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Rincon Project #: 19-08435

Tricia Pontau
City of Livermore
1052 S Livermore Ave
Livermore, California 94550
Via email: pepontau@cityoflivermore.net

Subject: **Memorandum Detailing GHG Emissions Inventory, Forecast, and Provisional Targets for Livermore Climate Action Plan Update**

Dear Ms. Pontau:

This memorandum details the results of the greenhouse gas (GHG) emissions inventories completed for Livermore, the forecast of future GHG emissions, and a discussion of provisional GHG emissions reduction targets identified for the Livermore Climate Action Plan (CAP) Update. Targets for the years 2030 (Senate Bill [SB] 32 target year) and 2045 (Executive Order [EO] B-55-018) are both included. This memorandum also quantifies the reduction impact that State regulations will have on Livermore's *business-as-usual forecast*[1] and presents the results in an *adjusted forecast.*[2]

This memo outlines the GHG emissions inventories[3] for 2010, 2015 and 2017 as well as an updated 2005[4] GHG inventory which was established in the 2012 Livermore Climate Action Plan (CAP)[5]. All of the inventories use the same methodologies and include the most recent population, employment, and emission factor data for each year allowing for consistent and comparable methodologies across all inventory years and between Bay Area jurisdictions that are also using the East Bay Energy Watch (EBEW) GHG calculation methodology. These inventories will assist in the preparation of the Livermore CAP Update by tracking progress in specific GHG emission sectors and be used to forecast future GHG emissions and develop a respective gap analyses that will assist in identifying CAP Update policies that will achieve longer-term GHG emissions targets.

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[1] Forecasts emissions based on population and job growth, with no reduction measures from federal, State, or local governments.

[2] The adjusted forecast scenario incorporates expected federal, State, and local GHG reduction measures into the emissions forecast to develop a more accurate forecast of emissions through 2045.

[3] Note that all reference to inventories, forecasts, and targets in this memorandum are in reference to communitywide GHG emissions.

[4] The Updated 2005 GHG Emissions Inventory is an update of the previously prepared 2005 inventory that informed the first City CAP. This was done to use the most recent methodology, emission factors, and data sources available, as well as for consistency between other inventory years. The original updated 2005 inventory was created by East Bay Energy Watch, and then updated by Rincon (for more information on these updates, refer to Section 2.3 of the Technical Appendix).

[5] City of Livermore. 2012. City of Livermore Climate Action Plan. *Accessed at* http://www.cityoflivermore.net/civicax/filebank/documents/9789/ Accessed on: April 12, 2020.

Future Livermore GHG emissions were forecasted using the 2017 inventory for five different years (2020, 2025, 2030, 2040, and 2045) for both a business-as-usual scenario[6] and an adjusted forecast scenario[7] in order to quantify expected emissions through 2045.

This memorandum also summarizes the City's progress towards the 2020 target established in the 2012 CAP as well as the minimum GHG reduction targets which will allow the City of Livermore to adopt a "qualified GHG reduction plan" pursuant to California Environmental Quality Act (CEQA) Guidelines Section 15183.5. Having a qualified GHG reduction plan will allow for future projects to tier off of the CAP for CEQA GHG significance analysis. The minimum targets that a qualified GHG reduction plan need to adopt are:

- Reduce GHG emissions a minimum of 15 percent below 2005 levels by 2020, which is consistent with Assembly Bill (AB) 32;[8]
- Reduce GHG emissions 40 percent below 1990 levels by 2030, which is consistent with SB 32;[9] and
- Achieve carbon neutrality by 2045, which is consistent with E0 B-55-18

The minimum requirement for qualified GHG reduction plan targets is to establish consistency with State GHG emissions targets. However, the City may choose to adopt a more stringent target pathway. Rincon has included one additional, more stringent, target pathway as an example. This memorandum is intended to summarize and inform City staff of the findings of the technical appendix attached to this memorandum that includes the full supporting methodology, calculations, and results.

GHG Emissions Inventory Results

GHG emissions inventories have been completed for the years 2005, 2010, 2015, and 2017. The 2005 inventory which was originally completed as part of the 2012 CAP development was re-inventoried using current methodologies consistent with that used for the 2010, 2015, and 2017 inventories to allow for comparison between all years. The results of the inventory are included below in Figure 1.

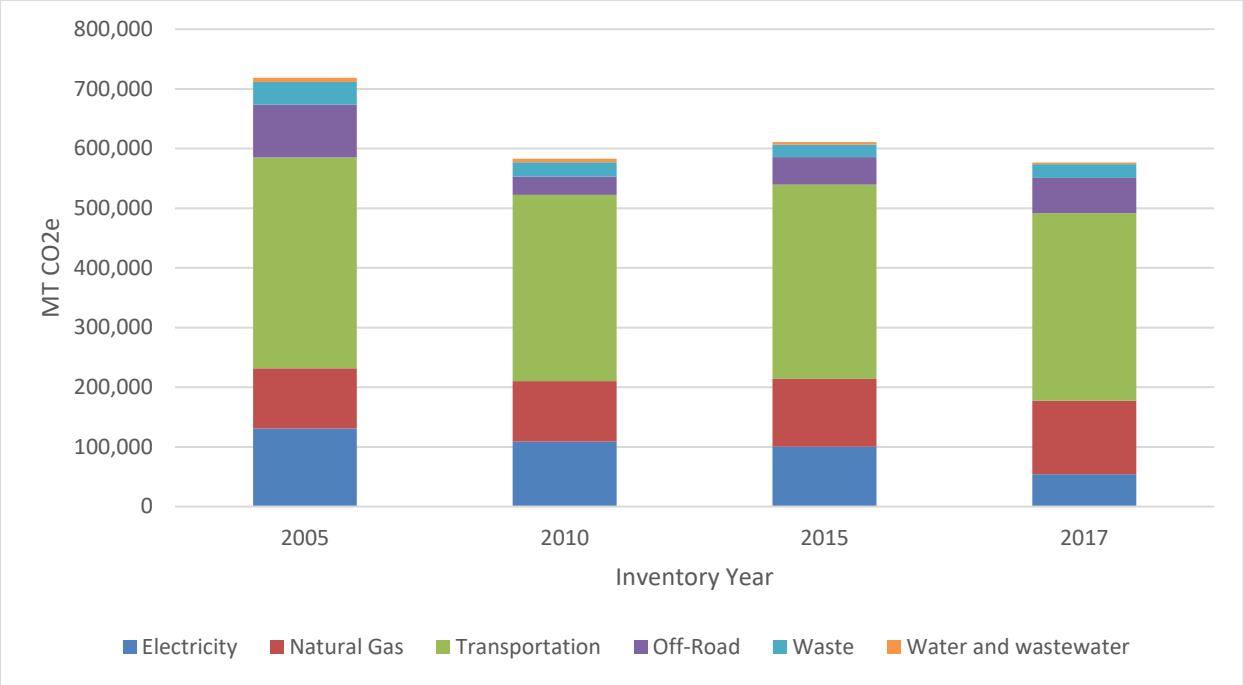
[6] Forecasts emissions based on population and job growth, with no reduction measures from federal, State, or local governments.

[7] The adjusted forecast scenario incorporates expected federal, State, and local GHG reduction measures into the emissions forecast to develop a more accurate forecast of emissions through 2045.

[8] AB 32 codified the State's 2020 GHG emissions target by directing the California Air Resources Board (CARB) to reduce California's Statewide emissions to 1990 levels by 2020 (approximately equivalent to a 15 percent reduction from 2005 to 2008 levels). The AB 32 Scoping Plan encourages local governments to adopt a target that parallels the State's target. Refer to discussion of AB 32 on page 8.

[9] SB 32 codified the State's 2030 GHG emissions target by directing CARB to reduce California's Statewide emissions to 40 percent below 1990 levels by 2030. CARB is currently working on a Scoping Plan to demonstrate how the State will achieve of the 2030 target.

Figure 1 GHG Inventory Results for the City of Livermore by Sector



This memo will focus primarily on the changes between 2005 and 2017 inventories in order to show progress to date. For a complete description of the inventory years, methodologies and assumptions please see the Inventory and Forecast Technical Appendix.

The 2017 Livermore GHG emissions inventory serves as the GHG emission data to inform development of future GHG emissions forecasts that will assist the City in setting GHG emissions targets that are consistent with State-level goals and the Livermore General Plan 2003-2025. In 2017, Livermore GHG emissions were estimated to be 576,416 metric tons (MT) of carbon dioxide equivalent (CO_2e).[10] Data was originally gathered by EBEW and then reviewed and updated by Rincon for consistency with the latest methodology available in the Community Protocol[11] and California Supplement[12]. The updates to the 2005 GHG Inventory added emissions from the water and wastewater inventory sectors and removed the Bay Area Rapid Transit (BART) emissions, because the City of Livermore does not have direct control over BART and is unable to directly reduce these emissions and because BART data was not available for the subsequent inventories. However, it should be noted that transportation emissions resulting from residents driving to and from the BART station are captured in the transportation section. A summary of the 2017 inventory emissions by sector is provided in Table 1 and shown in Figure 2.

[10] Carbon dioxide equivalent is a term for describing GHG emissions in a common unit, signifying for any GHG the amount of CO_2 that would have the equivalent global warming impact. The equivalent amount of CO_2 is calculated based on the GHG global warming potential value.

[11] ICLEI. 2012. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. Available: <https://icleiusa.org/publications/us-community-protocol/>. Accessed: April 23, 2020.

[12] Association of Environmental Professionals. 2013. The California Supplement to the United States Communitywide GHG Protocol. Available: <https://califaep.org/docs/California_Supplement_to_the_National_Protocol.pdf>. Accessed: April 23, 2020.

Table 1 2017 Livermore GHG Emissions Inventory Summary

Sector	Activity Data	Emission Factors	Units	MT CO_2e
Residential Electricity (kWh)	205,232,521	0.00009635	MT CO_2e/kWh	19,775
Nonresidential Electricity (kWh)	288,894,815	0.00009635	MT CO_2e/kWh	27,836
Direct Access Electricity[5] (kWh)	32,283,926	0.0002027	MT CO_2e/kWh	6,545
Residential Gas (therms)	12,408,537	0.00531	MT CO_2e/therms	65,896
Adjusted Nonresidential Gas (therms)	10,820,445[1]	0.00531	MT/CO_2e/therms	57,462[1]
Passenger On-Road Transportation (VMT)	538,932,050	0.000338	MT CO_2e/mile	181,900
Commercial On-Road Transportation (VMT)	96,824,903	0.001366	MT CO_2e/mile	132,254
Off-Road Transportation (VMT)	N/A[2]	0.0946[3]	Effective Change in Service Population	58,852
Waste (tons)[6]	81,766	0.2860	MT CO_2e/Ton	23,052
Wastewater (kWh)	N/A[4]	N/A[4]	MT CO_2e/kWh	1,366
Water (kWh)	15,344,462	0.00009635	MT CO_2e/kWh	1,479
Total Emissions				**576,416**

MWh: megawatt hours; kWh: kilowatt hours; CO_2e: carbon dioxide equivalent; MT: metric tons; VMT: vehicle miles traveled; ADC: Alternative Daily Cover

[1] No natural gas usage was reported by PG&E for large industrial users after 2013 due to California Public Utilities Commission privacy rules. Natural gas emissions reported by the Lawrence Livermore National Laboratory to the California Air Resources Board as a part of the Cap-and-Trade program were added to allow for accurate comparison of emissions from nonresidential gas in previous inventory years. Data reported as a part of the Cap-and-Trade program can be found here: https://ww2.arb.ca.gov/mrr-data. All natural gas data has been provided through the EBEW inventories.

[2] Off-road emissions calculated as a proportion of total emissions in Alameda County based on local population and does not have activity data.

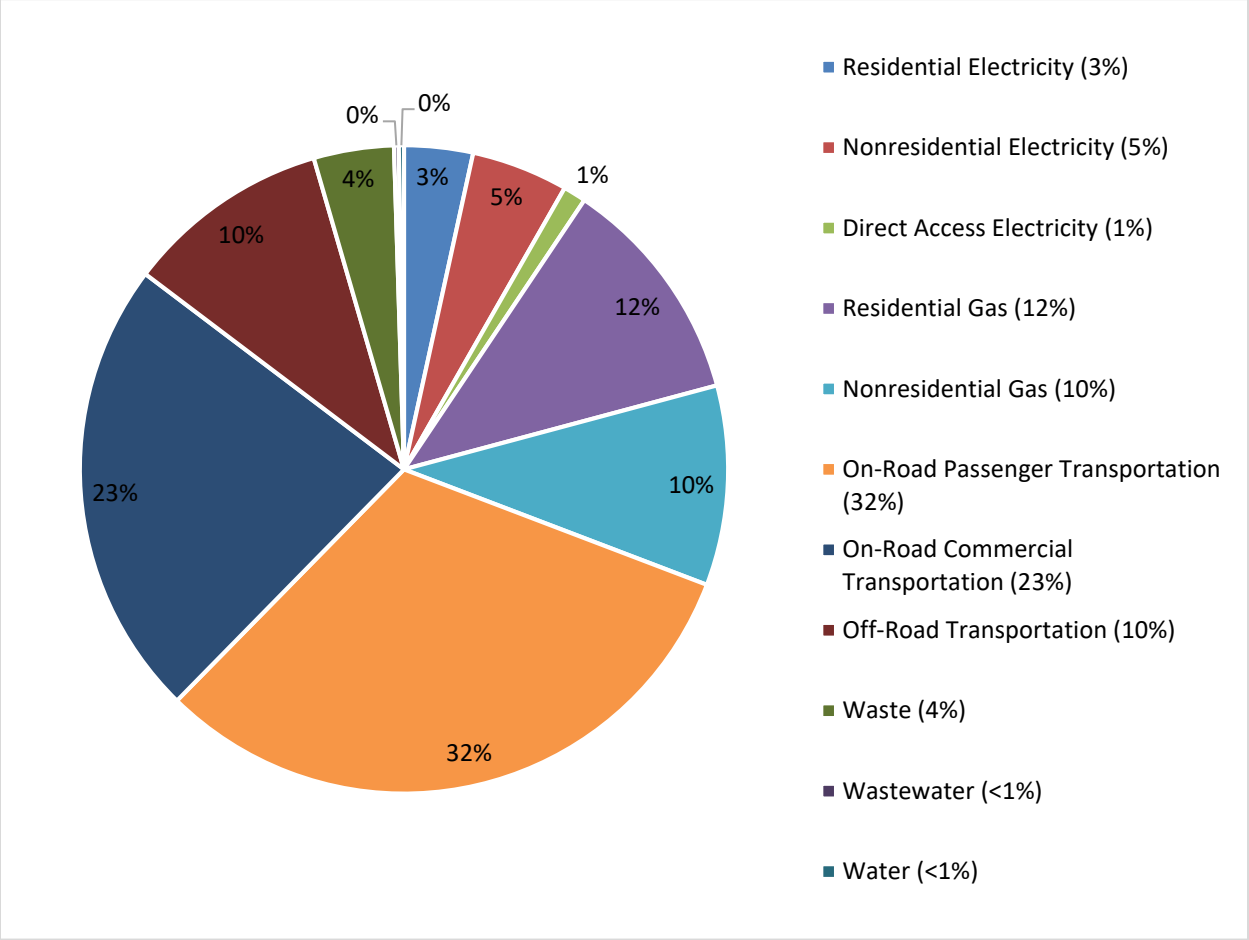
[3] Effective change in service population was defined as on the sum of new population and jobs in Livermore divided by the total sum of new jobs and population in Alameda County for each inventory year.

[4] Wastewater is a combination of stationery and process emissions, further detail is Section 3.3 of the Technical Appendix.

[5] Direct access service is retail electric service where customers purchase electricity from a competitive provider called an Electric Service Provider instead of from a regulated electric utility. An Electric Service Provider is a non-utility entity that offers electric service to customers within the service territory of an electric utility.

[6] Includes 8,329 tons of Alternative Daily Cover Waste for which a different emission factor was used (.246 MTCO_2e/ton). This emissions factor was calculated using data from the CARB California Landfill Emissions Tool Version 1.3.

Figure 2 2017 Livermore Community GHG Emissions by Sector



Between 2005 and 2017, Livermore experienced a population increase of 16 percent and a per-capita emissions reduction of 30 percent. This translates to approximately a 20 percent reduction in total Livermore GHG emissions from 2005 to 2017. A 20 percent reduction from 1990 levels exceeds the AB 32 target of a 15% reduction from 2005 levels by 2020. Table 2 summarizes GHG emission changes in Livermore from 2005 to 2017, and Table 3 summarizes changes in activity data.

Between 2005 and 2017, Livermore reduced GHG emissions in every sector except for nonresidential gas, which likely increased due the addition of Lawrence Livermore National Laboratory and Sandia National Laboratory to the City boundary in 2012. Major GHG emissions reductions were achieved in the waste sector and wastewater sectors, although these sectors make up smaller proportions of the Livermore's overall emissions as shown in Figure 2. It is worth noting that large GHG emissions reductions from electricity usage were driven largely by PG&E's electricity fuel mix, which saw a significant decrease in carbon intensity[13] from 2005 to 2017. Although there was an increase in commercial vehicle miles traveled (VMT), GHG emissions associated with the commercial on-road

[13] Carbon intensity is the amount of carbon by weight emitted per unit of energy consumed. For example, as the percentage of renewable energy sources used to produce electricity increases, the carbon intensity of that electricity decreases.

transportation sector declined because of the increased fuel efficiency of vehicles as detailed in Table 2 and Table 3.

Table 2 Summary of Livermore GHG Emissions Changes from 2005 to 2017

	2005 ($MT CO_2e$)	2017 ($MT CO_2e$)	Percent Change
Residential Electricity	49,822	19,775	-60%
Nonresidential Electricity	65,872	27,836[1]	-58%
Direct Access Electricity	15,192	6,545[2]	-57%
Residential Gas	71,139	65,896	-7%
Nonresidential Gas	29,771	57,462[1]	+93%
Solid Waste	35,008	21,006	-40%
Alternative Daily Cover Waste	3,487	2,046	-41%
Water	4,680	1,479	-68%
Wastewater	1,839	1,366	-26%
On-Road Passenger Transportation	218,684	181,900	-17%
On-Road Commercial Transportation	134,636	132,254	-2%
Off-Road Transportation	88,179	58,852	-33%
Total Emissions	**718,358**	**576,416**	**-20%**
Emissions Per Capita	**9.21**	**6.37**	**-31%**

$MT CO_2e$: metric tons of carbon dioxide equivalent

[1] PG&E did not report data for industrial natural usage in Livermore for 2015 and 2017 due to the CPUC's 15-15 privacy rule. Industrial natural gas usage was estimated for these years using the reported GHG emissions from the Livermore Lawrence National Laboratory for those years as a part of California's Cap-and-Trade program. (see Section 2.3 for more details on this calculation).

[2] PG&E did not report data for direct access electricity usage in Livermore for 2017 due to the CPUC's 15-15 privacy rule, and was estimated using the average of 2015 and 2016 data as they were the closest available years (see Section 2.3 for more details on this calculation).

Table 3 Summary of Livermore Activity Data Changes from 2005 to 2017

Raw Activity Data	2005 Activity Data	2017 Activity Data	Percent Change
Population	78,019	90,454	+16%
Residential Electricity (kWh)	223,251,790	205,232,521	-8%
Residential Gas (therms)	13,395,923	12,408,537	-7%
Nonresidential Electricity (kWh)	295,174,279	288,894,815	-2%
Adjusted Nonresidential Gas (therms)	5,606,070	10,820,445[1]	+93%
Direct Access Electricity (kWh)	39,378,526	32,283,926[2]	-18%
Wastewater (kWh)	4,546,080	3,671,304	-19%
Water (kWh)	20,975,856	15,344,462	-27%
Solid Waste (tons)	119,384	73,437	-38%
Alternative Daily Cover Waste (tons)	14,193	8,329	-41%
Passenger VMT	548,153,828	538,438,400	-2%
Commercial VMT	91,610,896	95,769,686	+5%
Passenger VMT Emission Factor (MT CO_2e/VMT)	0.000399	0.000338	-15%
Commercial VMT Emission Factor (MT CO_2e/VMT)	0.001470	0.001366	-7%
Off-Road Emission Factor (Effective Change in Service Population)	.2155	.0946	-56%
PG&E Elec Factor (MT CO2e/MWh)	0.000223	0.000096	-57%

MT CO_2e: Metric tons of carbon dioxide equivalent; kWh: Thousand watt hours; MWh: Million watt hours; ADC: Alternative Daily Cover

[1] Includes activity data from Lawrence Livermore National Laboratory, calculated using reported emissions to CARB as a part of the Cap-and-Trade Mandatory GHG Reporting program and the natural gas emission factor from Table 1.

[2] Activity data for 2017 direct access electricity unavailable from PG&E due to CPUC privacy rules and was estimated for consistency with other inventory years based on an average of 2015 and 2016 direct access electricity data.

Progress Towards Livermore's 2020 GHG Emissions Goal

The first City of Livermore Climate Action Plan was adopted in 2012, and implements policies in the Climate Change Element of City's 2003 General Plan.[14] The 2012 CAP identified how the City and broader community can reduce Livermore's GHGs and included a GHG emissions reduction target of 15 percent below 2008 emissions levels by 2020. The 2012 CAP used an estimated value for 2008. This CAP update recalculated the 2005 inventory using consistent methodologies but did not update the 2008 estimate as no real data was available. Therefore, progress towards the 2012 CAP goal is being evaluated as a 15% reduction from 2005, which is more stringent as 2005 emissions were lower than 2008. According to the updated 2005 and 2017 inventories, Livermore met and surpassed the 2020 reduction goal three years ahead of schedule by decreasing emissions by an estimated 141,943 MT CO_2e in 2017; this equates to an overall emissions reduction of 20 percent below 2005 levels.

Due to the population growth of the City between 2005 and 2017 analyzing per capita emissions changes is useful as the metric effectively removes the impact of population growth as a variable and is

[14] Livermore, City of. 2012. 2020 Climate Action Plan. Available: http://www.cityoflivermore.net/civicax/filebank/documents/9789/. Accessed: April 13, 2020.

recommended in the 2017 Scoping Plan. In 2005, GHG emissions were an estimated 9.21 MT CO_2e per person. This was calculated by dividing total GHG emissions from the updated 2005 GHG inventory by Livermore's 2005 population. In 2017, per capita emissions dropped to 6.37 MT CO_2e per person. This equates to a per capita emissions reduction of 31 percent below 2005 levels.

GHG Emission Forecast

Business-as-Usual Forecast

A business-as-usual (BAU) future GHG emissions forecast provides a forecast of how GHG emissions would change over time if consumption and activity trends were to continue as they did in 2017 and if growth were to occur as projected in the City's 2003-2025 General Plan and Association of Bay Area Government's future demographic forecasts. This does not include emission reductions from any regulations which would reduce local emissions. The business-as-usual forecast results for 2020, 2025, 2030, 2035, 2040, and 2045 are provided in Table 4.

Table 4 Summary of Livermore Business-as-Usual Future GHG Emissions Forecast by Sector

	2017 (MT CO_2e)	2020 (MT CO_2e)	2025 (MT CO_2e)	2030 (MT CO_2e)	2035 (MT CO_2e)	2040 (MT CO_2e)	2045 (MT CO_2e)
Population	90,454	91,474	96,699	105,967	113,218	120,925	129,158
Jobs	48,133	48,340	48,686	49,372	50,649	51,499	52,364
Residential Electricity	19,775	19,998	21,140	23,167	24,752	26,437	28,237
Nonresidential Electricity	27,836	27,956	28,156	28,553	29,291	29,783	30,283
Direct Access Electricity	6,545	6,618	6,996	7,667	8,192	8,749	9,345
Residential Gas	65,896	66,639	70,445	77,197	82,479	88,094	94,091
Nonresidential Gas	57,462	57,709	58,123	58,941	60,465	61,481	62,513
Waste	23,052	23,256	24,183	25,839	27,257	28,681	30,194
Water	1,479	1,492	1,551	1,657	1,748	1,840	1,937
Wastewater	1,366	1,378	1,433	1,531	1,615	1,699	1,789
On-Road Passenger Transportation	181,900	184,250	191,175	198,101	201,095	204,090	207,084
On-Road Commercial Transportation	132,254	132,641	134,445	136,248	138,355	140,462	142,568
Off-Road Transportation	58,852	62,867	69,559	76,252	84,025	91,799	99,572
Total Emissions	**576,416**	**584,804**	**607,208**	**635,152**	**659,275**	**683,114**	**707,613**
Emissions Per Capita	**6.37**	**6.39**	**6.28**	**5.99**	**5.82**	**5.65**	**5.48**

MT CO_2e: metric tons of carbon dioxide equivalent

Note: VMT data are provided by the MTC traffic demand model that are based on a variety of factors besides only projected demographic changes.

The business-as-usual forecast shows how Livermore's emissions would change without any changes to the current conditions. While this forecast provides useful information, it predominately acts as an

upper bound on GHG emissions within the City. For a more accurate depiction of GHG emissions over time, an adjusted forecast which includes the impacts of current legislation was developed.

Adjusted Forecast

California has enacted multiple regulations that will reduce future emissions throughout the State. The impact of these regulations on GHG emissions have been incorporated into an *adjusted forecast*, which provides a more accurate picture of future emissions growth and the emission reduction the City and community will be responsible for after State regulations have been implemented. These State regulations include SB 100 (which sets a goal for reaching 100 percent electricity from renewable energy and zero-carbon sources by 2045), Title 24 building efficiency standards, and California Air Resources Board (CARB) tailpipe emissions standards (Pavley Standards, Advanced Clean Cars Program).[15]

Calculating the difference between the adjusted forecast and the reduction targets set by the City determines the gap to be closed through City CAP policy implementation. The adjusted forecast shows that Livermore's GHG emissions will decrease approximately 12 percent (67,529 metric tons) by 2030, continue to decrease but at a slower rate to approximately 14 percent (80,422 metric tons) by 2040, and then begin to increase again through 2045 to approximately 13 percent (72,690 metric tons). This eventual increase in emissions is due to the sunset of current State legislation, particularly Title 24 and California's vehicle efficiency standards, and expected population and job growth beginning to outpace the impact of the SB 100 zero-carbon electricity GHG emission reductions by 2045. The summary results of the adjusted future GHG emissions forecast are provided in Table 5 and shown in Figure 3.

Table 5 Summary of Livermore Adjusted Future GHG Emissions Forecast by Sector

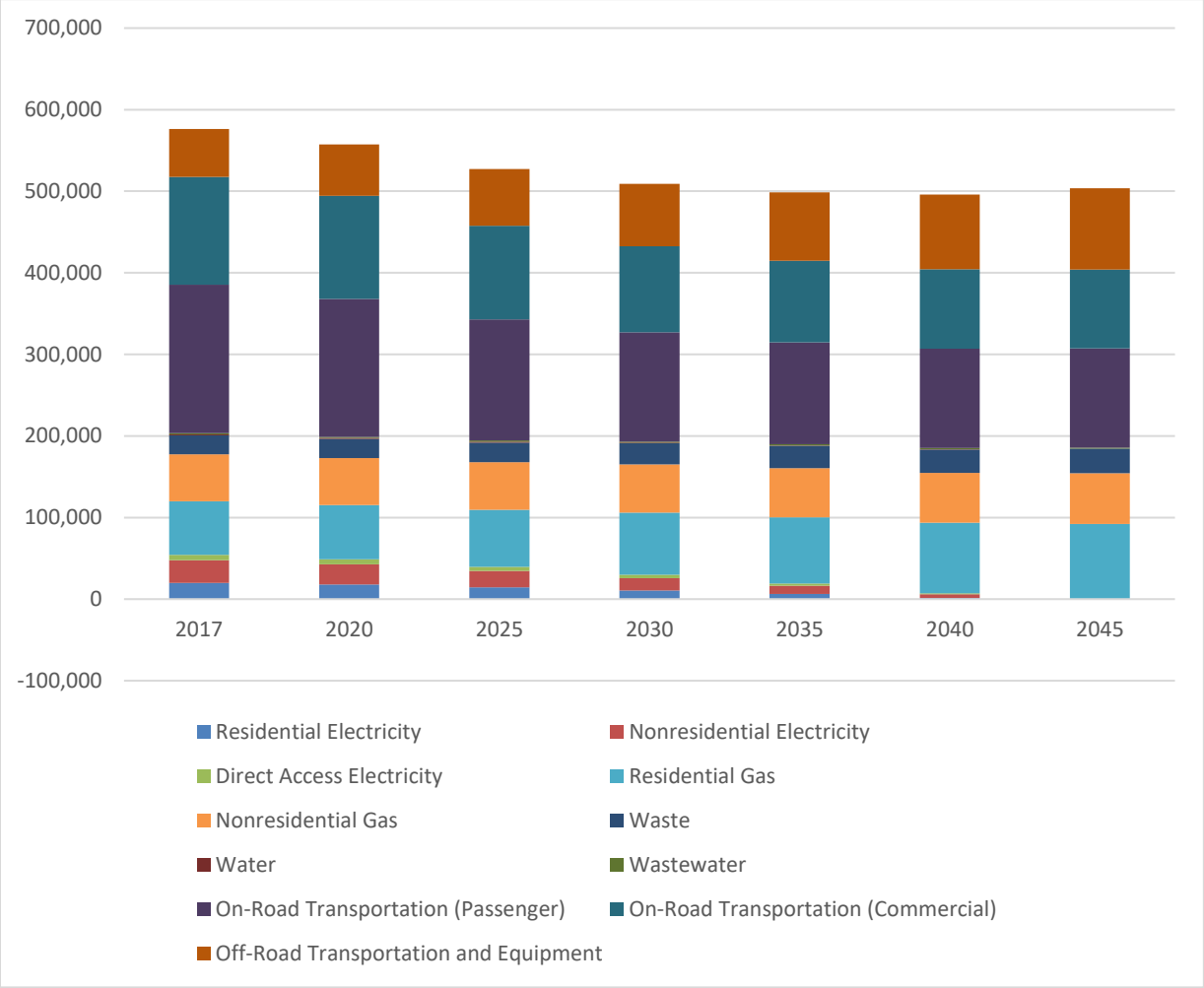
	2017 (MT CO_2e)	2020 (MT CO_2e)	2025 (MT CO_2e)	2030 (MT CO_2e)	2035 (MT CO_2e)	2040 (MT CO_2e)	2045 (MT CO_2e)
Population	90,454	91,474	96,699	105,967	113,218	120,925	129,158
Jobs	48,133	48,340	48,686	49,372	50,649	51,499	52,364
Residential Electricity	19,775	17,816	14,455	10,692	6,281	1,269	0
Nonresidential Electricity	27,836	24,949	20,040	15,105	10,049	4,758	0
Direct Access Electricity	6,545	5,944	4,996	3,997	2,597	996	0
Residential Gas	65,896	66,621	70,161	76,440	81,353	86,575	92,152
Nonresidential Gas	57,462	57,703	58,088	58,849	60,267	61,211	62,171
Waste	23,052	23,256	24,183	25,839	27,257	28,681	30,194
Water	1,479	1,332	1,108	888	624	328	0
Wastewater	1,366	1,340	1,327	1,347	1,346	1,338	1,326
On-Road Passenger Transportation	181,900	169,242	148,578	133,987	125,081	121,771	121,487
On-Road Commercial Transportation	132,254	126,305	114,922	105,492	99,881	97,268	96,823

[15] Refer to Section 4.2 of the Technical Appendix for the full list of State and federal legislation that was considered in the forecasting model.

Off-Road Transportation	58,852	62,867	69,559	76,252	84,025	91,799	99,572
Total Emissions	**576,416**	**557,375**	**527,418**	**508,887**	**498,761**	**495,994**	**503,726**
Emissions Per Capita	**6.37**	**6.09**	**5.45**	**4.80**	**4.41**	**4.10**	**3.90**

MT CO_2e: metric tons of carbon dioxide equivalent

Figure 3 Livermore Adjusted Future GHG Emissions Forecast by Sector



Note: *As of the time of this writing, the federal Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule Part 2 has been posted in the Federal Register but will not take effect until June 29, 2020. This new rule rolls back California fuel efficiency standards for on-road passenger vehicles, so that cars and trucks will now only achieve a 40.4 mpg industry average by 2026 compared to the 46.7 mpg projected requirement under the previous California Advanced Clean Car Program/federal Corporate Average Fuel Economy (CAFE) standards. No methodology currently exists for extracting or altering the on-road passenger vehicles fuel efficiency standard aspect of the Emissions Factors (EMFAC) model[16] used to calculate forecasted vehicle GHG emissions. In addition, the California Climate Change Scoping Plan does not yet address or provide guidance related to this pending change in fuel efficiency standards with regard to GHG emissions determination. Furthermore, California is currently challenging this new rule in the court system. Therefore, the Livermore adjusted forecasts have not been modified to reflect the new SAFE Rule Part 2.*

[16] The EMFAC model is developed and used by CARB to assess emissions from on-road vehicles including cars, trucks, and buses in California and to support CARB regulatory and planning efforts to meet Federal Highway Administration transportation planning requirements.

2030 and 2045 Provisional GHG Emissions Targets

California currently has established goals for reducing GHG emissions by 40 percent compared to 1990 levels by 2030 (SB 32) and achieving carbon neutrality by 2045 (EO B-55-18). It is recommended that Livermore establish GHG emissions targets for the years 2025 (General Plan horizon year), 2030 (SB 32 target year), 2040 (interim target), and 2045 (EO B-55-18 target year) to show compliance and track progress with these multiple-year State goals.

The City of Livermore has the ability to establish GHG emissions reduction targets that suit its needs. However, to be considered a "Qualified GHG Reduction Plan" that can be used for CEQA GHG emissions analyses streamlining purposes pursuant to CEQA Guidelines Section 15183.8, the City should adopt a GHG emissions target that is at least as stringent as the State targets described above. Specifically, the City should target emission reductions of at least 40 percent below 1990 levels by 2030 and adopt a longer-term target of carbon neutrality by 2045 consistent with EO B-55-18, which appears likely to be codified soon by the State legislature.[17] The carbon neutrality target has been adopted by many other California cities in their CAP updates, and some jurisdictions, such as the Sacramento Metropolitan Air Management District, have adopted carbon neutrality as a CEQA GHG emissions significance threshold.[18]

The following discussion outlines the minimum GHG reduction targets required for CEQA GHG emissions analyses streamlining. However, Livermore can choose to adopt other GHG emissions reduction pathways that exceed these reductions and still maintain status as a Qualified GHG Reduction Plan under CEQA. While more aggressive targets will initially require additional effort, a more stringent short-term goal (2030) may make it easier to reach longer-term goals like carbon neutrality. On the contrary, any target that reduces less emissions (than the State target) by 2030 would not be considered consistent with the State goals.

There are several different methodologies for calculating the minimum GHG emissions reductions. The City could choose to adopt mass emission or per capita targets. The Livermore 2012 CAP includes only mass emissions targets. Mass emission targets describe emissions in terms of total MT CO_2e without any adjustment for population growth. The most recent State Climate Change Scoping Plan (2017) includes guidance that details the methodology and benefits of developing per capita targets. The key benefit of a per capita target is that it corrects for population growth. This means that the target does not become more difficult to reach if the City grows faster than projected. Per capita emissions targets are developed by dividing the emissions in each target year by the forecasted population. Emission targets in both mass emissions and per capita emissions are discussed below.

Mass Emissions Pathway

The first proposed methodology for setting a GHG emissions reduction target pathway is based on a total GHG emissions basis (i.e., mass emissions). This is the traditional methodology for establishing

[17] There is also EO S-3-05, which was signed in 2006 and set a goal of reducing GHG emissions to 80 percent below 2050 levels. Although technically neither EO B-55-18 or EO S-3-05 have been codified into law, it is generally understood that EO S-3-05 has been superseded by EO B-55-18. There is currently legislation at the State level which if passed would codify the EO B-55-18 target of achieving carbon neutrality by 2045, and many other California jurisdictions have been adopting 2045 carbon neutrality goals into their CAP updates. For these reasons, Rincon recommends adopting targets that align with the 2045 carbon neutrality goal set forth by EO B-55-18 in 2018.

[18] Sacramento Metropolitan Air Management District. 2020. Guide to Air Quality Assessment in Sacramento County. Available: http://www.airquality.org/businesses/ceqa-land-use-planning/ceqa-guidance-tools. Accessed: May 31, 2020.

emissions targets as a part of CAP and was employed by the City for development of the 2020 target. The SB32/B-55-18 pathway meets the minimum requirements for CEQA GHG emissions analyses streamlining. The pathway sets a 40 percent reduction from 1990 levels by 2030 and then carbon neutrality by 2045 consistent with EO B-55-18.

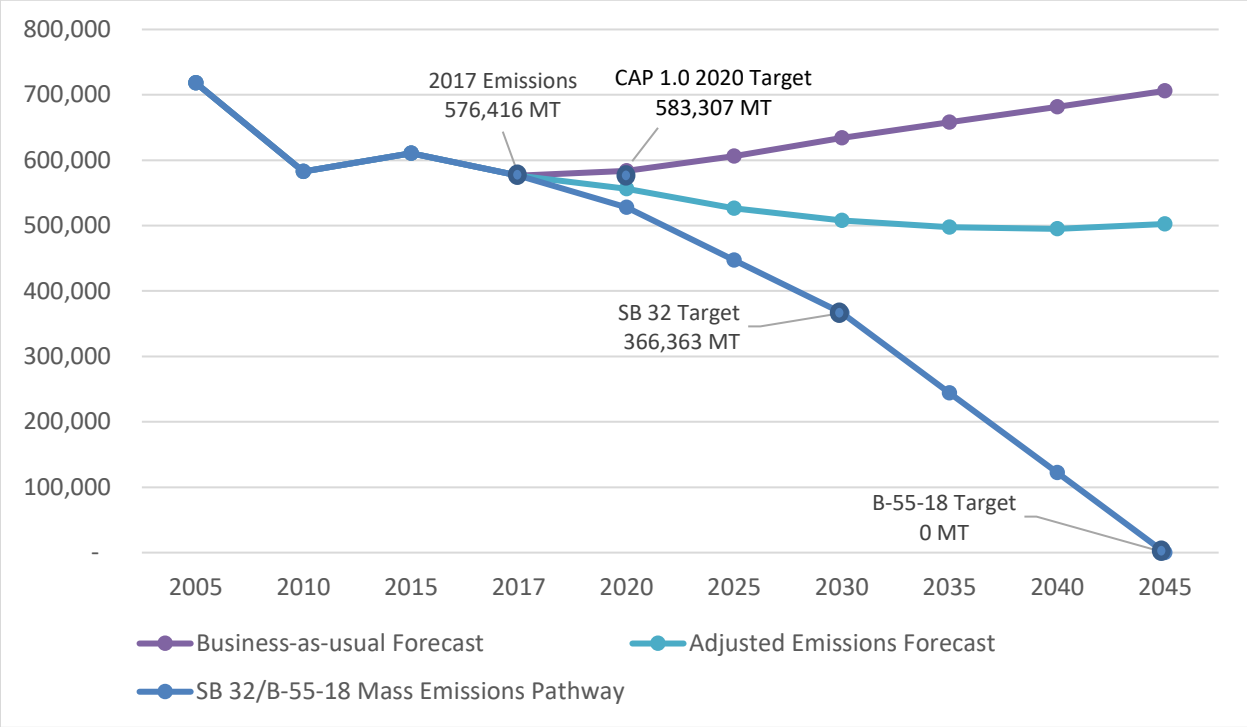
Table 6 provides GHG emissions targets for 2025, 2030, 2035, 2040, and 2045 for Livermore based on the SB 32/B-55-18 GHG mass emissions reduction target pathway. Figure 4 details the reduction necessary to achieve the mass emission targets in relation to the baseline inventory, business-as-usual forecast, and adjusted forecast. Forecasted emissions for 2020 are based off the 2017 inventory year, which already exceeds the AB 32 State target for local jurisdictions. The mass emissions targets for the SB 32/B-55-18 mass emissions pathway is 366,363 MT CO_2e in 2030 to meet the SB 32 target, and 0 MT CO_2e in 2045 to meet the B-55-18 target. The gap between the adjusted emissions forecast and SB 32/B-55-18 mass emissions pathway in 2030 is 142,524 MT CO_2e, and the gap in 2045 is 503,726 MT CO_2e.

Table 6 Summary of Livermore Future GHG Emissions Forecasts by Mass Reduction Target Pathway

Emissions Forecast	2017 (MT CO_2e)	2020 (MT CO_2e)	2025 (MT CO_2e)	2030 (MT CO_2e)	2035 (MT CO_2e)	2040 (MT CO_2e)	2045 (MT CO_2e)
Business-as-Usual Emissions Forecast	576,416	584,804	607,208	635,152	659,275	683,114	707,613
Adjusted Emissions Forecast	576,416	557,375	527,418	508,887	498,761	495,994	503,726
SB 32/B-55-18 Mass Emissions Pathway	576,416	527,942	447,152	366,363	244,242	122,121	0

MT CO_2e: metric tons of carbon dioxide equivalent

Figure 4 Minimum Required Reduction Pathways for CEQA Streamlining (Mass Emissions)



Per Capita Emissions Pathway

The mass GHG emission targets can also be expressed on a per capita basis (the second proposed methodology for setting GHG emissions reduction target pathways). Per capita targets are derived by dividing the mass emissions by the forecasted population in each target year. The benefit of per capita targets is primarily the ability to control for population growth over time. By adopting a per capita target, Livermore can continue to grow without sacrificing the ability to reach its GHG reduction goals. The SB 32/B-55-18 Per Capita Pathway translates the emissions targets referenced above under the mass emissions pathway into a per capita target by dividing each target year by the forecasted population. This pathway achieves a 40 percent reduction below 1990 levels by 2030 and then carbon neutrality by 2045 and is consistent with the state goals.

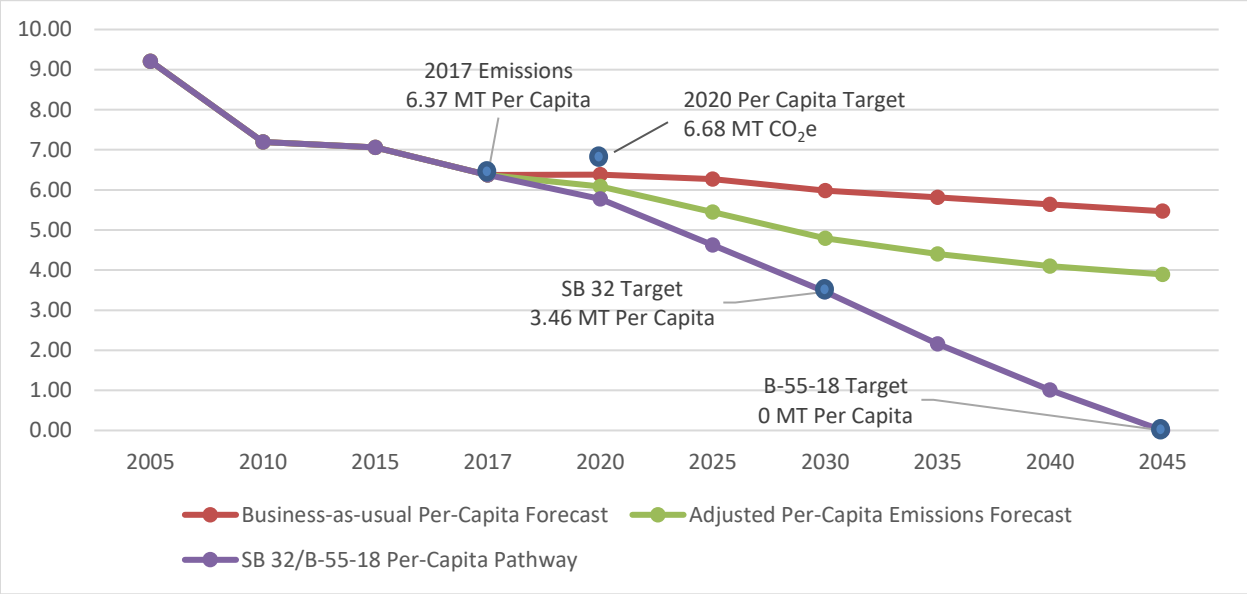
Table 7 provides per capita GHG emissions targets for 2025, 2030, 2035, 2040, and 2045 for Livermore based on the SB 32/B-55-18 GHG per-capita emissions reduction target pathway. Figure 5 details the GHG emission reduction necessary to achieve the per capita emission targets, in relation to the baseline inventory, business-as-usual forecast, and adjusted forecast. The per capita targets for the SB 32/B-55-18 per capita target pathway are 3.46 MT CO_2e per capita in 2030 to meet the SB 32 target, and 0 MT CO_2e per capita in 2045 to meet the B-55-18 target. The gap between the adjusted per capita emissions forecast and SB 32/B-55-18 per capita target pathway in 2030 is 1.34 MT CO_2e per capita, and the gap in 2045 is 3.90 MT CO_2e per capita.

Table 7 Summary of Livermore Future GHG Emissions Forecasts by Per Capita Efficiency Reduction Target Pathway

Emissions Forecast	2017 (MT CO_2e)	2020 (MT CO_2e)	2025 (MT CO_2e)	2030 (MT CO_2e)	2035 (MT CO_2e)	2040 (MT CO_2e)	2045 (MT CO_2e)
Business-as-Usual Per Capita Emissions Forecast	6.37	6.39	6.28	5.99	5.82	5.65	5.48
Adjusted Per Capita Emissions Forecast	6.37	6.09	5.45	4.80	4.41	4.10	3.90
SB 32/B-55-18 Per Capita Pathway	6.37	5.77	4.62	3.46	2.16	1.01	0.00

MT CO_2e: metric tons of carbon dioxide equivalent

Figure 5 Minimum Required GHG Reduction Pathways for CEQA Streamlining (Per Capita Emissions)



Suggested GHG Emissions Reduction Pathway

The City of Livermore could adopt any of the GHG emissions target reduction targets discussed above for the CAP Update, as all of these pathways would comply with the state emissions reduction goals and requirements for a CEQA Qualified GHG Reduction Strategy. However, the City could also choose to adopt a more stringent 2030 target. One option would be a linear reduction from current emissions using per-capita emission. For the City of Livermore this would lead to slightly more aggressive reductions in 2030 compared to the SB32 minimum requirement, as detailed in Figure 6. In the case of Livermore, the population growth and remaining reduction required make the SB32 minimum pathway and the linear per capita reduction pathway similar. However, the adoption of a per capita target is also suggested due to the increased flexibility associated with controlling for population growth. Having a per-capita target allows the City to continue to grow without hindering the ability to meet the GHG reduction targets.

Table 8 shows the GHG emissions gaps through 2045 between the two per capita pathways and the and forecast emissions. The per capita targets for the suggested pathway are 3.41 MT CO_2e per capita in 2030 to meet the SB 32 target, and 0 MT CO_2e per capita in 2045 to meet the B-55-18 target. As the GHG emissions reduction targets require more emissions reductions through 2045, the GHG emissions gap between forecast emissions increases. This gap will be bridged by GHG emissions reduction measures developed in the Livermore CAP Update. The suggested pathway leads to a larger emissions gap before 2030 than the SB 32/B-55-18 per capita pathway, but a smaller emissions gap from 2030 to 2045.

Figure 6 Suggested GHG Emissions Reduction Pathway Compared to Minimum CEQA-compliant Pathways (Per Capita Emissions)

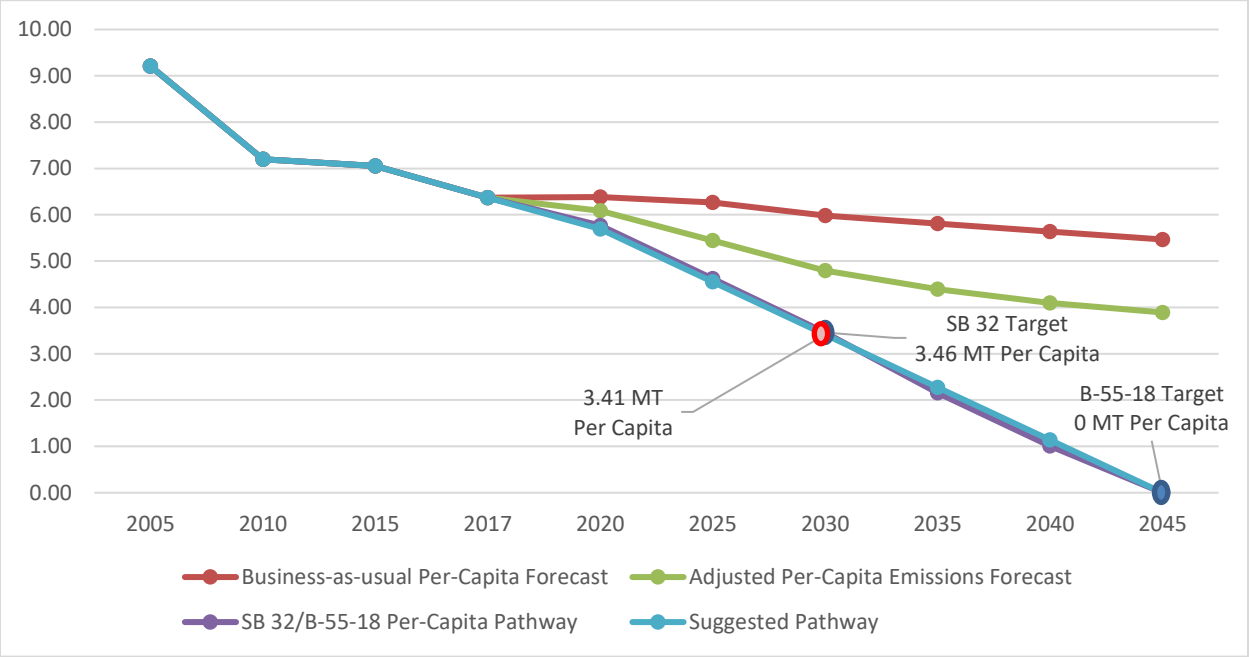


Table 8 Summary of Per Capita GHG Emissions Gap for Meeting Suggested Targets by Forecast Year

Emissions Forecast	2017 (MT CO_2e)	2020 (MT CO_2e)	2025 (MT CO_2e)	2030 (MT CO_2e)	2035 (MT CO_2e)	2040 (MT CO_2e)	2045 (MT CO_2e)
Adjusted Per Capita Emissions Forecast	6.37	6.09	5.45	4.80	4.41	4.10	3.90
2045 SB 32/B-55-18 Per Capita Pathway	6.37	5.77	4.62	3.46	2.16	1.01	0.00
Suggested Pathway	6.37	5.69	4.55	3.41	2.28	1.14	0.00
2045 SB 32/B-55-18 Per Capita Pathway Emissions Gap	**0**	**0.32**	**0.83**	**1.34**	**2.25**	**3.09**	**3.90**
Suggested Pathway Emissions Gap	**0**	**0.40**	**0.90**	**1.39**	**2.13**	**2.96**	**3.90**

MT CO_2e: metric tons of carbon dioxide equivalent

Although this suggested pathway is slightly more stringent than the state goals, it offers the following key benefits:

- The per capita target is more flexible and allows for population growth over time;
- More stringent short-term targets could spur the adoption of significant actions and smooth the transition to carbon neutrality in the long term; and
- A target of carbon neutrality by 2045 will ensure CAP targets are consistent with longer-term future State targets.

Meeting the GHG Emissions Targets

The GHG emissions targets identified above will be achieved through implementation of local GHG emissions reduction measures that are to be identified within the Livermore CAP Update. Local measures will be identified through a comprehensive assessment of existing local and regional policies, programs, and actions and by assessing gaps and identifying additional opportunities. Additional measures will be developed from best practices worldwide and 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), Attorney General's office, and Air Resources Board. Measures will be vetted by City staff and the community and will be quantified to identify their overall contribution to meeting the Livermore GHG reduction targets.

Although the measures in the Livermore CAP Update will continue to achieve GHG emissions reductions after 2030 and establish a trajectory for reaching longer-term goals, another phase of climate action planning and the realization of additional technological advances and State measures will be needed to meet the longer-term targets. This next phase will build on the measures in the CAP Update, informed by monitoring and adaptive management, and take advantage of new technologies and climate protection science that will be available in the future.

If you have any questions about the GHG inventory, forecast, and targets methodology and calculations, please reach out to Ryan Gardner at rgardner@rinconconsultants.com or (510) 671-0177.

Sincerely,
Rincon Consultants, Inc.

Ryan Gardner, MESM, LEED-AP, ENV-SP
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Principal

Attachment

GHG Inventory and Forecast Technical Appendix