

Clean and Connected Communities Technical Appendix

Climate Pollution Reduction Grants – Implementation Grants

Section 1. Analytic Approach

The analysis described in this technical appendix evaluates the greenhouse gas (GHG) emissions impact of a diverse portfolio of mitigation measures that are designed to support clean and transit-connected communities.

Four (4) measures were evaluated, including:

- I. Smart Growth Acceleration Program: Smart growth planning, zoning, and predevelopment program to encourage communities to adopt smart growth land use patterns and expedite development in accordance with smart growth principles.
- II. Clean Mobility Program Expansion: Clean mobility grants for localities to encourage mode shift from personal vehicles to micro-mobility or shared zero-emission mobility.
- III. Truck Voucher Incentive Program – Municipal Track: Incentives for local governments to adopt zero-emission medium- and heavy-duty vehicles and non-road equipment used in providing public services.
- IV. Bid Specs and Group Purchasing Program: Engagement of local governments in the development of clean fleet bid specifications and group purchasing to spur transformation to zero-emission public sector fleets.

To estimate the GHG emissions impact of this portfolio, Energy and Environmental Economics, Inc. (E3) developed an Excel-based tool (**Attachment E, GHG Emission Reduction Calculation Spreadsheet**) that conducts a bottom-up analysis for each measure in the Climate Pollution Reduction Grants Program Priority Climate Action Plan for New York State (**Attachment F, Priority Climate Action Plan**). The tool is designed to comply with EPA guidance and incorporates inputs from publicly available literature, data, and tools. A custom-built tool was determined to be the best solution for organizing results and accounting for the various implementation timelines, activity levels, resulting energy and emissions impacts, and costs of measures within the portfolio. The tool provides both annual measure-level results, as well as consolidated portfolio-level results for GHG emissions impact and cost.

In general, the GHG emissions reduction for each measure is calculated by multiplying the increase in measure ‘activity’ by its associated GHG emission factor. The reference case used for each measure assumes that the CPRG-funded measures result in incremental activity levels. For example, emissions impacts of the Truck Voucher Incentive Program – Municipal Track are calculated as the difference in fuel and electricity consumption for electric vehicles adopted due to CPRG funding, multiplied by their relative emissions factors and portion attributable to the CPRG. The specific inputs and assumptions used to calculate emissions impacts vary by measure and are driven by each measure’s given activity. This bottom-up approach to evaluating each measure is designed to ensure that only emissions impacts of incremental activities are calculated and to prevent potential double-counting of emissions reductions.

The calculation of co-pollutant benefits for each measure mirrors the bottom-up calculation used to estimate GHG emissions reductions. The increase in measure ‘activity’ was multiplied by its associated co-pollutant emissions factors for ammonia (NH₃), nitrogen oxides (NO_x), fine particulate matter (PM_{2.5}), sulfur dioxide (SO₂), and volatile organic compounds (VOC). Co-pollutant benefits were only calculated for measures that are expected to meaningfully impact co-pollutants, which are defined for the purpose of this analysis as measures

that impact fuel consumption. EPA's Co-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA)¹ was then used to convert co-pollutant emissions impacts into estimated health impacts.

The allocation of co-pollutant benefits to low income and disadvantaged communities (LIDAC) was then estimated based on the portion of a measure expected to be implemented within federally designated LIDAC census tracts or blocks. For example, the Bid Specs and Group Purchasing Program is expected to be applied statewide, rather than targeted at only LIDAC areas; therefore, the analysis assumes that the co-pollutant benefits are allocated broadly across New York. This results in the allocation of co-pollutant benefits to LIDAC census tracts or blocks, equating to the portion of New York's population that is estimated to live in LIDAC areas (41%). The portion of New York's population that is estimated to live in LIDAC areas was estimated using the EPA-provided Inflation Reduction Act Disadvantaged Communities Map².

While inputs and assumptions are naturally uncertain, the measure analyses are designed to minimize uncertainty through primary research and feedback from New York State (NYS) agencies. The analyses included in the tool are intended to be easily updated as newer or more robust information becomes available and as program implementation guidelines are solidified.

Section 2. Proposal-wide Assumptions

Measures share a common set of emission assumptions including fuel GHG emissions factors, grid GHG emissions factors, global warming potentials (GWPs), and co-pollutant emission factors. In addition to accounting for combustion-related emissions, the analysis includes upstream GHG emissions. The tables below provide an overview of the shared emissions assumptions, which have been sourced from publicly available data sets, including EPA and New York State sources.

Table 1. Global Warming Potentials (from IPCC AR5)

GHG	100yr GWP
Carbon Dioxide (CO ₂)	1
Methane (CH ₄)	28
Nitrous Oxide (N ₂ O)	265

Table 2. Electricity Grid Emissions Factors for New York State³

	Unit	2025	2030	2035	2040
CO ₂	MT/MWh	0.1812	0.0742	0.0474	0.0005
CH ₄	MT/MWh	0.0010	0.0004	0.0003	0
N ₂ O	MT/MWh	0	0	0	0

Table 3. Combustion Fuel GHG Emissions Factors⁴

Fuel	Unit	CO ₂	CH ₄	N ₂ O
Gasoline	Kg/MMBtu	70.22	3.0	0.60
Diesel	Kg/MMBtu	73.96	3.0	0.60

¹ [EPA COBRA](#)

² [Inflation Reduction Act – Disadvantaged Communities Map](#)

³ [Integration Analysis, NY Scoping Plan](#)

⁴ [EPA GHG Emissions Factors Hub](#)

Table 4. Upstream Fuel GHG Emissions Factors⁵

Fuel	Unit	CO ₂	CH ₄	N ₂ O
Gasoline	g/MMBtu	4,915	33	0.08
Diesel	g/MMBtu	14,599	119	0.25

Table 5. Co-pollutant Emissions Factors⁶

Fuel	Vehicle Type	Weight Class	Unit	NH ₃	NO _x	PM _{2.5}	SO ₂	VOC
Gasoline	Combo Short-Haul Truck	8	g/mile	0.05	1.14	0.03	0.03	0.20
Diesel	Combo Short-Haul Truck	8	g/mile	0.03	1.12	0.03	0.02	0.04

Measures also share a common analytical approach, which involves establishing an activity-based reference case that is then compared to the mitigation case to understand the net emissions benefit of each measure. As the activities involved with each measure vary, the tool includes measure-specific assumptions to evaluate each measure. The following section identifies the activity-data, implementation assumptions, measure-specific assumptions, and emissions calculations used for each measure.

Section 3. Measure-Specific Assumptions

NYS agency stakeholders worked closely to define each measure's scope, including a realistic implementation timeline for the measure, the lifetime of the measure, and the funding needed to implement. For each measure, E3 incorporated agency feedback to develop an implementation timeline. These measure implementation assumptions are based on New York's extensive experience delivering GHG emission reduction programs. Where other funding sources would be leveraged, total implementation cost is then calculated based on the number of units of a given measure installed and the dollar-per-unit cost for each measure prorated by the amount attributable to CPRG, per the CPRG program guidance. The sections below outline the measure-specific assumptions that were identified through this process.

3.1 Smart Growth Acceleration Program

This measure will provide planning/zoning/predevelopment grants to communities that enable smart growth, driving increases in population density and improved access to public transit and other zero/low-emission transit modes (e.g., walking, ride share). 60-70 grants will be distributed, but it is assumed some communities may apply for more than one grant. Therefore, the analysis assumed 50 communities would be impacted by CPRG-funded activities, and all planning, zoning, and predevelopment activities will be completed by the end of 2029. This timeline assumes that all funds would be allocated immediately to communities and that communities would not encounter any delays in completing the awarded activities. Delays may be associated with the complexity of proposed planning/zoning/predevelopment activity and local concerns about land use changes, which are often a sensitive local topic. Emissions reductions are realized gradually over time as planning, zoning, and associated predevelopment activities enable increases in population density. Due to the nature of planning and zoning and the long-term impacts they have on infrastructure, this analysis assumes that the measure lifetime extends beyond the CPRG timeframe (2050).

⁵ [2022 NYS Statewide GHG Emissions Report](#)

⁶ [Integration Analysis, NY Scoping Plan](#)

Table 6. Measure Implementation Schedule

	2025	2026	2027	2028	2029	2030
Cumulative Communities with Planning/Zoning/Predevelopment Activities Completed	-	-	-	25	50	50

Cost estimates for this measure were developed based on New York’s existing smart growth activities and research into costs of comparable activities. The analysis assumes that CPRG funds will be used to support incremental activities and that there are no funding opportunities available to blend into projects, thus no existing state or federal funding is applied. In addition, the grants are designed to cover 90% of the cost of planning, zoning, and predevelopment activities for communities, with participants estimated to provide the remaining 10% as cost share. Given that there are no other funding sources for these projects, the analysis assumes 100% of GHG impacts are attributable to CPRG.

The volume of emissions that could be reduced through this measure is calculated based on an assumed change in density over time. The analysis includes two typologies for communities that would receive grant funding, a Downstate NY, and an Upstate NY community. Pre-measure density for each community was developed using EPA’s Smart Location Database.⁷ Post-measure density is assumed to increase by 50%, and this increase in density is expected to occur linearly over the 10 years following planning/zoning/predevelopment activities. The impact of density on emissions is calculated by first establishing an average per capita emissions factor for NY residents, and then estimating the percent reduction in emissions for each percent increase in density. Extensive research has been conducted on density’s impact on per capita carbon footprint. This analysis uses results from a New Climate Economy report to establish the percent reduction in emissions for each percent increase in density. This percent reduction in emissions per capita is then applied at the community level to represent changes in emissions due to planning/zoning/predevelopment activities that increase density within the community. The equations used to calculate total measure emissions reductions are provided in the figure below.

$$C_m = C_r * D * F_r$$

Where C_m is per capita emissions after planning/zoning/predevelopment activities are complete, C_r is the starting per capita emissions, D is the increase density achieved by measure, and F_r is the percent change in carbon footprint per percent change in density.

$$ER = C_m * P * N$$

Where ER is emissions reductions due to measure, C_m is per capita emissions after planning/zoning/predevelopment activities are complete, P is average population size per community and N is number of communities that receive planning/zoning/predevelopment grants.

Table 7. Input Values and Sources

Input	Value	Source(s)
Starting per capita emissions	9.0 MTCO2e/capita	Integration Analysis Annex 2
Starting population density	19.4 housing units/acre Downstate 5.6 housing units/acre Upstate	EPA Smart Location Database
Increase in density achieved by measure	50% increase in density	NYS Department of State

⁷ [EPA Smart Location Database](#)

Percent change in carbon footprint per percent change in density	0.2% decrease in carbon footprint	New Climate Economy (2018)
Average population size per community	3,380 people/Downstate community 980 people/Upstate community	EPA Smart Location Database US Census Bureau

3.2 Clean Mobility Program Expansion

This measure will provide up to 12 implementation grants and technical assistance for micro-mobility and shared mobility projects with a focus on serving disadvantaged and/or underserved areas with new mobility options. The outcome of this measure is an expected reduction in annual vehicle miles traveled (VMT) by community members. Grants will be distributed once CPRG funding is received, and implementation is anticipated to begin in 2026. Emissions reductions are realized once the project is implemented and are expected to continue indefinitely, as part of the program includes identifying long-term financial sustainability strategies after the initial grant-supported investments. This analysis assumes 12 implementation grants are awarded. In the event that fewer projects are awarded (e.g., 8 projects), the assumption is that those projects would be larger and result in greater per-project emissions reductions, and therefore should not impact total emissions reduced.

Table 8. Measure Implementation Schedule

	2025	2026	2027	2028	2029	2030
Communities with clean mobility projects completed	-	12	12	12	12	12

The analysis assumes that CPRG funds will be used to support incremental activities, thus no existing state or federal funding is applied. The analysis assumes that program participants provide 20% cost share for projects; therefore, analysis assumes 100% of GHG impacts are attributable to CPRG.

The volume of emissions reductions that could be reduced through this measure is calculated based on assumed community size, community participation, and resulting VMT impacts. The community size and community participation inputs used in the calculation are based on NYC's Citi Bike program and additional agency input.⁸ The emissions impact of VMT reductions is based on EPA estimates.⁹

$$ER = N * R * M * I * V * EF_{vmt}$$

Where ER is emissions reductions due to measure, N is number of communities implementing clean mobility projects, R is residents per community, M is portion of residents using new mode, I is impact to VMT for participating residents, V is average starting VMT per resident and EF_{vmt} is the average CO₂e per VMT.

Table 9. Input Values and Sources

Input	Value	Source(s)
Residents per community	100,000 people/community	Agency Input
Portion of residents using new mode	2% participation	Citi Bike Participation
Impact to VMT for participating residents	5% VMT offset	ICF ; DOE
Average starting VMT per resident	10,084 annual VMT/capita	Bureau of Transportation Statistics
Average CO ₂ e per VMT	400 g/mile	EPA

⁸ [Citi Bike Participation](#)

⁹ [EPA Fact Sheet: GHG from a Typical Passenger Vehicle](#)

3.3 Truck Voucher Incentive Program – Municipal Track

This measure will provide incentives to replace a portion of New York’s public sector vehicle fleet with zero-emissions vehicles (ZEVs). The analysis assumes electric vehicles rather than other forms of zero-emission vehicles due to the assumption that a vast majority of, if not all, new vehicles under this program would be electric. Incentives will be made available after CPRG funding is received, and, in total, the measure is scoped to replace 120 medium-duty vehicles (MDV), 50 heavy-duty vehicles (HDV), and 250 non-road vehicles (e.g., lawnmowers) by Q1 2028. Emissions reductions are realized once an electric vehicle is placed in service in lieu of an internal combustion engine (ICE) vehicle. The measure lifetime used within this analysis is 16 years, based on the typical lifetime used for a vehicle.

Table 10. Measure Implementation Schedule

	2025	2026	2027	2028	2029	2030
Cumulative HDVs purchased under program	5	25	45	50	50	50
Cumulative MDVs purchased under program	12	60	108	120	120	120
Cumulative non-road vehicles purchased under program	25	125	225	250	250	250

Inputs for HDV and MDV costs were sourced from New York’s Climate Action Council (CAC) Scoping Plan, Annex 1.¹⁰ Vendor equipment prices were used to estimate non-road vehicle costs. This analysis accounts for existing federal funding sources for electric vehicle purchases, estimated to amount to \$34,000 per HDV and \$34,000 per MDV. This estimate considers the federal 45W Commercial Clean Vehicle Credit. Existing funding sources are displayed as a negative cost in Table 11. Program funding would be made available to all three vehicle types on a first-come-first-serve basis, which means the distribution of the number of HDV, MDV, and non-road vehicles may differ from projections here.

Table 11. Measure Cost Assumptions

Budget component	Unit	Value
Vehicle Cost		
HDV upfront cost	\$/vehicle	418,667
MDV upfront cost	\$/vehicle	160,000
Non-road vehicle upfront cost	\$/vehicle	33,750
Program Size		
HDVs purchased	No. vehicles	50
MDVs purchased	No. vehicles	120
Non-road vehicles purchased	No. vehicles	250
Total implementation cost	\$	48,571,429
Participant cost sharing	\$	(8,791,429)
Existing federal/state funding	\$	(5,780,000)
CPRG funding need	\$	\$34,000,000
GHGs attributable to CPRG		88%

Based on NYS agency input, it was assumed that \$34 million would be made available via CPRG funding, which would cover 70% of the total program cost. The remaining 30% would come from a combination of available federal funding, with municipal cost sharing covering the remaining funding need. This resulted in a total

¹⁰ [NY CAC Scoping Plan, Annex 1](#)

implementation cost of \$48.6 million; based on the available CPRG funds and additional funding available through cost sharing and existing federal/state funding.

The program's emissions abatement is derived by the number of vehicles adopted and the difference in emissions between an ICE vehicle and the electricity emissions that result from its replacement with an electric model. Emissions reductions attributable to the Truck Voucher Incentive Program measure are adjusted based on the CPRG portion of the total measure cost (see Table 11).

$$ER = N * (C_{CF} - C_{EV}) * P$$

Where ER is emissions reductions due to measure, N is the number of electric vehicles adopted under the program, C_{CF} is the counterfactual emissions associated with an ICE vehicle, C_{EV} is the electricity emissions associated with an electric vehicle, and P is the percent of abatement that can be attributed to CPRG based on the ratio of CPRG funding to total program cost.

$$C_{CF} = D_D * EF_D$$

$$C_{EV} = D_E * EF_e$$

Where D_D and D_E are the diesel and electricity demand per vehicle per year, and EF_e is the NYS electrical grid emissions factor in a given year, and EF_D is the emissions factor for motor diesel.

MDV and HDV emission inputs were calculated using VMT and vehicle efficiency assumptions from the Integration Analysis completed as part of the CAC Scoping Plan;¹¹ these assumptions were used to calculate both diesel and electricity demand for ICE and electric vehicles, respectively. Diesel and electricity demand for non-road vehicles were calculated based on data within the DOE Clean Cities Guide,¹² vendor information, and a California Air Resources Board (CARB) report.¹³ Emissions for ICE vehicles were calculated using the EPA GHG Emission Factors Hub,¹⁴ and EV emissions were calculated using NY electrical grid emissions from the NY Scoping Plan (see Table 12) adjusted for federal GWP assumptions.

Table 12. Input Values and Sources

Input	Value	Source(s)
Counterfactual HDV diesel demand	8,123 gallons/year	Integration Analysis Annex 1
Counterfactual MDV diesel demand	2,027 gallons/year	Integration Analysis Annex 1
Counterfactual nonroad diesel demand	2,000 gallons/year	DOE Clean Cities Guide
HDV electricity demand	16,620 kWh/year	Integration Analysis Annex 1
MDV electricity demand	11,631 kWh/year	Integration Analysis Annex 1
Nonroad vehicle electricity demand	2,695 kWh/year	DOE; CARB; Vendor

3.4 Bid Specs and Group Purchasing Program

Through this measure, New York will develop a bid specification that municipalities can sign onto, ensuring that future municipal vehicle purchases are zero-emission wherever feasible. In addition, this measure will provide

¹¹ [Integration Analysis, NY Scoping Plan](#)

¹² [DOE Clean Cities Guide](#)

¹³ [CARB](#)

¹⁴ [EPA GHG Emissions Factors Hub](#)

technical assistance to municipalities looking to decarbonize their fleets. Municipalities will be able to join with the state to participate in group purchases for zero-emission MDV and HDV models. The program will begin in the second half of 2026 and will continue through the implementation grant timeline (2050) until all participating state and municipal fleets have fully adopted MHDV and non-road ZEV fleets. The exact number of vehicles participating will depend on the parameters of the bid specifications that are developed, as well as how many municipalities sign on to bid specs or group purchasing. For the sake of this analysis, it is assumed that the number of participating vehicles will be 1,120 HDVs, 2,080 MDVs, and 100 non-road publicly owned vehicles, based on initial inventory data provided by NYS Agencies. These numbers are expected to increase as participation data becomes available. Emissions reductions are realized once an electric vehicle is placed in service in lieu of an internal combustion engine vehicle. The measure lifetime used within this analysis is 16 years, based on the typical lifetime used for a vehicle. Therefore, the analysis assumes that 1/16th of the available fleet is converted in each year throughout the CPRG timeframe.

Table 13. Measure Implementation Schedule

	2025	2026	2027	2028	2029	2030
Cumulative HDVs purchased under program	-	35	105	175	245	315
Cumulative MDVs purchased under program	-	65	195	325	455	585
Cumulative non-road vehicles purchased under program	-	3	9	16	22	28

As this measure results in changes to state and municipal vehicle procurement ensuring ZEVs are purchased in place of ICE, this analysis does not incorporate the cost of vehicle purchases; therefore, analysis assumes 100% of GHG impacts are attributable to CPRG.

The Bid Specs and Group Purchasing Program utilizes the same inputs and calculation approach as the Truck Voucher Incentive Program. The programs have different impacts over NYS transportation emissions based on the number of vehicles purchased under each program, the program timeline, and the percentage of emissions abatement that can be attributed to CPRG funding.

Section 4. GHG Emissions Reduced

Table 14 and Table 15 describe the measure-specific annual GHG emission reductions in metric tons of CO₂e equivalent (mtCO₂e) and the cumulative GHG emission reductions for the periods 2025-2030 and 2025-2050, respectively.

Table 14. Measure-specific annual thousand mtCO₂e GHG emissions reductions (2025-2050)

Measure	'25	'26	'27	'28	'29	'30	'31	'32	'33	'34	'35	'36	'37	'38	'39	'40	'41	'42	'43'	'44	'45	'46	'47	'48	'49	'50
Smart Growth	0	0	0	3	17	29	40	52	63	75	86	98	109	115	115	115	115	115	115	115	115	115	115	115	115	115
Clean Mobility	0	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Truck Voucher	0.2	4	9	12	13	13	13	13	13	13	13	13	13	13	13	13	12	9	4	1	0	0	0	0	0	0
Bid Specs	0	3	10	21	31	42	52	63	73	84	95	106	116	127	138	149	160	168	165	155	144	133	123	112	101	91
Total	0.2	9	24	41	66	88	110	132	154	176	199	221	243	260	271	282	292	297	289	275	264	253	243	232	221	211

Table 15. Measure-specific cumulative mtCO₂e GHG emissions reductions (2025-2030, 2025-2050)

Measure	2025 – 2030	2025-2050
Smart Growth	48,935	2,069,655
Clean Mobility	21,781	118,587
Truck Voucher	49,912	202,279
Bid Specs	106,316	2,462,574
Total	226,944	4,853,094