures as the non-federal share of a statewide program of federal projects, and 2) Adjustments to MDOT's budget which would provide funding to be used as federal aid match.

MDOT has been working with the FHWA, the Canadian federal and provincial governments, the City of Detroit, local residents, and the business community to identify solutions that support the regional, state, provincial and national economies while addressing civil and national defense, and homeland security needs of the busiest trade corridor between Canada and the United States. The culmination of those efforts is the recommendation to proceed with the NITC project and its associated connectors to the U.S and Canadian freeway networks.

The Match All Federal Aid Highway Program investment strategy that MDOT plans to move forward in 2012-2015, pending Legislative approval of the NITC and budgetary adjustments is based on the Canadian pledged of $550 million for NITC project components in Michigan. MDOT is able to match federal aid over the Five-Year Program timeframe pending legislative approval of the NITC programmatic agreement and MDOT budgetary adjustments. However, there remains a funding shortfall of approximately $200 million to fully fund anticipated highway program investments.[1]

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 2012. 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 $1,300 million annually, while the Current program would average $831 million. A reduced Highway Program investment strategy, cutting approximately $677 million annually beginning in FY 2012, will be implemented if federal funding continues to go unmatched.[2]

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

[1] For complete discussion on the Match All Federal Aid assumptions see the *Michigan Department of Transportation 2011-2015 Five-Year Transportation Program, Volume XIII*, Final Draft, Michigan Department of Transportation, February 16, 2011.

[2] Based on Highway and Bridge Program investment level snapshot, *Michigan Department of Transportation 2011-2015 Five-Year Transportation Program, Volume XIII*, Final Draft, Michigan Department of Transportation, February 16, 2011.

compiled by comparing the benefits of transportation investments to fewer or no transportation investments.

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 of its spin-off benefits, as generated by the Regional Economic Models, Inc. (REMI) model of the Michigan economy.[3]

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").[4]

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.

3 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

[3] *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.

[4] 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.

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.

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.

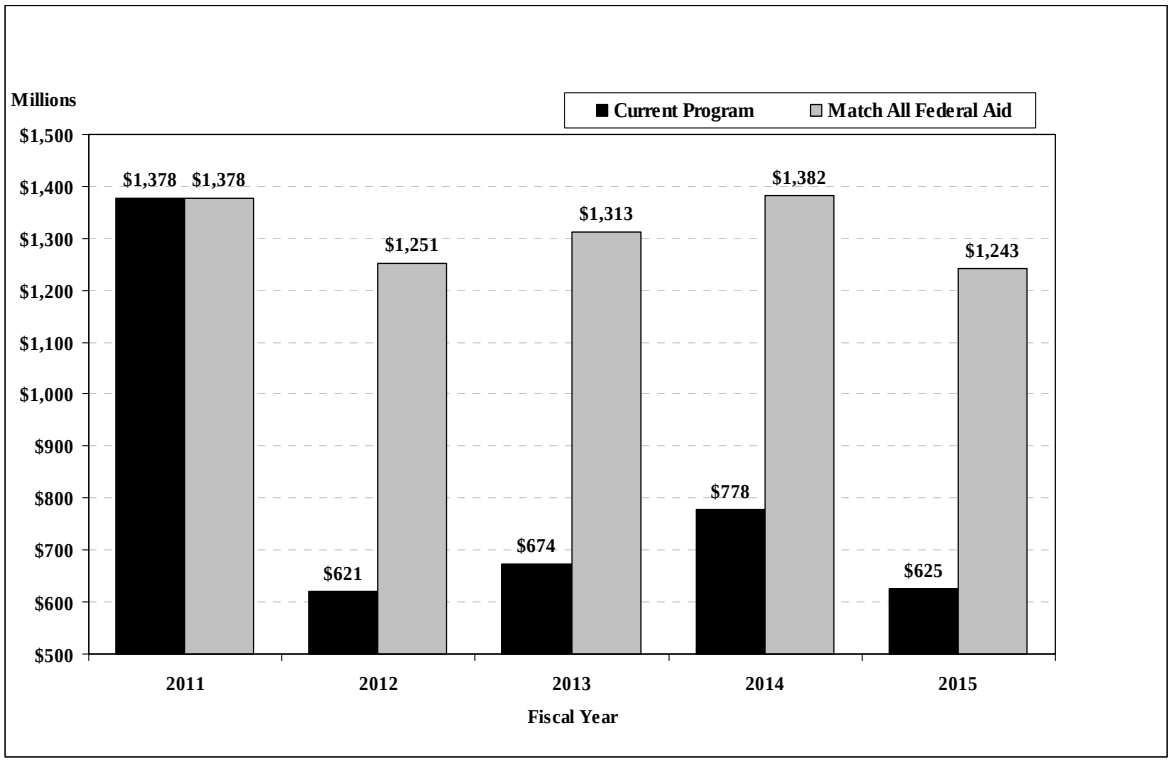
The REMI model is run following the calculation step of the MI BEST Tool. The application passes the policy variable adjustments and investment levels into the REMI model. Construction, operations, and maintenance-related expenditures are entered into the MI BEST Tool as direct impacts which, with the 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.

2.1 Revenue Assumptions and Investment Levels

The Five-Year Transportation Program document identifies two Highway Program investment strategies. The first reflects a reduced Highway Program investment assuming

insufficient state revenues, the Current Program. The second assumes that MDOT can match all federal revenues available, the Match All Federal Aid Program. Annual investment levels for the Current Program and Match All federal Aid programs are shown in Figure 1.

Figure 1 **Current Program and Match All Federal Aid**
MDOT Five-Year Highway Program
FY 2011-2015 Investment Levels



The FY 2011-2015 federal-aid revenue estimate is based on the 2009 Federal Highway Administration estimates of federal funding available for Michigan. The 2009 level of funding is assumed to remain flat for two years (2011-2012) and then increase at an annual average compounded rate of 3.2 percent in 2013-2015. It is projected that $3.7 billion in federal-aid obligation authority will be made available to the Highway Capital Program for this Five-Year Transportation Program.[5]

Total revenue available for the 2011-2015 Capital Highway and Maintenance Program is estimated at $4.1 billion. This level of investment assumes that nearly half of all federal-aid highway funding made available to the department can not be utilized due to insufficient state matching funds.

It is estimated that $2.2 billion in non-federal revenues will be available for MDOT's Capital and Maintenance Program from FY 2011 to FY 2015. This estimate includes state

[5] *Michigan Department of Transportation 2011-2015 Five-Year Transportation Program, Volume XIII,* Final Draft, Michigan Department of Transportation, February 16, 2011.

transportation revenues from the State Trunkline Fund and bond proceeds to be used to support the Blue Water Bridge Plaza Project and routine maintenance activities.

The Match All Federal Aid scenario will allow Michigan to capture $2.2 billion in federal aid not matched in the Current program. An annual average of $1.3 billion (including Blue Water Bridge Plaza, Michigan freeway components associated with the NITC and routine maintenance) will be invested in the Highway Program over the 2011-2015 timeframe.

Anticipated capital and maintenance investments for the Match All Federal Aid strategy for FY 2011-2015 Highway Program are estimated to be $6.4 billion. Approximately $2.7 billion in non-federal revenues are anticipated to be available for MDOT's Capital and Maintenance Program from FY 2011 to FY 2015. This includes state transportation revenues from the State Trunkline Fund (STF), $350 million in Canadian funds for the NITC freeway connections and utility work, and $336 million in bond proceeds to be used to support the Blue Water Bridge Plaza Project.

MDOT is able to advance a fully funded highway program in FY 2011 (as a result of one-time funding shifts within the department's budget) as well as FY 2012 pending legislative approval of the NITC programmatic agreement and additional budget adjustments. There remains a state funding shortfall in FY 2013-2015 to fully fund the highway program after the NITC agreement expenditures are accounted for. The department will continue to monitor revenue and program investments and make adjustments as needed to ensure fiscal constraint.

Additional detail is available for both programs in Table 1 and Table 2, 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 Current and Match All Federal Aid program for FY 2011 is $1.378 billion. As a comparison, investment levels for FY 2012-2015 of the Current program are only 52 percent of the Match All Federal Aid program. The annual average investment for the Current program for FY 2012-2015 is $677 million, and for Match All Federal Aid $1,300 million.

Table 1 **Current Program**
MDOT Five-Year Highway Program
FY 2011-2015 Investment Levels

MI BEST Tool Investment Category	Annual Average ($ million)	Five-Year Total ($ million)
Highway Expansion	**$67.50**	**$404.98**
New Roads/Capacity	$10.98	$65.89
Capacity Improvement (adding lanes)	$56.52	$339.09
Highway Preservation	**$184.38**	**$1,106.28**
Pavements Resurfacing	$70.14	$420.82
Pavements Reconstruction	$70.14	$420.82
Pavements Preventive Maintenance	$44.11	$264.63
Bridge	**$77.73**	**$466.37**
Rehabilitation and Replacement	$47.50	$284.97
Preventative Maintenance and Special Needs	$11.73	$70.40
Big Bridge (All Needs)	$18.50	$111.00
Highway Modernization	**$58.55**	**$351.32**
Operational Improvement, Safety, and ITS	$58.55	$351.32
Highway Other	**$289.81**	**$1,738.83**
Borders	$8.78	$52.67
Other Highway Capital	$281.03	$1,686.16
Multimodal Operation	**$0.55**	**$3.30**
Carpool/Park Lots - Preservation	$0.55	$3.30
Multimodal Expansion	**$0.37**	**$2.20**
Carpool/Park Lots - Expansion	$0.37	$2.20
Total Annual Average Five-Year Program	**$678.88**	**$4,073.28**

Table 2 **Match All Federal Aid Program**
MDOT Five-Year Highway Program
FY 2011-2015 Investment Levels

MI BEST Tool Investment Category	Annual Average ($ million)	Five-Year Total ($ million)
Highway Expansion	**$143.52**	**$861.12**
New Roads/Capacity	$86.12	$516.74
Capacity Improvement (adding lanes)	$57.40	$344.38
Highway Preservation	**$362.14**	**$2,172.86**
Pavements Resurfacing	$141.75	$850.52
Pavements Reconstruction	$141.75	$850.52
Pavements Preventive Maintenance	$78.64	$471.83
Bridge	**$161.44**	**$968.66**
Rehabilitation and Replacement	$107.02	$642.09
Preventative Maintenance and Special Needs	$30.93	$185.57
Big Bridge (All Needs)	$23.50	$141.00
Highway Modernization	**$80.44**	**$482.66**
Operational Improvement, Safety, and ITS	$80.44	$482.66
Highway Other	**$345.35**	**$2,072.08**
Borders	$8.78	$52.67
Other Highway Capital	$336.57	$2,019.41
Multimodal Operation	**$0.75**	**$4.50**
Carpool/Park Lots - Preservation	$0.75	$4.50
Multimodal Expansion	**$0.50**	**$3.00**
Carpool/Park Lots - Expansion	$0.50	$3.00
Total Annual Average Five-Year Program	**$1,094.15**	**$6,564.89**

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 two scenarios.

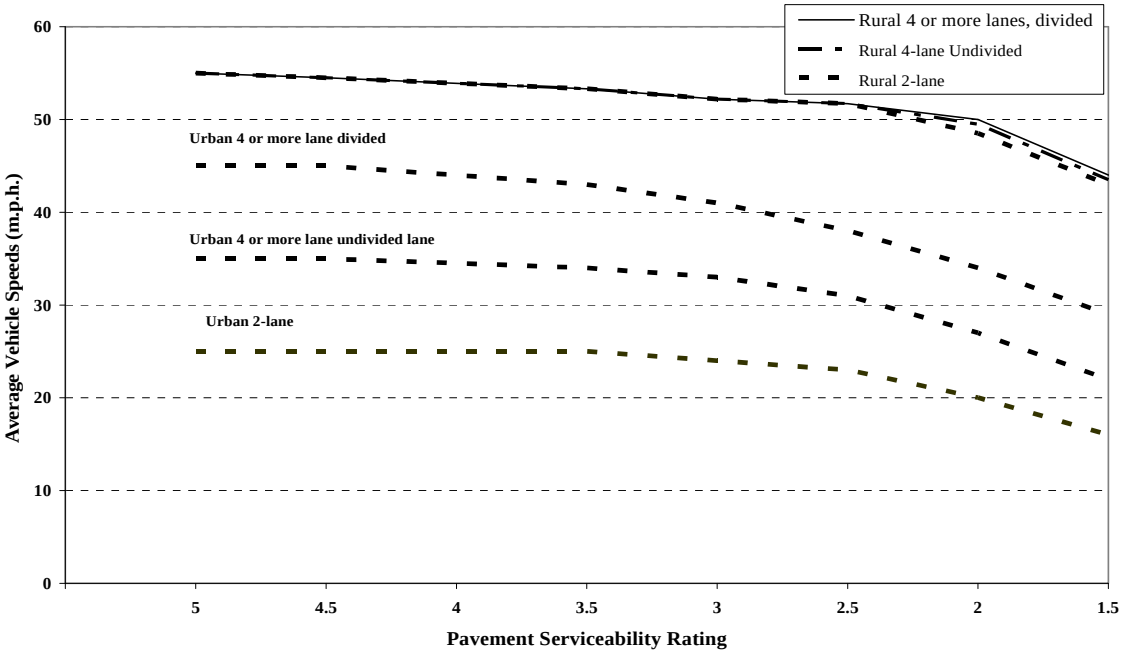
The resulting VHTs and VMTs are categorized (e.g., aggregated and/or proportioned) to correspond with the trip purposes used by the MI BEST Tool, which include commercial as well as passenger trips. Passenger trips include business, work/commuting, and non-work (e.g., social, recreational, shopping, 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.[6]

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

[6] 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 2009 (Table 3), describes the percentage of annual VMT in a region by passenger and commercial vehicles and applies to both the Current and Match All Federal Aid strategies. Cumulative annual VHT savings (Table 4) 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 3 2009 Annual Vehicle Miles Traveled (AVMT) Composition (Current or Match All Federal-Aid Program)

Region	Passenger AVMT	Percent AVMT	Commercial AVMT	Percent Commercial VMT
Superior	1,996,900,000	4.1%	137,848,312	3.9%
North	3,820,434,376	7.8%	212,765,686	6.1%
Grand	5,692,469,758	11.7%	366,337,391	10.4%
Bay	6,230,802,856	12.8%	357,758,536	10.2%
Southwest	5,398,006,824	11.1%	711,087,272	20.2%
University	8,830,105,424	18.1%	878,022,702	25.0%
Metro	16,734,774,309	34.4%	849,963,521	24.2%
State Total	48,703,493,547	100.0%	3,513,783,421	100.0%

Table 4 Cumulative Annual Vehicle Hours Traveled Savings, FY 2011–2015

	Current Program		Match All Federal Aid	
Year	Commercial	Auto	Commercial	Auto
2011	-1,901,664	-3,260,708	-1,901,664	-3,260,708
2012	-1,999,859	-4,251,020	-2,797,556	-4,372,897
2013	-2,100,379	-5,070,497	-3,499,439	-5,430,292
2014	-2,158,620	-5,699,260	-4,017,447	-6,707,282
2015	-2,176,657	-6,548,546	-4,700,768	-8,018,431

As part of the travel-time savings process, traffic compositions for daily vehicle hours-traveled savings expected from improved pavement conditions were derived. This data is annualized for each year and denotes a "before and after" reconstruction VHT value respective to either scenario. The before values are subtracted from the after reconstruction values to arrive at the total expected vehicle travel-time savings.

The annual VHT savings expected from improved pavement conditions under the Current program are considerably less than the savings anticipated from the Match All federal Aid program.

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.[7] 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

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

expenditures are reduced, which are monetized and represented as reductions in the cost of doing business and changes in consumption patterns.

- 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.[8]

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.

[8] 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.

2.4 Value of Time

Additional analysis is preformed to quantify the total travel time savings. For this analysis savings are assessed for household auto travel time savings, business share of employee's auto travel time savings, on-the-clock savings, business share of employees total commute travel time savings, commercial (truck) savings, and total business travel time savings. The U.S. Department of Transportation (U.S. DOT) has provided guidance on a range of values for quantifying time.[9]

The U.S. DOT guidance recommends using the median income for all U.S. households divided by 2,000 hours per year. For this analysis, the value of time for households is based on the median household income, reported in U.S. Census Bureau, Current Population Survey, Annual Social and Economic Supplements.[10]

For commercial, that is truck, the valuation of time recommend by U.S.DOT looks at median weekly earnings of full-time truck drivers divided by average weekly hours for full-time operators in transportation and material moving occupations, plus total benefits. This does not address the full marginal cost of operating a truck one mile or one hour in standard operating conditions. The American Transportation Research Institute undertook an analysis and found that total marginal costs for the industry were $1.73 per mile and $83.68 per hour. Marginal costs were divided into vehicle- and driver-based.[11]

For this analysis, the value of time for households is based on one half the median household hourly wages ($23.23) in Michigan, $11.61. Michigan businesses experience savings related to their commercial VHT, $84.75 per hour in driver wages, freight logistics cost, and vehicle operating costs is used.

[9] Revised Departmental Guidance on the Evaluation of Travel Time in Economic Analysis, memo, U.S. Department of Transportation, 2003, (http://ostpxweb.dot.gov/policy/reports.htm).

[10] U.S. Census Bureau, Current Population Survey, Annual Social and Economic Supplements, Table H-8 Median Household Income by State: 1984 to 2009, (http://www.census.gov/hhes/www/income/data/historical/household/H08_2009.xls).

[11] An Analysis of the Operational Costs of Trucking, American Transportation Research Institute, 2008, (http://www.atri-online.org/index.php?option=com_content&view=article&id=62&Itemid=73).

4 MDOT Highway and Bridge Program's Economic Impacts on Michigan

The results of the economic analysis using the MI BEST Tool indicated that MDOT's Five-Year Highway & Bridge Program FY 2011-2015 contributes significantly to the Michigan economy. In all, over the course of the five-year period, planned investments are estimated to generate:

Estimated Match All Federal-Aid Program (2011 dollars)

- 16,900 job-years in 2011.[12]
- An average of 16,383 job-years annually for 2012-2015.
- $6.0 billion in personal income over five-year period.
- $5.9 billion in GSP over five-year period.
- $37.9 million (2011) to $93.1 million (2015) in travel-time savings to households.
- $96.1 million (2011) to $237.3 million (2015) Michigan business savings.

Estimated Current Program (2011 dollars)

- 16,900 job-years in 2011.[13]
- An average of 7,955 job-years annually for 2012-2015.
- $3.6 billion in personal income over five-year period.
- $3.4 billion in GSP over five-year period.
- $37.9 million (2011) to $76.1 million (2015) in travel-time savings to households.
- $96.1 million (2011) to $125.5 million (2015) 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 Match All Federal Aid program, these savings are worth between $15.5 million (2011) and $38.1 million (2015) per year. The equivalent savings under the Current program would be $15.5 million (2011) and $33.3 million (2015) per year.

In addition, Michigan businesses experience savings related to their commercial VHT savings. The standard used here is $84.75 per hour in driver wages, freight logistics cost, and vehicle operating costs. Under the Match All Federal Aid program, these savings would be between $80.5 million (2011) and $199.2 million (2015) per year. Under the Current program, the equivalent savings would be between $80.5 million (2011) and $92.2 million (2015) per year.

[12] 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.

[13] Ibid.

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 2011 dollars using a 2.7 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 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 16,900 jobs in Michigan in 2011. The effect of employment is impacted by reduced spending levels as a result of a decline in revenue beginning in FY 2012. 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 3 and 4 and tables 5 and 6 on the following pages show the employment impact of the FY 2011-2015 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 12,858 in 2011 compared to the no-build case. Under the Current program, the number of unemployed decreases by only 1,358 in 2015 compared to 5,310 for the Match All Federal Aid program in the same year.[14]

[14] Source: REMI model: includes amenity effect, household time savings valued at $11.61 (approximately one-half the hourly wage rate). Changes compared with baseline forecasts.

Figure 3

Match All Federal-Aid
Effect on Employment of MDOT's Five-Year Highway & Bridge Program
FY 2011-2015

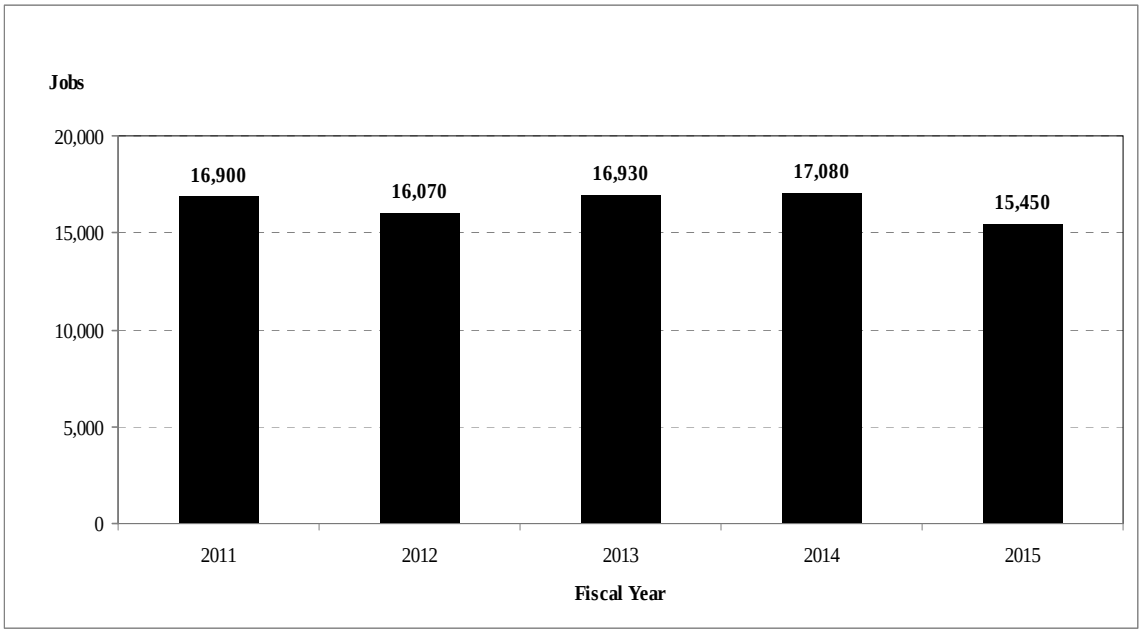


Figure 4

Current Program
Effect on Employment of MDOT's Five-Year Highway & Bridge Program
FY 2011-2015

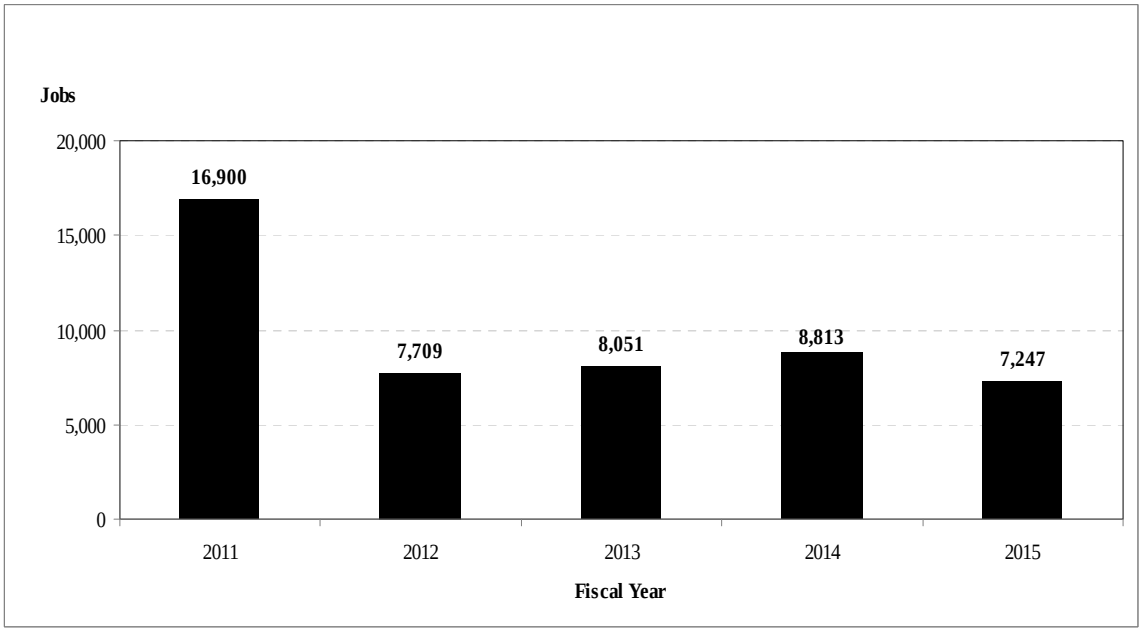


Table 5 Match All Federal Aid Economic Benefits of MDOT's Five-Year Highway & Bridge Program FY 2011-2015[15]

	2011	2012	2013	2014	2015	Total 2011-15
Total Employment	16,900	16,070	16,930	17,080	15,450	
Population	4,129	7,077	9,760	12,070	13,730	
Reduction in out-migration	4,084	2,825	2,501	2,075	1,390	
Reduction in number of unemployed	12,858	9,793	8,829	7,622	5,310	
Labor force	4,042	6,277	8,101	9,458	10,140	
Value of shipments ($ millions – 2011$)	1,879	1,829	1,977	2,027	1,858	9,570
Gross State Product ($ millions - 2011$)	1,137	1,123	1,219	1,261	1,178	5,918
Real Personal income ($ million - 2011$)	1,033	1,100	1,250	1,344	1,302	6,029
Labor $ proprietors' income ($ millions)	1,000	1,023	1,133	1,190	1,116	5,462
Less: Social insurance taxes ($ millions)	101	106	118	125	119	568
Plus: Non-labor income ($ millions)	-90	-57	-38	-14	21	-178
Equals: Total personal income ($ millions)	808	860	978	1,051	1,018	4,715

Table 6 Current Program Economic Benefits of MDOT's Five-Year Highway & Bridge Program FY 2011-2015[16]

	2011	2012	2013	2014	2015	Total 2011-15
Total Employment	16,900	7,709	8,051	8,813	7,247	
Population	4,129	5,356	6,721	8,048	8,886	
Reduction in outmigration	4,084	1,319	1,234	1,170	661	
Reduction in number of unemployed	12,858	3,356	3,020	3,094	1,358	
Labor force	4,042	4,353	5,031	5,719	5,889	
Value of shipments ($ millions – 2011$)	1,879	826	884	991	806	5,386
Gross State Product ($ millions - 2011$)	1,137	531	569	637	540	3,415
Personal income ($ million - 2011$)	1,033	567	625	711	634	3,570
Labor $ proprietors' income ($ millions)	1,000	504	541	606	512	3,162
Less: Social insurance taxes ($ millions)	101	53	57	64	55	330
Plus: Non-labor income ($ millions)	-90	-8	4	14	39	-41
Equals: Total personal income ($ millions)	808	443	488	556	496	2,792

[15] 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.

[16] Ibid.

The employment benefits by major industry division are shown in Tables 7 and 8. Construction has the largest gains, which includes the direct employment of highway construction workers. There also are large gains in Professional Services, reflecting the employment of engineers and other professional workers.

Table 7 Match All Federal Aid
Employment Benefits of MDOT's Five-Year Program by Industry
FY 2011-2015

Industry	2011	2012	2013	2014	2015
Total Employment	16,900	16,070	16,930	17,080	15,450
Private Sector	15,520	14,570	15,340	15,380	13,650
Manufacturing	353	330	329	303	265
Non-manufacturing except out-of-state tourism	15,167	14,240	15,011	15,077	13,385
Construction	8,681	7,962	8,329	8,339	7,189
Retail trade	1,647	1,583	1,704	1,743	1,569
Professional services	582	549	573	570	513
Accommodation and food services	814	763	799	791	728
Other [17]	3,444	3,382	3,605	3,634	3,387
Public Sector	1,373	1,509	1,589	1,699	1,802

Table 8 Current Program
Employment Benefits of MDOT's Five-Year Program by Industry
FY 2011-2015

Industry	2011	2012	2013	2014	2015
Total Employment	16,900	7,709	8,051	8,813	7,247
Private Sector	15,520	6,669	6,997	7,700	6,056
Manufacturing	353	108	103	106	73
Non-manufacturing except out-of-state tourism	15,167	6,561	6,894	7,595	5,983
Construction	8,681	3,751	3,892	4,289	3,239
Retail trade	1,647	722	778	869	702
Professional services	582	249	257	279	224
Accommodation and food services	814	330	350	379	307
Other [18]	3,444	1,509	1,616	1,779	1,511
Public Sector	1,373	1,040	1,054	1,113	1,192

[17] The "Other" designation in tables 7 and 8 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.

[18] 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 5, the real cumulative impact on GSP from 2011 to 2015 is $5.9 billion for the Match All Federal Aid scenario. This is substantially lower in the current program, dropping to $3.4 billion.

Figure 5 **Match All Federal Aid**
Cumulative Effect on Real Gross State Product
of MDOT's Five-Year Highway & Bridge Program FY 2011-2015

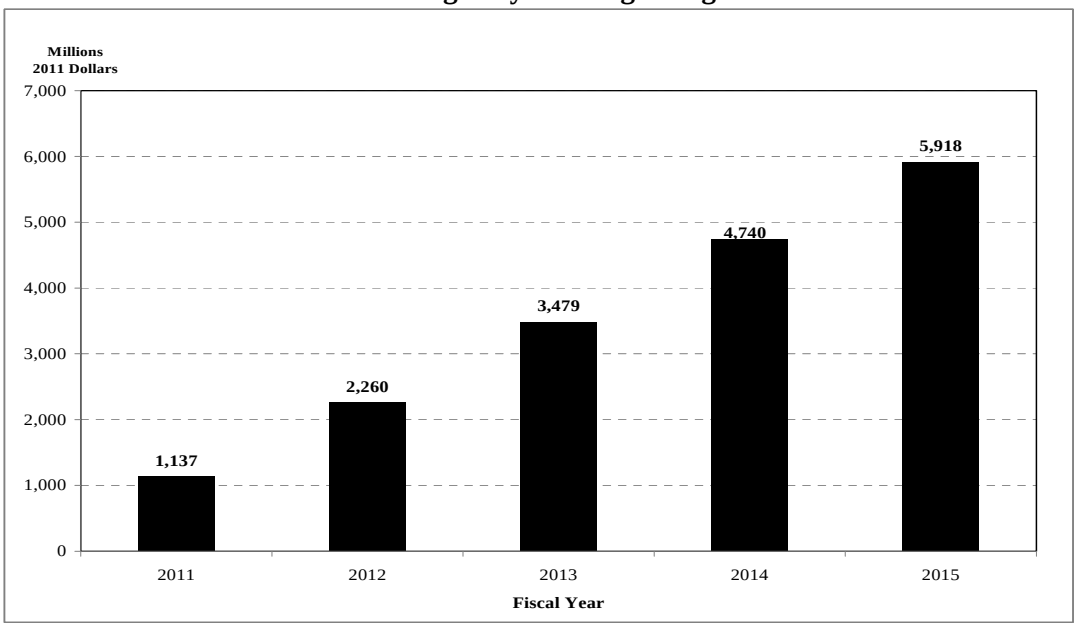
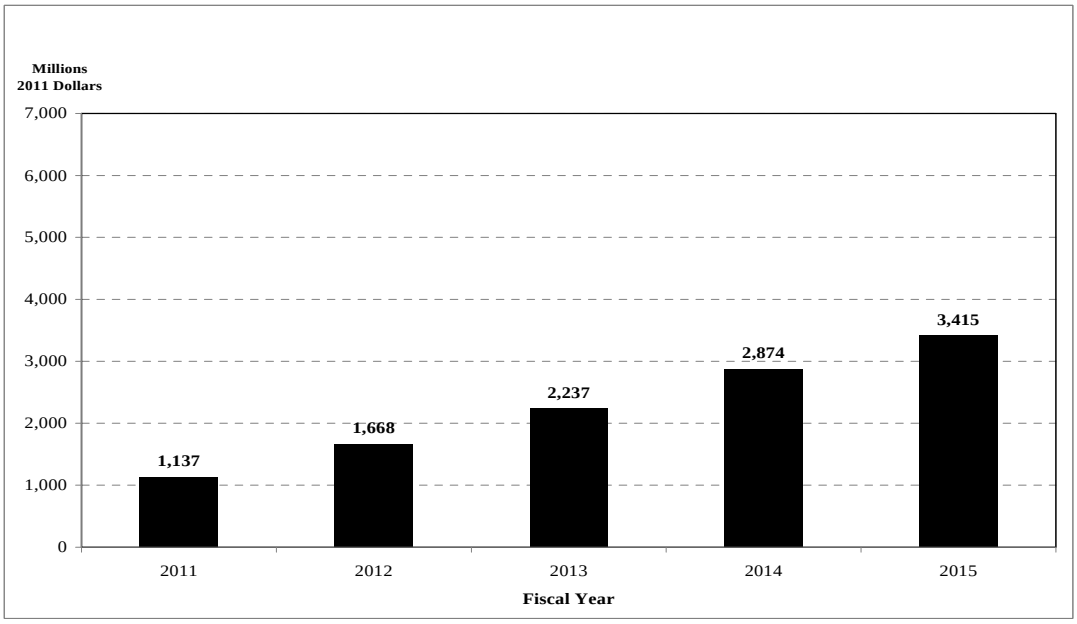


Figure 6 **Current Program**
Cumulative Effect on Real Gross State Product
of MDOT's Five-Year Highway & Bridge Program FY 2011-2015



Real personal income also increases for the analysis period, cumulating to $6.0 billion under the Match All Federal Aid program. However, the real income benefits under the Current program cumulate to only $3.6 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.

Figure 7 **Match All Federal Aid**
Cumulative Effect on Real Income
of MDOT's Five-Year Highway & Bridge Program FY 2011-2015

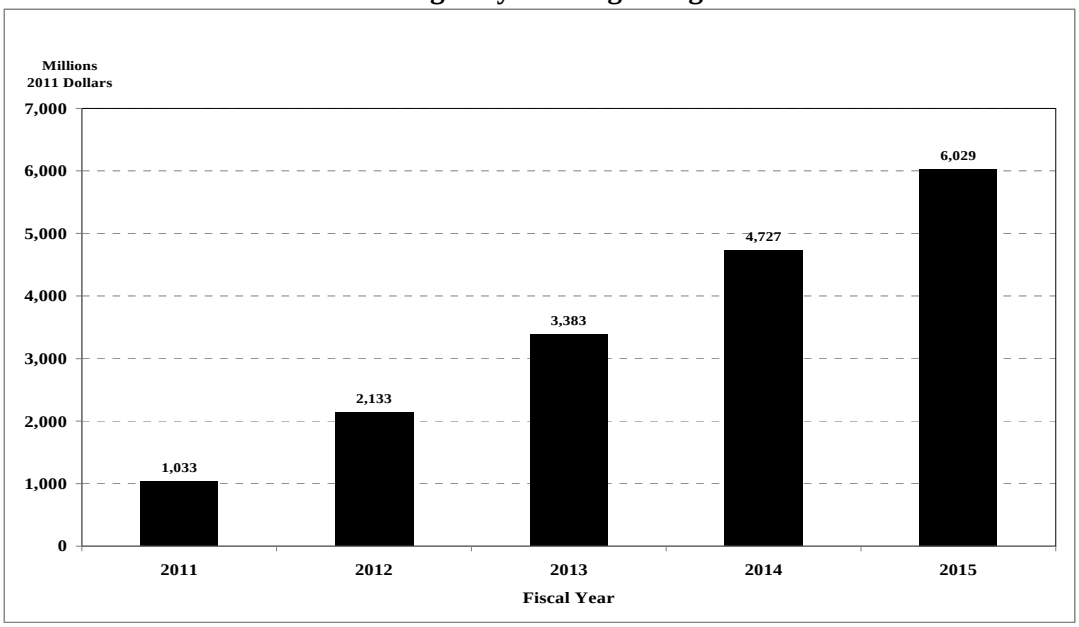
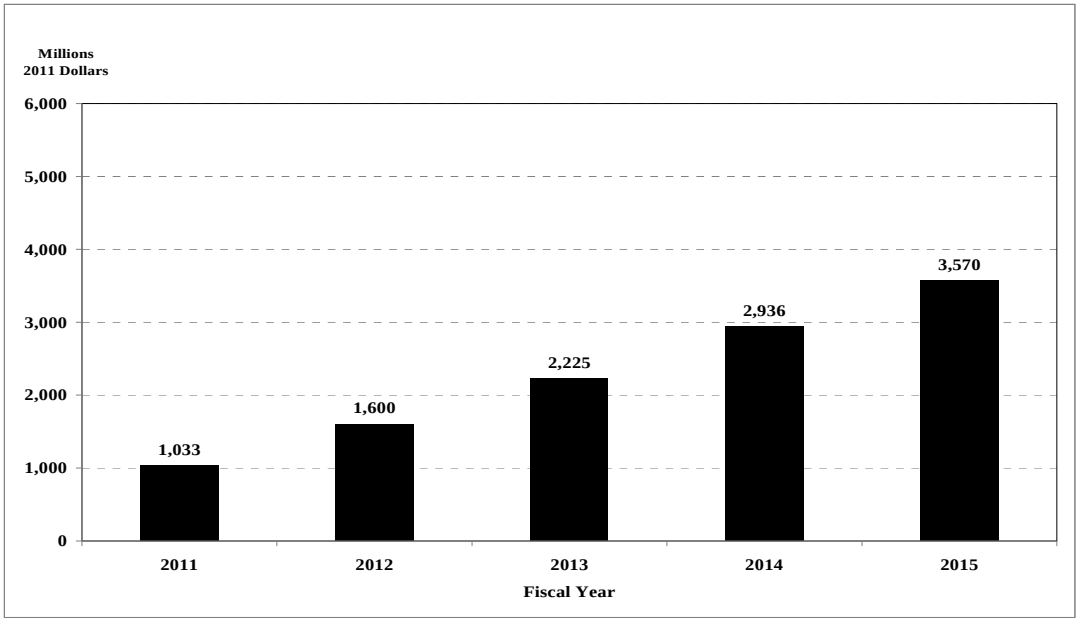


Figure 8 **Current Program**
Cumulative Effect on Real Income
of MDOT's Five-Year Highway & Bridge Program FY 2011- 2015



5 Conclusion

The purpose of this study was to determine the economic impacts to the state of Michigan of MDOT's FY 2011-2015 Five-Year Transportation Program. This analysis covers its highway and bridge component only. Additional impacts will accrue from the investments in Passenger Transportation, Rail freight and Aviation programs.

MDOT plans to spend $1,378 million in FY 2011 on its highway and bridge program, supporting 16,900 jobs. Expenditure per job in FY 2011 amounts to $81,538. Investment in Michigan's transportation increases capacity, improves service, reduces travel time, lowers trip cost, increases business access and mobility, and improves travel time reliability. These improvements translate into greater productivity and better access to labor and markets, for individuals, as well as for businesses.