INTRODUCTION

This report examines the economic benefits of the Gateway Program, a comprehensive rail investment program to preserve and expand intercity and commuter service to Penn Station, New York. This is achieved by building a new tunnel under the Hudson River, expanding Penn Station, and making other major investments to create a modern four-track rail system from Newark, New Jersey to Penn Station, New York.

The analysis, summarized here, demonstrates that the economic benefits delivered by the Gateway Program—to current and future Amtrak and NJ TRANSIT rail passengers, as well as to bus and highway commuters, and to the public in general from reduced auto emissions and safer travel—will exceed the full costs of the Program by a wide margin. The benefit to cost ratio ranges from 2.2 under the most conservative assumptions about the time value of money to a 3.9 ratio when using less conservative assumptions. A benefit cost ratio that exceeds 1.0 indicates that a project is a good investment because the present value of the benefits received over time exceeds the present value of the costs that are incurred by the project.

While these results give great confidence in the economic merits of the project, they do not capture all economic benefits—indeed, they reflect only the narrower range of benefits felt on the transportation system, and do not include the potentially much wider, long term economic impacts to the region. For example, as Manhattan—the New York Region’s economic core—continues the strong economic growth seen in the past decade, and as the share of commuting from west of the Hudson also grows, the need to expand trans-Hudson rail capacity will become increasingly urgent. With other trans-Hudson transportation infrastructure essentially at full capacity, the ability to deliver the essential workers to fuel regional growth will be seriously jeopardized. A wider economic analysis would almost certainly show that without these investments, the New York regional economy is at significant risk.

PROJECT OVERVIEW

The Gateway Program is a comprehensive series of investments designed to preserve and improve current services and create new track, tunnel, bridge, and station capacity that will allow the doubling in the number of passenger trains crossing under the Hudson River and an expansion of Penn Station, New York. The program will eventually create four mainline tracks between Newark, NJ, and Penn Station, New York, including a new, two-track Hudson River tunnel, and replace the Portal Bridge with twin two-track, high-level fixed rail bridges. The program also includes updates to, and modernization of, existing infrastructure, such as the electrical system that supplies power to the 450 daily trains using this segment of the Northeast Corridor (NEC). Finally, the program focuses on expanding Penn Station, New York with new tracks, platforms and concourses to accommodate the growth in train services made possible by the other aspects of the program.
**Gateway Program Overview**

- **High Line State-of-Good-Repair**
  - Replacement and renewal of 105-year-old two-track rail bridges/infrastructure.

- **High Line Expansion**
  - Expansion from two to four track system.

- **Rail Yard and Operational Support Facilities; Location TBD**

- **Penn Station Newark**
  - Platform and pedestrian circulation improvements to accommodate Gateway Program new capacity.

- **4th Track at Harrison**
  - Expansion from three to four tracks through Harrison.

- **Sawtooth Bridge**
  - Replacement of distressed, outmoded structures.
  - Expansion from two to four tracks.

- **Penn Station Newark**
  - Platform and pedestrian circulation improvements to accommodate Gateway Program new capacity.

- **Frank R. Lautenberg Secaucus Junction**
  - Expansion of tracks and platforms.
  - Addition of loop tracks.

- **Portal North Bridge**
  - Replacement of existing bridge with two-track, high-level fixed bridge.

- **Portal South Bridge**
  - Addition of two-track fixed bridge to support Gateway Program new capacity.

- **4th Track at Harrison**
  - Expansion from three to four tracks through Harrison.

- **4th Track at Harrison**
  - Expansion from three to four tracks through Harrison.

- **Penn Station Newark**
  - Platform and pedestrian circulation improvements to accommodate Gateway Program new capacity.

- **Penn Station Newark**
  - Platform and pedestrian circulation improvements to accommodate Gateway Program new capacity.

- **Penn Station NY**
  - Expansion of Penn Station.
  - Option for future expansion of new tracks eastward.
  - Planning for vertical circulation to future deep cavern high-speed rail station.

- **Hudson Tunnel Project**
  - New two-track tunnel connecting to Penn Station.
  - Complete rehabilitation and rebuilding of existing two-track tunnel.
**PROJECT NEED**

The Gateway Program is needed to address critical capacity constraints on the Northeast Corridor between Newark, New Jersey and Manhattan, where the corridor narrows from four tracks to two tracks. The two existing Hudson River rail tubes into midtown Manhattan—the only intercity passenger rail crossings into New York City from New Jersey—currently operate at 95 percent capacity during rush hour, creating a severe bottleneck that limits NEC train volume across the entire rail corridor. Moreover, the volume of trains relying on the 21 tracks at Penn Station, which is severely congested at peak periods, is projected to increase significantly by 2030. Train traffic at Penn Station, New York has roughly doubled since the mid-1970s, growing from 661 average weekday train movements in 1976 to 1,302 average weekday train movements today. Additionally, much of the existing rail infrastructure in this portion of the NEC faces reliability challenges due to age and the intensity of current use, with the potential for very significant delays when problems arise.

These reliability and capacity constraints were further complicated by the saltwater inundation of the Hudson and East River tunnels, which connect to Penn Station, during Superstorm Sandy in October 2012. After the saltwater was pumped out, chlorides remained in the concrete tunnel liner and bench wall and fouled the track bed, threatening electrical and signal systems, and the reliability of railroad operations. An independent engineering analysis commissioned by Amtrak in 2014 recommended the removal of the damaged rail tubes from service for complete rehabilitation, a process which takes 18-24 months per rail tube. The Hudson Tunnel Project, described on the next page, undertakes this rehabilitation after constructing two new bypass rail tubes to maintain uninterrupted service to Penn Station during the rehabilitation period. While the Hudson Tunnel Project has independent utility as a resiliency and reliability project, it can be combined with additional Gateway Program projects to deliver a doubling of rail service for NJ TRANSIT and Amtrak customers by 2030, the benefits of which this study examines in detail.
The major elements of the Gateway Program work in concert, and include the following:

» **Hudson Tunnel Project:** A new Hudson River rail tunnel from the Bergen Palisades in New Jersey to Manhattan will directly serve Penn Station. This will allow the existing North River Tunnel\(^1\) to be taken out of service for extensive rehabilitation. Once the new tunnel is built and the existing tunnel is repaired, there will be a total of four tracks under the Hudson River, which will provide greater service reliability and operational flexibility for NJ TRANSIT and Amtrak services and lay the basis for the expansion of rail capacity as envisioned under the Gateway Program.

» **Expanded Moynihan/Penn Station, New York:** The expansion of existing Penn Station tracks and platforms, and the creation of new Gateway concourses with direct connections to the future Moynihan Station, will support the long-term growth of commuter and intercity passenger rail service at both Penn Station and the historic Farley Post Office Building. The expansion of Penn Station, in concert with the new, two-track tunnel under the Hudson River, will allow the doubling of rail service into Penn Station from New Jersey.

» **New Portal Bridges:** Two new high-level, fixed bridges, known as Portal North Bridge and Portal South Bridge, will replace the 100-year-old moveable Portal Bridge over the Hackensack River between Kearny and Secaucus, New Jersey, doubling corridor capacity. Final design and federal environmental review for the Portal North Bridge, the first to be constructed, have been completed. The new bridge is awaiting funding to proceed.

» **Newark-to-Secaucus Improvements:** The existing NEC will be greatly improved between Newark and Secaucus, New Jersey. The mainline will be expanded from two to four tracks between Newark and the Bergen Palisades tunnel portals. Better connections will be built to link the NEC with existing NJ TRANSIT rail services, as well as new direct connections to NJ TRANSIT's Main, Bergen, Pascack Valley and Metro-North Port Jervis Lines. Various bridges will also be upgraded or replaced.

\(^1\)The “North River” is an historic Dutch name for the lower Hudson River and is used here to distinguish the existing North River Tunnel from the new, Hudson River Tunnel.
ECONOMIC CONTEXT

Key regional economic factors that, together, strongly point to the need for and potential economic gains from the Gateway Program include the following.

» Together, Penn Station and the Hudson River tunnel form the most critical link of the Northeast Corridor, which is essential for the megaregion to thrive. Penn Station is the busiest rail station in North America, and anchors the entire NEC, as well as the NEC economic megaregion. Without the trans-Hudson linkage, the entire NEC rail system would be severed and fragmented.

» The New York City economy is stronger and increasingly more industrially diverse than in the past, and its jobs are increasingly well paid and specialized. Manhattan is a powerhouse employment destination for the entire New York City region, and beyond.

» Trans-Hudson commuting is essential to supporting these economic realities. In order to fill Manhattan’s high-quality jobs, access to a highly-trained and skilled workforce is essential; without that, Manhattan’s continued economic expansion and its ability to drive the regional economy will be hindered.

» Residential communities west of the Hudson River have lower housing costs and greater housing choices that compare favorably with those of New York City. Because of these comparative advantages for workers, reliance on west of Hudson commuting will almost certainly increase in the future. A key factor contributing to increased reliance on West of Hudson labor markets is the high cost of housing in New York City.

» Assuming Manhattan—the New York City region’s economic core—continues the strong economic growth seen in the past decade, and as the share of commuting from west of the Hudson also grows, the need to expand trans-Hudson rail capacity will become increasingly urgent. With other trans-Hudson transportation infrastructure essentially at full capacity, the ability to deliver the workers essential to fueling regional growth will be seriously jeopardized.

» New York City is the epicenter of a regional mega-economy that is unmatched in the United States. New York’s economy, including the City itself and its surrounding region, is the linchpin of the entire Northeast Corridor megaregion, which produces about $3 trillion in economic output, comprising a full 20 percent of the national GDP; the New York regional economy contributes more than $1.3 trillion in output, about one-third of the NEC economy and close to 9% of the entire national economy—by far the largest share of any metropolitan region of the U.S. Moreover, its linkages to the global economy make it critical to the U.S. economy as a whole. But there are many more competitors now vying for a global economic role, and the New York region must have the infrastructure to retain its competitive position. Other global cities are developing their infrastructure to meet the challenge. In London, for example, the Crossrail Project addresses many of the same problems Gateway Program will.
Manhattan provides the regional economy with more than 2.1 million jobs, many of them in high-paying, high-growth knowledge sector fields. These jobs are filled by workers from throughout the metropolitan region, resulting in more than 1.6 million people commuting into Manhattan each day. A significant number of these workers come from west of the Hudson River, which includes all workers from New Jersey and Pennsylvania, and a portion of those from New York counties north of the city. In 2013, these commuters made up approximately 15 percent of the Manhattan workforce, or about 320,000 workers.

Trends over the past decade demonstrate Manhattan’s revived importance as a job generator. Since 2004, there has been a major shift in employment in New York City and its Manhattan core relative to the rest of the region, compared to preceding decades. Between 1950 and 2004, New Jersey gained 2.3 million jobs...
as its economy matured and expanded; during that period, New York City gained just 82,000 jobs. By contrast, between 2004 and 2014, New York City as a whole gained a remarkable 550,000 jobs, nearly seven times what had been generated in the preceding five decades combined.\(^1\) About half of that growth took place in Manhattan. Growth throughout the rest of the region, including West of Hudson, has been considerably less since 2004. New Jersey during that period lost 37,000 jobs. As skilled workers and the companies looking to hire them increasingly prefer denser communities with walking, recreation, and transit opportunities close by, this trend of job growth in the city’s core shows no sign of stopping.

Manhattan’s economy in particular is more concentrated in knowledge-based and creative industries than New Jersey and the US economy as a whole. Wages per worker are comparatively higher in Manhattan – for all industries and for knowledge sector industries, highlighting the high value added of these positions.

\(^1\)U.S. Bureau of Labor Statistics; data compiled by Professor James Hughes, Edward J. Bloustein School of Planning and Public Policy, Rutgers University. October 2015.
Wage Earnings per Worker - Manhattan vs. Surrounding Area, by Industry

Source: Bureau of Labor Statistics; data are derived from total wage earnings and total full time workers, and thus represent mean earnings
LABOR MARKETS AND COMMUTE PATTERNS

Commuting from areas west of the Hudson to Manhattan is on the rise. New Jersey, the largest portion of the West of Hudson area, supplied 13.6 percent of Manhattan workers in 2013, as compared to 11.6 percent a decade earlier. All other major labor contributors to Manhattan—the outer boroughs, Long Island, Connecticut, and suburban New York counties—had constant or slightly declining shares. If these trends continue, the West of Hudson area will supply an increasing number of Manhattan’s workers.

A significant proportion of New Jersey’s workforce is employed in Manhattan, and the share of New Jersey workers commuting to NYC is rising; from 2002-2014, New Jersey total employment grew less than 1 percent, while the number of New Jersey residents commuting to Manhattan grew by more than 35 percent.

The service improvements that would result from the Gateway Program would provide benefits to metropolitan area residents across a wide range of income bands. In addition to travel time savings for relatively higher wage peak-hour commuters to Manhattan, the Gateway Program would generate benefits for other rail users, including reverse and off peak commuters, a population that encompasses daytime workers with lower average wages, as well as students, older travelers, and “third-shift” workers. The Gateway Program would also result in reduced congestion on roadways throughout the region. As a result, auto and bus commuters at all income levels would experience reduced travel times and increased reliability. In addition, improvements in transportation systems across the region would expand job access for lower-income workers who live farther from primary nodes of economic activity. Economic benefits would therefore accrue to a wide range of wage-earners; these benefits, along with the likely safety and environmental benefits that would result from the Gateway Program, would help address social and economic justice concerns.

The number of NJ residents commuting to Manhattan grew by more than 35 percent from 2002-2012.

Likewise, Manhattan is growing more and more reliant on labor from New Jersey; the share of Manhattan jobs filled by NJ commuters increased from 11.4 percent to 13.3 percent between 2002 and 2012.
HOUSING DIFFERENTIALS

As noted previously, commuting from areas west of the Hudson to Manhattan is on the rise. A key factor contributing to these dynamics is the high cost and limited supply of housing in New York City. This dynamic is increasingly acute overall, and particularly to accommodate the entry of “millennials” into the workforce—soon to be the largest contingent in the workforce—many of whom are two income households requiring the kind of commuting flexibility made possible by NEC service. West of Hudson communities in New Jersey and New York, as well as other suburban areas of the region, boast relatively affordable living that provides many workers with realistic housing and school options.

New York City housing costs are considerably higher than those in the West of Hudson counties surrounding the city. Manhattan is by far the most expensive, but the other boroughs have seen substantial increases in housing costs in recent years. Moreover, the typical size of those median homes in Manhattan is three rooms, compared to five to six rooms in counties throughout New Jersey and suburban New York counties.
GLOBAL CONTEXT

Beyond its regional significance, New York City is the epicenter of a megaregion economy that is unmatched in the United States. Its linkages to the global economy make it critical to the U.S. economy as a whole. But there are many more competitors now vying for a global economic role, and the New York region must have the infrastructure to retain its competitive position. Other global cities, such as London, Tokyo, and Berlin, as well as newly-emerging global competitors, are renewing and expanding their transportation infrastructure to meet the challenge. In London, for example, the Crossrail Project addresses many of the same problems Gateway will, by providing a new high-capacity rail link across London, linking Heathrow Airport, the West End, the City of London and Canary Wharf. Crossrail service will operate through a new 13-mile twin-bore tunnel under central and southeast London. The combined cost of Crossrail I and a second phase, Crossrail II, will be about £35 billion ($51 billion at today’s exchange rates).
BENEFIT COST ANALYSIS
BENEFIT COST ANALYSIS

While the economic context for the project relates to the wider economic risks and opportunities facing the region and the NEC in general, decisions about funding transportation projects of this size and significance are greatly aided by a more formal and rigorous economic analysis.

To accomplish this, applying the economic method of Benefit Cost Analysis (BCA) to transportation or other infrastructure projects is essential in understanding whether the project is a good use of public resources. BCA compares the economic benefits of a project over an extended time period to the costs incurred to design, construct, operate, and maintain the project over the comparable time period.

The BCA described in this report examines the range and magnitude of benefits associated with the capacity gains and service expansion made possible by the Gateway Program. It does this by examining the scenario of undertaking the Gateway Program. It compares this to a scenario in which the Gateway Program is not pursued and Amtrak performs the necessary rehabilitation to the existing Hudson River Tunnel by taking each tube out of service sequentially for approximately two years, resulting in a severe reduction of service over a four-year period; this scenario is known as the “Extended Disruption” scenario.

Both the Gateway Program and the Extended Disruption scenarios assume that the existing tubes will be rehabilitated to a newly-restored condition. They also assume that Portal Bridge will be replaced, and that other corollary investments will be made to address the most immediate problems hindering NEC service through the Gateway territory. The key differences between the Gateway Program and the Extended Disruption scenario are:

» Under the Extended Disruption scenario, bringing the existing two-tube North River Tunnel to a modernized state of good repair will require taking each tube out of service one at a time for approximately two years each from 2025 through 2028.

» Under the Gateway Program, service will operate out of the two new Hudson tubes and out of one operational existing North
River tube while the remaining tube is completely rehabilitated and modernized. Once both tunnels are operational, four tubes will provide increased operational flexibility for existing service; the ability to perform maintenance without reducing service; and redundancy in case of extreme weather or other major events. Furthermore, four tubes can accommodate additional trains and growth in service when all the elements of the Gateway Program are delivered, including the expansion of Penn Station, Portal South Bridge, Secaucus Station/Bergen Loop, Sawtooth Bridge Replacement, and Newark-to-Secaucus Improvements.

The BCA defines benefits across a range of categories that capture broader benefits to society, whether those benefits are exchanged in markets directly or not. These include transportation system user benefits, such as travel time savings and improved reliability for rail users, and the environmental, congestion, and safety benefits from increasing rail mode share and reducing the number of trans-Hudson auto trips. The analysis covers the period beginning with existing tunnel rehabilitation in 2025, covers the three-year period of rehabilitation, and includes thirty years of project operation through the years 2028 through 2058.

The results of this analysis, which are described below in more detail, find that the economic benefits of the Gateway Program greatly exceed its costs under even the most conservative economic assumptions. The benefit cost ratio ranges between 2.2 and 3.9 depending on assumptions about the time value of money. A benefit cost ratio that exceeds 1.0 indicates that a project is a good investment because the present value of the benefits received over time exceeds the costs that are incurred by the project. Benefit cost ratios in excess of 2.0 can be considered extremely robust.

What are the Differences between a Constant, Discounted, and Year of Expenditure Dollar?

This study references Constant Dollars, Discounted Dollars, and Year of Expenditure, or YOE, dollars. Discounted dollars, also known as present value dollars because they capture what a dollar in the future is worth at present, are relevant only to the computations involved in Benefit Cost Analysis: they reflect the discounting to present value of costs as they are expected to occur in a given year. Since the discount rate required by U.S. Department of Transportation is 7 percent, and because project costs and benefits are programmed to be incurred starting mainly in the next decade, the discounted values appear significantly lower than the costs shown in financial planning work associated with the Gateway Program, which are in Year of Expenditure, or YOE, dollars. YOE dollars include the effects of inflation, as compared with costs when expressed in Constant (2015) dollars. For example, if inflation is 2 percent per year, a “2015 dollar” would be the equivalent of $1.22 in 2025 YOE dollars. A glossary of economic dollars and cents accounting is given below:

- **Constant dollars** – A dollar expressed in a given base or reference year, which removes the effects of inflation on its value. For example, if inflation is 2% per year, spending $1.02 in 2016 would be the same as spending $1.00 in 2015.
- **YOE dollars** – This is the converse of the above; the $1.02 spent in 2016 would be in YOE dollars, but would be equal to $1.00 if you wanted to express it in 2015 constant dollars. It is sometimes referred to as “current dollars” by economists.
- **Discounted dollars** – Discounting, unlike inflation, captures the time value or the “opportunity” cost of money over time. If a dollar spent today could earn 4% in a safe investment vehicle, $1.04 (or $1.04 in economic benefits) received next year would be the equivalent of $1.00 received today. Similarly, $1.04 paid next year would have the discounted present value equivalent of $1.00 today, since the $1.00 could be held and invested for a year, and would yield $1.04 for purchases made one year from today. Discounting costs expressed in constant (e.g., 2015) dollars requires a “real discount” rate which already nets out inflation.
BCA FAQs

» What is a benefit cost analysis? Benefit cost analysis is a method developed by economists that has been widely used for many years by Federal, State and local agencies to evaluate the economic merits of public projects, including transportation investments. It compares the economic benefits of a project over a long period of time (for example, over thirty years) with all the costs that are incurred to build and operate the project, starting from when construction begins, and while it is in operation. It produces economic measures, the most important of which are the benefit cost ratio (the ratio of all benefits to all costs) and the net present value (the total economic benefit minus the total cost). These BCA measures adjust for the fact that the real value of future costs and benefits in today’s money is less than if they were incurred today, because money can earn interest when it is not spent or received today.

» What does it measure? The BCA compares the discounted present value of costs to the discounted present value of benefits; it reveals whether the lifecycle benefits of a project exceed the lifecycle costs. A benefit cost ratio exceeding 1.0 indicates that a project is a good investment because the present value of benefits received over time exceeds the present value of costs that are incurred by the project.

» What is a discount rate? A discount rate is similar to an interest rate; it defines the time value of money, based on what investments can be expected to earn per year over time. It is called a discount rate because it reduces the value of future costs and benefits in order to express all costs and benefits in a common “present value” amount. While economists do not always agree about the appropriate discount rate, the Federal government provides standards for evaluating Federally-funded projects; those rates are used by most transportation agencies. Following those guidelines, this BCA estimates present value benefits and present value costs at two alternate discount rates that represent the upper and lower range for different types of projects: 7 percent and 3 percent. Higher discount rates reduce the value of benefits received in the future more than lower discount rates do; as a result, projects like Gateway that generate benefits long into the future do not “score” as well on a BCA as do projects that generate their benefits much sooner. The higher discount rate would be appropriate if we assumed that the costs of the project would reduce private investment, while the lower rate would be more appropriate if we assume that the costs would reduce investment in other public projects.

» What are its limitations? BCAs, as noted, are generally rather conservative, and may not capture the wider economic benefits from enhanced accessibility, such as increased productivity of businesses, job and income growth, and increased tax revenues. Discount rates also can greatly influence the outcome of a BCA, which is why a range of discount rates is used. Finally, and most important, a BCA is a forecast—it relies in particular on ridership projections under each scenario, as well as on the costs of each scenario. While the ridership projections used in the BCA have been thoroughly reviewed and coordinated with Amtrak and NJ TRANSIT and the cost estimates are based on the best engineering information available, future conditions can change, and those estimates may ultimately be higher or lower than what has been forecasted. For that reason, Benefit Cost ratios that indicate (as in the Gateway BCA) a very significant margin above 1.0 help to provide additional confidence, regardless of whether the ridership and cost estimates prove optimistic.
BENEFIT COST ANALYSIS RESULTS

The BCA, as noted, has been conducted to include 30 years of full operation, after the new tunnel, bridges, and other improvements are completed. As also noted, very significant benefits are expected to also be realized prior to completion of the full Gateway Program, from 2025-2029, when the existing tunnel would be rehabilitated. The benefits during that period arise in comparison to an Extended Disruption scenario in which no new tunnel is constructed. In the latter case, about three-quarters of the train capacity will be lost during rehabilitation. Under the Gateway Program, the new tunnel would be available for operations while the existing tunnel is rehabilitated.

More details of the BCA results are given in the table above. The benefits of the full Gateway Program greatly exceed its costs under even the most conservative discount rate assumptions. The benefit cost ratio ranges between 2.2 at a conservative 7 percent discount rate and an even larger 3.9 ratio at a more favorable 3 percent rate.

Because the period of analysis concludes prior to the end of the useful lives of the railroad investments, a residual value is included in the analysis. A residual value reflects the remaining un-depreciated value of the Gateway Program railroad infrastructure assets in 2058.
COSTS

CAPITAL COSTS

Capital costs were estimated for various project elements, including preservation, resiliency, new capacity, and acquisition of land for right of way. Note that these are the incremental capital costs relative to the Extended Disruption scenario; because of this, the costs of the Renewal Program of the existing North River Tunnel and the Portal North Bridge construction are not included in the table, because they are included in the Extended Disruption scenario. These costs appear different than in other planning or financial documents for the Gateway Program because they are presented in constant dollars and only account for Program costs not included in the Extended Disruption scenario. Other published cost estimates of the Gateway Program have usually been expressed in Year of Expenditure dollars. Incremental capital costs are shown in the chart on the right.

| Incremental Capital Costs (2015 Dollars) Relative to Extended Disruption scenario |
|---------------------------------|---------------------------------|
| **Program Element** | **(2015 $)** |
| North River Tunnel Rehabilitation | 0 (netted out of BCA) |
| Portal North Bridge | 0 (netted out of BCA) |
| Remaining project elements, including Hudson Tunnel Project, Penn Station Expansion, Secaucus Loop, Portal South Bridge, Frank R. Lautenberg Secaucus Station, Highline Renewal and SOGR, West-of-Hudson Rail Yard, Rolling Stock Acquisition (Commuter Rail) | 17,126,000,000 |
| **Total Incremental Capital Costs Used in the BCA** | **17,126,000,000** |

- Note: Renewal Program of the North River Tunnel and the Portal North Bridge are not included in the table, because they are included in the Extended Disruption scenario.
- Note: Base cost estimates were in 2013 dollars, and were adjusted here upward by 2.5% per year to 2015.
- Note: Costs are conceptual and reflect feasibility level design.
- Note: Rail rolling stock acquisition costs include only the initial acquisition. Replacement costs occur after 20 years, but are not shown in the table, but they are included in the BCA.

OPERATIONS AND MAINTENANCE COSTS

In addition to the capital costs, additional operating and maintenance (O&M) costs were estimated for the Gateway Program. Under the Gateway Program, significant amounts of additional rail service would be operated by NJ TRANSIT and Amtrak, the costs of which have been included in the analysis. In 2035, about five years after the new projects are operational and service patterns have stabilized, these would amount to $185 million per year (in 2015 dollars). These costs were estimated using simplified operating assumptions and costing values derived from Amtrak and NJ TRANSIT operating expenditure information. Costs would hold fairly steady in real terms in subsequent years. The O&M cost also includes an estimated incremental cost of maintaining the new tunnels of $5 million per year in 2015 dollars.
BENEFITS

The benefits included in the BCA are a conservative list, but the types of benefits are very consistent with USDOT guidance and overall best practices for BCAs. Even with this conservative approach, the range of benefits is wide, arising in multiple ways. These include transportation system user benefits such as travel time and cost savings; improved reliability for rail users; and the environmental, congestion, and safety benefits from increasing rail mode share and reducing the number of trans-Hudson auto trips. Benefit categories used specifically in the BCA include:

» Benefits Derived Through Increased Rail Mode Share – By providing more capacity, the Gateway Program allows Amtrak and NJ TRANSIT to accommodate many more rail passengers than they could without Gateway. Those passengers would otherwise either have to use their cars or take buses to cross the Hudson via already very crowded roadways, bus networks, and PATH services; a significant number of potential riders would simply forego travel altogether. The benefits of more rail use and fewer cars on the road are travel time and cost savings, reduced auto emissions, enhanced safety (trains are much safer than driving), and less congestion for remaining highway users.

» Travel Time Savings – New riders that would be accommodated by the additional capacity will enjoy significant travel time savings in the long run. In the absence of the Gateway Program, during the 2025-2029 period of rehabilitation, many riders would be essentially “pushed off the railroad” because of the greatly diminished capacity. Those riders would use slower alternative modes. After rehabilitation, the doubling of capacity would bring many more rail riders onto the system, and they too would experience travel time savings compared to slower modes. By 2045, the annual benefit to new rail users will amount to $444 million (undiscounted).

» Travel Cost Savings – Like time savings, riders who would otherwise be using slower and more costly modes of transport would benefit. Indeed, the majority of user benefits are obtained in this way. By 2045, the annual benefits to new rail users from reduced travel costs (both in added auto operations and maintenance costs, parking, bus operations, maintenance and lease costs, and highway congestion) will equal $2.1 billion (undiscounted).

» Reduced Emissions – The reductions in auto and bus vehicle miles traveled (VMT) on the road network will result in net emissions reductions valued at $152 million (undiscounted) in 2045. Electric trains, unlike automobiles, produce very low emissions. Emissions reductions are based on research relating emissions by type to VMT for different categories of vehicles.

» Safety – Similar to emissions, reducing roadway VMT results in fewer auto accidents. Accident rate data from the USDOT are used to estimate these impacts, which in 2045 will result in an annual benefit of $736 million (undiscounted).

» Avoidance of Trips Not Taken – Under the Extended Disruption scenario, some passengers who cannot be accommodated on rail during the rehabilitation of the existing Hudson Tunnel will not make the trip rather than diverting to other modes. When a trip is not made, the productivity and spending impacts associated with that trip are lost to the region. The Gateway
Program therefore generates a benefit by avoiding the cost resulting from the loss of productivity and spending that would occur in the Extended Disruption scenario.

» Highway Congestion – By removing thousands of vehicles from the surrounding roadways each day, remaining highway users enjoy reduced congestion. Studies show that every additional vehicle added to already congested roadways slows all drivers down even further. By 2045, the annual benefit resulting from reduced highway congestion will be $650 million (undiscounted).

» In-Service Rail Passenger Benefits – While a large proportion of the Gateway Program benefits will result from increased rail mode share, existing rail riders (that is, the base of current ridership at current capacity) will also experience substantial benefits from improved rail operations.

» Rail Travel Time Reliability – The improved conditions resulting from the Gateway Program would reduce infrastructure-based tunnel delays for both Amtrak and NJ TRANSIT trains. From 2025-2029, the Hudson Tunnel Project would reduce infrastructure-related train delays by 50 percent; from 2030 onwards, the Gateway Program would reduce infrastructure-related delays by the same 50 percent, resulting in a $0.4 million (undiscounted) annual benefit by 2045.

» Reduced In-Vehicle Crowding – Crowding on trains imposes a cost on system users in the form of additional discomfort by being on an overly packed train, and potentially having to stand. Every hour that a passenger spends on a train at some level of crowding incurs a cost. By increasing capacity on the rail system, the Gateway Program would decrease average load factors on Amtrak and NJ TRANSIT trains to below 85 percent, the level at which crowding begins to incur costs. By eliminating this cost, the Gateway Program would result in a benefit that starts when the increased capacity comes online in 2030; the benefit, however, is eliminated once the additional capacity is absorbed by increased ridership, which is projected to occur in 2040.

» Resiliency (2025-28) – The Gateway Program would generate a benefit from 2025-2028 by eliminating the single-tunnel operational period that would occur in the Extended Disruption scenario. Beginning in 2029, the Extended Disruption scenario would include tunnel redundancy, so the benefit would cease.

The present value of benefits, by category, as well as single year (2045) benefits are summarized in the chart on the next page.

It should be noted that passenger revenues from fares are not included in the list of economic benefits for Gateway Program—and generally not in other transportation related BCAs—because fares are considered a “transfer” of benefit from riders to the agencies collecting the fares and providing the service. Those revenues, once collected, are used by the provider agency, such as Amtrak or NJ TRANSIT, to offset annual operating and maintenance costs. However, what people pay to ride the train is a measure of the value that travelers place on the service, and setting the fares at the appropriate levels improves efficiency and helps with funding the project.
## Benefits Gateway Program Scenario

**Benefits Derived Through Avoided Diversions**

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Analysis Period, including 30 years of full operation (2025–2058)</th>
<th>Single Year Costs/Benefits in 2045</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cumulative Present Value in $2015M</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7% Discount Rate</td>
<td>3% Discount Rate</td>
</tr>
<tr>
<td>Net Travel Time</td>
<td>$2,279</td>
<td>$5,845</td>
</tr>
<tr>
<td>Net Travel Cost</td>
<td>$9,684</td>
<td>$25,800</td>
</tr>
<tr>
<td>Net Emissions</td>
<td>$872</td>
<td>$1,428</td>
</tr>
<tr>
<td>Net Safety</td>
<td>$3,063</td>
<td>$8,565</td>
</tr>
<tr>
<td>Avoidance of Trips Not Taken</td>
<td>$1,129</td>
<td>$1,752</td>
</tr>
<tr>
<td>Highway Congestion</td>
<td>$2,707</td>
<td>$7,569</td>
</tr>
</tbody>
</table>

**In-Service Rail Passenger Benefits**

<table>
<thead>
<tr>
<th>Benefits</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail Travel Time Reliability</td>
<td>$11</td>
</tr>
<tr>
<td>Reduced In-Vehicle Crowding</td>
<td>$298</td>
</tr>
<tr>
<td>Resiliency (2025-28)</td>
<td>$16</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$20,059</strong></td>
</tr>
</tbody>
</table>

*This analysis assumes conservatively that after 2030 Gateway trips would be otherwise made by auto or transit in the absence of the project. An analysis that assumed some share of those trips are not taken at all would result in higher benefit levels.

**This benefit declines from $52M in 2031 to $0 in 2045 as ridership grows relative to rail vehicle capacity.**

***All resiliency benefits are realized between 2025 and 2029.
THE ECONOMIC COSTS OF DISRUPTION OF TRANS-HUDSON RAIL ACCESS

A PARTIAL TUNNEL CLOSURE DURING ITS REHABILITATION (Extended Disruption scenario)

The first major phase of the Gateway Program is the Hudson Tunnel Project. Without the new two-track tunnel being built first, the New York City Region will suffer major economic losses during the 2025-2029 period when the existing tunnel would be rehabilitated. These costs arise during that interval because about three-quarters of the train capacity will be lost during rehabilitation. By contrast, with the Hudson Tunnel Project the new tunnel would be constructed first and would therefore be available for service while the existing tunnel is rehabilitated.

Using the same BCA methodology as applied to the overall Gateway Program, it is found that the economic costs to commuters and to the environment would be in the billions of dollars. Because these costs would be incurred relatively soon, within a three to four year period, they would not be heavily discounted. If, for example, a low 3 percent discount rate (corresponding to a public investment) was applied, the present value of the losses over that time period would be about $2.3B in 2015 dollars; undiscounted, the economic losses would be approximately $3.0B in 2015 dollars.

Beyond these more directly measurable costs—which include increased trip times, loss of reliability, higher transportation costs, and greatly increased roadway congestion and resulting increased air emissions—are the wider and more fundamental economic losses to the region that would likely occur as a result of such a sustained period of disruption. While some of the 45,000–50,000 daily rush hour rail commuters would find ways to adjust to a degree—for example, by telecommuting more—some trans-Hudson commuters would likely leave their jobs or have to relocate to other areas either within the metropolitan region or outside the region entirely. At the same time, some businesses (together with their high paying jobs) would similarly move out due to the increased costs and productivity losses from longer worker commutes, and much worsened roadway congestion, which would limit access to markets, customers, and workers. Some other firms that might have come to the region would look elsewhere.
SUMMARY/CONCLUSION

The Gateway Program would result in decades of extensive benefits for the economies of the New York Region, the Northeast Megaregion, and the United States. Those benefits would far surpass the costs that would be incurred during the Program’s construction. By eliminating critical rail capacity constraints, the Gateway Program would not only remedy a long-standing transportation bottleneck, but also provide the expanded network capacity required to facilitate substantial economic growth for the rest of the 21st century.

The Gateway Program is critical within the economic context of the New York Region. With about 45,000 – 50,000 commuter rail riders now crossing the Hudson River during rush hours, the risks of doing nothing are sizeable. While the New York City economy has continued to grow in recent years, that growth has been dependent on the expansion of a specialized, highly-skilled workforce. As New York City’s population growth exerts upward pressure on housing costs, skilled workers are increasingly taking advantage of less expensive housing options in communities west of the Hudson River. As a result, continued economic growth depends on the region’s mass transit systems’ ability to transport a more dispersed workforce to and from Manhattan, the New York Region economic core. With the existing trans-Hudson transportation infrastructure at full capacity—and with the damage to the existing infrastructure caused by Superstorm Sandy—the prospect of sustained regional economic growth is dim without the substantial expansion of system capacity that would result from the Gateway Program.

Over time, with heavily constrained trans-Hudson commuting capacity, some trans-Hudson commuters would likely leave their jobs or have to relocate to other areas either within the metropolitan region or outside the region entirely. At the same time, some businesses (together with their high paying jobs) would be inclined to move out due to the increased costs and productivity losses from longer worker commutes, and much worsened roadway congestion that would limit access to markets, customers, and workers. Some other firms that might have come to the region would look elsewhere. The stakes are high.

Benefit Cost Analysis (BCA) Findings

The BCA that has been prepared in support of the project illustrates the breadth and magnitude of the benefits that would be realized across the region. The additional rail capacity that would be introduced by the Gateway Program would accommodate existing commuters currently traveling by car or bus, thus reducing vehicle emissions, auto accidents, and traffic congestion across the region; in addition, the additional capacity could accommodate the new workers who will propel continued regional economic growth. Existing rail commuters would benefit from reduced commute times and substantially improved system reliability, as well as from reduced train crowding. Finally, the rail system
would benefit from the increased resiliency and redundancy that would result from the construction of a new tunnel across the Hudson River.

*The benefit cost ratio of the Gateway Program—2.2 at a very conservative 7% USDOT prescribed discount rate and 3.9 at a 3% discount rate, which may be considered more reflective of public investments—indicates the extent to which the benefits of the project would outweigh the costs required for its construction.*

But beyond the more directly measurable benefits used in transportation BCAs are the wider and more fundamental long-term economic benefits that are not included in the BCA. The long-term economic payoff from Gateway to the region would be of utmost significance. As the share of Manhattan jobs filled by west of Hudson commuters is growing significantly, employment gains in the region—especially the Manhattan core—will much more likely be realized if trans-Hudson capacity is significantly increased. Moreover, west of Hudson communities boast relatively affordable living options compared with New York City. The Gateway Program enables growth west of Hudson and ultimately will increase incomes and lower costs throughout the entire region. The breadth of these benefits highlights how the project would promote diverse and sustainable economic growth for the region’s residents and businesses. And finally, the role of New York City’s economy in the broader Northeast Megaregion indicates how crucial the Gateway Program would be for the global economic competitiveness of the entire United States.
All costs and benefits are expressed in 2015 present value dollars.

The Gateway Program BCA includes only incremental benefits and costs relative to the Extended Disruption scenario. For example, the cost of rehabilitating the existing tunnel is not considered in the BCA, as it is included in the Extended Disruption scenario and is thus common to both scenarios.

The analysis period extends from 2025 through 2058, covering the period of construction of Gateway Program elements and tunnel rehabilitation, followed by 30 years of operation.

Residual values of assets with useful lives greater than 30 years are estimated based on straight line depreciation, and are discounted to 2015. These values are offsets against initial capital costs in the BCA.

Amtrak and NJ TRANSIT ridership assumptions reflect extensive and detailed input provided by Amtrak and NJ TRANSIT planning staff.

Key construction, operations, capacity, and ridership assumptions are highlighted in the table to the right.

Additional assumptions include the following:

Under the first phase of the Gateway Program – i.e., the Hudson Tunnel Project scenario -- all projected Amtrak passengers can be accommodated by the two tubes of the new Hudson Tunnel along with the one operational tube of the existing North River Tunnel; there are no diversions of Amtrak passengers to other modes. Similarly, all projected NJ TRANSIT passengers can be accommodated by the three tubes; no NJ TRANSIT passengers divert to other modes under the Hudson Tunnel Scenario.

### Extended Disruption

<table>
<thead>
<tr>
<th>Construction</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing North River Tunnel is rehabbed (2025-28)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operations</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Each tube is closed separately and traffic can only flow through one tube during rehab (2025-28)</td>
<td></td>
</tr>
<tr>
<td>Two tubes rehabbed (2029)</td>
<td></td>
</tr>
<tr>
<td>Potential OTP/reliability changes (2027+)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Capacity</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>75% reduction in capacity as only one tube is operational</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ridership</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak and off-peak diversions and lost trips (2025-28)</td>
<td></td>
</tr>
</tbody>
</table>

### Gateway Program

<table>
<thead>
<tr>
<th>Construction</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>New Hudson Tunnel is built</td>
<td></td>
</tr>
<tr>
<td>Existing North River Tunnel is rehabbed (2025-28)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operations</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>New Hudson Tunnel opens (2025)</td>
<td></td>
</tr>
<tr>
<td>Service operates through 3 tubes (2025-28)</td>
<td></td>
</tr>
<tr>
<td>Four tubes rehabbed or new (2029)</td>
<td></td>
</tr>
<tr>
<td>Potential OTP/reliability changes (2025+)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Capacity</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity is doubled once all Gateway Program elements are complete (2030)</td>
<td></td>
</tr>
<tr>
<td>Other project components that provide additional capacity for the 4 operational tubes:</td>
<td></td>
</tr>
<tr>
<td>- Penn Station Expansion</td>
<td></td>
</tr>
<tr>
<td>- Secaucus Station/Bergen Loop</td>
<td></td>
</tr>
<tr>
<td>- Portal South Bridge</td>
<td></td>
</tr>
<tr>
<td>- Newark-to-Secaucus Improvements</td>
<td></td>
</tr>
<tr>
<td>- West-of-Hudson rail yard</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ridership</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No lost trips or diversions</td>
<td></td>
</tr>
<tr>
<td>Full Gateway Program allows for doubling of capacity and increased ridership</td>
<td></td>
</tr>
</tbody>
</table>
Following this first phase, additional investment needed to fully utilize the new tunnel capacity is assumed completed in 2030. This will allow for an increase of the number of trains using the tunnel. The analysis assumes a doubling of the current service with a resulting 60 percent increase over the projected ridership in 2030. Amtrak will continue to increase ridership by one percentage point annually from 2031 through 2045, reaching a maximum 75 percent increase over Amtrak’s current projections for ridership by 2045. Ridership is assumed to remain constant beyond 2045.

Similarly the additional capacity after 2030 will allow NJ TRANSIT to increase its ridership by 80 percent in 2030. NJ TRANSIT trip volumes are projected to continue rising by two percentage points annually from 2031 through 2040, reaching a 100 percent increase in ridership by 2040. Projected load factors are approximately the same as today by 2040. Ridership will continue to grow in line with Moody’s (2013) New York County employment forecast through 2042. Growth will remain constant, equaling Moody’s 2042 growth rate from 2043-2058.

Hourly values of time are consistent with USDOT guidance. Values reflect 2014 wage rates based on BLS wage data and household income based on Census data. Fifty percent of the value of time for household income is used to estimate commuter travel time (NJ TRANSIT) while 70 percent of household income is used to estimate intercity travel time (Amtrak) based on US DOT guidance. The value of time is increased 1.2 percent per annum over the analysis period based on US DOT guidance to account for increased productivity.

Travel cost savings estimate the additional travel costs that would be incurred for driving instead of taking rail. The per-mile cost of driving is provided by AAA. This $0.31 ($2015) cost per mile is applied to the projected VMT diversions. Additionally, auto travel costs included 2010 daily parking costs in Midtown Manhattan of $43.33 ($2015). Transit costs are based on the marginal costs of NJ TRANSIT bus O&M and vehicle rentals.

The economic value of reduced vehicle emissions is based on diverted vehicle miles traveled. Emissions per gallon per vehicle mile traveled are based on Federal Transit Administration guidance. Emissions factors are used to estimate total volume of emissions per total vehicle mile traveled diverted. Total emissions volumes are then monetized utilizing economic emissions values obtained from USDOT guidelines. Emissions are net of rail emissions, which increase under Gateway. The analysis estimates rail emissions based on EPA guidance. The volume of rail emissions is estimated based on rail passenger miles traveled and converts all emissions into carbon dioxide equivalent.

Avoiding diversions to auto under the rehabilitation of the existing Hudson Tunnel and encouraging additional diversions from auto under the Gateway Program reduce the number of fatalities and injuries to the Northeast Corridor. The economic value of improved safety is estimated by deriving the net crashes avoided from reduced Vehicle Miles Traveled (VMT). Auto crash rates for fatal, injury, and property damage only from the Bureau of Transportation Statistics were applied to determine the number and type auto of crashes avoided. The number of accidents is monetized following US DOT guidance. The value of a statistical life grows 1.18 percent per annum to capture increased productivity over time.

Under the Extended Disruption scenario, some passengers who cannot be accommodated on rail during the rehabilitation of the existing Hudson Tunnel are assumed to not make the trip rather than diverting to other modes. The analysis is based on Federal Emergency Management Agency (FEMA) guidance, which assumes a 12-hour penalty for each one-way trip lost.
Capital costs are based on a feasibility study and reflect conceptual planning or less than 10% design, and are consistent with cost estimates being utilized for financial planning purposes. All costs are expressed in 2015 dollars.

Net operations and maintenance costs for rail operations reflect the additional rail service associated with increased rail capacity and operations. Rail operations costs are based on National Transit Data Base data for NJ TRANSIT, and Amtrak monthly operating reports. The operations and maintenance costs were estimated using estimates of the additional number of trains, and a valuation of $9.36 per vehicle mile for Amtrak trains, and $7.80 per vehicle mile for NJ TRANSIT—these values are in real 2015 dollars, and are assumed to remain constant over time in real terms. Based on Amtrak input, it is also assumed that there will be an additional $5 million per year in tunnel maintenance costs compared with the Extended Disruption scenario, as there are four tubes rather than two tubes.

Highway congestion cost savings are included in the benefits. This refers to the value of additional congestion avoided due to avoiding the additional VMT if the Gateway Program is not undertaken. When passengers elect to use their automobiles, they worsen congestion overall and cause delays to all other drivers, thus imposing additional delay costs on everyone else on the roads. To estimate this value, a regression analysis was conducted specifically for this BCA using data from the 2012 Texas Transportation Institute’s annual Urban Mobility Study. That report provides extensive data including congestion delay (in hours), VMT, as well as data on population and lane miles. The regression analysis finds that at the level of New York City regional lane-miles, each additional VMT on the highway network causes 0.0072 hours of total highway delay (about 0.43 seconds). This analysis then used the value of time to monetize the additional hours of delay resulting from the VMT added. Overall, this translated to around $0.20 to $0.30 per VMT, depending on year.

HUDSON TUNNEL EXTENDED DISRUPTION SCENARIO ANALYSIS METHODOLOGY

The costs of not undertaking the Hudson Tunnel Project reflect the 75 percent loss of capacity between 2025 and 2029. They are estimated using the same BCA model as applied to the full Gateway Program.
1Direction by Market Analysis Group, Amtrak 2015.
2Direction by Market Analysis Group, Amtrak 2015
3Gateway Trans-Hudson Partnership.
4New Jersey Transit, November 2015.
9Includes fuel, maintenance, tires, and half of depreciation.
13Ibid.
15Texas Transportation Institute, 2012 Urban Mobility Study
*All photographs except on page 11 by Chuck Gomez, Amtrak.