City of Manhattan Beach

2016 Inventory of Community Greenhouse Gas Emissions

Produced by ICLEI - Local Governments for Sustainability USA for City of Manhattan Beach

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Introduction

Naturally occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence shows that human activities are increasing the concentration of greenhouse gases and changing the global climate. The most significant contributor is the burning of fossil fuels for transportation, electricity generation and other purposes, which introduces large amounts of carbon dioxide and other greenhouse gases into the atmosphere. Collectively, these gases intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise.

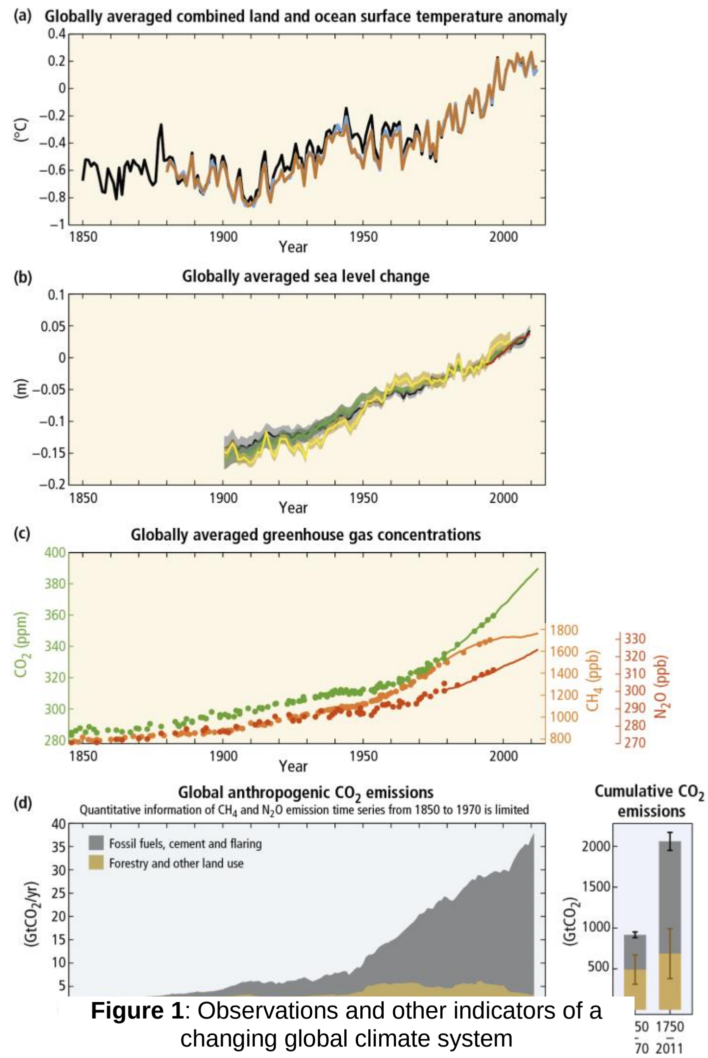

Figure 1: Observations and other indicators of a changing global climate system

The City of Manhattan Beach is likely to be impacted by climate change. Like the rest of California, Manhattan Beach may expect increased upstream water shortages, air pollution from wildfire, flooding, and the disruption of ecosystems, habitats, and agricultural activities.

Reducing fossil fuel use in the community can have many benefits in addition to reducing greenhouse gas emissions. More efficient use of energy decreases utility and transportation costs for residents and businesses. Retrofitting homes and businesses to be more efficient creates local jobs. In addition, money not spent on energy is more likely to be spent at local businesses and add to the local economy. Reducing fossil fuel use improves air quality and promotes opportunities to utilize alternative transportation. Increasing opportunities for walking and bicycling also improves residents' health.

EVIDENCE OF HUMAN-CAUSED CLIMATE CHANGE

There is overwhelming scientific consensus that the global climate is changing, and that human actions, primarily the burning of fossil fuels, are the main cause of those changes. The Intergovernmental Panel on Climate Change (IPCC) is the scientific body charged with bringing together the work of thousands of climate scientists. The IPCC's Fifth Assessment asserts that:

> "It is *extremely likely* that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in GHG concentrations and other anthropogenic forces together. Globally, economic and population growth continued to be the most important drivers of increases in CO2 emissions from fossil fuel combustion. Changes in many extreme weather and climate events have been observed since about 1950. Some of these changes have been linked to human influences, including a decrease in cold temperature extremes, an increase in warm temperature extremes, an increase in extreme high sea levels and an increase in the number of heavy precipitation events in a number of regions".

In short, the Earth is already responding to climate change drivers introduced by mankind.

Inventory Methodology

UNDERSTANDING A GREENHOUSE GAS EMISSIONS INVENTORY

The first step requires identifying baseline emissions levels and the sources and activities generating emissions in the community. This report presents emissions from the Manhattan Beach community as a whole.

As local governments have continued to join the climate protection movement, the need for a standardized approach to quantify GHG emissions has proven essential. This inventory uses the approach and methods provided by the Global Protocol for Community Scale GHG Inventories (GPC). The GPC was developed in 2014 by C4O, ICLEI, and the World Resources Institute as a global standard protocol for GHG inventorying. The GPC is the official protocol specified by the Global Covenant of Mayors, and defines what emissions must be reported and how. In addition, this inventory draws on methods from the U.S. Community Protocol[1], which provides more detailed methodology specific to U.S. communities. Inventory calculations were performed using the ClearPath[2] tool.

QUANTIFYING GREENHOUSE GAS EMISSIONS

Emissions Scopes

There are three emission scopes for community emissions:

- **Scope 1:** GHG emissions from sources located within the city boundary, such as stationary fuel consumption.
- **Scope 2:** GHG emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam, and/or cooling within the city boundary
- **Scope 3:** All other GHG emissions that occur outside the city boundary as a result of activities taking place within the city boundary

This inventory follows the city-inducted framework in the GPC, which totals GHG emissions attributable to activities taking place within the geographic boundary of the city. Under the BASIC reporting level, the inventory requirements covers scope 1 and scope 2 emissions from stationary energy and transportation, as well as scope 1 and scope 3 emissions from waste.

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[1] http://icleiusa.org/publications/us-community-protocol/
[2] http://icleiusa.org/clearpath/

Base Year

The inventory process requires the selection of a base year with which to compare current emissions. Manhattan Beach's community greenhouse gas emissions inventory utilizes 2005 as its base year. City of Manhattan Beach worked with the South Bay Cities Council of Governments to develop their past inventories.

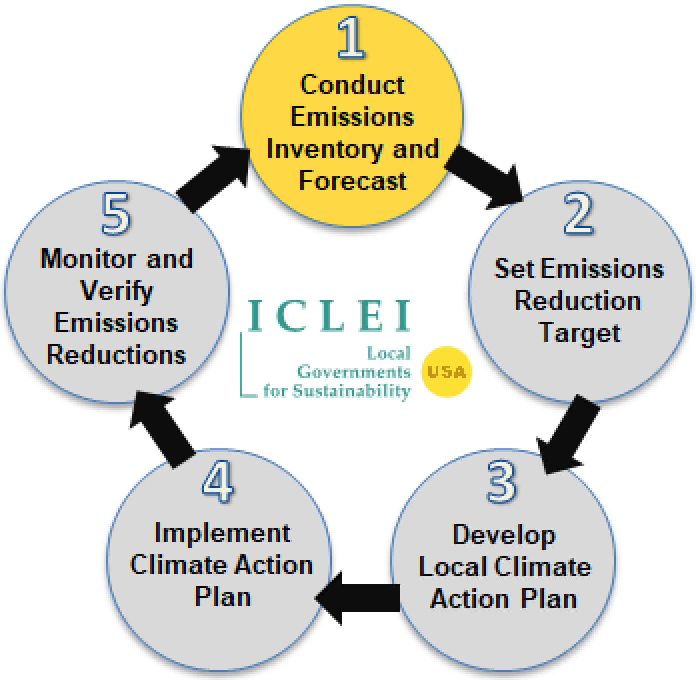
Quantification Methods

Greenhouse gas emissions can be quantified in two ways:

- Measurement-based methodologies refer to the direct measurement of greenhouse gas emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility.
- Calculation-based methodologies calculate emissions using activity data and emission factors. To calculate emissions accordingly, the basic equation below is used: *Activity Data x Emission Factor = Emissions*

Emission sources in this inventory are quantified using calculation-based methodologies. Activity data refer to the relevant measurement of energy use or other greenhouse gas-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled.

Known emission factors are used to convert energy usage or other activity data into associated quantities of emissions. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g. lbs CO_2/kWh of electricity).



WHAT IS THE FIVE MILESTONES FRAMEWORK?

The Five Milestones build on ICLEI's 20+ years of experience as the leader in local emissions management. Over 1000 communities nationwide have benefited from ICLEI's well-managed approach to building more sustainable, climate-friendly communities. The proven Five Milestones framework offers a systematic approach for analyzing baseline greenhouse gas emissions, developing an emissions reduction target, developing and implementing a climate action plan, and monitoring emissions reduction progress. This framework helps you reduce energy costs, be a responsible steward of the global environment, and improve quality of life for your community.

ICLEI's Five Milestones program provides a framework, methodology, and comprehensive assistance for local governments to identify and reduce greenhouse gas emissions.

1. Conduct an inventory and forecast of local greenhouse gas emissions;
2. Establish a greenhouse gas emissions reduction target;
3. Develop a climate action plan for achieving the emissions reduction target;
4. Implement the climate action plan; and,
5. Monitor and report on progress.

INVENTORY DATA SOURCES

Energy

Electricity and natural gas data was obtained from Southern California Edison and SoCalGas respectively for the residential and commercial sectors. Table 1 shows the electricity emission factors utilized. The industrial sector failed the 15/15 rule, indicating that Southern California Edison dropped some data.

California Air Resources Board (CARB)'s mandatory GHG reporting program for industrial facilities was checked for sites in Manhattan Beach. However, no industrial data was reported for the city.

Table 1: Energy Emissions Factors for 2016 Inventory

Sector	Emission Factor	Unit	Source
Residential Electricity	529	CO2 lb/kWh	Southern California Edison 2016
Residential Natural Gas	53.02	CO2 kg/MMBtu	US Community Protocol
Commercial Electricity	529	CO2 lb/kWh	Southern California Edison 2016
Commercial Natural Gas	53.02	CO2 kg/MMBtu	US Community Protocol
On Road: Gasoline	382.52	CO2 g/mile	EMFAC calculation
On Road: Diesel	1198.07	CO2 g/mile	EMFAC calculation
Off Road	n/a	modeled	CARB ORION Model 2017
Water Energy	529	CO2 lb/kWh	Southern California Edison 2016
Fugitive Emissions (Natural Gas)	0.30%	Leakage rate	EDF User Guide for Natural Gas Leak Rate Modeling Tool
Wastewater	35,924	population	US Community Protocol

Waste

Solid waste emissions were calculated based on the methane commitment model outlined in the GPC. Solid waste disposal totals were obtained from Waste Management. No disposal data was available through CalRecycle.

The waste characterization data comes from a statewide survey and is not specific to the City of Manhattan Beach beyond population proportion and the type of industries operating in the area. The waste categories listed in Table 2 are categories that appear from CalRecycle's profile. However, ClearPath's waste characterization profile has slightly different sectors, so some of the categories were aggregated based on best fit. The CalRecycle waste characterization profile is not updated on an annual basis, so the data in Table 2 reflects the survey as retrieved from the website in 2018.

Table 2: CalRecycle Waste Characterization Profile

Sector	Percentage	Included Categories
Newspaper	2.05%	Newspaper
Office paper	2.37%	White Ledger Paper
		Other Office Paper
Magazines/Third Mail	13.96%	Magazines and Catalogs
		Phone Books and Directories
		Other Miscellaneous Paper - Compostable
		Other Miscellaneous Paper - Other
		Remainder / Composite Paper - Compostable
		Remainder / Composite Paper - Other
		Paper Bags
Cardboard	8.86%	Cardboard
Food scraps	20.64%	Food scraps
Grass	5.81%	Leaves and Grass
Leaves	1.71%	Prunings and Trimmings
Branches	0.26%	Branches and Stumps
Lumber	5.84%	Clean Dimensional Lumber
		Clean Engineered Wood
		Clean Pallets & Crates
		Other Wood Waste
Other Inert Material	38.50%	Electronics category, Household Hazardous Waste (HHW) category, Mixed Residue category, Inerts and Other category (minus Lumber and Gypsum Board sub-types), and Special Waste category (minus Tires sub-type)

Transportation

Off-Road

California Air Resources Board (CARB)'s statewide ORION2017 software results were used for the off-road vehicle emissions. The database is a coarse model that estimates off road emissions at the county level. Los Angeles County emissions were scaled down to Manhattan Beach by population for 2016. By the nature of Manhattan Beach, categories included marine, port, construction, landscaping equipment, and industrial equipment. No agricultural or airport activity was included for the total.

On-Road

Vehicles miles traveled (VMT) transportation data was obtained from Southern California Association of Governments (SCAG). SCAG had modeled VMT for their jurisdictions in the past, but updated data was not available in 2016. The alternative data source, California Public Roads Database, provided a significantly lower total than what was generated from SCAG's modeling, which suggested that there were additional modifications that needed to be made. Therefore, for the consistency of comparison across inventory years, the 2012 VMT model results were taken instead and scaled up to 2016 (Table 3). The scaling was done following instructions by Harold Brazil at the Metropolitan Transportation

Commission for using PeMS.,CalTrans' Freeway Performance Measurement (PeMS) System's highway data, to track the highway traffic change from 2012 to 2016. This scaler was calculated by downloading the aggregate day of week data for the inventory year on PeMS and following the equation below:

$$\text{Scaler} = \left(\frac{average\ week\ VMT}{average\ Tues\ to\ Thurs\ VMT}\right) x\ 365$$

Table 3: On-Road Transportation VMT and CO2 Emission Factors

	Annual VMT 2012	Annual VMT 2016	CO2 Emission Factors
Gasoline total	272,983,734.2	289434665.2	1198.066637
Diesel total	13891041.36	14728162.9	382.5190813
Scaler	1.060263411		

The On-Road Factor calculation method from ClearPath was used for the transportation calculations, requiring breakdown of the VMT by vehicle and fuel type and assigning a CO2, CH4, and N2O emission factor per set. The CO2 transportation emission factors were calculated for 2016 and are detailed in Table 3. The calculation methodology for the EMFAC CO2 transportation emission factors and the fuel breakdown are detailed at the SEEC Resource Portal. This methodology is standard across CA and is taught in the Statewide Energy Efficiency Collaborative (SEEC) Inventory Cohort for local governments. Since no further updated CH4 and N2O data is available, 2015 emission factors were used for 2016 (Table 4). These CH4 and N2O emission factors were obtained from the US Community Protocol.

Table 4: Transportation N2O and CH4 Emissions Factors by Inventory Years (g/mile) from US Community Protocol

Inventory year	Gasoline passenger car		Gasoline light truck	
	N2O	**CH4**	**N2O**	**CH4**
2015	0.011	0.0187	0.017	0.0201
2014	0.0126	0.0193	0.0194	0.0212
2013	0.0143	0.02	0.0223	0.0225
2012	0.0143	0.02	0.0254	0.0241
2011	0.0184	0.022	0.0291	0.026
2010	0.0174	0.0201	0.0251	0.0232
2009	0.0201	0.0214	0.0294	0.0251
2008	0.023	0.023	0.0343	0.0274
2007	0.0262	0.0249	0.0399	0.0302
2006	0.0297	0.0271	0.0461	0.0336
2005	0.0333	0.0299	0.0531	0.0375
2004	0.0369	0.0332	0.0601	0.0419
2003	0.0408	0.0368	0.0675	0.0471

2002	0.0444	0.0408	0.0744	0.0523
2001	0.0477	0.0451	0.0799	0.0576
2000	0.0513	0.0496	0.0871	0.0642
	Diesel Passenger		**Diesel Light Truck**	
	N2O	**CH4**	**N2O**	**CH4**
All	0.001	0.005	0.0015	0.001
	Commercial Gasoline		**Commercial Diesel**	
	N2O	**CH4**	**N2O**	**CH4**
All	0.0134	0.0333	0.0048	0.0051

Water and Wastewater

No updated data was available for potable water treatment and distribution. Therefore, the water energy usage was scaled up by population from the 2012 results. District-wide recycled water electricity usage was obtained from West Basin Water District and scaled down to Manhattan Beach by population. It was assumed that the same SCE emission factor was applied to the water treatment plant as for the City as a whole.

Wastewater emissions were calculated using the ClearPath calculators for nitrification/denitrification, effluent disposal, and process N2O emissions. These only required population as their input; no local wastewater data was used for the calculations.

Fugitive Emissions

ClearPath has a standard calculation available for fugitive emissions from natural gas leakage during distribution with an assumption of 0.3% leakage rate from the total therms distributed. Manhattan Beach's past inventories did not include this category, but the calculation was added for apples to apples comparison. The total natural gas usage from residential and commercial sectors was used for the calculation of the fugitive emissions from natural gas distribution, following the default settings in ClearPath for the leakage rate.

INVENTORY CALCULATIONS

The 2016 inventory was calculated following the GPC and ICLEI's ClearPath software, which City of Manhattan Beach has used before. To be consistent with the past inventories, the 4th IPCC Climate Assessment was used for the methane conversion for all inventories. ClearPath's inventory calculators allow for input of the sector activity (i.e. kWh or VMT) and emission factor to calculate the final CO_2e emissions.

2016 Inventory Key Findings

The total emissions for the 2016 inventory were calculated at 245,367 MTCO2e (Table 5). This represents over 24% decrease from the 1990 inventory and 28% decrease from the 2005 inventory. The dominance of transportation emissions is consistent with the trend seen in other urban areas in California.

Table 5: Inventory Comparisons 1990-2016

Year	Transportation & Mobile Sources	Solid Waste	Commercial Energy	Residential Energy	Process & Fugitive Emissions	Water & Wastewater	Total	Change from 1990	Change from 2005
1990	181,653	12,016	72,134	59,516	1,507		326,826		
2005	156,438	11,829	81,622	67,855	1,467	22,051	341,262	4.42%	
2007	152,598	11,682	80,481	67,411	1,477	30,717	344,366	5.37%	0.91%
2010	147,193	7,879	78,320	69,368	1,536	13,434	317,730	-2.78%	-6.90%
2012	143,270	6,022	75,826	72,377	1,494	12,612	311,601	-4.66%	-8.69%
2016	136,376	9,253	31,337	55,962	1,278	11,161	245,367	-24.92%	-28.10%

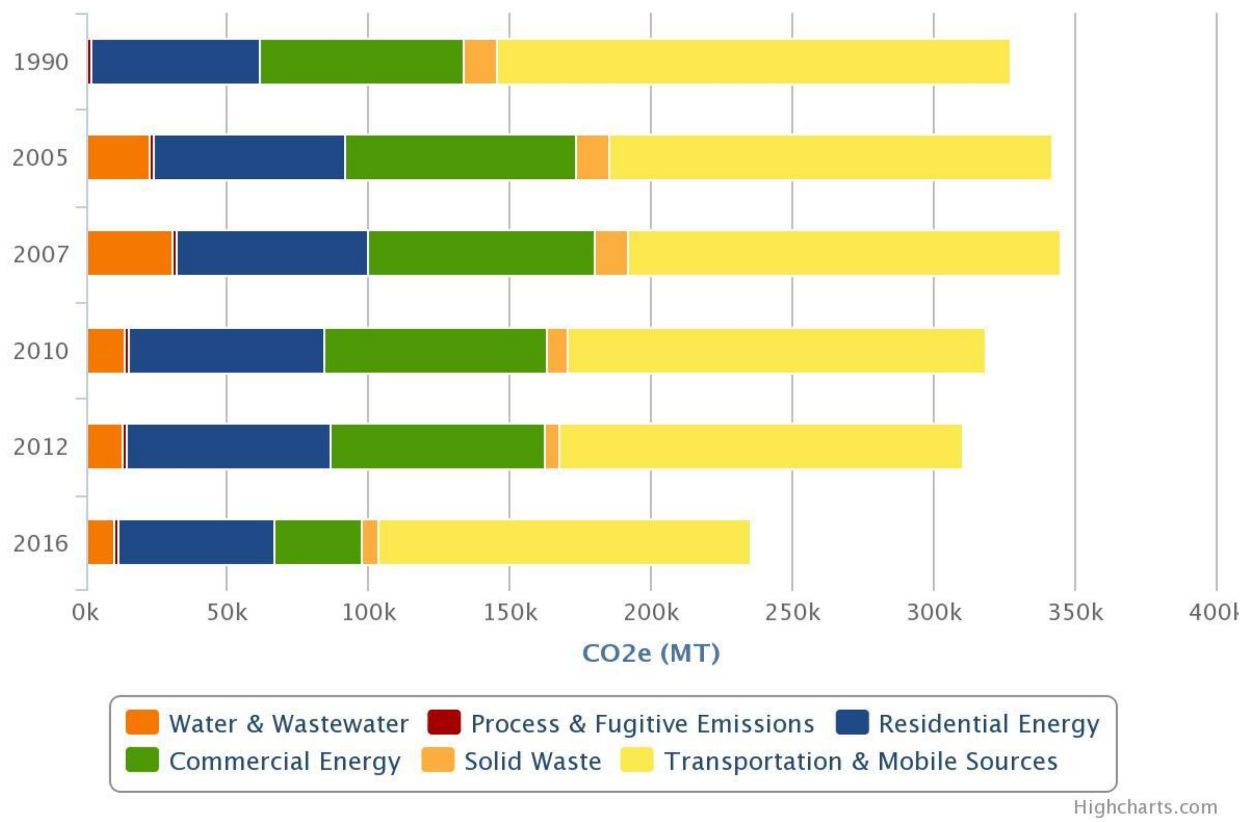


Figure 2: City of Manhattan Beach 1990-2016 GHG Inventories

Table 6 shows the comparison of inventory sector activities for select sectors where similar data was collected for 2012 and 2016. While train emissions increased due to more ridership, overall encouraging more mode shift from passenger vehicles is good.

Table 6: Comparison of 2012 and 2016 Inventory Emissions by Sector

Sector	Sub Sector	2012 MTCO2	2016 MTCO2	Change	Percentage
Residential Energy		72,377.01	55,962.00	-16,415.01	-22.68%
	Residential Electricity	33,217.45	24,141.00	-9,076.45	-27.32%
	Residential Natural Gas	39,159.57	31,821.00	-7,338.57	-18.74%
Commercial Energy		75,826.35	31,337.00	-44,489.35	-58.67%
	Commercial Electricity	63,698.81	20,431.00	-43,267.81	-67.93%
	Commercial Natural Gas	12,127.54	10,906.00	-1,221.54	-10.07%
Transportation		143,270.34	136,375.99	-6,894.35	-4.81%
	On Road: Gasoline	123,388.37	112,326.00	-11,062.37	-8.97%
	On Road: Diesel	18,099.69	17,652.00	-447.69	-2.47%
	Off Road	1,782.27	6,397.99	4,615.72	258.98%
Solid Waste	Solid Waste	6,022.89	9,253.71	3,230.82	53.64%
Water		12,506.49	11,096.86	-1,409.63	-11.27%
	Water Energy	12,393.00	10,182.00	-2,211.00	-17.84%
	Recycled Water Energy	113.49	914.86	801.37	706.12%
Wastewater		64.83	64.87	0.04	0.07%
	Nitrification/Denitrification Process N2O Emissions	0.00	0.00	0.00	0.00%
	Combustion of Digester Gas	2.30	2.35	0.04	1.94%
	Process N2O from Effluent Discharge	62.52	62.52	0.00	0.00%
Fugitive Emissions	Fugitive Emissions (Natural Gas)	1,494.10	1,278.80	-215.30	-14.41%
Total		311,562.01	245,369.23	-64,783.15	-20.79%

Table 7 shows the activity data for 2016 and how they compare with the previous inventory.

Table 7: Subsector Activity for 2012 and 2016

Sector	Unit	2012	2016	Change	Percentage
Residential Electricity	kWh	103,874,968	99,908,916	-3,966,052	-3.82%
Residential Natural Gas	therms	7,364,309	5,984,262	-1,380,047	-18.74%
Commercial Electricity	kWh	199,193,850	84,554,550	-114,639,300	-57.55%
Commercial Natural Gas	therms	2,280,694	2,051,010	-229,684	-10.07%
On Road: Gasoline	VMT	272,983,734	289,434,665	16,450,931	6.03%
On Road: Diesel	VMT	13,891,041	14,728,163	837,122	6.03%

Solid Waste	tons	24,390	34,977	10,587	43.41%
Water Energy	kWh	41,317,836	42,136,545	818,709	1.98%
Recycled Water Energy	kWh	378,366.36	3,786,176.90	3,407,810.55	900.66%
Nitrification/Denitrification Process N2O Emissions	population	35,239	35,924	685	1.94%
Combustion of Digester Gas	population	35,239	35,924	685	1.94%
Process N2O from Effluent Discharge	daily N load (kg/day)	73	73	0	0.00%
Fugitive Emissions (Natural Gas)	therms	9,645,003	8,035,272	-1,609,731	-16.69%

INTERPRETATION

Energy

There are several possible reasons for the substantial drop in energy emissions from 2012. These include the electricity grid getting cleaner, implementation of local energy efficiency programs, or changes in the data source availability. When the electricity grid becomes less carbon intensive, this allows for fewer emissions from electricity. The local electricity utility, Southern California Edison (SCE), experienced a shift from 705 lb CO_2/MWh in 2012 to 529 lb CO_2/MWh in 2016. Therefore, there will be some emission reduction from this cleaner electricity.

It is highly probable that data was excluded from the electricity usage given in 2016 as compared to 2012. The commercial electricity usage in 2012 was 199,193,850 kWh as compared to 84,554,550 kWh in 2016. This 57.55% decrease is most likely due to SCE's privacy rules leading to certain businesses being excluded from the data set. Industrial data was not included at all. It is also possible that energy datasets provided for earlier inventories did not have the privacy ruling applied as strictly.
Effective implementation of SCE's local energy efficiency programs may contribute to the drop. Although it is not expected that the entire reduction is due to local program implementation, they may contribute an important part.

Transportation

The on-road emissions for 2016 reduced in comparison to 2012. This may be due to vehicle fuel efficiency, since the actual VMT increased by 6% during this time. Since this data was scaled up from 2012, the interpretations should not be taken too heavily as the same VMT model was used as the basis.

Off-road emissions increased significantly. However, an updated model from CARB was utilized for the 2016 inventory and may have included some new data.

Water

The recycled water energy usage increased by 900% from 2012 to 2016, but this is due to methodology differences rather than changes in behavior. The trends for recycled water usage in West Basin Water District's 2018-19 Water Use Report indicated that usage went down during that time period. Previous inventories gathered water consumption data that was converted into water energy usage through water intensity factors. In the 2016 inventory, actual energy usage from the water district was obtained instead. Water intensity factors tend to be region-wide and may include upstream processes as well whereas actual energy usage likely does not include upstream processes. Tracking the water consumption may be most useful for policy implementation, although having updated water intensity factors may be challenging to obtain. Either method is acceptable – for sake of comparison to previous inventories, water consumption may be the simplest solution.

Contribution Analysis

ICLEI USA recommends that a more complete analysis of the inventory comparisons should be done with the contribution analysis. The contribution analysis will allow for breakdown of each sector by drivers like weather or population. Such an analysis can also account for differences in methodology since multiple consultants have worked on Manhattan Beach's inventories with potentially different methodologies or data sources. It is important to recognize if a decline in emissions is due to policy implementation, external forces like weather/population, or changes in methodology/data sources. Resources for doing the contribution analysis are available publicly on ICLEI USA's website under the Department of Energy's Cities Leading on Energy Analysis Program (CLEAP).

Conclusion

This inventory marks completion of Milestone One of the Five Milestones for Climate Mitigation. In addition, City of Manhattan Beach should continue to track key transportation activity and emissions indicators on an on-going basis. ICLEI recommends completing a re-inventory at least every five years to measure emissions reduction progress.

Emissions reduction strategies to consider for the climate action plan include energy efficiency, renewable energy, vehicle fuel efficiency, alternative transportation, vehicle trip reduction, land use and transit planning, and waste reduction among others. This inventory shows that transportation will be particularly important to focus on. Through these efforts and others the City of Manhattan Beach can achieve additional benefits beyond reducing emissions, including saving money and improving Manhattan Beach's economic vitality and its quality of life.