Chapter 4F: Greenhouse Gas Emissions

A. INTRODUCTION

Increased concentrations of greenhouse gases (GHGs) in the atmosphere are changing the global climate, resulting in 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.

Subsequent to the completion in 2006 of the Final Environmental Impact Statement (FEIS) for the Atlantic Yards Arena and Redevelopment Project, the 2010 and 2012 updates to the *City Environmental Quality Review (CEQR) Technical Manual* identified types of projects undergoing environmental review for which consideration of GHG emissions and the assessment of the project's consistency with the City's GHG emission reduction goal are appropriate. The City's goal to reduce citywide GHG emissions to 30 percent below 2005 levels by 2030 was codified by Local Law 22 of 2008, known as the New York City Climate Protection Act (the "GHG reduction goal").[1]

Phase II under the Extended Build-Out Scenario would result in development of more than 350,000 square feet (one of the triggers for conducting a GHG assessment under CEQR). Therefore, this chapter assesses the GHG emissions associated with the construction and operation of Phase II under the Extended Build-Out Scenario. A project's consistency with the GHG reduction goal is evaluated in terms of qualitative goals to reduce GHG emissions. Accordingly, this chapter also discusses measures that would be implemented to limit GHG emissions. An analysis of greenhouse gas emissions was not included in the CEQR methodology at the time of the 2006 FEIS. This analysis is new to the environmental review of Phase II of the Project.

As discussed in Chapter 1, "Project Description", Phase II development would include up to 4,932 dwelling units and 156,007 square feet of local retail in 11 buildings to be located on blocks 1120, 1121, 1128, and 1129 to the east of 6th Avenue. The local retail space may also house community facility uses, such as the intergenerational community center planned for Phase II of the Project and a public school, if built at the election of the New York City Department of Education.

PRINCIPAL CONCLUSIONS

Phase II of the Project upon completion under the Extended Build-Out Scenario would result in annual GHG emissions of approximately 82,163 metric tons of CO_2 equivalent (CO_2e) from the operation of the buildings. Of that amount, approximately 72,840 metric tons of CO_2e would be emitted as a result of grid electricity use and natural gas consumption on-site, while the

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

remainder would be emitted as a result of project -generated vehicle trips. During the construction period and as a result of off-site production of construction materials for Phase II of the Project an estimated 195,785 metric tons of CO_2e would be emitted. Estimated construction-related emissions include on-site emissions from construction equipment, emissions from construction material delivery and construction waste truck trips, construction employee trips, as well as off-site emissions associated with the production of concrete and steel that would be used in construction. In developing these estimates, conventional construction materials and methods were assumed. As the Project would include efforts to reduce emissions during construction and use locally sourced and recycled materials, to the extent practicable, the construction emission estimate provided is conservatively high. The construction schedule for the Project would have minimal effect on the GHG emissions from construction, as long as the proposed construction activity is of similar scope. Therefore, the overall conclusions of the assessment presented here for the Extended Build-Out scenario would also be applicable to different construction schedules.

As per the Amended Memorandum of Environmental Commitments (MEC), all Phase II buildings would obtain the United States Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) certification for new construction with the goal of achieving a Silver rating for each proposed building. Specific sustainable measures would be incorporated into the design and construction of the Project, which would decrease the potential GHG emissions. Based on the sustainable measures that would be included, Phase II of the Project would be consistent with the City's emissions reduction goal, as defined in the *CEQR Technical Manual*. In addition, as discussed in the 2009 Technical Memorandum and the 2006 FEIS, the project site is located at one of the largest transportation hubs in the City and construction of this high density transit-oriented development at this location would encourage use of mass transit, thereby reducing GHG emissions from automobile travel. The Project would also promote non-motorized modes of transportation, including cycling and walking. The 2009 Technical Memorandum had concluded that the Project is consistent with PlaNYC, New York City's long-term sustainability program, including the goal to reduce GHG emissions. The assessment presented in this chapter confirms the 2009 Technical Memorandum conclusion with respect to consistency with the City's GHG emission reduction goal.

B. POLICY, REGULATIONS, STANDARDS, AND BENCHMARKS FOR REDUCING GHG EMISSIONS

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. Although the U.S. has not ratified the international agreements that set emissions targets for GHGs, in a step toward the development of national climate change regulation, the U.S. has stated a commitment to 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 GHGs under the Clean Air Act (CAA), and has promulgated regulations addressing newly manufactured vehicles and the permitting of large stationary sources. In addition, the American Recovery and Reinvestment Act of 2009 (ARRA, the "economic stimulus package") funded actions and

[1] Todd Stern, U.S. Special Envoy for Climate Change, letter to Mr. Yvo de Boer, United Nations Convention Framework on Climate Change (UNCFCC), January 28, 2010.

research that can lead to reduced GHG emissions, and 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 GHG capture and storage options.

The U.S. Department of Transportation (USDOT) and USEPA have also established GHG emission standards and more stringent combined corporate average fuel economy (CAFE) standards for vehicles. These regulations will all serve to reduce vehicular GHG emissions over time.

There are also regional, state, and local efforts to reduce GHG emissions. In 2009, Governor Paterson issued Executive Order No. 24, 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[1]). The 2009 New York State Energy Plan[2] outlines the state's energy goals and provides strategies and recommendations for meeting those goals. The state's goals include:

- Implementing programs to reduce electricity use by 15 percent below 2015 forecasts;
- Updating the energy code and enacting product efficiency standards;
- Reducing vehicle miles traveled by expanding alternative transportation options; and
- Implementing programs to increase the proportion of electricity generated from renewable resources to 30 percent of electricity demand by 2015.

New York State has also developed regulations to cap and reduce CO_2 emissions from power plants to meet its commitment to the Regional Greenhouse Gas Initiative (RGGI). Under the RGGI agreement, the governors of nine Northeast and Mid-Atlantic states have committed to regulate the amount of CO_2 that power plants are allowed to emit. The regional emissions cap for power plants will be held constant through 2014, and then gradually reduced to 10 percent below the initial cap through 2018. The states participating in RGGI have conducted a comprehensive program review and proposed amendments that include revisions to the RGGI CO_2 emissions cap. 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.

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 sustainability program, PlaNYC 2030, includes GHG emissions reduction goals, specific initiatives that can result in emission reductions and initiatives targeted at adaptation to climate change impacts. For certain projects subject to CEQR, an analysis of the project's GHG emissions and an assessment of the project's consistency with the City's citywide emission reduction goal are required.

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1 New York State Department of Environmental Conservation (NYSDEC), Climate Action Planning. http://www.dec.ny.gov/energy/80930.html, accessed November 13, 2013

2 New York State, 2009 New York State Energy Plan, December 2009. *Note: the planning effort for the 2013 State Energy Plan is underway.*

In December 2009, the New York City Council enacted four laws addressing energy efficiency in new and existing buildings, in accordance with PlaNYC. The laws require owners of existing buildings larger than 50,000 square feet to conduct energy efficiency audits every ten years, to optimize building energy efficiency, and to "benchmark" the building's energy and water consumption annually, using a USEPA online tool. By 2025, commercial buildings over 50,000 square feet will also require lighting upgrades, including the installation of sensors and controls, more efficient light fixtures, and the installation of sub-meters, so that tenants can be provided with information on their electricity consumption. The legislation also created a New York City Energy Code, which requires equipment installed during a renovation to meet current efficiency standards (in addition to the State code addressing new construction only).

A number of voluntary rating systems for energy efficiency and green building design have also been developed. For example, LEED is a benchmark for the design, construction, and operation of high performance green buildings that includes energy efficiency components. Another voluntary rating system is USEPA's *Energy Star*—a labeling program designed to identify and promote the construction of new energy efficient buildings, facilities, and homes and the use of energy efficient appliances, heating and cooling systems, office equipment, lighting, home electronics, and building envelopes.

C. METHODOLOGY

Although the contribution of any single project to climate change is infinitesimal, the combined GHG emissions from all human activity are believed to have a severe adverse impact on global climate. 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. As required by the *CEQR Technical Manual*, this chapter presents the total GHG emissions potentially associated with Phase II of the Project and identifies the measures that would be implemented and measures that are under consideration to limit the emissions, as part of the project sponsor's goal of achieving a LEED Silver rating for each proposed building.

The analysis of GHG emissions that would be generated by the Project is based on the methodology presented in the *CEQR Technical Manual*. Emissions of GHGs associated with Phase II of the Project have been quantified, including off-site emissions associated with on-site use of electricity, on-site emissions from heating and hot water systems, emissions from motor vehicle trips attributable to Phase II of the Project, and emissions from construction activity and associated with the use of construction materials. The beneficial effect of implementation of energy-efficiency measures and sustainable project elements has not been accounted for, with the exception of energy-efficient boilers for heating and hot water, which were assumed in developing energy consumption projections.

POLLUTANTS OF CONCERN

GHGs are those 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. This property causes the general warming of the Earth's atmosphere, or the "greenhouse effect."

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 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 nitrous oxide also play an important role since the removal processes for these compounds are limited and these pollutants have 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 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 an EIS: CO_2, nitrous oxide (N_2O), methane, Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and Sulfur Hexafluoride (SF_6). This analysis focuses on CO_2, N_2O, and methane. There are no significant direct or indirect sources of HFCs, PFCs, or SF_6 associated with the 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 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 4F-1**.

BUILDING OPERATIONAL EMISSIONS

Emissions from electricity and on-site use of natural gas for heating, hot water, and cooking were calculated using information provided by the engineering consultant responsible for designing the heating, ventilation, and air conditioning (HVAC) systems. The building floor area, projected electricity use, and total natural gas use is shown in **Table 4F-2**.

Table 4F-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: International Panel on Climate Change (IPCC), Climate Change 1995—Second Assessment Report.

Table 4F-2
Building Floor Area and Annual Energy Use

Building / Use	Floor Area (gsf)	Electricity (MWh/yr)	Natural Gas (DKT/yr)
Building 5	556,674	15,342	80,515
Building 6	392,741	10,457	50,423
Building 7	639,431	17,910	84,051
Building 8	456,027	12,867	58,919
Building 9	587,437	16,756	79,706
Building 10	408,722	11,563	58,291
Building 11	330,778	9,388	40,607
Building 12	317,185	9,257	40,432
Building 13	327,215	8,872	40,553
Building 14	283,971	8,302	37,942
Building 15	341,910	9,638	40,776
Proposed School[1]	100,000	4,479	1,045
Total	**4,642,091**	**134,831**	**613,260**

Notes:
gsf is gross square feet; MWh/yr is megawatt hours per year; DKT/yr is dekatherms per year.
1. The project sponsors have committed to provide, at the election of the New York City Department of Education (DOE), adequate space for the construction and operation of a 100,000 gsf elementary and intermediate school in the base of one of the Phase II residential buildings.
Source: WSP Group.

The electricity emission factor of 82.9 kg CO_2e per gigajoule (GJ) [1] or approximately 0.3 metric tons of CO_2e per megawatt hour (MWh) was used to calculate GHG emissions from the electricity use. The emission factor for natural gas provided in *CEQR Technical Manual* Table 18-2 was used to calculate emissions from natural gas use.

OPERATIONAL MOBILE SOURCE EMISSIONS

The number of annual motorized vehicle trips and miles traveled by mode (cars, taxis, trucks, and school buses) that would be generated by Phase II of the Project was calculated using the transportation planning assumptions developed for the analysis presented in Chapter 4D, "Operational Transportation." The assumptions used in the calculation of annual trips and vehicle miles traveled (VMT) include average daily weekday person trips and delivery trips, the percentage of vehicle trips by mode, and the average vehicle occupancy. Travel distances shown in Table 18-4 and Table 18-5 of the *CEQR Technical Manual* for "Other NYC", i.e. boroughs other than Manhattan, were used to calculate annual vehicle miles traveled by personal vehicles and taxis. The average one-way truck trip was assumed to be 38 miles, as per the *CEQR Technical Manual*. Table 18-6 of the *CEQR Technical Manual* was used to determine the percentage of vehicle miles traveled by road type and the mobile GHG emissions calculator was used to project car, taxi, and truck GHG emissions attributable to Phase II of the Project.

To account for the emissions from the proposed school generated school bus trips, 24 metric tons of CO_2e per year were added to the public school mobile source emissions shown in **Table 4F--6** and **Table 4F--8**, presented in subsequent sections of this chapter. These school bus

[1] PlaNYC, Inventory of New York City Greenhouse Gas Emissions, December 2012.

emissions were calculated based on the projected number of up to 3 school buses needed to serve the proposed school, and the annual school bus GHG emissions of approximately 8 metric tons of CO_2e per bus, based on PlaNYC GHG emissions inventory and related information.

USEPA estimates that the well-to-pump GHG emissions of gasoline and diesel are approximately 22 percent of the tailpipe emissions.[1] Upstream emissions (emissions associated with production, processing, and transportation) of all fuels can therefore be substantial and are important to consider when comparing the emissions associated with the consumption of different fuels. The Project would use natural gas as fuel and a comparison of emissions with the use of other fuels is not considered. Consistent with the *CEQR Technical Manual* guidance the well-to-pump emissions are not considered in the analysis for the Project. The projected annual VMT, forming the basis for the GHG emissions calculations from mobile sources, are presented in **Table 4F-3**.

Table 4F-3
Annual Vehicle Miles Traveled

Building / Use	Personal Vehicles	Taxis	Trucks	Total
Building 5	1,195,977	188,411	439,888	1,824,276
Building 6	849,228	182,111	325,539	1,356,878
Building 7	1,371,024	191,592	497,615	2,060,231
Building 8	977,528	134,354	354,181	1,466,063
Building 9	1,255,485	139,404	445,845	1,840,734
Building 10	877,469	132,536	321,184	1,331,189
Building 11	712,603	129,540	266,815	1,108,958
Building 12	683,851	129,018	257,334	1,070,203
Building 13	705,067	129,403	264,330	1,098,800
Building 14	613,597	127,741	234,166	975,504
Building 15	736,729	135,196	276,195	1,148,120
Proposed School[1]	262,479	2,832	225,238	490,549
Total	10,241,037	1,622,138	3,908,330	15,771,505

Notes:
1. The project sponsors have committed to provide, at the election of DOE, adequate space for the construction and operation of a 100,000 gsf elementary and intermediate school in the base of one of the Phase II residential buildings.

Emissions from school buses were calculated based on per bus emission data. Therefore, VMT for the school buses did not need to be determined. Emissions from school buses are included in **Table 4F-6** and **Table 4F-8**.

CONSTRUCTION GHG EMISSIONS

Construction activities for Phase II of the Project under the Extended Build-Out scenario would result in GHG emissions from on-site construction equipment, truck travel associated with construction material deliveries and disposal, construction worker trips, and the use of steel and concrete – two construction materials whose manufacturing process requires substantial energy use and generate considerable GHG emissions.

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

Construction Activity

GHG emissions from construction delivery trucks and other construction traffic, as well as construction equipment, were quantified using the construction activity estimates developed as part of Chapter 3I, "Construction Air Quality." The emission factors for construction equipment were obtained from the EPA's NONROAD2008 Emission Model (NONROAD). The model is based on source inventory data accumulated for specific categories of nonroad equipment. The assumptions used in the calculation of emissions from construction employee trips, including trips by mode, and the average vehicle occupancy were based on information developed for Chapter 3H, "Construction Transportation." The construction employee vehicle trip travel distance was assumed to be 8 miles.[1] With 55 percent of construction employees anticipated to be traveling to the site by car, and vehicle occupancy of 1.9, the employee VMT over the entire construction period was calculated to be approximately 6.5 million miles.

The average one-way truck trip was assumed to be 38 miles, as per the *CEQR Technical Manual*. Based on the truck delivery projections developed for the construction analysis, the total truck VMT over the construction period was calculated to be approximately 15.1 million miles.

The *CEQR Technical Manual* was used to determine the percentage of person vehicle miles and truck vehicle miles traveled by road type. The mobile GHG emissions calculator was used to estimate construction employee trip and truck delivery GHG emissions attributable to Phase II of the Project under the Extended Build-Out scenario, assuming 2026, as the mid-year of construction.

Construction Materials

Upstream emissions associated with the production of steel and cement are included in this assessment because their production would comprise a major component of overall emissions from construction. Although the project would aim to maximize the use of recycled steel and cement replacements, the GHG reduction benefits of those sustainable measures have not been quantified because the fraction of recycled steel and cement replacements has not yet been determined.

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. 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 and other metals also generates process-related emissions of CO_2 and methane. The official U.S. National GHG inventory accounted for process and energy use emissions from GHG intensive industrial activity, including emissions from the production of cement, steel, and aluminum,

[1] The distance used is based on office trips distance shown in Table 18-4 of the *CEQR Technical Manual for "Other NYC"*, i.e. boroughs other than Manhattan. The references that were used to develop the office trip distances provided in the *Technical Manual* included surveys of work-related trips in the region. The surveys were not specific regarding the type of work (office or other) for the work-related trips. Therefore, as the trips for the construction employees are work-related trips, the use of the "office" trip distance provided in the *Technical Manual* is appropriate.

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

following IPCC guidelines.[1] Emissions associated with the production of construction materials other than steel and concrete are small in comparison with the emissions from the production of the materials that were included. Furthermore, the *CEQR Technical Manual* identified steel and concrete as the materials needing consideration in cases when a quantified assessment of construction emissions is performed.

The production of ordinary portland cement (OPC) results in substantial GHG emissions, which can be reduced through use of cement component replacements, such as flyash (a byproduct of coal-fired power generation) and/or slag (a byproduct of iron production). These cement component replacements are often included as a small fraction of the total cement used in the concrete mix. Phase II of the Project would aim to use cement replacement instead of traditional content to the extent feasible considering the need to maintain appropriate building and design features and the need to comply with applicable building and fire codes. The Project will use cement replacements to the extent practicable, but the fraction of cement to be replaced is unknown at this time. Therefore, for the purposes of this analysis, it was conservatively assumed that the concrete used for the development of Phase II of the Project would be produced using 100 percent OPC. A lifecycle emission factor for OPC of approximately 0.018 metric tons of CO_2e per cubic foot of cement was based on Building for Environmental and Economic Sustainability (BEES) software results.

A range of values for the steel production GHG emission factor can be found in research literature (0.44 to 1.95 metric tons of CO_2 per metric ton of steel produced). A factor of 1.83 metric tons of CO_2 per metric ton of steel was used in the present analysis, based on the U.S. average emissions from integrated steelmaking in 1994.[2] More recent literature,[3] as well as the World Steel Association,[4] indicates that the value used in the analysis is typical for integrated steel plants. The Project would use recycled steel to the extent practicable, but the percentage of recycled steel that would be used has not yet been determined. Emissions associated with the use of recycled steel are over 70 percent lower than emissions from steel made from iron ore. Therefore, the emissions estimates provided are conservatively high. While the percentage of recycled steel that would be used is unknown at this time and the associated emission reduction can therefore not be applied, by way of illustration the Atlantic Yards Arena was constructed using structural steel with 99 percent recycled content. Emissions from the use of aluminum and other metals were not calculated explicitly, but a greater amount of steel was assumed to account for aluminum and other metals. The amounts of concrete and steel that are anticipated to be required for the project are shown in **Table 4F-4.**

[1] IPCC, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3, Industrial Processes and Product Use.

[2] Worrell, Martin, and Price, Energy Efficiency and Carbon Dioxide Emissions Reduction Opportunities in the U.S. Iron and Steel Sector, Ernest Orlando Lawrence Berkeley National Laboratory, 1999.

[3] Hasanbeigi, Price, and Arens, Emerging Energy-efficiency and Carbon Dioxide Emissions-reduction Technologies for the Iron and Steel Industry, Ernest Orlando Lawrence Berkeley National Laboratory, 2013.

[4] World Steel Association, http://www.worldsteel.org/publications/position-papers/Steel-s-contribution-to-a-low-carbon-future.html, accessed December 3, 2013

Table 4F-4
Concrete and Steel for Construction

Building	Concrete (cubic feet)	Steel (metric tons)
Building 5	767,515	2,548
Building 6	546,618	1,821
Building 7	879,044	2,915
Building 8	631,916	2,102
Building 9	809,320	2,686
Building 10	568,055	1,892
Building 11	465,214	1,556
Building 12	446,726	1,495
Building 13	460,706	1,542
Building 14	401,887	1,347
Building 15	479,775	1,603
Total	**6,456,776**	**21,507**

Source: Estimated based on data for buildings of similar size and type of use.

EMISSIONS FROM SOLID WASTE MANAGEMENT

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

D. GHG EMISSIONS WITH PHASE II OF THE PROJECT

BUILDING OPERATIONAL EMISSIONS

The GHG emissions from energy use of the Phase II buildings are presented in detail in **Table 4F-5**. Except for the high-efficiency boilers proposed for use in the proposed buildings, the energy savings that would be achieved through the various sustainability measures that would be implemented (discussed below) are not accounted for in the GHG emissions calculated. Therefore, the emissions associated with the proposed buildings shown in **Table 4F-5**, are conservatively high.

Table 4F-5
Annual Building Operational Emissions (metric tons CO_2e)

Building / Use	Electricity	Natural Gas	Total
Building 5	4,577	4,282	8,859
Building 6	3,120	2,682	5,801
Building 7	5,343	4,470	9,813
Building 8	3,839	3,134	6,972
Building 9	4,999	4,239	9,238
Building 10	3,450	3,100	6,550
Building 11	2,801	2,160	4,960
Building 12	2,762	2,150	4,912
Building 13	2,647	2,157	4,804
Building 14	2,477	2,018	4,495
Building 15	2,875	2,169	5,044
Proposed School[1]	1,336	56	1,392
Total	40,224	32,617	72,840

Note:
1. The project sponsors have committed to provide, at the election of DOE, adequate space for the construction and operation of a 100,000 gsf elementary and intermediate school in the base of one of the Phase II residential buildings.

Source: CO_2e estimates were developed by AKRF based on projected energy consumption data provided by WSP Group.

MOBILE SOURCE EMISSIONS

The detailed mobile-source GHG emissions from each building developed in Phase II of the Project under the Extended Build-Out scenario are presented in **Table 4F-6**.

Table 4F-6
Annual Mobile Source Emissions (metric tons CO_2e)

Building	Personal Vehicles	Taxis	Trucks	Total
Building 5	375	53	635	1,063
Building 6	266	51	470	787
Building 7	429	53	718	1,200
Building 8	306	37	511	854
Building 9	393	39	643	1,075
Building 10	275	37	463	775
Building 11	223	36	385	644
Building 12	214	36	371	621
Building 13	221	36	381	638
Building 14	192	36	338	566
Building 15	231	38	339	668
Proposed School[1]	82	1	349	432
Total	3,207	453	5,663	9,323

Notes:
1. The project sponsors have committed to provide, at the election of the DOE, adequate space for the construction and operation of a 100,000 gsf elementary and intermediate school in the base of one of the Phase II residential buildings.

The annual school bus emissions are included in the emissions for the school, reported under "Trucks".

CONSTRUCTION GHG EMISSIONS

Table 4F-7 summarizes the GHG emissions from the expected construction activity and GHG emitted off-site during the steel and concrete manufacturing process.

Table 4F-7
Construction Emissions for the 2018-2035 Construction Period for Phase II
(metric tons CO_2e)

Building	Construction Equipment	Mobile Sources	Construction Materials	Total
Building 5	1,000	2,983	18,832	22,815
Building 6	1,264	2,105	13,424	16,792
Building 7	1,309	3,427	21,563	26,229
Building 8	778	2,444	15,512	18,734
Building 9	961	3,148	19,856	23,965
Building 10	1,138	2,190	13,948	17,276
Building 11	1,192	1,773	11,436	14,401
Building 12	1,197	1,700	10,983	13,880
Building 13	1,089	1,753	11,326	14,168
Building 14	1,069	1,522	9,885	12,476
Building 15	1,356	1,832	11,791	14,979
Total	**16,732**	**24,877**	**158,556**	**195,785**

Notes: Mobile source emissions include employee personal vehicle trips and truck trips for deliveries and construction waste removal.
The proposed school, if built upon the election of DOE, would be within one of the Phase II buildings and the emissions from the construction of the school are accounted for within the building envelopes and construction activity assumed.

SUMMARY

A summary of annual operational GHG emissions by Phase II building and by emission source is presented in **Table 4F-8**.

Table 4F-8
Annual Operational Emissions (metric tons CO_2e)

Building	Building Operational	Mobile Source[1]	Total Operational
Building 5	8,859	1,063	9,922
Building 6	5,801	787	6,588
Building 7	9,813	1,200	11,013
Building 8	6,972	854	7,826
Building 9	9,238	1,075	10,313
Building 10	6,550	775	7,325
Building 11	4,960	644	5,604
Building 12	4,912	621	5,533
Building 13	4,804	638	5,442
Building 14	4,495	566	5,061
Building 15	5,044	668	6,712
Proposed School[2]	1,392	432	1,824
Total	72,840	9,323	82,163

Notes: 1. Mobile source emissions include emissions from personal vehicle trips, taxis, deliveries by truck, and school buses.
2. The project sponsors have committed to provide, at the election of DOE, adequate space for the construction and operation of a 100,000 gsf elementary and intermediate school in the base of one of the Phase II residential buildings.

Phase II of the Project under the Extended Build-Out scenario would result in annual GHG emissions of approximately 82,163 metric tons of CO_2e from operation of the buildings. Of that amount, approximately 9,323 metric tons of CO_2e would be emitted as a result of fuel consumption for vehicle trips generated by Phase II of the Project. A total of approximately 72,840 metric tons of CO_2e would be emitted as a result of grid electricity use and on-site fuel use for energy systems. The operational emissions from building energy use include emissions from fuel that would be consumed on-site as well as emissions associated with the production and delivery of the electricity to be used on site. These operational emissions are conservatively high, as they do not account for all of the energy efficiency and emissions savings that would result from the implementation of sustainable measures described below.

During the construction period and as a result of production of construction materials for Phase II of the Project, approximately 195,785 metric tons of CO_2e would be emitted. Improvements in energy efficiency of construction equipment, construction trucks, personal vehicles, and the reduction of GHG emissions during the manufacturing of construction materials are likely over the long term. However, extending the construction schedule for the Project under the Extended Build-Out Scenario would have minimal effect on the GHG emissions from construction, because the proposed construction activity would be of similar scope under both the Extended Build-Out Scenario and a more accelerated schedule. Moreover, extending the construction schedule would result in greater portion of construction occurring later in the future, when more efficient equipment and more sustainable materials would likely be available.

It should be noted that the operational emissions are presented on an annual basis, while the construction emissions provided are the total for the entire construction period. The total construction emissions are typically put in the context of overall emissions, to provide a sense of their relative contribution, by calculating the amount of time over which operational emissions are comparable to emissions from construction. For the Project, the construction emissions would be approximately equivalent to emissions during 29 months of Phase II project operation.

E. ELEMENTS OF THE PROJECT THAT WOULD REDUCE GHG EMISSIONS

Phase II of the Project would include a number of sustainable design features that would lower GHG emissions from the Project. These features are discussed in this section, assessing the consistency of the Project with the GHG reduction goal as outlined in the *CEQR Technical Manual*.

BUILD EFFICIENT BUILDINGS

As per the MEC, all Phase II buildings would obtain the USGBC LEED certification for new construction with the goal of achieving a Silver rating for each proposed building. The following sustainable design elements would be incorporated:

- Energy efficient building envelope, which would reduce cooling and heating needs, exceeding the building energy code requirements.
- Highly reflecting roofing material, which would reduce air conditioning needs in the summer and help mitigate the urban heat island effect.[1]

[1] The urban heat island effect refers to the temperature difference between urban areas and surrounding suburban or rural areas. Much of this temperature difference is attributed to the prevalence of dark roofs

- Use of efficient, directed exterior lighting.
- Third party building commissioning to ensure energy performance.
- Construction and design guidelines to facilitate sustainable build-out by tenants.
- Storage space and collection of recyclables, including paper, corrugated cardboard, glass, plastic and metals in each building.

The proposed buildings would also likely incorporate window glazing that would optimize daylighting, heat loss, and solar gain. It is likely that high-efficiency HVAC systems, efficient lighting, elevators, and generators that would exceed requirements would be used, and that motion sensors for lighting control would be installed in storage areas and other accessory spaces. In addition, the use of water conserving fixtures that exceed building code requirements, low impact development for stormwater design, and water efficient landscaping will likely be incorporated, as part of the goal of achieving a LEED silver rating for each building. While the proposed open space and water conservation measures would not directly reduce GHG emissions, benefits of these features would indirectly reduce GHG emissions. Reduced water consumption reduces the energy needed to treat and deliver water and wastewater. Green open space helps reduce the heat-island effect, thereby lowering cooling requirements and associated energy use and GHG emissions in the summer. Other sustainable design measures that may be considered in meeting the LEED Silver rating goal include the reduction of energy demand using green roofs, peak shaving or load shifting strategies, and the re-use of gray water and collection and re-use of rainwater.

USE CLEAN POWER

Fuel from less GHG-intense fuels, specifically natural gas, would be used. While the on-site generation of wind or solar power is not anticipated, purchasing renewable energy credits would be considered on a building-by-building basis, as part of the goal of achieving a LEED Silver rating.

ENHANCE AND USE TRANSIT-ORIENTED DEVELOPMENT AND SUSTAINABLE TRANSPORTATION

Phase II of the Project is easily accessed by public transportation and is located in an area with one of the densest concentrations of transit services in the City. Nearby transit services include 11 subway routes, 11 bus routes, and the Long Island Rail Road. Construction and operation of a high density transit-oriented development at this location would encourage the use of mass transit, thereby reducing GHG emissions from automobile travel. The Project is also easily accessed by walking and cycling routes from multiple entry points.

A bicycle path through the open space is also proposed. It is anticipated that the bicycle path would enter the project site along Atlantic Avenue at Cumberland Street and would continue southbound between Buildings 6 and 7 (see Figure 1-4). The route would turn east running along Pacific Street where it would reenter the project site at a pedestrian pathway at Carlton Avenue. As currently conceived, it would continue southeast around Building 14 to Dean Street. The bike path would continue eastward along Dean Street toward Vanderbilt Avenue where it would connect with the larger city bicycle network. There would be a storage area for 400 bicycles on

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and dark colored pavement, which absorb more heat than lighter surfaces, as well as the declining presence of vegetation in cities.

the Arena block, anticipated to be located in the base of Building 3. The bicycle station would include space for supporting ancillary uses.

As noted in Chapter 1, "Project Description," the project sponsor proposes to reduce accessory parking for the Project from the 3,670 spaces analyzed in the 2006 FEIS to 2,896 parking spaces, and this proposal is included in the program for Phase II analyzed in the Extended Build-Out Scenario. In addition, as discussed in Chapter 6, "Alternatives," a Reduced Parking Alternative is analyzed to consider modified parking requirements that would reduce the amount of accessory parking provided for the Project's residential uses. The "Reduced Parking Alternative" would be an alternative that would further reduce on-site parking to reflect the recent zoning changes for Downtown Brooklyn, which eliminated accessory parking requirements for affordable housing units and reduced accessory parking requirements for market-rate housing. In addition, designated on-site parking for alternative fuel or fuel efficient vehicles and on-site charging stations for electric vehicles would likely be provided, as part of the goal of achieving a LEED Silver rating. By reducing parking to the extent practicable and permitted, the construction materials and construction activity would be reduced, resulting in lower GHG emissions. It is also possible that less abundant parking would encourage the use of public transit and non-motorized modes of transportation, which are associated with lower GHG emissions.

REDUCE CONSTRUCTION OPERATION EMISSIONS

Effort to reduce construction operation emissions is one of the five goals considered in the assessment of consistency of a project with the City's GHG reduction goal. Some of the measures identified in the *CEQR Technical Manual* that are generally considered, such as the use of diesel particulate filters, reduce particulate matter, rather than CO_2 and other GHGs. While particulate matter is not included in the list of standard greenhouse gasses, recent studies have shown that black carbon—a constituent of particulate matter—may play an important role in climate change.[1] As detailed in Chapter 3I, "Construction Air Quality," a number of measures that would reduce particulate emissions during construction would be implemented, to the extent feasible, including: diesel equipment reduction by substituting electric-powered equipment where feasible, use of clean fuel (ULSD), use of best available tailpipe reduction technologies (consistent with specific measures identified for consideration in the *CEQR Technical Manual* as part of the goal for reducing construction-related emissions), use of new equipment, and fugitive dust control measures, and idling restrictions on-site.

USE BUILDING MATERIALS WITH LOW CARBON INTENSITY

To limit the GHG emissions from emissions generated during extraction, production, and transport of construction materials, the use of recycled steel would be required and construction waste would be diverted from landfill through reuse and recycle efforts. The following sustainable measures would also likely be incorporated, as part of the goal of achieving a LEED Silver rating:

- Use of building materials with recycled content.
- Use of building materials that are extracted and/or manufactured within the region.

[1] Intergovernmental Panel on Climate Change, *Fourth Assessment Report: Climate Change 2007*, September 2007.

- Use of rapidly renewable building materials.
- Use of wood that is locally produced and/or certified in accordance with the Sustainable Forestry Initiative or the Forestry Stewardship Council's Principles and Criteria.

Where appropriate, cement replacements would be used, and the use of cement produced using lower-GHG fuel or concrete with optimized cement content would be considered where opportunities exist.

Based on the sustainable measures that would be included, Phase II of the Project would be consistent with the City's emissions reduction goal, as defined in the *CEQR Technical Manual*.✷