COMPREHENSIVE ROADMAP TO REDUCE EMISSIONS IN TEXAS

Prepared for:
The Climate Pollution Reduction Grants Program
State and Local Climate Energy Program
U.S. ENVIRONMENTAL PROTECTION AGENCY

Prepared by:
TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
P.O. BOX 13087
AUSTIN, TEXAS 78711-3087

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EXECUTIVE SUMMARY

The Comprehensive Roadmap to Reduce Emissions in Texas was developed by the Texas Commission on Environmental Quality (TCEQ) as part of the United States Environmental Protection Agency's (EPA) Climate Pollution Reduction Grants (CPRG) Phase I Planning Grant. Texas is highly committed to improving air quality and places a priority on reducing pollutants that have a direct health impact on Texans. This roadmap builds on actions outlined in the Priority Action Plan (PAP), which was submitted to EPA on March 1, 2024.

This roadmap outlines voluntary actions that state agencies, local governments, private entities, or the public can take to reduce emissions for all economic sectors in Texas. TCEQ identified these actions during the priority planning phase with extensive input from a variety of stakeholders. Those actions for each economic sector are summarized below.

Industry:

- Electrify industrial process equipment or modify equipment to use hydrogen or other low emission fuels.
- Energy efficiency improvements to processes and equipment.
- Use of low carbon cement.
- Improvement/expansion of carbon capture.
- Replace hydrofluorocarbon (HFC) with ultra-low global warming potential (GWP) refrigeration equipment.
- Replace pneumatic controllers, motors, and pumps, add surveillance, add monitoring, and remove redundant equipment to reduce fugitive emissions from oil and gas activities.
- Reduce flaring and capture methane from oil and gas activities.
- Remediate and/or plug low producing and abandoned wells.

Electric Generation:

- Upgrade transmission lines to improve capacity.
- Use advanced nuclear energy or geothermal energy.
- Add grid scale renewable energy storage.
- Lower demand with load shifting, load management, and energy efficiency.
- Add infrastructure to capture, use, and store carbon from both power plants and industrial processes.

Transportation:

- Reduce emissions from sea and inland ports and associated support equipment and use low emission passenger or freight locomotives.
- Add infrastructure for electric vehicle (EV) charging and hydrogen fueling.
- Use zero emissions light-, medium-, and heavy-duty vehicles, including school buses and fleet vehicles.
- Reduce airport emissions by using lower emission support equipment, vehicles, and use of low emission jet fuels.

Agriculture, Residential and Commercial, Municipal and Industrial Wastewater and Landfills, and Natural and Working Lands:

- Create biofuels through methane capture from landfills and wastewater treatment plants, or by using surplus biomass.
- Add solar arrays to closed landfills and add solar to commercial and residential buildings.
- Switch to electric heat pumps.
- Increase energy efficiency and weatherization in homes and commercial buildings.
- Support projects to increase recycling, reduce waste, increase composting, and add recycling infrastructure.
- Use sustainable agriculture or forestry practices to reduce emissions and restore coastal landscapes.
- Reforest agriculture lands no longer in use and increase urban tree canopy.

Estimates show that full implementation of these measures could reduce emissions in Texas by 121 million metric tons (MMT) carbon dioxide equivalents (CO_2e) by 2030 and 252 MMT CO_2e by 2050. These actions would save entities in Texas $2.6 billion in capital, fuel, and operational expenditures. Co-pollutants could also be reduced by 0.7 MMT by 2030 and 2.7 MMT by 2050.

Implementation of these actions is expected to improve air quality, public health, and quality of life, while reducing heat risk, creating jobs, mitigating extreme weather risks, and increasing community engagement for all Texans. Texas will continue to educate on these emission reduction actions to encourage voluntary implementation and will continue to seek input from stakeholders.

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AFFP	Alternative Fueling Facilities Program (AFFP)
AR4	Fourth Assessment Report
BAU	business-as-usual
CAP	criteria air pollutant
C-Pace	Commercial Property Assessed Clean Energy
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
CPRG	Climate Pollution Reduction Grants
DOE	United States Department of Energy
DOT	United States Department of Transportation
DRE	destruction and removal efficiency
DSIRE	Database of State Incentive for Renewable and Efficiency
EI	emissions inventory
EIA	United States Energy Information Administration
EMP	Emissions Modeling Platform
EPA	United States Environmental Protection Agency
EPS	Energy Policy Simulator
ERIG	Emissions Reduction Incentive Grants Program
EV	electric vehicle
F-gases	fluorinated gases
FI	full implementation
FHWA	Federal Highway Administration
GAFF	Governmental Alternative Fuel Fleet Grant Program
GHG	greenhouse gas
GHGRP	Greenhouse Gas Reporting Program
GURI	Governor's University Research Initiative
GWP	global warming potential
HAP	hazardous air pollutant
HFC	hydrofluorocarbon
HFE	hydrofluoroether

HOMES	Home Energy Performance-Based, Whole House
IECC	International Energy Conservation Code
IOUs	Investor Owned Utilities
IPCC	Intergovernmental Panel on Climate Change
IRA	Inflation Reduction Act
IRC	International Residential Code
ITAC	Industrial Training and Assessment Center
LDPLIP	Light-Duty Motor Vehicle Purchase or Lease Incentive Program
LULUCF	land use, land use change, and forestry
MMT	million metric tons (MMT)
MOVES	Motor Vehicle Emission Simulator
MSA	metropolitan statistical area
MT	metric tons (MT)
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEI	National Emissions Inventory
NF_3	nitrogen trifluoride
NHV	net heating value
NO_X	nitrogen oxides
NTIG	New Technology Implementation Grants
PAP	Priority Action Plan
PASPP	Port Authority Studies and Pilot Projects Program
PM_{10}	coarse particulate matter
$PM_{2.5}$	fine particulate matter
PUCT	Public Utilities Commission of Texas
QAPP	quality assurance project plan
REC	renewable energy credit
SECO	State Energy Conservation Office
SF_6	sulfur hexafluoride
SIT	State Inventory Tool
SO_X	sulfur oxides
SPRY	Seaport and Rail Yard Areas Emissions Reduction Program
TAPs	Technical Assistance Partnerships
TCAA	Texas Clean Air Act

TCEQ	Texas Commission on Environmental Quality
TCFP	Texas Clean Fleet Program
TCSB	Texas Clean School Bus Program
TERP	Texas Emissions Reduction Plan
THIVE	Texas Hydrogen, Infrastructure, Vehicle, and Equipment Program
TIEEN	Texas Industrial Energy Efficiency Network
TIEEP	Texas Industrial Energy Efficiency Program
TNGVGP	Texas Natural Gas Vehicle Grant Program
TxDOT	Texas Department of Transportation
TxMCW	Texas Voluntary Marginal Conventional Well Plugging Program
TWC	Texas Water Code
U.S.	United States
USD	United States Dollars
UT Austin	University of Texas at Austin
VOC	volatile organic compounds

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CHAPTER 1: INTRODUCTION

The Comprehensive Roadmap to Reduce Emissions in Texas was developed by TCEQ as part of EPA's Climate Pollution Reduction Grants (CPRG) Phase I Planning Grant. Texas is highly committed to improving air quality and places a priority on reducing pollutants that have a direct health impact on Texans. As such, significant state resources have been and will continue to be directed toward compliance with the established National Ambient Air Quality Standard (NAAQS) as outlined under the federal Clean Air Act. While Texas remains focused on addressing compliance with health-based federal NAAQS, we acknowledge there are opportunities to implement strategies and measures that could result in criteria air pollutants, hazardous air pollutants, and greenhouse gas (GHG) co-benefits.

This roadmap focuses on voluntary emission reduction actions with co-pollutant benefits from all economic sectors in Texas. It builds on measures outlined in the Priority Action Plan (PAP) and supports investment in practices and technologies that reduce pollutant emissions, create high-quality jobs, spur economic growth, and enhance the quality of life for all Texans. Voluntary actions included in this plan could be implemented by state government, local government, private entities, or the public.

This roadmap contains the following elements:

- GHG Emissions Inventory
- Emissions Projections and Potential Reductions
- Actions to Reduce Emissions
- Benefits Analysis
- Funding Opportunities
- Workforce Planning Analysis

TCEQ conducted extensive intergovernmental coordination and outreach in the development of this roadmap. The framework TCEQ used to develop this roadmap, support engagement strategies, and ensure comprehensive stakeholder representation is outlined in Figure 1-1. Appendix A contains a list of identified stakeholders, intergovernmental agencies contacted, participating metropolitan statistical areas (MSAs), outreach meetings held, and survey results.

TCEQ worked to coordinate plans and strategies with MSAs; however, inventories, projections, and quantifications between participating MSAs and the state were developed independently due to time constraints. Results may not match due to the differing methodologies and models each area used.

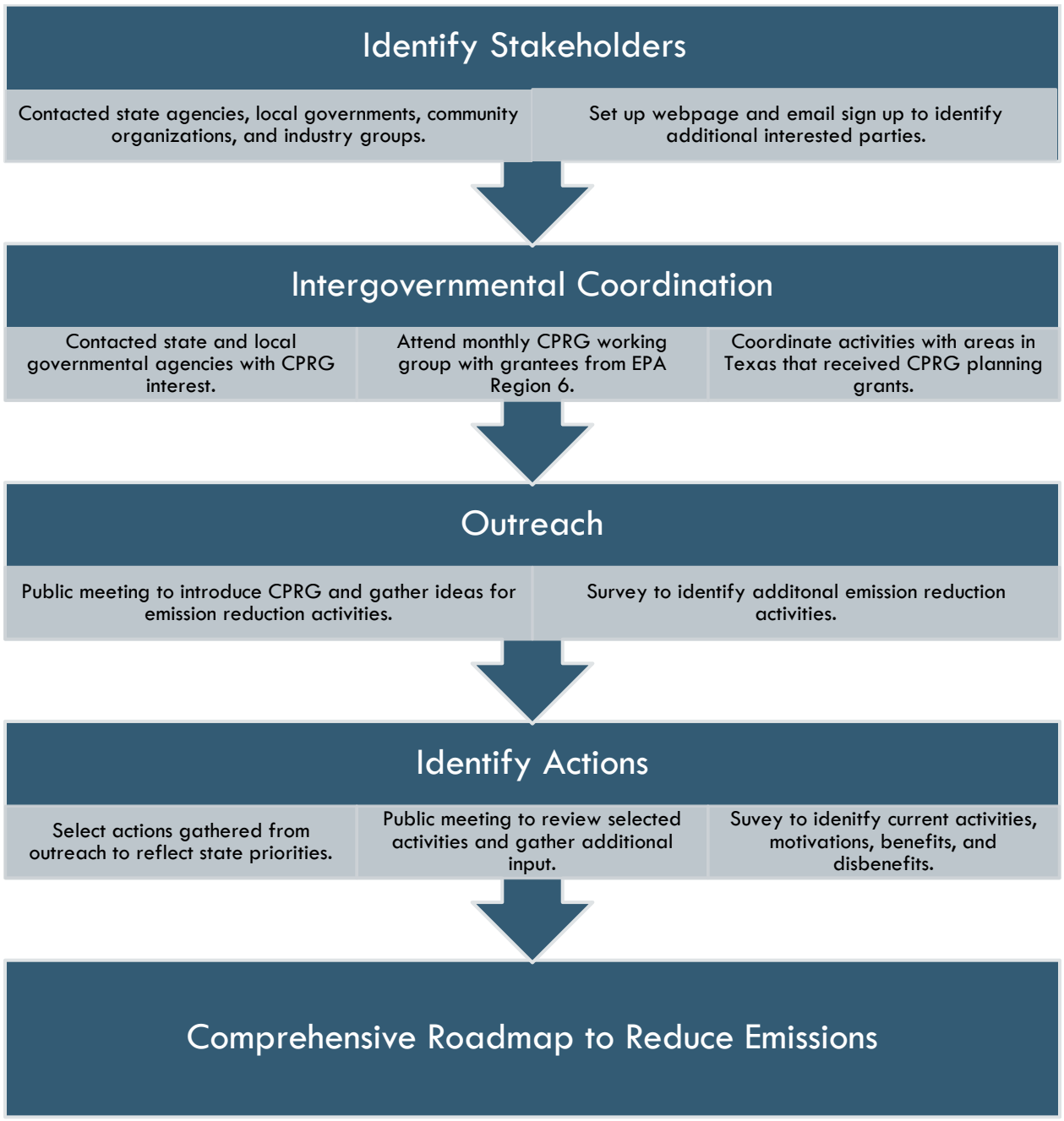

Figure 1-1: Approach to Develop Texas' Comprehensive Roadmap to Reduce Emissions

CHAPTER 2: AUTHORITY TO IMPLEMENT

This roadmap is not a regulatory document. Measures included in this roadmap are voluntary actions that are available statewide for implementation by governmental entities, private entities, or the public. TCEQ has reviewed existing statutory and regulatory authority to implement measures in this plan and determined that no new regulatory authority is required to implement these voluntary measures.

TCEQ has existing legal authority to implement measures that maintain or control the quality of the state's natural resources and that protect the state's environment. TCEQ's authority is found in both the Texas Water Code (TWC) and the Texas Clean Air Act (TCAA). The TCAA is codified as Chapter 382 of the Texas Health and Safety Code. The TCAA is frequently amended for various purposes during the biennial legislative sessions.

TCEQ's general authority is found in TWC, Chapter 5. TWC, Chapter 5, Subchapters A - F, H - J, and L, include the general provisions, organization, and general powers and duties of TCEQ, and the responsibilities and authority of the executive director. TWC, Chapter 5, also provides TCEQ with authority to award grants for any purpose regarding resource conservation or environmental protection.

The TCAA, Subchapters A - D, authorize TCEQ to collect information to enable the commission to develop an inventory of emissions; to conduct research and investigations; to prescribe monitoring requirements; to enter into contracts and execute instruments; to formulate rules; and to issue, establish, and operate a system of permits for construction or modification of facilities. Subchapter C gives TCEQ the authority to permit GHGs to the extent required under federal law.

The statutes described above provide the necessary authority for Texas to implement the voluntary measures included in this roadmap.

CHAPTER 3: GREENHOUSE GAS EMISSIONS INVENTORY

3.1 GREENHOUSE GAS EMISSION INVENTORY

TCEQ contracted with the University of Texas at Austin (UT Austin) to prepare a statewide emissions inventory (EI) of major sources of GHG emissions within Texas for a 2022 base year. The full inventory report, which includes methodology, assumptions, and a comparison to EPA's state-level GHG EI is available in Appendix B. Detailed quality assurance procedures for preparation of this GHG EI are contained in Amendment 1 to TCEQ's Quality Assurance Project Plan (QAPP) (TCEQ 2024). The Texas GHG EI includes the emissions from the sectors and gases outlined in Table 3-1.

Table 3-1: Sectors and Gases Included in the GHG EI within Texas

Sectors	Gases (across all sectors)
• Electric power generation • Transportation • Industry • Residential and Commercial • Municipal and Industrial Wastewater • Municipal and Industrial Landfills • Agriculture • Natural and working lands	carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), fluorinated gases (F-gases) including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3)

Table 3-2 summarizes GHG emissions in metric tons (MT) CO_2e for all economic sectors and GHGs in Texas. To be consistent with emissions from the Greenhouse Gas Reporting Program (GHGRP), the inventory used 100-year global warming potentials (GWPs) from the Intergovernmental Panel on Climate Change's (IPCC's) Fourth Assessment Report (AR4) to calculate CO_2e from non-CO_2 emissions (IPCC 2007). Figure 3-1 shows how much each sector contributes to the total GHG emissions in Texas. Three sectors account for 87% of the 2022 GHG emissions in Texas: industry, transportation, and electric power generation.

Table 3-2: 2022 GHG EI in MT by Economic Sector and GHG in Texas

Economic Sector	CO_2 (MT)	CH_4 (MT)	N_2O (MT)	All Other GHG[7] (MT CO_2e)	Total (MT CO_2e)
Industry[1]	229,534,262	911,569	5,718	6,318,175	260,345,680
Electric Power Generation[2]	191,101,017	10,832	1,747		191,892,519
Transportation[3]	179,039,963	10,278	8,241		181,752,666
Agriculture[4]	268,000	1,146,000	66,000		48,590,000
Residential and Commercial[5]	31,949,823	690.9	597.4		32,145,115
Municipal and Industrial Wastewater[6]		77,200	2,450		2,660,000
Municipal and Industrial Landfills[6]		422,960			10,574,000
Total Emissions (sources)	**631,893,065**	**2,579,530**	**84,754**	**6,318,175**	**727,959,980**
Natural and Working Lands[6]	(46,700,000)				(46,700,000)

Economic Sector	CO_2 (MT)	CH_4 (MT)	N_2O (MT)	All Other GHG[7] ($MT CO_2e$)	Total ($MT CO_2e$)
Net Total Emissions (sources and sinks)	**585,193,065**	**2,579,530**	**84,754**	**6,318,175**	**681,259,980**

1 Based primarily on reporting to the EPA GHGRP and extrapolation to non-reporters.
2 Based on EPA GHGRP, Energy Information Administration (EIA), continuous emission monitoring reports and other data.
3 Based on mobile source emission modeling (MOVES modeling) from the Emissions Modeling Platform (EMP) and data on certain non-road sectors from the National Emission Inventory (NEI).
4 Based on procedures used in EPA Greenhouse Gas Inventory.
5 Based on fuel consumption reported to the EIA.
6 From EPA State Inventory Tool (SIT).
7 Other gases include HFCs, PFCs, SF_6, NF_3, Other Fully Fluorinated GHGs, hydrofluoroether (HFEs), Very Short-Lived Compounds, and Other as reported to the EPA GHGRP.

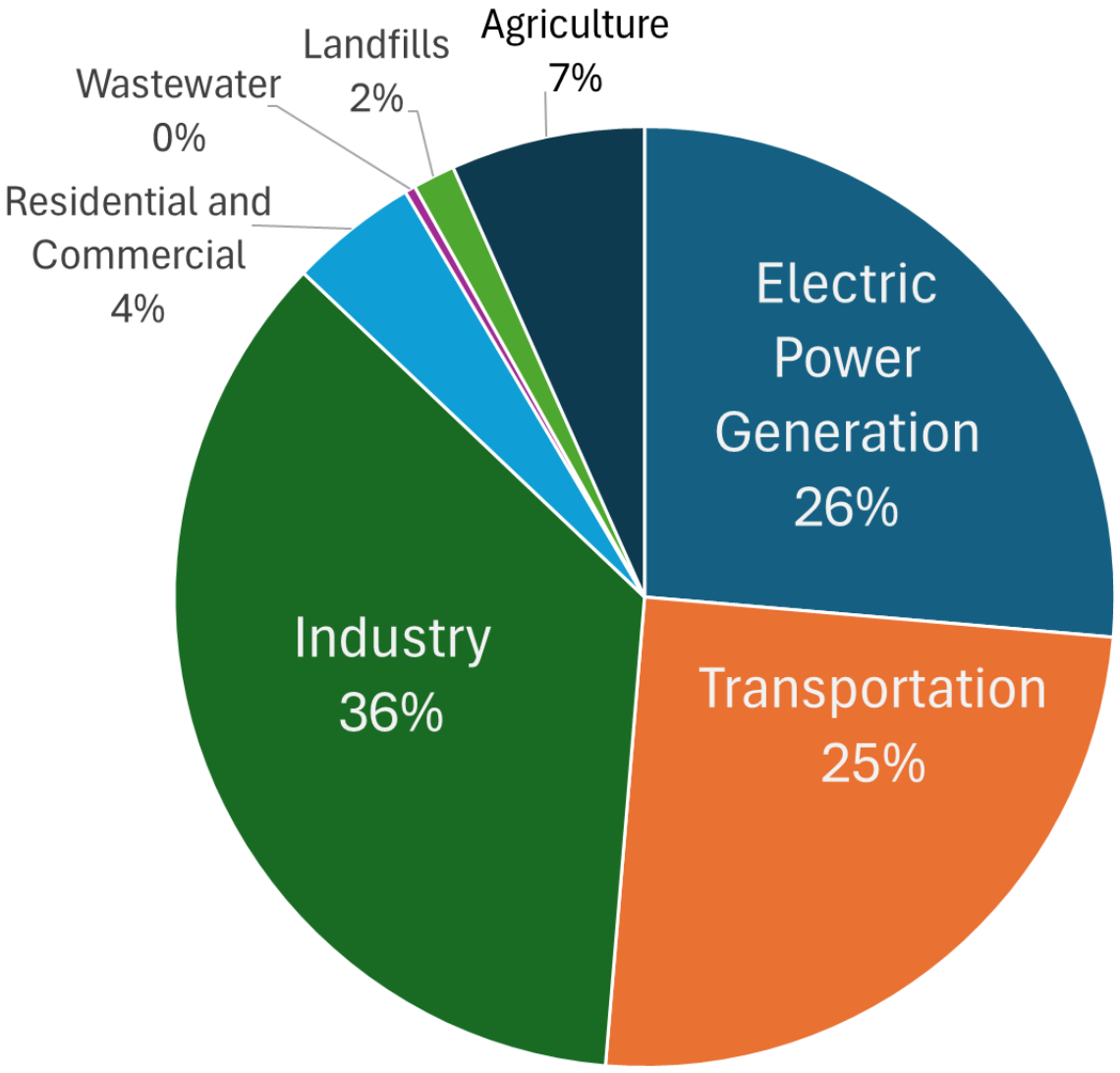

Figure 3-1: 2022 GHG Emissions in CO_2e by Economic Sector in Texas

Since industry is the largest contributor, it was further broken down into sectors and subsectors as defined by the GHGRP (EPA 2024a). The contributions from each industry sector to the 2022 Texas GHG EI are shown in Figure 3-2. The figure shows the industrial sector contributions on the inner ring. The outer ring shows the sub-sector contributions. Only the largest subsectors are labeled. The full breakdown of industrial emissions by sector and subsector is shown in Table 3-3. The figure and table show that most industrial emissions (88%) are from three sectors: Petroleum and Natural Gas Systems (44%), Chemicals (23%), and Refineries (21%).

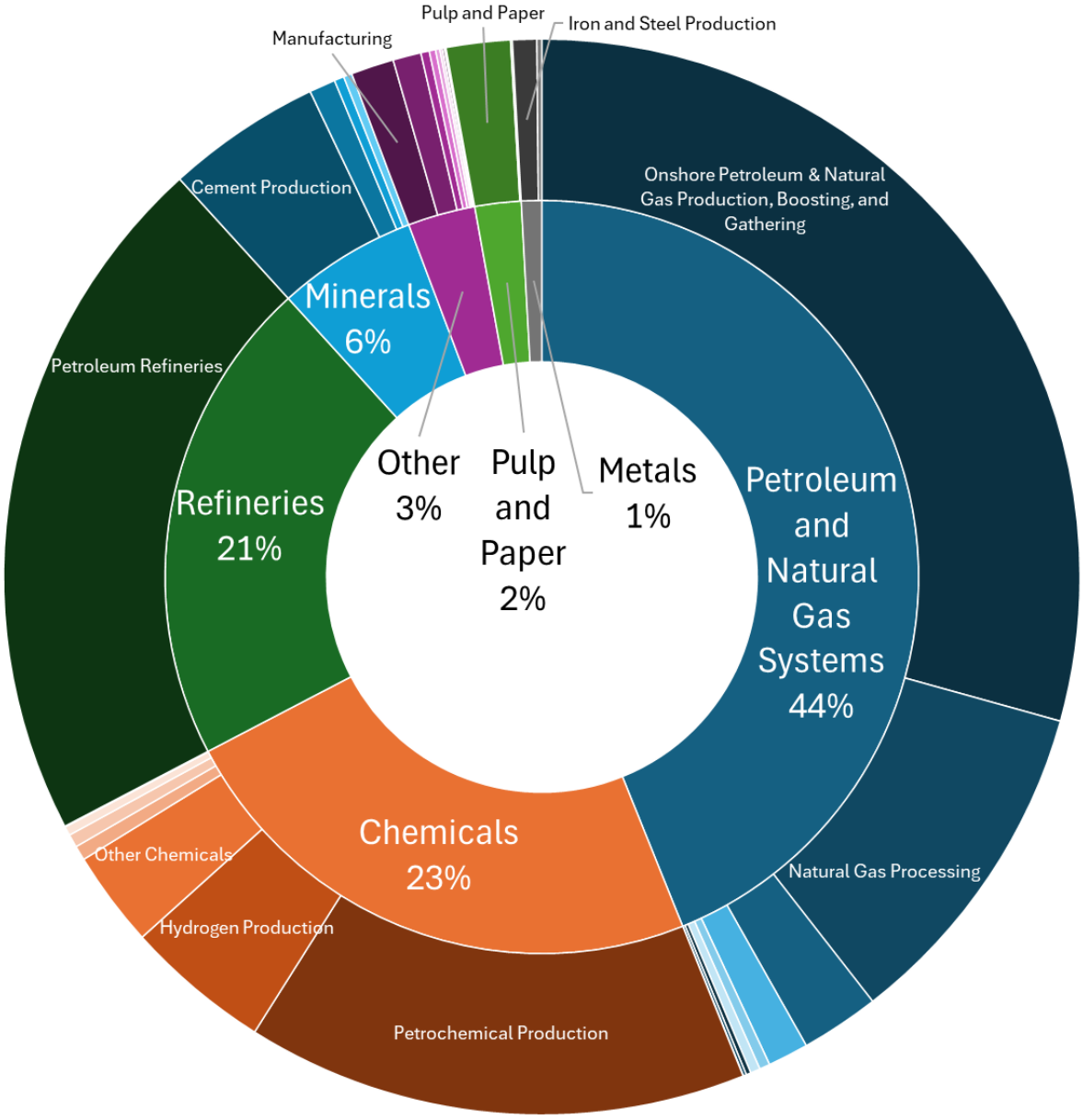

Figure 3-2: Industry Sector and Subsector Contributions to the 2022 GHG EI in Texas

Table 3-3: 2022 GHG Emissions in Texas by Industry Sector and Subsector

Industry Sector/Subsector	2022 GHG Emissions in Texas (MT CO_2e)
Petroleum and Natural Gas Systems	**114,293,233**
Onshore Petroleum & Natural Gas Production, Boosting, and Gathering	76,328,848
Natural Gas Processing	26,413,821
Natural Gas Transmission Compression	6,149,666
Liquefied Natural Gas Imp/Exp Equipment	3,179,424
Natural Gas Local Distribution Companies	822,315
Onshore Natural Gas Transmission Pipelines	761,316
Abandoned Wells	368,278
Underground Natural Gas Storage	249,069
Offshore Petroleum & Natural Gas Production	20,497
Liquefied Natural Gas Storage	-
Chemicals	**61,011,731**
Petrochemical Production	39,203,932
Hydrogen Production	11,363,400
Other Chemicals	7,505,491
Adipic Acid Production	1,140,479
Ammonia Manufacturing	1,026,667
Nitric Acid Production	704,206
Fluorinated GHG Production	67,554
Refineries	**54,457,659**
Petroleum Refineries	54,457,659
Minerals	**15,622,087**
Lime Manufacturing	2,057,253
Other Minerals	762,706
Glass Production	661,289
Other	**7,531,219**
Manufacturing	3,362,753
Electronics Manufacturing	2,202,871
Other	661,842
Food Processing	488,250
Ethanol Production	328,366
Universities	212,505
Use of Electrical Equipment	159,459
Military	115,173
Pulp and Paper	**5,155,108**
Pulp and Paper	5,014,969
Other Paper Producers	140,138
Metals	**2,274,643**
Iron and Steel Production	1,894,723
Other Metals	379,919

Industry Sector/Subsector	2022 GHG Emissions in Texas (MT CO_2e)
Total	**260,345,680**

3.2 GREENHOUSE GAS EMISSIONS INVENTORY TRENDS

The state-level GHG EI developed by UT Austin was the first GHG emissions inventory developed by Texas. Due to the methodological differences between the Texas inventory and the EPA state-level inventory, which is explained in detail in Appendix B, a trend comparison using the Texas developed inventory is not possible. To assess GHG emissions trends, TCEQ used EPA's state-level inventory data (EPA 2024b).

Figure 3-3 shows GHG trends by economic sector in Texas from 2005 through 2022 in million metric tons (MMT) of CO_2e. Note that these sectors do not align with the Texas developed inventory and are not directly comparable. Most sectors in Texas have seen an increase in GHG emissions from 2005 through 2022, with only the Electric Power Industry sector realizing a significant decrease over that time. Note that since the land use, land use change, and forestry (LULUCF) sector is a GHG sink the numbers for that sector are negative.

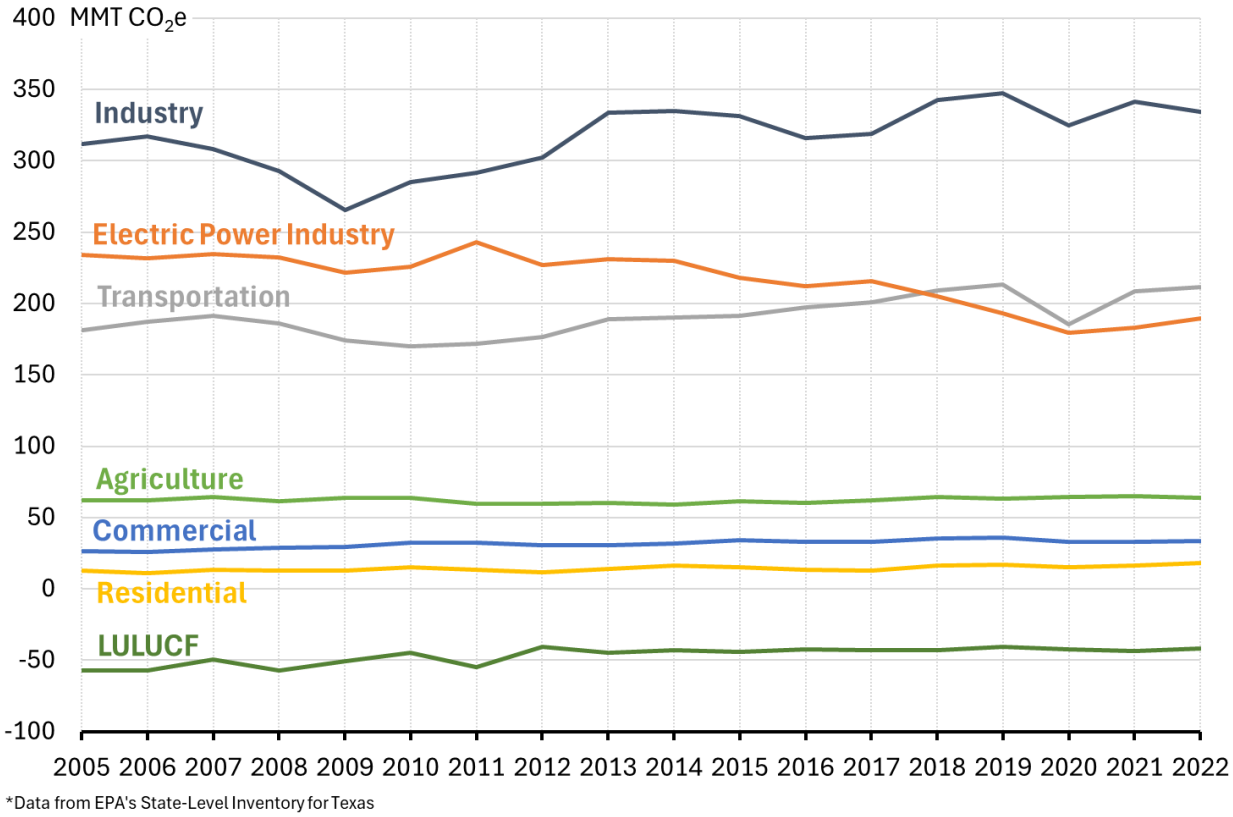

Figure 3-3: GHG Emissions Trends in Texas by Economic Sector

3.3 EI IMPROVEMENT

Inventory development identified sources of methane and nitrous oxide as those with the largest uncertainty because estimations are often based on extrapolations of

measurements from a small number of sources. A full discussion of improvements for any future GHG EI for Texas is discussed in Appendix C.

One source that has the potential for more development would be emissions from flares. Recent updates to GHGRP reporting requirements have changed the default destruction and removal efficiency (DRE) from 98% to 92%, which would nearly double reported emissions from flares burning natural gas. TCEQ is evaluating various research opportunities to assess the DRE at flares under various net heating values (NHV) and flow rates to determine what parameters would achieve higher DRE results.

CHAPTER 4: PROJECTIONS AND EMISSIONS REDUCTIONS

TCEQ used the Energy Policy Simulator (EPS) tool in combination with the GHG EI developed by UT Austin to determine projections, emissions reduction potential, and associated abatement costs (Energy Innovation and Rocky Mountain Institute 2025). Emissions of CO_2e were projected to 2050 for a business-as-usual (BAU) scenario, which includes Inflation Reduction Act (IRA) programs and EPA rules in place prior to January 1, 2025.

Emissions reductions were estimated using a full implementation (FI) scenario for the actions that are detailed in Chapter 5. FI projections are based on BAU projections. Changes in federal policies and programs after January 1, 2025, may impact the final reductions identified in this plan. TCEQ will rerun the EPS tool once updated to reflect current federal policy and provide more accurate numbers for the status report. Associated abatement costs reported include capital, fuel, and operating expenditures. These costs represent all expenses and savings associated with a measure for all associated entities. Negative abatement costs represent an overall saving associated with the emissions reduction action. Appendix C provides additional details about the methodology used for emissions projections, emission reduction quantifications, and implementation cost estimations.

Base year emissions and projections for the BAU and FI scenarios for all sectors are shown in Table 4-1. Figure 4-1 shows the 2022 base case emissions and projections for both scenarios for industry, electric power generation, and transportation; all other sectors are combined into a category titled “other.” Total emissions decrease for both scenarios, although there is some variability between sectors. All sectors in the FI scenario show a decrease in emissions from the BAU scenario. Overall, projected emissions show that full implementation of the actions described in Chapter 5 could reduce emissions by 121 MMT CO_2e by 2030 and 252 MMT CO_2e by 2050 and would lead to a net savings of $2.6 billion U.S. dollars (USD) in capital, fuel, and operating expenditures. As stated above, reductions may vary with changes to federal policy and programs.

EPS also provided quantified emission changes of volatile organic compounds (VOC), carbon monoxide (CO), coarse particulate matter (PM_{10}), nitrogen oxides (NO_X), fine particulate matter ($PM_{2.5}$), and sulfur oxides (SO_X). TCEQ used surrogate pollutant correlations to quantify changes in hazardous air pollutants (HAP). Estimates show total co-pollutant reductions of over 0.7 MMT by 2030 and over 2.7 MMT by 2050. Chapter 6 contains more details on co-pollutant benefits.

Table 4-1: Projected Emissions in Texas in MMT CO_2e by Sector

Sector/Source	Base Year 2022	BAU 2030	BAU 2050	FI 2030	FI 2050
Industry	260.346	252.155	241.005	204.996	93.129
Electric Power Generation	191.893	72.677	64.263	10.11	10.413
Transportation	181.753	158.747	94.931	148.912	47.529
Agriculture	48.590	46.160	45.000	45.920	44.670
Residential and Commercial	32.145	32.360	34.78	30.82	33.46
Wastewater and Landfills	13.234	13.410	12.960	13.390	12.050

Sector/Source	Base Year 2022	BAU 2030	BAU 2050	FI 2030	FI 2050
Total Emissions (Sources)	727.96	575.51	492.94	454.15	241.25
Natural and Working Lands Sector Net Total (Sinks)	(46.700)	(48.640)	(55.100)	(48.590)	(54.950)
Net Emissions (Sources and Sinks)	681.26	526.870	437.840	405.560	186.30

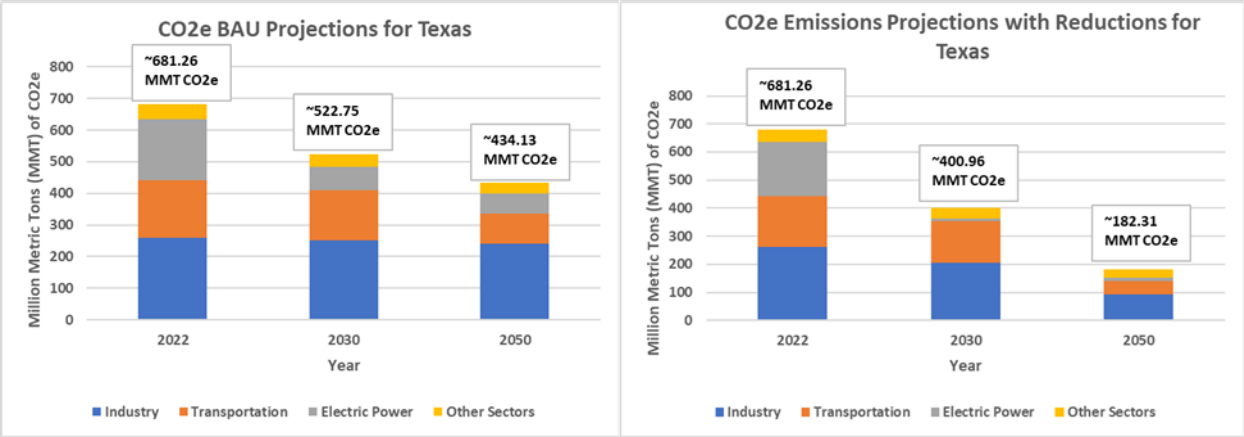

Figure 4-1: CO_2e Projections for Texas for a BAU Scenario (left) and a FI Scenario (right)

TCEQ used the projected emissions reductions from the full implementation scenario to estimate the achievable emissions reductions. To be consistent with EPA recommendations and targets set by other states, TCEQ chose 2005 as the base year. The 2005 base year emissions were obtained from EPA's state level inventory (EPA 2024b). Achievable emissions reductions were then set by calculating the change from 2005 levels to the full implementation scenario levels.

Based on the above method, Texas could reduce economy-wide emissions 6% below 2005 levels by 2030 and 19% below 2005 levels by 2050. The inclusion of achievable emissions reductions in this roadmap does not render achievement of these reductions binding on any entity of the state of Texas, its subdivisions, organizations operating in the state, and individuals living within the state.

CHAPTER 5: ACTIONS TO REDUCE EMISSIONS

The actions in this roadmap were identified by TCEQ with input from a variety of stakeholders. These are voluntary actions that may be implemented by the state, municipalities, private entities, or the public to reduce emissions throughout the state of Texas. Although there are actions for all economic sectors, many of these actions focus on the three economic sectors that produce the most emissions in the state: industry, transportation, and electric generation.

5.1 INDUSTRY ACTIONS

The industrial sector, which contributes 36% to GHG emissions in the state, presents the largest opportunity for impactful emissions reductions. Actions to encourage industrial innovation and to reduce emissions are listed in Table 5-1. Actions focus on upgrades to industrial equipment to facilitate electrification, fuel switching, energy efficiency, carbon capture, and methane reductions. These actions would be available for voluntary implementation by any industry within Texas.

Emissions reductions achievable through full implementation of industry actions and associated program costs or savings are also outlined in Table 5-1. Implementation schedules were determined from default scenarios built into EPS; more information on these scenarios is available in Appendix C. The low carbon cement, HFC replacement, and methane capture/flaring reductions were modeled for full implementation by 2030, and all of the other measures were modeled to have full implementation by 2050. If these voluntary actions are fully implemented, they would reduce industry emissions by 47 MMT CO_2e through 2030 and 148 MMT CO_2e through 2050 and would cost implementing entities approximately $5.7 billion in capital, fuel, and operational expenditures.

To encourage implementation of the actions in Table 5-1 by 2050, TCEQ will rely on existing programs in addition to regular communication to inform stakeholders of new emission reduction technologies and funding opportunities as they become available. One program Texas uses to incentivize industrial emissions reductions is TCEQ's New Technology Implementation Grant (NTIG) program, which is part of the Texas Emissions Reduction Plan (TERP). TERP is a TCEQ program, established in 2001 (TCEQ 2025a), that provides people and businesses grant funding to purchase new vehicles and equipment. As a part of TERP, NTIG offers competitive grants to implement new technologies that reduce emissions of pollutants from facilities and other stationary sources (TCEQ 2025b).

Texas may also continue to rely on federal programs such as the U. S. Department of Energy's (DOE) and EPA's Mitigating Emissions from Marginal Conventional Wells program. TCEQ is implementing this program, called the Texas Voluntary Marginal Conventional Well Plugging Program (TxMCW), to remediate or plug low producing wells (TCEQ 2025c). Additionally, a new bill from Texas' 89th legislative session limits extensions for plugging inactive oil, gas, or injection wells, which may lead to additional well remediation (Tex. S.B. 1150, 89th Leg., R.S. (2025)).

Additional funding may be needed to achieve full implementation of reduction actions. Other potential funding sources are listed in Chapter 7.

Table 5-1: Voluntary Actions to Reduce Industry Emissions in Texas

Action	2030 Reductions (MMT CO_2e)	2050 Reductions (MMT CO_2e)	FI Cost (Million USD)
Electrify industrial process equipment or modify equipment to use hydrogen or other low emission fuels	18.52	77.58	$5,608
Energy efficiency improvements to processes and equipment	7.03	8.09	-$848
Use of low carbon cement	0.96	0.05	-$55
Improvement/expansion of carbon capture	17.81	53.96	$1,142
Replace HFC with ultra-low GWP refrigeration equipment	1.02	1.34	$27
Replace pneumatic controllers, motors, and pumps, add surveillance, add monitoring, and remove redundant equipment to reduce fugitive emissions from oil and gas activities	0.81	1.03	-$611
Reduce flaring and capture methane from oil and gas activities	0.36	5.52	$686
Remediate and/or plug low producing and abandoned wells	0.64	0.30	-$236
Total	**47.15**	**147.87**	**$5,713**

Table 5-2 outlines the milestones and timelines to encourage industrial innovation to reduce emissions.

Table 5-2: Implementation Timelines and Milestones for Encouraging Industrial Emissions Reductions

Milestone	Timeline
Newsletter to inform stakeholders of new or existing funding programs and highlight implemented projects	Four months to develop. Newsletter sent twice a year.
Conference to inform stakeholders of new emissions reduction innovations	Ten months to develop content. Held annually.
Implementation of NTIG program	Two-year increments.
Implementation of TxMCW	Five years to complete program.

To track progress towards full implementation of these actions, TCEQ intends to use the following metrics:

- Number of newsletter subscribers.
- Number of conference attendees.
- Number of NTIG projects awarded.
- Number of electric boilers installed.
- Estimated amount of energy efficiency improvements made.
- Estimated amount of low carbon cement produced.
- Number of carbon capture projects permitted.

- Number of abandoned or low producing wells plugged.

5.2 ELECTRIC GENERATION ACTIONS

Texas leads the nation in electricity generation, and the electric power sector is the second largest source of GHG emissions in Texas. This sector is one of the only economic sectors in the state to show GHG emission reductions from 2005 through 2022. These decreases are mainly due to the transition from coal to natural gas, but Texas also has a strong renewable energy portfolio. Texas leads the nation in wind generation and is the nation's second largest producer of solar power (US EIA 2025).

Actions to reduce emissions from the electric generation sector, emissions reductions achievable through full implementation of those actions, and associated program costs are listed in Table 5-3. Actions focus on facilitating access to clean energy with upgraded transmission and storage, promotion of advanced clean energy sources, such as nuclear or geothermal, lowering demand, and carbon capture and storage. These actions would be available for voluntary implementation by any entity within Texas.

Actions were modeled for implementation dates ranging from 2025 through 2050, with most actions having full implementation by 2050. Details on specific implementation dates modeled are available in Appendix C. If these actions are fully implemented, they would reduce electric generation emissions by 63 MMT CO_2e through 2030 and by 54 MMT CO_2e through 2050. These actions would save implementing entities $4.3 billion in capital, fuel and operational expenses.

TCEQ intends to leverage the NTIG program to encourage renewable energy storage projects and will use existing programs and communication channels to encourage adoption of the actions in Table 5-3. Implementation of projects in advanced nuclear energy are expected through the Texas Advanced Nuclear Energy Office and the Texas Advanced Nuclear Development fund, which was established during Texas' 89th legislative session in 2025 (Tex. H.B. 14, 89th Leg., R.S. (2025)). The new office will support the development and deployment of advanced nuclear energy in the state as well as provide grants to fund advanced nuclear projects within Texas.

Implementation of load shifting, load management, and energy efficiency projects may happen through the newly created Texas Energy Waste Advisory Committee; established during Texas' 89th legislative session in 2025 (Tex. H.B. 5323, 89th Leg., R.S. (2025)). The advisory committee will be composed of several state agencies, including TCEQ, and will make recommendations for coordinating and improving programs that increase energy efficiency, enhance demand response programs, and reduce energy waste.

Energy efficiency actions may also be implemented through the Public Utilities Commission of Texas (PUCT), which oversees energy efficiency programs administered by eight investor-owned utilities (IOUs) (PUCT 2025). These IOUs have energy efficiency goals set by the Texas Public Utility Regulatory Act Section 39.905. IOU energy efficiency programs can be found on the PUCT's Energy Efficiency Programs website. Other funding sources to reduce emissions from electric generation are in Chapter 7.

Table 5-3: Voluntary Actions to Reduce Electric Generation Emissions

Action	2030 Reductions (MMT CO_2e)	2050 Reductions (MMT CO_2e)	FI Cost (Million USD)
Upgrade transmission lines to improve capacity	0.380	7.587	-$425
Use advanced nuclear energy or geothermal energy	61.381	23.388	-$3,426
Add grid scale renewable energy storage	0	7.991	$65
Lower demand with load shifting, load management, and energy efficiency	0.806	14.884	-$1,650
Add infrastructure to capture, use, and store carbon from both power plants and industrial processes[1]	0	0	$1,114
Total	**62.567**	**53.85**	**-$4,322**

1 Reductions from carbon capture, use, and storage were projected to be 11.5 MMT CO_2e by 2047, but those projections increased in 2050 resulting in zero overall reductions.

Table 5-4 outlines the milestones and timelines to encourage electric generation emissions reductions.

Table 5-4: Implementation Timelines and Milestone for Encouraging Electric Generation Emissions Reductions

Milestone	Timeline
Implementation of NTIG program	Two-year increments.
Newsletter to inform stakeholders of new or existing funding programs and highlight implemented projects	Four months to develop. Newsletter will be sent twice a year.
Development and implementation of Texas Advanced Nuclear Energy Office and Texas Advanced Nuclear Energy fund	Bill to establish the office and fund are effective September 1, 2025, and will expire in 2040
Energy saving recommendations from Texas Energy Waste Advisory Committee	By December 1 of even numbered years beginning on September 1, 2025

To track progress towards full implementation of these actions, TCEQ intends to use the following metrics:

- Number of battery storage projects granted through NTIG.
- Number of newsletter subscribers.
- Projects awarded through the Texas Advanced Nuclear Energy Fund.
- Energy efficiency demand reductions.

5.3 TRANSPORTATION ACTIONS

The transportation sector in Texas is the third largest GHG emissions sector and contributes one quarter of the total GHG emissions in the state. Actions to reduce emissions from the transportation sector are listed in Table 5-5. These actions include using zero emission light-, medium-, and heavy-duty vehicles, infrastructure, and decarbonization incentives for ports, airports, and railways and are available for voluntary implementation by any entity within Texas.

Table 5-5 also includes the emissions reductions achievable through full implementation of these actions and the associated program costs or savings. Infrastructure actions were modeled for full implementation by 2030, port and locomotive actions were modeled for full implementation by 2035, and all other actions were modeled to have full implementation by 2050. If these actions are fully implemented, they would reduce transportation emissions by 10 MMT CO_2e through 2030 and by 47 MMT CO_2e through 2050 and would save implementing entities $3.7 billion in capital, fuel, and operational expenditures.

Texas will continue to use the highly successful incentive programs established through TERP to encourage transportation emissions reductions. TERP provides people and businesses grant funding to purchase new vehicles and equipment in industries like trucking, farming, and construction. Grant recipients use awarded funds for replacement or retrofit of older vehicles and equipment with newer, cleaner technology generating emissions reductions from a wide variety of mobile sources. Information on grant funding programs, including those available through TERP, is in Chapter 7.

Other federal programs that Texas is using to encourage transportation sector emissions reductions are the U.S. Department of Transportation's (DOT) Federal Highway Administration (FHWA) National Electric Vehicle Infrastructure (NEVI) Formula Program and EPA's Clean Ports Program. The Texas Department of Transportation (TxDOT) is implementing the NEVI program, which will add electric vehicle (EV) charging infrastructure throughout Texas (TxDOT 2025). Three ports in Texas, City of Wilmer, Port of Houston, and Port Freeport, were awarded funding to create a Climate and Air Quality Plan through the Clean Ports Program (EPA 2025a). Those plans will include emissions inventories, emissions reductions strategies, and resiliency planning. In addition, the Port of Corpus Christi Authority was awarded a zero-emissions technology grant through the Clean Ports Program (EPA 2025a) to implement electric cargo handling equipment, locomotives, and vessels, charging infrastructure, and vessel shore power.

Table 5-5: Voluntary Actions to Reduce Transportation Emissions in Texas

Action	2030 Reductions (MMT CO_2e)	2050 Reductions (MMT CO_2e)	FI Cost (Million USD)
Reduce emissions from sea and inland ports and associated support equipment and use low emission passenger or freight locomotives	0.419	1.832	-$32
Add infrastructure for electric vehicle (EV) charging and hydrogen fueling	0.008	0.120	-$12
Use zero emissions light-, medium-, and heavy-duty vehicles, including school buses and fleet vehicles	3.382	24.671	-$2,467
Reduce airport emissions by using lower emission support equipment, vehicles, and use of low emission jet fuels.	6.411	20.780	-$1,164
Total	**9.8349**	**47.403**	**-$3,675**

Table 5-6 outlines the milestones and timelines to encourage transportation emissions reductions.

Table 5-6: Implementation Timelines and Milestone for Encouraging Transportation Emissions Reductions

Milestone	Timeline
Administer TERP	Two-year increments for all grants.
Fully implement NEVI	Program completed at the end of fiscal year 2026.
Implement awards from the Clean Ports Program	Three to four years.

To track progress towards full implementation of these actions, TCEQ intends to use the following metrics:

- Number of registered EVs.
- Number of EV charging stations installed.
- Number of TERP projects awarded for each TERP grant.

5.4 OTHER ACTIONS

The remaining economic sectors, residential, commercial, municipal wastewater and landfills, agriculture, and natural and working lands, have much lower emissions when compared with industry, electric generation, and transportation. The actions from these remaining sectors will be grouped into a category labeled "other."

Actions to reduce emissions from these remaining economic sectors, the emissions reductions achievable through full implementation, and associated program costs or savings are listed in Table 5-7. These actions span multiple economic sectors and include biogas recovery and utilization, rooftop solar, electric heat pumps, energy efficiency, sustainable agricultural processes, reforestation, and landscape restoration. These actions are available for voluntary implementation by any entity within Texas.

Actions were modeled for implementation dates ranging from 2025 through 2050, with most actions having full implementation by 2050. Details on specific implementation dates modeled are available in Appendix C. If fully implemented, the actions in Table 5-7 would reduce emissions by 2 MMT CO_2e through 2030 and 3 MMT CO_2e through 2050 and save implementing entities $314 million in capital, fuel, and operational expenses.

TCEQ relies on the statewide Take Care of Texas Campaign to communicate waste reduction strategies to stakeholders and the public (Take Care of Texas 2025). TCEQ also administers the Galveston Bay Estuary Program (GBEP), one of two estuary programs in Texas, which preserves and improves the coastal areas surrounding Galveston Bay (GBEP 2025). TCEQ will use other existing communication channels and programs to educate stakeholders and encourage emissions reductions in Table 5-7.

Energy efficiency in new homes and commercial buildings could be implemented with newer building and energy codes. A bill from Texas' 89th legislative session gave Texas' State Energy Conservation Office (SECO) the authority to adopt new energy codes and high-performance building codes (Tex. S.B. 783, 89th Leg., R.S. (2025)). SECO has started the process by collecting comments on the adoption consideration of the 2024

International Energy Conservation Code (IECC) and the 2024 International Residential Code (IRC) (SECO 2025a).

Other federal programs that Texas is using to encourage emissions reductions for other economic sectors are the DOE's Home Energy Performance-Based, Whole House (HOMES) rebate program and the Home Electrification and Appliances Rebate (HEAR) program, implemented by SECO (SECO 2025b). The HOMES rebate program incentivizes whole-home retrofits in both single-family and multifamily units, while the HEAR program provides energy efficient appliance rebates. Information on additional funding programs related to these other economic sectors is in Chapter 7.

Table 5-7: Voluntary Actions to Reduce Emissions from Other Sectors

Action	Sector	2030 Reductions (MMT CO_2e)	2050 Reductions (MMT CO_2e)	FI Cost (Million USD)
Create biofuels through methane capture from landfills and wastewater treatment plants, or by using surplus biomass	Industry/ Commercial/ Municipal Wastewater and Landfills	0.021	0.067	$5
Add solar arrays to closed landfills and add solar to commercial and residential buildings	Commercial/ Residential/ Electric Power/ Industry/ Landfills	1.223	0.020	$78
Switch to electric heat pumps	Industry/ Commercial/ Residential	0.315	1.162	$88
Increase energy efficiency and weatherization in homes and commercial buildings	Commercial/ Residential	0.003	0.141	-$55
Support projects to increase recycling, reduce waste, increase composting, and add recycling infrastructure	Industry/ Commercial/ Residential/ Municipal Wastewater and Landfills	5.11E-07	0.837	-$451
Use sustainable agriculture or forestry practices to reduce emissions and restore coastal landscapes	Agriculture/ Natural and Working Lands	0.212	0.257	$13
Reforest agriculture lands no longer in use and increase urban tree canopy	Agriculture/ Natural and Working Lands	0.077	0.213	$8
Total		**1.851**	**2.697**	**-$314**

Table 5-8 outlines the milestones and timelines to encourage emissions reductions from other economic sectors.

Table 5-8: Implementation Timelines and Milestone for Encouraging Emissions Reductions from Other Sectors

Milestone	Timeline
Send Take Care of Texas Newsletter	Monthly
Implement GBEP strategic plans	36-month period ending in 2026

Milestone	Timeline
Initiate process to adopt new energy codes for residential and commercial buildings	3 years for commercial codes and 6 years for residential codes
Implement HOMES and HEAR rebate program	Six years, ending in 2031

To track progress towards full implementation of these actions, TCEQ intends to use the following metrics:

- Number of newsletter subscribers.
- Report card trends for GBEP.
- Number of rebates from HOMES and HEAR program.
- Megawatt hours of commercial small scale solar.
- Acres of forested land.

CHAPTER 6: BENEFITS ANALYSIS

6.1 CO-POLLUTANT INVENTORY

Due to the broad scope of this roadmap, co-pollutant reduction benefits are anticipated from almost all emissions sources within Texas. TCEQ obtained criteria air pollutant (CAP) emissions for base year 2022 from EPA's 2020 National Emissions Inventory (NEI), which EPA projected to 2022 for modeling purposes (EPA 2025b). TCEQ used EPA's 2020 NEI to obtain HAP emissions since EPA did not project those emissions for 2022 (EPA 2025c). Details of specific HAPS included in the inventory are in Appendix C.

Table 6-1 shows 2022 CAP and 2020 HAP emissions for Texas by economic sector. The co-pollutant inventory by county is available in Appendix D. The inventory shows that Texas emissions are mostly from VOC, CO, PM_{10}, and NO_X. Most of those emissions are in the industry, transportation, and agriculture sectors.

Table 6-1: 2022 CAP Emissions Inventory and 2020 HAP Emissions Inventory for Texas by Economic Sector and Pollutant

Sector	VOC (tons)	CO (tons)	PM_{10} (tons)	NO_X (tons)	$PM_{2.5}$ (tons)	SO_X (tons)	HAP (tons)
Industry	1,661,462	344,886	62,682	411,689	27,075	217,834	61,272
Electric Power Generation	2,691	109,294	12,908	79,414	11,148	110,737	NA
Transportation	174,721	2,086,185	982,498	336,570	124,182	3,107	40,710
Agriculture	2,779,427	382,141	421,170	100,774	85,608	12	290,204
Residential and Commercial	8,026	45,982	14,051	34,368	13,337	463	1,822
Wastewater and Landfills	14,010	115,386	19,409	4,256	17,290	1980	2,278
Natural and Working Lands	230,385	1,078,944	178,380	19,891	151,298	12,368	43,251
State Total	**4,870,721**	**4,162,818**	**1,691,099**	**986,961**	**429,940**	**346,501**	**439,537**

6.2 CO-POLLUTION PROJECTIONS AND REDUCTIONS

TCEQ used the EPS tool to determine projections and emissions reductions of VOC, CO, PM_{10}, NO_X, $PM_{2.5}$, and SO_X for both a BAU scenario and a FI scenario. TCEQ determined projections and emissions reductions of HAP emissions using surrogate pollutant correlations. The FI scenario represents the maximum achievable CAP and HAP emissions reductions that could occur if the actions in Chapter 5 are fully implemented. As mentioned in Chapter 4, these projections and quantifications do not account for changes to federal policy and programs that occurred after January 1, 2025. TCEQ plans to update projections with more accurate numbers in the status report. Appendix C contains full details on the methodology used to project criteria pollutant and HAP emissions.

CAP and HAP emissions projections for 2030 for both the BAU and the FI scenarios are displayed in Figure 6-1. Detailed information on the projections for each sector is in Appendix C. Although there is some variability within each economic sector,

projections show overall decreases from the BAU to the FI scenario for all pollutants in 2030.

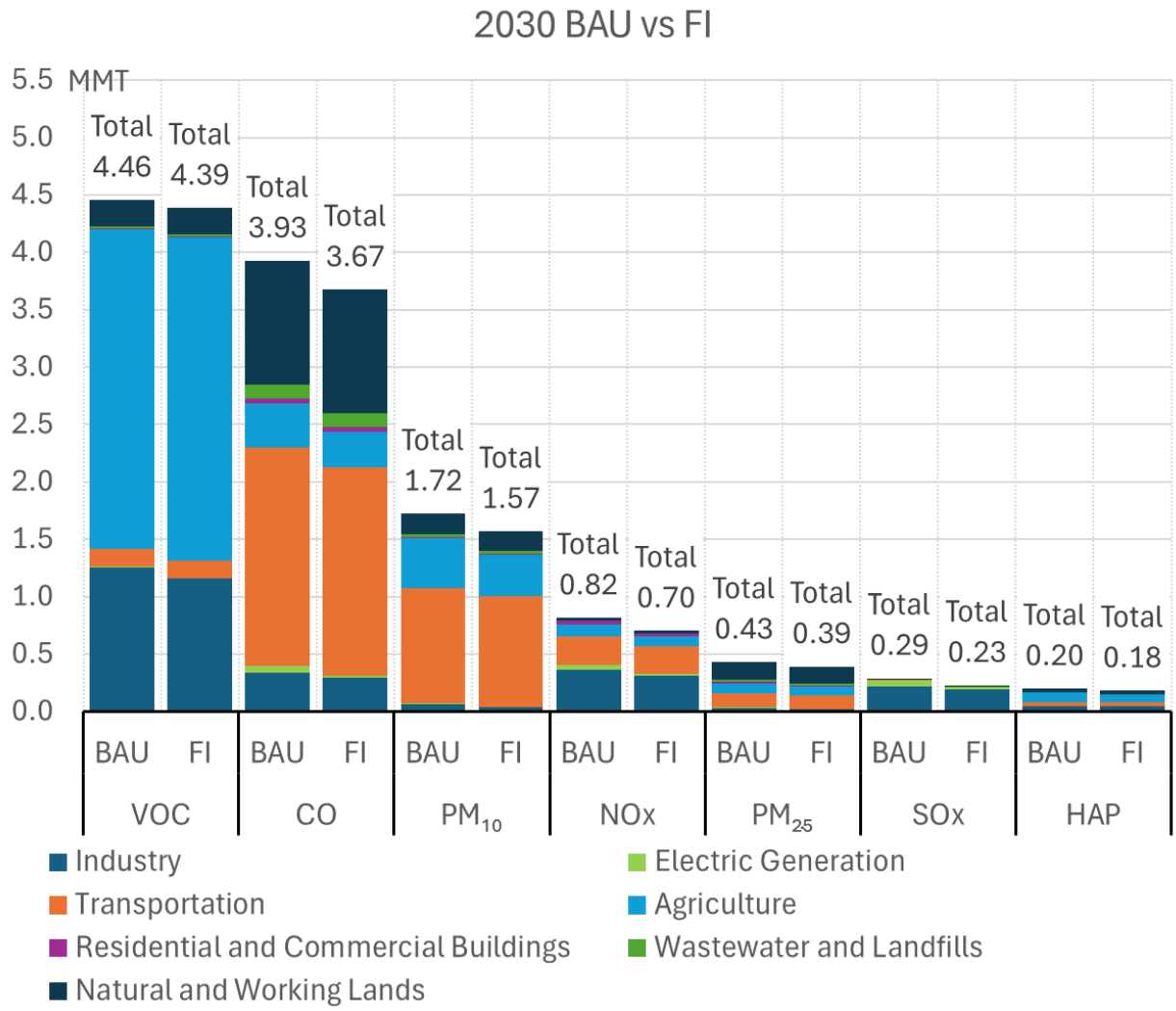

Figure 6-1: 2030 CAP and HAP Emissions Projections for the BAU and the FI Scenarios

Table 6-2 lists the 2030 CAP and HAP emissions changes that are achievable through full implementation of the actions detailed in Chapter 5. Values in parentheses indicate an increase while all other values indicate a decrease. Overall, CAP and HAP emissions show total decreases of over 0.7 MMT by 2030. Most reductions are from CO, PM_{10}, and NO_X and occur within the industry, transportation, and agriculture sectors. VOC and NO_X, precursors to ozone formation, showed reductions of 70,070 tons and 113,200 tons, which should result in ozone reductions.

The only increase was in VOC from agriculture. Trends in VOC from agriculture will be closely monitored to determine if these disbenefits will occur. Use of low VOC agriculture products and materials will be encouraged to help mitigate this potential disbenefit.

Table 6-2: 2030 CAP and HAP Emissions Changes Achievable with FI

Sector	VOC (tons)	CO (tons)	PM_{10} (tons)	NO_X (tons)	$PM_{2.5}$ (tons)	SO_X (tons)	HAP (tons)
Industry	99,350	48,550	31,470	51,900	6,400	30,840	816
Electric Power Generation	1,590	43,150	6,300	30,880	5,730	30,480	
Transportation	7,790	82,820	34,680	4,310	4,470	430	1,548
Agriculture	(39,890)	71,320	71,070	18,880	14,490	3	15,826
Residential and Commercial	1,230	6,050	291	7,220	2,730	85	192
Wastewater and Landfills	0	0	0	0	0	0	0
Natural and Working Lands	0	0	0	0	0	0	0
State Total	**70,070**	**251,900**	**153,240**	**113,200**	**39,030**	**61,850**	**18,382**

CAP and HAP emissions projections for 2050 for both the BAU and the FI scenarios are displayed in Figure 6-2. Note that the 2050 FI projection for SO_X is less than 0. This is because the model and methods used to calculate these projections rely on trends. Values below 0 are retained so that the differences can be used to determine quantifications. Further information on the projections for each sector is in Appendix C. Although there is some variability within each economic sector, projections show further decreases from the BAU to the FI scenario for all pollutants in 2050.

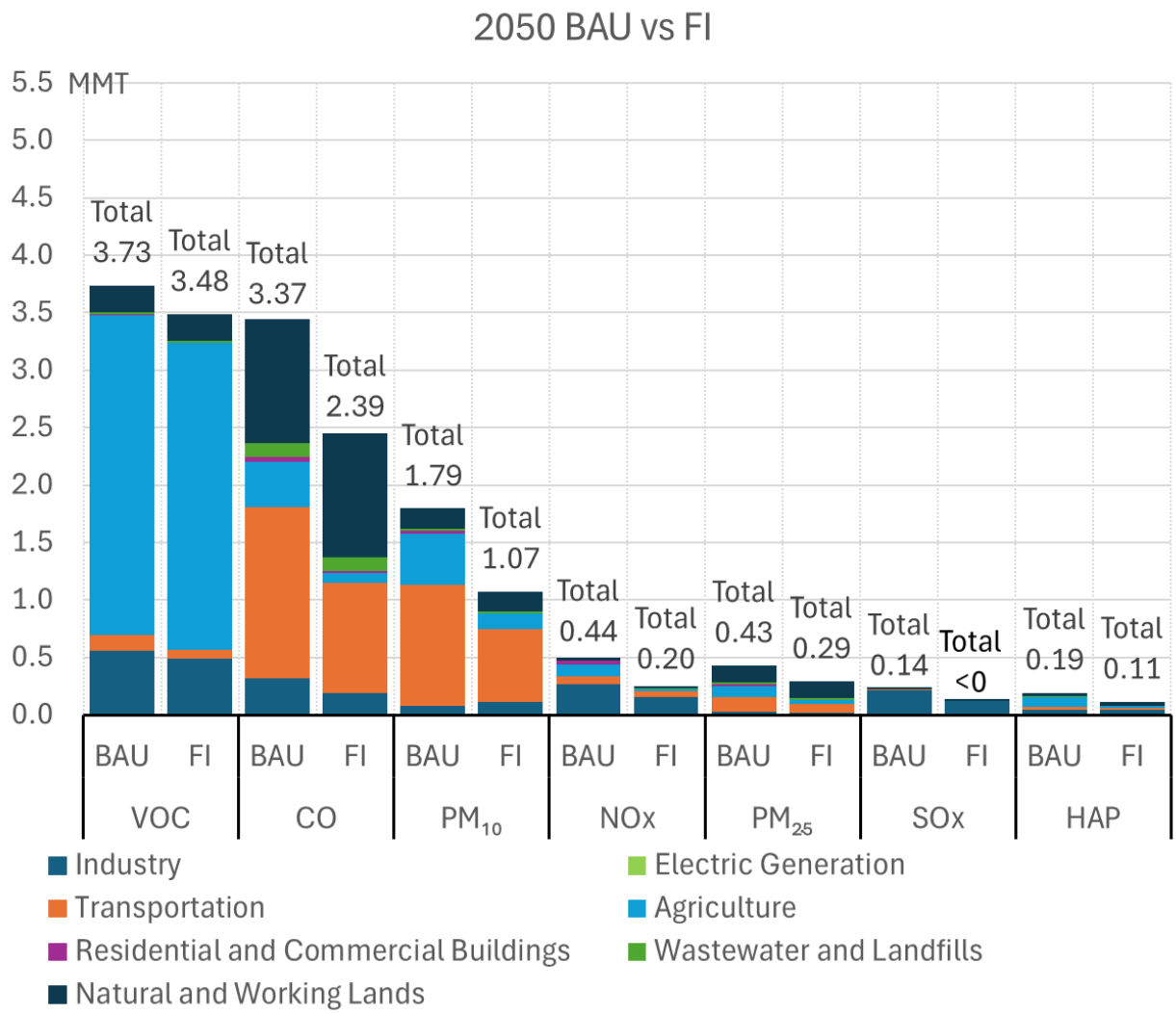

Figure 6-2: 2050 CAP and HAP Emissions Projections for the BAU and the FI Scenarios

Table 6-3 lists the 2050 CAP and HAP emissions changes that are achievable through full implementation of the actions detailed in Chapter 5. Values in parentheses indicate an increase while all other values indicate a decrease. Overall, CAP and HAP emissions show total decreases of over 2.7 MMT by 2050. Most reductions are from CO and PM_{10} and occur within the industry, transportation, and agriculture sectors. VOC and NO_x, precursors to ozone formation, showed reductions of 250,510 tons and 239,200 tons, which should result in ozone reductions. Although VOC emissions from agriculture increased in 2030, they decreased by 2050.

There were some emission increases in 2050, mainly from VOC, CO, PM_{10}, NO_x, and $PM_{2.5}$ from the electric power sector. There were also increases in PM_{10} from industry. These increases cannot be linked to a specific measure because EPS only quantifies economy-wide reductions of co-pollutants. One reason for the co-pollutant increases in the electric power sector and the PM_{10} increases in the industry sector could be carbon capture, use, and storage, which can increase emissions if using energy intensive processes (Bose et al. 2024). Emissions from these sectors will be tracked to determine

if disbenefits are occurring. Process optimization will be encouraged to mitigate disbenefits from electric power generation. Dust suppression and process optimization will be encouraged to mitigate PM_{10} disbenefits from industry.

Table 6-3: 2050 CAP and HAP Emissions Changes Achievable with FI

Sector	VOC (tons)	CO (tons)	PM_{10} (tons)	NO_X (tons)	$PM_{2.5}$ (tons)	SO_X (tons)	HAP (tons)
Industry	74,800	135,520	(38,070)	115,210	6040	99,220	860
Electric Power Generation	(660)	(13,460)	(2300)	(6260)	(1880)	183,610	
Transportation	49,250	523,920	424,910	20,990	50,530	1990	9800
Agriculture	120,780	304,220	313,300	79,320	63,870	14	67,531
Residential and Commercial	6340	29,170	15,970	29,920	14,980	330	926
Wastewater and Landfills	0	0	0	0	0	0	0
Natural and Working Lands	0	0	0	0	0	0	0
State Total	**250,510**	**979,370**	**720,620**	**239,200**	**138,760**	**285,160**	**79,117**

6.3 IMPACTS TO COMMUNITIES

Because actions in this roadmap are broad in scope, Texas anticipates significant benefits to communities. There are several areas encompassing large populations in Texas that fail to meet the NAAQS for ozone, particulate matter, or sulfur dioxide. Texas currently has three nonattainment areas for the 2015 eight-hour ozone NAAQS that span 16 counties. Those counties are Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Tarrant, Wise, Brazoria, Chambers, Fort Bend, Galveston, Harris, Montgomery, and Bexar. Texas has one county, El Paso, designated as nonattainment for PM_{10} and eight counties designated as nonattainment for the 2010 sulfur dioxide NAAQS - Anderson, Freestone, Howard, Hutchinson, Navarro, Panola, Rusk, and Titus. Emissions reductions from this roadmap should produce improved air quality for these areas.

Texas counties with numerous industrial facilities include, but are not limited to, Harris, Dallas, Tarrant, Brazoria, Jefferson, Wise, Chambers Nueces, Bexar, Galveston, Johnson, and Orange. Many of these counties are also located within a nonattainment area. In addition to large industrial facilities, many counties include oil and gas operations. Oil and gas activities span across Texas but are concentrated in areas such as the Permian Basin in west Texas, the Granite Wash in the Panhandle, the Barnett Shale west of the Dallas-Fort Worth Area, the Eagle Ford Shale south of San Antonio, and the Haynesville Shale in east Texas.

Anticipated, qualitative benefits and the actions associated with each benefit are listed in Table 6-4. TCEQ used EPA's report on Climate Change and Social Vulnerability to determine potential qualitative benefits from reduced emissions (EPA 2021).

Table 6-4: Action Benefits

Benefit	Related Measure
Improved public health due to co-pollutant reductions of ozone, nitrogen oxides (NO_X) volatile organic compounds (VOC), sulfur dioxide (SO_2), fine particulate matter ($PM_{2.5}$), coarse particulate matter (PM_{10}), black carbon, organic carbon, and carbon monoxide (CO).	Electrify industrial equipment and use hydrogen; promote energy efficiency in industry; low carbon cement; carbon capture, storage, and utilization; fugitive reduction, methane capture, and well remediation and/or plugging in the oil and gas industry; port, airport, and railway decarbonization; electric vehicle infrastructure; zero emission vehicles and equipment; methane capture for biogas; electric heat pumps in buildings; rooftop solar in buildings; and energy efficiency in buildings.
Less heat exposure, less premature heat related deaths, less labor hours lost, and increased quality of life due to mitigation of extreme temperatures.	All measures.
Decreases in traffic, decreased property loss, and decreased deaths due to less coastal flooding.	All measures.
Creation of high-quality jobs, increased opportunities for small businesses, increased training in new and emerging technologies.	All measures.
Enhanced community engagement.	All measures.
Improved access to services and community amenities, new green spaces, increased community beautification.	Electric vehicle and hydrogen fueling infrastructure; zero emission school buses; rebates for light-duty zero emission vehicles; medium and heavy-duty scrappage program; electric heat pumps; rooftop solar; energy efficiency and weatherization in buildings; recycling and waste reduction; increased urban tree canopy and reforestation; and coastal restoration.
Lower energy costs.	Industrial energy efficiency; transmission line upgrades; increased renewable storage; nuclear energy; geothermal energy; lowering demand through load shifting, load management, and energy efficiency; capturing methane to create biogas; rooftop solar on buildings; and energy efficiency and weatherization for buildings.

CHAPTER 7: AVAILABLE FUNDING AND PROGRAMS TO REDUCE EMISSIONS

To implement voluntary industrial actions, stakeholders may choose to participate in an existing program or use an existing funding opportunity. Funding may be in the form of grants; rebates; loans; tax deductions, exemptions, or credits; technical assistance; or free assessments. Stakeholders must verify eligibility before participating in any program listed in this document. Programs listed in this section are current as of September 15, 2025, and availability is subject to change.

Table 7-1 lists out the existing programs in Texas, the relevant economic sector, a short description of the program, eligibility, and funding type. Detailed information is provided on each individual program's website. The program website is included as a link in the program name. Note that this list is not an all-inclusive list of available funding within the state; there are many local incentive programs available through local governments and energy efficiency programs available through electric utilities. A list of additional programs is available in the Database of State Incentive for Renewable and Efficiency (DSIRE) for Texas.

Table 7-1: Emissions Reductions Programs and Funding Opportunities in Texas

Program	Sector(s)	Description	Eligible Applicants	Funding Type(s)
TxMCW	Industry	Financial assistance to plug low producing conventional oil and gas wells	Owners and operators of marginal conventional wells	Grants
NTIG	Industry; Electric Generation	Competitive grants for projects that reduce emissions from stationary sources or from upstream, midstream, and downstream oil and gas industry activities	Individuals, state and local governments, corporations, or any other legal entity	Competitive Grants
Industrial Training and Assessment Centers (ITAC)	Industry	Provides free energy efficiency assessments and grants to implement those assessments.	Small to medium size manufacturers	Free Assessment; Grants
Onsite Energy Technical Assistance Partnerships (TAPs)	Industry; Commercial	Provides free technical assistance to identify and implement technologies to achieve site-specific energy objectives	Industrial facilities and large energy users with onsite energy generation	Technical Assistance; Free Assessment;
Better Plants	Industry; Wastewater	Free program provides technical assistance, tools, resources and national recognition to organizations that set energy, water, or waste reduction goals	U.S. based manufacturing company or industrial-scale energy using organizations	Technical Assistance

Program	Sector(s)	Description	Eligible Applicants	Funding Type(s)
Texas Property Assessed Clean Energy (TX-PACE)	Industry; Residential and Commercial	Long-term financing for property owners to upgrade to energy efficient, water conserving, or on-site generation technologies	Property owners located withing a TX-PACE program area	Loans
Lone Star Commercial Property Assessed Clean Energy (C-Pace)	Industry; Residential and Commercial	Long-term financing for property owners to upgrade to energy efficient, water conserving, or on-site generation technologies	Property Owners located withing a C-Pace program area	Loans
Texas Industrial Energy Efficiency Program (TIEEP)	Industry	Provide education, awareness, and assistance for state-of-the-art developments in energy and water conservation	Oil refineries and Chemical processors	Technical Assistance
Texas Industrial Energy Efficiency Network (TIEEN)	Industry	Similar to TIEEP. Connect proprietors with project financing, engineering firms, and supplemental resources to solve energy efficiency challenges	Small to medium size manufacturing operations	Technical Assistance
Light Duty Motor Vehicle Purchase or Lease Incentive Program (LDPLIP)	Transportation	Statewide grants to purchase or lease an eligible, new light-duty vehicle powered by alternative fuels	Individuals, corporations, organizations, governments, business trusts, partnerships, associations, or any other legal entity who purchased or leased a new alternate fuel light-duty vehicle on or after September 1, 2025	Grants
Alternative Fueling Facilities Program (AFFP)	Transportation	Competitive grants to construct or expand alternative fueling stations within Texas' Clean Transportation Zone	Individuals, state and local governments, corporations, or any other legal entity	Competitive Grants
Texas Clean School Bus Program (TCSB)	Transportation	Statewide grants to replace or retrofit pre-2007 diesel-fueled school busses	All public-school districts and open-enrollment charter schools	Grants

Program	Sector(s)	Description	Eligible Applicants	Funding Type(s)
Texas Hydrogen Infrastructure, Vehicle, and Equipment Program (THIVE)	Transportation	Competitive grants in eligible counties for on-road and non-road heavy-duty hydrogen-powered vehicles, equipment powered by hydrogen, and hydrogen refueling infrastructure	Individuals, state and local governments, corporations, or any other legal entity	Competitive Grants
Rebates Grants Program	Transportation	Grants in eligible counties to upgrade or replace on-road heavy-duty vehicles and select non-road diesel equipment Applicants may also request additional funds to install onsite refueling infrastructure for the grant-funded vehicles	Individuals, state and local governments, corporations, or any other legal entity	Grants
Emissions Reduction Incentive Grants Program (ERIG)	Transportation	Competitive grants in eligible counties to repower or replace older locomotives, marine vessels, stationary equipment, or select non-road equipment Applicants may also request additional funds to install onsite refueling infrastructure	Individuals, state and local governments, corporations, or any other legal entity	Competitive Grants
Seaport and Rail Yard Areas Emissions Reduction Program (SPRY)	Transportation	Grants in eligible counties to replace older drayage trucks and cargo handling equipment operating at eligible seaports and rail yards	Individuals, corporations, organizations, governments, government agencies, and any other legal entity	Grants
Texas Natural Gas Vehicle Grant Program (TNGVGP)	Transportation	Grants in eligible counties to repower heavy-duty or medium-duty vehicles with natural gas engines or replace the vehicles with natural gas vehicles	Individuals and entities operating an on-road heavy-duty or medium-duty vehicle registered to operate in Texas	Grants

Program	Sector(s)	Description	Eligible Applicants	Funding Type(s)
Port Authority Studies and Pilot Projects Grant Program (PASPP)	Transportation	Grants to port authorities in eligible counties for studies and pilot programs to reduce emissions from cargo movement	Port authorities that administer a public seaport in a nonattainment area or affected county	Grants
Governmental Alternative Fuel Fleet Grant Program (GAFF)	Transportation	Statewide, competitive grants to assist with purchasing or leasing new vehicles that operate primarily on compressed natural gas, liquefied natural gas, liquefied petroleum gas, hydrogen fuel cells, or electricity	State agencies, counties, municipalities, school districts, junior college districts, river authorities, water or other special districts, or other political subdivisions with a fleet of more than 15 vehicles A portion of the funds may be used for the purchase, lease, or installation of refueling infrastructure or equipment, or refueling services	Competitive Grants
Texas Clean Fleet Program (TCFP)	Transportation	Competitive grants in eligible counties to replace heavy-duty and light-duty on-road diesel vehicles with alternative fuel and hybrid vehicles	An individual or entity operating a fleet of 75 or more vehicles that are registered in Texas	Competitive Grants
The State of Texas Renewable Energy Credit (REC) Trading Program	Electric Generation	Voluntary trading program established to increase renewable energy capacity in Texas	Eligible to earn RECs if facility relies exclusively on an energy source that is naturally regenerated such as solar, wind, geothermal, hydroelectric, wave/tidal, biomass or biomass-based waste products	Credits
Project Development and Supply Chain Reimbursement Program	Electric Generation	Grant for expenses associated with the initial development of an advanced nuclear project in the state	Businesses, nonprofit organizations, and governmental entities, including institutions of higher education	Grants

Program	Sector(s)	Description	Eligible Applicants	Funding Type(s)
Advanced Nuclear Construction Reimbursement program	Electric Generation	Grant for advanced nuclear construction expenses	Businesses, nonprofit organizations, and governmental entities, including institutions of higher education	Grants
LoanSTAR Revolving Loan Program	Commercial	Low-interest loans for energy-related, cost-reduced retrofits of facilities supported by the state	Facilities supported by the state, including public school districts and public colleges and universities, as well as units of local government such as counties, cities, towns, public hospital taxing districts or political subdivisions	Loans
HOMES	Residential	Incentives for energy efficient whole-home retrofits in both single-family and multifamily dwelling units	Households of any income level, but rebate amounts are doubled for low- and moderate-income households	Rebates
HEAR	Residential	Energy efficient appliance rebate program	Low- or moderate-income (LMI) households	Rebates
Better Buildings Challenge	Commercial and Residential	Challenge to reduce energy use by at least 20% over 10 years. Partners share their annual progress and solutions that provide replicable models for others to follow	U.S. commercial and manufacturing companies, universities, school districts, multifamily residential organizations, data centers, and state and local governments	Technical Assistance
Property Tax Exemption for Renewable Energy Systems	Industry; Electric Generation; Commercial and Residential	Exemption from taxation on the appraised value of real property arising from a solar or wind-powered device used for on-site energy production and distribution.	Individual real property owners	Tax Exemption

Program	Sector(s)	Description	Eligible Applicants	Funding Type(s)
Solar and Wind Energy Business Franchise Tax Exemption	Industry; Electric Generation; Commercial	Deduct from its apportioned margin 10 percent of the amortized cost of a solar energy device	A partnership, limited liability partnership, corporation, banking corporation, savings and loan association, limited liability company, business trust, professional association, business association, joint venture, joint stock company, holding company, or other legal entity	Tax Deduction

CHAPTER 8: WORKFORCE PLANNING ANALYSIS

The actions included in this roadmap are anticipated to create high-quality jobs for Texas. Texas has a large population of highly skilled and diverse talents as well as worldclass schools that will meet the workforce needs of the actions in this roadmap.

8.1 ANTICIPATED WORKFORCE CHANGES

To fully implement actions in this roadmap, Texas will need a wide variety of highly skilled engineers, technicians, project managers, scientists, electricians, and other various skilled trade workers. Due to the broad scope of emissions reduction actions in this plan, these jobs will be needed throughout the state and many of these jobs will be required for multiple measures.

To determine potential workforce shortages, TCEQ identified key industries and occupations that most closely align with the actions to reduce emissions. The number of jobs required to fully implement the actions in this roadmap was obtained from EPS and labor trends for Texas were obtained from the Texas Workforce Commission (EPS 2025, Texas Workforce Commission 2025a). Full details on the gap analysis are available in Appendix E.

Table 8-1 shows current jobs, added jobs, and the gaps identified grouped by aggregated industry categories. A positive gap number indicates more jobs than job seekers, indicating a workforce shortage. Details on gaps for specific occupations are available in Appendix E. Overall it is estimated this plan could create an average of over 200,000 jobs for each year from 2025 through 2050. Gap information using the latest 2025 data indicates that actions in this plan will not create a near-term workforce shortage. Longer term projections show that there may be gaps in the fossil and energy utilities category and the manufacturing and construction category.

Table 8-1: Gap Analysis by Aggregated Industrial Category

	Fossil and Energy Utilities	Manufacturing and Construction	Other	Total
Current Employment (2024)	285,460	980,970	4,068,430	5,334,860
Current Demand (Aug 2025)	10,712	37,232	175,008	222,952
2025 Jobs Added from Plan Actions	1,431	180,610	7,698	189,739
New 2025 Demand	12,143	217,842	182,706	412,691
Current Supply	81,640	315,727	1,002,641	1,400,008
GAP (2025)	**-69,497**	**-97,885**	**-819,935**	**-987,317**
Average Annual Openings	31,516	106,345	530,577	668,438
Average Jobs Added from Plan Actions	34,993	61,011	127,313	223,317
New Average Openings	66,509	167,356	657,890	891,755
Annual Graduates	40,965	89,013	941,377	1,071,355
GAP (Annual)	**25,544**	**78,343**	**-283,487**	**-179,600**

8.2 WORKFORCE SOLUTIONS AND PARTNERSHIPS

Texas will employ several strategies to fill the workforce gaps that may be created from implementation of actions in this plan. There are a variety of jobs that are within the fossil and energy utilities and manufacturing and construction categories. These jobs, which require critical thinking and a creative workforce, include managers, scientists, engineers, technicians, and multiple tradespeople. Technical skills such as mathematical, computational, and analytical skills will also be required.

Texas will leverage programs through the Texas Workforce Commission and local workforce development boards as needed to ensure the availability of an appropriately trained workforce to meet the needs of this roadmap. As listed below, many existing programs in Texas can be used as a solution to fill workforce shortages, bridge gaps, and train diverse skillsets. Programs are through the Texas Workforce Commission unless otherwise noted. A full list of programs can be found on the Texas Workforce Commission's Programs website (Texas Workforce Commission 2025b).

- Skills Development Fund: Provides information, grants, funding, education, and training for businesses who want to train new workers or upgrade the skills of existing workers.
- Texas Talent Connection Grant: Grants to support workforce training projects, deliver workforce services, and provide workforce services to populations with special needs (Texas Workforce Investment Council 2025).
- Governor's University Research Initiative (GURI): Grants to help Texas public institutions of higher education recruit distinguished researchers from around the world (Texas Economic Development & Tourism Office 2025).
- Texas Industry Partnership Program: Funding to support workforce development projects focused on high-demand, target occupations.
- Skills for Small Business Program: Program for small businesses to apply for training provided by a local community college.
- Apprenticeship Program: Supports apprenticeship programs that help employers build their current and future talent and workers progress in their careers and move into better-paying jobs.
- Lone Star Workforce of the Future Fund: A program to increase the supply of qualified workers for entry-level to mid-level jobs in high demand occupations.

For industries that may experience job reductions, these programs can assist those workers to transition into newer careers, especially those where there may be a workforce shortage.

CHAPTER 9: CONCLUSION

The Comprehensive Roadmap to Reduce Emissions in Texas is the second major deliverable under the CPRG planning grant awarded to TCEQ. It includes economy-wide emissions reduction actions identified by TCEQ with extensive input from a variety of stakeholders. Although there are actions for all sectors, the focus is on incentivized, voluntary actions with co-pollutant benefits from the three largest GHG emitting sectors in Texas: industry, transportation, and electric power. If fully implemented, the actions in this roadmap are anticipated to reduce emissions in Texas by 121 MMT CO_2e by 2030 and 252 MMT CO_2e by 2050 and would save $2.6 billion. Co-pollutants would also be reduced by 0.7 MMT by 2030 and 2.7 MMT by 2050.

TCEQ and its partners will continue planning, engagement, and action to reduce emissions; invest in infrastructure, technologies, and best practices; build our economy; and enhance the quality of life for all Texans. In 2027, TCEQ will publish a status report that details implementation progress for actions included in this roadmap, updates to quantifications, and next steps and future budget and staffing needs to continue to encourage implementation of roadmap actions.

If you have questions, input, or comments regarding this roadmap, or input for the upcoming status report, contact TCEQ at cprg@tceq.texas.gov.

CHAPTER 10: REFERENCES

Bose, Debajyoti, Riya Bhattacharya, Tanveen Kaur, Ravindra Pandya, Abhijeeta Sarkar, Aritra Ray, Surajit Mondal, Arnab Mondal, Paulami Ghosh, Rhea Ishani Chemudupati. 2004. "Innovative approaches for carbon capture and storage as crucial measures for emission reduction within industrial sectors." *Carbon Capture Science & Technology*, Volume 12, 2024, 100238. https://doi.org/10.1016/j.ccst.2024.100238.

Energy Innovation and Rocky Mountain Institute. 2025. "Texas Energy Policy Simulator, Version 4.04" April 1, 2025." https://energypolicy.solutions/simulator/texas/en.

EPA. 2021. "Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts." U.S. Environmental Protection Agency, EPA 430-R-21-003. https://www.epa.gov/cira/social-vulnerability-report.

EPA 2024a. "Greenhouse Gas Reporting Program (GHGRP)." Last modified May 22, 2025. https://www.epa.gov/ghgreporting

EPA. 2024b. "State GHG Emissions and Removals." Last modified October 3, 2024. https://www.epa.gov/ghgemissions/state-ghg-emissions-and-removals.

EPA. 2025a. "Clean Ports Program Awards." Accessed September 9, 2025. https://www.epa.gov/ports-initiative/clean-ports-program-awards.

EPA. 2025b. "2022v2 Emissions Modeling Platform." Last updated June 26, 2025. https://www.epa.gov/air-emissions-modeling/2022v2-emissions-modeling-platform.

EPA. 2025c. "2020 Air Emissions Data." Last Updated May 7, 2025. https://www.epa.gov/air-emissions-inventories/2020-air-emissions-data.

EPS. 2025. "Energy Policy Simulator Documentation. Input-Output Model." April 1, 2025. https://docs.energypolicy.solutions/io-model.

GBEP. 2025. "About the Estuary Program." Accessed September 11, 2025. https://gbep.texas.gov/about-the-estuary-program/.

IPCC. 2007. "Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change." Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp.

PUCT. 2025. "Energy Efficiency at the PUCT." Accessed November 17, 2025. https://www.puc.texas.gov/industry/electric/energy-efficiency/#iou.

SECO. 2025a. "Energy Code Adoption." Accessed November 17, 2025. https://comptroller.texas.gov/programs/seco/code/adoption.php.

SECO. 2025b. "Inflation Reduction Act Rebates and Tax Credits." Accessed November 17, 2025. https://comptroller.texas.gov/programs/seco/funding/ira/#homes.

Take Care of Texas. 2025. “Take Care of Texas.” Accessed September 11, 2025. https://takecareoftexas.org/.

TCEQ. 2024 “Amendment 1 to Climate Pollution Reduction Grants Program: Texas Quality Assurance Project Plan, Revision 0.” November 12, 2024.

TCEQ 2025a. “Texas Emissions Reduction Plan.” Accessed September 9, 2025. https://www.tceq.texas.gov/airquality/terp.

TCEQ. 2025b. “Grants for Electricity Storage, Stationary Emissions Sources, and Oil and Gas-related Projects.” Accessed September 9, 2025. https://www.tceq.texas.gov/airquality/terp/ntig.html.

TCEQ. 2025c. “Texas Voluntary Marginal Conventional Well Plugging Program (TxMCW).” Accessed September 10, 2025. https://www.tceq.texas.gov/airquality/txmcw.

Texas Economic Development & Tourism Office. 2025. “Governor’s University Research Initiative (GURI).” Accessed September 19, 2025. https://gov.texas.gov/business/page/guri.

Texas Workforce Commission. 2025a. “Regional Occupational Analysis Tool.” Accessed September 19, 2025. https://texaslaboranalysis.com/.

Texas Workforce Commission. 2025b. “Programs.” Accessed September 19, 2025. https://www.twc.texas.gov/programs.

Texas Workforce Investment Council. 2025. “Texas Talent Connection Grant Program.” Accessed September 19, 2025. https://gov.texas.gov/organization/twic/wagner_peyser_7b_program.

TxDOT. 2025. “Texas electric vehicle planning.” Accessed September 9, 2025. https://www.txdot.gov/projects/projects-studies/statewide/texas-electric-vehicle-planning-03-22-22.html.

US EIA. 2025. “Texas State Profile and Energy Analysis.” August 21, 2025. https://www.eia.gov/state/analysis.php?sid=TX.