A. INTRODUCTION

This chapter evaluates the greenhouse gas (GHG) emissions that would be generated by the construction and operation of the Proposed Project and its consistency with the citywide and statewide GHG reduction goals.

As discussed in the Federal National Climate Assessment,[1] New York State Department of Environmental Conservation (DEC) policy,[2] and the 2020 *City Environmental Quality Review* (*CEQR) Technical Manual*,[3] climate change is projected to have wide-ranging effects on the environment, including rising sea levels, increases in temperature, and changes in precipitation levels. Although this is occurring on a global scale, the environmental effects of climate change are also likely to be felt at the local level. The federal government, New York State, and New York City have all established sustainability initiatives and goals for greatly reducing GHG emissions and for adapting to climate change.

Empire State Development (ESD), as the lead agency for the Proposed Project, has elected to follow New York State and New York City guidance to quantify GHG emissions where data inputs are reasonably available to assess the general effects of direct and reasonably foreseeable indirect GHG emissions, in order to inform its decisions with respect to the Proposed Project. Moreover, the lead agency has determined to follow additional guidance set forth in the above-referenced DEC policy and the *CEQR Technical Manual* in assessing the GHG impacts of the Proposed Project. The assessment of a project's consistency with GHG reduction goals, identified in the *CEQR Technical Manual,* is currently the most appropriate standard by which to analyze a project's impacts on GHG emissions. The *CEQR Technical Manual* recommends that a GHG consistency assessment be undertaken for projects expected to result in the development of 350,000 square feet (sf) of floor area. The Proposed Project would exceed that threshold, since it would result in 20 million gross square feet (gsf) of developed floor area. Accordingly, a detailed GHG consistency assessment is provided for the above-ground commercial development called for under the General Project Plan (GPP).

As discussed in Chapter 1, "Project Description," the railroad entities—which include Amtrak, the Metropolitan Transportation Authority (MTA), and New Jersey Transit (NJT)—are working together on a project that, if approved upon completion of an environmental review under the National Environmental Policy Act (NEPA) and compliance with various other statutory

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[1] U.S. Global Change Research Program. *Climate Science Special Report: Fourth National Climate Assessment*. Volume I. 2017.

[2] NYSDEC. DEC Policy: Assessing Energy Use and Climate Change in Environmental Impact Statements. July 15, 2009.

[3] New York City Mayor's Office of Environmental Coordination. *City Environmental Quality Review Technical Manual*. March 2014.

requirements, would expand Penn Station into the below-grade portions of Sites 1, 2, and 3. However, a conceptual design has not yet been prepared for the Penn Station expansion. Therefore, a GHG consistency assessment for that project will be performed qualitatively in this DEIS, and a more detailed analysis will be prepared in the future under NEPA.

The Project Area would not be located within the nearest potential end-of-century flood hazard zone identified by the New York City Panel on Climate Change (NPCC). Therefore, the Proposed Project is unlikely to be impacted by future climate conditions related to sea level rise and flooding, and a more detailed assessment of the potential impacts of climate change on the Proposed Project is not warranted.

PRINCIPAL CONCLUSIONS

As demonstrated in this chapter, the Proposed Project would be consistent with New York City's GHG reduction goals, and would be developed in compliance with recently adopted state and City requirements intended to reduce GHG emissions from buildings. In order to attain the City's *OneNYC* GHG reduction goal to achieve carbon neutrality by 2050, the City of New York enacted the Climate Mobilization Act (CMA). The CMA includes a number of laws geared towards moving New York City's buildings towards the City's goal of reducing GHG emissions by targeting increased energy efficiency, utilizing roof space for installation of solar energy sources and green roofing, and reducing GHG emissions associated with building energy use.

As part of the CMA, Local Law 97 (LL97) places carbon intensity limits on most buildings larger than 25,000 sf, and those limits become more stringent over time. The City, in consultation with stakeholders, is establishing a program to implement those limits with enforcement of the first carbon intensity limits beginning in 2024. ESD would require compliance with the requirements of the CMA, so the Proposed Project buildings would be required to meet applicable future carbon intensity limits as well as the green/solar rooftop requirements established under the law.

The building energy use and vehicle use associated with commercial development envisioned under the GPP is expected to result in up to approximately 231 thousand metric tons of carbon dioxide equivalent (CO_2e) emissions per year in the 2038 analysis year, and up to approximately 179 thousand metric tons per year pursuant to the future 2050 citywide average carbon intensity limit. Compliance with the CMA would ensure consistency with the efficient buildings goal defined in the *CEQR Technical Manual* as part of the City's GHG reduction goal.

New York State has enacted the Climate Leadership and Community Protection Act (CLCPA), which calls for stringent limits on the statewide emission of GHGs, requiring that those emissions on a statewide basis be reduced by 40 percent by 2030 and 85 percent by 2050, compared with statewide 1990 levels. Pursuant to the CLCPA, a newly created body called the Climate Action Council will issue a scoping plan outlining recommendations for attaining the GHG emission limits established under the statute. A final scoping plan is anticipated to be issued by 2022. Based upon recommendations made in the final scoping plan, the CLCPA charges the New York State Department of Environmental Conservation (DEC) with promulgating regulations to reduce emissions, as necessary, to meet the statutory mandates. The CLCPA also increases the State's investment in renewable energy sources, and requires that significant portions of those investments be directed to disadvantaged communities. The DEC regulations would apply across various sectors, including the buildings and construction industry.

Since the scoping plan called for by the CLCPA has not yet been issued by the Climate Action Council and the DEC regulations needed to implement the plan have not been promulgated, there

are no specific CLCPA regulations currently applicable to the Proposed Project. However, by requiring the developers of the Proposed Project to achieve the stringent emission reductions and comply with the green/solar rooftop requirements imposed by the CMA, ESD expects that development in accordance with the GPP will be consistent with any future statewide emissions limits established under the CLCPA. If the CLCPA regulations impose emission standards even more stringent than the City's CMA, the Proposed Project buildings would in any event be required to comply with such CLCPA regulations.

While emissions associated with the operation of the expanded Penn Station have not been quantified, current design goals seek to advance the railroad entities' goals of achieving a 50 percent reduction from current emissions of GHG by 2030 as well as achieving net-zero carbon emissions for Penn Station by 2050.

The total emissions associated with construction of the commercial developments along with construction associated with the expanded Penn Station throughout the construction period, including both direct energy and emissions embedded in materials (extraction, production, and transport), would be approximately 1.4 million metric tons CO_2e, equivalent to approximately 6 years of operational emissions.

The *CEQR Technical Manual* defines five goals by which a project's consistency with the City's emission reduction goals is evaluated: (1) efficient buildings; (2) clean power; (3) sustainable transportation; (4) construction-related emissions; and (5) building materials carbon intensity.

Specific energy efficiency measures and design elements needed for the proposed developments to comply with the requirements of the CMA are not known at this time; however, potential measures have been identified for consideration, such as high-efficiency heating, ventilation, and air conditioning (HVAC) systems, efficient lighting and heating controls, inclusion of rooftop solar arrays, as well as potentially requiring sustainability measures in connection with tenant build-out. In addition, consideration will be given to increased or fully electric building designs, utilization of a centralized geothermal heat plant, or use of utility steam. In order to be completed and operational by the 2028 Phase 1 analysis year, the design for Site 7 has been further developed and these measures are being actively evaluated for implementation.

The proposed developments would also be subject to the City's 2020 building energy code—the New York City Environmental Conservation Code (NYCECC), which imposes stringent energy efficiency requirements. In order to meet the requirements of the CMA, the building design efficiencies would likely exceed these recently enacted code requirements.

Moreover, the commercial developments contemplated by the GPP may seek certification under one of a number of developed benchmarks for energy efficiency and green building design (green building design considerations include factors such as material selection, which affects GHG emissions associated with materials extraction, production, delivery, and disposal.)

The Proposed Project would also support the other GHG goals by virtue of its inclusion and proximity to public transportation, increased and/or full electrification (where practicable), avoidance of the use of fossil fuels other than natural gas for on-site combustion sources, commitment to construction air quality controls, and the fact that as a matter of course, construction in New York City generally uses recycled steel and includes cement replacements. All of these factors demonstrate that the proposed development supports the GHG reduction goal.

The Proposed Project would be a transit-oriented development located in close proximity to abundant mass transportation services, and would implement a wide variety of energy efficiency

and sustainability measures to (i) comply with the stringent requirements of the CMA; (ii) meet any requirements of the CLCPA as applicable under future regulations; and (iii) meet or exceed the City's stringent building energy code. Accordingly, the Proposed Project would be consistent with the City's emissions reduction goals, as defined in the *CEQR Technical Manual*.

B. POLLUTANTS OF CONCERN

GHGs are gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds. The general warming of the Earth's atmosphere caused by this phenomenon is known as the "greenhouse effect." Water vapor, carbon dioxide (CO_2), nitrous oxide (N_2O), methane, and ozone are the primary GHGs in the Earth's atmosphere.

There are also a number of entirely anthropogenic GHGs in the atmosphere, such as halocarbons and other chlorine- and bromine-containing substances, which also damage the stratospheric ozone layer (and contribute to the "ozone hole"). Since these compounds are being replaced and phased out due to the 1987 Montreal Protocol, there is no need to address them in GHG assessments for most projects. Although ozone itself is also a major GHG, it does not need to be assessed as such at the project level since it is a rapidly reacting chemical and efforts are ongoing to reduce ozone concentrations as a criteria pollutant (see Chapter 15, "Air Quality"). Similarly, water vapor is of great importance to global climate change, but is not directly of concern as an emitted pollutant since the negligible quantities emitted from anthropogenic sources are inconsequential.

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 and, therefore, the most influential GHG. 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. CO_2 is included in any analysis of GHG emissions.

Methane and N_2O also play an important role since the removal processes for these compounds are limited and because they have a relatively high impact on global climate change as compared with an equal quantity of CO_2. Emissions of these compounds, therefore, are included in GHG emissions analyses when the potential for substantial emission of these gases exists.

The *CEQR Technical Manual* lists six GHGs that could potentially be included in the scope of a GHG analysis: CO_2, N_2O, methane, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). This analysis focuses mostly on CO_2, N_2O, and methane. 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 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[4] of each chemical over a period of 100 years (e.g., CO_2 has a much shorter

[4] *Radiative forcing* is a measure of the influence a gas has in altering the balance of incoming and outgoing energy in the Earth-atmosphere system and is an index of the importance of the gas as a GHG.

atmospheric lifetime than SF_6, and therefore has a much lower GWP). The GWPs for the main GHGs discussed here are presented in **Table 16-1**.

Table 16-1
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

Note: The GWPs presented above are based on the Intergovernmental Panel on Climate Change's (IPCC) Second Assessment Report (SAR) to maintain consistency in GHG reporting. The IPCC has since published updated GWP values that reflect new information on atmospheric lifetimes of GHGs and an improved calculation of the radiative forcing of CO_2. In some instances, if combined emission factors were used from updated modeling tools, some slightly different GWP may have been used for this study. Since the emissions of GHGs other than CO_2 represent a very minor component of the emissions, these differences are negligible.
Source: 2014 *CEQR Technical Manual*

C. POLICY AND REGULATIONS FOR REDUCING GHG EMISSIONS

Because of the growing consensus that GHG emissions resulting from human activity have the potential to profoundly impact the Earth's climate, countries around the world have undertaken efforts to reduce emissions by implementing global, regional, state, and local measures addressing energy consumption and production, land use, and other activities. The U.S. Environmental Protection Agency (EPA) is required to regulate GHGs under the Clean Air Act and has begun preparing and implementing regulations. Furthermore, a number of states have joined forces to fight climate change despite the United States government's withdrawal from international agreements. Under the Regional Greenhouse Gas Initiative (RGGI), ten northeastern and Mid-Atlantic states (including New York State) have committed to regulate the amount of CO_2 that power plants are allowed to emit, gradually reducing annual emissions to half the 2009 levels by 2020, and reducing an additional 30 percent from 2020 to 2030. The RGGI states and Pennsylvania have also announced plans to reduce GHG emissions from transportation, through the use of biofuel, alternative fuel, and efficient vehicles

On a state level, the New York State Energy Plan outlines the state's energy goals and provides strategies and recommendations for meeting those goals. The latest version of the plan was published in June 2015. The plan outlines a vision for transforming the state's energy sector that would result in increased energy efficiency (both demand and supply), increased carbon-free power production and cleaner transportation, in addition to achieving other goals not related to GHG emissions. The 2015 plan also establishes new targets: (1) reducing GHG emissions in New York State by 40 percent, compared with 1990 levels, by 2030; (2) providing 50 percent of electricity generation in the state from renewable sources by 2030; and (3) increasing building energy efficiency gains by 600 trillion British thermal units (BTU) by 2030.

In April 2019, New York State enacted the CLCPA to impose a mandate that statewide GHG emissions be reduced by 40 percent by 2030 and 85 percent by 2050, compared with 1990 levels. The legislation charges DEC with establishing quantified GHG emission limits consistent with the statutory mandates, along with agency regulations to achieve those limits (in accordance with a

scope prepared by a newly created body called the New York State Climate Action Council). The statute also calls for increasing investments in renewable energy sources, and ensuring that significant portions of investments are made in disadvantaged communities. Pursuant to these requirements, the Climate Action Council will prepare and approve a scoping plan outlining recommendations for attaining the GHG emission limits and reduction goals. A final scoping plan is anticipated to be approved by 2022.

The New York City Council enacted the CMA in May 2019—a legislative package imposing requirements regarding increased energy efficiency, utilization of roof space for installation of solar energy sources/green roofing, and reductions in GHG emissions associated with building energy use. One component of the CMA is LL97, which is applicable to most buildings that exceed 25,000 gsf (excluding electricity/steam generation facilities, rent-regulated accommodations, places of public worship, and City-owned properties). LL97 establishes annual building emission limits beginning in 2024 and requires the owner of a covered building to submit annual reports demonstrating the building is in compliance with the applicable GHG emission limits, or be subject to prescribed financial penalties. In order to realize the GHG reduction goals of the CMA, the New York City Climate Advisory Board was established—a 15-member advisory board that was created by the City to provide advice on potential updates to LL97 and recommendations in order to optimize its implementation. Board members are architects, engineers, property owners, representatives from the business sector and public utilities, environmental justice advocates, and tenant advocates. The board is to provide a report to the mayor by 2023.

Local Laws 92 and 94 within the CMA would include requirements for buildings to utilize available roofing space for the installation of either a green roof or a solar photovoltaic system. A contiguous area of rooftop space (200 sf or smaller) not occupied by rooftop structures (i.e. mechanical equipment) or used for recreational purposes would be required to install a solar photovoltaic system of at least 4 kW, a green roof system, or some combination thereof. The requirements would be applicable to all new construction and any building that would undergo major modification of the rooftop requiring a permit.

The CMA is a culmination of actions taken over the last several years by New York City, and local governments generally, to grapple with the problem of climate change. Many local governments worldwide, including New York City, are participating in the Cities for Climate Protection™ campaign and have committed to adopting policies and implementing quantifiable measures to reduce local GHG emissions, improve air quality, and enhance urban livability and sustainability. New York City's long-term comprehensive plan for a sustainable and resilient New York City, which began as *PlaNYC* 2030 in 2007, and continues to evolve today as *OneNYC*, includes GHG emissions reduction goals, many specific initiatives that can result in emission reductions, and initiatives aimed at adapting to future climate change impacts. The goal to reduce citywide GHG emissions to 30 percent below 2005 levels by 2030 ("30 by 30") was codified by Local Law 22 of 2008, known as the New York City Climate Protection Act (the "GHG reduction goal").[5] The City has also announced a longer-term goal of reducing emissions to 80 percent below 2005 levels by 2050 ("80 by 50"), which was codified by Local Law 66 of 2014, and has published a study evaluating the potential for achieving that goal. More recently, as part of *OneNYC*, the City has announced a more aggressive goal for reducing emissions from building energy down to 30 percent below 2005 levels by 2025 and achieving carbon neutrality by 2050.

[5] Administrative Code of the City of New York, §24-803.

In December 2009, the New York City Council enacted four laws addressing energy efficiency in large new and existing buildings, in accordance with *PlaNYC*. The laws require owners of existing buildings larger than 50,000 sf to conduct energy efficiency audits and retro-commissioning every 10 years, to optimize building energy efficiency, and to "benchmark" the building energy and water consumption annually, using an online tool from the EPA. By 2025, commercial buildings over 50,000 sf will also require lighting upgrades, including the installation of sensors and controls, more efficient light fixtures, and the installation of submeters, so that tenants can be provided with information on their electricity consumption. The legislation also creates the NYCECC, which along with the Energy Conservation Construction Code of New York State, requires equipment installed during a renovation to meet current efficiency standards.

Earlier this year, as part of the City's implementation of strategies aimed at achieving the *OneNYC* GHG reduction goals, the City brought the NYCECC up to date with the 2020 Energy Conservation Code of New York State (2020 ECCNYS), which substantially increased the stringency of the building energy efficiency requirements and adopted the ASHRAE 90.1-2016 standard as a benchmark, and aligns with NYStretch Energy Code 2020 developed by New York State Energy Research and Development Authority (NYSERDA).

In 2015, the City convened a Buildings Technical Working Group (TWG) to develop the policies and programs necessary to achieve the City's GHG reduction goals. The TWG brought together dozens of leaders across many sectors, including the real estate industry, architecture, engineering, labor unions, academia, affordable housing, and environmental advocacy. A final report from the TWG was published in 2016 that outlined the analyses and recommendations for changes in building code, energy efficiency, and planning that needs to take place in order for the City to meet its GHG reduction goal. The CMA is based in large measure upon the findings of the TWG.

A number of benchmarks for energy efficiency and green building design have also been developed (green building design considerations include factors such as material selection, which affects GHG emissions associated with materials extraction, production, delivery, and disposal). For example, the LEED system is a benchmark for the design, construction, and operation of high-performance green buildings that includes energy efficiency components.

To support the construction of both sustainable and resilient development consistent with the City's goals, New York City has also released the New York City Active Design Guidelines and the New York City Climate Resiliency Design Guidelines. The Active Design Guidelines contain strategies for developing sustainable buildings, streets, and urban spaces that encourage active transportation, strategic placement of stairs and elevators, and protection against potential future climate change impacts. They provide design professionals with a menu of strategies for creating healthier buildings, streets, and urban spaces and include:

- Urban design strategies for creating neighborhoods, streets, and outdoor spaces that encourage walking, bicycling, and active transportation and recreation;
- Building design strategies for promoting active living where we work, live, and play through the placement and design of stairs, elevators, and indoor and outdoor spaces; and
- Discussion of synergies between active design with sustainable and universal design initiatives, such as LEED.

In connection with the expansion of Penn Station, the railroad entities would endeavor to incorporate project-specific climate resilient design solutions for critical infrastructure as part of the design of the expanded station. The railroads would coordinate to develop project-specific goals for the climate resilient design of the proposed expansion. The project goals for climate

resilient design solutions would be developed in light of historic climate data supplemented by specific, regional, forward-looking climate change data to account for the projected severity and frequency of future storms, sea level rise, heat waves, and precipitation.

D. METHODOLOGY

Climate change is driven by the collective contributions of diverse individual sources of emissions to global atmospheric GHG concentrations. Identifying potential GHG emissions from a proposed action can help decisionmakers identify practicable opportunities to reduce GHG emissions and ensure consistency with policies aimed at reducing overall emissions. While the increments of criteria pollutants and toxic air emissions are assessed in the context of health-based standards and local impacts, there are no established thresholds for assessing the significance of a project's contribution to climate change. Nonetheless, prudent planning dictates that all sectors address GHG emissions by identifying GHG sources and practicable means to reduce them. Based on *CEQR Technical Manual* guidance, this chapter presents the total GHG emissions associated with the Proposed Project (from the proposed new buildings on the eight development sites in the Project Area), evaluates the GHG emissions of the Proposed Actions overall qualitatively, and identifies measures that would be implemented and measures that are still under consideration to limit emissions. This differs from most other technical areas in that it does not account for only the increment between the condition with and without the Proposed Project, in that the focus is on the total emissions associated with the uses, and on the effect of measures to reduce those emissions.

Estimates of potential GHG emissions associated with the Proposed Project are based on the methodology presented in the *CEQR Technical Manual*. Estimates of emissions of GHGs from operation of the commercial development have been quantified, including off-site emissions associated with use of electricity and steam, on-site emissions from heat and hot water systems, and emissions from vehicle use associated with the proposed development. GHG emissions that would result from construction are discussed as well. As per the guidance, analysis of building energy is based on the average current carbon intensity of electricity in 2008, which will likely be lower in the 2028 analysis year of Phase 1 or the 2038 analysis year of Phase 2 and lower still in future years as the fraction of electricity generated from renewable sources continues to increase. Emissions from transportation conservatively apply the vehicle emission factors for the 2028 analysis year to the traffic generated in the 2038 analysis year. Vehicular emission factors will also continue to decrease in future years as vehicle engine efficiency increases and emissions standards continue to decrease, resulting in lower emissions in future years. Because the methodology does not account for future years and other changes described above, it also does not explicitly address potential changes in future consumption associated with climate change, such as increased electricity for cooling, or decreased on-site fuel for heating. Overall, this analysis results in conservatively high estimates of potential GHG emissions.

CO_2 is the primary pollutant of concern from anthropogenic emission sources and is accounted for in the analysis of emissions from the proposed development at the eight development sites in the Project Area. GHG emissions for gases other than CO_2 are included where practicable or in cases where they comprise a substantial portion of overall emissions. The various GHG emissions are added together and presented as metric tons of CO_2e emissions per year (see "Pollutants of Concern," above).

BUILDING OPERATIONAL EMISSIONS

As part of the legislative package comprising the CMA, a series of annual carbon intensity limits associated with building energy use were established, with initial limits taking effect in 2024 and periodically lowered in subsequent years. The City, in consultation with stakeholders, is in the process of establishing a program to implement those limits. ESD would require project developers to comply with the applicable future carbon intensity limits at the time of construction. Estimates of emissions due to building electricity and fuel use were prepared using the 2030–2035 carbon intensity limits by use type as specified in LL97.[6,7] Since the emissions represent the maximum emissions allowed as of 2035 and not a future analysis year under the City's more stringent carbon intensity limits, future emissions are expected to be lower as efficiency and renewable energy use continue to increase with the objective of meeting state and City GHG reduction goals.

MOBILE SOURCE EMISSIONS

The number of annual weekday vehicle trips by mode (cars, taxis, and trucks) that would be generated by the Proposed Project was calculated using the transportation planning assumptions developed for the analysis and presented in Chapter 14, "Transportation." The assumptions used in the calculation include average daily weekday person trips and delivery trips by proposed use, the percentage of vehicle trips by mode, and the average vehicle occupancy. Travel distances shown in Tables 18-6 and 18-7 and associated text of the *CEQR Technical Manual* were used in the calculations of annual vehicle miles traveled by cars, taxis, and trucks. Table 18-8 of the *CEQR Technical Manual* was used to determine the percentage of vehicle miles traveled by road type and the mobile GHG emissions calculator provided with the manual was used to estimate GHG emissions from all trips attributable to the Proposed Project.

Based on the latest fuel lifecycle model from Argonne National Laboratory,[8] emissions from producing and delivering fuel ("well-to-pump") are estimated to add an additional 25 percent to the GHG emissions from gasoline and 27 percent from diesel. Although upstream emissions (emissions associated with production, processing, and transportation) of all fuels can be substantial and are important to consider when comparing the emissions associated with the consumption of different fuels, fuel alternatives are not being considered for the proposed development, and as per *CEQR Technical Manual* guidance, the well-to-pump emissions are not considered in the analysis. The assessment of tailpipe emissions is only in accordance with the *CEQR Technical Manual* guidance on assessing GHG emissions and the methodology used in developing the New York City GHG inventory, which is the basis of the GHG reduction goal.

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[6] Specific future carbon intensity limits by use group beyond 2035 have not yet been established; therefore the 2030-2035 limits were conservatively used to estimate GHG emissions in the Phase II 2038 Analysis Year. Future carbon intensity limits would be set to achieve and maintain an annual citywide average carbon intensity limit of 1.4 kg CO_2e per sf per year by the year 2050.

[7] Completion of construction and operation of Site 7 would occur in the Phase 1 2028 Analysis Year building and operational emissions for Site 7 would initially be subject to the immediate 2024-2030 carbon intensity limits.

[8] Based on GREET1_2016 model from Argonne National Laboratory.

The projected total annual vehicle miles traveled by roadway type for the 2038 Build Year, forming the basis for the GHG emissions calculations from mobile sources, are summarized in **Table 16-2**.

Table 16-2
Vehicle Miles Traveled per Year (2038)

Roadway Type	Passenger	Taxi	Truck
Local	4,353,038	1,529,697	15,010,659
Arterial	9,497,537	3,337,520	32,750,529
Interstate/Expressway	5,935,960	2,085,950	20,469,081
Total	**19,786,535**	**6,953,166**	**68,230,269**

CONSTRUCTION EMISSIONS

A description of construction activities is provided in Chapter 20, "Construction." Construction emissions include emissions from on-road trips, on-site non-road engines, and materials extraction, production, and transport.

The number of vehicle trips by mode (worker cars, delivery trucks) that would be generated by construction of the Proposed Project was calculated using the assumptions developed for the analysis and presented in Chapter 20, "Construction." The assumptions used in the calculation include average daily workers, the percentage of auto trips, and the average vehicle occupancy to develop annual vehicle miles traveled (VMT) associated with commuting workers. An average round-trip commute distance of 25.3 miles (based on the average trip to work distance for the New York Metropolitan Area)[9] for construction workers in the New York City Region was used. Similarly, the numbers of trucks (concrete trucks, dump trucks, and tractor trailers) for each phase of construction activity were used to estimate truck VMT. Distances for truck deliveries were developed based on estimates of the origin and destination of materials for the Proposed Project. Table 18-8 of the *CEQR Technical Manual* was used to determine the percentage of vehicle miles traveled by road type and the most recent version of the EPA MOVES model was used to obtain an estimate of car and truck GHG emission factors used to produce the associated emissions attributable to the Proposed Project.

The Proposed Project would result in construction worker travel of 12,725,108 VMT. Additionally, the Proposed Project would result in construction truck trips totaling 19,320,316 VMT. These data were used as the basis for the GHG emissions calculations from mobile sources, applying emission factors as described above for operational mobile source emissions.

On-site emissions from non-road construction engines have been estimated based on specific estimates of construction activity and fuel consumption data from EPA's NONROAD emissions model. A detailed schedule for the use of non-road construction engines was developed, as described in Chapter 20, "Construction." The detailed data, including the number, type, power rating, and hours of operation for all construction engines was coupled with fuel consumption rate data from EPA's NONROAD model to estimate total fuel consumption throughout the duration of construction activities. Non-road construction engines are estimated to require approximately

[9] NYSDOT. *2009 NHTS, New York State Add-On*. Key Tables. Table 3: Average Travel Day Person-Trip Length By Mode and Purpose, trip-to work distance for SOV in NYMTC 10-county area. 2011.

3.7 million gallons of diesel equivalent throughout the duration of construction. The quantity of fuel was then multiplied by an emission factor of 10.30 kilograms CO_2e per gallon of diesel fuel.[10]

Upstream emissions related to the production of construction materials were estimated based on the expected quantity of iron or steel and cement. Although other materials will be used, cement and metals have the largest embodied energy and direct GHG emissions associated with their production, and substantial quantities would be used for the Proposed Action.

The construction is estimated to require 991,927 metric tons of cement. An emission factor of 0.928 metric tons of CO_2e per metric ton of cement produced was applied to estimate emissions associated with energy consumption and process emissions for cement production.[11] The precise origin of cement for this project is unknown at this time.

The construction is estimated to require 396,119 metric tons of steel and other metals (e.g., structural, rebar, aluminum). An emission factor of 0.6 metric tons of CO_2e per metric ton of steel product produced was applied to estimate emissions associated with production energy consumption,[12] and 0.65 metric tons of CO_2e per metric ton of steel product produced for process emissions associated with steel production were applied.[13]

EMISSIONS FROM SOLID WASTE MANAGEMENT

The Proposed Project would not fundamentally change the City's solid waste management system. Therefore, as per the *CEQR Technical Manual*, GHG emissions from solid waste generation, transportation, treatment, and disposal are not quantified.

E. PROJECTED GHG EMISSIONS

BUILDING OPERATIONAL EMISSIONS

The building floor area, emission intensity, and resulting GHG emissions from each of the uses included in the Proposed Project across all proposed development sites are presented in detail in **Table 16-3**. While emissions associated with the operation of the expanded Penn Station are not quantified, current design strategies seek to advance the railroad entities' goal of achieving a 50 percent reduction from current emissions of GHG by 2030 and net-zero carbon emissions for Penn Station by 2050. Therefore, emissions associated with the expanded Penn Station are anticipated to decrease over time as compared to existing conditions.

[10] EPA. *Emission Factors for Greenhouse Gas Inventories*. 19 November 2015.

[11] The Portland Cement Association. *Life Cycle Inventory of Portland Cement Manufac*ture. 2006.

[12] Arpad Horvath et al. *Pavement Life-cycle Assessment Tool for Environmental and Economic Effects, Consortium on Green Design and Manufacturing*. UC Berkeley. 2007.

[13] Based on 42.3 teragrams of CO_2e emitted and 65,460 thousand tons produced; USEPA. *Inventory of U.S. Climate Change and Sinks: 1990–2009*. April 15, 2011.

Table 16-3
Annual Building Energy Emissions, Proposed Project

Source Use	Building Area (gsf)	GHG Intensity[(1)] (kg CO_2e/gsf-year)	Annual GHG Emissions (metric tons CO_2e)
Office	14,250,085	4.53	64,553
Local Retail	497,064	4.03	2,003
Destination Retail	307,000	4.03	1,237
Hotel	758,443	5.26	3,989
Mechanical / Non-Program	3,732,583	1.10	3,235
Parking	100,000	1.10	110
			Total: 75,128

Notes: Totals may not sum due to rounding.
Sources: (1) LL97 carbon intensity limits for 2030-2035.

As discussed above, estimates of emissions due to building electricity and fuel use were prepared using the 2030–2035 carbon intensity limits by use type as specified in LL97. When compared to estimates for existing buildings using the carbon intensity factors set forth in the *CEQR Technical Manual*, the proposed development—by complying with the more stringent emission limits codified in LL97—would have approximately 51 percent lower total annual emissions per square foot of building floor area.[14] Based on the size of the Proposed Project, this would reduce emissions from approximately 153,000 metric tons annually (using the *CEQR Techincal Manual* factors for existing buildings) to approximately 75,000 metric tons annually. Furthermore, while specific future carbon intensity limits beyond 2035 have not yet been established, limits would be required by LL97 to be established to achieve an annual citywide average carbon intensity limit of 1.4 kg CO_2e per sf per year by the year 2050.

While the developers of the proposed commercial buildings would design buildings with emission intensities below the future 2030-2035 carbon intensity limits in order to meet the more stringent carbon intensity limits beyond 2035, the 2030-2035 emission intensity limits are used to conservatively estimate emissions from the proposed development sites. Therefore, annual building GHG emissions for the proposed developments are conservative and may fall below those in **Table 16-3**.

MOBILE SOURCE EMISSIONS

The mobile-source-related GHG emissions from the proposed developments are presented in detail in **Table 16-4**.

Table 16-4
Annual Mobile Source Emissions
(metric tons CO_2e, 2038)

Use	Passenger Vehicle	Taxi	Truck	Total
Office	8,868	2,254	131,971	**143,093**
Local Retail	548	75	5,035	**5,657**
Destination Retail	912	239	3,110	**4,261**
Hotel	355	800	2,252	**3,407**
Total	**10,683**	**3,367**	**142,368**	**156,417**

[14] Emission for representative existing buildings were estimated using the building carbon intensity data represents 2008 citywide averages by use type specified under *CEQR Technical Manual guidance and* carbon intensity data calculated from the 2014 local law 88 benchmark data.

In addition to the direct emissions included in the analysis, an additional approximately 25 percent would be emitted upstream, associated with fuel extraction, production, and delivery.

CONSTRUCTION EMISSIONS

The estimated GHG emissions from construction of the commercial developments along with construction associated with the expanded Penn Station are presented in **Table 16-5**.

Table 16-5
GHG Emissions from Construction—Proposed Project
(metric tons CO_2e)

	Total
Nonroad Construction Equipment	39,013
On-Road Vehicles	18,578
Construction Materials:	
Cement	920,496
Steel	493,466
Total	**1,413,962**

SUMMARY

A summary of operational GHG emissions by source type is presented in **Table 16-6**. Note that if new buildings were to be constructed elsewhere to accommodate the same amount of office space, hotel rooms, and retail space, the emissions from the use of electricity, energy for heating and hot water, and vehicle use could differ the emissions estimated for the Proposed Project. Furthermore, due to the Project Area's uniquely extensive rail and transit resources, with direct access to the Amtrak, LIRR, and NJT trains at Penn Station, the PATH train line running from Hoboken to 33rd Street, 14 New York City Transit (NYCT) subway lines (A, B, C, D, E, F, M, N, Q, R, W, 1, 2, and 3 trains), and numerous bus lines, new building constructed elsewhere could result in increased emissions without acess to sustainable transit options. Location of the Proposed Project's buildings at the nation's largest rail and transit hub would be expected to reduce GHG emissions compared to most other project locations in New York State, or elsewhere in the United States. In addition, the total emissions associated with construction throughout the construction period, including both direct energy and emissions embedded in materials (extraction, production, and transport), would be approximately 1.4 million metric tons CO_2e, equivalent to approximately 6 years of operational emissions. The Proposed Project is not expected to fundamentally change the City's solid waste management system, and therefore emissions associated with solid waste are not presented.

The operational emissions from building energy use were estimated using carbon intensity limits by use group as specified under LL97 and include on-site emissions from fuel consumption as well as emissions associated with the production and delivery of the electricity to be used on-site. Specific energy efficiency measures and design elements that would be implemented in order for the proposed developments to meet these limits are not known at this time. However, several measures are under consideration (see the following section). While the above estimate reflects the current building design (where available), the energy evaluation is not final and detailed design measures may continue to evolve as designs to attain future carbon intensity limits progress. Furthermore, design guidelines for tenant build-out after completion of construction would likely

result in much greater savings since much of a building's energy use and efficiency is tied to tenant uses, which are unknown at this time.

Table 16-6
Summary of Annual GHG Emissions, 2038
(metric tons CO_2e)

Use	Building Operations	Mobile	*Total*
Office	64,553	143,093	*207,646*
Local Retail	2,003	5,657	*7,660*
Destination Retail	1,237	4,261	*5,498*
Hotel	3,989	3,407	*7,396*
Mechanical / Non-Program	3,235	0	*3,235*
Parking	110	0	*110*
Total	**75,128**	**156,417**	***231,545***

F. ELEMENTS THAT WOULD REDUCE GHG EMISSIONS

In order to meet the City's future carbon intensity limits beyond 2050, the proposed developments will need to incorporate the most effective reduction technologies and designs as they are developed; therefore, specific energy efficiency measures and design elements that may be implemented to comply with the requirements of the CMA have not been established at this time. However, the proposed developments would include a number of sustainable design features to meet the City's carbon intensity limits, and potential measures have been identified for consideration in the new buildings to be constructed under the Proposed Project. Such measures include the construction of energy efficient buildings and the use of clean power. These measures would address the GHG reduction goals outlined in the *CEQR Technical Manual* and are discussed in more detail below. The request for proposals (RFP) to potential developers for the new buildings on Sites 1, 2, and 3 would call for submissions that commit to GHG emission limits as needed to comply with the emission intensity limits of the CMA and any future regulations under the CLCPA. In order for construction to be completed and the building to be operational by the 2028 Phase 1 analysis year, the design for Site 7 has been further developed and these measures are currently being evaluated for implementation. However, specific mechanical systems and building design elements to meet the City's GHG requirements will be guided by the available technologies at the time of construction.

In addition, dense, mixed-use development with access to transit and existing roadways is in general consistent with sustainable land use planning and smart growth strategies to reduce the carbon footprint of new development. The requirements of the New York City's energy code regulate energy consumption to align with the City's reduction goals for GHG emissions, and the proposed development sites would be subject to the City's stringent building energy codes adopted in 2020, which substantially increased the energy efficiency required.

Following the approach defined in the *CEQR Technical Manual*, the Proposed Actions would result in development that is compliant with the CMA and consistent with the City's emissions reduction goal implemented to date. Such development would also be consistent with statewide emission limits and applicable future regulations promulgated by DEC under the CLCPA.

BUILD EFFICIENT BUILDINGS

The Proposed Project would include 20 million gsf of new Class A commercial office space, retail, and hotel space on eight development sites within the Project Area. The new buildings would comply with LL97 (as it may be clarified or amended over time), related laws under the CMA, and any requirements under the CLCPA in effect at the time of construction. Additionally, the proposed developments would be subject to the 2020 NYCECC, which imposes stringent energy efficiency requirements.

The proposed developments would implement on-site energy conservation measures that would result in carbon emissions meeting the limits established under City and State law. While final designs have not been developed for the buildings at the eight proposed development sites, potential energy efficiency measures and design elements that may be implemented at any individual proposed development have been identified for consideration. These measures could include the installation of fully electric systems or commitments to the exclusive use of a district steam system for the buildings' heating and hot water systems, instead of systems that burn natural gas or other fossil fuels. Both systems would avoid on-site fossil fuel combustion. Fully electric systems typically utilize high-efficiency heat pumps systems to transfer heat between the building interior and the surrounding environment—typically requiring one-third the electrical energy of the required thermal energy to be transferred. Use of steam or electric systems may result in an approximately 5 or 20 percent reduction, respectively, in emissions when compared to the use of natural gas systems. Both the City and state are targeting 100 percent renewable energy sources for electrical generation by 2050. As sources of electrical and steam generation incorporate cleaner fuels and/or renewable energy sources, emissions under these measures are anticipated to decrease significantly.

As noted above, in order to be completed and operational by the 2028 analysis year, design elements for Site 7 have been further developed and potential design elements identified for consideration are currently being evaluated. The design of this building would contain progressive designs to achieve sustainability, energy consumption reduction and carbon emission planning to align with the goals of LL97. It is expected that the design would include elements of energy recovery systems—systems designed to capture waste heat energy before it leaves the building through a cooling tower or an exhaust louver. The energy systems would minimize the wasted heat energy by utilizing high-efficiency HVAC systems, and minimize the overall energy demand by including building components designed to reduce energy consumption. Motion sensors for lighting would be incorporated in all areas controlled by the core and shell design (back of house, stairwells, amenity spaces) resulting in efficient energy consumption.

Efficient lighting in all areas controlled by design, daylight harvesting in areas where practicable, and elevators with regenerative breaking would be installed to reduce electricity consumption. Exterior lighting would be energy efficient and directed. Third-party fundamental and enhanced building energy systems commissioning would be undertaken upon completion of construction to ensure energy performance. To qualify for LEED Interior Design and Construction (ID+C): Commerical Interiors rating system, version 4, the proposed developments would be required to exceed the energy requirements of New York City's 2020 NYCECC building code (currently the same as ASHRAE 90.1-2016), resulting in energy expenditure lower than a baseline building designed to meet but not exceed the minimum building code requirements by approximately three percent for new construction. Additionally, sustainable design measures could be required of tenants at the time of build-out via lease requirements to ensure that tenant energy use is in-line with the sustainable designs of the development site. Since much of a building's energy use and efficiency

is tied to tenant uses, this would likely result in significant savings. However, these measures have not been identified at this time.

Furthermore, water conserving fixtures, meeting New York City's stringent building code requirements, would be installed and water-efficient landscaping would be selected to reduce water consumption, indirectly reducing energy consumption associated with potable water production and delivery. Storage and collection of recyclables would be incorporated in building design. Large tenants would install submeters for electricity, allowing tenants to track and optimize their electricity use.

EXPANDED PENN STATION

The Proposed Project would also support the proposed expansion of Penn Station, and would upgrade existing infrastructure currently serving the existing Penn Station. In expanding Penn Station, the participating railroads would seek to achieve a reduction in GHG emissions by 50 percent below current levels and to certify Penn Station as a zero carbon facility by 2050. While design elements are currently being developed to meet these goals, a sustainability framework for the expanded Penn Station is under consideration to identify measures that may be included.

The design effort would include consideration of an optimized central plant using high-efficiency systems with capacity for multiple buildings, and may utilize energy recovery to capture and distribute excess heat from mechanical systems. In particular, the expanded Penn Station may use the excess heat from train platforms. Increased daylight, efficient lighting, as well as smart monitoring and control systems may be used to decrease overall energy consumption of the station. Other measures under consideration would include a potential geothermal heat pump system installed below Site 2. Similar to other fully electric heat pump systems, the implementation of a geothermal heat pump system would reduce building energy consumption as well as GHG emissions. Furthermore, emissions would be anticipated to decrease significantly as the City and state target increased renewable energy sources and carbon neutral electrical generation. The expanded Penn Station would be designed to incorporate project-specific climate resilient design solutions. The railroads would coordinate to develop project-specific goals for the climate resilient design of the proposed expansion. The project goals for climate resilient design solutions would consider specific, regional, forward-looking climate change data to account for the projected severity and frequency of future storms, sea level rise, heat waves, and precipitation.

USE CLEAN POWER

As noted above, ESD would require compliance with the CMA, so developers under the GPP would be subject to the clean energy provisions of those local laws. The proposed developments would be required to utilize available roofing space for the installation of either a green roof or a solar photovoltaic system. Per LL92, a contiguous area of at most 200 sf would be required to incorporate a solar photovoltaic system of at least 4 kilowatts. The installation of a solar array system would offset grid electricity usage.

Additionally, while the exclusive use of clean power would not be specifically required to meet the carbon intensity limits of LL97, the buildings may use natural gas, a lower carbon fuel, for the normal operation of the heat and hot water systems. In order to meet the City's carbon intensity limits, the proposed developments may also implement a fully electric systems or commitments to the exclusive use of a district steam system for the buildings' heating and hot water systems, instead of systems that burn natural gas or other fossil fuels. Furthermore, it is possible that local

renewable power production (e.g., geothermal, solar, wind) would be considered while reviewing options for LEED, EPA Energy Star, and achieving the above efficient building goal.

Therefore, the Proposed Actions would support the goal identified in the *CEQR Technical Manual* of using clean power.

TRANSIT-ORIENTED DEVELOPMENT AND SUSTAINABLE TRANSPORTATION

As noted above, the Proposed Project would be one of the most prominent transit-oriented developments in the United States. Transit-oriented development encourages public transit usage by making transit a convenient option for commuters and residents, and constructing high-density development near transit results in more efficient use of land—if most users of the high-density development are commuting by transit, less space is required for parking and less vehicular traffic is generated on a per capita basis. Locating high-density uses near transit also ensures that ridership will be high. The Proposed Project is located in an area heavily supported by many transit options with existing rail, subway, and bus services located immediately adjacent to the development sites. In addition, the Project Area is located adjacent to the Eighth Avenue and West 30th Street bike routes, as well as within 500 feet of several CitiBike stations surrounding Penn Station and along Broadway.

The Proposed Project would also support the proposed expansion of Penn Station. The proposed expansion of Penn Station would alleviate the limitations on train operations within Penn Station and would be integrated with Penn Station, including Moynihan Train Hall, to create the Empire Station Complex. Furthermore, the new developments would provide new entrances and connections for both Penn Station and the subway system, further increasing transit access for the area.

REDUCE CONSTRUCTION OPERATION EMISSIONS

Construction specifications would include an extensive diesel emissions reduction program, as described in detail in Chapter 20, "Construction," including diesel particle filters for large construction engines and other measures. These measures would reduce particulate matter emissions; while particulate matter is not included in the list of standard GHGs ("Kyoto gases"), recent studies[15] have shown that black carbon—a constituent of particulate matter—may play an important role in climate change.

USE BUILDING MATERIALS WITH LOW CARBON INTENSITY

Recycled steel would most likely be used for most structural steel since the steel available in the region is mostly recycled. Some cement replacements such as fly ash and/or slag may also be used, and concrete content would be optimized to the extent feasible.

The core and shell components would use recycled materials, materials produced regionally, rapidly renewable materials, certified sustainable wood products, and materials that contain recycled content (as appropriate). The greatest opportunity would be associated with tenant build-out. As potential tenants have not been identified, design details and specific measures are not currently known. However, future tenants could be required to utilize sustainable practices during construction and operation of leased space in the proposed commercial developments in order to ensure tenants use low carbon intensity materials. Such measures could be required through lease

[15] Journal of Geophysical Research: Atmospheres. Vol 118. *Bounding the role of black carbon in the climate system: A scientific assessment*. June 6, 2013.

provisions that call for the use of low carbon intensity materials in any final build-out construction or installation, to the extent practicable.

Construction waste would be diverted from landfills to the extent practicable by separating out materials for reuse and recycling, with a diversion target of minimum 75 percent. ✷