

Technical Appendix – GHG Emissions Benefits Analysis

Please see the attached Albany CPRG GHG Benefits Model.xlsx workbook for full calculations and references.

GHG Calculations Overview

- The workbook model independently quantifies GHG benefits from each program measure.
- The Benefits Review tab sums up all cumulative benefits between 2025-2030 and 2025-2050 as required.
- All references, calculations, and assumptions are summarized here and performed in the workbook. All work can be verified and reproduced.
- GHG methods use EPA emission factors for stationary fuels and EPA's 2022 E-GRID baseload emissions factor for grid electricity for the NYUP grid region.
- All project impact assumptions reference an appropriate EPA, DOE, EIA, CARB, or NREL publication, and/or are created based on engineering principles. Specific references are found in the Calculation References tab, and/or may be discussed in specific methodology tabs.

GHG Emissions Summary Benefits

Metric Tons Carbon Dioxide Equivalent (MTCDE)

PCAP Measure Component	Overall GHG Reductions (MTCDE)	
	2025-2030	2025-2050
Fleet Electrification	744.18	1,700.98
Building Electrification	2,090.63	8,362.54
Household Electrification (LIDAC)	236.21	2,912.93
Household Electrification (non-LIDAC)	653.74	4,901.39
Totals	3,724.77	17,877.84

Method Description – GHG Baseline, Methods, and Assumptions

Household electrification and readiness programs

GHG benefits are calculated from the reduction of natural gas and electricity expected from weatherization and related electrification activities.

To estimate baseline household energy use, the City used the 2010 Capital District Regional GHG Inventory¹ which includes a detailed breakdown of emissions by sector for communities in the region. This inventory is the approved GHG baseline used by the Capital District Regional Planning Commission (CDRPC) for the related Metropolitan Statistical Area (MSA) Preliminary Climate Action Plan (PCAP). It was developed with NYSERDA support and is highly accurate. It uses utility meter-aggregated data for the City as reported to New York's Utility Energy Registry².

The City calculated per-household rates of GHG emissions, natural gas and electricity consumption, and the amount of energy used for heating and cooling. The City then applied DOE / Weatherization Assistance Program (WAP) references to estimate energy and GHG reductions expected from the program. To estimate the number of households reached, the City consulted local housing programs with experience implementing HUD funded home rehab projects and determined that \$20,000 per building is adequate to support electrification, prerequisites, and weatherization for low income households. For moderate and higher income residents, a \$10,000 low-interest loan will support prerequisite weatherization and electrification to enable these households to invest in heat pumps over legacy natural gas replacements.

The program is expected to engage 150 buildings at the requested funding level.

¹ <https://cdrpc.org/data/2010-ghg-inventory>

² <https://utilityregistry.org>

Municipal Fleet Electrification

The City proposes to make investments in battery electric fleet vehicles (BEVs) and charging infrastructure shown in the table below. All vehicles will replace existing gasoline or diesel vehicles.

GHG Emissions (MTCDE/year) from Fleet Measures	GHG Benefits (MTCDE/year)
Electric Garbage Truck (MAC)	23.67
E-Garbage Truck Charging Equipment	-
Fast Charger Water and Battery Storage (including upgrades)	-
Fast Charger DGS Battery Storage. (including make ready)	-
Ford Lightning	9.86
Sprinter Van	6.76
Chevy Bolt	3.93
Charging Equipment / Electric Golf Carts	58.93
Street Sweeper	38.59
Building electrical upgrades in anticipation of fast charges (Police first)	-
Totals	141.75

For this measure, baseline GHG emissions are calculated from the gasoline and diesel used in vehicles being replaced. The City reviewed service and fleet fuel records, or used estimated VMT and fuel economy (mpg) to calculate consumption. Because the exact models of new vehicles will be reviewed during procurement, the City used conservation of energy principles to calculate how much grid electricity would be needed to power equivalent BEVs. GHG benefits are the difference between fossil fuel emissions and BEV electricity-related emissions using the 2022 E-GRID baseload emissions factor. The City double-checked electricity consumption estimates against online specifications for representative electric vehicles by class.

The attached spreadsheet includes all calculations, emission factors, and efficiency assumptions needed for these calculations.

Municipal Building Electrification

With support from NYSERDA, the City developed a Clean Energy Master Plan (CEMP) in 2023 that identified hundreds of energy conservation measures (ECMs) across the city's building portfolio. From that plan, the City proposes to install air-to-water heat pumps to electrify eleven key buildings that still possess legacy natural gas powered heating systems.

Building	Energy Conservation Measure (ECM)	GHG Benefits (MTCO ₂ e/year)
AFD Engine No. 10	air-to-water Multistack Chiller(s)	35.64
AFD South End Firehouse	air-to-water Multistack Chiller(s)	55
Boxing Gym	air-to-water Multistack Chiller(s)	18
Swinburne Park Skating Rink	electric mini splits	2
APD West Station/AFD Engine No. 4	air-to-water Multistack Chiller(s)	47
Center Station	air-to-water Multistack Chiller(s)	25
AFD Engine No. 11	air-to-water Multistack Chiller(s) + prerequisites	43
Arbor Hill Firehouse	ducted VRF system	39
APD Communications	air-to-water Multistack Chiller(s)	7
AFD Engine No. 1	air-to-water Multistack Chiller(s) + prerequisites	26
APD Headquarters	ducted VRF system	20
AWD HQ: 10 North Enterprise	Heat pumps in office space and 500k btu heat pump in warehouse space	81.77

The CEMP energy audit provides annual natural gas and electricity usage for 2021-2022, a description of existing gas boilers, and an estimate of how much natural gas is used for heating in each building.

To estimate heat pump GHG benefits, the CEMP used conservation of energy principles to calculate the amount of grid electricity that would be needed to power heat pumps to deliver the same amount of thermal energy as provided by the gas systems. The GHG benefits are calculated as the difference between natural gas emissions reduced and additional emissions from grid electricity needed to power the heat pumps.

The attached spreadsheet includes all calculations, emission factors, and assumptions included in the CEMP.