Chapter 16: Greenhouse Gas Emissions

A. INTRODUCTION

There is general consensus in the scientific community that the global climate is changing as a result of increased concentrations of greenhouse gases (GHGs) in the atmosphere. GHGs are those gaseous constituents of the atmosphere, from both natural and anthropogenic (i.e., resulting from the influence of human beings) emission sources, that absorb infrared radiation (heat) emitted from the earth's surface, the atmosphere, and clouds. This property causes the general warming of the earth's atmosphere, or the "greenhouse effect."

As discussed in the *CEQR Technical Manual*, climate change could 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. Through PlaNYC, New York City has established sustainability initiatives and goals for both greatly reducing GHG emissions and adapting to climate change in the city. The 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] Per the *CEQR Technical Manual*, the citywide GHG reduction goal is currently the most appropriate standard by which to assess a project's consistency with GHG goals. The *CEQR Technical Manual* recommends that a GHG consistency assessment be conducted for any project resulting in 350,000 gross square feet (gsf) of development or more and other energy-intense projects. As the proposed project would result in new development that would be slightly in excess of 350,000 gsf, a GHG consistency assessment is provided. This chapter addresses the GHG emissions that would be generated by the proposed project and describes the measures that would be implemented to limit those emissions.

PRINCIPAL CONCLUSIONS

As discussed in the following sections, the building energy use and vehicle use associated with the proposed project would result in approximately 5,604 metric tons of carbon dioxide equivalent (CO_2e) emissions per year. Of that amount, 2,798 metric tons of CO_2e per year would result from building operational energy use, and the rest from mobile sources.

The proximity of the project site to public transportation and the design of the building would contribute to the energy efficiency of the proposed development. The proposed project would result in new mixed-use development and reuse of an existing building in a developed area with excellent access to public transit. As such, the proposed project is consistent with sustainable land-use planning and smart-growth strategies that aim to reduce the carbon footprint of new development. Furthermore, the proposed project will be designed to meet the standards for the United States Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) Silver certification. As such, specific measures would be incorporated into the

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

design and construction of the proposed project that would decrease potential GHG emissions. Based on these project components and efficiency measures, the proposed project would be consistent with New York City's GHG reduction goal.

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

As a result of the growing consensus that human activity resulting in GHG emissions has the potential to profoundly impact the earth's climate, countries around the world have undertaken efforts to reduce emissions by implementing both global and local measures addressing energy consumption and production, land use, and other sectors. Although the U.S. has not ratified the international agreements which set emissions targets for GHGs, in a step toward the development of national climate change regulation, the U.S. has committed to reducing emissions to 17 percent lower than 2005 levels by 2020 and to 83 percent lower than 2005 levels by 2050 (pending legislation) via the Copenhagen Accord.[1] Without legislation focused on this goal, the U.S. Environmental Protection Agency (EPA) is required to regulate greenhouse gases under the Clean Air Act (CAA), and has already begun preparing regulations. In May 2010, EPA issued a final rule (effective August 2010) to tailor the applicability criteria for stationary sources subject to permitting requirements under CAA, setting thresholds for GHG emissions that define when permits are required for new and existing industrial facilities under the New Source Review Prevention of Significant Deterioration (PSD) and Title V Operating Permit programs.

In addition, EPA has published regulations regarding geological sequestration of CO_2, a GHG reporting rule to collect information on GHG emissions, and has also established various voluntary programs to reduce emissions and increase energy efficiency. The American Recovery and Reinvestment Act of 2009 (ARRA, "economic stimulus package") funds actions and research that can lead to reduced GHG emissions.

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 promoting research on GHG capture and storage options. The most recent renewable fuel standards regulations (February 2010) require 12.95 billion gallons of renewable fuels be produced in 2010, increasing annually up to 36.0 billion gallons in 2022. The renewable fuel standards regulations also set volume standards for specific categories of renewable fuels including cellulosic, biomass-based diesel, and total advanced renewable fuels, and specify lifecycle GHG reduction thresholds ranging from 20 percent for renewable fuel to 60 percent for cellulosic biofuel (as compared with the baseline gasoline or diesel replaced).

In March 2009, the U.S. Department of Transportation (USDOT) set combined corporate average fuel economy (CAFE) standards for light-duty vehicles for the 2011 model year (MY). In June 2009, EPA granted California a previously denied waiver to regulate vehicular GHG emissions, allowing 19 other states (representing 40 percent of the light-duty vehicle market, including New York) to adopt the California mobile source GHG emissions standards. In April 2010, EPA and USDOT established the first GHG emission standards and more stringent CAFE standards for MY 2012 through 2016 light-duty vehicles. The agencies also proposed the first-ever program to reduce GHG emissions and improve fuel efficiency of medium- and heavy-duty

[1] Todd Stern, U.S. Special Envoy for Climate Change, letter to Mr. Yvo de Boer, UNFCCC, January 28, 2010.

vehicles, such as large pickup trucks and vans, semi trucks, and vocational vehicles. These regulations would 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, which established a goal of reducing GHG emissions in New York State by 80 percent compared with 1990 levels, by 2050, and created 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 10 northeastern 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. Each power source with a generating capacity of 25 megawatts or more must purchase a tradable CO_2 emission allowance for each ton of CO_2 it emits. The 10 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™ (CCP) 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 (e.g., projects with 350,000 gsf or more of development or other energy-intense projects), an analysis of the project's contribution of GHG emissions is required to determine its consistency with the citywide reduction goal, which is currently the most appropriate standard by which to analyze a project under CEQR, and is therefore applied in this chapter.

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 10 years, to optimize building energy efficiency, and to "benchmark" the building energy and water consumption annually, using an EPA 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 submeters, so that tenants can be provided

[1] http://www.nyclimatechange.us/

[2] New York State, *2009 New York State Energy Plan*, December 2009.

with information on their electricity consumption. The legislation also creates a local New York City Energy Code, which requires equipment installed during a renovation to meet current efficiency standards. New York City has also enacted laws that will require the use of cleaner heating fuel in both existing and new buildings and that remove barriers to implementation of renewable energy and energy efficiency measures for buildings.

Beyond the policy, a number of benchmarks for energy efficiency and green building design have also been developed. For example, the LEED system is a privately developed benchmark for the design, construction, and operation of high-performance green buildings that includes energy efficiency components.

EPA's Energy Star is a voluntary labeling program designed to identify and promote the construction of new energy-efficient buildings, facilities, and homes, and the purchase of energy-efficient appliances, heating and cooling systems, office equipment, lighting, home electronics, and building envelopes.

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. Nonetheless, prudent planning dictates that all sectors address GHG emissions by identifying GHG sources and practicable means to reduce them. Therefore, this chapter presents the total GHG emissions potentially associated with the proposed project, and identifies the measures that would be implemented to limit the emissions as well as measures that are under consideration.

The analysis of GHG emissions that would be generated by the proposed project is based on the methodology presented in the *CEQR Technical Manual*. Emissions of GHGs from the proposed project have been quantified, including off-site emissions associated with use of electricity on-site, on-site emissions from heat and hot water systems, and emissions from vehicle use attributable to the proposed project. GHG emissions that would result from construction are discussed as well.

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."

The *CEQR Technical Manual* lists six GHGs that could potentially be included in the scope of an environmental impact statement: carbon dioxide (CO_2), nitrous oxide (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.

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, or metal

production; from 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 result in a relatively high impact on global climate change 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.

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 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
Source: IPCC, Climate Change 1995—Second Assessment Report.	

BUILDING OPERATIONAL EMISSIONS

Emissions from electricity and on-site fossil fuel use were calculated using the "carbon intensity factors" provided in the *CEQR Technical Manual* (Table 18-3) by building type and the approximate floor areas for the various components of the development that would occur as a result of the proposed project, as shown in **Table 16-2**). The energy savings that would be achieved through the various sustainability measures that would be implemented (discussed below) are conservatively not accounted for in the GHG emissions calculated, as the specific energy efficiency improvements have not yet been determined.

For the residential and hotel uses, the carbon intensity factor for large residential buildings was used. For retail and cultural uses, the carbon intensity factor for commercial buildings was used. For indoor parking areas, since an emission intensity is not provided in the 2012 *CEQR Technical Manual*, the annual energy intensity of 27,400 British Thermal Units (Btu) per gsf was assumed (provided in the 2001 *CEQR Technical Manual* Table 3N-1). The electricity emission factor of 35.902 kg CO_2e per million Btu (2012 *CEQR Technical Manual* Table 18-2) was used to calculate GHG emissions from the energy use associated with the parking and mechanical space.

Table 16-2
Building Floor Area and Type for GHG Analysis

Use	Approximate Size (gsf)	Building Type	Carbon Intensity (kg CO2e/sf)
Residential	164,760	Large Residential	6.59
Destination Retail	22,500	Commercial	9.43
Local Retail	4,500	Commercial	9.43
Hotel	127,993	Commercial	9.43
Cultural/Community Facility	25,000	Commercial	9.43
Mechanical and Parking	15,380	Other	0.98

Sources: The GHG intensity for parking and mechanical space was calculated based on an energy intensity of 27,400 Btu/gsf/year (provided in only in the earlier version of the *CEQR Technical Manual*, 2001, Table 3N-1) assuming all energy use is electricity, with an emission rate of 35.902 kg CO2e per million Btu (*CEQR Technical Manual*, 2012, Table 18-2). All other GHG Intensities were obtained from the 2012 *CEQR Technical Manual*, Table 18-3.

MOBILE SOURCE EMISSIONS

The number of annual 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 presented in Chapter 14, "Transportation." The assumptions used in the calculation include average daily weekday and weekend person trips and delivery trips by proposed use, the percentage of vehicle trips by mode, and the average vehicle occupancy. Travel distances shown in Table 18-4 of the *CEQR Technical Manual* were used in the calculations of annual vehicle miles traveled by cars and trucks. An average one-way taxi trip distance of 2.32 miles was used. This distance, provided in Table 18-5 of the *CEQR Technical Manual*, is based on regional modeling for taxi trips with either Manhattan as the trip origin and/or destination. The average 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 obtain an estimate of car, taxi, and truck GHG emissions attributable to the proposed project in 2014, the analysis year.

The EPA estimates that the well-to-pump GHG emissions of gasoline and diesel are approximately 22 percent of the tailpipe emissions.[1] 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, as per the *CEQR Technical Manual* guidance the well-to-pump emissions are not considered in the analysis for the proposed project. The assessment of tailpipe emissions only is 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.

[1] Environmental Protection Agency, *MOVES2004 Energy and Emission Inputs*, Draft Report, EPA420-P-05-003, March 2005.

The projected annual vehicle miles traveled, which form the basis for the GHG emissions calculations from mobile sources, are presented in **Table 16-3**.

Table 16-3
Annual Vehicle Miles Traveled

Use	Car	Taxi	Truck
Residential	277,911	14,798	155,048
Destination Retail	126,690	195,947	81,661
Local Retail	13,241	20,479	16,332
Hotel	343,958	167,158	174,762
Cultural/Community Facility	41,625	60,726	413,437
Total	**803,425**	**459,108**	**841,240**

CONSTRUCTION EMISSIONS

GHG emissions from construction include both direct emissions, such as emissions from construction equipment and delivery trucks, and emissions embedded in the production of materials, such as emissions from the production of steel, rebar, aluminum, and cement used for construction. Emissions associated with construction have not been estimated explicitly for the proposed project, as the construction of the project and extraction and production of construction materials is not likely to be a significant portion of the GHG emissions associated with the project. Analyses for similar developments have shown that construction emissions are equivalent to the total emissions from the operation of the development over approximately 5 to 10 years.

EMISSIONS FROM SOLID WASTE MANAGEMENT

The proposed project would not fundamentally change the city's solid waste management system. Therefore, following the guidance of the *CEQR Technical Manual*, the GHG emissions from solid waste generation, transportation, treatment, and disposal are not quantified.

D. GHG EMISSIONS WITH THE PROPOSED PROJECT

BUILDING OPERATIONAL EMISSIONS

The GHG emissions from each component of the proposed project are presented in detail in **Table 16-4**.

Table 16-4
Building Operational Emissions

Use	GHG Emissions (metric tons of CO_2e)
Residential	1,086
Destination Retail	212
Local Retail	42
Hotel	1,207
Cultural/Community Facility	236
Mechanical and Parking	15
Total	**2,798**

MOBILE SOURCE EMISSIONS

The detailed mobile-source-related GHG emissions from each component of the development that would occur as a result of the proposed project are presented in detail in **Table 16-5**.

Table 16-5
Mobile Source Emissions (metric tons CO_2e)

Use	Car	Taxi	Truck	Total
Residential	197	9	358	565
Destination Retail	90	125	189	403
Local Retail	9	13	38	60
Hotel (estimated)	244	106	404	754
Cultural Community Facility	30	39	955	1,023
Total	**571**	**292**	**1,942**	**2,805**

CONSTRUCTION EMISSIONS

Following the *CEQR Technical Manual* guidance, construction emissions are not quantified. As described in Section C, "Methodology," construction emissions are not modeled explicitly, but are estimated to be equivalent to approximately 5 to 10 years of operational emissions, including both direct energy and emissions embedded in materials (extraction, production, and transport). Through reuse of the existing South Building, the proposed project would avoid at least some of the emissions that would result from construction of a similar new building on that site.

EMISSIONS FROM SOLID WASTE MANAGEMENT

The proposed project would not fundamentally change the city's solid waste management system. Therefore, emissions from solid waste management are not quantified.

SUMMARY

A summary of GHG emissions for the proposed project, by emission source type, is presented in **Table 16-6**.

Table 16-6
Summary of Proposed Project's Annual GHG Emissions
2014 (metric tons CO2e)

Use	Building Operations	Mobile	Total
Residential	1,086	565	1,651
Destination Retail	212	403	615
Local Retail	42	60	103
Hotel	1,207	754	1,961
Cultural/Community Facility	236	1,023	1,259
Mechanical and Parking	15	N/A	15
Total	**2,798**	**2,805**	**5,604**

The operational emissions from building energy use 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. The proposed project would be designed to meet or exceed the standards for

LEED Silver certification (under the LEED for New Construction and Major Renovations Rating System). To meet these standards, the proposed project would need to meet energy efficiency requirements that exceed code requirements. The proposed project would limit the emissions associated with electricity consumption and heating through energy-efficient design, and reduce emissions associated with transportation because of the available alternatives to driving. The proposed project would include uses and density appropriate for a developed urban area, and would reuse an existing site and building thereby not requiring the use undeveloped land.

E. ELEMENTS OF THE PROPOSED PROJECT THAT WOULD REDUCE GHG EMISSIONS

The proposed project would include sustainable design features that would, among other benefits, result in lower GHG emissions than would occur from a similarly sized project without such features. The proposed project would result in reuse of an existing building and new development in an area with excellent access to public transit. As such, the proposed project is consistent with sustainable land-use planning and smart-growth strategies that aim to reduce the carbon footprint of new development. Furthermore, new construction would be designed to meet current standards for LEED Silver certification, focusing on reduced energy use and sustainable transportation, which would result in lower GHG emissions. LEED standards for new construction require a minimum of 10 percent reduction in energy expenditure as compared with buildings constructed to meet code requirements; this would result in reduced GHG emissions. These features and other measures currently under consideration that would address GHG emissions are discussed in this section.

BUILD EFFICIENT BUILDINGS

As described above, the proposed project would be designed to meet the standards for LEED Silver certification.

Specifically, the project would include an energy-efficient building envelope, with high-albedo roofing materials. High-efficiency heating, ventilation, and air conditioning (HVAC) systems would be installed. Interior daylighting in the hotel portion of the proposed project would be maximized. To the extent practicable, super insulation would be incorporated to minimize heat loss. The installation of motion sensors, lighting and climate control, efficient indoor and exterior lighting, elevators, and Energy Star appliances would also be considered. Water conserving fixtures exceeding building code requirements would be used to the extent practicable. Storage and collection of recyclables would be provided for the residential portion of the proposed project. Third-party fundamental building energy systems commissioning as required by USGBC to achieve LEED certification would be conducted to ensure energy performance. Construction and design guidelines to facilitate sustainable design for build-out by tenants will be provided.

USE CLEAN POWER

The proposed buildings would use natural gas fired systems for heating and hot water; natural gas has lower carbon content per unit of energy than other fuels, and thus reduces GHG emissions.

TRANSIT-ORIENTED DEVELOPMENT AND SUSTAINABLE TRANSPORTATION

The project site is located in an area supported by many public transit options. Thus, the proposed project supports an important goal of continuing transit-oriented development. The mix of uses that would be developed would fit well within a walkable neighborhood, and would place new uses in close proximity to public transit options. Indoor bicycle parking, sufficient to meet zoning requirements for a building the size of the proposed project, would be provided in the basement of the building.

DIRECT CONSTRUCTION EMISSIONS

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. As detailed in Chapter 20, "Construction", a number of measures that would reduce particulate emissions during construction would be implemented, to the extent feasible, including: diesel equipment reduction, clean fuel (ULSD), best available tailpipe reduction technologies, use of new equipment, and fugitive dust control measures, and idling restrictions on-site.

BUILDING MATERIALS

The use of construction materials extracted, processed and/or manufactured within 500 mile of the project will be maximized. In addition, the use of recycled building materials and certified sustainable or salvaged wood products would be considered.

CONCLUSION

The proposed project will include substantial energy efficiency measures and design elements which would result in an energy efficient building, transit-oriented development and the use of sustainable transportation. Based on these project components, the proposed project would be consistent with the city's GHG emissions reduction goal, as defined in the *CEQR Technical Manual*. ✷