Memo

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Date: March 20, 2024

To: Christopher Jordan and Carrie Whitlock (City of Elk Grove)

From: Brenda Hom, Hannah Kornfeld, Sonam Sahu, and Honey Walters (Ascent)

Subject: City of Elk Grove Climate Compass: Final Greenhouse Gas Emissions Forecasts Memorandum

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INTRODUCTION

The City of Elk Grove (COEG) is developing its *Climate Compass: A Plan for Implementing Elk Grove's Climate, Sustainability, and Resilience Goals* (Climate Compass), the update to the City's 2019 Climate Action Plan (CAP). The goal of the Climate Compass is to provide a comprehensive and transformative framework for both mitigating and adapting to climate change while also supporting COEG's broader sustainability and resilience goals.

In preparation of the Climate Compass, COEG first completed a baseline greenhouse gas (GHG) emissions inventory to estimate emissions from the community and from COEG operations in 2021. The next step in this process is to forecast these GHG emissions and establish reduction targets. This technical memorandum provides the results of these forecasts as well as associated methods, assumptions, emissions factors, and data sources. The GHG emissions forecasts will provide the foundation for the forthcoming steps of the Climate Compass planning process, including the development and quantification of GHG emissions reduction measures and "gap analysis" evaluation (i.e., the calculated gap between the estimated GHG reductions from local action and the established targets).

ORGANIZATION OF THIS MEMORANDUM

This memorandum consists of two main parts:

- **Section 1: Summary of Inventory Results** presents an overview of the city's 2021 community and COEG operations inventories.
- **Section 2: Greenhouse Gas Emissions Forecasts** summarizes the forecasted GHG emissions under "business-as-usual" (BAU) and legislative-adjusted BAU scenarios for years 2030, 2035, 2040, 2045 and 2050 for the community inventory and for years 2030 and 2045 for COEG operations inventory.

1 SUMMARY OF INVENTORY RESULTS

1.1 2021 COMMUNITY INVENTORY

Based on the modeling conducted, community activities in the city generated approximately 1,039,181 metric tons of carbon dioxide equivalent ($MTCO_2e$) in 2021. The largest emissions-generating sectors include on-road transportation and building energy. The 2021 inventory serves as the city's GHG emissions baseline for the Climate Compass to forecast emissions and set emissions reduction targets. Table 1 and Figure 1 present the results of the city's 2021 community GHG emissions inventory by sector. A description of each emissions sector, including key sources of emissions, is provided in further detail in the *City of Elk Grove Climate Compass: Greenhouse Gas Inventory Update Technical Memorandum*.

Table 1 2021 Elk Grove Community GHG Emissions Inventory

Sector	GHG Emissions ($MTCO_2e$)	Percent of Total
On-Road Transportation	586,220	56%
Building Energy	398,365	38%
Solid Waste	20,222	2%
Off-Road Vehicles and Equipment	18,341	2%
Wastewater Treatment	2,957	<1%
Water Supply	2,802	<1%
Agriculture	10,275	1%
Total	**1,039,181**	**100%**

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gases; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by Ascent in 2023.

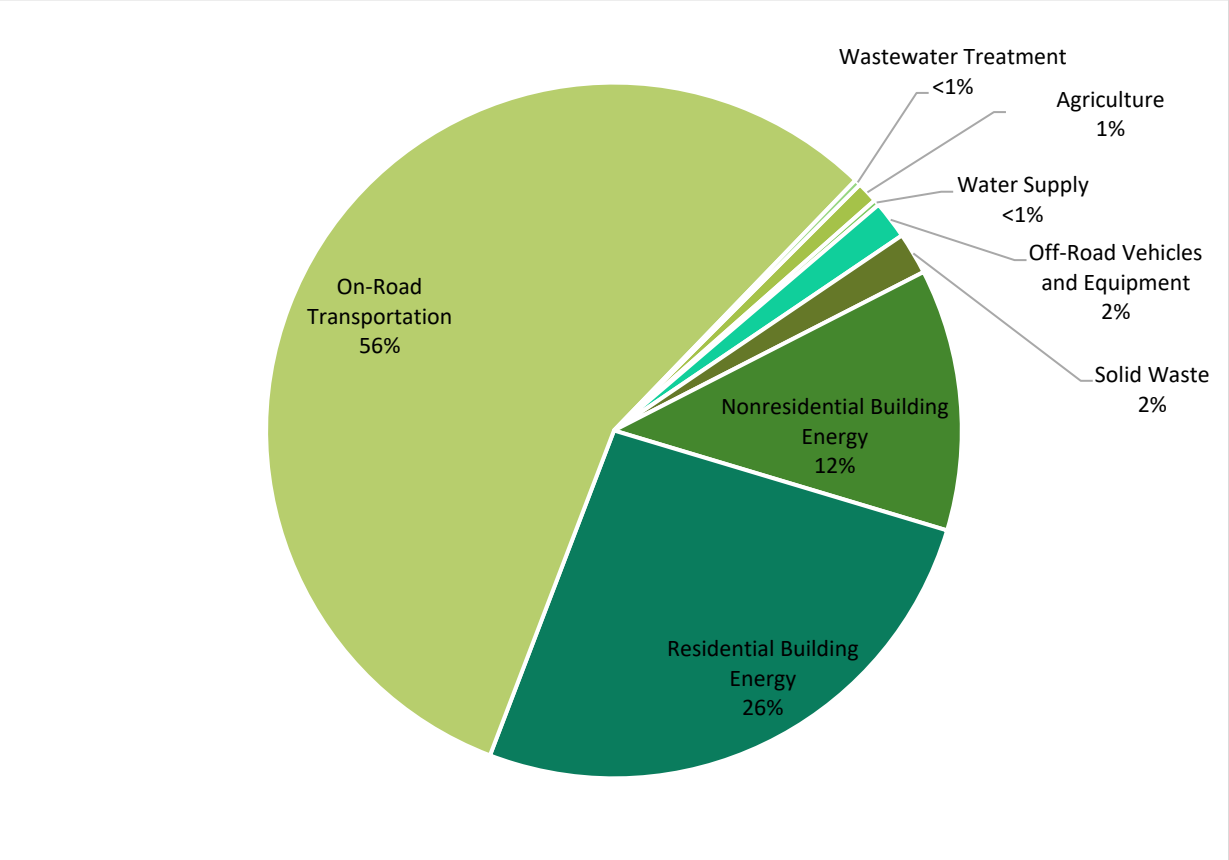

Figure 1 2021 City of Elk Grove Community GHG Emissions Inventory
Source: Prepared by Ascent in 2023.

1.2 2021 CITY OF ELK GROVE'S OPERATIONS INVENTORY

Based on modeling conducted, COEG operations generated approximately 4,275 $MTCO_2e$ in 2021, which makes up less than one percent of the community emissions. Buildings and facilities, streetlights and traffic signals, and employee commute are the largest emissions-generating sectors. The 2021 City operations inventory serves as the baseline for forecasting COEG operations. Table 2 and Figure 2 present COEG's 2021 operations GHG emissions inventories by sector. A description of each emissions sector, including key sources of emissions, is provided in further detail in the *City of Elk Grove Climate Compass: Greenhouse Gas Inventory Update Technical Memorandum*.

Table 2 2021 City of Elk Grove Operations GHG Emissions Inventory

Sector	$MTCO_2e$	Percent of Total
Buildings and Facilities	1,741	41%
Streetlights and Traffic Signals	893	21%
Employee Commute	835	20%
Vehicle Fleet	620	14%
Solid Waste	139	3%
Water Supply	9	<1%
Wastewater Treatment	7	<1%
Process and Fugitive Emissions	32	1%
Total	**4,275**	**100%**

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gases; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by Ascent in 2023.

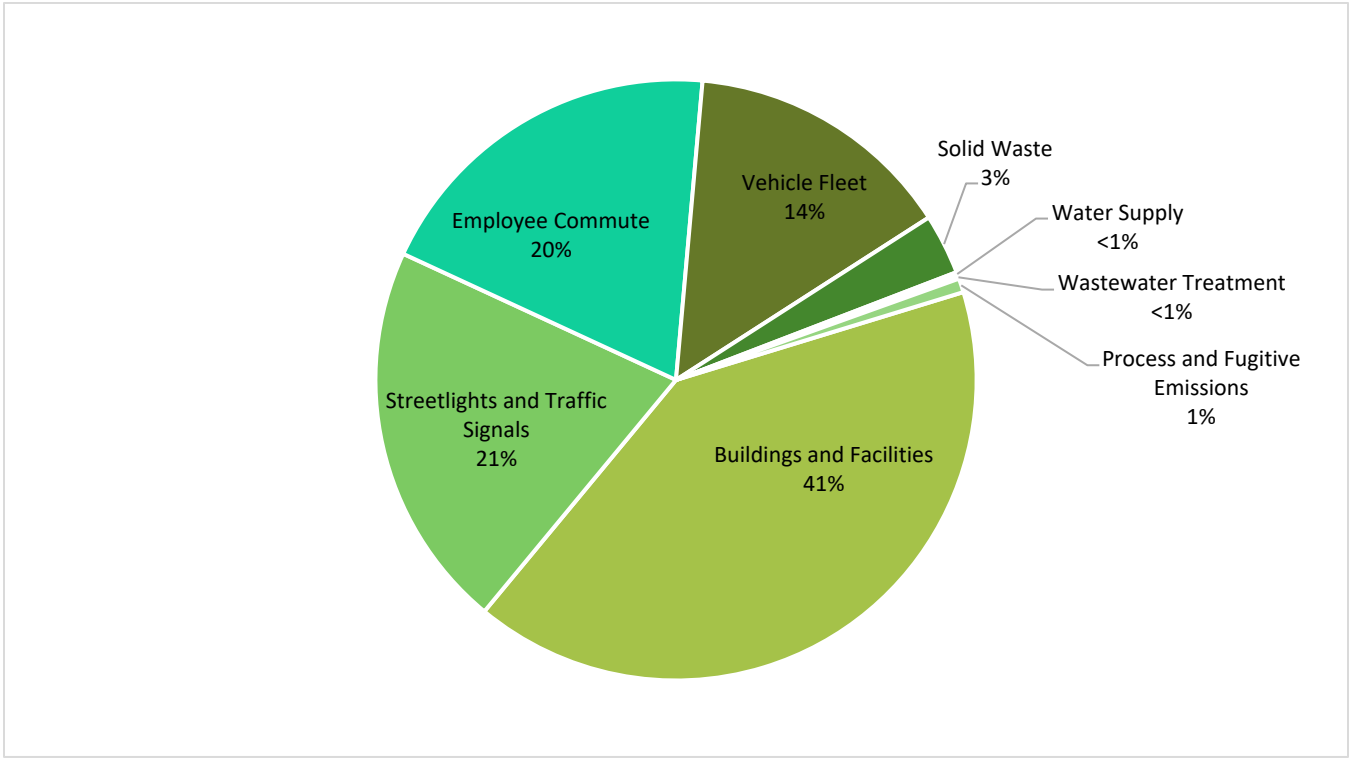

Figure 2 2021 City of Elk Grove Operations GHG Emissions Inventory
Source: Prepared by Ascent in 2023.

2 GREENHOUSE GAS EMISSIONS FORECASTS

The purpose of GHG emissions forecast for a CAP prepared by a local agency is to estimate how community and government operations GHG emissions may evolve in the future given changes in population and housing, economic growth, and local operations, and how state and federal legislation may help to reduce local emissions. Developing a GHG emissions forecast is an essential step in the climate action planning process, as it provides insight into what future emissions levels may be, and the necessary scale of action that may be needed in each GHG emissions sector to reduce emissions within local control for state GHG reduction target alignment.

The updated GHG emissions forecast prepared for the city is presented as a sector-level assessment of GHG emissions forecasts based on current conditions under two scenarios. The first scenario is a baseline scenario where GHG emissions grow from 2021 levels at the same rates as housing, population, employment, and vehicle travel, which is known as a business-as-usual scenario (BAU) forecast. The BAU forecast serves as a basis for understanding how emissions levels may change with growth, and how far GHG emissions will need to be reduced in future years to meet GHG reduction targets. The second scenario considers the local GHG reduction impact of state and federal legislation, which is known as a legislative adjusted business-as-usual scenario (legislative-adjusted BAU) forecast. The legislative-adjusted BAU forecast shows how currently adopted state and federal legislation can help the city to meet its GHG reduction targets.

As mentioned above, the Climate Compass uses an updated calendar year 2021 GHG emissions inventory for both the community and COEG operations (City of Elk Grove Climate Compass: Greenhouse Gas Inventory Update Technical Memorandum, completed November 2023), to provide a baseline for forecasting future emissions from the most recently available data.

2.1 COMMUNITY GREENHOUSE GAS EMISSIONS FORECASTS

The BAU GHG emissions forecasts provide an assessment of how emissions generated by community activities will change over time without further state, federal, regional, or local action. In addition to accounting for the city's population, employment, and land use change(s) under a BAU scenario, an adjusted BAU forecast (i.e., the legislative-adjusted BAU forecast) was prepared, which includes adopted policies and regulations at the state and federal levels that would affect emissions without any local action, such as regulatory requirements to increase vehicle fuel efficiency and increase renewable energy sources in grid electricity portfolios. These forecasts provide COEG with the information needed to focus efforts on certain emissions sectors and sources that have the greatest opportunities for GHG emissions reductions. It is important to note that the legislative-adjusted BAU forecasts only account for emissions reductions associated with adopted policies and regulations; they do not account for goals established by regional, state, and federal agencies or executive orders outside of adopted legislation and regulations.

The GHG emissions forecasts for 2030, 2035, 2040, 2045, and 2050 described in this section are aligned with the state's GHG reduction target years established in key legislation and policies, including Senate Bill (SB) 32 and Assembly Bill (AB) 1279, as well as the city's General Plan.

The adopted statewide GHG reduction targets and goals are:

- 40 percent below 1990 levels by 2030 (SB 32),
- 85 percent below 1990 levels by 2045 (AB 1279), and
- to achieve carbon neutrality no later than 2045 (AB 1279).

2.1.1 Activity Growth Forecast

The GHG emissions forecasts were based on projected changes in city demographics (i.e., population, employment, and service population [residents plus employees]) and land use between 2021 and 2050, which was provided by Fehr & Peers. These growth factors were used to forecast emissions for 2030, 2035, 2040, 2045, and 2050 for most sectors in the inventory. Additional information regarding growth factors used for each sector is included in the following sections.

Vehicle miles traveled (VMT) data were obtained from a VMT analysis conducted by Fehr & Peers using the EGSIM20 travel model. It considered daily VMT in the city and annualized the daily VMT using a factor of 334.[1] VMT estimates are associated with trips that begin or end in the city. VMT estimates included 100 percent of vehicle trips modeled to both originate from and end in the city (i.e., fully internal trips), 50 percent of trips that either end in or depart from the city (i.e., internal-external, or external-internal trips), and 0 percent of vehicle trips that are passing through the city boundaries (i.e., external-external, or "pass-through," trips). This vehicle trip accounting method is consistent with the Regional Targets Advisory Committee (RTAC) origin-destination method established through SB 375 and California Air Resources Board recommendations.

VMT estimates were provided for 2021 and forecasted for 2030, 2035 2040, 2045, and 2050. Table 3 shows anticipated growth in the city for the forecast years. It is important to note that 2021 VMT is for the city limits only but forecast years include the city limits and study areas to accommodate future annexures. Both the city limit and study area VMT estimates use the RTAC method.

Table 3 Elk Grove Community Demographic and Vehicle Miles Traveled Forecasts

Forecast Factor	2021	2030	2035	2040	2045	2050
Population	179,287	229,222	255,346	281,470	307,593	333,717
Households	55,507	70,967	79,055	87,142	95,230	103,318
Employment	46,757	71,638	84,538	97,437	110,336	123,235
Annual VMT	1,136,700,664	1,362,762,808	1,481,202,826	1,599,642,844	1,718,082,863	1,836,522,881
Annual VMT per capita	6,340	5,945	5,801	5,683	5,586	5,503

Notes: VMT = vehicle miles traveled.

Sources: Modeling conducted by Fehr & Peers in 2023.

STUDY AREAS INCLUDED IN GHG EMISSIONS FORECASTS

The growth in housing units and number of employees used in the GHG emissions forecast includes growth expected to occur in Elk Grove with the annexure of four study areas. Table 4 outlines reasonably foreseeable growth assumed in the city by 2050 within the city limits and study areas.

[1] This annualization factor comes from an analysis using Caltrans Performance Measurement System (PeMS) that determined the relationship between daily and annual volume for interstates in the Sacramento region.

Table 4 Demographic Assumptions for 2050 Included in the GHG Emissions Forecast

Plan Area	Households	Employees
City Limit (Excluding East Study Area)	76,449	74,738
East Study Area	4,806	9,183
North Study Area	323	0
South Study Area	11,379	33,694
West Study Area	10,361	5,620
Total	**103,318**	**123,235**

Source: Modeling conducted by Fehr & Peers in 2023.

2.1.2 Community Business-as-Usual Scenario Greenhouse Gas Emissions Forecast

For the community BAU forecast, the activity growth in each emissions sector was scaled using the appropriate growth scaling factors without considering the local GHG reduction impact of the state and federal legislation. The results of the community BAU forecast show that community GHG emissions would be expected to grow through 2050, given no further GHG reduction efforts beyond 2021, as shown in Table 5. Emissions are presented in units of metric tons of carbon dioxide equivalent ($MTCO_2e$). While a more realistic scenario for future GHG emissions can be provided with a legislative-adjusted BAU forecast, the BAU provides the basis for understanding the GHG impact of growth in the city.

Table 5 Elk Grove Community GHG Emissions Inventory and BAU Forecasts ($MTCO_2e$)

Sector	2021	2030	2035	2040	2045	2050
On-Road Transportation	586,220	718,743	787,865	856,987	926,109	995,231
Residential Building Energy	271,900	347,631	387,249	426,868	466,486	506,104
Nonresidential Building Energy	126,465	193,762	228,650	263,539	298,428	333,316
Solid Waste	20,222	26,034	29,411	32,788	36,165	39,542
Off-Road Vehicles and Equipment	18,341	25,296	28,917	32,537	36,158	39,778
Agriculture[1]	10,275	4,372	1,154	1,154	1,154	1,154
Wastewater Treatment	2,957	6,707	7,577	8,447	9,317	10,187
Water Supply	2,802	3,731	4,214	4,698	5,183	5,666
Total	**1,039,181**	**1,326,277**	**1,475,038**	**1,627,018**	**1,779,000**	**1,930,979**
Percent Change from 2021 Levels	-	28%	42%	57%	71%	86%

Notes: Total may not sum exactly due to independent rounding. BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

[1] Agricultural emissions are anticipated to decrease under the business-as-usual forecast because the acres in agricultural production in the city limits are anticipated to decrease over the coming decades.

Source: Data modeled by Ascent in 2023.

2.1.3 Community Legislative-Adjusted Business-as-Usual Scenario Greenhouse Gas Emissions Forecast

Legislative-adjusted BAU emissions forecasts were prepared using the same demographic and VMT data that were used for the BAU forecasts, while also accounting for state and federal policies and regulations that would affect local emissions. For example, growth in residential building electricity consumption was scaled using housing units as the growth scaling factor, and a legislative reduction was applied to incorporate the California Code of Regulations, Title 24, Part 6 building energy efficiency standards for new development. The GHG reductions considered in the legislative-adjusted BAU forecast fall generally into four categories: building energy efficiency standards, fuel efficiency standards, electric vehicle sales requirements, and renewable and zero carbon electricity requirements. The primary drivers of the emissions reductions are the requirements of SB 100 and SB 1020, as well as increased electric vehicle penetration from the Advanced Clean Cars II (ACC II) regulation. These forecasts provide COEG with a more robust understanding of future community emissions to assist with the prioritization of emissions reduction measures developed to meet GHG targets. The full list of legislation considered is provided in Table 6.

Table 6 Federal and State Legislative Reductions Applied under the Legislative-Adjusted BAU Scenario

Source	Legislative Reduction	Description	Sectors Applied
State	SB 100 (The 100 Percent Clean Energy Act of 2018)	Requires that 60 percent of retail electricity sold in California must come from renewable or zero-carbon resources by 2030 and 100 percent by 2045.	Building Energy
State	SB 1020 (Clean Energy, Jobs, and Affordability Act of 2022)	Requires that eligible renewable energy resources and zero-carbon resources supply 90 percent of all retail sales of electricity to California end-use customers by December 31, 2035, 95 percent of all retail sales of electricity to California end-use customers by December 31, 2040, 100 percent of all retail sales of electricity to California end-use customers by December 31, 2045, and 100 percent of electricity procured to serve all state agencies by December 31, 2035.	Building Energy
State	California's Building Energy Efficiency Standards (2019 and 2022 Title 24, Part 6)	Effective January 1, 2023, new residential and nonresidential buildings in California are required to comply with energy efficiency standards established by the California Energy Commission (CEC 2022). The 2022 standards establish energy performance requirements that require energy-efficient approaches to building decarbonization by emphasizing electric heat pumps for space heating and water heating and extending the benefits of photovoltaic and battery storage systems and other demand flexible technology to work in combinations with heat pumps.	Building Energy
State	Advanced Clean Car I Regulations	Establishes GHG emission reduction standards for model years 2017 through 2025 that are more stringent than federal CAFE standards.	On-Road Vehicles
State	Advanced Clean Cars II Regulations	Establishes a target for all new passenger cars, trucks, and SUVs sold in California to be 100 percent zero-emission vehicles by 2035.	On-Road Vehicles
State	Advanced Clean Fleets	Starting in 2036, all medium- and heavy-duty trucks sold in California must be zero emissions with limited exceptions. In addition to this sales mandate, fleet owners must also purchase electric trucks on an accelerated timeline.	Vehicle Fleet
State	Truck and Bus Regulation	Requires diesel trucks and buses that operate in California to be upgraded to reduce GHG emissions.	On-Road Vehicles
Federal	Fuel Efficiency Standards for	Establishes fuel efficiency standards for medium- and heavy-duty engines and vehicles.	On-Road Vehicles

	Medium- and Heavy-Duty Vehicles		
Federal	EPA Off-Road Compression-Ignition Engine Standards	Establishes standards for phasing of EPA diesel engine tiers for off-road compression-ignition equipment.	Off-Road Vehicles and Equipment

Notes: CAFE = Corporate Average Fuel Economy; CEC = California Energy Commission; EPA = US Environmental Protection Agency; GHG = greenhouse gas; SUV = sports utility vehicle; SB = Senate Bill.

Source: Compiled by Ascent in 2024.

The results of community legislative-adjusted BAU forecasts show that emissions are expected to decline from 2021 levels through 2045 and then slightly increase by 2050, as shown in Table 7.

Table 7 Elk Grove Community GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$)

Sector	2021	2030	2035	2040	2045	2050
On-Road Transportation	586,220	446,591	326,936	212,048	130,040	94,359
Residential Building Energy	271,900	299,782	199,731	191,876	178,777	190,410
Nonresidential Building Energy	126,465	152,746	77,061	68,787	55,643	61,825
Solid Waste	20,222	26,034	29,411	32,788	36,165	39,542
Off-Road Vehicles and Equipment	18,341	25,296	28,917	32,537	36,158	39,778
Agriculture	10,275	3,869	686	630	575	575
Wastewater Treatment	2,957	6,707	7,577	8,447	9,317	10,187
Water Supply	2,802	2,875	812	453	0	0
Total	**1,039,181**	963,901	671,131	547,567	446,674	436,676
Percent Change from 2021 Levels		-7%	-35%	-47%	-57%	-58%

Notes: Total may not sum exactly due to independent rounding. BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by Ascent in 2024.

The community BAU and legislative-adjusted BAU forecast results presented together demonstrate the impact of the state and federal legislation on the city's community GHG emissions profile over time, as shown in Figure 3.

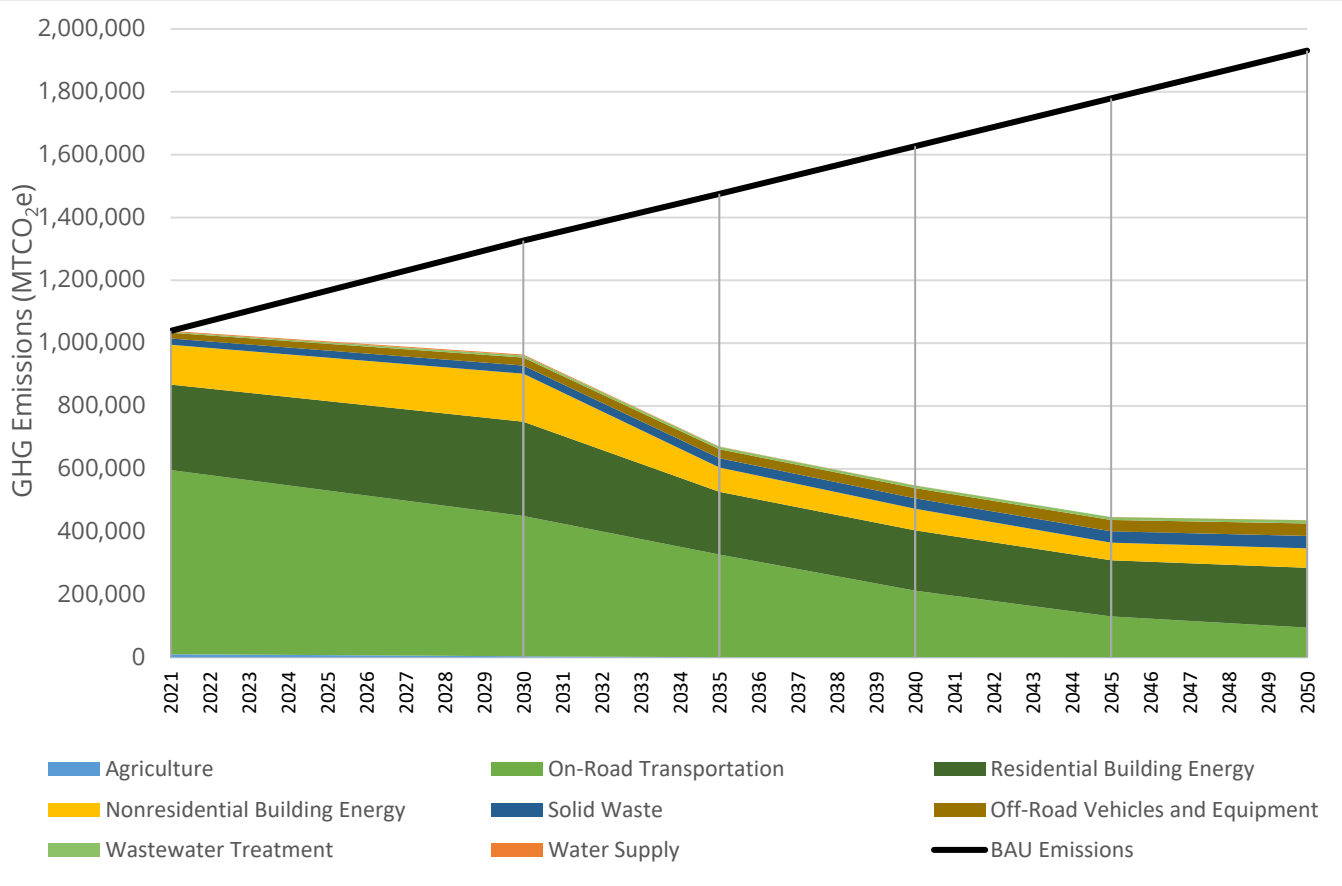

Figure 3 Elk Grove Community GHG Emissions Inventory and Forecasts
Source: Prepared by Ascent in 2024.

2.1.4 Discussion

As shown in Table 7 and Figure 3, the city's legislative-adjusted BAU community emissions would decrease modestly by approximately 7 percent between 2021 and 2030 and would see an accelerated decrease after 2030 through 2045. Between 2021 and 2045, emissions are expected to decrease by 57 percent. However, forecasted reductions are expected to level out by 2050. This is primarily due to the continued increase in natural gas in residential and nonresidential buildings. Electricity-related emissions would continue to be zero through 2050 and the city would continue to see a moderate decrease in on-road transportation emissions due to ACCII and the Advanced Clean Fleets regulation (ACF). With these anticipated trends, building energy (residential and nonresidential building combined) would replace on-road transportation as the largest emissions-generating sector in the city, accounting for more than 50 percent of total emissions through 2045. On-road transportation is also expected to contribute to emissions significantly.

Without legislative adjustments, BAU emissions would increase baseline emissions by approximately 28 percent between 2021 and 2030 and 86 percent between 2021 and 2050. The relatively lower increase under the legislative-adjusted BAU forecast scenario in 2030, despite significant growth projected in the city, is associated with reductions that would be achieved from several legislative actions, including:

- a greater renewable mix in electricity (60 percent by 2030, 90 percent by 2035, 95 percent by 2040, and 100 percent by 2045 and 2050),
- improved building energy efficiency through compliance with Title 24 standards, and
- reductions in on-road vehicle emissions factors from state vehicle standards as forecasted in EMFAC2021, ACCII, and ACF.

Going forward, new legislative actions that would affect emissions may be adopted by regional, state, and federal agencies; however, because information regarding these regulatory changes is currently unknown, emissions reductions from future potential legislative actions are not quantified in this memorandum. Where new regulations or actions are imminent and reasonably foreseeable, they can be incorporated as complementary actions to locally based GHG reduction measures.

2.2 CITY OF ELK GROVE OPERATIONS GREENHOUSE GAS EMISSIONS FORECASTS

The estimated COEG operations BAU emissions forecast was based on projected growth in COEG employment between 2021 and 2045 and is based on the emissions levels of the 2021 COEG operations GHG emissions inventory (City of Elk Grove Climate Compass: Greenhouse Gas Inventory Update Technical Memorandum).

2.2.1 Activity Growth Forecast

The number of COEG employees was the sole factor used to forecast BAU emissions for 2030 and 2045 for all sectors in the COEG operations inventory. Table 8 shows 2021 COEG employment and anticipated change in COEG employment for the forecast years.

Table 8 City of Elk Grove City Operations Demographic Forecasts

Forecast Factor	2021	2030	2045
City Employment	424	561	727

Source: Data provided by City of Elk Grove; calculations by Ascent in 2023.

2.2.2 City of Elk Grove Operations Business-as-Usual Scenario Greenhouse Gas Emissions Forecast

COEG operations BAU forecast was developed by scaling COEG operations GHG emissions from the 2021 emissions inventory by the growth in number of employees. The results of COEG operations BAU forecast show that emissions would be expected to grow, given no further GHG reduction efforts beyond 2021, as shown in Table 9. While a more realistic scenario for future GHG emissions can be provided with a legislative-adjusted BAU forecast, the BAU provides the basis for understanding the GHG impact of growth at COEG.

Table 9 City of Elk Grove Operations GHG Emissions Inventory and BAU Forecasts (Annual $MTCO_2e$)

Sector	2021	2030	2045
Buildings and Facilities	1,741	2,304	2,987
Streetlights and Traffic Signals	893	1,136	1,532
Employee Commute	835	1,104	1,432
Vehicle Fleet	620	820	1,064

Solid Waste	139	184	239
Process and Fugitive Emissions	32	42	55
Water Supply	9	12	16
Wastewater Treatment	7	8	11
Total	**4,275**	**5,611**	**7,334**
Percent Change from 2021 Levels	—	31%	72%

Notes: Total may not sum exactly due to independent rounding. BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by Ascent in 2023.

2.2.3 City of Elk Grove Operations Legislative-Adjusted Business-as-Usual Scenario Greenhouse Gas Emissions Forecast

COEG operations legislative-adjusted BAU forecast was developed by accounting for the expected GHG reductions in COEG operations GHG emissions incorporating new State and federal legislation, such as SB 100, SB 1020, ACC II, ACF. The full list of legislation considered is provided in Table 10. The results of COEG operations legislative-adjusted BAU forecasts show that emissions are expected to slightly increase by 2030 with the city's rapid population growth and then decline by 2045 with the zero-carbon electricity legislation under SB 100. Legislative-adjusted BAU forecast results are shown in Table 11 and Figure 4.

Table 10 Buildings and Facilities Energy Emissions Forecast Legislative Reductions by Energy Type

Source	Legislative Reduction	Description	Sectors Applied
State	SB 100 (The 100 Percent Clean Energy Act of 2018)	Requires that 60 percent of retail electricity sold in California must come from renewable or zero-carbon resources by 2030 and 100 percent by 2045.	Buildings and Facilities; Streetlights and Traffic Signals
State	SB 1020 (Clean Energy, Jobs, and Affordability Act of 2022)	Requires that eligible renewable energy resources and zero-carbon resources supply 90 percent of all retail sales of electricity to California end-use customers by December 31, 2035, 95 percent of all retail sales of electricity to California end-use customers by December 31, 2040, 100 percent of all retail sales of electricity to California end-use customers by December 31, 2045, and 100 percent of electricity procured to serve all State agencies by December 31, 2035.	Buildings and Facilities; Streetlights and Traffic Signals
State	Advanced Clean Car I Regulations	Establishes GHG emission reduction standards for model years 2017 through 2025 that are more stringent than federal CAFE standards.	Vehicle Fleet; Employee Commute
State	Advanced Clean Cars II Regulations	Establishes a target for all new passenger cars, trucks, and SUVs sold in California to be 100 percent zero-emission vehicles by 2035.	Vehicle Fleet; Employee Commute
State	Truck and Bus Regulation	Requires diesel trucks and buses that operate in California to be upgraded to reduce GHG emissions.	Vehicle Fleet
Federal	Fuel Efficiency Standards for Medium- and Heavy-Duty Vehicles	Establishes fuel efficiency standards for medium- and heavy-duty engines and vehicles.	Vehicle Fleet; Employee Commute
State	Advanced Clean Fleets	Except for small government fleets of 10 or fewer vehicles and those in designated counties, starting in 2024, state and local agencies would be required to ensure 50% of vehicle purchases are zero emissions. This requirement is increased to 100% starting in 2027.	Vehicle Fleet

Notes: CAFE = Corporate Average Fuel Economy; GHG = greenhouse gas; SB = Senate Bill.

Source: Compiled by Ascent in 2023.

Table 11 City of Elk Grove Operations GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (Annual $MTCO_2e$)

Sector	2021	2030	2045
Buildings and Facilities	1,741	2,054	1,588
Streetlights and Traffic Signals	893	907	0
Employee Commute	835	769	201
Vehicle Fleet	620	497	533
Solid Waste	139	184	239
Water Supply	9	9	0
Wastewater Treatment	7	7	3
Process and Fugitive	32	42	55
Total	**4,275**	**4,470**	**2,619**
Percent Change from 2021 Levels	—	*5%*	*-39%*

Notes: Total may not sum exactly due to independent rounding. BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by Ascent in 2024.

Figure 4 also shows the emissions trend that would occur without anticipated legislative reductions, accounting only for changes in COEG employment (i.e., BAU emissions). Without the legislative reductions, emissions would be higher in 2045 compared to the legislative-adjusted BAU forecast.

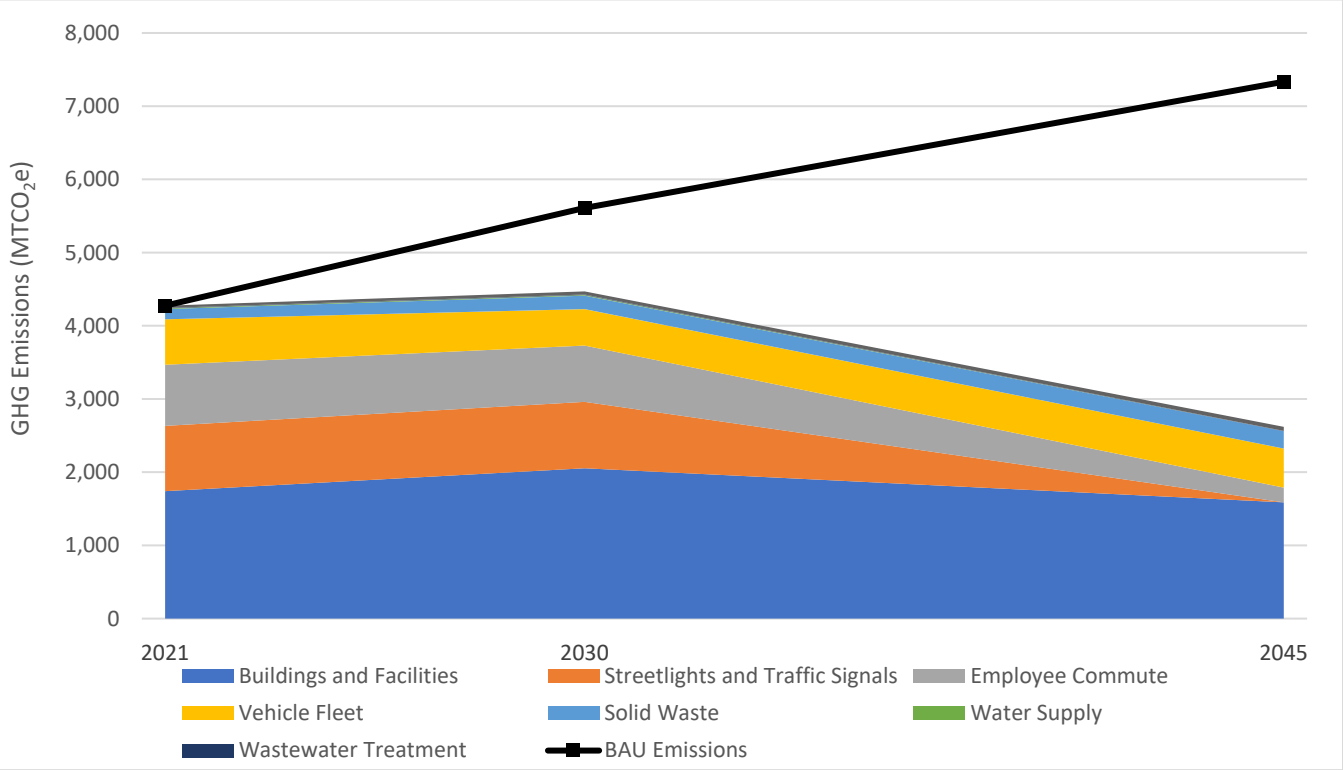

Figure 4 City of Elk Grove Operations GHG Emissions Inventory and Forecasts
Source: Prepared by Ascent in 2024.

2.2.4 Discussion

As shown in Table 11 and Figure 4, COEG's operational legislative-adjusted BAU emissions would decrease by approximately 31 percent in 2030 and by 40 in 2045 compared to 2021. This reduction in emissions would be achieved from several legislative actions including:

- a greater renewable mix in electricity (60 percent by 2030 and 100 percent by 2045),
- improved building energy efficiency through compliance with Title 24 standards, and
- reductions in on-road vehicle emissions factors from state vehicle standards as forecasted in EMFAC2021, ACC II, and ACF standards.

Going forward, new legislative actions that would affect emissions may be adopted by state and federal agencies; however, because information regarding these regulatory changes is currently unavailable or not final, emissions reductions from future potential legislative actions are not quantified in this forecast. Where new state regulations or programs are imminent and reasonably foreseeable, they can be incorporated as complementary actions to locally based GHG reduction measures.

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CEC. *See* California Energy Commission.

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Appendix A

City of Elk Grove Climate Compass: Final Greenhouse Gas Emissions Forecasts Technical Memorandum

INTRODUCTION

This document is an appendix to the City of Elk Grove (COEG) Climate Compass: Final Greenhouse Gas Emissions Forecasts Technical Memorandum (hereafter referred to as "Forecast Memorandum") to provide technical documentation for the results presented in the memorandum. This document presents the summary of the community and COEG operations emissions forecasts and explains the forecast methodology.

1 GREENHOUSE GAS EMISSIONS FORECASTS METHODOLOGY

For estimating community forecast, the 2021 community greenhouse gas (GHG) emissions are forecasted for 2030, 2035, 2040, 2045, and 2050 based on growth scaling factors and known impacts of currently adopted legislation on GHG emissions (e.g., adopted federal and California regulations, policies, and programs affecting fuels and energy efficiency). The growth scaling factors (e.g., population, housing, employment, and service population[1]) are applied to activity growth factors (electricity consumption per housing unit and vehicle miles traveled [VMT] per service population).

For estimating COEG operations forecast, the 2021 COEG operations GHG emissions are forecasted for 2030 and 2045 based on number of COEG employees and known impacts of currently adopted legislation on GHG emissions. These future growth factors were applied to the electricity, natural gas, water consumption, and waste generation in COEG buildings and facilities and fuel consumed by COEG's on-road vehicle fleet and employee commute.

The following section describes the methodology behind forecasting both the community and COEG operations business-as-usual (BAU) and legislative-adjusted BAU emissions for each sector. The BAU emissions forecast provides an assessment of how emissions generated by activities in the city will change over time without further state or federal action. The legislative-adjusted BAU emissions forecast includes adopted legislative and regulatory actions at the state and federal levels that would affect emissions without additional action.

1.1 COMMUNITY GREENHOUSE GAS EMISSIONS FORECASTS

1.1.1 Business-as-Usual Forecast

The community BAU forecasted emissions are estimated by scaling the 2021 baseline emissions by four growth scaling factors: housing, population, employment, and service population in the city. These scaling factors are used as a basis for the forecasts of activity for most sectors. The scaling factors are assigned to different activities for emissions sectors and sub-sectors depending on how each sector or sub-sector is affected. These assignments are shown in Table 1. For example, the activity for both the residential building energy sector and the nonresidential building energy sector is in kilowatt-hours (kWh) of electricity and therms of natural gas. Increases in residential building energy (in kWh and therms) are assumed to be proportional to the growth in households, whereas increases in nonresidential building energy (also in kWh and therms) are assumed to be proportional to the growth in employment. These projections in the activities are then translated to emissions using 2021 emission factors to represent the BAU scenario. Under the BAU scenario, it is assumed that baseline emission factors remain unchanged in the future. The resulting scaled activity growth factor are shown in Table 2.

[1] Service population is the sum of population and number of employment in the city.

Table 1 Community BAU Growth Scaling Methods by Emissions Sector for Community Forecast

Sector	Sub-Sector	Activity Growth Method
Building Energy	Nonresidential	Employment
	Residential	Population
	Backup Generator	Employment
On-Road	Passenger	Estimated VMT forecast
	Commercial	Estimated VMT forecast
Off-Road	Construction Equipment[1]	Service Population
	Industrial	Employment
	Lawn and Garden Equipment	Population
	Light Commercial Equipment	Employment
	Portable Equipment	Employment
	Recreational Equipment	Population
	Transport Refrigeration Units	Service Population
Solid Waste	Waste Generation	Service Population
Wastewater Treatment	Septic System	Service Population
	Waste Water Treatment Plant (WWTP)	Service Population
Agriculture	Fertilizer Application	Agricultural Acres
	Irrigation Pumps	Agricultural Acres
	Livestock	Agricultural Acres
	Agricultural Offroad	Agricultural Acres
	Agricultural Building Energy	Agricultural Acres
Water Supply	NA	Service Population

Notes: BAU = business-as-usual; kWh = kilowatt-hours; NA = not applicable; VMT = vehicle miles traveled

[1] This is part of the "construction and mining" combined category in CARB's OFFROAD model. Mining does not occur within the city, therefore this subsector is used to represent the construction-related emissions in the city.

Source: Compiled by Ascent in 2023.

Table 2 Community BAU Activity Data Forecast by Emissions Sector

Sector	Source	Quantity Type	Quantity Units	Quantity				
				2030	2035	2040	2045	2050
Building Energy	Residential	Electricity	kWh	789,582,752	879,568,854	969,554,956	1,059,541,058	1,149,527,159
	Nonresidential	Electricity	kWh	637,878,776	752,734,947	867,591,117	982,447,288	1,097,303,459
	Electricity Total		kWh	1,427,461,528	1,632,303,800	1,837,146,073	2,041,988,346	2,246,830,618
	Residential	Natural Gas	therms	29,225,349	32,556,064	35,886,780	39,217,495	42,548,210
	Nonresidential	Natural Gas	therms	7,225,582	8,526,617	9,827,652	11,128,687	12,429,722
	Natural Gas Total		therms	36,450,931	41,082,681	45,714,431	50,346,182	54,977,932
	Backup Generators (Nonresidential)	Diesel	gal	10,663	12,583	14,503	16,423	18,343
	Backup Generators (Nonresidential)	Natural Gas	therms	214	252	291	329	368

Sector	Source	Quantity Type	Quantity Units	Quantity				
				2030	2035	2040	2045	2050
	Backup Generators (Nonresidential)	LPG	gal	174	205	237	268	300
On-Road Transportation	On-Road Passenger Transportation	Annual VMT	miles	1,114,891,221	1,204,569,915	1,294,248,608	1,383,927,302	1,473,605,996
	On-Road Commercial Transportation	Annual VMT	miles	247,871,587	276,632,912	305,394,236	334,155,561	362,916,885
	Total	Annual VMT	miles	1,362,762,808	1,481,202,826	1,599,642,844	1,718,082,863	1,836,522,881
Off-Road Vehicles and Equipment [1]	NA	NA	NA	NA	NA	NA	NA	NA
Solid Waste	Community-Generated Solid Waste	Waste	tons	86,100	97,268	108,435	119,603	130,770
	Compost	Waste	tons	32,582	36,808	41,034	45,260	49,486
	Total	Waste	tons	118,682	134,076	149,469	164,863	180,256
Water Supply	Elk Grove Water District	Electricity	kWh	3,623,489	4,093,471	4,563,452	5,033,434	5,503,415
	Sacramento County Water Agency	Electricity	kWh	11,709,337	13,228,086	14,746,835	16,265,584	17,784,333
	Wells	Electricity	kWh	11,694	13,211	14,728	16,244	17,761
	Total	Electricity	kWh	15,344,520	17,334,768	19,325,015	21,315,262	23,305,509
Wastewater Treatment [2]	NA	NA	NA	NA	NA	NA	NA	NA
Agriculture	Fertilizer Application (Lime)	NA	tons	13	3	3	3	3
	Fertilizer Application (Nitrogen)	NA	tons	133	35	35	35	35
	Off-Road Agricultural Equipment	NA	NA	NA	NA	NA	NA	NA
	Diesel-Powered Irrigation Pumps	Pumps	NA	1	0	0	0	0
	Cattle and Calves	Heads	NA	246	65	65	65	65
	Sheep and Lambs	Heads	NA	57	15	15	15	15
	Goats	Heads	NA	64	17	17	17	17
	Poultry	Heads	NA	78	21	21	21	21
	Swine	Heads	NA	4	1	1	1	1
	Horses	Heads	NA	31	8	8	8	8
	Agricultural Building Energy	Electricity	kWh	9,022,676	2,381,934	2,381,934	2,381,934	2,381,934

Notes: BAU = business-as-usual; gal = gallon; kWh = kilowatt-hours; NA = not applicable; VMT = vehicle miles traveled.

[1] Activity data has not been scaled for Off-Road Vehicles and Equipment. CARB's 2021 OFFROAD model was used to estimate emissions forecasts.

[2] Activity data has not been scaled for Wastewater Treatment. Forecast emissions are estimated by scaling 2021 inventory emissions directly.

Source: Data modeled by Ascent in 2023.

1.1.2 Legislative-Adjusted Business-as-Usual Forecast

The legislative-adjusted BAU scenario accounts for the effect of adopted legislative and regulatory actions at the state and federal levels on local emissions without additional action by COEG. For the building energy sector, legislative reductions affect energy use through energy efficiency standards and electricity emission factors to account for increased zero-carbon requirements for the electricity sector. For on-road transportation, agricultural building energy sub-sector, and water supply sectors, legislative reductions affect emissions factors only. For solid waste, wastewater treatment, off-road vehicles and equipment, and agriculture sectors (excluding agricultural building energy sub-sector), the legislative-adjusted BAU forecast is equivalent to the BAU forecast. Although legislation exists that would affect these sectors (e.g., Senate Bill [SB] 1383 would impact the solid waste sector), there is not sufficient information to quantify the legislative reductions from these sectors. As such, any additional GHG reductions in these sectors would be factored as part of local actions as part of the Climate Compass's GHG reduction measures and not as part of the forecasts.

Table 6 in the Forecast Memorandum presents a summary of the legislative adjustments applied to the activity data and emissions factors by sector under the legislative-adjusted BAU scenario. Table 3 below lists community forecast sectors where activity data is affected by legislative reductions. A detailed discussion of each sector is provided in Section 1.1.3.

Table 3 Community Legislative-Adjusted BAU Activity Data Forecast by Emissions Sector Affected by Legislative Reductions

Sector	Source	Quantity Type	Quantity Units	Quantity				
				2030	2035	2040	2045	2050
Building Energy	Residential	Electricity	kWh	831,404,941	943,270,190	1,055,135,440	1,167,000,689	1,278,865,939
	Nonresidential	Electricity	kWh	616,743,756	720,642,952	824,542,148	928,441,344	1,032,340,540
	Electricity Total		kWh	1,448,148,697	1,663,913,142	1,879,677,588	2,095,442,034	2,311,206,479
	Residential	therms	therms	27,037,421	29,223,528	31,409,635	33,595,742	35,781,850
	Nonresidential	therms	therms	6,949,873	8,107,973	9,266,073	10,424,173	11,582,273
	Natural Gas Total		therms	33,987,294	37,331,501	40,675,708	44,019,915	47,364,122
	Backup Generators (Nonresidential)	Diesel	gal	10,663	12,583	14,503	16,423	18,343
	Backup Generators (Nonresidential)	Natural Gas	therms	214	252	291	329	368
	Backup Generators (Nonresidential)	LPG	gal	174	205	237	268	300

Notes: BAU = business-as-usual; gal = gallon; kWh = kilowatt-hours; LPG = liquid propane gas.

Data modeled by Ascent in 2023.

1.1.3 Forecast Details by Emissions Sector

BUILDING ENERGY

Building Energy Assumptions

Building energy emissions in the city result directly from onsite combustion of natural gas and indirectly from electricity consumption. The combustion of fossil fuels (i.e., diesel, liquid propane gas [LPG], propane and natural gas)

in backup generators also contributes to the city's building energy emissions. This section presents the methodology behind forecasting the energy consumption for residential and nonresidential sources and estimating future emission factors. BAU forecasted energy consumption for residential building energy is estimated by scaling 2021 energy consumption using population. For nonresidential sources, BAU forecasted energy consumption is estimated by scaling 2021 energy consumption using employment. BAU forecasted energy consumption in buildings using backup generators is estimated by scaling 2021 energy consumption using employment. The BAU forecast uses the GHG emissions factors used to calculate emissions in the 2021 inventory for all forecast years. The legislative-adjusted BAU forecast considers the effects of legislation on energy use in new residential and nonresidential buildings pursuant to California's Building Energy Efficiency Standards (California Code of Regulations Title 24 Part 6, hereafter referred to as "Title 24"). The legislative-adjusted BAU forecast also considers changes to the carbon intensity of electricity generation under SB 100 and SB 1020 that would affect future electricity emission factors. Emissions are calculated by multiplying the annual projected building energy use by the respective emission factors.

Emission Factor Forecasts

Electricity

Sacramento Municipal Utility District (SMUD) provides all electricity in the city. Under BAU forecasts, SMUD's 2021 electricity supply emissions factor is assumed to remain unchanged through 2045 because the BAU forecast does not account for the effects of SB 1020 and SB 100 beyond the inventory year (2021). According to The Climate Registry (TCR), SMUD's emissions factor in 2021 was 535 pounds of carbon dioxide equivalent per megawatt-hour and represented a 48 percent carbon-free electricity mix (TCR 2021), meaning that 48 percent of the electricity generated by SMUD in 2021 was generated by sources that emit no GHG emissions.

Under the legislative-adjusted BAU forecasts, SMUD's carbon-free mix for 2030 through 2050 is set to align with the mandates outlined in SB 1020 and SB 100. Thus, under legislative-adjusted BAU forecast, the emissions factors align with California Public Utilities Commission's Renewables Portfolio Standard (RPS) which are set through SB 1020 and SB 100 (see Emission Factor Forecasts in Forecast Details by Emissions Sector 1.1.3 for details). Through SB 100, RPS requires that "all electricity providers procure a minimum 60% eligible renewable energy by 2030" (State of California 2023a). And through SB 1020, RPS requires that "eligible renewable energy resources and zero-carbon resources supply 90% of electricity to end-use customers by 2035, 95% by 2040, and 100% by 2045" (State of California 2023b). Given that SB 1020 and SB 100 have set 2045 as the ultimate target year by which carbon-free electricity mix is achieved and the heavy investments needed to achieve that target, the 100-percent GHG-free mix was assumed to continue from 2045 through 2050. To calculate future emission factors, SMUD's 2021 electricity supply emissions factor was adjusted to reflect the additional carbon-free electricity mix percentage to meet the minimum RPS standards. As a result, the legislative-adjusted BAU emission factors for all future years are estimated by incorporating SMUD's 2021 carbon-free electricity mix for each forecast year and carbon-free mix set by RPS standard. The emission factors and carbon-free mix of electricity and associated GHG emissions factors for the legislative-adjusted BAU forecast are presented in Table 4.

Table 4 Emission Factors and Carbon-Free Mix of Electricity Used in Elk Grove

	2021	2030	2035	2040	2045	2050
Emission Factor (lb CO_2e/MWh)	536	413	103	52	0	0
Carbon-Free Electricity Mix (%)	48	60	90	95	100	100

Notes: lb CO_2e/MWh = pounds of carbon dioxide equivalent per megawatt-hour.

Source: Compiled by Ascent in 2023.

Natural Gas

Natural gas in the city is provided by Pacific Gas & Electric (PG&E). According to TCR, 11.73 pounds of carbon dioxide equivalent is released for every therm of natural gas combusted (TCR 2021). Emissions factors associated with natural gas combustion are not anticipated to change over time, as there are no legislative actions that would reduce the

carbon intensity of natural gas. The emission factors of natural gas for PG&E supplied natural gas are presented in Table 5.

Table 5 Natural Gas Emission Factors in (lb CO_2e/therm) Used in Elk Grove

Provider	2021	2030	2035	2040	2045	2050
PG&E	11.73	11.73	11.73	11.73	11.73	11.73

Notes: PG&E = Pacific Gas and Electric Company; lb CO_2e/therm = pounds of carbon dioxide equivalent per therm.

Source: Compiled by Ascent in 2023.

Backup Generator Fuel

Emissions from diesel fuel used to power backup generators are based on emissions factors obtained from TCR, using a regional-specific average consumption of 22.55 pounds of carbon dioxide equivalent per gallon (lb CO_2e/gal). Emissions factors associated with diesel combustion are not anticipated to change over time, as there are no legislative actions that would reduce the carbon intensity of diesel.

Emissions from propane and LPG used to power backup generators are also based on emissions factors from TCR and are estimated to be 0.9 lb CO_2e/gal and 0.34 pounds of carbon dioxide equivalent per standard cubic feet, respectively. These emissions factors are also not anticipated to change over time, as there are no legislative actions that would reduce the carbon intensity of propane and LPG. The emission factors of backup generator fuels are presented in Table 6.

Table 6 Backup Generator Fuel Emission Factors Used in the City of Elk Grove

Provider	Units	2021	2030	2035	2040	2045	2050
Diesel	lb CO_2e/gal	22.55	22.55	22.55	22.55	22.55	22.55
Propane	lb CO_2e/gal	0.9	0.9	0.9	0.9	0.9	0.9
LPG	lb CO_2e/scf	0.34	0.34	0.34	0.34	0.34	0.34

Notes: lb CO_2e/gal = pounds of carbon dioxide equivalent per gallon; lb CO_2e/scf = pounds of carbon dioxide equivalent per standard cubic foot.

Source: Compiled by Ascent in 2023.

ENERGY USE FORECASTS

For new buildings, energy use is adjusted to reflect increased stringency under Title 24. Title 24 standards apply to new construction. The 2019 Title 24 standards apply to projects constructed after January 1, 2020; 2022 Title 24 standards apply to projects constructed after January 1, 2023; and the next standards will apply after January 1, 2026. To estimate adjusted future energy consumption resulting from Title 24 requirements in new residential and nonresidential building construction, electricity- and natural gas-specific adjustment factors are calculated using the difference in the average energy use in residential and nonresidential buildings between those built to 2019 Title 24 standards and those built to 2022 Title 24 standards. Adjustment factors are calculated using data available from the California Energy Commission (CEC) that were developed for the 2022 Title 24 standards. In addition to accounting for Title 24 requirements by land use type (i.e., residential and nonresidential), CEC also developed estimates for energy usage rates by climate zone, and the county's climate zone (Zone 12) is used for the residential buildings analysis. Climate zone-specific data for nonresidential buildings are unavailable; therefore, nonresidential adjustment factors relied on statewide averages.

The adjustment factors (specific to both building type and energy type) are applied to the projected fuel use that is estimated by scaling 2021 energy use by the appropriate scaling factor (population for residential buildings and employment for non-residential buildings). Title 24 adjustment factors are then applied to this projected energy use to estimate legislative-adjusted BAU energy consumption and associated GHG emissions of future development with legislative adjustments. The adjustment factors are shown in Table 7. They are presented in terms of the percent change in energy use for buildings compliant with the 2022 Title 24 standards compared to those built to meet the 2019 Title 24 standards. Positive values indicate an anticipated increase in energy use (e.g., increased electrical

demands from additional appliances, electrification of natural gas appliances), while negative values indicate an anticipated decrease in energy use (e.g., more energy efficiency, shifting away from natural gas appliances). It is important to note that although average electricity use in new residential buildings is anticipated to rise (due to an increase in electrical demand associated with electric appliances installed instead of natural gas appliances), emissions from new residential buildings are expected to be lower than they would be under 2019 Title 24 as a result of overall lower building emissions intensities (due to lower emissions factors associated with electricity compared to natural gas).

Table 7 Title 24 Building Energy Adjustment Factors for 2022 Standards Compared to 2019 Standards

Building Type	Electricity	Natural Gas
Residential Buildings	24%	-34%
Nonresidential Buildings	-10%	-11%

Source: Compiled by Ascent in 2023.

BUILDING ENERGY RESULTS

Based on the building energy legislative reductions for new buildings and the expected net growth in the city's housing and employment, Table 8 shows the legislative-adjusted BAU forecast results for residential buildings and Table 9 shows legislative-adjusted BAU forecast results for nonresidential buildings. Under the BAU scenario, the 2021 emission factors would remain unchanged through 2045.

Table 8 Residential Building Energy Community GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$)

Energy Type	2021	2030	2035	2040	2045	2050
Electricity	150,260	155,905	44,220	24,732	0	0
Natural Gas	121,641	143,877	155,511	167,144	178,777	190,410
Total	**271,900**	**299,782**	**199,731**	**191,876**	**178,777**	**190,410**

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by Ascent in 2023.

Table 9 Nonresidential Building Energy Community GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$)

Energy Type	2021	2030	2035	2040	2045	2050
Electricity	101,296	115,651	33,784	19,327	0	0
Natural Gas	25,096	143,877	155,511	167,144	178,777	190,410
Backup Generators	73	111	131	151	171	191
Total	**126,465**	**259,640**	**189,426**	**186,622**	**178,948**	**190,602**

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by Ascent in 2023.

ON-ROAD TRANSPORTATION

The emissions projections associated with the on-road transportation sector are calculated by multiplying the projected annual VMT and the vehicle emission factors by vehicle category. VMT projections were developed using data provided by Fehr & Peers and the origin-destination method, consistent with SB 375. For the BAU forecast, the applied future emission factors are based on 2021 emission factors. For the legislative-adjusted BAU forecast, the future vehicle emission factors are based on those from the CARB EMFAC2021 webtool which includes legislative

adjustments from state and federal policies and regulations including the Pavley Clean Car Standards, Advanced Clean Car I (ACC I) regulation, and fuel efficiency standards for medium- and heavy-duty vehicles. It should be noted that the Low Carbon Fuel Standard was excluded in EMFAC2021 forecasts because the emissions benefits originate from upstream fuel production and do not directly reduce vehicle tailpipe emissions that affect the city's GHG emissions forecasts. Additionally, the effects of the Advanced Clean Cars II (ACC II) and Advanced Clean Fleets (ACF) regulation were incorporated in this forecast. For ACC II, sales of electric vehicles are adjusted upwards from the default EMFAC values to be consistent with the state's target where 100 percent of new passenger vehicle sales are plug-in hybrids or battery electric vehicles by 2035 (California Air Resources Board 2022). The total estimated VMT and corresponding legislative-adjusted BAU emissions from on-road transportation for each forecast year are given in Table 10 and Table 11 respectively.

Table 10 On-Road Transportation Community Total Estimated VMT

Source	2021	2030	2035	2040	2045	2050
On-Road Passenger Transportation	944,367,693	1,114,891,221	1,204,569,915	1,294,248,608	1,383,927,302	1,473,605,996
On-Road Commercial Transportation	192,332,970	247,871,587	276,632,912	305,394,236	334,155,561	362,916,885
Total	1,136,700,663	1,362,762,808	1,481,202,826	1,599,642,844	1,718,082,863	1,836,522,881

Notes: VMT= vehicle miles traveled.

Source: Compiled by Ascent in 2023.

Table 11 On-Road Transportation Community GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$)

Source	2021	2030	2035	2040	2045	2050
On-Road Passenger Transportation	339,716	279,273	200,153	122,018	69,997	41,927
On-Road Commercial Transportation	246,504	275,753	261,297	250,448	251,466	262,644
Total	586,220	555,026	461,450	372,466	321,463	304,571

Notes: BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by Ascent in 2023.

OFF-ROAD VEHICLES AND EQUIPMENT

Emissions for different sources under the off-road vehicles and equipment sector were estimated by scaling 2021 inventory emissions by growth factors listed in Table 12. This approach was used instead of using CARB's 2021 OFFROAD model to account for the growth in various emission sources by the various scaling methods (for example, growth in employment, change in agricultural acres). No legislative reductions could be applied to this sector, so legislative-adjusted BAU emissions are equivalent to BAU emissions.

Table 12 Off-Road Vehicles and Equipment Forecast Methods by Source

Source	Forecast Methods	
	Scale Factor	Applied Legislative Reductions
Construction Equipment[1]	Service Population	OFFROAD2021 emissions factor considerations include EPA off-road compression-ignition engine standards implementation schedule.
Industrial Equipment	Employment	
Lawn and Garden Equipment	Population	
Light Commercial Equipment	Employment	
Portable Equipment	Employment	
Recreational Equipment	Population	
Transport Refrigeration Units	Service Population	

Notes: EPA = US Environmental Protection Agency; OFFROAD2021 = California Air Resources Board's OFFROAD2021 model.

[1] This is part of the "construction and mining" combined category in CARB's OFFROAD model. Mining does not occur within the city, therefore this subsector is used to represent the construction-related emissions in the city.

Source: Compiled by Ascent in 2023.

Table 13 shows the 2021 inventory and legislative-adjusted BAU forecasted emissions from the off-road vehicles and equipment sector for 2030, 2035, 2040, 2045, and 2050.

Table 13 Off-Road Vehicles and Equipment Community GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$)

Source	2021	2030	2035	2040	2045	2050
Construction Equipment	9,033	12,023	13,583	15,142	16,701	18,261
Industrial Equipment	1,219	1,868	2,204	2,540	2,876	3,213
Lawn and Garden Equipment	2,817	3,602	4,012	4,423	4,833	5,243
Light Commercial Equipment	2,071	3,173	3,745	4,316	4,888	5,459
Portable Equipment	1,905	2,918	3,444	3,969	4,495	5,020
Recreational Equipment	229	293	326	360	393	426
Transport Refrigeration Units	1,066	1,419	1,603	1,787	1,971	2,155
Total	**18,341**	**25,296**	**28,917**	**32,537**	**36,158**	**39,778**

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by Ascent in 2023.

SOLID WASTE

Solid waste sector emissions are associated primarily with the decomposition of mixed municipal solid waste generated in landfills by community activities, while a smaller proportion of emissions are produced by the decomposition of composted yard trimmings. No legislative reductions could be applied to this sector, so legislative-adjusted BAU emissions are equivalent to BAU emissions, which were scaled by service population growth within the city. Table 14 shows the 2021 inventory and legislative-adjusted BAU forecasted emissions from the solid waste sector for 2030, 2035, 2040, 2045, and 2050.

Table 14 Solid Waste Community GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$)

Source	2021	2030	2035	2040	2045	2050
Community-Generated Solid Waste	18,508	23,754	26,835	29,916	32,997	36,078
Compost	1,714	2,281	2,577	2,872	3,168	3,464

Total	**20,222**	**26,034**	**29,411**	**32,788**	**36,165**	**39,542**

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by Ascent in 2023.

WATER SUPPLY

Water supply emissions occur indirectly from the consumption of electricity associated with extracting, conveying, treating, and distributing imported water to the city. For water supplied from local sources (i.e., water supplied by the Elk Grove Water District and Sacramento County Water Agency), the electricity usage associated with extracting, conveying, treating, and distributing water is captured in the building energy sector because these activities take place within the city and SMUD provided electricity usage data that reflects electricity consumption for all end uses within the city. Energy consumption for future years is estimated by scaling 2021 energy consumption using population. The BAU forecast uses the GHG emissions factors used to calculate emissions in the 2021 inventory for all forecast years. Under the legislative-adjusted BAU forecast, the emissions factors align with RPS, consistent with the requirements of SB 1020 and SB 100 (see emission factor forecasts in Forecast Details by Emissions Sector 1.1.3 for details). To calculate future emission factors, SMUD's 2021 electricity supply emissions factor was adjusted to reflect the additional carbon-free electricity mix percentage obtained to meet the minimum RPS standards. As a result, the emission factors are estimated by incorporating the associated carbon-free mix in SMUD's 2021 carbon-free electricity mix for each forecast year. The emission factors and carbon-free mix of electricity and associated GHG emissions factors for the legislative-adjusted BAU forecast are presented in Table 4. Emissions are calculated by multiplying the annual projected energy use by the respective emission factors. Table 15 presents projected fuel consumption and Table 16 presents 2021 inventory and legislative-adjusted BAU forecasted emissions from the water supply sector for 2030, 2035, 2040, 2045, and 2050.

Table 15 Water Supply Community Electricity Consumption in kWh

Source	2021	2030	2035	2040	2045	2050
EGWD	2,722,412	3,623,489	4,093,471	4,563,452	5,033,434	5,503,415
SCWA	8,797,498	11,709,337	13,228,086	14,746,835	16,265,584	17,784,333
Wells	8,786	11,694	13,211	14,728	16,244	17,761
Total	**11,528,696**	**15,344,520**	**17,334,768**	**19,325,015**	**21,315,262**	**23,305,509**

Notes: Totals may not sum exactly due to independent rounding. EGWD = Elk Grove Water District; kWh = kilowatt-hours; SCWA = Sacramento County Water Agency.

Source: Data modeled by Ascent in 2023.

Table 16 Water Supply Community GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$)

Source	2021	2030	2035	2040	2045	2050
EGWD	662	679	192	107	0	0
SCWA	2,140	2,196	620	346	0	0
Wells	0	0	0	0	0	0
Total	2,802	2,875	812	453	0	**0**

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by Ascent in 2023.

WASTEWATER TREATMENT

Emissions projections associated with the wastewater treatment sector account for emissions generated from several different sources during the treatment and collection of wastewater from centralized wastewater treatment plants (WWTPs) in the city. 2021 emissions are directly scaled to estimate emissions forecast in future years using service population growth within the city. No legislative reductions could be applied to this sector, so legislative-adjusted BAU emissions are equivalent to BAU emissions. Table 17 shows the 2021 inventory and legislative-adjusted BAU forecasted emissions from the wastewater treatment sector for 2030, 2035, 2040, 2045 and 2050.

Table 17 Wastewater Treatment Community GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$)

Source	2021	2030	2035	2040	2045	2050
Centralized WWTP	2,791	6,485	7,326	8,167	9,009	9,850
Septic Systems	167	222	251	280	309	337
Total	**2,957**	**6,707**	**7,577**	**8,447**	**9,317**	**10,187**

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent; WWTP = wastewater treatment plant.

Source: Data modeled by Ascent in 2023.

AGRICULTURE

Emissions projections associated with the agriculture sector include emissions from livestock management, fertilizer application, use of off-road equipment on agricultural land, and electricity consumption in agricultural buildings. 2021 activity data for this sector is scaled using growth in agricultural land to estimate future emissions. Agricultural land use acres in the city are projected to decline from 2021 through 2035 and remain steady after 2035. This projected change in agricultural land acres was used to scale GHG emissions from livestock management, fertilizer application, and agricultural off-road vehicles and equipment. As a result, emissions from these sources are projected to decline through 2035 and remain steady through 2050. The projected decline in agricultural emissions is also associated with a decline in emissions from agricultural buildings as a result of the reduction in electricity emission factors through SB 100 and SB 1020 (see Emission Factor Forecasts in Forecast Details by Emissions Sector 1.1.3 for details). Table 18 shows the 2021 inventory and legislative-adjusted BAU forecasted emissions from agriculture for 2030, 2035, 2040, 2045, and 2050.

Table 18 Agriculture Community GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$)

Source	Livestock Management		Fertilizer Application		Agricultural Equipment		Agricultural Building Energy		Total	
	BAU	Legislative-Adjusted BAU	BAU	Legislative-Adjusted BAU	BAU	Legislative-Adjusted BAU	BAU	Legislative-Adjusted BAU	BAU	Legislative-Adjusted BAU
2021	2,779	2,779	1,518	1,518	875	875	5,104	5,104	**10,275**	**10,275**
2030	1,195	1,195	653	653	329	329	2,195	1,692	**4,372**	**3,869**
2035	316	316	172	172	87	87	580	112	**1,154**	**686**
2040	316	316	172	172	87	87	580	56	**1,154**	**630**
2045	316	316	172	172	87	87	580	0	**1,154**	**575**
2050	316	316	172	172	87	87	580	0	**1,154**	**575**

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by Ascent in 2023.

1.2 CITY OF ELK GROVE OPERATIONS GREENHOUSE GAS EMISSIONS FORECASTS

1.2.1 Business-as-Usual Forecast

Estimated COEG operations BAU emissions forecasts were based on predicted growth in COEG employment between 2021 and 2045. Change in employment was the sole factor used to forecast BAU emissions for 2030 and 2045 for all sectors in COEG operations inventory. COEG staff provided employment estimates for 2030 and 2045 forecasts were based on the city's overall employment growth between 2021 and 2045. Table 19 shows 2021 COEG employment and anticipated change in employment for the forecast years.

Table 19 City of Elk Grove Operations Demographic Forecasts

Forecast Factor	2021	2030	2045
City of Elk Grove Employment	424	561	727
Percent Growth from 2021	NA	32%	72%

Notes: NA = Not applicable.

Source: Data provided by City of Elk Grove; calculations by Ascent in 2023.

BAU projections in activity growth (e.g., electricity use, vehicle fuel use) are translated to emissions using emission factors from the 2021 inventory year. Under the BAU scenario, it is assumed that baseline emission factors remain unchanged in the future because without adopted legislation requiring reduced emissions from such sources as electricity generation and vehicles (e.g., SB 100), future emission factors would stay the same as they do currently. The resulting scaled activity growth factors are shown in Table 20.

Table 20 City of Elk Grove Operations BAU Activity Data Forecast by Emissions Sector

Emissions Sector	Source	Units	Activity levels in 2030	Activity levels in 2045
Buildings and Facilities	Electricity	MWh	4,435	5,751
	Natural Gas	therms	229,728	297,883
	Backup Generators (Diesel)	gallons	239	310
Streetlights and Traffic Signals	Streetlights Electricity	MWh	4,093	5,308
	Traffic Signals Electricity	MWh	763	989
Employee Commute	Employee Commute	VMT	3,069,503	3,980,157
Vehicle Fleet	Combustion Vehicles	VMT	1,864,742	2,417,969
	Electric Vehicles	VMT	1,932	2,505
Solid Waste	Landfill	tons	496	644
	Compost	tons	606	786
Water Supply	EGWD	MWh	1	2
	SCWA	MWh	48	62
Wastewater Treatment	NA	NA	NA	NA
Process & Fugitive Emissions	NA	therms	229,728	297,883

Note: BAU = Business-as-usual forecast; EGWD = Elk Grove Water District; MWh = megawatt-hours; NA = Not applicable; SCWA = Sacramento County Water Agency; VMT = vehicle miles traveled.

Source: Data modeled by Ascent in 2023.

1.2.2 Legislative-Adjusted Business-as-Usual Forecast

The legislative-adjusted BAU scenario accounts for the effect of adopted legislative and regulatory actions at the state and federal levels on local emissions without additional action by COEG. For building energy, streetlights and traffic signals, and water supply sectors, legislative reductions affect electricity emission factors through SB 100 and SB 1020 to account for increased carbon-free requirements for the electricity sector. For the employee commute sector and vehicle fleet sectors, legislative reductions affect emissions factors through ACC II and ACF. The wastewater treatment and solid waste sectors do not incorporate legislative reductions. Table 10 in the Forecast Memorandum presents a summary of the legislative adjustments applied to COEG operations activity data and emissions factors by sector under the legislative-adjusted BAU scenario. A detailed discussion of each sector is presented in section 1.2.3.

1.2.3 Forecast Detail by Emissions Sector

BUILDINGS AND FACILITIES ENERGY

Emissions associated with COEG-owned buildings and facilities are generated from the upstream generation of electricity and on-site combustion of natural gas and diesel (in backup generators). Emissions from future electricity, natural gas, and backup generator use in COEG buildings and facilities were estimated by multiplying anticipated energy use by forecasted emissions factors. Forecasted energy consumption for COEG buildings and facilities is estimated by scaling 2021 energy consumption using COEG employment. The BAU forecast uses the GHG emissions factors used to calculate emissions in the 2021 inventory for all forecast years. The legislative-adjusted BAU forecast considers changes to the carbon intensity of electricity generation under SB 100 and SB 1020 that would affect future electricity emission factors. Emissions are calculated by multiplying the annual projected building energy use by the respective emission factors.

Emission Factor Forecasts

Electricity

Under BAU forecasts, SMUD's 2021 emissions factor is assumed to remain unchanged through 2045. Under the legislative-adjusted BAU forecast, the emissions factors align with RPS standards which are set through SB 1020 and SB 100 (see Emission Factor Forecasts in Forecast Details by Emissions Sector 1.1.3 for details). To calculate future emission factors, SMUD's 2021 electricity supply emissions factor was adjusted to reflect the additional carbon-free electricity mix percentage obtained to meet the minimum RPS standards. As a result, the emission factors are estimated by incorporating the associated carbon-free mix in SMUD's 2021 carbon-free electricity mix for each forecast year. The emission factors and carbon-free mix of electricity and associated GHG emissions factors for the legislative-adjusted BAU forecast are presented in Table 4.

Natural Gas

Emissions factors associated with natural gas combustion are based on emissions factors from TCR, as described in Section 1.1.3 under natural gas emission factors. These emissions factors are not anticipated to change over time, as there are no legislative actions that would reduce the carbon intensity of natural gas. The emission factors of natural gas for PG&E supplied natural gas are presented in Table 5.

Diesel

Emissions from diesel fuel used to power backup generators are based on emissions factors from TCR, as described in Section 1.1.3. Emissions factors associated with diesel combustion are not anticipated to change over time, as there are no legislative actions that would reduce the energy intensity of diesel. The emission factors of diesel fuel used to power backup generators are presented in Table 6. Table 21 shows the 2021 inventory and legislative-adjusted BAU forecasted emissions for COEG buildings and facilities energy sector by energy type for 2030 and 2045.

Table 21 Buildings and Facilities Energy GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (Annual $MTCO_2e$)

Energy Type	2021	2030	2045
Electricity	815	829	0
Natural Gas	924	1,222	1,585
Backup Generators	2	2	3
Total	**1,741**	**2,054**	**1,588**

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by Ascent in 2023.

STREETLIGHTS AND TRAFFIC SIGNALS

Emissions projections associated with the streetlights and traffic signals sector account for emissions generated from purchased electricity from SMUD to operate the streetlights and traffic signals. Forecasted electricity consumption is estimated by scaling 2021 electricity use using COEG's employment factor. The BAU forecast uses the GHG emissions factors used to calculate emissions in the 2021 inventory for all forecast years. Under the legislative-adjusted BAU forecast, the emissions factors align with RPS standards which are set through SB 1020 and SB 100 (see Emission Factor Forecasts in Forecast Details by Emissions Sector 1.1.3 for details). To calculate future emission factors, SMUD's 2021 electricity supply emissions factor was adjusted to reflect the additional carbon-free electricity mix percentage obtained to meet the minimum RPS standards. As a result, the emission factors are estimated by incorporating the associated carbon-free mix in SMUD's 2021 carbon-free electricity mix for each forecast year. The emission factors and carbon-free mix of electricity and associated GHG emissions factors for the legislative-adjusted BAU forecast are presented in Table 4. Emissions are calculated by multiplying the annual projected electricity use by the respective emission factors. Table 22 presents 2021 inventory and legislative-adjusted BAU forecasted emissions for the streetlights and traffic signals sector for 2030 and 2045.

Table 22 Streetlights and Traffic Signals GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (Annual $MTCO_2e$)

Source	2021	2030	2045
Streetlights and Traffic Signals	893	907	0

Notes: BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by Ascent in 2023.

EMPLOYEE COMMUTE

The emissions projections associated with the employee commute sector are calculated by multiplying the projected annual VMT and the vehicle emission factors by vehicle category in 2030 and 2045. According to an employee commute survey that COEG conducted in 2022, 97 percent of employees drove to work alone. To be conservative, it was assumed that employees that commute to work all use passenger vehicles based on the 2022 employee commute survey conducted by COEG. Annual VMT for the sector is projected by scaling the 2021 annual COEG employee VMT using the number of COEG employees. For the BAU forecast, the applied future emission factors are based on 2021 emission factors. For the legislative-adjusted BAU forecast, the future vehicle emission factors are based on those from the CARB EMFAC2021 webtool and are adjusted to account for the effects of ACC II. For ACC II, sales of electric vehicles are adjusted upwards from the default EMFAC values to be consistent with the state's target where 100 percent of new passenger vehicle sales are plug-in hybrids or battery electric vehicles by 2035 (California Air Resources Board 2022). Table 23 shows the 2021 inventory and legislative-adjusted BAU forecasted emissions from COEG employee commutes for 2030 and 2045.

Table 23 Employee Commute GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (Annual $MTCO_2e$)

Source	2021	2030	2045
Employee Commute	835	769	201

Notes: BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by Ascent in 2023.

VEHICLE FLEET

Vehicle fleet VMT data for 2021 were provided by COEG for all COEG-owned vehicles by vehicle class. The BAU forecast uses the GHG emissions factors used to calculate emissions in the 2021 inventory for all forecast years. Under the legislative-adjusted BAU forecast, the total VMT was adjusted to incorporate the impacts of ACC II and ACF under which additional electric vehicles are expected to be added to COEG's vehicle fleet. This will spread the total VMT into VMT by conventional vehicles and VMT by electric vehicles. Under ACC II and ACF, vehicle emission factors will also decrease due to better fuel efficiency. Table 24 shows the 2021 inventory and legislative-adjusted BAU forecasted emissions from the vehicle fleet sector by fuel source for 2030 and 2045. As shown by the increase in fleet emissions from 2045 to 2050, the forecasted growth in COEG's fleet is expected to outpace the applied legislative reductions.

Table 24 Vehicle Fleet GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (Annual $MTCO_2e$)

Source	2021	2030	2045
Vehicle Fleet	620	497	533

Notes: BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent; VMT = vehicle miles traveled

Source: Data modeled by Ascent in 2023.

SOLID WASTE

Emissions projections associated with the solid waste sector include emissions from the landfill and compost. Waste tonnage projections are based on the growth in the number of employees in COEG. Emissions were calculated using the ClearPath[2] tool. No legislative reductions were applied to this sector. This is because SB 1383 (legislation applicable to the solid waste sector) requires COEG to take actions locally, hence these reductions will be applied as part of the Climate Compass's GHG reduction measures and not as part of the forecasts. Therefore, the legislative-adjusted BAU emissions forecast for the solid waste sector is equivalent to BAU emissions forecast. Table 25 shows the 2021 inventory and legislative-adjusted BAU forecasted emissions from the municipal operations solid waste sector for 2030 and 2045.

Table 25 Solid Waste GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (Annual $MTCO_2e$)

Source	2021	2030	2045
Landfill Disposed Waste	107	142	184
Compost	32	42	55
Total	**139**	**184**	**239**

Notes: BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by ClearPath in 2023.

[2] ClearPath is an online software platform for estimating emissions. ClearPath was used for this sector because it provides geographically specific results.

WATER SUPPLY

For the water supply from local sources within the city, the electricity usage associated with extracting, conveying, treating, and distributing water is captured in the buildings and facilities energy sector because these activities take place within the city. Therefore, the electricity usage and emissions associated with extracting, conveying, treating, and distributing water from outside the city boundary were applied to the municipal water supply sector. Table 26 shows the 2021 inventory and legislative-adjusted BAU forecasted emissions from municipal operations water supply for 2030 and 2045.

Table 26 Water Supply GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (Annual $MTCO_2e$)

Activity	2021	2030	2045
EGWD	0.27	0	0
SCWA	8.8	9	0
Total	**9.1**	**9**	**0**

Notes: BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent; EGWD = Elk Grove Water District; SCWA = Sacramento County Water Agency.

Source: Data modeled by Ascent in 2023.

WASTEWATER TREATMENT

Emissions projections associated with the wastewater treatment sector account for emissions generated from several different sources during the treatment and collection of wastewater. Although by 2050, electricity emissions factors are reduced to zero, increases in process and fugitive emissions resulting from wastewater collection and treatment would offset decreased electricity emissions. Table 27 shows the 2021 inventory and legislative-adjusted BAU forecasted emissions from wastewater treatment for 2030 and 2045.

Table 27 Wastewater Treatment GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (Annual $MTCO_2e$)

Source	2021	2030	2045
Wastewater Treatment	7	7	3

Notes: BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by Ascent in 2023.

PROCESS AND FUGITIVE EMISSIONS

Emissions in this sector are generated from the natural gas that escapes into the atmosphere during different processes and pipeline leakages. Activity projections are based on the growth in the number of employees at COEG. Emissions were calculated using the ClearPath tool for consistency with previous COEG operations inventories. No legislative reductions were applied to this sector. Table 28 shows the 2021 inventory and legislative-adjusted BAU forecasted emissions from process and fugitive emissions sector for 2030 and 2045.

Table 28 Process and Fugitive Emissions GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (Annual $MTCO_2e$)

Source	2021	2030	2045
Process and Fugitive Emissions	32	42	55

Notes: BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data modeled by ClearPath in 2023.

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