DATE: September 11, 2017

TO: Council Sustainability Committee

FROM: Director of Utilities & Environmental Services

SUBJECT CY 2015 Greenhouse Gas Emissions Inventory

RECOMMENDATION

That the Committee reviews and comments on this informational report.

SUMMARY

The City Council has set greenhouse gas (GHG) emission reduction targets for the Hayward community. To track progress, staff completes a full community GHG inventory every five years. This report provides the results of calendar year 2015 inventory and compares it to the previous two inventories. The table below summarizes the emissions totals for the three sectors - energy, transportation, and solid waste. Emissions are displayed in metric tons of carbon dioxide equivalent[1] (MT C02e).

Table 1: GHG Emissions by Sector (MT C02e)

	2005	2010	% Change*	2015	% Change*
Energy Emissions	395,790	373,453	-5.6%	365,711	-7.6%
Transportation Emissions	696,013	644,044	-7.5%	664,442	-4.5%
Solid Waste Emissions	62,285	28,628	-54.0%	24,909	-60.0%
Total Emissions	**1,154,088**	**1,046,125**	**-9.4%**	**1,055,061**	**-8.6%**
Hayward Population[2]	140,305	146,002	4.1%	159,104	13.4%
Total Emissions/Capita	**8.23**	**7.17**	**-12.9%**	**6.63**	**-19.4%**

*Percent change is compared to the baseline year of 2005

In 2015, the Hayward community achieved an 8.6% reduction in GHG emissions compared to 2005. Total *per capita* emissions were 19.3% lower in 2015 given Hayward's increasing population. If we consider population growth, Hayward is making good progress toward

[1] Carbon dioxide is not the only gas that contributes to climate change. Each greenhouse gas causes varying amounts of warming. For example, one ton of methane (CH4) causes the same amount of warming as 23 tons of CO2 (1 ton of CH4 = 23 tons CO2e). To simplify reporting, it is standard practice to report carbon equivalent emissions (CO2e) as opposed to the actual emissions of each gas.

[2] Population data source: California Department of Finance estimates for the end of each year (1/1/2006 and 1/1/2011, and 1/1/2016): www.dof.ca.gov/Forecasting/Demographics/Estimates/

meeting Council's 2020 goal of a 20% emissions reduction. However, the goals adopted by Council in the 2040 General Plan apply to the total GHG emissions, not the per capita amount.

BACKGROUND

The last report on GHG emissions was presented to the Council Sustainability Committee in July 2016 and included a partial inventory for calendar year 2015; however, transportation and solid waste-related data were not yet available at that time. The 2016 report and previous reports are available on the City's Climate Action Plan page.

The purpose of this report is to update the Committee on the 2015 community GHG emissions inventory. The City of Hayward's General Plan Policy NR-2.4 sets the following GHG emissions reduction targets.

> *NR-2.4: Community Greenhouse Gas Reduction*
> The City shall…reduce community-based GHG emissions by 20 percent below 2005 baseline levels by 2020, and strive to reduce community emissions by 61.7 percent and 82.5 percent by 2040 and 2050, respectively.

To track compliance with these targets, the City conducts community GHG emissions inventories every five years, starting with 2005 as the baseline year. For 2005 and 2010, staff worked with ICLEI–Local Governments for Sustainability and StopWaste to complete the inventories. For the 2015 inventory, Hayward's CivicSpark Fellows used the Statewide Energy Efficiency Collaborative's (SEEC) ClearPath software. SEEC is a collaboration between ICLEI, the Institute for Local Government, the Local Government Commission, and all California investor-owned utilities.

All three inventories use the Global Protocol for Community-Scale (GPC) methodology to calculate GHG emissions. The GPC methodology is a global reporting standard created by ICLEI, the World Resources Institute, and C40 Cities Climate Leadership Group. The Global Covenant of Mayors for Climate and Energy, which the Hayward City Council voted to join on March 7, 2017, has adopted the GPC as its standard reporting format.

Over the past ten years, the organizations mentioned above have continuously refined and updated the GPC methodology to estimate emissions more accurately. In response, staff has recalculated select emissions for the 2005 and 2010 inventories in ClearPath to make an apples-to-apples comparison. Therefore, the numbers reported in this report do not match the numbers from previous reports. In particular, the data sources and methodology for calculating the transportation sector have been updated since 2010 to include a more detailed breakdown of vehicle types.

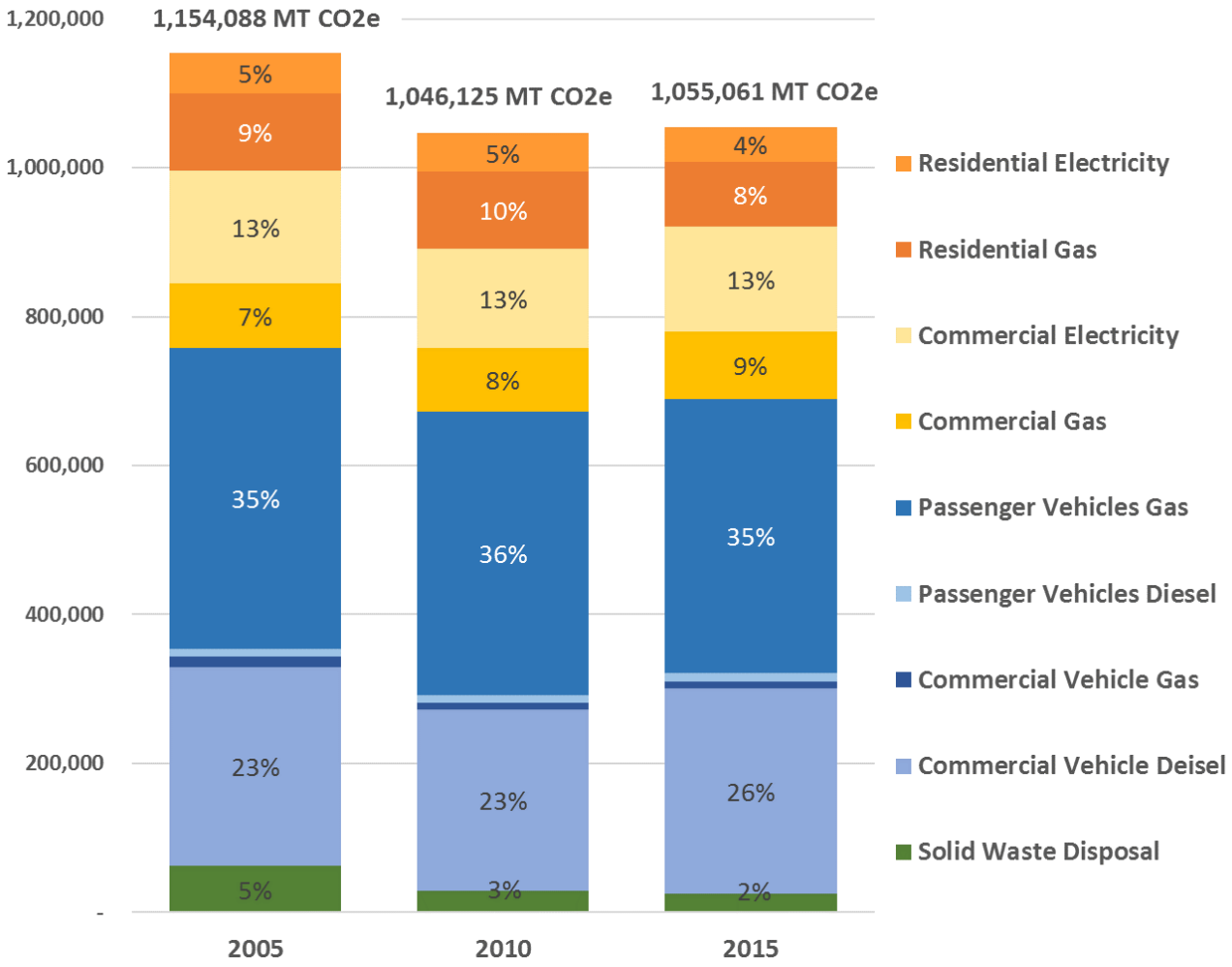
Since the baseline year of 2005, staff has also begun to track additional emissions from wastewater and public transit sources. However, because these emissions were not included in the baseline year and an apples-to-apples comparison cannot be made, they have been left out of the year-to-year comparison.

In the discussion below, staff has made educated guesses about the factors driving emission reductions or increases. However, for some trends, sufficient data sources are unavailable to draw conclusions. Because of this, staff applied and was selected to participate in a U.S. Department of Energy Project: Analyzing Drivers of Change in Greenhouse Gas Emissions Inventories. In the coming months, the City will work with ICLEI to help develop a "contribution analysis," which can be used to help explain trends in greenhouse gas emissions inventories and forecast future changes.

DISCUSSION

Hayward's GHG inventory is comprised of three sectors: energy, transportation, and solid waste. The chart below shows the subsector breakdown for each year and the percent of each subsector for that year. Transportation, shown in shades of blue, is the largest sector, making up 60-63% of the total. Energy makes up 34-35% of the total and solid waste makes up 2-5%.

Figure 1: GHG Emissions by Subsector (MT C02e)[3]



[3] The percentages for each subsector are relative to the total emissions for each year.

Energy Sector

As shown in Table 2 on page 5, energy emissions in 2015 were 7.6% below 2005 levels. Emissions decreased 2% more from the 5.6% reduction achieved in 2010. Emissions from residential electricity, residential gas, and commercial electricity usage all declined in 2015. The primary reason that electricity emissions have decreased is that Pacific Gas & Electric Company (PG&E) sources have become cleaner over the past ten years as PG&E strives to meet the State's Renewable Portfolio Standard goal of 33% by 2020, and PG&E's continued use of large hydro and nuclear energy, which typically has low GHG emissions.

The 16% reduction in residential gas emissions in 2015 is likely related to the mild winter that year, which reduced the need for residents to heat their homes. A mild winter equates to fewer Heating Degree Days (HDD). HDD is the unit which measures how many degrees, and for how many days, outside air temperatures were lower than the base temperature of 65 degrees Fahrenheit. In 2015, Hayward saw fewer days when outside temperatures dipped below 65 degrees compared to 2005 and 2010 (see Attachment II).

Despite the warm winter, natural gas emissions from the commercial sector increased by 5% in 2015. This is likely due to the improved economy and increase in business activities. However, there may be additional factors driving this increase, which staff hopes to uncover as part of the DOE contribution analysis.

Data Inputs for Table 2:

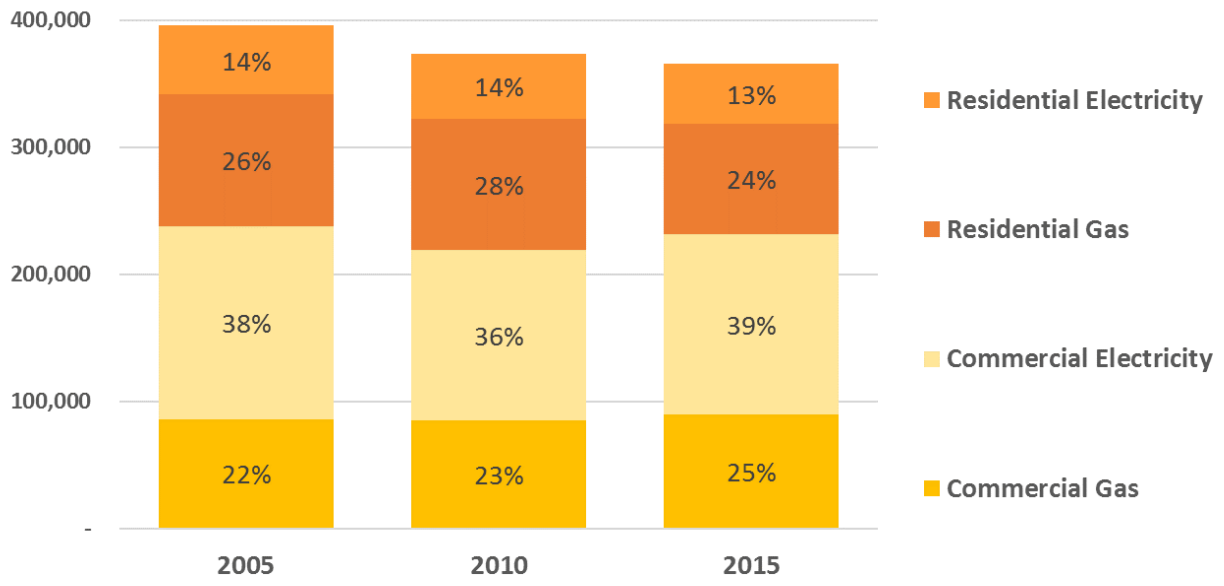
- Usage: PG&E provides the City with total kWhs and Therms for all residential and commercial buildings in Hayward.
- Emission Factor for Electricity = Average MT C02e emitted per kWh, including carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O). This factor has decreased over time as PG&E's electricity sources have become cleaner.
- Emission Factor for Natural Gas = Average MT C02e emitted per therm, including C02, CH4, and N2O. This factor remains constant.

Table 2: Energy Sector GHG Emissions

		2005	2010	% Change*	2015	% Change*
Residential Electricity	kWh	242,674,455	252,427,371	4%	241,804,751	0%
	Emission Factor	0.000224	0.000203	-9%	0.000196	-12%
	MT CO2e	54,288	51,335	-5%	47,334	-13%
Residential Gas	Therms	19,496,859	19,400,629	0%	16,326,344	-16%
	Emission Factor	0.005317	0.005317	0%	0.005317	0%
	MT CO2e	103,674	103,162	0%	86,815	-16%
Commercial Electricity	kWh	678,989,309	657,204,663	-3%	722,945,746	6%
	Emission Factor	0.000224	0.000203	-9%	0.000196	-12%
	MT CO2e	151,894	133,653	-12%	141,519	-7%
Commercial Gas	Therms	16,160,661	16,041,943	-1%	16,933,488	5%
	Emission Factor	0.005317	0.005317	0%	0.005317	0%
	MT CO2e	85,934	85,303	-1%	90,043	5%
Total Energy MT CO2e		**395,790**	**373,453**	**-5.6%**	**365,711**	**-7.6%**

*Percent change is compared to the baseline year of 2005

Figure 2: Energy Sector GHG Emissions (MT C02e)[4]



[4] The percentages for each subsector are relative to the total emissions for each year.

Transportation Sector

As shown in Table 3, transportation emissions in 2015 were 4.5% below emissions in 2005. This is less than the 7.5% reduction achieved between 2005 and 2010. As seen in the table below, the total vehicle miles traveled (VMT) decreased in 2010 and then increased again in 2015. This is likely related to the economic recession and recovery. While total passenger VMT for 2015 remains lower than 2005, total commercial VMT is higher than in 2005, especially for diesel construction vehicles.

Overall emissions factors have decreased in all categories over the last ten years as vehicles have become cleaner.[5] Passenger diesel vehicles have experienced the greatest decrease and commercial gas have experienced the least.

Data Inputs for Table 3:

- Usage: The Metropolitan Transportation Commission (MTC) provides the City with estimated VMT for passenger and commercial vehicles. MTC uses modeling software and data from regional transportation studies to come up with these estimates.
- Emission Factors = Average MT C02e emitted per mile, including C02, CH4, and N2O. This factor is calculated for each of the vehicle categories below using California Air Resources Board (CARB) data for Alameda County. CARB uses transportation studies to estimate the ratio of vehicle types by VMT and the pollution levels for each type.

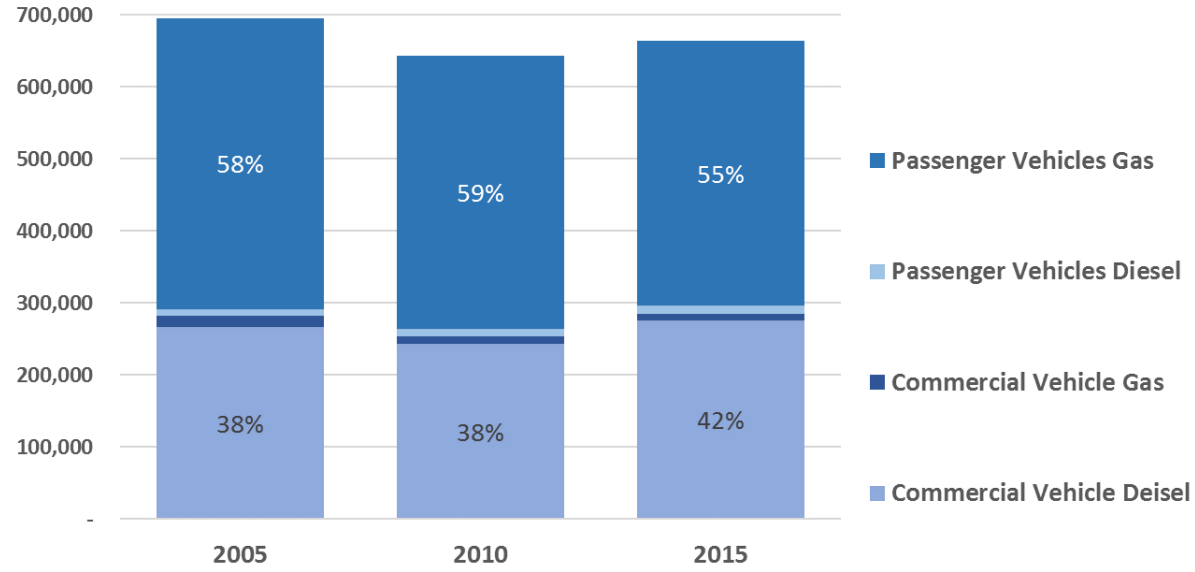
Table 3: Transportation Sector GHG Emissions

		2005	2010	% Change*	2015	% Change*
Passenger Gas	Miles (VMT)	977,958,199	916,538,305	-6.3%	936,472,744	-4.2%
	Emission Factor	0.000413	0.000415	0.5%	0.000393	-4.9%
	MT CO2e	403,877	380,315	-5.8%	367,744	-8.9%
Passenger Diesel	Miles (VMT)	15,579,684	16,459,159	5.6%	19,305,403	23.9%
	Emission Factor	0.000656	0.000628	-4.2%	0.000583	-11.1%
	MT CO2e	10,216	10,342	1.2%	11,258	10.2%
Commercial Gas	Miles (VMT)	10,883,273	7,069,442	-35.0%	6,832,281	-37.2%
	Emission Factor	0.001369	0.001367	-0.1%	0.001365	-0.3%
	MT CO2e	14,895	9,661	-35.1%	9,325	-37.4%
Commercial Diesel	Miles (VMT)	165,254,960	149,177,668	-9.7%	174,788,663	5.8%
	Emission Factor	0.001616	0.001634	1.1%	0.001580	-2.2%
	MT CO2e	267,025	243,726	-8.7%	276,114	3.4%
Total Transportation MT CO2e		**696,013**	**644,044**	**-7.5%**	**664,442**	**-4.5%**

*Percent change is compared to the baseline year of 2005

[5] Two of the 2010 emissions factors increased compared to 2005. The emissions factors likely increased because less efficient vehicles made up a greater share of total vehicles on the road that year. One possibility is that the age of the vehicles may have decreased their fuel efficiency, which may be related to the economic downturn.

Figure 3: Transportation Sector GHG Emissions (MT C02e)



Solid Waste Sector

Solid Waste emissions in 2015 were 60% below emissions in 2005. This dramatic reduction is primarily because the Altamont Landfill completed a landfill gas to liquified natural gas plant in 2009, which allowed it to achieve an estimated 93% methane gas capture rate. The reduction is also due in part to Hayward's efforts to increase diversion of organic material away from landfills. Over this ten-year period, Hayward implemented mandatory recycling and organics.

Data Inputs for Table 4:

- Usage: CalRecycle provides the City will the total tons of waste disposed into landfills that originated from Hayward.
- Emission Factor = Average MT C02e emitted per ton of waste, comprised solely of methane. This factor applies a methane oxidation rate based on the estimated mix of organic and non-organic material in the waste. This factor also gives credit for any methane captured at the landfill.

Table 4: Solid Waste Sector GHG Emissions

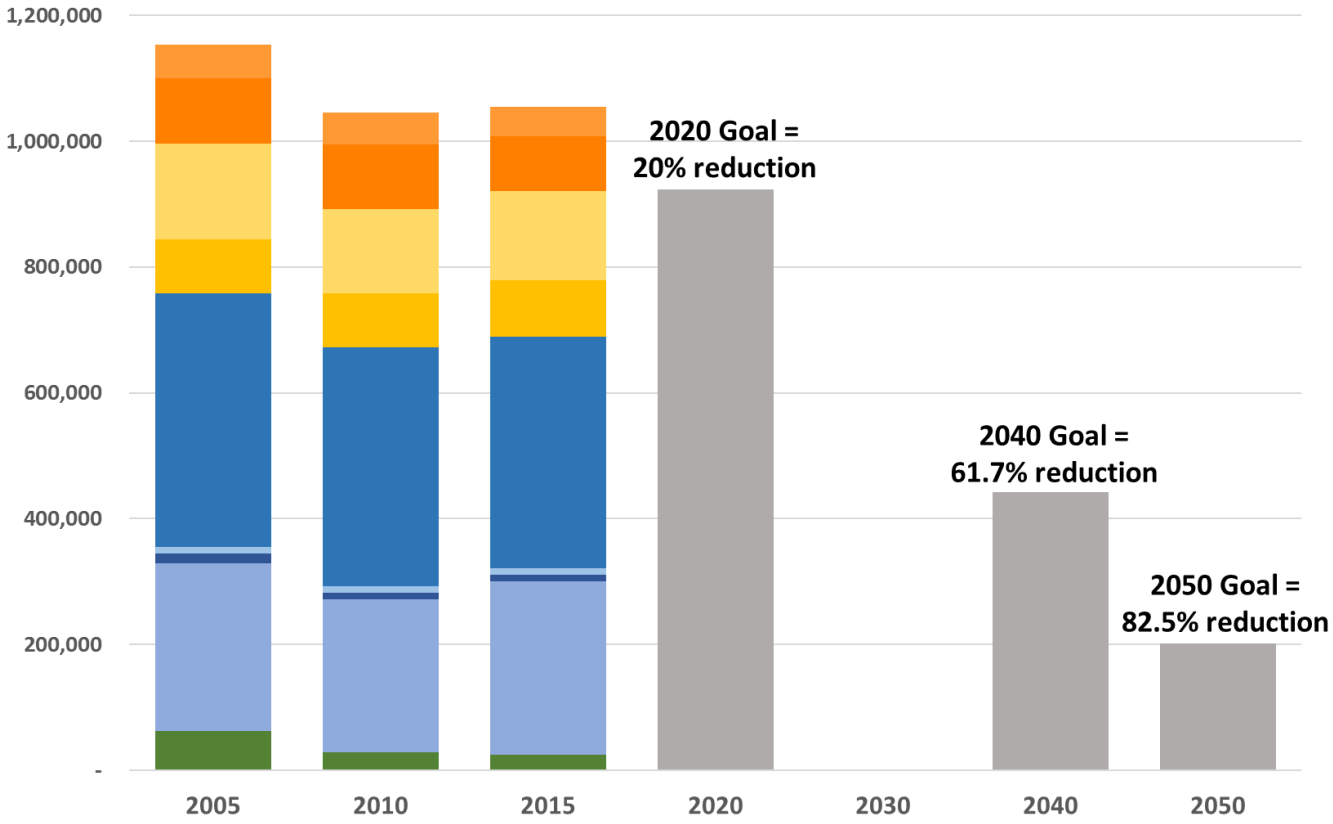
		2005	2010	% Change*	2015	% Change*
Waste Sent to Landfill	Tons of waste	173,509	119,483	-31.1%	108,106	-37.7%
	Emission Factor	0.358973	0.239595	-33.3%	0.230410	-35.8%
	MT CO2e	62,285	28,628	-54.0%	24,909	-60.0%
Total Solid Waste MT CO2e		**62,285**	**28,628**	**-54.0%**	**24,909**	**-60.0%**

*Percent change is compared to the baseline year of 2005

Emission Reduction Goals

The chart below shows the inventories in 2005, 2010, and 2015, as well as the emission reduction targets for 2020, 2040, and 2050. At the current trend, Hayward will fall short of its 2020 goal of a 20% *total* emissions reduction.

Figure 4: GHG Emission Inventories and Goals



Progress Towards the 2020 Goal

East Bay Community Energy (EBCE) is a newly formed community choice aggregator (CCA) that will serve cities in Alameda County and the County unincorporated areas. EBCE will take over the role of procuring energy for its customers and PG&E will continue to provide transmission and billing services. The Agency is scheduled to launch in Spring of 2018. In the implementation plan submitted to the California Public Utilities Commission, EBCE stated that it intends to provide electricity that is *at least* 10% cleaner than PG&E in terms of GHG emissions. EBCE's mission is to deliver cleaner electricity, and 10% cleaner should be considered the minimum improvement over PG&E.

Table 5 on page 9 shows three scenarios for the possible impact of EBCE on Hayward's 2020 GHG emissions. For all three scenarios, staff is assuming that transportation, solid waste, and natural gas emissions remain flat because staff does not anticipate that there will be sufficient

reductions in any of these categories by 2020 to make up for Hayward's growing population and increased commercial activity.

Table 5 separates out Direct Access (DA) customers, which make up 16% of Hayward's electricity load. DA customers will not be automatically enrolled in EBCE. Instead, they will need to proactively switch their energy contracts to EBCE. The three scenarios below each assume a different DA switch rate to EBCE. The City is aware of some DA customers, such as Cal State East Bay, and can conduct outreach to these customers. However, PG&E will not share the full list of DA customers with the City due to data-privacy regulations.

Staff feels that the first scenario in Table 5 is the minimum impact that EBCE will deliver. It assumes that EBCE will procure 73% of its electricity from GHG-free sources, either renewables or hydropower (this is 10% cleaner than PG&E). In addition, this scenario assumes that there will be a 5% opt out rate for Hayward customers, who will instead be served by PG&E. Finally, it assumes that 20% of the DA energy load will switch to EBCE. The first scenario would result in an overall emission reduction of 9.1% in 2020, far short of the 20% reduction goal set by Council.

The second, middle scenario assumes that EBCE will procure 85% of its electricity from GHG-free sources. It assumes that 5% of customers will opt out and that 50% of the DA energy load will switch to EBCE. This scenario results in an overall emissions reduction of 13.3%, still short of the 20% goal.

Staff feels that the third scenario is the maximum impact that EBCE will be able to deliver. It assumes that EBCE will procure 100% of its electricity from GHG-free sources. It assumes that 10% of Hayward customers will opt out due to potentially higher costs. Finally, it makes the optimistic assumption that 65% of the DA energy load will switch to EBCE. This scenario would result in an overall emissions reduction of 20.1%, meeting Council's goal.

Table 5: Three Scenarios Showing Potential Impact of EBCE

Scenario #	Assumptions			Total GHG Reduction from 2005 - 2020
	GHG-Free Electricity	Opt Out Rate	DA Load Switch to EBCE	
1	73%	5%	20%	-9.1%
2	85%	5%	50%	-13.3%
3	100%	10%	65%	-20.1%

As mentioned above, these results reflect total emission reductions, not per capita reductions. For all three scenarios above, Hayward will achieve a greater than 20% per capita emissions reduction due to increasing population.

The 2040 Goal

Hayward's 2040 General Plan sets a goal of achieving a 61.7% GHG emissions reduction by 2040 as compared to 2005. Staff has calculated a theoretical scenario that will achieve this goal in Table 6 on page 10.

To achieve the 2040 goal, there will need to be a significant reduction in emissions from the transportation sector, the largest contributor to Hayward's GHG inventory. Unfortunately, the City has limited control over regional transportation patterns. The method used to calculate transportation emissions in Hayward includes both local trips as well as vehicles traveling regionally on highways through Hayward. Any programs to reduce vehicle trips on Hayward roads, such as increased bike ways and car sharing, would pale in comparison to highway trips.

Fortunately, the State is actively developing policies and implementing strategies to address emissions from the transportation sector. The State of California's Alternative Fuels Plan, created by the California Energy Commission and Air Resources Board, lays out a path for majority electrification of passenger and commercial vehicles. The agencies estimate that the California could reduce its transportation GHG emissions as much as 70% by 2050[6] if it implements the recommendations set forth in the Plan.

The scenario in Table 6 makes the following assumptions to reduce Hayward's emissions by 61.7% by 2040. Staff feels that these assumptions are ambitions and will largely depend on State leadership, cultural change, and technological advances over the next 22 years.

1. It assumes EBCE's procurement practices and local efficiency efforts can reduce electricity emissions by 75% compared to 2015.
2. It assumes that gas efficiency efforts and energy-switching[7] measures will reduce natural gas emissions by 70% compared to 2015.
3. It assumes that state and local efforts to electrify vehicles and reduce vehicle trips result in a 50% reduction in transportation emissions compared to 2015.
4. It assumes that increased waste diversion, especially of organic material, will reduce solid waste emissions by 60% compares to 2015.

Table 6: 2040 Emissions Reduction Scenario

Hayward GHG Emissions Summary Table (MT CO2e)	2005	2015	2040	% Change from 2015	% Change from 2005
Electricity Emissions	206,182	188,853	47,213	-75.0%	-77.1%
Natural Gas Emissions	189,608	176,858	53,057	-70.0%	-72.0%
Transportation Emissions	696,013	664,442	332,221	-50.0%	-52.3%
Solid Waste Emissions	62,285	24,909	9,964	-60.0%	-84.0%
Total Emissions	**1,154,088**	**1,055,061**	**442,455**	**-58.1%**	**-61.7%**

[6] California Air Resources Board & California Energy Commission (2007). State Alternative Fuels Plan. http://www.energy.ca.gov/2007publications/CEC-600-2007-011/CEC-600-2007-011-CMF.PDF

[7] Energy switching refers to replacing gas appliances with electric appliances, such as hot water heaters, clothes dryers, or stove tops.

Limitations of this Inventory

The GHG inventory method that Hayward uses, along with most cities worldwide, was originally designed by ICLEI and partners in the early 2000s. The focus then and now is on measuring emissions from the data sources that are most readily available, such as utility data. This approach is practical, but it comes with limitations.

Reporting Timeframe

One of the most significant limitations is the five-year gap between each inventory, which makes it difficult to assess the progress and effectiveness of policies and programs. There are regional efforts to increase the frequency of data availability. For example, MTC has recently launched a data portal to provide transportation data, rather than each city having to request the data. Unfortunately, this data only covers certain years. In addition, PG&E has created tailored reports specifically designed to help with emissions inventories[8]. Unfortunately, the PG&E reports are often significantly delayed.

Staff is currently working with the East Bay Energy Watch (EBEW), StopWaste, and other Bay Area cities to discuss ways to streamline the inventory process. One possibility may be for the Bay Area Air Quality Management District (BAAQMD) to take the lead on data gathering and providing the necessary emission factors to each city, rather than each city gathering data and calculating these factors on their own. Another possibility may be for EBEW to hire a consultant to do annual inventories for individual cities, which is currently done for cities in San Mateo County.

Missing Emission Sources

Another limitation is that the current inventory omits large sources of emissions over which the City may have some influence. Specifically, the inventory does not include the upstream emissions of the goods consumed in Hayward. For example, emission reductions from green purchasing policies would not be reflected in the current inventory. And food, one of the biggest contributors to GHG emissions worldwide, is not reflected in Hayward's inventory.

As mentioned above, the reason upstream emissions are not included is that it is difficult to obtain data on consumer consumption patterns. However, some attempts are being made. In 2016, the BAAQMD launched a project with UC Berkeley to create consumption-based inventories for Bay Area cities[9]. Staff has concerns with the data sources used for this project, but feels that the intent is meaningful.

[8] There are currently discussions between investor owned utilities and local government advocates about energy data access and privacy issues. In particular, many cities in the bay area have struggled to get energy data for their industrial users. Hayward has not yet encountered this issue, but it could in the future.

[9] The City's current inventory is a hybrid of consumption and production. For example, energy consumed by residents is consumption-based and energy consumed by industry is production-based. The State of California performs a true production-based inventory, measuring all emissions produced in California from all sectors, including agriculture.

STRATEGIC PRIORITIES

This agenda item is an informational report, and does not relate to one of the Council's Strategic Initiatives.

NEXT STEPS

Staff will continue to work with StopWaste and regional agencies to identify potential opportunities to streamline GHG inventories on a county or regional level, with the goal of increasing the frequency of reporting to annually rather than every five years.

Staff will also continue to implement the GHG reduction programs identified in Hayward's General Plan. As mentioned above, one highlight is that East Bay Community Energy will be serving Hayward customers by 2020, which as mentioned above may have a positive impact on the 2020 inventory. Additional reduction actions will need to be identified for Hayward to meet its 2040 and 2050 goals.

Most Alameda County cities have not set GHG emission reduction goals beyond 2020. These cities will be updating their Climate Action Plans over the next year to set future goals, which creates an opportunity to establish regional goals as well as city-specific goals.

The potential solutions to GHG emissions are evolving rapidly. Just a few years ago, staff could not have predicted the formation of EBCE, the rise of electric cars and trucks, and the trend towards self-driving cars. Given the rapid changes that are taking place, staff recommends adopting shorter-range GHG emission reduction goals. Staff will return to the Committee at a future meeting to present the possibility of establishing 2025 and 2030 goals and potential strategies to help the City meet these goals.

Prepared by: Mary Thomas, Management Analyst,
Chris Sturken, CivicSpark AmeriCorps Fellow

Recommended by: Alex Ameri, Director of Utilities & Environmental Services

Approved by:

Kelly McAdoo, City Manager