Appendix A: Updated 2019 Greenhouse Gas Inventory

Update to Scranton 2019 Greenhouse Gases (GHG) Inventory

June 2024

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Introduction

As the City of Scranton, Pennsylvania continues its commitment to sustainability and environmental stewardship, the city proudly presents its updated 2019 Greenhouse Gas (GHG) inventory. This report expands upon the work previously completed in 2022 in partnership with the Local Climate Action Plan (LCAP) Program, a joint initiative by the Pennsylvania Department of Environmental Protection and Penn State University, which created a 2019 comprehensive GHG inventory for the City. For this Sustainability and Climate Action Plan, the 2019 GHG inventory was reviewed, and it was decided to integrate a crucial component previously unaccounted for: fugitive emissions from natural gas. By diligently quantifying emissions from various sources including industrial processes, transportation, energy consumption, and now fugitive emissions, Scranton aims to enhance its understanding of its carbon footprint and take proactive steps towards mitigating climate change. This inventory contains all necessary information including usage data, emission factors, and metric tons of carbon dioxide equivalent (MT CO_2e).

Greenhouse Gases

Local governments are expected to evaluate emissions of the six internationally recognized greenhouse gases (GHG) under the Kyoto Protocol,[1] namely carbon dioxide (CO_2), methane (CH_4), Nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and Sulfur hexafluoride (SF_6). Each of these greenhouse gases is reported and converted into metric tons (MT), differentiated by their respective Global Warming Potential (GWP). The GWP of each is benchmarked on carbon dioxide's potential, which is set at 1, as it serves as the reference point for the other gases. Methane, with a GWP of 28, is largely emitted from landfills, wastewater, and natural gas leakage. Nitrous oxide, with a higher GWP of 265, is primarily associated with energy production and wastewater treatment. Hydrofluorocarbons, having a wide GWP range of 12-11,700, are mainly tied to refrigerant usage. Perfluorocarbons, with a GWP between 6,500-9,200, typically result from manufacturing and production processes. Sulfur hexafluoride, possessing the highest GWP of 23,900, is principally connected with power transmission and distribution. This inventory primarily uses carbon dioxide, methane, and nitrous oxide[2] to establish the carbon dioxide emission equivalents (CO_2e) for all sectors analyzed. All emissions with statistical significance are reported and calculated within this inventory.

[1] United Nations Framework Convention on Climate Change. (1998). Kyoto Protocol to the United Nations Framework Convention on Climate Change. Retrieved from https://unfccc.int/kyoto_protocol

[2] As referenced in the US Community Protocol the high GWP GHG's perfluorocarbons and sulfur hexafluoride are not required to complete an accurate inventory. The city reported no refrigerant loss, and therefore no hydrofluorocarbons do not appear in the inventory. All other GHGs are measured and reported.

Inventory Boundary

In the City of Scranton, Pennsylvania, this inventory measures emissions from community-wide activities. This focuses on emissions from individuals residing within Scranton's jurisdiction, including those within the city limits, as well as those resulting from residents' activities. Key sectors included in the community inventory are building energy usage, transportation, solid waste, wastewater, water management, and fugitive emissions. Building energy usage sources consisted of residential and commercial electricity, natural gas, propane, fuel oil consumption, and fugitive emissions. Transportation emissions cover both on-road and off-road transportation activities. This inventory also accounts for emissions occurring from transportation, distribution, and processing of water and wastewater. Finally, emissions from solid waste management are calculated.

Comprehensive Approach

The 2019 Scranton Community-wide Inventory includes the analysis of residential and commercial energy consumption through utility bills and energy audits, alongside transportation metrics like vehicle miles traveled. Waste generation and recycling statistics, water usage data from utility records, and population-based emissions for wastewater treatment plants are also applied.

The methodology employed for the community inventory of Scranton, PA, adheres to international standards for greenhouse gas accounting, namely the U.S Community Protocol that ensures accuracy and reliability in emission assessments. Leveraging the capabilities of the International Council for Local Environmental Initiatives (ICLEI USA) ClearPath tool,[3] emissions were meticulously calculated across various sectors including energy consumption, transportation, waste management, and industrial processes. The ClearPath tool facilitates a systematic approach, guiding practitioners through the collection of relevant data, application of appropriate emission factors, and the execution of calculations tailored to the specific characteristics of Scranton's local context. By utilizing this tool, Scranton's inventory process benefits from standardized methodologies, enabling compatibility with other municipalities and fostering best practices in emissions accounting and reduction strategies.

Summary Table

Table A.1 provides a breakdown of greenhouse gas emissions by sector and fuel/source type, detailing usage metrics and corresponding emissions. It includes residential, commercial,

[3] ICLEI - Local Governments for Sustainability USA. (n.d.). *ClearPath: The leading online software for community-scale greenhouse gas inventories, forecasts, climate action plans, and monitoring.* Retrieved from https://icleiusa.org/clearpath/

industrial, transportation & mobile sources, solid waste, fugitive emissions, upstream activities[4] and water & wastewater sectors. The data includes usage in various units such as kWh, Therms, MMBtu, and VMT, with corresponding emission values in metric tons.

Table A.1: Summary of GHG emissions and usage data[5].

Sector	Fuel Or Source	Usage	Usage Units	Emissions
Residential Energy	Electricity	234,872,100	kWh	74,402
Residential Energy	Natural Gas	28,841,485	Therms	153,398
Residential Energy	Distillate Fuel Oil No. 2	24,259	MMBtu	1,806
Residential Energy Total				229,702
Commercial Energy	Electricity	408,244,185	kWh	129,322
Commercial Energy	Natural Gas	10,599,264	Therms	56,374
Commercial Energy Total				185,696
Industrial Energy	Electricity	165,098,164	kWh	52,299
Industrial Energy	Natural Gas	11,983,945	Therms	63,604
Industrial Energy Total				115,903
Transportation & Mobile Sources	Gasoline	355,153,934	VMT	146,508
Transportation & Mobile Sources	Diesel	36,848,201	VMT	54,244
Transportation & Mobile Sources Total				200,752
Solid Waste	Waste Sent to Landfill	71,816	Tons	30,694
Solid Waste Total				30,694

[4]Upstream transportation and distribution of natural gas. **U.S. Environmental Protection Agency.** (n.d.). *Scope 3 inventory guidance*. Retrieved December 13, 2024, from https://www.epa.gov/climateleadership/scope-3-inventory-guidance

[5] ICLEI - Local Governments for Sustainability USA. (n.d.). *ClearPath: The leading online software for community-scale greenhouse gas inventories, forecasts, climate action plans, and monitoring.* Retrieved from https://icleiusa.org/clearpath/

Water & Wastewater	Water Supply Energy			900
Water & Wastewater	Fugitive Emissions			232
Water & Wastewater Total				1,132
Process & Fugitive Emissions	Other			8,922
Process & Fugitive Emissions Total				8,922
Upstream Impacts of Activities	Other			36,013
Upstream Impacts of Activities Total	Upstream Natural Gas			36,013

Summary by Sector

This inventory breaks down emissions by sectors (see figure A.1 and A.2). These sectors are outlined by the U.S. Community Protocol and calculated in ICLEI ClearPath. Residential energy consumption emerges as the foremost contributor, emitting 229,606 metric tons of carbon dioxide equivalent (MT CO_2e). This finding suggests the need for initiatives targeting residential energy efficiency and renewable energy adoption to curb emissions effectively. Following closely, commercial energy usage contributes 185,696 MT CO_2e, indicating the importance of engaging businesses in sustainability practices and energy conservation measures.

Transportation and mobile sources rank as another significant emissions source, totaling 200,752 MT CO_2e. Addressing transportation emissions may involve promoting public transit, supporting electric vehicle adoption, and implementing infrastructure for active transportation modes like biking and walking. Industrial energy usage, while substantial at 115,903 MT CO_2e, could benefit from energy efficiency improvements and transitioning to cleaner energy sources.

Solid waste management presents an opportunity for emissions reduction, with emissions amounting to 30,693 MT CO_2e. Strategies such as waste reduction, recycling, and organic waste diversion can mitigate these emissions effectively. Moreover, upstream impacts of activities and process emissions, though smaller in scale, warrant attention to ensure a holistic approach to emission reduction across all sectors.

Figure A.1: 2019 GHG emissions inventory by sector[6]

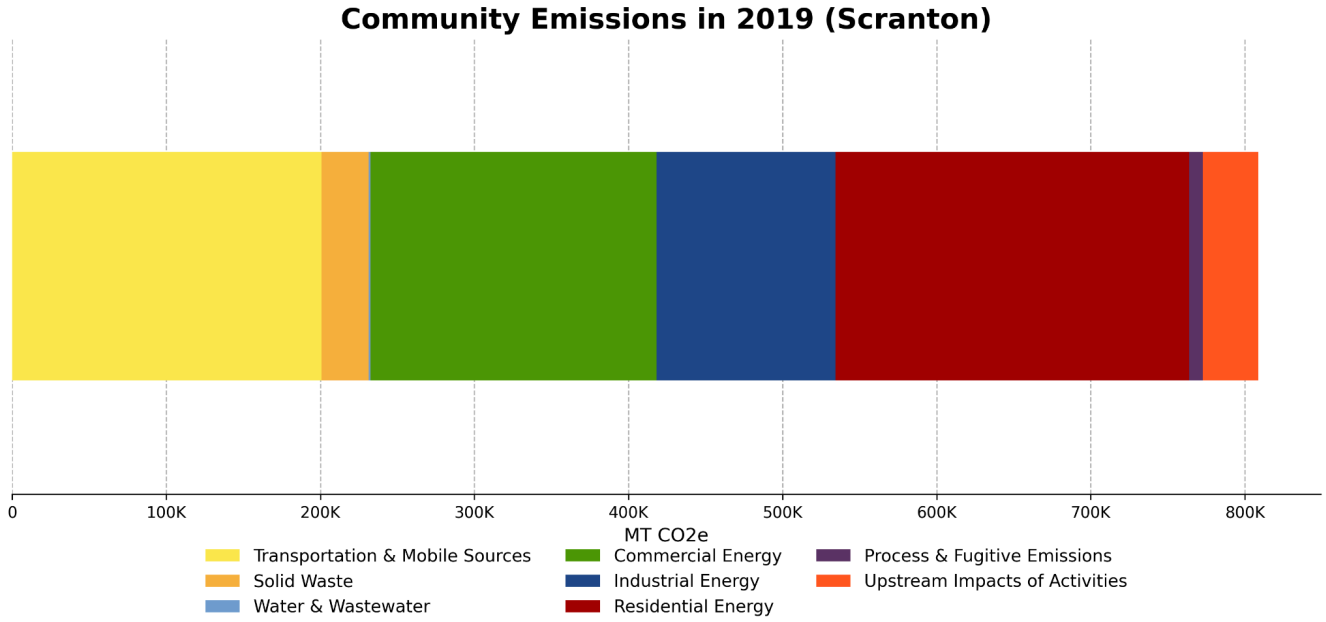
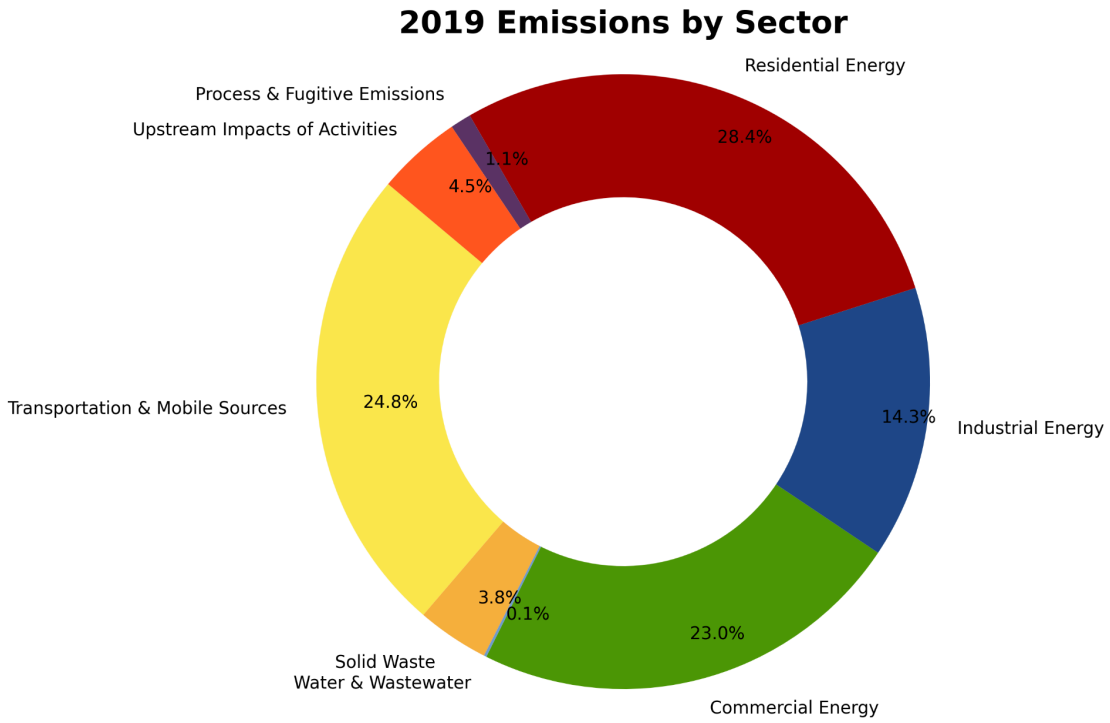


Figure A.2: 2019 GHG emissions by percentage



[6] Data from ICLEI - Local Governments for Sustainability USA. (n.d.). *ClearPath: The leading online software for community-scale greenhouse gas inventories, forecasts, climate action plans, and monitoring.* Retrieved from https://icleiusa.org/clearpath/

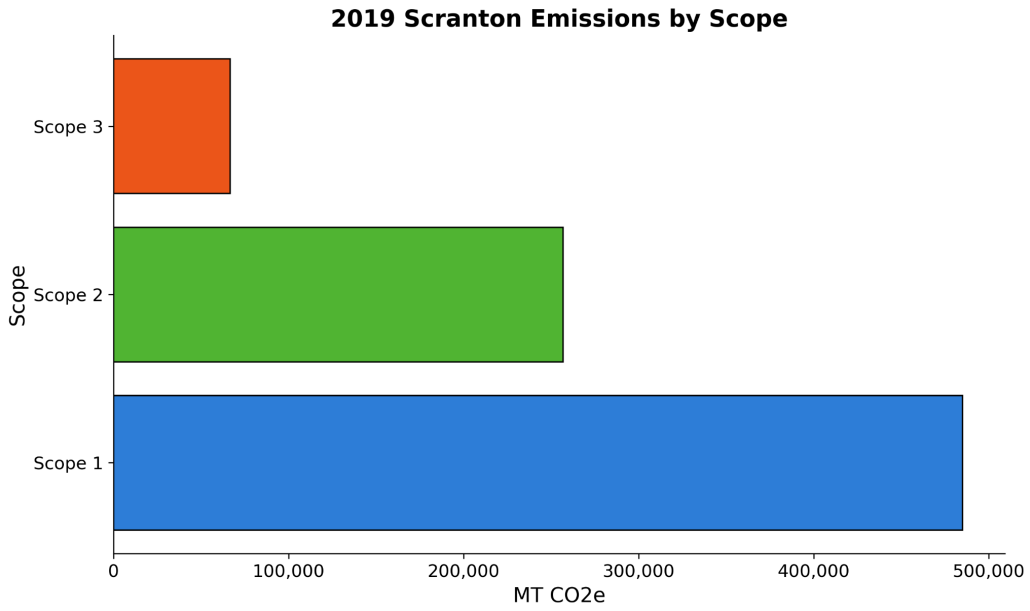
Emissions by Scope

In Scranton's carbon emissions breakdown, Scope 1 accounts for direct emissions originating from sources owned or controlled by the City. These emissions primarily include those from activities like transportation, industrial processes, and heating facilities, totaling 485,088 MT CO_2e. Scope 2, on the other hand, involves indirect emissions stemming from the consumption of purchased electricity, heat, or steam, which amounts to 256,923 MT CO_2e. Lastly, Scope 3 includes all other indirect emissions occurring throughout Scranton's value chain, such as those from waste generation, and supplier activities, totaling 66,706 MT CO_2e. These details are illustrated in Table A.2, A.3 and visually represented in Figures A.3 and A.4, highlighting various sources of Scranton's carbon footprint and underscoring the importance of addressing emissions comprehensively across all scopes.

Table A.2: Summary of GHG emissions by scope[7]

Scope	MT CO_2e
Scope 1	485,088
Scope 2	256,923
Scope 3	66,706

Figure A.3: 2019 scope GHG emissions by scope

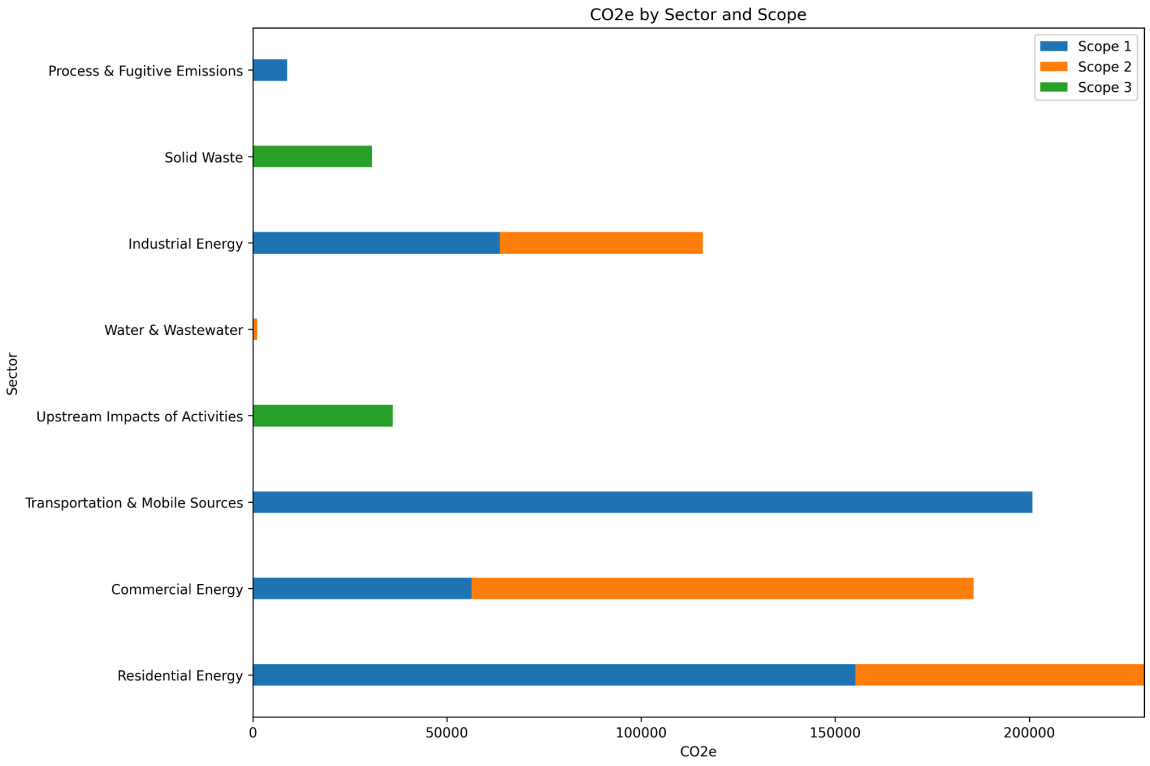


[7] ICLEI - Local Governments for Sustainability USA. (n.d.). *ClearPath: The leading online software for community-scale greenhouse gas inventories, forecasts, climate action plans, and monitoring.* Retrieved from https://icleiusa.org/clearpath/

Table A.3: Summary of GHG emissions by scope and sector.

Scope	Sector	CO_2e
Scope 1	Transportation & Mobile Sources	200,752
Scope 1	Water & Wastewater	231
Scope 1	Commercial Energy	56,373
Scope 1	Industrial Energy	63,604
Scope 1	Residential Energy	155,204
Scope 1	Process & Fugitive Emissions	8,921
Scope 2	Water & Wastewater	899
Scope 2	Commercial Energy	129,322
Scope 2	Industrial Energy	52,299
Scope 2	Residential Energy	74,402
Scope 3	Solid Waste	30,693
Scope 3	Upstream Impacts of Activities	36,013

Figure A.4: Emissions by scope and sector



Emissions Factors and Activity Data

The following tables provide detailed emissions factors and activity data across various sectors, including residential energy, commercial energy, industrial energy, transportation & mobile sources, water & wastewater, solid waste, process & fugitive emissions, and upstream impacts of activities. The data includes CO_2, CH_4, and N_2O emissions, along with their equivalents (CO_2e), across different activities and energy sources. This information was collected from the ICLEI ClearPath Tool.[8]

Residential Energy

Inventory Record	Calculator	GPC Scope	GPC Ref Number	Factor Profiles	Global Warming Potential	Category	Activity Source
PPL Electric 2019 Residential Electricity	Emissions from Grid Electricity (USCP Required)	Scope 2	I.1.2	RFC East (RFCE) eGRID 2019	IPCC 5th Assessment 100 Year Values	Residential Energy	Activity
UGI 2019 Residential Natural Gas Combustion	Emissions from Stationary Fuel Combustion (USCP Required)	Scope 1	I.1.1	-	IPCC 5th Assessment 100 Year Values	Residential Energy	Source and Activity
Estimated 2019 Residential Distillate Fuel Combustion	Emissions from Stationary Fuel Combustion (USCP Required)	Scope 1	I.1.1	-	IPCC 5th Assessment 100 Year Values	Residential Energy	Source and Activity

Inventory Record	CO_2 (MT)	CH_4 (MT)	N_2O (MT)	CO_2e (MT)	Electricity Energy Equivalent (MMBtu)	CO_2 Emissions Factor	CO_2 Emissions Factor Units	CH_4 Emissions Factor	CH_4 Emissions Factor Units	N_2O Emissions Factor	N_2O Emissions Factor Units
PPL Electric 2019 Residential Electricity	74,046	5.6464	0.74575	74,402	801,611	0.092372	MT/MMBtu	7.0438×10^{-6}	MT/MMBtu	9.3032×10^{-7}	MT/MMBtu
UGI 2019 Residential Natural Gas Combustion	152,918	14.421	0.28841	153,398	-	53.02	kg/MMBtu	0.005	kg/MMBtu	1×10^{-4}	kg/MMBtu

[8] ICLEI - Local Governments for Sustainability USA. (n.d.). *ClearPath: The leading online software for community-scale greenhouse gas inventories, forecasts, climate action plans, and monitoring.* Retrieved from https://icleiusa.org/clearpath/

Estimated 2019 Residential Distillate Fuel Combustion	1,794.2	0.26369	0.017579	1806.2	-	73.96	kg/MMBtu	0.01087	kg/MMBtu	7.2464×10^{-4}	kg/MMBtu

Inventory Record	US Community Protocol Reference	Energy Equivalent (MMBtu)	Biogenic CO_2 Emissions Factor	Biogenic CO_2 Emissions Factor Units
PPL Electric 2019 Residential Electricity	BE.2.1	-	-	-
UGI 2019 Residential Natural Gas Combustion	BE.1.1	2.8841×10^{6}	0	kg/MMBtu
Estimated 2019 Residential Distillate Fuel Combustion	BE.1.2	24,259	0	kg/MMBtu

Commercial Energy

Inventory Record	Calculator	GPC Scope	GPC Ref Number	Factor Profiles	Global Warming Potential	Category	Activity Source
PPL Electric 2019 Commercial Electricity	Emissions from Grid Electricity (USCP Required)	Scope 2	I.2.2	RFC East (RFCE) eGRID 2019	IPCC 5th Assessment 100 Year Values	Commercial Energy	Activity
PPL Electric 2019 Other Electricity	Emissions from Grid Electricity (USCP Required)	Scope 2	I.2.2	RFC East (RFCE) eGRID 2019	IPCC 5th Assessment 100 Year Values	Commercial Energy	Activity
UGI 2019 Commercial Natural Gas Combustion	Emissions from Stationary Fuel Combustion (USCP Required)	Scope 1	I.2.1	-	IPCC 5th Assessment 100 Year Values	Commercial Energy	Source and Activity

Inventory Record	CO_2 (MT)	CH_4 (MT)	N_2O (MT)	CO_2e (MT)	Electricity Energy Equivalent (MMBtu)	CO_2 Emissions Factor	CO_2 Emissions Factor Units	CH_4 Emissions Factor	CH_4 Emissions Factor Units	N_2O Emissions Factor	N_2O Emissions Factor Units
PPL Electric 2019 Commercial Electricity	128,091	9.7676	1.2901	128,706	1.3867×10^{6}	0.092372	MT/MMBtu	7.0438×10^{-6}	MT/MMBtu	9.3032×10^{-7}	MT/MMBtu
PPL Electric 2019 Other Electricity	613.07	0.04675	0.006175	616.02	6,637	0.092372	MT/MMBtu	7.0438×10^{-6}	MT/MMBtu	9.3032×10^{-7}	MT/MMBtu
UGI 2019 Commercial	56,197	5.2996	0.10599	56,374	-	-	kg/MMBtu	-	kg/MMBtu	-	kg/MMBtu

Natural Gas Combustion											

Inventory Record	US Community Protocol Reference	Energy Equivalent (MMBtu)	CO_2 Emissions Factor (kg/MMBtu)	CH_4 Emissions Factor (kg/MMBtu)	N_2O Emissions Factor (kg/MMBtu)	Biogenic CO_2 Emissions Factor	Biogenic CO_2 Emissions Factor Units
PPL Electric 2019 Commercial Electricity	BE.2.1	-	-	-	-	-	-
PPL Electric 2019 Other Electricity	BE.2.1	-	-	-	-	-	-
UGI 2019 Commercial Natural Gas Combustion	BE.1.1	1.0599 $x10^{6}$	53.02	0.005	1 $x10^{-4}$	0	kg/MMBtu

Industrial Energy

Inventory Record	Calculator	GPC Scope	GPC Ref Number	Factor Profiles	Global Warming Potential	Category	Activity Source
PPL Electric 2019 Industrial Electricity	Emissions from Grid Electricity (USCP Required)	Scope 2	I.3.2	RFC East (RFCE) eGRID 2019	IPCC 5th Assessment 100 Year Values	Industrial Energy	Activity
UGI 2019 Industrial Natural Gas Combustion	Emissions from Stationary Fuel Combustion (USCP Required)	Scope 1	I.3.1	-	IPCC 5th Assessment 100 Year Values	Industrial Energy	Source

Inventory Record	CO_2 (MT)	CH_4 (MT)	N_2O (MT)	CO_2e (MT)	CO_2 Emissions Factor	CO_2 Emissions Factor Units	CH_4 Emissions Factor	CH_4 Emissions Factor Units	N_2O Emissions Factor	N_2O Emissions Factor Units
PPL Electric 2019 Industrial Electricity	52,049	3.969	0.52421	52,299	0.092372	MT/MMBtu	7.0438 $x10^{-6}$	MT/MMBtu	9.3032 $x10^{-7}$	MT/MMBtu
UGI 2019 Industrial Natural Gas Combustion	63,539	1.1984	0.11984	63,604	0.05302	MT/MMBtu	1.0 $x10^{-6}$	MT/MMBtu	1.0000 $x10^{-7}$	MT/MMBtu

Inventory Record	US Community Protocol Reference	Energy Equivalent (MMBtu)	Biogenic CO_2 Emissions Factor	Biogenic CO_2 Emissions Factor Units

PPL Electric 2019 Industrial Electricity	BE.2.1	-	-	-
UGI 2019 Industrial Natural Gas Combustion	BE.1.1	1.1984 x10^{6}	0	0

Transportation & Mobile Sources

Inventory Record	Calculator	GPC Scope	GPC Ref Number	Factor Profiles	Global Warming Potential	Category	Activity Source
Google EIE 2019 On-Road Transportation Gasoline	On Road Transportation (USCP Required)	Scope 1	II.1.1	RFC East (RFCE) eGRID 2019 and 2019 US National Defaults (updated 2020)	IPCC 5th Assessment 100 Year Values	Transportation & Mobile Sources	Source and Activity
Google EIE 2019 On-Road Transportation Diesel	On Road Transportation (USCP Required)	Scope 1	II.1.1	RFC East (RFCE) eGRID 2019 and 2019 US National Defaults (updated 2020)	IPCC 5th Assessment 100 Year Values	Transportation & Mobile Sources	Source and Activity

Inventory Record	CO_2 (MT)	CH_4 (MT)	N_2O (MT)	CO_2e (MT)	On Road VMT	Fossil Fuel Energy Equivalent (MMBtu)	Biofuel Energy (MMBtu)	CO_2 Emissions Factor	CO_2 Emissions Factor Units
Google EIE 2019 On-Road Transportation Gasoline	145,317	6.9188	3.7636	146,508	3.5515 x10^{8}	2.0689 x10^{6}	0	0.07024	MT/MMBtu
Google EIE 2019 On-Road Transportation Diesel	54,197	0.16945	0.16188	54,244	3.6848 x10^{7}	733037	0	0.073934	MT/MMBtu

Inventory Record	Biogenic CO_2 Emissions Factor	Biogenic CO_2 Emissions Factor Units	CH_4 Emissions Factor	CH_4 Emissions Factor Units	N_2O Emissions Factor	N_2O Emissions Factor Units	US Community Protocol Reference
Google EIE 2019 On-Road Transportation Gasoline	0.068414	MT/MMBtu	1.9481 x10^{-8}	MT/mile	1.0597 x10^{-8}	MT/mile	TR.1.A
Google EIE 2019 On-Road Transportation Diesel	0.073773	MT/MMBtu	4.5987 x10^{-9}	MT/mile	4.3931 x10^{-9}	MT/mile	TR.1.A

Water & Wastewater

Inventory Record	Calculator	GPC Scope	GPC Ref Number	Factor Profiles	Global Warming Potential	Category	Activity Source
2019 Potable Water Emissions	Emissions from the Supply of Potable Water (USCP Recommended)	Scope 2	VI.1	RFC East (RFCE) eGRID 2019	IPCC 5th Assessment 100 Year Values	Water & Wastewater	Activity
2019 Scranton Sewer Authority Wastewater	Process N2O Emissions from Wastewater Treatment (USCP Recommended)	Scope 1	III.4.1	RFC East (RFCE) eGRID 2019	IPCC 5th Assessment 100 Year Values	Water & Wastewater	Source and Activity

Inventory Record	CO_2 (MT)	CH_4 (MT)	N_2O (MT)	CO_2e (MT)	Electricity Energy (MMBtu)	Electricity CO_2 Emissions Factor	Natural Gas CO_2 Emissions Factor	CO_2 Emissions Factor Units
2019 Potable Water Emissions	895.57	0.068292	0.00902	899.87	9,695.2	0.092372	0.05302	MT/MMBtu
2019 Scranton Sewer Authority Wastewater	-	-	0.875	231.88	-	-	-	-

Inventory Record	Electricity CH_4 Emissions Factor	Natural Gas CH_4 Emissions Factor	CH_4 Emissions Factor Units	Electricity N_2O Emissions Factor	Natural Gas N_2O Emissions Factor	N_2O Emissions Factor Units	US Community Protocol Reference	Process N_2O Population Served	N_2O Emissions Factor (g/person)
2019 Potable Water Emissions	7.0438×10^{-6}	5.0×10^{-6}	MT/MMBtu	9.3032×10^{-7}	1.0000×10^{-7}	MT/MMBtu	WW.14	-	-
2019 Scranton Sewer Authority Wastewater	-	-	-	-	-	g/person	WW.7	100000	0

Solid Waste

Inventory Record	Calculator	GPC Scope	GPC Ref Number	Factor Profiles	Global Warming Potential	Category	Activity Source
2019 Keystone Landfill Solid Waste	Landfilled Waste (USCP Required, Preferred, where applicable)	Scope 3	III.1.2	PA DEP Waste Characterization Report 2021	IPCC 5th Assessment 100 Year Values	Solid Waste	Activity

2019 Alliance Landfill Solid Waste	Landfilled Waste (USCP Required, Preferred, where applicable)	Scope 3	III.1.2	PA DEP Waste Characterization Report 2021	IPCC 5th Assessment 100 Year Values	Solid Waste	Activity

Inventory Record	**CO_2 (MT)**	**CH_4 (MT)**	**N_2O (MT)**	**CO_2e (MT)**	**Waste Generated (wet tons)**	**Mixed MSW Emissions Factor (MT CH_4/wet short ton)**
2019 Keystone Landfill Solid Waste	-	1,096.2	-	30,694	71,816	0.0648
2019 Alliance Landfill Solid Waste	-	616.86	-	17,272	40,413	0.0648

Inventory Record	**Newspaper Emissions Factor (MT CH_4/wet short ton)**	**Office Paper Emissions Factor (MT CH_4/wet short ton)**	**Corrugated Cardboard Emissions Factor (MT CH_4/wet short ton)**	**Magazines/Third Class Mail Emissions Factor (MT CH_4/wet short ton)**	**Food Scraps Emissions Factor (MT CH_4/wet short ton)**	**Grass Emissions Factor (MT CH_4/wet short ton)**	**Leaves Emissions Factor (MT CH_4/wet short ton)**	**Branches Emissions Factor (MT CH_4/wet short ton)**	**Dimensional Lumber Emissions Factor (MT CH_4/wet short ton)**
2019 Keystone Landfill Solid Waste	0.042	0.1556	0.1048	0.0476	0.0648	0.0228	0.026	0.058	0.0068
2019 Alliance Landfill Solid Waste	0.042	0.1556	0.1048	0.0476	0.0648	0.0228	0.026	0.058	0.0068

Inventory Record	**Mixed MSW LFG Capture Rate (%)**	**Newspaper LFG Capture Rate (%)**	**Office Paper LFG Capture Rate (%)**	**Corrugated Containers LFG Capture Rate (%)**	**Magazines/Third Class Mail LFG Capture Rate (%)**	**Food Scraps LFG Capture Rate (%)**	**Grass LFG Capture Rate (%)**	**Leaves LFG Capture Rate (%)**	**Branches LFG Capture Rate (%)**	**Dimensional Lumber LFG Capture Rate (%)**	**Oxidation Rate**

2019 Keystone Landfill Solid Waste	60	59	58	55	55	53	43	51	53	59	0.1
2019 Alliance Landfill Solid Waste	60	59	58	55	55	53	43	51	53	59	0.1

Process & Fugitive Emissions

Inventory Record	Calculator	GPC Scope	GPC Ref Number	Factor Profiles	Global Warming Potential	Category
Within City Gates	Fugitive Emissions from Natural Gas Distribution (USCP Recommended)	Scope 1	I.8.1	-	IPCC 5th Assessment 100 Year Values	Process & Fugitive Emissions

Inventory Record	CO_2 (MT)	CH_4 (MT)	N_2O (MT)	CO_2e (MT)	Natural Gas Used (MMBtu)	CH_4 Emissions Factor	CH_4 Emissions Factor Units	CO_2 Emissions Factor	CO_2 Emissions Factor Units
Within City Gates	3.4103	318.52	-	8,921.9	5.1425 $x10^{6}$	6.1939 $x10^{-5}$	MT CH4/MMBtu natural gas used	6.6316 $x10^{-7}$	MT CO_2/MMBtu natural gas used

Upstream Impacts of Activities

Inventory Record	Calculator	GPC Scope	GPC Ref Number	Factor Profiles	Global Warming Potential	Category
PA transportation and extraction	Fugitive Emissions from Natural Gas Distribution (USCP Recommended)	Scope 1	I.8.1	-	IPCC 5th Assessment 100 Year Values	Process & Fugitive Emissions

Inventory Record	CO_2 (MT)	CH_4 (MT)	N_2O (MT)	CO_2e (MT)	Natural Gas Used (MMBtu)	CH_4 Emissions Factor	CH_4 Emissions Factor Units	CO_2 Emissions Factor	CO_2 Emissions Factor Units

PA transportation and extraction	13.765	1285.7	-	36013	5.1425×10^{6}	2.5001×10^{-4}	MT CH_4/MMBtu natural gas used	2.6768×10^{-6}	MT CO_2/MMBtu natural gas used

Emission Forecasts

In the realm of environmental planning and policy making, forecasts serve as invaluable tools for anticipating future trends and informing the decision-making processes. By analyzing historical data, current trends, and emerging factors, forecasts provide insights into potential outcomes and help stakeholders prepare for various scenarios. In the context of greenhouse gas emissions, forecasts play a crucial role in understanding the trajectory of emissions over time and assessing the effectiveness of mitigation strategies. These forecasts incorporate a range of factors, including demographic changes, technological advancements, policy interventions, and socioeconomic trends, to paint a comprehensive picture of future emissions patterns. As the global community grapples with the urgent need to address climate change, accurate and reliable forecasts are essential for guiding efforts towards a sustainable and resilient future.

Business-as-Usual Forecast

A Business as Usual (BAU) Forecast provides an estimation of emission projections from the base year of the GHG Inventory (2019) to a future horizon year, in this instance, 2050. This forecast (Table B.1 and Figure B.1) will show where emissions are anticipated to stand in 2050 if no action is undertaken for emission mitigation, with population growth being the sole influencing factor. Population growth is estimated at 1.7% per year, as indicated by the ICLEI Cohort held in 2022.

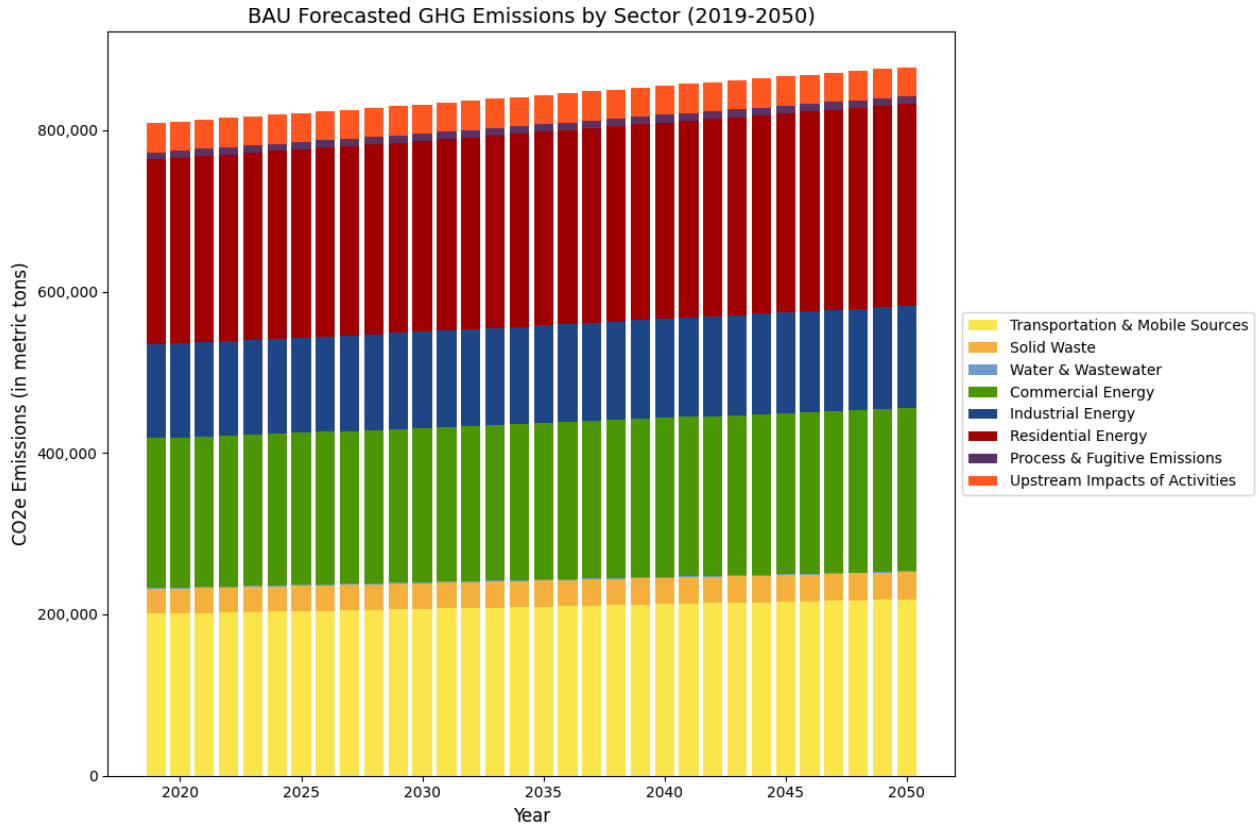
The City of Scranton's BAU forecast reveals a notable shift in various sectors' greenhouse gas emissions from 2019 to 2050, measured in million MT CO_2e. In the realm of residential energy consumption, the projection anticipates a rise from 229,606 MT CO_2e in 2019 to 250,196 MT CO_2e by 2050, indicating a consistent annual growth rate. Similarly, commercial energy usage is slated to surge from 185,696 MT CO_2e to 202,349 MT CO_2e over the same period. Industrial energy consumption follows suit, increasing from 115,903 MT CO_2e to 126,297 MT CO_2e, signaling a steady upward trend. Transportation and mobile sources depict a significant uptick, with emissions climbing from 200,753 MT CO_2e to 218,756 MT CO_2e. In the domain of water and wastewater management, modest gains are projected, with emissions rising from 1,132 MT CO_2e to 1,233 MT CO_2e. Upstream impacts of activities are forecasted to remain constant at 36,013 MT CO_2e throughout the period. Meanwhile, solid waste generation is set to increase from 30,694 MT CO_2e to 33,446 MT CO_2e, with process and fugitive emissions also witnessing a rise from 8,922 MT CO_2e to 9,722 MT CO_2e. Overall, the total greenhouse gas emissions are expected to ascend from 808,719 MT CO_2e in 2019 to 878,012 MT CO_2e by 2050, reflecting the city's evolving dynamics and economic activities over the years.

Table B.1: Table with data influencing BAU forecast

Impact	Change

Population Growth	1.7% per year[9]

Figure B.1: Scranton Business-as-Usual Forecast



Adjusted Business-as-Usual Forecast

The Adjusted Business-as-Usual Forecast (ABAU) for the City offers insight into the emissions landscape for 2050 under the premise of actions deemed highly probable to be implemented. This forecast (Table B.2 and Figure B.2) considers two crucial factors: firstly, the utility goals, where PPL (Scranton's electricity provider) is anticipated to achieve decarbonization by the year 2050. Secondly, the Corporate Average Fuel Economy (CAFE) standards, which are expected to gradually reduce transportation emissions by 1.8% annually. These influential elements shape the ABAU forecast, reflecting a proactive stance toward emission reduction strategies.

This ABAU forecast shows substantial emission reductions across sectors from 2019 to 2050. Residential energy emissions drop from 229,606 to 169,933 units, while commercial energy

[9] According to ICLEI cohort from 2022. ICLEI - Local Governments for Sustainability USA. (n.d.). *ClearPath: The leading online software for community-scale greenhouse gas inventories, forecasts, climate action plans, and monitoring.* Retrieved from https://icleiusa.org/clearpath/

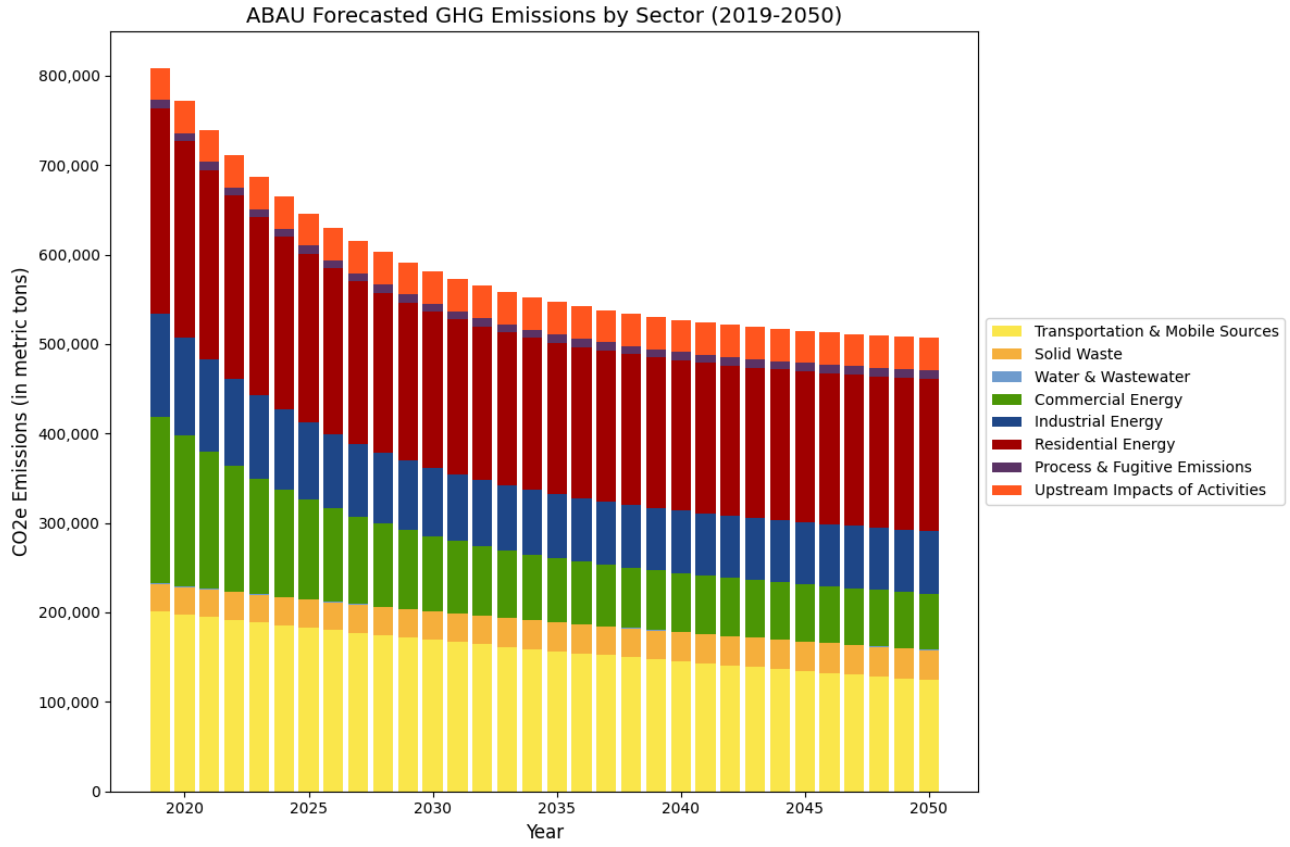
emissions decrease from 185,696 to 62,838 units. Industrial energy emissions also decline, from 115,903 to 69,878 units. Water and wastewater emissions decrease from 1,132 to 262 units. Transportation emissions notably decreased from 200,753 to 124,570 units. Process and fugitive emissions remain stable at 9,722 units. Upstream impacts and solid waste emissions remain relatively unchanged at 36,013. Overall, total emissions decreased from 808,719 to 506,662 units, indicating the effectiveness of emission reduction measures in the ABAU scenario.

Table B.2: Table with data influencing ABAU forecast

Policy	**Reductions**
PPL	Net zero emissions by 2050[10]
CAFE[11]	1.8% reduction per year[12]

[10] PPL has a plan for net zero emissions by the year 2050 which would in turn reduce electricity emissions for the City to zero by 2050. This is displayed in the ABAU forecast.
[11] Corporate Average Fuel Economy.
[12] According to the ICLEI ClearPath tool: ICLEI - Local Governments for Sustainability USA. (n.d.). *ClearPath: The leading online software for community-scale greenhouse gas inventories, forecasts, climate action plans, and monitoring.* Retrieved from https://icleiusa.org/clearpath/

Figure B.2: Adjusted Business-as-Usual Forecast



Appendix B: Recommended Targets

MEMORANDUM

Date: June 19, 2024

To: Environmental Advisory Council

Organization: City of Scranton

From: Blue Strike Environmental
Sol Shepherd

Re: Recommended GHG Mitigation Reduction Targets

SUMMARY

In response to the pressing threat of climate change, Scranton faces a pivotal opportunity to align its efforts with statewide and global climate goals. The State of Pennsylvania has set ambitious targets to reduce greenhouse gas (GHG) emissions, aiming for a 26% reduction by 2025 and an 80% reduction by 2050 from 2005 levels. Scranton, through its commitment to sustainability and community well-being, is in the process of laying a foundational plan to contribute to emissions reduction through the creation of its Sustainability and Climate Action Plan (SCAP).

To further these efforts, Blue Strike Environmental recommends that the City of Scranton adopt science-based targets.[1] Specifically for Scranton, these targets would represent a 62.7% reduction in city-wide GHG emissions by 2035 compared to 2019 levels, and achieving carbon neutrality by 2050. These targets not only align with the Paris Agreement's goal to limit global warming to 1.5°C but also position Scranton as a leader in sustainable urban development.

Our recommendations are supported by emission forecasts, which show potential trajectories under different scenarios. The Business-as-Usual forecast shows projected future emissions based on current practices and regulations, assuming that no additional efforts or policies are implemented beyond the status quo. Conversely, the Adjusted Business-as-Usual forecast demonstrates anticipated changes and improvements in policies or actions at the state, regional, and national levels that are expected to impact Scranton's future GHG emissions, even if no new

[1] Science Based Targets Network. (n.d.). *Guidance for cities*. Retrieved December 3, 2024, from https://sciencebasedtargetsnetwork.org/resources/#guidance-for-cities

local actions are taken by Scranton. This includes existing initiatives such as the decarbonization of utilities and improved fuel economy standards.

In conclusion, the proposed Sustainability and Climate Action Plan will serve as a roadmap for achieving these targets, outlining actionable steps that capitalize on Scranton's strengths and commitment to a sustainable future. By embracing these recommendations, Scranton can lead by example and demonstrate its dedication to mitigating climate change and safeguarding the well-being of its community and environment.

This memo summarizes the imperative for immediate action and outlines a clear path forward for Scranton to achieve its climate goals in alignment with broader regional and global initiatives.

BACKGROUND

The State of Pennsylvania considers greenhouse gas (GHG) emissions and the impacts of global warming to be a serious threat to public health, the environment, economic well-being, and natural resources. Blue Strike recommends that Scranton exceeds climate action efforts compared to state-level goals and initiatives, which are summarized below.

- Pennsylvania Climate Action Plan:[2] The state has set targets to reduce GHG emissions by 26% by 2025 and 80% by 2050 from 2005 levels. The State's climate targets do not follow a Science-Based Target (SBT) and do not meet international goals of keeping global temperature change below 1.5 degrees celsius.
- Act 129 Energy Efficiency and Conservation Program:[3] This state mandate requires utilities to implement energy efficiency and conservation measures.
- Alternative Energy Portfolio Standards (AEPS) Act:[4] Pennsylvania's AEPS requires a certain percentage of electricity sold by utilities to come from renewable and alternative energy sources.
- Regional Greenhouse Gas Initiative (RGGI): In 2023 Pennsylvania joined RGGI, a cooperative effort among several states to cap and reduce CO_2 emissions from the power sector.

The City of Scranton has already released planning documents that indirectly address the reduction of greenhouse gasses, including the 2020 Bicycle and Pedestrian Study, the Scranton

[2] Pennsylvania Department of Environmental Protection. (n.d.). *Pennsylvania Climate Action Plan*. Retrieved December 3, 2024, from https://www.dep.pa.gov/Citizens/climate/Pages/PA-Climate-Action-Plan.aspx#:~:text=Pennsylvania%20Climate%20Action%20Plan,plan%20or%20a%20booklet%20overview

[3] Pennsylvania Public Utility Commission. (n.d.). *Act 129 Energy Efficiency and Conservation Program*. Retrieved December 3, 2024, from https://www.puc.pa.gov/filing-resources/issues-laws-regulations/act-129/

[4] Pennsylvania Public Utility Commission. (n.d.). *Alternative Energy Portfolio Standards (AEPS) Act*. Retrieved December 3, 2024, from https://www.puc.pa.gov/filing-resources/issues-laws-regulations/aeps-act/

Recreation Needs Assessment & Master Plan, and the Scranton-Abingtons Planning Association's Comprehensive Plan. While these plans do not largely reference emissions, they demonstrate Scranton's commitment to enhancing community well-being, and the currently adopted actions outlined in them can lead to reductions in greenhouse gas emissions. The City is currently drafting a Sustainability and Climate Action Plan to create a roadmap for achieving long-term environmental, economic, & social sustainability. Mitigation targets are a crucial piece of all climate action plans.

SCIENCE BASED TARGETS

In 2020, the Intergovernmental Panel on Climate Change (IPCC) released guidance for cities to develop targets for GHG mitigation.[5] These targets have been developed by the Science Based Target Network (SBTN). Science-based targets are measurable and actionable, enabling states, regions and cities to align their actions with societal sustainability goals and the biophysical limits that define the safety and stability of Earth's systems. Targets adopted to reduce greenhouse gas (GHG) emissions are considered "science-based" if they align with the goals of the Paris Agreement to limit warming to 1.5°C. Additionally, a science-based target should consider the latest scientific findings, account for equity, and be comprehensive in the GHGs and emission sources included. In 2023, **656** sub-national governments reported jurisdiction-wide emissions reduction targets. Across the U.S., **609** local governments reported that they consider their target to be science-based or are working towards a science-based target. Additionally, **355** sub-national governments reported having a net zero target to achieve by 2050 or sooner. Blue Strike Environmental recommends adopting a science based emission mitigation target. These recommended science based targets identify a mid-term target year for approximately 10 years after the target is set, and a horizon year of 2050, which would exceed state climate targets.

Learn more about Science-based targets.

GHG REDUCTION TARGETS

As stated, Blue Strike Environmental recommends adopting a science-based target of a 62.7% reduction of GHG emissions by 2035 compared to 2019, and a 100% reduction by 2050. These targets are in line with the goals necessary to mitigate the impacts of climate change effectively. The recommended GHG reduction targets for Scranton are as follows:

- Reduce GHG emissions 62.7% below 2019 levels by 2035.
- Achieve carbon neutrality by 2050 (100% reduction in GHG emissions by 2050)

Blue Strike Environmental recommends a science based target with a mid-term target year of 2035 based on 2019, and a horizon year of 2050. Science based targets typically use a baseline

[5] Science Based Targets Network. (n.d.). *Guidance for cities*. Retrieved December 3, 2024, from https://sciencebasedtargetsnetwork.org/resources/#guidance-for-cities

around 2020 to align with recent and comprehensive data. In contrast, the State of Pennsylvania uses a baseline of 2005 for its climate goals. Using a 2019 baseline allows Scranton to set more current and relevant targets, though it may impact the perceived progress when compared to Pennsylvania's goals, which might appear more aggressive due to the earlier baseline year.

These targets are designed to align with the overarching goal of limiting global warming to 1.5°C, as stipulated in the Paris Agreement. Given the significant role that state and federal policies play in achieving these reductions, local actions in Scranton will need to be ambitious and innovative to meet these targets, in which the Sustainability and Climate Action Plan will outline the steps for the City to reach carbon neutrality by 2050.

GHG EMISSION FORECASTS

Emission forecasts incorporate a range of factors, including demographic changes, technological advancements, policy interventions, and socioeconomic trends to paint a comprehensive picture of future emissions patterns. As the global community grapples with the urgent need to address climate change, accurate and reliable forecasts are essential for guiding efforts towards a sustainable and resilient future. Two forecasts were created for this SCAP, a Business as Usual (BAU), and an Adjusted Business-as-Usual Forecast (ABAU).

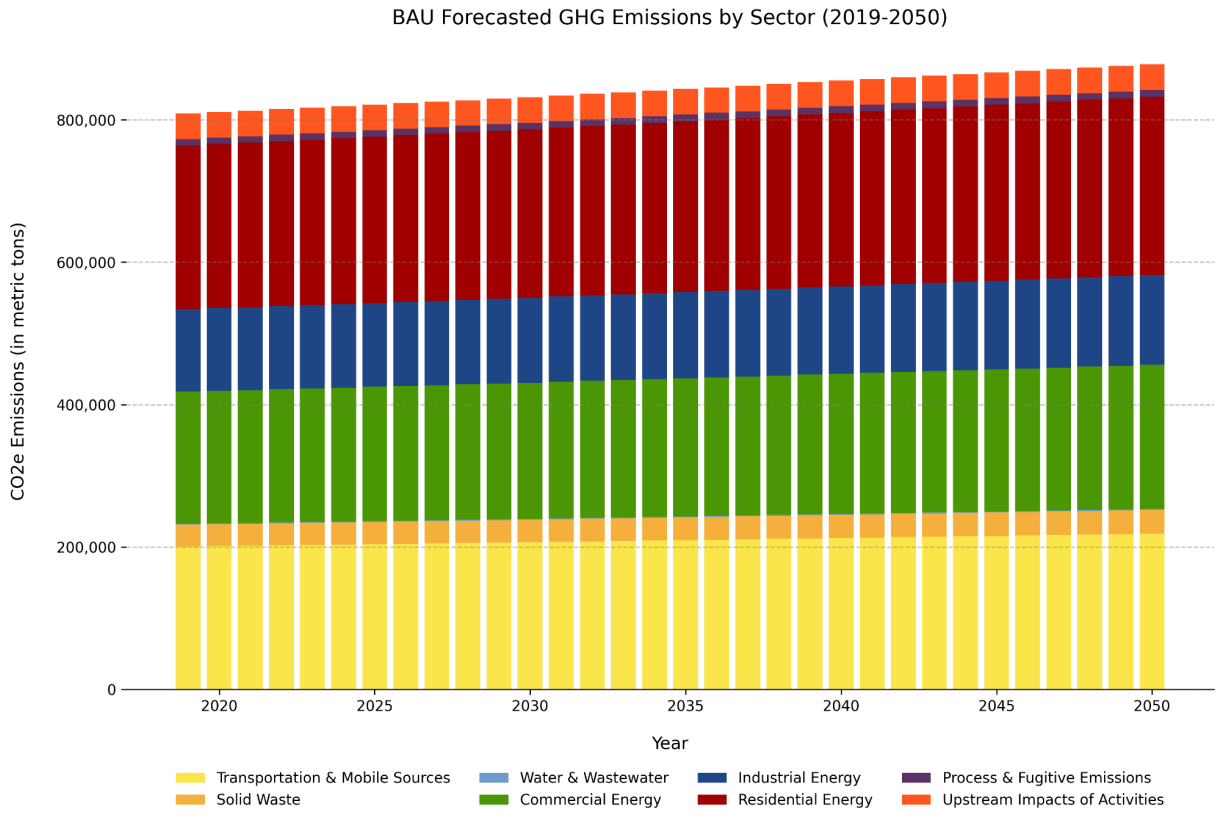
Business-as-Usual Forecast

A Business as Usual (BAU) Forecast provides an estimation of emission projections from the base year of the GHG Inventory (2019) to a future horizon year, in this instance, 2050. This forecast (Table 1 and Figure 1) will show where emissions are anticipated to stand in 2050 if no action is undertaken for emission mitigation, with population growth being the sole influencing factor. Population growth is estimated at 1.7% per year, as indicated by the ICLEI Cohort held in 2022. Overall, the total greenhouse gas emissions are expected to ascend from 808,719 MT CO_2e in 2019 to 878,012 MT CO_2e by 2050, reflecting the city's evolving dynamics and economic activities over the years.

Table 1: Emission Change in a BAU scenario

Year	**MT CO_2e**
2019 Baseline	808,719
2035 BAU Forecast	843,284
2050 BAU Forecast	878,012

Figure 1: Scranton Business-as-Usual Forecast



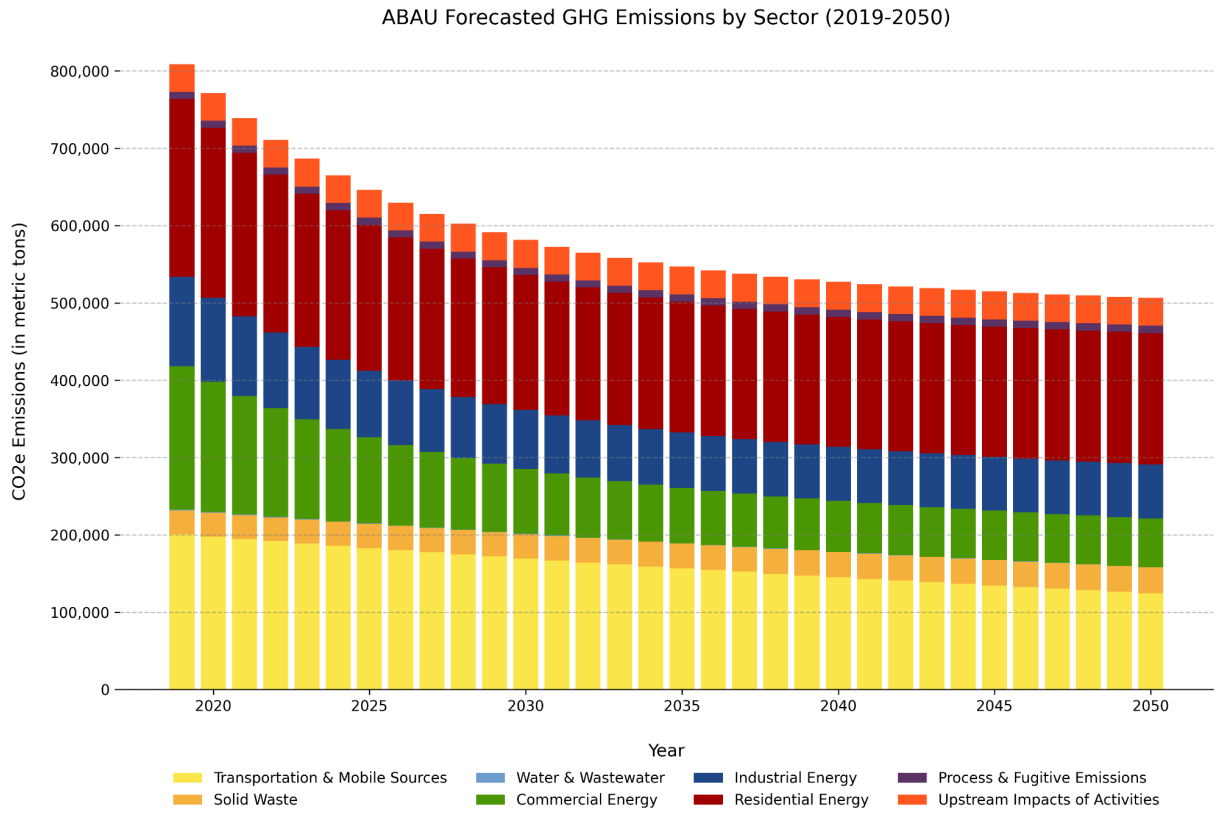
Adjusted Business-as-Usual Forecast

The Adjusted Business-as-Usual Forecast (ABAU) for the City offers insight into the emissions landscape for 2050 under the premise of actions deemed highly probable to be implemented. This forecast (Table 2 and Figure 2) considers two crucial factors: firstly, the utility goals, where PPL (Scranton's electricity provider) is anticipated to achieve decarbonization by the year 2050. Secondly, the Corporate Average Fuel Economy (CAFE) standards, which are expected to gradually reduce transportation emissions by 1.8% annually. These influential elements shape the ABAU forecast, reflecting a proactive stance toward emission reduction strategies. In this scenario the City's emissions would decrease approximately 32.5% between 2019 and 2035.

Table 2: Emission Change in an ABAU scenario

Year	**MT CO_2e**
2019 Baseline	808,719
2035 ABAU Forecast	546,892
2050 ABAU Forecast	506,662

Figure 2: Adjusted Business-as-Usual Forecast



RECOMMENDED REDUCTION TARGETS

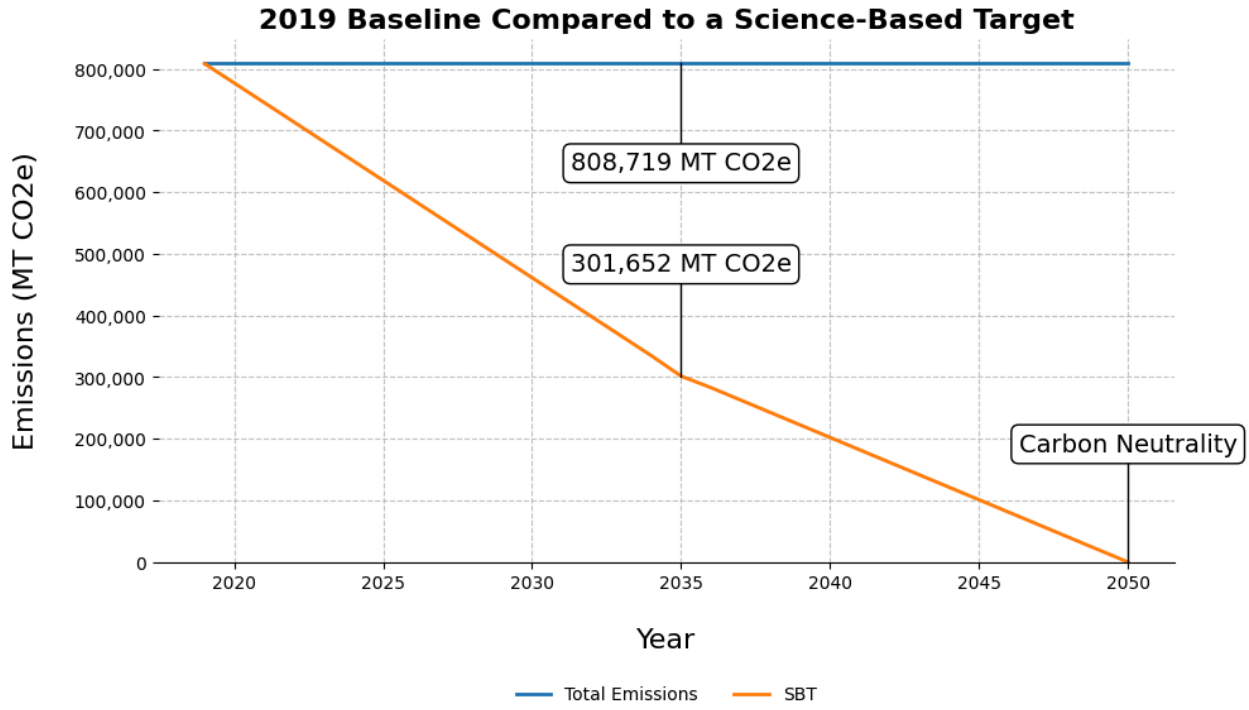
Table 3 illustrates the projected emission changes for Scranton under the recommended Science-Based Target scenario. Starting from a 2019 baseline of 808,719 metric tons of CO_2 equivalent (MT CO_2e), the target is to reduce emissions to 303,304 MT CO_2e by 2035. This represents a substantial decrease of 62.7%, in line with the science-based target. By 2050, the goal is to achieve carbon neutrality, completely eliminating net greenhouse gas emissions. This ambitious target highlights Scranton's commitment to mitigating climate change and aligning with global efforts to limit warming to 1.5°C.

Table 3: Emission Change in a Science-Based Target Scenario

Year	**MT CO_2e**
2019 Baseline	808,719
2035 BAU Forecast	303,304
2050 BAU Forecast	Carbon Neutral

Figure 4 illustrates the projected greenhouse gas (GHG) emissions trajectory for the City of Scranton under a Science-Based Target (SBT) Scenario. The horizontal blue line represents the 2019 baseline emissions level of 808,719 metric tons of CO_2 equivalent (MT CO_2e). The orange line represents the SBT trajectory, targeting a reduction to approximately 301,652 MT CO_2e by 2035 and achieving carbon neutrality (zero emissions) by 2050.

Figure 4: Projected Emissions Reduction under a Science-Based Target Scenario



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Pennsylvania Public Utility Commission. (n.d.). *Act 129 Energy Efficiency and Conservation Program*. Retrieved December 3, 2024, from https://www.puc.pa.gov/filing-resources/issues-laws-regulations/act-129/

Pennsylvania Department of Environmental Protection. (n.d.). *Pennsylvania Climate Action Plan*. Retrieved December 3, 2024, from https://www.dep.pa.gov/Citizens/climate/Pages/PA-Climate-Action-Plan.aspx#:~:text=Pennsylvania%20Climate%20Action%20Plan,plan%20or%20a%20booklet%20overview

Science Based Targets Network. (n.d.). *Guidance for cities*. Retrieved December 3, 2024, from https://sciencebasedtargetsnetwork.org/resources/#guidance-for-cities

Appendix C: Stakeholder Engagement Report

STAKEHOLDER ENGAGEMENT REPORT

Project Title: Sustainability & Climate Action Plan

Collaborators: City of Scranton
Blue Strike Environmental

Background

Prior to the Sustainability & Climate Action Plan (SCAP) development, the project team formulated a stakeholder engagement plan. This strategy aimed to assess the City's current environmental initiatives, understand the reasons for any shortcomings in these actions, and gain insights into the community's aspirations and objectives for environmental sustainability. The Project Team conducted one online public meeting as well as a community-wide survey to gather broader input. Additionally, a steering committee was created and met twice throughout the planning process. This report summarizes the key feedback and insights gathered from these engagement activities.

Public Meeting

Date: June 13, 2024 @ 6 PM to 7:30 PM ET
Location: Online via Zoom
Attendees: 9 people
Meeting Objective: Introduction to the SCAP, celebrate the city's achievements to date, introduce best practices, and identify potential opportunities and challenges.
Comprehensive Results: Linked here
Key Takeaways:

- The community is first concerned with reducing GHG emissions, followed by equity and climate justice.
- Opportunities for climate action in the community include youth initiatives, stormwater management, nature-based solutions, transportation alternatives, and energy transitions.
- Anticipated challenges for climate action include funding, persistence, inspiring and educating the community, resistance to change, and outreach to vulnerable communities.
- The top best practices for the **Buildings & Energy** category were "replace fossil fuel appliances & equipment with energy-efficient alternatives" and "behavior change techniques to reduce energy use."

- The top best practice for the **Transportation and Mobility** category was “create a more bikeable and walkable City.”
- The top best practice for the **Resource Management** category was “behavior change programs to reduce consumption and waste.”
- The top best practice for the **Green Community** category was “promote water-efficient buildings and native landscapes at City buildings and facilities.”

Community Survey

Date: April 22, 2024 – August 16, 2024
Location: Online via Zoom
Participants: 101 community members
Details: The aim of the survey was to involve the community at large, giving every resident the chance to express their views on climate change issues. The survey provided valuable insights into the community's awareness, attitudes towards climate change, priorities, and main interests. Efforts were made to ensure the survey reached as many people as possible through distribution and promotion. Distribution methods included updates on the City's website, email blasts, the City-wide newsletter, and pop-up events.
Comprehensive Results: Linked here
Key Takeaways:

- The biggest concerns related to climate risks are extreme weather events, health risks, and water scarcity, followed by economic impacts and environmental justice.
- The primary challenges include a lack of understanding and concern about climate change, difficulty knowing what actions will make a difference, accessibility of actions, and the high cost of taking action.
- Most respondents believe climate change has already negatively impacted the natural environment, city infrastructure, and their personal health, finances, and safety.
- The top three transportation strategies include making neighborhoods more walkable, improving public transit, and transitioning city-owned vehicles to electric or other clean options.
- Expanding the recycling program, supporting local food systems, and reducing single-use plastics are the top resource conservation strategies.
- Parks and open space preservation, expanding the urban tree canopy, and improving stormwater management are seen as critical strategies for a green community.
- Respondents emphasize the need for inclusive planning, community engagement, and accessible programs to ensure that climate strategies are fair and equitable across all neighborhoods in Scranton.
- Several respondents expressed frustration with strategies that place the burden of climate change solutions on residents, rather than addressing the contributions of large corporations.
- There is a strong belief that involving the community, particularly through education and opportunities for participation, is essential for the success of climate-related initiatives.

- The majority of survey respondents live in Scranton, with many also working or regularly attending events in the city.

Steering Committee

A steering committee was created at the beginning of the planning process. The goal of creating a steering committee was to engage a wider variety of stakeholders at key junctures within the project. The Steering Committee includes members of the Environmental Advisory Council (EAC) as well as additional members of the community. The steering committee was invited to attend two of the stakeholder meetings: the Kick-off Meeting and Equity Screening Workshop. These sessions were designed to facilitate comprehensive discussions on various aspects of the project, from initiation to completion.

Kick-off Meeting

Date: Friday, March 22, 2024 @ 2 PM to 3 PM ET
Location: Online via Zoom
Attendees: Project Team and Steering Committee (20 participants)
Meeting Objective: Introduce the project, gather initial input and set the stage for collaborative effort.
Comprehensive Results: Linked here
Key Takeaways:

- Concerns were raised about infrastructure vulnerabilities due to old mines under roads causing sinkholes, and the risk of flooding from mountain runoff, posing major challenges for the city's management and safety.
- Extending electric vehicle infrastructure to include other city-operated vehicles was highlighted, emphasizing the need for a customized plan for Scranton.
- The importance of soliciting input from historically excluded populations, such as refugee and immigrant communities, was emphasized to ensure inclusivity in public outreach.
- Suggestions included exploring alternative energy production, such as utilizing underground flooded mine voids for heat pumps and hydro generation from streams.
- Implementing citywide planning policies to institutionalize environmental changes, like eliminating minimum parking requirements to improve walkability, was highlighted.
- Leveraging current funding opportunities through the EPA and other federal sources was emphasized, prioritizing strategies with immediate funding availability and long-term sustainability.
- Marketing the sustainability and climate action plan as a proactive measure to prevent future problems and improve public perception was stressed, focusing on long-term cost savings and health benefits.
- Engaging private property owners and landowners in partnership with the city for infrastructure improvements and environmental initiatives was deemed crucial due to limited enforcement authority.

- Recruiting businesses interested in innovative energy technologies to Scranton was suggested, marketing the city as a climate-responsive municipality.
- Compiling a comprehensive list of potential funding sources, including federal, state, and private sector options, was requested to support infrastructure improvements and other initiatives.

Equity Screening Workshop

Date: October 3, 2024 @ 6 PM to 7:30 PM ET
Location: Online via Zoom
Attendees: Project Team and Steering Committee (11 participants)
Meeting Objective: Review and vet the drafted SCAP goals and strategies with a climate equity lens.
Comprehensive Results: Linked here
Key Takeaways:

- Focus on expanding EV infrastructure and educating the community, especially low-income and refugee populations, about available tax credits and affordable options like EV car-sharing.
- Prioritize public transit improvements and active transportation infrastructure by connecting directly with vulnerable and underserved communities.
- Promote community-wide renewable energy projects and energy efficiency programs, with a focus on collaboration with housing authorities and landlords.
- Implement composting, recycling, and waste reduction programs, with a strong focus on community education and university collaboration.
- Enhance water conservation through water-saving fixtures, sustainable water management, and rebates.
- Integrate green infrastructure for stormwater management and link tree canopy efforts to improve resilience and water retention.