Appendix C to the Comprehensive Roadmap to Reduce Emissions in Texas:
Methodology for Emissions Projections, Reductions, and Implementation Costs

EPA Grant Number 02F35501

This project has been funded wholly or in part by the United States Environmental Protection Agency (EPA) under assistance agreement 02F35501to the Texas Commission on Environmental Quality. The contents of this document do not necessarily reflect the views and policies of EPA, nor does EPA endorse trade names or recommend the use of commercial products mentioned in this document.

October 17, 2025

This page intentionally left blank

TABLE OF CONTENTS

LIST OF ACRONYMS

°C	degree Celsius
AR4	Fourth Assessment Report
AR5	Fifth Assessment Report
BAU	business-as-usual
CAP	criteria air pollutants
CCS	carbon capture and sequestration
CO	carbon monoxide
CO_2e	carbon dioxide equivalent
EIA	United States Energy Information Administration
EI	emissions inventory
EMP	Emissions Modeling Platform
EPA	United States Environmental Protection Agency
EPS	Energy Policy Simulator
EV	electric vehicle
F-gas	fluorinated gas
FI	full implementation
GHG	greenhouse gas
GWP	global warming potential
HAP	hazardous air pollutants
HFC	hydrofluorocarbon
IIJA	Infrastructure Investment and Jobs Act
IPCC	Intergovernmental Panel on Climate Change
IRA	Inflation Reduction Act
kWh	kilowatt hour
LCFS	Low Carbon Fuel Standard
LPG	liquified petroleum gas
LULUCF	land use, land use charge and forestry
MMT	million metric tons
MT	metric ton
MW	megawatt
MWh	megawatt hour
NDC	nationally determined contributions
NEI	National Emissions Inventory

NO_x	nitrogen oxides
NREL	National Renewable Energy Laboratory
$PM_{2.5}$	fine particulate matter
PM_{10}	coarse particulate matter
PV	photovoltaic
RMI	Rocky Mountains Institute
SCC	subsidy for capacity construction
SEP	subsidy for electricity production
SO_x	sulfur oxides
VOC	volatile organic compounds
U.S.	United States
UT Austin	University of Texas at Austin

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: MODELS/TOOLS USED

Emissions reductions were estimated using the Energy Policy Simulator (EPS) v. 4.0.4 in combination with the Greenhouse Gas (GHG) Emissions Inventory (EI) for Texas. EPS is an open-source computer model created by Energy Innovation and Rocky Mountain Institute (RMI) (Energy Innovation and RMI 2025). EPS is a system dynamics computer model simulated by a tool called Vensim. Vensim was developed by Ventana Systems for the creation and simulation of System Dynamics models. (Energy Innovation and RMI 2025). EPS uses a 100-year global warming potential (GWP) from the Intergovernmental Panel on Climate Change's (IPCC's) Fifth Assessment Report (AR5). Emissions data from the simulator were calibrated to GHG EI for Texas, which was developed by the University of Texas at Austin (UT Austin) and uses a GWP of AR4. Business as usual (BAU) and future projection scenarios were modeled based on the GHG EI for Texas, which is available in Appendix B. Note that the BAU scenario includes Inflation Reduction Act (IRA) programs and United States Environmental Protection Agency (EPA) rules in place prior to January 1, 2025.

The co-pollutant emissions reductions were estimated using the National Emissions Inventory (NEI) and EPS. The BAU criteria air pollutants (CAP) were obtained from NEI's 2022v1 Emissions Modelling Platform (EMP) Data Retrieval Tool for the county level data (EMP, 2022). The BAU hazardous air pollutants (HAP) were obtained from the 2020 NEI's Data Retrieval Tool for the county level data (EMP, 2020).

Carbon dioxide equivalent (CO_2e) Abatement Cost Curve; Effects by Policy was obtained from EPS for each sector. This was used to estimate the costs of the voluntary actions included in the plan.

Detailed emission reduction calculations are available on request.

CHAPTER 2: METHOD TO ESTIMATE EMISSIONS REDUCTION

As reported in the EPS documentation, data used to estimate the BAU and emission reductions were obtained primarily from national datasets and datasets that are open source such as energy consumption per sector from the Energy Information Administration (EIA). Other data used included sector specific data from the GHG EI for Texas, which was developed by UT Austin, and data on technology stock and cost of technologies from the National Renewable Energy Laboratory (NREL). These data from external text files are generated as accompanying excel files and are read by the simulator. A summary of the data sources is shown in Table 1-1.

Table 2-1: Data Sources for State Energy Consumption and Emissions Data

Sector	Subsectors	Source
Electricity	In-state capacity and generation; out of state imports	For capacity and generation: EIA's Form 923 and EIA's Form 860. For imports/exports: EIA's State Electricity Profiles (https://www.eia.gov/electricity/state/)
Building Energy Use	All energy use, all building components, residential and commercial buildings	EIA's State Energy Data Systems from 2021
Industrial Energy Use	All fuel use for industrial sector	EIA's Annual Energy Outlook tables on Industrial Energy Use & EIA's State Energy Data Systems
Industrial Process Emissions	Agriculture and industrial process emissions	United States (U.S.) State-level Non-Carbon Dioxide (CO_2) GHG Mitigation Report
Land Use	Natural carbon sinks and sources Land Use, Land Use Charge and Forestry (LULUCF)	EPA's State GHG Emissions and Removals 2021 Inventory Report
Transportation	All energy use, vehicle miles	EIA's State Energy Data Systems from 2021, Energy Information Association's Annual Energy Outlook tables on Industrial Energy Use & NREL Electrification Futures Study - Reference Scenario

Emissions reduction projections were estimated by extrapolating the GHG EI for Texas based on the emissions reductions obtained from the EPS-developed model. The GHG EI for Texas was developed with a base year of 2022. The CAP BAU projections were obtained by interpolation to get the BAU estimates for years not reported in the NEI database. CAP emissions reductions were obtained by multiplying the BAU by an equivalent factor based on the CAP model developed by EPS. The 2020 HAP BAU was obtained from the NEI database. HAP projections for future years were calculated by carrying out a correlation to surrogate, where the ratio of carbon monoxide (CO) BAU emissions increase was used to estimate HAP emissions (Joseph Stolle, 2022). HAP emissions reductions were also obtained using the CO model as a surrogate.

Abatement cost curves were calculated based on the average annual abatement of each policy and were obtained from the wedge diagrams showing the CO_2e emissions for each policy.

The quantification considered voluntary actions for the three main sectors in Texas with the most GHG emissions: Transportation, Industry and Electric Power. The other sectors, wastewater and landfills, agriculture, residential and commercial, and natural and working lands, were combined and quantified as one category labeled “other.” The nationally determined contribution (NDC) scenario in EPS was used for most assumptions on policy levers. The NDC is a commitment made as part of the Paris Agreement agreed to by 196 Parties. The Parties agreed to keep global warming below 2 degrees Celsius (°C) above pre-industrial levels and to actively pursue efforts to “limit the temperature increase to 1.5°C above pre-industrial levels”. Participating parties are looking to reach a target of net zero GHG emissions by 2050 (Kate Whiting, 2025).

Detailed policy lever assumptions for each sector are discussed below.

2.1 INDUSTRY

Electrification and hydrogen combustion of several industrial processes were modeled for industrial categories such as agriculture and forestry; coal mining; oil and gas extraction; food, beverage, and tobacco; textile apparel and leather; wood products; pulp, paper, and printing; refined coke; rubber and plastics; chemicals; glass products; iron and steel; other metals; computer and electronics; road and nonroad vehicles; construction; manufacturing; energy pipelines and gas processing; water and waste; and other machinery. Processes modeled include cooling; machine drive; boiler and steam; non-boiler low, medium, and high temperature; electrochemical; and other processes. The percentage of fuel shifted to electrification was set based on the industry category using the NDC scenario. A 25% fuel shift to hydrogen combustion was modeled for certain high energy industries. An implementation schedule of 100% by 2050 was set.

The action on promoting industrial processes that would improve or expand carbon capture was modeled using the industry carbon capture and sequestration (CCS) policy. CCS was modeled for refined petroleum and coke, chemicals, and cement industries. The types of emissions tracked were energy-related emissions and process emissions. Energy related emissions include those that come from fuel combustion to create either usable heat or onsite electricity. Process emissions are those from pollutants that occur because of industry operations not related to combustion of fuel for energy; for example, CO_2 from limestone breakdown and methane leaks from wells and pipes. The percentage of CO_2 captured was set based on the NDC scenario. An implementation schedule of 100% by 2050 was set.

The measure on energy efficiency was modeled using the industry energy efficiency standard policy. A 25% reduction in energy use of various industrial fuels was modelled. Fuels reduced include natural gas, petroleum, liquified petroleum gas (LPG) propane and butane, coal, and heavy or residual fuel oil use. An implementation schedule of 100% by 2050 was set.

The use of low carbon cement was modeled using the cement clinker substitution policy. CO_2 emissions are reduced by substituting other inputs like fly ash, for a part of the clinker cement. A 100% potential achievement was adopted. An implementation schedule of 100% by 2030 through 2050 was set.

Replacement of hydrofluorocarbon (HFC) with ultra-low GWP measure was modeled using the fluorinated gas (F-gas) measures of F-gas substitution, F-gas destruction, F-gas recovery, and F-gas equipment maintenance and retrofit. A set point of 100% potential achieved was used based on the NDC pathway. An implementation schedule of 100% by 2030 through 2050 was set.

The fugitive emissions reduction measure was modeled using the improved system design policy. This policy reduces fuel consumption in the industry sector by improving the way components are put together and the way material or energy flows between them. A set point of 100% potential achieved was used based on the NDC pathway. An implementation schedule of 100% by 2050 was set.

The measure on reducing flaring and capturing methane emissions for beneficial use was modeled using the methane capture and destruction policy. Industry categories used include oil and gas extraction; energy pipelines and gas processing; coal mining; and water and waste. A set point of 100% potential achieved was used based on the NDC pathway. An implementation schedule of 100% by 2030 through 2050 was set.

The measure on remediating low producing wells was modeled using the early retirement of industrial facilities policy. This policy reduces fuel consumption in the industry sector by retiring older, inefficient industrial facilities sooner than they otherwise would retire. A set point of 100% potential achieved was used based on the NDC pathway. An implementation schedule of 100% by 2050 was set.

Figure 2-1 shows the emissions effects from the different policy levers on the industrial sector from 2022 to 2050, comparing the BAU with the model industry. The graph shows that industrial electrification will have the most impact on emissions reductions compared to other policy measures (EPS 2025e).

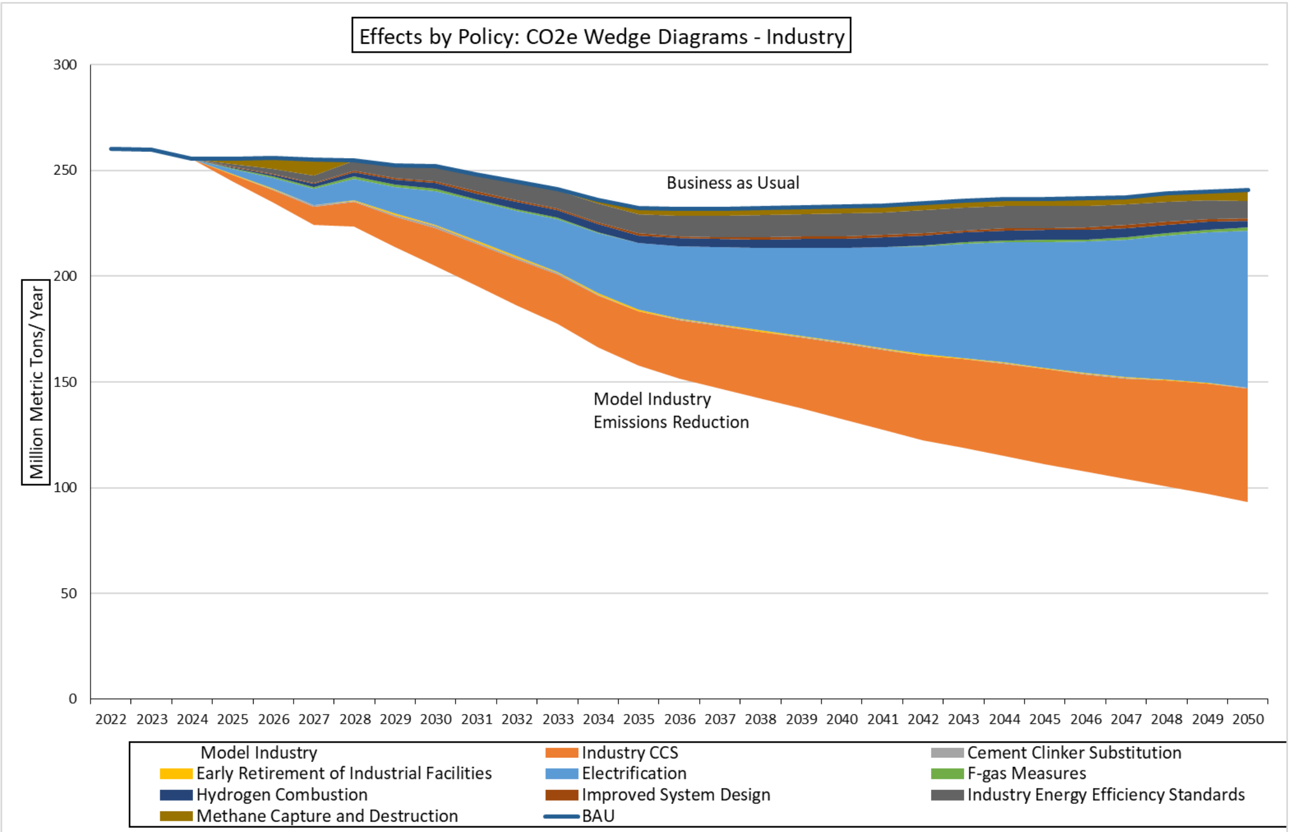

Figure 2-1: Emissions Change from Industrial Sector Actions from 2022 to 2050

2.2 ELECTRIC POWER GENERATION

In the electric power generation sector, the transmission line upgrade measure was modeled using the policy on reducing transmission and distribution losses. A 33% policy setting of losses avoided was used to match NDC by 2050. Currently the U.S. has a 6% reduction in transmission and distribution losses. An implementation schedule of 100% by 2050 was set.

The measure on promoting advanced nuclear energy and geothermal energy was modeled using the policies on subsidy for capacity construction (SCC) and subsidy for electricity production (SEP). The policy describes payment of subsidy to electricity suppliers for the addition of renewable sources. For geothermal, solar thermal, and offshore wind 42% of construction cost was used. For the subsidy for electricity production, $18/megawatt hour (MWh) was used for nuclear, $32/MWh was used for onshore wind, and $31/MWh for solar photovoltaic (PV) based on the NDC scenario. An implementation schedule of 100% by 2050 was set for SCC and 100% by 2025 through 2050 was set for SEP.

The measure on grid scale renewable energy storage was modeled using the subsidy for grid battery production, set at $44/kilowatt hour (kWh), and grid battery capacity at 42% of capital cost. The implementation schedule was set based on the NDC scenario.

The measure on lowering demand with improved load management and energy efficiency was modeled using the demand response, banning new power plants (focusing on only coal, lignite and municipal solid waste power plants), and clean electricity standard policies. The demand response was set for 100%. Electricity source power plants set to be banned by 2030 include hard coal, lignite, and municipal solid waste. The clean electricity standard was set for 95% of electricity generation. The implementation schedule was set based on the NDC scenario.

The measure on capturing and storing carbon from power plants and industrial processes was modeled using the electricity CCS subsidy policy. This policy specifies the amount of dollar subsidized per metric ton (MT) of CO_2e emissions. An $84/MT CO_2e was set for several electric sources with CCS including hard coal, natural gas combined cycle, biomass, and lignite. An implementation schedule of 100% by 2036 through 2050 was set.

Figure 2-2 shows the emission effects from the different policy levers on the electric power generation sector from 2022 to 2050, comparing the BAU with the modeled emission reduction (EPS 2025d). There is a decrease in the emissions reduction in 2050 compared to 2030 because the BAU assumes IRA tax credits will begin phasing out after the year 2039, when electricity sector emissions reach the target of 25% below 2022 levels. Tax credits are claimed as the Investment Tax Credit (per unit electricity generation), depending on the plant type.

Figure 2-2 shows that the subsidy for electricity production will have the most impact on emission reduction compared to other policy measures (EPS 2025d).

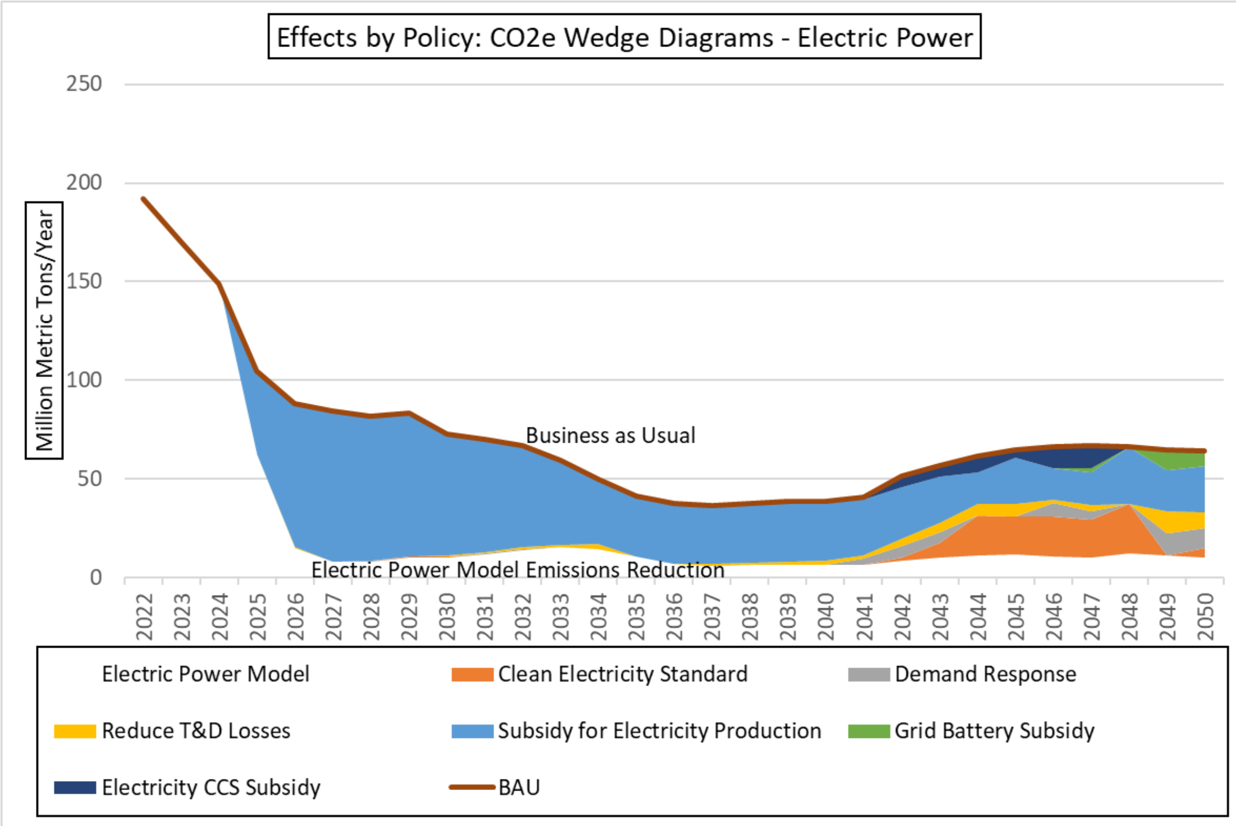

Figure 2-2: Emissions Change from Electric Power Generation Sector Actions from 2022 to 2050.

2.3 TRANSPORTATION

The voluntary actions to reduce emissions in the transportation sector were modeled in EPS using related policy levers. Variables and quantities considered for quantification were cargo-distance transported i.e., passenger miles and freight ton-miles transported, number of vehicles, and amounts of fuel consumed. The actions on reducing emissions from sea and inland ports and on low emissions passenger or freight locomotives were modeled using the fuel economy standard policy in EPS. An implementation schedule of 30% by 2030 and 100% by 2035 through 2050 was used. The Electric Vehicle (EV) Charger Deployment policy lever was used to model infrastructure for EV charging and hydrogen fueling. This was set at 30% change from BAU. An implementation schedule of 100% by 2030 through 2050 was set. For measures on zero emissions light duty, medium and heavy-duty vehicles, school buses and government fleets, the zero emission vehicle sales standards lever in the EPS was used. Using the NDC scenario, percentages of new vehicles sold were set based on the vehicle type, ranging from 100% for cars and SUVs to 45% for light- and medium- duty commercial trucks. An implementation of 100% by 2050 was set. The airport emissions reduction was modeled using the policy levers on Low Carbon Fuel Standard (LCFS) and the Non-BAU LCFS-qualifying vehicles. The LCFS was set at 60% of reduction in carbon emissions and an implementation schedule of 33% by 2030 and 100% by 2050 was set.

Figure 2-3 shows the effects of the different policy levers on emissions in the transportation sector from 2022 to 2050, comparing the BAU with the TCEQ model. The graph shows that deployment of zero emissions vehicles and adaptation of low carbon fuel standards will have the most impact on emission reduction compared to other policy levers (EPS 2025h).

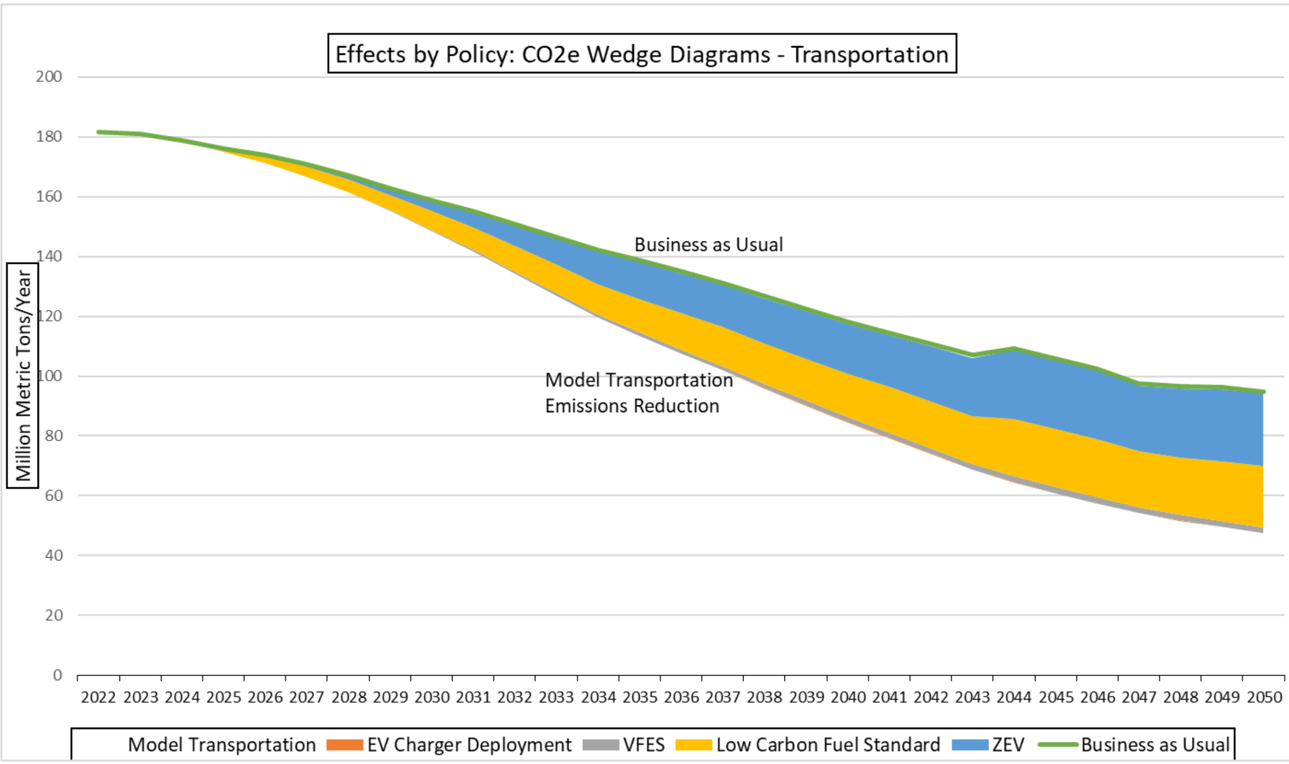

Figure 2-3: Emissions Change from Transportation Sector Actions from 2022 to 2050

2.4 OTHER SECTORS

Other sectors include policies in agriculture, residential and commercial buildings, municipal and industrial wastewater, municipal and industrial landfills, and natural and working lands.

The measure on capturing methane from landfills or wastewater treatment plants was modeled using the methane capture policy, industry category: Water and Waste. A 100% of potential achieved was set. An implementation schedule of 100% by 2050 was set.

The measure on adding solar arrays at closed landfills and adding solar to commercial and residential buildings was modeled using the policy on distributed solar carve-out, distributed solar subsidy, and distributed solar capacity requirement policies. A 6% minimum electricity from solar was set with an implementation schedule of 50% by 2030 and 100% by 2050. For the subsidy, 20% of the PV system cost was set for residential and commercial buildings with an implementation schedule of 100% by 2025 through 2050. The distributed solar capacity requirement was set at 595000 megawatts (MW) for urban residential, 135000 MW for rural residential, and 385000 MW for commercial with an implementation schedule of 100% by 2050.

The measure on switching to electric heat pumps was modelled using the building component electrification policy. This policy replaces the specified fraction of newly sold non-electric building components of the selected type(s) with electricity-using components. For the building components (heating and appliances), newly sold non-electric building components were set to be replaced at 100% compared to the BAU case. An implementation schedule of 100% by 2030 up to 2050 was set.

The measure on increasing energy efficiency and weatherization in homes and commercial buildings was modeled using the building energy efficiency standards policy. A 25% reduction in energy use was set for the envelope section of urban residential, rural residential, and commercial buildings. An implementation schedule of 100% by 2050 was set.

The measure on supporting projects to increase recycling and reduce waste was modeled using the capital cost reduction policy. This is a policy under the research and development lever and is used for modelling research in technological advancement. Based on the EPS, a 30% lever was used, implying a 1% annual improvement. The implementation schedule was set based on the NDC scenario.

The measure on promoting sustainable agricultural practices to reduce emissions and restoration of coastal landscapes to sequester carbon was modeled using the policies on grassland restoration and avoided conversion, cropland, and rice measures, improved forest management, and livestock based on the NDC pathway. The implementation schedule was set based on the NDC scenario.

The measure on reforesting agriculture lands no longer in use was modeled using the afforestation and reforestation policy. This policy increases the sequestration of CO_2 by planting forests. Planted forests are assumed to be managed with best practices and are not used for timber harvesting. A 50% potential achieved was used. An implementation schedule of 100% by 2025 through 2050 was used.

Figure 2-4 shows the emissions effects from the different policy measures from agriculture, residential and commercial buildings, municipal and industrial wastewater, municipal and industrial landfills, and natural and working lands from 2022 to 2050, comparing the BAU with the model. The graph shows that building component electrification and afforestation/reforestation will have the most impact on emission reduction compared to other policy measures (EPS 2025a, EPS 2025b. EPS 2025, EPS 2025g).

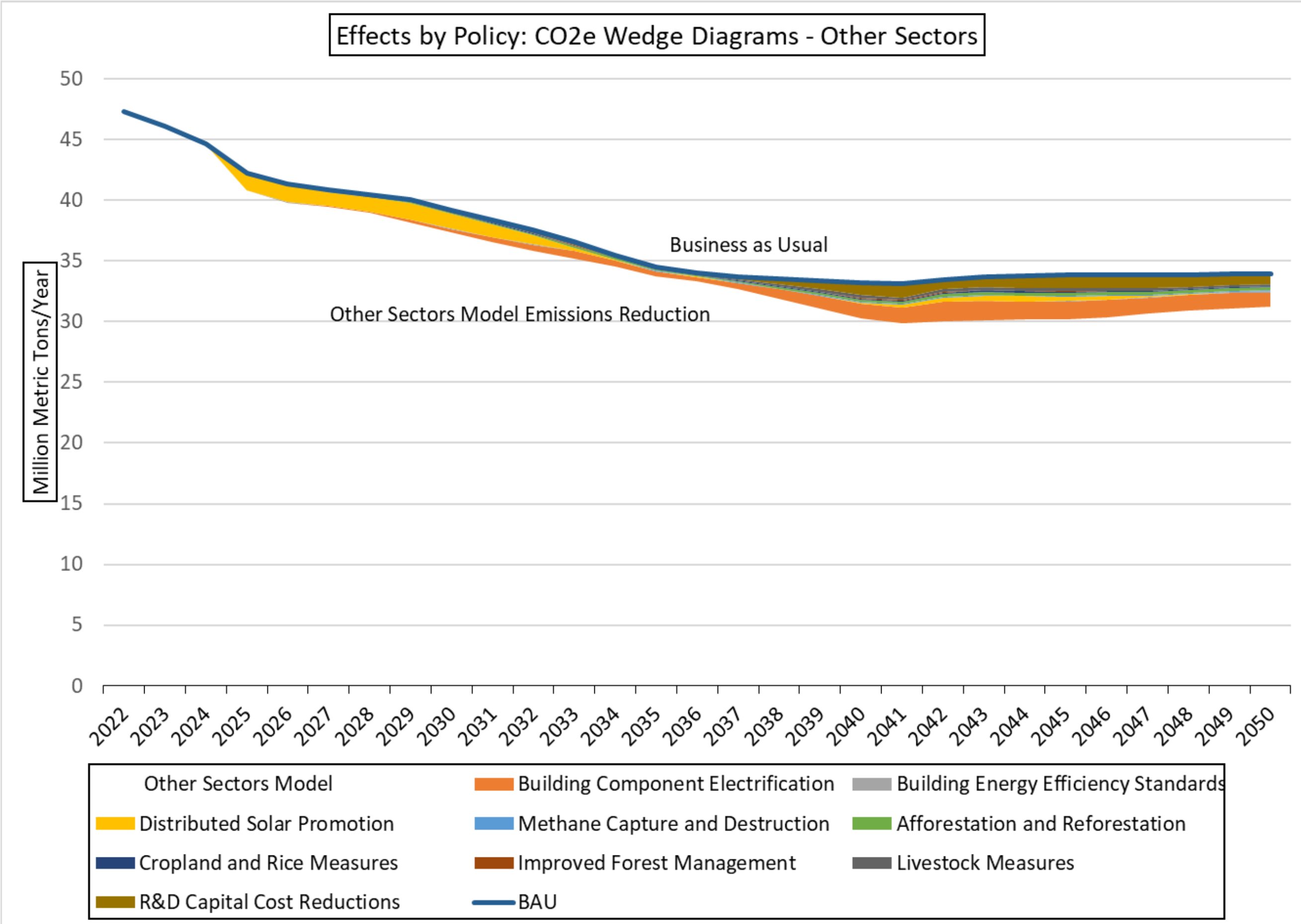

Figure 2-4: Emissions Changes from Actions in Other sectors from 2022 to 2050.

2.5 ASSUMPTIONS, LIMITATIONS AND UNCERTAINTIES

EPS is designed to compute policies as actions and not targets. It predicts the outcome of a combination of specific policies. Policies that include setting targets to meet specific goals are not included in EPS.

The study and policy setting in EPS was done under certain real-world conditions thus changes in the social and economic environment could result in changes in the elasticities related to certain policies. There is an increase in uncertainty as the policy package has more policies and as the settings become more extreme.

Basic Model Assumptions:

- Uses AR5 GWP Values
- Runs from 2021-2050
- Applied policies start in 2024
- Accounts for funding and tax credits included in the IRA in state models
- Incorporates most of the latest state policies but some specific sectoral policies may be missing, especially if they principally affect energy demand.

- Includes all Clean Energy Standards (including electricity standards and renewable portfolio standards), Advanced Clean Cars, Advanced Clean Cars II, Advanced Clean Trucks, carbon pricing, and electric vehicle subsidies passed before August 2024.

More details on assumptions are in the EPS documentation (EPS 2025c).

There may be several reasons why the emissions results for various sectors in EPS can differ from other sources, models or inventories:

- Categorization of emission types. For example, EPS considers waste management including landfills, wastewater treatment and water treatment as part of the industrial sector while EPA emissions inventory puts it under commercial buildings thus the building sector.
- Differences in emission indices particularly for non-CO_2 gases since their indices vary more by combustion technology. Thus, for GHGs, emission indices are taken from EPA while for non-GHG, indices are calculated to match the official EPA data (EPS 2025c).
- Differences in global warming potential values
- In specific cases, data sources rather than official inventories were used. For example, most of the input data for U.S. scenario is mostly sourced from the U.S. EIA Annual Energy Outlook, which uses different methodologies compared to EPA for some sectors.

CHAPTER 3: CO-POLLUTANT EMISSIONS REDUCED

3.1 CRITERIA AIR POLLUTANTS

Implementation of voluntary actions for the different economic sectors is predicted to also reduce a cumulative 0.7 million metric tons (MMT) of criteria air pollutants from 2025 through 2030 and a cumulative 2.7 MMT for the period between 2025 through 2050. Table 3-1 through Table 3-4 show the BAU and full implementation (FI) scenarios for CAPs and HAP for 2030 and 2050. Figure 3-1 through Figure 3-6 show the CAP emissions reductions for the different sectors.

These figures show that nitrogen oxides (NO_X), and sulfur oxides (SO_X), have the most emissions in the industrial sector while coarse particulate matter (PM_{10}), and CO have the most emissions in the transportation sector. Fine particulate matter ($PM_{2.5}$) is highest in the land use sector and volatile organic compounds (VOC) are highest in the agricultural sector. Comparing the business-as-usual scenario with the projected model, we can see a decline in the emissions for all CAPs up to 2050 with the implementation of the priority measures.

Table 3-1: 2030 BAU Co-Pollutant Projections by Economic Sector in Texas

Sector	NO_X (tons)	$PM_{2.5}$ (tons)	SO_X (tons)	CO (tons)	PM_{10} (tons)	VOC (tons)	HAP (tons)
Industry	365,570	26,880	219,970	339,920	67,880	1,257,820	45,049
Transportation	248,340	125,090	3,570	1,899,780	1,001,570	159,270	35,499
Electric Generation	43,580	7,570	50,910	60,950	8,470	2,040	-
Agriculture	100,830	87,360	13	384,650	429,750	2,782,680	85,352
Residential and Commercial Buildings	32,850	14,490	430	45,690	15,290	8210	1,451
Wastewater and Landfills	4370	17,410	2,120	115,700	19,620	14,750	1,298
Natural and Working Lands	19,890	151,300	12,370	1,078,940	178,380	230,380	30,567
State Total	**815,430**	**430,100**	**289,380**	**3,925,630**	**1,720,960**	**4,455,160**	**199,215**

Table 3-2: 2030 FI Co-Pollutant Projections by Economic Sector in Texas

Sector	NO_X (tons)	$PM_{2.5}$ (tons)	SO_X (tons)	CO (tons)	PM_{10} (tons)	VOC (tons)	HAP (tons)
Industry	313,670	20,480	189,120	291,370	36,410	1,158,470	44,233
Transportation	244,020	120,630	3,140	1,816,960	966,890	151,490	33,951
Electric Generation	12,700	1,840	20,430	17,790	2,170	450	-

Sector	NO_x (tons)	$PM_{2.5}$ (tons)	SO_x (tons)	CO (tons)	PM_{10} (tons)	VOC (tons)	HAP (tons)
Agriculture	81,950	72,870	11	313,330	358,680	2,822,580	69,526
Residential and Commercial Buildings	25,640	11,760	350	39,640	12,380	6,980	1,259
Wastewater and Landfills	4,360	17410	2,120	115,700	19,540	14,750	1,298
Natural and Working Lands	19,890	146,080	12,370	1,078,940	171,660	230,380	30,567
State Total	**702,230**	**391,070**	**227,540**	**3,673,740**	**1,567,720**	**4,385,090**	**180,834**

Table 3-3: 2050 BAU Co-Pollutant Projections by Economic Sector in Texas

Sector	NO_x (tons)	PM2.5 (tons)	SOX (tons)	CO (tons)	PM10 (tons)	VOC (tons)	HAP (tons)
Industry	269,430	26,140	218,410	321,190	77,370	561,630	42,652
Transportation	69,000	128,140	4,330	1,488,170	1,053,990	129,790	27,838
Electric Generation	(57,250)	(4,480)	(95,910)	(68,040)	(6,330)	(1,230)	-
Agriculture	100,970	91,320	17	390,990	449,080	2,788,970	86,802
Residential and Commercial Buildings	30,300	17,380	370	45,560	18,390	8730	1,447
Wastewater and Landfills	4,690	17,730	2,490	116,540	20,180	16,640	1,307
Natural and Working Lands	19,890	151,300	12,370	1,078,940	178,380	230,380	30,567
State Total	**437,020**	**427,520**	**142,070**	**3,373,360**	**1,791,060**	**3,734,910**	**190,613**

Table 3-4: 2050 FI Co-Pollutant Projections by Economic Sector in Texas

Sector	NO_x (tons)	$PM_{2.5}$ (tons)	SO_x (tons)	CO (tons)	PM_{10} (tons)	VOC (tons)	HAP (tons)
Industry	154,210	20,090	119,190	185,680	115,440	486,840	41,792
Transportation	48,010	77,610	2,340	964,240	629,090	80,540	18,038
Electric Generation	(50,990)	(260)	(279,520)	(54,580)	(4,030)	(580)	-
Agriculture	21,650	27,450	35	86,780	135,780	2,668,190	19,271
Residential and Commercial Buildings	380	2,400	42	16,390	2,420	2400	521
Wastewater and Landfills	4,670	17730	2,490	116,540	20,090	16,640	1,307
Natural and Working Lands	19,890	146,080	12,370	1,078,940	171,660	230,380	30,567
State Total	**197,820**	**288,760**	**(143,090)**	**2,393,990**	**1,070,440**	**3,484,400**	**111,495**

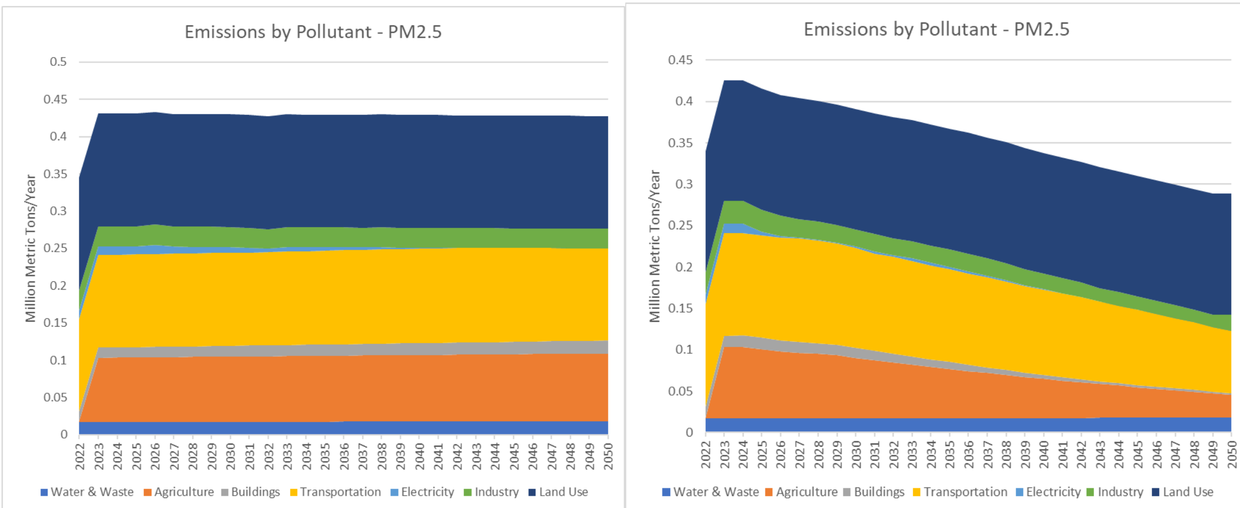

Figure 3-1: $PM_{2.5}$ Emissions Reductions for BAU (left) and FI (right) Scenarios

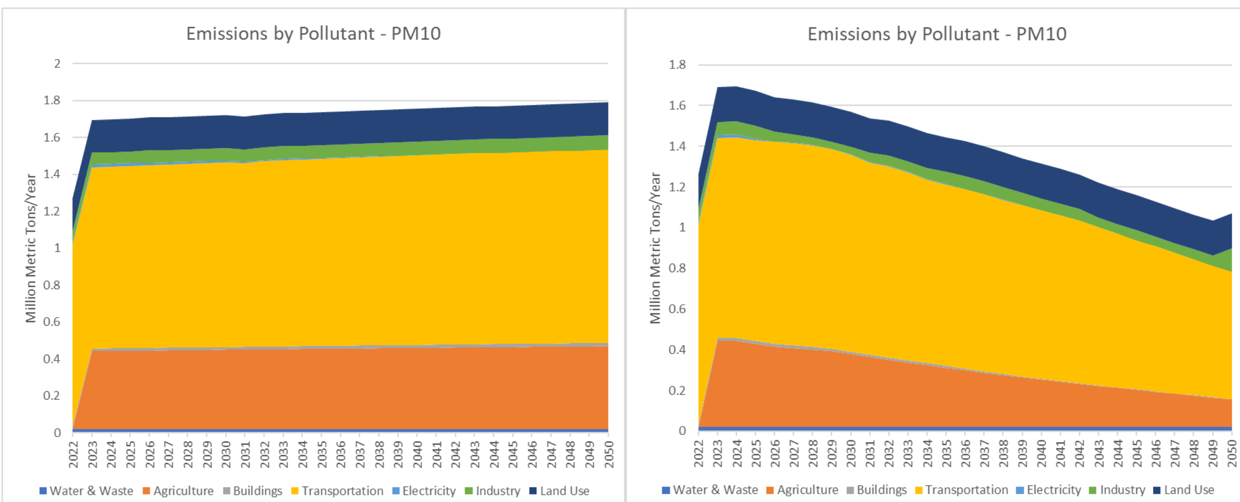

Figure 3-2: PM_{10} Emissions Reductions for BAU (left) and FI (right) Scenarios

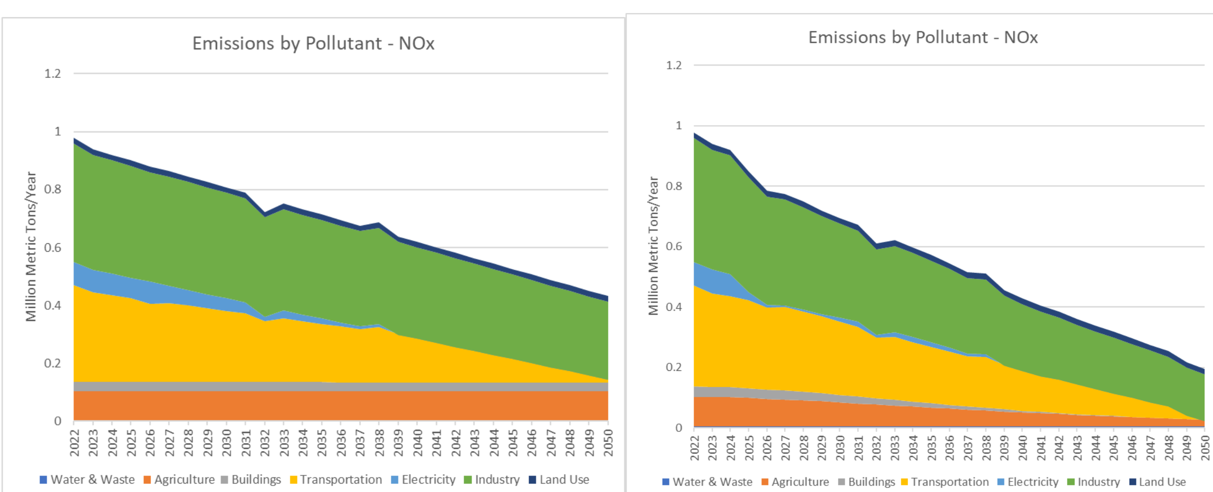

Figure 3-3: NO_x Emissions Reductions for BAU (left) and FI (right) Scenarios

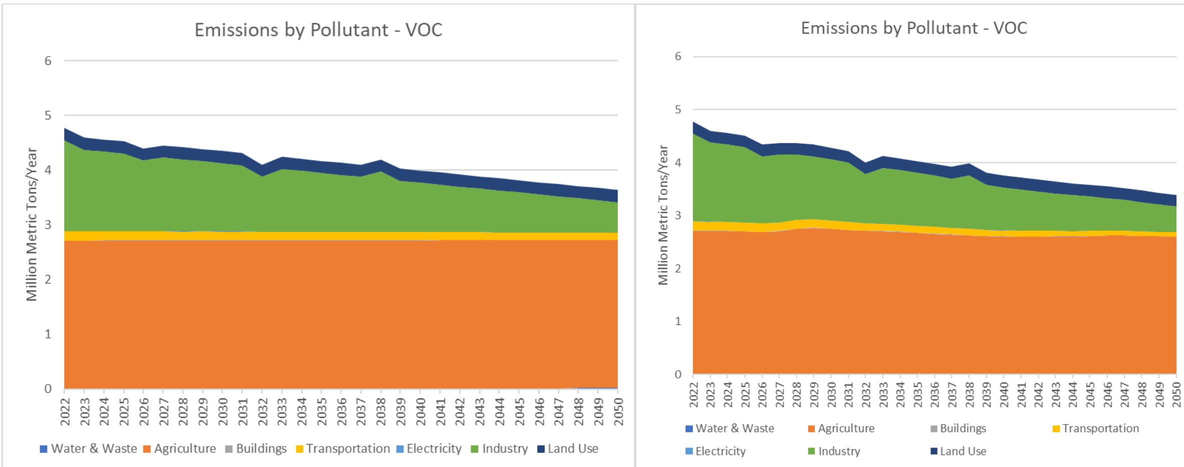

Figure 3-4: VOC Emissions Reductions for BAU (left) and FI (right) Scenarios

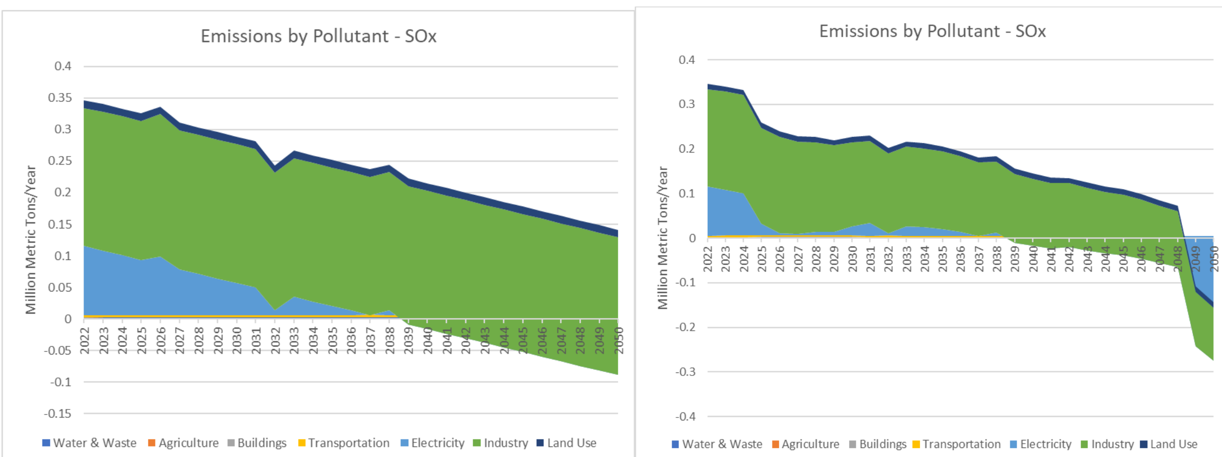

Figure 3-5: SO_x Emission Reductions for BAU (left) and FI (right) Scenarios

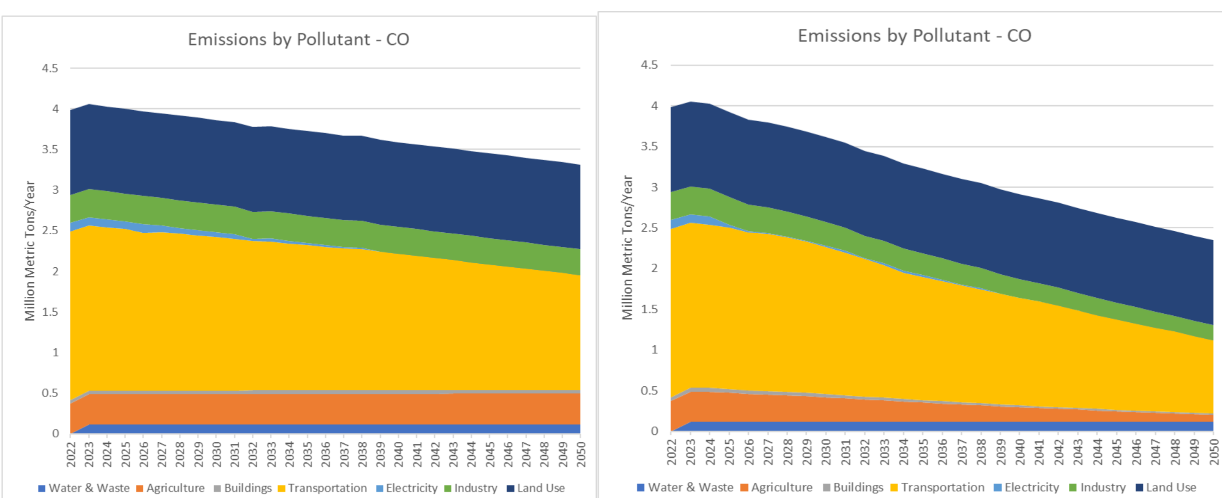

Figure 3-6: CO Emission Reductions for BAU (left) and FI (right) Scenarios

3.2 HAZARDOUS AIR POLLUTANTS

Full implementation of the actions in this plan is predicted to reduce a cumulative 0.02 MMT of selected HAPs by 2030 and a cumulative 0.1 MMT by 2050. Figure 3-7 through Figure 3-20 show the emissions reductions by selected HAPs for the different sectors.

The graphs show that styrene, toluene, hexane and benzene have the most emissions in the industrial sector while ethylbenzene, propionaldehyde, xylene and 2,2,4-trimethylpentane have the most emissions in the transportation sector. 1,3 butadiene, acrolein, naphthalene and o-xylene are highest in the natural and working land sector and formaldehyde, and acetaldehyde are highest in the agricultural sector. Comparing the BAU scenario with the FI scenario, there is a decline in emissions for the selected HAPs up to 2050.

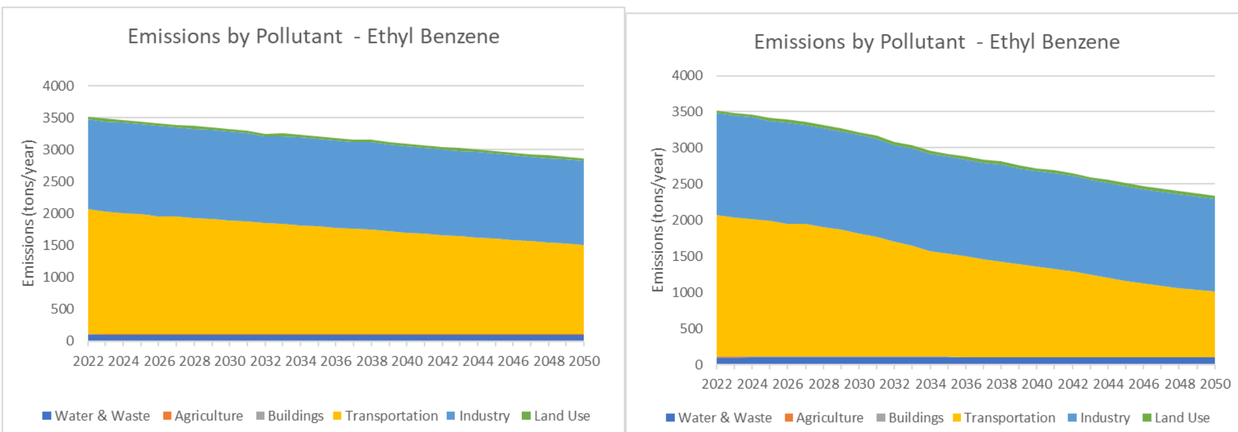

Figure 3-7: Ethyl-Benzene Emissions Reductions for BAU (left) and FI (right) Scenarios

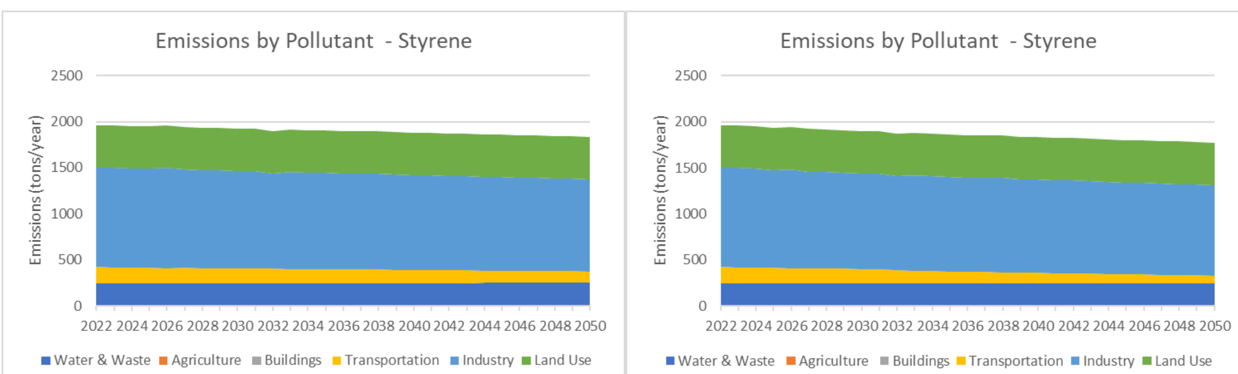

Figure 3-8: Styrene Emissions Reductions for BAU (left) and FI (right) Scenarios

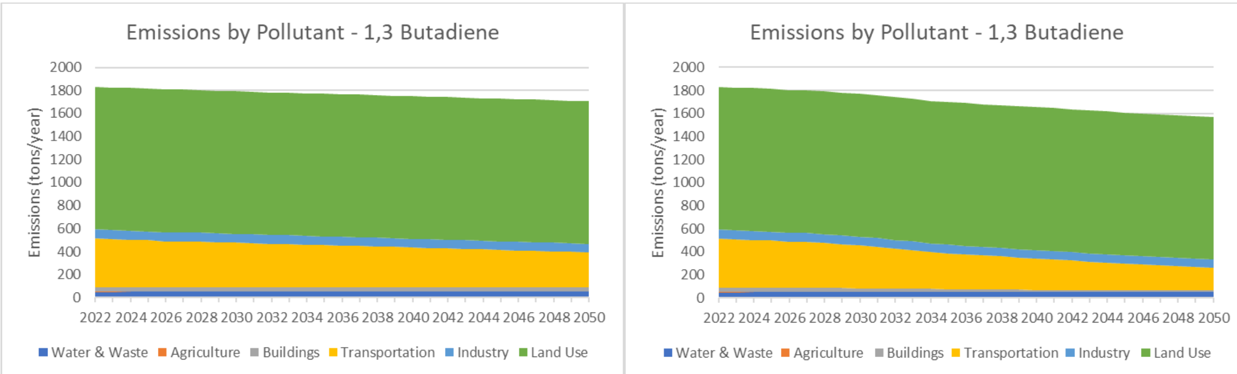

Figure 3-9: 1,3-Butadiene Emissions Reductions for BAU (left) and FI (right) Scenarios

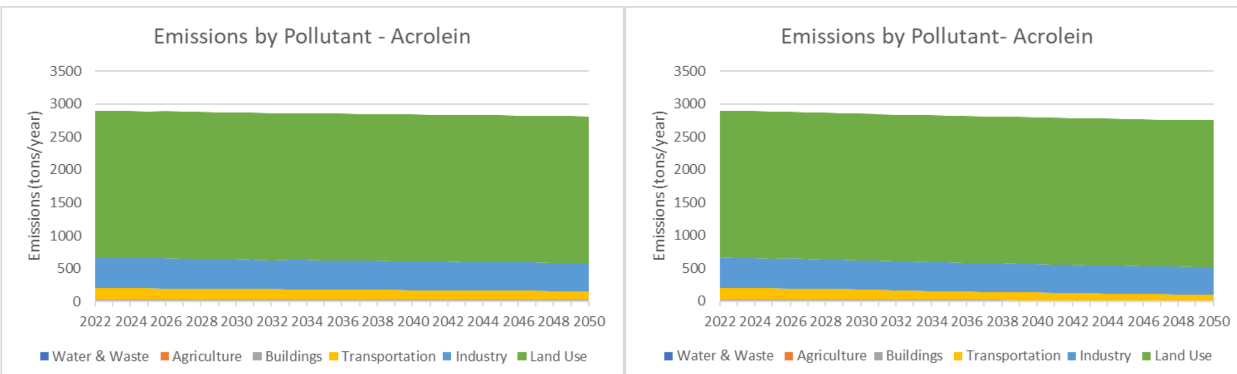

Figure 3-10: Acrolein Emissions Reductions for BAU (left) and FI (right) Scenarios

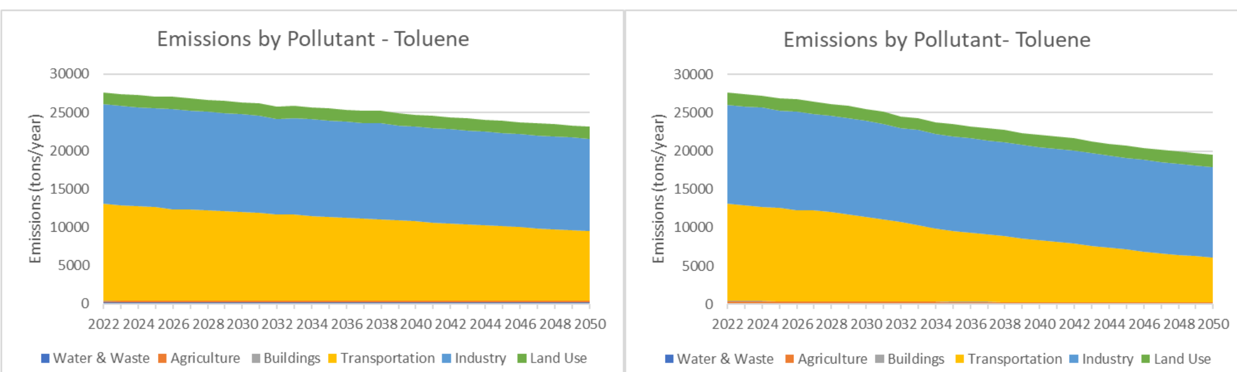

Figure 3-11: Toluene Emissions Reductions for BAU (left) and FI (right) Scenarios

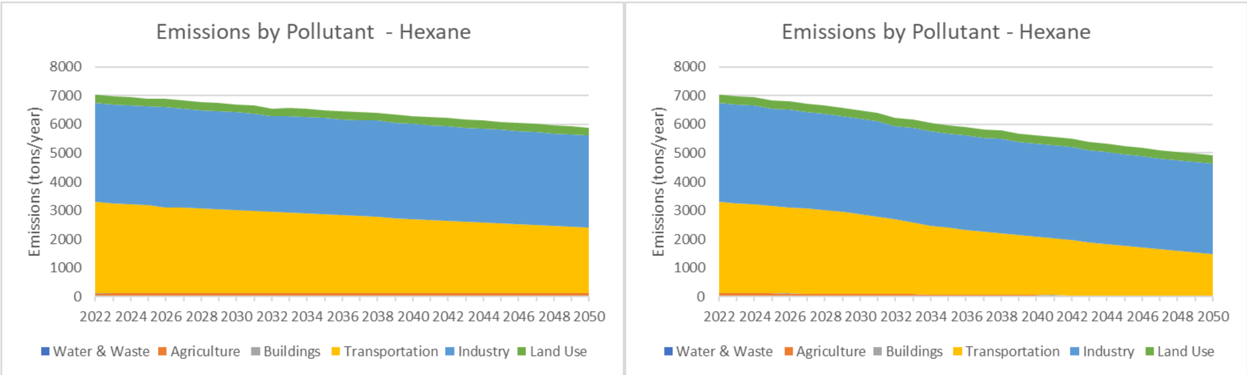

Figure 3-12: Hexane Emissions Reductions for BAU (left) and FI (right) Scenarios

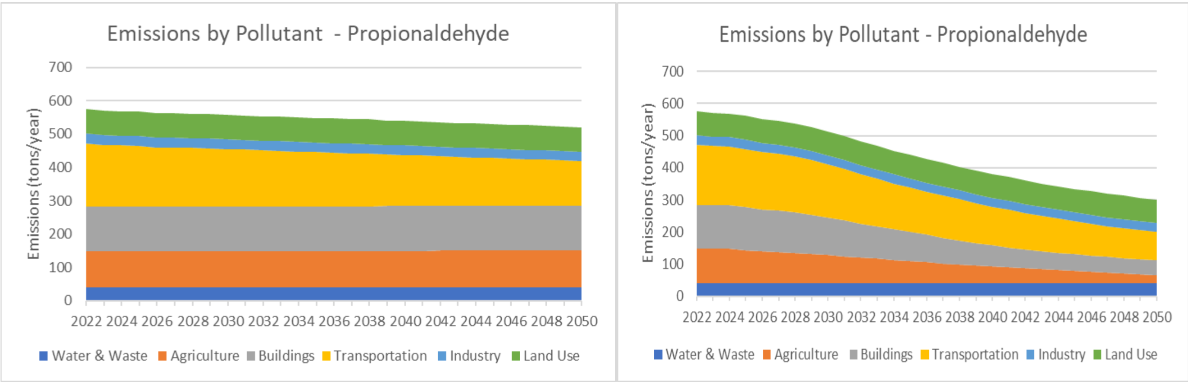

Figure 3-13: Propionaldehyde Emissions Reductions for BAU (left) and FI (right) Scenarios

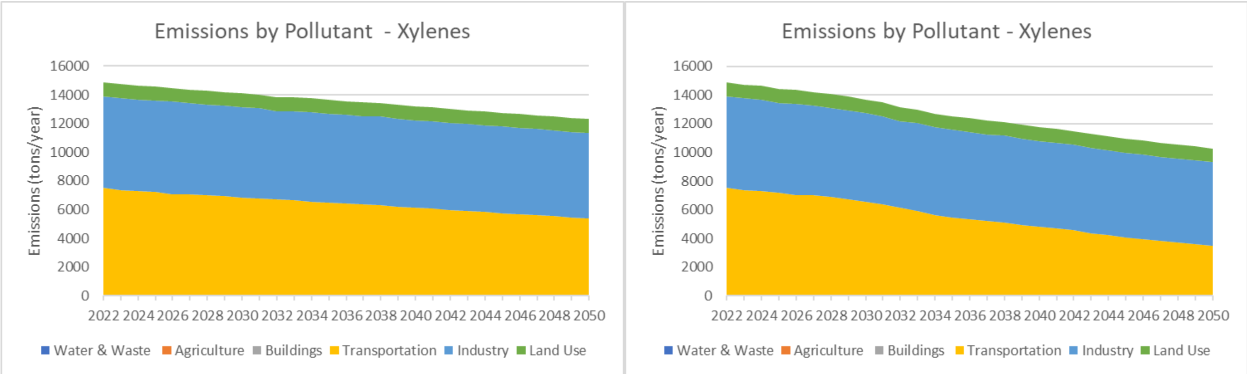

Figure 3-14: Xylene Emissions Reductions for BAU (left) and FI (right) Scenarios

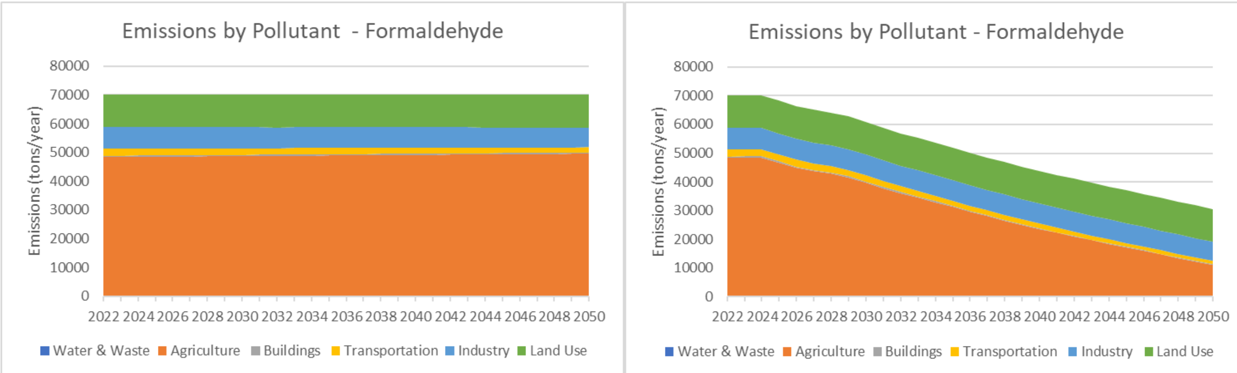

Figure 3-15: Formaldehyde Emissions Reductions for BAU (left) and FI (right) Scenarios

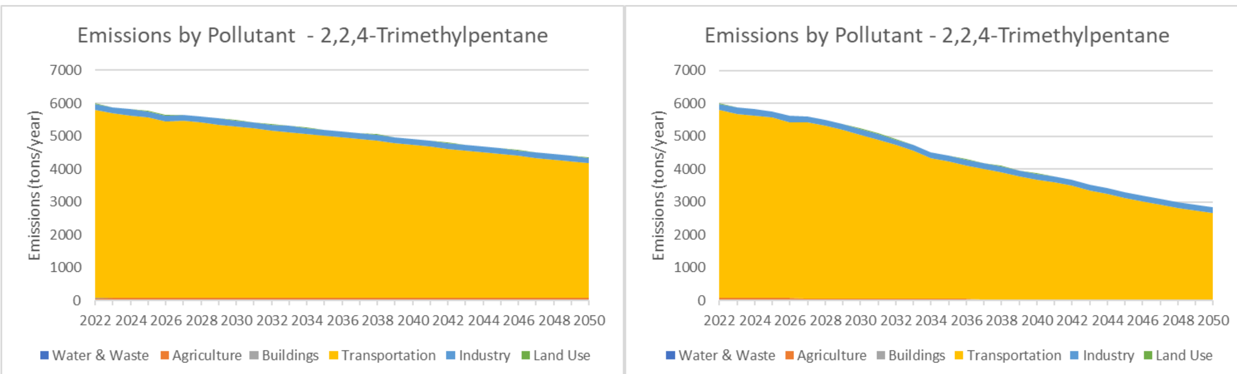

Figure 3-16: 2,2,4-Trimethylpentane Emissions Reductions for BAU (left) and FI (right) Scenarios

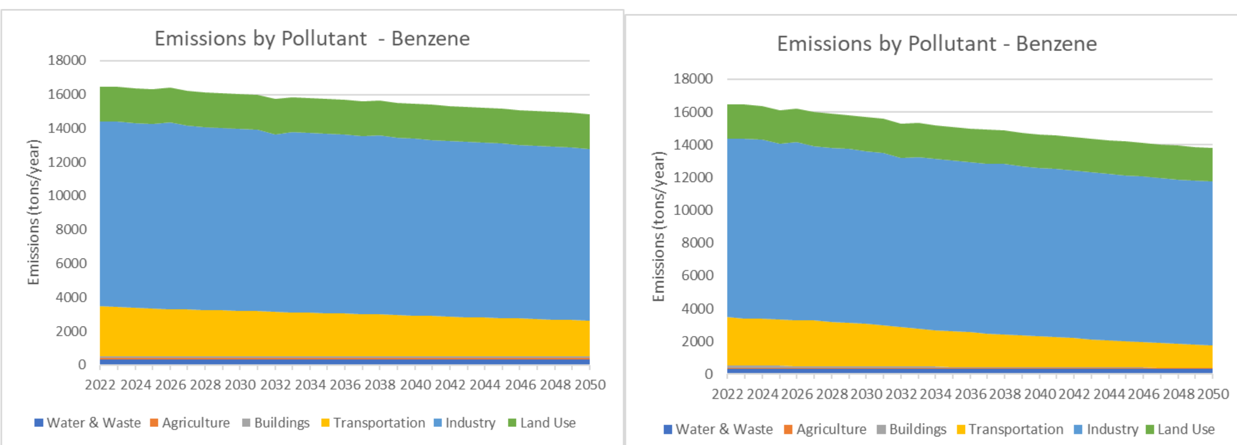

Figure 3-17: Benzene Emissions Reductions for BAU (left) and FI (right) Scenarios

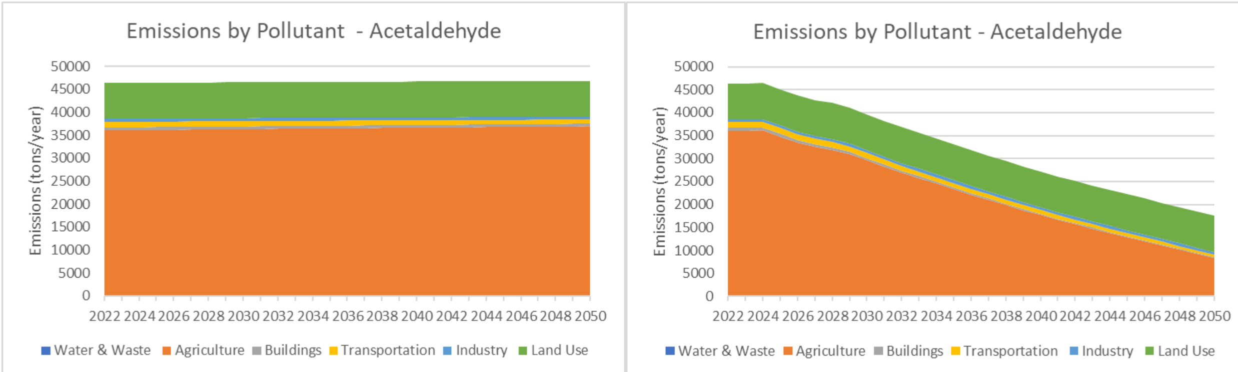

Figure 3-18: Acetaldehyde Emissions Reductions for BAU (left) and FI (right) Scenarios

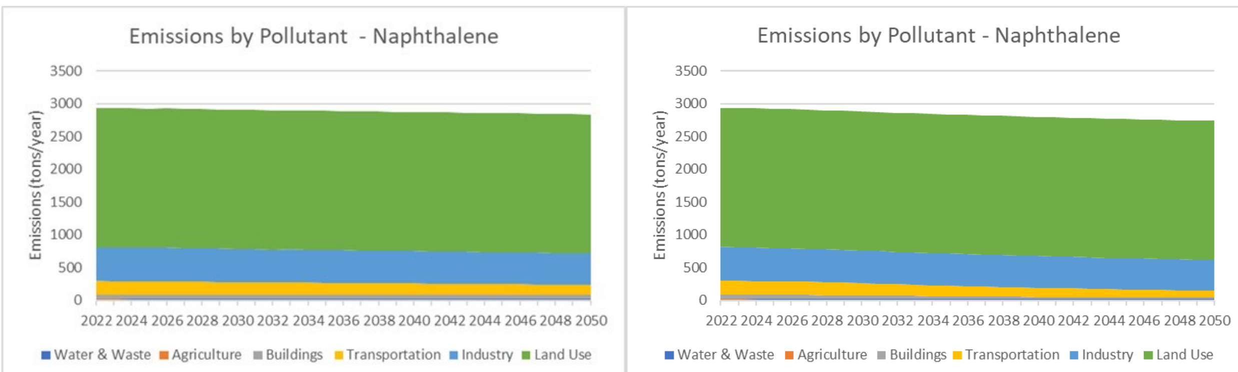

Figure 3-19: Naphthalene Emissions Reductions for BAU (left) and FI (right) Scenarios

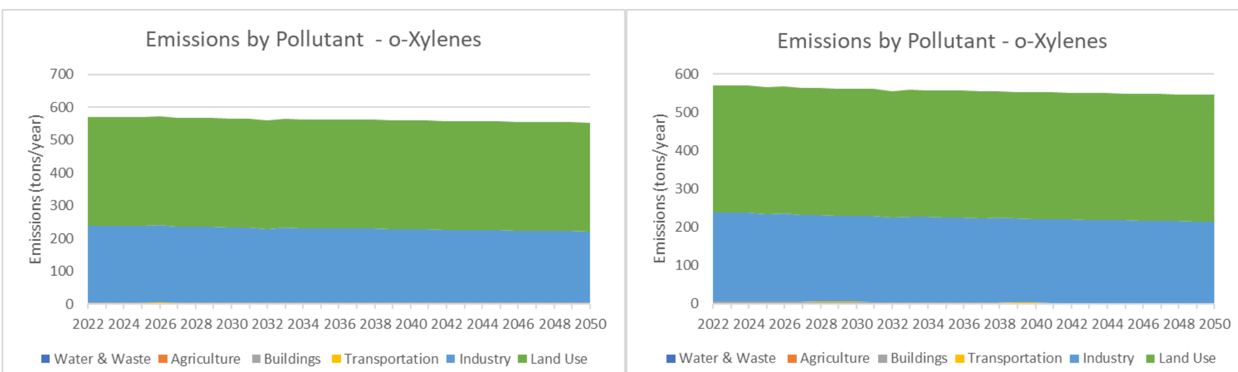

Figure 3-20: O-Xylene Emissions Reductions for BAU (left) and FI (right) Scenarios

CHAPTER 4: MEASURE COSTS

The costs of the actions for each sector were calculated using the CO_2e Abatement Cost Curve in EPS. For each policy, an average annual abatement cost attribution is allocated. This calls on the wedge diagram calculations done for the emissions reductions. It uses the annual output from the emissions wedge diagram and sums it across all model-run years, divided by the number of model-run years. Thus, the average cost per ton of CO_2e abated is calculated by dividing the cumulative CO_2e emissions reductions attributed to a given policy through 2030 or 2050 by the net present value of the policy-induced change in capital, operational, and fuel expenditures caused by that policy through 2030 or 2050.

Cost values from EPS represent changes in the amounts paid and do not account for the amounts received. Negative values would represent cost savings. For example, a consumer buying less fuel due to an action taken would represent a cost saving.

The results obtained from the simulator were extrapolated based on the Texas emissions inventory. Tables 4-1 through Table 4-4 below show the annual average abatement potential, cost effectiveness, and cost of the proposed actions. Negative values would represent dollars saved.

Table 4-1: Annual Average Abatement Potential and Cost Effectiveness of Industrial Sector Actions

Action	Annual Average Abatement Potential [MMT CO_2e]	Cost Effectiveness [$/ton CO_2e]	Cost (Million USD)
Electrify industrial process equipment or modify equipment to use hydrogen or other low emission fuels	32.00	508.00	$5,608.00
Energy efficiency improvements to processes and equipment	6.00	-86.00	-$848
Use of low-carbon cement	0.20	-182	-$55
Improvement/expansion of carbon capture	23.00	32.00	$1,142.00
Replace HFC with ultra-low global warming potential (GWP) refrigeration equipment	0.40	39.00	$27.00
Replace pneumatic controllers, motors, and pumps, add surveillance, add monitoring, and remove redundant equipment to reduce fugitive emissions from oil and gas activities	1.00	-382.00	-$611.00
Reduce flaring and capture methane from oil and gas activities	3.00	140.00	$686.00
Remediate and/or plug low producing and abandoned wells	0.40	-394.00	-$236.00
Total	**66.00**	**-325.00**	**$5,713.00**

Table 4-2: Annual Average Abatement Potential and Cost Effectiveness of Electric Power Sector Actions

Action	Annual Average Abatement Potential [MMT CO_2e]	Cost Effectiveness [$/ton CO_2e]	Cost (Million USD)
Lower demand with load shifting load management and energy efficiency	2.00	-413.00	-$536.00
Upgrade transmission lines to improve capacity	1.00	-532.00	-$425.00
Use advanced nuclear energy or geothermal energy	47.00	-84.00	-$3426.00
Add grid scale renewable energy storage	1.00	162.00	$65.00
Total	**51.00**	**-867.00**	**-$4322.00**

Table 4-3: Annual Average Abatement Potential and Cost Effectiveness of the Transportation Sector Actions

Action	Annual Average Abatement Potential [MMT CO_2e]	Cost Effectiveness [$/ton CO_2e]	Cost (Million USD)
Reduce emissions from sea and inland ports and associated support equipment and use low emission passenger or freight locomotives	1.00	-26.00	-$32.00
Infrastructure for electric vehicle (EV) charging and hydrogen fueling	0.10	-120.00	-$12.00
Use zero emissions light-, medium-, and heavy-duty vehicles, including school buses and fleet vehicles	11.00	-193.00	-$2,467.00
Reduce airport emissions by using lower emission support equipment, vehicles, and use of low emission jet fuels.	10.00	-99.00	-$1,164.00
Total	**22.10**	**-438.00**	-$**3,675.00**

Table 4-4: Annual Average Abatement Potential and Cost Effectiveness of Other Sector Actions

Action	Annual Average Abatement Potential [MMT CO_2e]	Cost Effectiveness [$/ton CO_2e]	Cost (Million USD)
Increase energy efficiency and weatherization in homes and commercial buildings	0.02	-137.00	-$55.00
Support projects to increase recycling, reduce waste, increase composting, and add recycling infrastructure	0.40	-61.00	-$451.00

Action	Annual Average Abatement Potential [MMT CO_2e]	Cost Effectiveness [$/ton CO_2e]	Cost (Million USD)
Use sustainable agriculture or forestry practices to reduce emissions and restore coastal landscapes	0.20	18.00	$13.00
Reforest agriculture lands no longer in use, use efficient pumps and irrigation systems in agriculture, and increase urban tree canopy	0.02	6.00	$3.00
Switch to electric heat pumps	1.00	7.00	$88.00
Create biofuels through methane capture from landfills and wastewater treatment plants, or by using surplus biomass	0.04	7.00	$5.00
Combine solar arrays with biogas at closed landfills and add solar to commercial and residential buildings	0.40	11.00	$78.00
Total	**2.08**	**-149.00**	**-$319.00**

CHAPTER 5: REFERENCES

EMP 2022, “Emissions Modeling Platform”, 2022v1 Emissions Modeling Platform | US EPA, Accessed August 12, 2025

EMP 2020, “Emissions Modeling Platform”, 2020 National Emissions Inventory (NEI) Data | US EPA, Accessed August 12, 2025

Energy Innovation and RMI. 2025. “Texas Energy Policy Simulator, Version 4.04” April 1, 2025.” https://energypolicy.solutions/simulator/texas/en.

EPS 2025a, Energy Policy Simulator Documentation for the Agricultural sector, Industry & Agriculture Sector (main) | Energy Policy Simulator Documentation

EPS 2025b, “Energy Policy Simulator Documentation for the Building sector, Accessed August 6, 2025”, Buildings Sector (main) | Energy Policy Simulator Documentation

EPS 2025c, “Energy Policy Simulator Documentation for Comparing Results to Reality or Other Models, Accessed August 29, 2025”, Comparing Results to Reality or Other Models | Energy Policy Simulator Documentation

EPS 2025d, “Energy Policy Simulator Documentation for the Electricity sector, Accessed July 30, 2025”, Electricity Sector (main) | Energy Policy Simulator Documentation

EPS 2025e, “Energy Policy Simulator Documentation for the Industrial sector, Accessed August 6, 2025”, Industrial Electrification and Hydrogen | Energy Policy Simulator Documentation

EPS 2025f, “Energy Policy Simulator Documentation”, Introduction | Energy Policy Simulator Documentation, Accessed August 12, 2025

EPS 2025g, “Energy Policy Simulator Documentation for Land use, Land use charge and Forestry, Accessed August 6, 2025”, Land Use, Land Use Change, and Forestry | Energy Policy Simulator Documentation

EPS 2025h, “Energy Policy Simulator Documentation for the Transportation sector, Accessed July 23, 2025”, Transportation Sector (main) | Energy Policy Simulator Documentation

Joseph Stolle 2022, “Hazardous Air Pollutants 101: Emission Calcs, Modeling, Trends 2022”, Midwest Environmental Compliance Conference, September 2022

Kate Whiting 2025, World Economic Forum, Paris Agreement: “What are NDCs and why do they matter?” COP30: What are NDCs and can they get us to net zero? | World Economic Forum, Accessed August 12, 2025.

RMI 2025, “States score card for Texas, Accessed August 12, 2025”. RMI | State Scorecard