An Economic Analysis of Spending on Marine Transportation System (MTS) Infrastructure

April 2020 Executive Summary

Report for the U.S. Committee on the Marine Transportation System
prepared by Inforum at the University of Maryland

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EXECUTIVE SUMMARY

"Extensive and efficient infrastructure is critical for ensuring the effective functioning of the economy, as it is an important factor in determining the location of economic activity and the kinds of activities or sectors that can develop in a particular instance."

Schwab & Sala-i-Martín, 2012

This study, conducted by Inforum[1] for the U.S. Committee on the Marine Transportation System[2] (CMTS), provides a historical accounting of spending and performance of U.S. marine transportation system (MTS) infrastructure that is essential to the well-being and growth of the U.S. economy. The report provides evidence on the state of MTS infrastructure and offers data that indicate insufficient efforts to maintain and develop the system, leading to a deteriorating state of U.S. public infrastructure.

By leveraging available historical data and previous work concerning the economic costs of degraded infrastructure, this report considers how an increase in MTS infrastructure spending would affect economic performance. The analysis uses the Inforum LIFT model[3] to explore more robust funding levels for MTS infrastructure during a 26-year period spanning 2020 to 2045, including an 11-year capital investment program stretching from 2020 through 2030. This ultimately shows how infrastructure expenditure above current funding levels will help to recover from the long pattern of underspending in infrastructure, thus enabling higher growth, improved trade performance, expanded employment opportunities, and enhanced value of household incomes.

Importance of Marine Transportation System Infrastructure

Modern economies require substantial high-quality infrastructure to thrive. Such assets are indispensable for facilitating production in various industries, particularly goods-producing sectors such as agriculture, mining, and manufacturing. The ability to safely and efficiently move resources and final products through the nation's economic system, from mines, farms, and manufacturing facilities to consumers and business customers located far away, is crucial to American industry's long-term health and global competitiveness.

The U.S. Marine Transportation System (MTS) plays a leading role in providing these essential services to businesses, consumers, and

1 This research was performed by Inforum at the University of Maryland with the support of the U.S. Committee on the Marine Transportation System. The author is Ronald Horst, Ph.D. Questions may be directed to RHorst@umd.edu or 301-405-4636. More information about Inforum may be found in Appendix A and at www.Inforum.umd.edu.

2 The CMTS is a Federal Cabinet-level partnership of more than 25 Federal Government departments, agencies, and bureaus directed under statute to coordinate and recommend policies related to marine transportation. The CMTS is directed to (1) assess the adequacy of the MTS, including ports, waterways, channels, and their intermodal connections; (2) promote the integration of the MTS with other modes of transportation and other uses of the marine environment; and (3) coordinate, improve coordination and make recommendations regarding Federal policies that impact the MTS.

3 The LIFT model is a dynamic general equilibrium representation of the U.S. national economy. It combines an inter-industry input-output formulation with extensive use of regression analysis to employ a "bottom-up" approach to macroeconomic modeling. In this way, the model works like the actual economy, building the macroeconomic totals from details of industrial activity, rather than by distributing predetermined macroeconomic quantities among industries. More information about the LIFT model may be found at www.inforum.umd.edu.

governments. About 25,000 miles of navigable waterways allow American farmers, manufacturers, and other producers to compete in world markets by keeping transportation costs low. Inland waterways carry more than 600 million tons of cargo annually (ASCE, 2017). Commercial marine ports number approximately 360[4] providing essential links to foreign markets through which billions of tons of goods flow each year.

In 2017, major U.S. ports handled more than 873 million tons of domestic shipments and 1,512 million tons of international freight traffic (USACE, October 2018). These systems do not operate in isolation but instead rely on connections to road, rail, pipeline, and other transportation infrastructure. Despite the vital services these systems provide to the U.S. economy, many need long-overdue and substantial maintenance, repair, and modernization. The symptoms of decay are many, including lock shutdowns along U.S. waterways and unexpected delays that totaled approximately 144,000 hours in 2016, a 90 percent increase since 2000 (Bureau of Transportation Statistics, 2017).

Declining US Infrastructure

The World Economic Forum (WEF) names insufficient investment in productive factors, such as transportation infrastructure, as an important cause of the sluggish productivity growth that has slowed global economic expansion over the past decade. WEF publishes rankings of the factors of productivity and economic health for 141 countries (Schwab, 2019), identifying infrastructure as the second of 12 pillars of competitiveness. In 2018-2019, the United States was ranked second overall in competitiveness, trailing only Singapore. However, the transportation infrastructure in the US was ranked lower, at 12th among the 141 ranked nations. Its scores for connectivity for roads, airports, and water ports tended to be high, but measures of quality and efficiency were lower.

The American Society of Civil Engineers (ASCE) conducts a quadrennial qualitative national assessment of conditions and investment needs for major types of infrastructure, including land, water, and air transportation systems and utilities. According to the ASCE, the nation's infrastructure is in poor condition, with the overall grade of D+ in 2017, unchanged from the 2013 score. Inland waterways infrastructure also earned a D, while the grade for ports was slightly higher at a C+ (ASCE 2017). As our trading-partner nations continue to develop modern, efficient, and well-maintained infrastructure systems, the United States will face growing competitive pressures. Despite currently strong competitiveness in general, deficient infrastructure will make it increasingly difficult for domestic firms and workers to compete in world markets.

Recent data concerning U.S. public and private sector spending indicates a decline in real investment spending for many types of infrastructure[5]. Real, or "constant-price" investment[6], is the purchase of structures and equipment by government entities and private companies, where these assets provide key transportation and other services and where dollar values have been adjusted for inflation (in this case to 2009 or 2012 dollars). Real investment spending indicates the physical volume of infrastructure installed in each year. Many infrastructure spending declines stretch more than a decade, and resulting costs in time, wasted fuel, and vehicle maintenance continue to grow annually.

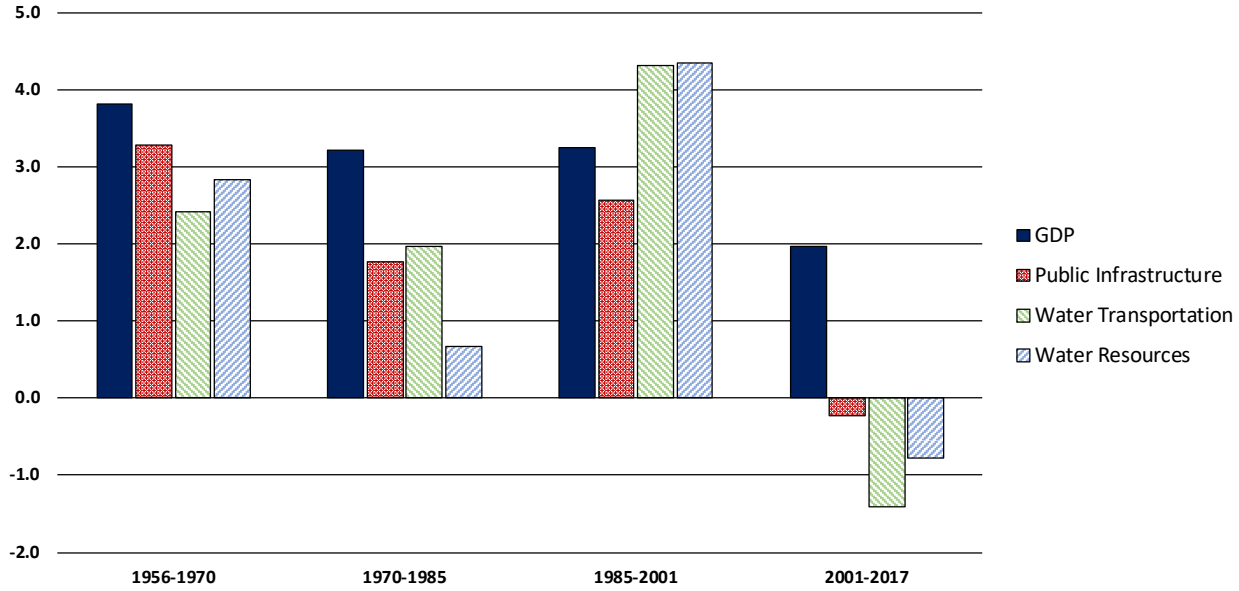
By re-igniting public and private investment in infrastructure, education, and innovation, countries not only would enhance productivity growth but also would foster additional employment and strengthen aggregate demand for goods and services.

4 According to the "2017 Transportation Facts & Information" published by the USACE, larger ports alone numbered 186 in 2017, with each handling at least 250,000 tons of freight, including 109 large coastal ports, 42 that serve traffic on the Great Lakes, and 35 inland ports. According to the U.S. Maritime Administration, in 2009 there were "approximately 360 commercial sea and river ports" ("America's Ports and Intermodal Transportation System," January 2009, www.glmri.org/downloads/Ports&IntermodalTransport.pdf).

5 See, for example, the Congressional Budget Office (October 2018).

6 A glossary of economic terms follows the report's conclusion.

Figure E-1. Real Public Infrastructure Expenditures (1956-2017)
Average Annual Percentage Growth Rates



Source: U.S. Congressional Budget Office (2018); U.S. Bureau of Economic Analysis, National Income and Product Accounts (October 2019); and authors' calculations.

Historic Infrastructure Investment

Recent trends in infrastructure investment reflect a mixed performance. Spending for some privately-owned infrastructure, such as freight rail and electric utilities, has been steady and relatively strong. On the other hand, spending for roads, maritime infrastructure, and many other types of public infrastructure has lagged, and with slower economic growth a likely consequence.

Figure E-1 shows the average annual growth of real (adjusted for inflation) GDP and real public infrastructure spending over four intervals, together with real spending growth for major components of MTS infrastructure. In the 46 years from 1956 through 2001, overall investment for public infrastructure[7] rose, at an average rate of about 1 percent lower than GDP growth. Between 2001 and 2017, GDP has grown more slowly on average, as real infrastructure spending contracted by 0.2 percent per year, lagging GDP growth by 2.2 percentage points. Between 1956 and 2001, investment in water transportation infrastructure (waterways, ports, vessels, and navigational systems) also increased, with growth exceeding 4 percent annually from 1985 to 2001. Spending on water resources infrastructure (dams, levees, reservoirs, and other assets) also surged in the 1980s and 1990s. However, real spending for both water transportation and water resources infrastructure has declined since 2001, with water transportation falling 1.4 percent per year and water resources contracting approximately 0.8 percent per year.

In this report, terms such as "Water Transportation" and "Water Resources" reflect concepts and data standards widely used by economists. In particular, economic data published by Bureau of Economic Analysis (BEA), Census Bureau, Congressional Budget Office (CBO), and other Agencies conform to these standards. These are related to the MTS concepts employed by CMTS and other agencies, but important differences exist. In this report, presentation and use of economic data and concepts will conform to the standards of the economics literature, while commentary on the

7 Public infrastructure included in these figures includes transportation infrastructure (highways, mass transit and rail, aviation, and water) and water infrastructure (water resources and water utilities) (CBO, 2018).

Table E-1. Real Public Infrastructure Expenditures, 2001-2017

	Billions of 2012$	Billions of 2012$	Average Annual Percentage Growth	Cumulative Percentage Change
	2001	2017	2001-2017	2001-2017
Real Gross Domestic Product	**13,262.1**	**18,108.1**	**2.0**	**36.5**
Public Infrastructure Spending	**419.5**	**404.3**	**-0.2**	**-3.6**
Capital	209.7	160.0	-1.7	-23.7
Operation and Maintenance	209.9	244.3	1.0	16.4
Water Transportation	11.8	9.4	-1.4	-20.4
Capital	6.9	3.4	-4.3	-50.7
Operation and Maintenance	4.9	6.0	1.2	21.6
Water Resources	29.9	26.4	-0.8	-11.7
Capital	13.4	7.4	-3.6	-44.7
Operation and Maintenance	16.6	19.0	0.9	14.5

Source: U.S. Congressional Budget Office (2018); U.S. Bureau of Economic Analysis, National Income and Product Accounts (October 2019); and authors' calculations.

broader subject will employ the MTS nomenclature.

Figure E-1 and Table E-1 data are from the CBO and BEA. MTS infrastructure is represented in the "Water Transportation" and "Water Resources" data categories.

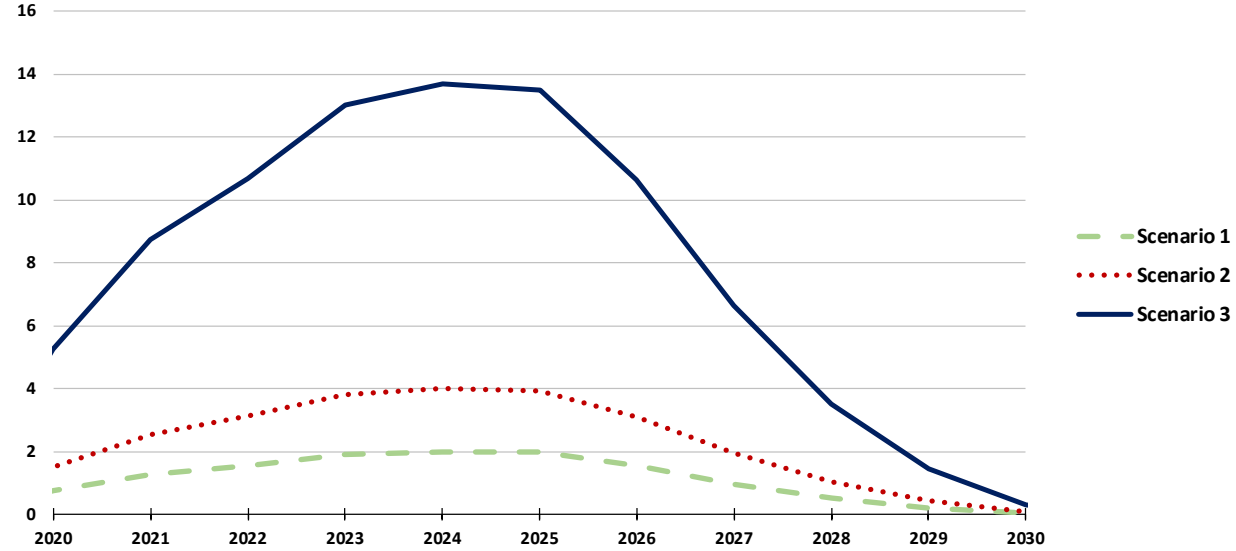
In contrast to most of the preceding 46 years, the volume of investment in the water transportation and water resources infrastructure categories contracted significantly from 2001 through 2017—with real spending on water transportation infrastructure contracting 1.4 percent annually. Table E-1 shows additional expenditure details for these components of infrastructure from 2001-2017, together with real GDP and overall public infrastructure spending. Each total spending figure is the sum of investment, or capital, spending and expenditure for operations and maintenance (O&M). The level of real expenditure for ports and inland waterways was 20.4 percent lower in 2017 than in 2001, with a dramatic decline in capital spending weighing heavily. Real expenditure for water resources was 11.7 percent lower in 2017 than in 2001. By 2017, capital spending for water resources, including dredging, plummeted 44.7 percent from 2001 levels.

Since the turn of the 21st century, escalating construction prices eroded effective investment because each dollar of Federal and state funding purchased relatively less infrastructure capital. Although construction inflation fell from previous highs, the volume of investment spending was far lower in 2017 than in 2001, due both to restrained nominal spending and higher construction prices. Budgets expanded more for O&M expenditure, and price growth for these activities was more subdued. Together, these imply real spending growth for O&M activities to be about 1 percent per year. The implication of these trends is a steady erosion of the Nation's essential MTS infrastructure base.

Benefits of Infrastructure Spending

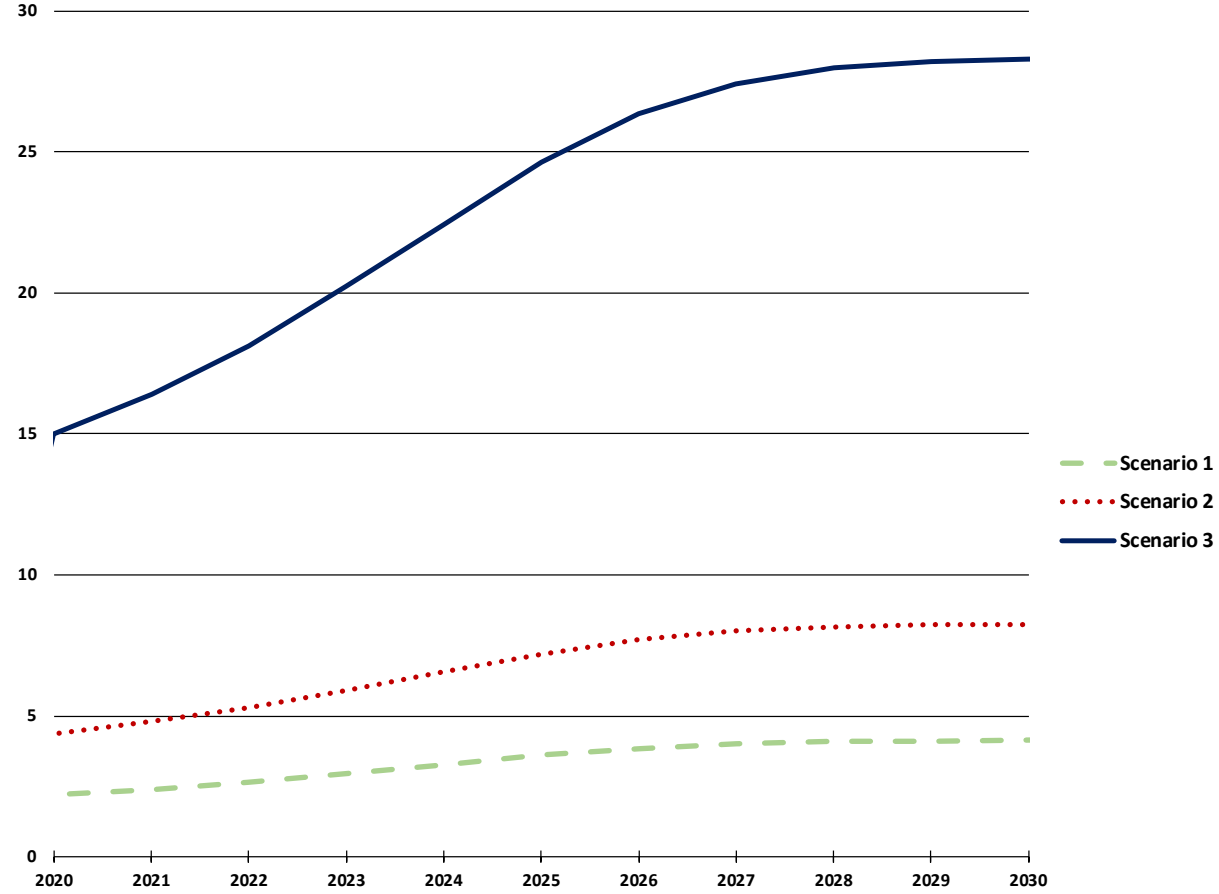
In the short run, spending on infrastructure stimulates aggregate demand that increases economic activity and creates jobs through direct, indirect, and induced demand impacts. However, the long-term benefits of infrastructure spending are even more significant and durable. Improvement of inland waterways and marine ports would boost international competitiveness—updated and well-maintained inland waterways and marine ports lower the cost of delivering goods both domestically and internationally by decreasing delays. The lower cost of imports reduces the cost of materials, positively affecting

Figure E-2. Nominal Investment Expenditure Enhancement (2020-2030)
Billions of Dollars



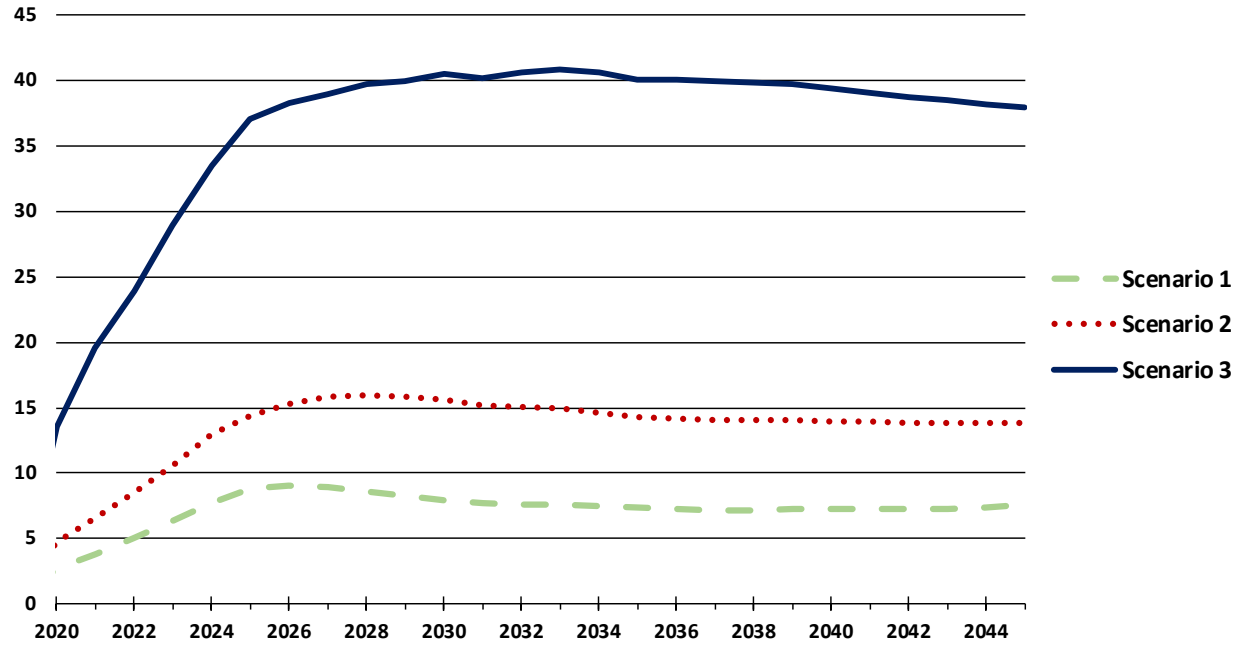
Source: Study assumptions.

Figure E-3. Nominal O&M Expenditure Enhancement (2020-2030)
Billions of Dollars



Source: Study assumptions.

Figure E-4. Effects of Enhanced Spending on Real GDP (2020-2045)
Billions of 2012$ Dollars



Source: Study assumptions.

both businesses and consumers through lower production costs and lower prices, while lower export costs help to boost our trade position in the international marketplace.

Scenarios and Baseline

The report contemplates three alternative potential efforts to improve MTS infrastructure spending. These scenarios range between $12 billion and $87 billion in additional capital spending from 2020 through 2030 (Figure E-2), with increases in O&M budgets ranging between $37 billion and $255 billion over the same period (Figure E-3).

Raising infrastructure expenditure by these amounts, as simulated using the LIFT model, illustrates how such enhanced spending can generate substantial long-term economic returns that significantly exceed their initial costs. A sustained multi-year investment boost for public infrastructure could be supported through a combination of funding sources—Federal, state, and local governments as well as the private sector. In the three scenarios, all entities responsible for supplying funding for public infrastructure make more significant commitments.

Findings

Compared to a baseline forecast that assumes continuation of limited public infrastructure investment that leads to reduced efficiencies and higher costs, the report finds the following:

- In the short term, enhancing the level of infrastructure spending would boost jobs by between 54.7 thousand and 182.5 thousand jobs in 2025, depending on the scenario; these numbers are shown in Table E-2. This number would fall over time as the productivity effects of better infrastructure take hold. As a result, the economy would improve meaningfully.
- By 2030, the level of real GDP would rise between about $8 billion and $41 billion in 2012 dollars (Figure E-4). Over the long term, competitiveness, output, and employment across industries would be enhanced thanks to the productivity-enhancing effects of better infrastructure. Increased productivity largely would be responsible for the higher GDP, but so would higher labor participation within a more dynamic economy.

Table E-2. Key Assumptions and Macroeconomic Results Summary (2020-2045)
Nominal Spending Assumptions, Real GDP, Employment, and Personal Income

	2020	2021	2022	2023	2024	2025	2030	2035	2040	2045
Assumed New Nominal Spending (Billions)										
Scenario 1	3.0	3.7	4.2	4.9	5.3	5.6	4.2	4.2	4.2	4.2
Scenario 2	5.9	7.3	8.4	9.7	10.6	11.1	8.3	8.3	8.3	8.3
Scenario 3	20.2	25.1	28.8	33.2	36.2	38.1	28.6	28.6	28.6	28.6
Gross Domestic Product (Billions 2012$)	**19,464.6**	**19,852.6**	**20,220.4**	**20,609.9**	**21,012.4**	**21,415.7**	**23,533.4**	**25,893.8**	**28,450.9**	**31,208.9**
	2.7	3.8	5.0	6.3	7.7	8.8	7.9	7.3	7.3	7.6
	4.7	6.6	8.5	10.6	12.9	14.4	15.6	14.2	14.0	13.9
	13.6	19.5	23.9	29.0	33.5	37.1	40.5	40.1	39.4	37.9
Personal Consumption Expenditures	**13,543.1**	**13,823.1**	**14,093.9**	**14,370.7**	**14,650.9**	**14,932.2**	**16,382.0**	**17,978.3**	**19,707.0**	**21,576.2**
	1.1	1.5	2.5	3.4	4.4	5.3	4.1	2.3	1.7	1.5
	1.2	1.9	3.1	4.4	5.7	6.8	7.6	4.3	2.9	1.8
	2.2	4.3	6.5	8.4	10.3	12.0	16.0	10.7	7.9	5.9
Gross private domestic investment	**3,534.3**	**3,642.3**	**3,743.4**	**3,854.2**	**3,975.7**	**4,099.0**	**4,764.3**	**5,516.7**	**6,341.6**	**7,297.7**
	0.7	1.4	1.7	2.0	2.5	2.7	1.8	2.1	1.9	1.8
	1.3	2.4	2.9	3.5	4.3	4.5	3.6	3.4	3.4	3.0
	3.0	6.7	7.9	9.5	11.0	11.7	9.4	10.2	10.2	8.9
Real Net Exports	**-967.6**	**-976.1**	**-986.8**	**-999.5**	**-1,015.5**	**-1,032.0**	**-1,108.4**	**-1,218.7**	**-1,323.6**	**-1,484.0**
	-0.8	-1.2	-1.6	-1.9	-2.2	-2.4	0.0	1.4	2.4	3.3
	-1.1	-1.9	-2.3	-2.8	-3.1	-3.2	0.4	3.6	5.4	7.3
	-3.0	-5.8	-7.1	-8.0	-8.3	-8.1	0.9	8.2	12.1	14.5
Government Consumption & Investment	**3,321.7**	**3,332.3**	**3,340.8**	**3,357.5**	**3,376.6**	**3,394.8**	**3,500.3**	**3,661.7**	**3,837.4**	**4,028.5**
	1.6	1.9	2.2	2.6	2.8	2.9	1.9	1.5	1.3	1.0
	3.1	3.9	4.5	5.1	5.5	5.8	3.9	3.1	2.6	2.1
	10.8	13.3	15.3	17.6	19.0	19.8	13.3	10.7	8.8	7.3
Total Jobs (Thousands)	**166,002.9**	**166,657.7**	**167,510.9**	**168,385.4**	**169,375.2**	**170,404.3**	**173,798.1**	**177,498.8**	**181,105.4**	**184,606.8**
	19.2	29.1	34.9	42.3	49.1	54.7	41.2	31.5	27.9	27.3
	31.5	48.3	59.0	70.8	82.6	90.9	71.5	49.6	45.5	45.0
	80.1	108.6	133.8	156.3	174.3	182.5	165.8	137.2	134.3	136.4
Unemployment Rate (Percent)	**3.76**	**4.17**	**4.33**	**4.58**	**4.73**	**4.60**	**4.61**	**4.61**	**4.60**	**4.60**
	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02	-0.00	-0.00	-0.00	0.00
	-0.02	-0.02	-0.03	-0.03	-0.04	-0.04	-0.01	-0.00	-0.00	0.00
	-0.04	-0.05	-0.06	-0.06	-0.07	-0.06	-0.02	-0.00	0.00	0.00
Total Labor Productivity (2012$/Hour)	**70.377**	**71.343**	**72.335**	**73.376**	**74.408**	**75.419**	**81.265**	**87.611**	**94.478**	**101.832**
	0.002	0.000	0.002	0.003	0.004	0.005	0.003	0.004	0.006	0.008
	0.001	-0.000	0.001	0.003	0.004	0.005	0.007	0.010	0.013	0.015
	0.002	-0.001	-0.001	0.001	0.004	0.007	0.017	0.026	0.032	0.033
Disposable Personal Income (Billions)	**17,081.3**	**17,848.3**	**18,687.5**	**19,536.6**	**20,414.2**	**21,290.5**	**26,012.8**	**31,669.5**	**38,490.2**	**46,899.2**
	2.1	4.4	6.8	9.3	12.1	14.7	17.0	14.0	14.2	14.3
	3.9	7.8	11.9	16.3	21.2	25.2	30.2	25.1	25.5	26.3
	11.5	21.9	31.9	41.3	51.0	58.7	69.2	65.6	72.1	79.9
Real Disposable Income (Billions 2012$)	**15,204.0**	**15,537.0**	**15,908.3**	**16,280.4**	**16,643.6**	**16,978.9**	**18,569.8**	**20,271.5**	**22,110.8**	**24,175.2**
	1.3	2.8	4.5	6.2	8.0	9.6	11.1	10.5	12.2	15.4
	2.3	4.7	7.6	10.5	13.7	16.3	20.3	18.7	20.7	24.5
	6.5	12.9	20.3	27.5	34.2	39.7	49.9	49.4	54.2	60.8
Real Disposable Income per Household (2012$)	**116,972.6**	**118,469.6**	**120,233.3**	**121,972.5**	**123,603.9**	**124,998.6**	**131,216.6**	**138,295.1**	**146,499.4**	**156,329.6**
	10.4	21.2	33.7	46.1	59.4	70.7	78.5	71.6	80.9	99.4
	17.6	35.6	57.6	79.0	101.9	120.4	143.8	127.7	137.2	158.5
	49.8	98.5	153.7	205.7	253.8	292.4	352.7	336.7	358.8	393.0

Baseline levels are shown first in billions of 2012 dollars, billions of dollars, thousands of jobs, or in other units as noted. Results for Scenarios 1-3 are shown next as deviations from baseline, except where noted. *Source: LIFT Modeling Analysis by Inforum.*

- The resulting increase in household disposable income is an important indicator of the net welfare gain. Enhanced infrastructure spending raises real disposable income, providing annual gains of $11 billion to $50 billion by 2030. Net of investment and after taxes, improvements to MTS infrastructure would imply a net gain in real annual income of $79 per household for the smallest program to $353 per household for the most ambitious proposal, measured in 2012 dollars.

- Sustained infrastructure spending creates a progressively more productive economy. Because of cumulative effects through time, by 2045 infrastructure investments could produce economy-wide returns of between $2 and $3 per every $1 spent, after adjusting for inflation.

- Enhanced economic growth from increased infrastructure investments ultimately would provide greater government revenue levels, which would help to recover the costs of higher public investment spending.

The Bottom Line

As multiple sectors of public infrastructure show increasing signs of aging and decay with no immediate plans for action, this seems an appropriate juncture to consider a highly focused infrastructure effort designed to improve safety, increase competitiveness, and improve economic throughput. Accelerated private and public sector efforts to develop MTS infrastructure, including a significant supply of new spending, allows the pursuit of two economic objectives at once:

1. New funding will help the United States catch up from a well-documented backlog of deferred infrastructure projects that have accumulated, including maintenance, repair, and new capacity.

2. Greater infrastructure investment will help to sustain economic growth and resiliency. By repairing and replacing old and obsolete infrastructure, we reduce the risk of failures that could cripple regional commodity flows or add substantial transportation costs that leave American industry at a competitive disadvantage. For relatively little additional expenditure on MTS infrastructure as a share of GDP, as is illustrated in this study, the U.S. economy not only can become larger but can become substantially more robust.

Widespread access to high-quality infrastructure is indispensable to the United States' economic development and standard of living. A more focused and outcomes-driven infrastructure effort is needed, and new ideas can, and should, accompany any increase in investment. Strong support exists within the business and manufacturing communities for building a more competitive, nationwide marine transportation system infrastructure network. This report reinforces the value of such action.