

Getting Back on Track

Unlocking the Full Potential
of the New Haven Line

January 2014



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Executive Summary

America's busiest rail line is in trouble. The New Haven Line is a 60-mile stretch of track that carries commuters between New York City and Connecticut, and long-distance travelers throughout the Northeast. The line suffered two major outages in 2013, including a collision that injured 76 people and an electrical outage that shut down service on the line for more than two weeks. Delays and service disruptions due to aging infrastructure and critical repair work occur regularly, slowing travel for the line's 125,000 daily passengers.

At the root of these incidents is old age. The line's infrastructure has been allowed to deteriorate. The line's owners, the states of Connecticut and New York, have made commendable progress improving the rail infrastructure they inherited in poor physical condition and under major funding constraints. But the funding shortfalls have forced both owners to defer long overdue capital investment needed for repairs and upgrades that are vital to protecting the line's passengers. For example, the four movable bridges in Connecticut, all well beyond their replacement age, get stuck open several times a week, frequently delaying train traffic and causing ripple effects up and down the line.

At the current pace of investment of less than \$200 million per year, it will take 20 more years to rebuild the New Haven Line's aging structures and systems to achieve a state of good repair. In other words, for 20 more years passengers will be suffering through longer trip times and delays caused by the continuous track outages required to accommodate the reconstruction of critical components of the New Haven Line and by unexpected shutdowns in service. The nation's busiest rail line in the nation's most productive region cannot wait that long to return to full capacity.

At the current pace of investment of less than \$200 million per year, **it will take 20 more years** to rebuild aging structures on the New Haven Line.

The New Haven Line plays a vital role in supporting the nearly \$3 trillion economy of the Northeast Megaregion. For over 160 years the line has been an essential commuter rail link between Manhattan, America's predominant economic powerhouse; the northern suburbs of New York City; and the cities of southwestern and south central Connecticut. The New Haven Line is also a vital intercity connection on the Northeast Corridor linking Boston, New York, and Washington, D.C.

Getting Back on Track documents the key issues affecting the New Haven Line and outlines the critical capital investments needed for it to function once again as a reliable, four-track railroad. The State of Connecticut has budgeted nearly \$1 billion for the line in its current 2013-2017 five-year capital plan. An analysis by Regional Plan Association found that an additional \$3.6 billion is needed by 2020 to repair or replace aging and obsolete infrastructure. This will improve the long-term strength and reliability of the rail line, enabling it to continue fostering greater ridership, which generates other indirect benefits.

The New Haven Line needs an additional **\$3.6 billion through 2020** to rebuild its aging and obsolete infrastructure.

The emergency actions recommended in this report would help prevent future service disruptions and lay the groundwork for a long-term capital investment program that would improve the speed, frequency, reliability, connectivity and safety of New Haven Line rail service. The report also includes a set of policy recommendations that would speed the implementation of the projects and unlock federal funding to help pay for them, and identifies the line's top investment priorities beyond 2020.

RPA's New Haven Line Plan

Emergency Action Plan

This emergency action plan addresses the New Haven Line's most immediate, mission-critical infrastructure needs over the next seven years. It identifies a funding gap for these projects totaling \$3.6 billion beyond the amount that is already budgeted by the State of Connecticut, the majority owner of the New Haven Line's infrastructure. The plan's biggest engineering and funding challenge is the rehabilitation or wholesale replacement of the five movable bridges that are all more than 100 years old and together will cost over \$2.8 billion.

This emergency action plan will get the New Haven Line back on track toward achieving full, four-track operations and a state of good repair. It also builds the foundation for expanding the line's overall capacity to increase ridership through faster and more frequent rail service. The additional service would require more track outages in the short term than are currently planned, but will get the line back to its full capacity sooner and reduce the long-term impacts to passengers.

RPA's Emergency Action Plan Recommended Investments*	Funding Gap**
Power system replacement and repairs by 2015. Coordinate with track, fixed bridge, and signal replacement, and station repair work.	\$30 million
Fixed bridge replacement through 2020. Coordinate with track, power, and signal replacement, and station repair work.	\$35 million
Track and interlocking repairs through 2020. Coordinate with power, fixed bridge, and signal replacement, and station repair work.	\$40 million
Station and high-level platform repairs through 2020. Coordinate with track, power, fixed bridge, and signal replacement work.	\$85 million
Signal and communication systems replacement through 2020, and install PTC by 2015. Coordinate with track, power, and fixed bridge replacement, and station repair work.	\$300 million
New Haven Rail Yard expansion and modernization. Complete all three tiers of the Facilities Improvements Program by 2020.	\$330 million
Movable bridges —replace or rehabilitate the Walk and Saga Bridges by 2018, and the Devon, Cos Cob, and Pelham Bay Bridges by 2020.	\$2.8 billion
TOTAL	\$3.6 billion

*More detail on pages 29-30.

**Order of magnitude cost, beyond what is already budgeted.

The returns on this investment will be:

- ▶ Greater **capacity** for more and better rail service by expediting construction projects that take tracks out of service;
- ▶ Higher **reliability** on a day-to-day and long-term basis by replacing the signal system and unreliable infrastructure;
- ▶ Improved **safety** for rail passengers and train crews by replacing aging infrastructure that is at risk of failure;
- ▶ Stronger **ridership** due to the improved service, which generates financial, environmental, and public health benefits;
- ▶ Greater **economic development** through improved access to employment and housing options;
- ▶ More sustainable **transit-oriented development** around existing, where appropriate, new train station; and
- ▶ **Cost savings** due to reduced maintenance of deteriorating, unreliable structures and systems.

Longer-Term Investment Priorities

Achieve and maintain a state of good repair: The New Haven Line was built more than 160 years ago, yet some of the original infrastructure is still in use today. Restoring the line to prime physical condition within a decade will require a significant upfront investment by the public sector and a commitment to fully funding normal replacement and routine maintenance on a continuing basis. This will result in significant long-term reliability and safety benefits.

Metro-North Penn Station Access: Grand Central Terminal is quickly running out of capacity on its tracks and platform to accommodate increased service. Routing some Metro-North trains into New York's Pennsylvania Station would give it the ability to increase service to Manhattan and allow New Haven Line passengers to more quickly reach destinations on Manhattan's rapidly expanding West Side.

Reduce travel times: The fastest trip time on a Metro-North train between Grand Central Terminal and New Haven Union Station is currently one hour and 45 minutes. The emergency action plan in this report would lay the foundation for significant trip-time improvements. Other strategic investments that expand capacity for more and faster express service could allow Metro-North to reduce trip times to one hour and 15 minutes or less. Construction of a true high-speed rail line would reduce trip times to less than 45 minutes.

Support economic development: The New Haven Line serves many communities in Connecticut and New York that have a significant amount of potential for more transit-oriented development, as documented in the recent RPA study, *Halfway There: How to Create Land Use Policy That Makes the Most of Connecticut's Transit Network*. One goal of future investments should be to support sustainable economic development around existing stations and, where appropriate, build new stations.

Recommendations for Implementation

Expedite the project delivery process: At its current pace, Metro-North faces 20 more years of continuous track outages on the New Haven Line to replace its aging structures and systems. Expediting construction would require more track outages and service reductions in the short term, but would get the line back to its full, four-track capacity sooner, and result in fewer delays, track outages, and service reductions in the long run.

Create a Northeast Regional Rail Authority: The Northeast Corridor's current institutional framework is fractured and unbalanced. A new corridor-wide governance and project delivery entity with equal representation from Northeast states and Amtrak, and adequate staffing, resources, and authorities to deliver major, long-term rail projects would balance the needs of intercity and commuter rail and be able to attract more private investment in the long run.

Invest federal and regional funds: Given the New Haven Line's vital importance to the Northeast Megaregion, America's most powerful economic engine, the federal government has a national responsibility to fund a significant portion of its critical infrastructure projects. The emergency action projects will need to be paid for with federal grants and loans that leverage existing state and local funds, and new regional revenue generated and collected from the Northeast states.

Introduction

For over 160 years the New Haven Line has been an essential commuter rail link between Manhattan and its northern suburbs in New York and Southern Connecticut, linking Stamford, Bridgeport and New Haven to the metropolitan economy and connecting some of the region's most desirable bedroom communities to regional employment. The New Haven Line is also a vital link for intercity rail connections between Washington, D.C., New York City, and Boston on the Northeast Corridor.

In 2012, Metro-North Railroad served a record 39 million passengers on the New Haven main line and its branch lines, a 69 percent increase since 1984.¹ Amtrak's intercity services on the Northeast Corridor also reached record highs in fiscal year 2013.² Over three million intercity rail riders now use the New Haven Line every year.³

Despite the New Haven Line's status as the single busiest rail line in North America, intense congestion along its length limits its ability to increase rail service.⁴ The line is in a state of disrepair because funding has not kept pace with its long and growing list of infrastructure needs. Its aging systems and structures require constant maintenance and construction work that impacts the provision of service. Construction work takes tracks out of service for planned work, reducing the capacity of the line, and aging structures prone to malfunction or failure cause unexpected service delays and disruptions.

According to the Northeast Corridor Infrastructure Master Plan, the total capital investment needed for the entire Northeast Corridor through 2030 is now more than \$52.3 billion.⁵ An investment of this magnitude would enable the railroads to fix all of the corridor's broken assets, build a modest amount of new capacity to increase service and grow ridership, and fully fund normal replacement (the process of replacing infrastructure assets on a normal schedule) to maintain a state of good repair.

At least \$8 billion of this total capital investment need is on the New Haven Line and the intersecting Hell Gate Line which links trains to New York's Penn Station.⁶ This figure does not include other capital investments needed in the New York City area, such as new tunnels under the Hudson River which will most likely cost over \$15 billion.⁷ Because the vast majority of New Haven Line riders want to travel to, from, or through New York City, these regional improvements are also of vital importance to communities served by the New Haven Line.

Many of the New Haven Line's major physical infrastructure problems are due to its old age. The line was originally built by a private railroad company in the late-1840s while the Mexican-American War was being waged, a dozen years prior to the start of the U.S. Civil War. James K. Polk was president during most of the line's initial construction. Some of the original rail infrastructure built over 160 years ago is still in use today.

The poor condition of the line's physical infrastructure and constant ongoing construction work reduce its reliability by putting it at greater risk for sudden, unanticipated service interruptions. The New Haven Line suffered two such disruptions in 2013 that left riders stranded for days: in May, a train derailment and collision in Bridgeport injured 76 people, and in September, a broken electrical feeder cable in Mt. Vernon caused a power outage that hampered service for nearly two weeks. These two events caused massive delays and headaches for New Haven Line riders at a significant cost to the region's economy.

Great strides have been made to keep up with normal replacement and maintenance on the line over the years, especially given constraints on federal and state funding. But at the current pace, repairing or replacing the line's aging structures will require another 20 years of constant construction and track outages.⁸ Expediting critical repairs will require more track outages and delays than are currently planned in the short run, but will get the line back to its full four-track capacity sooner to enable continued growth in ridership. Allocating emergency funds for critical repairs will also reduce overall cost repairs given the higher cost of operating and maintaining deteriorating infrastructure.

The New Haven Line has helped fuel the region's growth for well over a century, but it is now at maximum capacity and badly deteriorated in many places. It is time to rebuild the line to enable the next 100 years of economic growth and prosperity. The New Haven Line needs major repairs and capacity upgrades

⁸ Connecticut Department of Transportation. 2011. New Haven Mainline Catenary & Bridge Replacement Program - Major Project Update. <http://1.usa.gov/16GWQb8>

¹ Metro-North Railroad. 2013.

² Amtrak. 2013. October 14, 2013 Press Release. <http://bit.ly/1euPiXw>

³ The Northeast Corridor Master Plan Working Group. 2010. The Northeast Corridor Infrastructure Master Plan. <http://bit.ly/X8tE1b>

⁴ Metro-North Railroad. 2013.

⁵ The Northeast Corridor Master Plan Working Group. 2010. The Northeast Corridor Infrastructure Master Plan. <http://bit.ly/X8tE1b>

⁶ Includes \$3.4 billion for state of good repair projects, \$2.7 billion for core capacity growth, \$2 billion for normal replacement, and \$22 million on the New Haven main line between New Rochelle and New Haven, and the Hell Gate Line.

⁷ The Gateway Program is currently estimated to cost \$14.7 billion in "The Amtrak Vision for Northeast Corridor: 2012 Update."



A Metro-North M8 rail car
Source: Metro-North



Scene of Metro-North derailment and crash
Source: Christian Abraham/Connecticut Post/AP

Train Derailment and Crash, May 2013

The train derailment and crash in Bridgeport on May 17 ground all of the New Haven Line's commuter and intercity rail service to a halt for days. The incident was caused by a broken piece of track. The derailment occurred in a segment with two of the four tracks out of service due to construction. If those two tracks had been open when the derailment and crash occurred, Metro-North could have continued to operate limited rail service as they repaired the two tracks that were damaged. Bottlenecks like this one affect the railroad's ability to recover from delay events. Given the age and poor condition of its infrastructure and its overall lack of available capacity, even minor problems on the New Haven Line can cause significant delays or even complete service outages.

to increase train speeds and frequency and prevent future disruptions. This will require substantially more capital funding than is currently available. Lastly, the Northeast Corridor needs a new paradigm for financing and managing rail infrastructure to better plan for the future of the line, and to expedite the delivery of improvement projects.

A program to complete the necessary repairs as soon as possible will allow future service to meet future ridership demand. A robust capital investment program can address the following:

Capacity: Track outages related to ongoing maintenance and construction projects temporarily reduce capacity along the line, causing bottlenecks similar to highway lane closures. Existing congestion limits capacity available for service expansion. These capacity constraints prevent Metro-North from operating more frequent rail service and scheduling more express trains, and also prevent Amtrak from operating more intercity service, since they limit opportunities for express Amtrak trains to pass local trains. Capacity constraints also affect reliability by making it more difficult to recover from service interruptions.

Speed: Speed restrictions are in place on the line where tracks are curvy, infrastructure is old or unreliable, and train traffic is heavy. The line's tracks are also spaced closer together than on modern railroads, further limiting train speeds. Improving trip times will require expanding capacity to ease congestion, making critical repairs, modifying curves, and widening track spacing where possible. In the long run, building new capacity on a new alignment separate from the New Haven Line would allow for more frequent express commuter and intercity rail service on the existing line, reducing average trip times.

Reliability: Replacing aging infrastructure components would ensure that the New Haven Line can maintain a level of reliability necessary to attract and retain ridership. The line's aging movable bridges cause frequent delays that will only get worse. As delays mount, riders will increasingly choose driving over unreliable rail service.

Safety: Rail is already one of the safest modes of travel, but it can always be safer. The derailments in Bridgeport in May and the Bronx in December illustrate the cost of catastrophic failure. Infrastructure in a state of disrepair requires constant maintenance to prevent events such as these from reoccurring. Addressing critical repairs now and completing them as soon as possible will limit future interruptions to service and get us a safer railroad sooner.

Structure of Report

Getting Back on Track begins by explaining the New Haven Line's regional importance by describing its geographic context, the services that use it, and the riders that depend on it today and in the future. Next, the report breaks down the line's historical development and transition from private to public ownership and operations and the roles and responsibilities of the agencies that own and operate it today. Finally, it lays out the significant physical challenges it is facing and recommends investments and policies that will protect the line and its passengers in the short-term, maximize the economic potential of communities along the line in the Bronx and southwestern Connecticut, and create new capacity to accommodate additional rail services that will drive ridership growth in the future.

The report concludes with the following:

- 1. Emergency Action Plan** that lays out the New Haven Line's most immediate, mission critical infrastructure needs. This plan projects a \$3.6 billion need for critical investments beyond what is already funded by the states of Connecticut and New York. It would make significant progress toward achieving a state of good repair on the line to prevent further service disruptions and makes minor expansions to the line's overall capacity to increase ridership by providing faster and more frequent service. Emergency projects include wholesale replacement of the line's aging signal and communications systems, and rehabilitation of several movable bridges.
- 2. Long-Term Investment Priorities** that build the foundation for future service and ridership growth on the New Haven Line, and its branch lines and connecting corridors. This strategy helps make New York and Connecticut more attractive to new residents, talented workers, and innovative businesses by providing faster, more frequent, and more reliable service along this growth corridor and by creating new connections to major markets in the Northeast, including New York Penn Station.
- 3. Recommendations for Implementation** that will help expedite the delivery of critical infrastructure projects and free up additional public funds. The recommendations aim to create a new framework for governing rail infrastructure, and financing and delivering rail projects in the Northeast Corridor, including the New Haven Line. The recommendations include creating a regional rail authority and regional sources of revenue to pay for rail projects in the Northeast and streamlining the project delivery process, including everything from planning to the federal environmental review process to construction and procurement.



Crowded platform after New Haven Line lost power
Source: @SrcasticComutr - pic.twitter.com/48TJval1n8

Power Outage, September 2013

On September 25, 2013, the New Haven Line lost all electrical power, leaving rail service crippled and passengers stranded for nearly two weeks. The power outage was caused by the sudden, unexpected failure of a 138,000 volt feeder cable that supplied electricity to the line's overhead catenary wires at Mount Vernon, NY. Normally, two cables feed power to the New Haven Line at Mount Vernon, but ConEdison de-energized one of them as part of a project to upgrade an electrical substation. The process of taking this cable out of service probably caused the failure of the other. The feeder cable that failed was installed 36 years ago and had a design life of 30 years. This event highlights the effect that aging, deteriorating infrastructure and a lack of back-up systems can have on transportation services that are critical to the functioning of the regional economy. Preventing major disruptions like this requires achieving a state of good repair.



The New Haven Line

Geographical Context

The Northeast Megaregion from Maine to Virginia is the nation's largest, densest, and most economically productive urban area. In fact, it is actually a large agglomeration of smaller urban areas with overlapping development and commuter sheds, shared infrastructure, economic and natural systems, and common histories and cultures. The population of the Northeast Megaregion is currently about 52 million and is projected to grow 33% to 69 million people by 2050.¹

The Northeast Corridor stretches from Washington, D.C. to Boston, connecting all of the Northeast's largest cities with commuter and intercity passenger rail services that carry over a quarter of a billion annual passengers.²

The New Haven Line is a critical link in this vital rail corridor along the north shore of Long Island Sound between Boston and New York. The New Haven main line is a 60-mile length of track between New Haven, Conn. and Woodlawn, N.Y. in two main sections: 56 miles between New Haven and New Rochelle, N.Y., where intercity and commuter rail services currently split; and four miles between New Rochelle and Woodlawn, where

the New Haven Line tracks merge with the Harlem Line on the approach to Grand Central Terminal. At New Rochelle, Amtrak's Northeast Corridor trains follows the Hell Gate Line through the Bronx and Queens to access Penn Station New York. East of New Haven, the Northeast Corridor continues on towards Boston.

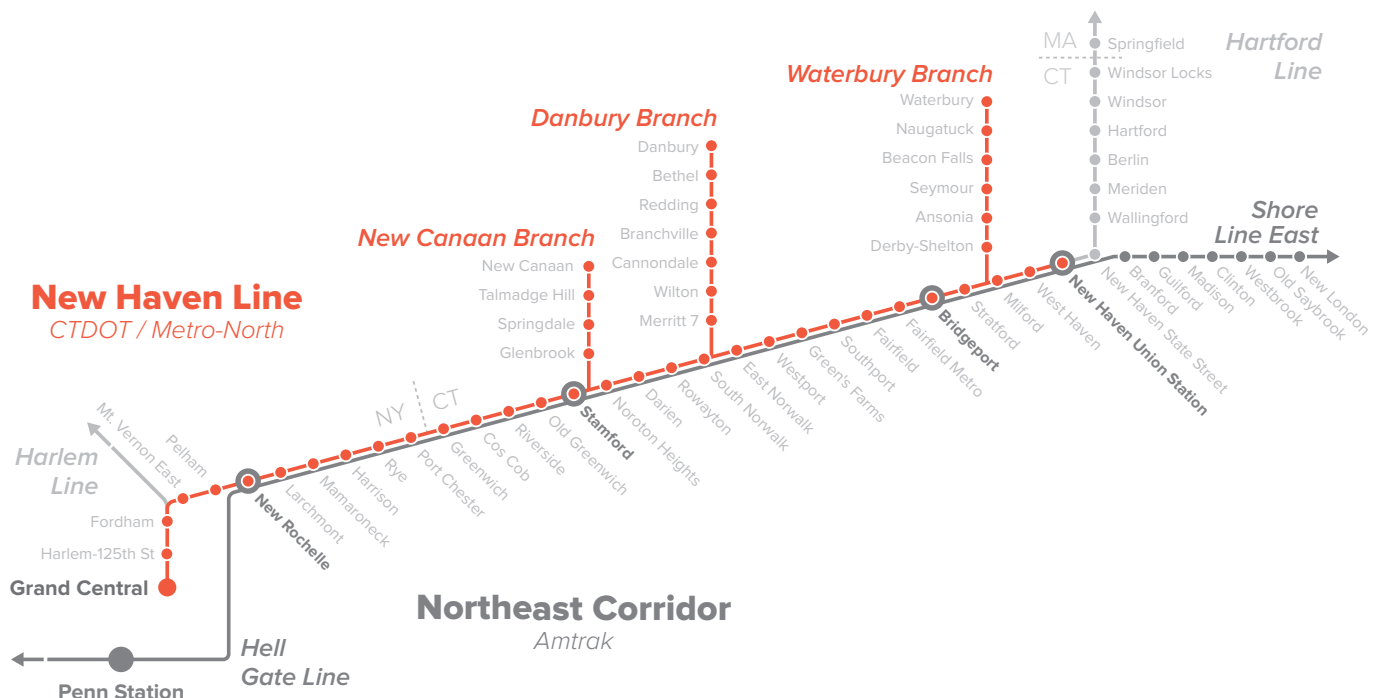
The New Haven Line connects with three branch lines with Metro-North commuter service, the New Canaan, Danbury, and Waterbury Branches as well as the New Haven-Hartford-Springfield Corridor (from now on referred to as the "Hartford Line"), a federally-designated high-speed rail corridor with Amtrak intercity rail service.

The populations of New York City and the State of Connecticut are projected to grow by 21 and 18 percent by 2050, respectively.³ In response, plans have been developed to increase rail service on the New Haven main and branch lines, initiate a new commuter rail service on the Hartford Line with some trains operating through to Manhattan on the main line, and run more frequent Shore Line East service to points along the main line. All of these service increases depend on the main line's ability to absorb more trains and more riders. Without reliable rail capacity, the region's growth will further strain highway networks, limiting economic prospects for most of Connecticut in the long run.

¹ U.S. Census Bureau / Woods & Poole County Projections / RPA analysis
² The Northeast Corridor Master Plan Working Group. 2010. The Northeast Corridor Infrastructure Master Plan. <http://bit.ly/X8tE1b>

³ U.S. Census Bureau / Woods & Poole County Projections / RPA analysis

The New Haven Line Network





Historical Development

The New York & New Haven Railroad was a private company chartered in 1844 to build the first rail line connecting New York City to Boston along the north shore of Long Island Sound. The company financed the initial construction and operation of the New Haven Line with virtually no public funding and completed the connection to New Haven in 1849. Prior to its construction, people traveled between New York and Boston on an inland rail route via Albany or by some combination of water and rail routes. From New Haven, passengers traveled to Boston via Hartford. A few years later the line to Boston via Providence was built. Some of the line's original infrastructure is still in use today more than 160 years later, but most of it has been replaced by newer equipment and technology.

Steam powered the first trains on the New Haven Line, but it was one of the first railroads in the nation to be electrified. Construction of the original overhead catenary power system began from New York to Stamford in 1907 and extended to New Haven in 1914. In 1982, the New Haven Line was named a National Historic Engineering Landmark because of its early adoption of electrification technology. Some segments of the original overhead catenary power system still exist but are currently being replaced.

Ownership & Operation: From Private to Public

In 1872, the New York & New Haven Railroad merged with the Hartford & New Haven Railroad to form the New York, New Haven & Hartford Railroad, and by 1900 the grade-separated four-track railroad now in service was complete. Soon after, the line was taken over by J. P. Morgan. In 1904, Morgan's railroad initiated major investments in infrastructure including the electrification of the line from New York City to Stamford and New Haven and the construction of the movable bridges at Pelham Bay, Cos Cob, Westport, and Old Saybrook. At the same time, Morgan attempted to monopolize all New England rail, steamship, and trolley transportation. The financial strain of these efforts led to severe cuts in the maintenance of the line beginning in 1907. By the end of the Morgan regime in 1913, the New Haven Line was not in good physical or financial condition.

Through the 1920s, the railroad regained strength due to the combination of World War I traffic and financial support from the federal government during wartime nationalization, prudent cuts in branch line service, a favorable economy, and improved maintenance. The Great Depression then drove it into bankruptcy in 1935. World War II traffic, sound planning by its bankruptcy trustees, and a \$300 million maintenance program once again returned the railroad to solvency in 1947. Almost immediately, the railroad suffered the first of several cycles of irresponsible management, which along with growing post-war competition from government-subsidized highway and air travel and New England's decline as a manufacturing center led the



THE NEW YORK, NEW HAVEN AND HARTFORD RAILROAD CO. OPERATED AND CONTROLLED LINES

New York New Haven & Hartford Railroad Map, 1929
Source: New Haven Railroad Historical and Technical Association

railroad into a downward spiral of disinvestment, slower and less reliable rail service, and loss of ridership, ending in a second and final bankruptcy in 1961.

After six years of trustee control, the Penn Central Transportation Company was forced to absorb the railroad and its assets in 1968. Only two years later, the states of New York and Connecticut agreed that New York would buy its section of the New Haven Line and Connecticut would buy its section as far as New Haven, along with the three branch lines. The states contracted with Penn Central for rail operations, which continued through 1970, when Penn Central went bankrupt (the largest corporate bankruptcy in American history at the time), to the formation of Consolidated Rail Corporation (Conrail) in 1976. In 1983, New York's Metropolitan Transportation Authority (MTA) formed Metro-North Railroad, which formally took over New Haven Line commuter rail operations from Conrail, signing a retroactive agreement with the State of Connecticut in 1985.

The federal government assumed post-bankruptcy control of all of Penn Central's assets except those under the control of New York, Connecticut, and Massachusetts. The following year, Amtrak, a public benefit corporation created by the federal government, took over the operation of intercity passenger rail service on the Northeast Corridor between Washington D.C. and Boston, including along the New Haven Line. Several other railroads on the corridor went bankrupt and could no longer maintain their infrastructure, so Amtrak began acquiring their property and assets. By 1976, Amtrak owned most of the Northeast Corridor. The federal government recognized that the

metropolitan economies of the Northeast Megaregion, America's economic powerhouse, relied on passenger rail travel on the corridor and knew it could not stand by as the railroads went bankrupt and service disappeared. In effect, the public sector saved passenger rail travel in the Northeast and has been the steward of the infrastructure ever since.

The last major overhaul of the New Haven Line was completed in the 1970s as part of the Northeast Corridor Improvement Project (NECIP). NECIP's goals included reducing trip times between New York City and Washington, D.C. to 2 hours and 40 minutes and to 3 hours and 40 minutes between New York City and Boston. NECIP was never fully funded and was unable to achieve its trip time goals.

There may be opportunities in the future for the private sector to get involved again in passenger rail service in the Northeast and potentially even assist with infrastructure development, but a backlog of state of good repair projects has accumulated while it has been in the care and custody of the public sector. The federal and state governments must make the necessary capital investments that have been deferred under their watch before the private sector will be inclined to get back into the business of passenger rail.

Existing Conditions

Today, the New Haven Line is one of the most complex and congested rail lines in the world. The main line is owned by two states and used by three different rail carriers. Many of its key segments are operating near or at capacity during peak periods. Over the years, ridership on the New Haven Line has grown as service has improved, but its future growth is now threatened by the multi-billion dollar backlog of state of good repair projects that is degrading its capacity, reliability, and safety.

Services

The New Haven main and branch lines support the single busiest mixed-rail operation in North America with high-volume commuter and intercity passenger rail services and a limited amount of freight activity.

The New Haven main line functions as both a local and through railroad. Locally, Metro-North trains deliver travelers to and from New York City, Westchester County, and Connecticut. Shore Line East provides limited commuter rail service west of New Haven to Stamford on the main line. Long-distance intercity service is fulfilled by Amtrak, which connects all of the major urban hubs of the Northeast with four intercity rail services. Two freight carriers, CSX and Providence & Worcester, operate on the line as well.¹ Currently, Metro-North commuter trains access Grand Central Terminal via the Harlem Line and intercity trains access Penn Station via the Hell Gate Line, splitting off from the main line at Shell Interlocking in New Rochelle.

On an average weekday, nearly 400 trains operate on the New Haven Line network. About 50 of these are empty "dead-head" trains traveling without passengers. Some of the 400 trains operate only on the branch lines, Hartford Line, or Shore Line East, but at least three quarters operate on the main line. More than 80 percent are Metro-North commuter trains. Only 42 are Amtrak intercity trains, or less than 20 percent of New Haven Line's total train traffic.²

Metro-North Railroad

Metro-North operates service on the New Haven main line and the three branch lines, running 336 trains on an average weekday, including 286 trains with passengers and 50 deadhead trains



Clock at Grand Central Terminal

Source: MTA

¹ CTDOT. 2012. Connecticut State Rail Plan (2012-2016). <http://1.usa.gov/16ynUsH>

² Connecticut State Rail Plan / NEC Infrastructure Master Plan.

Metro-North Services on the New Haven Main Line and Branch Lines

Rail Service	Weekday Trains	Stations Served	Weekday Inbound Boardings	Annual On-Time Performance (%)	Fastest Travel Time*
New Haven Main Line	246	31	59,000	96.8	1:45
New Canaan Branch	52	4	2,500	98.3	0:15
Danbury Branch	28	7	1,200	95.5	0:45
Waterbury Branch	15	6	500	96.5	0:52
Total	336	48	63,200	96.8	n/a

*Fastest trip on the New Haven Main Line is between New Haven Union Station and Grand Central Terminal; New Canaan Branch is between New Canaan and Stamford; Danbury Branch is between Danbury and South Norwalk; and Waterbury Branch is between Waterbury and Bridgeport.

Sources: Metro-North. 2013. Annual Reports & Schedules

moving into position. Metro-North trains serve 48 stations. Over 63,000 passengers board inbound trains on an average weekday.

Metro-North's rail operations on the New Haven Line have been exceptionally reliable compared to many other rail operations in the U.S. In 2012, average on-time performance ("on-time" means a train arrived within six minutes of its scheduled arrival) on the New Haven main and branch line services was 96.8 percent.³

New Haven Main Line: Commuter service between New Haven and Grand Central operates in two segments – an inner segment between Grand Central and Stamford and an outer segment between Stamford and New Haven. About 61 percent of riders travel in the inner segment and 39 percent in the outer segment. In the morning peak period, about 85 percent of riders are destined for Grand Central, with Stamford the next busiest destination. Most inbound trains originate at New Haven or Stamford and terminate at Grand Central with about half running express from Stamford to Grand Central. Most outbound trains originate at Grand Central and terminate at Stamford or New Haven, with a few exceptions in off-peak periods.

New Canaan: Commuter service on the New Canaan Branch consists of 45 weekday revenue trains serving four stations on the branch line plus Stamford on the main line. All inbound trains begin in New Canaan and most terminate in Stamford with connecting service to New Haven Line trains. A few peak-hour trains run through to Grand Central Terminal and make stops on the main line. Most outbound trains originate in Stamford and a few peak-hour trains originate at Grand Central. All trains terminate in New Canaan.

Danbury: Commuter service on the Danbury Branch consists of 28 weekday revenue trains serving seven stations on the branch line plus South Norwalk on the main line. All inbound trains originate in Danbury. Most terminate in South Norwalk with connecting service to New Haven Line trains, and a limited number of peak-hour trains run through to Stamford and

Grand Central. While a few Danbury Branch trains originate at Grand Central and Stamford during peak periods, most trains originate in South Norwalk and terminate in Danbury.

Waterbury: Commuter service on the Waterbury Branch consists of 15 weekday revenue trains serving six stations on the branch line plus Stratford and Bridgeport on the main line. All inbound trains originate in Waterbury and terminate in Bridgeport with connecting service to New Haven Line trains, and all outbound trains originate in Bridgeport, operating as a scheduled connection with trains from Grand Central, and terminate in Waterbury. One Waterbury Branch train runs through to Stamford in the morning.

Amtrak

On weekdays, Amtrak operates 44 intercity trains on the New Haven main line as far as New Rochelle, where they then travel along the Hell Gate Line through the Bronx and Queens, under the East River, and into New York Penn Station. The two busiest Amtrak services in the country – Northeast Regional and Acela Express – operate along the length of the Northeast Corridor. Amtrak also operates two other intercity services on the New Haven main line – the Springfield Shuttle and the Vermonter – as well as Shore Line East, a rail service operated under contract to the State of Connecticut that runs between New Haven and New London, with some trains running west to Stamford.

Acela Express: This "high-speed" intercity service on the Northeast Corridor between Boston and Washington, D.C. stops on the New Haven main line in New Haven and Stamford. Eight round trips run per weekday between New York and Boston, spread throughout the day with an average interval between trains of two hours. Acela trains can reach speeds as high as 150 miles per hour but average about half of that due to sharp curves, aging infrastructure, and congested segments along the corridor. Between Penn Station New York and New Haven, Acela trains average less than 75 mph due to the high volume of rail traffic and the relatively narrow inter-track spacing. Acela service was initiated in 2000.

³ Metro-North Railroad. 2013.

Amtrak Services that Use the New Haven Main Line

Rail Service	Weekday Trains on the Main Line	Stations Served on the Main Line	Total Annual Ridership on the Whole Route (2013)	On-Time Performance on the Route (2012%)	Fastest Travel Time*
Acela Express	20	2	3,400,000	89.7	1:26
Northeast Regional	20	4	8,000,000	86.5	1:33
Hartford Line	2	4	385,000	86.9	2:45
Vermont	2	4	82,000	85.4	2:53
Shore Line East	6	3	626,000	unknown	1:00
Total	44	n/a	n/a	n/a	n/a

*Fastest trips on the Acela Express and Northeast Regional services is between New Haven and New York's Penn Station; Hartford Line is between Hartford and Penn Station; Vermonter is between Hartford and Penn Station; and Shore Line East is between New Haven and Stamford. Sources: Amtrak. 2013. Schedules, NEC Infrastructure Master Plan & Website

Northeast Regional: This intercity service connects points on the Northeast Corridor between Boston and Washington, D.C., with some trains operating to points in Virginia. Northeast Regional trains stop on the New Haven Line in New Haven and Stamford as well, and selected trains also stop at Bridgeport and New Rochelle. This service operates nine round trips per day on weekdays, generally operating during hours when Acela Express trains are not. When combined with through trains on the Springfield Line and Vermonter services (described below), there are a total of eleven weekday intercity regional trains running in each direction on the New Haven Line between New Haven and New York. The trains used for this service are slower than Acela trains, make a greater number of stops, and tickets are less expensive.

Springfield Shuttle: This intercity service connects riders along the Hartford-Springfield corridor with transfers to the Northeast Corridor service at New Haven. Eight of the nine stations on this line are in Connecticut, with only Springfield serving Massachusetts. The Hartford-Springfield route uses diesel locomotives since the route is not electrified. Four inbound and four outbound trains run between Springfield and New Haven Union Station per day, with connections to Northeast Corridor service. One daily round trip shuttle train runs through to Penn Station New York and Washington D.C., stopping in New Haven, Bridgeport, and Stamford, but it must shut down in New Haven for several minutes to allow the diesel locomotive to be switched out for an electrical locomotive.

Vermonter: This intercity service runs along the Northeast Corridor, the Hartford Line and north to St. Albans, VT, serving nine stations in Vermont, one in New Hampshire, ten in Massachusetts and Connecticut on the Hartford Line, and four on the New Haven Line (New Haven, Bridgeport, Stamford, and New Rochelle), and then running through Penn Station New York and on to Washington, D.C. Only one round-trip Vermonter train runs each day, taking 13 hours and 45 minutes to make the full trip from St. Albans to Washington, D.C.

Shore Line East: A commuter rail service between Stamford and New London operated by Amtrak under contract with the State of Connecticut Department of Transportation (CTDOT). This service was initiated in 1990 between New Haven and Old Saybrook and extended east to New London in 1996. These trains mainly operate between New Haven and points east with 16 weekday trains between Old Saybrook and New Haven, and 10 between New London and New Haven. Four of these trains operate through New Haven to points west, including Bridgeport and Stamford where they connect with Metro-North's New Haven Line services into Manhattan. In 2011, Shore Line East ridership was 614,000.

Freight: CSX & P&W

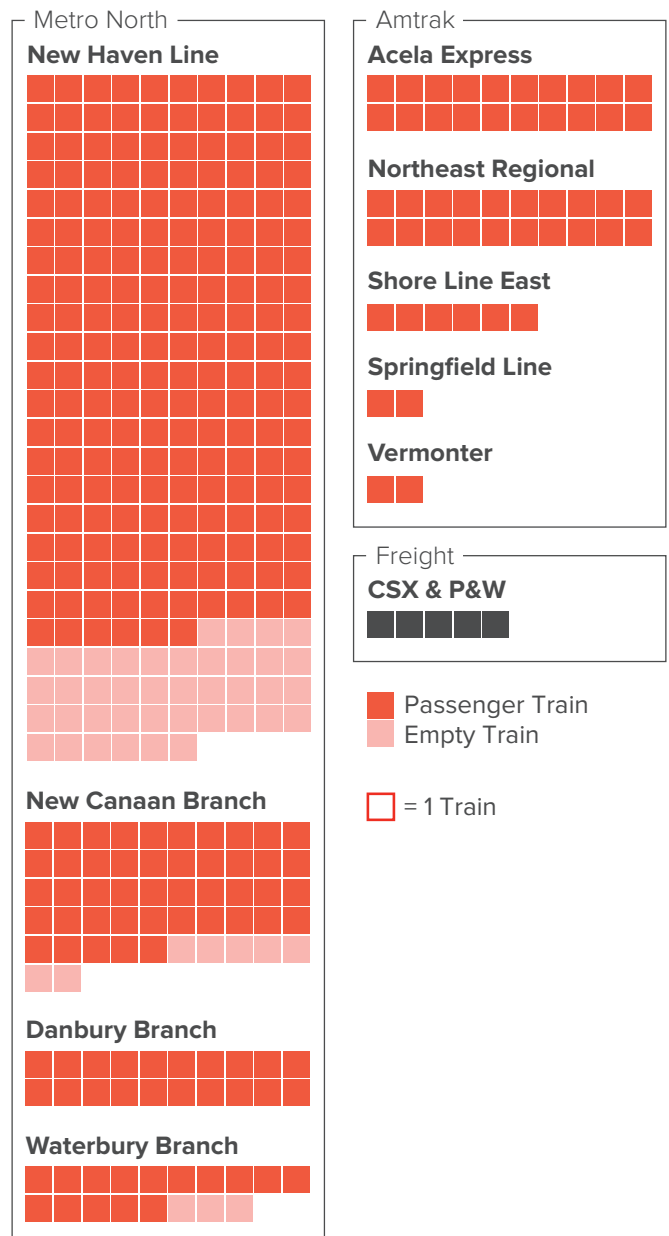
CSX, a Class I railroad, and Providence & Worcester (P&W), a Class II railroad, operate a couple of freight trains per day on the New Haven Line. Most of the freight train movements are at night, when passenger traffic is at its lightest. There are far fewer

freight trains than passenger trains on the New Haven Line, but because they are heavier than passenger trains, they have a disproportionate impact on the physical infrastructure. On the main line, CSX and P&W provide through freight service and CSX provides local freight service.

Throughout Connecticut, CSX ships mostly lumber, municipal and construction, waste, plywood, limestone, and wood pulp; and P&W ships chemicals, plastics, and minerals and nearly 24,000 inter-modal shipments, some of which originate or terminate in Connecticut. One of the largest products shipped out of Connecticut is debris from construction and demolition sites, including materials like wood scraps, roofing and flooring, cinder blocks, and insulation.

New Haven Line Service

Number of Weekday Trains on the New Haven Line



Source: CTDOT. 2012. Connecticut State Rail Plan (2012-2016). <http://1.usa.gov/16ynUsH>



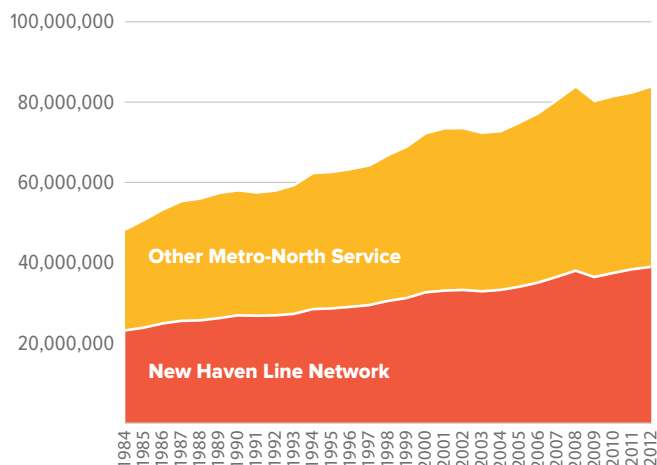
A conductor collects tickets on a Metro-North train
Source: MTA / Patrick Cashin

Ridership

These passenger and freight services on the New Haven Line make it one of the busiest rail lines in America, carrying more than 125,000 passenger trips and dozens of carloads of freight every weekday. Metro-North makes up nearly 90 percent of ridership and 85 percent of train movements on the New Haven

Growth in Metro-North Ridership

Annual Ridership on the New Haven Line Network and the Total Metro-North Regional Rail System



Source: Metro-North. 2012.

Line.⁴ In comparison, while Amtrak's rail ridership is far lower than Metro-North's, intercity rail passengers generally travel much farther than Metro-North customers.

In the 30 years since Metro North's inception, the total annual system-wide ridership on all of its commuter rail lines, including the New Haven, Harlem, Hudson, Pascack Valley, and Port Jervis Lines has doubled from 40 million to over 83 million today. Service on Metro-North's New Haven main and branch lines has driven this growth with a two-thirds increase in ridership from 23 million in 1984 to over 38 million in 2012, breaking an annual record set the year before. Record-breaking ridership in 2012 was an incredible achievement given that Hurricane Sandy in October 2012 cost Metro-North an estimated 1.8 million riders system-wide, with the New Haven Line along the north shore of Long Island Sound suffering the bulk of the damage.⁵

Amtrak has also seen significant ridership growth on the New Haven Line and the larger Northeast Corridor. In 1999, Amtrak carried 7.8 million riders on the Northeast Corridor. As of 2013, ridership has grown to 11.4 million riders, an increase of nearly 50 percent.⁶ Much of this growth can be attributed to the success of Amtrak's Acela Express service, which was introduced in 2000. Amtrak has broken ridership records on the Northeast

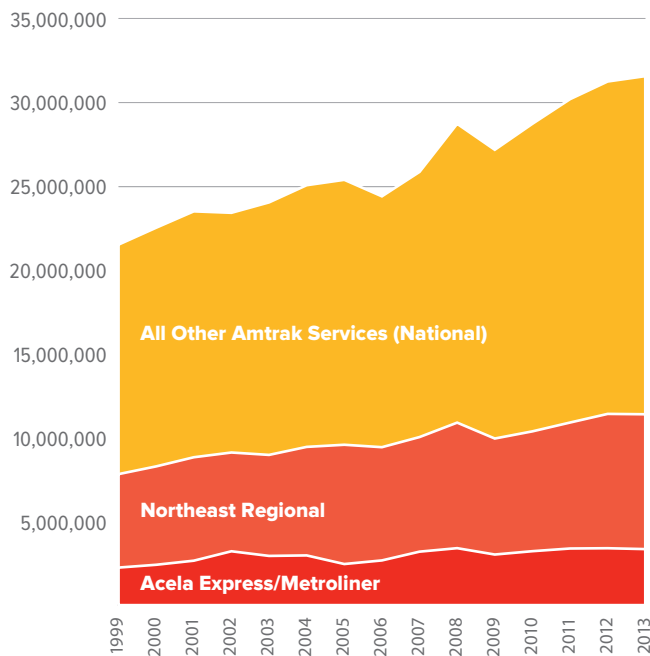
⁴ The Northeast Corridor Master Plan Working Group. 2010. The Northeast Corridor Infrastructure Master Plan. <http://bit.ly/X8tE1b>

⁵ Metro-North Railroad. 2013.

⁶ Amtrak. 2013. October 14, 2013 Press Release. <http://bit.ly/1euPiXw>

Growth in Amtrak Ridership

Annual Ridership on the Northeast Corridor and the Total Amtrak National Rail Network



Source: Amtrak. 2013.

Corridor ten of the last twelve years. In 2010, Amtrak's intercity rail ridership on the New Haven Line segment of the Northeast Corridor was 2.8 million.⁷

Work trips to and from Grand Central dominate the total share of rail ridership with over 80 percent of morning weekday inbound passengers during the peak period getting off the train there. However, reverse-peak travel and intrastate Connecticut trips have been growing rapidly. Today, more people get off Metro-North commuter rail trains in Stamford than board them in the morning peak-period, showing Stamford's importance as a work trip destination as well as an origin. Two-thirds of Metro-North's New Haven Line riders are Connecticut-based. These riders logged 1.2 billion passenger miles, more than four-fifths of which were in Connecticut. These two statistics show that the vast majority of New Haven Line riders still live in Connecticut and are travelling within the state or to and from New York City for work or non-work trips.⁸

According to a 2007 survey of Metro-North customers, nearly three quarters of inbound riders on the New Haven Line during morning peak hours are destined for Grand Central. The next two busiest stations on the New Haven Line, Stamford and Fordham, are destinations for only 6 to 7 percent of riders each. In the morning, by far the most common departure point for trips to Grand Central is Stamford, with New Haven Union Station ranked second. Reverse commuting from Manhattan and the Bronx only makes up about 6 percent of all Metro-North trips system-wide, including the Harlem and Hudson Lines.⁹

⁷ The Northeast Corridor Master Plan Working Group. 2010. The Northeast Corridor Infrastructure Master Plan. <http://bit.ly/X8tE1b>

⁸ CTDOT. 2012. Connecticut State Rail Plan (2012-2016). <http://1.usa.gov/16ynUsH>

⁹ RSG. 2008. 2007 MTA / Metro-North Railroad Origin-Destination Survey.

New York Penn Station is by far the busiest station in Amtrak's national rail network with 9.6 million intercity rail passengers getting on or off trains there in 2013. New Haven Union Station is the tenth-busiest with over 746,000 ons and offs, and Stamford is also a major Amtrak station with nearly 389,000 ons and offs.¹⁰

Infrastructure Ownership, Operations & Maintenance

About 75 percent of the New Haven main line, including its right-of-way and physical infrastructure, is in Connecticut and owned by CTDOT. The rest of it is in New York and owned by the MTA. CTDOT owns the portion of the New Haven main line between New Haven and the CT-NY state border at Port Chester, as well as the three branch lines. The MTA owns the main line between Port Chester and Woodlawn, as well as the Harlem Line. Finally, Amtrak owns the Hell Gate Line, the Hartford Line, and the Northeast Corridor east of New Haven to the Rhode Island/Massachusetts state border.

There are 28 stations on the New Haven main line: 20 in Connecticut and 8 in New York. Most of the stations in Connecticut are owned by the State and leased to the municipalities or townships in which they are located. Stations in New York are generally owned by the MTA. Station platforms are technically in the rail right-of-way and therefore state-owned.

CTDOT and the MTA share ownership of the commuter trains that operate on the main line, 65 and 35 percent, respectively, and CTDOT owns all of the diesel trains that operate on the non-electrified branch lines. Amtrak owns its intercity trains, and CSX and P&W own their equipment.

Four rail yards – the New Haven Yard, East Bridgeport Yard, Stamford Yard, and Danbury Yard – maintain the trains that operate on the main and branch lines, including diesel and newer electric multiple unit equipment. All of these rail yards are owned by CTDOT and operated by Metro-North.¹¹

Rail Operations

The operating agreement between the State of Connecticut (the "owner") and the MTA (the "operator") dictates operating protocol on the New Haven Line. It was last amended in 2002 after the initiation of Amtrak's Acela service. Metro-North controls the dispatching of trains on the New Haven Line, including its commuter trains and Amtrak's intercity trains. Metro-North also manages operations at the four CTDOT-owned rail yards. The agreement also established the cost-sharing formula for operating expenses incurred by Metro-North on infrastructure owned by Connecticut. According to this formula, the State of Connecticut and Metro-North split operating expenses on the main line 65 and 35 percent, respectively. Connecticut covers 100 percent of operating expenses on the three branch lines.

¹⁰ Amtrak. 2013. October 14, 2013 Press Release. <http://bit.ly/1euPiXw>

¹¹ CTDOT. 2012. Connecticut State Rail Plan (2012-2016). <http://1.usa.gov/16ynUsH>

Metro-North and Amtrak also have an operating agreement in place that limits Amtrak intercity operations to no more than two trains per hour on the New Haven Line.

The U.S. Coast Guard requires CTDOT to open its movable bridges for boats. However, oftentimes due to their old age, after they open, they malfunction and cannot close, which causes train delays. The bridges opened 747 times in 2010 and had trouble closing 70 times.¹² Bridge operations limit the throughput capacity of the main line for Metro-North as well as for Amtrak and Shore Line East on the Northeast Corridor east of New Haven.

Maintenance

Infrastructure maintenance is conducted when something breaks. Maintenance is different from normal replacement in that maintenance costs are considered operating expenses. Maintenance on the New Haven Line is done by Metro-North and its costs are shared by CTDOT for work in Connecticut.

Capital Improvements

CTDOT and the MTA are responsible for maintaining, replacing, and upgrading the New Haven Line's physical rail infrastructure, and Amtrak is supposed to contribute funding to mutually beneficial projects. However, since Amtrak does not own the infrastructure, virtually all infrastructure projects along the line are ineligible to receive Amtrak's annual federal capital assistance. As a result, comparatively few federal dollars have been spent on the New Haven Line since the 1970s. In 2011, CTDOT and the MTA spent \$71.5 million and \$28 million, respectively, to cover capital expenses.

The State of Connecticut is responsible for capital upgrades on the three branch lines and is sharing the cost of capital improvements on the Hartford Line with Amtrak.¹³

The Northeast Corridor Infrastructure & Operations Advisory Commission (NEC Commission) was created by Congress in part to determine a more equitable formula for sharing capital and operating costs, revenues, and compensation on the Northeast Corridor. This cost allocation study is currently underway (see below, "Current Plans & Investments") and all of the states coming to agreement on this formula is a prerequisite to funding long-term capital improvements on the Northeast Corridor.

Normal Replacement

Rail infrastructure supporting a high volume of traffic is subject to significant wear and tear, and eventually needs to be replaced or upgraded. "Normal replacement" is the process of replacing infrastructure assets on a regular scheduled interval based on the condition and expected useful life of the asset. The New Haven Line's normal replacement work is carried out by Metro-North, funded by CTDOT for work in Connecticut and by Metro-North for work in New York State.

Tracks, ties, and other infrastructure elements must be replaced regularly, each following its own cycle. Curved tracks wear down faster and need to be replaced every 20 years while straight tracks can last for 40 years before replacement.¹⁴

The Northeast Corridor will need a total of \$9 billion to fully fund normal replacement through 2030. Of that total, the New Haven Line and Hell Gate Line need \$2 billion, or 22 percent, to replace its aging structures on a normal schedule before they reach a state of disrepair.¹⁵

State of Good Repair Backlog

Major structures like bridges and tunnels are built to last longer than other components, but many major structures in use today on the New Haven Line have long surpassed the end of their useful life and are handling more train traffic now than when they were originally constructed. When a structure reaches the end of its useful life and is not replaced, it becomes part of the state of good repair backlog. By fully funding normal replacement and replacing structures on a normal schedule, a railroad can avoid having a state of good repair backlog altogether.

Today, the total state of good repair backlog throughout the Northeast Corridor and all of its branch lines is \$8.8 billion, of which \$3.4 billion, or 39 percent, is for the New Haven Line and Hell Gate Line, which form less than nine percent of the overall Northeast Corridor system.¹⁶

Infrastructure

The physical infrastructure components and characteristics of the New Haven Line that have the greatest impact on its capacity, speed, frequency, reliability, and safety are aging structures, sharp track curvature, and bottlenecks at stations, bridges, and interlockings.

Age: Much of the New Haven Line's rail infrastructure is old and deteriorating. The Federal Railroad Administration, CTDOT, and Metro-North have to impose speed restrictions on old infrastructure to ensure the safety of passengers, which increases travel times. Replacing major rail structures takes construction work that requires track outages while work is being completed, reducing the line's capacity and reliability. The faster construction can be completed, the faster the full capacity of the line can be unlocked, speeds increased and trip times reduced, and reliability improved.

Curves: The New Haven Line was built over dozens of rivers, streams, and inlets that drain into Long Island Sound. The track alignment has many sharp curves to avoid obstacles or maneuver towards narrow sections of rivers. Sharp curves force trains to travel at slower speeds to ensure the safety and comfort of their passengers, leading to congestion and longer trip times. The line's maximum authorized speeds are currently constrained but could be raised if infrastructure were repaired, upgraded, and expanded, including re-aligning tracks in strategic locations.

Bottlenecks: Segments where limited track capacity leads to congestion are considered "bottlenecks." One example is in Milford, where the New Haven main line narrows from four

¹² Ibid

¹³ Ibid

¹⁴ Ibid

¹⁵ NEC Infrastructure Master Plan / RPA analysis

¹⁶ Ibid

to three tracks for 5.5 miles between Devon and Woodmont. Interlockings, where trains traveling at various speeds merge together, are also major bottlenecks where speed restrictions can be enforced. Grade-separated flyovers at interlockings and other locations can permit trains to access branch lines, yards, or turn-back tracks without crossing express tracks and creating congestion.

Track Capacity

Track capacity on the New Haven main line is constrained by the condition of its tracks and right-of-way, train congestion, and ongoing construction work. All of the branch lines and corridors that utilize the main line depend on its capacity to handle projected service increases. The segments of the New Haven main line with the greatest track capacity constraints today and in the future are:

New Rochelle-Harrison (N.Y.): Shell Interlocking is one of the busiest junctions on the Northeast Corridor and Metro-North inner zone trains turn back in the vicinity of New Rochelle and Harrison, both of which create congestion in this segment.

Stamford-Rowayton (Conn.): The New Canaan Branch merges with the main line east of Stamford, creating traffic congestion, where capacity is already constrained during peak hours.

Bridgeport, Conn.: Congestion is heavy in Bridgeport during the peak hours due to traffic at the Bridgeport Rail Yard and speed restrictions on curves.

The New Haven main line currently has a weight limit of 263,000 pounds per carload, which mainly restricts the weight of freight trains. CTDOT's goal is to upgrade the line to allow for 286,000 pound freight cars, which would improve the ability of the freight railroads to move cargo within and throughout the region, making important connections from the Connecticut state rail network to the rest of the national rail network. CTDOT also plans to upgrade the Hartford Line and Danbury and Waterbury Branches to handle 286,000-pound train cars. The New Canaan Branch can handle 263,000 pound carloads, but because there is no through freight service on this branch, CTDOT does not consider upgrading for freight to be a high priority.

The weight limit on a rail line is affected by the quality of the soil beneath the tracks. The New Haven Line was built on the coast of Long Island Sound through wet and swampy areas. This makes upgrading the line for heavier train cars more difficult and expensive than other rail lines. Other factors that determine the weight limit of a rail line include ballast material, drainage through ballast and culverts and off of bridges, age and strength of cross-ties, and strength of the running rails. The most important and expensive step in upgrading a rail line for 286,000-pound carloads is replacing bridges and culverts.¹⁷

Tracks

The New Haven Line is a four-track main line railroad except for the 5.5-mile segment in Milford. The branch lines are single-track with sidings. The Hartford Line is single-track, but the State of Connecticut is currently adding a second track between New Haven and Hartford (future phases will extend the second track to Springfield). The Shore Line East segment of the Northeast Corridor is two-track. The Harlem Line from the junction with the New Haven Line to Grand Central is four-track, and the Hell Gate Line is three-track, with two reserved for passenger service and one for freight.

The New Haven main line's tracks are constructed with continuously welded rail and generally maintained at FRA Class 4 track standards, which means that the roadbed, track geometry, and track structure can safely support passenger trains running at a maximum speed of 80 miles per hour and freight trains running at a maximum speed of 60 miles per hour. Several miles of track are maintained at Class 5, allowing a maximum speed of 90 miles per hour.¹⁸

A physical design characteristic of the New Haven Line that limits speeds is its relatively narrow track center spacing. The standard minimum distance between track centers for new rail lines today is 14 feet with more space on curves, but the New Haven Line's tracks are 12 to 13 feet apart. The narrow spacing of the tracks affects the comfort of passengers on trains as they pass one another and does not allow for trains to use "tilting" technology to maintain higher speeds around curves. The segments of the New Haven Line with the greatest speed restrictions today are:¹⁹

Shell Interlocking (New Rochelle, N.Y.): The Hell Gate Line merges with the New Haven Line at Shell Interlocking in New Rochelle, where speeds are restricted to 30 miles per hour. Tracks one and three permit travel at 50 miles per hour.

Byram River (Port Chester, N.Y.): Speeds are reduced on all tracks to 45 miles per hour near Port Chester because of a sharp curve in the track alignment.

Norwalk River (South Norwalk, Conn.): Trains are prohibited from traveling over 45 miles per hour while crossing the Walk Bridge over the Norwalk River.

Saugatuck River (Westport, Conn.): Speeds are reduced on all tracks to 40 miles per hour in the area of Westport while crossing the Saga Bridge over the Saugatuck River.

Bridgeport, Conn.: Speeds are reduced on all tracks to 30 miles per hour west and 45 miles per hour east of Bridgeport because of two extremely sharp curves in the track alignment.

Housatonic River (Milford, Conn.): Speeds are reduced on all tracks to 40 miles per hour in the area of Devon while crossing the Devon Bridge over the Housatonic River.

¹⁷ CTDOT. 2012. Connecticut State Rail Plan (2012-2016). <http://1.usa.gov/16ynUsH>

¹⁸ Ibid

¹⁹ Metro-North Railroad. 2013.



Metro-North and Amtrak trains share the New Haven Line
Source: Peter Ehrlich (Flickr)

The National Transportation Safety Board's investigation of the February derailment in Bridgeport is still underway and the exact cause of the derailment has yet to be determined, but one of its areas of focus is a "joint bar" (a steel bar bolted to two lengths of rail to hold them together) in the area of the derailment, which was found to have insufficient support from the rail bed beneath it two days prior in a regular inspection. The loose rail bed was allowing vertical movement of the tracks when trains passed over them, which probably cracked the joint bar in question and caused the derailment. In response, Metro-North has inspected every joint bar in place on all 800 miles of its rail network, including the New Haven Line.

Interlockings

There are several interlockings, or signalized junctions, on the main line that allow trains to switch between tracks. They exist where the line converges with other rail lines, or on the approach to stations or rail yards. As trains switch tracks, they usually have to reduce their speed due to the track geometry of the junction.

Shell Interlocking, where the main line converges with the Hell Gate Line, is controlled by signals that ensure trains merge in safe, proper sequence. In 1994, the FRA proposed rebuilding Shell as a grade-separated junction, or "flyover," which would allow trains to maintain higher speeds through the interlocking. Due to budgetary constraints, Amtrak and Metro-North built an at-grade, or non-elevated, junction a few years ago instead.

Other interlockings are located where the New Haven Line converges with the branch lines and Hartford Line. The service and ridership on these lines are projected to increase, and congestion is already high, so these interlockings may also require grade-separation at some point in the future.

Rail Yards

Metro-North trains are maintained at four rail yards along the New Haven Line, in Stamford, East Bridgeport, Danbury, and New Haven. Amtrak trains are maintained at Sunnyside Yard in Queens; Ivy City Yard in Washington, D.C.; New Haven Rail Yard in New Haven; and Southampton Street Yard in Boston.

The maintenance facilities at the New Haven Rail Yard are aging and congested, and unprepared to maintain the line's new fleet of M-8 rail cars. The facility was built over 30 years ago to maintain the M-2 rail cars that were put into service in the 1970s. CTDOT has embarked on a major expansion of this yard complex that will "transform it into a fully functional facility that provides for efficient and effective storage, dispatching, inspection, maintenance, and cleaning of an increasing fleet of rail cars. The improvements will provide the space, equipment, and administrative support structures needed to operate and maintain a new generation of rail cars."²⁰

Many of Metro-North's trains were formerly serviced at Madison Yard below Grand Central Terminal, but Long Island Rail Road's East Side Access project has taken over that space, with maintenance facilities relocated to Highbridge Yard on the Hudson Line. As a result, Metro-North now has to store

²⁰ CTDOT & Michael Baker Engineering, 2011. New Haven Rail Yard Facilities Improvements website. <http://bit.ly/18TFKVO>



The Norwalk River Bridge opens for nautical traffic
Source: CTDOT

its trains at Highbridge Yard and at Grand Central's platforms between the peak hours. This affects available capacity at Grand Central by requiring outbound capacity to move empty dead-head trains to Highbridge.²¹

Fixed & Movable Bridges

Due to its location on the shore of Long Island Sound, the New Haven Line has over 100 fixed and movable bridges and other grade-separation structures that carry it over harbors, inlets, rivers and streams along the Sound. There are 134 bridges on the main line in Connecticut alone and over half of these bridges are rated in fair or poor condition. The primary factors that lead a bridge to deteriorate are the weather and natural elements it is exposed to and the volume of train traffic and weight of trains that operate on it.

There are nine movable bridges on the New Haven Line network between Manhattan and the CT-RI state border. Three have been replaced recently—the Peck Bridge over the Pequonnock River in Bridgeport, originally built in 1902, was replaced in the 1990s; the Thames River Bridge between New London and Groton, originally built in 1919, was replaced in 2008; and the Niantic River Bridge between East Lyme and Waterford, originally built in 1907, was replaced in 2012. The latter two bridges are on the Shore Line East segment of the Northeast Corridor, not on the New Haven Line.

The other six movable bridges were built between 1889 and 1907 and are in need of replacement. Two are owned by Amtrak: the Pelham Bay Bridge on the Hell Gate Line in New York, and the Connecticut River Bridge east of New Haven on the Shore Line East portion of the Northeast Corridor. Both are

crucial to continued intercity travel as well as current commuter service on Shore Line East or for future Metro-North access to Penn Station. The latter is not on the New Haven Line and so therefore not included in the emergency action plan at the end of this report. The other four movable bridges in critical condition are owned by the State of Connecticut within the Connecticut segment and on the New Haven main line.²²

It will cost **\$2.8 billion** to replace or repair the five movable bridges that are in critical condition on the New Haven Line and Hell Gate Line.

Given their location on the most heavily trafficked sections of the New Haven Line, ensuring these movable bridges remain in working condition for the next century is critical to both Metro-North and Amtrak's current operations, and all future plans for services upstream that depend on them to access Manhattan. Below are descriptions of each of the Connecticut-owned bridges, as well as the Pelham Bay Bridge, which is vital for access to Penn Station:

Norwalk River Bridge (aka Walk Bridge): A four-track, 562-foot long bridge in Norwalk owned by the State of Connecticut. Walk is one of two swing bridges on the Northeast Corridor. It was constructed in 1896 and is currently awaiting major rehabilitation. The original swing span is still in use today.

²¹ Metro-North Railroad. 2013.

²² CTDOT. 2012. Connecticut State Rail Plan (2012-2016). <http://1.usa.gov/16ynUsH>

Saugatuck River Bridge (aka Saga Bridge): A four-track, 458-foot long bridge (actually two parallel two-track bridges) owned by the State of Connecticut. It was constructed in 1904 and is currently awaiting replacement. It is the "easiest" of the five movable bridges to fix because two of its four tracks can be replaced while trains operate on the other two tracks.

Cos Cob: A four-track, 1,089-foot long bridge over the Mianus River in Greenwich owned by the State of Connecticut. Cos Cob is the busiest bridge on the New Haven Line. It was constructed in 1904 and is currently awaiting rehabilitation.

Devon: A four-track, 1,067-foot long bridge over the Housatonic River between Stratford and Milford, owned by the State of Connecticut. It was constructed in 1905 and is currently awaiting rehabilitation.

Pelham Bay: A two-track, 891-foot long bridge on the Hell Gate Line that carries the Northeast Corridor over the Hutchinson River. It is owned by Amtrak and used by Amtrak and freight trains. Metro-North plans to eventually use it as well to access Penn Station. It was constructed in 1907 and is currently awaiting rehabilitation.

Train Stations

Metro-North's New Haven Main Line trains serve 31 stations between Grand Central Terminal and New Haven Union Station – 29 on the main line, and Pelham and Mount Vernon East between New Rochelle and the connection with the Harlem Line at Woodlawn. These include Fairfield Metro, a new station on the main line that opened in December 2011, the line's first new station in over 100 years, and West Haven, which opened in

August 2013. There are also 17 stations on the branch lines, eight on the Shore Line East portion of the Northeast Corridor, and eight on the Hartford Line. Four new commuter rail stations are also planned for the Hartford Line at North Haven, Newington, West Hartford, and Enfield, but their construction is currently unfunded.

In Connecticut, all but three station buildings are owned by the state and leased to their respective municipalities. The city of South Norwalk owns its own station and the downtown Greenwich station is privately owned. All but 12 of these stations are operated and maintained by their respective municipalities, and CTDOT maintains the rest. Over the years, customer surveys have indicated a degree of displeasure with the appearance, comfort, and ease of movement throughout many stations. In 2007, CTDOT conducted a visual inspection survey of all of its stations and confirmed these complaints, but rated that their overall structural soundness, functionality, and safety as "good."

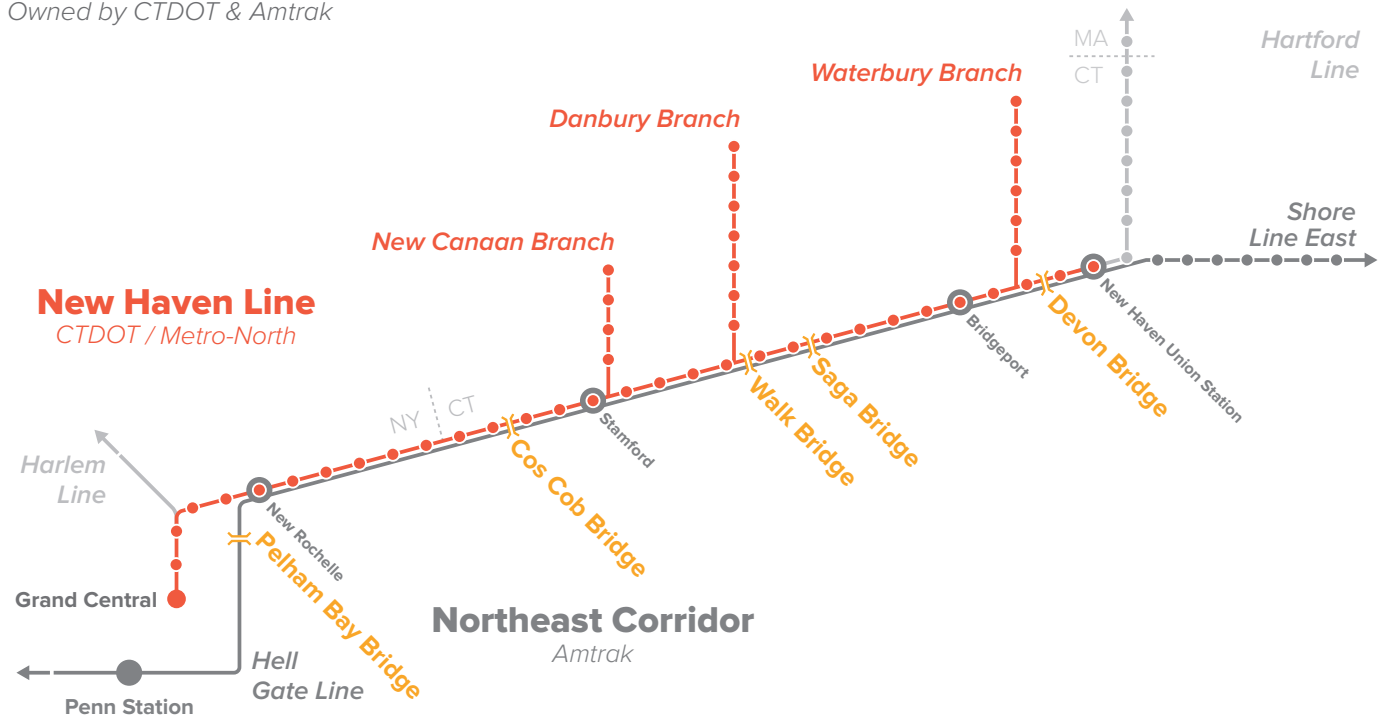
According to the survey's final report, the most common disrepair issues are "peeling paint, litter, poor signage, weathered metal surfaces, outdated or missing amenities (benches, kiosks, bike racks, etc.), rust, graffiti, poor lighting, and deteriorated structure surfaces."

Train platforms at all stations are technically in the rail right-of-way, and therefore owned and maintained by CTDOT.²³ The survey inspected platform surfaces, canopies, stairs, ramps, and railings, and identified several major necessary capital improvements. These include projects such as "the installation or extension of high-level platforms and canopies, the replacement or addition of shelters, and major ADA improvements." CTDOT has budgeted \$75 million over the next five

²³ Ibid

Movable Bridges in Critical Condition

Owned by CTDOT & Amtrak





Grand Central Terminal
Source: MTA

years to accomplish many of these projects, but acknowledges that at least \$30 million worth of high-level platform rehabilitation needs are currently unfunded.²⁴

The deterioration of platforms is often unseen by the average passenger, making it more difficult to generate support for these investments, but platform deterioration is more of a safety concern than many other more visible state of good repair issues.

New Haven's Union Station was designed by noted American architect Cass Gilbert and opened in 1920. By 1972 the station had fallen into disrepair and was shuttered. In 1979, as part of the NECIP, the station began the process of extensive renovations and was reopened in 1985. Offices above the station were also renovated for CTDOT, Amtrak, Metro-North and others.

New York's Grand Central Terminal was built just over a century ago and is a historic icon that serves as a model for rail station design and development worldwide. It was built by the New York Central Railroad with virtually no public funding. Today, a mega-project is underway by the Long Island Rail Road (LIRR), East Side Access, which is creating a separate terminal below Grand Central that will allow LIRR trains to pick up and deliver passengers on the east side of Manhattan in addition to Penn Station. This would potentially free up space at Penn Station for some Metro-North trains to terminate there, which is important for Metro-North as Grand Central is quickly running out of capacity to handle additional service.

New York's Pennsylvania Station was originally as ornate and magnificent as Grand Central Terminal, but was torn down and replaced with the current station in the 1960s. Today, Penn Station is operating at capacity and future service increases will put additional pressure on its limited platform slots. The LIRR's East Side Access Project eliminated some storage space at Grand Central for Metro-North trains, which has forced Metro-North to store its trains at platforms, thereby reducing terminal capacity in New York City. Adding capacity for Metro-North trains must be accomplished to accommodate increasing demand for rail access to New York from cities along the New Haven Line. A potential solution is for some Metro-North trains to access Penn Station via the Hell Gate Line. However, this will require LIRR to reduce its service at Penn Station, especially during the peak periods. Eventually, capacity expansion at Penn Station is required to accommodate the needs of all of the passenger rail services in the future.

Power Systems

The New Haven main line is powered with high-voltage, alternating current, single-phase electricity conducted through overhead catenary wires. The trains use a pantograph to draw power from the overhead wires. Metro-North New Haven Line trains must also be able to collect power from a second system, direct current third rails used on the Harlem Line for access Grand Central Terminal, and on a portion of the Hell Gate Line for access Penn Station. Rail cars used on the New Haven Line therefore have to be equipped with both third rail shoes and

²⁴ CTDOT. 2007. Train Station Visual Inspection Report. <http://1.usa.gov/169oWcn>



New Haven Union Station
Source: Mike Loukides (Flickr)

pantograph poles. The M-8 cars also have the ability to operate east of New Haven where a more modern catenary system with 25 kV alternating current catenary voltages is used.

The 11 kV catenary system also extends to the Hell Gate Line, the East River Tunnels, Penn Station New York, and the Northeast Corridor main line all the way to Washington, D.C. Therefore, Amtrak trains and any future Metro-North New Haven Line trains that would operate into Penn Station can operate with electric locomotives and trainsets equipped with pantographs.²⁵

The original power system infrastructure on the New Haven Line was built over a century ago and parts of it are still in use today, hampering its overall reliability. Metro-North has replaced the overhead catenary wires, structures, and substations in New York, and CTDOT has made significant progress replacing their portion of the system over the last decade. Initially, the catenary replacement program included a concurrent program to replace or rehabilitate the line's deteriorating fixed bridges in each segment. However, the bridge replacements were moving slower than the catenary replacement work, so the fixed bridge program was divorced from the catenary program to speed its completion. The completion of catenary replacement had to be phased over several years because of limited funding. Phase one was completed in 2004, phase two in 2008, and phase three in 2011. The fourth phase is underway and scheduled for completion in 2014. Two additional phases are scheduled in the future and expected to be complete by 2016.²⁶

Signal & Communication Systems

The type of signal system on the New Haven Line is cab signal with Automatic Train Control (ATC) under centralized traffic control (CTC). Using this system, train movements throughout the network are routed and dispatched from a centralized office. New Haven Line trains are dispatched from Metro-North's offices at Grand Central Terminal in Manhattan. This dispatching office controls train movements between tracks and issues speed restrictions. The signal system keeps trains at a safe distance from each other by automatically reducing the speed of a train if it comes within a certain distance of another train or when a train approaches an interlocking where it will switch from one track to another. These signals are viewed by the engineer on a display in the cab at the front of the train.

The signal system in use today on the New Haven Line was installed between 1980 and 1985. This type of signal system can last for about 30 years, so it is past due for replacement. Increased speeds reduce operational capacity, so the new signal and communication system must balance Amtrak's need for improved speed against Metro-North's need for improved operational capacity while improving reliability for all rail services.²⁷

In addition, the federal government has mandated the installation of Positive Train Control (PTC) systems on all commuter and intercity railroads. By law, installation is required by December 31, 2015. The project to install PTC is beginning, but the cost to Metro-North and Connecticut is significant.²⁸

²⁵ CTDOT. 2012. Connecticut State Rail Plan (2012-2016). <http://1.usa.gov/16ynUsH>

²⁶ CTDOT. 2013. Major Project Updates.

²⁷ CTDOT. 2012. Connecticut State Rail Plan (2012-2016). <http://1.usa.gov/16ynUsH>

²⁸ Ibid

Current Plans & Investments

The New Haven Line is operating at capacity in key segments and future growth is constrained by congestion and deteriorating infrastructure, which will require constant maintenance and construction over the next several years. Below is a description of the service increases that are contemplated for the line and the ridership they are projected to attract.

Potential Future Services

CTDOT, Metro-North, and Amtrak are all planning for major increases in frequency on their rail services. However, the New Haven Line will not be able to support all of the potential service increases given its aging infrastructure and capacity constraints as well as the general lack of funding for repairs and expansions. Significantly greater investment is needed to increase the capacity of the New Haven Line to absorb all of this future demand.

Metro-North Penn Station Access

Since 1999, Metro-North and the Federal Transit Administration (FTA) have been studying alternative ways of routing New Haven Line trains into Penn Station. Four alternatives are still being investigated. One alternative includes routing New Haven Line trains to Penn Station via Amtrak's Hell Gate Line to provide Metro-North passengers with increased service into New York and greater accessibility to destinations on the west side of Manhattan. Penn Station is the only place for Metro-North to

Metro-North Access to Penn Station

The Hell Gate Line, owned by Amtrak, could be used by Metro-North to access Penn Station



Current & Future Rail Service to Manhattan

Weekday Revenue Trains to/from Grand Central Terminal (GCT) and Penn Station New York (PSNY)

Operator (NYC Station)	2013	2030	Increase
Metro-North (GCT)	235	284	+49 (21%)
Metro-North (PSNY)	0	121	+121 (n/a)
Amtrak (PSNY)	42	54	+12 (29%)
Total	277	459	+182 (66%)

Source: NEC Infrastructure Master Plan and Metro-North Penn Access Study

increase terminal capacity in Manhattan because Grand Central Terminal is already operating close to capacity. Absent capacity expansions at Penn Station, this can only happen if the LIRR vacates some of its train slots at Penn Station after East Side Access opens. If and when this happens, it will free up space in the tunnels under the East River and in Penn Station. Some of this space could be used for Metro-North trains to access Penn Station. However, Metro-North's plans to access Penn Station will not occur until after East Side Access opens in 2019.

Metro-North access to Penn Station will require additional capacity on the Hell Gate Line and put increased pressure on Penn Station, which already operates at capacity and will need to be expanded in the long-term even with the capacity it regains after East Side Access opens. The exact impacts and required investments on the New Haven Line and at Penn Station will depend on the final operating plan for the project and how it fits with Metro-North service to Grand Central and LIRR service to Penn Station.¹

Northeast Corridor High-Speed Rail

A comprehensive planning effort for future investments in the Northeast Corridor including the potential introduction of a world-class high-speed rail service is currently underway by the Federal Railroad Administration (FRA). The FRA launched the "NEC Future" study in February 2012 to develop a vision for future investments in the corridor. NEC Future is studying the current and future markets for improved service and capacity on the corridor and will produce an integrated, long-term transportation solution, and evaluate its impacts on the environment.²

Under all future scenarios, a high-speed rail service in the Northeast would utilize a combination of new, dedicated tracks and an upgraded existing corridor. A mix of rail services including premium, high-speed express trains and frequent intercity corridor trains would operate on both the existing upgraded corridor and the new high-speed tracks.

¹ Metro-North Railroad. 2013. Penn Station Access Study. <http://bit.ly/1ajx2P4>

² Federal Railroad Administration. 2013. NEC Future website. www.necfuture.com

Amtrak has plans to improve intercity rail service on the Northeast Corridor, including the New Haven Line. In 2010, it released a proposal for a high-speed rail service that would reduce trip times on the corridor by building new capacity and purchasing new rolling stock capable of reaching 220 miles per hour. This plan has been integrated with Amtrak's prior capital planning work, including the Northeast Corridor Infrastructure Master Plan, which called for a \$52 billion investment in system repairs and upgrades, and increased capacity. Amtrak's high-speed rail plan calls for major new tunnels in Baltimore, Philadelphia, and New York City, and primarily uses the existing rail right-of-way along the southern half of the corridor. North of New York City, Amtrak's plan would utilize a new alignment north through Westchester County, east through Connecticut to Hartford, and northeast through Rhode Island and Massachusetts to Boston. Amtrak's latest plans call for \$151 billion in total capital investment to achieve a state of good repair, increase capacity to accommodate ridership growth on existing services, and build a high-speed rail service on the Northeast Corridor.³

A University of Pennsylvania Graduate School of Design studio project proposes a different concept for high-speed rail on the Northeast Corridor. The proposed system would mainly utilize existing rail rights-of-way from Washington, D.C. to New York City. Then, recognizing that the New Haven Line is near capacity with commuter rail traffic and is hemmed in by dense urban development, the proposed route would extend east on Long Island to Ronkonkoma—MacArthur Airport and then north through a tunnel under Long Island Sound to New Haven. Similar to Amtrak's concept, it would diverge from the existing corridor at New Haven and travel north to Hartford and then northeast along an inland route to Boston. The order of magnitude cost would be similar to the concept suggested by Amtrak.⁴

Both of these plans call for significant infrastructure upgrades and improved trip times on the New Haven Line.

Branch Line Improvements

CTDOT and Metro-North also plan to increase service on all three of the branch lines, presumably with some through service to Grand Central and Penn Station. Any major service increases on the branch lines will require significant infrastructure improvements. While the main line is predominantly four tracks, the branch lines are all single-track, so service increases will require new passing sidings or a second-track. They are also in need of programmatic improvements to their power and signal systems.⁵ Service increases on the branch lines would also absorb more capacity at the connecting stations on the main line and, depending on the level of service to Manhattan, absorb more of the little capacity that is remaining on the main line, Harlem and Hell Gate Lines to New York.

Hartford Line

CTDOT and Amtrak are working together to double-track and electrify the Hartford Line and introduce commuter rail service between New Haven, Conn. and Springfield, Mass. Service will

begin in 2016 between New Haven and Hartford, the portion of the project funded thus far. The improvements will allow for 24 additional commuter and intercity trains per day between New Haven and Hartford with connecting or through service to Grand Central and Penn Station. Ridership from the Hartford line will absorb additional capacity on the main line and put more pressure on Grand Central and Penn Station, which are already operating at capacity.⁶

Ridership Projections

By 2030, Metro-North projects that its commuter rail ridership on the New Haven Line will reach 57 million annual trips and Amtrak projects that its intercity rail ridership will double, reaching 5.4 million annual trips. These future ridership projections assume that capital investments stay comparable to today's levels. However, both agencies have proposed more ambitious plans for infrastructure improvements and faster, more frequent, reliable, and convenient service that could boost total ridership if greater capital investments are made.

For example, CTDOT and Metro-North have both individually set a goal of doubling the New Haven Line's commuter rail ridership by 2030. In other words, they plan to make investments that will cause commuter rail ridership to reach nearly 80 million annual trips by 2030. The biggest impediments to achieving this goal are the New Haven Line's aging, unreliable infrastructure, curvy track alignment and narrow track center spacing, and current and future levels of congestion caused by high-volume commuter rail service operating alongside less frequent intercity service, but which absorbs much of the capacity on the line's inner two express tracks, as well as freight service.⁷

Additionally, Amtrak and the University of Pennsylvania have projected significant unmet demand for high-speed rail in the Northeast Megaregion. If a new high-speed rail service were introduced, Amtrak projects that total intercity rail ridership would surpass 40 million annual trips by 2040, nearly four times the today's intercity rail ridership levels. A large proportion of these trips would be attracted from highway and air, while many others would be induced trips, meaning the riders would not have made the trips if the service did not exist.⁸

Projected Ridership on the New Haven Line

Current and Projected Annual Ridership on the New Haven Main Line (000s)

Operator	Current	2030	Increase
Metro-North	38,800	57,007	46.9%
Amtrak	2,759	5,402	95.8%
Total	43,569	64,439	47.9%

Source: NEC Working Group. 2010. NEC Infrastructure Master Plan.

³ Amtrak. 2012. The Amtrak Vision for the Northeast Corridor. <http://bit.ly/Prw1ML>

⁴ University of Pennsylvania. 2010. Making High-Speed Rail Work in the Northeast Megaregion. <http://bit.ly/haZVc4>

⁵ CTDOT. 2012. Connecticut State Rail Plan (2012-2016). <http://1.usa.gov/16ynUsH>

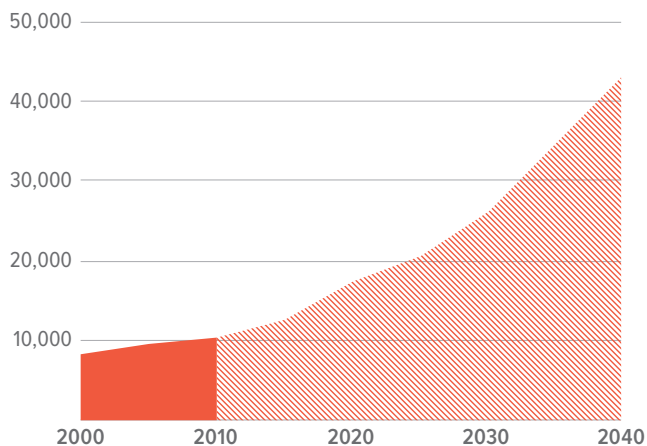
⁶ CTDOT. 2013. New Haven-Hartford-Springfield Rail Program. www.nhhsrail.com

⁷ CTDOT. 2012. Connecticut State Rail Plan (2012-2016). <http://1.usa.gov/16ynUsH>

⁸ Amtrak. 2012. The Amtrak Vision for the Northeast Corridor. <http://bit.ly/Prw1ML>

Projected Ridership on the Northeast Corridor

Current and Projected Annual Ridership on the Northeast Corridor with High-Speed Rail (000s)



Source: Amtrak. 2012. The Amtrak Vision for the Northeast Corridor. <http://bit.ly/Prw1ML>

Current & Past Planning

As has been stated, ridership on the New Haven Line has grown and continues to grow rapidly, and is projected to grow even more. The New Haven Line is already operating at capacity in some segments and investments in the line's infrastructure are needed to support additional rail service in the future. The multi-billion dollar backlog of state of good repair projects presents safety concerns and has a significant negative effect on the line's reliability and ridership. The time has come to plan for the next chapter of rail travel on the New Haven Line and the Northeast Corridor.

Long-term planning efforts are underway by the three primary organizations: the State of Connecticut Department of Transportation (CTDOT), the Northeast Corridor Infrastructure & Advisory Commission (NEC Commission), and the Federal Railroad Administration (FRA). In 2010, a Northeast Corridor Working Group produced an infrastructure master plan for the corridor.

Northeast Corridor Infrastructure Master Plan

In May 2010, a corridor-wide working group whose members represented Amtrak, every state and commuter railroad between Maine and Washington, as well as freight operators completed an infrastructure master plan for the Northeast Corridor that lists the capital improvements necessary to achieve a state of good repair, improve trip times, and expand capacity enough to handle projected increases in ridership on existing services through 2030. The projects included in this master plan would not accommodate the demand for new high-speed rail services.

To achieve these goals, the master plan estimates that the Northeast Corridor needs a capital investment program totaling \$52.3 billion through 2030, of which at least \$8.1 billion, or 16 percent, is on the New Haven Line and Hell Gate Line. About \$7.2 billion worth of needs are on Connecticut- and New York-owned infrastructure assets on the main line, such as replace-

Northeast Corridor Infrastructure Master Plan

Total Corridor-Wide Capital Needs (2010–2030)

Master Plan Category	Cost (millions)
Safety/Positive Train Control	264
State of Good Repair Backlog	8,8786
Core Service/Capacity Growth	32,245
Special Issue (Baltimore Freight Tunnel)	2,000
Normal Replacement	9,035
TOTAL CAPITAL	52,330

Total New Haven Line & Hell Gate Line Capital Needs (2010–2030)

Master Plan Category	Cost (millions)
Safety/Positive Train Control	22
State of Good Repair Backlog	3,412
Core Service/Capacity Growth	2,721
Normal Replacement	1,978
TOTAL CAPITAL	8,132

Source: NEC Working Group. 2010. NEC Infrastructure Master Plan.

ment of four movable bridges and the signal system. Another \$960 million worth of needs are on Amtrak-owned assets on the Hell Gate Line, such as the replacement or rehabilitation of the Pelham Bay Bridge. However, this does not include the critical investments needed in the New York City area, including the construction of a pair of new tunnels under the Hudson River and repairs in the East River tunnels, which are now estimated to cost well over \$15 billion.

The infrastructure master plan also includes a list of "Phase 1 Priority Improvements" totaling \$13.9 billion that represents the most important projects on the Northeast Corridor that need to be initiated as soon as possible. Completing these projects would make progress towards achieving a state of good repair, improving trip times, and expanding capacity in strategic locations. The list includes projects on the New Haven Line totaling \$2.4 billion, including replacement of the Walk and Saga Bridges, finishing the replacement of the catenary system, replacement of the signals and communications system, installation of positive train control technology, adding a fourth track between Devon and New Haven, modifying curves, and making ballast deck bridge improvements. Again, this does not include New York City area improvements, which total roughly \$3.5 billion on this list of high-priority infrastructure needs.⁹

Federal Railroad Administration & NEC Future

As discussed above, "NEC Future" is a planning effort launched by the Federal Railroad Administration in February 2012 to define, evaluate and prioritize future investments in the Northeast Corridor through 2040.

By 2016, NEC Future will prepare an investment plan for the corridor that will consist of a service development plan that articulates the overall scope, various alternatives, and approach for proposed improvements, and a tier 1 environmental impact statement that evaluates and addresses broad, corridor-wide environmental impacts due to these improvements.

⁹ NEC Infrastructure Master Plan / RPA analysis

The NEC Future study has evaluated multiple alternative futures for the Northeast Corridor and is currently refining their preliminary alternatives. These range from conventional service and modest, low-cost improvements to enhanced and expanded service on the existing corridor as well as a second corridor spine.

Early indications are that NEC Future is advancing multiple concepts for future upgrading of the New Haven Line, some of which also provide for new alignments for high-speed service, through to the tier 1 EIS analysis. New route options are expected to include both "Inland" and "Island" routes. The first is essentially the same as Amtrak's latest plan through inland Connecticut and the second is the plan proposed by the University of Pennsylvania Graduate School of Design studio routed through Long Island.

Both of these alternative futures have major implications for the future of the New Haven Line. If the New Haven Line is selected as the preferred alignment for a new, high-speed rail service, additional capacity would need to be built to accommodate the huge increase in train traffic.

If a high-speed rail line is built off of the existing corridor, intercity rail service on the New Haven Line will still improve significantly as high-speed trains would also be capable of running on the existing spine and switching to the new high-speed route at junctions along the corridor. For example, passengers could board a high-speed train on the New Haven Line that would travel at conventional or higher speeds to a junction with the new, high-speed rail corridor, then switch on to the high-speed corridor and travel to points along the Northeast Corridor at speeds up to 220 miles per hour with passengers never having to transfer trains.

The New Haven Line's infrastructure will need to be upgraded to prepare for this new service. Major stations will need to be expanded and, in some cases, reconfigured to handle additional traffic. Station platforms will need to be extended to accommodate longer high-speed train sets, which are typically 1,300 feet long. Tracks will need to be grade separated to create conflict-free operations at key stations and interlockings.

Northeast Corridor Commission

In January 2013, the Northeast Corridor Infrastructure and Operations Advisory Commission (NEC Commission) released a report that details the highest-priority infrastructure projects on the corridor. According to the NEC Commission, the list of projects totaling more than \$30 billion represents "the improvements needed to reduce delays, achieve a state of good repair, and build capacity for growth" on the corridor, including more than \$3 billion worth of projects on the New Haven Line Network.

The NEC Commission's members include representatives from the Northeast Corridor states, U.S. DOT, and Amtrak. It was created by Congress to lead the creation and implementation of a visionary, long-term, regional investment strategy for the Northeast Corridor; advance near-term projects to improve Northeast Corridor performance; coordinate regional planning and communication; and educate stakeholders and the public about the Northeast Corridor's investment needs and its role in the future economic growth and development of the region.¹⁰

Connecticut Department of Transportation

CTDOT updates a five-year capital plan for its rail assets every few years. Their most recent capital plan was updated in March 2013 and includes authorized funding for projects during fiscal years 2013 through 2017 as well as a summary of needs that remain unfunded. The plan dedicates over \$250 million for New Haven Line projects in 2013. Annual spending ramps down for two years to roughly \$100 and \$150 million in 2014 and 2015, respectively, before increasing again to roughly \$230 million per year in 2016 and 2017.¹¹

The total amount authorized for New Haven Line projects each year is listed below. See Appendix A for greater detail.

CTDOT's Five-Year New Haven Line Capital Plan

Fiscal Year	Cost (000s)
2013	253,400
2014	146,400
2015	107,400
2016	229,300
2017	226,000
TOTAL FUNDED INITIATIVES	962,500
TOTAL UNFUNDED INITIATIVES	2,500,000+

Source: CTDOT. 2013. Transportation Infrastructure Capital Plan 2013-2017.

CTDOT has an authorized budget of just under \$1 billion for the New Haven Line through 2017, but has acknowledged that needs exceed funding resources. At least another \$2.5 billion worth of priority projects have been identified for which no funding is currently available.

In 2013, the biggest expenditure is the final amount for the catenary replacement program. In 2014, CTDOT will begin the first phase of the signal and communication system replacement program, which is the biggest expenditure in 2014 and 2015. In 2016, CTDOT will begin work on the replacement and rehabilitation of the Walk and Saga bridges as well as three other fixed bridges on the New Haven Line. In 2017, CTDOT will begin work on the second phase of the signal and communication system replacement program, continue work on the Walk and Saga Bridges, and complete the installation of positive train control.

The most expensive of CTDOT's programs over the next five years, in order, are the completion of the catenary system replacement, the installation of positive train control, the first phase of the signal and communication system replacement, and the replacement and rehabilitation of the Walk and Saga bridges as well as three other fixed bridges.

The major unfunded initiatives are an additional \$500 million for the replacement and rehabilitation of the Walk and Saga Bridges, \$165 million for the third and fourth phases of the signal and communication system replacement, \$330 for the New Haven Rail Yard Facilities Modernization Program, and \$1.8 billion for the replacement and rehabilitation of the Devon and Cos Cob Bridges.

¹⁰ NEC Commission. 2013. NEC Commission website. www.nec-commission.com

¹¹ CTDOT. 2013. Transportation Infrastructure Capital Plan 2013-2017.



Metro-North M8 rail car at Cos Cob
Source: Peter Ehrlich (Flickr)

Recommendations for Action: RPA's New Haven Line Plan

The New Haven Line is the artery that has carried the lifeblood of southwestern Connecticut's economy for more than a century. Without it, the region certainly would not have developed and prospered to the same degree. However, today it is clogged with congestion and beginning to break down, and requires emergency action to save it. Continuing to fund it at current levels and rebuild it at the current pace will result in decades of constant construction and diminished service, and a significant loss of potential economic gains. This is simply not an option.

Furthermore, the Northeast Megaregion is a powerhouse of density, productivity and output. It is home to 18 percent of the U.S. population, which produces 20 percent of the nation's gross domestic product on only two percent of its land area, and the New Haven Line is a key segment of the Northeast Corridor, which links it all together. The issues facing the New Haven Line are not just Connecticut and New York's challenges, they are the Northeast Megaregion's challenges.

RPA believes the future of passenger rail in the Northeast Corridor and New Haven Line comes down to three key factors:

Funding & Financing: The federal government owns most of the Northeast Corridor, but not the New Haven Line. Given the importance of the New Haven Line to the national economy and the fact that Amtrak operates on the line, the federal government should contribute more to address its capital needs. Federal grants and loans should help pay for the New Haven Line's critical repairs, but Connecticut and the rest of the Northeast states will also need to pay for a large share of the investment.

Governance: The Northeast Corridor's current structure of fractured ownership, infrastructure management, and project delivery is insufficient to deliver a comprehensive, corridor-wide program of basic improvements, let alone construction of a true high-speed rail line. A new regional rail entity should be created that can ensure the successful completion of a program of this magnitude and attract private sector participation.

Vision & Leadership: The Northeast needs a single, compelling vision for passenger rail service that will drive future investment decision, which all of the owners, operators, and passengers can agree on. The NEC Future study is currently developing this vision, but it is scheduled for completion in 2016. In the meantime, critical investments must be made to prevent incidents and service disruptions like thus that occurred in 2013.

RPA's New Haven Line Plan offers three sets of recommendations: 1) an emergency action plan that calls for an immediate investment of \$3.6 billion for critical projects above and beyond what is currently budgeted; 2) longer-term investment priorities that will provide new capacity, cut travel times, and improve the

long-term strength and reliability of the line's infrastructure and rail services; and 3) recommendations for implementation that help expedite the construction of these projects and unlock additional public funding.

Emergency Action Plan

CTDOT lives and breathes the New Haven Line and has prepared a five-year capital plan that fits within current constraints. But the current pace of investment is far too slow and repairs will take far too long, leaving the New Haven Line unable to provide reliable service that keeps pace with growing ridership demand. RPA has prepared a more ambitious, modified five-year capital plan, unconstrained by current funding levels, that supports completion of repairs and replacement within ten years.

RPA's Emergency Action Plan for the New Haven Line includes a list of rail improvement programs and projects that will help prevent future service disruptions, increase throughput capacity and operational flexibility on the line in the short term (through 2020), and get the New Haven Line back onto a path towards full, four-track capacity as soon as possible.

The emergency action plan requires an additional \$3.6 billion through 2020 above and beyond what is already funded in CTDOT's current five-year capital plan. These investments would help get the New Haven Line back on track to achieve its full four-track capacity and a state of good repair within ten years, twice as fast as now contemplated.

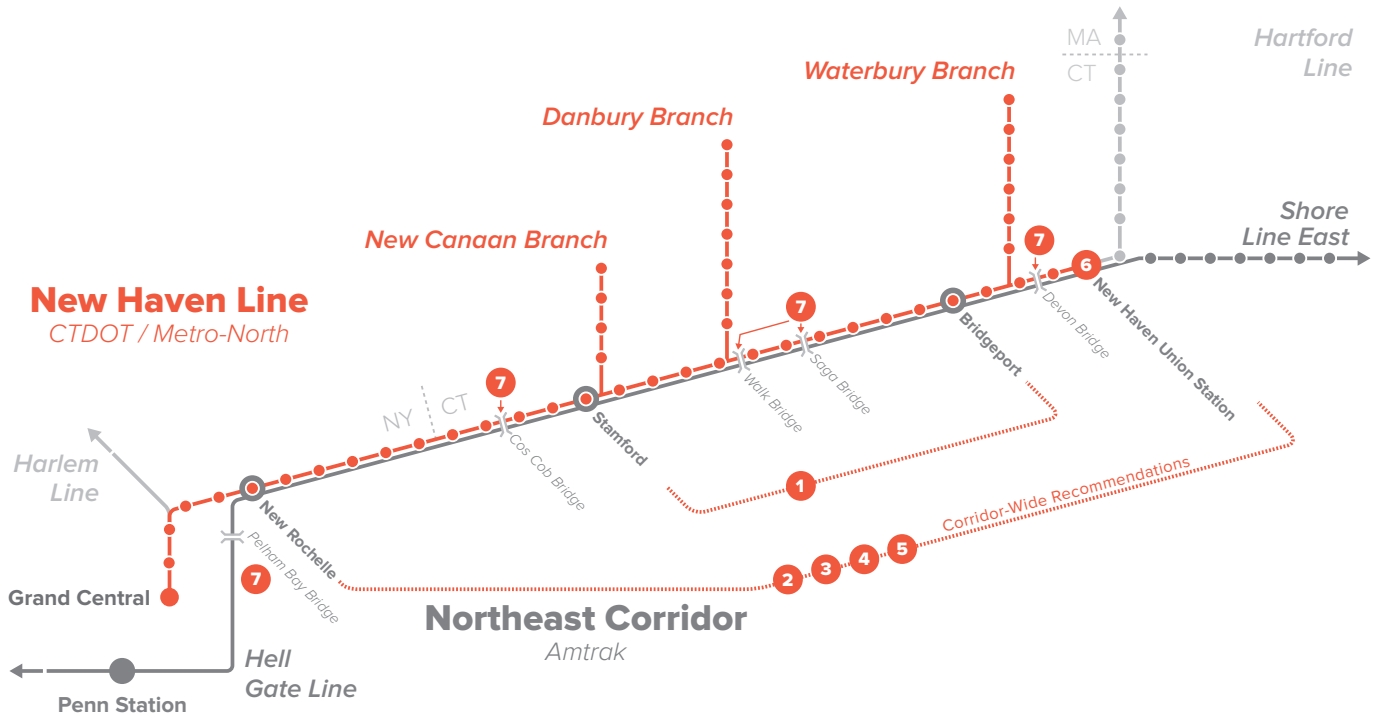


Construction on the New Haven Line
Source: MTA / Kevin Ortiz

RPA's Emergency Action Plan Recommended Investments

#	Program	Description	Recommendation	Funding Gap*
1	Power System Replacement	Replacement of the century-old overhead catenary system with a "constant tension" system is fully funded, but this program has been underway for over a decade and CTDOT will complete the last phase in 2016. This program takes two tracks out of service. While tracks are out, fixed bridge, signal and communication systems work, and other repairs should be completed concurrently to minimize track outages. Substation components also need to be replaced to prevent future power failures.	Replace catenary and substation components by 2015. Coordinate with fixed bridge, and signal and communication systems replacement work.	\$30 million
2	Fixed Bridge Replacement	Many of the line's fixed bridges are more than a century old and need to be replaced. This program, also ongoing for over a decade, is funded through 2018 and an additional \$35 million is needed for work through 2019. This program should be coordinated with the power, and signal and communication systems replacement programs so they can be completed concurrently rather than sequentially.	Replace all critical fixed bridges by 2020. Coordinate with power, and signal and communication system replacement work.	\$35 million
3	Track and Interlocking Repairs	Maintaining the New Haven Line's tracks and interlockings is critical to providing rail services that are safe, comfortable, and reliable for their passengers. The train derailment in May 2013 highlighted the need to keep tracks in safe, working condition. CTDOT needs an additional \$40 million to make critical repairs to tracks and interlockings through 2020.	Make all critical repairs to tracks and interlockings by 2020.	\$40 million
4	Station Facility & Platform Repairs	Over the next five years, available funding should be prioritized for critical maintenance needs and normal replacement projects at existing stations, as opposed to building new stations. Building a new station is a major capital investment that needs to be weighed carefully against a long list of other regional rail priorities. Opportunities for new stations are included in the following long-term investment strategy.	Make all critical repairs to station facilities and platforms by 2020.	\$85 million
5	Signal & Communication Systems Replacement and PTC Compliance	Replacement of the signal system is a phased program that will cost roughly \$500 million. CTDOT will begin phase one in 2014, complete it in 2016 and begin phase two in 2017. CTDOT also funds the positive train control (PTC) program through 2018. An additional \$300 million is needed to complete PTC by the 2015 deadline and complete all phases of the signal and communication system replacement program by 2020.	Replace the signal and communication systems by 2020, and install PTC by 2015.	\$300 million
6	New Haven Rail Yard Expansion and Upgrade	The New Haven Rail Yard is not equipped to service Metro-North's new fleet of M-8 rail cars. A facilities improvement program is underway to expand and upgrade the yard to effectively and efficiently store, dispatch, inspect, maintain, and clean a growing fleet of rail cars.	Complete all tiers of this expansion and upgrade program by 2020.	\$330 million
7	Rehabilitate or Replace the Five Movable Bridges	There are five movable bridges on the New Haven Line in need of major repairs or replacement. Two – Walk and Saga – are in one of the final segments of the power system replacement program. CTDOT plans to begin addressing these two bridges in 2016 with only \$100 million through 2018. Another \$2.8 billion is needed to complete the rehabilitation or reconstruction of all five movable bridges by 2020.	Replace or repair the Walk and Saga bridges by 2018, and the Devon, Cos Cob, and Pelham Bay bridges by 2020.	\$2.8 billion

* Order of magnitude costs, beyond what is already budgeted.



Why Invest?

Providing enough rail service to accommodate existing and future demand will require significant repairs to the New Haven Line's existing infrastructure as well as expansion. But far greater funding for capital improvements than is currently available will be needed to make this a reality. The long-term benefits far outweigh the upfront costs.

This emergency action plan will lay the foundation for future upgrades and capacity expansion. The returns on these emergency action investments will be:

Capacity: Expediting construction projects that take tracks out of service would allow the New Haven Line to reach its full capacity by 2020. This capacity could be used to increase the frequency of rail service on the main line or allow more trains from the branch lines to enter the main line. More capacity could also allow New Haven Line rail service to recover more quickly from events that cause major delays, such as the train derailment and crash on May 17th that ground all service to a halt for days.

Reliability: Several major structures still in use today on the New Haven Line were built over 100 years ago. Deteriorating infrastructure is often unreliable and the risk of failure increases with age. For example, the four movable bridges in Connecticut malfunction one out of every ten times they open. The long-term and day-to-day reliability of rail service has a major impact on its ridership. Replacing or rehabilitating aging infrastructure will ensure New Haven Line services can maintain their high on-time performance, and attract and absorb future demand.

Safety: Deteriorating infrastructure threatens the safety of rail passengers by putting trains at risk of derailments or other failures, which could lead to injuries or deaths. At a minimum, it requires constant maintenance, which is costly and reduces track capacity. These emergency actions would return the New Haven Line to a state of good repair by 2020, improving the safety of the railroad.

Ridership: Greater capital investment in the New Haven Line will improve its capacity, reliability and safety, which will help boost and maintain its already strong ridership, reduce congestion on the already-burdened regional highway network, and improve public health.

Economy & Jobs: Businesses in New York and Connecticut rely on the line to move workers, clients, and customers. Greater transit ridership will support economic growth in cities along the main line and its branches by improving access to employment.

Transit-Oriented Development: Transit service supports the development of transit-oriented neighborhoods that attract new residents and provide opportunities for job and housing growth.

Cost Savings: It is costly to keep aging, deteriorating infrastructure operating safely. By replacing obsolete infrastructure, the owners will reduce maintenance costs in the long run. The sooner these investments are made, the more will be saved.

The dangers of not making these emergency investments are that New Haven Line infrastructure continues to deteriorate, service delays and disruptions worsen, and passengers abandon Metro-North for cars and commuter buses, or Amtrak for intercity buses or airplanes, exacerbating congestion on the region's highways, connecting roads and airports. Continued deterioration increases the risk of catastrophic failure, which can lead to long-term service outages, injuries, or even deaths. Moreover, the lack of a reliable, high-quality rail system would threaten the economic and real estate development potential in communities along the line, and forgo the environmental benefits rail has over competing modes.

Longer-Term Investment Priorities

Beyond 2020, the New Haven Line will require longer-term investments to increase speeds and reduce trip times, increase the line's capacity to add more frequent service, and improve reliability to fuel the line's ridership growth for the next half-century.

Top Investment Priorities for the New Haven Line:

Achieve and maintain a state of good repair: The New Haven Line was built more than 160 years ago, yet some of the original infrastructure is still in use today. Restoring the line to prime physical condition within a decade will require a significant upfront investment by the public sector and a commitment to fully funding normal replacement and routine maintenance on a continuing basis. This will result in significant long-term reliability and safety benefits.

Metro-North Access to Penn Station: Grand Central Terminal is quickly running out of capacity on its tracks and platform to accommodate increased service. Routing some Metro-North trains into New York's Pennsylvania Station would give it the ability to increase service to Manhattan and allow New Haven Line passengers to more quickly reach destinations on the Manhattan's rapidly expanding West Side.

Reduce travel times: The fastest trip time on a Metro-North train between Grand Central Terminal and New Haven Union Station is currently one hour and 45 minutes. The emergency action plan in this report would lay the foundation for significant trip-time improvements. Other strategic investments that expand capacity for more and faster express service could allow Metro-North to reduce trip times to one hour and 15 minutes or less. Construction of a true high-speed rail line would reduce trip times to less than 45 minutes.

Support economic development: The New Haven Line serves many communities in Connecticut and New York that have a significant amount of potential for more transit-oriented development, as documented in the recent RPA study, [Halfway There: How to Create Land Use Policy That Makes the Most of Connecticut's Transit Network](#). One goal of future investments should be to support sustainable economic development around existing stations and, where appropriate, build new stations.

RPA's Long-Term Goals for the New Haven Line:

Upgrade the existing corridor: including the New Haven Line, for faster and more frequent and reliable commuter and conventional intercity rail service, including high-speed service. This will include achieving a state of good repair, expanding the capacity of the existing Northeast Corridor for significant trip-time reductions, and upgrading the tracks to accommodate the more modern high-speed trainsets.

Build a world-class, high-speed rail system: two new tracks between New York City and Boston and south to Washington, D.C., exclusively for modern, high-speed trainsets, which would benefit both the existing Northeast Corridor and the new high-speed tracks. Rail service on the new tracks would operate at over 220 miles per hour, reducing trip times between New York and Boston to 90 minutes.

Due to its existing traffic congestion, narrow track center spacing, sharp curves, and constrained right-of-way, the New Haven Line may not be the best route for the fastest trains operating between Boston and New York. Off-corridor alignments, such as the "Island" or "Inland" routes, deserve a closer look for these high-speed services. However, choosing to build an off-corridor high-speed rail alternative does not constitute a "no build" alternative for the New Haven Line. An upgraded New Haven Line would work in tandem with a new high-speed alignment to permit to permit faster travel between points on the line via a combination of existing corridor and higher-speed routing and capacity to maintain and expand commuter rail services. Creating a rail network with an improved New Haven Line as well as off-corridor high-speed routes would result in enhanced commuter and intercity rail network for the entire Northeast Megaregion.

An off-corridor solution for a high-speed rail service between Boston and New York would result in enhanced commuter and intercity rail service on the New Haven Line. Key nodes on the New Haven Line, such as Stamford, Bridgeport and New Haven would benefit from:

New, modern, high-speed rolling stock: Use of new, modern high-speed train sets capable of reaching speeds of 220 miles per hour or more;

Reduced travel times: One hour and 15 minutes or less between Grand Central and New Haven Union Station versus the one hour and 45 minutes it currently takes;

More frequent service: Four high-speed intercity trains per hour versus the one and occasionally two trains per hour currently operated by Amtrak; and

More connections: Direct high-speed rail service to more destinations in the Northeast.

The New Haven Line's multi-million dollar backlog of state of good repair projects must be addressed. It is time to get back on track and invest in the future of the New Haven Line and the Northeast Corridor with the same zeal of past generations.

Recommendations for Implementation

Expedite the Project Delivery Process

Given the importance of the New Haven Line to the regional and national economy, the most critical infrastructure improvement projects should be initiated as soon as possible. Everything from permitting and approvals to procurement and construction should be expedited to speed the delivery of these projects and their benefits.

Streamlined Environmental Review

Most of the New Haven Line's critical projects are within an existing right-of-way and will have no negative environmental impacts. The line's state of good repair backlog should be eliminated within the next five years, but the environmental review process often delays the delivery of complex projects. The public sector has a responsibility to consider all of the potential impacts and include the public in decision-making, but the states of Connecticut and New York cannot afford to wait any longer for these critical improvements.

RPA recommends the Obama Administration issue an Executive Order that puts all of the Northeast Corridor's state of good repair projects, including the New Haven Line, on an accelerated track for federal environmental review, requiring no action or approval from Congress.

Accelerated Construction Techniques

One of the New Haven Line's biggest challenges will be the replacement of its movable bridges. Traditional bridge replacement projects take several years to complete, but new accelerated construction techniques can significantly reduce on-site construction time to months. Accelerated bridge construction entails assembling the bridge mega-structures off-site and then quickly installing them on-site to minimize track outages and service disruptions. CTDOT is planning to use accelerated bridge construction to replace the Atlantic Street Railroad Bridge Overpass in Stamford in 2016, which will reduce the construction time frame from five years to 18 months.

RPA recommends CTDOT continue its efforts to advance the practice of accelerated bridge construction to speed project delivery and minimize track outages on the New Haven Line as its many bridges are replaced.

Schedule-Focused Contracting

Incentives and disincentives can be written into contracts to encourage contractors to complete construction projects on time or even ahead of schedule. These incentives need to be enough to convince contractors to accelerate their schedules while, at the same time, making up for any cost they incur when doing so.

RPA recommends CTDOT include schedule-focused incentives and/or disincentives to prevent project delivery delays and ensure that all of the New Haven Line's emergency action projects are addressed within the next five years.

Create a Northeast Regional Rail Authority

The NEC Commission brings together stakeholders to confer on the design and administration of the corridor, and its future plans and goals, but does not fundamentally change the way the corridor is operated and managed. One of its biggest challenges is that the corridor's institutional framework does not balance the needs of its four infrastructure owners, eight passenger rail operators, and three freight carriers. To deliver an improvement program of this magnitude, a regional entity with new capabilities, governance, and management structures is required. This new entity would include representation from the Northeast states, Amtrak, and possibly others on its governing body. It would require adequate staffing, resources, and authorities to deliver complex projects, apply for federal grants and loans, borrow against current or future potential revenue streams, enter into development agreements to buy real property, and procure equipment and services from Amtrak and/or other partners.

RPA recommends the federal government create a new corridor management and project delivery structure with representation from the Northeast states and Amtrak that has adequate staffing and resources and the necessary authorities to deliver a major, long-term rail improvement program on the Northeast Corridor, including the New Haven Line.

Use Federal & Regional Funds

The total amount of monetary investment that the New Haven Line will need for emergency action and long-term upgrades is massive. It will require a significant upfront capital investment by the public sector before private-sector funding will materialize. Financing through loans and bonds will be necessary in the long term, but will also need to be paid back somehow. The bottom line is that new revenues need to be generated from somewhere and that Connecticut, New York, and the rest of the Northeast Corridor states should prepare to go it alone in case the federal government cannot muster the votes to fund these improvements.

RPA recommends the Congress immediately authorize and obligate \$3.6 billion in emergency funding for the New Haven Line's emergency action projects to protect the passengers, communities, and economies of Connecticut and New York from future delays and service disruptions.

RPA recommends the Northeast states begin raising regional revenues through an interstate compact, such as a corridor-wide gas tax, sales tax, or rail ticket surcharge on commuter and intercity rail tickets, to pay for long-term rail projects needs on the New Haven Line and the Northeast Corridor.

Appendix A

CTDOT's New Haven Line Five-Year Capital Plan

Funded Initiatives (000s)

Program / Project	2013	2014	2015	2016	2017	Total
S Program/Timber Program	6,000	6,000	6,000	6,000	6,000	30,000
Bridge Design	4,000	4,000	4,000	5,000	5,000	23,000
Bridge Culvert Replacement Program	12,400	12,400	11,000	10,000	15,000	60,800
New Haven Line Track Program	15,000	12,000	-	15,000	20,000	62,000
Interlocking & Drainage	8,000	8,000	8,000	8,000	8,000	40,000
New Haven Line Positive Train Control	30,000	12,000	28,000	35,000	42,000	147,000
Main Line Catenary - Sections C1a & C2	158,000	-	-	-	-	158,000
Code Compliance Upgrades of Rail Maint. Facilities	5,000	5,000	5,000	5,000	10,000	30,000
Station Improvement/Parking Program	15,000	15,000	15,000	15,000	15,000	75,000
New Haven Line Signal System Replace - Phase 1	-	30,000	29,400	45,300	-	104,700
New Haven Line Signal System Replace - Phase 2	-	-	-	-	40,000	40,000
Smart Card Implementation	-	5,000	-	25,000	25,000	55,000
Substation Replacement - Norwalk	-	10,000	-	-	-	10,000
New Haven Line Radio System Upgrade	-	25,000	-	-	-	25,000
CT Rail Fleet Replacement Strategy	-	2,000	-	-	-	2,000
New Haven Line Bridges-Walk, Saga, East Av, Osborne Av, Maple	-	-	-	60,000	40,000	100,000
Total	253,400	146,400	107,400	229,300	226,000	962,500

Unfunded Initiatives (000s)

Program / Project	2013	2014	2015	2016	2017	Total
Substation Component Change Out	-	30,000	-	-	-	30,000
High Level Platform Rehabilitation (Annual)	-	10,000	10,000	10,000	-	30,000
Security Improvements	-	10,000	-	-	-	10,000
New Haven Line Customer Service Initiatives	-	20,600	-	-	-	20,600
New Haven Line Parking Program	-	-	10,000	10,000	-	20,000
New Haven Line Signal System Replace - Phase 3	-	-	-	-	80,000	80,000
Total	-	70,600	20,000	20,000	80,000	190,600

Major Long-Term Unfunded Initiatives (000s)

Program / Project	Total
New Haven Line Signal System Replace - Phase 4	85,000
New Haven Yard Master Plan Complex - Tier 1	160,000
New Haven Yard Master Plan Complex - Tiers 2 & 3	170,000
Devon Movable Bridge	800,000
Cos Cob Movable Bridge	1,000,000
Danbury Branch Line	TBD
Waterbury Branch Line	TBD
Orange RR Station	TBD
New Haven Line Customer Communications Program	TBD
Total	2,500,000+

Appendix B

RPA's New Haven Line Five-Year Capital Plan

Funded Initiatives (000s)

Program / Project	2014	2015	2016	2017	2018	Total
S Program/Timber Program	6,624	6,624	6,624	6,624	6,624	33,120
Bridge Design	5,244	5,244	5,244	5,244	5,244	26,220
Bridge Culvert Replacement Program	13,358	13,358	13,358	13,358	13,358	66,792
New Haven Line Track Program	15,134	15,134	15,134	15,134	15,134	75,670
Interlocking & Drainage	8,832	8,832	8,832	8,832	8,832	44,160
New Haven Line Positive Train Control	134,550	-	-	-	-	134,550
Code Compliance Upgrades of Rail Maint. Facilities	5,000	5,000	5,000	10,000	10,000	35,000
Station Improvement/Parking Program	29,040	29,040	29,040	29,040	29,040	145,200
New Haven Line Signal System Replace - Phase 1	85,477	85,477	-	-	-	170,954
New Haven Line Signal System Replace - Phase 2	-	-	85,477	-	-	85,477
New Haven Line Signal System Replace - Phase 3	-	-	-	85,477	-	85,477
New Haven Line Signal System Replace - Phase 4	-	-	-	-	85,477	85,477
Smart Card Implementation	5,000	-	25,000	25,000	25,000	80,000
Substation Replacement - Norwalk	10,000	-	-	-	-	10,000
New Haven Line Radio System Upgrade	28,750	-	-	-	-	28,750
CT Rail Fleet Replacement Strategy	2,000	-	-	-	-	2,000
Substation Component Change Out	30,000	-	-	-	-	30,000
Security Improvements	10,000	-	-	-	-	10,000
NHL Customer Service Initiatives	20,600	-	-	-	-	20,600
New Haven Yard Master Plan Complex - Tier 1	72,600	72,600	-	-	-	145,200
New Haven Yard Master Plan Complex - Tier 2	-	-	72,600	72,600	-	145,200
New Haven Yard Master Plan Complex - Tier 3	-	-	-	-	72,600	72,600
NHL Bridges-Walk, Saga, East Av, Osborne Av, Maple	201,667	201,667	201,667	-	-	605,000
NHL Bridges-Devon, Cos Cob & Pelham Bay	-	-	751,667	751,667	751,667	2,255,000
Total	683,876	442,976	1,219,643	1,022,976	1,022,976	4,392,448

Methodology

The recommended five-year capital plan above includes the additional \$3.6 billion in funding needed to pay for the cost of the emergency action plan. This plan fully funds the emergency action capital projects through 2018 with the assumption that all construction of these projects would be completed by 2020 (annual normal replacement projects are funded at their normal annual level throughout the plan). All of CTDOT's "unfunded initiatives" and "major long-term unfunded initiatives" are funded in RPA's plan except for the Danbury Branch, Waterbury Branch and Orange Railroad Station projects, and the Customer Communications Program. These projects were excluded

because their costs are unknown and they do not constitute emergency actions. "Unfunded initiatives" with a specific year assigned were simply added. If an initiative was expedited, the total cost was increased by 10 percent to account for additional costs and staggered forward in time. If an initiative was expedited and coordinated with other initiatives, the total cost was increased by 15 percent to account for additional costs and staggered forward in time. The cost of replacing Amtrak's Pelham Bay Bridge was included because it is more than 100 years old and critical to Metro North's plans to access Penn Station via the Hell Gate Line.



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Regional Plan Association is America's oldest and most distinguished independent urban research and advocacy group. RPA works to improve the economic competitiveness, infrastructure, sustainability and quality of life of the New York-New Jersey-Connecticut metropolitan region. A cornerstone of our work is the development of long-range plans and policies to guide the growth of the region. Through our America 2050 program, RPA also provides leadership in the Northeast and across the U.S. on a broad range of transportation and economic-development issues. For more information visit, www.rpa.org.

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