Business Roundtable

Delivering for America

The macroeconomic impacts of reinvesting in America's infrastructure systems

JANUARY 2019

Business Roundtable partnered with Inforum, also known as the Interindustry Forecasting Project at the University of Maryland, to model the effects of infrastructure investment on the U.S. economy. Inforum pioneered the construction and use of dynamic, general-equilibrium models that portray the economy in a unique “bottom-up” fashion and specializes in developing and using structural economic models to improve general understanding of the economy.

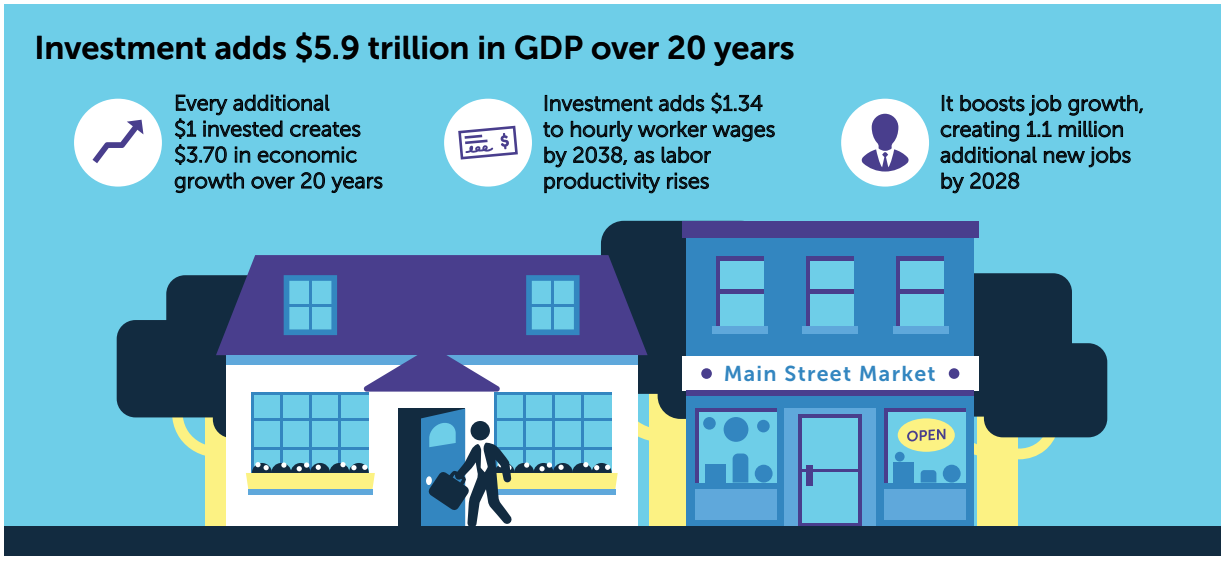
Business Roundtable CEO members lead companies with nearly 15 million employees and $7.5 trillion in revenues. The combined market capitalization of Business Roundtable member companies is the equivalent of over 27 percent of total U.S. stock market capitalization, and Business Roundtable members invest nearly $147 billion in research and development — equal to over 40 percent of total U.S. private R&D spending. Our companies pay $296 billion in dividends to shareholders and generate $488 billion in revenues for small and medium-sized businesses. Business Roundtable companies also make more than $8 billion in charitable contributions.

Delivering for America

The macroeconomic impacts of reinvesting in America's infrastructure systems

Contents

Executive Summary



A modern infrastructure system is key to unleashing the full productive potential of the U.S. economy. In recent years, however, public-sector investment in infrastructure has not kept pace with the dynamism, innovation and growth elsewhere in the U.S. economy. This study is designed to quantify and make the case for the benefits of taking action to reverse this trend. Using an industry-based macroeconomic model, it estimates the economic impacts of a fiscally responsible investment of $737 billion over 10 years in surface transportation, water and wastewater, aviation, water resources, and water transportation, plus the crucial step of establishing a "new normal" level of public-sector commitment to maintaining American infrastructure.

Infrastructure investment delivers tangible benefits for the average American family. This study finds that the investment scenario adds an average of $1,400 in disposable income for the average U.S. household every year for 20 years, or $28,300 by 2038. At the same time, average wages are $1.34 per hour higher after 20 years. In addition to these direct benefits, workers and families benefit indirectly from time savings, reduced costs, and a more dynamic economic and employment environment.

Modernized, improved and expanded infrastructure can shift U.S. business into a higher gear. Infrastructure investment boosts productivity across all sectors of the economy, allowing businesses to do more with less as they see fewer delays, eliminate unnecessary costs and overcome drags on efficiency that harm U.S. competitiveness. Over 20 years, average annual labor productivity is 0.56 percent higher than baseline, and the gap widens over time.

Infrastructure investment is good for America. An investment of this scale adds $5.9 trillion to gross domestic product (GDP) over 20 years as a result of the average annual real GDP growth rate increasing by 0.10 percentage point over that time period. It also catalyzes private investment, with U.S. businesses investing an additional $1.9 trillion over 20 years.

The unique benefit of infrastructure investment is its ability to drive productivity growth and with it the long-run potential productive capacity of the economy. While positive labor market outcomes and accelerated growth are observed in the short term, the true benefits of infrastructure are observed over a much longer time frame and at a much larger scale. Over 20 years, every additional $1 invested in infrastructure drives roughly $3.70 in additional economic growth. Investing in infrastructure is not just about delivering for U.S. businesses and workers now — it is about creating a new foundation for our economy to be more competitive for the foreseeable future.

The results of this study clearly demonstrate that investing in renewing America's infrastructure represents a vital opportunity to advance the interests of American families, workers and businesses and the economy as a whole. **The daily costs of inaction are observable to all, but a full understanding of the benefits of taking action is equally, if not more, important for leading the way toward the modern, dynamic and prosperous economy of the future.**

Introduction and Policy Context

The Role of Infrastructure in the U.S. Economy

A modern infrastructure system is key to unleashing the full productive potential of the U.S. economy.

This report examines the state of U.S. infrastructure, where the country needs to go and the economic effects of taking action.

- **Infrastructure undergirds a modern, competitive U.S. economy.** The collection of roads and bridges, airports, water systems, dams and levees, ports, and urban transit systems facilitates and helps drive innovation, competitiveness, job growth and productivity.
- **Infrastructure affects us all.** For U.S. businesses, every element of economic output depends on the nation's infrastructure — from the transport of imports, exports and services to our daily commutes. For U.S. households, infrastructure makes America accessible, lowers the costs of everyday goods and activities, helps provide clean water to drink, and improves people's lives.
- **America's infrastructure is falling behind.** The scale and ambition of American infrastructure projects long defined the global gold standard. Over time, however, this commitment and our nation's critical infrastructure systems have begun to erode. Public financing has not kept pace with population and economic growth. The growing gap between our needs and our investment threatens not only the quality and reliability of our national infrastructure but also America's economic foundation.
- **It is time to reinvest in America's infrastructure.** Investing in American infrastructure is a prerequisite for delivering job creation, growth and improved living standards for Americans. It is also a catalyst for the connections and creativity that will power the innovation and economy of the future. Meeting this urgent need requires strong leadership that is focused on restoring America's gold standard of infrastructure excellence.

Current Trends in U.S. Infrastructure Investment

Public spending on infrastructure fell by 8 percent from 2003 to 2017.

Investment in infrastructure has not kept pace with the dynamism, innovation and growth elsewhere in the U.S. economy.

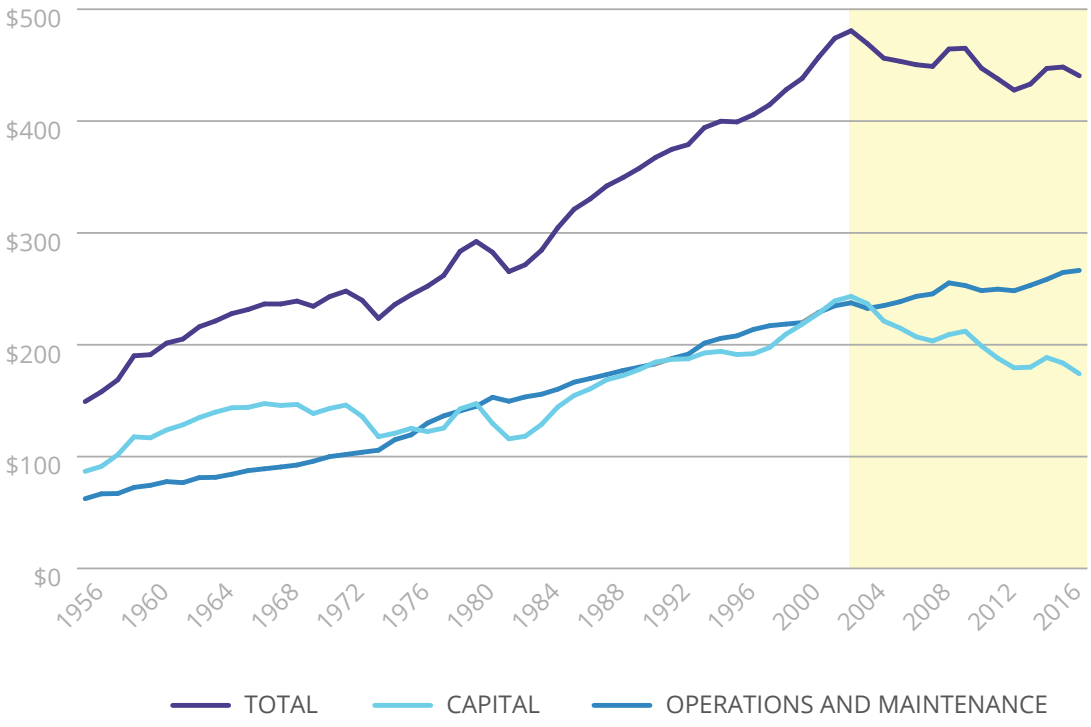
U.S. public infrastructure spending fell by 8 percent from 2003 to 2017.[1] As a share of gross domestic product (GDP), public infrastructure spending fell by nearly 11 percent over this period, when adjusted for inflation and the cost of infrastructure inputs.[2]

This decline was driven by a sharp drop in capital investment: -28 percent from 2003 to 2014. While spending on capital and on operations and maintenance was roughly equal from the 1970s until 2002, increases in input costs coupled with only marginal increases in nominal spending have created a widening gulf between forward-looking capital investment and maintenance of existing infrastructure.[3]

The United States has also fallen behind its competitors. All but two G7 countries, Italy and Germany, spend a larger share of GDP on infrastructure than the United States.[4]

Public Spending on Infrastructure

Spending by Category, Billions 2017$, Adjusted for Inflation Using Infrastructure-Specific Price Indexes as Specified by the Congressional Budget Office



Source: Congressional Budget Office, "Public Spending on Transportation and Water Infrastructure, 1956–2017," October 2018, p. 6.

Implications of a Growing Gap in Infrastructure Investment

The lack of investment has taken a toll, and a bold plan is needed to reimagine and rebuild American infrastructure. Investing in infrastructure now can reduce costs and provide benefits at a new scale.

IMPLICATIONS FOR SYSTEM PERFORMANCE

- **44 percent** of the country's major roads are in poor or mediocre condition, and **45 percent** of major urban highways are congested.[5]
- More than **one in five** bridges (23 percent) in the national highway system is either structurally deficient or functionally obsolete.[6]
- Lock shutdowns along U.S. waterways as a result of maintenance and unexpected delays totaled approximately **144,000 hours** in 2016, nearly 90 percent more than in 2000.[7]

COSTS TO U.S. HOUSEHOLDS AND BUSINESSES

- Inadequate infrastructure costs American businesses **$27 billion** per year in extra transportation costs.[8]
- Approximately 38 million people avoided domestic plane trips due to prior air travel complications in 2013, costing the U.S. economy nearly **$36 billion.**[9]
- Congestion on major urban roadways cost the average commuter **$960** and 42 hours of travel time in 2014.[10]
- If infrastructure policies and funding remain at their recent levels, wasted fuel will increase from 3.1 billion gallons in 2014 to **3.8 billion gallons** in 2020.[11]

Methodology and Approach

About This Study

The goal of this study is not to provide a prescriptive policy roadmap for increasing infrastructure investment but to make a clear and compelling case for the economic benefits of taking action.

PURPOSE

The purpose of this modeling study is to quantify the significant, long-term economic benefits of right-sizing investment in the nation's public infrastructure systems. The costs of doing nothing have been well documented. This study endeavors to advance the national conversation by articulating the benefits of doing something.

What the study is **not** intended to do is advocate a specific spending amount or particular policy mechanisms for increasing investment. What is clear — and what is reflected in the policy scenario — is that it will take hundreds of billions of dollars in additional investment to bring America's infrastructure systems back into a state of good repair and capacity capable of supporting continued economic growth and international competitiveness. What is also clear is that the federal government must take a leadership role in renewing investment in the nation's infrastructure systems and that this investment can and must be made in a fiscally responsible manner.

SCOPE

The study is focused narrowly on a core set of infrastructure systems that are **primarily publicly funded,** particularly those that receive significant federal funding (see p. 9). Investment in privately funded infrastructure systems — freight rail, broadband, energy pipelines, etc. — is robust, and barriers to accelerating investment in these systems are generally related to regulatory and permitting roadblocks, not a lack of funding.

TECHNICAL APPROACH

Business Roundtable partnered with the University of Maryland Inforum modeling group to a conduct a macroeconomic modeling study of the impact of increasing infrastructure investment on the U.S. economy. The model is **not** an engineering model that estimates the specific community-level impacts of repairing a bridge versus widening a road versus expanding a port. Rather, it is a fully dynamic, general-equilibrium model of the U.S. economy that captures the impacts and feedback loops of increased infrastructure investment across all sectors of the economy. Inputs to the model include (a) a policy scenario that specified spending amount by infrastructure system and funding source and (b) estimates of sector-specific productivity effects associated with improved infrastructure.

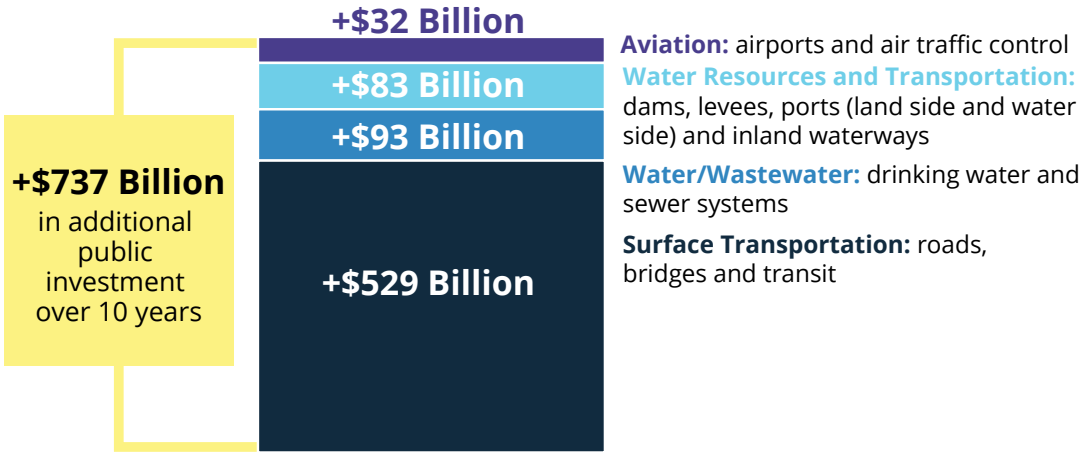
About the Policy Scenario

Infrastructure investment needs are heavily concentrated in surface transportation systems.

- The policy scenario reflects a fiscally responsible approach to an infrastructure investment package with $737 billion (2018$) invested over 10 years in roads, bridges, transit, water and sewer, airports and air traffic control, dams, levees, ports, and inland waterways. *(Note: All inputs and outputs to the model — spending figures and benefits — are reported in 2018 dollars. Conversions have been made based on an estimated 2018 GDP deflator of 110.224, or 2.1 percent inflation for the year.)*
- This investment represents an increase of approximately one-third over projected baseline spending levels over the 10-year period.
- In addition to the $737 billion capital investment package over 10 years (i.e., the "policy period"), the scenario also establishes a new normal for infrastructure spending in the "out years" (i.e., after the 10-year $737 billion spending package) by holding public capital investment in infrastructure steady at a fixed share of GDP, in the range of 1.2 percent of the total. This new rate of investment corrects the declining trend in public infrastructure investment and reflects a right-sized commitment to maintaining, expanding and improving the nation's vital infrastructure systems.
- This scenario represents an investment amount that will (1) return these systems to a state of good repair, (2) expand capacity to meet future demand and (3) fund innovative approaches to future infrastructure challenges.
- The magnitude of the scenario was arrived at based on bottom-up, system-level research comparing current capital spending with consensus estimates of the "need" by system.
- These "need" estimates represent the capital investment required to return each system to a state of good repair and to expand and improve the system to meet future demand, as determined by current asset conditions and performance and reported by system-level experts. *(See Appendix A for detailed scenario tables; see Appendix D for a detailed list of sources.)*

Policy Scenario: Incremental Investment by System

Capital Investment Above Baseline, Billions (2018$)

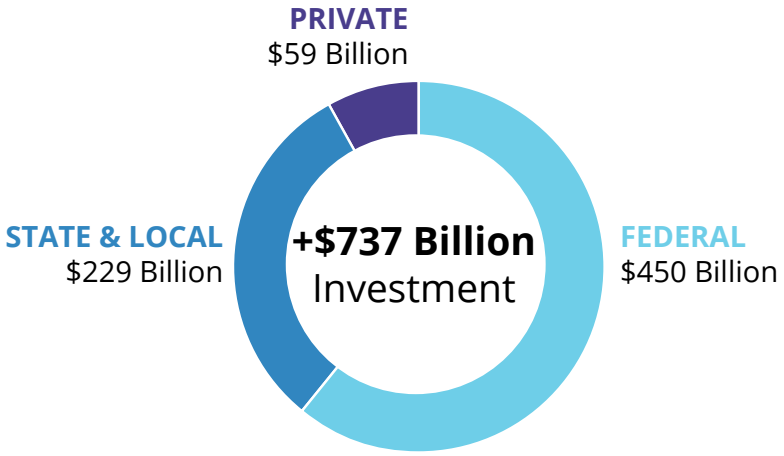


The policy scenario reflects a strong federal role and a fiscally responsible approach.

- Federal funding accounts for more than 60 percent of the investment package, illustrating the needed leadership from the federal government in addressing infrastructure deficiencies.
- The breakdown between federal and state/local spending generally reflects cost-sharing requirements of federal grant and loan programs. The exception is the water/wastewater system, where the vast majority of funding is state/local. *(See Appendix D for a detailed list of sources.)*
- The private sector's share of the infrastructure investment is based on assumptions that those systems that currently receive some private-sector investment will experience a modest increase in that investment as steps are taken to incentivize increased private-sector investment in the nation's infrastructure systems.
- The study models a fiscally responsible approach to funding $737 billion of additional infrastructure investment.
    - Federal spending: Two-thirds of federal spending is funded by taxes and user fees, and one-third is deficit financed.
    - State/local spending: All state and local spending is funded by debt that is retired via taxes and fees over 15 years.

Policy Scenario: Sources of Funding/Financing*

Additional Spending by Source, Billions (2018$)



The source of funding or financing is **not necessarily the same entity that directly spends the funds. For example, most federal dollars invested in roads and bridges are distributed to state governments for direct spending on projects.*

The policy scenario reflects a bottom-up assessment of infrastructure investment need.

System	Additional Investment (Billions 2018$)	Spending Source	Spending Share	Spending Amount (Billions 2018$)
SURFACE TRANSPORTATION Roads and Bridges	$475.7	Federal	69%	$327.3
		State/Local	19%	$91.3
		Private	12%	$57.1
SURFACE TRANSPORTATION Transit	$52.9	Federal	78%	$41.2
		State/Local	22%	$11.6
		Private	0%	$0.0
AVIATION	$32.3	Federal	81%	$26.0
		State/Local	14%	$4.7
		Private	5%	$1.6
WATER TRANSPORTATION Ports and Inland Waterways	$41.7	Federal	60%	$25.0
		State/Local	40%	$16.7
		Private	0%	$0.0
WATER RESOURCES Dams and Levees	$41.7	Federal	60%	$25.0
		State/Local	40%	$16.7
		Private	0%	$0.0
WATER/WASTEWATER	$92.7	Federal	6%	$5.1
		State/Local	94%	$87.6
		Private	0%	$0.0

Note: Numbers may not sum or share out exactly due to rounding.

Modeling Assumptions and Qualifications

INVESTMENT TIMING

The $737 billion in additional infrastructure capital investment is distributed over the course of the 10-year policy period. To reflect a realistic spending trajectory, and the fact that most projects do not have the capability to "turn on" immediately, the spending level ramps up gradually and peaks in the sixth year of the 10-year period. It gradually declines in the subsequent years, settling in year 11 (i.e., 2029) at a "new normal" steady state pegged to GDP growth.

This "new normal" is intended to reflect a future state in which, instead of reverting to the historical suboptimal level of investment after the policy period, capital investment settles at a share of GDP that is below the "surge" level in the policy period but above baseline and thus grows in tandem with the rest of the economy.

CAPITAL VERSUS OPERATIONS AND MAINTENANCE SPENDING

Capital spending on infrastructure includes new structures (e.g., bridges and ports), new equipment (e.g., buses and air traffic control systems), and the improvement and major rehabilitation of existing infrastructure (e.g., widening a road or repaving a runway). Operations and maintenance includes services (e.g., lock and dam operation), minor repairs, and other related activities such as research and development. The $737 billion policy scenario reflects capital spending only, with no consideration given to the increased operations and maintenance requirements associated with a larger future stock of infrastructure assets. For this reason, the economic impacts of increased public infrastructure investment presented in this study should be considered conservative. *(Note: The inability to accurately estimate the additional operations and maintenance spending associated with major infrastructure investment is a typical constraint of macroeconomic modeling studies of infrastructure investment.)*

OFFSETTING EFFECTS OF INFRASTRUCTURE INVESTMENT

The modeling approach incorporates a slight offsetting effect of expanded infrastructure investment on state and local noninfrastructure spending. In this case, the study assumes that state and local noninfrastructure investment shrinks by an amount equal to 10 percent of the additional state and local spending on infrastructure specified in the policy scenario. This decrease reflects the likelihood that states and localities will face budgetary pressures that cause them to temporarily decrease their focus on other types of spending during the policy period.

ALLOCATION OF INVESTMENT SPENDING

The majority (75 percent) of the spending package is allocated to investment in structures. Structures make up the core category of infrastructure capital investment, covering assets such as dams, roads and buildings. Meanwhile, the remaining investment categories of equipment, intellectual property, and real estate and acquisition are allocated 13 percent, 7 percent and 5 percent, respectively, of the investment spending total.

THE LIFT MODEL

The study uses the University of Maryland Inforum's Long-term Interindustry Forecasting Tool (LIFT) model — a 97-sector dynamic, general-equilibrium model of the U.S. economy. It takes a "bottom-up" approach to macroeconomic forecasting, building up to macroeconomic totals by modeling industry-level effects. *(See Appendix B for a detailed description of the model.)* The policy scenario is imposed upon the model, resulting in increases in both aggregate demand and labor productivity, which are observed both for individual sectors and in the overall macroeconomy.

INDUSTRY-LEVEL PRODUCTIVITY RESPONSES

The model incorporates expectations for industry-level labor productivity gains in response to infrastructure improvements. Each industry experiences different changes to input costs and efficiency due to improved infrastructure, and the model internalizes this variation as an input to forecasts of employment, output, wages and other key indicators. For example, labor productivity in the trucking sector — an industry undeniably dependent on public infrastructure — responds strongly to improved infrastructure, as drivers are able to move goods more quickly and efficiently. The estimated magnitudes of these effects are the product of detailed studies and research conducted by Inforum in collaboration with engineering and industry experts.

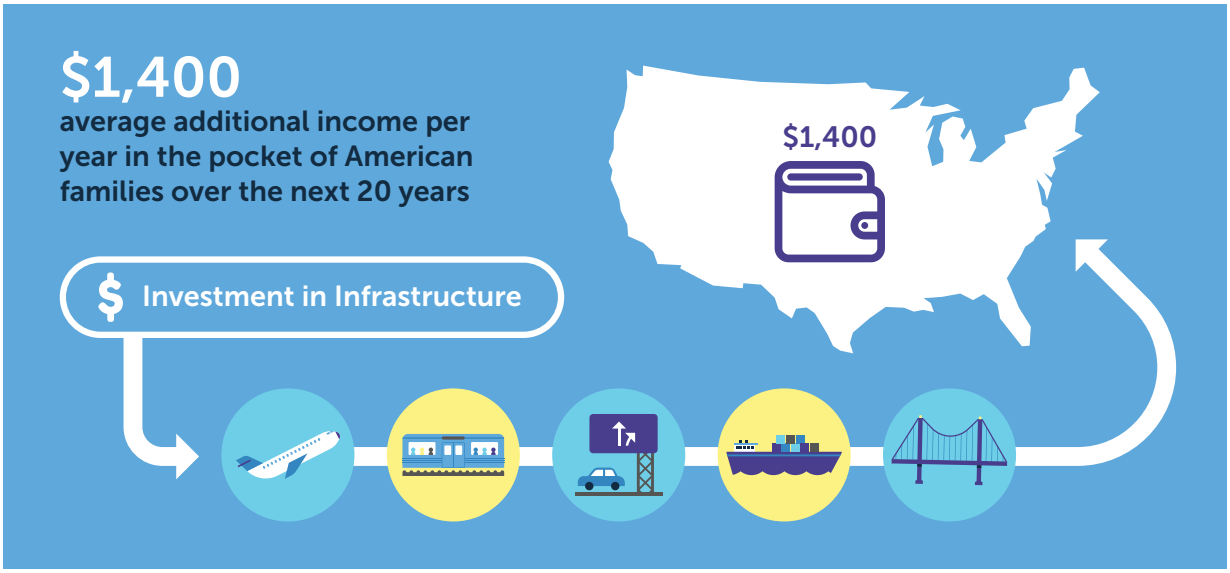
THE BASE CASE

The baseline assumptions in the model represent a steady-state forecast of the macroeconomy over the specified time period (i.e., 2019–38). The model extrapolates current macroeconomic and demographic trends and trends in infrastructure spending from recent history to set the baseline. As a result, the baseline reflects the unique economic environment of the present day, which is characterized by near-full employment, relatively low borrowing costs and healthy GDP growth. The $737 billion policy scenario is imposed on top of this baseline.

Results

Summary of Key Results

Infrastructure investment unlocks meaningful productivity growth and boosts U.S. household income.



- **Investing in infrastructure pays for itself** several times over. Every additional $1 invested in infrastructure delivers roughly $3.70 in additional economic growth over 20 years.
- It adds $5.9 trillion to **real GDP** over 20 years as a result of a 0.10 percentage point increase in the average annual real GDP growth rate over that period.
- It increases **labor productivity,** the benefits of which reach all corners of the economy. Over 20 years, average annual labor productivity is 0.56 percent higher than baseline, and the gap widens with time.
- It contributes to higher **job growth,** with 1.1 million additional jobs created by year 10 of the policy scenario (2028).
- It raises **worker wages,** adding $1.34 to average real hourly wages by 2038, compared to the baseline scenario.
- It adds to bank accounts, boosting **household real disposable income** by an average of $1,400 every year, or $28,300 over 20 years.
- It catalyzes **private investment,** adding an additional $1.9 trillion in investment over 20 years.

Macroeconomic Effects

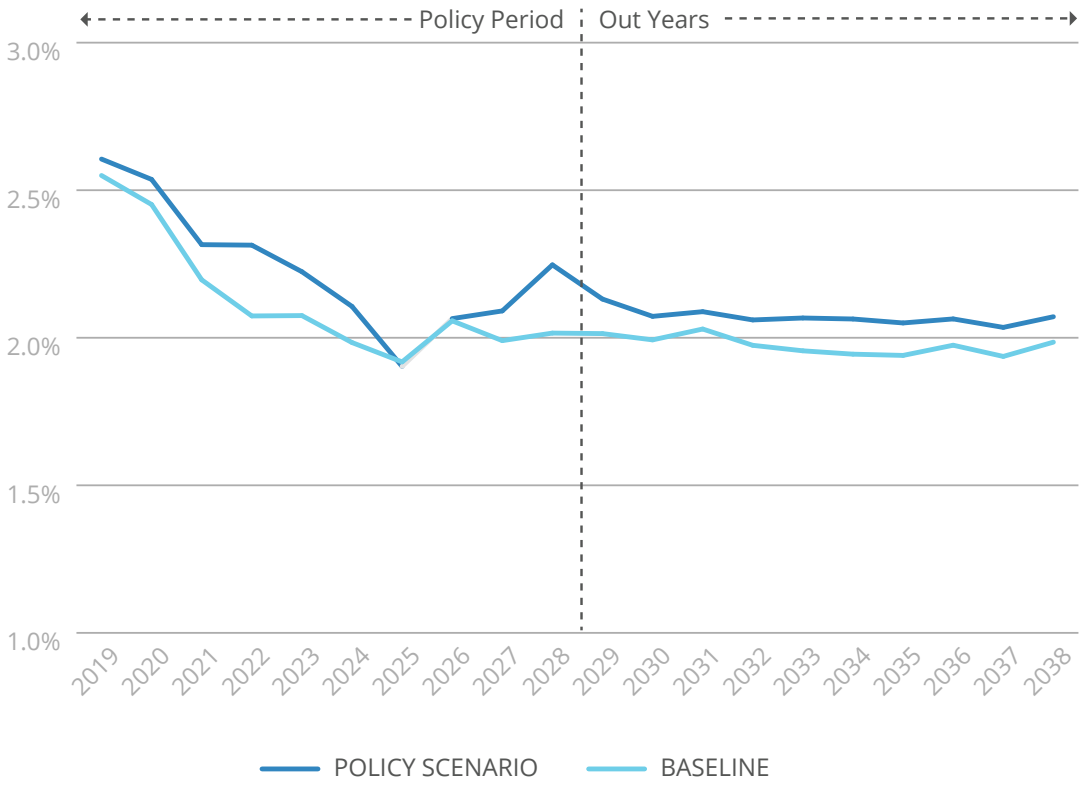
Gross Domestic Product

Investing in American infrastructure adds $5.9 trillion to real GDP over 20 years.

The infrastructure investment scenario adds an average of **0.10 percentage point to annual real GDP growth** over a 20-year period. This acceleration in the economic growth rate reflects a sustained increase in long-run potential U.S. economic output that extends well beyond the 10-year policy period. An impact of this magnitude is the equivalent of adding approximately **$5.9 trillion to real GDP** over 20 years.

Impact of Additional Infrastructure Investment on Real GDP

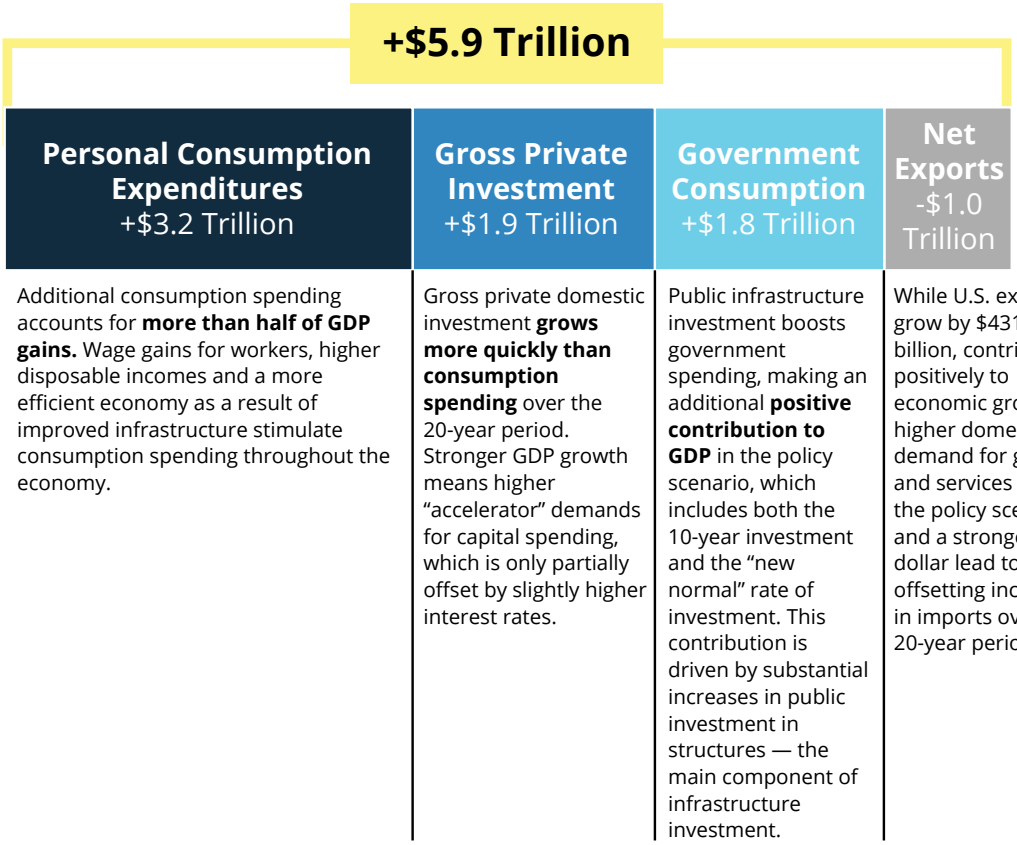
Annual GDP Growth Rate, 2019–38



Faster real GDP growth compounds over time, leading to a substantial increase in long-term potential output. The $5.9 trillion increase in GDP in the policy scenario comprises strong growth in consumption expenditures, meaningful contributions from private investment and government consumption, a boost in U.S. exports, and an offsetting increase in imports.

Contributions to Change in Real GDP from Baseline

Cumulative Additional GDP (2018$), 2019–38



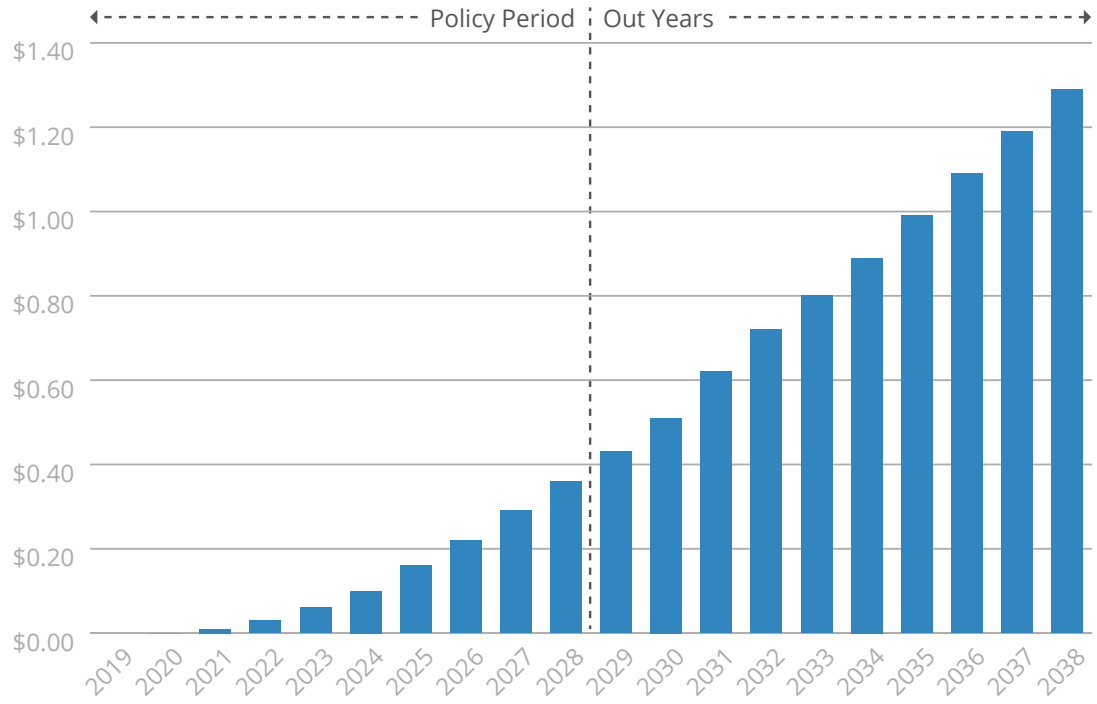
Productivity

Labor productivity drives long-term economic growth.

- Improved infrastructure reduces economic friction and accelerates productivity by shortening transit times, reducing input costs, lowering inflation and stimulating aggregate demand.
- Increased infrastructure investment would **add an average of 0.07 percentage point to the annual labor productivity growth rate** each year through 2038.
- The gap between the labor productivity growth rate in the baseline and policy scenarios widens over time, illustrating sustained and growing benefits.
- Impacts on labor productivity accelerate over time. In year 10 of the policy scenario (2028), average labor productivity is 0.4 percent above baseline, compared to **1.3 percent above baseline in 2038.**

Improvement to Labor Productivity

Incremental Labor Productivity Relative to Baseline (2018$/Hour), 2019–38



Employment

The stimulative effects of increased investment drive short-term job growth and draw more workers into the labor force.

With the U.S. economy effectively operating at full employment in late 2018 (with an unemployment rate in the mid to high 3 percent range), the scope for strong employment effects from higher infrastructure spending is limited.

Nonetheless, results still indicate a small positive labor market response to increased infrastructure investment. Most of these impacts are concentrated during the 10-year policy period: By the 10th year of the scenario (i.e., 2028), the economy has 1.1 million more jobs than under the baseline scenario. These gains are maintained over the following decade.

As should be expected, many of these additional jobs are in the construction sector — 301,000 at the end of the 10-year policy period — though other sectors, including retail trade (+125,000) and wholesale trade (+23,000); finance, insurance and real estate (+67,000); and durables manufacturing (+46,000) also enjoy meaningful gains.

The impact of increased infrastructure spending in terms of higher aggregate demand, in the presence of already low unemployment, means that more Americans are pulled into the labor force as wages increase. This effect translates into 846,000 more people in the labor force by 2038 than in the baseline scenario — leading to a modest increase in the labor force participation rate.

Household Effects

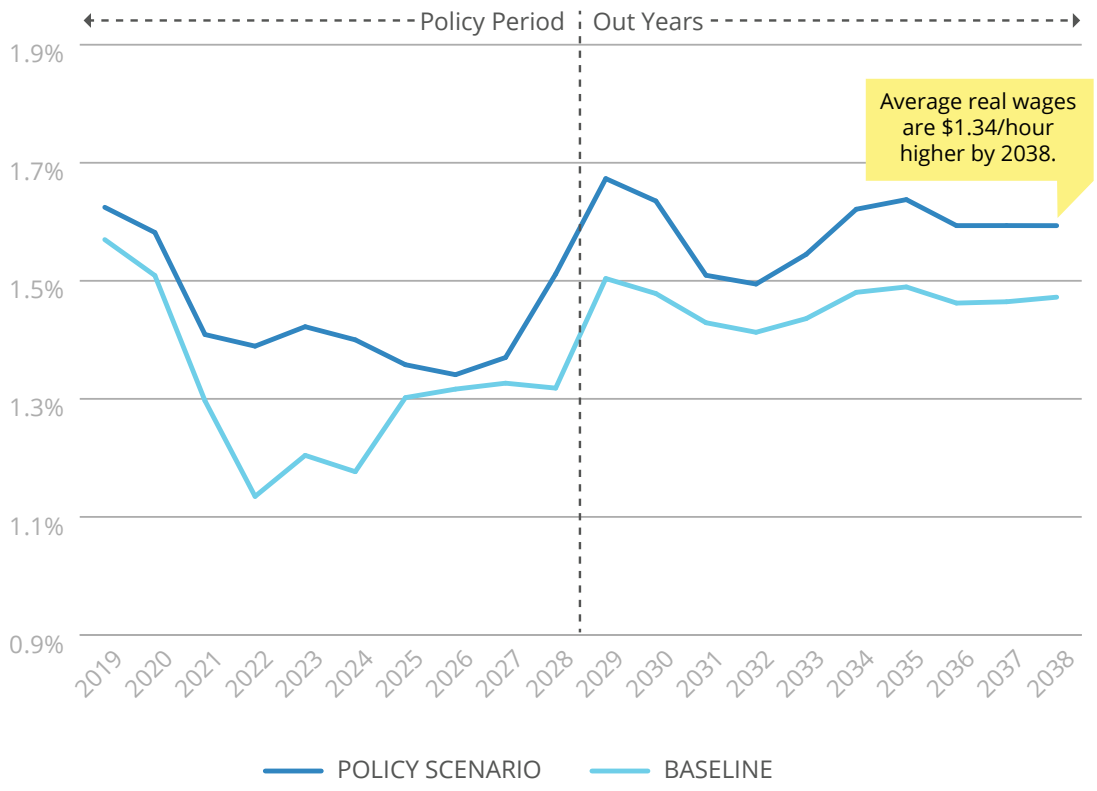
Wages

Infrastructure investment adds $1.34 per hour to average real wages by 2038.

- Infrastructure investment — and the related gains in labor productivity — boosts **average annual real wage growth by 0.13 percentage point** over 20 years.
- By 2038, faster wage growth results in average real hourly real wages that are **$1.34 per hour higher** than in the baseline scenario — an increase of 2.5 percent.
- Wage growth responds strongly to the short-term effects of increased investment during the policy period.
- In the out years, the productivity effects of additional investment sustain higher rates of wage growth over the long term.

Average Real Wage Growth

Average Annual Real Hourly Wage Growth, 2019–38



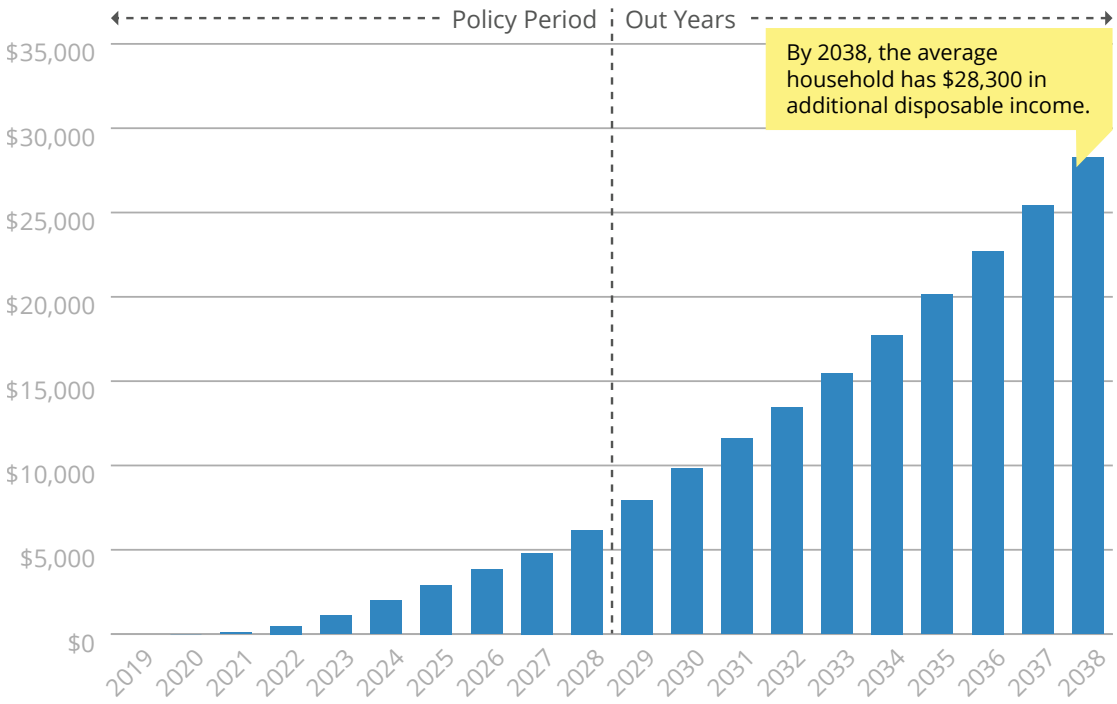
Household Disposable Income

Infrastructure investment adds $28,300 to average real disposable household income over 20 years.

- The average U.S. household's cumulative real disposable income is **$28,300 above baseline** by the end of the 20-year period.
- This increase equates to more than **$1,400 per year per household** in additional disposable income as a consequence of infrastructure investment.
- Higher wages — a product of gains in labor productivity — are a key driver of increased household income.

Growth in Real Average Household Disposable Income

Cumulative Difference in Average Real Disposable Household Income (2018$), 2019–38



Industry Effects

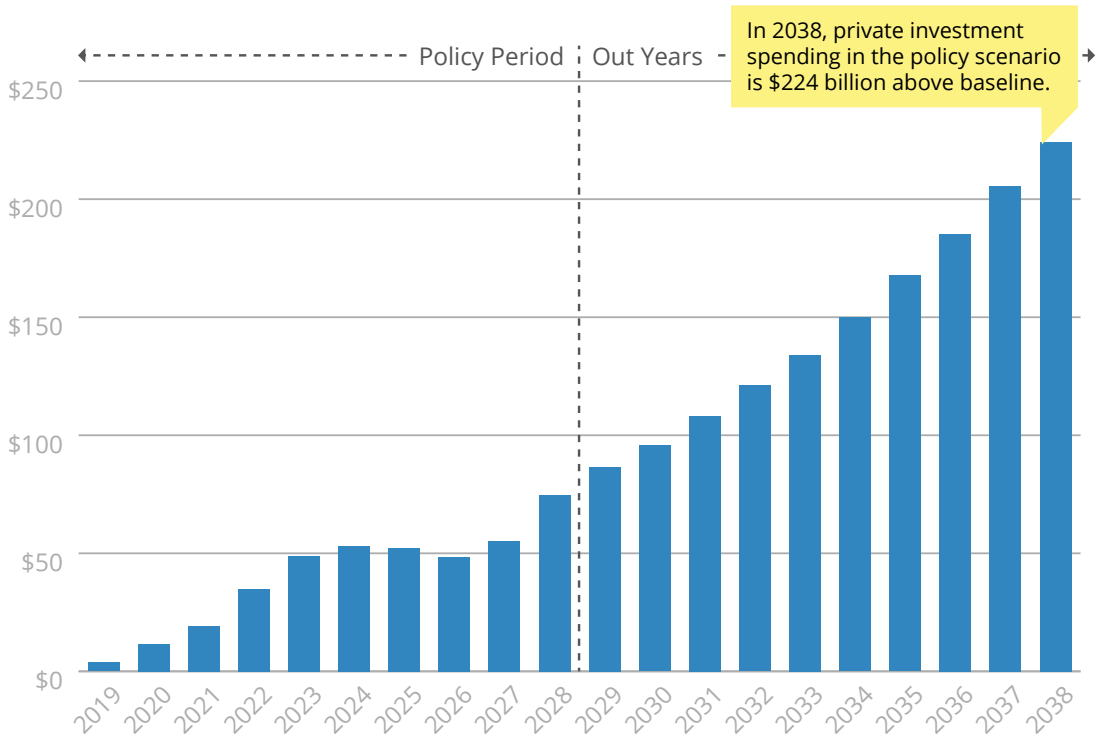
Private Investment

Infrastructure investment spurs additional private investment in both the short and long terms.

- Over 20 years, infrastructure investment spurs an additional **$1.9 trillion in gross private investment,** relative to baseline.
- Infrastructure investment boosts the average annual growth rate of gross domestic private investment by **0.16 percentage point** over baseline during the 20-year period.
- Private investment is highly responsive to improved infrastructure and **constitutes a larger share of GDP** in the policy scenario than under baseline conditions.
- The vast majority (79 percent) of the increase in private investment spending is due to an **increase in business investment spending.**

Annual Incremental Gross Domestic Private Investment

Additional Private Investment Relative to Baseline, Billions (2018$)



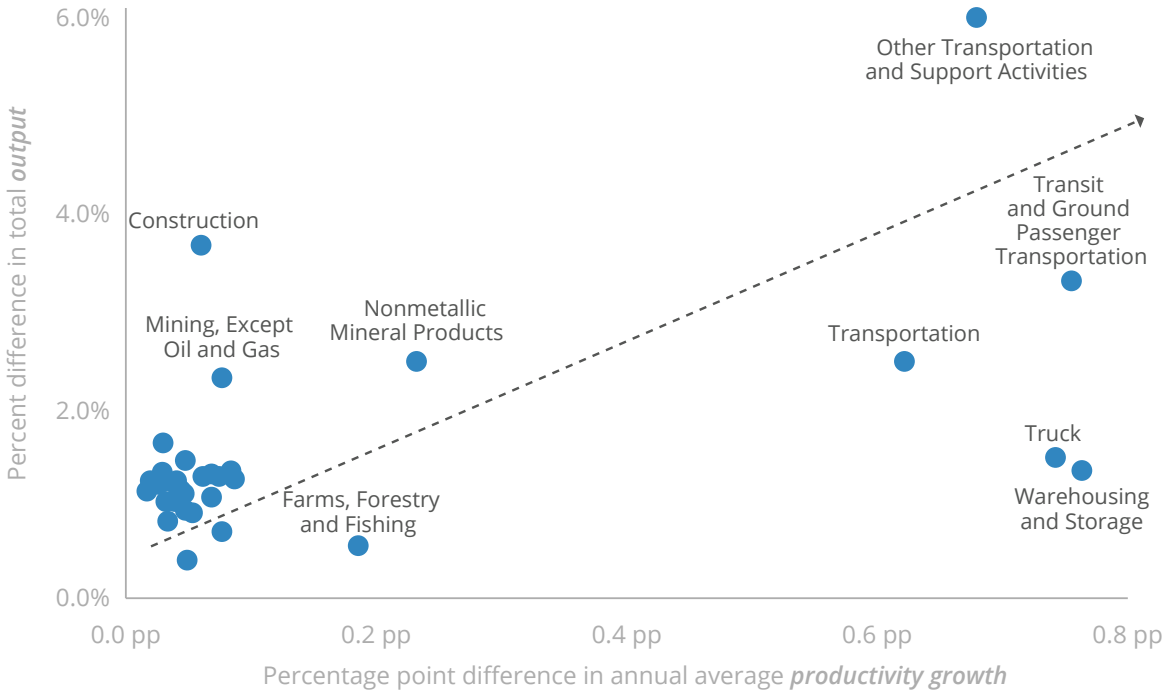
Productivity and Output Change by Sector

Higher productivity boosts output in virtually every sector of the economy, with particularly strong gains in the transportation sector.

- Higher productivity drives an **additional $715 billion in real gross output in the transportation sector** over 20 years, relative to baseline.
- Improved infrastructure drives productivity gains that let industries **do more with less,** which leads to substantial increases in real output.
- Improved transportation sector productivity translates into higher efficiencies in other sectors as well, leading to broad-based growth in real gross output.

Sector Output and Productivity Growth

Increase in Total Output by Increase in Productivity Growth, 2019–38



Discussion of Key Results

The benefits of infrastructure investment are driven and sustained by a long-term boost in productivity.

Infrastructure investment has two broad categories of economic benefits: **short-term stimulus** and **long-term productivity gains.** While these are distinct policy goals, the findings presented in this study reflect both types of benefits to different degrees.

In the short term, the direct effects of infrastructure spending are evident. The injection of investment spending creates jobs, pulls additional workers into the labor market, stimulates demand, and prompts a temporary acceleration in consumption spending and business investment. This boost in economic activity eventually leads to an increase in interest rates. In this study, the historically low interest rate environment and relatively tight labor market mean that the economy's short-term response to the stimulus of capital investment is relatively modest.

Over the longer term, it is not the additional dollars spent on infrastructure that generate meaningful and sustained economic benefits but the productivity-enhancing effects of the infrastructure itself. Chief among these benefits is a steady, accelerating increase in labor productivity. An increase in productivity is like tightening the gears of the economy — a frame shift that allows it to do more for less, boosting efficiency and generating positive ripple effects throughout the entire economy. Increases in labor productivity are most concentrated in the sectors that are intuitively linked with infrastructure — particularly passenger transportation, trucking, and warehousing and storage. However, the ripple effects are virtually universal, reaching diverse industries from farming to manufacturing to wholesale and retail trade — driving widespread efficiencies and cost savings.

The impacts of productivity growth are reflected most clearly in the increase in potential U.S. GDP, driven by increased consumption and investment, which accelerates economic growth for the foreseeable future. Households also see tangible benefits from increased productivity — higher wages, increased disposable income, lower prices, and lower spending on key goods and services like transportation. Meanwhile, American industry supports a sustained increase in private investment and output, strengthening its competitive edge and continuing to propel economic growth.

The most compelling rationale for infrastructure investment, which this study quantifies, is long-term economic growth driven by productivity. These gains are broadly distributed, are meaningful in scale and build over time — increasing economic efficiency and prosperity nationwide.

Appendix A

Detailed Results: Macroeconomic Results

Indicator	Units	Scenario	Policy Period: 2019–28	Out Years: 2029–38	20-Year Period: 2019–38
Real Gross Domestic Product	Level (Billions 2018$)	Baseline	230,390	280,911	511,300
		Policy Scenario	231,754	285,435	517,190
	Average Annual Growth Rate	Baseline	2.13%	1.97%	2.05%
		Policy Scenario	2.24%	2.07%	2.16%
Real Personal Consumption Expenditures	Level (Billions 2018$)	Baseline	158,948	191,562	350,510
		Policy Scenario	159,469	194,253	353,722
	Average Annual Growth Rate	Baseline	2.01%	1.86%	1.93%
		Policy Scenario	2.10%	1.95%	2.02%
Real Gross Domestic Private Investment	Level (Billions 2018$)	Baseline	45,748	62,875	108,622
		Policy Scenario	46,149	64,353	110,502
	Average Annual Growth Rate	Baseline	3.86%	2.94%	3.40%
		Policy Scenario	4.01%	3.12%	3.56%
Nonresidential Fixed Investment	Level (Billions 2018$)	Baseline	34,971	47,562	82,534
		Policy Scenario	35,295	48,719	84,014
	Average Annual Growth Rate	Baseline	3.54%	3.01%	3.27%
		Policy Scenario	3.68%	3.20%	3.44%
Residential Fixed Investment	Level (Billions 2018$)	Baseline	9,888	14,025	23,913
		Policy Scenario	9,953	14,316	24,270
	Average Annual Growth Rate	Baseline	4.89%	2.75%	3.82%
		Policy Scenario	5.02%	2.90%	3.96%
Real Government Consumption and Investment	Level (Billions 2018$)	Baseline	35,317	38,329	73,646
		Policy Scenario	36,048	39,413	75,461
	Average Annual Growth Rate	Baseline	0.70%	0.93%	0.82%
		Policy Scenario	0.94%	1.00%	0.97%
Real Net Exports	Level (Billions 2018$)	Baseline	(8,829)	(9,700)	(18,529)
		Policy Scenario	(9,150)	(10,388)	(19,538)
	Average Annual Growth Rate	Baseline	1.89%	0.27%	1.08%
		Policy Scenario	2.48%	0.54%	1.51%
Real Exports	Level (Billions 2018$)	Baseline	31,096	42,568	73,664
		Policy Scenario	31,086	43,009	74,095
Real Imports	Level (Billions 2018$)	Baseline	39,925	52,268	92,193
		Policy Scenario	40,236	53,397	93,633

Indicator	Units	Scenario	Policy Period: 2019–28	Out Years: 2029–38	20-Year Period: 2019–38
Total Jobs	Average Annual Level (Millions)	Baseline	170.119	180.522	175.320
		Policy Scenario	170.788	181.642	176.215
Total Civilian Labor Force	Average Annual Level (Millions)	Baseline	170.495	181.369	175.932
		Policy Scenario	170.928	182.196	176.562
Total Labor Productivity	Average Annual Level (2018$/Hour)	Baseline	81.12	93.29	87.20
		Policy Scenario	81.24	94.14	87.69
	Average Annual Growth Rate	Baseline	1.40%	1.46%	1.43%
		Policy Scenario	1.45%	1.55%	1.50%
Real Average Disposable Household Income	Average Annual Level (2018$)	Baseline	130,729	146,204	138,467
		Policy Scenario	131,346	148,415	139,880
Average Real Wage	Average Annual Level (2018$)	Baseline	43.35	49.74	46.55
		Policy Scenario	43.66	50.72	47.19
	Average Annual Growth Rate	Baseline	1.32%	1.46%	1.39%
		Policy Scenario	1.44%	1.59%	1.52%
Personal Savings Rate	Average Annual Level	Baseline	5.90%	6.68%	6.29%
		Policy Scenario	6.02%	6.77%	6.40%
Interest Rate: 10-Year Treasury Bond Yields	Average Annual Level	Baseline	3.64%	4.02%	3.83%
		Policy Scenario	3.72%	4.11%	3.91%
Interest Rate: 3-Month Treasury Bill Yields	Average Annual Level	Baseline	2.75%	2.91%	2.83%
		Policy Scenario	2.85%	2.98%	2.92%
GDP Deflator (2009 = 100)	Average Annual Level	Baseline	130.13	160.48	145.30
		Policy Scenario	130.56	160.59	145.57

Detailed Results: Results by Sector

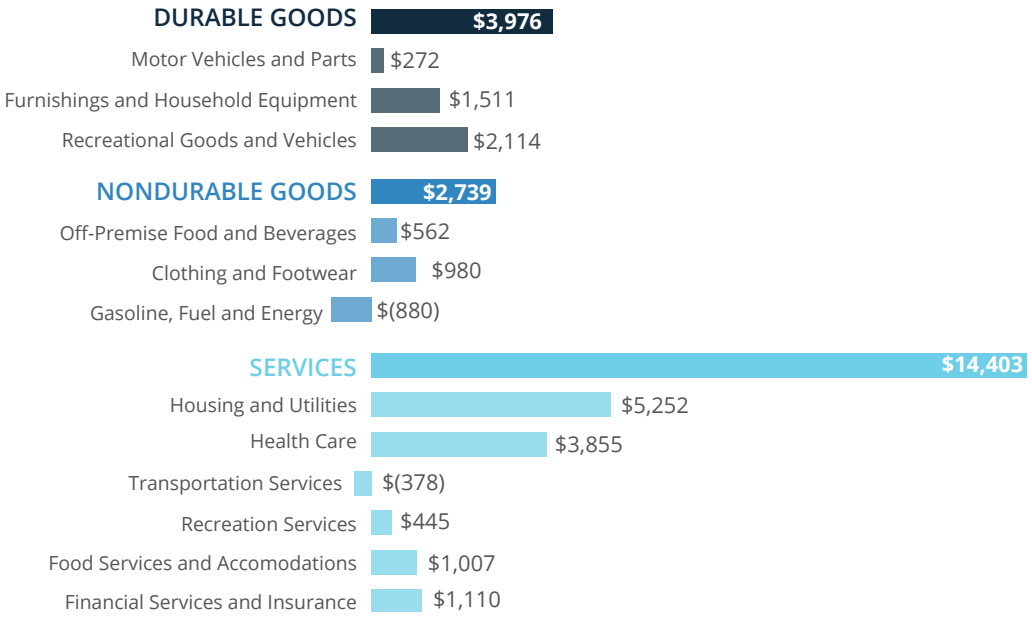
Industry	Percent Difference in Employment Level by 2038	Percent Difference from Baseline: 20-Year Cumulative Industry Output	Percentage Point Difference from Baseline: Annual Average Labor Productivity Growth Rate
Total	**0.62%**	**1.15%**	**0.07 pp**
Farms, Forestry and Fishing	-2.59%	0.47%	0.19 pp
Mining	1.24%	1.34%	0.05 pp
Mining, Except Oil and Gas	1.71%	2.23%	0.08 pp
Utilities	2.05%	1.00%	-0.01 pp
Construction	3.22%	3.59%	0.06 pp
Nondurables Manufacturing	0.32%	0.78%	0.05 pp
Food, Beverage and Tobacco	-0.26%	0.33%	0.05 pp
Textiles and Apparel	1.58%	1.01%	0.02 pp
Wood and Paper Products	0.78%	1.04%	0.05 pp
Printing and Support Activities	0.81%	0.90%	0.04 pp
Petroleum and Coal Products	0.93%	1.02%	0.05 pp
Chemical, Plastics and Rubber Products	0.62%	0.76%	0.04 pp
Nonmetallic Mineral Products	-1.49%	2.34%	0.23 pp
Durables Manufacturing	0.85%	1.10%	0.04 pp
Metals	1.08%	1.16%	0.03 pp
Machinery	1.23%	1.13%	0.03 pp
Computer and Electronic Products	0.52%	1.20%	0.09 pp
Electrical Equipment and Appliances	1.33%	1.24%	0.03 pp
Transportation Equipment	1.12%	1.13%	0.02 pp
Miscellaneous	-0.27%	0.64%	0.08 pp
Trade	0.57%	1.16%	0.08 pp
Wholesale Trade	0.28%	1.14%	0.09 pp
Retail Trade	0.66%	1.17%	0.07 pp

Industry	Percent Difference in Employment Level by 2038	Percent Difference from Baseline: 20-Year Cumulative Industry Output	Percentage Point Difference from Baseline: Annual Average Labor Productivity Growth Rate
Transportation	-7.91%	2.34%	0.63 pp
Air	1.86%	1.47%	0.03 pp
Rail	1.08%	1.07%	0.03 pp
Water	0.75%	0.91%	0.03 pp
Truck	-11.82%	1.36%	0.75 pp
Transit and Ground Passenger Transportation	-8.51%	3.21%	0.76 pp
Pipeline	0.37%	0.80%	0.05 pp
Other Transportation and Support Activities	-4.02%	5.88%	0.69 pp
Warehousing and Storage	-11.92%	1.29%	0.77 pp
Finance, Insurance and Real Estate	0.89%	1.10%	0.05 pp
Other Services	1.12%	1.09%	0.04 pp
Civilian Government	0.20%	1.02%	0.07 pp

Detailed Results: Consumer Spending

Additional Consumption Spending per Household

Cumulative Additions to Personal Consumption, Select Categories (2018$), 2019–38



Savings from improved infrastructure flow directly to households in the form of decreased spending on transportation and fuel. On average, each household saves a cumulative $1,258 on gas, fuel, energy and transportation over 20 years. These savings, as well as higher wages and household incomes, allow households to increase their consumption of a wide variety of other goods and services, including recreation, entertainment, health care, insurance, etc.

Appendix B

Description of Model

LIFT is a dynamic interindustry macroeconomic model.

This analysis was performed using the University of Maryland's Inforum LIFT (Long-term Interindustry Forecasting Tool) model — a widely used econometric model of the U.S. economy. The LIFT model is unique among large-scale models of the U.S. economy; combining an interindustry (input-output) formulation with extensive use of regression analysis, the LIFT model utilizes a dynamic, general-equilibrium structure that portrays the economy in a "bottom-up" fashion and allows effects to be captured at the detailed industry and product level.

LIFT models the behavior of 71 industries producing 121 commodities, allowing interrelated demand and price relationships to cascade through the economy from the ground up. The model works like the actual economy, building the macroeconomic totals from details of industry activity rather than distributing predetermined macroeconomic quantities among industries. The detailed industry foundation enables industry-specific calculations of the benefits of infrastructure investment, including direct and indirect impacts. It also traces the flow of additional consumer spending arising from employment shifts and productivity boosts across industries.

Despite its industry basis, LIFT is a full macroeconomic model with more than 800 macroeconomic variables determined consistently with the underlying industry detail. This macroeconomic "superstructure" contains functions for key indicators that reflect the macroeconomic impacts of infrastructure investment. The model also has a detailed federal government fiscal accounting, which allows it to describe revenue collection and spending for a specific investment scenario.

Appendix C

Detailed Policy Scenario by System

System	Additional Investment (Billions 2018$)	Sources and Assumptions Overview
SURFACE TRANSPORTATION Roads and Bridges	$475.7	Compared "business as usual" spending to needed investment to "expand and enhance" the system from the Department of Transportation (DOT) "2015 Conditions & Performance Report," including addressing a capital backlog. State and local shares of spending are based on Highway Trust Fund cost-sharing guidelines and leverage ratios of existing federal grant and credit programs that fund road and bridge projects, such as the Transportation Infrastructure Finance and Innovation Act (TIFIA) and the Better Utilizing Investments to Leverage Development (BUILD) Transportation Discretionary Grant program. Assumes that private share of spending increases to 5 percent of the total, in turn decreasing the state and local share. Also incorporates a nonspecified 5 percent "plus up" to account for new and innovative infrastructure investments not included in DOT need estimates.
SURFACE TRANSPORTATION Transit	$52.9	Compared "business as usual" spending to needed investment to "expand and enhance" the system from the DOT "2015 Conditions & Performance Report," including addressing a capital backlog. State and local shares of spending are based on leverage ratios of existing federal grant and credit programs that fund transit projects (e.g., TIFIA, BUILD). Assumes no significant additional private share of spending. Assumes a 5 percent add factor for new and innovative infrastructure investments not included in DOT need estimates.
AVIATION	$32.3	Compared "business as usual" spending from the Congressional Budget Office (CBO) 2014 Infrastructure Spending Tables for public sector spending on aviation and Federal Aviation Administration (FAA) estimates of operator-funded upgrades required by the Next Generation Air Transportation System (NextGen) for private-sector spending to the capital need estimates from Airports Council International — North America and FAA estimates of capital needs for NextGen. State and local shares of spending are based on FAA Airport Improvement Program cost-sharing requirements and leverage ratios. Assumes that the private share of spending increases to 5 percent of the total, in turn decreasing the state and local share.

System	Additional Investment (Billions 2018$)	Sources and Assumptions Overview
WATER TRANSPORTATION Ports and Inland Waterways	$41.7	Compared "business as usual" spending from the CBO 2014 Infrastructure Spending Tables for public-sector spending on water resources and American Association of Port Authorities (AAPA) estimates for private-sector spending to need estimates from AAPA for ports and the Inland Marine Transportation System Capital Investment Strategy Team for inland waterways. State and local shares of spending are based on cost-sharing guidelines of various applicable programs — such as the Water Infrastructure Improvements for the Nation (WIIN) Act, Inland Waterways Trust Fund (IWTF), and Water Infrastructure Finance and Innovation Act (WIFIA) — and their leverage ratios. Assumes no significant additional private share of spending, given that private spending on ports from AAPA is incorporated into the baseline, not assumed to be additional spending in the policy scenario.
WATER RESOURCES Dams and Levees	$41.7	Compared "business as usual" spending from the CBO 2014 Infrastructure Spending Tables for public-sector spending on water resources to need estimates from the American Society of Civil Engineers for levees and dams. State and local shares of spending are based on cost-sharing guidelines of various applicable programs (e.g., WIIN, IWTF, WIFIA) and their leverage ratios. Assumes no significant additional private share of spending.
WATER/ WASTEWATER	$92.7	Compared "business as usual" spending from the CBO 2014 Infrastructure Spending Tables for public-sector spending on water and wastewater systems to need estimates from the Environmental Protection Agency's 2012 needs assessment, which accounts for expanded future demand and necessary capital replacements. Assumes no significant additional private share of spending.

Appendix D

Sources Consulted for System-Level Investment Needs

AECOM on Behalf of the U.S. Department of Treasury. (2016). *40 proposed U.S. transportation and water infrastructure projects of major economic significance.*

Airports Council International. (2018). *Airport infrastructure needs 2017–2021.*

American Association of Port Authorities. (2012). *2012 infrastructure investment survey.*

American Association of Port Authorities. (2017). *Building America's 21st century seaport infrastructure.*

American Road & Transportation Builders Association. (2011). *The role of private investment in meeting U.S. transportation & infrastructure needs.*

American Society of Civil Engineers. (2016). *Failure to act: Closing the infrastructure investment gap for America's economic future.*

American Society of Civil Engineers. (2017). *Alternative financing and delivery of waterways infrastructure.*

American Society of Civil Engineers. (2017). *Dams report card.*

American Society of Civil Engineers. (2017). *Inland waterways report card.*

American Society of Civil Engineers. (2017). *Levee report card.*

American Society of Civil Engineers. (2017). *Ports report card.*

American Water Works Association. (2017). *Buried no longer: Confronting America's water infrastructure challenge.*

Association of State Dam Safety Officials. (Updated 2016). *The cost of rehabilitating our nation's dams.*

Association of State Dam Safety Officials. (2017). *Testimony of the Association of State Dam Safety Officials to the Environment and Public Works Committee, U.S. Senate.*

Bipartisan Policy Center. (2017). *Status of airport P3s in the U.S.*

Congressional Budget Office. (2015). *Public spending on transportation and water infrastructure, 1956 to 2014.*

Congressional Research Service. (2013). *Inland waterways: Recent proposals and issues for Congress.*

Congressional Research Service. (2017). *Army Corps of Engineers: Water resource authorizations, appropriations, and activities.*

Congressional Research Service. (2017). *Public private partnerships (P3s) in transportation.*

Congressional Research Service. (2017). *Reauthorization of the Federal Aviation Administration (FAA) in the 115th Congress.*

Congressional Research Service. (2018). *Federal civil aviation programs: In brief.*

Federal Aviation Administration. (2014). *National airspace system capital investment plan FY 2016–2020.*

Federal Aviation Administration. (2016). *Update to the business case for the Next Generation Air Transportation System based on the future of the NAS report.*

Government Accountability Office. (2017). *FAA's and industry's cost estimates for airport development.*

Inland Marine Transportation Systems Capital Investment Strategy Team. (2010). *Inland Marine Transportation Systems (IMTS) capital projects business model final report.*

Inland Waterways Users Board. (2017). *Inland Waterways Users Board 30th annual report to the Secretary of the Army and the United States Congress.*

The National Academies of Sciences, Engineering, and Medicine. (2015). *Funding and managing the U.S. inland waterways system: What policy makers need to know.*

National Research Council. (2013). *Corps of Engineers water resources infrastructure: Deterioration, investment, or divestment?*

RAND. (2017). *Not everything is broken: The future of U.S. transportation and water infrastructure funding & finance.*

United States Army Corps of Engineers. (2016). *Inland and intracoastal waterways 20-year investment strategy.*

United States Bureau of Economic Analysis. (2017). *National income and product accounts.*

United States Department of Transportation. (2011–17). *TIGER & BUILD background & awards.*

United States Department of Transportation. (2016). *Transportation Infrastructure Finance and Innovation Act 2016 report to Congress.*

United States Department of Transportation. (2017). *TIFIA credit program overview & projects financed by TIFIA.*

United States Department of Transportation, Federal Highway Administration & Federal Transit Administration. (2016). *2015 Conditions & performance report.*

United States Department of Transportation Office of Highway Policy Information (2017). *Highway statistics 2015.*

United States Environmental Protection Agency. (2015). *Clean watersheds needs survey 2012.*

United States Environmental Protection Agency. (2017). *Fiscal year 2018 justification of appropriation estimates for the Committee on Appropriations, Water Infrastructure Finance and Innovation Fund.*

United States Environmental Protection Agency. (2018). *Drinking water infrastructure needs survey & assessment.*

Endnotes

1. Congressional Budget Office. (2018, October). *Public spending on transportation and water infrastructure, 1956–2017,* 3.
2. *Ibid,* 4.
3. *Ibid,* 6.
4. Congressional Research Service. (2018, January). *Economic impact of infrastructure investment,* 8.
5. The Road Information Project (TRIP). (2018, September). *Key facts about America's surface transportation system and federal funding,* 2.
6. United States Department of Transportation, Bureau of Transportation Statistics. (2017). *Transportation statistics annual report 2017,* 1-6.
7. *Ibid,* 4-1.
8. The White House. (2014, July). *An economic analysis of transportation infrastructure investment,* 2.
9. U.S. Travel Association. (2014, June). *Survey: Flying hassles keep travelers at home.*
10. Texas A&M Transportation Institute, INRIX. (2015, August). *2015 urban mobility scorecard,* 5.
11. *Ibid,* 5, 11.

300 New Jersey Avenue, NW
Suite 800
Washington, DC 20001

Telephone 202.872.1260
Twitter @BizRoundtable
Website brt.org

Printed on recycled paper