Tennessee Volunteer Emission Reduction Strategy

Priority Climate Action Plan

Tennessee Department of Environment & Conservation | March 2024

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Commissioner's Message

Fellow Tennesseans:

I am pleased to share the Tennessee Volunteer Emission Reduction Strategy (TVERS) **Priority Climate Action Plan** on behalf of the Tennessee Department of Environment and Conservation. This plan is an initial step in a multiphase process in which forty-five other states are participating. By submitting this plan to the Environmental Protection Agency, state and local governmental entities will be eligible to compete and receive federal funding to implement community-based projects from Memphis to Bristol.

The actions outlined in this plan focus on major emission sources in Tennessee, including transportation, electricity generation, and industrial activities. It targets impactful activities to reduce emissions that are near-term, implementation-ready, and have the support of an engaged public and stakeholder community. I appreciate the plan is both flexible and actionable as it will inform our direction as we move forward through this process.

While this plan is focused on reducing harmful air pollution, the measures outlined in the plan will also protect our natural resources, enhance creation of new businesses and jobs, and improve the quality of life for all Tennesseans. Indeed, the thoughtful, responsible and inclusive approach to developing TVERS reflects our state's leadership position and builds upon on that momentum. Tennessee has not only been recognized as a top state for job creation and economic development but has also dramatically reduced air emissions while increasing population and Gross Domestic Product over the last few decades. We have demonstrated it's possible to have economic opportunity, prosperity and growth while taking steps to decrease emissions and protect public health and the environment. This plan incorporates what we have learned from our success and seeks to leverage science, stakeholder input and strategic direction to produce even more opportunities and progress for all communities across Tennessee.

Protecting our environment and enhancing quality of life through the development of this plan required the efforts of a cross section of Tennesseans—including citizens, local and state agencies, nonprofit organizations, community groups, universities, and private businesses. We appreciate the input received from more than 1,500 responses to a public survey and the meaningful citizen participation during public meetings. This plan is stronger due to the numerous stakeholders from across the state that provided feedback and municipal and coordinating partners who helped guide this effort. I would also thank the professionals at Civil & Environmental Consultants, Inc, and Ernst & Young that served as our consultants for this initiative. Finally, I want to acknowledge the effort and expertise of department staff that produced this project:

> **Division of Air Pollution Control:** Michelle Walker Owenby, Mary-Margaret Chandler, Travis Blake, Nikki Thompson, Michelle Oakes, PhD, Chen-En Yang, PhD, Marc Corrigan, and Randy Powers
>
> **Office of Policy and Planning:** Jennifer Tribble, PhD and Rachael Maitland
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With support from the **Office of Energy Programs** (Molly Cripps, Alexa Voytek, Mark Finlay, and Lizzy Gaviria), the **Office of Sustainable Practices** (Matt Taylor and Joelle Ciriacy), and the **Office of General Counsel** (Michael Lewis).

We will continue the Tennessee Volunteer Emission Reduction Strategy by taking the next step in the process: developing our state's *Comprehensive Action Plan*. We are excited about the opportunity to work on it with you for the benefit of current and future generations of Tennesseans.

Sincerely,

David W. Salyers, P.E.
Commissioner

Acronyms and Abbreviations

AVERT	Avoided Emissions and Regeneration Tool
BAU	Business-As-Usual
BEV	Battery Electric Vehicles
BIL	Bipartisan Infrastructure Law
CAA	Clean Air Act
CAPs	Criteria Air Pollutants
CEC	Civil & Environmental Consultants, Inc.
CCAP	Comprehensive Climate Action Plan
CEJST	Climate and Economic Justice Screening Tool
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CPRG	Climate Pollution Reduction Grant
EIA	Energy Information Administration
EJScreen	Environmental Justice Screening and Mapping Tool
DOE	Department of Energy
EPA	Environmental Protection Agency
ERPAC	Emissions Reduction Planning Advisory Committee
EV	Electric Vehicle
EY	Ernst & Young
F-gases	Fluorinated Gases
FCEV	Fuel Cell Electric Vehicles
GHG	Greenhouse Gas
GLIMPSE	Global Change Analysis Model Long-term Interactive Multi-Pollutant Scenario Evaluator
GWh	Gigawatthour
HAPs	Hazardous Air Pollutants
HFCs	Hydrofluorocarbons
HPS	High Pressure Sodium Vapor Light
ICE	Internal Combustion Engine
IRA	Inflation Reduction Act
kW	Kilowatt
kWh	Kilowatthour

LDV	Light-Duty Vehicle
LED	Light Emitting Diode
LIDAC	Low-Income and Disadvantaged Communities
LULUCF	Land Use, Land Use Change, and Forestry
MW	Megawatt
MWh	Megawatthour
MT	Metric Ton
MMT	Million Metric Ton
MMT CO_2e	Million Metric Tons Carbon Dioxide Equivalents
MSA	Metropolitan Statistical Area
MSW	Municipal Solid Waste
NAAQS	National Ambient Air Quality Standards
NEI	National Emissions Inventory
NF_3	Nitrogen Trifluoride
N_2O	Nitrous Oxide
NO_2	Nitrogen Dioxide
NO_X	Nitrogen Oxides
O_3	Ozone
PCAP	Priority Climate Action Plan
PFCs	Perfluorocarbons
PM/$PM_{2.5}$	Particulate Matter
Project Team	TDEC, Civil & Environmental Consultants, Inc. and Ernst & Young
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
SF_6	Sulfur Hexafluoride
SIT	State Inventory Tool
SO_2	Sulfur Dioxide
TDEC	Tennessee Department of Environment and Conservation
TN	Tennessee
TVA	Tennessee Valley Authority
TVERS	Tennessee Volunteer Emission Reduction Strategy
VOCs	Volatile Organic Compounds
WARM	Waste Reduction Model

Introduction

Overview

The Tennessee Volunteer Emission Reduction Strategy (TVERS) is a collaborative emissions reduction plan developed by the Tennessee Department of Environment and Conservation (TDEC) with partners statewide. The intent of this plan is to support investment in programs and strategies that reduce pollutant emissions, create high-quality jobs, spur economic growth, and enhance the quality of life for all Tennesseans. This plan is built so future generations can enjoy the economic prosperity and abundant natural resources, including our clean air, that we enjoy today. It highlights and honors our natural heritage while providing pathways to economic growth.

TVERS is funded through the US Environmental Protection Agency's (EPA) Climate Pollution Reduction Grant (CPRG) program, which was established in the Inflation Reduction Act of 2022 (IRA). The CPRG program is providing $5 billion in grants to states, local governments, tribes, and territories to develop and implement plans for reducing greenhouse gas (GHG) emissions and other harmful air pollutants. EPA has organized the program into two phases: Phase 1 provides $250 million in noncompetitive planning grants and Phase 2 provides $4.6 billion for competitive implementation grants ($4.3 billion available to states and municipalities, and $300 million available to tribes and territories) for eligible entities to implement measures identified in a plan.

The first deliverable in the planning phase of the CPRG is a Priority Climate Action Plan (PCAP). The PCAP is focused on a simplified GHG Inventory and near-term, high-priority, implementation-ready measures. The measures contained herein should be construed as broadly applicable to any entity in the state eligible for receiving funding under the CPRG implementation grants and other funding streams. This plan serves as the basis and requirement to position Tennessee for additional federal funding for programs that will benefit Tennessee communities and Tennesseans statewide.

This plan includes the following required elements, established in the CPRG guidelines:

- GHG Emissions Inventory,
- Priority Measures and Reduction Estimates,
- Benefits Analysis,

- Low-Income and Disadvantaged Communities (LIDAC) Benefits Analysis,
- Review of Authority to Implement,
- Intersection with Other Funding Availability, and
- Coordination and Engagement.

TDEC contracted with Civil & Environmental Consultants, Inc. (CEC) and Ernst & Young (EY) to complete the required technical sections of the PCAP, specifically the GHG Emissions Inventory (TN PCAP Inventory or Inventory), priority measures and reduction estimates, and benefits analyses. TDEC, CEC, and EY represent the Project Team for the PCAP. In selecting priority measures for inclusion in the PCAP, TDEC focused on voluntary or incentive-based activities that resulted in significant GHG emissions reductions. The development of the PCAP involved extensive coordination with Tennessee (TN) citizens, other state agencies, local governments, nonprofits, utilities, industries, and other diverse stakeholders. TDEC coordinated with the three metropolitan statistical areas (MSAs) in Tennessee that received CPRG planning grants: Knoxville, Memphis, and Nashville. The resulting plan is meant to encompass and represent the entirety of the state and allow for state, regional, and local adaptations regarding projects and programs that can reduce emissions and benefit all Tennesseans.

TDEC utilized data handling procedures to condense meaningful information into an accessible format for a broad audience in the PCAP. For each table and figure, data were carefully truncated/rounded to accurately represent data estimates and trends while avoiding extraneous details. Data rounding was dependent on the magnitude and type of data being presented and varied across data sets. Certain data sets were truncated to two decimal places, while others were not. These differences in data presentation occasionally resulted in minor discrepancies when comparing data across various tables and figures. The Project Team will explore a standard method of data rounding for the Comprehensive Climate Action Plan (CCAP).

Next Steps

The PCAP is the first deliverable in EPA’s CPRG program. In Summer 2025, TDEC will submit the next deliverable to EPA: a CCAP. The CCAP will touch on all significant GHG sources/sinks and sectors present in Tennessee, establish near-term and long-term GHG emissions reduction goals, and provide strategies and identify measures to achieve those goals. TDEC intends to build upon the foundation established in the PCAP in developing the

CCAP. This includes further refining the TN PCAP Inventory to understand county-level emissions, broadening measures to achieve the state's GHG emissions reduction goals and continuing comprehensive coordination and engagement.

This project has been funded wholly or in part by the US EPA under assistance agreement 02D51423 to TDEC. The contents of this document do not necessarily reflect the views and policies of the EPA, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document.

Greenhouse Gas Emissions Inventory

The first required element of the PCAP is a statewide GHG inventory. Broadly, a GHG inventory tracks GHG emissions within a specific geographic region and a specific period of time by sector and GHG pollutant type. TDEC has developed a simplified inventory for the PCAP, with additional analyses and modifications planned for the comprehensive GHG inventory in the CCAP. Based on the availability of underlying data to support the development of GHG reduction estimates, TDEC used a baseline year of 2019 for the Inventory.

The TN PCAP Inventory was prepared using EPA's State Inventory and Projection Tool[1] (SIT), a comprehensive tool developed to assist states in producing GHG inventories. The SIT calculates emissions and provides an aggregated total for each sector at the state level. Detailed methodology and quality assurance procedures for preparation of the TN PCAP Inventory are presented in Appendix A. The TN PCAP Inventory includes the following sectors and gases (Figure 1):

Emission Sectors	Greenhouse Gases (all sectors)
• Transportation • Electricity Generation • Industry • Agriculture • Commercial and Residential Buildings • Waste and Materials Management • Wastewater • Land Use, Land Use Change, and Forestry	• Carbon dioxide (CO_2) • Methane (CH_4) • Nitrous oxide (N_2O) • Fluorinated gases (F-gases, reported as "Other")

Figure 1. Emission Sectors and GHGs in the TN PCAP Inventory

[1] "State Inventory and Projection Tool | US EPA." *US EPA*, 30 June 2017, https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool.

Table 1 provides the TN PCAP Inventory GHG emissions in millions metric tons of carbon dioxide equivalent (MMT CO_2e) for all sectors in the baseline year of 2019. Net emissions include both emission sources for each identified sector and carbon sinks from Land Use, Land Use Change, and Forestry (LULUCF). Carbon sinks indicate that more carbon is absorbed from the atmosphere than is released to the atmosphere for that sector and is designated by a negative number.

Sector	Emissions (MMT CO_2e)
Transportation	44.2
Electricity Generation	24.1
Industry	22.9
Agriculture	9.2
Commercial & Residential Buildings	8.6
Waste & Materials Management	2.4
Wastewater	0.7
Total Emissions	**112.1**
Land Use, Land Use Change, & Forestry	-32.6
Net Emissions (Sources & Sinks)	**79.5**

Table 1. TN PCAP Inventory GHG emissions in MMT CO_2e by Sector

Figure 2 provides the CO_2e percentage of total emissions for each sector. The TN PCAP Inventory indicates that transportation is the highest emitting sector, accounting for 39% of total emissions, followed by electricity generation (22%) and industry (20%).[2]

[2] The TN PCAP Inventory considers emissions from electricity consumed within the Electricity Generation sector. This includes electric energy consumed by buildings, industry, and the transportation sector. For more information, see Appendix A.

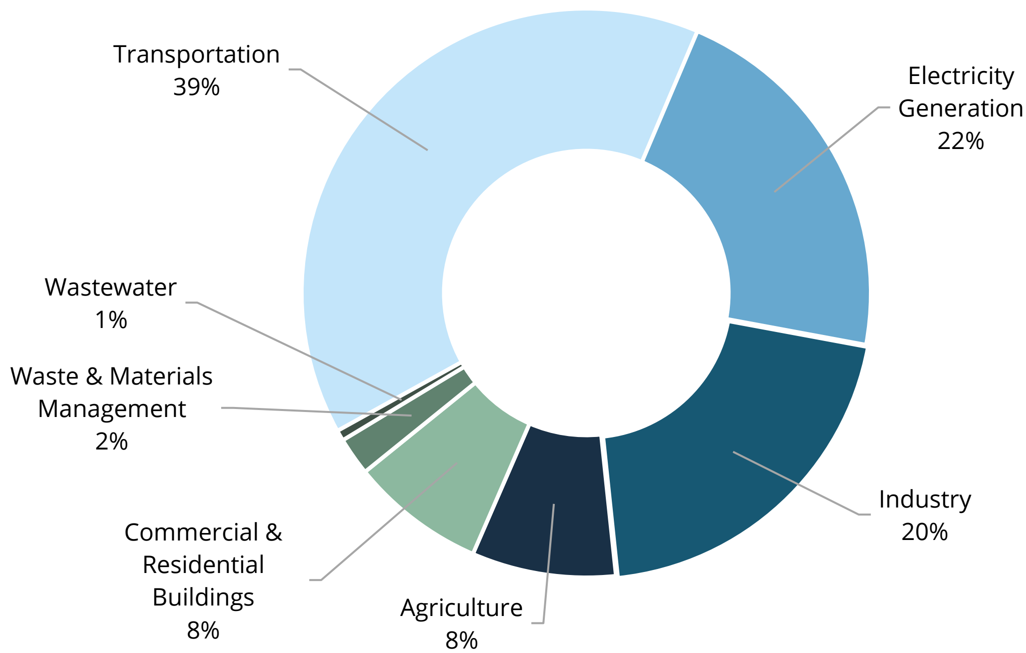

Figure 2. Sector CO_2e % of Total Emissions

Tennessee has a large carbon sink resulting from the LULUCF sector, resulting in a 32.6 MMT CO_2e decrease (-29%) of the total emissions. Figure 3 shows the impact of the carbon sink on the TN PCAP Inventory.

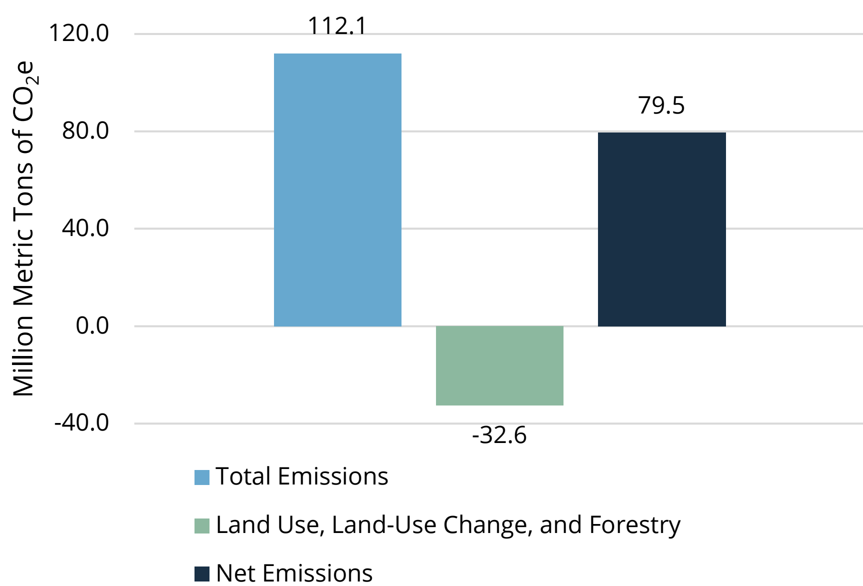

Figure 3. TN PCAP Inventory Net GHG Emissions in MMT CO_2e

Table 2 provides the subsector breakdown included in the TN PCAP Inventory in MMT CO_2e.[3]

Sector/Source	Emissions (MMT CO_2e)
Transportation	**44.21**
Mobile Combustion - Aviation Gasoline	0.03
Mobile Combustion - Distillate Fuel	12.26
Mobile Combustion - Jet Fuel, Kerosene	4.13
Mobile Combustion - Jet Fuel, Naphthalene	0.00
Mobile Combustion - Hydrocarbon Gas Liquids	< 0.005
Mobile Combustion - Motor Gasoline	26.26
Mobile Combustion - Residual Fuel	< 0.005
Mobile Combustion - Natural Gas	0.83
Mobile Combustion - Lubricants	0.21
Mobile Combustion - Other	--
Mobile Combustion - CH_4 & N_2O	0.48
Non-Energy Use of Fuels	--
Substitution of Ozone Depleting Substances	--
Electric Generation	**24.13**
Combustion - Coal	17.73
Combustion - Distillate Fuel	0.12
Combustion - Residual Fuel	0.00
Combustion - Natural Gas	6.29
Combustion - Other	--
Combustion - Petroleum Coke	0.00
Combustion - Wood	0.00
Industry	**22.88**
Abandoned Oil & Gas Wells	--
Abandoned Underground Coal Mines	0.08
Adipic Acid Production	0.00
Aluminum Production	0.00
Ammonia Production	0.00

[3] The following symbology is noted in the table:
"--" Indicates that the value has not been estimated at this time.
"< 0.005" Indicates the value does not exceed 0.005 MMT CO_2e.
"0.00" Indicates the value is not applicable to the State.

Sector/Source	Emissions (MMT CO_2e)
Caprolactam, Glyoxal, & Glyoxylic Acid Production	--
Carbide Production & Consumption	--
CO_2 Consumption	--
Cement Production	1.14
Coal Mining	0.01
Electrical Transmission & Distribution	0.11
Electronics Industry	0.05
Ferroalloy Production	--
Glass Production	--
Hydrochlorofluorocarbons-22 Production	0.00
Iron & Steel Production	2.34
Lead Production	--
Lime Production	0.64
Limestone & Dolomite Use	0.37
Magnesium Production & Processing	--
N_2O from Product Uses	--
Natural Gas Production & Flaring	--
Natural Gas Transmission & Distribution	--
Nitric Acid Production	--
Non-Energy Use of Fuels	--
Other Process Uses of Carbonates	--
Petroleum Systems	< 0.005
Phosphoric Acid Production	--
Soda Ash Production	0.04
Substitution of Ozone Depleting Substances	4.63
Titanium Dioxide Production	--
Urea Consumption for Non-Agricultural Purposes	0.02
Zinc Production	--
Combustion - Distillate Fuel	0.87
Combustion - Hydrocarbon Gas Liquids	0.06
Combustion - Motor Gasoline	0.40
Combustion - Residual Fuel	< 0.005
Combustion - Natural Gas	7.55
Combustion - Other	--
Combustion - Lubricants	0.14

Sector/Source	Emissions (MMT CO_2e)
Combustion - Petroleum Coke	0.51
Combustion - Coking Coal	0.00
Combustion - Other Coal	2.72
Combustion - Asphalt & Road Oil	0.01
Combustion - Aviation Gasoline Blending	< 0.005
Combustion - Crude Oil	0.00
Combustion - Feedstocks, Naphthalene	0.00
Combustion - Feedstocks, Other Oils	0.00
Combustion - Kerosene	< 0.005
Combustion - Motor Gasoline Blending	0.00
Combustion - Miscellaneous Petroleum Products	0.00
Combustion - Pentanes Plus	0.00
Combustion - Still Gas	0.92
Combustion - Special Naphthalenes	0.08
Combustion - Unfinished Oils	0.10
Combustion - Waxes	0.01
Combustion - Wood	0.08
Agriculture	**9.17**
Enteric Fermentation	3.28
Field Burning of Agricultural Residues	< 0.005
Liming	0.04
Manure Management	0.47
Mobile Combustion	0.01
Rice Cultivation	--
Stationary Combustion	--
Urea Fertilization	0.12
Fertilizers	1.30
Crop Residues	0.59
Nitrogen-Fixing Crops	0.96
Histosols	--
Livestock	1.94
Fertilizer Runoff/Leached	0.40
Manure Runoff/Leached	0.08
CO_2 from Fossil Fuel Combustion	--
Commercial & Residential Buildings	**8.58**

Sector/Source	Emissions (MMT CO_2e)
Combustion - Coal	0.00
Combustion - Distillate Fuel	0.45
Combustion - Hydrocarbon Gas Liquids	0.60
Combustion - Motor Gasoline	0.47
Combustion - Residual Fuel	0.00
Combustion - Natural Gas	6.97
Combustion - Other	--
Combustion - Kerosene	0.02
Combustion - Wood	0.08
Substitution of Ozone Depleting Substances	--
Waste & Materials Management	**2.43**
Landfills (Municipal)	2.51
Landfilled Yard Trimming Carbon Flux	-< 0.005
Landfilled Food Scrap Carbon Flux	-< 0.005
Landfills (Industrial)	0.15
Composting	--
Incineration of Waste	--
Wastewater	**0.67**
Municipal Wastewater Treatment	0.66
Industrial Wastewater Treatment - Red Meat	0.01
Industrial Wastewater Treatment - Fruits & Vegetables	--
Industrial Wastewater Treatment - Poultry	--
Industrial Wastewater Treatment - Pulp & Paper	--
Total Emissions	**112.08**
LULUCF	**-32.61**
Agricultural Soil Carbon Flux	1.22
Forest Fires	--
N_2O from Settlement Soils	0.14
Urban Trees	-3.75
Forest Land Remaining Forest Land	-29.42
Land Converted to Forest Land	-3.23
Forest Land Converted to Land	2.44
Net Emissions (Sources & Sinks)	**79.47**

Table 2. TN PCAP Inventory GHG Emissions in MMT CO_2e by Sector and Subsector

Table 3 provides the total and net GHG emissions by gas in MMT CO_2e for all sectors in the TN PCAP Inventory.

Sector	CO_2	CH_4	N_2O	Other[4]
Transportation	43.73	0.06	0.43	0.00
Electricity Generation	24.05	0.01	0.08	0.00
Industry	17.87	0.14	0.07	4.80
Agriculture	0.16	3.64	5.38	0.00
Commercial & Residential Buildings	8.47	0.09	0.02	0.00
Waste & Materials Management	-0.23	2.66	0.00	0.00
Wastewater	0.00	0.49	0.18	0.00
Total Emissions	**94.04**	**7.10**	**6.14**	**4.80**
LULUCF	-32.75	0.00	0.14	0.00
Net Emissions	**61.29**	**7.10**	**6.28**	**4.80**

Table 3. TN PCAP Inventory GHG Emissions by Gas in MMT CO_2e by Sector

Figure 4 visualizes the total and net emissions by gas. Carbon dioxide (CO_2) emissions account for 84% of total emissions in the TN PCAP Inventory.

[4] Other emissions include fluorinated gases (e.g., HFCs, PFCs, SF_6, NF_3).

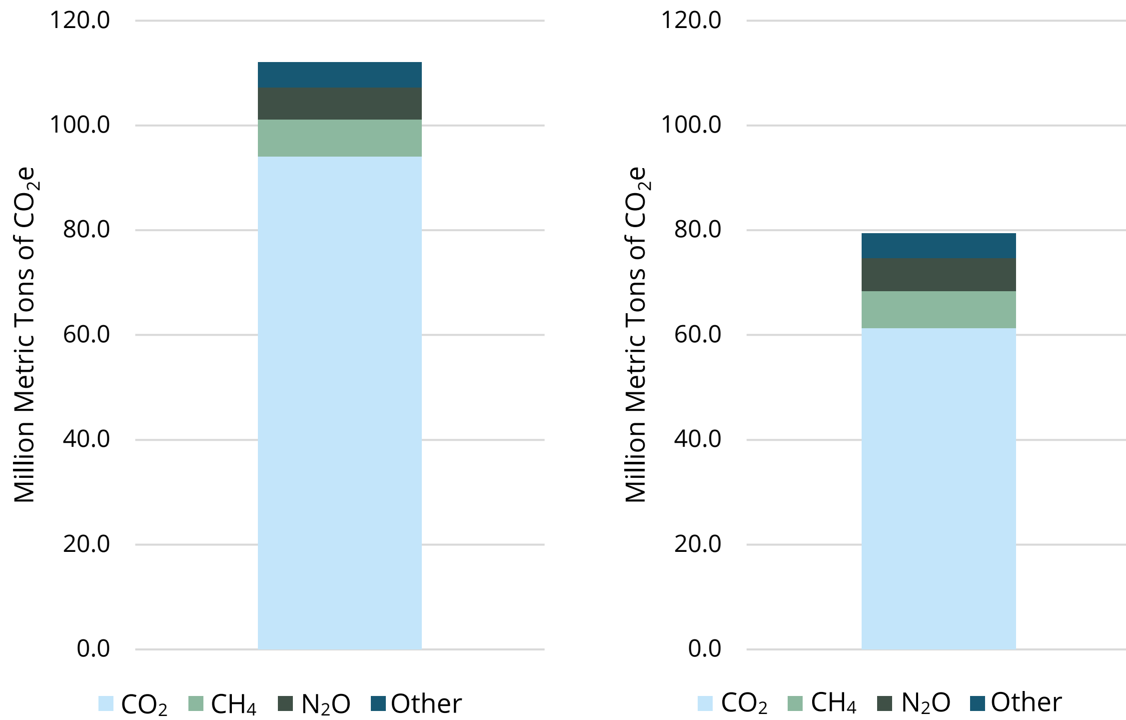

Figure 4. TN PCAP Inventory Total (left) and Net (right) GHG Emissions by Gas in MMT CO_2e[5]

Transportation Sector Detail

The transportation sector is 39% (44.2 MMT CO_2e) of the total emissions in the TN PCAP Inventory. GHG emissions for this sector were calculated based on upon fuel consumption, not vehicle miles traveled, per EPA guidance. To provide additional subsector emissions detail, Table 4 provides the transportation emissions partitioned and ratioed according to end-use subsectors.

[5] Total emissions include those from the Transportation, Electricity Generation, Industry, Agriculture, Commercial & Residential Buildings, Waste & Materials Management, and Wastewater sectors. Net emissions include all sectors included in the total emissions with the reduction from the LULUCF sector.

End-Use Subsector	Emissions ($MMT\ CO_2e$)
Light-Duty Cars	16.95
Light-Duty Trucks	6.56
Heavy-Duty Vehicles	9.88
Heavy-Duty Buses	0.56
Non-Highway Other	3.88
Aviation	5.21
Locomotives	0.65
Boats	0.44
Motorcycles	0.07
Alternative Fuel Vehicles	0.02
Sector Total Emissions	**44.2**

Table 4. Transportation Sector Emissions Partitioned by End-Use Subsector

Figure 5 provides the percentage of CO_2e emissions for each end-use within the transportation sector.

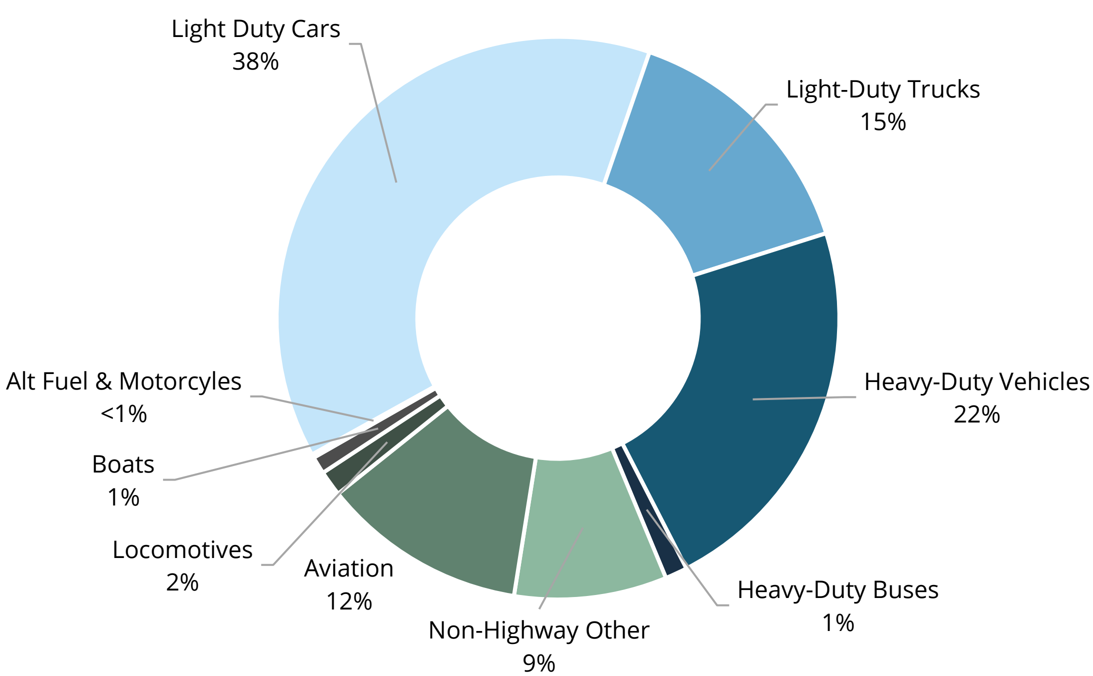

Figure 5. End-Use Subsector CO_2e % of Transportation Emissions

Electricity Sector Detail

The electricity generation sector is 22% (24.1 MMT CO_2e) of the total emissions in the TN PCAP Inventory. GHG emissions for this sector were calculated based upon fuel used for electricity generation (e.g., coal, natural gas), per EPA guidance. To provide additional subsector emissions detail, Table 5 provides the electricity generation emissions partitioned and ratioed according to end-use subsectors.

End-Use Subsector	Emissions (MMT CO_2e)
Residential	**10.29**
Space Heating	1.63
Air-conditioning	2.33
Water Heating	1.58
Refrigeration	0.57
Other Appliances & Lighting	4.17
Commercial	**8.74**
Space Heating	0.13
Cooling	1.78
Ventilation	1.25
Water Heating	0.05
Lighting	1.43
Cooking	0.18
Refrigeration	1.35
Office Equipment	0.35
Computers	0.74
Other	1.48
Industrial	**5.10**
Conventional Boiler Use	0.07
Process Heating	0.46
Process Cooling & Refrigeration	0.41
Machine Drive	2.72
Electro-Chemical Processes	0.55
Other Process Use	0.09
Facility Heating, Ventilation, & Air Conditioning	0.38
Facility Lighting	0.24

End-Use Subsector	Emissions (MMT CO_2e)
Other Non-process Use	0.12
Other	0.05
Sector Total Emissions	**24.1**

Table 5. Electricity Generation Sector Emissions Partitioned by End-Use Subsector

Figure 6 illustrates the percentage of CO_2e emissions for each electricity generation end-use subsector.

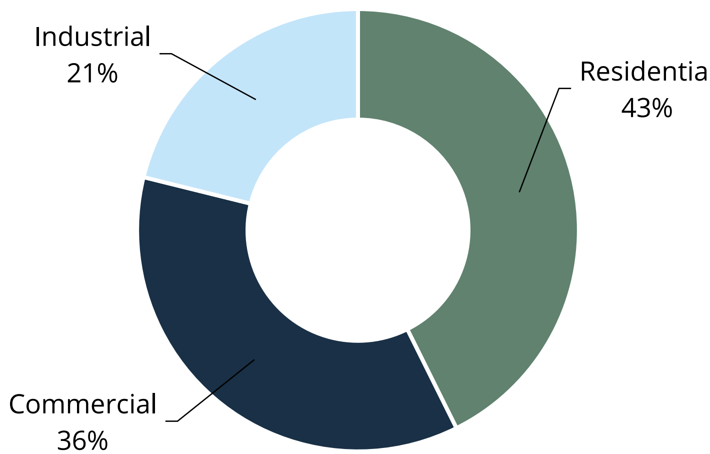

Figure 6. End-Use Subsector CO_2e % of Electricity Generation Emissions

Summary

The TN PCAP Inventory has total GHG emissions of 112.1 MMT CO_2e, utilizing the baseline year of 2019. Transportation was the economic sector contributing the largest quantity of GHG emissions to the atmosphere, followed by electricity generation and the industrial sector. Combined, the top three sectors account for 81% of the total GHG emissions in the TN PCAP Inventory. Land Use, Land Use Change and Forestry, considered a carbon sink, decreases the total emissions by 29%. Net emissions for 2019 are 79.5 MMT CO_2e.

Carbon dioxide was the GHG emitted in the largest quantity in Tennessee during 2019, accounting for 84% of the total TN PCAP Inventory GHG emissions. The sectors contributing to the largest CO_2 emissions are transportation, electricity generation, and industry. Together, these three sectors account for a combined 91% of the TN PCAP Inventory CO_2 emissions.

Methane (CH_4) accounts for 6% of the GHGs emitted in Tennessee during 2019, with agriculture and waste and materials management as the highest CH_4 emitters, contributing to 89% of the CH_4 emissions in TN. Nitrous Oxide (N_2O) was 5% of the TN PCAP Inventory GHG emissions. Agriculture accounts for the majority of the N_2O emissions, accounting for 88% of the statewide N_2O emissions. The industrial sector accounted for the entirety of the other emissions (fluorinated gases), which was 4% of the GHG emissions in 2019.

For technical background on the underlying methodologies and assumptions that have been used to develop the TN PCAP Inventory, please refer to Appendix A.

Priority Measures and Reduction Estimates

The measures in this section have been identified as “priority measures” for reducing emissions in Tennessee. These measures meet the criteria below and adequate information is available for any eligible entity to pursue funding through Phase 2 of EPA’s CPRG program. The measures selected are not exhaustive of all possible reduction measures. Instead, the selected priority measures included in this PCAP meet the following criteria:

- The measure is **implementation ready**, with a preference for measures that may already exist and can be expanded or replicated in the state according to input from state agencies, local governments, and other partners. Additionally, all priority measures are voluntary initiatives.
- The measure **can be completed in the near term**, indicating that it can be implemented within approximately five years.
- The measure has broad **public and stakeholder support**, including the potential for positive impacts in LIDACs.

The Project Team began by aggregating a list of over 230 emissions reduction measures using the following sources:

1. The “Building Blocks of State Climate Policy,” featured in a white paper published by the Climate XChange and cited in EPA trainings.
2. Example measures listed in the EPA’s Notice of Funding Opportunity for CPRG implementation grants.
3. Specific measures aggregated from state and local climate action plans within EPA’s Quantified Climate Action Measures Directory.
4. State climate action plan strategies presented in “State Climate Plan Summaries,” published by the Conveners Network to support CPRG plan execution.

The Project Team utilized the criteria above to develop a list of eleven priority measures, organized into the following categories:[6]

- Building Energy Efficiency Enhancements (4 measures),
- Electricity Distribution Upgrades (1 measure),
- Land Use Enhancement (1 measure),
- Transportation Sector Electrification (3 measures),
- Waste Management Enhancement (1 measure), and
- Renewable Energy Enhancement (1 measure).

Measures are organized into specific categories; however, many of the priority measures have benefits that could impact emissions across multiple sectors.

Key information about the GHG emissions reduction estimates for each priority measure is summarized in Table 6. For each measure, cumulative GHG emissions reductions from 2025 to 2030 and 2025 to 2050 are defined. These emissions reduction estimates do not consider any future changes to load growth due to increased energy demand in the state or changes to the electricity generation portfolio. Appendix B details the methodology used to quantify emissions reductions for each measure.

Building Energy Efficiency Enhancements

Incentive programs for implementation of end-use energy efficiency measures in existing commercial and industrial buildings.

This measure addresses the commercial and industrial building sectors from the perspective of energy efficiency improvements that can be made to existing buildings. Examples include, but are not limited to, the replacement of existing products (e.g., space heating, ventilation, air-cooling systems, cooking appliances) with certified energy-efficient products. The geographic boundary for assessment of this measure is statewide.

Incentive programs for the purchase of certified energy-efficient lighting in commercial and industrial buildings, as well as streetlights.

This measure aims to reduce emissions by improving lighting efficiency through conversion to light-emitting diode (i.e., LED) bulbs. This transition will save energy and associated

[6] The timeframe available to develop the PCAP limited the number of selected priority measures.

emissions that would otherwise be generated. The ultimate emission sources are the existing and future fleet of electric generating units serving Tennessee, which are necessary to power lights. However, this measure focuses on the end-use of lighting specifically. Emission reductions are translated from energy saved (measured in kilowatthours (kWh)) to emissions reduced in the production of electricity. The geographic boundary for assessment of this measure is statewide.

Incentive programs for the purchase of certified energy-efficient building products to replace inefficient products in residential buildings.

This measure addresses the residential building sector from the perspective of energy efficiency improvements that can be made to existing buildings. Examples include but are not limited to the replacement of existing products (e.g., space heating, ventilation, air-cooling systems, cooking appliances, lighting) with certified energy-efficient products. The geographic boundary for assessment of this measure is statewide.

Weatherization programs for residential buildings.

This measure focuses on residential actions to improve energy efficiency. Specifically, this includes building envelope weatherization and insulation improvements. Such measures can reduce homeowner energy combustion for heating as well as reduce the demand for electricity associated with space heating and cooling. These weatherization programs may result from home energy audit programs and do-it-yourself energy workshops (e.g., window and door seals and improved insulation, more efficient water heating systems). The geographic boundary for assessment of this measure is statewide.

Electricity Distribution Upgrades

Upgrading electricity distribution.

The US Energy Information Administration (EIA) estimates that from 2018 through 2022, annual electricity transmission and distribution losses averaged about 5% of the electricity transmitted and distributed.[7] Transmission losses are a function of the distance between the generator and the consumer (i.e., the farther electricity has to travel, the more is lost), the voltage and resistance of the transmission lines (i.e., the “quality” of the lines), and the

[7] “Frequently Asked Questions (FAQs) – US Energy Information Administration (EIA).” *Homepage – US Energy Information Administration (EIA)*, https://www.eia.gov/tools/faqs/faq.php?id=105. Accessed 30 January 2024.

amount of energy flowing through the line (i.e., higher loads generally mean more heat and more loss). The geographic boundary for assessment of this measure is statewide.

This priority measure aims to reduce transmission loss and thereby reduce overall power consumption through increased efficiency. There are other, related, electricity distribution measures that focus on upgrading the electricity distribution system and positioning Tennessee for increased load growth in response to vehicle and industrial electrification. These measures could provide further improvements to the electric grid. Such additional measures will be considered further during the CCAP phase.

Land Use Enhancement

Reduce deforestation by implementing sustainable land use practices, protecting forests.

Tennessee is blessed with a rich natural heritage and a long-standing commitment to the conservation and promotion of the state's outstanding natural resources. This measure aims to protect the state's primary carbon sink - its existing forests. A range of sustainable land use practices are available to protect existing forests and enhance the carbon capture capacity of those forests. Forests degrade through a variety of anthropogenic causes (e.g., converting forest land to residential, commercial, or industrial development, lack of end-use markets to promote holistic forest health, limited sustainable forest management) or natural causes (e.g., degrading forest health, invasive plants and pests, wildfires). Specific practices to protect the existing forests could include strengthening forest health, prevention and management of invasive forest pests and plants, acquiring and protecting forested parcels, and expansion of fire management, including prescribed burning.

For this measure, modeling assumed that loss of forested land meant that the new land use had zero potential to sequester or store carbon. However, other types of conserved land use, such as grasslands and wetlands, serve as carbon sinks. [8,9] Preserving or enhancing this type of land use yields significant emission reduction benefits. Such additional measures will be considered further during the CCAP phase.

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[8] Bai, Yongfei, and M. Francesca Cotrufo. "Grassland soil carbon sequestration: Current understanding, challenges, and solutions." *Science*, vol. 377, no. 6606, 5 Aug. 2022, pp. 603–608, https://doi.org/10.1126/science.abo2380.
[9] Schlesinger, William H. Biogeochemistry an Analysis of Global Change. Academic Press, 1997.

Of the 95 Tennessee counties, 59 counties are estimated to have greater than 50% forest land cover, and eleven counties have greater than 75% forest land cover.[10] Therefore, the geographic boundary for assessment of this measure is statewide.

Transportation Sector Electrification

Programs to increase the share of state and local government fleets of light-duty electric vehicles.

Building on four decades of automotive manufacturing leadership, Tennessee is proud to be at the forefront of this industry's market growth in vehicle electrification and advanced manufacturing. Home to four automotive Original Equipment Manufacturers that are or will soon be producing electric vehicles (EVs), investment in the conversion of light-duty vehicles will have both positive environmental and economic impacts. This measure is focused on the conversion of fuel-burning light-duty fleet automobiles and trucks owned and operated by state and local governments to EVs. This measure also covers the charging infrastructure required to operate EV fleet vehicles as a requirement for EV fleet conversion. The geographic boundary for assessment of this measure is statewide.

Programs to expand community electric vehicle charging infrastructure.

This measure is focused on the installation of community EV charging stations to help promote EV adoption. These charging stations are intended for use by light-duty cars and trucks. Medium-duty vehicles, such as buses, could utilize these stations for periodic charging. The use of electric light-duty cars and trucks requires an expanded network of reliable charging stations to support increased charging demand. As such, this measure includes the planning and deployment of EV charging infrastructure to promote fuel switching. The geographic boundary for assessment of this measure is statewide.

Programs to increase the share of electric medium- and heavy-duty vehicles, including buses.

This measure is focused on the conversion of fuel-burning private and government-owned fleet medium- and heavy-duty vehicles to EVs. Where appropriate and feasible, this also

[10] "Tennessee Forest Action Plan." *Tennessee State Government – TN.Gov*, https://www.tn.gov/agriculture/forests/protection/ag-forests-action-plan.html. Accessed 29 January 2024.

covers state and local government agencies electrifying fleets and equipment including transit buses, school buses, public work trucks, and other department vehicles. This measure also covers the charging infrastructure required to operate EV medium- and heavy-duty fleet vehicles as a requirement for EV fleet conversion. The geographic boundary for assessment of this measure is statewide.

Waste Management Enhancement

Programs and incentives to reduce or divert waste, including food and/or yard waste.

This waste and material management measure focuses on food waste reduction and diversion to reduce emissions. By reducing the volume of food waste disposed in landfills, it is possible to reduce the methane emissions that are the inevitable by-product of landfilling food and yard waste. Food and yard waste diversion (e.g., disposing of food and yard waste through composting rather than landfilling) reduces methane production and provides economic value through the creation of nutrient-rich fertilizer.[11] The geographic boundary for assessment of this measure is statewide.

This measure does not address the enhanced capture and beneficial use of methane from landfills as an alternative to natural gas, which also has beneficial impacts on reducing GHG emissions. Such additional measures will be considered further during the CCAP phase.

Renewable Energy Enhancement

Development of renewable energy generation.

This measure addresses the fossil fuel-fired electric power generation sector by promoting the development of renewable energy. Specifically, this measure focuses on the expansion of solar power as the most likely near-term area for renewable energy growth. The geographic boundary for assessment of this measure is statewide.

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[11] Lou, X.F., and J. Nair. "The impact of landfilling and composting on greenhouse gas emissions – A Review." *Bioresource Technology*, vol. 100, no. 16, Aug. 2009, pp. 3792–3798, https://doi.org/10.1016/j.biortech.2008.12.006.

Table 6 describes the potential, cumulative GHG emission reduction estimates for implementing the eleven measures. The values in Table 6 reflect the high end of the reduction estimates. See Appendix B for more details.

	Cumulative GHG Emission Reductions ($MMT\ CO_2e$)	
Priority Measure	**2025 to 2030**	**2025 to 2050**
Building Energy Efficiency Enhancement		
Incentive programs for implementation of end-use energy efficiency measures in existing commercial and industrial buildings.	-6.1	-63.3
Incentive programs for the purchase of certified energy-efficient lighting in commercial and industrial buildings, as well as streetlights.	-1.0	-23.5
	-0.1 (streetlights)	-2.1 (streetlights)
Incentive programs for the purchase of certified energy-efficient building products to replace inefficient products in residential buildings.	-6.2	-60.0
Weatherization programs for residential buildings.	-2.1	-21.9
Electricity Distribution Upgrades		
Upgrading electricity distribution.	-0.4	-1.8
Land Use Enhancement		
Reduce deforestation by implementing sustainable land use practices, protecting forests.	-12.7	-130.3
Transportation Sector Electrification		
Programs to increase the share of state and local government fleets of light-duty electric vehicles.	-0.1	-0.7
Programs to expand community electric vehicle charging infrastructure.	-0.01	-0.1
Programs to increase the share of electric medium- and heavy-duty vehicles, including buses.	-0.4	-12.4
Waste Management Enhancement		
Programs and incentives to reduce or divert waste (including food and/or yard waste).	-1.2	-15.2
Renewable Energy Enhancement		
Development of renewable energy generation.	-8.1	-215.7
Total Reduction Estimates	-38.4	-547.0

Table 6. GHG Emission Reduction Estimates for Priority Measures

Benefits Analysis

The Clean Air Act's (CAA) National Ambient Air Quality Standards (NAAQS) are subject to periodic review and have been strengthened several times over the past decades. During this period, Tennessee's emissions of criteria air pollutants (i.e., regulated under EPA's NAAQS program), including particulate matter (PM), ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), lead, and carbon monoxide (CO) steadily declined, while Tennessee's population and economy experienced substantial growth. Not only has Tennessee's clean air been a hallmark in protecting public health and environmental welfare, but the quality of the state's air resources has propelled economic development opportunities.

The priority measures in this plan will not only reduce GHG emissions, but also criteria air pollutant (CAPs),[12] hazardous air pollutant (HAPs),[13] and volatile organic compound (VOC) emissions.[14] All of these pollutants have been linked to adverse health effects, including respiratory and cardiovascular health outcomes.[15] Therefore, by implementing these measures, Tennessee may also realize improvements in air quality and public health for Tennesseans.

This section includes the 2017 National Emissions Inventory (NEI) for co-pollutants in Tennessee by sector and pollutant. Estimated changes in co-pollutants and expected benefits from the priority measures are shown.

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[12] CAPs include particulate matter (PM), ozone, sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and lead. Exposure to these pollutants can cause respiratory difficulties, cardiac issues, and other health problems. "Criteria Air Pollutants | US EPA." *US EPA*, 9 April 2014, https://www.epa.gov/criteria-air-pollutants.
[13] The EPA has listed 188 substances as HAPs, including substances like benzene, found in gasoline; and methylene chloride, which is used as a paint stripper by numerous industries. Exposure to HAPs can cause cancer or other serious health effects, such as reproductive effects or birth defects. "What are Hazardous Air Pollutants?|US EPA." *US EPA*, 3 December 2015, https://www.epa.gov/haps/what-are-hazardous-air-pollutants.
[14] VOCs are organic chemicals that have a high vapor pressure at ordinary room temperature, meaning they easily become gases or vapors. VOCs are found in many products, including paints, cleaning supplies, pesticides, building materials, and furnishings, and are emitted from burning fuel. High levels of VOCs contribute to respiratory illnesses and other health issues.
[15] "Criteria Air Pollutants | US EPA." *US EPA*, 9 April 2014, https://www.epa.gov/criteria-air-pollutants.

2017 Inventory for Co-Pollutants

TDEC obtained emissions data from EPA's 2017 NEI and extracted CAP and HAP emissions data to create a 2017 base inventory across multiple subsectors.[16]

Table 7[17] presents a summary of CAPs, HAPs, and VOCs inventories from subsectors relevant to the eleven priority measures. Note that the sectors and subsectors identified in the co-pollutants NEI inventory do not directly correspond to the TN PCAP Inventory. Relevant subsectors include, but are not limited to, electricity generation, on-road mobile sources, industrial processes, commercial/industrial sources, land use and vegetation. Emissions from electricity consumed by end-use sectors (e.g., commercial & residential buildings, transportation) is reflected in the fuel combustion sector (i.e., electric generation).

Sector	NO_x (tons)	$PM_{2.5}$ (tons)	SO_2 (tons)	VOCs (tons)	HAPs (tons)
NEI Sectors Relevant to Priority Measures					
Agriculture - Livestock Waste	4	1	--	1,367	146
Biogenics - Vegetation and Soil	19,463	--	--	658,206	47,021
Fuel Combustion - Commercial/Institutional – Biomass	453	335	35	16	12
Fuel Combustion - Commercial/Institutional - Coal	220	7	--	5	1
Fuel Combustion - Commercial/Institutional - Natural Gas	2,233	38	12	129	6
Fuel Combustion - Commercial/Institutional - Oil	129	10	35	5	1
Fuel Combustion - Commercial/Institutional - Other	113	--	--	2	0
Fuel Combustion - Electric Generation - Biomass	29	20	1	1	2

[16] The latest available NEI data is from 2017 and 2020. Due to the impacts of COVID-19 on emissions, 2020 data is not considered for this PCAP, as it would set an impractical baseline due to lower than usual activity data. Instead, 2017 was selected as the base year. "2017 National Emissions Inventory (NEI) Data | US EPA." US EPA, 30 June 2017. https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data.
[17] "--" Indicates that the value has not been estimated at this time.

Sector	NO_x (tons)	$PM_{2.5}$ (tons)	SO_2 (tons)	VOCs (tons)	HAPs (tons)
Fuel Combustion - Electric Generation - Coal	14,750	2,418	24,239	496	172
Fuel Combustion - Electric Generation - Natural Gas	889	188	22	124	19
Fuel Combustion - Electric Generation - Oil	246	9	5	7	0
Fuel Combustion - Electric Generation - Other	130	40	61	15	0
Fuel Combustion - Residential - Natural Gas	2,781	7	12	159	2
Fuel Combustion - Residential - Oil	19	0	1	0	0
Fuel Combustion - Residential - Other	425	0	0	1	0
Fuel Combustion - Residential - Wood	522	4,391	107	5,009	848
Gas Stations	0	0	0	15,908	1,597
Industrial Processes - Cement Manufacturing	2,725	207	123	44	26
Industrial Processes - Chemical Manufacturing	720	506	450	6,157	1,889
Industrial Processes - Ferrous Metals	531	558	430	300	43
Industrial Processes - Mining	0	581	0	0	0
Industrial Processes – Not Elsewhere Classified	3,993	5,934	1,360	16,174	2,682
Industrial Processes - Non-Ferrous Metals	332	400	397	1,241	200
Industrial Processes - Oil & Gas Production	849	33	1	2,798	41
Industrial Processes - Petroleum Refineries	340	218	168	385	192
Industrial Processes - Pulp & Paper	1,950	703	148	1,299	1,003
Industrial Processes - Storage & Transfer	245	329	30	2,236	105
Mobile - On-Road Diesel Heavy-Duty Vehicles	39,539	1,577	110	2,822	598
Mobile - On-Road Diesel Light-Duty Vehicles	2,912	122	1	902	145
Mobile - On-Road non-Diesel Heavy-Duty Vehicles	1,388	24	3	846	210

Sector	NO_x (tons)	$PM_{2.5}$ (tons)	SO_2 (tons)	VOCs (tons)	HAPs (tons)
Mobile - On-Road non-Diesel Light-Duty Vehicles	59,559	1,178	540	43,461	10,956
Waste Disposal	2,011	8,411	729	5,447	6,215
Other[18]					
Agriculture	--	14,256	--	--	--
Commercial & Residential Buildings	--	2,832	--	43,870	3,941
Industry	21,904	8,426	15,498	43,330	5,079
LULUCF	3,605	15,684	1,682	40,469	7,549
Transportation	34,920	7,441	432	23,793	7,055
Other	32	285	2	1,469	305
Totals	219,961	77,169	46,634	918,493	98,063

Table 7. 2017 NEI Tennessee CAPs and HAPs emissions inventory by sector and pollutant

Note: Pollutants from NEI sectors that are not relevant to the reduction measures are summarized in the "Other" section in this table.

Across pollutants, combustion-related activities from electricity generation, on-road vehicles (e.g., light- and heavy-duty), and industrial processes comprise the largest portion of Tennessee's CAPs emissions. Biogenic processes from vegetation (e.g., trees, crops) and soils also contribute to nitrogen oxides (NO_X), VOCs, and HAPs emissions. Priority measures aimed at reducing emissions from combustion and biogenic activities are expected to decrease CAPs, HAPs, and VOCs emissions. Appendix C provides additional information about the co-pollutant inventory sectors relevant to each priority measure.

Co-Pollutant Emission Changes from Priority Measures

The priority measures in the PCAP are voluntary activities that will improve building efficiency, upgrade electricity distribution, reduce deforestation, electrify on-road transportation, enhance waste management, and promote renewable energy resources. These activities are expected to significantly impact electricity and vehicle fuel consumption

[18] The sectors in this table titled "Other" have been consolidated and aligned to correspond with the sectors as outlined in the TN PCAP Inventory.

as well as land use activities, which in turn will result in a net reduction of both GHG and co-pollutant (CAPs and VOCs) emissions.

Table 8[19] lists expected CAPs and VOCs emissions reductions resulting from implementing each priority measure from 2025 to 2030. See Appendix B for the methodology used to quantify co-pollutant reduction estimates.

	Emission Reduction Estimates, 2025 to 2030 (tons)			
Priority Measure	NO_x	$PM_{2.5}$	SO_2	VOCs
Building Energy Efficiency Enhancement				
Incentive programs for implementation of end-use energy efficiency measures in existing commercial and industrial buildings.	-2,932	—	-4,322	—
Incentive programs for the purchase of certified energy-efficient lighting in commercial and industrial buildings, as well as streetlights.	-458	—	-676	—
	-47 (streetlights)	—	-69 (streetlights)	—
Incentive programs for the purchase of certified energy-efficient building products to replace inefficient products in residential buildings.	-2,967	—	-4,372	—
Weatherization programs for residential buildings.	-1,024	—	-1,510	—
Electricity Distribution Upgrades				
Upgrading electricity distribution.	-227	—	-335	—
Land Use Enhancement				
Reduce deforestation by implementing sustainable land use practices, protecting forests.	-1,508	-7,916 *	—	—
Transportation Sector Electrification				
Programs to increase the share of state and local government fleets of light-duty electric vehicles.	-31	2	16	-96
Programs to expand community electric vehicle charging infrastructure.	-2	—	—	-8

[19] ”—"Co-pollutant benefit has not been evaluated for the PCAP.
* This estimate was calculated as PM, with the assumption that PM = $PM_{2.5}$. See Appendix B for more details.

	Emission Reduction Estimates, 2025 to 2030 (tons)			
Priority Measure	NO_x	$PM_{2.5}$	SO_2	VOCs
Programs to increase the share of electric medium- and heavy-duty vehicles, including buses.	-35,496	-<0.05	-<0.05	-2,240
Waste Management Enhancement				
Programs and incentives to reduce or divert waste (including food and/or yard waste).	-22	-8 *	—	—
Renewable Energy Enhancement				
Development of renewable energy generation.	-3,277	-809	-3,928	-211
Total Reduction Estimates	-47,991	-8,731	-15,196	-2,555

Table 8. Air Pollution Emission Estimates of Priority Measures, 2025-2030

In the near-term (i.e., 2025 to 2030), CAPs and VOCs reduction estimates are substantial. By implementing the priority measures, NOx reduction estimates are 47,991 tons, while SO_2 reduction estimates are 15,196 tons. These emission reductions estimates align with measures that improve building energy efficiency and promote vehicle electrification. In the NEI, these emissions are quantified under fuel combustion for electricity generation not by the end-use sector (e.g., commercial & residential buildings, transportation). However, the emission reduction estimates are categorized by priority measure. The near-term $PM_{2.5}$ reduction estimates are 8,731 total tons and are primarily associated with decreasing deforestation.

Table 9[20] lists expected CAPs and VOCs emissions reductions resulting from implementing each priority measure from 2025 to 2050. See Appendix B for the methodology used to quantify co-pollutant reduction estimates.

[20] ”—"Co-pollutant benefit has not been evaluated for the PCAP.

* This estimate was calculated as PM, with the assumption that PM = $PM_{2.5}$. See Appendix B for more details.

	Emission Reduction Estimates, 2025 to 2050 (tons)			
Priority Measure	**NO_x**	**$PM_{2.5}$**	**SO_2**	**VOCs**
Building Energy Efficiency Enhancement				
Incentive programs for implementation of end-use energy efficiency measures in existing commercial and industrial buildings.	-30,213	—	-44,532	—
Incentive programs for the purchase of certified energy-efficient lighting in commercial and industrial buildings, as well as streetlights.	-11,201	—	-16,509	—
	-1,019 (streetlights)	—	-1,502 (streetlights)	—
Incentive programs for the purchase of certified energy-efficient building products to replace inefficient products in residential buildings.	-28,658	—	-42,240	—
Weatherization programs for residential buildings.	-10,457	—	-15,413	—
Electricity Distribution Upgrades				
Upgrading electricity distribution.	-1,137	—	-1,675	—
Land Use Enhancement				
Reduce deforestation by implementing sustainable land use practices, protecting forests.	-15,416	-80,936 *	—	—
Transportation Sector Electrification				
Programs to increase the share of state and local government fleets of light-duty electric vehicles.	-262	17	140	-816
Programs to expand community electric vehicle charging infrastructure.	-14	—	—	-68
Programs to increase the share of electric medium- and heavy-duty vehicles, including buses.	-259,259	-2,420	-1,320	-7,804
Waste Management Enhancement				
Programs and incentives to reduce or divert waste (including food and/or yard waste).	-311	-120 *	—	—
Renewable Energy Enhancement				
Development of renewable energy generation.	-86,831	-21,445	-104,081	-5,579
Total Reduction Estimates	-444,778	-104,904	-227,132	-14,267

Table 9. Air Pollution Emission Estimates of Priority Measures, 2025-2050

From 2025 to 2050, the CAPs and VOCs reduction estimates are significant and vary by pollutant. The largest emissions benefits are estimated for NOx (444,778 tons) and SO_2 (227,132 tons) based on total tons avoided during this time period. Such reductions align with priority measures that reduce electricity and fuel consumption, such as building energy efficiency, lighting upgrades, and vehicle electrification. In the NEI, these emissions are quantified under fuel combustion for electricity generation not by the end-use sector (e.g., commercial & residential buildings, transportation). However, the emission reduction estimates in Table 9 categorized by priority measure. The combined $PM_{2.5}$ reduction potential from 2025 to 2050 is 104,904 total tons; this is largely associated with reducing deforestation activities.

On an annual basis, co-pollutant reductions are a substantial portion of the 2017 NEI. Figure 7 displays the maximum cumulative emissions reduction estimates for NOx, $PM_{2.5}$, and SO_2 from 2025 to 2050 (VOCs not shown). By 2050, the maximum reduction estimates of annual emissions from implementing priority measures are expected to be approximately 21,000 tons/year for NO_X and 12,000 tons/year for SO_2. $PM_{2.5}$ reductions at full potential are expected to be roughly 6,000 tons/year. These reduction estimates are significant in comparison to the co-pollutant emissions in the 2017 NEI.

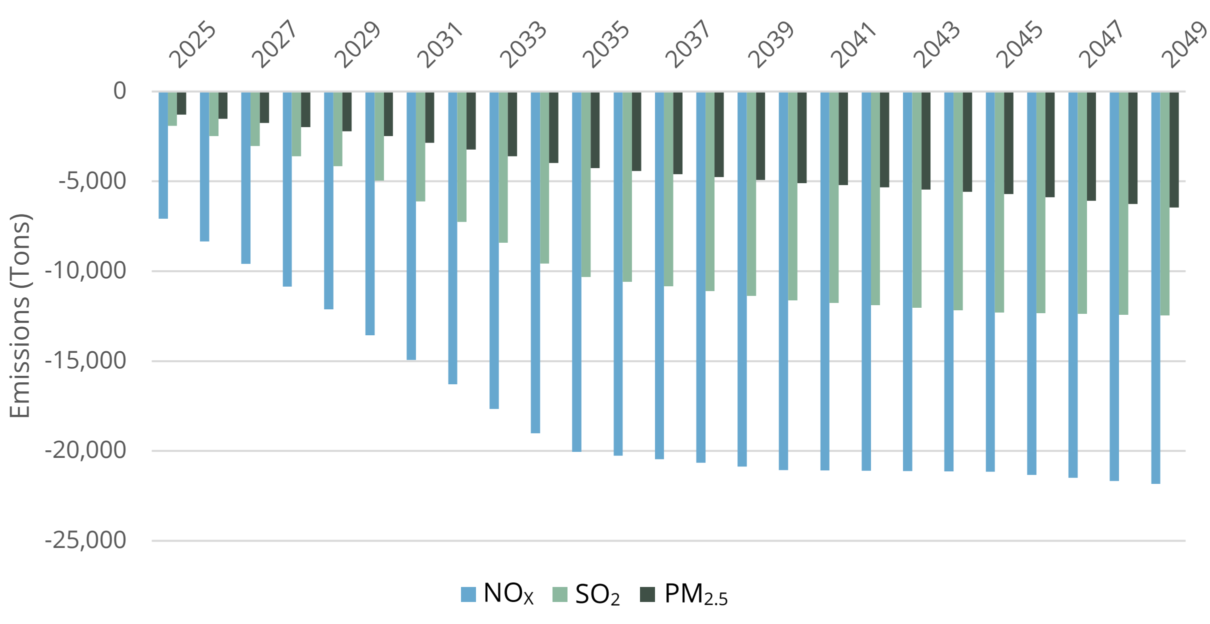

Figure 7. Maximum Cumulative Emissions Reduction Estimates for NO_X, $PM_{2.5}$, and SO_2 from 2025 to 2050

Potential Co-Pollutant Benefits from Priority Measures

Each co-pollutant included in this analysis is associated with specific public health impacts. Most criteria pollutants, including the co-pollutants in the benefits analysis (e.g., NOx[21], SO_2[22], $PM_{2.5}$[23], O_3[24]), are associated with respiratory disease exacerbation, emergency department visits, and hospitalizations.[25] Exposure to $PM_{2.5}$ is directly linked to cardiovascular disease, and in severe cases, premature death. These health impacts not only affect individual well-being, but can also burden communities through missed workdays, increased school absences, and more frequent medical interventions.

The severity of these air-quality related health impacts depends on both the exposure duration and an individual's susceptibility to pollution. Some health impacts occur after short-term exposure to high levels of pollution. Other impacts occur after chronic exposure (months to years) to lower pollution levels. Children, individuals with underlying lung or heart conditions, pregnant women, and the elderly are particularly susceptible to these negative health effects from CAPs.

Co-pollutant emission reductions from implementing priority measures are expected to result in cleaner, healthier air in communities across Tennessee. While specific co-pollutant health benefits from priority measures were not estimated in the PCAP, a general improvement in respiratory and cardiovascular health is expected as a result of reducing co-pollutant emissions. These co-pollutant benefits underscore the value of implementing the priority measures on promoting individual and community health benefits for all Tennesseans.

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[21] "Integrated Science Assessment (ISA) for Oxides of Nitrogen – Health Criteria (Final Report, Jan 2016)" |ISA: Integrated Science Assessments | Environmental Assessment |*US EPA*. https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=310879.

[22] "Integrated Science Assessment (ISA) for Sulfur Oxides – Health Criteria (Final Report, Jan 2017)" |ISA: Integrated Science Assessments | Environmental Assessment |*US EPA*. https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=338596.

[23] "Supplement to the 2019 Integrated Science Assessment for Particulate Matter (Final Report, 2022)" |ISA: Integrated Science Assessments | Environmental Assessments | *US EPA*. https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=354490.

[24] "Integrated Science Assessment (ISA) for Ozone and Related Photochemical Oxidants." *US EPA*, 19 February 2015. https://www.epa.gov/isa/integrated-science-assessment-isa-ozone-and-related-photochemical-oxidants.

[25] "Criteria Air Pollutants | US EPA." *US EPA*, 9 April 2014, https://www.epa.gov/criteria-air-pollutants.

Secondary Pollution Benefits from Priority Measures

Secondary air pollution is considered a class of contaminants that are not directly emitted to the atmosphere but are formed by reactions involving precursor pollutants under certain conditions (e.g., abundant sunlight, high humidity). A prime example of secondary pollution is ozone. Ozone forms when sunlight is abundant in the presence of ozone-forming pollutants, or ozone precursors (NOx and VOCs). These precursors are emitted by combustion-related activities from transportation and electricity generation, as well as biogenic sources. In Tennessee, high ozone concentrations are generally observed during sunny, summer days, with concentrations peaking during mid-morning to late afternoon.

Figure 8 displays monitored ozone levels observed in metropolitan areas in Tennessee. Ozone is monitored by state and local air quality programs to determine compliance with the ozone NAAQS. In Figure 8, the red line represents the ozone NAAQS over time.

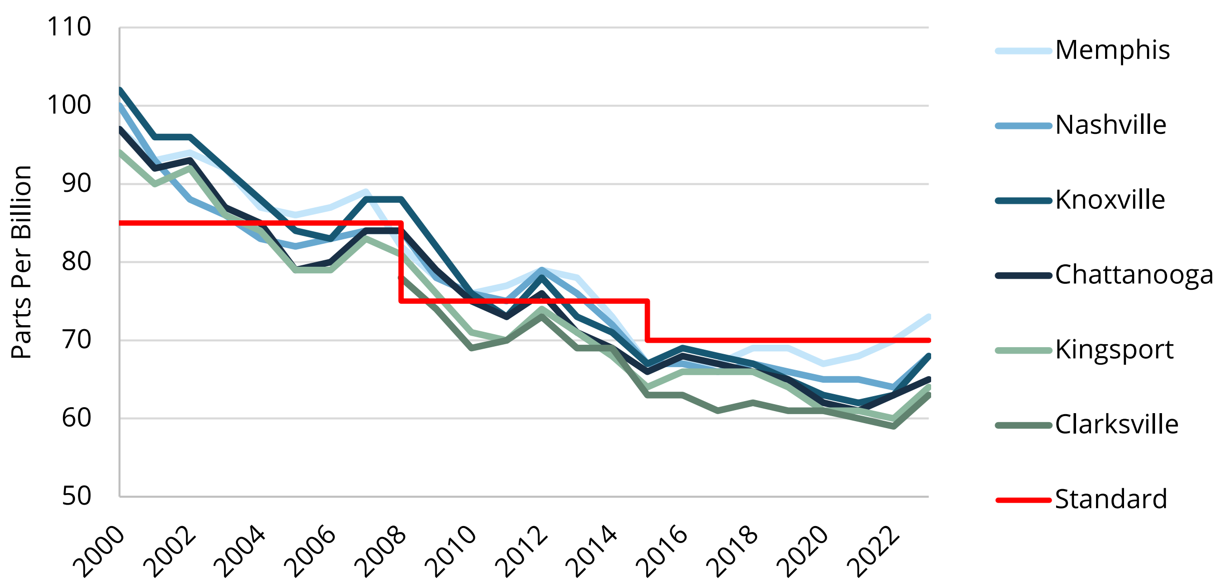

Figure 8. Ozone Trends Observed in Tennessee from 2000-2023[26]

Across Tennessee, steady declines in ozone have been observed since 2000. This decrease has been largely attributed to implementation of federal programs aimed at reducing

[26] "Air Quality System (AQS) | US EPA." *US EPA*, 1 August 2013, https://www.epa.gov/aqs.

ozone-forming pollution (NOx) over the past two decades. At the same time, the ozone NAAQS has been strengthened several times, from 85 parts per billion in the early 2000s to the current level of 70 parts per billion.

Implementation of several priority measures are directly linked to reductions in ozone-forming pollution (i.e., NOx, VOCs). Significant reductions in NOx are estimated from decreasing electricity loads resulting from building energy efficiency measures, in addition to decreasing on-road emissions from vehicle electrification. These reductions are particularly important as Tennessee's population and economy continue to grow. This growth may present challenges in maintaining ozone below the NAAQS.

Data Considerations

There are a few important considerations to bear in mind when interpreting co-pollutant emissions reductions from priority measures. While overall co-pollutant emissions benefits are estimated to be substantial across Tennessee, these benefits may not be spatially uniform across the state and may lead to disbenefits in some areas. For example, electrification of on-road vehicles may result in improved air quality in communities near busy roadways or interstates. These reductions are important as these communities are generally exposed to elevated levels of pollution. However, vehicle electrification will increase electricity consumption due to charging demands, which may have air quality disbenefits in communities located near power plants with air emissions. There may be additional disbenefits that apply to other priority measures but have not been identified in the PCAP. Disbenefits will be further explored in the CCAP phase.

Low-Income and Disadvantaged Communities Benefits Analysis

Implementing the priority measures included in this PCAP would reduce GHG emissions and provide opportunities to benefit LIDACs. LIDACs may disproportionally experience negative environmental impacts and may have limited access to resources to mitigate these impacts. The PCAP LIDAC benefits analysis in this section includes:

- The identification of LIDACs in Tennessee,
- A description of LIDAC engagement and how community priorities were incorporated into measure selection, and
- A qualitative discussion of potential benefits or disbenefits of implementing priority measures for LIDACs.

The CCAP will expand upon this preliminary analysis.

Identification of LIDACs in Tennessee

LIDACs are defined as any census tract that is included as disadvantaged in the Climate and Economic Justice Screening Tool (CEJST) and/or any census block group that is at or above the 90th percentile for any of EPA's Environmental Justice Screening and Mapping Tool's (EJScreen) Supplemental Indexes when compared to the nation or state.[27] For the purpose of the PCAP, LIDAC areas were identified using the CEJST with EJScreen as a supplement to CEJST. The CEJST tool includes an interactive map and uses datasets that incorporate eight indicators of burden related to the environment, health, and economic opportunity. A community is considered disadvantaged if one of the burden indicators is at or above the 90th percentile.

LIDACs represent 54% of Tennessee census tracts, with the statewide distribution shown in Figure 9. LIDACs in Tennessee are demographically and geographically diverse, covering

[27] "Climate Pollution Reduction Grants Program: Technical Reference Document for States, Municipalities and Air Pollution Control Agencies | US EPA." *US EPA*, 27 April 2023, https://www.epa.gov/system/files/documents/2023-05/LIDAC%20Technical%20Guidance%20-%20Final_2.pdf.

both rural communities and urban areas. For a list of Tennessee LIDACs by census tract, see Appendix D.

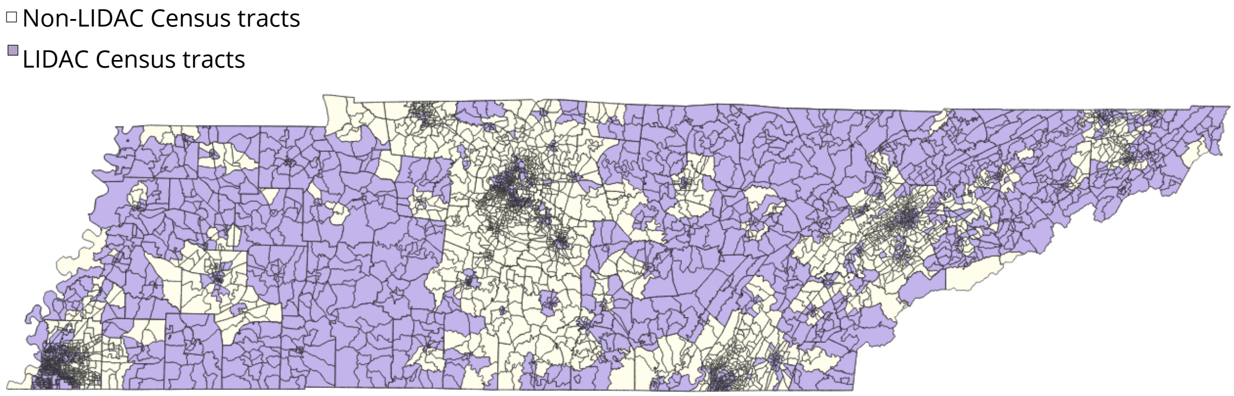

Figure 9. Map Showing Tennessee LIDACs by Census Tract

The indicators of burden in the CEJST tool were used to further understand the burdens that communities face in Tennessee's urban and rural areas. In Tennessee's urban areas, like Memphis, Nashville, Chattanooga, and Knoxville, LIDACs are often clustered in the city center, and surrounded by more affluent suburbs. These communities tend to experience high housing and energy costs, historic disinvestment, lack of green space, proximity to hazardous waste facilities and legacy pollution, and traffic proximity and volume. In Tennessee's rural areas, LIDACs may experience challenges such as expected agricultural loss resulting from natural hazards, transportation barriers, and high unemployment rates.

LIDAC Engagement and Measure Selection

LIDAC communities were intentionally engaged in the planning process as part of our public coordination and engagement.[28] After identifying Tennessee LIDACs, TDEC conducted meaningful engagement to ensure that the priorities and concerns identified by affected communities were incorporated into the selection of priority measures. Specifically, LIDAC priority was included as a factor to select potential measures, alongside emission reduction estimates and implementation readiness.

[28] For more information about engagement with LIDACs, see the "Coordination and Engagement" section of the PCAP.

Benefits to LIDACs

The priority measures, if implemented, can provide both direct and indirect benefits to LIDACs. To determine potential benefits of priority measures for LIDACs, each measure was reviewed against the following emission reduction benefits identified through TDEC's public survey and in collaboration with stakeholders:

- Improved air quality and public health resulting from decreased air pollution,
- Transportation improvements, such as bike, walk, transit options, and electric vehicle infrastructure,
- Housing and housing affordability, including reduced utility costs,
- Community beautification, such as new or improved green spaces, bike paths, or walking trails,
- Community resilience, or the ability to withstand extreme weather events,
- Reduced noise pollution, including traffic and construction noise, and
- Workforce development.

In Table 10, measures that have the potential to provide a direct benefit are indicated with a closed circle (●), measures that have the potential to provide an indirect benefit are indicated with an open circle (○), and measures that are not applicable to a specific benefit are indicated with a dash (–). Measures were also reviewed for potential disbenefits. While LIDAC benefits from the priority measures are expected to outweigh disbenefits, negative impacts may be realized in communities based on how a measure is implemented, among many other variables.

Table 10 is followed by a discussion of some anticipated, potential benefits to LIDACs based on measure implementation. Not all potential benefits indicated in Table 10 are discussed.

Priority Measure	Potential Benefit						
	Improved air quality and public health	Transportation improvements	Housing affordability	Community beautification	Community resilience	Reduced noise pollution	Workforce development
Building Energy Efficiency Enhancement							
Incentive programs for implementation of end-use energy efficiency measures in existing commercial and industrial buildings.	○	–	–	–	○	○	○
Incentive programs for the purchase of certified energy-efficient lighting in commercial and industrial buildings, as well as streetlights.	○	–	–	●	○	–	○
Incentive programs for the purchase of certified energy-efficient building products to replace inefficient products in residential buildings.	○	–	●	–	○	–	○
Weatherization programs for residential buildings.	○	–	●	–	○	○	●
Electricity Distribution Upgrades							
Upgrading electricity distribution.	○	–	●	–	●	–	●
Land Use Enhancement							
Reduce deforestation by implementing sustainable land use practices, protecting forests.	●	–	–	●	●	○	–
Transportation Sector Electrification							
Programs to increase the share of state and local government fleets of light-duty electric vehicles.	●	●	–	–	○	●	○
Programs to expand community electric vehicle charging infrastructure.	○	●	–	–	○	○	●
Programs to increase the share of electric medium- and heavy-duty vehicles, including buses.	●	●	–	–	○	●	○
Waste Management Enhancement							
Programs and incentives to reduce or divert waste (including food and/or yard waste).	●	–	–	–	–	–	●
Renewable Energy Enhancement							
Development of renewable energy generation.	●	–	●	–	●	–	●

Table 10. Qualitative Assessment of Potential Benefits to LIDACs Resulting from Priority Measure Implementation

Potential Benefits of Building Energy Efficiency Enhancement

Promoting the use of certified energy-efficient equipment and lighting in commercial, industrial, and residential buildings and weatherizing homes has the potential to reduce excess energy use and associated electricity generation emissions. Additional benefits that could be realized from these measures include workforce development opportunities related to installing and maintaining energy-efficiency improvements.

Benefits to LIDACs
Improved air quality and public health: All measures in this category have the potential to indirectly improve air quality by reducing the amount of energy consumed for heating, cooling, and operating buildings. Improving outdoor air quality can provide public health benefits to LIDACs. A large portion of outdoor air quality benefits may be near energy generation sources (i.e., power plants), where a decreased energy demand from buildings corresponds to lower power plant emissions. However, these reduced power plant emissions can also decrease secondary pollution, such as ozone, which is more geographically widespread. Reducing power plant and secondary ozone emissions will have a positive impact on air quality as well as respiratory and cardiovascular public health across Tennessee.
Housing affordability: The measures that address residential buildings both support reduced energy demand and thereby lower utility costs, supporting housing affordability.
Workforce development: Measures to replace inefficient appliances and lighting support short-term work opportunities and weatherization requires a sustained, skilled workforce.

Table 11. Benefits to LIDACs Related to Building Energy Efficiency Enhancement Measures

Figure 10 shows census tracts at or above the 90th percentile for energy burden (i.e., energy cost), a category of burden tracked in the CEJST to designate an area as disadvantaged. The map shows that both rural and urban LIDACs face high energy costs, indicating that reducing energy costs has the potential to improve the lives of people across the state.

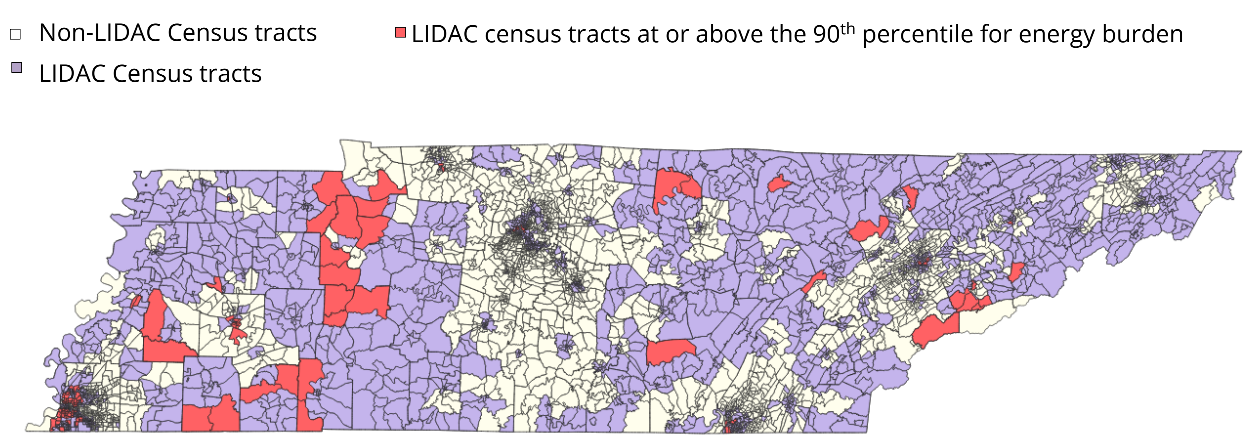

Figure 10. Map Showing LIDACs at or Above the 90th Percentile for Energy Burden

Potential Benefits of Electricity Distribution Upgrades

Upgrading electricity distribution has the potential to reduce emissions by reducing power losses during distribution. Modernizing electrical infrastructure enhances the overall system efficiency and may reduce outage occurrences. Reduced outage occurrences support cost savings, increase housing affordability, and improve quality of life.

Benefits to LIDACs
Improved air quality: Greater efficiencies in electricity distribution would reduce energy losses in transmission, therefore reducing total energy demand from fossil fuel-powered plants, which impacts air quality near power plants and secondary pollution.
Housing affordability: More advanced distribution systems can reduce electricity losses, translating to utility cost savings for rate payers.
Community resilience: Upgrading distribution can help improve load management and isolate faults, reducing the strain on the power grid during extreme weather events.
Workforce development: Skilled labor is required to implement electricity distribution upgrades, resulting in an increased demand for trained professionals to build, upgrade, and install the required infrastructure.

Table 12. Benefits to LIDACs Related to Electricity Distribution Upgrade Measures

Potential Benefits of Land Use Enhancement

Land use enhancement, including programs related to sustainable land use and protection of forests serve to protect and enhance the value of carbon sinks in Tennessee. Additionally, implementing these measures may have numerous benefits, including improved air quality and public health, more attractive and resilient communities, and the conservation of natural resources.

Benefits to LIDACs
Improved air quality and public health: Forests can provide positive benefits to air quality, health, and well-being. For example, urban forests can improve energy efficiency by providing natural shade and cooling to reduce consumption. Managed natural lands are often used by the public for hiking, camping, or other recreation, contributing to positive mental and physical health outcomes.
Community beautification: Forests and other natural areas often provide community green space and recreational opportunities that can support community livability.
Community resilience: Adopting sustainable land use practices and protecting forests can increase community resilience by preserving natural ecosystems, preventing soil erosion,

Benefits to LIDACs
and conserving water.
Reduced noise pollution: Vegetation and forests can reduce noise pollution by absorbing sounds and creating a noise barrier.

Table 13. Benefits to LIDACs Related to Land Use Enhancement Measures

Potential Benefits of Transportation Sector Electrification

Measures to increase transportation electrification can benefit LIDACs by providing increased access to EVs and increasing the availability of charging infrastructure. Expanding these programs can reduce barriers to transportation alternatives including financial hardship, increased transit options, and reliable access to charging and maintenance.

Benefits to LIDACs
Improved air quality and public health: As EVs do not produce tailpipe emissions, air pollutants produced from internal combustion engine vehicles can be reduced through increasing the share of EVs. This benefit is realized in the community that the vehicle is driven in, with the largest benefits potentially in communities with elevated exposures to traffic pollution. This benefit may be partially offset for some pollutants by increased power generation emissions. The increase in power plant emissions would be both near the electric generating units and to some extent across the state and region through increased secondary ozone pollution.
Transportation improvements: Investing in EVs and charging infrastructure may reduce transportation costs and improve reliability over time. Reducing reliability on gasoline may create more stable transportation options because gasoline is susceptible to price fluctuations and supply chain disruptions.
Workforce development: Investment in transportation measures requires skilled workers for infrastructure installation, manufacturing, and vehicle maintenance. These investments can directly enhance economic development and support job creation.
Reduced noise pollution: EVs produce significantly less noise than internal combustion engines, reducing traffic noise and making busy areas more pleasant.

Table 14. Benefits to LIDACs Related to Transportation Sector Electrification Measures

Manufacturing EVs takes more energy compared to internal combustion engine vehicles.[29] Battery production requires large amounts of electricity to prepare for use. However, this is made up during the lifecycle as EVs use less energy and produce no fuel-based emissions.

[29] "Electric Vehicle Myths | US EPA." *US EPA*, 14 May 2021, http://www.epa.gov/greenvehicles/electric-vehicle-myths. Accessed 14 February 2024.

Near-road LIDAC residents may be more vulnerable to air pollution due to proximity to major roadways and ports with diesel truck operations. Transportation electrification may lessen this burden for those communities.

Potential Benefits of Waste Management Enhancement

Emissions from waste decomposition include methane, which is significantly more potent in the atmosphere than CO_2.[30] The priority measure will reduce emissions from waste by diverting and reducing total waste.

Benefits to LIDACs
Improved air quality and public health: Reducing or diverting waste from landfills can reduce methane and VOCs emissions. Additionally, waste reduction lowers vehicle emissions associated with waste transportation.
Workforce development: Advanced waste management can create job opportunities in collecting, sorting, recycling, and composting, which support economic growth in this area.

Table 15. Benefits to LIDACs Related Waste Management Measures

Potential Benefits of Renewable Energy Enhancement

Renewable energy has the potential to reduce reliance on carbon-intensive energy sources and bring associated environmental, economic, and social benefits to Tennessee. Installation of solar energy is a land-intensive activity, with an estimated 3.0-5.5 acres of land required for each gigawatthour (GWh)/year.[31] Therefore, it is important to consider the siting of utility-scale solar projects and the potential disbenefit of siting these projects on greenfield or forested land, which may interrupt existing carbon sinks. This disbenefit would not apply to rooftop solar or community solar installed on brownfields or otherwise-developed land.

Benefits to LIDACs
Improved air quality and public health: Renewable energy may improve air quality by reducing emissions from fossil fuel combustion at the source. These reductions have potential to improve certain health outcomes, such as the occurrence of respiratory disease.

[30] "Importance of Methane | US EPA." *US EPA*, November 2023, https://www.epa.gov/gmi/importance-methane. Accessed on 25 February 2024.
[31] "Land-Use Requirements for Solar Power Plants in the United State | NREL." *NREL*, June 2013, https://www.nrel.gov/docs/fy13osti/56290.pdf. Accessed 14 February 2024.

Benefits to LIDACs
Housing affordability: Increased use of renewable energy can improve utility costs over time, especially alongside measures to upgrade electricity distribution, which also increases energy reliability. This is especially important to low-income households that may experience barriers to energy due to outdated infrastructure and rising utility costs. By installing renewable energy systems, homeowners and renters can experience reduced utility bills, and communities could jointly invest in solar programs.
Community resilience: Decentralized, community-controlled renewable energy systems can enhance grid performance power during outages, reducing community vulnerability and addressing concerns over energy security and emergency preparedness.
Workforce development: The renewable energy sector is labor-intensive and requires a skilled workforce for solar panel manufacturing, installation, and maintenance. The planning, installation, maintenance, and management of renewable energy systems may contribute to job creation.

Table 16. Benefits to LIDACs Related to Renewable Energy Enhancement Measures

Potential Impacts of Extreme Weather Events for Low-Income and Disadvantaged Communities

The risks of air pollution and extreme weather events are not evenly shared. LIDACs burdened by lack of access to healthcare, chronic exposure to environmental hazards, and other factors are often more susceptible to the negative impacts of extreme weather events. Those that are applicable to Tennesseans[32] may include:

- Air Quality Hazards: Although air quality, including concentrations of $PM_{2.5}$, has improved overall in the last decade, the unequal distribution of pollutants persists along socio-economic and demographic lines. Children, pregnant women, and elderly people are especially vulnerable.
- Extreme Temperature: LIDACs may be less prepared to adapt to extreme temperatures. In addition, extreme temperatures are likely to lead to unsafe working conditions and productivity losses for outdoor laborers.
- Inland Flooding: In the last two decades, Tennesseans have experienced unprecedented flood events that have cost billions in property damage and resulted in dozens of lives lost. In the case of flooding for low-income individuals, the road to

[32] "Collaborating to Improve Community Resiliency to Natural Disasters. | TACIR." *TACIR*, September 2020, www.tn.gov/content/dam/tn/tacir/2020publications/2020CommunityResilience.pdf.

recovery may be more difficult and expensive, due to restricted access to capital, potential lack of flood insurance, and bureaucratic hurdles to access federal assistance programs to support recovery.

While the PCAP is focused on GHG emission reductions, there are important additional benefits that may be realized through implementing the eleven priority measures. This PCAP focused on a preliminary, qualitative analysis of the expected benefits, with identification of some potential disbenefits, to LIDACs associated with implementing the priority measures. This analysis will be further explored during the CCAP phase.

Review of Authority to Implement

TDEC has reviewed the existing statutory and regulatory authority to implement each priority measure. This plan is non-regulatory in nature and the priority measures contained herein constitute a list of voluntary actions available to state and local governments for implementation. No new regulatory authority is given by CPRG, nor is new authority sought by this plan. TDEC has the existing authority to apply for, administer, and subaward federal grants, as set forth in the following provisions in the Tennessee Code Annotated, which provide sufficient authority for the voluntary implementation by state and local governments of the priority measures:

- Title 4, Chapter 3, Part 5 (Department of Environment and Conservation),
- Title 4, Chapter 4 (Administration of State Departments),
- Title 11 (Natural Areas and Recreation), and
- Title 68, Chapters 201–221 (Environmental Protection).

Intersection with Other Funding Availability

Many of the priority measures included in the PCAP expand upon or complement existing federal funding opportunities, particularly those available through the Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA). Federal funding opportunities and tax incentives are identified for each priority measure, with a focus on BIL and IRA programs for which TN is an eligible applicant.

Priority Measure	Federal Funding Opportunities
Building Energy Efficiency Enhancements	
Incentive programs for implementation of end-use energy efficiency measures in existing commercial and industrial buildings.	• BIL Energy Efficiency Conservation Block Grant (US Department of Energy (DOE)) • BIL Energy Efficiency Revolving Loan Fund Capitalization Grant Program (US DOE) • IRA Home Energy Rebate Programs (US DOE) • Pathway Lending Energy Efficiency Loan Program
Incentive programs for the purchase of certified energy-efficient lighting in commercial and industrial buildings, as well as streetlights.	• BIL Energy Efficiency Conservation Block Grant (US DOE) • BIL Energy Efficiency Revolving Loan Fund Capitalization Grant Program (US DOE) • IRA Commercial Buildings Energy-Efficiency Credit (US DOE) • Pathway Lending Energy Efficiency Loan Program
Incentive programs for the purchase of certified energy-efficient building products to replace inefficient products in residential buildings.	• BIL Energy Efficiency Conservation Block Grant (US DOE) • BIL Energy Efficiency Revolving Loan Fund Capitalization Grant Program (US DOE) • IRA Home Energy Rebate Programs (US DOE) • IRA Energy Efficient Home Improvement Credit • IRA Residential Energy Clean Property Credits (US DOE)
Weatherization programs for residential buildings.	• BIL Energy Efficiency Revolving Loan Fund Capitalization Grant Program (US DOE) • IRA Home Energy Rebates (US DOE) • BIL Weatherization Assistance Program (US DOE) • Low-Income Home Energy Assistance Program (US Department of Health and Human Services)
Electricity Distribution Upgrades	

Priority Measure	Federal Funding Opportunities
Upgrading electricity distribution.	• BIL Grid Resilience Formula Grant Program (US DOE)
Land Use Enhancement	
Reduce deforestation by implementing sustainable land use practices, protecting forests.	• Forest Legacy Program (US Forest Service) • Urban and Community Forestry Program (US Forest Service)
Transportation Sector Electrification	
Programs to increase the share of state and local government fleets of light-duty electric vehicles.	• IRA Clean Vehicle Tax Credit • IRA Commercial Vehicle Tax Credit • BIL State Energy Program (US Department of Energy)
Programs to expand community electric vehicle charging infrastructure.	• Volkswagen Diesel Settlement Environmental Mitigation Trust Fund • National Electric Vehicle Infrastructure Program (US Department of Transportation- Federal Highway Administration) • Charging and Fueling Infrastructure Discretionary Grant Program (US Department of Transportation- Federal Highway Administration) • BIL State Energy Program (US Department of Energy)
Programs to increase the share of electric medium- and heavy-duty vehicles, including buses.	• Volkswagen Diesel Settlement Environmental Mitigation Trust Fund • Diesel Emissions Reduction Act Program (US EPA) • BIL Clean School Bus Program (US EPA) • IRA Clean Heavy-Duty Vehicle Program (US EPA)
Waste Management Enhancement	
Programs and incentives to reduce or divert waste (including food and/or yard waste).	• Solid Waste Infrastructure for Recycling Infrastructure Grants (US EPA) • Composting and Food Waste Reduction Pilot Project (US Department of Agriculture)
Renewable Energy Enhancement	
Development of renewable energy generation.	• US EPA Solar For All

Table 17. Priority Measures and Intersection with Other Federal Funding

Coordination and Engagement

Intergovernmental and Interagency Coordination

TDEC conducted extensive intergovernmental and interagency coordination in the development of this PCAP. The PCAP reflects coordination with other state agencies, air pollution control agencies, municipalities, and key stakeholders. These partners would be essential to implementing the priority measures that have been established and supporting future CCAP development.

Emission Reduction Planning Advisory Committee

To guide the development and adoption of the PCAP and future CPRG deliverables, TDEC formed a diverse, multidisciplinary advisory committee, called the Emission Reduction Planning Advisory Committee (ERPAC). The ERPAC is serving as the primary entity advising TDEC on the processes to develop CPRG deliverables, including broadening public and stakeholder engagement capacity, identifying priority programs and measures, and ensuring responsible and transparent use of planning funds. ERPAC information, including committee charter, meeting materials, and members is housed on TDEC's TVERS website.[33]

The ERPAC includes representatives from agencies and offices involved in environmental protection, energy, utilities, transportation, housing, and other sectors that overlap with emissions reductions. The ERPAC also includes representatives from local governments that did not receive their own planning funding to represent local interests in the state plan. TDEC leveraged existing statewide partnerships to form the ERPAC and ensure that members have an opportunity to provide feedback to TDEC at all stages of the planning grant lifecycle.

During the development of the PCAP, TDEC held three meetings with the ERPAC:

- August 14, 2023: Review of CPRG and TVERS, ERPAC roles and responsibilities, and initial support for coordination and engagement,

[33] "Tennessee Volunteer Emission Reduction Strategy." *TDEC*, August 2023, https://www.tn.gov/environment/policy/tvers.

- December 15, 2023: Review of draft TN PCAP Inventory and priority measure selection, and
- February 15, 2024: Review of draft PCAP.

Given the time constraints in developing the PCAP, the ERPAC served an essential role in representing stakeholder interests, reviewing key deliverables, sharing public engagement opportunities, and providing feedback to TDEC.

MSA Coordination

TDEC engaged regularly with the Greater Nashville Regional Council, City of Memphis-Shelby County, and City of Knoxville as the municipal CPRG Planning Grant recipients for the Nashville, Memphis, and Knoxville MSAs, respectively (Figure 11). These meetings and discussions focused on developing grant deliverables, aligning priority measure selection, coordinating data needs, and promoting coordination and engagement. MSAs partnered on coordinating the public meetings in each of their cities and supported survey outreach. TDEC shared the results of the survey with the respective MSA area for those survey respondents that provided their home location.

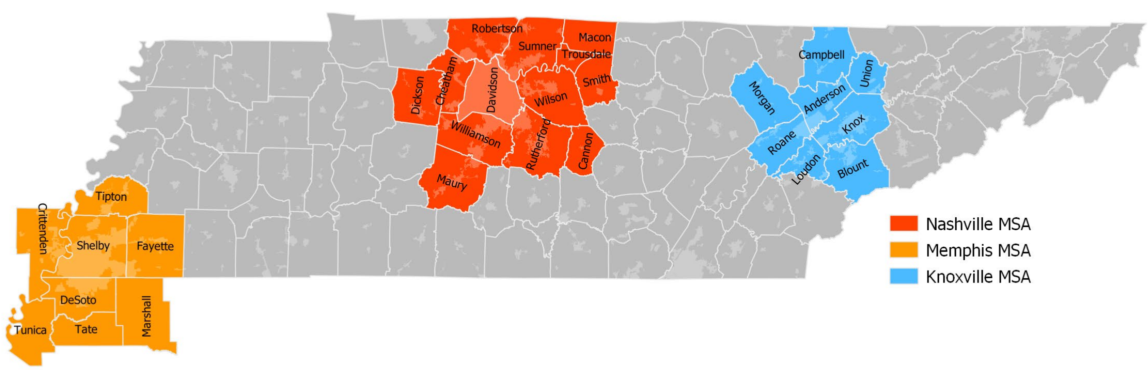

Figure 11. CPRG Planning Grant MSA Areas

Program Survey

As an early step in the PCAP development, TDEC surveyed state and local governmental agencies and other coordinating entities about existing programs that reduce GHG emissions. This survey was used to build an inventory of existing emission reduction measures in Tennessee, including programs, policies, and strategies. TDEC received over 100 responses describing existing programs in Tennessee. These programs were strongly considered during priority measure selection as the existing programs are both near-term and implementation-ready.

Sector Conversations

In January 2024, TDEC engaged with subject matter experts in each emission sector to review the TN PCAP Inventory and gather input regarding the proposed priority measures. The conversations were used to inform TDEC's consideration of the Inventory and potential measures for the PCAP and CCAP. The conversations were organized around sectors (Transportation, Electrical Power, Residential and Commercial Buildings, Waste and Materials Management, Industrial Use, and Natural and Working Lands including Agriculture) and covered opportunities and challenges for reducing emissions in the targeted sector.

Participants were asked to provide feedback and insights on the TN PCAP Inventory, including data sources to inform potential customization of that sector for the CCAP comprehensive GHG inventory. Additionally, participants were asked to provide feedback on all measures including challenges, benefits, and data needs.

Public and Stakeholder Engagement

TDEC conducted public and stakeholder engagement that was commensurate with the timeframe to complete the PCAP as required by EPA. Building relationships with stakeholders and communities takes time and transparency. Public participation activities require relationship building, incorporating and responding to community input, and sharing the results of engagement with the public and stakeholders. Varying communication strategies may be used to fit the needs of the community.

TDEC worked to research, develop, and implement strategies to effectively engage LIDACs, stakeholders, and the general public throughout the PCAP development process. TDEC's Office of External Affairs leads public participation, stakeholder engagement, and outreach efforts across all TDEC programs. To maximize community knowledge, engagement, and trust, a Regional Director of External Affairs is stationed in each of the largest population centers across the state. These individuals develop proactive relationships with stakeholders to conduct effective outreach.

Online Resources

At the start of the CPRG program, TDEC established a TVERS website to share pertinent information and resources. Sub-pages were developed to share a CPRG and TVERS overview, ERPAC information, engagement opportunities, and state, local, and EPA resources. Over the course of the CPRG program, the webpage will be regularly updated to reflect current information and resources for the public and stakeholders. TDEC also established a dedicated email inbox for TVERS: TDEC.TVERS@tn.gov.

Finally, TDEC created an email listserv[34] at the start of this initiative. Email addresses were collected via targeted stakeholder outreach, public meetings, and by request. As of January 2024, the listserv has 671 active contacts.

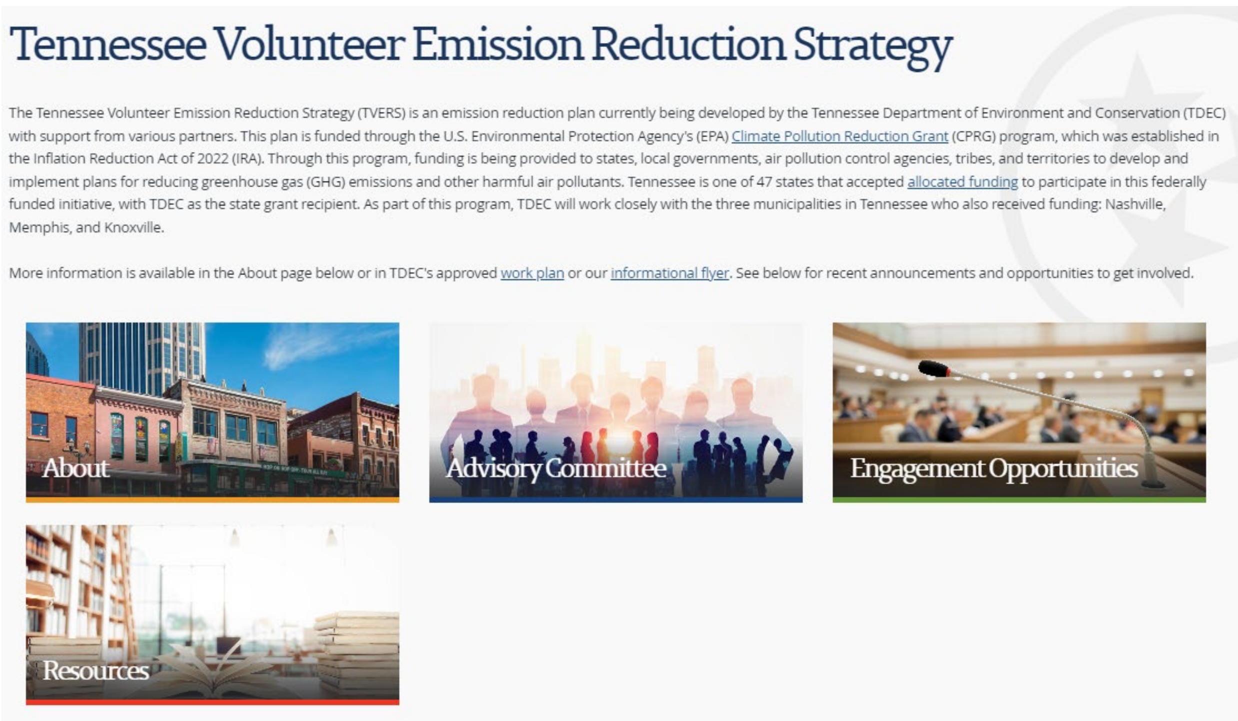

Figure 12. TVERS Website Homepage

[34] "Join Our List | Tennessee Volunteer Emission Reduction Strategy (TVERS)." *TDEC*, August 2023, https://signup.e2ma.net/signup/1987878/1718855/.

Engagement with LIDACs

As mentioned earlier in this plan, LIDACs were identified using CEJST with EJScreen as a supplement. To support LIDAC engagement, the Project Team compiled Community Reports for the five largest population centers in the state: the Memphis MSA, Nashville/Davidson County, Chattanooga, Knoxville MSA, and the Tri-Cities area. TDEC focused on these population centers because the public meetings were held in these locations. These reports can be found in Appendix E.

TDEC utilized the EJScreen Community Report for each area to summarize demographic information such as population data, the percentage of low-income residents, and households with limited English proficiency, as well as an assessment of the environmental justice indexes to screen for environmental indicators of concern. The reports showed the environmental justice indexes for each location.

According to the Community Reports, Limited English Proficient households represented approximately 2% of the population in all communities except the Tri-Cities (0%). Spanish was the second most common language spoken at home. In Memphis, Nashville, and Chattanooga, Spanish language speakers represented more than 5% of the population. Additionally, in Nashville, 2% of households speak Arabic in the home.

To provide effective outreach to Limited English Proficient persons, TDEC translated the public survey into Spanish. Additionally, TDEC translated promotional materials for the public meeting in Nashville into both Spanish and Arabic. Registration for all public meetings was optional; however, a question inquiring about a need for in-person interpretive services was included. Of the 110 respondents to the registration survey, no requests for interpretive services were made.

Going beyond demographics, TDEC spatially overlayed CEJST with environmental metrics like $PM_{2.5}$, Ozone, Air Toxics Cancer Risk, Toxic Releases to Air, and Cumulative Impacts. This community analysis identified census tracts and zip codes within each of Tennessee's major population centers that were either disadvantaged or overburdened, providing insights to support enhanced public engagement efforts in LIDACs.

Based on the findings from the Community Reports, TDEC took additional steps to enhance outreach efforts for LIDACs. These activities included a direct mailers campaign, personalized email invitations, and individual presentations to community groups. Flyers promoting the public meetings and public survey were mailed or hand delivered to houses of worship, neighborhood associations, nonprofit organizations, and popular gathering places like community centers, parks, and libraries in LIDAC communities. In Nashville, public meeting flyers in Spanish and Arabic were mailed to cultural heritage organizations, affinity groups, and places of worship providing services in these languages. A total of 337 pieces of mail were sent to these organizations.

Additionally, personalized emails were sent to numerous higher learning institutions, including Historically Black Colleges and Universities leadership and professors, community and neighborhood groups, cultural heritage organizations, affinity groups, and environmental nonprofits.

Individual Communications, Presentations, & Meetings

Regional Directors and staff from TDEC's Office of Energy Programs and Office of Sustainable Practices included TVERS program information and engagement opportunities in regularly scheduled quarterly or monthly email newsletters. A total of 6,815 individuals opened emails promoting TVERS engagement opportunities.

Regional Directors also sent 357 personalized emails to stakeholders encouraging them to engage with TVERS, including the opportunity to request a speaker for their neighborhood, community, affinity, cultural, and environmental organizations. These presentations were tailored to gather feedback and educate the community on GHG emissions, CPRG opportunities, and TDEC's engagement process.

Regional Directors gave five presentations about TVERS to individual community groups in the fall of 2023, including members of the Historic Germantown Neighborhood Association, Hill City Neighborhood Association, Sierra Club, Norris Lake Protection Alliance, and at the Tennessee Environmental Council's Policy & Practice Forum. TDEC's Division of Air Pollution Control presented on TVERS at Tennessee's SMART Mobility Expo on December 5, 2023 with 250 attendants. Finally, the annual Tennessee Environmental Conference in Kingsport, held October 23-25, included TVERS information for the 213 attendees. A TVERS presentation was given during the Pollution Prevention workshop held at the conference, where 25 industry representatives were in attendance. The Kingsport public meeting was held in conjunction with the conference and promoted via conference materials and announcements. Additionally, Anthony Tony (US EPA Region 4) and Michelle Owenby (TDEC Director of Air Pollution Control) hosted a panel discussion on air pollution topics that included TVERS and CPRG.

TDEC placed TVERS engagement materials at various tabling events throughout the fall. The team recorded a total of 1,185 individual interactions. A listing of the primary events and individual interactions can be found in Table 18.

Date	Event Name	Interactions
9/26/23	MTSU Chemistry and Biology Career Fair, Murfreesboro	50
9/28/23	MTSU All Majors Career Fair, Murfreesboro	200
10/3/23	UT-Knoxville College of Agriculture Career Fair	45
10/4/23	Tiger Blue Goes Green at University of Memphis	150
10/13/23	University of Memphis football game	40
10/21/23	UT-Chattanooga football game	60
10/23-25/23	Tennessee Environmental Conference, Kingsport	100
10/29-30/23	AARST Symposium, Nashville	300
10/31-11/3/23	TN Academy of Family Physicians Conference, Gatlinburg	200
11/4/23	University of Memphis football game	40

Table 18. TVERS Tabling Events and Interactions

Public Meetings

TDEC hosted a combination of virtual and in-person public meetings to share program information and receive feedback. In September, TDEC hosted a virtual kickoff webinar to introduce CPRG and TVERS. The slides and recording from the webinar are hosted on the TVERS website.

Figure 13. Public Meeting Locations

Throughout the fall, TDEC hosted five in-person, 90-minute meetings across the state in collaboration with local governments. TDEC coordinated with the lead agencies for the MSA in Memphis, Nashville, and Knoxville to promote and execute public meetings in the three largest metropolitan areas. In Chattanooga and the Tri-Cities, TDEC worked with the City of Chattanooga and City of Kingsport, respectively, to coordinate and promote the public meetings.

Date	Location	Meeting Format	Sign-Ins Recorded
9/7/23	TVERS Kickoff Webinar	Virtual: Presentation and Q&A via Microsoft Teams	29
9/21/23	Chattanooga	In-person: Presentation, Q&A & Small Group Discussion	8
10/2/23	Memphis	In-person: Presentation, Q&A & Small Group Discussion	30
10/16/23	Knoxville	In-person: Presentation, Q&A & Small Group Discussion	36
10/19/23	Nashville	In-person: Presentation, Q&A & Gallery Walk	28
10/24/23	Kingsport	In-person: Presentation, Q&A & Gallery Walk	15

Table 19. Public Meeting Location, Format, and Sign-Ins Recorded

During the public meetings, TDEC provided an overview of CPRG and TVERS and facilitated a Q&A. Attendees were then asked to participate in small group discussions to gather feedback on:

- What emission sectors and initiatives to prioritize,
- How individuals and the community are currently reducing emissions and motivations for these actions,
- Challenges the community faces to implementing actions, and
- What co-benefits are of primary importance.

Figure 14. Knoxville Public Meeting

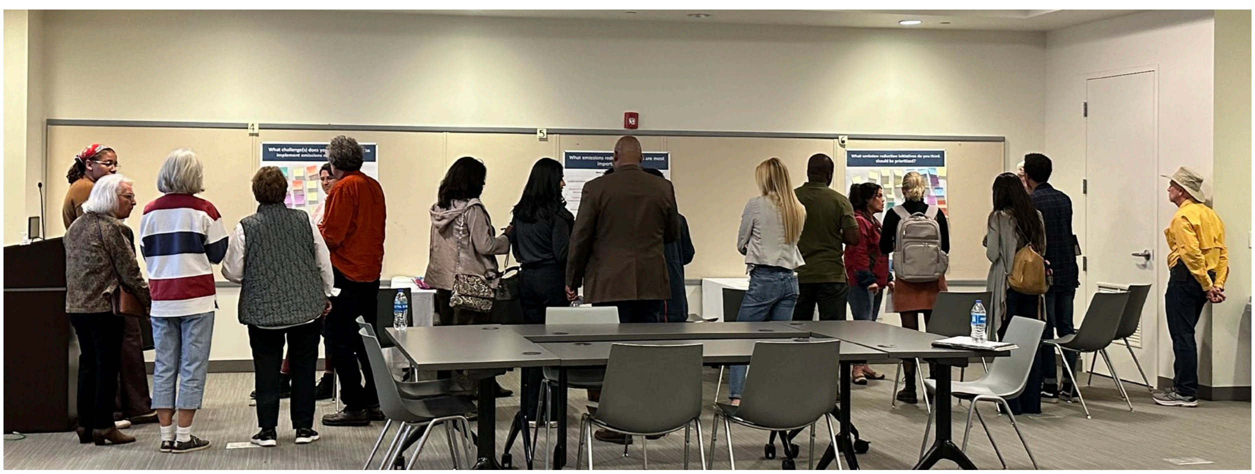

Figure 15. Nashville Public Meeting with Gallery Walk

As the public meetings progressed, TDEC adapted the meeting format from small tabletop discussions guided by a facilitator to a dynamic gallery walk. The gallery walk consisted of six stations set up around the room for participants to rotate through, with a facilitator and discussion question assigned to each station. Responses to the questions were written on a shared poster, so that a new group could consider a previous group's thoughts and either concur and build upon them or offer another perspective. This modification facilitated better engagement, streamlined brainstorming, and ensured a broader participation by preventing a few individuals from monopolizing discussions.

Responses to the discussion questions were transcribed and analyzed by the discussion themes and incorporated in the process used to select priority measures. The feedback received in the meetings will also continue to be analyzed for consideration in the development of the CCAP and other deliverables. A summary of participant feedback can be found in Figure 16.

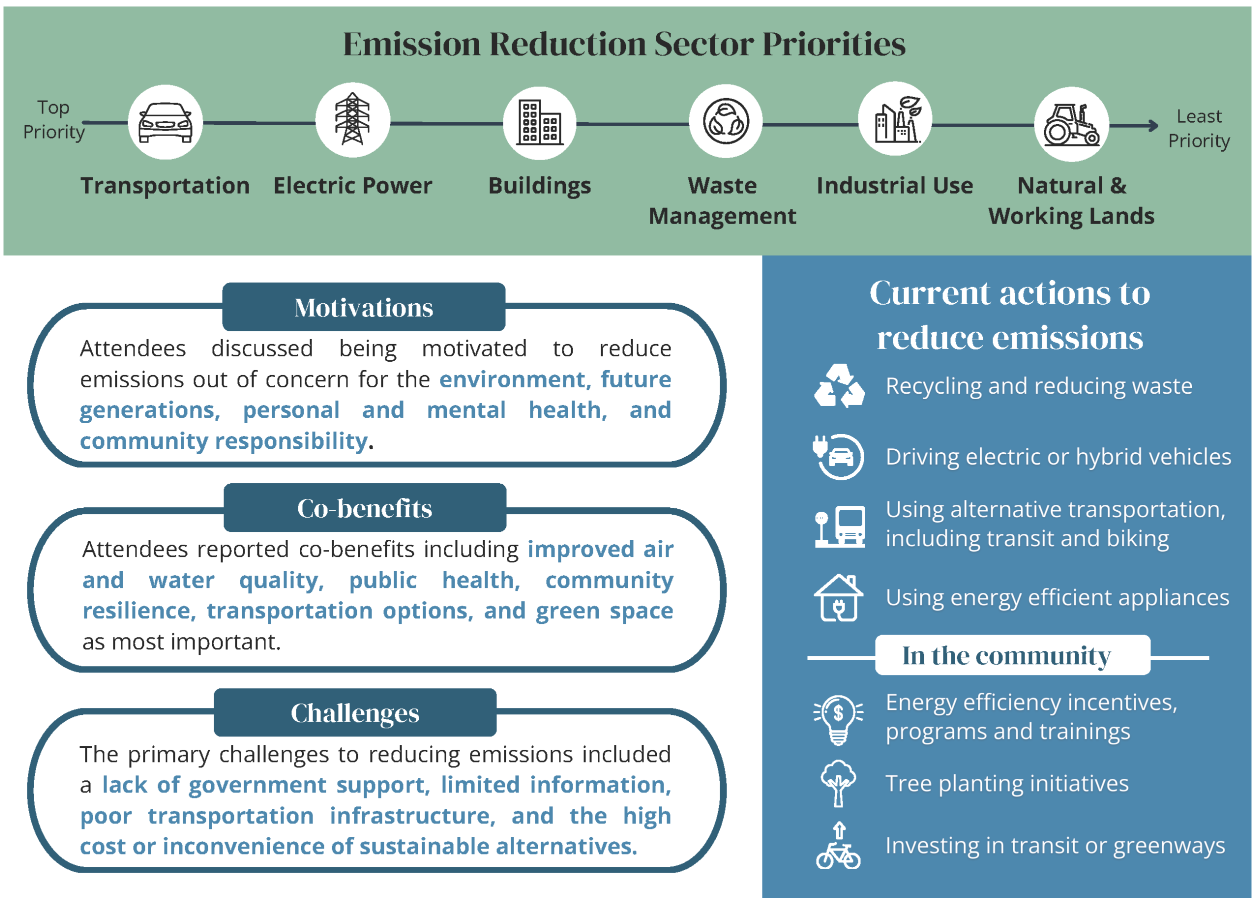

Figure 16. Summary of Public Meeting Feedback

Public Survey

Recognizing the hurdles associated with attending an evening in-person public session, TDEC broadened engagement through an online public survey distributed statewide. In this survey, participants were asked to prioritize emission sectors for action, identify current individual actions they engage in to reduce greenhouse gas emissions and perceived barriers, and describe benefits and disbenefits to implementing emission reduction measures. A map screen also provided the option for participants to identify their home location, current community projects, and priority areas for emission reduction projects. The survey was promoted via extensive outreach including social media, meetings, email newsletters, and media mentions. TDEC worked with internal teams as well as our engaged stakeholder community to promote the survey.

The survey was open from September – November 2023 and received 1,639 responses. Of the 1,639 responses,1,294 included home location; out of those that provided home locations, 38% were located in LIDACs. Figure 17 shows the geographic spread of survey respondents across the state based on home location data. The map also shows LIDAC census tracts as defined by the CEJST.

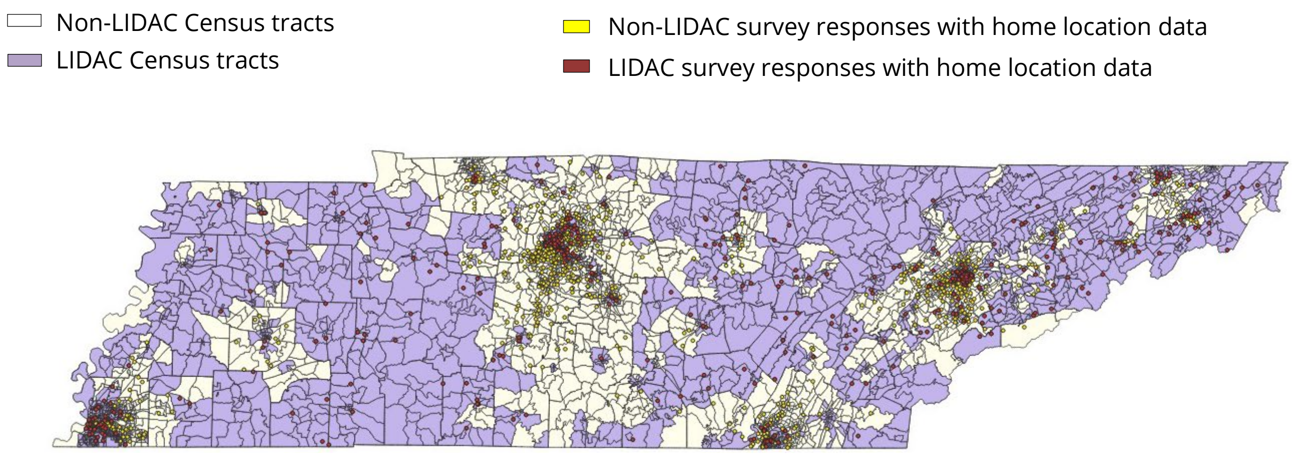

Figure 17. Map Showing Home Location of Survey Responses and LIDAC Communities

For participants who indicated a home location in the Nashville, Memphis, or Knoxville MSA, survey data was provided to the lead MSA agency to support their plan development. One completed survey was submitted in the Spanish language version. Approximately 5% of responses came from organizations while 95% were submitted by individuals.

Figure 18 summarizes survey responses. In both the survey and public meetings, transportation was indicated as the priority emission sector, aligning with the results of the TN PCAP Inventory. Survey feedback will be further analyzed and incorporated into the CCAP.

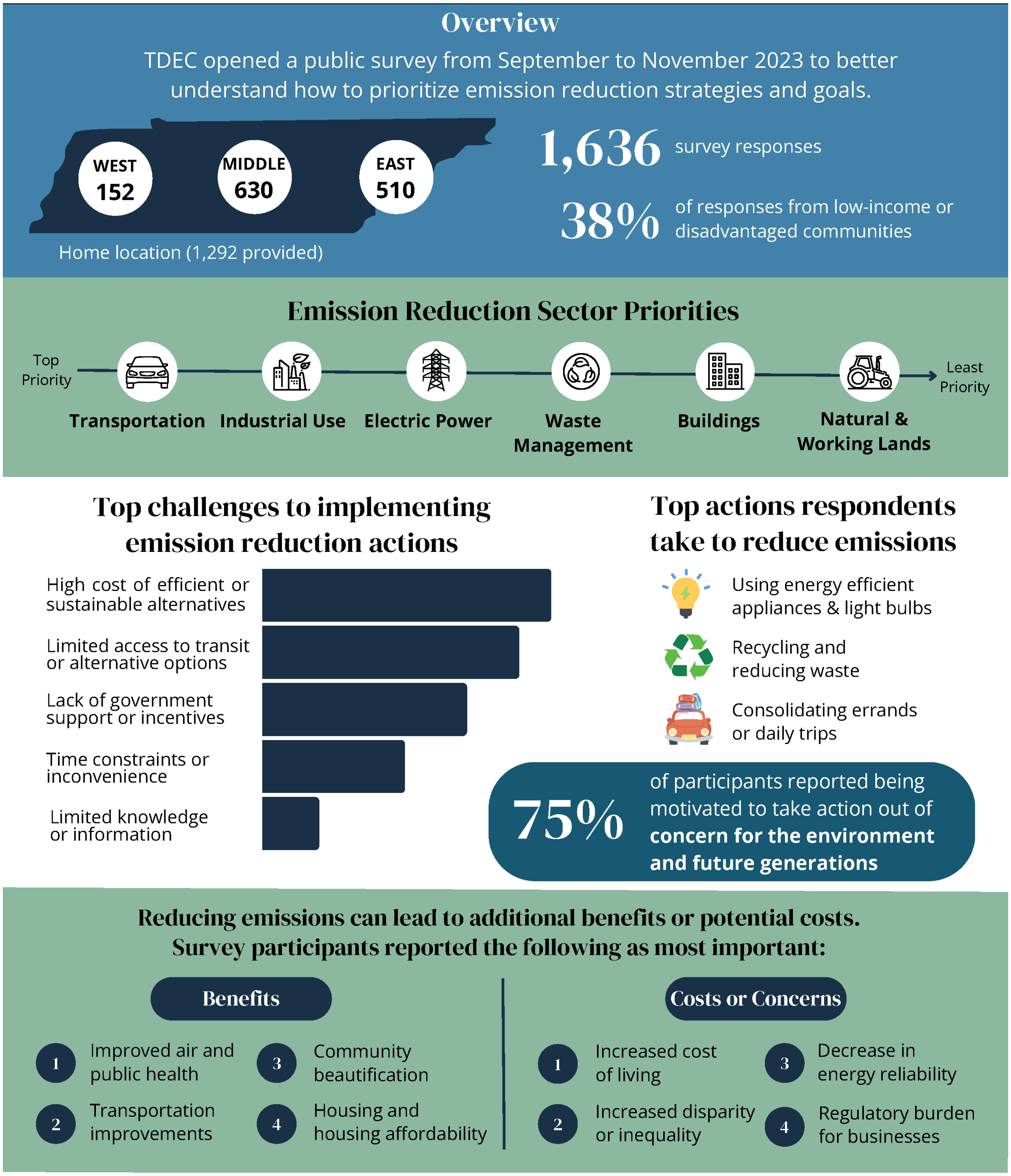

Figure 18. Summary of Public Survey Feedback

Future Coordination and Engagement

The coordination and engagement conducted in the development of the PCAP has established a foundation for the CCAP. Both stakeholders and the public are engaged in this process and eager to learn more and participate further to support this work in Tennessee. TDEC also received comments and feedback that were beyond the scope of the near-term, implementation ready focus of the PCAP. TDEC will revisit the responses from our public survey, meetings, sector-specific discussions, and other conversations as we begin the CCAP process.

Conclusion

The PCAP is the first deliverable under the CPRG planning grant awarded to TDEC. The priority measures allow eligible entities the opportunity to apply for the CPRG implementation grant program, with approximately $4.3 billion in competitive funding available to implement projects at the state and local levels. The PCAP focuses on near-term, implementation-ready measures to reduce GHG emissions in Tennessee.

TDEC will develop two additional deliverables through the CPRG planning grant, a CCAP due in 2025 and a Status Report due in 2027. Each of these deliverables has a specific set of US EPA requirements:

CCAP	Status Report
•Due Summer 2025 •Comprehensive GHG Inventory that identifies all emission sources and sinks •Near- and long-term GHG emission projections and reduction targets •Measures benefits analyses (including LIDAC) •Intersection with federal funding •Workforce planning analysis	•Due in 2027 •Updated analyses and plans •Implementation progress for measures in PCAP and CCAP •Next steps and future budget and staffing needs to continue implementation of CCAP

Figure 19. Future CPRG Deliverables and Required Content

TDEC will continue to focus on coordination and engagement with partners, stakeholders, and Tennessee citizens throughout this program. For questions about TVERS or to stay updated on this work:

Visit our Website (https://www.tn.gov/environment/policy/tvers)

Email TDEC.TVERS@tn.gov

Sign up for our Listserv (https://signup.e2ma.net/signup/1987878/1718855/)

Appendix A: Technical Specifications for GHG Inventory

This technical appendix provides detail about the statewide GHG inventory that has been developed for Tennessee under the PCAP phase of the CPRG program, referred to as the TN PCAP Inventory or Inventory.

QAPP Process

Prior to beginning technical analysis associated with the PCAP, US EPA required that a Quality Assurance Project Plan (QAPP) be developed in accordance with EPA guidance.[35] US EPA required that the QAPP be submitted for their review and approval between 30 and 90 days after the grant was awarded. TDEC's grant was awarded on June 29, 2023 and the QAPP was submitted on September 8, 2023 (72 days later). EPA provided their written approval on October 13, 2023 after which technical analysis associated with the TN PCAP Inventory, as described in the QAPP, commenced.

The QAPP specifies the software tools and procedures that would be used to develop the Inventory and the emission reductions associated with the priority GHG reduction measures. It also defines the quality assurance and quality control (QA/QC) requirements and technical activities that were established to ensure that the inventory and the emission reduction estimates are reliable and defensible. QA/QC steps employed during the TN PCAP Inventory and reductions measures development include Project Team training, independent quality checks of model simulations and calculations, quality assurance documentation, and data management. TDEC's final approved QAPP is provided as Appendix A, Attachment 1.

PCAP Inventory Overview

Emission Inventory Basics

An emission inventory is an accounting of the sources of atmospheric emissions (in this case GHG) and the amounts emitted by each of those sources within a specific geographic

[35] "EPA Requirements for Quality Assurance Project Plans. | US EPA." *US EPA*, March 2001, https://www.epa.gov/sites/default/files/2016-06/documents/r5-final_0.pdf.

region over a specific period. The following details were used to develop the TN PCAP Inventory:

- The geographic region is the entire state of Tennessee: no regional, county, or site-specific source information has been developed at this time.
- The specific period of time is annual: all emission estimates are reported as the quantity emitted during an entire year.
- The sources of emissions have been evaluated according to several sectors of the economy, as discussed below and as presented in figures and tables within the PCAP.

Baseline Year

Because Tennessee did not have an existing GHG inventory prior to the PCAP, it was necessary to establish a starting point. The starting point is referred to as the baseline year, meaning that actual or projected emissions associated with subsequent years are compared to emissions generated during that initial baseline year. The US EPA did not specify what year to choose as a baseline year for CPRG purposes; it was left to the discretion of the applicant.

The baseline year for the Inventory is calendar year 2019. Potential options that were considered were calendar years 2020 and 2019. 2020 is the most recent year presented by US EPA in its NEI[36] and the SIT[37] collection of emission estimation modules that were ultimately selected to develop the TN PCAP Inventory.

Review of US EPA data such as its GHG Inventory Data Explorer[38] indicated that 2020 was an atypical year due to COVID-19. Specifically, significant drops in emissions associated with electricity generation and transportation were observed. Consequently, calendar year 2019 was selected as the most recent representative year for which readily-available data could be obtained for the Inventory.

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[36] "National Emissions Inventory (NEI) | US EPA." *US EPA*, 2 June 2015, https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei.
[37] "State Inventory and Projection Tool | US EPA." *US EPA*, 5 February 2024, https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool.
[38] "Greenhouse Gas Inventory Data Explorer | US EPA." *US EPA*. https://cfpub.epa.gov/ghgdata/inventoryexplorer/#allsectors/allsectors/allgas/econsect/all.

Sectors Included

The following eight (8) sectors of the Tennessee economy were selected for evaluation.

Sector	% of US Emissions (2019)[39]	% of TN Emissions (2019)[40]	Description
Transportation	28%	39%	Transportation activities were the largest source of US and Tennessee GHG emissions. Emissions from this sector are primarily associated with the combustion of petroleum-based fuels by mobile sources such as cars, trucks, buses, boats, trains, and aircraft.
Electricity Generation	25%	22%	Electricity generation was the second-largest GHG emitting sector across the US and Tennessee. GHG emissions from electricity generation are associated with the combustion of fossil fuels such as coal, natural gas, and fuel oil.
Industry	24%	20%	Industrial activities are the third-largest GHG sector of the US and Tennessee economy. GHG emissions from industrial sources are largely due to the combustion of fossil fuels. Some industrial processes produce non-fuel-related GHG emissions and some industrial processes are associated with GHG emissions from fluorinated gases.
Agriculture	10%	8%	Enteric fermentation, livestock, and the use of fertilizers are large sources of GHG emissions from this sector in Tennessee.
Commercial and Residential Buildings	10%	8%	The TN PCAP Inventory indicates that emissions from this sector are primarily associated with the combustion of fossil fuels (largely natural gas).

[39] Based on 2019 data from "Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2021 | US EPA." *US EPA*, 1 February 2023, https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2021.

[40] See Figure 2 of the PCAP.

Sector	% of US Emissions (2019)[39]	% of TN Emissions (2019)[40]	Description
Waste & Materials Management	2%	2%	This sector is primarily associated with landfills, both municipal and industrial. Landfills contribute a significant amount of methane emissions.
Wastewater	0.6%	1%	This sector accounts for emissions generated during the processing of municipal and industrial wastewater. Such activity is a significant source of both methane and nitrous oxide emissions.
Land Use, Land –Use Change, and Forestry (LULUCF)	-11%	-29%	The LULUCF sector in the state of Tennessee is a net sink of GHG rather than a source, meaning that the forests and other natural resources remove more GHG from the atmosphere than what is emitted from these resources.

Table A.1. TN PCAP Inventory Emission Sectors

Gases Included

The US EPA's CPRG guidance for preparation of the Inventory states that it should account for the following primary greenhouse gases:

- Carbon dioxide (CO_2),
- Methane (CH_4),
- Nitrous oxide (N_2O), and
- Fluorinated gases (F-gases) including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).

In the summaries provided in the PCAP, emissions of CO_2, CH_4, and N_2O are reported individually. Emissions of the F-gases are combined and reported as "Other."

AR5 Global Warming Potential

Consistent with US EPA guidance, the global warming potentials presented in the Intergovernmental Panel on Climate Change Fifth Assessment Report [41] have been used to convert estimates of individual gases to the CO_2 equivalent (CO_2e) form. The corresponding global warming potentials are:

- CO_2: 1
- CH_4: 28
- N_2O: 265
- F-Gases: SF_6 (23,500); NF_3 (16,100); HFCs and PFCs vary by gas[42]

To calculate the emissions of a gas in the units of CO_2e, the tons of the gas are multiplied by the global warming potential to derive the emissions in CO_2e. As an example, if emissions from a source consist of one metric ton (MT) of CO_2 and one MT of CH_4, then the combined emissions in terms of CO_2e would be:

$$Combined\ Emissions\ = 1\ MT\ CO_2 + \left(1\ MT\ CH_4\ x\ 28\ {}^{MT\ CO_2e}/_{MT\ CH_4}\right) = 29\ MT\ CO_2e$$

For reporting purposes, all emission estimates have been converted to MMT CO_2e.

Calculation methodology

As presented in the QAPP, all emission estimates were developed utilizing US EPA's SIT. The SIT includes eleven separate calculation modules. The TN PCAP Inventory was developed utilizing the default state-wide Tennessee data provided in the SIT for calendar year 2019. Results of the TN PCAP Inventory are provided in the "Greenhouse Gas Emissions Inventory" section of the PCAP.

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[41] Global Warming Potential Values. https://ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf.

[42] *Id.*

SIT Module and Inventory Sector Alignment

As an aid to understanding how the baseline annual GHG emission estimates were derived from the SIT modules, Table A.2 maps each inventory sector (columns) against the respective SIT modules (rows) that have been used to compile the TN PCAP Inventory.

SIT Module	TN PCAP GHG Inventory Sector							
	Transportation	Electricity Generation	Industry	Agriculture	Commercial & Residential Buildings	Wastewater	Waste & Materials Management	LULUCF
Agriculture				X				
CO_2 from Fossil Fuels	X	X	X		X			
Coal Mining			X					
Industrial Processes			X					
LULUCF							X	X
Mobile Combustion (CH_4 & N_2O)	X			X				
Nat Gas & Oil			X					
Solid Waste							X	
Stationary Combustion (CH_4 & N_2O)		X	X		X			
Wastewater						X		
Indirect CO_2 (consumed electricity)	Informational only. Not included in TN PCAP Inventory.							

Table A.2. SIT Module Compared to Inventory Sector

PCAP Sector-Specific Approaches

Sector-specific GHG estimates were derived from the SIT modules in default mode. However, the following sectors had additional methodologies applied to the calculations.

Transportation

The transportation sector CO_2 emissions were calculated based on fuel consumption (e.g., gasoline, diesel) in the *CO_2 from Fossil Fuel* SIT module instead of vehicle miles traveled from the *Mobile Combustion* SIT module. Calculations based on vehicle miles traveled would have introduced more uncertainty than the fuel consumption calculation approach for the Inventory. Emissions based on fuel consumption are in line with guidance included in the EPA *Mobile Combustion* SIT Module User Guide.

Additionally, International Bunker Fuel is calculated as part of the Transportation sector in the *CO_2 from Fossil Fuel* SIT module. However, this has been subtracted out of transportation and is not included in the TN PCAP Inventory due to guidance included in the EPA *CO_2 from Fossil Fuel* SIT Module User Guide.

Electricity Generation

The electricity generation GHG emissions were calculated based on fuel use (e.g., coal, natural gas) in the *CO_2 from Fossil Fuel* and *Stationary Combustion* SIT modules. Electricity consumption by the end user of electricity, such as residential, commercial, or industrial, is not included in those respective sectors of the Inventory. This approach was utilized to avoid double counting of emissions from electricity generation and consumption.

Industry

As discussed above, electricity consumption GHG emissions are not included in the industry sector in the Inventory. Instead, this sector accounts for industrial process emissions and fossil fuels consumed onsite, such as natural gas space heaters and boilers.

Commercial & Residential Buildings

Similar to the industry sector, electricity consumption GHG emissions are not included in the commercial and residential buildings sector in the Inventory. Instead, this sector accounts for fossil fuels consumed onsite, such as natural gas space heaters.

Transportation and Electricity Generation Supplemental End-Use Information

In order to provide additional context on the top two Inventory sectors (transportation and electricity generation), emissions for each sector were partitioned and ratioed according to end-use subsectors.

Transportation

The total CO_2 emissions derived using the *CO_2 from Fossil Fuel* SIT module (as reported as 43.7 MMT CO_2e in the Inventory) were partitioned according to end-use subsectors defined in the *Mobile Sources* SIT Module (emissions were calculated as total 50.9 MMT CO_2e). Each subsector CO_2 line item was ratioed by the total from the *CO_2 from Fossil Fuel* SIT Module to the total from Mobile *Sources* SIT Module (86%) to derive the corresponding mobile source estimates. CH_4 and N_2O values calculated from *Mobile Sources* SIT Module were then added to obtain totals.

Electric Generation

The total CO_2 emissions derived using the *CO_2 from Fossil Fuel* SIT module (as reported as 24.1 MMT CO_2e in the Inventory) were partitioned according to end-use subsectors defined in the *Indirect CO_2* SIT module (emissions were calculated as total 33.6 MMT CO_2e). Each subsector CO_2 line item was ratioed by the total from the *CO_2 from Fossil Fuel* SIT Module to the total from *Indirect CO_2* SIT Module (72%) to derive the corresponding subsector source estimates. CH_4 and N_2O values were ratioed based on the emissions from *CO_2 from Fossil Fuel* SIT module to the *Stationary Combustion* SIT module.

PCAP Inventory Alignment with Regional Inventories

The TN PCAP Inventory was the first step in Tennessee's CPRG process. It provides a point of reference from which the subsequent CCAP and its comprehensive GHG inventory will be developed. The process used to develop the TN PCAP Inventory was independent of prior and ongoing efforts by others to develop regional GHG inventories. At the time of this publication, available or forthcoming GHG inventories have been developed for the following metropolitan statistical areas (MSAs), and their populations in 2019:

- Nashville (~1.98 million),
- Memphis (~1.32 million),
- Knoxville (~0.87 million), and
- Chattanooga (~0.55 million).

These four MSAs are listed in order of decreasing population in 2019. They represent an estimated 4.7 million people (about 69% of the state's 6.8 million residents). A fifth geographic region is represented by the Tennessee Valley Authority (TVA). TVA is the regional electrical power generating organization that encompasses nearly all of Tennessee and parts of six other states, serving ~10 million customers.

Each of these regions have developed Climate Action Plans and/or associated GHG inventories. Some inventories date to the early 2000s (e.g., Knoxville published a version in 2005) while others are recent (e.g., the TVA Valley Pathways emission inventory was released on February 14, 2024)[43]. Consequently, these inventories may or may not present calendar year 2019 emission estimates that are comparable to the TN PCAP Inventory. In addition, most of the existing inventories have been calculated utilizing earlier global warming potentials (e.g., Intergovernmental Panel on Climate Change's Fourth Assessment Report was commonly used, which causes non-CO_2 emission estimates to be scaled differently when converting to CO_2e). Further, there has been no standardization among the inventories for the sectors of the economy to organize the emission estimates. Specifically, these inventories use different mixes of residential, institutional, commercial, industrial, agricultural, and energy sources that make it difficult to compare them to the TN PCAP Inventory. As such, no attempt has been made to evaluate the methodologies used

[43] "Tennessee Valley Authority - Valley Pathways Study | TVA." *TVA*, https://www.tva.com/environment/valley-pathways-study.

to develop regional GHG inventories. Similarly, no attempt has been made to evaluate the sources or quality of data used to develop the regional emission inventories.

To align or inform the TN PCAP and CCAP inventories with existing or ongoing regional inventories, Table A.3 compares some available information from the existing inventories.

	Emissions in Million Metric Tons CO_2e (Calendar Year)					
Sector	**PCAP TN (2019)**	**Nashville (2019)**	**Memphis (2016)**	**Knoxville (2019)**	**Chattanooga (2018)**	**MSA Totals**
Transportation	44.2	5.7	7.2	2.6	1.0	16.5
Electricity Generation	24.1	(1)	(1)	(1)	(1)	(1)
Industrial	22.9	1.0	0.8	Not Reported	(2)	(3)
Agriculture	9.2	Not Reported	Not Reported	Not Reported	Not Reported	Not Reported
Buildings (Commercial & Residential)	8.6	4.1	7.1	1.7	1.9	14.8
Waste & Materials Mgmt	2.4	0.45	2.0	0.07	0.01	2.63
Wastewater	0.7	0.06	0.09	0.11	0.02	0.28
Total Emissions	112.1	11.3	17.2	4.5	3.0	36.0
LULUCF	-32.6	Not Reported	Not Reported	Not Reported	Not Reported	Not Reported

Table A.3. Comparison of Existing Regional GHG Inventories to the PCAP Inventory[44]

[44] (1) Emissions from electricity generation is not presented. Instead, emissions associated with energy consumption are presented.
(2) Included with Commercial & Residential Buildings.
(3) Not all MSAs provided a value so no sum is included.

Some observations that can be made from Table A.3 and review of the TVA Pathways inventory include:

1. Transportation emissions represent the greatest sector for the TN PCAP Inventory (39%) and for each of the MSA inventories (ranging from 34% to 59%). This can also be seen from the TVA Valley Pathways summaries that indicate transportation emissions represent the largest portion (36%) of their baseline 2019 inventory. This consistency emphasizes the importance of transportation-related GHG reduction measures.
2. Both the TVA Valley Pathways study and the TN PCAP Inventory identify electricity generation as the second largest source of GHG emissions, ranging from 21% (TN PCAP Inventory) to 27% (TVA Valley Pathways).
3. The sum of MSA Commercial & Residential Building emissions (14.8 MMT) exceeds the TN PCAP Inventory estimate for that sector (8.6 MMT). This is believed to be primarily a result of the exclusion of electric power consumption emissions from the building sector (i.e., TN PCAP Inventory totals focus primarily on fossil fuel combustion by buildings) in the TN PCAP Inventory. In contrast, the MSA inventories as well as the TVA Valley Pathways inventory, are believed to account for electricity consumption by buildings in addition to fuel consumption. Note that none of the four MSA inventories separately account for electricity generation.
4. The Waste & Material Management total for the four MSAs is within 10% of the TN PCAP Inventory statewide total which suggests that the majority of emissions from this sector are associated with activities occurring in these four largest metropolitan areas. This suggests that methane emissions from solid waste landfills are a significant opportunity for GHG reduction measures.

Based on the data sources and methodologies used, there are inherent uncertainties associated with the estimates provided. Those uncertainties are discussed in the following section.

Data Gaps and Uncertainties

As discussed, the TN PCAP Inventory is the first iteration of a GHG inventory for all of Tennessee. Therefore, certain data gaps are present in the Inventory. A data gap was considered insignificant if accounted for less than 5% of Inventory Total Emissions. The main data gaps are related to the following:

- SIT module does not have calculations for certain subsectors,

- SIT module can calculate the subsector but does not have default data for the calculation, and
- The default data utilized in the SIT module is statewide and might not provide the most accurate representation of Tennessee activities.

Each known data gap was assessed for significance. Examples of known data gaps are emissions from the following subsectors:

- Transportation: ozone depleting substances associated with air conditioning systems,
- Industrial Processes: nitric acid production, magnesium production, zinc production, glass production, titanium dioxide production, hydrogen manufacturing, pulp and paper manufacturing, natural gas systems, and petrochemical production,
- Agriculture: fossil fuel combustion,
- Waste & Materials Management: composting and incineration of waste,
- Wastewater: fruits and vegetables wastewater treatment plants, pulp and paper wastewater treatment plants, and poultry wastewater treatment plants, and
- LULUCF: forest fires.

Sources for the data gap calculations were state-level GHG Inventories prepared by the US EPA[45] and data reported to the US EPA's GHG Reporting Program[46]. Each known-data gap was insignificant and accounted for less than 5% of the Inventory Total Emissions. The significance of the default data utilized in the SIT module as compared to more customized and local inputs (#3 above) was not assessed for the PCAP Inventory. This will be further assessed and refined for the CCAP phase.

Appendix A, Attachment 1: QAPP

The Quality Assurance Project Plan (QAPP) was approved by the US EPA in October 2023. The signed approval page is displayed. To access the full QAPP, email TDEC.TVERS@tn.gov.

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[45] "State GHG Emissions and Removals | US EPA." *US EPA*,1 February 2022, https://www.epa.gov/ghgemissions/state-ghg-emissions-and-removals.
[46] "Data Sets | US EPA." *US EPA*, 5 October 2023, https://www.epa.gov/ghgreporting/data-sets.

1. Project Management (Group A)

1.1. Title and Approval Page

Quality Assurance Project Plan for
Tennessee Volunteer Emission Reduction Strategy
5D-02D51423

Prepared by:
Tennessee Department of Environment and Conservation
(TDEC)
William R. Snodgrass Tennessee Tower, 15th Floor
312 Rosa L. Parks Avenue
Nashville, TN 37243

Prepared for:
U. S. EPA Region 4
Sam Nunn Atlanta Federal Center
61 Forsyth Street SW
Atlanta, GA 30303

September 8, 2023

APPROVALS:

Michelle Walker Owenby, TVERS Project Manager — Date: September 8, 2023

Michelle Oakes, TVERS Quality Assurance Manager — Date: September 7, 2023

USEPA Region 4 Grants Project Officer: — Date: October 13, 2023

KAYLA KERN Digitally signed by KAYLA KERN Date: 2023.10.13 13:46:06 -04'00'

USEPA Region 4 Quality Assurance Manager: — Date:

HEIDI LESANE

QAPP Revision History

Revision No.	Description	Author	Date
0	Original Version	TDEC	10/13/2023

Appendix B: Priority Measures

This appendix provides technical detail on the emission reduction estimates associated with each priority measure presented in the PCAP. Cumulative emission reductions are calculated for the 5-year time period from January 1, 2025 through December 31, 2029 and for the 25-year time period from January 1, 2025 through December 31, 2049, per CPRG guidance. All estimates reflect maximum potential benefits. Unless otherwise indicated, modeling output was generated in 5-year increments. To get annual results for years between the 5-year increments, linear interpolation was utilized. The Project Team utilized the US EPA's Emissions and Generation Resource Integrated Database (eGRID) Power Profiler for SRTV (SERC Tennessee Valley) [47] emission factors to determine the CO_2e emissions from electricity consumption estimations.

Building Energy Efficiency Enhancements

Incentive programs for implementation of end-use energy efficiency measures in existing commercial and industrial buildings.

GHG Methodology

This measure was evaluated using the US EPA Global Change Analysis Model Long-term Interactive Multi-Pollutant Scenario Evaluator (GLIMPSE) and manual calculations. Results were produced using the preexisting GLIMPSE component of "Tech-HighEffTechs-bldgs." This scenario is defined as: High efficiency technology adoption in buildings by no longer purchasing non-high efficiency technology options starting in 2025. Adjustments were made to the scenario by (1) excluding residential buildings high efficiency upgrades, and (2) applying it to only Tennessee. GLIMPSE modeling produces projected emission reductions savings in electricity generation (i.e., MWh) and corresponding mass emissions rates.

For this measure, GLIMPSE assumed that the standard efficiency (not high efficiency) technologies included in Table B.1.1 would no longer be purchased. Only commercial building technologies are shown in Table B.1.1 because GLIMPSE is currently unable to perform this type of analysis for industrial buildings. To estimate the additional emissions

[47] "Power Profiler | US EPA." *US EPA*, 23 July 2021, https://www.epa.gov/egrid/power-profiler#/SRTV. Accessed 30 January 2024.

reductions for industrial buildings, the Project Team used electricity end-use information from PCAP Table 5 to develop a multiplier that was applied to the commercial results.

As indicated in Table 5 of the PCAP, the electricity consumed for commercial space heating (0.13 MMT), cooling (1.78 MMT), ventilation (1.25 MMT), and water heating (0.05 MMT) in the 2019 baseline year resulted in combined CO_2e emissions of 3.21 MMT. Also shown are the emissions associated with industrial building heating, ventilation, and air conditioning (0.38 MMT CO_2e). Assuming the GLIMPSE emission reductions modeled for commercial buildings will be proportional to those achievable in industrial buildings, GLIMPSE commercial building output can be scaled using the relationship between their baseline emissions. In this case, the industrial portion (0.38 MMT) is 11.9% of the commercial portion (3.21. MMT). To adjust the commercial result to the corresponding commercial plus industrial result, the commercial result is multiplied by the factor of 1.119. The same multiplier was applied to the co-pollutants SO_2 and NO_x.

Sector	Subsector	Technology
Commercial cooking	Electricity	Electric range
Commercial cooking	Gas	Gas range
Commercial cooling	Electricity	Air conditioning
Commercial cooling	Electricity	Electricity
Commercial heating	Coal	Coal
Commercial heating	Coal	Coal furnace
Commercial heating	Electricity	Electric furnace
Commercial heating	Electricity	Electricity
Commercial heating	Gas	Gas
Commercial heating	Gas	Gas furnace
Commercial heating	Refined liquids	Fuel furnace
Commercial heating	Refined liquids	Refined liquids
Commercial hot water	Electricity	Electric resistance water heater
Commercial hot water	Gas	Gas water heater
Commercial lighting	Electricity	Incandescent
Commercial other	Refined liquids	Refined liquids
Commercial other	Coal	Coal
Commercial other	Refined liquids	Refined liquids
Commercial refrigeration	Electricity	refrigeration
Commercial ventilation	Electricity	Ventilation

Table B.1.1. The Lower Efficiency Version of Technologies are Assumed to No Longer Be Purchased

Co-Pollutant Methodology

GLIMPSE output in electricity consumption savings was converted to mass emissions rates using US EPA eGRID factors for SO_2 (0.594 lb/MWh) and NO_x (0.403 lb/MWh).

Results

Table B.1.2 provides the total CO_2e emissions that would be reduced for 2025 to 2030 and 2025 to 2050.

	2025 to 2030 (MMT CO_2e)	2025 to 2050 (MMT CO_2e)
Avoided Emissions	-6.1	-63.3

Table B.1.2. CO2e Reduction Measure Estimates in MMT CO2e

Table B.1.3 provides the total co-pollutant emissions that would be avoided for 2025 to 2030 and 2025 to 2050.

	2025 to 2030 (Tons)	2025 to 2050 (Tons)
Sulfur Dioxide (SO_2)	-4,322	-44,532
Nitrogen Oxides (NO_x)	-2,932	-30,213

Table B.1.3. Co-Pollutant Reduction Measure Estimates in Tons

Discussion

Full implementation of this measure by 2050 would result in a reduction of an average 2.5 MMT of CO_2e each year. The commercial and industrial electricity consumption subsector baselines (calendar year 2019) account for 13.8 MMT CO_2e. This annual average improvement would equate to an 18% reduction in emissions for that subsector.

Performance Metrics

The primary performance metric for this measure will be to track the annual consumption of energy (GWh) used by the upgraded building components in commercial and industrial buildings, compared with that of building components today. These reductions in energy use will lead to a reduction in GHG emissions that are emitted while still generating the electricity needed to power these building components.

Incentive programs for the purchase of certified energy-efficient lighting in commercial and industrial buildings, as well as municipal streetlights.

GHG Methodology

This measure was evaluated using GLIMPSE with default settings. The results associated with this measure were produced using a scenario in which there are no purchases of commercial and industrial fluorescent and incandescent lighting starting in 2030. As explained for the prior measure, because GLIMPSE does not yet accommodate industrial building evaluations of this type, a multiplier was developed using data from PCAP Table 5 to derive the commercial plus industrial benefit. In this case, the multiplier was found by the ratio of industrial lighting emissions for the baseline year (0.24 MMT CO2e) compared to the commercial lighting emissions (1.43 MMT CO2e). Since the industrial emissions are 16.7% of the commercial, a multiplier of 1.167 was used to convert the GLIMPSE commercial output to the corresponding commercial plus industrial building benefit.

Co-Pollutant Methodology

GLIMPSE output in electricity consumption savings was converted to mass emissions rates using EPA eGRID factors for SO_2 (0.594 lb/MWh) and NO_x (0.403 lb/MWh)

Results

Table B.1.4 provides the total CO_2e emissions that would be reduced for 2025 to 2030 and 2025 to 2050.

	2025 to 2030 (MMT CO_2e)	2025 to 2050 (MMT CO_2e)
Avoided Emissions	-1.0	-23.5

Table B.1.4. CO_2e Reduction Measure Estimates in MMT CO_2e

Table B.1.5 provides the total co-pollutant emissions that would be reduced for 2025 to 2030 and 2025 to 2050.

	2025 to 2030 (Tons)	2025 to 2050 (Tons)
Sulfur Dioxide (SO_2)	-676	-16,509
Nitrogen Oxides (NO_x)	-458	-11,201

Table B.1.5. Co-Pollutant Reduction Measure Estimates in Tons

Discussion

Full implementation of this measure by 2050 would result in a reduction of an average 0.94 MMT of CO_2e each year. The commercial and industrial lighting subsector baseline (calendar year 2019) accounts for an estimated 1.67 MMT CO_2e. This annual average reduction represents nearly a 56% reduction in emissions for that subsector.

Performance Metrics

The primary performance metric for this measure will be to track the annual consumption of energy (GWh) used by the upgraded certified energy-efficient lighting in commercial and industrial buildings, compared with that of commercial and industrial lighting today. These reductions in energy use will lead to a reduction in GHG emissions that are emitted while generating the electricity needed to power these commercial and industrial lights.

Exterior municipal streetlighting conversion.

A streetlighting measure was evaluated separately as part of the commercial and industrial lighting sector.

GHG & Co-Pollutant Methodology

This measure was calculated manually. Light emitting diode (LED) streetlight conversion programs that exist or are planned, outlined in Table B.1.6 below were primarily sourced from municipalities' websites or local news articles. Emissions from electricity consumed by Tennessee's existing streetlight inventory served as the business-as-usual (BAU) case. Those emissions were compared to the LED state-wide conversion program outlined below. Table B.1.7 summarizes cumulative emission reductions from 2025 to 2030 and 2025 to 2050. The eGRID Power Profiler factors were used to derive mass emission rates. Table B.1.8 summarizes cumulative co-pollutants reductions from 2025 to 2030 and 2025 to 2050 for the LED conversion program.

- **Assumptions across the BAU and LED conversion program:**
    - Inventory is stagnant, no additional light fixtures added to the inventory
    - Total estimated TN municipal streetlight inventory: 772,496
    - Current high pressure sodium (HPS) streetlights already converted or planned to LEDs: 224,202
        - Total from conversions in Table B.1.6

- Streetlights wattage was assumed to be similar to typical highway fixture at 250 W and 400 W[48]
  - Total light fixtures and converted fixtures were split evenly (50% of lights are 250 W, 50% of lights are 400 W)
- LED conversion wattage for a 250 W HPS fixture is 130 W and a 400 W high pressure sodium vapor light (HPS) fixture is converted to a 196 W LED[49]
- TN's electricity GHG emission rate and co-pollutant emission rates (lb/MWh) are assumed to remain constant.

- **Business as usual case**: all HPS light fixtures remain, all current or planned LED remain.
  - Remaining inventory as HPS streetlights to remain as HPS fixtures: 548,295
    - Remaining inventory = total inventory – (known current HPS + current and planned LED conversions)
  - 2025-2050 LED fixtures converted or planned: 224,202
- **Statewide 100% HPS conversion to LED case**: from 2025 to 2050 the remaining 548,295 inventory of HPS streetlights are converted linearly by 21,088 until all remaining HPS fixtures are converted.
  - 2025 HPS streetlight inventory: 527,206 (split 50% by 250W and 400W)
  - 2025 LED inventory: 245,290
  - Each year the total HPS inventory decreases by 21,932 and added to the LED fixture inventory (10,966 HPS converted per fixture type).

Data type	No. of streetlights	Source
Nashville - streetlights converted to LEDs	55,688	https://mainstreetmediatn.com/articles/mainstreetnashville/nashville-plans-to-convert-all-streetlights-to-led/News article
Memphis streetlights converted to LEDs	77,300	Memphis LED upgrade program site

[48] "Roadway and Intersection Lighting | TDOT." *TDOT*, December 2016, https://www.tn.gov/content/dam/tn/tdot/traffic-engineering/manual-8-11/CHAPTER%2015%20-%20ROADWAY%20AND%20INTERSECTION%20LIGHTING.pdf. Accessed 29 January 2024.

[49] "LED Street Lighting Assessment and strategies for the Northeast and Mid – Atlantic | Northeast Energy Efficiency Partnerships, Table A3." *Northeast Energy Efficiency Partnerships,* https://neep.org/led-street-lighting-assessment-and-strategies-northeast-and-mid-atlantic. Accessed 29 January 2024.

Data type	No. of streetlights	Source
Knoxville - streetlights converted to LEDs	29,500	Knoxville LED program
Chattanooga - total streetlights and will be converted to LEDs	26,500	Chattanooga.gov
Brentwood - streetlights converted to LEDs	4,000	News article
Athens - streetlights converted to LEDs	2,505	TN DOE OLA LED streetlight workshop
Bartlett - streetlights converted to LEDs	8,628	Barlett's project map
Collierville - streetlights converted to LEDs	7,450	Collierville project maps
La Vergne - streetlights converted to LEDs	4,916	News article
Columbia - streetlights converted to LEDs	6,189	Columbia LED program
Goodlettsville - streetlights converted to LEDs	1,124	Goodlettsville LED program
Goodlettsville - unconverted street lights	1,276	News article
Murfreesboro - streetlights converted to LEDs	300	News release
Franklin - streetlights converted to LEDs	102	Franklin LED program

Table B.1.6. Municipalities' Streetlight Inventory

Results

Table B.1.7 provides the total CO_2e emissions that would be reduced for 2025 to 2030 and 2025 to 2050.

	2025 to 2030 (MMT CO_2e)	2025 to 2050 (MMT CO_2e)
Avoided Emissions	-0.1	-2.1

Table B.1.7 CO_2e Reduction Measure Estimates in MMT CO_2e

Table B.1.8 provides the total co-pollutant emissions that would be reduced for 2025 to 2030 and 2025 to 2050.

	2025 to 2030 (Tons)	2025 to 2050 (Tons)
Sulfur Dioxide (SO_2)	-69	-1,502
Nitrogen Oxides (NO_x)	-47	-1,019

Table B.1.8 Co-Pollutant Reduction Measure Estimates in Tons

Discussion

Full implementation of this measure by 2050 would result in a reduction of an average of about 0.08 MMT of CO_2e each year. While the 2019 baseline GHG inventory does not provide detail on emissions associated with streetlighting, this represents about 6% of the 2019 commercial lighting emissions total (1.43 MT CO_2e).

Performance Metrics

The rate at which HPS streetlights are converted to LED streetlights and actual efficiency of LED lights compared to HPS fixtures (more savings may be realized).

Incentive programs for the purchase of certified energy-efficient building products to replace inefficient products in residential buildings.

GHG Methodology

This measure was evaluated with GLIMPSE with the "Tech-HighEffTechs-bldgs" scenario. This scenario is defined as: High efficiency technology adoption in buildings by no longer purchasing non-high efficiency technology options in residences starting in 2025. An adjustment was made to this scenario by (1) excluding commercial buildings high efficiency upgrades, and (2) applying it to only Tennessee. Specifically, this evaluation assumes that the standard efficiency (not high efficiency) technologies included in Table B.1.9 are no longer purchased.

Sector	Subsector	Technology
Residential clothes dryers	Electricity	Clothes dryer
Residential clothes washers	Electricity	Clothes washers
Residential cooking	Gas	Gas
Residential cooking	Refined liquids	Refined liquids
Residential cooling	Electricity	Air conditioning
Residential cooling	Electricity	Electricity

Sector	Subsector	Technology
Residential dishwashers	Electricity	Dishwashers
Residential freezers	Electricity	Freezer
Residential heating	Coal	Coal
Residential heating	Coal	Coal furnace
Residential heating	Electricity	Electric furnace
Residential heating	Electricity	Electricity
Residential heating	Gas	Gas
Residential heating	Gas	Gas furnace
Residential heating	Refined liquids	Fuel furnace
Residential heating	Refined liquids	Refined liquids
Residential hot water	Electricity	Electric resistance water heater
Residential hot water	Gas	Gas water heater
Residential hot water	Refined liquids	Fuel water heater
Residential lighting	Electricity	Incandescent
Residential others	Refined liquids	Refined liquids
Residential others	Refined liquids	Refined liquids
Residential refrigerators	Electricity	Refrigerator

Table B.1.9 No Longer Purchased Standard Efficiency Technologies

Co-Pollutant Methodology

GLIMPSE output in electricity consumption savings was converted to mass emissions rates using EPA eGRID factors for SO_2 (0.594 lb/MWh) and NO_x (0.403 lb/MWh).

Results

Table B.1.10 provides the total CO_2e emissions that would be reduced for 2025 to 2030 and 2025 to 2050.

	2025 to 2030 (MMT CO_2e)	2025 to 2050 (MMT CO_2e)
Avoided Emissions	-6.2	-60.0

Table B.1.10. CO2e Reduction Measure Estimates in MMT CO_2e

Table B.1.11 provides the total co-pollutant emissions that would be reduced for 2025 to 2030 and 2025 to 2050.

	2025 to 2030 (Tons)	2025 to 2050 (Tons)
Sulfur Dioxide (SO_2)	-4,327	-42,240
Nitrogen Oxides (NO_x)	-2,967	-28,658

Table B.1.11. Co-Pollutant Reduction Estimates Results in Tons

Discussion

Full implementation of this measure by 2050 would reduce CO_2e emissions by an average 2.4 MMT of CO_2e each year. The Residential Electricity Consumption subsector baseline (calendar year 2019) accounts for 10.29 MMT CO_2e. This improvement would equate to a 23% reduction in emissions for that subsector if existing conditions remain unchanged.

Performance Metrics

The primary performance metric for this measure will be to track the annual consumption GWh of energy used by the upgraded building components in residential buildings, compared with that of building components today. These reductions in energy use will lead to a reduction in carbon emissions (MT of CO_2) that are emitted while generating the electricity needed to power these building components.

Weatherization programs for residential buildings.

GHG and Co-Pollutant Methodology

This measure was evaluated using manual calculations in combination with GLIMPSE output. We started with an estimate of the total residential energy use in Tennessee provided by the GLIMPSE model in calendar years 2030 (6.39 E10 kWh) and 2050 (6.25 E10 kWh). We assumed that residential energy use was constant from 2025 to 2030, and we used linear interpolation between 2030 and 2050 to establish values for the intervening years.

We developed a measure implementation schedule based on an estimate provided by the Knoxville Utilities Board that weatherization and energy-efficient products can decrease energy consumption 16% yearly. We assumed that the effectiveness of the measure would ramp up linearly from a 5% reduction in 2025, to 8% reduction in 2030, and finally to the target 16% reduction in 2040 after which it would remain constant to 2050.

We used GLIMPSE output in GWh obtained through the evaluation of residential energy-efficient product use discussed above to determine the annual percentage of electricity saved that was associated with non-weatherization measures. Using the implementation % goal as the reference, we determined the difference of power savings that could be achieved through weatherization as the difference between the two for each year. The resultant annual energy savings were then converted to mass emissions using eGRID factors.

Results

Table B.1.12 provides the total CO_2e emissions that would be reduced for 2025 to 2030 and 2025 to 2050.

	2025 to 2030 (MMT CO_2e)	2025 to 2050 (MMT CO_2e)
Avoided Emissions	-2.1	-21.9

Table B.1.12 CO_2e Reduction Measure Estimates in MMT CO_2e

Table B.1.13 provides the total co-pollutant emissions that would be reduced for 2025 to 2030 and 2025 to 2050.

	2025 to 2030 (Tons)	2025 to 2050 (Tons)
Sulfur Dioxide (SO_2)	-1,510	-15,413
Nitrogen Oxides (NO_x)	-1,024	-10,457

Table B.1.13. Co-Pollutant Reduction Measure Estimates in Tons

Discussion

Full implementation of this measure by 2050 would be a reduction of an average 0.88 MMT of CO_2e each year. The Residential Electricity Consumption subsector baseline (calendar year 2019) accounts for 10.29 MMT CO_2e. This improvement would equate to a 9% reduction in emissions for that subsector.

Performance Metrics

The primary performance metric for this measure will be to track the annual consumption of electricity at the residential level before and after weatherization measures have been taken. These reductions in energy use will lead to a reduction in carbon emissions (MT of CO_2) that are emitted while generating the electricity needed to power these building components.

Electricity Distribution Upgrades

Upgrading electricity distribution.

GHG Methodology

A calculation utilizing the Tennessee 2019 baseline data included in the SIT[50] Electricity Consumption module version 2023.2 was completed to estimate the potential emission reductions that can be gained by increasing transmission line efficiencies. The following assumptions were made to complete the calculation:

- Transmission improvements apply to all sectors (residential, commercial, industrial),
- The 2019 SIT default electricity emission factor of 0.7 lb CO_2e/kWh is constant for 2025 to 2050,
- The 2019 SIT default electricity consumption is constant for 2025 to 2050, and
- The business-as-usual (BAU) case includes utilizing the 2019 SIT default transmission loss factor of 5.10% will stay constant for 2025 to 2050.

The measure assumes the transmission lines would have a 0.5% to 4.0% improvement of the BAU transmission loss factor (5.10%). The transmission loss factor with the improvement is calculated using the equation below. Table B.2.1 displays the improvement % and corresponding transmission loss factor with improvements.

$$Transmission\ Loss\ Factor\ with\ Improvements\ (\%) = 5.10\% \times (1 - \%\text{improvement})$$

% Improvements	Transmission Loss Factor (w/ Improvements)
0.5%	5.075%
1.0%	5.049%
1.5%	5.024%
2.0%	4.998%
2.5%	4.973%
3.0%	4.947%
3.5%	4.922%
4.0%	4.896%

Table B.2.1. Transmission Loss Factor with Improvements

[50] "State Inventory and Projection Tool | US EPA." *US EPA*, 30 June 2017, https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool.

The BAU emissions were calculated utilizing the SIT electricity consumption module default 2019 transmission loss factor of 5.10% in the SIT module.

The Alternative Transmission Loss emissions were calculated for each % improvement listed in Table B.2.1 by entering the Transmission Loss Factor with improvements was entered into the "EF Selection" Tab of the SIT module. Total electricity consumption emissions were pulled from the SIT module's summary sheet for 2019, and the avoided emissions were calculated by subtracting the Alternative Transmission Loss Emissions from the BAU. Emissions for 2025 to 2030 and 2025 to 2050 were calculated by multiplying the annual avoided emissions by 5 years and 25 years, respectively. Table B.2.2 shows the avoided emissions for each improvement.

Business-as-Usual		Alternative Transmission Loss		Avoided Emissions		
Transmission Loss Factor %	Electricity Consumption Emissions (MMT CO_2e)	% Improvement	Electricity Consumption Emissions (MMT CO_2e)	Annual Avoided Emissions (MMT CO_2e)	2025 - 2030 (MMT CO_2e)	2025 - 2050 (MMT CO_2e)
5.10%	33.611	0.5%	33.602	0.009	0.05	0.23
		1.0%	33.593	0.018	0.09	0.45
		1.5%	33.584	0.027	0.14	0.68
		2.0%	33.575	0.036	0.18	0.90
		2.5%	33.566	0.045	0.23	1.13
		3.0%	33.557	0.054	0.27	1.35
		3.5%	33.548	0.063	0.32	1.58
		4.0%	33.539	0.072	0.36	1.80

Table B.2.2. Avoided Emissions for Transmission Improvement

Co-Pollutant Methodology

To model the co-pollutants, the EPA eGRID Power Profiler for SRTV (SERC Tennessee Valley)[51] emission factors for SO_2 (0.594 lb/MWh) and NO_x (0.403 lb/MWh) were utilized. Additionally, the 2019 SIT default electricity emission factor of 0.7 lb. CO_2e/kWh was utilized to convert the CO_2e reductions for 2025 to 2050 and 2025 to 2050 into electricity

[51] "Power Profiler | US EPA." *US EPA*, 23 July 2021, https://www.epa.gov/egrid/power-profiler#/SRTV. Accessed 30 January 2024.

reductions (MWh). The electricity reductions were multiplied by the emission factors to calculate the co-pollutant emission reductions, included in Table B.2.4.

Results

Table B.2.3 provides the total CO_2e emissions that would be preserved for 2025 through 2030 and 2025 through 2050. The values reflected represent the maximum estimates.

	2025 to 2030 (MMT CO_2e)	2025 to 2050 (MMT CO_2e)
Avoided Emissions	-0.4	-1.8

Table B.2.3. CO_2e Reduction Measure Estimates in MMT CO_2e

	2025 to 2030 (Tons)	2025 to 2050 (Tons)
Sulfur Dioxide (SO_2)	-335	-1,675
Nitrogen Oxides (NO_x)	-227	-1,137

Table B.2.4. Co-Pollutant Emission Reduction Estimates in Tons

Discussion

Full implementation of this measure would be a 4% improvement of the transmission loss factor, which would reduce an average of 0.07 MMT of CO_2e each year. The Electricity Transmission and Distribution subsector baseline (calendar year 2019) accounts for 0.11 MMT CO_2e. This improvement would equate to a 65% reduction in emissions for that subsector.

Performance Metrics

Performance metrics for this measure will be the rates at which the transmission loss factor is improved across the state. The electricity consumption and transmission loss factors can be updated on an annual basis to provide a more refined estimate of reductions.

Land Use Enhancement

Reduce deforestation by implementing sustainable land use practices, protecting forests.

GHG Methodology

A first-order linear approximation based on carbon flux data included in the SIT[52] Land Use, Land Use Change and Forestry module was utilized to estimate the potential emission reductions that can be gained by maintaining forest lands in Tennessee.

The emissions and removals from "forests remaining forest" (FRF) in Tennessee from 1990-2020 is located in the *FRF Carbon Flux* tab of the Land Use, Land Use Change and Forestry SIT Module. This information is sourced from US Forest Service report, "Greenhouse Gas Emissions and Removals from Forest Land, Woodlands, and Urban Trees in the United States, 1990-2020" (US Forest Service Report 1990 -2020).

The emissions and removals from FRF in Tennessee from 1990-2020 were graphed in Figure B.3.1 according to several storage pools: aboveground biomass, belowground biomass, deadwood, litter, and soil organic carbon. Each carbon pool is described below.[53] Note that the Y-axis in Figure B.3.1 depicts negative values that indicate that these storage pools remove carbon from the atmosphere.

- Aboveground biomass—all living biomass above the soil including stem, stump, branches, bark, seeds, and foliage. This pool includes living understory.
- Belowground biomass—all living biomass of coarse living roots with diameters greater than 2 millimeters.
- Dead wood—all nonliving woody biomass either standing, lying on the ground (but not including litter), or in the soil.
- Litter—all duff, humus, and fine woody debris above the mineral soil, including woody fragments with diameters of up to 7.5 centimeters.
- Soil organic carbon (SOC)—all organic material in soil to a depth of 1 meter but excluding the coarse roots of the belowground pools.

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[52] "State Inventory and Projection Tool | US EPA." *US EPA*, 30 June 2017, https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool.

[53] US Forest Service, "Greenhouse Gas Emissions and Removals from Forest Land, Woodlands, and Urban Trees in the United States, 1990-2019" https://www.fs.usda.gov/nrs/pubs/ru/ru_fs307.pdf, accessed January 26, 2024.

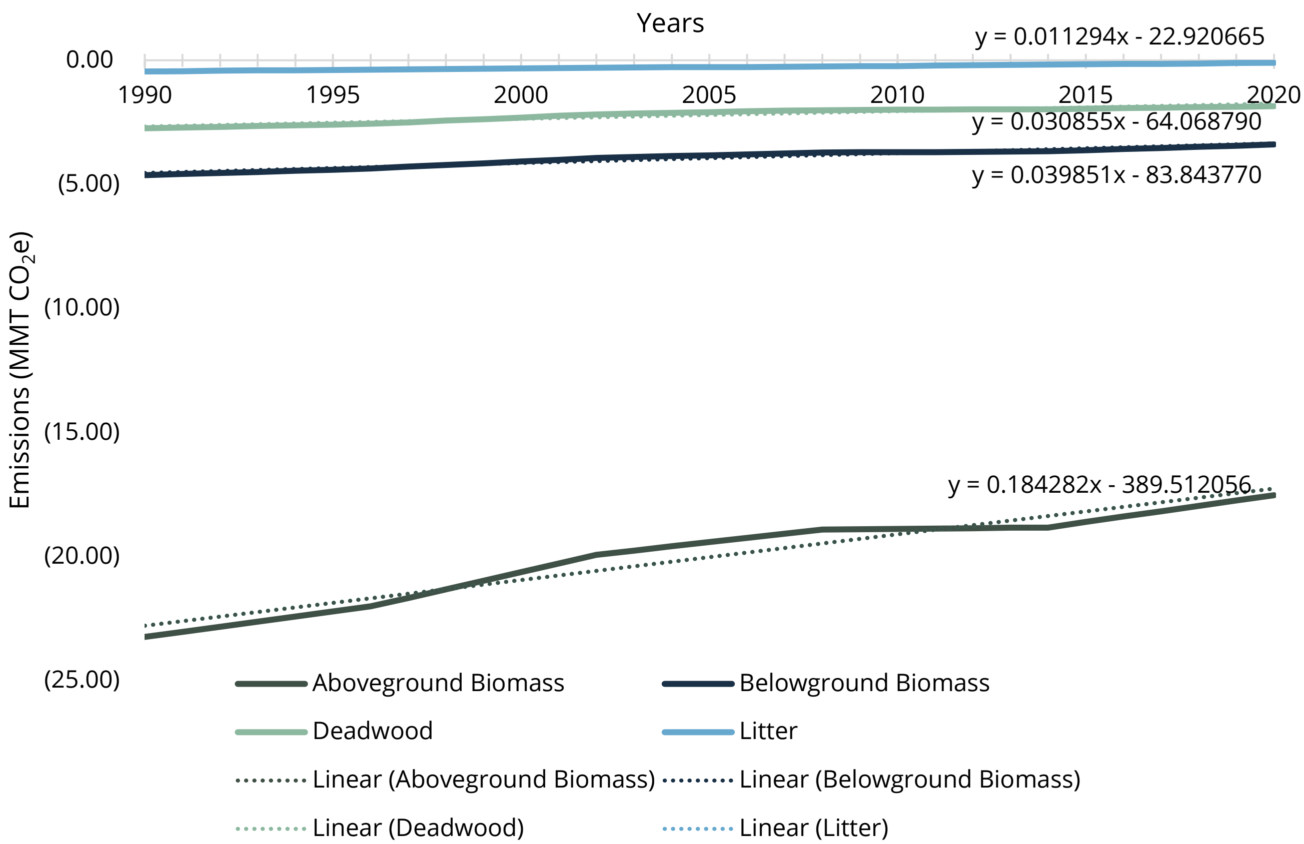

Figure B.3.1. Emissions and Removals from Forests Remaining Forest in TN, 1990-2020 (MMT CO_2e)

Linear trendlines, identified in Table B.3.1 for each carbon pool were developed based on the graphed data. Soil (mineral) was consistent over 1990 – 2020, so an average was utilized instead. Soil Organic and Drained Organic Soil data was not available in the US Forest Service Report 1990 -2020.

Carbon Pool	Trendline
Aboveground Biomass	y = 0.184282x - 389.512056
Belowground Biomass	y = 0.039851x - 83.843770
Deadwood	y = 0.030855x - 64.068790
Litter	y = 0.011294x - 22.920665
Soil (Mineral)	Average of 1990 - 2020
Soil (Organic)	NA
Drained Organic Soil	NA

Table B.3.1. Carbon Flux Linear Trendline Equations

For 2025 through 2050, carbon flux was calculated as follows and displayed in Table B.3.2:

- The BAU condition indicates the carbon flux decreases overtime as the forest degrades. This was calculated utilizing the trendline equations listed in Table B.3.1. All carbon pools were summed to obtain a single total Tennessee carbon flux.
- The Alternate Carbon Flux emissions indicate the carbon flux of the forest remaining forest if conserved and maintained with similar conditions as what occurred in 2019. This was calculated utilizing the Baseline GHG inventory (calendar year 2019) data from the US Forest Service Report 1990 -2020. All carbon pools were summed for a single total Tennessee carbon flux.

The annual emission avoidance was calculated by subtracting the Alternative Carbon Flux values from the BAU values. Essentially, the annual emission avoidance indicates the amount of carbon that would be released as forest degrades or is converted from forest land if not conserved and maintained in similar conditions to 2019.

Date	Business-as-Usual Carbon Flux (MMT CO_2e)	Alternate Carbon Flux (MMT CO_2e)	Emission Avoidance (MMT CO_2e)
2025	-21.32	-23.34	-2.02
2026	-21.06	-23.34	-2.28
2027	-20.79	-23.34	-2.55
2028	-20.53	-23.34	-2.81
2029	-20.26	-23.34	-3.08
2030	-19.99	-23.34	-3.35
2031	-19.73	-23.34	-3.61
2032	-19.46	-23.34	-3.88
2033	-19.19	-23.34	-4.15
2034	-18.93	-23.34	-4.41
2035	-18.66	-23.34	-4.68
2036	-18.40	-23.34	-4.94
2037	-18.13	-23.34	-5.21
2038	-17.86	-23.34	-5.48
2039	-17.60	-23.34	-5.74
2040	-17.33	-23.34	-6.01
2041	-17.06	-23.34	-6.28

Date	Business-as-Usual Carbon Flux (MMT CO_2e)	Alternate Carbon Flux (MMT CO_2e)	Emission Avoidance (MMT CO_2e)
2042	-16.80	-23.34	-6.54
2043	-16.53	-23.34	-6.81
2044	-16.26	-23.34	-7.08
2045	-16.00	-23.34	-7.34
2046	-15.73	-23.34	-7.61
2047	-15.47	-23.34	-7.87
2048	-15.20	-23.34	-8.14
2049	-14.93	-23.34	-8.41

Table B.3.2. Annual Emission Avoidance for Reduction Measure

Co-Pollutant Methodology

Wildfires are the worst-case scenario for modeling co-pollutants for this reduction measure. It can be assumed that preserving the forest would include preventing wildfires. Similarly, if under the BAU scenario, forest areas are removed and converted to other land uses, the worst-case outcome is that 100% of the converted forest is burned. While woodland carbon can be sequestered effectively as biochar, lumber, or material goods, this PCAP analysis presents a worst-case analysis.

To calculate the worst-case co-pollutant emissions of this measure, US EPA AP-42 Chapter 13.1, Table 13.1-2 Southern (Region 8) emission factors were utilized. In general, particulate matter from wildfires can span the range from fine to coarse. However, the finer particulate matter is the more harmful to human health. Therefore, as a conservative assumption, it is assumed that PM equals $PM_{2.5}$. The acreages preserved by the reduction measure discussed above (2025 to 2030 preserves an estimated 85,000 acres forest and 2025 to 2050 preserves an estimated 864,000 acres) were multiplied by the emission factors. This results in the co-pollutant reductions included in Table B.3.4.

Results

Table B.3.3 provides the total CO_2e emissions that would be preserved for 2025 through 2030 and 2025 through 2050.

	2025 to 2030 (MMT CO_2e)	2025 to 2050 (MMT CO_2e)
Avoided Emissions	-12.7	-130.3

Table B.3.3. CO_2e Reduction Measure Estimates in MMT CO_2e

Utilizing the Conversion Factor of -150.79 metric tons CO_2/acre/year preserved from conversion to cropland as the worst-case scenario, the 2025 to 2030 emission reduction of 12.7 MMT CO_2e, equates to approximately 85,000 acres of preserved forest (about 133 square miles). For 2025 to 2050, the emission reduction of 130.3 MMT CO_2e, equates to approximately 864,000 acres of preserved forest (approximately 1,350 square miles).

	2025 to 2030 (Tons)	2025 to 2050 (Tons)
Nitrogen Oxides (NO_x)	-1,508	-15,416
Carbon Monoxide (CO)	-53,149	-543,431
Respirable Particulate Matter (PM)	-7,916	-80,936

Note: Emission Factors from US EPA AP-42 Chapter 13.1, Table 13.1-2
NOx: 40 kg/ha
CO: 1410 kg/ha
PM: 210 kg/ha

Table B.3.4. Co-Pollutant Emission Estimates in Tons

Discussion

EPA provides the following Greenhouse Gas Equivalence conversion factors[54]:

> *Conversion Factor for Carbon Sequestered by 1 Acre of Forest Preserved from Conversion to Cropland = -150.79 metric tons CO_2/acre/year. This means that 150.79 metric tons CO_2 is prevented from being emitted to the atmosphere for every acre of forest that is not converted to cropland or any other end-use that results in the carbon in that acre of forest being oxidized to CO_2.*

As a worst-case estimate (meaning 100% of the converted forest is oxidized in that year), 150.79 metric tons CO_2 will be released per acre converted to cropland per year. As shown in Table B.3.2, during the initial 5-year period from 2025 through 2029, the average benefit of this measure would be retention of about 2.55 MMT CO_2e of carbon sink annually. Based

[54] "Greenhouse Gas Emissions and Removals From Forest Land, Woodlands, and Urban Trees in the United States, 1990 -2019 | USDA." *USDA*, April 2021, https://www.fs.usda.gov/nrs/pubs/ru/ru_fs307.pdf. Assessed 26 January 2024.

on the referenced quantity of CO_2 that would be released from converting one acre of forest to non-forest use (150.79 MT CO_2/acre), the estimated area of forest that this measure aims to preserve is about 17,000 acres.

Additionally, the Forest Land Remaining Forest Land subsector baseline (calendar year 2019) accounts for a carbon sink of 29.42 MMT CO_2e. Full implementation of this measure by 2050 would result in an average of 5.21 MMT of CO_2e avoided each year. If full implementation is not completed, there would be an 18% decrease in the carbon sink of this sector (i.e., an increase in 18% of CO_2e emissions).

Performance Metrics

The main performance metrics for this measure will be the conserving the forest in similar conditions as of the 2019 Baseline included in the US Forest Service Report 1990 -2020. The actual conservation rates on an annual basis can be updated to refine first-order linear approximation. Additionally, conservation rates can be further assessed with the EPA Greenhouse Gas Equivalence conversion factors.

Transportation Sector Electrification

Programs to increase the share of state and local government fleets of light-duty electric vehicles.

GHG and Co-Pollutant Methodology

This measure focuses on the emission benefits associated with converting the existing fossil-fuel internal combustion engine (ICE) light-duty vehicle (LDV) municipal fleets operated by state and local governments to EVs over the period 2025 to 2050. The methodology estimated the net change in emissions associated with eliminating ICE LDV exhaust emissions but increasing electricity generation emissions associated with charging EV batteries.

This analysis was performed using the US EPA's Avoided Emissions and Generation Tool Version 4.2 (AVERT). AVERT can be used to evaluate the impacts of energy policy scenarios at the state level. A Regional Data File provided with AVERT reflects the eGRID non-baseload mix of electricity generation. This 2022 data reflects the generation mix within the SERC Tennessee Valley subregion, of which Tennessee is a part.

In addition to the selected baseline generation mix (which for purposes of the PCAP has been assumed to remain unchanged through calendar year 2050), input variables for evaluation of this measure include:

- The number of ICE LDV that will be replaced by EV. The future population of state and local government EVs was estimated from a detailed inventory provided by the City of Chattanooga, as explained below. Using that inventory and the estimated population of the county, a relationship between fleet EVs and population was established. That same relationship was then applied to project statewide population estimates to arrive at the number of state and local governmental EVs that the measure would aim to convert over time as shown in Table B.4.1.
- When the EV replacements will occur. Two different rates were established for the phase-in of EVs: one for the period 2026 through 2030 and another for the period 2031 through 2040. These phase-in periods were based on information provided by the City of Chattanooga where the objective was to replace 80% of the fleet by 2030 and the remaining 20% by 2040 after which the number of EVs would remain constant through 2050. To develop those rates, the Chattanooga implementation schedule was compared to annual population estimates for each year and an average ratio was derived. That same ratio was then applied to the state-wide population estimates by year to derive the annual EV conversion rate.
- What percentage of EVs will be trucks and what percentage will be passenger vehicles (including cars, vans, and SUVs). The City of Chattanooga provided a comprehensive inventory of about 1,300 vehicles. That information was reviewed and sorted to identify LDV and the percentage that are LDV trucks vs. passenger vehicles (cars, SUVs, and vans). Vehicles that were designated for replacement prior to calendar year 2025 were removed. The final collection of 836 vehicles was evaluated to determine the relative percentages of trucks (19% overall) and non-trucks (81%). The same relative percentage of LDV trucks and non-trucks was assumed to apply to state and local governments.
- What percentage of cars and trucks will be battery EVs and what percentage will be plug-in hybrids. In all cases, we assume that all conversions will be

split evenly between plug-in hybrids (50%) and battery EVs (50%) and that once converted, all vehicles will remain that style of EV for the duration.

The following table summarizes the projected fleet conversion rates based on the assumptions stated above.

Year Beginning[55]	Hamilton Co. Chattanooga EV Count	Hamilton County Population	County EV per capita	TN Census	State-wide Fleet EV
2025	134	*382,014*	0.00035	7,073,125	7,272
2026	268	*385,176*	0.000695	7,134,627	7,336
2027	401	*388,337*	0.001034	7,196,129	7,399
2028	535	*391,499*	0.001367	7,257,630	7,462
2029	669	*394,660*	0.001695	7,319,132	7,525
2030	686	*397,822*	0.001724	7,380,634	7,588
2031	702	*401,256*	0.001751	7,418,989	13,710
2032	719	*404,690*	0.001777	7,457,344	13,781
2033	736	*408,125*	0.001803	7,495,700	13,852
2034	753	*411,559*	0.001828	7,534,055	13,923
2035	769	*414,994*	0.001854	7,572,410	13,993
2036	786	*418,428*	0.001878	7,610,765	14,064
2037	803	*421,862*	0.001903	7,649,120	14,135
2038	819	*425,297*	0.001926	7,687,476	14,206
2039	836	*428,731*	0.00195	7,725,831	14,277
2040	836	*432,166*	0.001934	7,764,186	14,348

Table B.4.1. Modeled Yearly Increase in LDV EVs

AVERT was used to develop a relationship between the number of EVs replaced and the corresponding change in GHG emissions. The AVERT options used to develop this relationship were:

- AVERT's analysis is limited to EV model years 2023 through 2028. For this evaluation, Model Year 2028 was selected for each year evaluated.

[55] Data is shown only to calendar year 2040 because we assume no changes to the EV population after that date through 2050.

- In all cases, it was assumed that EVs replaced existing ICE vehicles.
- It is assumed to 100% of the miles that would have been driven by ICE vehicles are driven by EVs.

AVERT modeling output also provided information about co-pollutant emissions as summarized. As shown, the net effect of replacing ICE LDV with EVs varies by pollutant. For NO_x, VOC, and NH_3, the elimination of ICE exhaust results in a decrease in emissions. However, as shown below for SO_2 and $PM_{2.5}$, the increased use of electricity for the charging of EV batteries contributes to an increase in these pollutants. This is based on the generating mix assumed by the default eGRID data used to characterize BAU reference case.

Results

Results of the AVERT modeling are summarized in Tables B.4.2 and B.4.3. As shown, the net effect of replacing ICE LDV with EVs is a reduction in CO_2 emissions. For the 5-year period ending 2025 through 2029, it is estimated that 81,304 metric tons of CO_2 would be avoided. For the 25-year period ending 2050, the total emissions avoided would increase to 690,103 metric tons CO_2. In AVERT, all avoided emissions are from CO_2.

	2025 – 2030 (MMT CO_2e)	2025 – 2050 (MMT CO_2e)
Avoided Emissions	-0.1	-0.7

Table B.4.2. CO_2 Reduction Measure Estimates in MMT CO_2e

The effect of replacing ICE LDV with EVs on co-pollutants varies by pollutant. For NO_x, VOC, and NH_3, the elimination of ICE exhaust results in a decrease in emissions. However, as shown below for SO_2 and $PM_{2.5}$, the increased use of electricity for the charging of EV batteries contributes to an increase in these pollutants. This is based on the generating mix assumed by the default eGRID data used to characterize the business-as-usual reference case.

	2025 to 2030 (Tons)	2025 to 2050 (Tons)
Sulfur Dioxide (SO_2)	16	140
Nitrogen Oxides (NO_x)	-31	-262
Respirable Particulate Matter ($PM_{2.5}$)	2	17
Volatile Organic Compounds (VOC)	-96	-816
Ammonia (NH_3)	-17	-142

Table B.4.3. Co-Pollutant Reduction Measure Estimates in Tons

Notes: Positive values indicate that emissions of the pollutant will be increased by the measure.

Discussion

The US EPA greenhouse gas calculator[56] was used to test the viability of the AVERT modeling evaluation using the maximum fleet EV estimate for calendar year 2040 of 14,348 vehicles. According to the calculator, operating 14,348 gasoline-powered vehicles for one year generates approximately 64,477 MT of CO_2e[57]. An AVERT model run reflecting the use of 100% battery EVs (no plug-in hybrids which also use ICE engines) resulted in a reduction of 59,350 MT CO_2 (not accounting for the increased electric power emissions). AVERT only calculates emissions reduced for CO_2. This result is within 10% of the EPA calculator estimate, which provide high confidence in the AVERT modeling results.

Additionally, full implementation of this measure by 2050 would result in a reduction of an average 0.03 MMT of CO_2e each year. The light-duty cars and light-duty trucks subsectors baseline (calendar year 2019) accounts for 23.51 MMT CO_2e. This improvement would equate to a 0.123% reduction in emissions for the subsector.

Performance Metrics

Performance metrics for this measure will be the rates at which ICE LDV are actually retired and converted to EV within each of the local governments or at the state level.

[56] "Greenhouse Gas Equivalencies Calculator | US EPA." *US EPA*, 28 August 2015, https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

[57] EPA guidance indicates that this estimate is based on an assumed 11,520 miles travelled annually and an average fuel efficiency of 22.9 mpg.

Programs to expand community electric vehicle charging infrastructure.

GHG & Co-Pollutant Methodology

The emissions benefits of a future electric vehicle charging infrastructure were estimated using a spreadsheet tool developed by the Argonne National Laboratory AFLEET[58]. The AFLEET tool was used to estimate the emissions benefit of expanding Tennessee's electric vehicle charging infrastructure for both level 2 (L2) and direct current fast charge (DC) infrastructure.

Drive Electric Tennessee[59] conducted a statewide electric vehicle charging infrastructure needs assessment with a projection year of 2028. The number of charging ports from the Drive Electric Tennessee Electric Vehicle Charging Needs Assessment[60] were allocated to the categories in AFLEET as indicated in Table B.4.5.

Location	Charger Type and of Number Ports	
	Level 2	DC Fast Charge
Parking Lot	91	692
Multi-Unit	--	49
Retail & Leisure	--	158
Total	91	899

Table B.4.5. Estimated Needs Assessment EV Charging Port Mapping to AFLEET

The emissions output from AFLEET reflects the benefit of the use of EVs instead of ICE LDVs. The emissions from ICE LDVs are offset by the use of EVs and their associated electricity generation emissions. Based on predictions of EV growth by the US EIA,[61] there

[58] "AFLEET Tool – Argonne National Laboratory." Argonne National Laboratory, https://afleet.es.anl.gov/home/.
[59] "Drive Electric Tennessee." Tennessee State Government – TN.Gov, https://www.tn.gov/environment/program-areas/energy/state-energy-office--seo-/programs-projects/programs-and-projects/sustainable-transportation-and-alternative-fuels/sustainable-transportation-and-alternative-fuels/drive-electric-tennessee.html. Accessed 30 January 2024.
[60] "Drive Electric Tennessee - Electric Vehicle Charging Needs Assessment." *Tennessee State Government – TN.Gov*, https://www.tn.gov/content/dam/tn/environment/energy/documents/DET%20Tennessee%20EVSE%20Needs%20Assessment%20-%20Presentation%20Slides.pdf. Accessed 30 January 2024.
[61] "Electric Vehicles Expected to Comprise 31% of the Global Fleet by 2050." Global Fleet Management, https://www.globalfleetmanagement.com/10159371/electric-vehicles-expected-to-comprise-31-of-the-global-

will be growth from 2031 to 2050 of an additional 31% over the 2030 charger population. These estimates are assumed to be cumulative over time. Additionally, it is assumed that there is no change in the electricity generation mix over time.

Results

Emissions benefit for the timeframes of 2025 to 2030 and 2025 to 2050 are contained in Table B.4.6 below.

	2025 to 2030 (MMT CO_2e)	2025 to 2050 (MMT CO_2e)
Avoided Emissions	-0.01	-0.1

Table B.4.6. CO2e Reduction Measure Estimates in MMT CO_2e

The co-pollutants emission reductions were modeled in AFLEET and are included in Table B.4.7.

	2025 to 2030 (Tons)	2025 to 2050 (Tons)
Nitrogen Oxides (NO_x)	-2	-14
Volatile Organic Compounds (VOC)	-8	-68

Table B.4.7. Co-Pollutant Emission Estimates in Tons

Discussion

Full implementation of this measure by 2050 would result in an average reduction of 0.005 MMT of CO_2e each year. The light-duty cars and light-duty trucks subsectors baseline (calendar year 2019) accounts for 23.51 MMT CO_2e. This improvement would equate to a 0.02% reduction in emissions for the subsector.

Performance Metrics

Performance metrics for this measure will be the rates at which the number of charging stations are installed or commissioned annually across the state.

fleet-by-2050#:~:text=One%20percent%20per%20year%20until,fleet%20EVs%20on%20the%20road. Accessed 30 January 2024.

Programs to increase the share of electric medium- and heavy-duty vehicles, including buses.

GHG Methodology

This measure was evaluated using the GLIMPSE model which includes medium and heavy trucks with the following five technology types: (1) Battery Electric Vehicles (BEV), (2) Fuel Cell Electric Vehicles (FCEV), (3) Hybrid Liquids, (4) Liquids, and (5) Natural Gas vehicles. In the default GLIMPSE reference scenario (i.e., baseline), BEVs and FCEVs are 7% of medium and heavy trucks in 2030 and 34% of medium and heavy trucks in 2050. In both 2030 and 2050, the EV share is higher for medium trucks than heavy trucks. The GLIMPSE model also includes buses with the following five technology types: (1) BEV, (2) FCEV, (3) Hybrid Liquids, (4) Liquids, and (5) Natural Gas. In the default GLIMPSE reference scenario (i.e., baseline), BEVs and FCEVs are 25% of buses in 2030 and 52% of buses in 2050.

Specifically, full electrification of medium trucks, heavy trucks, and buses was modeled, and the results were scaled to reached desired share in each year. This measure was modeled by increasing the share of medium and heavy trucks that are EVs by 1 percentage point in 2030 and 10 percentage points in 2050 plus increasing the share of buses that are EVs by 1 percentage point in 2030 and 10 percentage points in 2050. The targeted share increases for years between 2030 and 2050 were linearly interpolated. GLIMPSE provides results at 5-year increments from 2025 to 2050. To get annual results for years between the 5-year increments, the analysis linearly interpolated the results.

Co-Pollutant Methodology

GLIMPSE also provides co-pollutant reduction results at 5-year increments. To get annual results for years between the 5-year increments, the analysis linearly interpolated the results.

Results

Table B.4.8 provides the total CO_2e emissions that would be reduced for 2025 to 2030 and 2025 to 2050.

	2025 to 2030 ($MMT\ CO_2e$)	2025 to 2050 ($MMT\ CO_2e$)
Avoided Emissions	-0.4	-12.4

Table B.4.8. CO2e Reduction Measure Estimates in MMT CO_2e

Table B.4.9 provides the total co-pollutant emissions that would be reduced for 2025 to 2030 and 2025 to 2050.

	2025 to 2030 (Tons)	2025 to 2050 (Tons)
Sulfur Dioxide (SO_2)	-<0.05	-1,320
Nitrogen Oxides (NO_x)	-35,496	-259,259
Respirable Particulate Matter ($PM_{2.5}$)	-<0.05	-2,420
Volatile Organic Compounds (VOC)	-2,240	-7,804

Table B.4.9. Co-Pollutant Reduction Measure Estimates in Tons

Discussion

Full implementation of this measure by 2050 would result in a reduction of an average 0.5 MMT of CO_2e each year. The Heavy Duty Trucks and Heavy Duty Buses subsectors baseline (calendar year 2019) accounts for 10.44 MMT CO_2e. This improvement would equate to a 5% reduction in emissions for the subsector.

Performance Metrics

Performance metrics for this measure will be the rates at which ICE medium- and heavy-duty vehicles are retired and converted to EVs in TN.

Waste Management Enhancement

Programs and incentives to reduce or divert waste, including food and/or yard waste.

GHG Methodology

EPA's Waste Reduction Model (WARM) Version 16 was used to estimate the potential emission reductions from programs and incentives to reduce or divert food waste. Specifically, it was used to estimate the benefit of an increase in composting, anaerobic digestion, and food diversion over landfilling food waste. The following assumptions were used to develop this methodology:

- In the United States as of 2018, per capita total municipal solid waste (MSW) generation was 4.90 lb/day, total MSW generation was 292.36 million tons, and total food waste generation was 63.13 million tons.[62] It was assumed that per capita MSW generation in Tennessee would equal this rate and remain constant for the period 2025 to 2050.
- The population of Tennessee for the years 2025 to 2050 was estimated using EPA's SIT[63].
- For the base modeling year (2025), it was assumed that all material solid waste was landfilled.
- The percentage of food diversion, composting, and anaerobic digestion was increased from the base year based on a proposed schedule detailed in Table B.5.1.
- The maximum percentage of each waste reduction or diversion of total MSW was assumed as follows:
  - Food Diversion 5%,
  - Composting 30%, and
  - Anaerobic Digestion 10%.
- It was assumed that once these maximum percentages were reached, they would stay constant for all future years.
- In EPA's WARM, all food waste was entered under the "Food Waste" category. The baseline case for each run assumed that all food waste generated was landfilled. The alternative case followed the schedule set in Table B.5.1.
- In EPA's WARM, the following was selected and/or assumed:
  - Tennessee was selected as the state.
  - Current mix was assumed for the materials that are reduced. This option assumes the current mix of virgin and recycled inputs.
  - The use of landfill gas recovery was assumed to be aligned with the national average.
  - Landfill gas that was recovered was assumed to be flared.

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[62] "Advancing Sustainable Materials Management: 2018 Fact Sheet | US EPA." *US EPA*, December 2020, https://www.epa.gov/sites/default/files/2021-01/documents/2018_ff_fact_sheet_dec_2020_fnl_508.pdf.
[63] "State Inventory and Projection Tool | US EPA." *US EPA*, 30 June 2017, https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool.

    - Landfill gas recovery control efficiency was assumed to follow typical landfill operation.
    - The wet moisture condition was selected. Based on data from the National Centers for Environmental Information and the National Oceanic and Atmospheric Administration[64], Tennessee averaged 4.84 inches of rain per month from 2012 to 2022. This results in an estimated annual rainfall of 58.08 inches per year for that time period. Based on WARM guidance, any rainfall greater than 40 inches per year falls in the wet moisture condition category.
    - It was assumed that the wet digestion process was used for anaerobically digested waste.
    - It was assumed that all digestate resulting from anaerobic digestion was cured. This represents the default option in WARM.
    - Distances for the transportation of materials to the management facility were assumed to be default given the number of facility locations that exist in the state of Tennessee.
- EPA's WARM uses global warming potentials from Intergovernmental Panel on Climate Change 2007 Report. While the majority of the analysis uses Intergovernmental Panel on Climate Change 2014 Report, it was assumed that using the 2007 value was conservative. Methane's global warming potential in 2007 is 25, while in 2014 it is 28.65. Since the primary driver of landfill emissions is methane, using the 2007 value would conservatively under-report CO_2e emissions.

Manual Calculations

Table B.5.1 details the implementation of the programs targeting increases in food diversion, composting, and anaerobic digestion of food waste. Table B.5.1 also assigns the amount of food waste generated in Tennessee on an annual basis. The model uses the equations below:

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[64] "Climate at a Glance | Statewide Time Series | National Centers for Environmental Information (NCEI)." *National Centers for Environmental Information (NCEI)*, https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/statewide/time-series.

[65] Global Warming Potential Values. https://ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf.

$$Daily\ Food\ Waste\left(\frac{\frac{lb}{person}}{day}\right) = Daily\ MSW\left(\frac{\frac{lb}{person}}{day}\right) \times \frac{Food\ Waste\ Generation}{Total\ MSW\ Generation}$$

$$Food\ Waste\left(\frac{ton}{yr}\right) = TN\ Population \times Daily\ Food\ Waste\left(\frac{\frac{lb}{person}}{day}\right)$$

Year	Food Waste (short ton/yr)	Food Diversion (%)	Composting Rate (%)	AD Rate (%)
2025	1,366,200	0	0	0
2026	1,378,079	1	5	1
2027	1,389,959	2	10	2
2028	1,405,679	3	15	3
2029	1,413,717	4	20	4
2030	1,425,597	5	25	5
2031	1,433,005	5	30	6
2032	1,444,360	5	30	7
2033	1,447,822	5	30	8
2034	1,455,230	5	30	9
2035	1,462,639	5	30	10
2036	1,474,075	5	30	10
2037	1,477,456	5	30	10
2038	1,484,864	5	30	10
2039	1,492,273	5	30	10
2040	1,503,790	5	30	10
2041	1,507,090	5	30	10
2042	1,514,498	5	30	10
2043	1,521,906	5	30	10
2044	1,533,505	5	30	10
2045	1,536,723	5	30	10
2046	1,544,132	5	30	10

Year	Food Waste (short ton/yr)	Food Diversion (%)	Composting Rate (%)	AD Rate (%)
2047	1,551,540	5	30	10
2048	1,563,220	5	30	10
2049	1,566,357	5	30	10

Table B.5.1. Programs and Incentives to Reduce or Divert Waste Implementation Schedule

Using the schedule shown in Table B.5.1, WARM runs were completed for each schedule period. The years 2035 through 2049 were modeled as one period given that the percentages of food diversion, composting, and anaerobic digestion were assumed to be constant for that period.

Table B.5.2 shows the annual CO_2e emissions for the following conditions: baseline, which assumes all MSW is landfilled; the alternative emissions, which follows the schedule detailed in Table B.5.1; and the emissions reduction esimate, which is the difference between the baseline and alternative emissions. Negative (-) emissions reductions values in Table B.5.2 represent an emissions savings.

<table>
<tr><th></th><th>Baseline Emissions (MT CO_2e)</th><th>Alternate Emissions (MT CO_2e)</th><th>Emission Reduction (MT CO_2e)</th></tr>
<tr><td>2025</td><td>726,992</td><td>726,992</td><td>0</td></tr>
<tr><td>2026</td><td>733,313</td><td>620,203</td><td>-113,110</td></tr>
<tr><td>2027</td><td>739,635</td><td>511,464</td><td>-228,170</td></tr>
<tr><td>2028</td><td>748,000</td><td>401,874</td><td>-346,126</td></tr>
<tr><td>2029</td><td>752,277</td><td>288,137</td><td>-464,141</td></tr>
<tr><td>2030</td><td>758,599</td><td>173,548</td><td>-585,051</td></tr>
<tr><td>2031</td><td>762,541</td><td>116,901</td><td>-645,640</td></tr>
<tr><td>2032</td><td>768,583</td><td>109,239</td><td>-659,344</td></tr>
<tr><td>2033</td><td>770,425</td><td>100,892</td><td>-669,534</td></tr>
<tr><td>2034</td><td>774,367</td><td>92,755</td><td>-681,613</td></tr>
<tr><td>2035</td><td rowspan="7">12,097,413</td><td rowspan="7">1,313,861</td><td rowspan="7">-10,783,551</td></tr>
<tr><td>2036</td></tr>
<tr><td>2037</td></tr>
<tr><td>2038</td></tr>
<tr><td>2039</td></tr>
<tr><td>2040</td></tr>
<tr><td>2041</td></tr>
</table>

	Baseline Emissions ($MT\ CO_2e$)	Alternate Emissions ($MT\ CO_2e$)	Emission Reduction ($MT\ CO_2e$)
2042			
2043			
2044			
2045			
2046			
2047			
2048			
2049			

Table B.5.2. Programs and Incentives to Reduce or Divert Waste CO_2e Reductions

Co-Pollutant Methodology

By implementing the waste reduction measure, the amount of waste sent to landfills each year in Tennessee can be reduced. This has the added benefit of reducing the worst-case potential co-pollutant emissions from waste management practices relating to the flaring of landfill gas. The flaring of landfill gas releases NOx, CO, and PM emissions. The total co-pollutant emissions savings would be the potential emissions release from the flaring of landfill gas created by waste had it not been diverted from landfills to other sources. While the particle fraction has not be characterized, most of the particulate matter from gas-fired combustions is the fine particulate matter (i.e., $PM_{2.5}$). Therefore, it is assumed that PM equals $PM_{2.5}$.

To calculate the worst-case co-pollutant emissions reductions of this measure, the amount of waste avoided from entering the landfill was converted to MT methane. Utilizing the ideal gas law, the methane produce was calculated and multiplied by EPA AP-42 Chapter 2.4, Table 2.4-4 Flare emission factors. This results in the co-pollutant reductions included in Table B.5.4.

Results

Table B.5.3 provides the total CO_2e emissions that would be preserved for 2025 to 2030 and 2025 to 2050. Based on these results a total of 15.9 MMT of CO_2e over the years 2025 through 2050 could be avoided.

	2025 to 2030 (MMT CO_2e)	2025 to 2050 (MMT CO_2e)
Avoided Emissions	-1.2	-15.2

Table B.5.3. CO_2e Reduction Measure Results

As detailed in the Methodology section, WARM uses the 2007 global warming potential estimate. Given that the primary GHG pollutant for waste management is methane, the results could be estimated for 2014 by assuming all CO_2e emissions are methane. Thus, the results could be scaled by 28/25, the difference in methane global warming potentials between the 2007 and 2014 reports. This would increase the emissions savings from 2025 to 2050 by 1.8 MMT CO_2e, for estimated emissions savings of 17.0 MMT of CO_2e.

The co-pollutants emission reduction estimates are included in Table B.5.4.

	2025 to 2030 (Tons)	2025 to 2050 (Tons)
Nitrogen Oxides (NO_x)	-22	-311
Respirable Particulate Matter ($PM_{2.5}$)	-8	-120
Carbon Monoxide (CO)	-25	-137

Table B.5.4. Co-Pollutant Reduction Measure Estimates in Tons

Discussion

Upon full implementation of these waste reduction measures in 2035, this analysis indicates that an average of 0.72 MMT of CO_2e could be reduced each year. This represents an 89% reduction in CO_2e emissions from food waste in TN when compared to the landfilling of all food waste based on WARM results. In comparison to the Municipal Landfill subsector baseline (calendar year 2019) emission inventory estimate of 2.51 MMT CO_2e, the improvement equates to a 29% reduction in emissions for the subsector.

Performance Metrics

The main performance metrics for this measure will be the food diversion, composting, and anaerobic digestion rates. The actual implementation rates for these three measures can be updated in WARM to accurately estimate the emissions reductions.

Renewable Energy Enhancement

Development of renewable energy generation.

GHG Methodology

A manual calculation has been used to estimate the benefit of increased solar power capacity. The methodology uses TVA projections for future solar capacity and TDEC data regarding the emission profile of existing fossil-fueled electric generating units. The following assumptions informed this methodology:

- TVA has a stated goal of 5,000 MW solar capacity by 2030 and 10,000 MW of solar installed by 2035[66,67] (not all of this will be installed or consumed in TN, but we assume here that it will be.)
- TN solar capacity as of December 2023 was 953 MW[68]. For purposes of this estimate we assume that 1,000 MW will have been installed as of the start of 2025 (baseline).
- TVA's existing Local Power Company program is estimated to result in 2,000 MW (5%) of TVA's capacity (not all of that will be installed or consumed in TN, but for this analysis the Project Team assumes it all will be).
- This suggests that the maximum potential installed utility-scale solar in addition to the baseline and already-promoted TVA programs could be: 10,000 future (2035) – 1,000 baseline – 2,000 anyway = 7,000 MW by 2035.
- Using the same approach, we get 2,000 additional MW by 2030: 5,000 future (2030) – 1,000 baseline – 2,000 anyway = 2,000 MW by 2030.
- Projections are not currently available beyond 2035, so for this analysis the Project Team halts new installation in 2035 and just apply the CO_2 savings for subsequent years as a constant benefit against the BAU baseline generation. AVERT only calculates CO_2 emissions reductions.
- Regarding an installation schedule, the Project Team assumed that each year, 2025 through 2029 inclusive, that 400 MW of capacity will be installed.

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[66] Tennessee Valley Authority – Solar | TVA." *TVA*, 19 May 2021, https://www.tva.com/energy-system-of-the-future/solar.

[67] "Tennessee Valley Authority – Energy Storage | TVA." *TVA*, https://www.tva.com/energy/technology-innovation/energy-storage.

[68] "Solar Energy Industries Association - Tennessee Solar | SEIA." *SEIA*, https://www.seia.org/state-solar-policy/tennessee-solar.

- Further we assume that 50% of new installed capacity will come online during each year. For example, in 2025, the target install is 400 MW, but we assume that only 200 MW will be available during that year for estimation purposes.
- For the period 2030 through 2034 inclusive, we assume that 1,000 MW will be installed each year and that 50% will come online each year.
- The total installed new solar capacity attributed to this measure is 7,000 MW installed and fully operational at the beginning of calendar year 2035.

Table B.6.1 illustrates the progression of solar capacity installation by year. Also shown are estimates of the MWh of energy delivered to the electrical grid by that capacity. Two key assumptions are needed to convert solar MW capacity to MWh consumed:

- The number of hours per year that the solar array delivers power to the grid which is referred to as the capacity factor, and
- The output rating of the proposed arrays represents alternating current as required by the electricity distribution system.

The capacity factor for solar arrays is controlled by the number of hours of sunlight available each day. Capacity factors vary by geography and by season and are affected by weather and other factors. Ranges in the continental United States are from 10% (2.4 hours of sun per 24 hours in a day) up to 30% (7+ hours of sun). The U. S. annual average is about 24.2%. For this analysis, a value of 23.25% was obtained from the U. S. EPA AVERT model.

The second assumption concerns the conversion of the direct current generated by solar arrays to the alternating current required by consumers. When solar array direct current is converted to alternating current through an inverter, there is a loss of output. A common rule of thumb for this loss is 10% and that value has been applied here. Based on review of the AVERT model, it is assumed here that all MW capacities are in alternating current output so no conversion for loss of output is required.

Therefore, the equation to convert from MW capacity to MWh consumed is:

$$MWh - AC = MW - AC \ x \ 8{,}760 \, {}^{hrs}/_{yr} \ x \ CF$$

For 2025, with the assumed 200 MW of solar capacity and an assumed capacity factor of 0.2325, the result is 407,340 MWh. As discussed below, this estimate agrees favorably with the AVERT estimate of 409,490 MWh (less than 1% difference).

Year	Target Year-End Annual Solar Installed (MW-AC)	Solar Installed Capacity Year Start (MW-AC)	Solar Installed Capacity Year End (MW-AC)	Modeled Average Available Capacity for Year (MW-AC) (1)	Potential Cumulative Annual MWh (AC) Generated by Photovoltaics (2)	TN Combustion Turbine Equivalent CO_2 emissions (metric tons)(3)	TN Coal & CC Equivalent CO_2 emissions (metric tons) (4)
2025	400	0	400	200	407,340	265,168	325,574
2026	400	400	800	600	1,222,020	795,504	976,722
2027	400	800	1,200	1,000	2,036,700	1,325,839	1,627,870
2028	400	1,200	1,600	1,400	2,851,380	1,856,175	2,279,018
2029	400	1,600	2,000	1,800	3,666,060	2,386,511	2,930,166
2030	1,000	2,000	3,000	2,500	5,091,750	3,314,599	4,069,675
2031	1,000	3,000	4,000	3,500	7,128,450	4,640,438	5,697,545
2032	1,000	4,000	5,000	4,500	9,165,150	5,966,277	7,325,415
2033	1,000	5,000	6,000	5,500	11,201,850	7,292,117	8,953,285
2034	1,000	6,000	7,000	6,500	13,238,550	8,617,956	10,581,155
2035	0	7,000	7,000	7,000	14,256,900	9,280,876	11,395,090
2036	0	7,000	7,000	7,000	14,256,900	9,280,876	11,395,090
2037	0	7,000	7,000	7,000	14,256,900	9,280,876	11,395,090
2038	0	7,000	7,000	7,000	14,256,900	9,280,876	11,395,090
2039	0	7,000	7,000	7,000	14,256,900	9,280,876	11,395,090
2040	0	7,000	7,000	7,000	14,256,900	9,280,876	11,395,090
2041	0	7,000	7,000	7,000	14,256,900	9,280,876	11,395,090
2042	0	7,000	7,000	7,000	14,256,900	9,280,876	11,395,090
2043	0	7,000	7,000	7,000	14,256,900	9,280,876	11,395,090
2044	0	7,000	7,000	7,000	14,256,900	9,280,876	11,395,090
2045	0	7,000	7,000	7,000	14,256,900	9,280,876	11,395,090
2046	0	7,000	7,000	7,000	14,256,900	9,280,876	11,395,090
2047	0	7,000	7,000	7,000	14,256,900	9,280,876	11,395,090
2048	0	7,000	7,000	7,000	14,256,900	9,280,876	11,395,090
2049	0	7,000	7,000	7,000	14,256,900	9,280,876	11,395,090

Table B.6.1. Development of Renewable Energy Generation CO_2 Reductions

Notes:

(1) We assume that 50% of each year's additional capacity will be online each year.

(2) Based on an assumed 23.25% capacity factor provided by US EPA's Avoided Emissions and Generation Tool (AVERT) v4.2.

(3) Based on TDEC's analysis of existing combustion turbine emissions from calendar year 2022: average emission factor = 0.7176 tons CO_2/MWh

(4) Based on TDEC's analysis of existing coal & CC emissions from calendar year 2022: average factor = 0.8810 tons CO_2/MWh

US EPA's AVERT Model was used to inform and validate the manual calculations and to establish relationships between CO_2 emissions and other co-pollutant emissions. The key input variable discussed above, the Capacity Factor, was obtained from AVERT using the Tennessee Regional Data File. The 2025 baseline year representing 200 MW of solar installation (estimated to reflect between 366,606 and 409,490 MWh of electricity that would not be generated by the existing electricity generating unit fleet) was modeled in AVERT as solar power. Model output is shown below in MT.

Tennessee, 2022 AVERT

Output: Annual Regional Results

Click here to return to Step 4: Display Outputs

	Original	Post Change	Change
Generation (MWh)	78,816,840	78,407,350	-409,490
Heat Input (MMBtu)	669,538,770	665,927,540	-3,611,230
Total Emissions from Fossil Generation Fleet (metric tons)			
SO_2	22,380	22,270	-110
NO_X	16,570	16,480	-90
Ozone season NO_x	7,400	7,340	-50
CO_2	46,293,610	46,047,530	-246,070
$PM_{2.5}$	3,120	3,100	-20
VOCs	720	720	-10
NH_3	1,000	990	-10
AVERT-derived Emission Rates (metric tons/M\	Average Fossil		Marginal Fossil
SO2	0.000		0.000
NO_X	0.000		0.000
Ozone season NO_x	0.000		0.000
CO_2	0.587		0.601
$PM_{2.5}$	0.000		0.000
VOCs	0.000		0.000
NH_3	0.000		0.000

Select unit for emissions: metric tons

Ozone season is defined as May 1 - September 30. Ozone season emissions are a subset of annual emissions.
Negative numbers indicate displaced generation and emissions.
All results are rounded to the nearest 10. A dash ("—") indicates non-zero results, but within +/- 10 units.
When users evaluate a portfolio scenario including EVs and EE or RE, marginal fossil values are not reported and a null sign ("Ø") is shown.
Data on this page do not include changes to ICE vehicle emissions (e.g., emissions from tailpipes).

Figure B.6.1. AVERT Output in Metric Ton

Tennessee, 2022 AVERT

Output: Annual Regional Results

Click here to return to Step 4: Display Outputs

	Original	Post Change	Change
Generation (MWh)	78,816,840	78,407,350	-409,490
Heat Input (MMBtu)	669,538,770	665,927,540	-3,611,230
Total Emissions from Fossil Generation Fleet (lb)			
SO_2	49,340,290	49,102,810	-237,480
NO_X	36,522,070	36,323,950	-198,120
Ozone season NO_x	16,308,200	16,187,020	-121,190
CO_2	102,059,900,530	101,517,407,860	-542,492,830
$PM_{2.5}$	6,879,370	6,830,440	-48,930
VOCs	1,591,400	1,578,670	-12,730
NH_3	2,207,590	2,187,600	-19,990
AVERT-derived Emission Rates (lb/MWh)	Average Fossil		Marginal Fossil
SO2	0.626		0.580
NO_X	0.463		0.484
Ozone season NO_x	0.431		0.296
CO_2	1,294.900		1,324.801
$PM_{2.5}$	0.087		0.119
VOCs	0.020		0.031
NH_3	0.028		0.049

Select unit for emissions: lb

Ozone season is defined as May 1 - September 30. Ozone season emissions are a subset of annual emissions.
Negative numbers indicate displaced generation and emissions.
All results are rounded to the nearest 10. A dash ("—") indicates non-zero results, but within +/- 10 units.
When users evaluate a portfolio scenario including EVs and EE or RE, marginal fossil values are not reported and a null sign ("Ø") is shown.
Data on this page do not include changes to ICE vehicle emissions (e.g., emissions from tailpipes).

Figure B.6.2. AVERT Output in Pounds

As shown, AVERT predicts that installation of 200 MW of solar capacity will result in the decrease of annual CO_2 emissions by 246,070 MT. The AVERT estimate is less than the hand calculations shown above due to the differences in the AVERT database and the TDEC-provided emission rates (MT/MWh). The AVERT database uses an “Average Fossil” value of 0.587 MT/MWh and a “Marginal Fossil” value of 0.601 MT/MWh, compared to TDEC-provided estimates ranging from 0.651 MT/MWh (Combustion Turbines) to 0.799 MT/MWh (Coal & Combined Cycle). The Project Team elected to use the TDEC data as it is more representative of the potential future range of fossil electric generating units that will be displaced by solar.

Co-Pollutant Methodology

The AVERT output in pounds for co-pollutants, shown in the note to Table B.6.3, has been used to scale the CO_2 emission estimates discussed above to reflect expected co-pollutant benefits. Assuming that the relationships between the rates of CO_2 emissions and co-pollutants will remain the same, ratios were developed for each pollutant and applied to the CO_2 estimates to derive co-pollutant reduction benefits as shown below.

Results

Table B.6.2 provides the total CO_2e emissions reductions that would occur for 2025 to 2030 and 2025 to 2050.

	2025 to 2030 (MMT CO_2)	2025 to 2050 (MMT CO_2)
Avoided Combustion Turbine	-6.6	-175.7
Avoided Coal & Combined Cycle	-8.1	-215.7

Table B.6.2. CO_2 Reduction Measure Results in MMT CO_2

Based on the CO_2 results included in Table B.6.1 and using the ratios derived from AVERT, the proportioned co-pollutant emission rates are shown in Table B.6.3. The values reflected represent the maximum estimates.

	2025 to 2030 (Tons)	2025 to 2050 (Tons)
Sulfur Dioxide (SO_2)	-3,928	-104,081
Nitrogen Oxides (NO_x)	-3,277	-86,831
Respirable Particulate Matter ($PM_{2.5}$)	-809	-21,455
Volatile Organic Compounds (VOC)	-211	-5,579
Ammonia (NH_3)	-331	-8,761

Notes: Co-pollutants have been scaled from the CO_2 results according to ratios derived from comparison modeling performed using US EPA AVERT, as listed below. The average CO_2 benefit has been used for these co-pollutant estimates (e.g., 7.35 MMT CO_2 for 2025 to 2030).

Pollutant	lb	Ratio to CO_2
CO_2	542,492,830	1
SO_2	237,480	4.378E-04
NO_x	198,120	3.652E-04
$PM_{2.5}$	48,930	9.019E-05
VOC	12,730	2.347E-05
NH_3	19,990	3.685E-05

Table B.6.3. Co-Pollutant Emission Reduction Estimates in Tons

Discussion

As shown in Table B.6.1, upon full implementation of installed solar starting in 2035, AVERT estimates that between 9.3 MMT and 11.4 MMT of CO_2 can be offset by solar per year, with an average of 10.3 MMT CO_2 per year. AVERT only calculates CO_2 emissions reductions. This represents an approximately 43% reduction of the total Electric Generation baseline (calendar year 2019) emission inventory estimate of 24.1 MMT CO_2e. For comparison, TVA's current generating capacity is estimated at 34,500 MW and consists of the following categories:

- Gas (26%)
- Coal (32%)
- Nuclear (31%)
- Hydro (10%)
- Other (1%)

Therefore, the baseline GHG emissions of 24.1 MMT CO_2e per year are associated with approximately 58% of TVA's capacity or about 20,010 MW.

Although the capacity factor for solar (23.25%) is much less than that for fossil generation, the proposed 7,000 MW of solar capacity would be equal to about 35% of today's fossil capacity. If it is assumed that 35% of the current fossil electricity generation total of 24.1 MMT CO_2e per year were offset by solar, an equivalent of 8.1 MMT CO_2e of year would be reduced.

Performance Metrics

The primary performance metric for the measure will be to track the annual installed MW of solar capacity through year 2035. The benefits analysis can be informed by adjustments to the CO_2 emission rates of the remaining fossil EGU fleet based on actual decommissioning over time.

Appendix C: Co-Pollutant Inventory

The co-pollutant inventory is comprised of the base year estimates of Criteria Air Pollutants (CAP) and Hazardous Air Pollutants (HAP) in all 95 counties in Tennessee using the National Emissions Inventory's (NEI) 2017 data. The inventory will be used as a part of the co-pollutant analysis to estimate co-pollutant reduction potential of the identified priority measures in the PCAP.

2017 was selected as the base year according to data quality and availability, following US EPA guidelines for selecting a base year. As the NEI releases data every three years, the latest available data is from 2020 and 2017. Due to the impacts of COVID-19 on emissions, 2020 data is not considered for this analysis, as it would set an impractical baseline due to lower than usual activity data.

The NEI 2017 encompasses 60 EIS emission sectors[69] that categorize GHGs, CAPs and HAPs in the inventory. For each measure within the scope of the analysis, we reviewed and identified the corresponding EIS sector(s). For example, for the measure "weatherization programs for residential buildings," the relevant emissions sectors are "fuel comb – electric generation – natural gas" and "fuel comb – electric generation – coal." Table C.1 lists the NEI sectors that align with each priority measure.

Priority Measure	Relevant Sector
Programs to increase the share of state and local governments fleets of light-duty electric vehicles.	• Mobile - On-Road non-Diesel Light-Duty Vehicles • Mobile - On-Road Diesel Light-Duty Vehicles • Fuel Comb - Electric Generation - Natural Gas • Fuel Comb - Electric Generation – Coal • Fuel Comb - Electric Generation – Biomass • Fuel Comb - Electric Generation – Oil • Fuel Comb - Electric Generation - Other
Programs to increase the share of electric medium- and heavy-duty vehicles,	• Mobile - On-Road Diesel Heavy Duty Vehicles • Mobile - On-Road non-Diesel Heavy Duty Vehicles • Fuel Comb - Electric Generation - Natural Gas • Fuel Comb - Electric Generation – Coal

[69] "2017 National Emissions Inventory (NEI) Data | US EPA." *US EPA*, 30 June 2017. https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data.

Priority Measure	Relevant Sector
including buses.	• Fuel Comb - Electric Generation – Biomass • Fuel Comb - Electric Generation – Other • Fuel Comb - Electric Generation – Oil
Programs to expand community electric vehicle charging infrastructure.	• Mobile - On-Road Diesel Light-Duty Vehicles • Mobile - On-Road non-Diesel Light-Duty Vehicles • Mobile - On-Road Diesel Heavy Duty Vehicles • Mobile - On-Road non-Diesel Heavy Duty Vehicles • Fuel Comb - Electric Generation - Natural Gas • Gas Stations • Fuel Comb - Electric Generation – Coal • Fuel Comb - Electric Generation – Biomass • Fuel Comb - Electric Generation – Other • Fuel Comb - Electric Generation - Oil
Development of renewable energy generation.	• Fuel Comb - Electric Generation - Natural Gas • Fuel Comb - Electric Generation – Coal • Fuel Comb - Residential – Wood • Fuel Comb - Electric Generation – Biomass • Fuel Comb - Residential - Natural Gas • Fuel Comb - Electric Generation – Other • Fuel Comb - Electric Generation – Oil • Fuel Comb - Residential – Other • Fuel Comb - Residential - Oil
Upgrading electricity distribution.	• Fuel Comb - Electric Generation - Natural Gas • Fuel Comb - Electric Generation – Coal • Fuel Comb - Electric Generation – Biomass • Fuel Comb - Electric Generation – Other • Fuel Comb - Electric Generation - Oil
Incentive programs for the purchase of certified energy-efficient building products to replace inefficient products in residential buildings.	• Fuel Comb - Electric Generation - Natural Gas • Fuel Comb - Electric Generation – Coal • Fuel Comb - Residential – Wood • Fuel Comb - Comm/Institutional - Natural Gas • Fuel Comb - Electric Generation – Biomass • Fuel Comb - Comm/Institutional – Biomass • Fuel Comb - Comm/Institutional – Coal • Fuel Comb - Residential - Natural Gas • Fuel Comb - Comm/Institutional – Oil • Fuel Comb - Electric Generation – Other • Fuel Comb - Comm/Institutional – Other • Fuel Comb - Electric Generation – Oil • Fuel Comb - Residential – Other • Fuel Comb - Residential - Oil

Priority Measure	Relevant Sector
Incentive programs for the purchase of certified energy-efficient lighting in commercial and industrial buildings, as well as streetlights.	• Fuel Comb - Electric Generation - Natural Gas • Fuel Comb - Electric Generation – Coal • Fuel Comb - Residential – Wood • Fuel Comb - Comm/Institutional - Natural Gas • Fuel Comb - Electric Generation – Biomass • Fuel Comb - Comm/Institutional – Biomass • Fuel Comb - Comm/Institutional – Coal • Fuel Comb - Residential - Natural Gas • Fuel Comb - Comm/Institutional – Oil • Fuel Comb - Electric Generation – Other • Fuel Comb - Comm/Institutional – Other • Fuel Comb - Electric Generation – Oil • Fuel Comb - Residential – Other • Fuel Comb - Residential - Oil
Incentive programs for implementation of end-use energy efficiency measures in existing commercial buildings.	• Fuel Comb - Electric Generation - Natural Gas • Fuel Comb - Electric Generation – Coal • Fuel Comb - Comm/Institutional - Natural Gas • Fuel Comb - Electric Generation – Biomass • Fuel Comb - Comm/Institutional – Biomass • Fuel Comb - Comm/Institutional – Coal • Fuel Comb - Comm/Institutional – Oil • Fuel Comb - Electric Generation – Other • Fuel Comb - Comm/Institutional – Other • Fuel Comb - Electric Generation - Oil
Weatherization programs for residential buildings.	• Fuel Comb - Electric Generation - Natural Gas • Fuel Comb - Electric Generation – Coal • Fuel Comb - Residential – Wood • Fuel Comb - Electric Generation – Biomass • Fuel Comb - Residential - Natural Gas • Fuel Comb - Electric Generation – Other • Fuel Comb - Electric Generation – Oil • Fuel Comb - Residential – Other • Fuel Comb - Residential - Oil
Reduce deforestation by implementing sustainable land use practices, protecting forests.	• Biogenics - Vegetation and Soil

Priority Measure	Relevant Sector
Programs and incentives to reduce or divert waste (including food and/or yard waste).	• Waste Disposal

Table C.1. Co-Pollutant Inventory Sectors Relevant to Each Priority Measure

Appendix D: LIDAC Census Tracts

In the table below, LIDAC census tracts in TN are identified with the county name and total population of the census tract. This table was generated using data from the Climate and Economic Justice Screening Tool (CEJST).[70] A Tennessee community is identified as disadvantaged by the CEJST if they are in census tracts that meet the thresholds for at least one of the tool's categories of burdens. The tool utilizes the census tract boundaries from 2010 to align with other publicly available, nationally consistent datasets. For more information about categories of burden and the datasets used in the CEJST, view the CEJST Technical Support Document.[71]

Census tract 2010 ID	County Name	Total population
47001020100	Anderson County	3196
47001020400	Anderson County	4275
47001020700	Anderson County	1575
47001020800	Anderson County	4909
47001021201	Anderson County	5231
47001021202	Anderson County	5297
47003950401	Bedford County	5828
47003950500	Bedford County	6769
47005963000	Benton County	3442
47005963200	Benton County	2183
47005963300	Benton County	3715
47005963400	Benton County	3878
47007953000	Bledsoe County	3768
47007953100	Bledsoe County	6325
47007953200	Bledsoe County	4743
47009010100	Blount County	2898
47009010500	Blount County	2786
47009010800	Blount County	3024
47009011401	Blount County	1624
47009980200	Blount County	12
47011010300	Bradley County	2738
47011010400	Bradley County	2691
47011010700	Bradley County	4869

[70] "Climate and Economic Justice Screening Tool." *White House Council on Environmental Quality*, https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5.

[71] "Climate and Economic Justice Screening Tool Technical Support Document." *White House Council on Environmental Quality*, November 2022, https://static-data-screeningtool.geoplatform.gov/data-versions/1.0/data/score/downloadable/1.0-cejst-technical-support-document.pdf.

Census tract 2010 ID	County Name	Total population
47011010800	Bradley County	3121
47011010900	Bradley County	2889
47011011402	Bradley County	2930
47013950100	Campbell County	3484
47013950200	Campbell County	2230
47013950300	Campbell County	1913
47013950400	Campbell County	4922
47013950600	Campbell County	4148
47013950700	Campbell County	4848
47013950800	Campbell County	2385
47013950900	Campbell County	2913
47013951000	Campbell County	2348
47015960100	Cannon County	4081
47015960200	Cannon County	6374
47017962000	Carroll County	4108
47017962100	Carroll County	6111
47017962201	Carroll County	3462
47017962300	Carroll County	4308
47017962400	Carroll County	2670
47017962500	Carroll County	2022
47019070100	Carter County	1757
47019070200	Carter County	3678
47019070300	Carter County	5382
47019070400	Carter County	2115
47019070500	Carter County	3983
47019070600	Carter County	2279
47019071000	Carter County	2821
47019071100	Carter County	1946
47019071200	Carter County	3987
47019071300	Carter County	8178
47019071400	Carter County	3305
47019071500	Carter County	2011
47019071600	Carter County	1544
47019071700	Carter County	3484
47021070300	Cheatham County	3583
47025970100	Claiborne County	2874
47025970400	Claiborne County	709
47025970500	Claiborne County	2738
47025970600	Claiborne County	4471
47025970700	Claiborne County	5834
47025970800	Claiborne County	3631
47025970900	Claiborne County	4374
47027955000	Clay County	5111
47027955100	Clay County	2543

Census tract 2010 ID	County Name	Total population
47029920100	Cocke County	4304
47029920200	Cocke County	5939
47029920300	Cocke County	4230
47029920400	Cocke County	2010
47029920501	Cocke County	5186
47029920502	Cocke County	5546
47029920600	Cocke County	4139
47029920700	Cocke County	4198
47031970100	Coffee County	3665
47031970300	Coffee County	1835
47031970400	Coffee County	7142
47031970700	Coffee County	4910
47031970801	Coffee County	4157
47031970900	Coffee County	4160
47031971000	Coffee County	6318
47033961100	Crockett County	3904
47033961200	Crockett County	1779
47033961300	Crockett County	2413
47035970102	Cumberland County	6136
47035970301	Cumberland County	2975
47035970302	Cumberland County	4049
47035970400	Cumberland County	6111
47035970501	Cumberland County	2788
47035970502	Cumberland County	4206
47035970701	Cumberland County	2266
47035970702	Cumberland County	4069
47035970800	Cumberland County	3953
47037010303	Davidson County	5105
47037010401	Davidson County	5014
47037010402	Davidson County	6701
47037010501	Davidson County	5240
47037010502	Davidson County	5726
47037010601	Davidson County	5365
47037010602	Davidson County	4125
47037010701	Davidson County	4092
47037010702	Davidson County	3066
47037010802	Davidson County	3685
47037010903	Davidson County	5863
47037010904	Davidson County	3213
47037011001	Davidson County	6746
47037011002	Davidson County	2553
47037011300	Davidson County	5643
47037011800	Davidson County	2700
47037012600	Davidson County	2205

Census tract 2010 ID	County Name	Total population
47037012701	Davidson County	6072
47037012702	Davidson County	2908
47037012801	Davidson County	5616
47037012802	Davidson County	4363
47037013601	Davidson County	3320
47037013700	Davidson County	6345
47037013800	Davidson County	2099
47037013900	Davidson County	1617
47037014200	Davidson County	2024
47037014300	Davidson County	1860
47037014400	Davidson County	2111
47037014800	Davidson County	3310
47037015404	Davidson County	2886
47037015613	Davidson County	5252
47037015615	Davidson County	5553
47037015618	Davidson County	6507
47037015620	Davidson County	7262
47037015623	Davidson County	5370
47037015626	Davidson County	6740
47037015627	Davidson County	2930
47037015628	Davidson County	3800
47037015802	Davidson County	5650
47037015803	Davidson County	2932
47037015804	Davidson County	4098
47037015900	Davidson County	2865
47037016000	Davidson County	945
47037016100	Davidson County	2345
47037016200	Davidson County	3074
47037016300	Davidson County	2560
47037017200	Davidson County	1427
47037017300	Davidson County	3382
47037017401	Davidson County	2313
47037017402	Davidson County	5386
47037017500	Davidson County	2967
47037018101	Davidson County	5451
47037018901	Davidson County	3054
47037018905	Davidson County	3247
47037019003	Davidson County	4519
47037019004	Davidson County	4736
47037019005	Davidson County	3337
47037019006	Davidson County	5309
47037019105	Davidson County	6456
47037019108	Davidson County	3613
47037019109	Davidson County	5476

Census tract 2010 ID	County Name	Total population
47037019118	Davidson County	6517
47037019200	Davidson County	3897
47037019300	Davidson County	3428
47039955001	Decatur County	1770
47039955002	Decatur County	4241
47039955101	Decatur County	2069
47039955102	Decatur County	3606
47041920101	DeKalb County	2801
47041920200	DeKalb County	6496
47043060100	Dickson County	4118
47043060200	Dickson County	7215
47043060300	Dickson County	6845
47043060700	Dickson County	4586
47045964000	Dyer County	7054
47045964300	Dyer County	5225
47045964400	Dyer County	6283
47045964500	Dyer County	2444
47045964600	Dyer County	2731
47045964800	Dyer County	3096
47047060300	Fayette County	2782
47047060501	Fayette County	4545
47047060502	Fayette County	3916
47047060600	Fayette County	3761
47049965000	Fentress County	3619
47049965100	Fentress County	4405
47049965200	Fentress County	4721
47049965300	Fentress County	5468
47051960100	Franklin County	3566
47051960500	Franklin County	3917
47051960600	Franklin County	4328
47051960800	Franklin County	3336
47053966100	Gibson County	2278
47053966200	Gibson County	3897
47053966300	Gibson County	2595
47053966400	Gibson County	5195
47053966500	Gibson County	5779
47053966700	Gibson County	5249
47053966800	Gibson County	1207
47053966900	Gibson County	2679
47053967000	Gibson County	6682
47053967300	Gibson County	1059
47053967400	Gibson County	3644
47055920100	Giles County	3361
47055920400	Giles County	2983

Census tract 2010 ID	County Name	Total population
47055920500	Giles County	4595
47055920600	Giles County	3051
47057500100	Grainger County	4424
47057500200	Grainger County	5188
47057500300	Grainger County	6276
47057500401	Grainger County	2419
47057500402	Grainger County	4794
47059090100	Greene County	5771
47059090400	Greene County	5493
47059090500	Greene County	6822
47059090600	Greene County	3943
47059090700	Greene County	2487
47059090800	Greene County	4341
47059091000	Greene County	7968
47059091100	Greene County	4002
47059091200	Greene County	3817
47059091300	Greene County	4532
47059091400	Greene County	2809
47061955000	Grundy County	2539
47061955100	Grundy County	1459
47061955200	Grundy County	4511
47061955300	Grundy County	4835
47063100100	Hamblen County	6296
47063100200	Hamblen County	5389
47063100300	Hamblen County	3271
47063100400	Hamblen County	6989
47063100500	Hamblen County	3101
47063100800	Hamblen County	3482
47065000400	Hamilton County	3415
47065000800	Hamilton County	1722
47065001200	Hamilton County	3058
47065001300	Hamilton County	1978
47065001400	Hamilton County	1838
47065001600	Hamilton County	2632
47065001900	Hamilton County	3730
47065002300	Hamilton County	1636
47065002400	Hamilton County	5439
47065002500	Hamilton County	5147
47065002600	Hamilton County	2337
47065002900	Hamilton County	2723
47065003000	Hamilton County	2148
47065003200	Hamilton County	2644
47065003300	Hamilton County	6725
47065003400	Hamilton County	3819

Census tract 2010 ID	County Name	Total population
47065010700	Hamilton County	2731
47065010800	Hamilton County	4047
47065010902	Hamilton County	1077
47065011443	Hamilton County	5804
47065011444	Hamilton County	3680
47065011600	Hamilton County	5558
47065011900	Hamilton County	1421
47065012200	Hamilton County	2358
47065012300	Hamilton County	4763
47067960500	Hancock County	2497
47067960600	Hancock County	4090
47069950100	Hardeman County	3657
47069950200	Hardeman County	5917
47069950300	Hardeman County	3435
47069950400	Hardeman County	5237
47069950500	Hardeman County	4478
47069950600	Hardeman County	2719
47071920100	Hardin County	3919
47071920200	Hardin County	4504
47071920300	Hardin County	4028
47071920400	Hardin County	5084
47071920500	Hardin County	5076
47071920600	Hardin County	3104
47073050100	Hawkins County	4319
47073050200	Hawkins County	4380
47073050301	Hawkins County	4642
47073050302	Hawkins County	3765
47073050400	Hawkins County	5966
47073050501	Hawkins County	4106
47073050502	Hawkins County	3228
47073050700	Hawkins County	3558
47073050900	Hawkins County	2813
47075930200	Haywood County	1494
47075930301	Haywood County	3881
47075930302	Haywood County	3120
47075930400	Haywood County	3656
47075930500	Haywood County	2724
47077975000	Henderson County	3259
47077975100	Henderson County	3781
47077975200	Henderson County	4752
47077975300	Henderson County	8183
47077975400	Henderson County	4403
47077975500	Henderson County	3599
47079969000	Henry County	4104

Census tract 2010 ID	County Name	Total population
47079969100	Henry County	3010
47079969200	Henry County	1741
47079969300	Henry County	3385
47079969400	Henry County	2014
47079969500	Henry County	5367
47079969600	Henry County	8139
47079969700	Henry County	2218
47079969800	Henry County	2306
47081950100	Hickman County	5856
47081950200	Hickman County	7341
47081950301	Hickman County	2398
47081950302	Hickman County	4567
47081950400	Hickman County	2088
47081950500	Hickman County	2563
47083120200	Houston County	2456
47083120300	Houston County	2538
47085130100	Humphreys County	5899
47085130200	Humphreys County	1745
47085130300	Humphreys County	5316
47085130400	Humphreys County	2412
47087960100	Jackson County	1646
47087960200	Jackson County	2363
47087960300	Jackson County	5652
47087960400	Jackson County	2021
47089070100	Jefferson County	7488
47089070200	Jefferson County	4666
47089070400	Jefferson County	3822
47091956000	Johnson County	981
47091956100	Johnson County	4312
47091956300	Johnson County	5271
47091956400	Johnson County	4957
47093000800	Knox County	3607
47093001400	Knox County	2447
47093001500	Knox County	3520
47093001700	Knox County	2273
47093001900	Knox County	1376
47093002000	Knox County	2852
47093002100	Knox County	3036
47093002300	Knox County	3054
47093002400	Knox County	4267
47093002600	Knox County	2581
47093002700	Knox County	2926
47093002800	Knox County	4414
47093002900	Knox County	3885

Census tract 2010 ID	County Name	Total population
47093003100	Knox County	2612
47093003200	Knox County	2826
47093003801	Knox County	4825
47093003902	Knox County	3185
47093004000	Knox County	4297
47093004615	Knox County	4622
47093005301	Knox County	4680
47093005402	Knox County	3057
47093006301	Knox County	3591
47093006302	Knox County	2708
47093006502	Knox County	3549
47093006600	Knox County	3346
47093006700	Knox County	2998
47093006800	Knox County	4510
47093007000	Knox County	2891
47095960100	Lake County	5051
47095960200	Lake County	2350
47097050200	Lauderdale County	3281
47097050300	Lauderdale County	2859
47097050400	Lauderdale County	3090
47097050504	Lauderdale County	2851
47097050505	Lauderdale County	3487
47097050506	Lauderdale County	2261
47097050600	Lauderdale County	2091
47099960100	Lawrence County	4482
47099960200	Lawrence County	2730
47099960300	Lawrence County	6389
47099960401	Lawrence County	5318
47099960501	Lawrence County	4445
47099960600	Lawrence County	2133
47099960700	Lawrence County	3940
47099960900	Lawrence County	2075
47101970100	Lewis County	4444
47101970200	Lewis County	7583
47103975300	Lincoln County	5712
47103975500	Lincoln County	4851
47103975601	Lincoln County	6716
47103975602	Lincoln County	3643
47105060201	Loudon County	4292
47105060202	Loudon County	8137
47105060502	Loudon County	2263
47107970200	McMinn County	6130
47107970500	McMinn County	3989
47107970600	McMinn County	6775

Census tract 2010 ID	County Name	Total population
47107970700	McMinn County	4047
47107970800	McMinn County	7962
47109930100	McNairy County	4203
47109930200	McNairy County	2485
47109930300	McNairy County	2804
47109930400	McNairy County	2094
47109930500	McNairy County	7497
47109930600	McNairy County	3761
47109930700	McNairy County	3000
47111970100	Macon County	5068
47111970300	Macon County	8319
47113000100	Madison County	3667
47113000200	Madison County	6370
47113000300	Madison County	4119
47113000400	Madison County	3476
47113000500	Madison County	4308
47113000600	Madison County	2028
47113000700	Madison County	2460
47113000800	Madison County	1443
47113000900	Madison County	2238
47113001000	Madison County	2135
47113001100	Madison County	975
47113001300	Madison County	5399
47113001501	Madison County	5586
47115050201	Marion County	4773
47115050301	Marion County	5660
47117955300	Marshall County	4724
47117955400	Marshall County	4202
47119010400	Maury County	6350
47119010500	Maury County	4255
47119010600	Maury County	5131
47119010700	Maury County	4603
47119011002	Maury County	6819
47121960100	Meigs County	3236
47121960200	Meigs County	4880
47123925200	Monroe County	4628
47123925300	Monroe County	7686
47123925501	Monroe County	3470
47123925502	Monroe County	5192
47125100100	Montgomery County	1162
47125100200	Montgomery County	1503
47125100400	Montgomery County	3077
47125100800	Montgomery County	2589
47125100900	Montgomery County	2346

Census tract 2010 ID	County Name	Total population
47125101001	Montgomery County	4222
47125101201	Montgomery County	2217
47129110100	Morgan County	2726
47129110200	Morgan County	3592
47129110300	Morgan County	6347
47129110400	Morgan County	4204
47129110500	Morgan County	4676
47131965000	Obion County	4330
47131965300	Obion County	3530
47131965400	Obion County	4571
47131965500	Obion County	2502
47131965600	Obion County	4029
47131965700	Obion County	4372
47131965800	Obion County	1670
47131965900	Obion County	1247
47133950100	Overton County	1604
47133950200	Overton County	1674
47133950301	Overton County	4524
47133950302	Overton County	2783
47133950400	Overton County	2069
47133950600	Overton County	2858
47135930100	Perry County	2978
47135930200	Perry County	4984
47137925100	Pickett County	5079
47139950100	Polk County	1404
47139950201	Polk County	2248
47139950300	Polk County	4053
47139950400	Polk County	3679
47141000100	Putnam County	5616
47141000302	Putnam County	6562
47141000700	Putnam County	3284
47141000800	Putnam County	6378
47141001000	Putnam County	3832
47141001100	Putnam County	6999
47143975000	Rhea County	5013
47143975100	Rhea County	4693
47143975300	Rhea County	5527
47143975401	Rhea County	7313
47145030500	Roane County	4170
47145030600	Roane County	3518
47145030700	Roane County	3471
47145030800	Roane County	5442
47145030900	Roane County	6469
47147080200	Robertson County	6196

Census tract 2010 ID	County Name	Total population
47147080301	Robertson County	2589
47147080302	Robertson County	2870
47147080401	Robertson County	5119
47149040101	Rutherford County	3630
47149040305	Rutherford County	2816
47149041600	Rutherford County	5719
47149041800	Rutherford County	4286
47149041900	Rutherford County	4403
47149042100	Rutherford County	10109
47151975000	Scott County	3908
47151975100	Scott County	6302
47151975200	Scott County	6501
47151975300	Scott County	2329
47151975400	Scott County	2929
47153060101	Sequatchie County	8289
47153060102	Sequatchie County	2535
47155080101	Sevier County	3699
47155080400	Sevier County	7339
47155080500	Sevier County	5402
47155080700	Sevier County	8920
47155080801	Sevier County	3022
47155080901	Sevier County	3527
47155080902	Sevier County	4801
47155081101	Sevier County	1722
47155081102	Sevier County	3478
47157000200	Shelby County	868
47157000300	Shelby County	767
47157000400	Shelby County	1352
47157000600	Shelby County	1815
47157000700	Shelby County	4305
47157000800	Shelby County	2355
47157000900	Shelby County	2326
47157001100	Shelby County	3155
47157001200	Shelby County	4370
47157001300	Shelby County	2870
47157001400	Shelby County	1567
47157001500	Shelby County	1708
47157001900	Shelby County	1143
47157002000	Shelby County	1829
47157002100	Shelby County	1298
47157002400	Shelby County	2253
47157002500	Shelby County	2620
47157002700	Shelby County	2131
47157002800	Shelby County	3105

Census tract 2010 ID	County Name	Total population
47157003000	Shelby County	2895
47157003600	Shelby County	1538
47157003700	Shelby County	1220
47157003800	Shelby County	754
47157003900	Shelby County	1534
47157004500	Shelby County	1109
47157004600	Shelby County	1185
47157005000	Shelby County	949
47157005300	Shelby County	3308
47157005500	Shelby County	2106
47157005600	Shelby County	4087
47157005700	Shelby County	2795
47157005800	Shelby County	756
47157005900	Shelby County	2241
47157006000	Shelby County	1855
47157006200	Shelby County	1616
47157006300	Shelby County	2714
47157006500	Shelby County	2441
47157006700	Shelby County	3580
47157006800	Shelby County	2019
47157006900	Shelby County	2665
47157007000	Shelby County	3133
47157007500	Shelby County	1445
47157007810	Shelby County	2414
47157007821	Shelby County	4926
47157007822	Shelby County	1754
47157007900	Shelby County	5154
47157008000	Shelby County	4448
47157008110	Shelby County	2296
47157008120	Shelby County	4909
47157008200	Shelby County	4870
47157008700	Shelby County	4792
47157008800	Shelby County	6889
47157008900	Shelby County	4532
47157009100	Shelby County	3352
47157009700	Shelby County	2765
47157009800	Shelby County	3248
47157009901	Shelby County	2967
47157009902	Shelby County	1793
47157010000	Shelby County	7242
47157010110	Shelby County	6475
47157010120	Shelby County	5563
47157010210	Shelby County	5571
47157010220	Shelby County	8526

Census tract 2010 ID	County Name	Total population
47157010300	Shelby County	1411
47157010500	Shelby County	1918
47157010610	Shelby County	6032
47157010620	Shelby County	3753
47157010630	Shelby County	4147
47157010710	Shelby County	5168
47157010720	Shelby County	3876
47157010810	Shelby County	5931
47157010820	Shelby County	4262
47157011010	Shelby County	3690
47157011020	Shelby County	1436
47157011100	Shelby County	1623
47157011200	Shelby County	1363
47157011300	Shelby County	1334
47157011400	Shelby County	5135
47157011500	Shelby County	2485
47157011600	Shelby County	2786
47157011700	Shelby County	1295
47157011800	Shelby County	5911
47157020101	Shelby County	3824
47157020222	Shelby County	2965
47157020300	Shelby County	5197
47157020511	Shelby County	2238
47157020512	Shelby County	5375
47157020521	Shelby County	3324
47157020523	Shelby County	2942
47157020524	Shelby County	4823
47157020541	Shelby County	5722
47157020542	Shelby County	5184
47157020610	Shelby County	4225
47157020621	Shelby County	8230
47157021111	Shelby County	4598
47157021112	Shelby County	6728
47157021200	Shelby County	1898
47157021710	Shelby County	3119
47157021721	Shelby County	4407
47157021725	Shelby County	4605
47157021726	Shelby County	3409
47157021731	Shelby County	3226
47157021732	Shelby County	6191
47157021741	Shelby County	8785
47157021900	Shelby County	5118
47157022022	Shelby County	4640
47157022023	Shelby County	1463

Census tract 2010 ID	County Name	Total population
47157022024	Shelby County	3364
47157022111	Shelby County	5009
47157022112	Shelby County	6190
47157022122	Shelby County	4265
47157022130	Shelby County	5819
47157022210	Shelby County	4210
47157022220	Shelby County	3655
47157022310	Shelby County	6133
47157022321	Shelby County	3599
47157022322	Shelby County	3873
47157022330	Shelby County	4928
47157022410	Shelby County	6131
47157022500	Shelby County	5189
47157022600	Shelby County	3993
47157022700	Shelby County	7386
47157980100	Shelby County	82
47159975000	Smith County	4240
47159975100	Smith County	3129
47159975200	Smith County	5784
47159975300	Smith County	1889
47161110600	Stewart County	2582
47163040200	Sullivan County	2393
47163040300	Sullivan County	2664
47163040500	Sullivan County	4572
47163040600	Sullivan County	3123
47163040700	Sullivan County	2464
47163040800	Sullivan County	3584
47163041100	Sullivan County	2513
47163041300	Sullivan County	4956
47163041700	Sullivan County	3274
47163041800	Sullivan County	4409
47163041900	Sullivan County	3016
47163042000	Sullivan County	3425
47163042100	Sullivan County	5978
47163042200	Sullivan County	2941
47163042600	Sullivan County	4074
47163042701	Sullivan County	4439
47163042702	Sullivan County	2302
47163042801	Sullivan County	2897
47163042802	Sullivan County	4592
47163043000	Sullivan County	4193
47163043100	Sullivan County	2958
47163043202	Sullivan County	4868
47163043302	Sullivan County	6149

Census tract 2010 ID	County Name	Total population
47163043401	Sullivan County	5703
47163043402	Sullivan County	4755
47165020101	Sumner County	4072
47165020102	Sumner County	5093
47165020206	Sumner County	1256
47165020300	Sumner County	5384
47165020800	Sumner County	7237
47165020902	Sumner County	7120
47167040100	Tipton County	5051
47167040200	Tipton County	1900
47167040304	Tipton County	6850
47167040400	Tipton County	2988
47167040602	Tipton County	3230
47167040700	Tipton County	4979
47167041000	Tipton County	2653
47171080100	Unicoi County	2490
47171080200	Unicoi County	6416
47171080300	Unicoi County	5245
47171080400	Unicoi County	3660
47173040100	Union County	7062
47173040201	Union County	4060
47173040202	Union County	5966
47173040300	Union County	2400
47175925000	Van Buren County	2895
47175925200	Van Buren County	2865
47177930100	Warren County	3668
47177930200	Warren County	6938
47177930500	Warren County	5249
47177930600	Warren County	3675
47177930900	Warren County	1842
47179060100	Washington County	3496
47179060900	Washington County	5937
47179061000	Washington County	2357
47179061200	Washington County	3963
47179061800	Washington County	6694
47179061901	Washington County	7240
47179061902	Washington County	5225
47179062000	Washington County	3633
47181950100	Wayne County	4932
47181950200	Wayne County	5226
47181950300	Wayne County	3416
47181950400	Wayne County	3119
47183968000	Weakley County	1221
47183968101	Weakley County	3263

Census tract 2010 ID	County Name	Total population
47183968202	Weakley County	2388
47183968203	Weakley County	2779
47183968300	Weakley County	2342
47183968500	Weakley County	4673
47183968600	Weakley County	3704
47183968700	Weakley County	1553
47185935000	White County	4632
47185935200	White County	3961
47185935300	White County	5096
47185935400	White County	3754
47185935500	White County	3681
47189030500	Wilson County	7961
47189030700	Wilson County	3779

Table D.1. Tennessee LIDAC Census Tracts

Appendix E: EJScreen Reports

Knoxville MSA

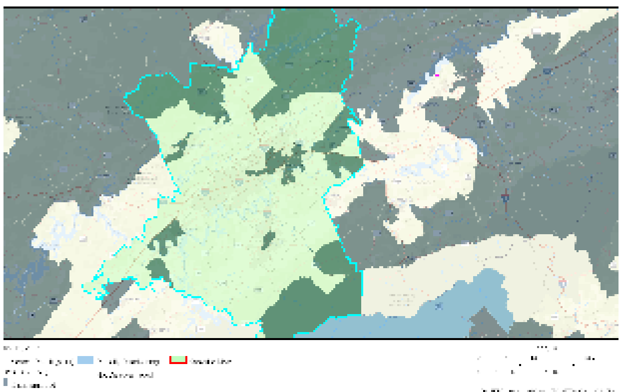
8/11/23, 9:21 AM EJScreen Community Report

EJScreen Community Report

This report provides environmental and socioeconomic information for user-defined areas, and combines that data into environmental justice and supplemental indexes.

Union County, TN

County: Knox,Loudon,Blount,Anderson,Union
Population: 759,957
Area in square miles: 1931.82



COMMUNITY INFORMATION

- Low income: 30 percent
- People of color: 16 percent
- Less than high school education: 9 percent
- Limited English households: 1 percent
- Unemployment: 4 percent
- Persons with disabilities: 14 percent
- Male: 49 percent
- Female: 51 percent
- 76 years Average life expectancy
- $32,684 Per capita income
- Number of households: 304,599
- Owner occupied: 69 percent

BREAKDOWN BY RACE

- White: 87%
- Black: 6%
- Asian: 2%
- Hispanic: 5%
- American Indian: 0%
- Hawaiian/Pacific Islander: 0%
- Other race: 1%
- Two or more races: 4%

BREAKDOWN BY AGE

From Ages 1 to 4	5%
From Ages 1 to 18	21%
From Ages 18 and up	79%
From Ages 65 and up	18%

LANGUAGES SPOKEN AT HOME

LANGUAGE	PERCENT
English	94%
Spanish	3%
Other Indo-European	1%
Total Non-English	6%

LIMITED ENGLISH SPEAKING BREAKDOWN

Speak Spanish	57%
Speak Other Indo-European Languages	8%
Speak Asian-Pacific Island Languages	16%
Speak Other Languages	18%

Notes: Numbers may not sum to totals due to rounding. Hispanic population can be of any race. Source: U.S. Census Bureau, American Community Survey (ACS) 2017-2021. Life expectancy data comes from the Centers for Disease Control.

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Nashville/Davidson County

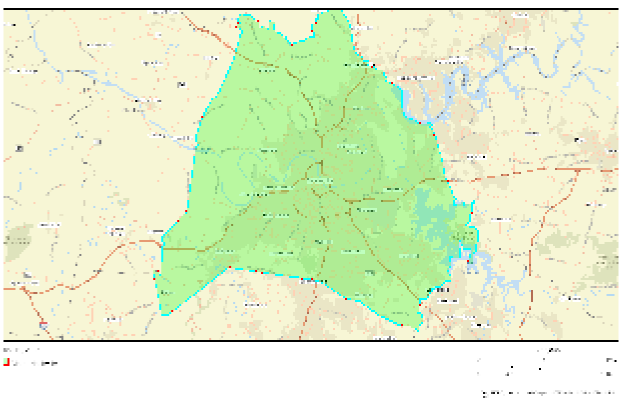
EPA

EJScreen Community Report

This report provides environmental and socioeconomic information for user-defined areas, and combines that data into environmental justice and supplemental indexes.

Davidson County, TN

County: Davidson
Population: 708,490
Area in square miles: 525.55



COMMUNITY INFORMATION

Low income: 31 percent
People of color: 44 percent
Less than high school education: 10 percent
Limited English households: 5 percent
Unemployment: 5 percent
Persons with disabilities: 12 percent
Male: 48 percent
Female: 52 percent
76 years Average life expectancy
$40,962 Per capita income
Number of households: 293,859
Owner occupied: 55 percent

BREAKDOWN BY RACE

White: 61%
Black: 27%
Asian: 4%
Hispanic: 10%
American Indian: 0%
Hawaiian/Pacific Islander: 0%
Other race: 4%
Two or more races: 5%

LANGUAGES SPOKEN AT HOME

LANGUAGE	PERCENT
English	83%
Spanish	9%
Other Indo-European	2%
Other Asian and Pacific Island	1%
Arabic	2%
Other and Unspecified	2%
Total Non-English	17%

BREAKDOWN BY AGE

From Ages 1 to 4	7%
From Ages 1 to 18	21%
From Ages 18 and up	79%
From Ages 65 and up	12%

LIMITED ENGLISH SPEAKING BREAKDOWN

Speak Spanish	52%
Speak Other Indo-European Languages	10%
Speak Asian-Pacific Island Languages	16%
Speak Other Languages	22%

Notes: Numbers may not sum to totals due to rounding. Hispanic population can be of any race.
Source: U.S. Census Bureau, American Community Survey (ACS) 2017-2021. Life expectancy data comes from the Centers for Disease Control.

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Memphis MSA

EPA

EJScreen Community Report

This report provides environmental and socioeconomic information for user-defined areas, and combines that data into environmental justice and supplemental indexes.

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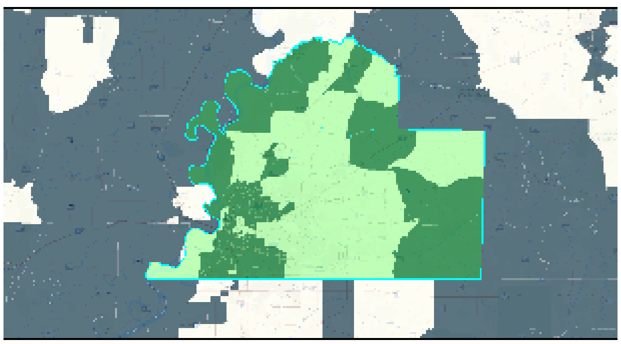
County: Shelby,Fayette,Tipton
Population: 1,031,630
Area in square miles: 1954.82



COMMUNITY INFORMATION

Low income: 38 percent
People of color: 61 percent
Less than high school education: 11 percent
Limited English households: 2 percent
Unemployment: 7 percent
Persons with disabilities: 14 percent
Male: 48 percent
Female: 52 percent
76 years — Average life expectancy
$33,296 — Per capita income
Number of households: 392,528
Owner occupied: 58 percent

LANGUAGES SPOKEN AT HOME

LANGUAGE	PERCENT
English	91%
Spanish	5%
Other Indo-European	1%
Other and Unspecified	1%
Total Non-English	9%

BREAKDOWN BY RACE

White: 41%
Black: 51%
Asian: 3%
Hispanic: 6%
American Indian: 0%
Hawaiian/Pacific Islander: 0%
Other race: 3%
Two or more races: 3%

BREAKDOWN BY AGE

From Ages 1 to 4	7%
From Ages 1 to 18	25%
From Ages 18 and up	75%
From Ages 65 and up	14%

LIMITED ENGLISH SPEAKING BREAKDOWN

Speak Spanish	63%
Speak Other Indo-European Languages	6%
Speak Asian-Pacific Island Languages	22%
Speak Other Languages	8%

Notes: Numbers may not sum to totals due to rounding. Hispanic population can be of any race.
Source: U.S. Census Bureau, American Community Survey (ACS) 2017-2021. Life expectancy data comes from the Centers for Disease Control.

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Chattanooga

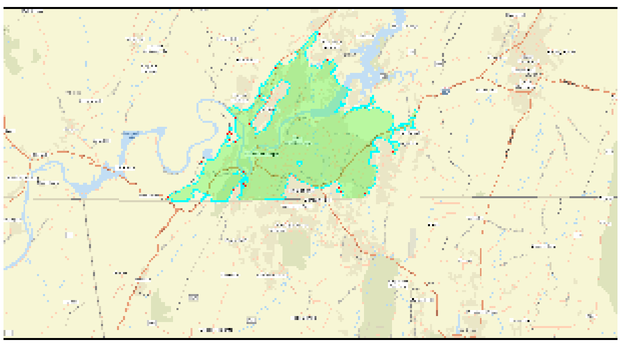
EPA

EJScreen Community Report

This report provides environmental and socioeconomic information for user-defined areas, and combines that data into environmental justice and supplemental indexes.

Chattanooga, TN

City: Chattanooga
Population: 182,218
Area in square miles: 150.08



COMMUNITY INFORMATION

Low income: 37 percent

People of color: 43 percent

Less than high school education: 11 percent

Limited English households: 2 percent

Unemployment: 5 percent

Persons with disabilities: 15 percent

Male: 48 percent

Female: 52 percent

69 years — Average life expectancy

$33,286 — Per capita income

Number of households: 75,909

Owner occupied: 52 percent

BREAKDOWN BY RACE

White: 60%

Black: 30%

Asian: 3%

Hispanic: 7%

American Indian: 0%

Hawaiian/Pacific Islander: 0%

Other race: 2%

Two or more races: 5%

LANGUAGES SPOKEN AT HOME

LANGUAGE	PERCENT
English	90%
Spanish	6%
French, Haitian, or Cajun	1%
Other Indo-European	1%
Total Non-English	10%

BREAKDOWN BY AGE

From Ages 1 to 4	6%
From Ages 1 to 18	20%
From Ages 18 and up	80%
From Ages 65 and up	17%

LIMITED ENGLISH SPEAKING BREAKDOWN

Speak Spanish	67%
Speak Other Indo-European Languages	11%
Speak Asian-Pacific Island Languages	16%
Speak Other Languages	6%

Notes: Numbers may not sum to totals due to rounding. Hispanic population can be of any race. Source: U.S. Census Bureau, American Community Survey (ACS) 2017 -2021. Life expectancy data comes from the Centers for Disease Control.

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Tri-Cities (Washington & Sullivan Counties)

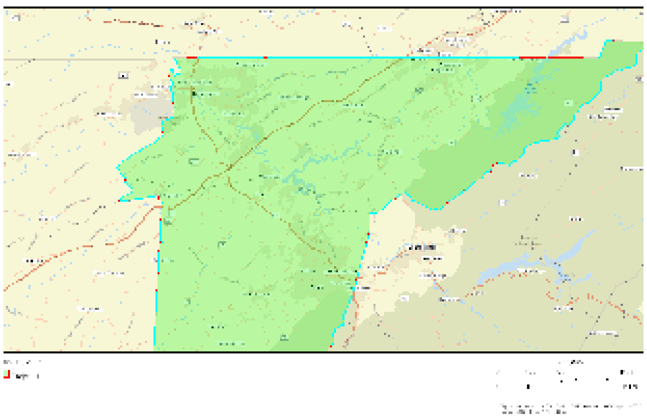
8/11/23, 9:45 AM EJScreen Community Report

EJScreen Community Report

This report provides environmental and socioeconomic information for user-defined areas, and combines that data into environmental justice and supplemental indexes.

Sullivan County, TN

County: Washington,Sullivan
Population: 289,910
Area in square miles: 759.53



COMMUNITY INFORMATION

- Low income: 35 percent
- People of color: 9 percent
- Less than high school education: 11 percent
- Limited English households: 0 percent
- Unemployment: 6 percent
- Persons with disabilities: 19 percent
- Male: 49 percent
- Female: 51 percent
- 76 years Average life expectancy
- $31,762 Per capita income
- Number of households: 121,938
- Owner occupied: 69 percent

LANGUAGES SPOKEN AT HOME

LANGUAGE	PERCENT
English	96%
Spanish	2%
Total Non-English	4%

BREAKDOWN BY RACE

- White: 92%
- Black: 3%
- Asian: 1%
- Hispanic: 3%
- American Indian: 0%
- Hawaiian/Pacific Islander: 0%
- Other race: 1%
- Two or more races: 3%

BREAKDOWN BY AGE

From Ages 1 to 4	5%
From Ages 1 to 18	19%
From Ages 18 and up	81%
From Ages 65 and up	20%

LIMITED ENGLISH SPEAKING BREAKDOWN

Speak Spanish	70%
Speak Other Indo-European Languages	6%
Speak Asian-Pacific Island Languages	20%
Speak Other Languages	4%

Notes: Numbers may not sum to totals due to rounding. Hispanic population can be of any race.
Source: U.S. Census Bureau, American Community Survey (ACS) 2017-2021. Life expectancy data comes from the Centers for Disease Control.

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