Appendix C

GHG Forecasts and Gap Analysis

Rincon Consultants, Inc.

Environmental Scientists *Planners* *Engineers*

M E M O R A N D U M

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Date: December 1, 2023

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Project: **Hayward Climate Action Plan Update**

Re: Future GHG Emissions Forecasts and Gap Analysis Memorandum

Rincon Consultants, Inc. (Rincon) has calculated the 2025, 2030, 2035, 2040, and 2045 greenhouse gas (GHG) emissions forecasts based on the Hayward 2019 GHG emission inventory as well as population and economic growth projections for Hayward. The 2019 GHG emissions inventory identifies the major sources and quantities of GHG emissions produced by communitywide activities within Haywards's city limits (i.e., the Hayward General Plan Update planning area). The inventory was developed by the City and provides the City with the data necessary to establish a GHG emissions baseline for the Climate Action Plan (CAP) Update, track GHG emissions trends, and identify the greatest sources of GHG emissions within their jurisdiction.

The GHG emissions forecast discussed in this memorandum provides an estimate of how Hayward's GHG emissions are expected to change in the years 2025 (interim year), 2030 (initial Senate Bill 32 compliance year), 2035 (interim year), 2040 (Hayward General Plan Update horizon year), and 2045 (initial Executive Order B-55-18 compliance year) as a result of anticipated Hayward economic and population growth, as well as the impacts that California climate-related legislation would have on these

future GHG emissions. This memorandum also discusses the 2025, 2030, and 2045 GHG emission reduction targets adopted by Hayward that are aligned with California goals as well as the total quantity of GHG emissions reduction that Hayward needs to achieve in order to contribute their fair share reduction of California's GHG emission reduction goal.[1] The gap between the 2030 adjusted forecast and Hayward's 2030 targets would be addressed through local actions to be included in the CAP Update.

This memorandum also describes updates to previous (2005, 2010, 2015, 2017, 2018, and 2019) GHG inventories that were recalculated due to changes and/or updated methodologies. These changes were made to align the factors and methodologies across all the inventories so that the inventory information and results can be compared across years. The following sections provide a summary of the results for the GHG emission inventories, GHG emission forecast, and GHG reduction targets to be included in the Hayward CAP Update.

GHG Emissions Sectors and Sources

The GHG emissions forecasts presented herein are based on the 2019 GHG emissions inventory calculated for Hayward by the City as well as population and economic growth projections for Hayward. Based on the findings in the *GHG Inventory Data Consistency and Analysis Approach Review Memorandum*, prepared for the City on November 5, 2021, the City updated the analysis and/or emission factors of several sectors within the previous 2005, 2010, 2015, 2017, 2018, and 2019 inventories to be consistent with the Community Protocol, ensure methodology consistency across inventories, and ensure the most updated emission factors and modeled data were utilized that are best representative of communitywide emissions.

Specifically, in the water and wastewater sectors, the inventories were updated to include the addition of emissions associated with indirect electricity use from the water and wastewater sectors as well as process emissions from wastewater generation attributed to the community. In the electricity sector, eGRID electricity emission factors were updated to align with the EPA's most current eGRID2019 emission factors. Also, three updates were made related to the transportation sector emissions:

1. Addition of the Hayward AC Transit bus system into the public transit calculations;
2. Update to on-road transportation data to use Google Environmental Insights Explorer (EIE) vehicle miles traveled (VMT) data[2] and the California Air Resources Board's (CARB) EMission FACtor (EMFAC) Model Version 2021 v1.01; and
3. Update to off-road transportation data to use the CARB EMFAC OFFROAD2021 Model v1.02.

No updates were made to the natural gas sector nor the solid waste sector. Updates to the 2019 GHG inventory are described in further detail in the *Hayward GHG Emissions Inventory Update Summary* section below. The GHG emissions sources included in the 2025, 2030, 2035, 2040, and 2045 forecasts analysis align with those in the GHG inventory, which includes GHG emissions sources related to land use and transportation in the Hayward General Plan Update planning area. The GHG emissions sectors and associated sources included in the inventories and forecasts are provided in Table 1.

[1] California's long-term GHG emission reduction goals were established by the landmark Assembly Bill 32, Senate Bill 32, and Executive Order B-55-18. Collectively, these legislative actions provide a GHG reduction trajectory of reducing Statewide GHG emissions to 1990 GHG emission levels by 2020, 40% below 1990 GHG emissions levels 2030, and carbon neutrality by 2045.

[2] EIE uses unique Google data sources and modeling capabilities to produce estimates of activity, emissions, and makes them freely available. Google EIE account for all VMT by all vehicle types that start or ends within the City boundary for a calendar year using anonymized and aggregated Location History data (i.e., the underlying information made available in Google Maps). More information can be found here: https://insights.sustainability.google/methodology

Table 1 Hayward GHG Emissions Sectors and Sources

GHG Emissions Sector	GHG Emissions Source
Transportation	Passenger On-Road Transportation
	Commercial On-Road Transportation
	Bus On-Road Transportation (excluding Public Transit)
	Off Road - Diesel
	Off Road - Gasoline
	Off Road - Natural Gas (LPG)
	Public Transit - BART
	Public Transit – AC Transit
Electricity[1]	Residential Electricity Consumption
	Non-Residential Electricity Consumption
Natural Gas	Residential Natural Gas Consumption
	Non-Residential Natural Gas Consumption
Water	Indirect Electricity Consumption from Water Delivery
Wastewater	Indirect Electricity Consumption from Wastewater Collection and Treatment
	Direct Wastewater Treatment Emissions
Solid Waste	Methane Commitment of Solid Waste Generated by Community

1. Electricity Consumption includes electricity provided by Pacific Gas and Electric (PG&E)and Other Providers including local Community Choice Aggregation (CCAs).

2. Direct wastewater treatment emissions are from the following sources: digester gas from anaerobic digesters at wastewater treatment plants, nitrification of wastewater, and effluent from treatment and discharge of wastewater

Hayward GHG Emissions Inventory Update Summary

The GHG emissions forecast analysis presented here is based upon the calculated GHG emissions from each source included in the 2019 GHG emissions inventory developed by the City. The City updated the emissions calculations for the 2019 GHG inventory for on-road transportation, off-road transportation, public transit, and for electricity. The updates made by the City are summarized below and are detailed in a City-prepared *Hayward GHG Emissions Inventory Technical Memorandum*.

Transportation Sector Updates

On-Road Transportation Updates

Hayward's previous inventories included VMT data from Metropolitan Transportation Commission (MTC) which included passenger vehicles and commercial vehicles. To ensure a complete representation of all on-road vehicles, the data set was adjusted in the previous GHG inventories to include motorcycles, motor homes, and buses using EMFAC data sets as those vehicle classes are not included in the MTC data set. However, the City plans to use Google EIE VMT data for all future inventories, starting with 2020. Google EIE account for all trips by all vehicle types that start or ends within the City boundary using anonymized and aggregated Location History data. Use of Google EIE VMT data is advantageous to trip based traffic models as the data is collected real time throughout the year and is reflective of changes occurring in City VMT year over year, unlike transportation models which estimate VMT based on population and land use changes.

It is important that the methodology and data sources utilized for the inventories and forecast developed from the most current inventory are consistent as this limits the risk of any emission changes observed to be an artifact of methodology or model changes. Therefore, to address the risk associated with transitioning to a different VMT data source that uses a different estimation methodology, the City updated all previous GHG emissions inventories (2005, 2010, 2015, 2017, 2018, and 2019) to be based on Google EIE VMT data. Google EIE began collecting VMT data in 2018 and does not have previous VMT values earlier than 2018. As such, the City updated the 2018 and 2019 inventories using available Google EIE data. Total annual VMT data obtained from Google EIE for Hayward for 2018 and 2019 was found to be on average 13 percent lower than the modeled 2018 and 2019 MTC data utilized in the previous inventories. To make the previous inventories 2005, 2010, 2015, and 2017 comparable to the revised 2018 and 2019 inventories, the previous MTC annual VMT data from 2005, 2010, 2015, and 2017 was scaled down by 12 percent. Reference the *VMT Memorandum* (forthcoming) for the detailed VMT methodology and comparative analysis between VMT data from the different sources and models.
A summary of the Hayward previous and updated on-road VMT emissions for each inventory year is provided in Table 2. Total annual VMT was attributed to either passenger or commercial vehicles based on the percent distribution determined for Alameda County using the recently updated California Air Resources Board (CARB) EMission FACtor (EMFAC) 2021 on-road model.[3] On-road transportation emissions were calculated using the updated VMT data and updated emissions factors were derived from EMFAC2021 on-road model.

[3] Passenger vehicles included the vehicle classes: LDA, LDT1, LDT2, MCY, MDV, MH, commercial vehicles included vehicle classes: LHDT1, LHDT2, HHDT, MHDT; bus vehicles included vehicle classes: OBUS, SUBUS, UBUS. See EMFAC2021 technical documentation for vehicle classification definitions.

Table 2 Hayward Previous and Updated On-Road Annual VMT and GHG Emissions

On-Road Total Annual VMT	2005	2010	2015	2017	2018	2019
Previous On-Road Total Annual VMT[1]	1,126,343,501	1,023,970,690	1,075,958,492	1,091,342,210	1,088,176,092	1,095,363,045
Previous On-Road Total CO_2e Emissions (MT)	630,735	576,052	577,103	568,684	550,025	547,339
Updated On-Road Total Annual VMT[2,3]	988,348,823	898,518,280	944,136,765	957,635,737	973,250,000	942,650,000
% Passenger Vehicles[4,5]	90.3%	90.9%	91.7%	91.2%	91.4%	91.2%
% Commercial Vehicles[4,5]	9.3%	8.7%	7.9%	8.4%	8.2%	8.2%
% Buses Vehicles[3,4,5]	0.4%	0.4%	0.4%	0.4%	0.4%	0.6%
Passenger EF (MT CO_2e/VMT)[6]	0.00042	0.00041	0.00038	0.00036	0.00035	0.00035
Commercial EF (MT CO_2e/VMT) [6]	0.00148	0.00146	0.00147	0.00144	0.00144	0.00144
Bus EF (MT CO_2e/VMT) [6]	0.00171	0.00175	0.00155	0.00150	0.00149	0.00147
Updated On-Road Total CO_2e Emissions(MT)[7]	520,768	458,988	441,751	437,514	436,005	417,862

Notes: Values in this table may not add up to totals due to rounding.
VMT = vehicle miles traveled; CO_2e = carbon dioxide equivalent

1. VMT data in previous inventories obtained from MTC. The method that MTC uses to model VMT omits certain types of vehicles, including motorcycles, motor homes and all types of buses. Previous inventories estimated VMT from these vehicle types to ensure a more complete inventory, using data from the California Air Resources Board's EMFAC model. VMT from these omitted vehicle types were added back into the MTC VMT total.

2. Google EIE data includes all trips from all vehicle classes (excluding transit buses). Because Google EIE data is only available for 2018 and 2019, MTC data for earlier inventory years (2005, 2010, 2015, and 2017) was scaled down by the average difference between Google EIE 2018 and 2019 data and 2018 and 2019 MTC data (i.e., Google EIE VMT data was ~12% lower than annual MTC VMT data for the corresponding year).

3. Updated VMT data for 2018 and 2019 were obtained from Google EIE where total VMT includes the Google EIE vehicle category "automobile", that encompasses passenger and commercial vehicles, and "buses" that includes all buses except AC Transit.

4. Percent distribution between passenger, commercial, and bus VMT was obtained from EMFAC2021 for Alameda County for inventory years 2005, 2010, 2015, and 2017. For 2018 and 2019, the percent distribution of total VMT that was buses was obtained directly from Google EIE, whereas the remaining VMT was allocated to either passenger or commercial VMT based on the percent distribution between passenger and commercial vehicles obtained from EMFAC2021 for Alameda County.

5. Vehicle types from EMFAC2021 are categories as passenger, commercial or buses as follows: Passenger (LDA, LDT1, LDT2, MCY, MDV, MH); Commercial (LHDT1, LHDT2, MHDT, HHDT); Buses (OBUS, SBUS, UBUS)

6. City-level data is not available from EMFAC2021 however it is assumed that county-level emission factors and vehicle class distribution is representative of the City.

7. VMT by vehicle class was determined by multiplying total adjusted VMT by % distribution by vehicle class. Emission factors by vehicle class were applied to the VMT by vehicle class and summed to calculate the updated on-road emissions total for all inventories.

Off-Road Transportation Updates

The City updated all GHG emissions inventories (2005, 2010, 2015, 2017, 2018, 2019) using the recently released OFFROAD2021 off-road emissions database. Off-road activity data, measured in U.S. gallons of fuel consumed by fuel type, was estimated using a combination of outputs from the CARB OFFROAD2021 Model (V1.0.2), per CARB recommendations. The updated inventories aggregate off-road activity by fuel type and allocate these emissions to the transportation sector using the same allocation factors previously used.

Public Transit Updates

The City updated all GHG emissions inventories (2005, 2010, 2015, 2017, 2018, 2019) to include emissions associated with Alameda-Contra Costa Transit (AC Transit) attributed to Hayward following the U.S. Community Protocol methodology for public transit attribution to a community. Transit emissions were first calculated for AC Transit using the U.S. Community Protocol methods TR.4.A and TR.4.B, where National Transit Database (NTD) reported fuel consumption data was multiplied by the fuels emission factor for buses. U.S. Community Protocol method TR.4.D was used to determine attribution of emissions to the community based on the amount of total vehicle revenue miles for the agency that were traveled within Hayward's city boundaries.

Electricity Sector Updates

The City updated all GHG emissions inventories (2005, 2010, 2015, 2017, 2018, 2019) to use updated regional electricity emissions factors for CH_4 and N_2O to supplement PG&E supplied CO_2 emission factors. Because PG&E does not provide CH4 and N2O emission factors for electricity, the City updated the eGRID CH_4 and N_2O emission factor to be regionally specific to the California grid by pulling the emission factor from the eGRID Summary Tables on the EPA's website[4].

Water and Wastewater Sectors Updates

The City previously had not included emissions associated with indirect electricity use for water and wastewater or process emissions associated with wastewater treatment attributed to the City in the historical inventories. Following the same *Methodological Summary* used to prepare the historical inventories, the City updated all GHG emissions inventories (2005, 2010, 2015, 2017, 2018, 2019) to include indirect electricity emissions and direct emissions associated with water and wastewater generation in the community. See the *East Bay Energy Watch Regional Greenhouse Gas Inventory Phase III Methodological Summary* (June 2020) for details on the activity data used and the analysis methodology consistent with the Community Protocol.

Natural Gas and Solid Waste Sectors Updates

No updates to Hayward's GHG emissions inventories were necessary related to the natural gas and solid waste sectors.

Overall Updated 2019 GHG Emissions Inventory

A detailed summary of the updated 2019 GHG emissions inventory, incorporating the aforementioned individual sector updates, is provided in Table 3. The updated 2019 GHG emissions inventory was utilized for forecasting future emissions.

[4] eGrid Summary Tables 2019. 2019. https://www.epa.gov/sites/default/files/2021-02/documents/egrid2019_summary_tables.pdf. Accessed March, 18 2022.

Table 3 Hayward Updated 2019 GHG Emissions Inventory Summary

GHG Emissions Sector/Source	Emissions (MT CO_2e)	Activity Data	Activity Data Units
Transportation			
Passenger On-Road Transportation[1]	298,256	859,527,091	VMT
Commercial On-Road Transportation[1]	111,329	77,472,909	VMT
Bus On-Road Transportation[2]	8,277	5,650,000	VMT
Off Road - Diesel	14,661	1,421,471	Gallons
Off Road - Gasoline	4,940	542,985	Gallons
Off Road - Natural Gas (LPG)	4,687	807,908	Gallons
Public Transit - BART	547	41,311,182	Passenger Miles
Public Transit- AC Transit[3]	4,308	1,666,441	Passenger Miles
Electricity[4,5]			
Residential Electricity - PG&E	1,144	12,136,210	kWh
Non-Residential Electricity – PG&E	3,032	32,163,187	kWh
Tier 1 Residential Electricity – Other Providers	5,182	84,954,304	kWh
Tier 1 Non-Residential Electricity – Other Providers	3,108	50,952,251	kWh
Tier 2&3 Residential Electricity – Other Providers	0	141,916,183	kWh
Tier 2&3 Non-Residential Electricity – Other Providers	0	428,524,234	kWh
Natural Gas[5]			
Residential Natural Gas	95,291	17,943,901	Therms
Non-Residential Natural Gas	81,358	15,320,155	Therms
Water			
Indirect Electricity from Water Delivery[6]	6	66,143	kWh
Wastewater			
Indirect Electricity from Wastewater Treatment[5]	380	4,029,050	kWh
Direct Emissions from Wastewater Treatment	1,702	160,197	Population
Solid Waste			
Solid Waste Generated/Disposal	43,171	150,924	Tons Landfilled
Alternative Daily Cover (ADC) Generated	3,015	12,272	Tons Landfilled

Notes: MT CO_2e = metric tons carbon dioxide equivalents; kWh = kilowatt hours; N/A = not applicable

1. As described in the above sections, the on-transportation sector was updated as moving forward the City will be using Google EIE data. EMFAC2021 percent allocation of VMT to passenger and commercial vehicles classes for the County of Alameda in 2019 was applied to the total annual automobile VMT data category obtained from Google EIE for Hayward.

2. Google EIE reports VMT from all bus types except public transit including AC Transit.

3. Emissions associated with public transit are those attributed to Hayward based on passenger miles occurring within City boundaries.

4. The City receives electricity from PG&E as well as the Community Choice Aggregation East Bay Community Energy (EBCE). Tier 2 and Tier 3 of EBCE provided electricity are both carbon-free. Tier 2 reaches a carbon-free emission factor through use of large hydro-electric power which is not considered a eligible renewable source per RPS definitions. Tier 3 reaches a carbon-free emission factor through power supplied 100% by eligible renewable sources per RPS definitions.

5. PG&E published data presented herein meets the aggregation and anonymization rules to meet privacy regulations. Details of privacy regulations can be found here: https://pge-energydatarequest.com/sites/default/files/PGE_Aggregation_and_Anonymization_Rules.pdf

6. City rounds indirect electricity emissions from water and wastewater to the tenths place in their inventory. These values have not been rounded here for the purpose of forecasting.

Hayward GHG Emissions Forecasts

Hayward's 2019 inventory establishes a reference point for communitywide emissions in a specific year. However, annual GHG emissions change over time and GHG emissions forecasts provide a way to estimate future emission levels based on both the continuation of current activities and external factors such as population and job growth. Forecasts also account for California legislative actions that are anticipated to reduce GHG emissions. Thus, the emissions forecast provides detail on the level of GHG reductions needed to achieve the GHG emissions reduction targets in a future year. Calculating the difference between the forecasted GHG emissions and the reduction target determines the gap to be closed through local actions and policies. This section includes an estimate of the future emissions for Hayward in the years 2025, 2030, 2035, 2040, and 2045 in a *business-as-usual scenario* (BAU) forecast and an *adjusted scenario* (adjusted) forecast, which are defined as follows:

- B*usiness-as-usual scenario*- Provides a forecast of how future GHG emissions would change if current activities continued as they did in 2019 and growth trends were to occur absent of any policies or legislation that would reduce local emissions. The BAU forecast is based on growth trends projected in population, housing, employment, and transportation activity over time, consistent with regional projections.
- *Adjusted scenario*- Provides a forecast of how currently adopted legislation would reduce GHG emissions from the *business-as-usual scenario*. The *adjusted scenario* represents the State's contribution to reducing local GHG emissions to meet State goals without any additional contribution from local policies or actions.

Business-as-usual (BAU) GHG Emissions Forecast

The BAU forecast provides an estimate of how GHG emissions would change in the forecast years if existing action continued as in 2019, absent any new regulations or actions which would reduce local GHG emissions. The BAU forecast is based on growth projected trends in population, and employment over time, consistent with local and regional projections. The BAU GHG emissions projections were calculated based on the guidance of the Association of Environmental Professionals 2012 whitepaper Forecasting Communitywide GHG Emissions and Setting Reduction Targets. The result is a BAU forecast in which GHG emissions change with time in relation to demographics, with the assumption that GHG emissions rates and activity data will continue in the future as they did in the year of the 2019 GHG emissions inventory. This methodology is used for all GHG emissions sectors and sources included in the 2019 GHG emissions inventory except for off-road transportation. Off-road equipment GHG emissions were alternatively projected using modeled activity data and emissions as detailed below. A description of the demographic metrics used to project activity data and associated growth factors for each forecasted GHG emission source are provided in Table 4 for each for the GHG emission sources in the 2019 community GHG emissions inventory. Detailed calculations for the BAU forecast are included in Attachment A.

Table 4 Growth Metrics and Associated GHG Emissions Sectors

GHG Emissions Sector	GHG Emission Source	Associated Growth Metric	Growth Metric Data Source
Transportation	Passenger On-Road	Households	Plan Bay Area 2040
	Commercial On-Road	Service Population	Plan Bay Area 2040
	Bus On-Road (excluding Public Transit)	Service Population	Plan Bay Area 2040
	Public Transit -BART	Service Population	Plan Bay Area 2040
	Public Transit – AC Transit	Service Population	Plan Bay Area 2040
Electricity	Residential GHG Emissions Sources	Households	Plan Bay Area 2040
	Non-Residential GHG Emissions Sources	Employment	
Natural Gas	Residential GHG Emissions Sources	Households	Plan Bay Area 2040
	Non-Residential GHG Emissions Sources	Employment	
Water	All GHG Emissions Sources	Service Population	Plan Bay Area 2040
Wastewater	All GHG Emissions Sources	Population	Plan Bay Area 2040
Solid Waste	All GHG Emissions Sources	Service Population	Plan Bay Area 2040

The BAU forecast for the Hayward planning area relies on the growth and demographic projections used in the Hayward Housing Element currently being drafted and was obtained from the Plan Bay Area 2040 for the Alameda CTC Zone.[5] Demographic projections were approved by the City for use in forecasting. Table 5 provides an overview of the growth metrics used to project GHG emissions for the BAU forecast calculations.

Table 5 Growth Metrics for Hayward BAU GHG Emissions Forecast

Growth Metric[1,2]	2019[1]	2025	2030	2035	2040	2045[3]
Population	160,197	161,781	167,425	173,069	178,713	184,358
Employment	70,739	70,326	72,073	73,821	75,568	77,315
Service Population	230,936	232,107	239,498	246,890	254,281	261,673
Housing	47,987	51,788	53,108	54,427	55,747	57,066

Notes: Service Population = Population + Employment

1. Previous inventories demographic data was obtained from MTC, including years 2005,

2. Forecasted demographic data for Hayward is based on the Alameda CTC Zone from plan Bay Area 2040 and is consistent with the projections used for the Housing Element and traffic analysis conducted by Kittleson & Associates, Inc. Data was provided for year 2020 and 2040, therefore interim years were linearly interpolated.

3. To estimate demographic growth past 2040, the annual compound growth rate between 2020 and 2040 was applied to the demographic data to estimate demographic projections in 2045.

The growth indicators for Hayward are provided in Table 6 for each GHG emissions source, excluding off-road fuel consumption which was modeled separately, described in more detail below.

[5] Although the Plan Bay Area 2050 was adopted in October 2021, at the time of drafting this forecast and Housing Element the demographic projections obtained and approved by the City from the Plan Bay Area 2040 are considered the best available data.

Table 6 Growth Indicators for BAU GHG Emissions Forecast

GHG Emissions Source	Activity Data	Units
Transportation		
Passenger On-Road	17,911.67	Passenger VMT/Household
Commercial On-Road	335.47	Commercial VMT/Service Population
Bus On-Road (excluding Public Transit)	24.47	Bus VMT/ Service Population
Off Road - Diesel	NA	OFFROAD Model
Off Road - Gasoline	NA	OFFROAD Model
Off Road - Natural Gas (LPG)	NA	OFFROAD Model
Public Transit - BART	178.89	Passenger Miles/Service Population
Public Transit – AC Transit	7.22	Passenger Miles/Service Population
Electricity		
Residential Electricity	4,980.66	kWh/Household
Non-Residential Electricity	7,232.81	kWh/Employment
Natural Gas		
Residential Natural Gas	373.93	Therms/Household
Non-Residential Natural Gas	216.57	Therms/Employment
Water		
Indirect Electricity from Water Delivery	0.00022	MG/Service Population
Wastewater		
Indirect Electricity from Wastewater Treatment	0.026	MG/Population
Direct Emissions from Wastewater Treatment	0.011	MT CO_2e/Population
Solid Waste		
Solid Waste Generation	0.65	Tons Landfilled/Service Population
ADC Generation	0.05	Tons Landfilled/Service Population
Notes: NA = not applicable; MT CO_2e = metric ton carbon dioxide equivalent; kWh = kilowatt-hour; MG = million gallons		

Off-Road Activity Data

Activity data for off-road GHG emissions forecast was modeled separately from the above growth metrics and growth indicators, using the outputs from the CARB web-based OFFROAD2021 model. The OFFROAD2021 database was queried for Alameda County for the forecast years to obtain fuel consumption for gasoline, diesel, and natural gas. The inclusion of specific equipment sectors from the database query was determined based on their relevance to activities occurring within Hayward and remained consistent with previous Hayward inventories. The following equipment sectors are included in the 2019 baseline year inventory and the GHG emissions forecast:

- Construction and Mining
- Light Commercial
- Industrial
- Pleasure Craft
- Portable Equipment

- Recreational Vehicles
- Lawn and Garden
- Transportation Refrigeration Units

The results of the database query were summarized for all equipment sectors in Alameda County. Hayward was allocated a percentage of county fuel consumption for each sector relative to Hayward's proportion of jobs or population in the county. The results are summarized in Table 7.

Table 7 Hayward BAU GHG Emissions Forecast Off-Road Fuel Consumption

Off-road Fuel Category	2019	2025	2030	2035	2040	2045
Diesel	1,421,471	1,591,090	1,741,895	1,882,487	2,034,506	1,500,899
Gasoline	542,985	585,183	624,078	665,017	710,483	712,605
Natural Gas	807,908	876,474	937,988	1,001,263	1,071,304	1,071,304

Notes: All values are of the unit gallons of fuel

Data Source: California Air Resources Board. 2021. OFFROAD2021 v1.0.2 Emissions Inventory . Available: https://arb.ca.gov/emfac/emissions-inventory/b3e3139ff7a2304c48acb2a0684ab41b38c5c26e. Accessed March 25, 2022.

Emissions Factors

The BAU GHG emissions forecast is representative of a scenario where community activities are generally similar to that of the most recent 2019 GHG emissions inventory. As such, BAU activity data growth is multiplied by the emissions factors used to calculate GHG emissions from the 2019 GHG emissions inventory to generate an estimate of future GHG emissions without influence from GHG reduction policies at the State or local level. The BAU GHG emissions factors for the relevant GHG emissions sources and sectors are provided in Table 8, reported in MT CO_2e.

Table 8 BAU GHG Emissions Factors

GHG Emissions Source	GHG Emissions Factor	Units
Transportation		
Passenger On-Road[1]	0.000347	MT CO_2e/VMT
Commercial On-Road[1]	0.00144	MT CO_2e/VMT
Bus On-Road (excluding Public Transit)[1]	0.00147	MT CO_2e/VMT
Off Road - Diesel	0.0103	MT CO_2e/Gallons
Off Road - Gasoline	0.0091	MT CO_2e/Gallons
Off Road - Natural Gas (LPG)	0.0058	MT CO_2e/Gallons
Public Transit - BART	0.0000133	MT CO_2e/Passenger Miles
Public Transit – AC Transit	0.00259	MT CO_2e/Passenger Miles
Electricity[2]		
Weighted Residential Electricity	0.0000265	MT CO_2e/kWh
Weighted Non-Residential Electricity	0.0000120	MT CO_2e/kWh
Natural Gas		
Residential Natural Gas	0.00531	MT CO_2e/Therm
Non-Residential Natural Gas	0.00531	MT CO_2e/Therm
Water		
Indirect Electricity from Water Delivery[3]	0.000094	MT CO_2e/kWh
Wastewater		
Indirect Electricity from Wastewater Treatment[3]	0.000094	MT CO_2e/kWh
Direct Emissions from Wastewater Treatment[4]	0.0106	MT CO_2e/person
Solid Waste		
Solid Waste Generation	0.29	MT CO_2e/Tons Landfilled
ADC Generation	0.25	MT CO_2e/Tons Landfilled

Notes: NA = not applicable; VMT = vehicle miles traveled; MT CO_2e = metric ton carbon dioxide equivalent; kWh = kilowatt-hour; ADC = alternative daily cover

1. On-road passenger, commercial, and bus VMT in the 2019 inventory does not differentiate EV vs ICE vehicles, as such its assumed that electricity associated with EV charging is captured in the building energy sector. The BAU forecast follows suit and electricity associated with EV charging is captured under the building energy sector.

2. Electricity emission factors for residential and non-residential are weighted based on the quantity of electricity consumed by each category by provider and the associated emission factor. It is assumed for the BAU forecast that the emission factors for all providers will not change from the 2019 year

3. Electricity emission factor for indirect electricity emissions from water and wastewater assumed to be PG&E default emission factor to remain consistent with previously prepared inventories.

4. Starting in 2018, Hayward began managing all the City's wastewater. Because wastewater treatment methods and the associated calculation parameters (i.e. default values and constants) remain the same year over year and change only with the change in population served, all direct emissions associated with wastewater treatment were aggregated and divided by the population served in 2019 to develop a single emission factor.

BAU GHG Emissions Forecast Results

The following provides a summary of the results of the BAU GHG emissions forecast for each source in Hayward. The results have been reported in MT CO_2e. The BAU forecast projects a gradual increase in GHG emissions above the baseline 2019 GHG emissions inventory from the energy sector, water and wastewater sector, and from solid waste due to projected population growth. Emissions associated with

transportation show a slight decline over time attributed to an increasing contribution of VMT traveled by EVs as projected by EMFAC2021 which offsets the increased VMT projected. Table 9 and Figure 1 provide a summary of the Hayward BAU GHG emissions forecast.

Table 9 Hayward BAU GHG Emissions Forecast Summary

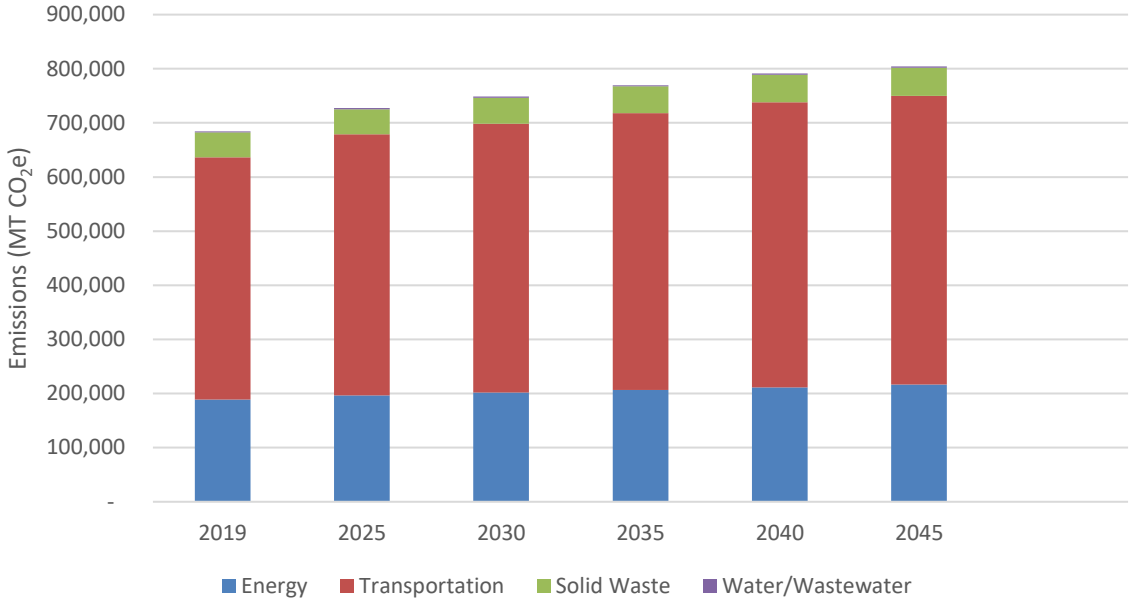
GHG Emissions Source	2019	2025	2030	2035	2040	2045
Transportation						
Passenger On-Road Transportation	298,256	321,882	330,084	338,285	346,486	354,687
Commercial On-Road Transportation	111,329	120,212	124,041	127,869	131,697	135,525
Bus On-Road Transportation[1]	8,277	8,319	8,584	8,849	9,114	9,379
Off Road – Transportation and Equipment	24,287	26,818	29,084	31,274	33,662	28,177
Public Transit - BART	547	550	568	585	603	620
Public Transit - AC Transit	4,308	4,330	4,468	4,605	4,743	4,881
Electricity[2]						
Residential Electricity	6,326	6,828	7,001	7,175	7,349	7,523
Non-Residential Electricity	6,140	6,104	6,256	6,408	6,560	6,711
Natural Gas						
Residential Natural Gas	95,291	102,840	105,460	108,080	110,701	113,321
Non-Residential Natural Gas	81,358	80,883	82,893	84,903	86,912	88,922
Water						
Indirect Electricity from Water Delivery	6	6	6	7	7	7
Wastewater						
Indirect Electricity from Wastewater Treatment	380	384	397	410	424	437
Direct Emissions from Wastewater Treatment	1,702	1,719	1,779	1,839	1,899	1,959
Solid Waste						
Solid Waste Generation	43,171	43,390	44,772	46,154	47,536	48,917
ADC Generation	3,015	3,030	3,127	3,223	3,320	3,416
TOTAL	**684,395**	**727,297**	**748,520**	**769,667**	**791,012**	**804,484**

Notes: Values in this table may not add up to totals due to rounding. All values are of the unit metric tons of carbon dioxide equivalent (MT CO_2e)

1. Bus on-road transportation does not include public transit. Public transit is calculated separately.

2. Electricity associated with EV charging is captured in the building energy sector in the BAU forecast.

Figure 1 Hayward BAU GHG Emissions Forecast (MT CO_2e) through 2045



Adjusted GHG Emissions Forecast

Several federal and State regulations have been enacted that would reduce Hayward's GHG emissions in 2025, 2030, 2035, 2040, and 2045. The impact of these regulations was quantified and incorporated into the adjusted forecast to project future emissions growth and the responsibility of the City and community once established State regulations have been implemented. The State legislation included in the adjusted forecast result in GHG emission reductions related to transportation, building efficiency and renewable electricity. A brief description of each regulation and the methodology used to calculate associated reductions is provided in the following, as well as a description of why specific legislation was excluded from the analysis. The following State legislation were applied to the Adjusted Forecasts based on the unique sectors within Hayward:

- **2019 Title 24 Building Energy Efficiency Standards:** The California Code of Regulations Title 24, Part 6: California's Energy Efficiency Standards for Residential and Nonresidential Buildings, was first adopted in 1978 in response to a legislative mandate to reduce California's energy consumption, which in turn reduces fossil fuel consumption and associated GHG emissions. The standards are updated triennially to allow consideration and possible incorporation of new energy-efficient technologies and methods. The 2019 Title 24 Energy Efficiency Standards have come into effect, creating significantly more efficient new building stock. Starting in 2020, new residential developments must include on-site solar generation and near-zero net energy use.
- **Renewable Portfolio Standard and Senate Bill 100:** Established in 2002 under Senate Bill 1078, enhanced in 2015 by Senate Bill 350, and accelerated in 2018 under Senate Bill 100, California's Renewables Portfolio Standard (RPS) is one of the most ambitious renewable energy standards in the country. The RPS program requires investor-owned utilities, publicly owned utilities, electric service providers, and community choice aggregators to increase procurement from eligible renewable energy resources to 50 percent of total procurement by 2026 and 60 percent of total procurement by 2030. The RPS program further requires these entities to increase procurement from GHG-free sources to 100 percent of total procurement by 2045.

- **Transportation Legislation:** Major regulations incorporated into CARB's 2021 transportation model (EMFAC2021) include Advanced Clean Car Standards (LEV III, ZEV program, etc.), Senate Bill 1, and Phase 2 Federal GHG Standards. Additional reductions were calculated for the newly promulgated Innovative Clean Transit (ICT) regulations from CARB. Signed into law in 2002, AB 1493 (Pavley Standards) required vehicle manufacturers to reduce GHG emissions from new passenger vehicles and light trucks from 2009 through 2016. Regulations were adopted by CARB in 2004 and took effect in 2009 when the United States Environmental Protection Agency (USEPA) issued a waiver confirming California's right to implement the bill. The CARB anticipates that the Pavley I standard will reduce GHG emissions from new California passenger vehicles by about 30 percent in 2016, while simultaneously improving fuel efficiency and reducing motorists' costs.[6] Prior to 2012, mobile emissions regulations were implemented on a case-by-case basis for GHG and criteria pollutant emissions separately. In January 2012, CARB approved a new emissions-control program combining the control of smog, soot-causing pollutants, and GHG emissions into a single coordinated package of requirements for passenger cars and light trucks for model years 2017 through 2025. The Advanced Clean Cars program coordinates the goals of the Low Emissions Vehicles, Zero Emissions Vehicles, and Clean Fuels Outlet programs into a single coordinated package of requirements for model years 2017 to 2025. The new standards are anticipated to reduce GHG emissions by 34 percent in 2025.[7] Public transit GHG emissions will also be reduced in the future through the Innovative Clean Transit (ICT) regulation, which was adopted in December 2018. It requires all public transit agencies to gradually transition to a 100-percent zero-emission bus fleet by 2040. Under ICT, large transit agencies are expected to adopt Zero-Emission Bus Rollout Plans to establish a roadmap towards zero emission public transit buses.[8]

Table 10 summarizes the legislation that was applied to each sector in the adjusted forecast.

[6] CARB. Clean Car Standards – Pavley, Assembly Bill 1493. May 2013. http://www.arb.ca.gov/cc/ccms/ccms.htm

[7] CARB. Facts About the Advanced Clean Cars Program. December 2011. http://www.arb.ca.gov/msprog/zevprog/factsheets/advanced_clean_cars_eng.pdf

[8] Innovative Clean Transit. Approved August 13, 2019. https://ww2.arb.ca.gov/sites/default/files/2019-10/ictfro-Clean-Final_0.pdf?utm_medium=email&utm_source=govdelivery

Table 10 Hayward Adjusted GHG Emissions Forecast Sectors and Applicable Legislation

GHG Emissions Sector	GHG Emissions Source	
Transportation	Passenger On-Road Transportation	Transportation Legislation (Advanced Clean Cars Standards, Pavley Standards, Phase 2 Federal GHG Standards)
	Commercial On-Road Transportation	Transportation Legislation (Advanced Clean Cars Standards, Pavley Standards, Phase 2 Federal GHG Standards)
	Bus On-Road Transportation	Transportation Legislation (Advanced Clean Cars Standards, Pavley Standards, Phase 2 Federal GHG Standards)
	Off Road - Diesel	None
	Off Road - Gasoline	None
	Off Road - Natural Gas (LPG)	None
	Public Transit - BART	None
	Public Transit – AC Transit	Innovative Clean Transit
Electricity[1]	Residential Electricity Consumption	Title 24 – applied to new buildings SB 100 – all electricity use
	Non-Residential Electricity Consumption	Title 24 – applied to new buildings SB 100 – all electricity use
Natural Gas	Residential Natural Gas Consumption	Title 24 – applied to new buildings
	Non-Residential Natural Gas Consumption	Title 24 – applied to new buildings[1]
Water	Indirect Electricity Consumption from Water Delivery	SB 100
Wastewater	Indirect Electricity Consumption from Wastewater Collection and Treatment	SB 100
	Direct Wastewater Treatment Emissions	None
Solid Waste	Methane Commitment of Solid Waste Generated by Community	None

1. As detailed below, though Title 24 impacts new building it is not anticipated to have a natural gas reduction impact on non-residential buildings under the 2019 Energy Efficiency Standards.

The following State legislation was not included in the emissions forecast calculations:

- **Assembly Bill 939 and 341:** In 2011, AB 341 set the target of 75 percent recycling, composting, or source reduction of solid waste by 2020 calling for the California Department of Resources Recycling and Recovery (CalRecycle) to take a Statewide approach to decreasing California's reliance on landfills. This target was an update to the former target of 50 percent waste diversion set by AB 939. As actions under AB 341 are not assigned to specific local jurisdictions, AB 939 has not been included as part of the adjusted forecast and instead measures addressing compliance with AB 939 will be included in the CAP Update.
- **Senate Bill 1383:** In 2016, SB 1383 established a methane emission reduction target for short-lived climate pollutants (SLCP) in various sectors of the economy. Specifically, SB 1383 establishes targets to achieve a 50 percent reduction in the level of the Statewide disposal of organic waste from the 2014 level by 2020 and a 75 percent reduction by 2025 (CalRecycle 2019). Additionally, SB 1383 requires a 20 percent reduction in "current" edible food disposal by 2025. Although SB 1383 has been signed into law, compliance at the jurisdiction-level is un-proven. For example, Santa Clara

County, in their SB 1383 Rulemaking Overview presentation (June 20, 2018),[9] suggest that the 75 percent reduction in organics is not likely achievable under the current structure; standardized bin colors are impractical; and the general requirement is too prescriptive. As such, SB 1383 has not been included as part of the adjusted forecast. Instead measures addressing compliance with SB 1383 will be included and quantified through GHG reduction measures included in the CAP Update.

GHG Reduction Legislation Calculations

The following methodology was used to calculate energy-related GHG emissions reduction related to Title 24 and SB 100.

- **Title 24:** It is assumed that all growth in building energy consumption is from new construction. Accordingly, Title 24 GHG emissions reduction for natural gas and electricity are calculated as a percentage of the projected increase in energy consumption beyond the baseline 2019 GHG emissions inventory, under the BAU forecast. For projects implemented after January 1, 2020, the California Energy Commission (CEC) estimates that the 2019 standards will have the following energy consumption reduction impact:
  - 53 percent reduction beyond the 2019 baseline for residential electricity;
  - 30 percent reduction beyond the 2019 baseline for commercial electricity; and
  - 7 percent reduction beyond the 2019 baseline for residential natural gas.[10]
- **SB 100:** PG&E and other providers such as the Community Choice Aggregation East Bay Community Energy (EBCE) that currently provide electricity in Hayward are subject to SB 100 requirements. GHG emissions from electricity consumption are largely determined by the emissions factor associated with the supplied electricity. Legislative GHG emissions reductions from SB 100 are calculated as the difference between GHG emissions under the BAU forecast electricity and GHG emissions calculated using a SB 100-adjusted GHG emissions factor for a given forecast year. An adjusted GHG emission factors is calculated by scaling the current electricity GHG emissions factor with the RPS percentage for eligible renewable electricity required for compliance with SB 100. Each of the electricity providers for Hayward has different electricity emissions factors due to different RPS percentages in their electricity delivery mix. The RPS percentages and associated GHG emissions factors used to determine the adjusted forecast electricity emissions are provided in Table 11. In 2019, the RPS percentage for all EBCE tiers of service already exceeded SB 100 requirements of a 60% RPS percentage by 2030. As such, EBCE emission factors in the forecasted years were linearly interpolated between the 2019 emission factor and an emission factor of 0 in 2045 which would correspond with the SB 100 requirement of 100% RPS by 2045. Note that while both Title 24 and SB 100 influence GHG emissions reductions in the electricity sector, double counting of these reductions is avoided by accounting for Title 24 reductions first and then accounting for reductions from SB 100.

[9] Santa Clara County. June 20, 2018. SB 1383 Rulemaking Overview. https://www.sccgov.org/sites/rwr/rwrc/Documents/SB%201383%20PowerPoint.pdf
[10] California Energy Commission. 2018. 2019 Building Energy Efficiency Standards Frequently Asked Questions. Available: <https://www.energy.ca.gov/sites/default/files/2020-03/Title_24_2019_Building_Standards_FAQ_ada.pdf>. Accessed June 21, 2021.

Table 11 Electricity Provider Forecasted RPS and Electricity GHG Emissions Factors

Energy Provider	2019	2025	2030	2035	2040	2045
PG&E						
Renewable Portfolio Standard Percentage	32%	47%	*60%*	73%	87%	100%
Adjusted Electricity Emission Factor (MT CO_2e/kWh)	0.000094	0.000073	0.000055	0.000037	0.000018	0.0
Tier 1 – Other Providers (EBCE -Bright Choice)						
Adjusted Electricity Emission Factor (MT CO_2e/kWh)	0.000061	0.000047	0.000035	0.000023	0.000012	0.0
Tier 2&3 – Other Providers (EBCE – Brilliant 100 and Renewable 100)						
Adjusted Electricity Emission Factor (MT CO_2e/kWh)	0.0	0.0	0.0	0.0	0.0	0.0
Weighted Community Electricity Emissions Factor[1,2]						
Residential Adjusted Electricity Emission Factor (MT CO_2e/kWh)[1]	0.000026	0.000020	0.000015	0.000010	0.000005	0.0
Non-residential Adjusted Electricity Emission Factor (MT CO_2e/kWh)[2]	0.000012	0.000009	0.000007	0.000005	0.000002	0.0

Notes: MT CO_2e = metric tons of carbon dioxide equivalent; kWh = kilowatt hour

1.The Residential Weighted Electricity Emission Factor is developed based on the percent of residential electricity provided by each provider in 2019. It is assumed that the percent of residential electricity provided by each provider remains consistent over time. Based on the 2019 inventory, residential electricity was provided by the providers as follows: ~ 5% by PG&E, ~35% by EBCE- Bright Choice (Tier 1), ~ 59% by EBCE – Brilliant 100 (Tier 2), ~.<0.1% by EBCE – Renewable 100 (Tier 3).

2.The Non-residential Weighted Electricity Emission Factor is developed based on the percent of non-residential electricity provided by each provider in 2019. It is assumed that the percent of residential electricity provided by each provider remains consistent over time. Based on the 2019 inventory, non-residential electricity was provided by the providers as follows: ~ 6% by PG&E, ~10% by EBCE- Bright Choice (Tier 1), ~ 84% by EBCE – Brilliant 100 (Tier 2), ~.<0.1% by EBCE – Renewable 100 (Tier 3).

The following methodology was used to calculate transportation-related GHG emissions reduction related to various State legislation.

- **Transportation Legislation:** Activity data for the adjusted forecasted on-road transportation VMT was similarly forecasted as the BAU forecast where the growth metrics were applied to the BAU growth indicators for passenger and commercial VMT to forecast passenger and commercial VMT. Reductions in GHG emissions from the above referenced transportation standards were calculated using CARB's EMFAC2021 model for Alameda County. The EMFAC2021 model integrates the estimated reductions into the mobile source emissions portion of the model.[11] The degree to which GHG emissions from on-road transportation will be reduced can be quantified as the difference between transportation emissions calculated using the 2019 provided emission factors and calculated using the reduced emission factors for the target years. In addition, passenger and commercial electric vehicle (EV) electricity consumption was calculated per forecast year based on EV penetration rates obtained from EMFAC 2021.

[11] Additional details are provided in CARB's EMFAC2017 Technical Documentation, July 2018. (https://www.arb.ca.gov/msei/downloads/emfac2017-volume-iii-technical-documentation.pdf). Note that the Low Carbon Fuel Standard (LCFS) regulation is excluded from EMFAC2017 because most of the emissions benefits due to the LCFS come from the production cycle (upstream emissions) of the fuel rather than the combustion cycle (tailpipe). As a result, LCFS is assumed to not have a significant impact on CO_2 emissions from EMFAC's tailpipe emission estimates.

Passenger and commercial EV emissions from electricity consumption are subtracted from residential and commercial energy emissions respectively in the adjusted forecast as emissions from EV charging in the forecast years are captured under the transportation sector. This emissions reallocation is labeled as an "EV adjustment" in the forecasts. The forecasted annual VMT and associated GHG emissions factors used to determine the adjusted forecast on-road emissions are provided in Table 12.

Table 12 Hayward Passenger On-Road Transportation Forecast

Growth Metric	2019	2025	2030	2035	2040	2045
Total VMT[1]	942,650,000	1,011,159,621	1,037,454,669	1,063,749,716	1,090,044,764	1,116,339,812
Passenger VMT[1]	859,527,091	927,615,232	951,249,744	974,884,257	998,518,769	1,022,153,281
Commercial VMT[1]	77,472,909	77,865,740	80,345,435	82,825,129	85,304,824	87,784,519
Bus VMT[1]	5,650,000	5,678,649	5,859,490	6,040,331	6,221,172	6,402,012
Passenger EV Share[2]	0.0%	6.9%	8.6%	9.6%	10.0%	10.2%
Commercial EV Share[2]	0.0%	0.7%	6.9%	17.6%	25.9%	27.5%
Bus EV Share[2]	0.0%	0.2%	14.1%	32.3%	47.3%	59.9%
Passenger ICE Emission Factor (MT CO_2e/mile)	0.00035	0.00033	0.00030	0.00029	0.00028	0.00028
Commercial ICE Emission Factor (MT CO_2e/mile)	0.00144	0.00134	0.00126	0.00122	0.00121	0.00121
Bus ICE Emission Factor (MT CO_2e/mile)	0.00147	0.00136	0.00127	0.00121	0.00121	0.00114

Notes: VMT = vehicle miles traveled, EV = electric vehicle; ICE = internal combustion engine

1. Data for forecast years estimated by multiplying the growth indicator for VMT from the 2019 inventory multiplied by growth metric (i.e., households for passenger vehicles and service population for commercial and bus vehicles). Vehicle categories include the following vehicle types: Passenger (LDA, LDT1, LDT2, MCY, MDV, MH); Commercial (LHDT1, LHDT2, MHDT, HHDT); Buses (OBUS, SBUS, UBUS). Bus VMT presented here does not include Public Transit -AC Transit which is calculated separately as described in this memorandum.

2.Previous inventories did not separately account for electricity used for EV charging. In forecast years EV share by vehicle category was obtained from EMFAC2021 and applied to the respective vehicle category to estimate electricity used for EVs. The calculated electricity is subsequently removed from the electricity sector in the adjusted forecast to avoid double counting.

Adjusted GHG Emissions Forecast Results

Compliance with State legislation is expected to result in GHG emissions reduction from the BAU GHG Emissions Forecast in the transportation and energy sectors for residential and non-residential activities. Compliance with both the Pavley regulation, which requires automakers to control GHG emission from new passenger vehicles for the 2009 through 2016 model years, and the Advanced Clean Car Program, which combines the control of smog-causing (criteria) pollutants and GHG emissions into a single package of regulations, are expected to reduce GHG emissions from transportation. Emissions associated with heavy-duty trucks and transit buses are also anticipated to be reduced through the Advanced Clean Trucks Regulation and Innovative Clean Transit, respectively. Compliance with Title 24 requirements are expected to reduce GHG emissions from reduced electricity and natural gas consumption in new buildings. Compliance with SB 100 requirements are expected to further reduce

GHG emissions in the residential sector through reduced GHG emissions associated with electricity generation, as well as similar reductions in the commercial sector. SB 100 is also anticipated to reduced indirect electricity emissions associated with water and wastewater conveyance and treatment. A detailed summary of the projected GHG emissions under the adjusted forecast by sector and year through 2045 can be found in Table 13 .

Table 13 Hayward Adjusted GHG Emissions Forecast Detail

GHG Emissions Source	2019	2025	2030	2035	2040	2045
Transportation						
Passenger On-Road Transportation	298,256	281,963	264,018	256,013	254,427	256,924
Commercial On-Road Transportation	111,329	103,620	94,404	83,586	77,090	74,698
Bus On-Road Transportation[1]	8,277	7,703	6,398	4,975	3,964	2,922
Off Road – Transportation and Equipment	24,287	26,818	29,084	31,274	33,662	28,177
Public Transit - BART	547	550	568	585	603	620
Public Transit - AC Transit	4,308	4,010	3,324	2,581	2,056	1,519
Electricity[2]						
Residential Electricity – EV Adjusted	6,326	4,771	3,586	2,401	1,210	-
Non-Residential Electricity -EV Adjusted	6,140	4,670	3,548	2,370	1,190	-
Natural Gas						
Residential Natural Gas	95,291	102,311	104,748	107,185	109,622	112,059
Non-Residential Natural Gas	81,358	80,883	82,893	84,903	86,912	88,922
Water						
Indirect Electricity from Water Delivery	6	5	4	3	1	-
Wastewater						
Indirect Electricity from Wastewater Treatment	380	297	232	160	83	-
Direct Emissions from Wastewater Treatment	1,702	1,719	1,779	1,839	1,899	1,959
Solid Waste						
Solid Waste Generation	43,171	43,390	44,772	46,154	47,536	48,917
ADC Generation	3,015	3,030	3,127	3,223	3,320	3,416
TOTAL	**684,395**	**665,743**	**642,486**	**627,251**	**623,574**	**620,134**

Notes: Values in this table may not add up to totals due to rounding. All values are of the unit metric tons of carbon dioxide equivalent (MT CO_2e)

1. Bus on-road transportation does not include public transit. Public transit is calculated separately.

2. Electricity associated with EV charging is captured in the transportation sector by vehicles class and has been removed from the electricity sector to avoid double counting of emissions.

Figure 2 presents the GHG emissions trends in terms of MT CO_2e for the Adjusted forecast. Adjusted forecast emissions trend downward over time through 2045 with the decrease becoming more gradual between 2035 and 2045.

Figure 2 Hayward Adjusted GHG Emissions Forecast (MT CO_2e) through 2045

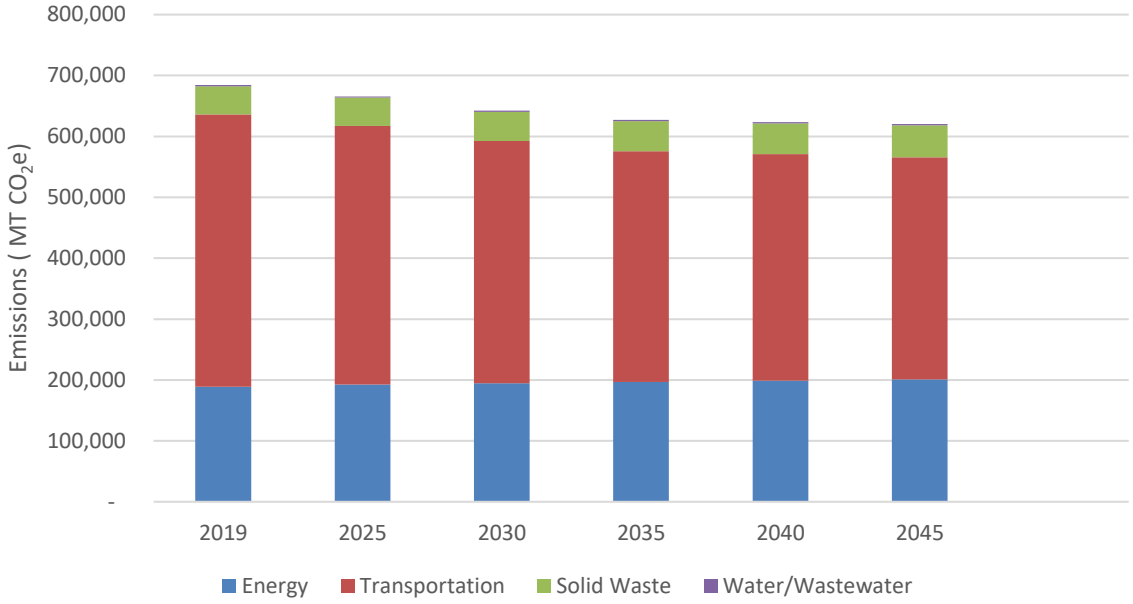


Table 14 provides the results summary of the GHG emissions forecast for Hayward, including the BAU GHG Emissions Forecast, the Adjusted GHG Forecast, and the expected percentage GHG emissions reduction based on compliance with State GHG legislation.

Table 14 Hayward GHG Emissions Forecast Results Summary

	2019	2025	2030	2035	2040	2045
Business-as-Usual Forecast	684,395	727,297	748,520	769,667	791,012	804,484
Transportation Reductions	0	-57,446	-99,031	-132,454	-154,504	-168,410
Title 24 Reductions	0	-1,212	-1,666	-2,136	-2,566	-2,962
SB 100 Reductions	0	-2,895	-5,337	-7,826	-10,367	-12,979
Legislative Adjusted Forecast	684,395	665,743	642,486	627,251	623,574	620,134
Percent Reduction in GHG Emissions from Legislation	0.0%	8.5%	14.2%	18.5%	21.2%	22.9%
SB = Senate Bill; GHG = greenhouse gas						

Hayward GHG Emissions Targets

GHG reduction targets are used in CAPs to establish measurable metrics intended to guide the community's commitment to achieve GHG emissions reduction and help gauge progress with reducing emissions over time. GHG targets are developed relative to a baseline emissions level. California has established Statewide GHG reduction goals for 2030 and 2045. The CARB 2017 Scoping Plan recommends that local agencies provide their fair share GHG reduction to achieve the States goals. Thus, local agencies are recommended to establish at a minimum, equivalent reduction targets at the local level by establishing communitywide GHG reduction goals for climate action that will help California achieve its 2030 and 2045 GHG emissions goals.

GHG reduction targets can be set as either an efficiency target (MT CO_2e per capita) or as a communitywide mass emissions target (total MT CO_2e). With CARB's 2017 Scoping Plan Update, California recommended using efficiency metrics for local targets to incentivize growth in a coordinated manner and not penalize cities which are growing at significant rates.[12] Throughout this section, targets are discussed in terms of mass emissions reduction, as Hayward developed the targets initially as mass emissions targets and has primarily tracked emissions as mass emissions.

Hayward GHG Emissions Targets for 2025, 2030, and 2045

State climate legislation compares emissions reduction targets to a 1990 baseline. However, Hayward does not have a 1990 GHG inventory, and the targets developed by the City are instead compared to their 2005 baseline. In the 2006 AB 32 Scoping Plan, the recommended target for local governments to meet 1990 levels was 15 percent below "current" levels by 2020, where "current" levels were construed as baseline years between 2005-2008.[13]

The City has adopted the following targets using the 2005 GHG inventory as the baseline:

- Reduce GHG emissions to 30 percent below 2005 levels by 2025;
- Reduce GHG emissions to 55 percent below 2005 baseline levels by 2030; and
- Work with the community to develop a plan that may result in the reduction of community-based GHG emissions to achieve carbon neutrality by 2045.

Hayward's target of 55 percent below 2005 levels by 2030 is consistent with the California 2030 target of 40 percent below 1990 levels.

With GHG emission reduction targets in place, the reduction gap that Hayward will be responsible for through local action can be calculated. The CAP Update will assess the GHG emissions reduction gap based on the difference between the *legislative* adjusted GHG emissions forecast and the adopted Hayward GHG reduction targets. Table 15 provides a summary of the Hayward GHG emission reduction targets and gap in both mass emissions and per capita emissions metrics. The per capita targets aligned with Hayward's targets are similarly calculated as the mass emission targets using the 2005 baseline mass emissions and City population in 2005 to establish a per capita baseline.

[12] California Air Resources Board. 2017. California's Climate Change Scoping Plan, p. 99-102.
[13] Governor's Office of Planning and Research (OPR). 2017. General Plan Guidelines. Ch 8 Climate Change. p. 228. https://opr.ca.gov/docs/OPR_C8_final.pdf.

Table 15 Summary of Hayward GHG Emission Reduction Targets and Gap Analysis

Metric	2005	2019	2020[1]	2025	2030[2]	2035	2040	2045[2]
Mass Emissions Target and Gap								
Mass Emissions Adjusted Forecast (MT CO_2e)	973,244	684,395	693,697	665,743	642,486	627,251	623,574	620,134
City and SB 32 Mass Emissions Target (Pathway) (MT CO_2e)[1,2]	N/A	N/A	778,595	681,271	437,960	291,973	145,987	-
Remaining Emissions Gap from State targets (MT CO_2e)[2]	N/A	N/A	-84,898	-15,528	204,526	335,278	477,588	620,134
Per Capita Emissions City set Target and Gap								
Population[3]	140,530	160,197	156,136	161,781	167,425	173,069	178,713	184,358
Per Capita Adjusted Forecast (MT CO_2e per capita)	6.9	4.3	4.4	4.1	3.8	3.6	3.5	3.4
Per Capita City Targets (MT CO_2e per capita)	N/A	N/A	5.5	4.8	3.1	2.1	1.0	0.0
Remaining Per Capita Emissions Gap (MT CO_2e per capita)	N/A	N/A	-1.1	-0.7	0.7	1.5	2.5	3.4

Notes: MT CO_2e = Metric tons of carbon dioxide equivalent

Emissions have been rounded to the nearest whole number and therefore sums may not match.

1. Hayward has set GHG reduction targets originally adopted with the 2009 CAP and 2014 General Plan that were slightly more aggressive than the State's target set by AB 32.

2. As of 2019, the City has exceeded the City's 2020 GHG reduction target of 20% reduction below 2005 GHG emissions levels, thereby exceeding the State's 2020 target of 15% below 2005 levels (AB 32).

3. Population projections for the GHG inventories (2005, 2010, 2015, 2017, 2018 , 2019) were obtained from MTC. Forecasted population projections obtained from Plan Bay Area 2040 and differ slightly.

Figure 3 provides a visual representation of past and future GHG emissions, with the impacts of State legislation. Figure 4 presents the remaining gap Hayward will be responsible for to the meet the GHG emission reduction targets. City targets as mass emissions and as efficiency targets converted to mass emissions are shown.

Figure 3 Past and Future GHG Emissions and Reduction Targets

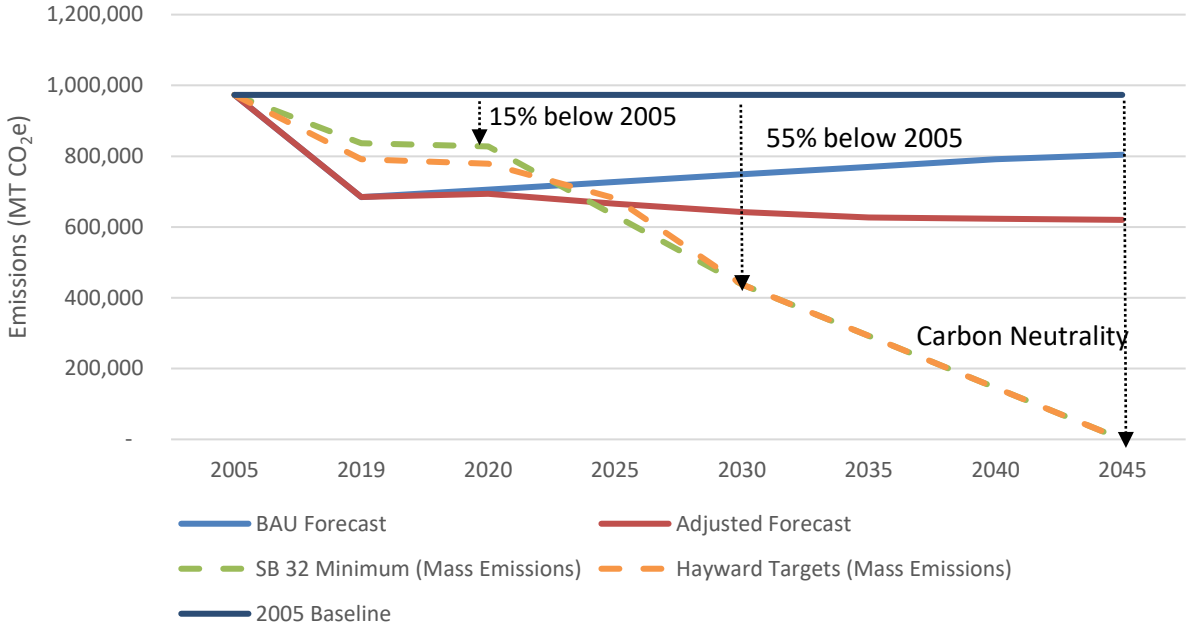
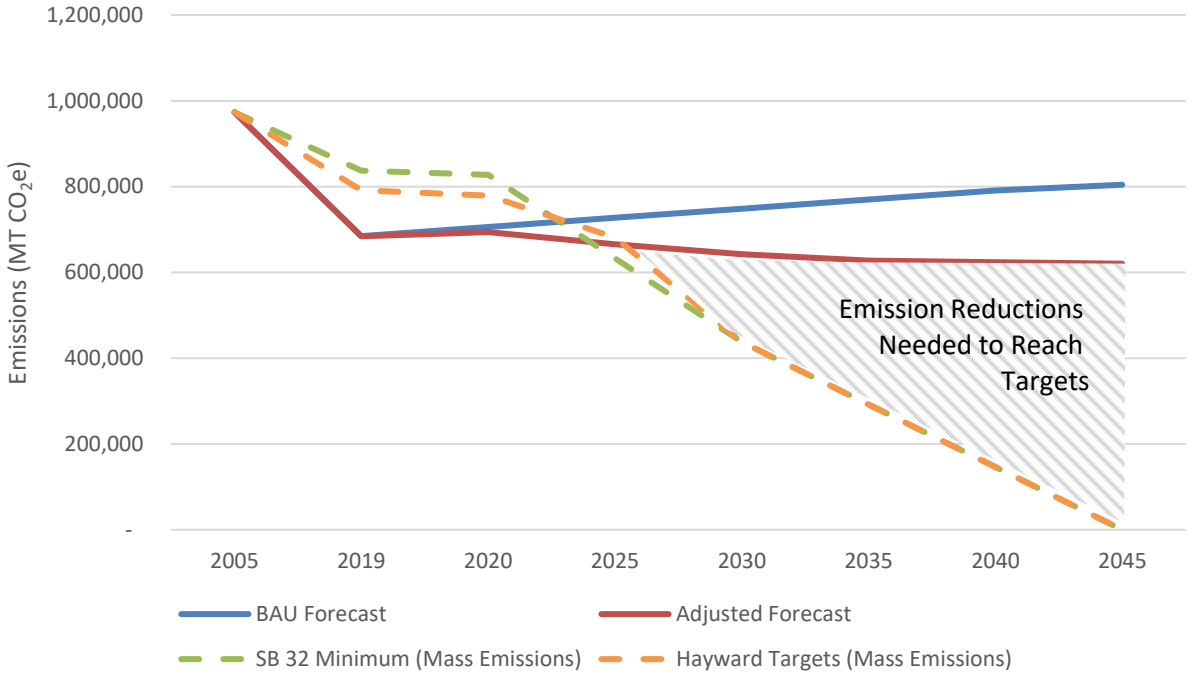


Figure 4 GHG Emissions Gap Analysis



Plan to Meet the Targets

The 2025, 2030, and 2045 targets identified above would be achieved through a combination of existing California measures and implementation of local measures identified in the Hayward CAP Update. Local measures will be identified through a comprehensive assessment of existing local and regional policies,

programs, and actions and by assessing any gaps and identifying additional opportunities. Additional measures will be developed from best practices of other similar and neighboring jurisdictions, as well as those recommended by organizations and agencies, such as the California Air Pollution Control Officers Association (CAPCOA), the Office of Planning and Research, CARB's 2017 Scoping Plan, and Association of Environmental Professionals (AEP). Measures will vetted by City staff, stakeholders, and the community and will be quantified to identify their overall contribution to meeting the City's 2025, 2030, and 2045 GHG reduction targets in the Hayward CAP Update.