The Economic Impact of Failing to Invest in Connecticut's Highways, Bridges and Transit

Prepared by the American Road & Transportation Builders Association

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CCIA

Building a Better Connecticut

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About the American Road & Transportation Builders Association

The Washington, D.C.-based American Road & Transportation Builders Association (ARTBA) is a federation whose primary goal is to aggressively grow and protect transportation infrastructure investment to meet the public and business demand for safe and efficient travel. In support of this mission, ARTBA also provides programs and services designed to give its 7,700 public and private sector members a global competitive edge.

About the Connecticut Construction Industries Association

The Connecticut Construction Industries Association (CCIA) was formed by combining the collective knowledge and strength of unique organizations to create the most comprehensive commercial construction trade association in Connecticut. CCIA represents many sectors of the industry, fostering cooperation to advance and promote a positive business climate, and shape the industry's future, with the oldest division operating for more than 80 years.

The Economic Impact of Failing to Invest in Connecticut's Highways, Bridges and Transit

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I. Executive Summary

Connecticut is at an important crossroads. The transportation investment decisions that elected officials make today will have a profound impact on the state economy and residents for decades to come.

This landmark report uses sophisticated modeling techniques and data from the U.S. Federal Highway Administration (FHWA), the U.S. Bureau of Economic Analysis (BEA), the Connecticut Department of Transportation (CTDOT) and the U.S. Census Bureau to analyze two different funding scenarios for Connecticut highway, bridge and transit investment over the next 20 years.

The report also examines the economic impact of transportation investment on six key economic sectors in Connecticut: healthcare/bioscience, insurance and financial services, advanced manufacturing, digital media, tourism and green technologies.

The difference between the economic outcomes will help lawmakers and the citizens of Connecticut understand how transportation investment decisions can change the trajectory of the economy and quality of life in Connecticut.

In the first scenario, transportation investment increases to address maintenance and capacity issues. The funding levels are in line with the full implementation of the needs-based transportation plan considered by the legislature in 2015. In the second scenario, the needs-based plan is not implemented and spending for highways, bridges and transit is set at a minimum investment level.

The potential loss in economic activity is staggering—an average of $3.2 billion per year in lost output, earnings and user benefits, which would have contributed $1.1 billion annually to state gross domestic product (GDP).

- By not fully implementing the needs-based plan in Scenario 1, it will cost Connecticut drivers, transit riders and businesses an additional $675 million per year. Some of this will be paid through lost time and higher costs. Truck drivers will spend more time idling on congested highways. Transit riders will take fewer trips. Poor roadway conditions will mean that vehicle owners spend more of their income to repair their cars and trucks.
- The loss in annual highway, bridge and transit construction activity will have ripple effects throughout all sectors of the economy. Connecticut businesses will lose out on nearly $2 billion in sales annually. This will cost the state GDP $1.1 billion each year.
- This lost investment would have supported or created another 10,227 jobs. Those workers would have earned an average of $573 million per year.

What Is At Stake?

What would Connecticut lose by failing to invest in transportation infrastructure? Over 20 years, Connecticut would forego:

- **Over $65 billion** in benefits, wages and output for drivers and businesses
- Nearly **$21.4 billion** in state GDP

Connecticut would lose $3.2 billion in economic activity each year.
This includes:

- **$675 million per year** in savings for Connecticut drivers, transit riders and businesses
- **$2.0 billion per year** in lost sales for Connecticut establishments
- **10,227 lost jobs**. These workers would have earned **$573 million per year**.

Average Annual Economic Impacts of Connecticut Highway, Bridge and Transit Investment 2018-2037			
	Scenario 1: Needs-Based	Scenario 2: Minimum Investment	Annual Difference
User Benefits	$1.98 billion	$1.30 billion	$0.68 billion
Economic Output	$4.22 billion	$2.24 billion	$1.98 billion
Earnings	$1.23 billion	$0.66 billion	$0.57 billion
Total	**$7.42 billion**	**$4.19 billion**	**$3.23 billion**

- By failing to invest at the needs-based level, Connecticut would be unable to replace 972 bridges over the next two decades. This would result in an additional 445 structurally deficient bridges across the state.

Over a 20 year period, that adds up to a $65 billion loss in benefits, wages and output for Connecticut drivers and businesses. The state would forego nearly $21.4 billion in additional GDP.

That lost investment would jump-start the Connecticut economy, which has still not recovered from the 2008 Great Recession. Connecticut's real GDP was $230.7 billion in 2016, down seven percent from pre-recession levels of $247.2 billion in 2007.

Major sectors of the Connecticut economy continue to struggle. Real GDP was down 41 percent in the manufacturing sector in 2016 compared to 2007, 24 percent in finance and insurance and 17 percent in the construction industry.

The transportation challenges facing Connecticut are significant, and will only continue to grow in the next 20 years:

- Demand by users is expected to increase with economic growth—freight shipments are projected to double between 2015 and 2045.
- The state is expected to add 60,000 new residents and 110,000 new workers during the same time period. These residents will need a variety of transportation options for getting to work, school, social functions and purchasing goods and services from local businesses.
- Connecticut drivers in urban areas spend anywhere from 16 to 74 hours a year stuck in traffic, at a total cost ranging from $68 million to $14.7 billion, depending on the area.[1]
- Poor roadway conditions are a contributing factor in more than half of the 265 roadway fatalities[2] on Connecticut roads, costing the state $2.2 billion annually.[3]

The economic impacts and user benefits of each funding scenario are presented in Section III. Some of the highlights include:

Scenario 1: Needs-Based Plan

The higher investment levels under the needs-based plan would have significant benefits for Connecticut residents and businesses over the next 20 years.

- As highway, bridge and transit construction activity grows each year, business output in Connecticut would grow from $3.6 billion per year in 2018 to nearly $5 billion in 2036. This includes sales by businesses throughout all sectors of the economy.
- The additional economic activity would contribute nearly $2.3 billion each year to the state GDP, increasing from $2 billion in 2018 to $2.7 billion after 20 years.

[1] Texas Transportation Institute 2015 Urban Mobility Scorecard

[2] National Highway Traffic Safety Administration, 2015 data.

[3] Ted Miller and Eduard Zaloshnja, "On a Crash Course: The Dangers and Health Costs of Deficient Roadways," Pacific Institute for Research and Evaluation, May 2009.

- The construction activity would support 26,000 jobs annually through all sectors of the economy. These workers would earn an estimated $1.2 billion per year.
- An estimated $1.2 billion in annual output would be in some of Connecticut's key economic sectors: healthcare and bioscience, insurance and financial services, advanced manufacturing, digital media, tourism and green technologies.
- Connecticut drivers, transit riders and businesses would save an estimated $2.0 billion per year. This includes lower operating costs for cars and trucks, less time spent in traffic and congestion, safety benefits and lower maintenance costs for travel on improved roads. The benefits from transit investment include additional work and medical related trips, transportation cost savings and greater mobility. Over 20 years, this adds up to $39.1 billion in savings that can be used for other purposes.
- The percent of travel on roads classified as "deficient" would fall from 40 percent to just over 10 percent over the 20-year period. These improvements would be on both urban and rural roads. The amount of travel on deficient urban Interstates, which are the key economic corridors in the state, would fall from 53 percent to six percent over 20 years.
- Based on the mix of projects selected, Connecticut would be able to replace 1,803 bridges over the 20-year period, and make needed repairs to 316 bridges.

About the Scenarios

Scenario 1 (Needs-Based):
In this scenario, the needs-based transportation plan considered by the legislature in 2015 would be implemented fully based on the latest funding levels provided in CDOT's FFY 2017-2021 Capital Plan. Total highway, bridge and transit investment would include state baseline funding, federal funding and "Ramp Up State Funding", and would average $2.42 billion per year over the next 20 years.

Scenario 2 (Minimum Investment):
In the second scenario the needs-based program is eliminated, resulting in the minimum level of transportation funding. Connecticut's federal aid highway apportionment and the state match provide funding for highway and bridge investment. Transit investment would stay at current levels minus "Ramp Up State Funding". Total investment would average $1.28 billion per year over the next 20 years.

Scenario 2: Minimum Investment

Transportation investment at the minimum investment level would provide some economic benefits, but not nearly at the same level as in the needs-based plan.

- The construction activity would support an average of $2.2 billion in economic output each year. An estimated $620 million in annual output would be in the healthcare and bioscience, insurance and financial services, advanced manufacturing, digital media, tourism and green technologies industries.
- This would account for an annual average of $1.2 billion in state GDP.
- The jobs supported by the investment would average 11,700 annually over the 20 years. These workers would earn an average of $655 million per year.
- System users would save an estimated $1.3 billion per year.
- With lower funding levels and fewer highways being repaired, the percent of travel on deficient roads would only fall by an estimated

four percent over the 20 year period. The percent of travel on deficient roads in rural areas would more than double, from 15 percent to 32 percent. Improvements would be made on urban interstates, but at the end of 20 years, 24 percent of travel would still be on highways classified as deficient.

- Connecticut would only be able to replace 831 bridges and repair 294 bridges over 20 years.

Funding Threat: Impact of a $700 Million Bond Sale Cap

Connecticut state budgets currently proposed by House Democrats and Republicans both included a $700 million annual bonding limitation. CTDOT estimates that the needed bonding level to support the transportation program would be $900 million, a difference of $200 million per year. CTDOT issues bonds to pay for ongoing projects, and then pays for past projects with debt service. **Therefore, such a restricted bond sales cap would have an immediate and strong impact on current CTDOT projects, resulting in insufficient funding to pay current bills**.

This bond sales cap would "save" the state an estimated $15.7 million per year in reduced debt service, however there are significant costs associated with such a drastic cut in bond funding, including the effective elimination of CTDOT's FY 2018 Capital program, and the potential shutdown of ongoing construction projects.

Potential effects include:

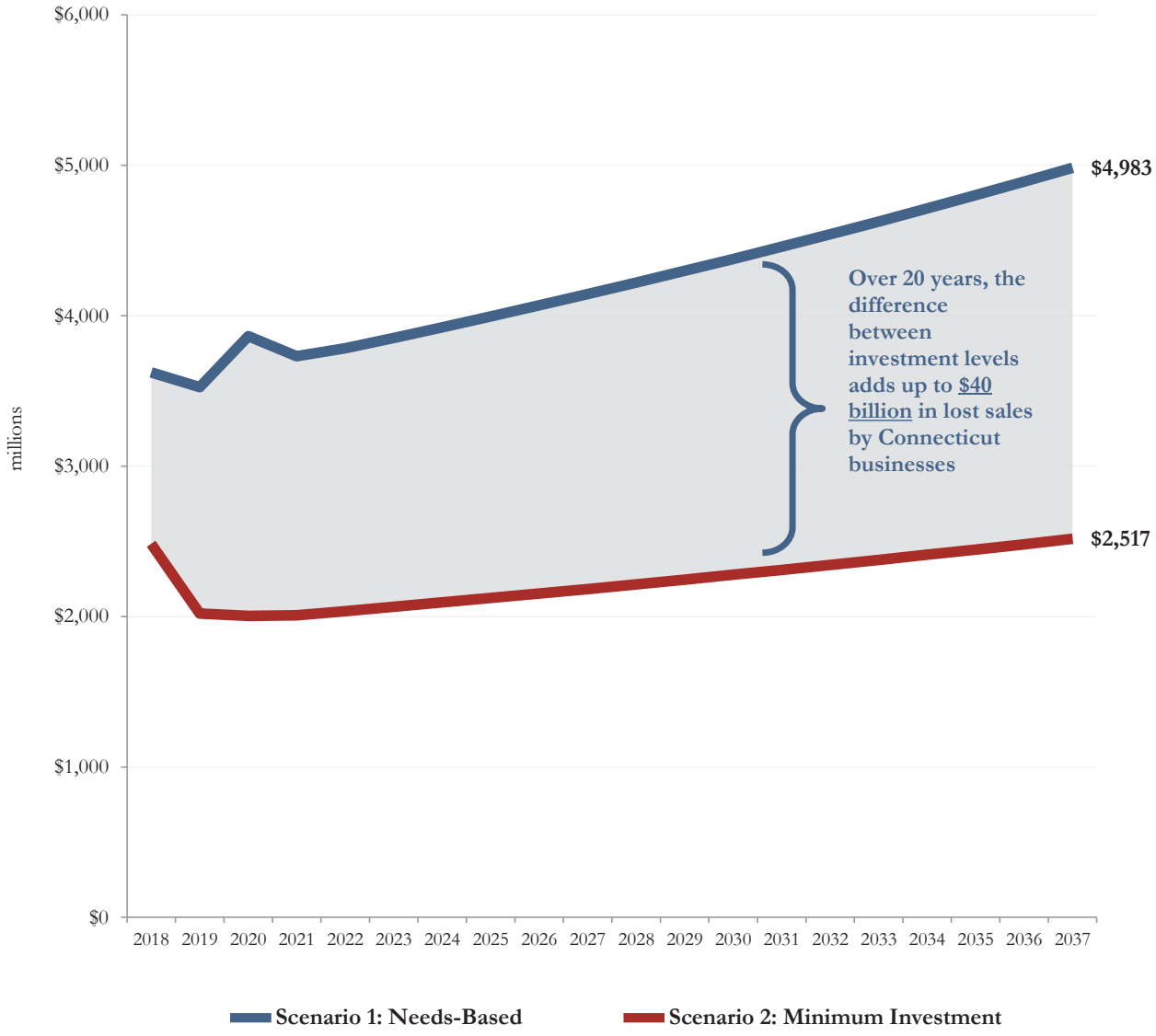
- Cancellation of all active roadway resurfacing projects (totaling approximately $70 million)
- Shutdown/suspension/cancellation of existing construction and/or consultant engineering projects, which could result in the state being required to pay penalties and/or pay back federal funds
- Cancellation of all the construction contract awards that are scheduled for FY 2018

CTDOT recently indicated that this bond sale cap could delay or cancel 22 highway, bridge and transit new construction projects valued at up to $689 million, suspend or delay 11 projects currently in varying stages of design, and cancel or delay $70 million in local aid programs. Some significant projects that could face cancellation or delay include:

- The $228 million Charter Oak Bridge project, as well as the associated $54 million I-91 bridge resurfacing project.
- The $97 million Gold Star Bridge northbound span project
- The $69 million Vendor-in-Place (VIP) resurfacing program, which includes most of Connecticut's capital resurfacing and related projects
- The $65 million I-84 West Hartford Operational Lanes project

The two scenarios examined in the report do not take into account the potential economic loss if the state were to shut down projects.

Economic Output Supported by Highway, Bridge & Transit Investment 2018 to 2037 (in millions)



II. Challenges Facing the Connecticut Transportation Network

Connecticut faces some of the most challenging road and bridge conditions in the country. Increasing investment to improve the safety, efficiency and conditions of the Connecticut highway and bridge network would help all system users.

- Road Conditions—According to FHWA, Connecticut has 21,512 miles of roadway.[4] Of the state's 6,330 miles of roadway eligible for federal aid, 57 percent are rated "not acceptable" and need major repairs or replacement. This is the second highest percentage in all 50 states.

  According to the American Society of Civil Engineers, driving on Connecticut roads in need of repair costs each driver $864 per year.[5]

- Deficient Bridges—Connecticut has 4,214 roadway bridges. FHWA reports 33.5 percent of these bridges are either "structurally deficient" (338 bridges) or "functionally obsolete" (1,072 bridges). This is well above the national average of 23 percent. CTDOT has identified nearly $8 billion in bridge-related inspections, repair and replacement work in the current constrained capital plan over the next five years, which would only address some of the identified needs.

  There are 257 railroad bridges in the state.[6] The Connecticut Department of Transportation estimates that repairing or replacing four key rail bridges across Connecticut will cost over $3 billion: the Devon and Walk bridges will cost $1.2 billion and $750 million to repair, respectively, and the Cos Cob and Saga bridges will cost $806 million and $330 million to replace, respectively.[7]

- Road Safety—The National Highway Traffic Safety Administration reports there were 253 fatal motor vehicle crashes, resulting in 266 fatalities, in Connecticut during 2015. Of these, 17 percent of fatalities occurred on rural roads and 38 percent occurred on the National Highway System. Motor vehicle crashes are the number one cause of death and permanently disabling injuries for young Americans under age 21.

- Freight Traffic—Inter-state truck shipments along Connecticut's highway and bridge network are vital to the economic growth of the state. Connecticut businesses shipped a total of $231.1 billion in freight in 2015. Of this total, 79 percent was shipped via truck. Truck traffic alone is expected to increase by 77 percent by 2045, reaching $322.5 billion in value.

- Congestion—Traffic congestion occurs when the number of vehicles on a roadway is greater than the road was designed to handle. Traffic is not able to move at speed, and the resulting slowdowns have a ripple effect along the roadway. Traffic congestion has adverse impacts on air quality, the quality of life and business activity. In Connecticut, this can cost urban drivers anywhere from $382 to $1,739 per year.[8]

  Air quality is affected due to increased vehicle emissions from cars and trucks stuck in traffic. Poor air quality has an impact on the health of at-risk populations, including the elderly and small children.

[4] FHWA Highway Statistics 2015 Table HM-10, <https://www.fhwa.dot.gov/policyinformation/statistics/2015/hm10.cfm>.

[5] American Society of Civil Engineers, "2017 Infrastructure Report Card," <http://www.infrastructurereportcard.org/state-item/connecticut/>.

[6] Federal Railroad Administration (FRA), "FRA Grade Crossings," May 19, 2017.

[7] CTDOT Special Inquiry

[8] Texas Transportation Institute 2015 Urban Mobility Scorecard

Personal time delays mean that commuters and other system users are behind the wheel longer, rather than spending more time at work or at leisure, impacting their quality of life. This increased traffic congestion means additional costs, which are associated with a reduced service area for business suppliers, customer markets and workforces.

A survey of business owners found that typical ways businesses deal with congestion include:[9]

- Costs for additional drivers and trucks due to longer travel times
- "Rescue drivers" to avoid missed deliveries due to unexpected delays
- Loss of productivity due to missed deliveries
- Shift changes to allow earlier production cut off
- Reduced market areas
- Increased inventories
- Costs for additional crews and decentralized operations to serve the same market area
- Business that are local can absorb the cost or pass it on
- Trade-oriented businesses can respond by moving their operations

[9]Economic Development Research Group, "The Cost of Congestion to the Economy of the Portland Region," November 2005, <https://www.edrgroup.com/pdf/trade_trans_studies_cocreport1128final.pdf >.

Annual Cost of Congestion in Connecticut Cities

Urban Area	Annual Hours of Delay Per Commuter	Annual Cost of Congestion Per Commuter	Total Annual Cost of Congestion (in millions)
New York-Newark NY-NJ-CT	74	$1,739	$14,712
Bridgeport-Stamford CT-NY	49	$1,174	$898
Hartford CT	45	$1,038	$656
Springfield MA-CT	38	$831	$408
New Haven CT	40	$932	$384
Worcester MA-CT	38	$865	$302
Waterbury CT	20	$458	$90
Norwich-New London CT-RI	20	$451	$69
Danbury CT-NY	16	$382	$68

Source: Texas Transportation Institute 2015 Urban Mobility Scorecard

III. Broader Economic Challenges

Increasing transportation investment would stimulate economic growth and lead to more job opportunities for Connecticut residents. This would help the state continue to recovery from the downturn of the Great Recession in 2008.

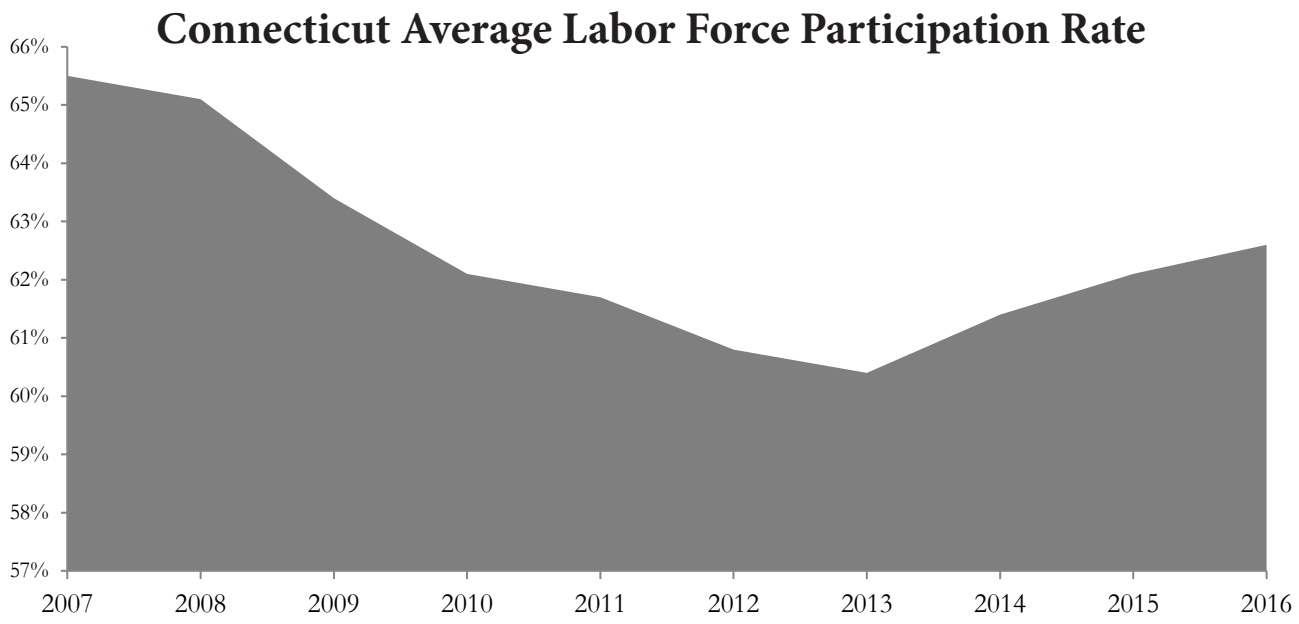
Real GDP in Connecticut was $230.7 billion in 2016, down seven percent from pre-recession levels of $247.2 billion in 2007.[10] Major sectors of the Connecticut economy continue to struggle. Compared to 2007, real GDP in 2016 was down 41 percent in the manufacturing sector, 24 percent in finance and insurance and 17 percent in the construction industry.

Although total employment in the state has shown modest growth in the last few years, employment in such key industries as manufacturing, retail sales and trade and transportation are still below pre-recession levels.

There are also signs that many Connecticut residents are still in need of a job. The unemployment rate has improved from 9.1 percent in 2010 to 5.1 percent in 2016, but is still above the rate of 4.5 percent in 2007.[11]

[10] U.S. Bureau of Economic Analysis

[11] U.S. Department of Labor Bureau of Labor Statistics Local Area Unemployment Statistics



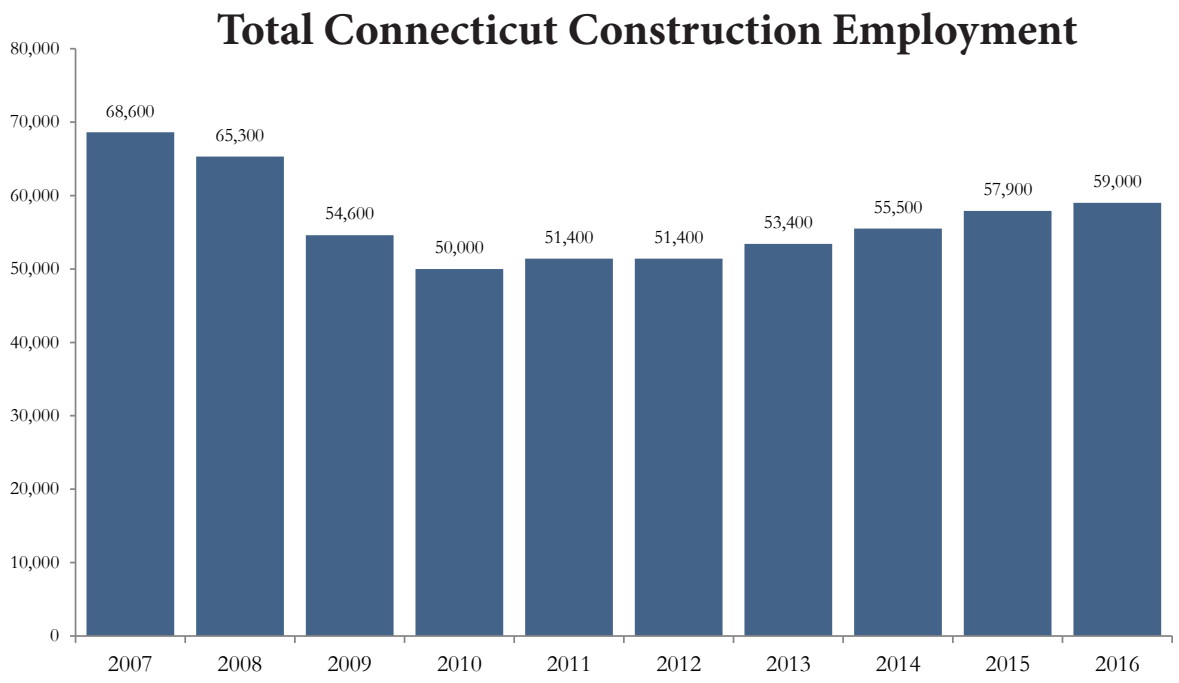
Source: U.S. Department of Labor Bureau of Labor Statistics

The labor force participation rate, which measures the percent of the population in Connecticut that is either employed or actively seeking work, has declined steadily since the recession began, reaching 60.4 percent in 2013 compared to 65.5 percent in 2007. Despite increases in recent years, the labor force participation rate, at 62.6 percent, is still four percent below pre-recession levels. Although an aging population is a factor, one of the reasons for this decline is that some Connecticut residents have given up looking for a job.[12]

The Connecticut construction sector continues to fall behind other parts of the economy. Though Connecticut construction employment increased steadily for the past four years, annual and summer employment levels are still well below pre-recession levels. Connecticut construction employment is estimated at 59,000 in 2016, 14 percent below 2007 levels.[13]

[12] U.S. Department of Labor Bureau of Labor Statistics Local Area Unemployment Statistics

[13] U.S. Department of Labor Bureau of Labor Statistics Local Area Unemployment Statistics



Source: U.S. Department of Labor Bureau of Labor Statistics

IV. The Economic Impact of Transportation Investment in Connecticut

Connecticut needs to invest to support an efficient and safe highway, bridge and transit network to maximize mobility and economic growth. What will happen to this network if spending decreases, and the needs-based plan is not implemented? What is the opportunity cost for Connecticut travelers and businesses?

About the Models

A sophisticated series of econometric models from the U.S. Department of Transportation, HERS-ST, allows us to analyze the changes in highway conditions, user costs and other key variables for roads that are part of the Connecticut National Highway System for various funding levels. In Connecticut, 83 percent of travel is on the federal-aid system modeled by HERS-ST.

Developed by FHWA, the National Bridge Investment Analysis System (NBIAS) is a modeling tool which allows us to estimate bridge performance levels for various budget levels. NBIAS models all bridges in the FHWA's National Bridge Inventory, which comprises all bridges that carry traffic.

Using HERS-ST and NBIAS, we can not only examine the impact of investing at needs-based levels on improvements to the road and bridge network in Connecticut, but we can also analyze the impact of lower investment levels. The difference between these two scenarios is illustrative of the opportunity cost of not implementing the needs-based program.

A number of academic studies have created multipliers for the long-run benefits of transit investment. For this study we use the Connecticut-specific state-wide multiplier from the National Center for Transit Research.[14] They estimate that every $1 in transit spending yields $1.60 in user benefits. The authors benefit-cost analysis includes quantifying savings from the cost of foregone medical and work trips, emissions, crashes, travel time and vehicle ownership and operation expenses.

The economic impact of highway, bridge and transit investment is analyzed using the Regional Input-Output Modeling System (RIMS-II) from the U.S. Bureau of Economic Analysis (BEA).[15] The models estimate the output, employment levels, earnings and value added (contribution to state GDP) specific to industry sectors in the state. Although construction activity will require some inputs and materials from other states, the model captures only the impact on Connecticut businesses.

The RIMS-II model does not include the longer term benefits to users, which are captured as part of HERS-ST, NBIAS and the transit multipliers. It is also important to note that the improvements selected by the HERS-ST and NBIAS models are based on benefit-cost ratios. This means the model will implement improvements with the greatest benefit relative to the cost. Although the exact projects selected by CTDOT and local governments would likely be different, the difference between the two scenarios illustrates the differences in economic impacts.

[14] Ranhjit Doavarthy, Jeremy Mattson & Elvis Ndembe, "Cost-Benefit Analysis of Rural and Small Urban Transit," National Center for Transit Research, North Dakota State University. Prepared for the U.S. DOT, October 2014

[15] A full explanation of the RIMS-II models is available from BEA: https://www.bea.gov/regional/pdf/rims/rimsii_user_guide.pdf>.

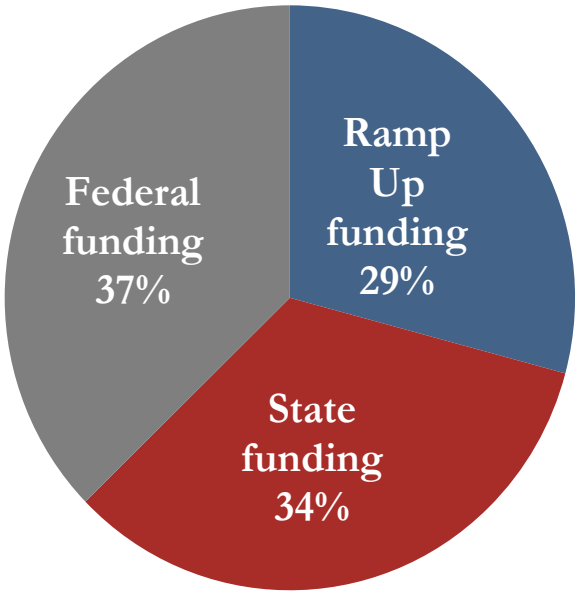
The overall system improvements in terms of increased safety, road conditions, operating costs and travel time will vary depending on the level of investment. By modeling each funding scenario, we are able to predict various levels of improvement on Connecticut's key highway network. As expected, an increased level of investment will provide greater benefits for system users.

Scenario 1: Needs-Based Plan

In 2015, Connecticut legislators considered a needs-based 30-year transportation vision for the state, which included a five-year, $2.8 billion ramp-up plan.[16] This plan significantly expands the CTDOT capital program. In addition to focusing on a "state of good repair" for Connecticut's highways, bridges and transit systems, the agency would be also able to invest in multi-modal system enhancements consistent with the needs of the traveling public.[17]

This five-year ramp-up plan is funded by $2.8 billion in additional bond authorizations, as well as a portion of the Connecticut sales & use tax which is diverted to the state's Special Transportation Fund (STF). After the five-year ramp-up period ends in FFY 2020, Connecticut's Regular Bond Program is estimated to increase by approximately $700 million in FFY 2021 to reflect the transition to a "ramped-up" regular program. Typically, federal funds account for 70-80 percent of CTDOT capital program revenues, however this ratio has shifted as the state has undertaken large bonding programs and incorporated Ramp Up funding. CTDOT began implementing this needs-based plan in 2016, however it will be limited in its' ability to move beyond the planning and design stage until the state legislature clearly defines a financial plan to support this plan.

CTDOT FFY 2017-2021 Highway, Bridge and Transit Capital Plan, by Funding Source



Total highway, bridge and transit capital spending over the 20-year period would reach $48.4 billion. This includes STF expenditures for roads and bridges, federal aid reimbursements, and Ramp Up spending. (See Appendix 1 for specific annual investment levels.)

Depending on the mix of projects, some of the potential benefits include:

- Over the 20-year period, Connecticut drivers would save $15.6 billion from safety improvements, lower operating costs and less congestion. That is money and time that can be put to more productive uses in the economy, spurring even more economic benefits and improvements in quality of life.

[16] Connecticut Department of Transportation, "Let's Go CT! Connecticut's 5 Year Transportation Ramp-Up Plan", February 2015, <http://www.transformct.info/img/documents/CTDOT%205%20YR%20Corrected_2.17.2015.pdf> and Connecticut Department of Transportation, "Let's Go CT! Fact Sheets," March 13, 2015.

[17] Connecticut Department of Transportation, "Transportation Capital Infrastructure Program Annual Capital Plan Report," January 2017, <http://www.ct.gov/dot/lib/dot/documents/dcommunications/press_release/capital_plan/current_capital_plan_report.pdf>.

- With improved conditions, drivers would spend less money on fixing their cars and trucks. Drivers would save an average of $132 million per year in operating costs, adding up to $2.8 billion over 20 years.
- As they are spending less time in congestion, annual savings would be as high as $486 million per year, or $10.2 billion over 20 years. Individuals would have more time for leisure or work-related activities. Collectively, Connecticut drivers would save about 6.2 million hours per year.
- Better roads also mean safer roads. This adds up to an average of $24.8 million per year in additional safety benefits or $521 million over 20 years.
- Improvements to the bridge network would save Connecticut residents $2.1 billion over 20 years, or over $104 million per year.

- Connecticut drivers would have a smoother ride. The percent of travel on deficient roads would fall from an estimated 40 percent to just over 10 percent over the 20 year period. These improvements would be on both urban and rural roads. Currently 53 percent of all urban interstate travel is on deficient highways. Under this funding scenario, that would drop to six percent over 20 years.

- Based on the HERS-ST model, the mix of the most cost-beneficial projects that could be funded under the minimum investment scenario would increase mobility for all Connecticut drivers. Peak travel speed on urban interstates would increase nearly eight percent. Average overall speed on rural roads would jump nearly seven percent, allowing motorists to get to their destinations with less delay and congestion.

- Connecticut businesses would experience cost savings from reduced travel time as trucks are able to reach their destinations with less delay. Travel time costs for the 34,000 heavy commercial trucks registered in Connecticut would decline by as much as $23 million annually for travel on federal aid highways as improvements are implemented.

- Fleet owners would spend less to repair vehicles — operating costs for trucks would fall an average of $6 million per year.

- As roads are maintained and fixed before they need major reconstruction work, total maintenance costs for CTDOT and local governments would save an average of $904 million per year, or $19 billion over 20 years.

- Depending on the mix of projects, this funding level would support the repair, repaving and reconstruction of nearly 5,000 miles of roadway. The results include widening existing roadways to add 727 lane-miles to help ease congestion.

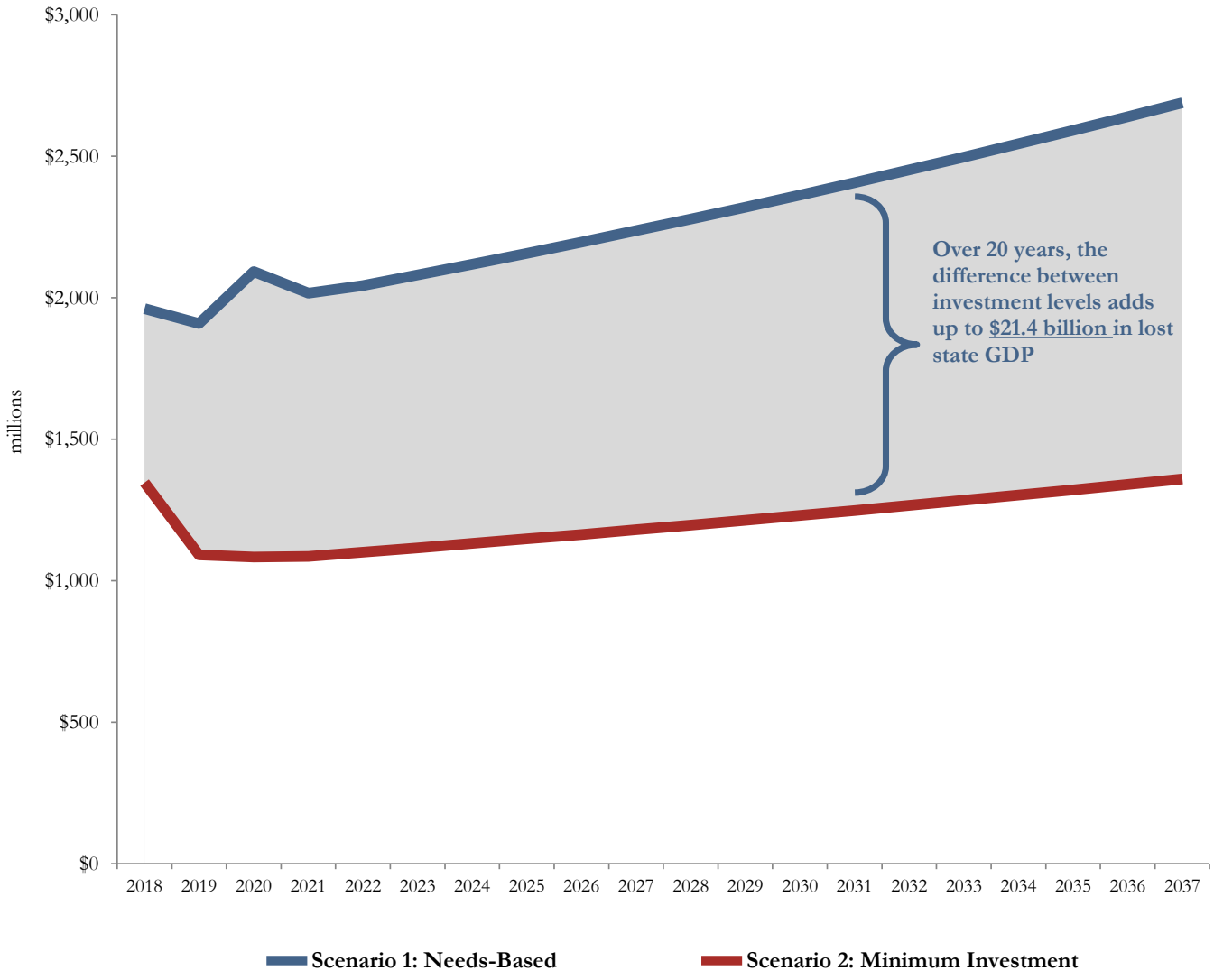
- Bridge conditions across the state would improve across the state, as Connecticut would be able to replace 1,803 bridges and make needed improvements to 316 bridges.

- Transit improvements would support cost savings and other benefits of an average of $1.2 billion per year.

In addition to providing significant user and business benefits, the highway, bridge and transit construction activity under this scenario would also support economic activity throughout the Connecticut economy. Implementing the needs-based plan would support nearly 26,000 jobs throughout the state in all sectors, including manufacturing, retail trade, services, health care, tourism and food services and construction. These employees would earn nearly $1.2 billion in annual wages, adding up to $24.5 billion over 20 years.

The purchases made by Connecticut construction firms, their suppliers and employees would support a total of $4.2 billion in economic output throughout all sectors of the economy each year. This would contribute $2.3 billion annually to the Connecticut GDP. Over 20 years this would be $84.4 billion in output and sales for Connecticut businesses and $45.6 billion in state GDP.

Additional State GDP Supported by Highway, Bridge & Transit Investment 2018 to 2037 (in millions)



Scenario 2: Minimum Investment

The second scenario assumes that the needs-based plan is not implemented, and highway and bridge investment falls to spending levels that include federal aid highway funds and a 20 percent state match.

Transit capital investment is assumed to continue at the baseline level identified before the introduction of the needs-based plan. **It is important to note that the model does not take into account any possible cuts to operational costs or transit services.**

Total highway, bridge and transit capital spending over the 20-year period would reach $25.6 billion, compared to $48.4 billion under the needs-based plan. The minimum investment scenario includes STF expenditures for roads, bridges and transit, funded only by federal aid reimbursements and a state match.

Although there would be some benefits for Connecticut residents as improvements to the highway, bridge and transit network are made, the economic output would be significantly less than under Scenario 1.

Some of the potential benefits include:

- Over the 20-year period, Connecticut drivers would save $12.3 billion from improvements in safety, lower operating costs and less congestion.
  - Drivers would save an average of $44.7 million per year in operating costs, adding up to $938 million over 20 years.
  - Travel time savings would average $421 million per year, or $8.8 billion over 20 years. Although there would be some overall savings, this is largely coming from the trucking sector. Individual travel time costs and hours of delay would actually go up slightly for passenger vehicles over time. Collectively, drivers would spend about 6.2 million additional hours per year sitting in traffic at the end of 20 years. Under Scenario 1, drivers actually saved those same number of hours. This is because as funding levels are lower in Scenario 2, more projects in the future are delayed.
  - Total safety benefits average of $23 million per year or $485 million over 20 years.
  - User benefits from bridge network improvements would average $98 million per year, or $2.0 billion over the next two decades.
- The percent of travel on deficient roads would fall by an estimated four percent over the 20 year period. Because of lower funding levels in Scenario 2, project improvements are put off for longer periods of time and conditions overall are worse. On rural roads, the percent of travel on deficient roads would more than double from 15 percent to 32 percent. Improvements would be made on urban interstates, but at the end of 20 years 24 percent of travel would still be on highways classified as deficient.
- Peak travel speed on urban interstates would decline slightly by 0.2 percent. Average overall speed on rural roads would increase slightly by 1.4 percent.
- Travel time costs for the 34,000 heavy commercial trucks registered in Connecticut would decline by an estimated $4.3 million annually for travel on federal aid highways as improvements are implemented.
- Fleet owners would spend less to repair vehicles — operating costs for trucks would fall an average of $6 million per year.

- Depending on the mix of projects, this funding level would support the repair, repaving and reconstruction of over 4,000 lane-miles of roadway on over 1,208 miles of roadway. The results include widening existing roadways to add 418 lane-miles to help ease congestion.

- At this level of funding, Connecticut would be able to replace 831 bridges and repair 294 bridges over 20 years.

- Transit improvements would support cost savings and other benefits of an average of $716 million per year.

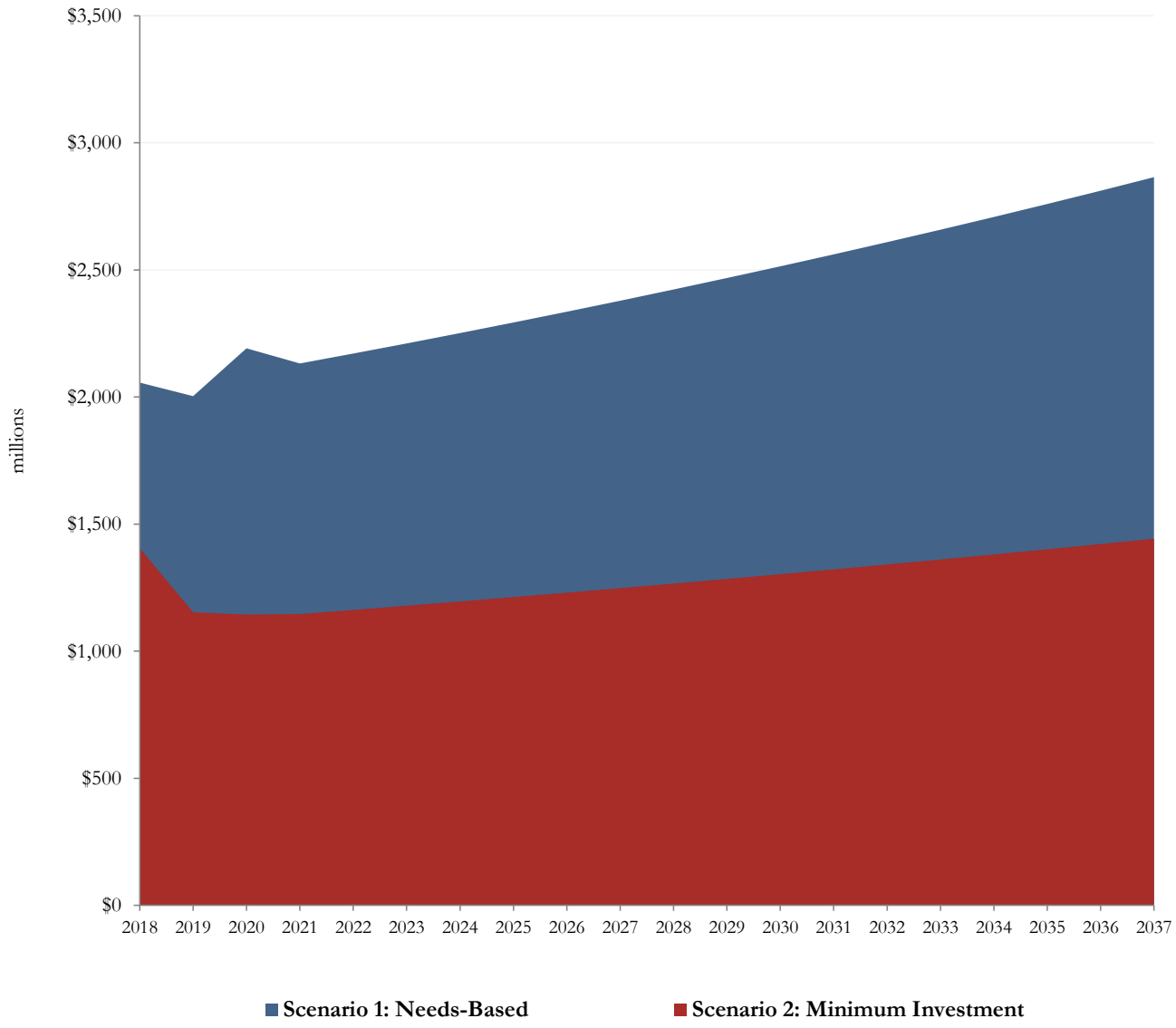
The transportation investment would support over 13,000 jobs throughout the state in all sectors, including manufacturing, retail trade, services, health care, tourism and food services and construction. These employees would earn an average of $655 million in annual wages, adding up to $13 billion over 20 years.

The purchases made by Connecticut construction firms, their suppliers and employees would support a total of $2.2 billion in economic output throughout all sectors of the economy each year. This would contribute $1.2 billion annually to the Connecticut GDP. Over 20 years this would be $44.8 billion in output and sales for Connecticut businesses and $24.2 billion in state GDP.

Transportation users would see some degree of benefits and savings under both the needs-based plan and the minimum investment scenario. But the difference between the two scenarios represents a lost opportunity and the real economic cost of not increasing transportation investment.

This economic loss averages $3.2 billion each year and adds up to $65 billion over two decades. The annual cost grows over time as businesses are not able to take advantage of productivity gains and system improvements are delayed.

Highway, Bridge & Transit Investment Scenarios
FFY 2018 to 2037 (in millions)



V. Transportation Investment is Key to Business Success

Connecticut's highway, bridge and transit network is integral to the success of the state economy—facilitating the shipment of over $231 billion in goods produced by Connecticut businesses. The efficient and safe movement of goods and people is critical to the economic competitiveness of Connecticut and the quality of life for its citizens. Every employee, customer and business pays a price when the system is congested, unsafe or in poor condition.

In addition to spurring immediate economic growth, investment in Connecticut's infrastructure creates tangible assets that are long-lived and facilitates economic activity for many years to come by providing access to jobs, services, materials and markets. An improved transportation network results in reduced operating costs and increased market access for Connecticut businesses. Sustained investment in highways, bridges and transit is critical to making the best use of these capital assets.

The importance of a robust transportation network has been well documented by business analysts, economists and the research community.[18] Overall estimates are that every $1 increase in the highway and bridge capital stock generates a total of 30 cents in business savings.[19]

Some of these specific benefits include:

- Staying Competitive: The overall business environment in the United States is changing, and there is likely to be a greater importance placed on logistics and global transportation networks.[20] The value of total truck freight shipments on Connecticut roads is expected increase from $247.3 billion in 2015 to $372.8 billion in 2040. Truck shipments of Connecticut goods for export alone are estimated to increase from $3.9 billion in 2015 to $12.5 billion—an increase of over 220 percent.[21]

- Access to Labor: A better transportation system means that it is easier for employees to get to work and businesses may recruit from a larger pool of potential workers. Investment in highway, bridge and transit allows businesses to benefit from an expanded labor pool of specialized workers, which means access to more productive employees. Investing in a high quality transit system specifically allows density to develop and business

[18] Glen Weisbrod, Don Very, & George Treyz, "Measuring Economic Costs of Urban Traffic Congestion to Business."

[19] Nadiri, M. Ishaq and Theofanis P. Mamuneas, "Contribution of Highway Capital to Output and Productivity Growth in the U.S. Economy and Industries," Federal Highway Administration, 1998.

[20] Ronald McQuaid, Malcom Greig, Austin Smith, & James Cooper, "The Importance of Transport in Business' Location Decisions," January 2004, < http://stopstanstedexpansion.com/documents/sse10_appendix_9.pdf>.

[21] Freight Analysis Framework

clusters to grow.[22] Downtown office district locations, which are often focused on financial services and related business sectors, usually coincide with the location of higher availability and usage of public transportation.[23]

- Increased Market Share & More Customers: A good transportation system means that Connecticut businesses can reach a greater pool of customers. For example, if a pharmaceutical company can count on better roads for its employees and key product delivery and supply routes, the company may be able to increase employment and its market access to hospitals and other linked industries. Local industries will benefit from these larger markets and reduced transaction costs.[24]

- Business Expansion: Connecticut businesses would increase their output of goods and services at higher levels of investment. A modern transportation system enables business growth, expansion, and increased hiring. Reducing congestion has a demonstrable impact on shipping volume and on prices, with a rate of return of about 10 percent a year, as a conservative estimate.[25] Lower transport costs also have a quantifiable effect on firm choices with respect to suppliers and relatively improve firm hiring ability.

- Increase in Demand for Inputs: As the economy expands, businesses will purchase more goods from their suppliers and will increase their demand for private capital. This includes buying more vehicles, equipment, office supplies or even building new plants and factories.[26]

- Reducing Production Costs: Economic studies show that reduced costs for inputs is one of the main business benefits from an increase in transportation investment. Typically businesses pay less for inputs when they have access to larger markets.[27]

- Agglomeration Economies: Firms benefit by locating near one another, even if they are competitors. This is known as the agglomeration of market activity. This happens because a group of firms will attract a greater number of suppliers and customers than one company alone. Lower transportation costs are a key factor for agglomeration, and will be important in attracting new firms to an area.[28] Increasing returns to local industries can be anticipated in areas with intermodal linkages or intra-modally, as between major highways.

[22] Daniel Graham, "Agglomeration Economies and Transport Investments," Imperial College, December 2007.

[23] Weisbrod, 20.

[24] McQuaid, 29.

[25] Zhigang Li andYu Chen, "Estimating the Social Return to Transport Infrastructure: A Price-Difference Approach Applied to a Quasi-Experiment," 2013, Journal of Comparative Economics, Vol. 41 (3), pg 669-683.

[26] The magnitude of the effect of highway capital on output will differ by industry, with the largest difference observed between manufacturing and non-manufacturing industries.

[27] It is an industry standard to use elasticities of supply and demand for materials as a measure of the impact of a change in transportation infrastructure investment. Based on a study conducted by the FHWA, the output elasticity of materials is usually the largest. The elasticity of labor and capital inputs is the second largest.

[28] Jean-Paul Rodrigue, "Transport and Location," The Geography of Transport Systems, 2017, <https://people.hofstra.edu/geotrans/eng/ch2en/conc2en/ch2c4en.html>.

Agglomeration effects are seen in public transportation as well, with clustering of economic activity around station stops. This clustering results in a smaller distance that Connecticut residents have to travel to access job opportunities. Subsequently, job seekers can expand the geographic area in which they can search for jobs, making a greater number of jobs available to them.[29] Additionally, by locating near public transit, businesses save money since they can build less parking infrastructure. A Washington Metropolitan Area Transit Authority study estimates that building parking for the federal employees who take the Metro instead each day would cost the government $2.4 billion.[30]

- More Efficient Operations: With an efficient transportation system, businesses can make better decisions about their products, inputs and workforce without worrying about poor roadways or congestion. Businesses respond in a variety of ways to congestion. Some businesses may change their mix of labor and capital, reduce the daily deliveries made by a driver or serve a smaller, more specialized market. All of these adjustments can mean a loss for business productivity and market share.[31]

- Intra-Industry Linkages: Connecticut industries are heavily interlinked, relying on other industries for the supply of inputs or for final processing. These linkages rely on an efficient network of well-maintained highways, roads, bridges and railways.

- Fostering Innovation: Transportation infrastructure investment is closely linked with economic competitiveness. Research suggests that highway investment results in industry growth and innovation.[32] Innovation results from infrastructure better supporting business activity. Infrastructure also attracts research and development firms for the large return on investment it offers.

- Access to Global Markets: Many Connecticut firms depend on connections to global markets. A robust and efficient transportation system makes Connecticut firms less vulnerable to economic shocks and less vulnerable to losing their competitive edge compared to other emerging industries. Industries also benefit from access to secondary markets, supported by a modern transportation infrastructure system.

- Emergency Management Operations: A well-invested transportation system will ensure that evacuation routes remain efficient and accessible during major storms. In addition, the proper transportation investments will ensure that road networks are resilient to future super storms.

[29] Anthony Venables, "Evaluating Urban Transport Improvements: Cost-Benefit Analysis in the Presence of Agglomeration and Income Taxation," September 2004.

[30] "Making the Case for Transit: WMATA Regional Benefits of Transit," WMATA, November 2011: 4.

[31] Weisbrod, 4.

[32] Katherine Bell. "Investing in Infrastructure Means Investing in Innovation." Harvard Business Review, March 2012. In 2011, researchers at the University of Texas A&M found a critical link between the forecasted growth of the industry and investment in the transportation infrastructure system, using standard supply and demand analysis (Rosson 2011)

- Spillover Savings: In addition to the cost-reducing impact of reducing road roughness, increasing average speed, and reducing total user and travel time costs on firm costs in this sector, reducing congestion has a demonstrable impact on shipping volume and on prices, with a return of about 10 percent a year, as a conservative estimate.[33] Lower transport costs also have a quantifiable effect on firm choices with respect to suppliers and relatively improve firm hiring ability. Reducing transportation costs within this sector will have a significant spillover effect on all industries in the state and can be expected to be reflected in relatively lowering the cost of goods within the state, for both consumers and businesses.[34]

Consider the benefits to a business in Connecticut when the state makes transportation improvements. The increase in construction activity will mean more demand for products and services in the area. A local business would sell more of its products and may even hire additional employees to increase output. With an improved transportation network, local business on the many main streets in Connecticut would thrive.

The business will also have lower distribution costs because of the improved highways, bridges and transit in the area. More customers will be able to reach the business, and the owner may be able to hire more talented, educated and skilled workers that live further away.

The increase in demand may also lead the business to expand, opening another store, plant or business location. Finally, the business will demand more inputs and raw materials from their own suppliers, creating economic ripple effects throughout the economy. It could also be the case that the business owner is able to purchase cheaper inputs because they have greater access to more markets.

[33] Li, 669-683.

[34] ICF Consulting, "Economic Effects of Transportation: The Freight Story," 2002.

VI. Economic Impact on Key Connecticut Industries

In 2015, Connecticut released an economic development strategy to increase the state's economic competitiveness. This strategy identified six key business clusters that are crucial to the future of the state's economic development and growth:[35]

- Healthcare/Bioscience
- Insurance and Financial Services
- Advanced Manufacturing
- Digital Media
- Tourism
- Green Technologies

Together, these six industries are strong drivers of Connecticut's economic growth, comprising over half of establishments across the state and employing 60 percent of employees[36]; employment growth and earnings for these industries are also above the state average[37]. Their future success is largely dependent on the state's transportation network.

How would increasing investment benefit each of these key sectors? And in turn, how will failing to adequately invest in the state's infrastructure network act as a deterrent for business expansion? This section examines the unique aspects of each of these key growth industries and how they are dependent on transportation investment.

Increased investment per the needs-based plan will increase economic productivity, reduce business costs, and stimulate the growth of these industries.

Failing to implement this plan will result in a loss of $10.9 billion in economic activity, 3,193 annual jobs and $3.14 billion in wages in these industries over the next 20 years.

[35] Connecticut 2015 Economic Development Strategy, 2015, <http://www.ct.gov/ecd/lib/ecd/2015_strategic_plan_final.pdf>.

[36] U.S. Census Bureau County Business Patterns 2015 data. Industry-level employment is defined using NAICS codes in the Appendix.

[37] Connecticut 2015 Economic Development Strategy.

Healthcare/Bioscience Industry

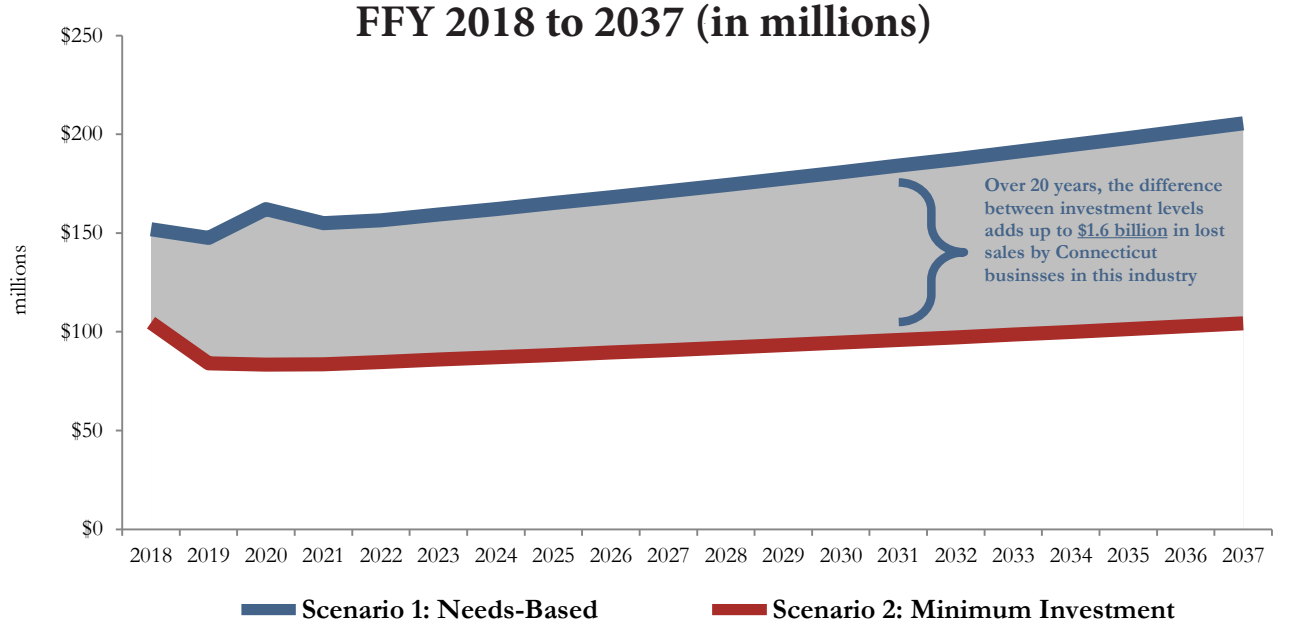
There are an estimated 9,298 firms in Connecticut's healthcare and bioscience industry, comprising major healthcare categories, including physician offices, outpatient care centers, medical laboratories and home healthcare services, as well as selected agricultural pharmaceutical and other subsectors that comprise the bioscience industry. These firms employ over 251,200 employees, who earn approximately $15.3 billion annually.[38]

Fully implementing the needs-based plan would support increased output, jobs and earnings in the healthcare and bioscience sector:

- Under Scenario 1, there would be an average of 1,248 jobs supported or created each year, compared to 665 jobs supported or created annually under Scenario 2.
- Those employees under Scenario 1 would earn $67 million in wages each year (compared to $36 million under Scenario 2), which would be spent on additional goods and services throughout the economy, thereby stimulating more market activity.
- Over the next 20 years, output by firms in the healthcare and bioscience sector would increase by about $3.5 billion under Scenario 1. Under Scenario 2, firms would face a potential economic loss of $1.6 billion.

[38] U.S. Census Bureau County Business Patterns 2015 data. Industry-level employment is defined using NAICS codes specified in Appendix 3. Earnings figures are adjusted for inflation to 2017 current dollars.

Healthcare/Bioscience Industry: Economic Output Supported by Highway, Bridge & Transit Investment FFY 2018 to 2037 (in millions)



- The value added by the healthcare and bioscience industry would increase Connecticut's annual GDP by $99 million under Scenario 1, compared to $53 million under Scenario 2.[39]

The healthcare and bioscience industry is one of the fastest growing business clusters in Connecticut today. As baby boomers age, traditional healthcare jobs continue to expand. At the same time, bioscience research and development is driving much of this growth. The Connecticut Bioscience Innovation Fund was created in 2013, and plans to invest $200 million in innovative research.[40] This comes after a massive government investment in "Bioscience Connecticut" in 2011. Designed to create construction jobs in the short term and bioscience growth in the long term, "Bioscience Connecticut" included the building of $450 million worth of infrastructure, mostly at UConn's Health Center.[41]

In the bioscience industry, there are more than 800 companies who employ over 50,000 employees.[42] In 2014, the biopharmaceutical sector alone generated over $8.2 billion in economic output.[43]

A robust highway and bridge network is necessary both to sustain Connecticut's healthcare and bioscience companies, and to support innovation, which will give the state a competitive edge in the twenty-first century.

[39] Value added is the sum of all output in an industry less the cost of inputs. Total industry output is the sum of all sales in the sector. Therefore the sale of an input in this sector would be counted as output, but that value would be subtracted from the total value of the final product it is used for. GDP measures the sum of all value added and final products in the economy.

[40] Connecticut 2015 Economic Development Strategy, 7.

[41] UConn Health, "Bioscience Connecticut Report to the General Assembly," March 2017.

[42] Connecticut 2015 Economic Development Strategy, 7.

[43] PhRMA, "The Economic Impact of the U.S. Biopharmaceutical Industry: National and State Estimates," May 2016. <http://phrma-docs.phrma.org/sites/default/files/pdf/biopharmaceuticaul-industry-economic-impact.pdf>.

Average Annual Economic Impacts of Connecticut Highway, Bridge and Transit Investment on the Healthcare/Bioscience Industry FFY 2018-2037

	Scenario 1: Needs-Based	Scenario 2: Minimum Investment	Annual Difference
GDP	$99 million	$53 million	$46 million
Economic Output	$175 million	$93 million	$82 million
Earnings	$67 million	$36 million	$31 million
Total	**$341 million**	**$182 million**	**$159 million**
Employment	1,248 people	665 people	583 people

Economic research has demonstrated the importance of a state's highway and bridge network to the healthcare and bioscience industry:

- Fostering Innovation: Innovation in the healthcare market is critical for patient care and life-saving technologies, but it is also important for healthcare firms to remain linked to transmit knowledge and resources across sub-industries.

- Agglomeration Economies: The presence of existing bioscience resources in a state encourages labs to relocate there. In fact, the Biological Industries firm has confirmed that a key reason they located in Connecticut was the proximity to Jackson Lab, another cell-focused organization.[44]

- Employee Access: An advantage of locating in Connecticut is the state's well-educated populous.[45] For bioscience companies looking to relocate to the region, the presence of a strong transportation system is beneficial; dependable highways provide employees easy access to the state's business districts, allowing companies to take advantage of hiring Connecticut's qualified citizens.

- Patient Access: Research demonstrates the importance of transportation for ensuring that healthcare customers are not cut off from hospitals, clinics, pharmacies and other businesses in the healthcare sector, an industry priority.[46] Transportation systems are also vital to connect healthcare firms to suppliers who bring in medicine and equipment, and to healthcare employees.

- Intra-Industry Linkages: The healthcare industry is heavily interlinked; private clinics are connected to hospitals which refer to specialists who outsource work to medical laboratories.[47] All of these linkages must be supported by a web of functioning highways and roads which can maintain a 21st century healthcare system[48]. While the physical distance between a hospital and a rural clinic may appear short on a map, a critically underfunded highway system could mean the difference between life and death for patients.

The businesses and employment in this cluster are focused in the Hartford region. As part of the New Haven to Springfield Corridor, Hartford relies on Interstates 91 and 84. Additionally, a new Springfield to New Haven commuter rail service is scheduled to begin operation in 2018. Maintaining and improving the infrastructure in this region will be important to maintaining Connecticut's growing healthcare and bioscience industry.

[44] Gregory Seay, "Amid budget headwinds, CT's bioscience gains solidify," HartfordBusiness.com, 04 April 2016.

[45] Gregory Seay, "Amid budget headwinds, CT's bioscience gains solidify," HartfordBusiness.com, 04 April 2016.

[46] Thomas A Arcury, W. Gesler, J.S. Presser, J. Sherman, J. Perin, "The Effects of Geography and Spatial Behavior on Health Care Utilization among the Residents of a Rural Region," Health Services Research, Vol 40, Issue 1, pg 1135-156, February 2005.

[47] David Dranove and M.A. Satterwaite, "The Industrial Organization of Health Care Markets," Handbook of Health Economics, Chapter 20, Volume 1, Part B, pg 1093-1139, 2000.

[48] Gary P. Jarret, "Logistics in the Health Care Industry," International Journal of Physical Distribution & Logistics Management, Vol. 28, pg 741-772.

Insurance and Financial Services Industry

There are an estimated 5,995 firms in Connecticut's insurance and financial services industry. These firms employ over 122,400 employees, who earn approximately $19.6 billion annually.[49] Known as the "Insurance Capital of the World," Connecticut owes a huge part of its economy to the insurance and financial services cluster. This industry has the highest concentration of actuaries and insurance employees per capita,[50] and accounted for 13 percent of Connecticut's GDP in 2016.[51] Additionally, the Connecticut Economic Resource Center projects that the finance sector will grow by as much as 30 percent by 2024.[52]

Fully implementing the needs-based plan would support increased output, jobs and earnings in the insurance and financial services sector:

- Under Scenario 1, there would be an average of 527 jobs supported or created each year, compared to 280 jobs supported or created annually under Scenario 2.
- Those employees under Scenario 1 would earn $39 million in wages each year (compared to $21 million under Scenario 2), which would be spent on additional goods and services throughout the economy, thereby stimulating more market activity.
- Over the next 20 years, output by firms in this sector would increase by about $3.3 billion under Scenario 1. Under Scenario

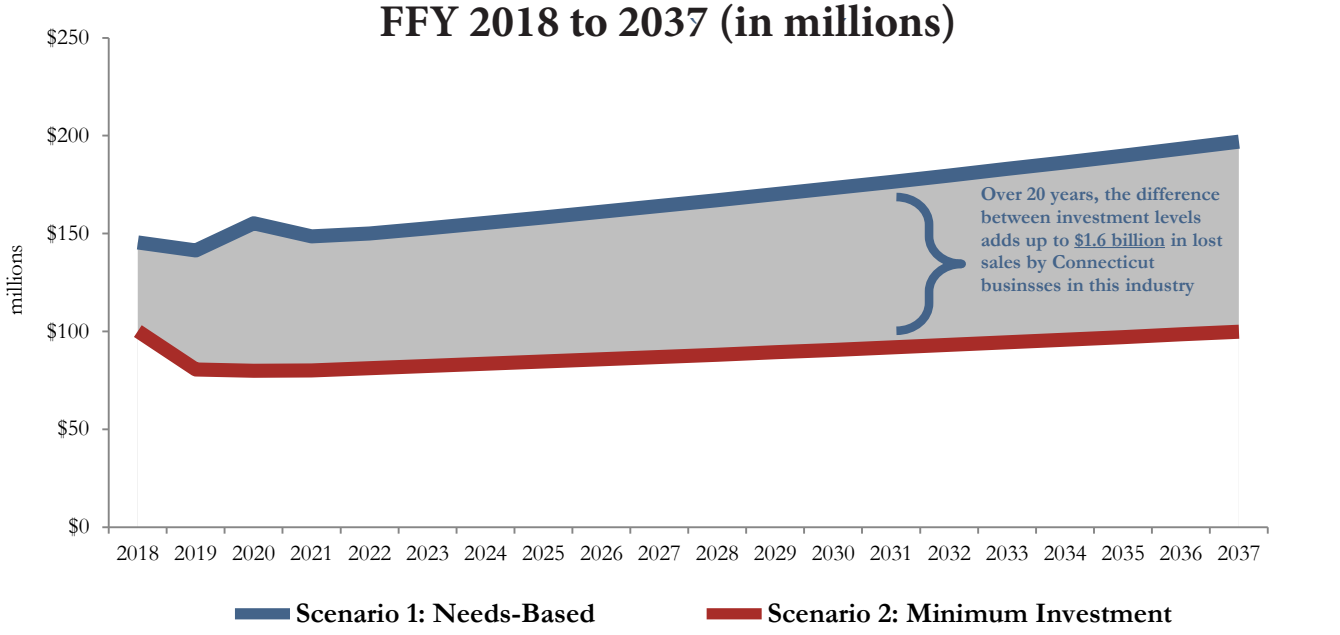
[49] U.S. Census Bureau County Business Patterns 2015 data. Industry-level employment is defined using NAICS codes specified in Appendix 3. Earnings figures are adjusted for inflation to 2017 current dollars.

[50] Connecticut Government, "Insurance and Financial Services". <http://portal.ct.gov/Business-Portal/Insurance-and-Financial-Services>.

[51] U.S. Bureau of Economic Analysis

[52] Connecticut 2015 Economic Development Strategy, 8.

Insurance and Financial Services Industry: Economic Output Supported by Highway, Bridge & Transit Investment FFY 2018 to 2037 (in millions)



Average Annual Economic Impacts of Connecticut Highway, Bridge and Transit Investment on the Insurance and Financial Services Industry FFY 2018–2037			
	Scenario 1: Needs-Based	Scenario 2: Minimum Investment	Annual Difference
GDP	$88 million	$47 million	$41 million
Economic Output	$167 million	$89 million	$78 million
Earnings	$39 million	$21 million	$18 million
Total	**$294 million**	**$157 million**	**$138 million**
Employment	527 people	280 people	247 people

2, firms would face a potential economic loss of $1.6 billion.

- The value added by this industry would increase Connecticut's annual GDP by $88 million under Scenario 1, compared to $47 million under Scenario 2.[53]

The success of this cluster is strongly tied to trade and transportation, as residents of neighboring states often rely on Hartford finance and insurance firms. Tourism Economics estimated that in 2015, travel spending across the state generated an economic impact of $2.3 billion in sales and $1.7 billion in GDP on the finance, insurance and real estate sector.[54]

The industry is heavily concentrated in Hartford, which is located in the strategic investment corridor of New Haven to Springfield. This region relies heavily on Interstates 91 and 84, especially for access to Hartford from neighboring states. Investment in the highways of this region will help to enable the continued dominance of Hartford's insurance industry.

There is a demonstrated importance of a strong transportation network to the insurance and financial services sector:

- Increased Market Access: As much as $2.3 billion in financial services and $893 million in insurance services were exported from Connecticut in 2014, with 41,700 finance and insurance sector jobs tied to trade.[55] The ability for employees of Hartford firms to travel to New York, Boston, or internationally, is significantly improved by a strong network of bridges and highways. Similarly, employees from other cities can travel to Hartford more easily.

- Agglomeration Economies: Hartford's concentration of insurance companies is an example of agglomeration. Many Connecticut residents go to Hartford for insurance and financial services, because the region is known for its success. The growth of this industry will be aided by lower transportation costs, through robust highway investment.

[53] Value added is the sum of all output in an industry less the cost of inputs. Total industry output is the sum of all sales in the sector. Therefore the sale of an input in this sector would be counted as output, but that value would be subtracted from the total value of the final product it is used for. GDP measures the sum of all value added and final products in the economy.

[54] Tourism Economics, "The Economic Impact of Travel in Connecticut: For Calendar Year 2015," March 2017, <http://www.cultureandtourism.org/cct/lib/cct/tourism/econimpact/Conn_Tourism_Economic_Impact_-_CY2015_full_Web.pdf.>.

[55] Business Roundtable, "How Connecticut's Economy Benefits from International Trade & Investment," 2015, < http://tradepartnership.com/wp-content/uploads/2015/01/CT_TRADE_2013.pdf>.

Advanced Manufacturing Industry

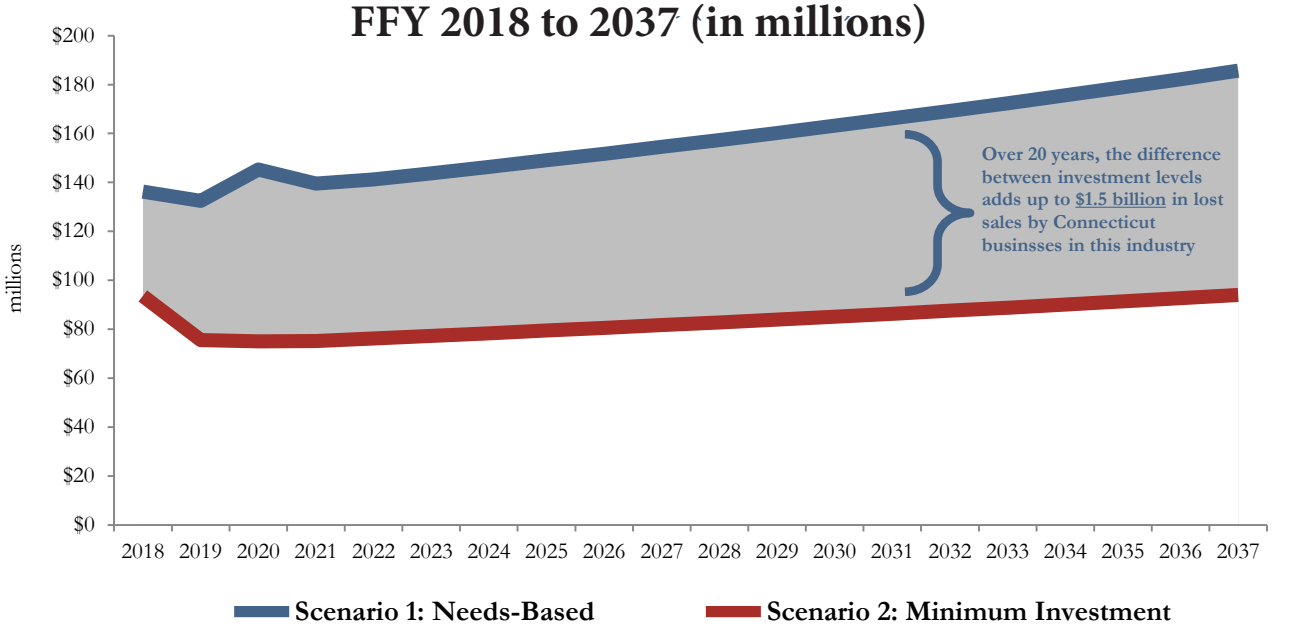
There are an estimated 1,343 firms in Connecticut's advanced manufacturing business cluster, which comprises research-intensive manufacturing industries that incorporate science, mathematics, engineering and technology skills. These firms employ over 57,700 employees, who earn approximately $4.8 billion annually.[56]

Fully implementing the needs-based plan would support increased output, jobs and earnings in the advanced manufacturing sector:

- Under Scenario 1, there would be an average of 499 jobs supported or created each year, compared to 266 jobs supported or created annually under Scenario 2.
- Those employees under Scenario 1 would earn $30 million in wages each year (compared to $16 million under Scenario 2), which would be spent on additional goods and services throughout the economy, thereby stimulating more market activity.
- Over the next 20 years, output by firms in this sector would increase by about $3.2 billion under Scenario 1. Under Scenario 2, firms would face a potential economic loss of $1.5 billion.

[56] U.S. Census Bureau County Business Patterns 2015 data. Industry-level employment is defined using NAICS codes specified in Appendix 3. Earnings figures are adjusted for inflation to 2017 current dollars.

Advanced Manufacturing Industry:
Economic Output Supported by Highway, Bridge & Transit Investment
FFY 2018 to 2037 (in millions)



Average Annual Economic Impacts of Connecticut Highway, Bridge and Transit Investment on the Advanced Manufacturing Industry FFY 2018-2037			
	Scenario 1: Needs-Based	Scenario 2: Minimum Investment	Annual Difference
GDP	$58 million	$31 million	$27 million
Economic Output	$158 million	$84 million	$74 million
Earnings	$30 million	$16 million	$14 million
Total	**$246 million**	**$131 million**	**$115 million**
Employment	499 people	266 people	233 people

- The value added by this industry would increase Connecticut's annual GDP by $58 million under Scenario 1, compared to $31 million under Scenario 2.[57]

The advanced manufacturing sector has been growing in recent years, aided in part by a state investment of $70 million through the Manufacturing Innovation Fund.[58]

These are among the significant economic benefits that the advanced manufacturing industry experiences from transportation investment:

- Employee Access: Upgrades in water infrastructure, highways, bridges, and similar infrastructure has been reported to stimulate the creation of skilled manufacturing jobs. Direct ties exist between manufacturing jobs and transportation, largely because better transit enables inner-city residents to access a wider range of jobs, as well as relevant education.[59]
- Distribution of Products: Improved rail systems and additional highway miles reduce traffic and other challenges faced in shipping products.[60] The distribution of manufactured goods is crucial to this sector of the economy, and is significantly hampered by congestion and limited infrastructure. A well-developed system will increase efficiency, reduce operation costs and promote service quality.[61]

[57] Value added is the sum of all output in an industry less the cost of inputs. Total industry output is the sum of all sales in the sector. Therefore the sale of an input in this sector would be counted as output, but that value would be subtracted from the total value of the final product it is used for. GDP measures the sum of all value added and final products in the economy.

[58] Connecticut 2015 Economic Development Strategy, 9.

[59] Karla Lindquist, "Report on Connecticut's Future," December 2014. <http://www.ct.gov/ecd/lib/ecd/futures/commission_on_connecticuts_future_report.pdf>.

[60] Lindquist, 12.

[61] Y. Tseng and W.L. Yue, "The Role of Transportation in Logistics Chain," 2005, Proceedings of the Eastern Asia Society for Transportation Studies, 5, p. 1657-1672.

- Agglomeration Industries: Although agglomeration is important for all businesses, it is especially important for the manufacturing sector. Collaboration among manufacturing sectors in nearby states can be beneficial to each individual state's industry. Improved infrastructure enables this exchange, creating a critical mass of manufacturing in the region.[62] For Connecticut's advanced manufacturing sector to continue to expand, it would benefit from a more accessible region.

- Business Logistics: The Connecticut transportation system is the most important factor when considering the business logistics systems for manufacturers. A well-developed system will increase efficiency, reduce operation costs and promote service quality.[63] Since transportation costs are an input to manufacturing, reducing those costs would make the industry more competitive.

- Trade Specialization: Research has shown that cities with more highways will specialize in the production of heavy goods, such as motor vehicles, ships and boats, railroad rolling stock, machinery and equipment. Studies estimate that a ten percent increase in a city's stock of highways causes about a five percent increase in the weight of exports. Thus city highways are a comparative advantage for the production of heavy goods, such as manufacturing equipment.[64]

There is a significant manufacturing sector located in Eastern Connecticut, an identified strategic investment corridor in the state plan.[65] This sector is largely dominated by General Dynamics Electric Boat which is located in Groton. Eastern Connecticut comprises New London and Windham counties, and is largely dependent on I-95 and I-395.

[62] Lindquist, 14-15.

[63] Tseng, 1657-1672.

[64] Gilles Duranton, Peter Morrow, & Matthew Turner, "Roads and Trade: Evidence from the US," 2013, CEPR Discussion Paper No. DP9393. Available at SSRN: <https://ssrn.com/abstract=2235491>.

[65] Connecticut Department of Transportation, "Let's Go CT! Connecticut's Bold Vision for a Transportation Future," February 2015.

Digital Media Industry

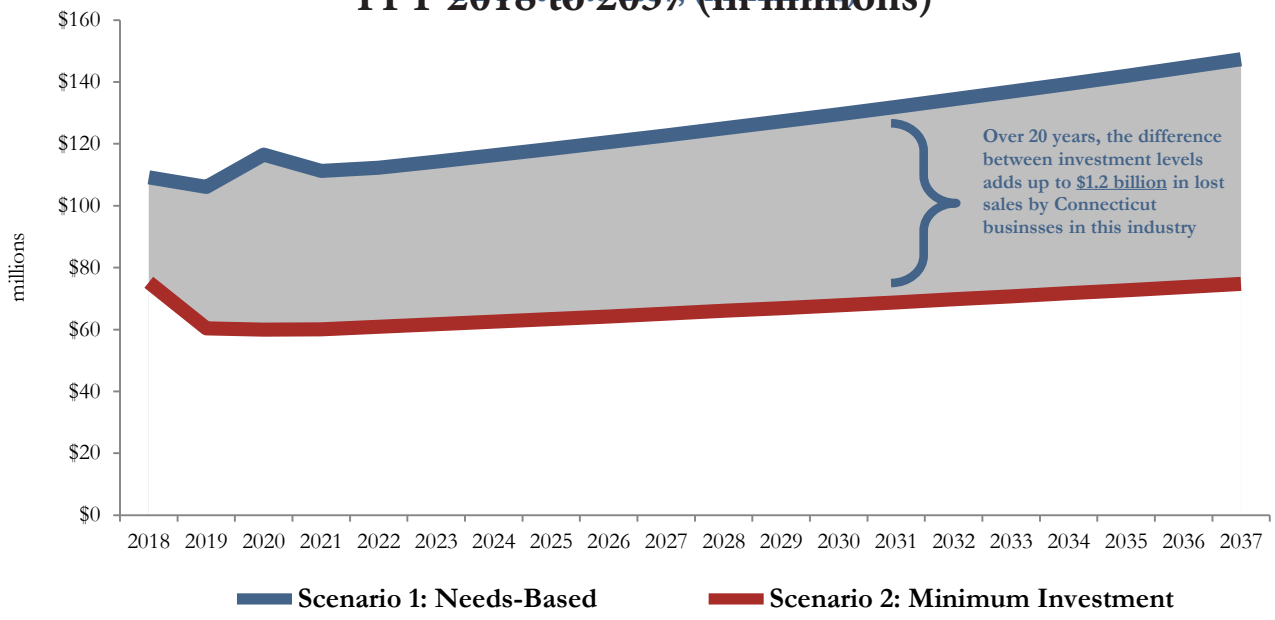
There are an estimated 5,570 firms in Connecticut's digital media business cluster, which comprises internet-dependent industries as well as telecommunications, broadcasting and data processing services. These firms employ over 90,800 employees, who earn approximately $9.1 billion annually.[66]

Fully implementing the needs-based plan would support increased output, jobs and earnings in the digital media sector:

- Under Scenario 1, there would be an average of 496 jobs supported or created each year, compared to 264 jobs supported or created annually under Scenario 2.
- Those employees under Scenario 1 would earn $34 million in wages each year (compared to $18 million under Scenario 2), which would be spent on additional goods and services throughout the economy, thereby stimulating more market activity.
- Over the next 20 years, output by firms in this sector would increase by about $2.5 billion under Scenario 1. Under Scenario 2, firms would face a potential economic loss of $1.2 billion.

[66] U.S. Census Bureau County Business Patterns 2015 data. Industry-level employment is defined using NAICS codes specified in Appendix 3. Earnings figures are adjusted for inflation to 2017 current dollars.

Digital Media Industry: Economic Output Supported by Highway, Bridge & Transit Investment FFY 2018 to 2037 (in millions)



Average Annual Economic Impacts of Connecticut Highway, Bridge and Transit Investment on the Digital Media Industry FFY 2018-2037			
	Scenario 1: Needs-Based	Scenario 2: Minimum Investment	Annual Difference
GDP	$72 million	$39 million	$34 million
Economic Output	$125 million	$67 million	$59 million
Earnings	$34 million	$18 million	$16 million
Total	**$231 million**	**$123 million**	**$108 million**
Employment	496 people	264 people	231 people

- The value added by this industry would increase Connecticut's annual GDP by $72 million under Scenario 1, compared to $39 million under Scenario 2.[67]

The digital media cluster has been a consistent powerhouse for the Connecticut economy, with an average spending of $200 million each year since 2006.[68] In addition to in-state benefits, the digital media sector had exports valued at $7 billion in 2015, accounting for almost three percent of the state's total exports.[69]

The economic advantages of investing in transportation infrastructure are not lost on the digital media industry:

- Inter-Industry Linkages: The digital media industry is closely linked with information technology, particularly as our access to media becomes increasingly technology-driven as time goes on. Information technology is used to produce company websites, edit news clips and articles, and distribute new content. The continued growth of the digital media industry is tied to the success of the IT sector. A strong highway and bridge network can facilitate exchange between industries, or between companies within an industry.

Some of the companies in this industry include such well-known names as ESPN, NBC Sports, and WWE, along with networks like YES and A&E, talk shows, and movie studios.[70] Many of these companies are headquartered in Stamford, which is located in the strategic New York-to-New Haven corridor. There are identified capital improvement needs in that corridor of $29.5 billion over the next 30 years.[71] This region is heavily dependent on highways like I-95, US-1, and SR-15.

[67] Value added is the sum of all output in an industry less the cost of inputs. Total industry output is the sum of all sales in the sector. Therefore the sale of an input in this sector would be counted as output, but that value would be subtracted from the total value of the final product it is used for. GDP measures the sum of all value added and final products in the economy.

[68] Connecticut 2015 Economic Development Strategy, 10.

[69] Connecticut Government, "Digital Media," <http://portal.ct.gov/Business-Portal/Digital-Media>.

[70] Connecticut 2015 Economic Development Strategy, 10.

[71] Connecticut Department of Transportation, "Let's Go CT! Connecticut's Bold Vision for a Transportation Future," February 2015.

Tourism Industry

There are an estimated 23,036 firms in Connecticut's tourism business cluster, which comprises industries related to travel and hospitality. These firms employ over 346,300 employees, who earn approximately $9.5 billion annually.[72]

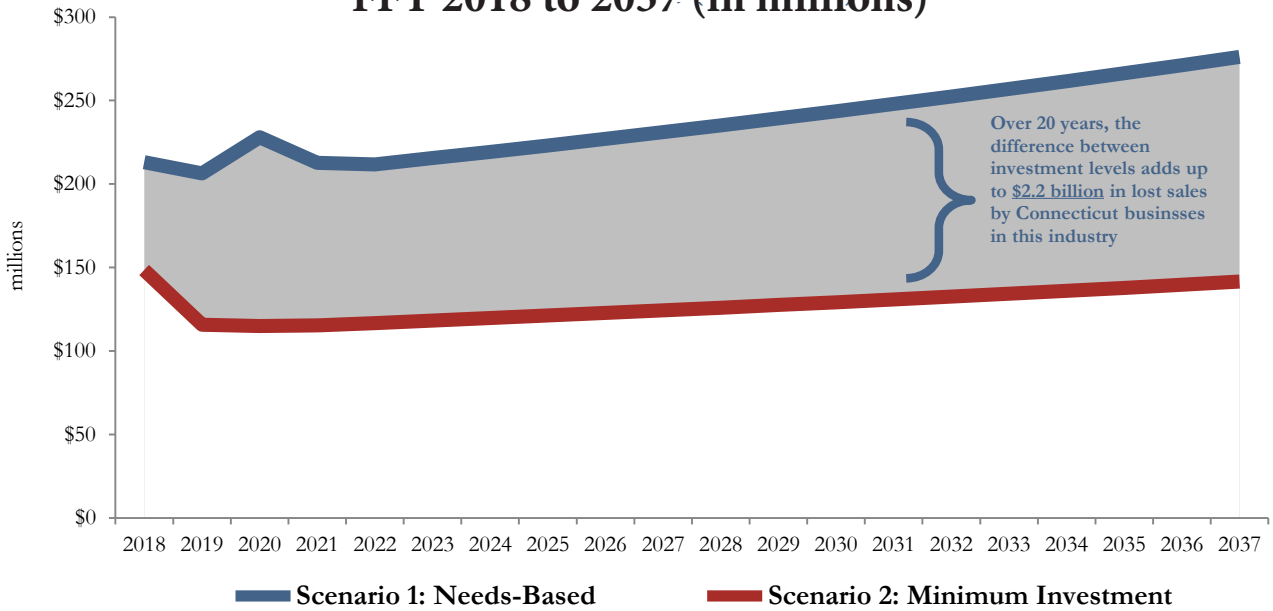
Fully implementing the needs-based plan would support increased output, jobs and earnings in the tourism sector:

- Under Scenario 1, there would be an average of 2,658 jobs supported or created each year, compared to 1,432 jobs supported or created annually under Scenario 2.
- Those employees under Scenario 1 would earn $77 million in wages each year (compared to $42 million under Scenario 2), which would be spent on additional goods and services throughout the economy, thereby stimulating more market activity.
- Over the next 20 years, output by firms in this sector would increase by about $4.7 billion under Scenario 1. Under Scenario 2, firms would face a potential economic loss of $2.2 billion.
- The value added by this industry would increase Connecticut's annual GDP by $148 million under Scenario 1, compared to $80 million under Scenario 2.[73]

[72] U.S. Census Bureau County Business Patterns 2015 data. Industry-level employment is defined using NAICS codes specified in Appendix 3. Earnings figures are adjusted for inflation to 2017 current dollars.

[73] Value added is the sum of all output in an industry less the cost of inputs. Total industry output is the sum of all sales in the sector. Therefore the sale of an input in this sector would be counted as output, but that value would be subtracted from the total value of the final product it is used for. GDP measures the sum of all value added and final products in the economy.

Tourism Industry: Economic Output Supported by Highway, Bridge & Transit Investment FFY 2018 to 2037 (in millions)



Average Annual Economic Impacts of Connecticut Highway, Bridge and Transit Investment on the Tourism Industry FFY 2018-2037			
	Scenario 1: Needs-Based	Scenario 2: Minimum Investment	Annual Difference
GDP	$148 million	$80 million	$68 million
Economic Output	$237 million	$128 million	$109 million
Earnings	$77 million	$42 million	$36 million
Total	**$462 million**	**$249 million**	**$213 million**
Employment	2,658 people	1,432 people	1,226 people

Travel and tourism in Connecticut generated $8.7 billion dollars in traveler spending in 2015, generating an economic impact of $14.7 billion in traveler sales and $8.4 billion in state GDP. Along with its existing prosperity, the cluster is growing; a study found that the industry has generated more jobs than the year before for five consecutive years.[74]

The Connecticut tourism industry is highly dependent on the state's highway and bridge network. Access to major cities or rural areas is crucial for vacationers to travel to the state. The economic benefits from highway investment are vast for the tourism sector:

- Access to Tourists: Tourist destinations would be useless without a transportation system enabling access to tourist locations and businesses. During high-peak tourism travel times, congestion and poor road conditions can deter travel to popular tourist areas. The more time Connecticut visitors spend on the road, the less time they participate in the local economy. A first class transportation system ensures a first rate experience for tourists and maximizes revenue-generating opportunities for the state and businesses, as highways, bridges and transit systems can form links to shopping and recreation.[75]
- Business Expansion: The majority of tourism firms are small businesses. Because an efficient and improved transportation system enables business growth, tourism firms would be able to expand and increase seasonal hiring.
- Inter-Industry Linkages: The tourism industry is closely linked with the information technology industry.[76] Information technology is used to advertise tourist locations and maintain supply linkages. The regular flow of tourists to tourist locations and businesses is tied to these linkages.

[74] Brian Hallenbeck, "New Study Details Growth in Connecticut Tourism Industry," The Day, 16 March 2017.

[75] Tourism Economics, "The Economic Impact of Travel in Connecticut: For Calendar Year 2015."

[76] P.J. Sheldon, "Tourism Information Technology," Tourism Information Technology, 1997, pg xvi – 224.

While every municipality supports many businesses related to tourism, the largest cluster stretches along the coast, from New York to New Haven, in Fairfield and New Haven Counties. These two counties comprise 40 percent of all estimated traveler spending in Connecticut.[77] This corridor contains three of Connecticut's largest cities (Stamford, Bridgeport and New Haven). The businesses and industry employment in this corridor are primarily dependent on I-95 and the Merritt Parkway, as well as the busiest commuter rail line in the nation, the New Haven Line. To address growing congestion in this critical travel corridor, the state plan includes $29.5 billion in capital investment (29 percent of the total plan) dedicated to that region alone over the next 30 years. The majority of planned improvements in this corridor will address increasing capacity on I-95 and improving rail infrastructure.[78]

The three other identified strategic investment corridors addressed in the state plan[79] also include a significant amount of traveler spending. Hartford and Middlesex counties fall within the New Haven – Hartford – Springfield corridor, along with New Haven county, where an additional 28 percent of travel spending occurs.[80] This state plan includes $5.6 billion in capital investment in the region in order to eliminate bottlenecks and enhance passenger rail along this travel corridor, including adding new stations on the Hartford Line.[81] Businesses along this corridor mostly rely on I-91 and I-84, as well as rail connections to New York, Boston and Montreal.[82]

The New York to Hartford corridor identified in the state plan covers most of the areas already addressed, but also includes an estimated four percent in travel spending in Litchfield county.[83] To restore major bridges and address major bottlenecks in this travel corridor, the plan includes $14.3 billion in capital investment dedicated to that region (14 percent of the total plan). Businesses along this corridor mostly rely on I-84, as well as rail connections to the New Haven Line.[84]

The identified Eastern Connecticut corridor includes a large tourism industry centered around Mystic Seaport, Mystic Aquarium and major casinos, comprising an estimated 27 percent of travel spending in Connecticut.[85] To address major needed improvements on I-95, the state plan includes $14.3 billion in capital investment dedicated to that region. Businesses along this corridor mostly rely on I-95, as well as the Shore Line East.[86]

[77] Tourism Economics, "The Economic Impact of Travel in Connecticut: For Calendar Year 2015."

[78] Connecticut Department of Transportation, "Let's Go CT! Connecticut's Bold Vision for a Transportation Future."

[79] Ibid

[80] Tourism Economics, "The Economic Impact of Travel in Connecticut: For Calendar Year 2015."

[81] Ibid

[82] Connecticut Department of Transportation, "Let's Go CT! Connecticut's Bold Vision for a Transportation Future."

[83] Tourism Economics, "The Economic Impact of Travel in Connecticut: For Calendar Year 2015."

[84] Connecticut Department of Transportation, "Let's Go CT! Connecticut's Bold Vision for a Transportation Future."

[85] Tourism Economics, "The Economic Impact of Travel in Connecticut: For Calendar Year 2015."

[86] Connecticut Department of Transportation, "Let's Go CT! Connecticut's Bold Vision for a Transportation Future."

Green Technologies Industry

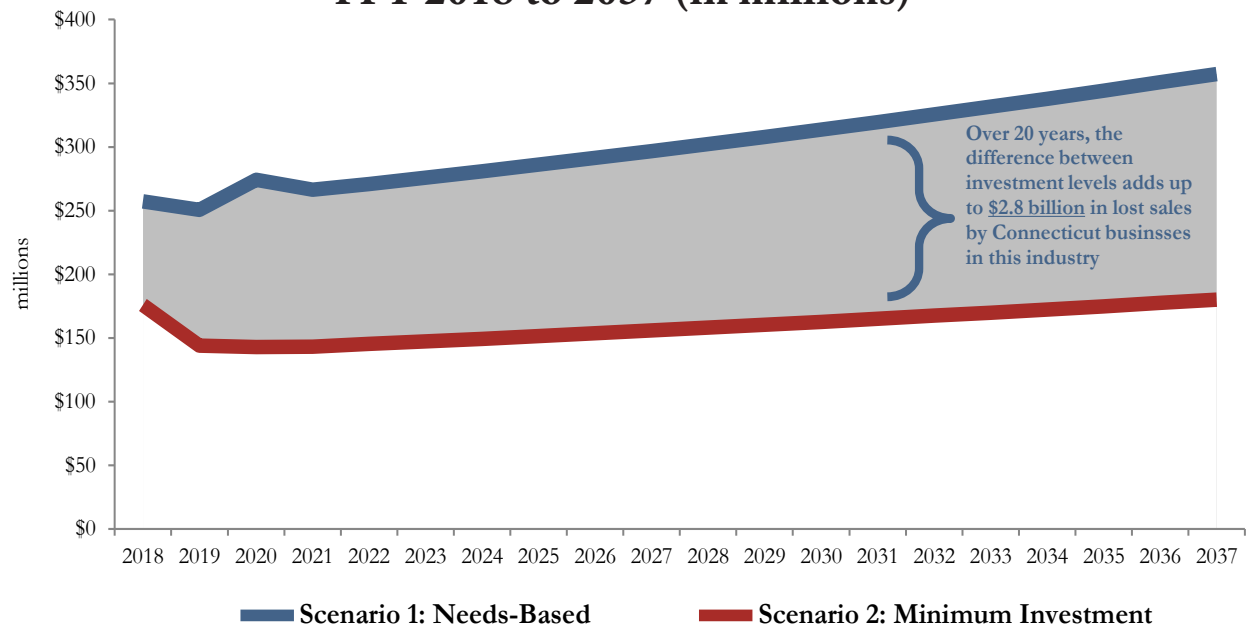
There are an estimated 2,744 firms in Connecticut's green technologies business cluster, which comprises an percentage of all but two sectors in Connecticut, calculated by the Bureau of Labor Statistics. These firms employ over 40,100 employees, who earn approximately $2.7 billion annually.[87]

Fully implementing the needs-based plan would support increased output, jobs and earnings in the green technologies sector:

- Under Scenario 1, there would be an average of 1,445 jobs supported or created each year, compared to 772 jobs supported or created annually under Scenario 2.
- Those employees under Scenario 1 would earn $90 million in wages each year (compared to $48 million under Scenario 2), which would be spent on additional goods and services throughout the economy, thereby stimulating more market activity.
- Over the next 20 years, output by firms in this sector would increase by about $6.0 billion under Scenario 1. Under Scenario 2, firms would face a potential economic loss of $2.8 billion.

[87] U.S. Census Bureau County Business Patterns 2015 data. Industry-level employment is defined using NAICS codes specified in Appendix 3. Earnings figures are adjusted for inflation to 2017 current dollars.

Green Technologies Industry: Economic Output Supported by Highway, Bridge & Transit Investment FFY 2018 to 2037 (in millions)



Average Annual Economic Impacts of Connecticut Highway, Bridge and Transit Investment on the Green Technologies Industry FFY 2018-2037			
	Scenario 1: Needs-Based	Scenario 2: Minimum Investment	Annual Difference
GDP	$158 million	$84 million	$74 million
Economic Output	$302 million	$160 million	$142 million
Earnings	$90 million	$48 million	$42 million
Total	**$550 million**	**$292 million**	**$258 million**
Employment	1,445 people	772 people	672 people

- The value added by this industry would increase Connecticut's annual GDP by $158 million under Scenario 1, compared to $84 million under Scenario 2.[88]

Connecticut is a top-3 state in fuel cells, and is the first state in the nation to create a green bank.[89] Additionally, the state has invested $9 million in seed companies in green technology in 2008.[90] These factors contribute to the growing green technologies cluster in Connecticut today. In fact, Connecticut alone hosts 30 percent of the US jobs, and 50 percent of the regional jobs, which are available in green technology.[91]

Economic research has demonstrated the importance of a strong transportation network to continuing to grow the green technologies cluster:

- Targeted Investments: Connecticut's Green Bank has increasingly been targeting transportation-related policies like low-carbon fuels or alternative fuel vehicles. These policies are important as part of an eco-friendly policy, since transportation accounts for 40 percent of the state's greenhouse gas emissions.[92] However, third party investments in transportation-related issues are inefficient to make if infrastructure is outdated and unchanging. Additional transportation funding enables the implementation of the additional, modernized infrastructure necessary to support electric vehicles, for example. As these developments become more widespread in Connecticut, the usage of green technology will become more economically efficient.

[88] Value added is the sum of all output in an industry less the cost of inputs. Total industry output is the sum of all sales in the sector. Therefore the sale of an input in this sector would be counted as output, but that value would be subtracted from the total value of the final product it is used for. GDP measures the sum of all value added and final products in the economy.

[89] Connecticut Government, "Green Technology," http://portal.ct.gov/en/Business-Portal/Green-Technology.

[90] Christine Stuart, "$9 Million Fund Will Invest in Green Start-Up Companies," New York Times, 21 November 2008.

[91] Connecticut 2015 Economic Development Strategy, 10.

[92] Connecticut Green Bank, "Moving Forward With Green Energy," September 2016, <http://www.ctgreenbank.com/wp-content/uploads/2016/09/CTGreenBank-Market-Potential-Assessment-Alternative-Fuel-Vehicles-090816-FF.pdf >.

- Access to Global Markets: Connecticut's technological firms are heavily dependent on connections to global markets via New York City. A transportation system that supports growth in technological services and technology manufacturing would buffer Connecticut against general economic shocks. The technology industry would also benefit from having low-cost access to Connecticut and New York financial firms, in order to finance and develop new waves of innovation.

- Agglomeration Economies: Twelve percent of green technology activity in Connecticut is estimated to fall under the manufacturing category and will benefit from agglomeration economies.[93] The example of Silicon Valley in California illustrates the importance of connecting related firms within an industry; through competition, the industry sustains growth that spills over to the whole state.

A 2009 study found that throughout the state, companies directly tied to green technologies employ 11,814 in "green jobs," with 4,544 directly tied to energy efficiency.[94] These are concentrated in the western part of the state, including the New York to New Haven and New Haven to Springfield corridors.

A robust highway and bridge network is necessary to sustain Connecticut's green technologies industry. The development of technology, particularly green technology, is intricately linked to innovation in and access to other industries. In the early stages, access to local markets is supported through quality infrastructure, particularly that of highway and other transportation investments. Businesses related to technology are dispersed throughout the state, and the industry heavily overlaps with manufacturing, stressing the need to maintain transportation linkages between existing networks.

[93] Rodrigue, "Transport and Location."

[94] CTEconomicDevelopment.com, <https://cteconomicdevelopment.com/CT-existing-companies.php>

VII. Methodology and Sources

The FHWA HERS-ST model is used to estimate the investment needs for Connecticut on the National Highway System, using the same modeling techniques as those employed by FHWA when preparing the federal Needs and Conditions report on the nation's transportation infrastructure.

HERS-ST selects a set of optimal improvements based on funding constraints, or can determine the cost of making all cost-beneficial improvements over a given time period to the state roads that are part of the federal aid system. Both approaches were used for the purposes of this study. All data used in the model is submitted by CTDOT to FHWA as part of the Highway Performance Monitoring System.

The FHWA NBIAS model is used to estimate the investment needs for bridges in Connecticut, also using the same modeling techniques as those employed by FHWA when preparing the federal Needs and Conditions report on the nation's transportation infrastructure. Similar to HERS-ST, NBIAS selects a set of optimal improvements based on funding constraints, or can determine the cost of making all cost-beneficial improvements over a given time period to roadway bridges across the state. The funding constraint approach was used for the purposes of this study, utilizing the NBIAS model which maximizes benefits. All data used in this model was submitted by CTDOT to FHWA as its' National Bridge Inventory data, which is collected by FHWA annually from all states.

The two investment scenarios in this report were developed with guidance from the Connecticut Office of Policy and Management and CTDOT, and are based on investment levels included in the CTDOT FFY 2017-2022 Capital Plan.

Transit capital investment includes spending on rolling stock such as train cars and buses in addition to stations, buildings and rail.

Actual highway construction spending is estimated based on historical averages in the Connecticut State Transportation Improvement Program (STIP) for 2015 and 2018. These documents detail spending breakdowns for capital outlays for right of way, planning and actual construction work.

To calculate the investment level in Scenario 1, we estimated the full implementation of the needs-based Let's Go CT! plan by using the full programmed amount for highways, bridges and transit in the capital plan from FFY 2018-FFY 2021. Under this scenario, the 20-year average for highway, bridge and transit investment is estimated at $2.42 billion, totaling $48.40 billion by FFY 2037. Highway and bridge, and transit investment are estimated to average $1.66 billion and $764 million over the 20-year period, respectively.

To calculate the investment level in Scenario 2, we assumed the full elimination of the Let's Go CT! plan, resulting in a minimum investment scenario with only federal funding and a 20 percent state match for highway and bridge investment, and the elimination of the Ramp Up program from the transit capital plan. Under this scenario, the 20-year average for highway, bridge and transit investment is estimated at $1.28 billion, totaling $25.60 billion by FFY 2037. Highway and bridge, and transit investment are estimated to average $832 million and $448 million over the 20-year period, respectively.

In Scenario 1, FFY 2022–2037 projections are estimated based on an assumption of an average annual two percent growth. Highway and bridge capital outlays are expected to increase at the same rate as projected STF revenue increases, with increases at the end of the five year Ramp Up program as major transit projects come to a close. Projections provided in June 2017 by the Connecticut Office of Policy and Management of sales & use tax revenues as well as STF revenues (excluding sales & use tax revenues) forecasted annual growth of two percent in FFY 2022 and an average two to three percent annual growth between FFY 2019 and FFY 2021. Transit investment is projected to increase in the next few years due to major projects included in the state Let's Go CT! plan, then average one percent growth annually through FFY 2037. Using a guideline provided by CTDOT, we expect that in Scenario 1, beginning in FFY 2022, highway and bridge investment will comprise 65 percent of the portion of investment attributed to the state plan, with transit investment comprising the remaining 35 percent of plan-related investment.

In Scenario 2, FFY 2022–2037 projections assume annual one percent growth. This minimum investment scenario also assumes an average annual two percent growth in highway and bridge capital investment, however decreases in the transit program temper total growth. Highway investment is expected to comprise 49 percent of total highway and bridge investment in Scenario 2. This reflects the average highway/bridge split in the CTDOT 2015–2018 STIP.

The split between highway and bridge investment in Scenario 1 is calculated by using the same 49/51 split as in Scenario 2 for the baseline portion of investment, and using a 46/54 split for the portion of investment attributed to the state plan. This 46/54 split reflects the average highway/bridge split in the Let's Go CT! plan.

To estimate the costs of not fully meeting investment needs, we take the difference between the investment and impacts calculated in Scenario 1 and the investment and impacts calculated in Scenario 2. This difference reflects the investment, economic activity, employment, earnings, and user benefits that would be lost if the state does not invest at this needs-based level of funding.

The immediate impact of an increase in transportation construction spending is calculated using the U.S. Department of Commerce Regional Input-Output Modeling System (RIMS II). RIMS II is based on input output (I-O) tables. For a given industry, the I-O tables show the industrial distribution of inputs purchased and outputs sold.

Research shows that RIMS II multipliers are similar to other regional I-O models based on in-depth and often expensive surveys. According to the U.S. Department of Commerce, RIMS multipliers have been used to estimate such things as the regional impact of military base closings, tourist expenditures, new energy facilities, offshore drilling and the opening or closing of manufacturing plants and other facilities. These multipliers are also used frequently to analyze the impact of new construction projects, including transportation construction.

Industry output for Connecticut is the most recent data from the U.S. Bureau of Economic Analysis GDP estimates for the state, broken out by industry, for 2016.

The impact of the two scenarios on the six identified priority investment areas was calculated using the RIMS II multipliers for the two different investment scenarios, and then by estimating the percent of Connecticut jobs in each sector involved in the six priority investment areas. Industries were identified using North American Industry Classification System (NAICS) codes. Full classification of the industries and NAICS codes included in each priority investment area are provided in Appendix 3.

Statewide employment estimates are derived from several different sources. The information includes establishment and employment data for sole proprietorships and businesses identified as relevant to highway, street and bridge construction. The total direct employment number for suppliers is calculated using the percentage of an industry's output that is related to highway, street and bridge construction, based on national input output tables from the U.S. Bureau of Economic Analysis. The private employment data is from the U.S. Census Bureau's County Business Patterns and Nonemployer Statistics series. Government employee data is from the U.S. Census Bureau's Annual State and Local Government Census.

Employment and establishment data for the six identified priority investment areas was calculated using the U.S. Census Bureau's County Business Patterns. All payroll data has been adjusted for inflation to 2017 dollars using the Bureau of Labor Statistics Consumer Price Index.

All bridge information, including conditions, is from FHWA's National Bridge Inventory and is for 2016, the latest year that data is available.

Average commute times are from the U.S. Census Bureau. Fatality and crash information is from the National Highway Traffic Safety Administration.

State data on freight shipments is from the FHWA Freight Analysis Framework and is for 2015, the latest year that data is available.

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Appendix 1: Supporting Studies

Transportation capital investments trigger immediate economic activity that creates and sustains jobs and tax revenue, yet yields long-lived capital assets that facilitate economic activity for many decades to come by providing access to jobs, services, materials and markets.

An improved highway, bridge and transit network results in lower operating costs, allowing businesses to increase investment in other capital outlays and expand their operations. Commuters spend less time in traffic and congestion as mobility increases, and safety enhancements help save lives and reduce injuries.

The overall economic benefits of transportation investment to a state's economic activity are well documented in the economics literature. There are numerous studies that have found a positive correlation between transportation infrastructure investment and economic development. Although the exact impact of the investment has varied among studies, the fact that there is a positive relationship is widely accepted.[95]

Some of the main findings include:

- A recent study commissioned by the U.S. Treasury Department found that for every **$1 in capital spent on select projects, the net economic benefit ranged between $3.50 and $7.00**.[96] Released in December 2016, "40 Proposed U.S. Transportation and Water Infrastructure Projects of Major Economic Significance" also explores some of the challenges of completing the work. The report found that a lack of public funding was "by far the most common factor hindering the completion" of the projects.

- A 2005 report by Dr. Robert Shapiro and Dr. Kevin Hassett found that the U.S. transportation network provides more than **$4 in direct benefits for every $1 in direct costs** that taxpayers pay to build, operate and maintain this system.[97] These economic benefits include lower costs and higher productivity for businesses, and time savings and additional income for workers. The authors noted that the estimate substantially understates the full net benefits of the U.S. transportation network and does not take into account the increased benefit from better access to schools and hospitals, or other ways these investments support economic growth and allow American workers and companies to compete successfully on the global stage.

[95] Economic studies have found output elasticities ranging from as high as 0.56 (Aschauer 1989) to a low of 0.04 (Garcia-Mila and McGuire 1992). This means that a one percent increase in highway investment would result in between 0.04 to 0.56 percent increase in output. Most of this variation is because studies have a different focus- looking at different types of investment measures and output at either the national, state or county level.

[96] Report available at https://www.treasury.gov/connect/blog/Pages/Importance-of-Infrastructure-Investment-for-Spurring-Growth-.aspx as of February 2017.

[97] R. Shapiro and K. Hassett, "Healthy Returns: The Economic Impact of Public Investment in Surface Transportation," 2005.

- According to an analysis by TRIP, a national transportation research group, the average **return to every $1 spent on highway and bridge investment is $5.20**, which takes the form of lower maintenance costs, fewer delays, improved safety and less congestions. This analysis is based on the U.S. Department of Transportation's Conditions and Performance Report.

- A study by Dr. Alicia Munnell of the Federal Reserve Bank of Boston concluded that states that invested more in infrastructure tended to have greater output, more private investment and more employment growth.[98] Her work found that **a one percent increase in public capital would raise national output by 0.15 percent**.[99] She further notes that the major impact of public capital output is from investment in highways and water and sewer systems. Other public capital investments, such as school buildings and hospitals, had virtually no measureable impact on private production.[100] Munnell also concludes that public capital and infrastructure investment have a significant positive impact on a state's private employment growth and private sector output.

- Federal Highway Administration economist Theresa Smith reached similar conclusions, finding that **a 10 percent increase in highway capital stock would increase a state's gross state product by 1.2 to 1.3 percent**.[101] This means a $1 billion increase in Connecticut's highway capital stock would increase state productivity between $1.21 million to $1.27 million.

- Additional studies have found that transportation infrastructure investments have an impact on the attractiveness of local communities, which helps determine local economic activity and land values. In general, most studies find that locations close to large transportation infrastructure investment have higher land values.[102]

- M. Ishaq Nadiri of New York University and the National Bureau of Economics Research and Theofanis P. Mamuneas of New York University find significant cost structure and productivity performance impacts on the U.S. manufacturing industry as a result of highway investment. Their work shows that the rate of return on highway investment can be greater than private investment.

Some major findings include:[103]

  - Over the period 1950 to 1989, U.S. industries realized production cost savings averaging 18 cents annually for each dollar invested in the road system.

[98] Alicia Munnell, "How Does Public Infrastructure Affect Regional Economic Performance," New England Economic Review, September/October 1990.

[99] Munnell's elasticity for private capital is 0.31, so that a one percent increase in private capital would raise national output by 0.31 percent. This is in line with other studies of returns from private capital investment.

[100] Munnell says she is not implying that government-provided education and health services have no effect on productivity, but rather "the stock of buildings ... may not be the best indicator of the quality of education services; teachers' salaries, for example, might be a better measure."

[101] Theresa Smith, "The Impact of Highway Infrastructure on Economic Performance," Public Roads Vol. 57 – No. 4 (Spring 1994).

[102] A synopsis of these studies are available in the Transportation Research Board's *Expanding Metropolitan Highways: Implications for Air Quality and Energy Use – Special Report 245,* 1995

[103] Summary provided by U.S. Department of Transportation, *Productivity and the Highway Network: A Look at the Economic Benefits to Industry form Investment in the Highway Network.*

- Investments in non-local roads yield even higher production cost savings – estimated at 24 cents for each dollar of investment.
- Although the impact of highway investment on productivity has declined since the early 1970s and the initial construction of the Interstate, evidence suggests that highway infrastructure investments more than pay for themselves in terms of industry cost savings.
- The U.S. highway network's contribution to economic productivity growth was between seven and eight percent over the time period 1980 to 1989.
- The net social rate of return on investment in the non-local road system during the 1980s was 16 percent, and the rate of return for the entire road network was ten percent.[104]
- This rate of return was significantly higher than the prevailing rate of return on private capital and the long-term interest rate during this time period.
- The higher return to highway capital is due to its network feature, since the benefits are shared by all industries.

- The Economic Development Research Group estimates that every billion dollars in capital spending on public transportation supports approximately 15,900 jobs, $2.9 billion in output (business sales), $1.3 billion in GDP, $0.9 billion in labor income, and $266 million in tax revenues.[105]

- Research by the American Public Transportation Association estimates that a two-car family living in a transit-rich area can eliminate one of its vehicles, saving over $9,900 a year. These savings are significant to families, and will likely shift household spending to more productive uses, which will in turn stimulate the local economy.[106] The Center for Neighborhood Technology also found that households that have access to high quality public transit spend less on housing and transportation as a percentage of their income.[107]

- Investment in public transportation provides better and more consistent access to jobs, particularly for service and entry level employees with limited mobility options, as well as the more than 51 million Americans with disabilities. Eighty three percent of older Americans say public transit provides them with easy access to everyday necessities.[108]

Overall, the benefits from investing to maintain and improve a state's transportation network are greater than the cost, and can help support economic growth throughout the economy for years to come.

[104] The net social rate of return is an estimate of the benefits to private industries derived from the shared use of public highways.

[105] Economic Development Research Group, Inc., "Economic Impact of Public Transportation Investment: 2014 Update," May 2014.

[106] American Public Transportation Association (APTA), "Commuters Who Resolve to Save Money in 2012 Take Note: Transit Riders Save More As Gas Prices Increase."

[107] "Penny Wise, Pound Foolish," Center for Neighborhood Technology, March 2010.

[108] APTA, "Economic Recovery: Promoting Growth."

Appendix 2: Highway and Bridge Investment Scenario Table

Highway, Bridge and Transit Investment Scenarios, 20-year Forecast FFY 2018-2037 (in millions)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	20-year average
Scenario 1 (Needs-Based)																					
Highway, Bridge and Transit Investment	**$2,057**	**$2,004**	**$2,192**	**$2,132**	**$2,171**	**$2,211**	**$2,252**	**$2,293**	**$2,336**	**$2,379**	**$2,423**	**$2,468**	**$2,514**	**$2,561**	**$2,609**	**$2,658**	**$2,708**	**$2,760**	**$2,812**	**$2,865**	**$2,420**
Highway and Bridge Investment	$1,186	$1,179	$1,247	$1,384	$1,500	$1,531	$1,562	$1,595	$1,628	$1,662	$1,697	$1,732	$1,768	$1,805	$1,843	$1,881	$1,920	$1,960	$2,001	$2,043	$1,656
Transit Investment	$871	$825	$945	$748	$672	$680	$689	$698	$708	$717	$727	$736	$746	$756	$767	$777	$788	$799	$811	$822	$764
Scenario 2 (Minimum Investment)																					
Highway, Bridge and Transit Investment	**$1,406**	**$1,153**	**$1,144**	**$1,146**	**$1,162**	**$1,179**	**$1,196**	**$1,213**	**$1,230**	**$1,248**	**$1,266**	**$1,284**	**$1,303**	**$1,322**	**$1,341**	**$1,361**	**$1,381**	**$1,401**	**$1,422**	**$1,443**	**$1,280**
Highway and Bridge Investment	$758	$737	$728	$727	$741	$755	$769	$784	$799	$814	$829	$845	$861	$877	$894	$911	$928	$946	$964	$982	$832
Transit Investment	$647	$416	$417	$419	$422	$424	$427	$429	$432	$434	$437	$439	$442	$445	$447	$450	$453	$455	$458	$461	$448

Appendix 3: List of NAICS Codes Included In Each Priority Investment Area

The U.S. Census Bureau maintains a national database of all businesses establishments in the United States, organized under the North American Industry Classification System (NAICS). The NAICS is used by government and business to classify individual businesses by the type of economic activity they conduct. Each firm selects its own NAICS designation, choosing a six-digit code that allows the firm to be correctly classified by specialty type under an umbrella of 20 major industry sector categories. Through this rich database, we are able to quantify the number of firms that conduct certain business activities within a state. In order to estimate the percent of Connecticut jobs involved in the state's six identified priority investment areas, we identified the number of jobs in each priority investment area using the following 2017 NAICS codes. For industries where 2017 NAICS codes were unavailable, previous years' NAICS codes were used and specified.

Healthcare/Bioscience

Healthcare/Bioscience jobs are identified by combining identified jobs in the healthcare and bioscience industries for Connecticut.

Healthcare jobs are identified as jobs in the following subsectors of the Health Care and Social Assistance sector (NAICS sector 62):

- Ambulatory Health Care Services (NAICS code 621)
- Hospitals (NAICS code 622)
- Nursing and Residential Care Facilities (NAICS code 623)

Bioscience jobs are identified using a 2014 report by Batelle and BIO which defined the bioscience industry as comprising the below NAICS codes:[109]

- Wet Corn Milling (NAICS code 311221)
- Soybean and Other Oilseed Processing (NAICS code 311224). In the Batelle/BIO report, this industry was defined by the following two industries, using 2007 NAICS codes which have been discontinued in the 2017 NAICS: Soybean Processing (2007 NAICS code 311222) and Other Oilseed Processing (2007 NAICS code 311223).
- Ethyl Alcohol Manufacturing (NAICS code 325193)
- Cellulosic Organic Fiber Manufacturing (2007 NAICS code 325221). This industry is no longer included in the 2017 NAICS so was excluded from our estimation.
- Nitrogenous Fertilizer Manufacturing (NAICS code 325311)
- Phosphatic Fertilizer Manufacturing (NAICS code 325312)
- Fertilizer (Mixing Only) Manufacturing (NAICS code 325314)

[109] Battelle/BIO, "Battelle/BIO State Bioscience Jobs, Investments and Innovation 2014," June 2014, <https://www.bio.org/sites/default/files/files/Battelle-BIO-2014-Industry.pdf>.

- Pesticide and Other Agricultural Chemical Manufacturing (NAICS code 325320)
- Medicinal and Botanical Manufacturing (NAICS code 325411)
- Pharmaceutical Preparation Manufacturing (NAICS code 325412)
- In-Vitro Diagnostic Substance Manufacturing (NAICS code 325413)
- Biological Product (except Diagnostic) Manufacturing (NAICS code 325414)
- Electromedical and Electrotherapeutic Apparatus Manufacturing (NAICS code 334510)
- Analytical Laboratory Instrument Manufacturing (NAICS code 334516)
- Irradiation Apparatus Manufacturing (NAICS code 334517)
- Surgical and Medical Instrument Manufacturing (NAICS code 339112)
- Surgical Appliance and Supplies Manufacturing (NAICS code 339113)
- Dental Equipment and Supplies Manufacturing (NAICS code 339114)
- Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers (NAICS code 423450)
- Drugs and Druggists' Sundries Merchant Wholesalers (NAICS code 424210)
- Farm Supplies Merchant Wholesalers (NAICS code 424910)
- Testing Laboratories (NAICS code 541380)
- Research and Development in the Physical, Engineering, and Life Sciences (NAICS code 54171)
- Medical Laboratories (NAICS code 621511)

Insurance and Financial Services

Insurance and Financial Services jobs are identified as all jobs in the Finance and Insurance sector (NAICS sector 52).

Advanced Manufacturing

Advanced Manufacturing jobs are identified using a 2015 Brookings report which defined the advanced industries sector using the below NAICS codes:[110]

- Petroleum and Coal Products Manufacturing (NAICS code 3241)
- Basic Chemical Manufacturing (NAICS code 3251)
- Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments Manufacturing (NAICS code 3252)
- Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing (NAICS code 3253)
- Pharmaceutical and Medicine Manufacturing (NAICS code 3254)
- Other Chemical Product and Preparation Manufacturing (NAICS code 3259)
- Clay Product and Refractory Manufacturing (NAICS code 3271)
- Other Nonmetallic Mineral Products Manufacturing (NAICS code 3279)

[110] Mark Muro, Jonathan Rothwell, Scott Andes, Kenan Fikri, & Siddharth Kulkarni, "America's Advanced Industries: What They Are, Where They Are, and Why They Matter," Brookings, February 2015, <https://www.brookings.edu/wp-content/uploads/2015/02/AdvancedIndustry_Final-Feb2lores-1.pdf>.

- Iron and Steel Mills and Ferroalloy Manufacturing (NAICS code 3311)
- Alumina and Aluminum Production and Processing (NAICS code 3313)
- Foundries (NAICS code 3315)
- Agriculture, Construction, and Mining Machinery Manufacturing (NAICS code 3331)
- Industrial Machinery Manufacturing (NAICS code 3332)
- Commercial and Service Industry Machinery Manufacturing (NAICS code 3333)
- Engine, Turbine, and Power Transmission Equipment Manufacturing (NAICS code 3336)
- Other General Purpose Machinery Manufacturing (NAICS code 3339)
- Computer and Peripheral Equipment Manufacturing (NAICS code 3341)
- Communications Equipment Manufacturing (NAICS code 3342)
- Audio and Video Equipment Manufacturing (NAICS code 3343)
- Semiconductor and Other Electronic Component Manufacturing (NAICS code 3344)
- Navigational, Measuring, Electromedical, and Control Instruments Manufacturing (NAICS code 3345)
- Manufacturing and Reproducing Magnetic and Optical Media (NAICS code 3346)
- Electric Lighting Equipment Manufacturing (NAICS code 3351)
- Household Appliance Manufacturing (NAICS code 3352)
- Electrical Equipment Manufacturing (NAICS code 3353)
- Other Electrical Equipment and Components Manufacturing (NAICS code 3359)
- Motor Vehicle Manufacturing (NAICS code 3361)
- Motor Vehicle Body and Trailer Manufacturing (NAICS code 3362)
- Motor Vehicle Parts Manufacturing (NAICS code 3363)
- Aerospace Products and Parts Manufacturing (NAICS code 3364)
- Railroad Rolling Stock Manufacturing (NAICS code 3365)
- Ship and Boat Building (NAICS code 3366)
- Other Transportation Equipment Manufacturing (NAICS code 3369)
- Medical Equipment and Supplies Manufacturing (NAICS code 3391)
- Other Miscellaneous Manufacturing (NAICS code 3399)

Digital Media

Digital Media jobs are identified using a 2017 Interactive Advertising Bureau report which identified 15 NAICS codes that likely contain meaningful amounts of internet-dependent employment:[111]

- Communications Equipment Manufacturing (NAICS code 3342)
- Computer and Peripheral Equipment Manufacturing (NAICS code 3341)

[111] John Deighton, Leora Kornfeld, & Marlon Gerra, "Economic Value of the Advertising-Supported Internet Ecosystem," Brookings, January 2017, <https://www.iab.com/wp-content/uploads/2017/03/Economic-Value-Study-FINAL-2017.pdf>.

- Electronic Shopping (2012 NAICS code 454111)
- Electronic auctions (2012 NAICS code 454112)
- Couriers and Express Delivery Services (NAICS code 49211)
- Software Publishers (NAICS code 51121)
- Wired telecommunications carriers (2012 NAICS code 51711)
- Wireless telecommunications carriers (2012 NAICS code 51721)
- Other Telecommunications (NAICS code 51791)
- Data Processing, Hosting, and Related Services (NAICS code 51821)
- Internet Publishing and Broadcasting and Web Search Portals (NAICS code 51913)
- Securities Brokerage (NAICS code 52312)
- Computer Systems Design and Related Services (NAICS code 54151)
- Management Consulting Services (NAICS code 54161)
- Advertising, Public Relations, and Related Services (NAICS code 5418)

Additionally, the 2015 Economic Development Strategy[112] identified the digital media field as comprising "production and post-production facilities, digital animation, film, and gaming companies", so we identified all jobs in the Information sector (NAICS sector 51) as Digital Media jobs as well, replacing any jobs previously identified as subsectors of the Information sector. The Information sector includes the following primary subsectors:

- Publishing Industries (except Internet) (NAICS code 511)
- Motion Picture and Sound Recording Industries (NAICS code 512)
- Broadcasting (except Internet) (NAICS code 515)
- Telecommunications (NAICS code 517)
- Data Processing, Hosting, and Related Services (NAICS code 518)
- Other Information Services (NAICS code 519)

Tourism

Tourism jobs are identified using a 2016 report by the U.S. Travel Association which defined the travel-related industry using the below NAICS codes:[113]

- Automobile Dealers (NAICS code 4411)
- Other Motor Vehicle Dealers (NAICS code 4412)
- Automotive Parts, Accessories, and Tire Stores (NAICS code 4413)
- Electronics and Appliance Stores (NAICS code 443)
- Building Material and Garden Equipment and Supplies Dealers (NAICS code 444)
- Food and Beverage Stores (NAICS code 445)
- Health and Personal Care Stores (NAICS code 446)
- Gasoline Stations (NAICS code 447)
- Clothing and Clothing Accessories Stores (NAICS code 448)

[112] Connecticut 2015 Economic Development Strategy, 10.

[113] "The Economic Impact of Domestic Travel On Virginia Counties 2015," U.S. Travel Association, August 2016, <https://www.vatc.org/uploadedFiles/Research/2015EconomicImpactofDomesticTravelonVirginiaandLocalities.pdf>.

- Sporting Goods, Hobby, Book, and Music Stores (NAICS code 451)
- General Merchandise Stores (NAICS code 452)
- Miscellaneous Store Retailers (NAICS code 453)
- Scheduled Passenger Air Transportation (NAICS code 481111)
- Nonscheduled Chartered Passenger Air Transportation (NAICS code 481211)
- Rail Transportation (NAICS code 4821)
- Deep Sea Passenger Transportation (NAICS code 483112)
- Coastal and Great Lakes Passenger Transportation (NAICS code 483114)
- Inland Water Passenger Transportation (NAICS code 483212)
- Interurban and Rural Bus Transportation (NAICS code 4852)
- Taxi and Limousine Services (NAICS code 4853)
- Charter Bus Industry (NAICS code 485510)
- Scenic & Sightseeing Transportation (NAICS code 487)
- Support Activities for Air Transportation (NAICS code 4881)
- Passenger Car Rental (NAICS code 532111)
- Travel Arrangement and Reservation Services (NAICS code 5615)
- Performing Arts, Spectator Sports, and Related Industries (NAICS code 711)
- Museums, Historical Sites, and Similar Institutions (NAICS code 712)
- Amusement, Gambling, and Recreation Industries (NAICS code 713)
- Traveler Accommodation (NAICS code 7211)
- RV (Recreational Vehicle) Parks and Recreational Camps (NAICS code 7212)
- Restaurants and Other Eating Places (NAICS code 7225). In the U.S. Travel Association report, this industry was defined by the following two industries, using 2007 NAICS codes which have been discontinued in the 2017 NAICS: Full service Restaurants (2007 NAICS code 7221) and Limited Service Eating Places (2007 NAICS code 7222).
- Drinking Places (Alcoholic Beverages) (NAICS code 7224)
- Automotive Repair and Maintenance (NAICS code 8111)

Green Technologies

Green Technologies jobs are identified by using estimates developed by the Bureau of Labor Statistics for the percent of Green Goods and Services jobs in the following industries in Connecticut:[114]

- 26.2% of Utilities (NAICS sector 22)
- 10.3% of Construction (NAICS sector 23)
- 3.2% of Manufacturing (NAICS sector 31–33)
- 0.8% of Wholesale Trade (NAICS sector 42)
- 0.8% of Retail Trade (NAICS sector 44–45)

[114] "News Release: Employment in Green Goods and Services – 2011," U.S. Department of Labor Bureau of Labor Statistics, March 2013, <https://www.bls.gov/news.release/pdf/ggqcew.pdf>.

- 20.5% of Transportation and Warehousing (NAICS sector 48–49)
- 7.4% of Professional, Scientific, and Technical Services (NAICS sector 54)
- 6.8% of Administrative and Support and Waste Management and Remediation Services (NAICS sector 56)
- 0.3% of Arts, Entertainment, and Recreation (NAICS sector 71)
- 0.3% of Accommodation and Food Services (NAICS sector 72)

For industries where Connecticut-specific percent estimates were unavailable, we used the national percent of Green Goods and Services jobs in the following industries:[115]

- 3.4% of Agriculture, Forestry, Fishing and Hunting (NAICS sector 11)
- 3.4% of Mining, Quarrying, and Oil and Gas Extraction (NAICS sector 21)
- 1.1% of Information (NAICS sector 51)
- 0.0% of Finance and Insurance (NAICS sector 52)
- 0.0% of Real Estate and Rental and Leasing (NAICS sector 53)
- 3.6% of Management of Companies and Enterprises (NAICS sector 55)
- 0.1% of Educational Services (NAICS sector 61)
- 0.1% of Health Care and Social Assistance (NAICS sector 62)
- 1.3% of Other Services (except Public Administration) (NAICS sector 81)

[115] "News Release: Employment in Green Goods and Services – 2011," U.S. Department of Labor Bureau of Labor Statistics.