Chapter 15: Greenhouse Gas Emissions

A. INTRODUCTION

As discussed in the *City Environmental Quality Review (CEQR) Technical Manual* (January 2012 edition), 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. Through PlaNYC, the 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 (the "GHG reduction goal") was codified by Local Law 22 of 2008, known as the New York City Climate Protection Act.[1] The *CEQR Technical Manual* recommends that any project resulting in 350,000 square feet or more of development and other energy-intense projects quantify project related GHG emissions and assess the project's consistency with the citywide GHG reduction goal.

The proposed actions would result in approximately 1.7 million gross square feet (gsf) of new development.[2] Accordingly, a GHG consistency assessment is provided. The GHG emissions that would be generated as a result of the proposed actions and measures that would be implemented to limit those emissions are presented in this chapter, along with an assessment of the proposed actions' consistency with the citywide GHG reduction goal.

PRINCIPAL CONCLUSIONS

Total potential GHG emissions associated with the operation of the proposed development are estimated to be 24,508 metric tons of CO_2 equivalent (CO_2e) per year, comprised of 13,615 metric tons CO_2e per year from building heating and electricity and 10,894 metric tons CO_2e per year from on-road emissions. Note that if the buildings were to be constructed elsewhere to accommodate the same uses as the proposed development, the emissions from the use of electricity, energy for heating and hot water, and vehicle use could equal or exceed those of the proposed development sites, depending on their location, access to transit, building type, availability of buildings for reuse, and energy efficiency measures.

Through a Request for Proposals (RFP) process, the City would look favorably upon proposals that enhance the energy-efficiency of buildings, use fewer raw materials, make the best of natural light where appropriate, improve indoor air quality, and decrease the total impact on the natural and human environment. Housing developments on all sites are expected to be certified under the Enterprise Green Communities Program or to incorporate measures which would achieve equivalent energy efficiency levels; in order to be certified, new multi-family buildings greater than four stories must be designed such that projects perform at least 15 percent better

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

[2] This number does not include below-grade parking space.

than the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 90.1-2007 energy code. In addition, all housing developments would also reduce construction and demolition waste by at least 25 percent.

All proposed buildings would likely produce heat and hot water using natural gas fired systems, which would produce lower GHG emissions than fuel oil. In addition, the proposed actions would support the City's transit-oriented development and sustainable transportation goal as the project site is well served by public transportation options, including both bus and subway services, is served by the city's bicycle lane network, and may also provide bicycle storage, showers and changing facilities. Further, the proposed actions would include a mix of uses, including residential and retail, and it is located in an area served by existing retail uses within walking distance.

Overall, the proposed actions would result in mixed-use development with energy efficient buildings. The proposed actions would also support the use of public transit and non-motorized commuting. The proposed design would include features aimed at reducing energy consumption and GHG emissions, and would, therefore, be consistent with the City's citywide GHG reduction goal.

B. POLLUTANTS OF CONCERN

GHGs are those gaseous constituents of the atmosphere, both natural and anthropogenic (resulting from human activity), 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." Water vapor, carbon dioxide (CO_2), nitrous oxide, 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 (contributing 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 project-related GHG assessments for most projects. Although ground level ozone 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 14, "Air Quality").

Similarly, water vapor plays an important role in global climate, but is not directly of concern as an emitted GHG since the negligible quantities resulting 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 nitrous oxide also play an important role since the removal processes for these compounds are limited, and they 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 analyzed in an EIS: CO_2, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. This analysis focuses on CO_2, nitrous oxide, and methane. There are no significant direct or indirect sources of other GHGs associated with the proposed actions.

To present a complete inventory of all GHGs, component emissions are added together and presented as CO_2 equivalent (CO_2e) emissions—a unit representing the quantity of each GHG weighted by its effectiveness using CO_2 as a reference. This is achieved by multiplying the quantity of each GHG emitted by a factor called global warming potential (GWP). GWPs account for the lifetime and the radiative forcing of each chemical over a period of 100 years (e.g., CO_2 has a much shorter atmospheric lifetime than sulfur hexafluoride, and therefore has a much lower GWP). GWPs for the main GHGs discussed here are presented in **Table 15-1**, as provided in the *CEQR Technical Manual* Table 18-1. Note that in this analysis, any calculation including GWP is embedded in factors and models provided in the *CEQR Technical Manual*.

Table 15-1
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—The Science of Climate Change, Contribution of Working Group I to the Second Assessment Report, Table 4, 1996.

C. POLICY, REGULATIONS, STANDARDS, AND BENCHMARKS

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 (USEPA) is required to regulate GHGs under the Clean Air Act (CAA), and has already begun preparing regulations addressing newly manufactured vehicles and permitted large stationary sources. In addition, the American Recovery and Reinvestment Act of 2009 (ARRA, "economic stimulus package") funded actions and 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.

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

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 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. The ten 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 GHG emissions associated with the proposed actions and an assessment of the project's consistency with the City's citywide emission reduction goal is required.

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 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 creates 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, Leadership in Energy and Environmental Design (LEED) is a benchmark for the design, construction, and operation of high performance green buildings that

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

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

includes energy efficiency components. Similarly, the Enterprise Green Communities Program is a voluntary program for sustainable development of affordable housing, and would be applied in this project. 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 purchase of energy efficient appliances, heating and cooling systems, office equipment, lighting, home electronics, and building envelopes.

D. METHODOLOGY

Although the contribution of any single project to climate change may be 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 directed by the *CEQR Technical Manual*, this chapter does not present net increments as compared to the future without the proposed actions, since those would not represent the actual increment on a global scale; instead, the analysis focuses on the total GHG emissions potentially associated with the proposed actions and identifies measures that would be implemented and measures that are still under consideration to limit the emissions.

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

CO_2 is the primary pollutant of concern from anthropogenic emission sources and is accounted for in the analysis of emissions from all development projects. 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 Section B, "Pollutants of Concern").

BUILDING OPERATIONAL EMISSIONS

Since detailed design information is not available because the design of specific buildings would follow the designation of a developer or developers pursuant to a future Request for Proposals process, emissions associated with electricity and fuel use were developed based on the proposed actions' development area (gross square feet) using data provided in the *CEQR Technical Manual* Table 18-3. For indoor parking areas, since an emission intensity is not provided in the *CEQR Technical Manual*, the energy intensity of 27,400 British Thermal Units (Btu) per gsf was assumed (2001 *CEQR Technical Manual* Table 3N-1) along with the electricity emission intensity of 35.902 kg CO_2e per million Btu (2012 *CEQR Technical Manual* Table 18-2).

MOBILE SOURCE EMISSIONS

The number of annual weekday motorized vehicle trips by mode (cars, taxis, trucks) that would be generated by the proposed actions was calculated using the transportation planning assumptions developed for the analysis presented in Chapter 13, "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 of the *CEQR Technical Manual* (Table 18-4) were used in the calculations of annual vehicle miles traveled by cars and trucks. An average one-way taxi trip of 2.32 miles, which is based on regional modeling for taxi trips with either Manhattan as the trip origin and/or destination, was provided by the Mayor's Office of Environmental Coordination. 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 obtain an estimate of car, taxi, and truck GHG emissions attributable to the proposed actions.

USEPA 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, fuel alternatives are not being considered for the proposed actions. As per the *CEQR Technical Manual* guidance, the well-to-pump emissions are not included in the analysis of the proposed actions.

The projected annual vehicle miles traveled, which form the basis for the GHG emissions calculations from mobile sources, are presented in **Table 15-2**.

Table 15-2
Total Vehicle Travel (vehicle-miles per year)

Roadway	Car	Taxi	Truck
Local	796,069	328,667	697,358
Arterial	1,736,878	717,093	1,521,508
Expressway	1,085,548	448,183	950,942

CONSTRUCTION EMISSIONS

Emissions associated with construction have not been estimated explicitly for the proposed actions, but analyses prepared for development projects in New York City[2] have shown that construction emissions (both direct and emissions embedded in the production of materials, including on-site construction equipment, delivery trucks, and upstream emissions from the production of steel, rebar, aluminum, and cement used for construction) would be equivalent to the total operational emissions from buildings energy over approximately 5 to 10 years.

EMISSIONS FROM SOLID WASTE MANAGEMENT

The proposed actions would not fundamentally 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.

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

[2] Examples include GHG analyses prepared for the EISs for Riverside Center, Domino Sugar Rezoning, and Western Rail Yard.

E. PROBABLE IMPACTS OF THE PROPOSED ACTIONS

GREENHOUSE GAS EMISSIONS

BUILDING OPERATIONAL EMISSIONS

The building areas, emission intensities, and resulting GHG emissions from the proposed actions are presented in detail in **Table 15-3**. Note that these are based on generic energy intensity rates, and do not include the specific design elements of the project or sustainability measures. See the following section for discussion of those measures.

Table 15-3
Building Operational Emissions

Use	Area (gsf)	GHG Intensity (Kg CO_2e / gsf / year)	GHG Emissions (metric ton CO_2e / year)
Residential	951,182	6.59	6,268
Retail	469,349	9.43	4,426
Public Market	29,152	9.43	275
Office	36,304	9.43	342
Cultural/ Community	114,000	11.42	1,302
Hotel	97,450	9.43	919
Sub-Level Parking[1]	314,502	0.98	309
Total	*2,011,939*	*6.88*	*13,842*

Sources: The GHG intensity for parking is calculated based on an energy intensity of 27,400 Btu/gsf/year (*CEQR Technical Manual*, 2001, Table 3N-1) assuming all energy use is electricity at an emission rate of 35.902 kg CO2e per million Btu (*CEQR Technical Manual*, 2012, Table 18-2). All other GHG Intensities are from the 2012 *CEQR Technical Manual*, Table 18-3.

Notes: [1] This parking area is a reasonable worst-case assumption for the maximum amount of below-grade space required to allow up to 500 parking spaces on up to four sites.

MOBILE SOURCE EMISSIONS

The detailed mobile source-related GHG emissions from the proposed actions are presented in **Table 15-4**.

Table 15-4
Mobile Source Emissions (metric tons CO_2e)

Roadway Type	Passenger Vehicle	Taxi	Truck	Total
Local	920	344	2,514	*3,778*
Arterial	1,222	452	3,384	*5,057*
Expressway	451	164	1,443	*2,058*
Total	*2,593*	*960*	*7,340*	*10,894*

CONSTRUCTION EMISSIONS

As described in Section D, "Methodology," emissions associated with construction have not been estimated explicitly for the proposed actions.

EMISSIONS FROM SOLID WASTE MANAGEMENT

As described in Chapter 11, "Solid Waste and Sanitation Services," the proposed actions would not fundamentally change the City's solid waste management system. Therefore, emissions from solid waste management were not quantified.

SUMMARY

Total potential GHG emissions associated with the operation of the proposed development are estimated to be 24,735 metric tons CO_2e per year, comprised of 13,842 metric tons CO_2e per year from building heating and electricity and 10,894 metric tons CO_2e per year from on-road emissions. Note that if the buildings were to be constructed elsewhere to accommodate the same uses as the proposed development, the emissions from the use of electricity, energy for heating and hot water, and vehicle use could equal or exceed those of the proposed actions, depending on their location, access to transit, building type, availability of buildings for reuse, and energy efficiency measures.

ASSESSMENT OF CONSISTENCY WITH THE GHG REDUCTION GOAL

The proposed actions would include sustainable design features that would, among other benefits, result in lower GHG emissions. These features are discussed in this section, assessing the consistency of the proposed actions with the GHG reduction goal outlined in the *CEQR Technical Manual*. Overall, as demonstrated below, the proposed actions would result in mixed-use development with energy efficient buildings and would likely use low-carbon fuel (natural gas). It would also support the use of public transit and non-motorized commuting. The proposed design would include features aimed at reducing energy consumption and GHG emissions, and would, therefore, be consistent with the City's citywide GHG reduction goal.

EFFICIENT BUILDINGS

Through a request for proposals process, the City would look favorably upon proposals that enhance the energy-efficiency of buildings, use fewer raw materials, make the best of natural light where appropriate, improve indoor air quality, and decrease the total impact on the natural and human environment. These designs would include features aimed at reducing energy consumption and greenhouse GHG emissions such as:

- Energy efficient building envelopes to reduce cooling and heating;
- High-efficiency HVAC systems, incinerators and/or generators;
- Window glazing to optimize energy performance by allowing for daylighting while managing both heat loss and solar heat gain; and
- Fuel from renewable sources or less GHG-intense fuels, such as natural gas, co-firing of biomass or use of biofuels or bioheat for heating fuel or in vehicles/equipment.

Housing developments on all sites are expected to be certified under the Enterprise Green Communities Program. If a housing development cannot be certified under the Enterprise Green Communities Program because ASHRAE Standard 90.1-2007 does not apply to its construction methodology, the development would be designed and constructed to reduce construction and demolition waste and to incorporate sustainable design features that reduce energy consumption and greenhouse gas emissions in an amount equivalent to that which would be necessary to achieve certification under the Enterprise Green Communities Program. For housing developments on City-owned sites that are managed by the New York City Economic Development Corporation (NYCEDC) and cannot comply with the Enterprise Green

Communities Program because ASHRAE Standard 90.1-2007 does not apply to their construction methodology, consultation with the Mayor's Office of Environmental Coordination would be required to ensure that sustainability measures equivalent to that which would be necessary to achieve certification under the enterprise green communities program are implemented.

In order to be certified, new multi-family buildings greater than four stories must be designed such that projects perform at least 15 percent better than the ASHRAE 90.1-2007 energy code. This level of energy efficiency would be expected of all project housing components resulting in 15 percent less energy use when compared to the appropriate baseline, and would apply to the whole building, including all uses within each building. Regarding sites that do not include housing components, some increased level of efficiency can be expected given the preferences that will be expressed in the request for proposals, as described above, but the specifics are not known at this time. Mandatory energy efficiency measures required by the Enterprise Green Communities program include:

- Heating and cooling systems must be sized according to the Air Conditioning Contractors of America (ACCA) Manuals, Parts J, S, and D, or ASHRAE handbooks;
- If provided, clothes washers, dishwashers, and refrigerators must be Energy Star-labeled;
- Interior lighting should be either Energy Star Advanced Lighting Package (ALP) or lighting specified in EPA's Multifamily High Rise Buildings (MFHR) program;
- For common areas and for emergency lighting, lighting specified in EPA's MFHR program should be installed;
- For exterior lighting, either Energy Star compact fluorescents or LEDs, or lighting specified in EPA's MFHR program should be installed;
- All dwelling units must be equipped with individual or sub-metered electric meters; and
- Installation of water-conserving fixtures in all units and any common facilities per minimum requirements.

CLEAN POWER

The proposed buildings would likely produce heat and hot water using natural gas fired systems; natural gas has lower carbon content per unit of energy than other fuels, and thus reduces GHG emissions. Fuel from renewable sources, such as co-firing or biomass or use of biofuels or bioheat for heating fuel, may also be considered. In addition, as one of the optional considerations under the Enterprise Green Communities certification or equivalent for all housing developments, the incorporation of electric-generating renewable energy may be considered.

TRANSIT-ORIENTED DEVELOPMENT AND SUSTAINABLE TRANSPORTATION

The proposed actions would support the City's transit-oriented development and sustainable transportation goal. The proposed development would be supported by several subway lines, bus lines, and bike lanes located immediately adjacent to the project site, and the buildings developed may provide bicycle storage, showers, and changing facilities.

The proposed actions would include mixed uses, including residential and retail, and is located in an area served by existing retail uses within walking distance.

DIRECT CONSTRUCTION EMISSIONS

Construction would include an extensive diesel reduction program 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 greenhouse gasses ("Kyoto gases"), recent studies have shown that black carbon—a constituent of particulate matter—may play an important role in climate change.

BUILDING MATERIALS

All housing developments would either be certified under the Enterprise Green Communities program or designed to achieve equivalent benefits. As such, all housing developments would reduce construction and demolition waste by at least 25 percent through recycling, salvaging, and/or diversion strategies (higher levels would achieve additional points). In addition, optional measures under the Enterprise Green Communities category of "Materials Beneficial to the Environment," which may be incorporated include:

- Use of recycled building materials;
- Use of products extracted, processed, and/or manufactured within 500 miles of the project; and
- Use of certified sustainable or salvaged wood products.

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