Town of Windsor
2021–2022 Biennial Greenhouse Gas Emissions Report

Adopted
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1. EXECUTIVE SUMMARY

The Town of Windsor's 2021-2022 Biennial Greenhouse Gas (GHG) Emissions Report (the Report) summarizes the Town's GHG emissions from government operations for 2021 and 2022 and proposes a set of GHG emission-reduction strategies to aid the Town in achieving its goal of net-zero GHG emissions by 2030. The Report is part of an ongoing effort by the Town to assess and reduce the GHG emissions from local governments operations and community-wide—most recently with the Municipal Climate Action Plan (2024).

The Report includes:

- A Town government operations GHG inventory for 2021 and 2022, compared to GHG emissions from the previous report (2019 and 2020) and from the baseline year of 2006.
- A business-as-usual forecast of GHG emissions to 2030 and 2045, which represents what GHG emission levels would be if the Town continued to operate as it does now without any emission reduction interventions.
- A discussion of the Town's local GHG emission reduction targets, which align with State-level goals, and suggested targets from the State.
- Quantification of existing local and State reduction activities and their impact on GHG emission reduction targets.
- A set of recommended government operations GHG emission-reduction strategies and their quantified impact on local and State-level targets.
- Recommended next steps and a brief discussion of carbon offsets.

The goal of the Report is to demonstrate the progress the Town has made in reducing its GHG emissions and to propose strategies to further decrease these emissions to meet its reduction targets. In 2019 the Town adopted a goal of net-zero GHG emissions from local government operations by 2030 (Resolution No. 3548-19). The State also recommends GHG emission reduction targets for 2030 and 2045 that align with the State's goals in the 2022 Scoping Plan for Achieving Carbon Neutrality. Though municipalities are not required to adopt the State's targets for their local government operations, these targets provide a helpful standard. The Report evaluates progress to both the local target and the State-recommended targets. Table ES-1 lists the local and State targets that are used throughout the Report.

TABLE ES-1: TOWN OPERATIONS GHG EMISSION REDUCTION TARGETS

TARGET	JURISDICTION
Achieve net-zero GHG emissions of municipal operations by 2030.	Local
Reduce GHG emissions from municipal operations 40 percent below estimated 1990 levels by 2030.	State
Reduce GHG emissions from municipal operations 85 percent below estimated 1990 levels by 2030 and achieve net-zero GHG emissions by 2045.	State

The Town emitted 2,420 $MTCO_2e$[1] in 2021 and 2,370 $MTCO_2e$ in 2022. Emissions decreased 12 percent from 2006 to 2022. Emissions from Town operations are predicted to rise 31 percent between 2022 and 2045 if no action is taken, also known as a business-as-usual forecast of GHG emissions. However, there are several State and local actions that have already been enacted or are underway that will result in GHG emission reductions in future years. Two major Town efforts underway are the Zero-Emission Fleet Transition Plan, which will result in an estimated savings of 220 $MTCO_2e$ in 2045, and the Biosolids Treatment and Disposal Project, which will result in an estimated savings of 1,400 $MTCO_2e$ by 2045. The Town can further reduce its GHG emissions from government operations through the proposed strategies in this report and other opportunities that may emerge. **Table ES-2** lists the proposed GHG emission reduction strategies and the projected emission reductions for 2030 and 2045.

TABLE ES-2: TOWN OPERATIONS GHG EMISSION REDUCTION STRATEGIES

STRATEGY	2030 REDUCTIONS ($MTCO_2e$)	2045 REDUCTIONS ($MTCO_2e$)
1. Building and Facilities Energy Efficiency	-10	-20
2. Building and Facilities Electrification	-90	-150
3. Fleet Electrification	-50	-220
4. Employee Commute Reduction	-10	-20
5. Employee Zero-Emission Vehicles	-20	--70
6. Wastewater Process Improvements	-1,210	-1,400
7. Solid Waste Reduction	-20	-50
8. Environmentally Preferable Refrigerants	Less than-10	Less than-10
Total Emission Reductions	**-1,410**	**-1,930**

Note: All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Table ES-3 lists the results of the 2021 and 2022 GHG emission inventories, the business-as-usual forecast, and projected reductions from the existing State and local actions and proposed GHG emission reduction strategies.

[1] $MTCO_2e$ stands for metric tons of carbon dioxide equivalent, a standard unit for measuring GHG emissions that takes into account the relative potencies of different greenhouse gases. A metric ton is equal to 1,000 kilograms, or approximately 2,205 pounds.

TABLE ES-3: TOWN OPERATIONS GHG EMISSIONS AND REDUCTIONS FROM EXISTING ACTIONS AND PROPOSED STRATEGIES

	2021	2022	2030	2045
GHG emissions inventory	2,420	2,370	NA	NA
GHG emissions forecast	NA	NA	2,680	3,100
Reductions from existing State and local actions	NA	NA	-250	-540
Reductions from proposed strategies	NA	NA	-1,410	-1,930
GHG emissions after implementing reduction strategies	NA	NA	1,020	630
State target	NA	NA	1,470	370
Net zero carbon by 2030 (local target)	NA	NA	0	0
Gap to local target	NA	NA	1,020	630

Note: All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows. Negative numbers indicate GHG emissions savings.

If the Town implements the proposed GHG emission reduction strategies, it will achieve the State target of reducing GHG emissions 40 percent 1990 levels in 2030. However, these strategies on their own do not achieve the goal of an 85 percent reduction below 1990 levels by 2045, nor do they achieve net-zero emissions by 2030 or 2045. The Town will need to consider additional strategies to achieve net-zero emissions, including further GHG reduction efforts, improving carbon sequestration, or using carbon offsets.

2. INTRODUCTION

The Town of Windsor (Town), with the support of PlaceWorks, prepared its 2021-2022 Biennial Greenhouse Gas (GHG) Emissions Report (the Report) to summarize the Town's GHG emissions from government operations and assess future GHG emission reduction strategies to achieve the Town's GHG reduction targets. This Report quantifies annual GHG emissions from 2021 and 2022 to assist the Town in establishing attainable GHG emissions-reduction goals for subsequent years, building on work that has been a community priority for over a decade. By associating GHG emissions with specific activities, the Town has the opportunity to develop targeted policies and programs to facilitate emissions reduction.

The Town completed its first government operations GHG emissions inventory in 2003, with an analysis of emissions data from 2000, and established 1990 as the baseline year from which to compare future inventories. In 2008, the Town published its first GHG Emissions Reduction Action Plan for Town operations. Since 2013, the Town has prepared biennial government operations inventories in conjunction with updated action plans and policies for reducing Town operations emissions. Current State guidance says that a GHG emissions level relative to 2005-2008 levels is appropriate for local governments to use as a baseline for measuring GHG reductions; therefore, this Report uses GHG emissions from 2006 as a baseline, as was established in the 2019-2020 Biennial GHG Emissions Report.

Beyond Town operations, the Town also supports the reduction of community-wide GHG emissions through policies, programs, and public education. In 2019, the Town passed a Climate Emergency Resolution (No. 3548-19), making reduction of GHG emissions a priority of the community and establishing the goal of net-zero GHG emissions by 2030. The Town has made significant progress in recent years to reduce Town operations and community-wide GHG emissions through focused programming and efficiency efforts, the hiring of a Sustainability Coordinator, the completion of a Municipal Climate Action Plan, and funding for sustainability efforts. For example, the Town developed a web page with educational sustainability and carbon-friendly resources for residents; passed Resolution 3539-19, which adopted the goal of Zero Waste by 2030; enacted Ordinance No. 2019-341, which prohibits the use and sale of disposable food service ware and other products containing polystyrene foam; encouraged the switch to Zero-Emission Vehicles (ZEVs) through the installation of public electric vehicle (EV) chargers; and streamlined the permitting process for additional charging stations. These actions are discussed in greater detail in the most recent Sustainability Action Status Report (2022).[2]

> "The scientific evidence indicates that an urban global climate mobilization effort to reverse global warming is needed as quickly as possible toward zero net emissions by 2030, and no later than 2045."
>
> - Town of Windsor Climate Emergency Resolution No. 3539-19

[2] https://www.townofwindsor.com/DocumentCenter/View/26754/05-16-2022-Sustainability-Action-Status-Report-2022-FINAL?bidId=https://www.townofwindsor.com/DocumentCenter/View/26754/05-16-2022-Sustainability-Action-Status-Report-2022-FINAL?bidId=.

This Report includes the results of the 2021-2022 inventory of GHG emissions from Town operations, a comparison of these results to past inventories, a business-as-usual projection of future GHG emissions from Town operations, and an analysis of the GHG emissions-reduction potential of existing, planned, and new reduction strategies. The results are meant to inform Town staff, elected and appointed officials, and the public of current and potential GHG emission sources and to enable the consideration of potential GHG emissions-reduction strategies.

3. GHG INVENTORY

GHG inventories are technical analyses that assess the total annual GHG emissions attributable to the Town from government operations and facilities. The most common GHGs are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Non-carbon dioxide GHGs are converted to their equivalent in metric tons of carbon dioxide. Therefore, the units of a GHG inventory are metric tons of carbon dioxide equivalent ($MTCO_2e$). GHG emissions are generated by commonplace daily activities. Some daily activities release GHG emissions at the location of the activity, such as carbon dioxide released from driving an internal combustion engine car. Alternatively, other activities cause GHG emissions to be released elsewhere, such as when fossil-fuel-derived electricity powers a building, generating GHG emissions at the location of the power plant. The Town should consider the GHG emissions caused by activities attributed to Town operations, including GHG emissions generated at facilities or locations outside Town jurisdictional boundaries.



Emissions in the Town operations inventory are also included in Windsor's community-wide GHG emissions inventory. Town operations GHG emissions are significantly less than (approximately 2 percent) the community-wide GHG emissions.

The Town has two types of GHG inventories: (1) community-wide inventories; and (2) Town operations inventories. The inventory in this Report is the Town operations inventory.

- A **community-wide inventory** identifies GHG emissions that result from activities of Town residents, businesses, visitors, and other community members. Examples include residents driving cars, homes using water, and businesses using electricity. In Sonoma County, the community-wide inventory for Windsor and other municipalities is prepared by the Regional Climate Protection Authority (RCPA).[3]
- A **Town operations inventory** summarizes GHG emissions that are a direct result of the Town's government operations. Examples include electricity used in Town buildings and infrastructure systems, or the fuel used for Town vehicles. Town operations GHG emissions are a subset of community-wide emissions and made up approximately 2 percent of community-wide emissions in 2022.[4]

[3] The Regional Climate Protection Authority's most recent GHG emissions inventory is for the 2022 calendar year and can be found online: https://rcpa.ca.gov/wp-content/uploads/2024/06/RCPA-GHG-Inventory-Update-2022-Full-Report-FINAL-2024-07-08.pdf.

[4] Regional Climate Protection Authority. 2022. "Sonoma County Greenhouse Gas Inventory 2022 Update." https://rcpa.ca.gov/wp-content/uploads/2024/06/RCPA-GHG-Inventory-Update-2022-Full-Report-FINAL-2024-07-08.pdf .

3.1 METHODS

For this Report, PlaceWorks worked with Town staff to prepare a 2021 and 2022 Town operations GHG emissions inventory compared to emissions from a baseline year of 2006. The GHG emission values for 2006 included in this Report are taken from the Town's 2017-2018 Biennial GHG Emissions Planning Report.[5] The project team made minor updates to the 2006 baseline data and to the 2019-2020 GHG emissions inventory. These changes are discussed in more detail in Section 2.2.

A series of guidance documents, called protocols, provide recommendations on how to adequately assess GHG emissions. PlaceWorks prepared the Town operations inventory in a manner consistent with a widely adopted, standard protocol document, the Local Government Operations Protocol (LGOP).[6]The protocols provide guidance on how to adequately assess GHG emissions, defining what activities should be included in the GHG emissions inventory, and how to consistently estimate GHG emissions from those activities. The use of standard methods allows for comparison of GHG emissions across multiple years and communities.

The LGOP was first developed in 2008 and updated in 2010. The LGOP is a tool for accounting and reporting GHG emissions of local government operations and is used throughout California and the United States. The LGOP includes guidance from several existing partner programs as well as the State's mandatory GHG reporting regulations.[7] GHG inventories are estimates of GHG emissions rather than direct measurements of GHG emissions. The use of the standard methods identified in the protocols, in combination with verified datasets from appropriate sources, makes GHG inventories accurate and consistent estimates of local emissions.

While other sources and models were used to determine the appropriate GHG emission levels from Town operations, the LGOP provides the basic framework for using the various data sources. The sources used for individual GHG emission sectors are noted in Section 2.2.

3.2 SECTORS

The Town operations GHG emissions inventory assessed the following nine sectors:

- Employee commute covers GHG emissions resulting from the total annual miles that Town staff drive to and from work.
- Energy accounts for the GHG emissions from electricity and natural gas used to power Town operations, including the subsectors of Buildings and Facilities and Streetlights and Traffic Signals. This does not include energy used to transport water to the Town or to power the Water Reclamation Facility.

[5] Report available as part of May 20, 2020, Town Council agenda at MetaViewer.php (granicus.com).

[6] California Air Resources Board. 2011. "Local Government Operations Protocol for Greenhouse Gas Assessments." https://ww3.arb.ca.gov/cc/protocols/localgov/localgov.htm.

[7] These partner programs include the California Climate Action Registry, ICLEI – Local Governments for Sustainability, The Climate Registry, and other stakeholders.

- Refrigerants account for GHG emissions associated with refilling air conditioners in Town buildings and vehicles. Inclusion of this sector is consistent with the guidance in the LGOP; however, it was not included in inventories prior to 2019.
- Solid waste accounts for the GHG emissions released during the decomposition of landfilled waste produced at Town buildings and facilities. This sector also includes the GHG emissions from vehicles used to haul the waste. Inclusion of this sector is consistent with the guidance in the LGOP; however, it was not calculated in inventories prior to 2019.
- Town fleet accounts for the GHG emissions from Town vehicles based on the total gallons of fuel used for internal combustion engine vehicles and energy used for electric vehicles. This covers all vehicles operated by Town staff. To be consistent with past reports, fleet emissions also include the Windsor Police Department, although the Town has limited operational control over WPD vehicles. This does not include emissions from Sonoma County Fire Department (SCFD) vehicles because the Town does not have operational control over SCFD operations.
- Wastewater direct emissions sector accounts for the direct emissions of methane and nitrous oxide from the wastewater treatment process. Inclusion of this sector is consistent with the guidance in the LGOP; however, it was not calculated in inventories prior to 2019. The results for methane emissions are derived from a report completed by Hazen and Sawyer in 2024, which used the Water Environment Federation's Biosolids Emissions Assessment Model (BEAM)2022 model, a widely used model for assessing GHG emissions from wastewater processing. The nitrous oxide emissions from the aeration basins are calculated using guidance from the U.S. Community Protocol and are based on population, not a direct measurement of emissions produced at the Water Reclamation Facility.[8]
- Wastewater facilities sector accounts for the GHG emissions associated with the energy used to treat wastewater at the Town's Water Reclamation Facility.
- Wastewater solids hauling sector accounts for GHG emissions from trucks needed to transport solids from the Water Reclamation Facility to off-site locations for processing and disposal. This sector was not calculated in inventories prior to 2019 and is not one of the specifically recommended sources of GHG emissions discussed in the LGOP. However, since there is available data on this emission source it is beneficial to calculate the impact.
- Water delivery facilities sector accounts for GHG emissions associated with the energy needed to transport and process potable water used by the Town and the community.

Since the publication of the 2019-2020 Biennial GHG Emissions Report, the project team revised some data in the 2006, 2019, and 2020 GHG emission inventories due to the availability of more accurate data and/or methodologies.

- Town fleet emissions were revised in the 2019 and 2020 inventories to reflect the use of renewable diesel versus standard diesel. Emissions from diesel vehicles are calculated using an emission factor for renewable diesel.

[8] ICLEI – Local Governments for Sustainability USA. 2019. *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions.* Version 1.2.

- Direct emissions from wastewater processing were updated in the 2019 and 2020 inventories based on a report produced by Hazen and Sawyer in 2024, which calculated the methane emissions from the sludge storage ponds at the Water Reclamation Facility operated by the Town of Windsor.[9] The Hazen and Sawyer report shows a substantial increase in emissions from wastewater processing as compared to the 2019-2020 Biennial GHG Emissions Report adopted last year. Emissions from the sludge ponds increased by over 500 $MTCO_2e$ between 2019 and 2020 due to higher concentrations of biochemical oxygen demand in the wastewater being processed and remained relatively stable across the 2021 and 2022 inventories.
- Emissions from hauling wastewater solids following processing at the Water Reclamation Facility were updated in the 2019 and 2020 inventories based on a revised emission factor that accounts for the weight of the trucks and the distance traveled (short-ton mile). The baseline emissions for this sector were calculated using a per-capita figure to back-cast emissions to 2006.

Table 1 shows the values from the previous Biennial GHG Emissions Report as compared to the revised values. This Report uses the revised totals moving forward.

TABLE 1: TOWN OPERATIONS GHG EMISSIONS REVISED VS. PREVIOUS (2019-2020)

SECTOR	PREVIOUS VALUES ($MTCO_2E$)		REVISED VALUES ($MTCO_2E$)	
	2019	2020	2019	2020
Employee commute	230	140	230	140
Energy: Buildings and facilities	130	120	130	120
Energy: Streetlights and traffic signals	10	30	10	30
Refrigerants*	—	Less than 10	—	Less than 10
Solid waste	130	120	130	120
Town fleet	400	350	390	350
Wastewater direct emissions	720	710	1,210	1,730
Wastewater facilities	90	150	90	150
Wastewater solids hauling	10	10	20	20
Water delivery facilities	20	40	20	40
Total	**1,740**	**1,670**	**2,230**	**2,700**
Fire Department vehicles	100	90	100	90

*There was no reported refrigerant use in 2019.

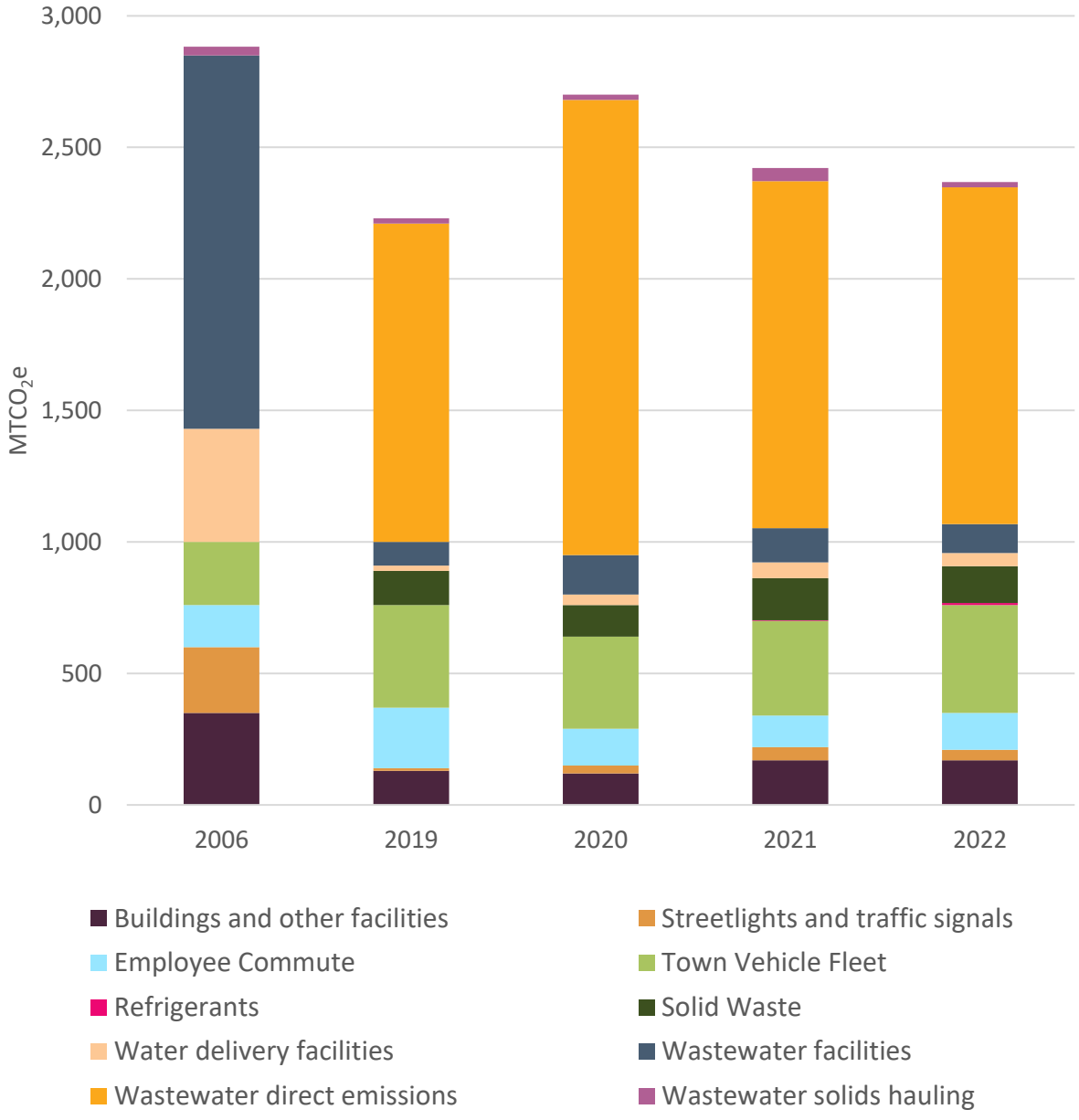
Note: All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows. Negative numbers indicate GHG emissions savings.

[9] Hazen and Sawyer. 2024, September 12. *Greenhouse Gas Emission Estimates for Sludge Storage Ponds*. Unpublished memorandum.

3.3 RESULTS

Figure 1 and Table 2 present the annual Town GHG emissions by sector for 2019, 2020, 2021, and 2022 compared to the 2006 baseline. Total annual GHG emissions decreased 12 percent from 2020 to 2022 and decreased 18 percent from the 2006 baseline. The decrease in emissions since 2006 is largely attributable to the increasing availability of electricity from renewable sources, both through Sonoma Clean Power (SCP), which began supplying power to the Town in 2014, and Pacific Gas and Electric Company (PG&E) (Figure 2).

FIGURE 1: TOTAL GHG EMISSIONS BY SECTOR ($MTCO_2E$)



Note: Refrigerants represent a miniscule percentage of total GHG emissions and may not be easily identifiable in the chart.

TABLE 2: TOTAL GHG EMISSIONS BY SECTOR ($MTCO_2E$)

SECTOR	2006	2019	2020	2021	2022	PERCENTAGE CHANGE, 2020 – 2022	PERCENTAGE CHANGE, 2006 – 2022
Employee commute	160	230	140	120	140	0%	-13%
Energy: Buildings and facilities	350	130	120	170	170	42%	-51%
Energy: Streetlights and traffic signals	250	10	30	50	40	33%	-84%
Refrigerants*	—	—	Less than 10	Less than 10	Less than 10	—	—
Solid waste*	—	130	120	160	140	17%	—
Town fleet	240	390	350	360	410	17%	71%
Wastewater direct emissions*	—	1,210	1,730	1,320	1,280	-26%	—
Wastewater facilities	1,420	90	150	130	110	-27%	-92%
Wastewater solids hauling*	30	20	20	50	20	-0%	-40%
Water delivery facilities	430	20	40	60	50	25%	-88%
Total	**2,880**	**2,230**	**2,700**	**2,420**	**2,370**	**-12%**	**-18%**
Informational Item							
Fire Department vehicles	—	100	90	100	100	11%	—
Geysers	—	—	—	-2,880	-2,530	—	—
Floating solar array	—	—	—	-80	-70	—	—

*Data for refrigerants, solid waste, and wastewater processing was not available for 2006. There was no reported refrigerant use in 2019.

Note: All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows. Negative numbers indicate GHG emissions savings.

GHG emissions from Town operations declined by 12 percent between 2020 and 2022. Below are the key takeaways from the 2021 and 2022 inventories as compared to the previous report for the years 2019 and 2020.

- The proportion of emissions from each sector remained relatively unchanged between 2020 and 2022 with Town fleet and direct emissions from wastewater making up the largest proportion of total emissions. Emissions from wastewater processing made up approximately 55 percent of total GHG emissions in 2022 and 43 percent of emissions in 2020. Town fleet emissions make up 17 percent of total emissions in 2022 and 23 percent in 2019.
- The power supply for PG&E and Sonoma Clean Power's CleanStart program was cleaner in 2020 than 2022, which means that a higher proportion of electricity was produced from renewable or carbon-free sources, like geothermal, wind, and solar (**Figure 2**). This led to lower emissions from sectors that rely on electricity even if more electricity was used in 2020 compared to 2022. For example, electricity use in buildings decreased between 2020 and 2022 by 14 percent, but GHG emissions from buildings and facilities increased 42 percent. Similarly, emissions from streetlights and traffic signals increased by 33 percent despite using about the same amount of electricity in 2020 and 2022. Finally, emissions from the delivery of water to the Town increased by 25 percent between 2020 and 2022 despite an overall decrease in the amount of water supplied to the Town (20 percent).
- Employee-commute GHG emissions remained constant between 2020 and 2022 despite more employees returning to work in the office in 2022 versus 2020. In July 2021, staff were beginning to return to the office following the COVID-19 shelter-in-place orders, and in 2022 most staff returned to the office on a part-time basis.
- Emissions from the Town's operational fleet vehicles increased 17 percent, which correlates to an increase in both gasoline and diesel fuel used in Town vehicles. This is likely due to Town operational activity returning to more normal levels following the COVID-19 pandemic shelter-in-place order, during which the Town only provided essential services.
- The amount of solid waste sent to a landfill from Town facilities increased 15 percent, resulting in higher emissions in 2022 than 2020. This is likely due to more Town employees being in the office following the COVID-19 pandemic shelter-in-place order.

The Geysers

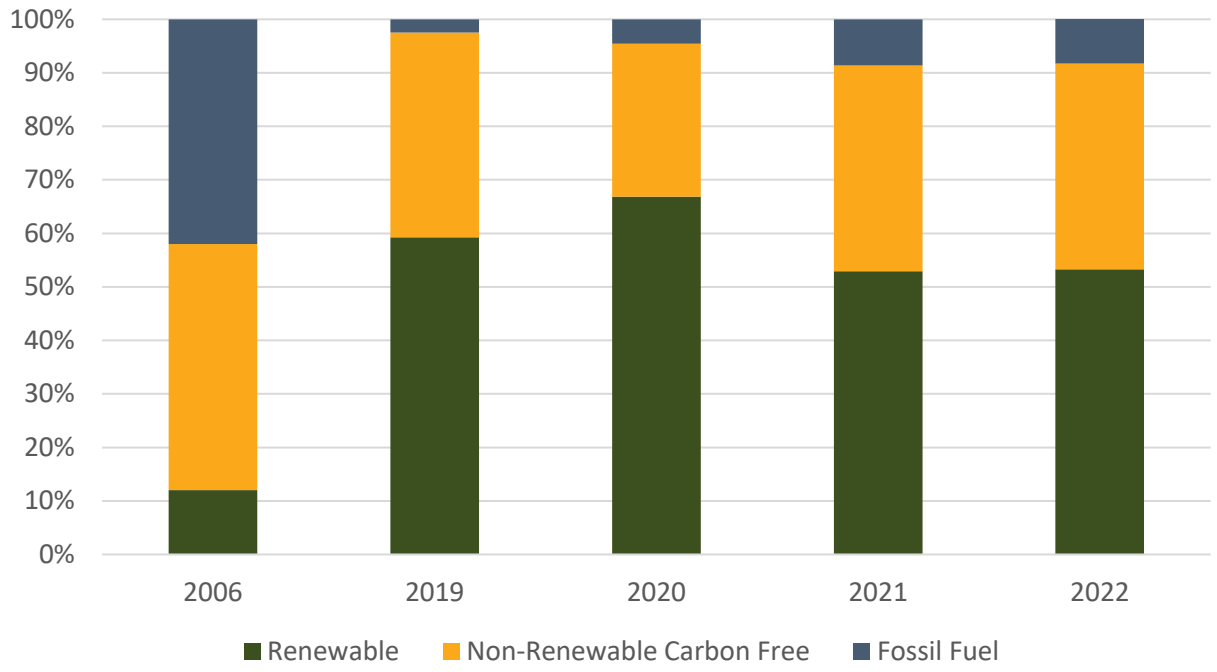
The Geysers project near Cloverdale is the largest geothermal energy facility in the world. It harnesses steam from naturally occurring underground reservoirs to generate clean, renewable electricity—enough to power 100,000 homes. Surrounding towns and cities also "recharge" the geothermal reservoirs with injections of treated wastewater. The Town of Windsor is responsible for approximately 7 percent of the recharge water sent to the geysers, which allows the Geysers to generate enough renewable electricity to offset the equivalent of 2,880 $MTCO_2e$ in 2021 and 2,530 $MTCO_2e$ in 2022.

Water Reclamation Facility Floating Solar Array

The Town installed a 1.8-megawatt (DC) floating photovoltaic system at the Water Reclamation Facility to generate electricity to power the operations of the facility. At the time of its completion in October 2020, the 4-acre system was the largest floating array in California. The system generated 63 percent of the facility's electricity in 2021 and 65 percent in 2022, equating to savings of 80 and 70 $MTCO_2e$, respectively.

- Indirect emissions from wastewater facilities decreased by approximately 27 percent, and direct emissions from the wastewater process decreased by 26 percent. This was driven by a cleaner electricity source in 2022 due to the floating solar array, which began supplying power to the Water Reclamation Facility at the end of 2020, and a decrease in the amount of water used by the Town between 2020 and 2022. Water supplied to the Town overall decreased by 20 percent and water use at Town facilities specifically decreased by 32 percent. This equates to a lower volume of wastewater and therefore lower direct and indirect emissions from processing wastewater.

FIGURE 2: ELECTRICITY SOURCES FOR TOWN OPERATIONS



Note: Values for 2006 represent the power mix for PG&E, the main power supplier for the Town in 2006. Values for 2019-2022 represent the power mix for Sonoma Clean Power (CleanStart and Evergreen) and PG&E weighted to reflect the percentage of power supplied to the town from each utility. All values are from the Power Content Labels for PG&E and Sonoma Clean Power.

Non-renewable carbon-free energy refers to energy sources that do not produce CO_2 emissions during their operation but are not renewable because their resources are finite. These energy sources contribute to reducing greenhouse gas emissions but are limited in availability. Examples of non-renewable carbon free energy sources include nuclear and hydroelectric.

Long-term trends indicate a significant decrease in GHG emissions from Town operations from the 2006 baseline to 2022, which can be attributed to cleaner sources of power (as shown in **Figure 2**) and the Town's various energy-efficiency upgrades to facilities. **Figures 3 and 4** show the proportions of each GHG emission sector for 2006 and 2022.

FIGURE 3: TOWN OPERATIONS GHG EMISSIONS BY SECTOR, 2006

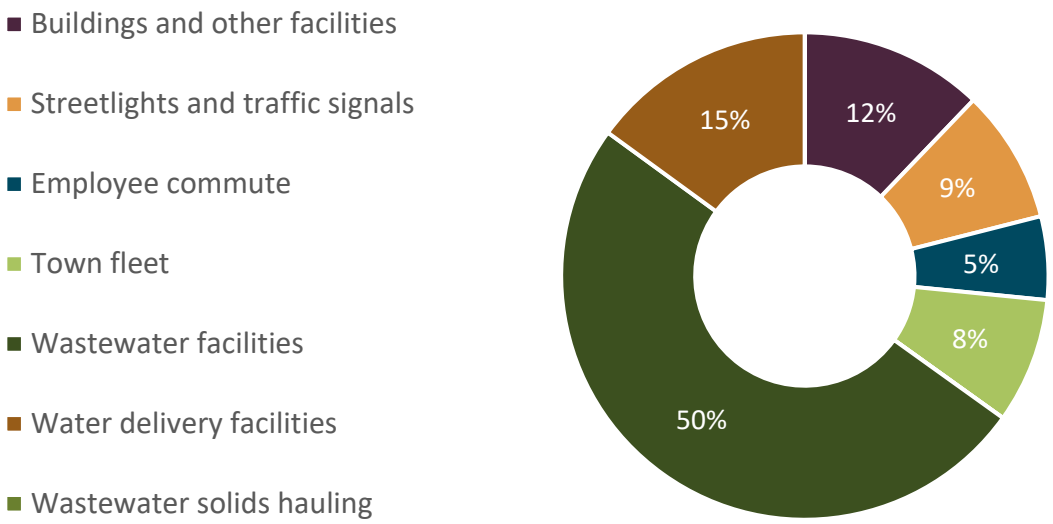
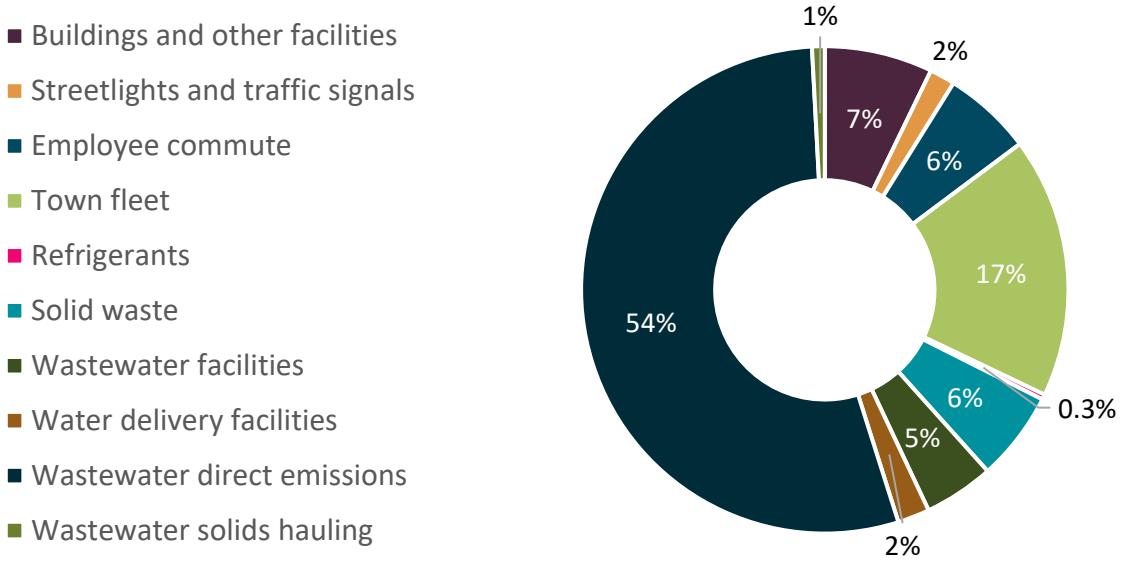


FIGURE 4: TOWN OPERATIONS GHG EMISSIONS BY SECTOR, 2022

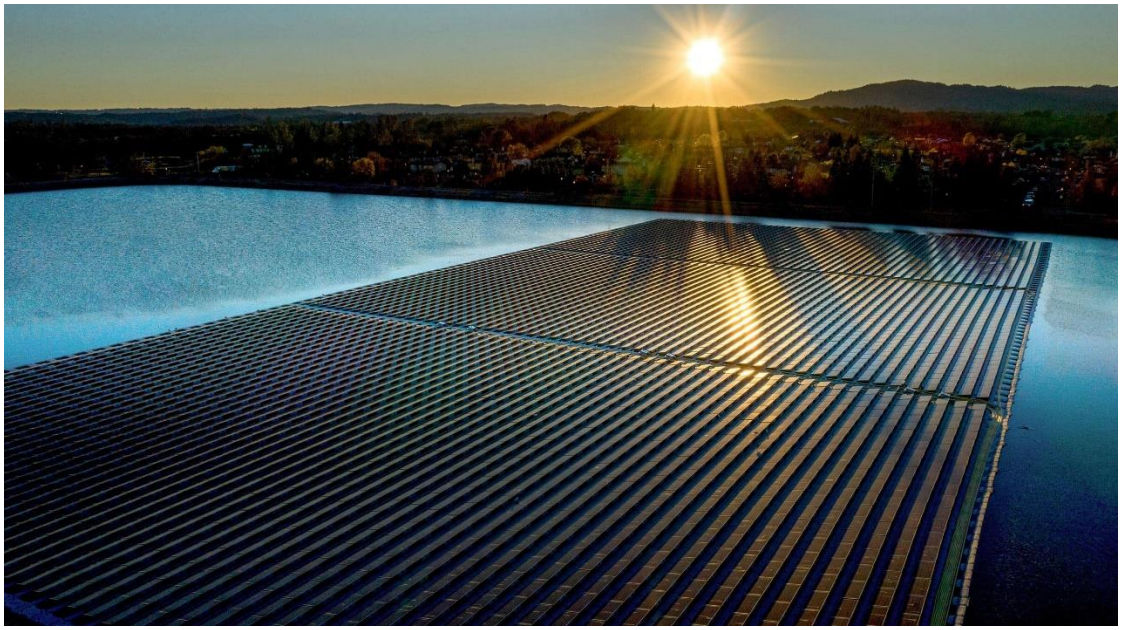


Between 2006 and 2022:

- The share of renewable energy increased 41 percentage points between 2006 and 2022, which likely drove the decrease in emissions from buildings, streetlights, and water and wastewater treatment and delivery. The Town has also upgraded lighting at Town facilities.
- The sector with the largest decrease in GHG emissions between the 2006 baseline and 2022 is water and wastewater, with an 88 percent reduction in water delivery emissions and a 92 percent reduction in wastewater facility emissions. This is likely also due to an increase in electricity from

renewable and carbon-free sources. Not only did PG&E's supply increase its proportion of renewable power sources, the floating solar array at the wastewater treatment facility also came online at the end of 2020.

- The GHG emissions from streetlights and traffic signals, and Town buildings and facilities, decreased by 84 percent and 51 percent, respectively. In addition to GHG emission decreases, the overall level of energy use for buildings and facilities and outdoor public lighting also declined. This decline in total energy use is likely due to the conversion of streetlights and indoor lighting to LEDs, the installation of more energy-efficient appliances as replacements for older and less-efficient appliances that reached the end of their operational life, and a greater share of Town staff working from home. The Town's streetlights were converted to LED bulbs by 2023.
- GHG emissions from the employee commute sector decreased 13 percent from 2006 to 2022. A long-term reduction in this sector is likely due to a different methodology used in the 2017–2018 Biennial GHG Emissions Planning Report, which contains the 2006 inventory data as well as the increased proliferation of ZEVs since 2006. ZEVs made up 10 percent of VMT in 2021 and 2022.
- The only sector that saw an increase in GHG emissions between 2006 and 2022 was the Town fleet. This increase is likely the result of methodological changes since the preparation of the 2017–2018 Biennial GHG Emissions Planning Report.
- GHG emissions for wastewater processing (direct emissions and solids hauling), refrigerants, and solid waste were not part of the 2006 baseline as they were not calculated in the 2017–2018 Biennial GHG Emissions Planning Report. Therefore, there are no long-term trends to report.



Town of Windsor Floating Solar Array at Water Reclamation Facility. Figure from https://laketricity-fpv.com/project/windsor-california/.

4. FORECAST AND TARGET SETTING

4.1 FORECAST

A forecast of future GHG emissions allows Town staff, elected and appointed officials, and community members to identify the reductions necessary to achieve GHG reduction targets and can help support long-range planning efforts. The forecast is a projection of GHG emissions associated with future government operations. It illustrates how Town emissions are expected to change over time. This forecast is known as a "business-as-usual" (BAU) or worst-case scenario, since it assumes that there is no action taken by the Town or its community members to reduce their GHG emissions. The BAU forecast is based on the established 2022 Town operations GHG emissions inventory combined with Windsor's 2022 demographics and future demographic projections in the Town limits through 2045 (shown in Table 3). These indicators determine the extent of expected Town growth and inform a projection of resulting GHG emissions.

TABLE 3: WINDSOR GROWTH INDICATORS, 2021-2045

	2021	2022	2030	2040	2045
Town employees	150	150	170	190	200
Community-wide population	26,100	25,780	30,470	33,650	35,370
Community-wide jobs	12,660	12,680	12,860	14,020	14,640
Community-wide service population	38,760	38,460	43,330	47,670	50,010

Sources: Town of Windsor 2024; Association of Bay Area Governments 2023.

Each indicator is used to project future emissions for the following sectors:

- Town employees: This is the number of full-time employee equivalents working for the Town of Windsor. This indicator is used to project GHG emissions for buildings and facilities electricity and natural gas use, commute trips, Town fleet, refrigerant use, solid waste, and Town facilities water delivery electricity use.
- Community-wide population: This is the total population of Windsor residents.
- Community-wide jobs: This is the total number of jobs available in Windsor town limits.
- Community-wide service population: This indicator is the number of jobs available in Windsor plus the resident population of Windsor and is used to project GHG emissions for streetlights and traffic signals, community water delivery, electricity use, and wastewater treatment.

As the Town adds employees and grows in population, the Town's GHG emissions increase proportionally. Figure 5 and Table 4 present the results of the Town's BAU GHG emissions forecast. GHG emissions are predicted to rise 31 percent by 2045 if no reduction actions are taken.

FIGURE 5: TOWN OF WINDSOR GOVERNMENT OPERATIONS GHG INVENTORY WITH BAU FORECAST, 2021-2045

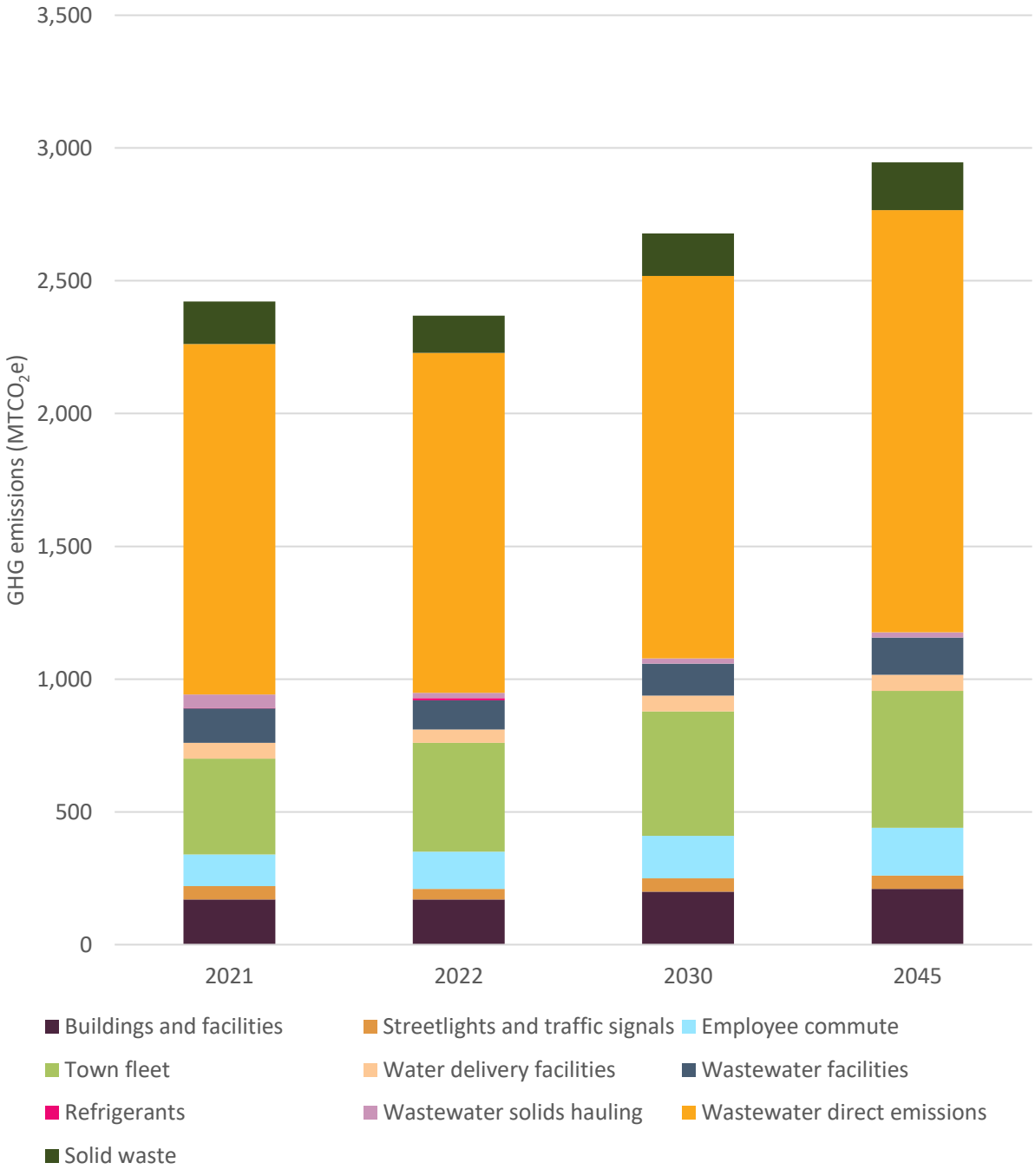


TABLE 4: TOWN OF WINDSOR GOVERNMENT OPERATIONS GHG EMISSIONS INVENTORIES (2021, 2022) AND BAU FORECAST EMISSIONS (2030, 2045)

SECTOR	SUBSECTOR	2021 ($MTCO_2E$)	2022 ($MTCO_2E$)	2030 ($MTCO_2E$)	2045 ($MTCO_2E$)	PERCENTAGE CHANGE, 2022-2045
Employee commute	Commute trips	120	140	160	190	36%
Energy: Buildings and facilities	Buildings and facilities – electricity	40	40	50	50	25%
	Buildings and facilities – natural gas	130	130	150	170	31%
Energy: Streetlights and traffic signals	Streetlights and traffic signals - electricity	50	40	50	50	25%
Refrigerants	Town facilities refrigerant use	Less than 10	Less than 10	Less than 10	Less than 10	-100%
Solid waste	Solid waste from Town facilities	160	140	160	190	36%
	Fuel used by waste hauling vehicles	Less than 10	Less than 10	Less than 10	Less than 10	-100%
Town fleet	Gasoline vehicles (not include Police)	220	230	260	310	35%
	Police gasoline vehicles	110	120	140	160	33%
	Diesel vehicles	30	60	70	80	33%
Wastewater direct emissions	Direct wastewater treatment	1,320	1,280	1,440	1,660	30%
Wastewater facilities	Indirect wastewater treatment	130	110	120	140	27%
Wastewater solids hauling	Wastewater solids hauling	50	20	20	30	50%
Water delivery facilities	Indirect community water delivery	60	50	60	70	40%
	Indirect Town facilities water use delivery	Less than 10	Less than 10	Less than 10	Less than 10	-100%
Total		**2,420**	**2,370**	**2,680**	**3,100**	**31%**

Note: All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows. The percentage change is for the total assessed time period 2021 to 2045 to show the full change over the assessed time period.

4.2 GHG REDUCTION TARGETS

State guidance establishes targets for reducing community-wide GHG emissions, those emissions resulting from activities of Town residents, businesses, visitors, and other community members. There are currently no State regulations or standards requiring the Town to reduce its GHG emissions from government operations. However, the Town can use State targets as a guide, in addition to locally adopted targets.

In 2019, the Windsor Town Council adopted Resolution 3548-19, declaring a climate emergency, acknowledging increasingly hazardous conditions created by climate change. The emergency resolution directs Town staff to reduce GHG emissions as quickly as possible toward net-zero emissions by 2030 and no later than 2045. Net-zero emissions, also known as net carbon neutrality, would be achieved when Town GHG emissions were significantly reduced and any remaining emissions were balanced by activities that remove GHGs from the atmosphere through carbon sequestration, carbon offsets, or similar carbon removal practices. As a result, the net level of GHG emissions is zero.

The targets adopted by the Town Council are consistent with the targets adopted by the State. Senate Bill (SB) 32 (2016) established a statewide GHG reduction target of reducing emissions 40 percent below 1990 levels by 2030. Assembly Bill (AB) 1279 (2022) established a further statewide GHG reduction target of reducing emissions 85 percent below 1990 levels by 2045 and offsetting the remaining GHG emissions to achieve net-zero emissions.

State guidance directs local governments to define their 1990 GHG emission levels as being 15 percent below 2005-2008 levels.[10] For this reason, the Town chose 2006 as the baseline year for current and future GHG inventories. According to the 2017-2018 Biennial GHG Emissions Planning Report, in 2006, the Town's government operations GHG emissions totaled 2,880 $MTCO_2e$. Figure 6 and Table 5 show the State GHG reduction targets as applicable for the Town's government operations GHG emissions.

In 2024, the Town adopted a Municipal Climate Action Plan (MCAP),[11] which carries over the 2030 net-zero emissions goal from Resolution 3548-19 and adds other targets for specific GHG emission-producing sectors and activities. The additional, specific targets in the MCAP related to GHG emissions reductions are:

- Achieve net-zero environmental impact of the Town's wastewater reclamation operations by 2030 through a three-pronged approach (Objective 1.2):
  - Net-zero GHG emissions from energy used in Town wastewater operations: achieved in 2023.
  - 100 percent recycled water reuse in Town wastewater reclamation operations by 2026.
  - 100 percent biosolids reuse in Town wastewater reclamation operations by 2028.
- Ensure 100 percent zero-emission vehicle (ZEV) Town fleet acquisitions by 2027, or as such vehicles become available. (Objective 1.3)

[10] California Air Resources Board. 2008. *Climate Change Scoping Plan. https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/document/adopted_scoping_plan.pdf.*

[11] Town of Windsor. 2024. *Municipal Climate Action Plan*. https://www.townofwindsor.ca.gov/1311/Sustainability.

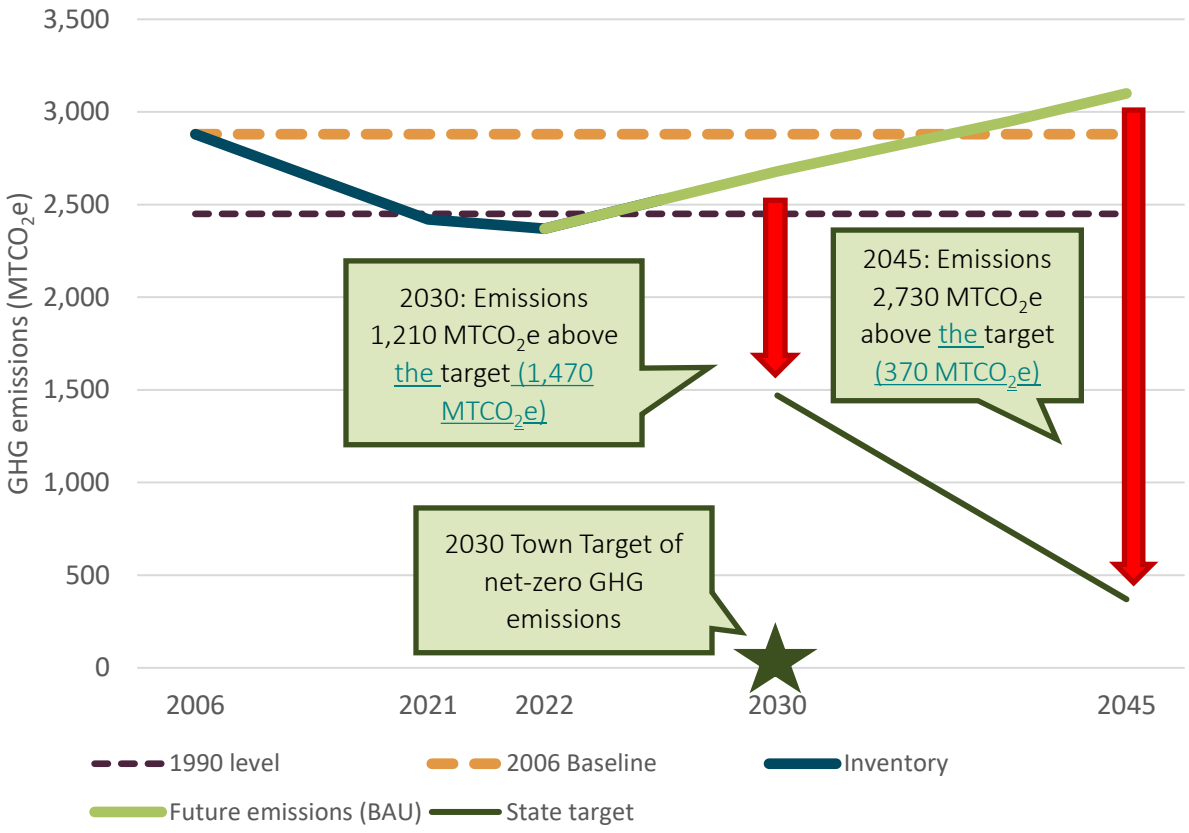
TABLE 5: TOWN OF WINDSOR GOVERNMENT OPERATIONS GHG EMISSION REDUCTION TARGETS

EMISSIONS LEVEL OR TARGET	$MTCO_2E$
1990 level (15 percent below 2006 levels)	2,450
2006 baseline	2,880
2030 target (40 percent below 1990 levels and net-zero emissions)	1,470
2045 target (85 percent below 1990 levels and net-zero emissions)	370

Note: 1990 levels are an estimate and calculated as 15 percent below the 2006 baseline. They are included in this table because the California 2008 Scoping Plan states that municipalities may consider a level 15 percent below 2005-2008 levels to be comparable to 1990 levels. The 2030 and 2045 targets are the local equivalents of California's statewide targets combined with the local target of net-zero emissions. The 2030 target is established by Senate Bill 32 (2016) and local Resolution 3548-19. The 2040 target is established by Assembly Bill 1279 (2022). GHG emissions are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Figure 6 shows the total Town-operations GHG emissions from the inventoried years (2006, 2021, and 2022) and the business-as-usual forecast (2030 and 2045) compared to the 2006 baseline emissions, State-recommended GHG reduction targets for 2030 and 2045, and the Town's 2030 net-zero GHG emissions goal. To achieve these State targets, the Town will need to enact strategies that reduce projected GHG emissions by 1,250 $MTCO_2e$ by 2030 and 2,770 $MTCO_2e$ by 2045. In addition to reductions in GHG emissions, the Town can consider other efforts to offset, sequester, or counteract GHG emissions to work toward net-zero emissions by 2045.

FIGURE 6: TOWN OF WINDSOR GHG EMISSIONS AND STATE GHG EMISSION REDUCTION TARGETS



5. EXISTING ACTIVITIES

This Report analyzes existing actions at the state, regional, and local level that influence GHG emissions. These are actions that have been enacted since 2022 (the last inventory year) or are expected to have a greater impact on reducing emissions in future years than they did in 2022. Understanding these activities informs the Town of the level of additional action it must take to close the gap between forecast emissions and the Town's reduction targets.

Since passing AB 32, the State has enacted regulations and programs to reduce GHG emissions. These statewide actions affect several sources of Windsor's GHG emissions, hence the Town will experience GHG emission reductions without having to take any direct action. This analysis describes the benefits from three State policies.

- Renewables Portfolio Standard: The Renewables Portfolio Standard (RPS) was first established in 2002 and has been amended multiple times, most recently by SB 100 in 2018. It requires all electricity providers in California to obtain at least 33 percent of their electricity from eligible renewable resources by the end of 2020, 60 percent of their electricity from eligible renewable resources by the end of 2030, and all their electricity from carbon-free (although not necessarily eligible renewable) resources by the end of 2045. This policy reduces GHG emissions associated with electricity use, including electricity used to transport and process water and wastewater, and electricity used for electric vehicles.
- Clean Car Standards: In 2002, California adopted AB 1493, the New Passenger Motor Vehicle Greenhouse Gas Emission Standards or Pavley standard. It requires a reduction in tailpipe GHG emissions from new vehicles produced from 2009 to 2015. In 2012, the California Air Resources Board (CARB) adopted an extension of this policy, the Advanced Clean Car Standards, which requires even more stringent reductions in tailpipe GHG emissions for vehicles produced from 2016 to 2025. In 2022, CARB adopted a further extension, known as Advanced Clean Car II Standards, which applies to vehicles produced from 2026 to 2035, and requires that all new light-duty vehicles sold in California be zero-emission by 2035. CARB has also extended these regulations to shipping fleets and trucks with the Advanced Clean Fleets and Advanced Clean Trucks guidelines that require manufacturers to develop zero-



The Renewables Portfolio Standard requires all California electricity to come from renewable and carbon-free sources by 2045. Image from Werner Slocum/NREL (65319).



Zero-emissions medium-duty and heavy-duty vehicles, such as this electric street sweeping vehicle, are becoming available. Image from Joshua Bauer/NREL (72866).

emission medium- and heavy-duty vehicles. The Clean Car Standards (including the Advanced Clean Car II Standards and related regulations) reduce GHG emissions from on-road transportation.

- **The Short-Lived Climate Pollutant Reduction Strategy (SB 1383):** California's SB 1383 aims to reduce GHG emissions from organic waste by requiring businesses and residents to separate their organic waste from other waste streams for recycling or composting. The law sets targets for reducing organic waste disposal in landfills by 75 percent by 2025 and requires local jurisdictions to implement organic waste recycling programs to meet these goals. The Town was in compliance with SB 1383 as of the 2022 GHG emissions inventory and therefore did not receive additional emission benefits from the quantification of this State strategy.

The Town has two quantifiable local strategies underway that are predicted to lower GHG emissions through 2045. This Report includes the reduction benefits from:

- **Transitioning all municipal accounts to Sonoma Clean Power EverGreen:** The Town transitioned all municipal accounts to 100 percent renewable SCP EverGreen service from SCP's CleanStart service in July 2023.
- **Electrifying Town facility water heaters:** As of 2023, seven of the nine Town facility hot water heaters were replaced with electric heat pumps. In the 2019-2020 Biennial GHG Emission Report, this action was included in the GHG emissions reduction strategies. Since publication of that report, the Town has completed these seven upgrades, and therefore this is considered an existing action.

Another Town program, not quantified in this analysis, is the effort to replace all streetlights and lighting in public facilities with smart-control LEDs. At the time of writing, all of the PG&E and Town-owned streetlights in the public right-of-way under control of the Public Works Department have been converted to LEDs. Public Works converted approximately half of the streetlights prior to 2019 and the remaining between 2019 and 2023. The Parks and Facilities Maintenance Division of the Parks and Recreation Department controls streetlights in Town parks. As of January 2025, the Parks and Recreation Department has replaced 58 out of the 260 public lights in parks with LED bulbs.

Existing local, regional, and State accomplishments reduce Windsor's forecast GHG emissions by a significant amount. Table 6 shows the GHG emission reductions from these individual efforts.

TABLE 6: EMISSION REDUCTIONS FROM EXISTING STATE AND LOCAL EFFORTS

MEASURE	2030 ($MTCO_2E$)	2045 ($MTCO_2E$)
Renewables Portfolio Standard	-40	-310
Clean Car Standards	-110	-220
All municipal accounts on EverGreen	-90	0
Electrifying Town facility water heaters	-10	-10
Total Reductions	**-250**	**-540**

Note: GHG emissions are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Existing efforts reduce 2030 and 2045 GHG emissions by 250 and 540 $MTCO_2e$, respectively. **Figure 7** and **Table 7** show the GHG emission reductions from these existing actions and the effect they have on the Town's future GHG emissions.

FIGURE 7: TOWN OF WINDSOR GHG EMISSIONS WITH EXISTING EFFORTS AND STATE GHG EMISSION REDUCTION TARGETS

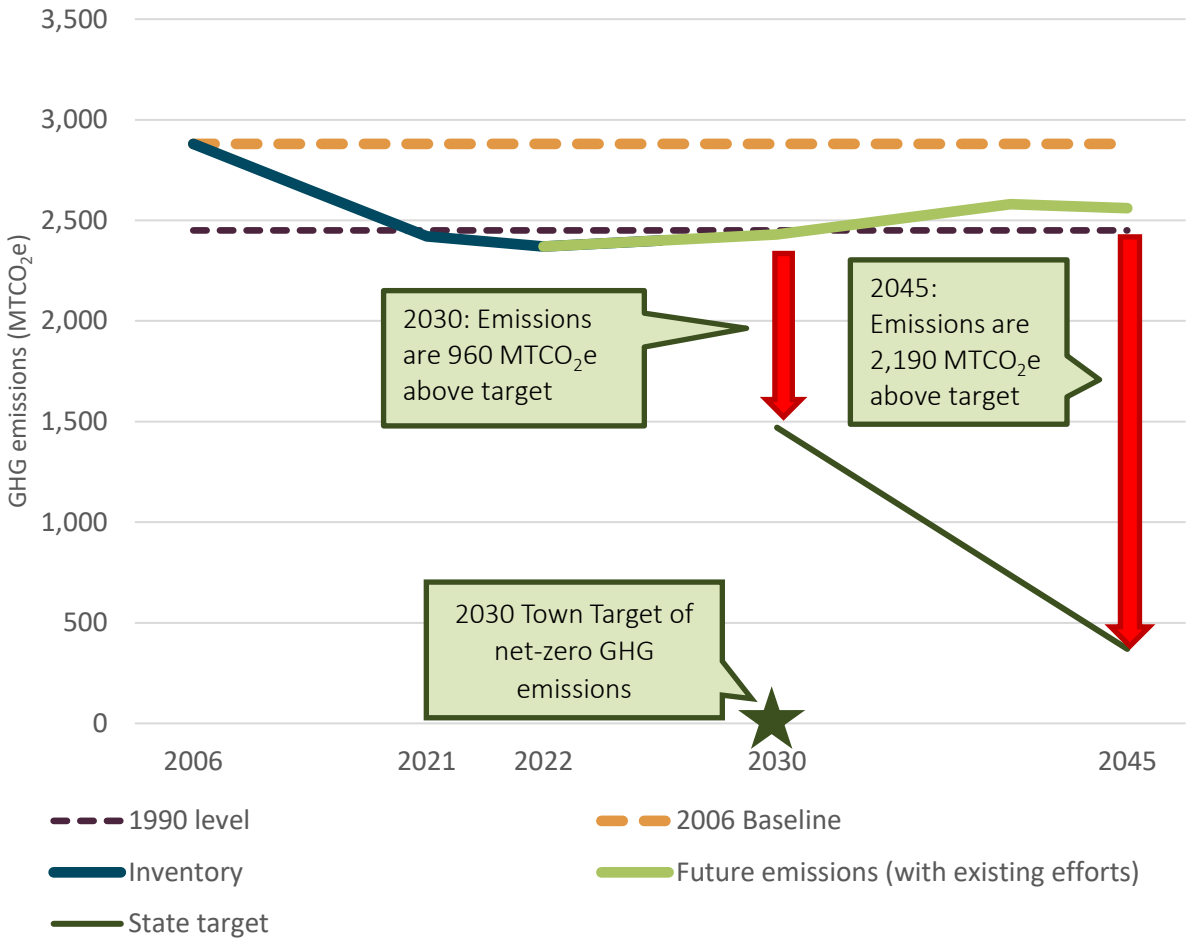


TABLE 7: GHG EMISSIONS WITH EXISTING ACTIONS

	2030 $MTCO_2E$	2045 $MTCO_2E$
Forecast BAU GHG emissions	2,680	3,100
Reductions from existing actions	-250	-540
Forecast GHG emissions minus existing actions	2,430	2,560
Target	1,470	370
Target met?	No	No
Gap to target	960	2,190

Note: Emissions are rounded to the nearest 10. Totals may not equal the sum of individual rows.

While the existing actions help to close the gap between the Town's forecast BAU GHG emissions and the targets, they do not achieve the targets on their own. As expected, the Town will need to take additional actions to reduce GHG emissions to a level consistent with State targets.

6. GHG EMISSIONS REDUCTION STRATEGIES

In conversations with Town staff, PlaceWorks identified a set of strategies for the Town to further reduce its government operations GHG emissions. These strategies are supported by the Town's priorities and direction, State and regional regulations and policies, technological advances, and expected changes in peoples' behavior and choices. The objectives identified in the 2024 MCAP are also integrated into the list of GHG emission-reduction strategies in this Report. The reductions resulting from each measure depend on how extensively the measure will be implemented. The greater the participation in the effort, the greater the level of GHG emission reductions.

The quantification approaches of each reduction measure are consistent with guidance provided by the Bay Area Air Quality Management District (BAAQMD). The baseline GHG inventory and forecast serve as the foundation for the quantification of the Town's GHG reduction measures. Activity data from the inventory form the basis of measure quantification, including vehicle miles traveled (VMT), kilowatt-hours (kWh) of electricity or therms of natural gas consumed, and tons of waste disposed. Activity data were combined with performance targets and indicators identified by the Town and PlaceWorks. The activity data, performance targets, and demographic indicators were used throughout the quantification process to calculate the GHG emissions reduction benefit of each measure. This approach ensures that the Town's GHG emission reductions are tied to the baseline and to future activities occurring in the Town.

6.1 TOWN ENERGY USE

1. BUILDING AND FACILITIES ENERGY EFFICIENCY

This reduction strategy emphasizes the Town retrofitting existing buildings to use less electricity and natural gas. Although replacing natural gas use with electricity (discussed in the next section) often results in greater GHG emission reductions, improving energy efficiency is still an important step in reducing the Town's energy use. Energy-efficiency retrofits can include improving the building envelope through updates to insulation and windows or by purchasing new energy-efficient appliances. Retrofits are also a useful strategy for buildings that cannot be easily converted to all-electric. Energy audits of existing buildings are encouraged to inform the process and prioritization of retrofits.

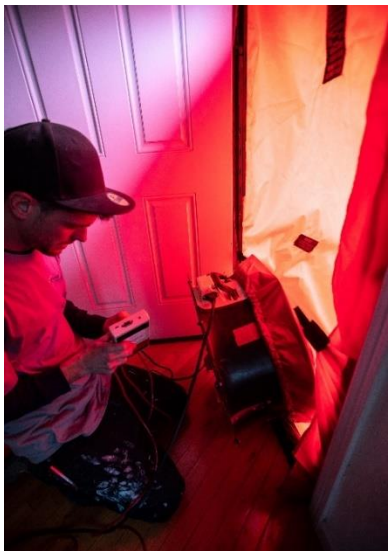
Along with improvements to existing buildings, the Town can construct new buildings to be more energy efficient than required by State standards.

Table 8 shows the reductions and assumptions from building energy-efficiency retrofits.

TABLE 8: TOWN OF WINDSOR GHG EMISSION REDUCTIONS AND ASSUMPTIONS: BUILDING ENERGY EFFICIENCY

	2030	2045
GHG emissions reduction ($MTCO_2e$)	-10	-20
Assumptions		
Reduction in electricity use from retrofit activities	-20%	-40%
Reduction in natural gas use from retrofit activities	-20%	-40%
Percentage of Town facilities undergoing retrofits	10%	25%

Recommended Actions



Energy audits, such as this test for air leaks, are a cost-effective way of identifying energy-efficiency opportunities. Image from Werner Slocum/NREL (72260).

- Action 1.1 Perform energy audits of existing Town buildings to identify opportunities for energy-efficiency improvements, including improvements to HVAC systems, lighting, insulation, windows and doors, and appliances.
    - Current Status: As of 2024, the Town is performing energy audits at seven Town-owned facilities in partnership with Sonoma County and anticipates completing the audits in early 2025.
- Action 1.2 Implement identified energy-efficiency actions, prioritizing those that reduce the greatest amount of GHGs and energy use.
    - Current Status: These actions are upcoming and dependent on the results of the energy audits.
- Action 1.3 Continue to replace lighting in public facilities with smart-control LEDs.
    - Current Status: The Town's Public Works department has converted all streetlights to LEDs that are controlled by a photocell system. The Parks and Facilities Maintenance Division of the Parks and Recreation Department controls public lighting in Town parks and converts them to LEDs as existing bulbs fail.
- Action 1.4 Coordinate with the Parks and Recreation Department to inventory and complete the replacement of public lighting in parks to smart-control LEDs.

Considerations

- Sonoma County and other regional partner agencies can provide funding for energy audits of existing buildings. In some cases, this funding can cover the full cost of the energy audit.
- If a building is set to receive all-electric upgrades or a solar energy system, conduct an energy audit first and make any identified efficiency improvements. This can allow the building to function with lower-capacity all-electric appliances, or a smaller solar energy system, saving purchase and installation costs. Older buildings, especially those constructed prior to the adoption of the California Energy Code in 1978, should be prioritized for energy audits.

- Energy-efficiency upgrades can also have safety and resilience benefits. For example, buildings with high-quality insulation can be heated and cooled more easily, making it easier to use these buildings as heating or cooling centers during extreme temperatures. Consider prioritizing energy-efficiency improvements for buildings that serve as heating/cooling centers or resilience hubs.

2. BUILDING AND FACILITIES ELECTRIFICATION

Building electrification involves replacing natural gas appliances in Town facilities with electrical ones. Using electricity to power an appliance produces fewer GHG emissions than using natural gas for the same purpose, given the clean sources of the Town's electricity. In March 2023, BAAQMD adopted regulations requiring that, when water and space heaters are replaced, any natural gas models must be replaced with electric-powered ones. This regulation will take effect between 2027 and 2031, depending on the appliance type. Similarly, the State anticipates phasing out most natural gas appliance sales by 2030, and all such sales by 2045. Recently, the federal government has made significant funding available for electrification through the 2022 Inflation Reduction Act. Table 9 shows the reductions and assumptions from building electrification. Assumptions regarding the percentage of electricity and natural gas used by space heaters, water heaters, and other appliances are based on energy use intensity information from the California Energy Commission Commercial End-Use Survey.[12]

TABLE 9: TOWN OF WINDSOR GHG EMISSION REDUCTIONS AND ASSUMPTIONS: BUILDING ELECTRIFICATION

	2030	2045
GHG emissions reduction ($MTCO_2e$)	-90	-150
Assumptions		
Electrification rate of space heaters	75%	100%
Electrification rate of other appliances	40%	60%

Recommended Actions

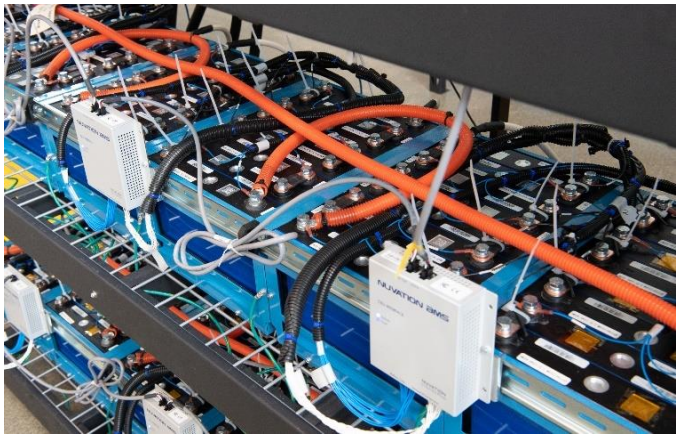
- Action 2.1 Replace space heaters, water heaters, and other natural gas-powered appliances with all-electric models as they fail.
    - Current Status: As of 2023, seven of the nine hot water heaters in Town facilities were replaced with electric heat pumps. Town anticipates replacing all Civic Center HVAC units in spring 2025, which may include heat-pump alternatives.
- Action 2.2 Require any new Town facilities to have all-electric appliances.
    - Current Status: An absolute requirement is not in place yet due to a lack of reasonable alternatives for all appliances. MCAP objectives 1.1, 1.4, and 1.8 aim to address this action.
- Action 2.3 Install additional solar photovoltaic systems at Town facilities to power Town buildings and appliances.

[12] The California Commercial End-Use Survey (CEUS) is a comprehensive study of commercial sector energy use. More information can be found online: https://www.energy.ca.gov/data-reports/surveys/california-commercial-end-use-survey.

  - Current Status: The Town plans to increase solar energy production at the Wastewater Reclamation facility and other Town facilities as feasible.
- Action 2.4 Work toward 100 percent carbon pollution-free energy by incorporating renewable energy alternatives and energy-efficient technologies (like heat pumps and hot water recirculation) into all new and existing Town facilities and buildings, guided by LEED Green Building Standards whenever possible (MCAP Objective 1.4).
  - Current Status: The Town transitioned all municipal accounts to 100 percent renewable SCP EverGreen service from SCP's CleanStart service in July 2023 and electrified seven out of nine Town facility water heaters.
- Action 2.5 Phase out natural gas use in municipal operations, except for emergency response measures awaiting renewable alternatives (MCAP Objective 1.8).

Considerations

- Space and water heaters use most of the natural gas in nonresidential buildings, so these should be prioritized for conversion to electric.
- Seek State and federal funding through such programs as the Inflation Reduction Act (2022) that offer direct grant funding or tax rebates for electric appliances and renewable energy systems.
- Although electricity from SCP is already very clean, there are still financial and resilience benefits from installing renewable energy systems.
- Buildings with solar energy systems are ideally suited for a battery storage system, which allows the building to function during a power outage with little or no need for a generator. Battery storage systems are also eligible for rebates under the Inflation Reduction Act, among other programs. Town facilities that are used for emergency response activities, or as community shelters or resilience hubs, are particularly suited for battery storage systems.



Battery storage systems allow buildings to function during power outages. This experimental hybrid system also uses expired batteries from electric vehicles. Image from Dennis Schroeder/NREL (62802).

6.2 TOWN FLEET AND COMMUTE ACTIVITIES

3. FLEET ELECTRIFICATION

This reduction strategy involves the Town replacing gasoline and diesel-powered vehicles in the Town's fleet with ZEVs, as advised in the Zero-Emission Fleet Transition Plan. The State has enacted regulations banning new sales of light-duty gasoline and diesel vehicles beginning in 2035 and transitioning larger vehicles to ZEVs by 2045. Table 10 shows the reductions and assumptions from fleet electrification.

TABLE 10: TOWN OF WINDSOR GHG EMISSION REDUCTIONS AND ASSUMPTIONS: FLEET ELECTRIFICATION

	2030	2045
GHG emissions reduction ($MTCO_2e$)	-50	-220
Assumptions		
Fleet light-duty vehicles converted to ZEVs	30%	90%
Fleet heavy-duty vehicles converted to ZEVs	15%	60%

Recommended Actions

- Action 3.1 Continue to uphold "electric first" procurement guidelines when purchasing new Town fleet vehicles, making ZEVs the default choice. If there is no viable ZEV for a specific need, purchase the most fuel-efficient alternative available, and explore opportunities to run the vehicle with biofuels or other renewable sources.
    - Current Status: In 2024, the Town purchased three electric vehicles to replace internal-combustion engine vehicles in the Town operational fleet: one pool car and two utility trucks. No new internal combustion engine vehicles were purchased in 2024.
- Action 3.2 Provide EV charging infrastructure at Town facilities where fleet vehicles are usually parked.
    - Current Status: The existing electric vehicle charging infrastructure, which includes six chargers at the Corporation yard and three public chargers at Civic Center, is being used, and design for full electrification of the Town Fleet as proposed in the Zero-Emission Fleet Transition Plan was authorized.
- Action 3.3 Ensure 100 percent ZEV Town fleet acquisitions by 2027, or as such vehicles become available (MCAP Objective 1.3).

Considerations

- State and federal regulations will influence the price of ZEVs, making them more affordable with time. There are also many tax rebates and other financial incentives available to help with the cost burden.
- EV chargers can be connected to solar energy systems to reduce charging costs. Adding a battery storage system can further reduce costs and ensure that vehicles can be recharged during power outages or at night.
- For some larger vehicles, battery-electric vehicles may not be viable. The State expects hydrogen fuel-cell vehicles to fill this gap. Although hydrogen vehicles currently have limited availability, they are expected to become more widely available in coming years.

4. EMPLOYEE COMMUTE REDUCTION

Although most Town employees commute to work in personal vehicles, they can choose to commute using methods that produce fewer GHGs, including bicycling, public transit, and carpool. Working remotely also allows Town employees to reduce their commute-related GHG emissions. The Town can

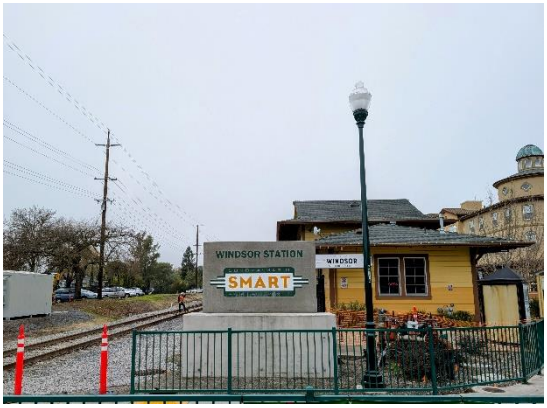
make it easier for employees to choose lower-carbon commute options through transit or active transportation subsidies or other incentives, guaranteed free-ride-home programs, establishing carpool programs, and supporting remote work for employees who can do so feasibly. **Table 11** shows the reductions and assumptions from employee commute reduction.

TABLE 11: TOWN OF WINDSOR GHG EMISSION REDUCTIONS AND ASSUMPTIONS: EMPLOYEE COMMUTE REDUCTION

	2030	2045
GHG emissions reduction ($MTCO_2e$)	-10	-20
Assumptions		
Reduction in employee commute VMT	-5%	-20%

Recommended Actions

- Action 4.1 Continue to offer a hybrid remote/in-office work policy to allow employees to continue to work remotely for a few days during the week, thereby reducing commute trips.
    - Current Status: The Town currently has a telework policy in place that allows administrative staff to work remotely up to two days per week.
- Action 4.2 Work with employees to design an incentive program for using carpools or other forms of transportation beyond a single-occupancy vehicle, such as a parking cash-out, subsidized transit pass, or Emergency Ride Home Program.
    - Current Status: Town staff completed a revised employee commute survey in October 2024, which will inform future incentive programs.
- Action 4.3 Explore the feasibility of a shuttle program between the SMART train station and locations where staff work regularly, including Town Hall, Public Works, Windsor Senior Center, Windsor Community Center, and Bluebird Center.



Extending the SMART train from Santa Rosa into Windsor will provide Town employees with additional commute options. Image from PlaceWorks. Source: Town of Windsor

- Action 4.4 Support the availability of carshare vehicles around Town facilities for use by employees during the day for work meetings, lunch breaks, and personal errands.
- Action 4.5 Continue to ensure that Town facilities are easily accessible through multiple means of transportation, including bike lanes and public transit.
    - Current Status: There are bike lanes and bike access to most Town facilities as well as bike parking. However, 11 percent of respondents to the employee commute survey note that more bike lanes would encourage them to choose an alternate mode for commuting to work, and 18 percent noted safer bikes lanes would encourage them to use an alternate

mode. There is a free public shuttle around Windsor operated by Sonoma County Transit Authority.

- Action 4.6 In all new public development and capital improvement projects, prioritize cycling, walking, and frequent and affordable public transport to reduce air and water pollution through smart and inclusive design, considering projects as outlined in the Windsor Bicycle and Pedestrian Master Plan and following the Complete Streets Guidelines (MCAP Objective 1.5).

Considerations

- Even in cases where alternative transit is viable for their daily commute, employees can be reluctant to use it out of concern that they will need a car for emergencies. The Sonoma County Transit Authority operates an Emergency Ride Home program that will reimburse Town staff for taking a taxi, ride-hailing service, car share, or rental car home from work if an unexpected situation arises.
- Windsor is expected to see Sonoma Marin Area Rail Transit (SMART) service beginning in 2025. The train station will be approximately a five-minute walk from Town Hall and Public Works. Consider last-mile transit options for employees at the Windsor Senior Center, Windsor Community Center, and Bluebird Center. Ensure that employees are aware of SMART as a viable commute option.
- 40 percent of respondents to the employee commute survey noted that a parking cash-out or some form of financial incentive not to drive is a transportation program that would appeal to them. The top two other programs following a parking cash-out were incentives to ride with a colleague (30 percent) and a last-mile option from the SMART station (30 percent).

5. EMPLOYEE ZERO-EMISSION VEHICLES

Even with several alternative commute modes available, it is likely that most Town employees will continue to commute using their personal vehicles. As State regulations on new vehicles take effect and new vehicles in California transition to all-ZEV by 2035, the personal vehicles of Town employees will also transition to ZEVs. The Town can further support this transition by ensuring that there are adequate EV charging stations near parking spaces for Town employees. Table 12 shows the reductions and assumptions from employee ZEVs.

TABLE 12: TOWN OF WINDSOR GHG EMISSION REDUCTIONS AND ASSUMPTIONS: EMPLOYEE ZEVS

	2030	2045
GHG emissions reduction ($MTCO_2e$)	-20	-70
Assumptions		
Percentage of employee VMT electrified	20%	85%

Recommended Actions

- Action 5.1 Expand the number of EV charging stations at Town facilities in preferential parking locations, and enforce time restrictions to ensure greater availability.
    - Current Status: There are currently nine EV chargers available for Town employees: six at the Corporation Yard and three public at Civic Center.
- Action 5.2 Ensure that employees are aware of available financial incentives to reduce the cost of purchasing a ZEV.

Considerations

- When installing EV charging stations at Town facilities, explore the feasibility of DC Fast Charging systems that can fully charge a car in less than an hour (and in some cases, in as little as 15 minutes). Consider these systems at locations where people do not park for hours or enforce a time limit for charging to allow multiple vehicles to charge per day.
- EV drivers have expressed frustration about public EV chargers that are inoperable, require a lengthy or confusing account set-up process, or lack clear instructions for use. Regularly check to make sure that any Town EV chargers are functioning properly and that there is easy-to-follow, clear information about how to use them.

6.3 WASTEWATER PROCESSING

6. WASTEWATER PROCESS IMPROVEMENTS

The Town is studying ways to reduce GHG emissions from wastewater processing activities, which are the single-largest source of GHGs from the Town's government operations. The Town is currently exploring converting the solids produced from wastewater processing into Exceptional Quality Class A biosolids in the form of biochar. As compared to current practice, this would result in an estimated 100 percent decrease in the vehicle miles needed to haul wastewater solids away from the treatment plant, which totaled 12,480 miles in 2021 and 4,960 miles in 2022. In addition, the Town is proposing to expand the solar power production of the Water Reclamation Facility with a 90,000 kWh array on the blower and electrical buildings. The Town can also change the technologies used in wastewater processing to methods that result in lower levels of GHG emissions. Table 13 shows the reductions and assumptions from reducing wastewater processing emissions.

TABLE 13: TOWN OF WINDSOR GHG EMISSION REDUCTIONS AND ASSUMPTIONS: REDUCTIONS IN WASTEWATER PROCESSING EMISSIONS

	2030	2045
GHG emission reduction ($MTCO_2e$)	-1,210	-1,400
Assumptions		
Percentage reduction in GHG emissions	-83%	-83%
Reduction in wastewater solids hauling	-100%	-100%

Recommended Actions

- Action 6.1 Implement the program to convert biosolids from wastewater processing into Exceptional Quality Class A biosolids or biochar, as feasible, which would eliminate the need to haul biosolids off-site.
    - Current Status: The design for converting biosolids is in progress, and 30 percent of the plans are complete. Construction on the project is expected to begin in 2027.
- Action 6.2 Continue to explore and implement opportunities to make improvements to the Town's wastewater treatment processes, including upgrades or alternatives to existing aeration basins, ultraviolet (UV) treatments, and other components as identified in the Biosolids Treatment and Disposal Project, which would result in an estimated 83 percent reduction in emissions from wastewater processing.
    - Current Status: The designs for other energy-efficiency building upgrades are approximately 60 percent complete, with construction planned for 2026. Though the aeration basin project is not anticipated to directly save GHG emissions, Town staff is looking for avenues to save GHG emissions. These avenues include installing solar panels on the roof of the new blower and electrical buildings to supplement the electrical use of new pumps and equipment.
- Action 6.3 As improvements to wastewater treatment processes are implemented, evaluate opportunities for capturing waste methane for beneficial reuse.
    - Current Status: There are no methane capture opportunities at this time.
- Action 6.4 Replace the current UV disinfection system with a new, more efficient unit and monitor the energy usage of the new unit to confirm expected results.
    - Current Status: The Town completed an upgrade to the UV disinfection system in December 2024.
- Action 6.5 Upgrade the electrical equipment for the Town's water and wastewater systems, including pumps and blowers, to more efficient models.
    - Current Status: The Town is planning further upgrades to the Wastewater Reclamation Facility that will improve efficiency. The designs for other energy-efficiency building upgrades are approximately 60 percent complete with construction planned for 2026

- Action 6.6 Since 2022, the Town's goal has been to achieve net-zero environmental impact of the Town wastewater reclamation operations by 2030 through a three-pronged approach (MCAP Objective 1.2):
    - Net-zero GHG emissions from energy used in Town wastewater reclamation operations: achieved in 2023 due to the transition of all Town accounts to Sonoma Clean Power's EverGreen service.
    - 100 percent recycled water reuse at Town wastewater reclamation operations by 2026.
    - 100 percent biosolids reuse by Town wastewater reclamation operations by 2028.

Considerations

- The safety and effectiveness of the Water Reclamation Facility is critical. While the Town should make improvements to the plant to reduce processing emissions as opportunities arise, the Town should consider such additional options in light of available funding opportunities, the effectiveness and lifespan of the technology, changes to operational costs, and other factors.

6.4 OTHER ACTIVITIES

7. SOLID WASTE REDUCTION

The Town can continue to take steps to reduce the amount of waste that is sent to the landfill from Town facilities. This can include adequate bins for collecting recyclables and organics from restrooms, workstations, common areas, and communal kitchens. Town employees and visitors should be aware of what materials should be deposited in the proper bins. Table 14 shows the reductions and assumptions from proper diversion practices resulting in solid waste reduction.

TABLE 14: TOWN OF WINDSOR GHG EMISSION REDUCTIONS AND ASSUMPTIONS: SOLID WASTE REDUCTION

	2030	2045
GHG emissions reduction ($MTCO_2e$)	-20	-50
Assumptions		
Percentage reduction in solid waste (tons)	-10%	-25%

Recommended Actions

- Action 7.1 Ensure a three-bin sorting system (landfill, recycling, and compost) is in each Town facility, restroom, and building.
    - Current Status: The Town provides containers for landfill waste and recycling in all staff desk areas, a three-bin sorting system in all common areas for food preparation, and battery recycling collection containers.
- Action 7.2 Ensure that Town facilities have a collection bin system for electronic waste, such as dead batteries, used printer cartridges, and burnt-out lightbulbs.

    - Current Status: The Town began collecting e-waste for proper disposal in 2017 and currently participates in Zero Waste Sonoma e-waste collection events.
- Action 7.3 Collaborate with the local waste hauler to provide educational materials and training to employees to raise awareness about how to use the waste bins properly.
    - Current Status: The Town has a collaborative relationship with the local waste hauler and provides educational materials, signage, and demonstrations to Town staff to encourage proper waste sorting and waste reduction.
- Action 7.4 Provide reusable, non-disposable materials in facilities with kitchens or food service areas.
    - Current Status: Common area kitchens have reusable food serviceware for staff to use. If items are not available, SB 1383 paper procurement requires the Town to purchase recyclable content items greater than 30 percent.
- Action 7.5 Conduct occasional waste audits to identify improper use of the waste bins and inform ideas for how to improve the system.
    - Current Status: The Town accommodates frequent audits by the waste hauler to assess contamination and service needs. Staff then works with the hauler to solve problems and improve waste sorting processes.
- Action 7.6 Ensure Town janitorial contracts provide a clear scope of work, aligned with SB 1383 guidance, detailing the proper handling of material and the use of collection bins serviced by the local waste hauler.
    - Current Status: The Town collaborates with custodial staff to ensure compliance with SB 1383 and provides reusable food service ware in staff kitchens.
- Action 7.7 When implementing changes to a building's waste collection system, meaningfully engage custodial staff throughout the process. Ensure that their expertise and any concerns are considered during the process update to ensure efficiency regarding the time and effort of custodial staff.
- Action 7.8 Establish and promote purchasing policies that favor and facilitate locally sourced, recycled, repurposed, and earth-friendly materials (MCAP Objective 4.1).
- Action 7.9 Champion replacing plastic with reusable products made from renewable materials (MCAP Objective 4.2).
- Action 7.10 Work toward the goal of Zero Waste by 2030 for municipal operations, including Town-sponsored events (MCAP Objective 4.3)

Considerations

- Improper use of waste bins often results from lack of training about what material goes where, or when the desired bin is missing or full. Providing clear and thorough signage, training opportunities, and ensuring that bins are easily accessible and frequently emptied, can help address these concerns.

8. ENVIRONMENTALLY PREFERABLE REFRIGERANTS

Refrigerant gases used in air conditioning units are often powerful GHGs. When these gases leak, they can have a significant effect on atmospheric GHG levels. Replacing these gases with refrigerants that have lower or no global warming potential (GWP) can help reduce the Town's GHG emissions profile. California has adopted new laws and strategies to help phase out these high-GWP refrigerants with more environmentally preferable alternatives. Table 15 shows the reductions and assumptions from environmentally preferable refrigerants.

TABLE 15: TOWN OF WINDSOR GHG EMISSION REDUCTIONS AND ASSUMPTIONS: ENVIRONMENTALLY PREFERABLE REFRIGERANTS

	2030	2045
GHG emissions reduction ($MTCO_2e$)	Less than -10	Less than -10
Assumptions		
Percentage of refrigerants replaced with environmentally preferable options	25%	100%

Recommended Actions

- Action 8.1 As required, replace refrigerants in appliances and vehicles with refrigerants that have lower GWP.
    - Current Status: The Town does not have an update on replacing refrigerants with lower GWP options. Given the small proportion of total emissions coming from this sector, reducing emissions from refrigerants is not a top priority.
- Action 8.2 Consider the refrigerants used in new appliances and vehicles. If feasible, buy appliances and vehicles with environmentally preferable refrigerants, or replace high GWP refrigerants with new appliances and vehicles with carbon-friendly refrigerants.
- Action 8.3 Ensure appropriate maintenance of refrigerant systems to avoid leakage.

Considerations

- Many new appliances and vehicles already have environmentally preferable refrigerants, and more will be switching away from high GWP refrigerants due to changes in State law. Prioritize refrigerant replacement for newer appliances and vehicles that are expected to remain in service for several years. Older appliances and vehicles that are set to be replaced shortly should be a lower priority.

6.5 RESULTS

In total, the GHG reduction strategies proposed reduce Town operations GHG emissions by 1,460 $MTCO_2e$ by 2030 and 1,990 $MTCO_2e$ by 2045. Table 16 shows the GHG emissions reductions from the individual reduction strategies discussed in the previous section. A compiled list of the proposed reduction strategies is included in Appendix A.

TABLE 16: GHG EMISSION REDUCTIONS FROM REDUCTION STRATEGIES ($MTCO_2E$)

	2030	2045
1. Building and Facilities Energy Efficiency	-10	-20
2. Building and Facilities Electrification	-90	-150
3. Fleet Electrification	-60	-220
4. Employee Commute Reduction	-10	-20
5. Employee Zero-Emission Vehicles	-20	-70
6. Wastewater Process Improvements	-1,210	-1,400
7. Solid Waste Reduction	-20	-50
8. Replace Refrigerants	Less than-10	Less than -10
Total	**-1,410**	**-1,930**

Note: GHG emissions are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Table 17 and Figure 8 show the GHG emission reductions from the reduction strategies discussed in the previous section and the effect they have on the Town's future GHG emissions and ability to meet reduction targets.

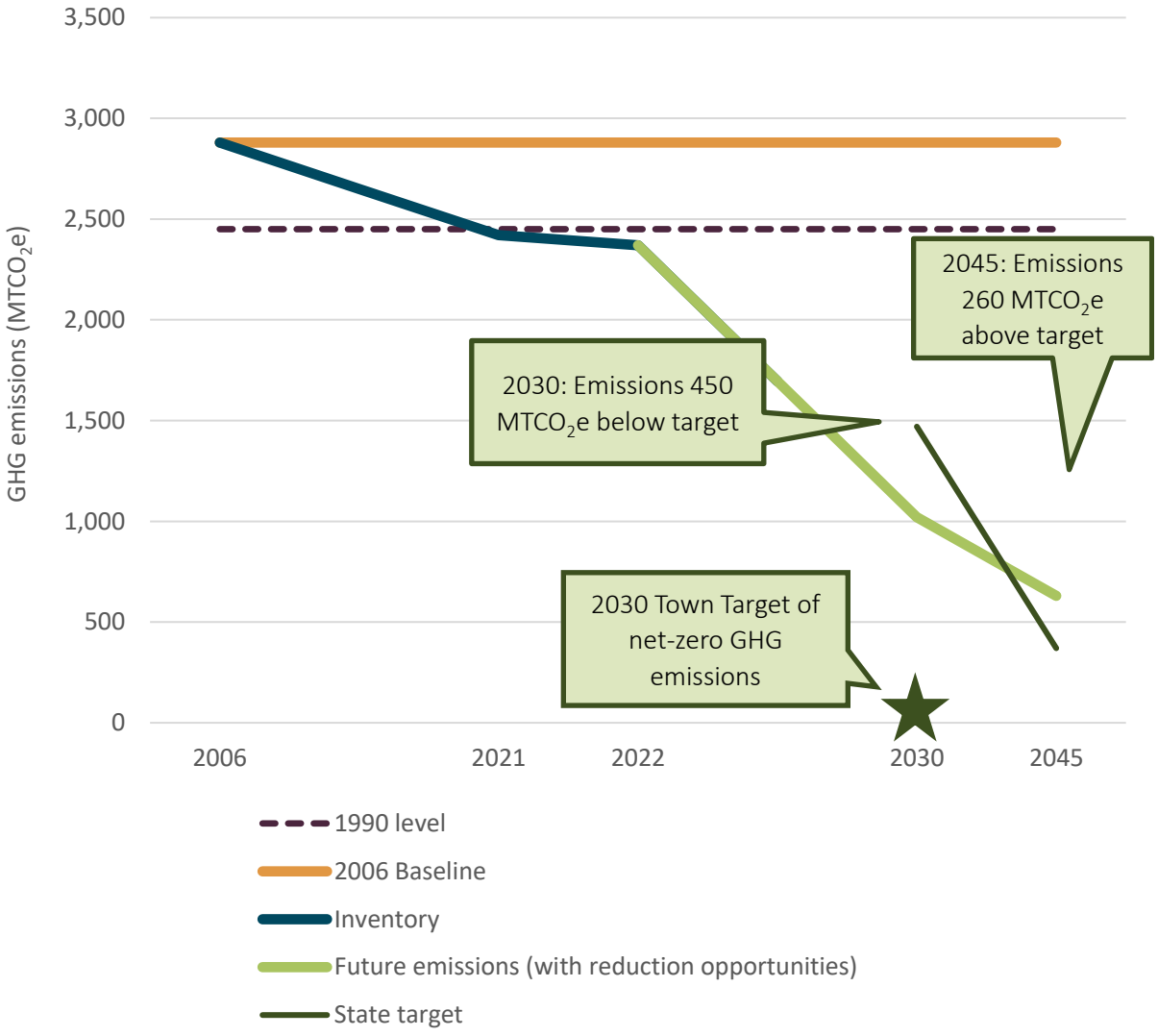
TABLE 17: TOWN OF WINDSOR GOVERNMENT OPERATIONS GHG EMISSIONS WITH REDUCTION STRATEGIES

	2030 $MTCO_2e$	2045 $MTCO_2e$
Forecast GHG emissions with existing actions	2,430	2,560
GHG reductions from reduction strategies	-1,410	-1,930
Forecast GHG emissions after implementing reduction strategies	1,020	630
State target	1,470	370
State target met?	Yes	No
Gap to State target	-450	260

Note: Emissions are rounded to the nearest 10. Totals may not equal the sum of individual rows.

This current set of GHG emission reduction opportunities, if implemented as described in this report, can reduce the Town's municipal operations GHG emissions in 2030 to 1,410 $MTCO_2e$. This is 51 percent below the 2006 baseline levels, or 58 percent below 1990 levels, which achieves the State goal of reducing GHG emissions 40 percent below 1990 levels by 2030, but not the Town goal of net-zero emissions. Under this scenario, the Town's municipal operations GHG emissions in 2045 are reduced to 630 $MTCO_2e$. This is 78 percent below 2006 levels, or 74 percent below 1990 levels. The Town will need to reduce its municipal operations GHG emissions another 260 $MTCO_2e$ by 2045 to achieve the State target of reducing GHG emissions to 85 percent below 1990 levels. As mentioned earlier, there are no State regulations that require the Town to reduce its municipal operations GHG emissions to levels consistent with State targets.

FIGURE 8: TOWN OF WINDSOR GHG EMISSIONS WITH REDUCTION STRATEGIES AND STATE GHG EMISSION-REDUCTION TARGETS



6.6 ADDITIONAL OPPORTUNITIES

To close the remaining gap to the targets, the Town will need to reduce emissions more aggressively than initially assumed in the reduction strategy scenarios described in Section 5.4. Table 18 lists the GHG emissions by sector that remain after implementation of the reduction strategies.

TABLE 18: REMAINING TOWN OPERATIONS GHG EMISSIONS AFTER GHG REDUCTION MEASURES

	2030 $MTCO_2e$	2045 $MTCO_2e$
Employee commute	110	50
Energy: Buildings and facilities	90	0
Energy: Streetlights and traffic signals	30	0
Refrigerants	Less than 10	Less than 10
Solid waste	140	140
Town fleet	310	180
Wastewater direct emissions	240	280
Wastewater facilities	70	0
Wastewater solids hauling	Less than 10	Less than 10
Water delivery facilities	30	0
Total	**1,020**	**630**

Note: Emissions are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Some actions that the Town could take include:

- **Eliminate natural gas use:** The Town can fully electrify its buildings and operations at a more rapid pace to further reduce natural gas emissions from buildings and facilities, including eliminating all natural gas use at Town facilities by 2030.
- **Further reduce employee commute emissions:** Following the employee commute survey, the Town can prioritize incentives and programs that will reduce emissions from employee commute by an additional 30 percent in 2030 and 50 percent in 2045. This may include supporting Town employees to make more use of public or active transportation, or helping to increase the rate of adoption of zero-emission vehicles by Town employees.
- **Achieve zero-waste by 2030:** As established in the MCAP, the Town can achieve zero-waste in Town buildings and facilities by 2030, resulting in a substantial reduction in emissions from the waste sector.
- **Accelerate transitioning the Town vehicle fleet to zero-emission vehicles**: While the MCAP directs the Town to only procure zero-emission vehicles starting in 2027, as such options are available, gasoline and diesel-powered vehicles purchased prior to 2027 can remain in operation for another 15 to 20 years or more. If the Town commits to replacing all vehicles with zero-emission models by 2030, this will substantially reduce the Town's emissions.

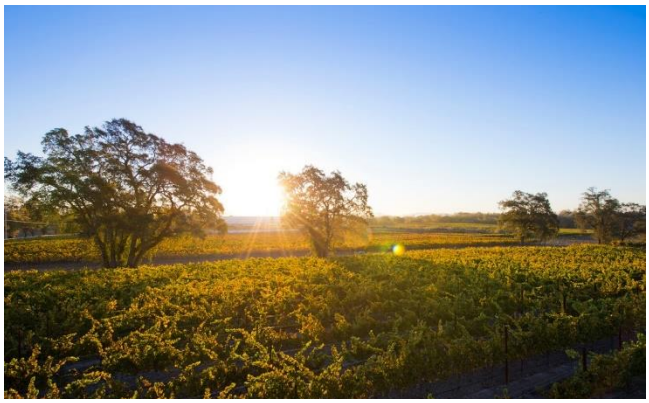
Table 19 shows how these additional reductions could contribute to the Town's progress in achieving its GHG reduction goals. By focusing on high-emitting sectors, such as wastewater, natural gas use, employee commute, and solid waste, the Town can accelerate its reductions and achieve the State targets in 2030 and 2045. The Town could also achieve additional reductions for many of these opportunities by going beyond the percentages specified in the list above.

TABLE 19: TOWN OPERATIONS ADDITIONAL REDUCTION OPPORTUNITIES AND PROGRESS TO GHG EMISSION TARGETS

	2045 $MTCO_2e$
Forecast GHG emissions with reduction strategies	630
Reduction from additional opportunity – Eliminate natural gas use by 2030	-
Reduction from additional opportunity – Further reduce employee commute emissions	-40
Reduction from additional opportunity – Achieve zero waste by 2030	-140
Reduction from additional opportunity – Accelerate transitioning the Town fleet to zero-emission vehicles	-80
Forecast GHG emissions with additional opportunities	**370**
State target	370
Target met?	Yes

6.7 A PATH TO NET-ZERO EMISSIONS

The Town has committed to reducing its total GHG emissions to net zero by 2030 if feasible, and no later than 2045. The existing set of strategies and their assumed participation rates do not achieve this target. However, with more aggressive participation rates in the proposed strategies, the addition of new GHG emission-reduction strategies, and/or an increase in carbon sequestration, the Town can achieve its goal.



Local natural and working lands, such as these vineyards bordering Windsor, offer opportunities for carbon sequestration projects to generate offsets that the Town can use to achieve its net-zero emissions target.
Source: https://russianrivervalley.org/uploads/users/2255/FarrowVineyardHarvest2013.0001.jpg.

Since some sources of GHG emissions are out of the Town's control, such as employee commute behavior, it is not likely that the Town will eliminate its government operations GHG emissions completely even if there are many economically, technologically, and politically feasible strategies to do so. To achieve this net-zero emissions goal, the Town will need to consider the use of carbon offsets to balance out the emissions that cannot be eliminated.

The State has not yet provided guidance on how local communities should use carbon offsets to meet GHG emission targets. In the absence of such guidance, PlaceWorks suggests that offsets be used with the following considerations in mind:

- Offsets should only be used as a last resort to balance out GHG emissions that cannot be feasibly eliminated. They should not be used as an alternative to GHG emissions-reduction activities.
- Offsets must provide a verifiable and trackable GHG emissions-reduction benefit, and this benefit should not be double counted.
- Offset activities should be in California, and ideally in Sonoma County or elsewhere in the North Bay or North Coast regions.
- Offset activities should benefit communities that have experienced environmental injustice and support green jobs and activities that promote an equitable transition to a carbon-free power system. They should not create or exacerbate environmental, social, or economic inequities.
- The Town should explore participating in offset programs in partnership with neighboring jurisdictions.

7. RECOMMENDATIONS AND NEXT STEPS

If the Town implements the recommended GHG emissions-reduction measures outlined in this Report, GHG emissions from Town operations and facilities can be reduced significantly. If the Town is to achieve the State targets and net-zero GHG emissions by 2030, they should explore how to further reduce GHG emissions from the sectors discussed in Section 5.5. Town staff and elected officials will need to continue to prioritize sustainability as a core tenant of the local governance culture in Windsor and support efforts to accelerate reductions in Town operations GHG emissions with dedicated funding and staff, keeping the Town's zero net emissions by 2030 goal at the forefront. With the adoption of the MCAP, regular reporting, such as this and subsequent iterations of the Biennial GHG Emissions Report, serve to hold stakeholders accountable to the objectives of the MCAP and provide opportunities to mark progress towards targets. The Town should also seek partnerships with regional agencies and neighboring jurisdictions to further reduce GHG emissions beyond Town boundaries.

APPENDIX A: 2019 AND 2020 TOWN OPERATIONS GHG INVENTORY

1. Introduction

PlaceWorks is working with the Town of Windsor (Town) to prepare its 2019-2020 Biennial Greenhouse Gas (GHG) Emissions Report (the Report). The Report is a summary of the Town's GHG emissions from government operations and an assessment of future emission-reduction opportunities, demonstrating a viable pathway to meet GHG reduction targets. PlaceWorks has worked with Town staff to prepare Town operations GHG inventories for the years 2019 and 2020. These are technical analyses that assess the total annual GHG emissions attributed to the Town from government operations and facilities. Quantifying annual GHG emissions will assist the Town in establishing attainable emissions reduction goals for subsequent years, building on work that has been a community priority for over a decade. Furthermore, associating GHG emissions with specific activities allows the Town the opportunity to develop targeted policies and programs to facilitate emissions reduction.

GHG emissions are generated by commonplace daily activities. Some GHG emissions are released at the location of the activity, such as carbon dioxide emissions from a vehicle's internal combustion engine. Alternatively, other activities, such as using fossil-fuel derived electricity in a building, cause GHG emissions to be released elsewhere, at the location of the power plant. Therefore, for this analysis the Town must consider GHG emissions attributable to Town operations, including GHG emissions generated at facilities or locations outside Town jurisdictional boundaries.

The Town has access to two types of GHG inventories: (1) a community-wide inventory; and (2) a Town operations inventory, both of which are described below. This Biennial GHG Emissions Report is the Town operations inventory.

- A community-wide inventory identifies GHG emissions that result from activities of Town residents, businesses, visitors, and other community members. Examples include residents driving cars, homes using water, and businesses using electricity. In Sonoma County, the community-wide inventory for Windsor and other municipalities is prepared by the Regional Climate Protection Authority (RCPA).
- A Town operations inventory summarizes emissions that are a direct result of the Town's government operations. Examples include electricity and water used in Town buildings or the fuel used for Town vehicles.

The Town completed its first government operations GHG inventory in 2003, with an analysis of emissions data from 2000, and established 1990 as the baseline from which to compare future inventories. Data from the 2000 inventory were backcast to 1990 to establish the baseline. In 2008, the Town published its first GHG Emissions Reduction Action Plan for Town operations. Since 2013, the Town has regularly prepared biennial operations inventories in conjunction with updated action plans and policies for reducing Town operations emissions. In 2019 the Town passed a Climate Emergency Resolution, making GHG mitigation a priority of the community. The Town supports reduction of community-wide emissions though policies, programs, and public education.

For this Report, PlaceWorks worked with Town staff to prepare a 2019 and 2020 Town operations GHG inventory using updated methodologies and a revised baseline year as compared to previous reports. Specific changes to the methodology are discussed in the following section. The Report shows GHG emissions for 2019 and 2020 compared to a baseline year of 2006. The 2006 numbers reported in this Appendix are taken from the Town's 2017-2018 Biennial GHG Emissions Planning Report. This Appendix presents the results of the Town operations GHG inventory and is the most up-to-date summary of the Town operations GHG emissions. This Appendix discusses the methods used to prepare the GHG inventory (Section 2), and the results of the Town operations GHG inventory (Section 3), along with next steps (Section 4).

2. Methods

PROTOCOLS

Guidance documents, called protocols, provide recommendations on how to adequately assess GHG emissions. PlaceWorks prepared the Town operations inventory in a manner consistent with two widely adopted, standard protocol documents, the Local Government Operations Protocol, and the United States Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. These protocols provide guidance by defining what activities should be included in the GHG inventory, and how to consistently estimate emissions from those activities. The use of standard methods allows for comparison of GHG emissions across multiple years and communities.

- The Local Government Operations Protocol (LGOP) was first developed in 2008 and updated in 2010. The LGOP is a tool for accounting and reporting GHG emissions of local government operations and is used throughout California and the United States. The LGOP includes guidance from several existing partner programs [1] as well as the State's mandatory GHG reporting regulations. This protocol provided guidance for the majority of the estimates made in the Town inventory.
- The United States Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (U.S. Community Protocol) was first developed in 2012 and updated most recently in 2019. The California Governor's Office of Planning and Research encourages cities and counties in California to follow the U.S. Community Protocol for community-wide GHG emissions. It is also used in this Town operations inventory in limited cases where the LGOP lacks specific calculations for an emissions type, for example, wastewater emissions.

GHG inventories are estimates of GHG emissions rather than direct measurements of emissions. The use of the standard methods identified in the protocols, in combination with verified datasets from appropriate sources, makes GHG inventories accurate and consistent estimates of local emissions.

UNITS OF MEASUREMENT

The GHG inventory reports emissions in a unit, the carbon dioxide equivalents (CO_2e), that allows combined reporting of all GHGs analyzed in the inventory. CO_2e is a weighted unit that reflects each GHG's relative potency. Non-carbon dioxide GHGs (methane and nitrous oxide) are converted to an equivalent quantity of carbon dioxide based on their global warming potential. The inventory reports the amounts of GHGs in metric tons of CO_2e ($MTCO_2e$). One metric ton is equal to 1,000 kilograms or approximately 2,205 pounds.

EMISSION FACTORS

In accordance with the LGOP, most of the GHG emissions are calculated using data on GHG-generating activities in combination with emission factors. An emissions factor describes how many $MTCO_2e$ are released per unit of an activity. For instance, an emissions factor for electricity describes the $MTCO_2e$ produced per kilowatt-hour (kWh) of electricity used, or an emission factor for on-road transportation describes the $MTCO_2e$ produced per mile of driving. **Table 1** below illustrates the emissions factors for 2019 and 2020.

[1] These partner programs include the California Climate Action Registry, ICLEI – Local Governments for Sustainability, The Climate Registry, and other stakeholders.

APPENDIX A: 2019 AND 2020 TOWN OPERATIONS GHG INVENTORY

Table 1: Emissions Factors 2019 and 2020 ($MTCO_2e$)

SECTOR	UNIT	2019	2020	PERCENTAGE CHANGE	SOURCE
Electricity	Per kWh	0.00000904	0.00007258	703%	PG&E
Electricity	Per kWh	0.00001792	0.00003629	103%	Sonoma Clean Power CleanStart
Electricity	Per kWh	0.00001855	0.00002903	56%	Sonoma Clean Power EverGreen
Natural gas	Per therm	0.005324	0.005324	0%	US Community Protocol
On-road transportation (light duty)	Per mile	0.000352	0.000348	-1%	California Air Resources Board
On-road transportation (heavy duty)	Per mile	0.001103	0.001093	-1%	California Air Resources Board
On-road transportation (combined)	Per mile	0.000385	0.000380	-1%	California Air Resources Board
Solid waste (municipal solid waste)	Per ton	0.286062	0.286062	0%	CalRecycle
Solid waste (alternative daily cover)	Per ton	0.246000	0.246000	0%	CalRecycle

CHANGES TO METHODOLOGY FOR 2019 AND 2020 TOWN OPERATIONS GHG INVENTORY

This 2019-2020 inventory marks a transition in preparers. While PlaceWorks and the previous preparers both followed the LGOP, there are several instances where there was a difference in how the protocol was applied, influencing results. Additional sectors or subsectors were added to the 2019 inventory as more data has become available. These changes are:

- Revision of the employee commute methodology using a survey completed by Town employees to reflect their pre-COVID-19 commute patterns.
- Use of 2006 as the baseline year, rather than 1990. This aligns well with state guidance, which recommends using an inventory from around 2005-2008 as a baseline. The 2006 numbers are reported in the Town's 2017-2018 Biennial GHG Emissions Planning Report.
- Addition of direct emissions from wastewater processing.
- Addition of emissions resulting from refrigerants used in Town buildings and vehicles.
- Addition of solid waste emissions, which includes the emissions associated with solid waste from Town facilities sent to a landfill and the fuel used by waste hauling vehicles.

Finally, 2019 represents a "business as usual" year. 2020 represents a potential anomaly due to shelter-in-place orders during the Covid-19 pandemic, which required remote work for non-essential Town employees.

3. Town Operations GHG Inventory

SECTORS

The Town operations GHG inventory assessed the following nine sectors:

- Employee commute covers GHG emissions resulting from the total annual miles that Town staff drive to and from work.
- Energy accounts for the GHG emissions from electricity and natural gas used to power Town operations, including the subsectors of Buildings and Facilities and Streetlights and Traffic signals.
- Refrigerants account for GHG emissions associated with refilling air conditioners in Town buildings and vehicles. Inclusion of this sector is consistent with the guidance in the LGOP; however, it was not calculated in previous inventories.
- Solid waste accounts for the GHG emissions released during the decomposition of landfilled waste produced at Town buildings and facilities. This sector includes the GHG emissions from vehicles used to haul the waste. Inclusion of this sector is consistent with the guidance in the LGOP; however, it was not calculated in previous inventories.
- Town fleet accounts for the GHG emissions released by Town vehicles based on the total gallons of fuel used. This covers all vehicles operated by Town staff, including the Windsor Police Department. This does not include emissions from Sonoma County Fire Department (SCFD) vehicles as the Town does not have operational control over SCFD operations.
- Wastewater direct emissions accounts for the direct emissions of methane and nitrous oxide from the wastewater treatment process. Inclusion of this sector is consistent with the guidance in the LGOP; however, it was not calculated in previous inventories.
- Wastewater facilities accounts for the GHG emissions associated with the energy used to treat wastewater at the Town's wastewater treatment plant.
- Wastewater solids hauling accounts for emissions from trucks needed to transport solids from the wastewater treatment plant to off-site locations for processing and disposal. This sector was not calculated in previous inventories.
- Water delivery facilities account for GHG emissions associated with the energy needed to transport and process potable water used by the Town and the community.

This 2019-2020 inventory marks a transition in preparers. While PlaceWorks and the previous preparers both followed the LGOP, there are several instances where there was a difference in how the protocol was applied, influencing results. Additional sectors or subsectors were added to the 2019 inventory as more data has become available. These changes are:

- Revision of the employee commute methodology using a survey completed by Town employees to reflect their pre-COVID-19 commute patterns.
- Use of the baseline year of 2006, rather than 1990. This better aligns with State guidance, which recommends using an inventory from around 2005-2008 as a baseline. The 2006 numbers referenced in this Report are gathered from the Town's 2017-2018 Biennial GHG Emissions Planning Report.[2]
- Addition of direct emissions from wastewater processing.

[2] Emission totals in this Report have been rounded and therefore may be slightly different than those listed in the 2017-2018 Biennial GHG Emissions Planning Report.

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- Inclusion of GHG emissions resulting from refrigerants used in Town buildings and vehicles.
- Addition of solid waste emissions, which includes the estimated GHG emissions associated with solid waste from Town facilities sent to a landfill and the fuel used by waste hauling vehicles.

Finally, 2019 represents a typical year. However, 2020 was anomalous due to shelter-in-place orders during the Covid-19 pandemic, requiring remote work for non-essential Town employees. As described in the sections below, this likely impacted results in several sectors.

TOWN OPERATIONS GHG INVENTORY RESULTS

Table 2 below illustrates the annual Town GHG emissions by sector for 2019 and 2020, compared to the 2006 baseline. Total annual emissions decreased 4 percent from 2019 to 2020 and decreased 41 percent from the 2006 baseline. The driver for the majority of this emissions reduction is the increase in availability of electricity from renewable sources both through PG&E, and Sonoma Clean Power (SCP). SCP began supplying power to the Town in 2014.

The sector with the largest decrease in emissions between 2006 and 2020 is water and wastewater with a 91 percent reduction in water delivery emissions and an 89 percent reduction in wastewater facility emissions. Between 2006 and 2020 there was also a significant reduction in emissions associated with the energy use of streetlights and traffic signals, and Town buildings and facilities, decreasing 88 percent and 66 percent respectively. Town fleet emissions increased 46 percent from 2006 to 2020, attributable in part to the growing Town population and therefore increased number of operational fleet vehicles, but which may also be the result of methodological changes between the 2017-2018 Biennial GHG Emissions Planning Report and this Report.

Between 2019 and 2020, the largest decrease in emissions (39 percent) came from the employee commute sector due to some non-essential Town employees working remotely during the COVID-19 quarantine period. 2020 represents an anomaly year as the shelter-in-place orders during the COVID-19 pandemic required all non-essential employees to work from home. These orders, which paused or reduced non-essential operations, also reduced emissions from Town buildings and operations and the Town fleet, causing emissions to decrease by 8 percent and 13 percent respectively between 2019 and 2020.

Table 2: Total GHG Emissions by Sector 2006, 2019, and 2020 ($MTCO_2e$)

Sector	2006	2019	2020	Percentage Change, 2019 – 2020	Percentage Change, 2006 – 2020
Employee commute	160	230	140	-39%	-13%
Energy: Buildings and facilities	350	130	120	-8%	-66%
Energy: Streetlights and traffic signals	250	10	30	200%	-88%
Refrigerants*	—	—	Less than 10	—	—
Solid waste*	—	130	120	-8%	—
Town fleet	240	400	350	-13%	46%
Wastewater direct emissions	—	720	710	-1%	—
Wastewater facilities	1,420	90	150	67%	-89%
Wastewater solids hauling	—	10	10	0%	—
Water delivery facilities	430	20	40	100%	-91%
Total	**2,850**	**1,740**	**1,670**	**-4%**	**-41%**
Informational Item					
Fire Dept. vehicles[3]	—	100	90	-10%	—

*Refrigerant use and solid waste data for 2006 were not available. There was no recorded refrigerant use in 2019.

Note: All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

The proportion of each sector's contribution to annual Town operations GHG emissions was relatively consistent between the years 2019 and 2020. As Table 3 below illustrates, the sector with the highest proportion of emissions was wastewater direct emissions, accounting for 41 percent in 2019 and 43 percent in 2020. As noted in the sector description, an estimate of wastewater direct emissions was not included by the previous preparer of the inventory reports; the reason for this omission is not clear. In both 2019 and 2020 the Town fleet accounted for the second-highest proportion of emissions at 23 percent and 21 percent respectively, an increase from 8 percent of total emissions in 2006 (likely due to changes in methods from the 2017-2018 report containing the 2006 baseline data and growth in the size of the Town fleet as a result of increased population). All other sectors represented less than 10 percent of total emissions in 2020. Note that, like wastewater direct emissions, previous reports do not include data for solid waste or refrigerants. In 2019, records indicate no refrigerant was replaced, while in 2020, refrigerants represented less than 1 percent of the Town's total emissions. Details on these emissions are provided in the sections that follow.

[3] Listed as an informational item, emissions from the vehicles used by Sonoma County Fire District (SCFD), which provides fire protection services to Windsor, were 100 $MTCO_2e$ in 2019 and 90 $MTCO_2e$ in 2020. Although the Town provides fuel for SCFD vehicles, these emissions are not included in the total as the Town does not have operational control over SCFD operations.

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Table 3: Proportions of Annual Town Operations GHG Emissions by Sector

SECTOR	2006	2019	2020
Energy: Buildings and other facilities	12%	7%	7%
Energy: Streetlights and traffic signals	9%	1%	2%
Employee commute	6%	13%	8%
Town fleet	8%	23%	21%
Solid waste	—	7%	7%
Water delivery facilities	15%	1%	2%
Wastewater facilities	50%	5%	9%
Wastewater direct emissions	—	41%	43%
Wastewater solids hauling	—	1%	1%
Refrigerants	—	—	Less than 1%

Note: Solid waste and direct wastewater emissions were not calculated for the 2006 inventory. Refrigerants were not tracked for the 2006 inventory and no new refrigerants were used in Town Facilities in 2019.

SECTOR DETAILS

Energy

This section covers the electricity and natural gas use of the Buildings and facilities sector, and the electricity use of the Streetlights and traffic signals sector. As shown in **Table 4** below, GHG emissions from Town operations energy use totaled 140 $MTCO_2e$ in 2019 and 150 $MTCO_2e$ in 2020. The short-term trend demonstrates that overall emissions from energy use increased by 7 percent from 2019 to 2020. GHG emissions associated with building and facility electricity use and public lighting, which includes streetlights and traffic signals, increased from 2019 to 2020, by 50 and 200 percent, respectively. While electricity use decreased between 2019 and 2020, the associated emissions were greater due to the higher emission factor associated with 2020 power sources (see **Table 1**). For example, all of PG&E's electricity came from renewable and carbon-free sources in 2019, compared to 84 percent in 2020. Similarly, renewable and carbon-free sources supplied 97 percent of SCP's CleanStart electricity, the Town's default electricity supply, in 2019, decreasing to 93 percent in 2020. Emissions from natural gas decreased by 18 percent from 2019 to 2020, likely due to increased energy-efficiency efforts, fewer heating needs due to employees working remotely during the COVID-19 quarantine period, or warmer outside temperatures requiring less heating.

Looking at long-term trends, emissions for these same subsectors decreased significantly from 2006 to 2020. Overall emissions from energy use decreased by 75 percent from the baseline. Building and facility energy use emissions (electricity and natural gas) decreased 192 percent and public lighting emissions decreased 88 percent. This is due to an increase in renewable energy sources, and Town energy conservation and efficiency efforts. The Town purchases energy from Sonoma Clean Power and PG&E, both of which have substantially increased their share of electricity from renewable sources. In addition to emission decreases, the overall level of energy use for building and facilities and public lighting has also declined. This is likely due to more energy-efficient appliances and the ongoing conversion to LED lighting. Earlier reports did not provide subsector data on natural gas use in Town facilities. Finally, the fuel used for emergency generators is not included in the inventories as it is a negligible amount when compared to overall use. Per the protocol, if accurate data for an emission source is difficult to obtain and likely contributes a minimal amount of emissions, it is appropriate to exclude results from the inventory.

Table 4: Energy Activity Data and GHG Emissions by Subsector

Sector	2006	2019	2020	Percentage Change, 2019 – 2020	Percentage Change, 2006 – 2020
Activity Data					
Building and facility electricity use (kWh)	—	971,660	860,640	-11%	—
Streetlights and traffic signals electricity use (kWh)	—	824,540	822,500	Less than -1%	—
Building and Facility natural gas use (therms)	—	21,440	17,350	-19%	—
Emissions ($MTCO_2e$)					
Building and facility electricity use	—	20	30	50%	—
Streetlights and traffic signals electricity use	250	10	30	200%	-88%
Building and facility natural gas use	—	110	90	-18%	—
Total Overall Emissions	**600 ***	**140**	**150**	**7%**	**-75%**

* The 2006 inventory also includes 350 $MTCO_2e$ in building and facility energy use. However, it is not known how much of these emissions come from electricity and natural gas, so emissions cannot be shown by subsector.
Note: All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Employee Commute

Employee commute GHG emissions are based on vehicle miles traveled (VMT), representing the annual miles driven by Town employees to get to and from work. This data came from a survey of Town employees conducted in 2020 where employees were asked about their 2019 pre-COVID-19 commute patterns. The project team extrapolated responses to reflect 2019 and 2020 employment levels and 2020 remote work policies. As shown in **Table 5**, annual GHG emissions from the employee commute sector decreased 39 percent from 240 $MTCO_2e$ in 2019 to 140 $MTCO_2e$ in 2020, largely due to many non-essential employees working remotely. Emissions decreased 13 percent from the 2006 baseline in 2020. In addition to the effects of the COVID-19 pandemic, this is likely due to a different methodology used in the 2017-2018 Biennial GHG Emissions Planning Report, which contains the 2006 inventory.

Table 5: Employee Commute GHG Emissions

Sector	2006	2019	2020	Percentage Change, 2019 – 2020	Percentage Change, 2006– 2020
Activity Data (VMT)					
Employee commute trips	—	741,140	456,160	-38%	—
Emissions ($MTCO_2e$)					
Employee commute trips	160	230	140	-39%	-13%
Total Overall Emissions	**160**	**230**	**140**	**-39%**	**-13%**

Note: All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

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Town Fleet

Town fleet data includes the gallons of gasoline and diesel used by the Town's vehicle fleet. Table 6 below shows overall fleet GHG emissions decreased 13 percent from 2019 to 2020, which is likely due to reduced operations during the COVID-19 shelter-in-place period. Fleet emissions increased by 46 percent from 2006 to 2020, likely due at least in part to an increase in operations and active Town vehicles, potentially linked to an increase in the Town's population growth. A different methodology employed in the 2017-2018 Biennial GHG Emissions Planning Report, which contains the 2006 inventory also likely influenced the results.

Shown as an informational item, emissions from Sonoma County Fire District vehicles decreased 12 percent from 2019 to 2020, largely due to a decrease in diesel fuel use. Per the LGOP, these emissions are not included in the Town's total fleet emissions because the Town does not have operational control over Sonoma County Fire District and its fuel use.

Table 6: Town Fleet GHG Emissions Change

Sector	2006	2019	2020	Percentage Change, 2019 – 2020	Percentage Change, 2006 – 2020
Activity Data (gallons)					
Town fleet: gasoline vehicles	—	36,740	34,400	-6%	—
Town fleet: diesel vehicles	—	6,360	5,110	-20%	—
Informational Items					
Fire Dept. gasoline vehicles	—	3,120	3,220	3%	—
Fire Dept. diesel vehicles	—	6,980	5,730	-18%	—
Emissions ($MTCO_2e$)					
Town fleet	240	400	350	-13%	46%
Total Overall Emissions	**240**	**400**	**350**	**-13%**	**46%**
Informational Items					
Fire Dept. gasoline vehicles	—	30	30	3%	—
Fire Dept. diesel vehicles	—	70	60	-18%	—

Note: All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Solid Waste

As shown in Table 7 below, Town GHG emissions related to solid waste decreased by 4 percent between 2019 and 2020. This decrease is due to a slight decline in the amount of waste produced as part of Town operations activities, potentially due to more employees working remotely during the COVID-19 quarantine period. Emissions from the fuel used by waste hauling vehicles were added to the 2019 and 2020 inventories and represent less than one $MTCO_2e$ each year. Solid waste emissions were not recorded in previous inventories.

Table 7: Solid Waste Activity Data and GHG Emissions by Subsector

SECTOR	2006	2019	2020	PERCENTAGE CHANGE, 2019 – 2020	PERCENTAGE CHANGE, 2006 – 2020
Activity Data					
Solid waste (tons)	—	450	430	-4%	—
Waste hauling vehicles fuel (gal)	—	1,900	2,340	23%	
Emissions ($MTCO_2e$)					
Solid waste	—	130	120	-8%	—
Waste hauler vehicles fuel		Less than 1	Less than 1	23%	—
Total Overall Emissions	—	**130**	**120**	**-8%**	—

Note: All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Water and Wastewater

In the short term, between 2019 and 2020, total GHG emissions from the water and wastewater sectors increased by eight percent, as shown in **Table 8** below. Emission trends for the individual subsectors varied. Emissions associated with the treatment and delivery of water for the community and for use in Town facilities increased by 100 percent and 20 percent respectively. The reasons for this increase are twofold. First, more water was delivered to the community and to the Town in 2020 as compared to 2019, potentially associated with low total rainfall (drought conditions) and increased need for irrigation. Second, there were higher emission factors for electricity sources in 2020 versus 2019. For the wastewater sector, indirect emissions associated with electricity increased by 67 percent from 2019 and 2020, due to a higher emission factor for SCP electricity in 2020. While a 1.7-megawatt solar array installed at the wastewater treatment plant became operational in November 2020 and slightly decreased the amount of electricity purchased for the year, the benefits will not be reaped until after the period of this inventory. Direct emissions from the processing of wastewater decreased by one percent between 2019 and 2020. Wastewater solids hauling, associated with transporting solids to a facility in Cordelia, California, did not change from 2019 to 2020.

The long-term trend demonstrates that emissions from water and wastewater operations decreased 51 percent from 2006 to 2020. This is likely due to the higher proportion of renewable energy sources providing the electricity used at the Town's wastewater treatment plant. Previous reports did not sub-divide water delivery emissions between community and Town use. Total emissions for water delivery facilities in 2006 were 430 $MTCO_2e$. Previous reports also do not include data on direct wastewater emissions.

Table 8: Water and Wastewater Emissions by Subsector

Sector	2006	2019	2020	Percentage Change, 2019 – 2020	Percentage Change, 2006 – 2020
Activity Data					
Total water use (acre-feet)	—	3,590	3,720	4%	—
Indirect community water delivery (kWh)	—	890,700	1,012,900	14%	—
Indirect Town facilities water delivery (kWh)	—	4,650	5,570	20%	—
Indirect wastewater treatment (kWh)	—	5,088,270	4,218,170	-17%	—
Wastewater solids hauling (VMT)	—	5,024	5,084	0%	—
Emissions ($MTCO_2e$)					
Indirect community water delivery	—	20	40	100%	—
Indirect Town facilities water delivery	—	Less than 10	Less than 10	20%	—
Indirect wastewater treatment	1,420	90	150	67%	-89%
Wastewater direct emissions	—	720	710	-1%	—
Wastewater solids hauling	—	10	10	0%	—
Total Overall Emissions	**1,850 ***	**840**	**910**	**8%**	**-51%**

* The 2006 inventory also includes 430 $MTCO_2e$ in water delivery-related use. However, it is not known how much of these emissions come with the water-related subsector, so they cannot be separated out into individual subsectors.
Note: All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Refrigerants

There was no refrigerant replacement recorded in 2019 and GHG emissions associated with refrigerants were not included in prior report years. In 2020, the Town used a total of 1.02 pounds of refrigerant in building and fleet air conditioner units, producing less than 10 $MTCO_2e$, which represents less than one percent of the Town's total GHG emissions.

4. Next Steps

Following Town review and confirmation of these GHG inventory results, PlaceWorks will prepare forecasts of future GHG emissions from Town operations and will assess the GHG-reduction benefits from existing and planned state, regional, and local activities. The results of the GHG inventory, forecast, and benefits of existing and planned activities will help inform new policies to reduce GHG emissions from Town operations.

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Appendix B: Implementation Measures

Actions	Start Date	Timeframe to Implement	2030 GHG Reduction ($MTCO_2e$)	2045 GHG Reduction ($MTCO_2e$)
1. Building and Facilities Energy Efficiency			**-10**	**-20**
Action 1.1 Perform energy audits of existing Town buildings to identify opportunities for energy-efficiency improvements, including improvements to HVAC systems, lighting, insulation, windows and doors, and appliances.	2023	1 year		
Action 1.2 Implement identified energy-efficiency actions, prioritizing those that reduce the greatest amount of GHGs and energy use.	2025	Ongoing		
Action 1.3 Continue to replace remaining lighting in public facilities with smart-control LEDs.	2024	Ongoing		
Action 1.4 Coordinate with the Parks and Recreation Department to inventory and complete the replacement of public lighting in parks to smart-control LEDs.	2025	2 years		
2. Building and Facilities Electrification			**-90**	**-150**
Action 2.1 Replace space heaters, water heaters, and other natural gas-powered appliances with all-electric models as they fail.	2024	Ongoing		
Action 2.2 Require any new Town facilities to have all-electric appliances.	2024	Ongoing		
Action 2.3 Install additional solar photovoltaic systems at Town facilities to power Town buildings and appliances.	2024	5 years		
Action 2.4 Work toward 100 percent carbon pollution-free energy by incorporating renewable energy alternatives and energy-efficient technologies (like heat pumps and hot water recirculation) into all new and existing Town facilities and buildings, guided by LEED Green Building Standards whenever possible (MCAP Objective 1.4).	2024	Ongoing		
Action 2.5 Phase out natural gas use in municipal operations, except for emergency response measures awaiting renewable alternatives (MCAP Objective 1.8).	2024	Ongoing		

3. Fleet Electrification			**-60**	**-220**
Action 3.1 Continue to uphold "electric first" procurement guidelines when purchasing new Town fleet vehicles, making ZEVs the default choice. If there is no viable ZEV for a specific need, purchase the most fuel-efficient alternative available, and explore opportunities to run the vehicle with biofuels or other renewable sources.	2024	Ongoing		
Action 3.2 Provide EV charging infrastructure at Town facilities where fleet vehicles are usually parked.	2024	4 years		
Action 3.3 Ensure 100 percent ZEV Town fleet acquisitions by 2027, or as such vehicles become available (MCAP Objective 1.3).	2024	3 years		
4. Employee Commute Reduction			**-10**	**-20**
Action 4.1 Continue to offer a hybrid remote/in-office work policy to allow employees to continue to work remotely for a few days during the week, thereby reducing commute trips.	2024	Ongoing		
Action 4.2 Work with employees to design an incentive program for using carpools or other forms of transportation beyond a single-occupancy vehicle, such as a parking cash-out, subsidized transit pass, or Emergency Ride Home Program.	2025	1 year		
Action 4.3 Explore the feasibility of a shuttle program between the SMART train station and locations where staff work regularly, including Town Hall, Public Works, Windsor Senior Center, Windsor Community Center, and Bluebird Center.	2024	2 years		
Action 4.4 Support the availability of carshare vehicles around Town facilities for use by employees during the day for work meetings, lunch breaks, and personal errands.	2024	Ongoing		
Action 4.5 Continue to ensure that Town facilities are easily accessible through multiple means of transportation, including bike lanes and public transit.	2024	Ongoing		

Action 4.6 In all new public development and capital improvement projects, prioritize cycling, walking, and frequent and affordable public transport to reduce air and water pollution through smart and inclusive design, considering projects as outlined in the Windsor Bicycle and Pedestrian Master Plan and following the Complete Streets Guidelines (MCAP Objective 1.5).	2024	Ongoing		
5. Employee Zero-Emission Vehicles			**-20**	**-70**
Action 5.1 Expand the number of EV charging stations at Town facilities in preferential parking locations and enforce time restrictions to ensure turnover.	2024	Ongoing		
Action 5.2 Ensure that employees are aware of available financial incentives to reduce the cost of purchasing a ZEV.	2024	Ongoing		
6. Wastewater Process Improvements			**-1,210**	**-1,400**
Action 6.1 Implement the program to convert biosolids from wastewater processing into Exceptional Quality Class A biosolids or biochar, as feasible, which would eliminate the need to haul biosolids offsite.	2024	3 years		
Action 6.2 Continue to explore and implement opportunities to make improvements to the Town's wastewater treatment processes, including upgrades or alternatives to existing aeration basins, UV treatments, and other components as identified in the Biosolids Treatment and Disposal Project, which would result in an estimated 83 percent reduction in emissions from wastewater processing.	2024	Ongoing		
Action 6.3 As other improvements to wastewater treatment process unfold, consider whether Study the effectiveness of capturing waste methane for use as a fuel is a viable option.	2024	Ongoing		
Action 6.4 Replace the current UV disinfection system with a new, more efficient unit and monitor the energy usage of the new unit to confirm expected results.	2025	2 years		
Action 6.5 Upgrade the electrical equipment for the Town's water and wastewater systems, including pumps and blowers, to more efficient models.	2024	Ongoing		

Action 6.6 Achieve Net-Zero environmental impact of the Town wastewater reclamation operations by 2030 through a three-pronged approach (MCAP Objective 1.2): - Net-zero GHG emissions from energy used in Town wastewater reclamation operations: achieved in 2023 due to the transition of all Town accounts to Sonoma Clean Power's EverGreen service. - 100 percent recycled water reuse at Town wastewater reclamation operations by 2026. - 100 percent biosolids reuse by Town wastewater reclamation operations by 2028.	2022	Ongoing		
7. Solid Waste Reduction			**-40**	**-50**
Action 7.1 Ensure a three-bin sorting system (landfill, recycling, and compost) is in each Town facility, restroom, and building.	2024	1 year		
Action 7.2 Ensure that Town facilities have a collection bin system for electronic waste, such as dead batteries, used printer cartridges, and burnt-out lightbulbs.	2025	1 year		
Action 7.3 Collaborate with the local waste hauler to provide educational materials andor trainings to employees to raise awareness about how to use the waste bins properly.	2024	Ongoing		
Action 7.4 Provide reusable, non-disposable materials in facilities with kitchens or food service areas.	2025	Ongoing		
Action 7.5 Conduct occasional waste audits to identify improper use of the waste bins and inform ideas for how to improve the system.	2025	Ongoing		
Action 7.6 Ensure Town janitorial contracts provide a clear scope of work, aligned with SB 1383 guidance, detailing the proper handling of material and the use of collection bins serviced by the local waste hauler.	2024	Ongoing		

Action 7.7 When implementing any changes to a building's waste collection system, meaningfully engage custodial staff throughout the process. Ensure that their expertise and any concerns are considered during the process update to ensure efficiency, and that the changes do not create additional burdens on the time andor effort ofneeded by custodial staff.	2024	Ongoing		
Action 7.8 Establish and promote purchasing policies that favor and facilitate locally sourced, recycled, repurposed, and earth-friendly materials (MCAP Objective 4.1).	2024	Ongoing		
Action 7.9 Champion replacing plastic with reusable products made from renewable materials (MCAP Objective 4.2).	2024	Ongoing		
Action 7.10 Work toward the goal of Zero Waste by 2030 for municipal operations, including Town-sponsored events (MCAP Objective 4.3)	2024	6 years		
8. Environmentally Preferable Refrigerants			**Less than -10**	**Less than -10**
Action 8.1 As required, replace refrigerants in appliances and vehicles with refrigerants that have lower global warming potentials (GWP).	2024	Ongoing		
Action 8.2 Consider the refrigerants used in new appliances and vehicles. As feasible, buy appliances and vehicles with carbon-friendly refrigerants, or replace high GWP refrigerants with new appliances and vehicles with carbon-friendly refrigerants.	2024	Ongoing		
Action 8.3 Ensure appropriate maintenance of refrigerant systems to ensure leakage is not occurring.	2024	Ongoing		