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 2012 *City Environmental Quality Review (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, 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 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"). See §24-803 of the Administrative Code of the City of New York. Per the 2012 *CEQR Technical Manual*, the City's citywide GHG reduction goal is currently the most appropriate standard by which to analyze a project under *CEQR*.

This chapter discusses the projected GHG emissions from the proposed project. The proposed project is being designed to achieve Leadership in Energy and Environmental Design (LEED®) Silver certification at a minimum, and as such would incorporate measures to reduce or offset its energy demand. In particular, the proposed project would include rooftop solar panels to produce a portion of the project's electricity demand. Other sustainability measures may include heat recovery (from the ice and comfort chillers), condensing boilers, low flow plumbing fixtures, lighting controls, and an air-water economizer. The proposed project may also include a cogeneration system, which can achieve more efficient energy use by capturing the heat by-product of electricity production and reusing it for heating and cooling. The range of sustainable design and energy efficiency measures under consideration would reduce GHG emissions, as discussed in this chapter in the context of the GHG reduction goal.

PRINCIPAL CONCLUSIONS

As discussed in the following sections, the building energy use and vehicle use associated with the proposed project are estimated to result in approximately 20,821 metric tons of carbon dioxide equivalent (CO_2e) emissions per year. The proximity of the proposed development to public transportation, reuse of an existing historic building, and measures to minimize non-renewable energy use are all factors that contribute to the proposed project's energy efficiency.

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 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 GHGs under the Clean Air Act (CAA), and has begun preparing regulations addressing newly manufactured vehicles and permitted large stationary sources. In addition, the American Recovery and Reinvestment Act of 2009 (ARRA, the "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.

The U.S. Department of Transportation (USDOT) and EPA 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 underway[2]). The 2009 New York State Energy Plan[3] 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 (VMT) 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 a number of 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.

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

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

[2] http://www.dec.ny.gov/energy/80930.html

[3] New York State, 2009 New York State Energy Plan, December 2009.

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.

In 2005, the New York City Council enacted one of the nation's first green building laws (Local Law 86 of 2005). Local Law 86 of 2005 requires new buildings, additions, and substantial building reconstruction work in capital projects that receive city funds to be built in accordance with the standards of the LEED® green building rating systems developed by the U.S. Green Building Council (USGBC). It also requires that most of this work, as well as larger lighting, boiler, heating, ventilation, and air conditioning (HVAC) controls, and plumbing upgrade work, be designed to reduce the use of both energy and potable water well beyond that required by the current NYC building code.

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 (sf) to conduct energy efficiency audits every ten 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 sf 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 along with the New York State Energy Conservation Code (as revised in 2010), requires equipment installed during a renovation to meet energy efficiency standards.

A number of voluntary rating systems for energy efficiency and green building design have also been developed. For example, the LEED® system is a benchmark for the design, construction, and operation of high performance green buildings that includes energy efficiency components. It is noteworthy that the proposed project would seek certification under LEED®, with a commitment to attaining a Silver rating. The project sponsor would work toward attaining the LEED® Gold rating, if possible.

Another voluntary rating system is EPA'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.

C. METHODOLOGY

Although the contribution of any single project to global 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 an estimate of the annual GHG emissions that would be generated with the proposed project and identifies the measures that would be implemented and measures that are under consideration to limit the those emissions.

The analysis of GHG emissions that would be generated by the proposed project is based on the methodology presented in the *CEQR Technical Manual*, and supplemented by the *General Reporting Protocol*[1] from The Climate Registry. Emissions of GHGs from the proposed project have been quantified, including off-site emissions associated with the use of electricity on-site, on-site emissions from the use of natural gas for heating, cooling, and potentially ice production, the use of refrigerants, and emissions from vehicle use attributable to the proposed project. GHG emissions that would result from construction of the proposed project are discussed as well.

It should be noted that the analysis conservatively overestimates the net increase in GHG emissions, as it takes no credit for emissions that would be generated if the proposed uses were to be developed elsewhere. For example, a similar facility could be constructed in an area that is not as easily accessible by transit, without enabling the adaptive reuse of a historic building, and avoiding the emissions from construction of a new building. The analysis also does not account for the potential reduction in VMT associated with providing opportunities for recreation on ice closer to the surrounding community than currently available.

Carbon dioxide (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. Emissions of hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), greenhouse gases commonly used as refrigerants, from refrigeration and air conditioning equipment are accounted for in this project because producing the ice for the ice rinks and maintaining the appropriate facility temperature would require substantial use of refrigerants. The various project-generated GHG emissions are added together and presented as metric tons of carbon dioxide equivalent (CO_2e) emissions per year, consistent with the New York City annual inventory.[2] CO_2e is a sum that includes the quantity of each GHG weighted by a factor of its effectiveness as a GHG 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). The GWP accounts for the lifetime and the radiative forcing of each gas 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 are presented in **Table 10-1**.[3]

Table 10-1
Global Warming Potential (GWP) for Major GHGs

Compound	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

Sources: IPCC, Climate Change 1995—The Science of Climate Change: Contribution of Working Group I to the Second Assessment of the Intergovernmental Panel on Climate Change, 1996.

[1] The Climate Registry, *General Reporting Protocol*, Version 2.0, March 2013.

[2] City of New York, *Inventory of New York City Greenhouse Gas Emissions*, December 2012, by Jonathan Dickinson, Jamil Khan, Douglas Price, Steven A. Caputo, Jr. and Sergej Mahnovski. Mayor's Office of Long-Term Planning and Sustainability, New York, 2012.

[3] Following standard protocol for greenhouse gas inventories, and consistent with New York City's GHG inventory, the GWP factors from IPCC's Second Assessment Report (1996) are used. These GWP factors are specified for use for national GHG inventories under the Kyoto Protocol.

BUILDING OPERATIONAL EMISSIONS

Emissions due to the proposed on-site electricity and natural gas use were calculated using project specific energy demand information developed by M-E Engineers. The energy demand projections shown in **Table 10-2** account for the unique energy demands of the ice rink facility. These estimates assume code compliant systems and do not account for potential reductions in energy demand due to the sustainability measures that would be incorporated as part of the proposed project. This estimate also assumes that the proposed ice chillers would operate using grid electricity. The system design has not yet been finalized, and it is possible that the chillers would use natural gas. With the use of gas chillers, the additional annual natural gas demand would be 160,000 therms, and the annual electricity demand for ice cooling would decrease. With the use of gas chillers, the emissions from on-site energy use would be less than with the use of electric chillers. Therefore, the scenario presented in **Table 10-2**, conservatively assumed electric chillers. The projected electricity demand also assumes public use of three electric charging stations that would be installed as part of the proposed project. In calculating energy demand and emissions, it was conservatively assumed that the three charging stations would be used for a total of 20 hours per day.

Table 10-2
Estimated Annual Energy Demand of Proposed Project

Electricity	kWh
Cooling	6,710,599
Ice Cooling	7,899,694
Lighting	5,201,000
Zamboni Charging	737,300
Misc. Equipment/Plug Loads	4,637,624
Car Charging Stations[1]	372,300
Total Electricity	**25,558,517**
Natural Gas	**Therms**
Heating/Dehumidification	1,083,456
Domestic Hot Water	89,177
Total NG	**1,172,633**

Notes: [1]The proposed project would include charging stations for electric vehicles. Therefore, the associated electricity use has been included. The charging stations would encourage and facilitate the reduction of GHG emissions from transportation and promote the use of alternative vehicle technology.
Source: M-E Engineers

The emission factors for electricity and natural gas of 82.9 kg CO_2e per gigajoule (GJ) and 50.4 kg CO_2e per GJ, respectively, were used to calculate GHG emissions from the electricity and natural gas at the proposed facility.[1]

FUGITIVE EMISSIONS FROM THE USE OF REFRIGERANTS

Emissions of HFCs and PFCs from refrigeration and air conditioning equipment result from the manufacturing process, leakage over the operational life of the equipment, and disposal at the end of the useful life of the equipment. The ice for the proposed facility would be produced

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

using electric or natural gas-fired ice chillers. Electric chillers are conservatively assumed for the purposes of this analysis, as the use of electric chillers would result in greater emissions from energy use, as well as greater fugitive emissions from the use of refrigerants. Comfort chillers would also be needed. For the purposes of this analysis, it is assumed that the chillers would be pre-charged with refrigerant by the manufacturer, and that at the end of the useful life of the chillers, the refrigerant would be recovered off-site. Therefore, the analysis accounts for the fugitive emissions associated with the annual leakage of the refrigerants. The electric ice chillers would likely use HFC-507A or R-404A, and comfort chillers would likely use HFC-134A. If natural gas ice chillers are selected, they would likely use HFC-134A as the refrigerant.

As the *CEQR Technical Manual* does not include a methodology for calculating fugitive emissions from refrigeration, Equation 16e and Table 16.2 provided in the *General Reporting Protocol*[1] from The Climate Registry were used to estimate annual fugitive emissions from the use of refrigerants. The project engineer (M-E Engineers) provided the likely equipment size and likely refrigerant that would be used. The operating emissions were calculated as a percentage of the charge capacity (amount of refrigerant charged into each chiller unit). The percent leakage (emissions factor k, shown in **Table 10-3**) was obtained from the *General Reporting Protocol*, Table 16.2. The GWP were obtained from the *General Reporting Protocol*, Appendix B: Global Warming Potentials."

Table 10-3
Assumptions for Calculation of Fugitive Emissions from Use of Refrigerants

Equipment Type	Number of Units	Cooling Capacity (tons)	Unit Charge Capacity (lbs)	Operating Emission Factor k	Refrigerant	GWP
Ice Chillers[1]	6	400 per unit	1,250	15%	HFC-507A[2]	3,300
Comfort Chillers	Not finalized	3,000 total	9,375 (total)	15%	HFC-134A	1,300

Notes: [1]Assumes the use of 6 electric chillers. Alternatively, twelve 200 ton electric chillers may be used. The use of gas chillers is also under consideration.
[2]The refrigerant blend R-404A, having a GWP of 3,260 may also be used. HFC-507A was conservatively assumed in the calculations because it has a greater GWP.

Sources: The Climate Registry, *General Reporting Protocol, April 2013.*
Equipment number, size, and refrigerant type provided by M-E Engineers.

MOBILE SOURCE EMISSIONS

The number of annual weekday and weekend vehicle trips by mode (cars, taxis, trucks, and school and tour buses) that would be generated by the proposed project was calculated using the transportation planning assumptions discussed in Chapter 8, "Transportation." The assumptions used in the calculation include average daily weekday and weekend person trips and delivery trips by proposed event type or use, the percentage of vehicle trips by mode, and the average vehicle occupancy. For employee trips, community facility trips, and ice center trips (other than trips associated with the peak main event), travel distances shown in Table 18-4 of the *CEQR Technical Manual* were used in the calculations of annual VMT by cars and school buses. The office use trip distance was used for employees, and the retail trip distance was used for the community facility auto trips, ice center auto trips, and school buses. For the main peak event trips, reasonable assumptions were made regarding the distribution of trip origins (ranging from 10 to 50 miles), and a weighted average trip distance of 19.5 miles was used in calculating the

[1] The Climate Registry, *General Reporting Protocol*, Version 2.0, March 2013.

annual auto and tour bus VMT for the peak events. The average one way taxi trip distance of 7.88 miles was obtained from Table 18-5 of the *CEQR Technical Manual*. The average truck trip was assumed to be 38 miles, as per the *CEQR Technical Manual*. Table 18-6 was used to determine the percentage of auto, taxi, and truck VMT by road type, and the mobile GHG emissions calculator was used to obtain the estimated GHG emissions from auto, taxi, and truck trips attributable to the proposed project. Emissions from tour buses were calculated using the average fuel efficiency for buses of 7.2 miles per gallon (mpg), obtained from the *National Transportation Statistics*.[1] The GHG emission factors were based on the diesel fuel carbon content,[2] assuming that all carbon is transformed to CO_2, resulting in emission factors of 10,186 g CO_2 per gallon of diesel.

Based on the estimated electricity use from the car charging stations, shown in **Table 10-2**, and assumed electric vehicle efficiency of 34 kWh per 100 miles, 1,095,000 miles per year could be attributed to electric car trips, instead of gasoline car trips. The emission reduction benefits of the car charging stations are quantified, but are conservatively not included in the results tables. Net GHG emissions benefit of the electric vehicles was calculated by determining the avoided emissions from 1,095,000 miles per year of gasoline vehicles, using Table 18-6 of the *CEQR Technical Manual* to determine the percentage of VMT by road type and the mobile GHG emissions calculator, and subtracting the emissions generated from charging stations electricity use from this benefit.

EPA estimates that the well-to-pump GHG emissions of gasoline and diesel are approximately 22 percent of the tailpipe emissions.[3] 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, they are not considered in the analysis of the proposed project. Accounting for tailpipe emissions but not well-to-pump emissions is in accordance with the *CEQR Technical Manual* guidance and the methodology used in developing the New York City GHG inventory, which is the basis of the GHG reduction goal.

The projected annual VMT, which form the basis for the GHG emissions calculations from mobile sources, are presented in **Table 10-4.**

Table 10-4
Annual Vehicle Miles Traveled (miles per year)

Use	Car	Taxi	Truck	School Bus	Tour Bus
Peak Event – Main Event Only	1,893,255	0	0	88,335	0
Peak Event – Other 8 Rinks	1,339,600	0	0	0	28,160
Non-Peak Event	5,958,596	0	0	0	112,944
Office (210 Employees)	248,200	17,257	0	0	0
Local Retail (Concession Space)	0	0	206,264	0	0
Community Facility	205,460	96,152	138,852	0	0
Total	9,645,111	113,409	88,335	141,104	345,116

Source: Based on traffic planning assumptions made for Chapter 8, “Transportation.”

[1] U.S. Department of Transportation, Research and Innovative Technology Administration (RITA), Bureau of Transportation Statistics, *National Transportation Statistics*, Table 4-15, updated April 2012, http://www.bts.gov/publications/national_transportation_statistics/.

[2] The Code of Federal Regulations (40 CFR 600.113).

[3] EPA, *MOVES2004 Energy and Emission Inputs*, Draft Report, EPA420-P-05-003, March 2005.

CONSTRUCTION EMISSIONS

Emissions associated with construction of the proposed project have not been estimated explicitly. Unlike typical ground-up construction, the proposed project would not involve extensive demolition, foundation, or superstructure construction activities, which often generate the highest levels of construction activity emissions. In addition, construction of the proposed project would result in a moderate number of construction-related vehicle trips and a need for new construction materials primarily for interior work. Therefore, GHG emissions associated with construction (both direct emissions 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 not be substantial and have not been estimated explicitly.

EMISSIONS FROM SOLID WASTE MANAGEMENT

As discussed in Chapter 6, "Solid Waste and Sanitation Services," the proposed project 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.

D. PROJECTED GHG EMISSIONS WITH THE PROPOSED PROJECT

BUILDING OPERATIONAL EMISSIONS

The annual GHG emissions from building operational energy use are presented in **Table 10-5**.

Table 10-5
Building Annual Operational Emissions

Energy End Use	GHG Emissions (metric tons of CO_2e)
Cooling	2,002
Ice Cooling	2,357
Lighting	1,552
Zamboni Charging	220
Misc. Equipment/Plug Loads	1,384
Car Charging Stations	111
Heating/Dehumidification	5,174
Domestic Hot Water	426
Total	**13,225**

The emissions associated with building energy use assume the use of electric chillers. If gas chillers were used instead, the total emissions from building energy use would be approximately 6 percent lower. It should be noted that the car charging stations could help offset 473 metric tons of CO_2e from mobile source emissions, which assumed the use of gasoline in all personal vehicles, achieving 362 metric tons of CO_2e of net benefit from the car charging stations. This potential benefit is conservatively not accounted for in the result summary tables.

FUGITIVE EMISSIONS FROM THE USE OF REFRIGERANTS

Fugitive emissions from leaking of refrigeration and air conditioning equipment are shown in **Table 10-6.**

Table 10-6
Annual Fugitive Emissions from the Use of Refrigerants

Equipment Type	Refrigerant	GHG Emissions (metric tons CO_2e)
Ice Chillers	HFC-507A	1,684
Comfort Chillers	HFC-134A	829
Total		2,513
Notes: The emissions shown in the table assume the use of six 400-ton electric ice chillers. Emissions would be lower with the use of a greater number of smaller units, the use of gas ice chillers, and the use of different refrigerants under consideration.		

The emissions presented in **Table 10-6** are conservatively based on the assumption that electric chillers would be used. With the use of gas chillers, the emissions would be lower. The emissions would also vary based on the number and size of the chiller units, and on the refrigerant used. With the use of twelve 200-ton gas ice chillers, charged with HFC-134A, the total annual fugitive emissions from the use of refrigerants would be 1,413 metric tons of CO_2e (44 percent lower than shown in **Table 10-6**).

MOBILE SOURCE EMISSIONS

The detailed mobile-source-related GHG emissions from each component of the proposed project are presented in detail in **Table 10-7**.

Table 10-7
Mobile Source Emissions (metric tons CO_2e)

Use	Car	Taxi	Truck	School Bus	Tour Bus	Total
Peak Event – Event Only	818	0	0	125	0	943
Peak Event – Other 9 Rinks	579	0	0	0	40	619
Non-Peak Event	2,573	0	0	0	160	2,733
Office (210 Employees)	107	7	0	0	0	114
Local Retail (Concession Space)	0	0	328	0	0	328
Community Facility	89	37	221	0	0	347
Total	4,165	44	549	125	200	5,083

SUMMARY

A summary of GHG emissions for the proposed project, by emission source type, is presented in **Table 10-8**. Note that much of these emissions would be associated with similar activity outside of the proposed project area.

Table 10-8
Projected Annual GHG Emissions (metric tons CO_2e)

Building	Refrigerants	Mobile	Total
13,225	2,513	5,083	20,821

As presented above, the estimated building-related emissions are conservatively high since to attain LEED® certification the proposed project would include energy efficiency measures that exceed building code requirements.

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

As described above, the proposed project would seek certification under LEED®, with a commitment to attaining a Silver rating. The project sponsor would work toward attaining the LEED® Gold rating, if possible. The proposed project's reuse of an existing building and developed land, with access to transit and existing roadways, is consistent with sustainable land use planning and smart growth strategies to reduce the carbon footprint of new development. A number of sustainable features that would reduce GHG emissions would be considered in achieving LEED® certification and the project's sustainability goals. The following text outlines features of the proposed project and measures that would be considered in achieving LEED® certification. The features listed would most directly reduce GHG emissions, addressing the GHG reduction goals as outlined in the *CEQR Technical Manual*.

BUILD EFFICIENT BUILDINGS

- To meet one of the prerequisites for LEED® certification, the proposed project's energy performance rating would need to be at least 5 percent better than the baseline performance rating (based on the ASHRAE 90.1-2007 standard). The proposed project would likely exceed the requirements of this prerequisite.
- Low-flow and/or ultra-low flow plumbing fixtures would be used to reduce hot and cold water consumption and water pumping energy.
- Melted shavings from ice finishing would be recovered to pre-cool condenser water and reduce condenser water use.
- High efficiency HVAC systems would be specified, as well as high efficiency domestic hot water systems. The energy efficiency measures would include heat recovery (ice and comfort chillers), condensing boilers, air/water economizers, and desiccant dehumidification to reduce cooling requirements.
- Rainwater and gray water capture would be maximized for use in ice rinks, landscape irrigation, toilet and urinal flushing, and custodial uses.
- Spectrally-selective window glazing would optimize daylighting, heat loss, and solar heat gain.
- Efficient lighting (including high efficiency fluorescent and LED, where cost effective) with advanced controls such as motion sensors and daylight dimming would reduce energy consumption.
- Efficient, directed exterior lighting would be specified.

- Third party building commissioning would be conducted to ensure proper energy performance of the building energy systems.
- Construction and design guidelines would be provided to facilitate sustainable design for build-out by tenants.
- The landscaping would be designed for water efficiency, through materials selection and rainwater reuse.

USE CLEAN POWER

Solar panels are proposed to be installed on the upper (flat) portion of the roof on the south side of the building to generate a portion of the proposed building's energy demand from renewable resources. While the design has not been finalized, nine panels with a total area of 20,000 sf are currently envisioned. Since the proposed building is a New York City Landmark (it also is listed on the State and National Registers of Historic Places [S/NR]), the installation of the solar panels, along with the other proposed alterations to the structure, would require approval from the New York City Landmarks Preservation Commission (LPC). Furthermore, the project is seeking federal historic preservation tax credits, and to receive the credits the proposed alterations to the Armory (including the installation of the solar panels) must be found to conform to~~confirm with~~ the Secretary of the Interior's Standards for Rehabilitation of Historic Properties.

The proposed project's heating and hot water systems would use natural gas, which has lower carbon content per unit of energy than other fossil fuels, and thus its use generates less GHG emissions. The use of natural gas-fired microturbines for co-generation is also under consideration. By producing some of the electricity needed for operation of the facility on-site, and using the heat by-product, the energy efficiency of the proposed project would be improved and GHG emissions could be further reduced. The inclusion of cogeneration in the proposed project, if pursued, would be consistent with Energy Initiative #9 in PlaNYC, which calls for expanding clean distributed generation and combined heat and power.

The potential reduction in GHG emissions that would result from the use of solar energy and cogeneration has not been quantified, as the plans for inclusion of these efficiency measures in the proposed project have not been finalized and the potential designs are too preliminary.

TRANSIT-ORIENTED DEVELOPMENT AND SUSTAINABLE TRANSPORTATION

The project site's location near subway and bus lines would reduce automobile dependence, and therefore GHG emissions from travel. The proposed project's access to transit and existing roadways is consistent with sustainable land use planning and smart growth strategies to reduce the carbon footprint of new development. In addition, the proposed project would feature the following elements:

- Bike storage and changing rooms, supporting alternative transportation (walking and biking);
- Most on-site support vehicles would be electric;
- Transit passes of employees would be subsidized;
- A marketing/information program that would include posting and distribution of ride sharing and transit information would be developed;

- A parking management program would be developed to minimize parking requirements, through measures such as parking cash-out, parking charges, and preferential carpool or vanpool parking;
- On-site parking for alternative vehicles would be designated;
- On-site charging stations for electric vehicles would be provided; and
- Tour or shuttle buses would be available for peak events.

REDUCE CONSTRUCTION OPERATION EMISSIONS

As discussed, the proposed project would not involve extensive long-term construction activity and therefore would not generate substantial GHG emissions during construction.

USE BUILDING MATERIALS WITH LOW CARBON INTENSITY

The proposed project would involve the rehabilitation and redevelopment of an existing historic structure, and would not require a substantial amount of new material. The primary concern in rehabilitating the Armory structure would be long-term stabilization and historic preservation. Because the proposed project involves the rehabilitation of a historic structure rather than new ground-up construction, opportunities to select construction materials with low embedded GHG emissions (emissions from material production and transport) may be limited. Nonetheless, the use of cement replacements, such as slag, fly ash, and calcined clay would be considered and steel and other building materials with recycled content, as well as materials that are extracted and/or manufactured within the region, would likely be used. Wood that is locally produced and/or certified in accordance with the Sustainable Forestry Initiative or the Forestry Stewardship Council's Principles and Criteria would potentially be used where feasible. Where appropriate, construction waste would be diverted from landfill through reuse and recycle efforts.

F. CONCLUSIONS

As previously detailed in **Table 10-8**, the potential GHG emissions associated with the proposed project would be approximately 20,821 metric tons of CO_2e. Measures for reducing GHG emissions that would be considered in achieving the LEED® rating have been identified. Overall, the project site's location, the reuse of an existing building, the project's commitments to achieve energy efficiency, and other measures incorporated in the proposed project would result in lower GHG emissions than would typically be generated by a similar facility, and the proposed project would be consistent with the GHG reduction goal. ✷