APPENDIX B: Charts and Tables for Methodologies

TABLE 5: Transportation & Mobile Sources			
Activity/Source	Data Source	Methodology	Data Gaps/Assumptions
On-Road	Baltimore Metropolitan Council/Maryland Department of Transportation	After BMC provided MOVES, we aggregated data by county, fuel/vehicle type.	Data is for 2022, which is the most recent year. Original dataset provided specific vehicle classifications, which were aggregated into Motorcycle, Passenger, Light-Duty, and Heavy Duty
On-Road Transit	Baltimore Metropolitan Council/Maryland Department of Transportation	n/a	Included in on-road activity
Rail	EPA's 2020 National Emissions Inventory	Extracted county data by GHG type, estimated MMBtu using MT CO2/MMBTU emissions factor	Because NEI does not provide activity data, we estimated MMBtu using the MT CO2/MMBTU emissions factor
Aviation	Not Included in PCAP		
Waterborne	EPA's 2020 National Emissions Inventory	Extracted county data by GHG type, estimated MMBtu using MT CO2/MMBTU emissions factor	Because NEI does not provide activity data, we estimated MMBtu using the MT CO2/MMBTU emissions factor
Off-Road/ Mobile	EPA's 2020 National Emissions Inventory	Extracted county data by GHG type, estimated MMBtu using MT CO2/MMBTU emissions factor	Because NEI does not provide activity data, we estimated MMBtu using the MT CO2/MMBTU emissions factor
Emissions factors	EIA's Annual Energy Review, Bureau of Transportation Statistics Average Fuel Efficiencies, and EPA's Emission Factors for Greenhouse Gas Inventories	n/a	n/a

TABLE 6: Grid Electricity			
Activity/Source	Data Source	Methodology	Data Gaps/Assumptions
Residential Electricity	Energy Information Administration State Energy Summaries	Extracted state electricity consumption data and downscaled using a ratio of county households out-of-state households	Since utility data was unavailable, this alternative was considered most applicable. This approach assumes every house uses grid electricity.
Commercial Electricity	Energy Information Administration State Energy Summaries	Extracted state electricity consumption data and downscaled using a ratio of county commercial jobs : out-of-state commercial jobs	Since utility and state commercial data was unavailable, this alternative was considered most applicable.
Industrial Electricity	Energy Information Administration State Energy Summaries	Extracted state electricity consumption data and downscaled using a ratio of county industrial jobs : out-of-state industrial jobs	Since utility and state industrial data was unavailable, this alternative was considered most applicable.
Electricity Generation	EPA FLIGHT	Extracted site-specific data per county and directly entered raw metric tons (per GHG)	This data is recorded but emissions are not considered in the GHGI total because electricity generation emissions are assumed to be captured in the residential, commercial, and industrial electricity emissions.
Emissions factors	EPA's eGRID2021	n/a	n/a

TABLE 7: Solid Waste			
Activity/Source	Data Source	Methodology	Data Gaps/Assumptions
Waste Generation (Open Landfills)	Maryland Department of Environment's MD Solid Waste Management and Diversion Report (2022, CY 2021 Data)	Enter site-specific Waste Accepted tonnage.	Waste data was split into Waste accepted, waste disposed, and waste transportation. We choose to use the waste accepted values as this best reflects annual generation. We assumed all landfills use typical landfill gas controls, have "wet" moisture contents, and all waste was generated and landfilled in the boundary.
Closed Landfills	FLIGHT data	Extracted site-specific data per county and directly entered raw metric tons CH4	n/a
Landfill Gas Flaring	Maryland Department of Environment's State-wide 2020 GHG Inventory	Extracted site-specific data	Source data is from 2020
Landfill Gas Combustion	Maryland Department of Environment's State-wide 2020 GHG Inventory	Extracted site-specific data	We assumed all energy from LFG combustion was sent to the grid. Source data is from 2020
Waste Characterization	Maryland Department of Environment's MD Solid Waste Management and Diversion Report (2022, CY 2021 Data)	n/a	Statewide waste characterization represents each landfill's waste composition. Because the waste composition categories differed from ClearPath categories, the following assumptions occurred: Paper and paperboard was split evenly into all 4 paper/cardboard categories, Yard trimmings was split evenly into grass, leaves, and branches, and 25% of the construction and demolition waste reported was lumber.
Emissions factors	EPA's Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM)	n/a	n/a

TABLE 8: Other Sources			
Activity/Source	Data Source	Methodology	Data Gaps/Assumptions
Residential Stationary Fuel	Energy Information Administration State Energy Summaries	Extracted state stationary fuel consumption data and downscaled using a ratio of county households : out-of-state households	Since utility data was unavailable, this alternative was considered most applicable.
Commercial Stationary Fuel	Energy Information Administration State Energy Summaries	Extracted state stationary fuel consumption data and downscaled using a ratio based on county commercial jobs : out-of-state commercial jobs	Since utility and state commercial square footage data was unavailable, this alternative was considered most applicable.
Industrial Stationary Fuel	EPA FLIGHT	Extracted site-specific data per county and directly entered raw metric tons (per GHG)	Assumed the majority of industrial stationary fuel consumption is captured in EPA FLIGHT.
Fugitive Emissions from Natural Gas Distribution	Energy Information Administration State Energy Summaries & FLIGHT	Enter natural gas consumption (MMBtu) per county	Used defaults from ClearPath Fugitive Emissions From Natural Gas Distribution Calculator
Fugitive Emissions from Oil and Natural Gas Systems	EPA FLIGHT	Extracted site-specific data per county and directly entered raw metric tons (per GHG)	Assumed any emissions from natural gas distribution is captured in "Fugitive Emissions from Natural Gas Distribution"
Industrial Process & Product Use	EPA FLIGHT	Extracted site-specific data per county and directly entered raw metric tons (per GHG)	GHGs are captured internally and entered as CO2 equivalent (CO2e)
Water Treatment Energy	n/a	n/a	Assumed to be captured in the commercial and/or industrial electricity and stationary fuel consumption estimates.
Wastewater Treatment	Maryland Department of Environment's State-wide 2020 GHG Inventory	Downscaled emissions data using population ratios and directly entered emissions	Due to the unavailability of site-specific wastewater treatment operations data, we assumed that wastewater is generated and treated in boundary location. Because MDE's 2020 GHGI provided total CH4 for wastewater treatment, we directly entered these emissions under septic activity.

			Source data is from 2020
Agriculture: Livestock and Crops	U.S. Department of Agriculture's (USDA) 2017 Census of Agriculture, County Data	Extracted livestock headcounts and crop counts and utilized the EPA's State Inventory Tool, Agriculture Module to estimate emissions	Due to the differing categorizations of the EPA's SIT Agriculture Modules and the USDA's 2017 Census of Agriculture county data, the following categories were grouped together/assumptions were made: Milks Cows = Dairy Cows; Cows and heifers that calved = Feedlot Heifers; Cattle/calves = Calves; Beef cows = Beef Cows; Other cattle = Heifer Stockers; Hogs are all assigned to the "Market 120-179 lbs" category, Layers = Layers; Pullets for laying flock replacement = Pullets/ Chickens; Broilers and other meat-type chickens = Broilers; All sheep = Sheep on Feed
Forestry and Land Use	Land Emissions And Removals Navigator (LEARN) Tool	Extracted county-level emissions and removals for forests, changes in forestry, urban trees, etc.	This data is recorded but emissions are not considered in the GHGI total per ICLEI's US Community Protocol (emissions and removals from forestry and land use should not count towards gross emissions) Used Baltimore, MD as the “representative urban area" for emissions factors
Stationary Fuel Emissions Factors	EPA's GHG Emission Factors Hub	n/a	n/a
Fugitive Emissions from Natural Gas Distribution	Environmental Defense Fund's (EDF) User Guide for Natural Gas Leakage Rate Modeling Tool	n/a	n/a
Wastewater Treatment Emissions Factors	IPCC Methods for Greenhouse Gas Inventories	n/a	n/a
Agriculture Emissions factors	EPA's State Inventory Tool Agriculture Module	n/a	n/a
Forestry and Land Use	U.S. Forest Service's Forest Inventory and Analysis (FIA) database	n/a	n/a

Table 9: Projection Growth Rates				
Activity/Source	Type	Data Source	Methodology	Data Gaps/Assumptions
Maryland State Grid Projections to 2050	Electricity Carbon Intensity Rate	2021 baseline data from eGRID2021 and projection data from National Renewable Energy Laboratory's (NREL) Cambium Scenario Viewer	n/a	n/a
Population Growth	Growth Rate (for various activities)	Baltimore Metropolitan Council, Round 10 Cooperative Forecasts	n/a	n/a
Household Growth	Growth Rate (for residential activities)	Baltimore Metropolitan Council, Round 10 Cooperative Forecasts	n/a	n/a
Commercial Employment	Growth Rate (for commercial activities)	S&P Global	n/a	Used non-manufacturing counts for commercial projections
Industrial Employment	Growth Rate (for industrial activities)	S&P Global		Used manufacturing employment counts for industrial projections
CAFE Standards Default On Road Carbon Intensity Factors	On Road (passenger/light duty) Carbon Intensity Rate	Center for Climate and Energy Solutions (C2ES)	Miles per Gallon fleet averages were converted to Gallons per Mile. Values were then utilized to calculate a Compound Annual Growth Rate from 2010 to 2040. Values were carried forward to 2050.	Although CAFE standards apply to medium/heavy-duty trucks, the provided Carbon Intensity Factors are based on passenger cars and light-duty trucks because limited analysis of the fleetwide impact has been performed. The test procedure for CAFE standards is different from that used for MPG of vehicles in actual driving conditions.
No Growth	n/a	n/a	n/a	n/a

TABLE 10: GHG Reduction Strategies			
Strategy	Data Used	Data Gaps/Assumptions	Data Source
VMT Reduction - 25% by 2030 - Gasoline	25% in 2050	State plan aims for a 20% reduction, the region increased this by 5%	Maryland Department of Environment's Maryland's Climate Pollution Reduction Plan
VMT Reduction - 25% by 2030 - Diesel	25% in 2050	State plan aims for a 20% reduction, the region increased this by 5%	Maryland Department of Environment's Maryland's Climate Pollution Reduction Plan
Advanced Clean Cars II	-Modeling of vehicle turnover -17% EV in 2030, 99% in 2050	6.2% of fleet turns over per year (16.2 years for full turnover)	DOE Alternative Fuels Data Center, Statista, California Air Resources Board
Advanced Clean Trucks	Heavy Duty Vehicles -27.5% EV in 2030, 99.6% in 2050	12.5% of fleet turns over per year (8 years for full turnover).	DOE Alternative Fuels Data Center, Statista, Rocky Mountain Institute (RMI)
Clean Power Standard	100% Renewable Energy by 2035		Maryland Department of Environment's Maryland's Climate Pollution Reduction Plan
Residential Energy Codes and Standards	-37% efficiency improvement for all new buildings -5% of homes and commercial space retrofit each year. -20% savings from retrofit	5% of building stock per year: Typical heating/cooling equipment life is around 15-20 years, and 20 years translates to 1/20, or 5%, each year. It can make sense to do an efficiency upgrade at the same time as equipment replacement - the efficiency may allow for a smaller, less expensive AC unit or furnace. -ACEE reported 10% typical energy savings for a 'light' retrofit and 29% for a 'medium' retrofit - so 20% falls in the middle between those. -Default Energy savings in new buildings was 37%, 37% improvement for new buildings comes from comparing estimated EUI	Pacific Northwest National Laboratory (PNNL), U.S. Energy Information Administration

		(energy use intensity) for 2018 commercial model energy code with average EUI of existing commercial buildings from 2012 commercial buildings energy consumption survey.	
Commercial Energy Codes and Standards	-37% efficiency improvement for all new buildings -5% of homes and commercial space retrofit each year. -20% savings from retrofit	5% of building stock per year: Typical heating/cooling equipment life is around 15-20 years, and 20 years translates to 1/20, or 5%, each year. It can make sense to do an efficiency upgrade at the same time as equipment replacement - the efficiency may allow for a smaller, less expensive AC unit or furnace. -ACEEE reported 10% typical energy savings for a 'light' retrofit and 29% for a 'medium' retrofit - so 20% falls in the middle between those. -Default Energy savings in new buildings was 37%, 37% improvement for new buildings comes from comparing estimated EUI (energy use intensity) for 2018 commercial model energy code with average EUI of existing commercial buildings from 2012 commercial buildings energy consumption survey.	Pacific Northwest National Laboratory (PNNL), U.S. Energy Information Administration

Residential Building Decarbonization	-5% of buildings electrified per year (100% by 2044) -Heat pump coefficient of performance 3.19 for Baltimore from RMI	-Default value of existing housing units with natural gas electrified per year is 5%, 5% of building stock per year: Typical heating/cooling equipment life is around 15-20 years, and 20 years translates to 1/20, or 5%, each year.	EnergyStar, Schroders (Peiser, R., & Wiegelmann, T. "Real Estate and Sustainability: The Moral Imperative." Property Chronicle.) Rocky Mountain Institute
Commercial Building Energy Performance Standards	-5% of buildings electrified per year (100% by 2044) -Heat pump coefficient of performance 3.19 for Baltimore from RMI	5% of building stock per year: Typical heating/cooling equipment life is around 15-20 years, and 20 years translates to 1/20, or 5%, each year.	EnergyStar, Schroders (Peiser, R., & Wiegelmann, T.. "Real Estate and Sustainability: The Moral Imperative." Property Chronicle.) Rocky Mountain Institute
Waste Diversion	-Current waste diversion of 49.2% (in 2017). Diversion increases to 65% in 2030 and stays at 65% through 2050.	Since 50% waste goes to landfill/incinerator in the baseline, increasing to 65% total diversion will reduce the waste tonnage to landfill/incinerator by 30%.	Maryland Department of Environment

TABLE 11: Authority to Implement			
Category	**Measure**	**Additional Authority to Implement Required?**	**Timeline to Acquire Additional Authority**
Transportation	VMT Reduction - 25% by 2050	Yes, local governments have the authority to advance the implementation of Maryland's Transportation Plan that aims to reach a 20% reduction.	Any aspects local government cannot currently implement, we will collaborate with the State of Maryland to achieve those goals.
Transportation	Advanced Clean Cars II	Yes, local governments have the authority to implement actions related to supporting the adoption of electric vehicles. State government has the ultimate authority to implement this action. The Advanced Clean Cars II law in Maryland requires manufacturers to continuously increase the share of vehicles they sell that are electric - reaching 100% of passenger car and light truck sales in model year 2035.	N/A Any aspects local government cannot currently implement, we will collaborate with the State of Maryland to achieve those goals.
Transportation	Advanced Clean Trucks	Yes, local governments have the authority to implement actions related to supporting the adoption of electric and/or zero emission trucks for municipal operations. State government has the ultimate authority to implement this action.	N/A Any aspects local government cannot currently implement, we will collaborate with the State of Maryland to achieve those goals.
Grid Electricity	Clean Power Standard - 100% Renewable Energy by 2035	Limited, the authority to implement this goal sits with local public utilities and regulatory authorities across the state such as the public service commission. Local governments can only control renewable electricity use for government operations.	Authority will be coordinated with the necessary state partners.
Grid Electricity	Energy Codes and Standards	Yes, local governments have the ability to implement local energy and building codes.	N/A
Grid Electricity	Building Energy Performance Standards	Yes, local governments will work closely with the State's Department of Environment to support the implementation of the CSNA.	N/A
Solid Waste	Food Residuals Diversion Law	Yes, local governments will work closely with the State's Department of Environment to support the implementation of HB264. MDE has regulatory authority through this law.	N/A