A. INTRODUCTION

The Cross Harbor Freight Program (CHFP) would reduce energy consumption and greenhouse gas (GHG) emissions from freight transport by increasing the share of goods moved through the region by rail and marine vessels, modes that are more energy-efficient than transport by trucks. Some of the Build Alternatives would also reduce energy consumption and GHG emissions by reducing congestion and consequent results of vehicles idling on existing Hudson crossings and roadways used by heavy trucks. Energy consumed and GHG emitted by locomotives, tugs and ferries, and freight facility equipment would increase. These energy and emissions savings and increases are discussed and quantified to the extent possible with the information available for this Tier I document. Energy consumption and GHG emissions associated with construction are discussed, and applicable information regarding energy use and GHG emissions from the 2004 *Cross Harbor Freight Movement Project DEIS* ("2004 DEIS") and other relevant projects is presented.

While the contribution of any single project to climate change is infinitesimal, the combined GHG emissions from all human activity have a severe adverse impact on global climate. The nature of the impact dictates that all sectors identify practicable means to reduce GHG emissions. Therefore, this chapter does not specify the incremental contributions of the CHFP to climate effects, but rather identifies opportunities to further reduce energy consumption and GHG emissions during operation and to minimize energy use and GHG emissions during construction.

Effects of climate change that could affect infrastructure for freight transport include, but are not limited to, more frequent and intense heat waves, severe cold weather, more frequent and intense downpours and flooding, sea-level rise, and more intense storms. The CHFP would constitute a major public investment in infrastructure and transportation right-of-way, with a useful life on a timescale at which the effects of climate change may become noticeable. Therefore, the need to consider the potential effects of climate change when designing or upgrading CHFP infrastructure is discussed, consistent with the available National Environmental Policy Act (NEPA) guidance,[1] and would be more thoroughly examined any Tier II documentation.

POLICY, REGULATIONS, STANDARDS, AND BENCHMARKS

ENERGY ANG GHG EMISSIONS

As a result of the growing consensus that human activity resulting in GHG emissions has the potential to profoundly affect the earth's climate, countries around the world have undertaken efforts to reduce emissions by implementing both global and local measures addressing energy consumption and production, land use, and other sectors. In a step toward the development of

[1] Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions, February 18, 2010.

national climate change regulation, the U.S. has agreed that deep cuts are necessary and has agreed to take action to meet this objective, with a stated goal of reducing emissions to 17 percent lower than 2005 levels by 2020 and to 83 percent lower than 2005 levels by 2050 via the Copenhagen Accord.[1] Without legislation focused on this goal, the U.S. Environmental Protection Agency (USEPA) is required to regulate greenhouse gases under the Clean Air Act (CAA), and has already begun preparing regulations.

USEPA has established various voluntary programs to reduce emissions and increase energy efficiency and has recently embarked on a few regulatory initiatives related to GHG emissions, including regulation of geological sequestration of carbon dioxide (CO_2), and a GHG reporting rule to collect information on GHG emissions as pollutants.

The Energy Independence and Security Act of 2007 includes provisions for increasing the production of clean renewable fuels, increasing the efficiency of products, buildings, and vehicles, and for promoting research on greenhouse gas capture and storage options. The most recent renewable fuel standards regulations require 16.55 billion gallons of renewable fuels to be produced in 2013, increasing annually up to 36.0 billion gallons in 2022[2]. The renewable fuel standards regulations also set volume standards for specific categories of renewable fuels including cellulosic, biomass-based diesel, and total advanced renewable fuels, and specify lifecycle GHG reduction thresholds ranging from 20 percent for renewable fuel to 60 percent for cellulosic biofuel (as compared to the baseline gasoline or diesel replaced).

The American Recovery and Reinvestment Act of 2009 (ARRA, "economic stimulus package") funds actions and research that can lead to reduced GHG emissions. Renewable energy tax credits have also been extended. Funds from ARRA are currently being disbursed. The U.S. Department of Transportation (USDOT) has already awarded funding for a number of freight rail infrastructure projects that are important for the region and support CHFP through the Transportation Investment Generating Economic Recovery (TIGER) grant program. Environmental sustainability is one of the five "Primary Selection Criteria" considered when choosing the project to fund. In the context of the grant, environmental sustainability includes improving energy efficiency, reducing dependence on oil, reducing GHG emissions and benefitting the environment. Regional project that have received TIGER grants to date most relevant to the CHFP alternatives are the following:

- **Hunts Point Freight Rail Improvement Project** to make key freight rail improvements at the Hunts Point Terminal Produce Market, in the Bronx. The planned rail improvements would modernize current infrastructure and create new circulation areas, reduce truck traffic and congestion, and improve air quality in the community.
- **South Hudson Intermodal Facility** project to expand the capacity of the largest port on the East Coast by building a new intermodal facility. New capacity is needed to accommodate larger, Post-Panamax vessels that will be too big to sail under the Bayonne Bridge, limiting the port's effectiveness. The improvements funded by this grant would allow for direct transfer of export and import containers from the terminal on the ocean side of the Bayonne Bridge to the national rail network.

[1] Todd Stern, U.S. Special Envoy for Climate Change, letter to Mr. Yvo de Boer, UNFCCC, January 28, 2010; UNFCCC Conference of the Parties, Copenhagen Accord, March 30, 2010.
[2] "Motor Vehicle Emissions and Fuel Standards," Title 42 *Code of Federal Regulations*, Part A. 2012 ed.

- **Rutherford Intermodal Facility Expansion** project to expand the Rutherford Intermodal Facility to accommodate an additional 125,000 lifts per year and enables the facility to keep pace with growing freight traffic demand in the Harrisburg area. The project includes track work, expansion of parking access, and the construction of cranes to increase capacity.

In April 2010, USEPA and USDOT established the first GHG emission standards and more stringent CAFE standards for 2012 through 2016 light-duty vehicles. In addition, a Final Rulemaking to establish standards for 2017 through 2025 light-duty vehicles was issued by the agencies in August 2012. The agencies also issued GHG emission and fuel efficiency standards for medium- and heavy-duty vehicles, such as large pickup trucks and vans, semi trucks, and vocational vehicles. These regulations all serve to reduce vehicular GHG emissions over time.

There are also regional, state, and local efforts to reduce GHG emissions. The State of New Jersey enacted the Global Warming Response Act in 2007, mandating the reduction of GHG emissions in the state to 1990 levels by 2020 and to 80 percent below the 2006 levels by 2050, and published a report detailing recommended actions for meeting the 2020 goal.[1] In December of 2009, New Jersey released Meeting New Jersey's 2020 Greenhouse Gas Limit: *New Jersey's Global Warming Response Act Recommendations Report* as required by the Global Warming Response Act. This report details a range of options for achieving New Jersey's statewide 2020 greenhouse gas limit, and provides a framework to meet its statewide 2050 greenhouse gas limit.

Similarly, in New York, Governor Paterson issued Executive Order No. 24 in 2009, establishing a goal of reducing GHG emissions in New York by 80 percent, compared to 1990 levels, by 2050, and creating a Climate Action Council tasked with preparing a climate action plan outlining the policies required to attain the GHG reduction goal (that effort is currently under way[2]).

Both New York and New Jersey have energy plans in place,[3,4] aimed at improving energy efficiency, increasing renewable energy production, and reducing peak power use. The New York State Energy Plan also includes a goal of reducing vehicle miles traveled by expanding alternative transportation options. Similarly, the 2011 New Jersey *Energy Master Plan* defined an overarching goal of capitalizing on emerging technologies for transportation, and recommended improving transportation efficiency. New York State and New Jersey are members of the Transportation and Climate Initiative (TCI), which is a collaboration of 12 northeast and mid-Atlantic jurisdictions that are seeking to develop a clean energy economy and reduce GHG emissions in the transportation sector. TCI efforts include work areas focused on clean vehicles and advancing more efficient freight movement. The State of New Jersey and New York State have already taken some actions aimed at reducing emissions from power production, and many local governments have also taken action to reduce GHG emissions.

The Port Authority of New York and New Jersey (PANYNJ) has also stated GHG reduction goals similar to the New York State goal for its operations,[5] and participates and supports climate action planning in both New York and New Jersey.[6] In addition, to reduce the

[1] The State of New Jersey, Meeting New Jersey's 2020 Greenhouse Gas Limit: New Jersey's Global Warming Response Act Recommendations Report, December 2009.
[2] http://ww.dec.ny.gov/energy/80930.html
[3] New York State, *2009 New York State Energy Plan*, December 2009.
[4] The State of New Jersey, *New Jersey Energy Master Plan*, December 2011.
[5] PANYNJ, Environmental Sustainability Policy, 2008.
[6] http://www.panynj.gov/about/climate-change-air-quality.html, accessed July, 2013.

environmental impacts of the design, construction, operation and maintenance of new or substantially renovated buildings and facilities, reconstruction projects, and programs the Port Authority has developed *Sustainable Infrastructure Guidelines*, many of which could be applied to the CHFP.[1]

New York City, where a number of the facilities directly supporting the CHFP would be located, has a long-term sustainability program, PlaNYC 2030. PlaNYC sets a citywide GHG emissions reduction goal of 30 percent below 2005 levels by 2030 and includes specific initiatives for various sectors, including transportation, that can result in emission reductions and initiatives targeted at increasing resilience to potential effects of climate change.

A number of benchmarks for energy efficiency and green building design have also been developed. For example, the New York State Department of Transportation's (NYSDOT) GreenLITES Project Design Certification Program is a self-certification rating system for enhancing the environmental performance of transportation projects. Many of the GreenLITES concepts and credits may be applicable to railroad and facilities construction, including credits addressing energy and materials. With respect to buildings and facilities, the United States Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) system is a benchmark for the design, construction, and operation of high performance green buildings that includes energy efficiency components. USEPA's Energy Star is a voluntary labeling program designed to identify and promote the construction of new energy efficient buildings, facilities, and homes and the purchase of energy efficient appliances, heating and cooling systems, office equipment, lighting, home electronics, and building envelopes.

CLIMATE CHANGE RESILIENCE

In recognition of the important role that the federal government has to play to address adaptation to climate change, a federal executive order signed October 5, 2009 charged the Interagency Climate Change Adaptation Task Force, composed of representatives from more than 20 federal agencies, with recommending policies and practices that can reinforce a national climate change adaptation strategy. The 2011 progress report by the Task Force included recommendations to build resilience to climate change in communities by integrating adaptation considerations into national programs that affect communities, facilitating the incorporation of climate change risks into insurance mechanisms, and addressing additional cross-cutting issues, such as strengthening resilience of coastal, ocean, and Great Lakes communities.[2] In June 2013, the President Obama issued *The President's Climate Action Plan* stating that the U.S. is firmly committed to reducing GHG Emissions in the range of 17 percent by 2020.

In New York State, the Sea Level Rise Task Force has prepared a final report of recommended protective and adaptive measures.[3] The recommendations are to provide more protective standards for coastal development, wetlands protection, shoreline armoring, and post-storm recovery; to implement adaptive measures for habitats; integrate climate change adaptation strategies into state environmental plans; and amend local and state regulations or statutes to respond to climate change. The Task Force also recommended the formal adoption of projections of sea level rise. In New York City, the Climate Change Adaptation Task Force is

[1] PANYNJ, Sustainable Infrastructure Guidelines, March 23, 2011.
[2] The White House Council on Environmental Quality, Progress Report of the Interagency Climate Change Adaptation Task Force: Recommended Actions in Support of a National Climate Change Adaptation Strategy, October, 2011.
[3] New York State Sea Level Rise Task Force, *Report to the Legislature*, December 2010.

tasked with securing the city's critical infrastructure against rising seas, higher temperatures, and fluctuating water supplies projected to result from climate change. To assist the task force, the New York City Panel on Climate Change (NPCC), has prepared a set of climate change projections for the New York City region,[1] updated in June 2013,[2] and has suggested approaches to create an effective adaptation program for critical infrastructure.[3] The NPCC projects that sea levels are likely to increase by 11 to 24 inches by the middle of the century (2050s middle range, 25th to 75th percentile), with possible increase up to 31 inches (high estimate, 90th percentile). While the 2013 update did not include 2080s data, based on 2009 NPCC report, sea levels could rise by up to 59 inches by 2080s. Local Law of42 of 2012 requires updates to climate projections at least every three years.

In the wake of Hurricane Sandy, the Special Initiative for Rebuilding and Resiliency (SIRR) was convened to analyze the impacts of the storm on the New York City buildings, infrastructure, and people; assess the risks the City faces from climate change; and outline ambitious, comprehensive, but achievable strategies for increasing resiliency citywide. SIRR published the City's resiliency policy, entitled *A Stronger, More Resilient New York*, in June 2013. Overall, strategies and guidelines for addressing the effects of climate change are rapidly being developed on all levels of government.

FHWA is currently working with State Departments of Transportation and Metropolitan Planning Organizations (MPOs) to develop approaches to conduct climate change vulnerability and risk assessments of transportation infrastructure through pilot programs. One of the pilot programs to assess climate vulnerability to both coastal and riverine impacts along the Atlantic coast and in the Delaware River Valley is led by the New Jersey Department of Transportation (NJDOT) and North Jersey Transportation Planning Authority (NJTPA), in partnership with the Delaware Valley Regional Planning Commission (DVRPC) and the South Jersey Transportation Planning Organization (SJTPO).

The Port Authority environmental sustainability policy is to develop strategies that reduce the risk posed by climate change to its facilities and operations, as well as to the region. It is likely that climate change considerations would be incorporated into state and local laws prior to the construction of the CHFP, and any future construction would meet or exceed the codes in effect at the time of construction.

B. METHODOLOGY

The energy, GHG emissions, and climate change analysis was prepared in accordance with the *Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions*,[4] NYSDOT's *Draft Air Quality, Energy and Greenhouse Gas Emission Analysis Procedures for Plans and TIPs and Draft Energy and Greenhouse Gas Emission Analysis Procedures for Projects*[5] and subsequent guidance and methods from NYSDOT. In additional to

[1] New York City Panel on Climate Change, *Climate Risk Information*, February 2009.
[2] New York City Panel on Climate Change, *Climate Risk Information 2013*, June 2013.
[3] New York City Panel on Climate Change, *Climate Change Adaptation in New York City: Building a Risk Management Response*, Annals of the New York Academy of Sciences, May 2010.
[4] Council on Environmental Quality, Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions, February 18, 2010.
[5] New York State Department of Transportation, Draft Air Quality, Energy and Greenhouse Gas Emission Analysis Procedures for Plans and TIPs and Draft Energy and Greenhouse Gas Emission Analysis Procedures for Projects, February 12, 2003.

the NYSDOT methodology, the general approach follows the New York State Department of Environmental Conservation (NYSDEC) policy on assessing GHG emissions in an EIS.[1]

ENERGY CONSUMPTION AND GREENHOUSE GAS EMISSIONS

Currently, there are no standards or regulations applicable to GHG emission levels or impacts from actions subject to environmental review under NEPA or the State Environmental Quality Review Act (SEQRA). Accordingly, the potential effects of the CHFP are evaluated in the context of their consistency with the objectives stated in federal and state policies. Potential GHG emissions and emission savings from the Build Alternatives are assessed and disclosed, and the feasibility and practicability of various measures available for reducing GHG emissions are discussed.

POLLUTANTS OF CONCERN

GHGs are those gaseous constituents of the atmosphere that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds. This property causes the general warming of the Earth's atmosphere, or the "greenhouse effect." NYSDEC and CEQ guidance list six GHGs that could potentially be included in the scope of an EIS: CO_2, nitrous oxide (N_2O), methane, Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and Sulfur Hexafluoride (SF_6). Carbon dioxide (CO_2) is the primary pollutant of concern from anthropogenic sources. Although not the GHG with the strongest effect per molecule, CO_2 is by far the most abundant. CO_2 is emitted from any combustion process (both natural and anthropogenic), from some industrial processes such as the manufacture of cement, mineral production, metal production, and the use of petroleum-based products, from volcanic eruptions, and from the decay of organic matter. CO_2 is removed ("sequestered") from the lower atmosphere by natural processes such as photosynthesis and uptake by the oceans. Methane and nitrous oxide also play an important role since they have limited removal processes and a relatively high impact on global climate change as compared to an equal quantity of CO_2. Emissions of these compounds, therefore, are included in GHG emissions analyses as appropriate. There are no significant direct or indirect sources of HFCs, PFCs, or SF_6 associated with the proposed project.

To present a complete inventory of all GHGs, component emissions are added together and presented as carbon dioxide equivalent (CO_2e) emissions—a unit representing the quantity of each GHG weighted by its effectiveness using CO_2 as a reference. This is achieved by multiplying the quantity of each GHG emitted by a factor called global warming potential (GWP). GWPs account for the lifetime and the radiative forcing of each chemical over a period of 100 years (e.g., CO_2 has a much shorter atmospheric lifetime than SF_6, and therefore has a much lower GWP). The GWPs for the main GHGs discussed here are presented in **Table 6.5-1**.

[1] New York State Department of Environmental Conservation, Assessing Energy Use and Greenhouse Gas Emissions in Environmental Impact Statements, July 15, 2009.

Table 6.5-1
Global Warming Potential (GWP) for Major GHGs

Greenhouse Gas	100-year Horizon GWP
Carbon Dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous Oxide (N_2O)	310
Hydrofluorocarbons (HFCs)	140 to 11,700*
Perfluorocarbons (PFCs)	6,500 to 9,200*
Sulfur Hexafluoride (SF_6)	23,900

Source: IPCC, Climate Change —The Second Assessment Report (SAR).
Note: Since the Second Assessment Report (SAR) was published, the IPCC has published updated GWP values in its Third Assessment Report (TAR) and Fourth Assessment Report (AR4) that reflect new information on atmospheric lifetimes of greenhouse gases and an improved calculation of the radiative forcing of CO_2. However, GWP values from the SAR are still used by international convention to maintain consistency in GHG reporting, including by the United States when reporting under the United Nations Framework Convention on Climate Change.
* The GWPs of HFCs and PFCs vary depending on the specific compound emitted.

EXTENT OF ASSESSMENT

Since the effect of GHGs emitted in the troposphere is generally the same regardless of where they are emitted, the analysis of energy use and GHGs addresses emissions or emissions reduced with the project alternatives, regardless of the location of emissions. Direct emissions include emissions from sources located on-site, such as freight facility equipment, locomotives, and other emissions that would be within local control, such as tug boat or ferry emissions. Indirect emissions include emissions from locomotives along the rail corridor, and emissions reduced through avoided truck travel. While the benefits of reduced energy use and reduced GHG emissions with the CHFP are quantified for the 23-county regional study area, shown in Figure 5-2 in Chapter 5, "Transportation," the project benefits for the Build Alternatives involving rail would be greater and would extend beyond the region, by diverting freight from trucks to rail well beyond the region. In addition, during operation, CHFP would reduce the "upstream" energy consumption and GHG emissions associated with avoided truck vehicle miles traveled (VMT). Emissions associated with the extraction, refining, and transport of fuel are referred to as "upstream" emissions, since they occur prior to the activity at the source of concern, in this case truck trips. The GHG analysis addresses both direct and indirect emissions, and discusses the upstream and downstream emissions as well.

Operational emissions and emissions reduced are presented for a single year, 2035. Operational emissions and emissions reduced may be lower in more distant years as the carbon content of fuels and the efficiency of the systems improve; however, the analysis represents the best projections available for 2035.

OPERATIONAL ENERGY AND GHG EMISSIONS

The analysis of energy used or avoided and GHG emissions generated or reduced by the Build Alternatives includes the following sources:

- Trucks
- Locomotives
- Marine vessels

- Tunnel ventilation systems

Emissions would also be generated by cargo handling equipment, locomotive switchers, transport refrigeration units (TRUs), and other equipment at the facilities where Cross Harbor freight would be processed. However, without more detailed information regarding the operation of these facilities, such as the type of equipment, the number of equipment units, and the hours and days of operation, an estimate of energy use and GHG emissions from the yards in this Tier I EIS would be premature and speculative. Instead, the potential emissions sources at the yards are described, and strategies to reduce energy consumption and minimize emissions are identified for further consideration in project implementation and any Tier II documentation.

Generally, the removal of vegetation on a site would accelerate the release of CO_2 sequestered in any vegetation found on the site back to the atmosphere. There are no large vegetated areas at the New Jersey or New York City facilities discussed in Chapter 4, "Alternatives." However, the development or expansion of any facilities in the Nassau/Suffolk area may encroach on vegetated land. As the amount and type of vegetation that may need to be removed is unknown at this time, the effect of such removal on GHG sequestration and potential measures to minimize or compensate for the removal would need to be considered when more detailed development plans for specific yards are available, or in any Tier II documentation.

Reduced Truck Travel with all Alternatives

The energy consumption and GHG emissions reduced by the Build Alternatives as a result of the change in commodity truck VMT (accounting for both regional reductions and local increases) within the 23-county regional study area were estimated, as discussed in Chapter 5. The VMT projections were multiplied by 2035 CO_2e emission factors from the USEPA MOVES model at the average vehicle speeds estimated in the regional transportation analysis to obtain the GHG emissions. CO_2e emission factors in grams per mile for combination short and long-haul trucks on restricted roadways (i.e., expressways, freeways and interstates) were used. Energy use was calculated by assuming all diesel trucks and dividing the CO_2 emissions obtained using the MOVES model by the per gallon CO_2 emission factor for diesel and multiplying the gallons calculated by the energy content per gallon of diesel.

Increased Rail Use with the Rail Tunnel Alternatives and Enhanced Railcar Float Alternative

The energy use and GHG emissions from locomotives were calculated using an energy consumption factor of 298 BTU/ton-mile,[1] or approximately 466 ton-miles per gallon of diesel. Rail ton-miles in year 2035 were estimated for the Build Alternatives involving rail by multiplying the amount of freight that would originate, terminate, or pass through the study area (based on the demand forecast) by the length of the most likely path along the rail network. The GHG emissions were calculated using GHG emission factors for diesel fuel.[2]

Use of Tug Boats and Ferries with the Waterborne Alternatives

PANYNJ compiled fuel expenditure data for its existing railcar float operations, and conducted a detailed analysis of fuel consumption and emissions from both the existing tugs used to operate the railcar float system and potential technologies that would be implemented in the future. For

[1] Oak Ridge National Laboratory and the U.S. Department of Energy, Transportation Energy Data Book, Table 9.8, Edition 32, 2013.

[2] U.S. Energy Information Administration, Carbon Dioxide Emission Factors for Transportation Fuels, http://www.eia.gov/oiaf/1605/coefficients.html, April 2012.

the purposes of this assessment it was assumed that the marine vessels for the Waterborne Alternatives would be powered by two 700 horsepower (hp) diesel propulsion motors and two 220 kW electric motors (arranged in parallel). The annual energy use by marine vessels associated GHG emissions was estimated based on the projected freight capacity for the marine vessels, the projected number of daily harbor crossings, and operation on 295 days out of the year for the Enhanced Railcar Float Alternative, as representative of the range of energy consumption that would occur under all Waterborne Alternatives. On average, the railcar float was assumed to be 75 percent full. Based on PANYNJ projections, the tugs would consume 105 gallons of diesel fuel per roundtrip across the harbor. Additional fuel, approximately 53 gallons per day per tug would be used in getting the tug to and from the Cross Harbor float bridges at the beginning and the end of the workday.

Tunnel Ventilation

With the Rail Tunnel Alternatives, tunnel ventilation shafts would be constructed on each side of the Harbor, as discussed in Chapter 4. The ventilation shafts would run on electricity and therefore consume energy. The ventilation systems have not been designed and information on the amount of energy that would be consumed for ventilation is not yet available. However, for the purposes of this Tier I assessment, it was assumed that the energy requirements for tunnel ventilation would be similar to those projected in the 2004 DEIS for the New Jersey alignment of the Double Tunnel System. Based on the previous study, annual energy needed for ventilation would be 167 billion BTU. While it is likely that the ventilation requirement for the Rail Tunnel Alternatives with shuttle or chunnel service, Automated Guided Vehicle (AGV) Technology, and truck access would be greater than for the Rail Tunnel Alternative, the same approximation was used in the energy and GHG analysis. By consuming this electricity, the Rail Tunnel Alternatives would result in indirect GHG emissions at power plants supplying the grid. The annual electricity usage was multiplied by the appropriate regional electricity emission factor, as obtained from the USEPA eGRID2012 model (based on 2009 data).[1] GHG emissions associated with electricity production have been steadily dropping. As the 2035 emissions from power production are expected to be much lower than in 2009, with increased use of renewable energy, the GHG emissions for tunnel ventilation are conservatively overestimated.

CONSTRUCTION ENERGY AND GHG EMISSIONS

During construction, energy would be consumed by construction equipment; by trucks, barges, and trains that would be used for transporting construction materials and excavated and dredged materials; and by worker vehicles. Upstream emissions related to the production of construction materials would be substantial, with the main contribution coming from the production of cement, iron or steel, and aluminum. Although other materials would be used, cement and metals have the largest embodied energy and process GHG emissions associated with their production, and large quantities would be used in construction. At this stage, the elements of the project alternatives have not been designed and detailed information regarding construction that would be needed to conduct a quantified assessment of GHG emissions is not available. For example, the information regarding needed construction equipment, type of fuel, loads, hours of operation, amounts of materials needed, and the modes and distances over which materials would be transported to and from the construction sites are not know. Nonetheless, the scope of the construction, particularly the construction of a tunnel, makes the substantial energy use and GHG emissions a crucial consideration in this Tier I EIS, and warrants a more quantified

[1] USEPA, eGRID2012 Version 1.0 Year 2009 GHG Annual Output Emission Rates, www.epa.gov/egrid

analysis in any Tier II documentation. Therefore, sources of GHG emissions during construction and, where available, their approximate magnitude are disclosed. More importantly, with the substantial GHG emissions that would be generated during construction, there is also the opportunity to greatly reduce them.

CLIMATE CHANGE RESILIENCE

The discussion of the potential effects of global climate change on the CHFP focuses on potential changes in sea level and storm surge. Existing scientific studies and information available from academic, state, and federal sources were reviewed, and relevant information is presented highlighting the need for consideration in project design and any Tier II documentation. Although changes in precipitation may occur in future years, affecting flood levels in non-coastal areas, the level of detail and certainty regarding those types of effects is currently insufficient for planning purposes.

C. EXISTING CONDITIONS

Energy use and GHG emissions from freight transportation have been growing because energy efficiency improvements in the freight sector have not kept up with the growth in demand. The majority of freight transportation emissions are generated by trucking, which is the most common mode of freight transport, particularly in the east-of-Hudson region. Reducing GHG emissions from freight transportation has been identified as a major challenge and achieving modal shifts has been proposed as a potential solution.[1] The transportation sector generates almost one third of GHG emissions in the country. From 1990 to 2011, transportation emissions rose by 17 percent due, in large part, to increased demand for transportation and the stagnation of fuel efficiency across the U.S. vehicle fleet.[2]

Currently, on a per ton mile basis, transport by rail is 3 to 4 times more energy efficient than transport by trucks, and while the efficiency of trucks is expected to improve by over 20 percent,[3] the efficiency of rail, which would also improve, would remain much greater, especially if national policy and incentives continue to encourage the use and development of the rail sector and if the logistics and cooperation in the rail sector leads to minimization of empty railcar moves.

There are a number of technology opportunities to improve rail efficiency. New locomotive designs are likely to reduce fuel use by capturing wasted energy and using more efficient fuel sources. Hybrid-electric and Generator-Set ("Genset") switcher locomotives are already in use in many locations. Union Pacific, for example, has more than 150 Genset locomotives working in California and Texas. Advanced hybrid-electric and fuel-cell locomotives are in the research and development stage. Locomotive information technology can reduce fuel use by optimizing train operation. Onboard computers can monitor engine performance and other characteristics (e.g., train tonnage, grade, speed) to optimize engine speeds, brake use, and fuel consumption. Electronically controlled pneumatic brakes save fuel by eliminating unnecessary braking and acceleration. When combined with satellite navigation, onboard computers can determine optimum speeds to ensure an on-time arrival, while maximizing fuel efficiency.

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[1] New York State Climate Action Council, Climate Action Plan Interim Report, November 2010.
[2] USEPA, 2013 U.S. Greenhouse Gas Inventory Report, April 2013.
[3] Energy Information Administration, Annual Energy Outlook 2013 Early Release, Transportation Sector Key Indicators and Delivered Energy Consumption, 2013.

Waterborne freight transport is also much more energy efficient than transport by truck and generates less GHG per ton, but is generally less efficient than rail. Possible efficiency improvements for waterborne freight movement include improvements in vessel design, propulsion system improvements, enhanced propeller design, and alternative fuels. [1]

D. PROBABLE EFFECTS OF THE PROJECT ALTERNATIVES

Energy and GHG emissions would be reduced by the project alternatives through avoided truck VMT. Energy would be used and GHG emissions would increase with increased use of rail and marine vessels. The net change in energy use and GHG emissions are shown below for the 2035 analysis year. The GHG emissions shown represent only direct "tailpipe" emissions from the trucks, locomotives, and marine vessels, and in the case of the tunnel ventilation systems, emissions from power plants supplying the electricity for those systems. The use of fuel is also associated with upstream emissions (emissions from the extraction, refining, and transportation of those fuels). By saving energy and reducing GHG emissions through a modal shift from trucks to rail and marine freight, the CHFP also indirectly reduces the energy use and GHG emissions from oil drilling, refining, and transport to gas stations. USEPA estimates that the upstream, also called well-to-pump, GHG emissions of diesel are approximately 21 percent of the tailpipe emissions.[2] Therefore, the net energy and GHG emission benefits shown for the region in the table below are actually approximately 21 percent greater, considering the upstream contribution.

In addition, the benefits estimated due to the avoided truck VMT represent only the portion of VMT reduced within the 23-county regional study area. Many of the truck trips that would be avoided with some of the Build Alternatives originate and/or terminate well outside of the area modeled. As estimated from freight diversion projections shown in Table 5-1 of Chapter 5, "Transportation," more than 41 percent of the freight that would be diverted to rail with the Rail Tunnel Alternative under the Seamless Operating Scenario would be freight that is currently moved by long-haul trucks that only pass through the region, delivering freight that may have an origin and destination well outside of the 23-county regional study area. For example, some of the freight that could potentially be diverted to rail includes chemical products transported from Florida to Massachusetts, and lumber products from Georgia to Massachusetts.

NET ENERGY AND GHG EMISSIONS SAVINGS

Net changes in energy use with the project alternatives are shown in **Table 6.5-2** and the net changes in GHG emissions are shown in **Table 6.5-3**. Regional totals for the Build Alternatives show benefits both in terms of lower energy consumption and decrease in GHG emissions. To put the numbers into perspective, the energy savings that would result from the Enhanced Railcar Float Alternative, as an example, exceed the energy needed to heat 1,000 homes, based on EIA data.[3] As another example, the energy that could result from the Rail Tunnel Alternatives would be enough to heat more than 17,000 homes. The regional GHG emissions savings from the Rail Tunnel Alternatives under the Seamless Operating Scenario would be

[1] U.S. Department of Transportation, Transportation's Role in Reducing U.S. Greenhouse Gas Emissions, Volume 1: Synthesis Report, April 2010.

[2] Environmental Protection Agency, *MOVES2004 Energy and Emission Inputs*, Draft Report, USEPA420-P-05-003, March 2005.

[3] Energy Information Administration, 2009 Residential Energy Consumption Survey: Energy Consumption and Expenditures Tables, December 2012.

sufficient to offset over 42 percent of existing emissions from rail in New York City, based on data from PlaNYC.[1] The Rail Tunnel Alternatives under the Seamless Operating Scenario would also more than offset the Port Authority direct GHG emissions, most recently reported under "Scope 1" emissions—emissions that the Port Authority has direct control over, excluding electricity use. As another example, the Enhanced Railcar Float Alternative would reduce GHG emissions comparable to approximately 8 percent of the Port Authority Scope 1 emissions.[2] The Waterborne Alternatives that would not significantly reduce long-haul truck VMT—the Truck Float/Ferry and Container Barge Alternatives—would have a negligible effect on energy use and GHG emissions.

Table 6.5-2
2035 Net Change in Energy Use

Alternative Class	Alternative	Net Change in Energy Use (Billion BTU per year)
Waterborne	Enhanced Railcar Float	-106
	Truck Float	Negligible
	Truck Ferry	
	LOLO Container Barge	
	RORO Container Barge	
Rail Tunnel	Rail Tunnel	-1,000 to -1,600
	Rail Tunnel with Shuttle Service	
	Rail Tunnel with Chunnel Service	
	Rail Tunnel with AGV Technology	
	Rail Tunnel with Truck Access	
	Rail Tunnel with Truck Access	

Note: The change in energy consumption for Build Alternatives is as compared with the No Action Alternative. Negative values reflect reduced energy use (benefit).

Table 6.5-3
2035 Net Change in GHG Emissions

Alternative Class	Alternative	Net Change in GHG Emissions (Metric Tons CO_2e per year)
Waterborne	Enhanced Railcar Float	-7,700
	Truck Float	Negligible
	Truck Ferry	
	LOLO Container Barge	
	RORO Container Barge	
Rail Tunnel	Rail Tunnel	-80,000 to -110,000
	Rail Tunnel with Shuttle Service	
	Rail Tunnel with Chunnel Service	
	Rail Tunnel with AGV Technology	
	Rail Tunnel with Truck Access	
	Rail Tunnel with Truck Access	

Note: The change in GHG emissions for Build Alternatives is as compared with the No Action Alternative. Negative values reflect GHG emissions reduced (benefit).

[1] The City of New York, Inventory of New York City Greenhouse Gas Emissions, December 2012.
[2] Port Authority of New York and New Jersey, Greenhouse Gas (GHG) and Criteria Air Pollutant (CAP) Emission Inventory (EI) For the Port Authority of New York & New Jersey 2008 Summary and 2006-2008 Trends, June 2010.

RESILIENCE TO CLIMATE CHANGE

All of the Build Alternatives would contain elements that may be vulnerable to the projected effects of climate change. For example, the operation of freight facilities and the tunnel could be affected by intense and more frequent flooding, rail tracks could be deformed by intense heat, and structures and equipment could be damaged by more intense winds. Of particular concern to the local study area and project infrastructure are temperature-related effects, including summertime strain on materials and increased peak electricity loads, precipitation-related effects, including increased flooding, and sea level rise related effects, including inundation of low-lying areas and increased structural damage and impaired operations.[1]

While guidelines for protecting infrastructure from extreme weather events are still being developed and would be more closely studied in any Tier II documentation, protective measures that exist for infrastructure located within the current floodplain could be extended to account for the expected expansion of the area that may be flooded more commonly in the future, as a result of climate change.

The 100-year floodplain as currently defined by the Federal Emergency Management Agency (FEMA) is presently the only regulatory standard relating to elevation of new development and infrastructure. FEMA released preliminary FIRMs on December 5, 2013 that precede the future publication of new, duly adopted, final FIRMs. The preliminary maps represent the Best Available Flood Hazard Data (BAFHD) at this time, but are based on current conditions and do not account for projected sea-level rise and increases in coastal flooding. NPCC has prepared a set of climate change projections for the New York City region,[2] updated in June 2013,[3] and has suggested approaches to create an effective adaptation program for critical infrastructure.[4] The NPCC includes leading climatologists, sea-level rise specialists, adaptation experts, and engineers, as well as representatives from the insurance and legal sectors. The climate change projections include a summary of baseline and projected climate conditions throughout the 21st century including heat waves and cold events, intense precipitation and droughts, sea level rise, and coastal storm levels and frequency. The NPCC projects that sea levels are likely to increase by 11 to 24 inches by the middle of the century (2050s middle range, 25th to 75th percentile), with possible increase up to 31 inches (high estimate, 90th percentile). While the 2013 update did not include 2080s data, based on 2009 NPCC report, sea levels could rise by up to 59 inches by 2080s. New York City Local Law 42 of 2012 requires updates to climate projections at least every three years. In general, the probability of sea level rise is characterized as "extremely likely" (>95 percent probability of occurrence). Intense hurricanes are characterized as "more likely than not" to increase in intensity and/or frequency, and the likelihood of changes in other large storms ("Nor'easters") are characterized as unknown. Therefore, the projections for future 1-in-100 coastal storm surge levels include only sea level rise at this time, and do not account for changes in storm frequency. Regardless of the frequency of the storms, the frequency of flooding events would increase because the sea level rise would result in flooding due to lesser storms, such that the current flood with 1 percent chance of occurring in any given year would have a 5 percent chance of occurring in any given year by mid-century, and higher by the end of the century.

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[1] New York City Panel on Climate Change (NPCC), *Climate Risk Information 2013*, June 2013.
[2] New York City Panel on Climate Change, *Climate Risk Information*, February 2009.
[3] New York City Panel on Climate Change, *Climate Risk Information 2013*, June 2013.
[4] New York City Panel on Climate Change, *Climate Change Adaptation in New York City: Building a Risk Management Response*, Annals of the New York Academy of Sciences, May 2010.

As discussed in Chapter 6.9, "Water Resources," a number of the freight facilities that would support the CHFP are located within the existing 100-year and 500-year floodplains, as defined by FEMA. For each alternative the potential terminals and supporting facilities that are within the floodplain currently in effect and are also within the Port District are listed below. Operating guidelines for all facilities and infrastructure, and particularly for the facilities and infrastructure within and around the areas listed above, would need to consider the potential effects of sea level rise, storm surge, and intense precipitation events and measure to improve resilience.

WATERBORNE ALTERNATIVES

Enhanced Railcar Float

The potential termini or supporting facilities that are within the floodplain currently in effect include Greenville Yard, 65th Street Yard, 51st Street Yard, Maspeth Yard, and Oak Point Yard.

Truck Float

The potential termini or supporting facilities that are within the floodplain currently in effect include Port Newark/Port Elizabeth, 65th Street Yard, 51st Street Yard, South Brooklyn Marine Terminal, Maspeth Yard, Oak Point Yard, and Hunts Point Yard.

Truck Ferry

The potential termini or supporting facilities that are within the floodplain currently in effect include, Port Newark/Port Elizabeth, 65th Street Yard, 51st Street Yard, South Brooklyn Marine Terminal, Maspeth Yard, Oak Point Yard, and Hunts Point Yard.

LOLO Container Barge

The potential termini or supporting facilities that are within the floodplain currently in effect include Port Newark/Port Elizabeth, 65th Street Yard, Red Hook Container Terminal, and South Brooklyn Marine Terminal.

RORO Container Barge

The potential termini or supporting facilities that are within the floodplain currently in effect include Greenville Yard, Port Newark/Port Elizabeth, 65th Street Yard, 51st Street Yard, Red Hook Container Terminal, and South Brooklyn Marine Terminal.

RAIL TUNNEL ALTERNATIVES

Rail Tunnel Alternative

The potential termini or supporting facilities that are within the floodplain currently in effect include Oak Island Yard, Greenville Yard, 65th Street Yard, 51st Street Yard, Maspeth Yard, and Oak Point Yard.

Rail Tunnel with Shuttle ("Open Technology") Service Alternative

The potential termini or supporting facilities that are within the floodplain currently in effect include Oak Island Yard, Greenville Yard, 65th Street Yard, 51st Street Yard, Maspeth Yard, and Oak Point Yard.

Rail Tunnel with Chunnel Service Alternative

The potential termini or supporting facilities that are within the floodplain currently in effect include Oak Island Yard, Greenville Yard, 65th Street Yard, 51st Street Yard, Maspeth Yard, and Oak Point Yard.

Rail Tunnel with AGV Technology Alternative

The potential termini or supporting facilities that are within the floodplain currently in effect include Oak Island Yard, Greenville Yard, 65th Street Yard, 51st Street Yard, Maspeth Yard, and Oak Point Yard.

Rail Tunnel with Truck Access Alternative

The potential termini or supporting facilities that are within the floodplain currently in effect include Oak Island Yard, Greenville Yard, 65th Street Yard, 51st Street Yard, Maspeth Yard, and Oak Point Yard.

E. CONSTRUCTION

ENERGY AND GHG EMISSIONS

During construction, energy would be consumed by construction equipment, by trucks, barges, and trains that would be used for transporting construction materials and excavated and dredged materials, and by worker vehicles. Upstream emissions related to the production of construction materials would be substantial, with the main contribution coming from the production of cement and iron or steel. Although other materials would be used, cement and metals have the largest embodied energy and process GHG emissions associated with their production, and large quantities would be used in construction.

CONSTRUCTION MATERIALS

Upstream emissions associated with the production of steel, aluminum, and cement are discussed because the production and transport of those materials comprises a major component of overall emissions from construction. GHG emissions from the chemical process and fossil fuel energy use in cement manufacturing account for more than 60 percent of industrial source GHG emissions in the U.S. In 2011, CO_2 emissions from cement production increased by more than two percent, from 2010.[1] The production of ordinary portland cement (OPC) results in substantial GHG emissions, which can be reduced through use of cement replacements such as flyash (a byproduct of coal-fired power generation) and/or slag (a byproduct of iron production). These cement replacements are often included as a small fraction of the total cement used in the concrete mix.

According to a report from the Energy Information Administration (EIA), producing iron and steel ranks as one of the top sources of manufacturing GHG emissions, largely because of use of coal-based resources to reduce iron ores in blast furnaces or heat metal in electric arc furnaces.[2] The production of steel also generates process-related emissions of CO_2 and methane. From 2010 to 2011, GHG emissions from iron, steel, and metallurgical coke production increased by almost 15 percent.

The infrastructure for the Rail Tunnel Alternatives would require large amounts of the construction materials discussed above, particularly for the construction of the tunnel, tunnel ventilation shafts, and rail tracks. Therefore, maximizing the amount of cement replacements and recycled materials could substantially reduce the energy consumption and GHG emissions from production of construction materials. The Enhanced Railcar Float Alternative would also

[1] USEPA, 2013 U.S. Greenhouse Gas Inventory Report, April 2013.

[2] Energy-Related Carbon Dioxide Emissions in U.S. Manufacturing Mark Schipper, Energy Information Administration (EIA) Report #: DOE/EIA-0573(2005) Released Date: November 2006.

require new tracks. All Waterborne Alternatives would require the development or expansion of freight facilities. The amount of materials, including steel and cement, needed for construction of the Waterborne Alternatives would be substantially smaller than the amount needed for the Rail Tunnel Alternatives. Nonetheless, the Waterborne Alternatives could also be implemented more sustainably by seeking opportunities for purchasing recycled and locally produced materials, as well as recycling, reusing, or disposing locally of construction waste.

CONSTRUCTION EQUIPMENT

Most construction equipment would be diesel powered and would run for considerable amount of time during the construction period. The most energy intensive piece of equipment used for construction of the Rail Tunnel Alternatives would be the tunnel boring machine (TBM). The TBM would run on grid power and since there are few suppliers and few available choices in selective the TBM, it would be difficult to require more energy efficient units for the project. However, significant GHG emission savings could be achieved during construction of freight facilities for Rail Tunnel Alternatives and the Waterborne Alternatives by requiring the use of biodiesel for construction equipment, such as graders, pavers, cranes, and generators, and to the extent allowed by cost considerations, using renewable power.

CONSTRUCTION MATERIAL TRANSPORT

As discussed in the 2004 DEIS, it is expected that most of the material deliveries and transport of excavated materials for the tunnel would be transported by rail, which, as shown through the analysis of the operational benefits of the CHFP, is a much more efficient mode than trucks. Even so, as an example, it is estimated that an average of 40 trucks per day may be needed just for the transportation of tunnel muck from the tunnel site. At an average truck efficiency of 7.1 miles per gallon, projected for 2018, over a construction period of 3 to 8 years, depending on the Build Alternative selected, the distances traveled by trucks for material delivery and construction debris disposal would result in a substantial amount of fuel energy that would be consumed and to the amount of GHG emitted. Options to specify the use of locally produced construction materials would be examined for both Rail Tunnel Alternatives and Waterborne Alternatives in any Tier II documentation. In addition, opportunities to reuse or dispose locally of material excavated to construct the tunnel for the Rail Tunnel Alternative would be examined more closely in any Tier II documentation.

CONSTRUCTION EMPLOYEE COMMUTES

Employee commutes would comprise a relatively minor contribution to energy use and GHG emissions from construction, considering the massive amounts of materials and energy used in operating the construction equipment. Nonetheless, based on the 2004 DEIS, for the Rail Tunnel Alternatives, an average of 400 workers per day over a 26 month period would be needed just for the tunnel work involving the TBM. With 400 round trips a day, with an assumed 50 percent of trips being by car, at an average of 8 miles trip length,[1] and average light duty vehicle fuel efficiency of 23.1 miles per gallon,[2] worker trips from this construction activity alone would consume almost 110 thousand gallons of gasoline and generate close to 1,000 metric tons of CO_2e. Providing incentives or accommodations for workers to commute by transit, share rides,

[1] NYMTC/NJTPA Regional Travel–Household Interview Survey General Final Report (Feb. 2000) and the NYMTC Best Practices Model General Final Report (Jan. 2005).

[2] Energy Information Administration, Annual Energy Outlook 2013, Transportation Sector Key Indicators and Delivered Energy Consumption, 2013.

or use alternative transportation modes would help reduce these emissions. The number of workers needed to construct or expand the freight facilities for both the Rail Tunnel Alternatives and the Waterborne Alternatives would be much smaller than the number needed for tunnel construction, approximately an average of up to 40 workers over a 3 to 4 year period.

CONSTRUCTION OF BUILD ALTERNATIVES

While information available at this time is not sufficient to provide a quantitative assessment of energy use and GHG emissions that would result from the Build Alternatives, a qualitative comparison of the sources of emissions relevant to each Build Alternative is provided below.

Waterborne Alternatives

The construction of the Waterborne Alternatives would take approximately two years and cost approximately $100 to $600 million, as discussed in Chapter 4. Close to 80 percent of the total construction cost would be required for the construction and expansion of the freight facilities. The emission sources would include the use of construction materials, their transport, the operation of construction equipment, and employee commutes. Emissions associated with the construction and expansion of the freight facilities would also occur with the Rail Tunnel Alternatives.

Rail Tunnel Alternatives

Based on the 2004 DEIS estimates of the electricity load for the construction of the tunnel (including the electricity that would be used by the tunnel boring machine), approximately 170,000 MWh of grid electricity would be needed, with approximately 77 percent attributable to the tunnel boring machine (TBM). Based on the most recent emission factors associated with electricity use in New York and New Jersey, the GHG emissions from this construction source alone would be more than 60,000 metric tons of CO_2e. A recent study estimates that the TBM accounts for at least 35 percent of total GHG emissions from construction equipment and transportation.[1] Based on this estimate, construction activity emissions would generate close to 120,000 metric tons of CO_2e. It is estimated that construction activity emissions account for approximately 40 percent of total construction emissions, with the rest of emissions being the upstream emissions associated with the use of construction materials. Based on this preliminary estimate the construction of the Rail Tunnel Alternatives would result in approximately 450,000 to 500,000 metric tons of CO_2e. It would take roughly five years of projected operational emission benefits to "pay back" the GHG emissions from construction.

In general, for the same type of construction, the energy use and GHG emissions roughly scale with the construction cost. Using the cost to GHG emission ratio from the 2004 DEIS of a recent water tunnel project,[2] and the expected cost of the Rail Tunnel Alternatives, the estimated GHG emissions for the Rail Tunnel Alternatives are reasonably close to the 450,000 to 500,000 metric tons of CO_2e estimated using the method described above.

[1] Proceedings of the 2010 Construction Research Congress, *Carbon Footprints Analysis for Tunnel Construction Process in the Preplanning Phase Using Collaborative Simulation*, edited by Ahn, C, Xier, H, Lee, S, Abourizk, S., and Pena-Mora, F, American Society of Civil Engineers, 2010.

[2] New York City Department of Environmental Protection, Draft Environmental Impact Statement, Water for the Future Program: Rondout-West Branch Bypass Tunnel Repair, December 20, 2011.

Based on the estimated construction cost and duration, the energy use and GHG emissions associated with the construction of the Rail Tunnel Alternative would be 58 times greater than with the Waterborne Alternatives.

F. CONSISTENCY WITH ENERGY AND CLIMATE ACTION PLANS

CONSISTENCY WITH ENERGY GHG EMISSION REDUCTION POLICY

The NYS CAP Interim Report calls for the development of freight strategies that reduce GHG emissions. Specifically relevant to the CHFP, the CAP Transportation and Land Use Strategy 8 (TLU-8) discusses the need for investment in freight rail infrastructure, and incentives for freight mode-shift.

The New York State Rail Plan[1] called for enhancing New York's rail infrastructure, with a focus on eliminating freight rail bottlenecks. It also stressed the importance of establishing a network of freight villages and urban distribution centers. By developing infrastructure for rail freight to cross the Hudson River, and improving and expanding existing yards at several key locations, to enable efficient distribution of goods from rail, the CHFP would be consistent with the energy and planning strategies described in the New York State Rail Plan.

PlaNYC identifies the improvement of freight movement as one of the strategies that the transportation sector can undertake to help reach the City's GHG emission reduction goals. Consistent with the CHFP, PlaNYC calls for a shift of freight from trucks to rail and barges, increase in cargo-handling capacity on the waterfront, and more rail transfer hubs along the waterfront. In fact, two facilities analyzed in this Tier I EIS are mentioned in PlaNYC—the 51st Street Yard and the 65th Street Yard.

CONSISTENCY WITH CLIMATE CHANGE RESILIENCE POLICY

New York State Climate Action Plan (NYS CAP) Interim Report[2] discusses the potential consequences of climate change for the transportation sector. Over the next few decades, heat waves, heavy precipitation events, and windstorms were identified as the main causes for moderate, frequent transportation problems. However, by 2050, sea level rise and storm surge were identified as more significant threats that would require major adaptations. Low lying transportation systems, including tunnels, especially in coastal and near-coastal areas were identified as being at a particular risk of flooding from sea level rise and heavy precipitation events. Materials used in transportation infrastructure, such as asphalt and train rails, are vulnerable to increased temperatures and extreme heat events. It is also expected that ventilation requirements for tunnels would increase.

Consistent with the NYS CAP strategies for addressing the potential effects of climate change CHFP would provide additional choices into the transportation system and improve system redundancy. In addition to the environmental benefit that a harbor crossing for rail and/or waterborne modes would provide by reducing freight transport by truck, the Build Alternatives would also provide additional infrastructure that would be important in responding to emergencies, including potential emergencies resulting from severe weather events related to climate change. For example, if severe flooding were to hamper other Hudson crossings and affect the efficient distribution of food, railcar floats could be used to transport the essentials. By considering the best available climate change projections at the time of construction and in

[1] New York State Department of Transportation, *New York State Rail Plan*, 2009.
[2] New York State Climate Action Plan Interim Report, November 2010.

preparing operational guidance and stormwater management plans, the CHFP would be consistent with federal, regional, state, and local policies that are increasingly highlighting the importance of protecting infrastructure and minimizing its vulnerability to climate change through prudent planning and design.

G. TIER II ANALYSIS AND POTENTIAL MITIGATION MEASURES

OPERATION

The most important strategies for reducing GHG emissions during operation are the use of more efficient new locomotives for the alternatives involving rail, and for the purchase of efficient tugs or ferries and adoption of hybrid propulsion technology for the Waterborne Alternative.

In addition, GHG emissions from operation could be reduced through:

- Use of biodiesel blended at a 20 percent level with standard diesel (B20) as fuel for yard equipment, locomotives, and tugs.
- Use of fuel efficient tug boats and railcar float design.
- Use of energy efficient yard equipment and operation.
- Shutting down of tug boat and equipment engines when not in use.
- High efficiency jet and ventilation shafts for the tunnel.
- To the extent practicable, location of the tunnel ventilation fans to optimize energy efficiency.
- Control of tunnel ventilation rate based on real-time rail traffic and air quality data, with the goal of reducing electricity consumption, while providing the needed ventilation.
- Use of energy efficient lighting at rail yards and in the tunnel.

The opportunities listed above for reducing GHG emissions would be explored in any Tier II documentation. A quantified analysis of GHG emissions from the operation of the yards and an assessment of the effect on CO_2 sequestration that would result from a potential removal of vegetated areas would also be examined in any Tier II documentation. PANYNJ would continue to collaborate with government agencies and organizations on planning for sea level rise and storm surge, precipitation rates, extreme temperatures and other climate change parameters and modify and design infrastructure and operations to be more resilient to these projected changes.

CONSTRUCTION

The strategies for reducing energy use and GHG emissions from construction are described below.

- Biodiesel blended at a 20 percent level with standard diesel (B20) could be used for construction non-road engines and generators. Biodiesel could potentially be used for all engines, subject to technical considerations.
- The largest potential contribution to on-road GHG emissions would be from material transport to and from the construction sites, particularly transport of materials excavated from the shafts and the tunnel. These emissions could be minimized by using rail rather than trucks as much as practicable and by selecting disposal sites near the tunnel shaft sites. Locally purchased construction materials would be used to the extent practicable, reducing GHG emissions associated with transport.

- The reuse of excavated material could offset the need to quarry and/or transport other materials that they would replace. Therefore, options for the reuse of excavated material, where practicable should be investigated to minimize GHG emissions from this source.
- Options for maximizing the fly ash, slag and interground limestone content of cement used for the construction would be considered. These materials would reduce the amount of cement needed, thereby reducing the GHG emissions associated with the production of the cement.
- Approximately 93 percent of steel currently used for construction in the United States is recycled from scrap material.[1] Options for requiring the use of recycled steel, where practicable, would be evaluated to minimize GHG emissions from the production of steel.
- Energy efficient equipment and best practices for equipment operation would be used.
- "No idling" policy would be enforced.
- Options to minimize energy use and GHG emissions from construction employee commutes would be considered.
- The PANYNJ Sustainable Infrastructure Guidelines would be followed.

A more quantified analysis of GHG emissions during construction and evaluation of options, including the options listed above, to reduce those emissions would be performed as part of any Tier II documentation. Tier II documentation would also address the potential design and construction measures that would be implemented to make the CHFP infrastructure less vulnerable to the more likely projected effects of climate change. Port Authority would continue to develop and implement adaptation strategies in infrastructure design. In Tier II documentation, adaptive measures provided by the Panel on Adaptation of America's Climate Choices[2] that could be incorporated into transportation planning would be considered in designing the infrastructure elements of the CHFP. These measures include:

- Protecting infrastructure with dikes and levees;
- Elevating critical infrastructure;
- Research on new, heat-resistant, or resilient materials;
- Designing changes to reduce stresses in rail lines;
- Developing new design standards for hydraulic structures, e.g., culverts and drainage channels;
- Construction of storm retention basins for short, high intensity storms, i.e., flash flooding;
- Moving critical infrastructure systems inland;
- Building or reconstructing more robust and resilient structures;
- Design for higher storm surges that progress further inland;
- Strengthening and elevating port and harbor facilities; and
- Installing surge barriers. ✷

[1] Steel Recycling Institute, "2009 The Inherent Recycled Content of Today's Steel," 2010.

[2] Panel on Adapting to the Impacts of Climate Change. *America's Climate Choices: Adapting to the Impacts of Climate Change*. National Research Council, National Academies Press, Washington, D.C., 2010.