CITY OF
BAINBRIDGE ISLAND

CLIMATE CHANGE
ADVISORY COMMITTEE
SPECIAL MEETING
THURSDAY, AUGUST 29, 2019
6:30 – 8:30 PM
CITY HALL
COUNCIL CONFERENCE ROOM
280 MADISON AVENUE NORTH
BAINBRIDGE ISLAND, WA 98110

AGENDA

Members:	Jens Boemer	Lara Hansen	David McCaughey (Co-Chair)
	Derik Broekhoff	Gary Lagerloef	Nora Ferm Nickum
	Michael Cox (Co-Chair)	Julie Matthews	Deborah Rudnick

Liaison: Councilmember Ron Peltier (for Joe Deets)

6:30 Call meeting to Order/Roll Call/Accept of Modify Agenda/Conflict of Interest Disclosure

6:35 Approve July 17, 2019 Minutes

6:40 Public Comment

6:50 Updates/Report Outs/Discussion

- City Council Study Session and Follow-up (Lara/David/Julie/Mike)
- Proposed Survey (Mike)
- Timeline for survey, workshop, and CAP (Materials Attached – Mike)
- SMP (Lara/Deb)
- GHG Inventory Report/Fact Sheet (Materials Attached – Gary/Mike)
- UAC/CCAC PSE Franchise Report (David)
- Sea Level Rise Analysis (Mike)
- Proposed Outline for Waste Section of CAP (Materials Attached - Nora/Deb)
- Green Building Memo from Design Review Board and CCAC (Materials Attached – Mike)
- Fire Station (Deb)

8:15 Other Business

8:30 Adjourn

CITY OF
BAINBRIDGE ISLAND

CLIMATE CHANGE ADVISORY COMMITTE
JULY 15, 2019

MINUTES

Present: Committee members Derik Broekhoff, Michael Cox, Lara Hansen, David McCaughey, Julie Matthews, Gary Lagerloef, Deborah Rudnick; Council Liaison Ron Peltier
Absent: Committee member Nora Ferm Nickum
Others:
Public: Rick Freeman, Gloria Saylor, Matt Perry (PSE)

The meeting was called to order at 6:32 pm.

Minutes from the previous meeting (June 19, 2019) were approved.

Public Comment

- Gloria Saylor wished to help with Communication track with David
- Matt Perry said that the PSE survey is complete, and they will be hosting a town hall at the end of July. PSE is looking at Public EV Charging pilots – Karen Brubeck

Report Out on Process for Developing Climate Action Plan

- Julie Matthews, Lara Hansen and Jens Boemer assisted in a timeline which bucketed the Committee work added in the Survey Data and the Climate Change Impact Assessment
- We will also recommend that the science portion in the beginning of the Assessment reflects what we have heard from SLR from James and his recent presentation to COBI.
- Survey timeline – it should be ready by mid-September. Plus, a <u>Community Workshop in mid-October or November</u> – interest is in getting those less common from Energy Forums
    . Provide Info
    i. Break up into Areas of Interest
    ii. Feedback will inform

  Survey must be 2 weeks before October 19th – promote with COBI Connects, Kristen Drew (Communications Coordinator) --- perhaps the best is <u>EARLY to MID NOVEMBER</u>

- Survey Questions (also updated in Google Doc) reordering of answers for #4, remove of #5 altogether, #9 neighborhood affiliation, #10 free text, and #11 would you consider a resurvey in the future

Climate Action Plan Outline

- Ideally, we would have Draft Plan by end of Jan 2020 – so by our Jan 13th CCAC meeting. With the ability to distribute to Council by March 2020
- It was decided to move away from adding to the title of Climate Action Plan with Adaptation or Mitigation and instead use a tag line after to create the awareness to adaptation and mitigation
- Need to provide more tabular format with actionable items – if you are making a suggestion please track changes
- Assignments were provided for the 5 different sections with a primary and an alternate in each section – see document for assignments

CITY OF
BAINBRIDGE ISLAND

CLIMATE CHANGE
ADVISORY COMMITTE
JULY 15, 2019

Updates

- Shoreline Master Plan Team – James Rufo-Hill is updating his presentation and will make his report out to 2100 by next week. Friday with Kristi Carr there will be an update from her.
- Green Building – Design Review Board (Nora) is expected to develop a survey in 3 weeks. Ron shared that Solar readiness for new homes and all new city buildings is certainly on the floor – as well as consideration of Solar Access in the siting of new construction. Ron has asked for Study Session on Green Building – There was discussion on having a joint letter from the Design Review Board and CCAC to the Council on moving ahead with a green building program.
- GHG Inventory – Ellen was to have a new date whereby the GHG would be in final copy from Cascadia – Gary will be checking in on the status of an August or Sept date.
    - Strive for Kitsap GHG or BICIA (BI Climate Impact Assessment) + Survey Results on a separate COBI website page

Other Business

- USC/CCAC – a change in the direction of looking at franchise in 2020 and a council desire to understand what is possible that could be written into the agreement.
- Parks Department is seeking assistance with Comp Plan – Terry Landis
- ICLEI as it relates to the GHG inventory and Bainbridge Island High School - how ICLEI has additional resources for Protocols. Jessie Sheldon and Deb Rudnick are looking at getting ICLEI tools (Clear Path). COBI is an ICLEI member and we feel strongly that CCAC should also have access to the same tools.
- Sept 21st Electric Car Day – including e-bikes and Jump Bikes
- New Fire House

Next meeting scheduled for Thursday, August 29 at 6:30 pm.

The meeting was adjourned at 8:10 pm.

Co-Chair 08/29/19

BI Climate Action Plan Draft Development Timeline (August 6th, 2019)

July/Oct.

Committee Work

Update BI Climate Assessment; finalize GHG Inventory and sea level rise analysis

Design Community Survey in collaboration with City staff

Rough first drafts early to mid October.

Sept. 9th – 30th

Community Survey

Establish baseline knowledge of climate change and actions they believe are needed

Use to design community workshop and shape Action Plan

Late. Oct/Early Nov.

Community Workshop

Provide information (BI Climate Assessment; GHG Inventory; sea level analysis)

Ask for community concerns and priorities related to climate change

Mid-January

Draft Plan Council/Community

City Council study session to discuss initial recommendations

Provide to public for comments

Early Spring

Final Plan Council/Community

Study session to present final recommendations

Start to implement plan

CITY OF BAINBRIDGE ISLAND GREENHOUSE GAS EMISSIONS INVENTORY

DRAFT FINDINGS REPORT

JULY 25, 2019

CASCADIA CONSULTING GROUP, INC.

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Fax (206) 343-9819
www.cascadiaconsulting.com

Table of Contents

Acronyms

ACS	American Community Survey (from the U.S. Census Bureau)
BOD	Biochemical oxygen demand (a metric of the effectiveness of wastewater treatment plants)
EIA	United States Energy Information Association
EPA	United States Environmental Protection Agency
CO_2e	Carbon dioxide equivalents
GHG	Greenhouse gas (limited to CO_2, CH_4, N_2O, and fugitive gases in this inventory)
GWP	Global Warming Potential
HFC	Hydrofluorocarbon
$MTCO_2e$	Metric tons of carbon dioxide equivalent
MOVES	Motor Vehicle Emission Simulator model (developed by EPA to quantify emissions from mobile sources)
MPG	Miles per gallon
NONROAD	Part of MOVES model developed by EPA to quantify non-road mobile emissions
O&M	Operations and Maintenance
ODS	Ozone depleting substance
PFC	Perfluorocarbon
PSCAA	Puget Sound Clean Air Agency
PSE	Puget Sound Energy
PSRC	Puget Sound Regional Council
SF_6	Sulfur hexafluoride
TCR	The Climate Registry
USDA	United States Department of Agriculture
WARM	Waste Reduction Model (model developed by EPA to quantify solid waste emissions)
WSDOT	Washington State Department of Transportation
WWTP	Wastewater and Treatment Plant
VMT	Vehicle Miles Traveled

Bainbridge Island's Climate Impact

Executive Summary of Bainbridge Island's Greenhouse Gas Emissions Inventory Report

The City of Bainbridge Island recently completed a comprehensive greenhouse gas (GHG) inventory. GHG inventories quantify the amount of climate pollution produced by an entity—in this case, from the Bainbridge Island community and municipal government operations. As Bainbridge Island continues to take action to reduce GHG emissions, these inventories will serve as helpful tools for tracking progress and making improvements along the way.

INVENTORY QUICK FACTS

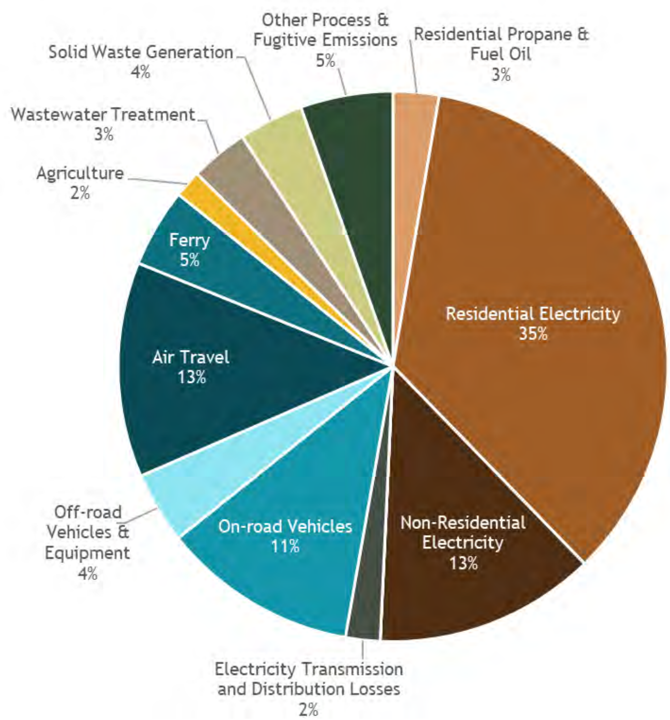
Which years did the inventories cover?	The inventory covered two representative years, **2014** and **2018**. Conducting inventories for two years allows you to see whether emissions are trending upward or downward over time.
What types of inventories were conducted?	Three types of inventories were conducted for each year: ▸ **Government operations:** Counts emissions from everyday City activities, including energy needed municipal buildings, City vehicle fleet ▸ **Communitywide:** Counts emissions from community activities, including household and business energy use, vehicle transportation, ferry and air travel, and solid waste disposal. ▸ **Consumption-based:** Accounts for the upstream impacts of materials and services we purchase, such as emissions from beef cows we consume. ▸ **Tree carbon sequestration:** Although not technically an inventory, we also estimated the amount of carbon that is absorbed from the atmosphere by trees currently growing on Bainbridge Island.
How were they calculated?	The inventories were conducted using widely accepted tools and protocols, including The Climate Registry's *Local Government Operations Protocol*, the *U.S. Community Protocol*, and U.C. Berkeley's *CoolClimate Calculator*.

INVENTORY RESULTS

Community Emissions

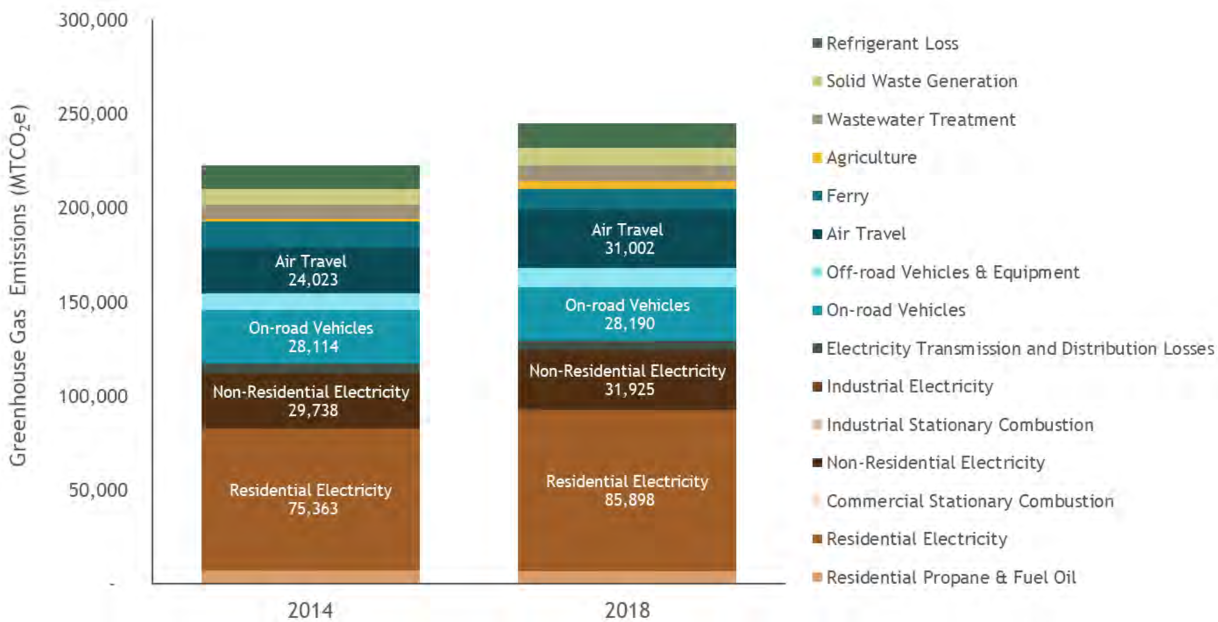
The Bainbridge Island community emitted an estimated 245,234 metric tons of carbon dioxide equivalent ($MTCO_2e$) in 2018. That equates to **9.8 $MTCO_2e$ per person**—or the equivalent of emissions from burning over 10,000 pounds of coal! The majority of those emissions are from consumption of electricity in homes and commercial buildings (Figure 1).

Figure 1. Bainbridge Island communitywide emissions in 2018 (total = 245,234 $MTCO_2e$).



Overall, communitywide emissions have increased by 10% since 2014 (Figure 2). Per-capita emission, however, have only increased 2% over that period. Increases are due to changes in the electricity fuel source (e.g., renewables versus coal) and growth in population and employment. Decreases are due to improvements in vehicle fuel economy, reductions in the distance each person drives, and declining per-household and per-business energy consumption.

Figure 2. Bainbridge Island community emissions trends, by year and source.



City Government Emissions

Emissions from City of Bainbridge Island activities—which only make up about 1% of the total community emissions—are largely from energy needed to power municipal buildings, equipment, and vehicles. Municipal emissions in 2018 increased 11% to 2,300 $MTCO_2e$ (Figure 3, Figure 4). Major emissions sources included facility electricity consumption (60%) and on-road fleet vehicles (17%).

Transportation and electricity also contributed the largest increases in emissions from 2014 to 2018. Municipal facility electricity and on-road fleet vehicles increased by 14% and 7%, respectively. Just four facilities accounted for 80% of all facility electricity use: Bainbridge Island Waste Water Treatment Plant (WWTP), City Hall, Fletcher Bay: Well Field, and Bainbridge Island Public Works Operations and Maintenance Yard. There were a few sectors with decreases in emissions, the largest coming from streetlights and traffic signals emissions.

Figure 3. City Operations GHG Emissions in 2018 (total = 2,300 MTCO$_2$e).

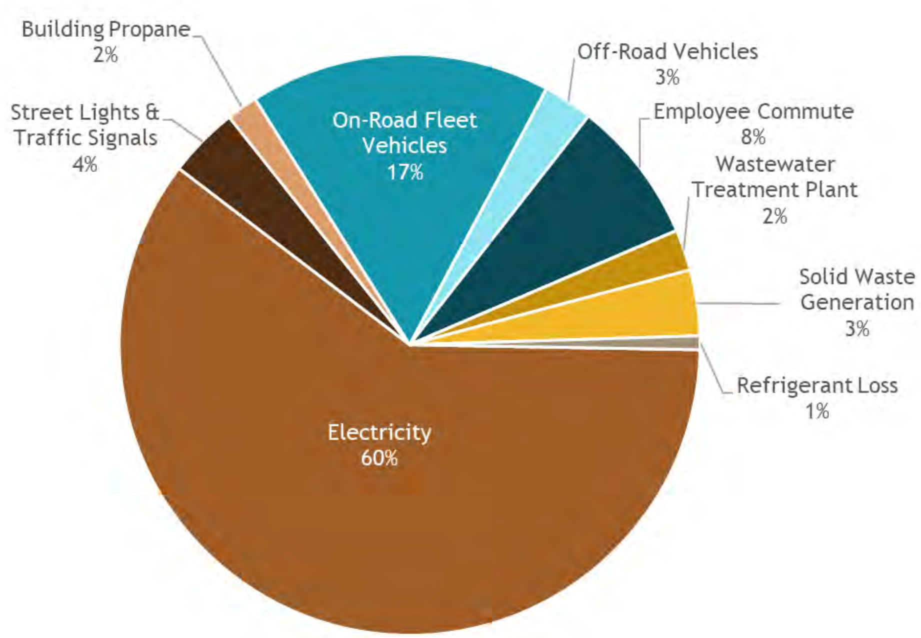
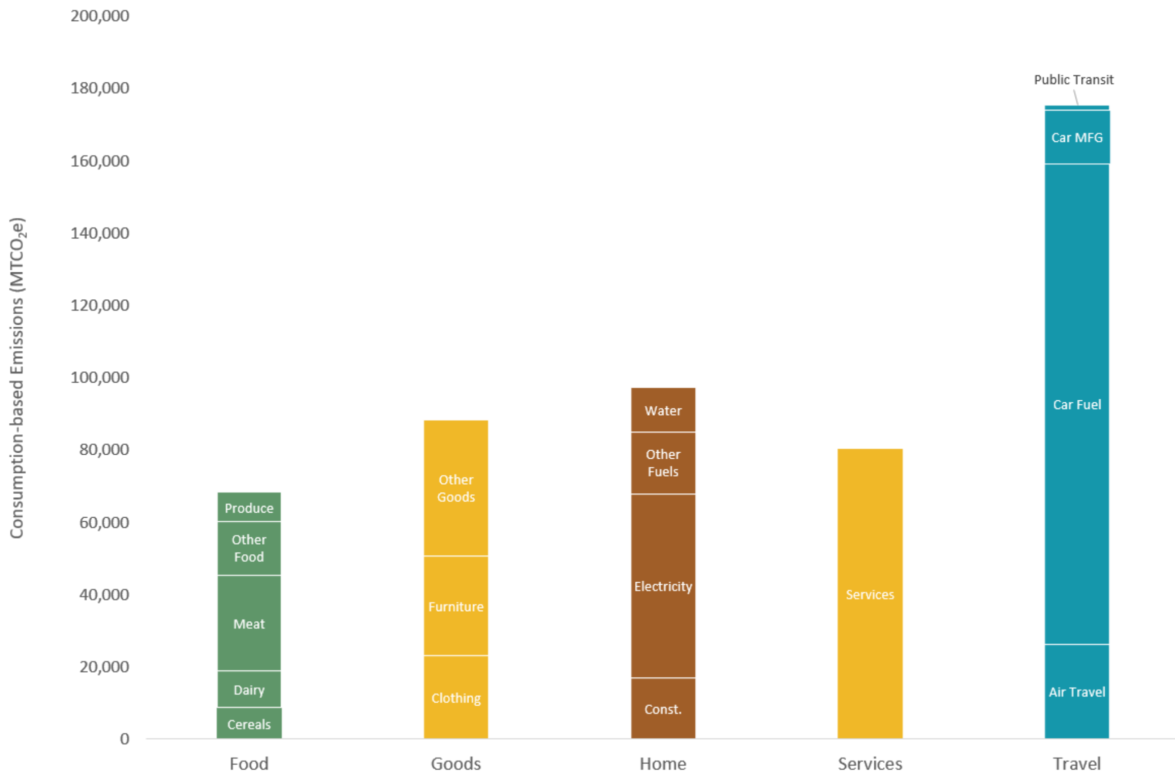


Figure 4. Bainbridge Island city operations emissions trends, by year and source.

Consumption Emissions

The purchasing decisions we make impact the environment. Some types of foods and materials, such as meat and furniture, can carry a significant GHG emissions burden. For example, meat and dairy cows emit methane—a potent greenhouse gas. Residents in Bainbridge Island who consume beef contribute to the emissions from these cows—even if the cows are raised outside the island.

It is estimated that Bainbridge Island households emit **52 $MTCO_2e$** a year through their purchasing behaviors—equivalent to 56,848 pounds of coal burned! Major drivers of this impact include the purchase of meat, furniture, clothing, home energy, and travel-related expenses such as car fuel and air travel.



Tree Carbon Sequestration

While GHG emissions inventories quantify the release of greenhouse gases into the atmosphere, trees and other vegetation can absorb carbon dioxide out of the atmosphere. We conducted a high-level analysis to understand how much Bainbridge Island trees are absorbing carbon dioxide out of the atmosphere. Using satellite imagery, we estimate that trees cover between 46% and 56% of Bainbridge Island, and absorb an estimated **59,000 $MTCO_2e$** of carbon dioxide from the air every year. That is enough to offset the emissions from all the vehicles driven on Bainbridge Island in a year!

Introduction

This GHG inventory report for the City of Bainbridge Island details estimated GHG emissions from activities within the city of Bainbridge Island. GHG inventories quantify emissions associated with a specific "scope"—or boundary condition—over a specific period. By conducting GHG inventories at regular intervals, they can illuminate trends, accomplishments, and opportunities for improvement. They also hold governments and communities responsible for their impact on the environment and keep organizations on track towards reaching climate action goals.

This report describes findings from three distinct inventories:

- A **community inventory** that estimates GHG emissions produced by activities of the Bainbridge Island community, including residents and businesses. The community GHG inventory includes emissions due to energy used to power and heat homes and businesses; fuel used by vehicles running within Bainbridge Island; solid waste that is generated by the community; agriculture activities; fuel use by off-road equipment and vehicles; and others.
- A **municipal inventory** that accounts for the GHG emissions resulting from City of Bainbridge Island government operations. This inventory can help the City understand GHG emissions stemming from various activities associated with municipal operations, including from municipal building and facility operation, transportation, solid waste, wastewater, and refrigerant leakage.
- A **consumption-based inventory** that estimates GHG emissions associated with the *consumption* of food, goods, and services within the community, regardless of their origin. For example, this inventory would not include emissions from the production of locally-manufactured goods that are consumed entirely outside the community; however, it would include emissions associated with the production of goods manufactured in another community but consumed by Bainbridge Island residents, visitors, or businesses.

This report also presents findings from additional analyses:

- Municipal and communitywide **contribution analyses** that identify key drivers of observed emission trends. For example, analysis calculates the impact that a hotter summer or colder winter may have had on household energy use, and thus, emissions.
- A **carbon sequestration analysis** that estimates the amount of carbon dioxide that Bainbridge Island trees absorb—or sequester—from the atmosphere on an annual basis.

GREENHOUSE GAS INVENTORY OVERVIEW

The municipal and communitywide GHG inventories conducted for the City of Bainbridge Island followed standard, accepted protocols. This section provides an overview of key inventory attributes.

Inventory Methodology

We used standard protocols to complete the municipal and communitywide inventories: the *Local Government Operations Protocol* and *U.S. Community Protocol*, respectively.

We obtained most data for the municipal inventory from City staff and detailed local reports such as Puget Sound Energy's (PSE) billing records, wastewater treatment plant (WWTP) records, and fleet vehicle records.

For the communitywide inventory, key data sources included electricity consumption data from PSE, Puget Sound Regional Council (PSRC) modeling outputs for vehicle miles traveled by fuel type, Bainbridge Disposal tonnage records, and Kitsap County Conservation District data on agricultural landowners and acreage. Where local data was not available, we referenced nationally verified data from sources such as the Federal Transit Administration, U.S. Census Bureau, and the U.S. Department of Agriculture.

Inventory Boundaries

The activities and sectors that are included in GHG inventories are often classified into three "scopes": (see Figure 5 and Figure 6 below):

- **Scope 1** emission sources include those directly caused by an organization's actions, such as from owned equipment and facilities.[1]
- **Scope 2** emissions are those indirectly associated with purchased electricity, steam, heating, or cooling.
- **Scope 3** includes all other indirect emissions that are not covered in Scope 2.

The communitywide and municipal inventories for Bainbridge Island included emissions sources from all three scopes: Scope 1, Scope 2, and Scope 3. The inventories included all sources required by the consulted protocols and additional sources, as relevant and available.

[1] Except direct carbon dioxide emissions from biogenic sources.

Figure 5. Sources and boundaries of municipal GHG emissions.[2]

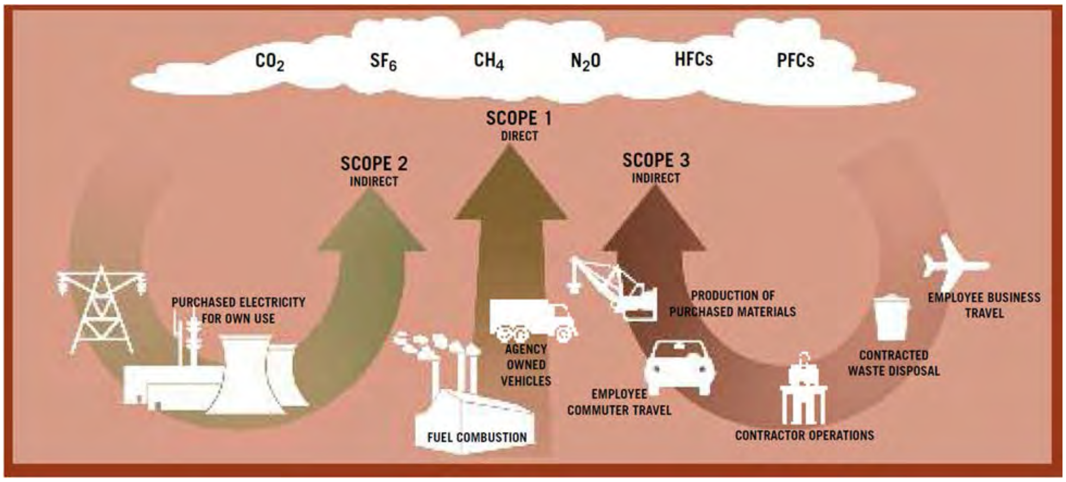
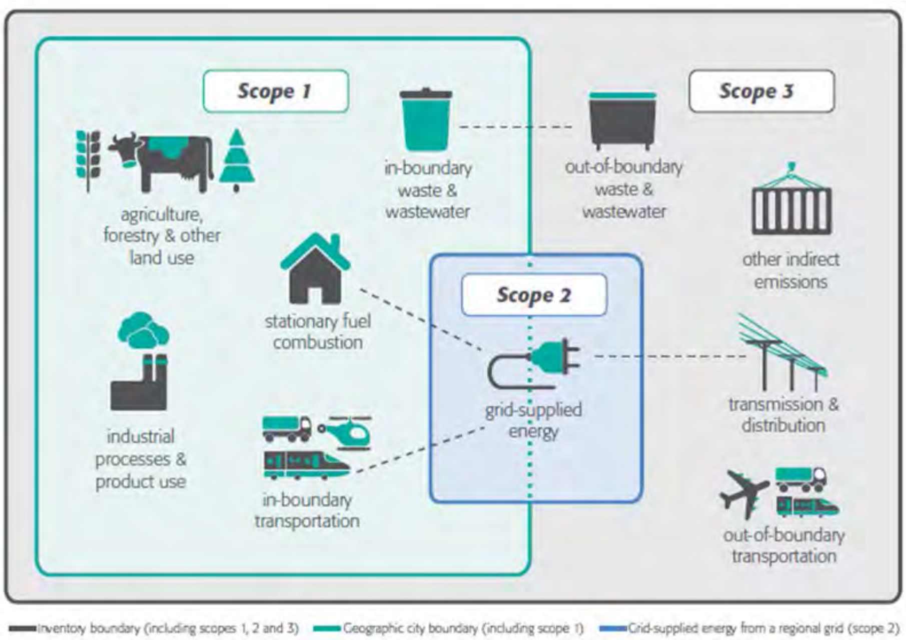


Figure 6. Sources and boundaries of community GHG emissions.[3]



[2] The Climate Registry. (2010). *Local Government Operations Protocol: For the quantification and reporting of greenhouse gas emissions inventories.*

[3] World Resource Institute (2014). Greenhouse Gas Protocol: *Global protocol for community-scale greenhouse gas emission inventories.*

The tables below summarize sectors included in the municipal and communitywide inventories.

Table 1. Community inventory emissions sources and scope categories.

Emissions Type	Required?	Scope 1	Scope 2	Scope 3
Residential Energy				
Electricity	×		✓	
Propane	×	✓		
Fuel Oil	×	✓		
Commercial Energy				
Electricity	×		✓	
Propane*	×	✓		
Industrial Energy				
Electricity	×		✓	
Propane*		✓		
Transportation				
On-Road Passenger Vehicles	×	✓		
On-Road Freight Vehicles	×	✓		
On-Road Transit Vehicles		✓		
Off-Road Vehicles and Equipment		✓		
Air Travel				✓
Ferry Travel				✓
Solid Waste, Potable Water, and Wastewater				
Solid Waste	×			✓
Potable Water Use Energy**	×		✓	
Wastewater Treatment	×		✓	
Refrigerant Leakage	×	✓		
Agriculture		✓		

**Commercial and industrial propane consumption data were not available at the time of study. We recommend that future inventories investigate methods for obtaining propane consumption data for these sectors.*
***Included in commercial energy consumption sector.*

Table 2. Municipal inventory emissions sources and scope categories.

Emissions Type	Required?	Scope 1	Scope 2	Scope 3
Buildings and Facility Energy				
Electricity	×		✓	
Propane	×	✓		
Streetlights and Traffic Signals	×		✓	
Transportation				
On-Road Fleet Vehicles	×	✓		
Off-Road Vehicles	×	✓		
Employee Commute				✓
Business Travel				✓
Solid Waste, Potable Water, and Wastewater				
Solid Waste	×			✓
Potable Water Use Energy	×		✓	
Wastewater Treatment	×		✓	
Refrigerant Leakage	×	✓		

Table 3. Consumption-based inventory emissions sources and scope categories.

Emissions Type	Required?	Scope 1	Scope 2	Scope 3
Consumption-Based Emissions				
Household Consumption				✓
City Government Consumption				✓
Upstream Energy				✓

Inventory Years

To provide Bainbridge Island with the most up-to-date information on their GHG emissions, we selected the most recent year available as an inventory year – 2018. For a comparison year, we selected 2014 because no major changes in organizational structure or infrastructure occurred after that year. For example, the wastewater treatment facility update was completed before 2014, so those changes would be reflected in the 2014 inventory, enabling a more apples-to-apples comparison with 2018.

ROADMAP OF THIS REPORT

This report is organized into the following sections to assess GHG emissions associated with Bainbridge Island:

- The **Communitywide Emissions** section presents methodologies and results for community-based inventory.
- The **Communitywide Contribution Analysis** section explores the drivers of communitywide emission trends.
- The **Municipal Operation Emissions** section presents methodologies and results for municipal-based inventory.
- The **Municipal Contribution Analysis** section that explores drivers of municipal operation emission trends.
- The **Consumption-Based Emissions** section presents methodologies and results from the consumption-based inventory.
- The **Tree Carbon Sequestration** section presents methodologies and results of the tree carbon sequestration analysis.

Each inventory section is organized as follows:

- **Results** section presents GHG inventory results for the study years. The results are quantified and, where relevant, summarized for trends between the two inventory years.
- **Data Sources and Methodology** section details the sources of inventory information by sector, with calculation methodologies, where relevant. The section also describes any data limitations or considerations.

The report concludes with a summary of the major trends across all the inventories and future considerations for climate action planning.

Communitywide Emissions

The communitywide GHG emissions inventory estimates GHG emissions from individuals, businesses, and commercial and industrial processes *within* Bainbridge Island. It also includes emissions associated with some activities that occur *outside* of Bainbridge Island, such as from electricity generation and solid waste transport to an out-of-state landfill.

Table 4 below outlines the various emissions sources included in the communitywide inventory, along with their corresponding scope. The table also shows which sectors are required by the *U.S. Community Protocol*.

Table 4. Community inventory emissions and scope categories.

Emissions Type	Required?	Scope 1	Scope 2	Scope 3
Residential Energy				
Electricity	✗		✓	
Propane	✗	✓		
Fuel Oil	✗	✓		
Commercial Energy				
Electricity	✗		✓	
Propane*	✗			
Industrial Energy				
Electricity	✗		✓	
Propane*				
Transportation				
On-Road Passenger Vehicles	✗	✓		
On-Road Freight Vehicles	✗	✓		
On-Road Transit Vehicles		✓		
Off-road Vehicles and Equipment		✓		
Air travel				✓
Ferry				✓
Solid Waste, Potable Water, and Wastewater				
Solid Waste	✗			✓
Potable Water Use Energy**	✗		✓	
Wastewater Treatment	✗		✓	
Other Process & Fugitive Emissions	✗	✓		
Agriculture		✓		

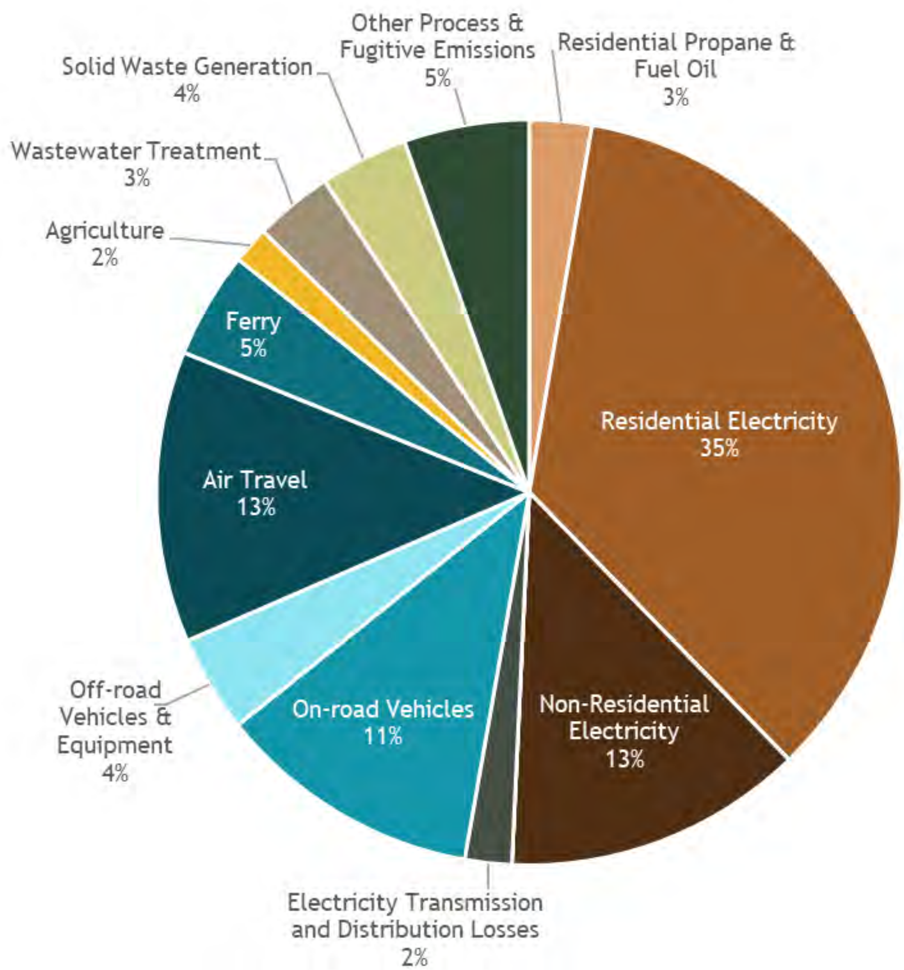
**Commercial and industrial propane consumption data were not available at the time of study. We recommend that future inventories investigate methods for obtaining propane consumption data for these sectors.*
***Included in commercial energy consumption sector.*

RESULTS

Overview

Bainbridge Island's communitywide emissions in 2018 totaled 245,234 $MTCO_2e$. Residential energy (35%) was responsible for the greatest proportion of communitywide emissions, followed by non-residential energy (13%), air travel (13%), and on-road vehicles (11%) (see Figure 7).

Figure 7. Bainbridge Island community emissions by source, 2018 (total = 245,234 $MTCO_2e$)



Communitywide GHG emissions increased by 10% from 2014 to 2018 (see Figure 8, Table 5, and Figure 9). These increases are primarily due to changes in electricity fuel sources (e.g., from renewables versus coal) and growth in population and employment. Improvements in vehicle fuel economy, reductions in the distance each person drives, and declining per-household and per-business energy consumption all reduced the extent of increase. Although communitywide emissions have increased by 10%, per capita emissions have increased only slightly—by 2% (see **Error! Reference source not found.**).

Figure 8. Bainbridge Island community emissions, by year and source. Major sources are labeled.

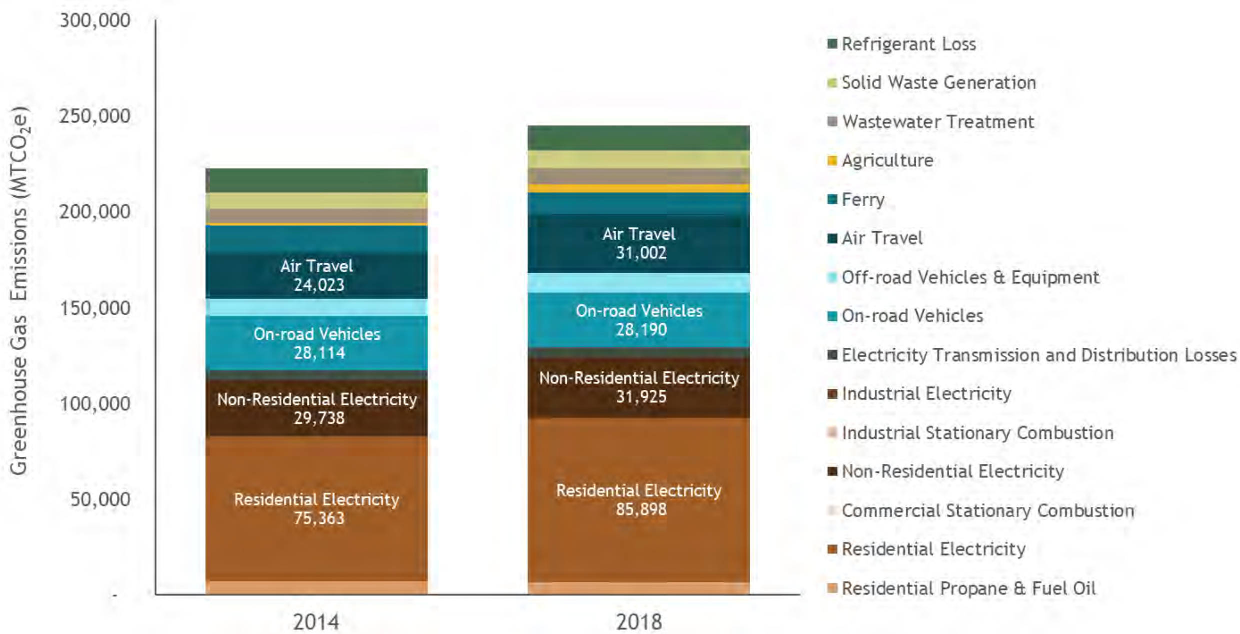


Figure 9. Bainbridge Island community and per-capita GHG emissions.

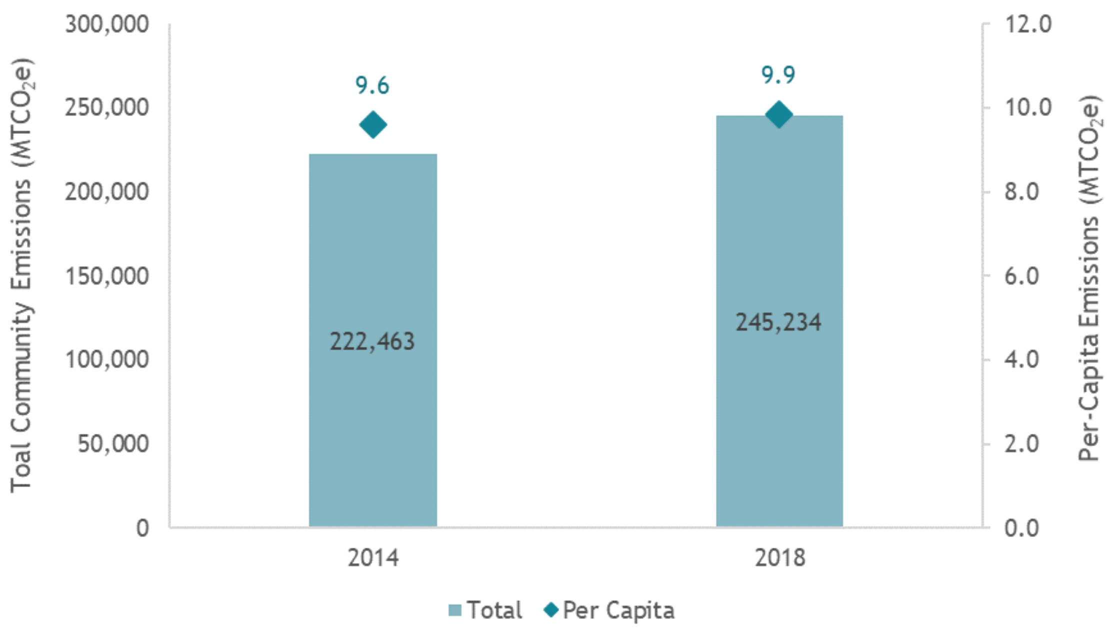
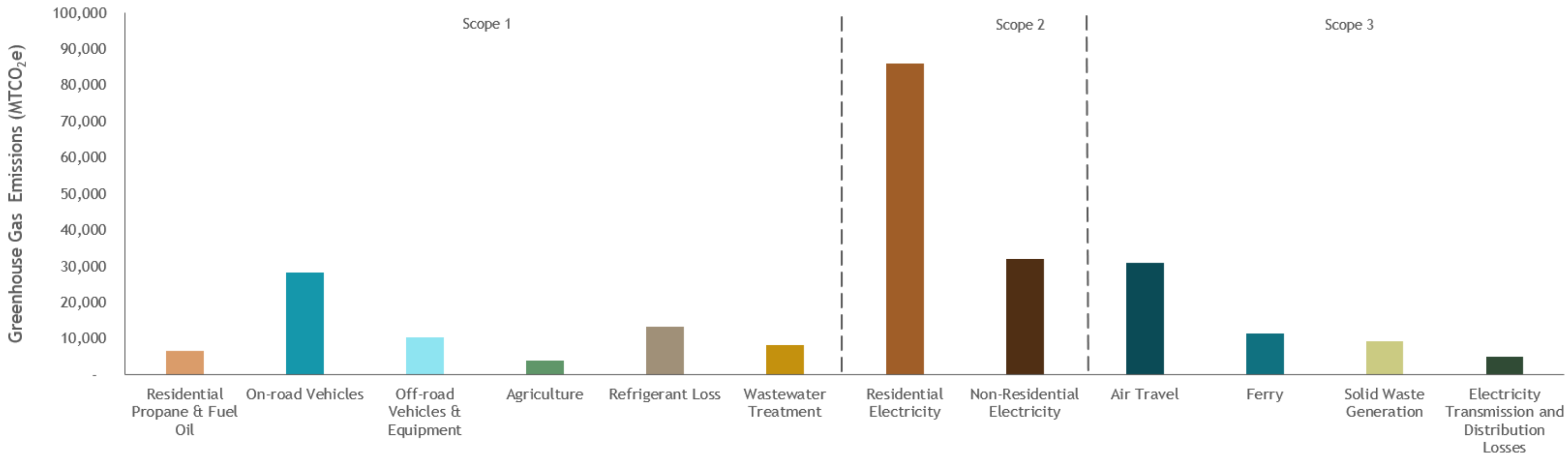


Table 5. Communitywide emissions, by sector.

GHG Emissions by Sector ($MTCO_2e$)	2014	2018	Change	% Change
Residential Energy	**86,214**	**96,154**	**+9,941**	**+12%**
Electricity	75,363	85,898	+10,535	+14%
Propane & Fuel Oil	7,241	6,619	-622	-9%
Losses from Transmission & Distribution	3,610	3,638	+28	+1%
Non-Residential Energy	**31,162**	**33,277**	**+2,115**	**7%**
Electricity	29,738	31,925	+2,187	+7%
Propane (no data available)	N/A	N/A	N/A	N/A
Losses from Transmission & Distribution	1,424	1,352	-73	-5%
Transportation	**75,392**	**80,858**	**+5,466**	**7%**
On-Road Passenger & Freight Vehicles	27,524	27,410	-114	0%
On-Road Transit Vehicles	590	781	+191	+32%
Air Travel	24,023	31,002	+6,979	+29%
Ferry Travel	14,051	11,334	-2,716	-19%
Other Off-Road Vehicles and Equipment	9,204	10,331	+1,127	+12%
Solid Waste & Wastewater Treatment	**16,167**	**17,680**	**+1,513**	**9%**
Solid Waste	8,423	9,348	+926	+11%
Wastewater Treatment	64	69	+5	+8%
Septic Tanks	7,680	8,262	+582	+8%
Other Process & Fugitive Emissions	**12,209**	**13,332**	**+1,123**	**+9%**
Agriculture	**1,320**	**3,933**	**+2,614**	**+198%**
Enteric Fermentation	1,200	3,793	+2,593	+216%
Manure Management	120	140	+21	+17%
TOTAL	**222,463**	**245,234**	**+22,772**	**+10%**

Figure 10. Bainbridge Island community emissions by source and scope, 2018.

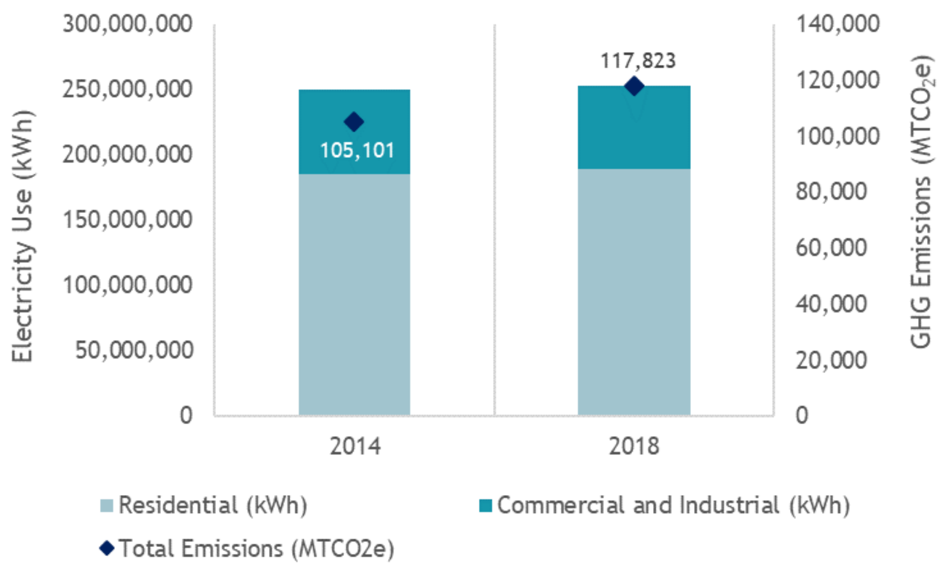


Residential Energy

The electricity Bainbridge Island residents use is the leading contributor to GHG emissions in the residential energy sector. Bainbridge Island residents' homes collectively have a larger impact than their commercial and industrial business counterparts.

Emissions from residential use of electricity, propane, and fuel oil accounted for 38% (92,517 $MTCO_2e$) of total communitywide emissions in 2018, a 12% increase from 2014. Residential electricity use alone makes up 35% of communitywide emissions; it also exceeds non-residential electricity use (see Figure 11).

Figure 11. Community building energy use, by sector and year.



Electricity

Emissions from residential use of electricity increased from 75,363 $MTCO_2e$ in 2014 to 85,898 $MTCO_2e$ in 2018, a 14% change. One contributing factor is that the consumption of electricity increased slightly from 184,865,169 kWh in 2014 to 189,165,563 kWh in 2018, an increase of 2%. Additionally, Bainbridge Island's population increased 8% from 23,135 to 24,891 during the study period.

Changes in the electricity fuel mix also contributed to increases in residential electricity emissions. Puget Sound Energy (PSE) provides power to Bainbridge Island. Approximately two-thirds of the power is from coal and hydroelectric generation. In 2017, the fuel mix was 38% coal, 33% hydroelectric, 21% natural gas, 6% wind, and 2% nuclear and other sources.[4] Between 2014 and 2018, Bainbridge Islanders

[4] Puget Sound Energy. Electricity Supply. www.pse.com/pages/energy-supply/electric-supply (accessed June 27, 2019). The emissions inventory for 2017 was used because the 2018 inventory was not yet available during the time of study.

significantly increased their participation in PSE's Green Power Program. The 2018 10% participation rate is among the highest in PSE's service area. However, due to the complexities of the electricity grid, the *U.S. Community Protocol* discourages consideration of renewable energy participation in calculating communitywide GHG inventories.

Propane and Fuel Oil

Due to a lack in locally available data, consumption of residential propane and fuel oil were estimated using data from the U.S. Energy Information Administration's (EIA) and 2017 American Community Surveys (ACS). These estimations suggest that emissions from residential use of propane and fuel oil totaled 7,241 $MTCO_2e$ in 2014 and 6,619 $MTCO_2e$ in 2018, a 9% decrease in four years. This decline is primarily due to a decrease in the number of households using those fuel sources, including for cooking and heating.

Electricity Transmission and Distribution Losses

As electricity travels from where it was generated, such as a hydroelectric dam or wind farm, to individual homes, businesses, and other buildings, some of the electricity is naturally lost over power lines and in substations and transformers. Although this electricity is not ultimately delivered to the consumer, it still results in the emission of greenhouse gases. We estimate that emissions from transmitting and distributing residential electricity to Bainbridge Island residents were relatively steady between 2014 and 2018, increasing slightly from 3,610 $MTCO_2e$ in 2014 to 3,638 $MTCO_2e$ in 2018. This is less than 1% change. These changes are a result of changes to the amount of electricity consumed and the "grid loss" factor associated with PSE infrastructure.

Non-Residential Energy

Non-residential energy includes greenhouse gas emissions from commercial and industrial electricity, and losses due to the transmission and distribution of that electricity. Commercial and industrial propane and fuel oil consumption data were not available at the time of study. We recommend future inventories investigate methods for obtaining consumption data for these sectors.

Electricity

Emissions from commercial and industrial energy accounted for 13% (31,925 $MTCO_2e$) of total communitywide emissions in 2018, making it the second-largest source of communitywide emissions along with air travel. Emissions from commercial and industrial use of electricity increased from 29,738 $MTCO_2e$ in 2014 to 31,925 $MTCO_2e$ in 2018, a 7% change. The increase in emissions can be partially attributed to the increased workforce from 8,224 to 8,943 employees. Changes in the electricity fuel mix paired with an increased emissions factor for electricity also contributed to an increase in non-residential GHG emissions between 2014 and 2018 (see Figure 11).

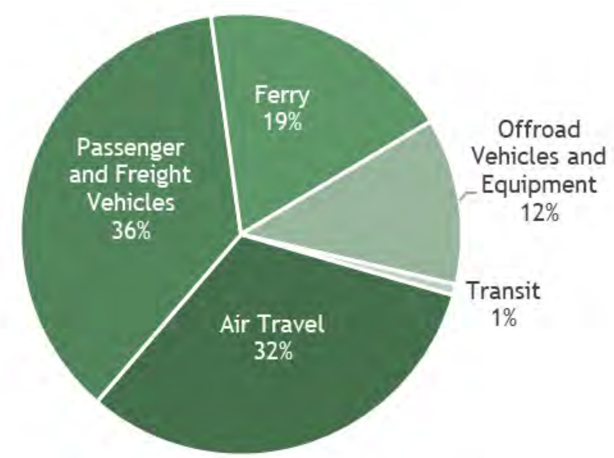
Electricity Transmission and Distribution Losses

Emissions from non-residential electricity transmission and distribution decreased approximately 5%, from 1,424 $MTCO_2e$ in 2014 to 1,352 $MTCO_2e$ in 2018. These changes are a result of changes in the amount of electricity consumed and the “grid loss factor” associated with PSE infrastructure.

Transportation

Transportation contributed a third of Bainbridge Island community emissions in 2018, making it the second-largest contributor to the community's greenhouse gas emissions. In 2014, most transportation emissions came from road vehicles, followed by on-road vehicles. However, in 2018, this trend shifted, with most transportation emissions coming from air travel followed by on-road vehicles (see Figure 12). The rapid growth of Sea-Tac Airport may explain this shift: there was a 30% increase in landings at SeaTac International Airport between 2014 and 2018.[5]

Figure 12. Community transportation emissions in 2018 (total = 80,858 $MTCO_2e$).



On-Road Vehicles

Most on-road emissions in Bainbridge Island stem from passenger cars. We estimate that passenger vehicles traveled over 69 million miles in Bainbridge Island in 2018 based on downscaled modeling by the Puget Sound Regional Council (see Table 6 and Figure 13).

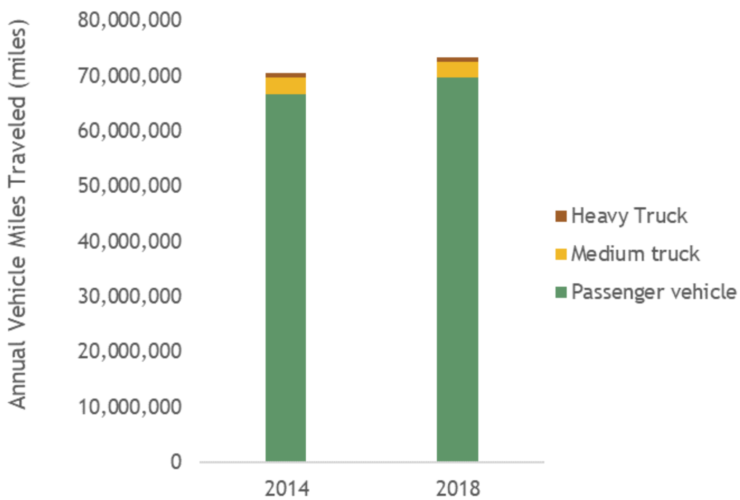
Table 6. Annual vehicle miles estimated for Bainbridge Island.

Type	2014	2018	Change
Passenger vehicle	66,612,870	69,543,904	4%
Medium truck	3,011,067	2,993,763	-1%
Heavy Truck	708,280	708,118	0%
Transit bus*	394,450	397,634	1%

**Miles for transit buses are in annual revenue miles.*

[5] Air travel emissions from Bainbridge residents were attributed by downscaling total fuel use at Sea-Tac Airport to the Bainbridge Island community based on population. More information can be found in the "Data Sources and Methodology" section of this report.

Figure 13. Distribution of on-road vehicle miles traveled, by vehicle type.



Despite a 4% increase in VMT for passenger vehicles between 2014 and 2018, emissions from on-road vehicles increased minimally—by 0.4%. The increasing average fuel economy of passenger vehicles accounts for the fact that the change in emissions did not match the increase in miles traveled.

Transit vehicle emissions increased 32% between 2014 and 2018, rising from an estimated 590 $MTCO_2e$ to 781 $MTCO_2e$ in 2018. As reported by Kitsap Transit to the Federal Transit Administration, annual revenue miles remained relatively constant between the two inventory years—only increasing 1%.

Off-Road Vehicles & Equipment

This inventory categorizes off-road vehicles and equipment into three categories: ferry travel, air travel, and other off-road vehicles and equipment. The other category includes emissions from vehicles and equipment used for agriculture, construction, lawn/gardening, and recreation such as boating.

Ferry Travel

Emissions from ferry travel decreased from 14,051 $MTCO_2e$ in 2014 to 11,334 $MTCO_2e$ in 2018, an overall decrease of 19%. This significant decrease is a result of a large reduction in fuel consumption by Bainbridge Island ferries. In 2014, we estimate that Bainbridge Island's share of ferry travel accounted for the consumption of 2.7 million gallons of fuel, compared to 2.2 million gallons in 2018.

Air Travel

Air travel contributed 13% to communitywide emissions, making it the largest source of off-road GHG emissions and second-largest source of emissions overall (tied with non-residential energy). Emissions from air travel increased 29%, from an estimated 24,023 $MTCO_2e$ in 2014 to 31,002 $MTCO_2e$ in 2018. This increase is largely attributable to population growth on Bainbridge Island and a 30% increase in total landings at SeaTac International Airport between 2014 and 2018. Our calculations are based on jet fuel usage in 2015, which were scaled by the proportion of landings at SeaTac International Airport. Bainbridge Island's population and businesses make up approximately 0.5% of the four-county area that SeaTac predominantly serves (King, Kitsap, Pierce, and Snohomish counties).

Other Off-Road Vehicles & Equipment

We estimate that emissions from other off-road equipment, including equipment used for agriculture, construction, lawn/garden maintenance, and recreation accounted for 12% of overall emissions in Bainbridge Island in 2018 (10,331 $MTCO_2e$). Most of these emissions—which are estimated by scaling county-level model outputs to Bainbridge Island based on population—are generated by construction equipment, lawn and garden equipment, and pleasure watercraft.

Solid Waste and Wastewater

Solid Waste

Most emissions from the disposal of solid waste are associated with the release of methane from decomposing waste in the landfill (see Figure 14 and Table 7). Emissions from waste disposal increased from 5,527 $MTCO_2e$ in 2014 to 6,134 $MTCO_2e$ in 2018, an 11% change that is largely due to population growth and associated increases in tons disposed. Based on waste characterization studies from Kitsap County, King County, and Washington State, the composition of waste over time remained relatively constant. Approximately two-thirds of waste is mixed solid waste, and about one-quarter is food scraps.

All of Bainbridge Island's waste is transported off-Island, first in trucks to the Olympic View Landfill in Bremerton then via train to the Columbia Landfill near Arlington, Oregon. We estimate that emissions from waste transportation increased from 2,352 $MTCO_2e$ to 2,611 $MTCO_2e$. This is associated with the rise in waste collected and transported, which grew from an estimated 22,616 tons in 2014 to 25,102 tons in 2018.

Emissions from equipment used at the landfill to process waste and from yard waste composting make up a nominal proportion of the Island's solid waste emissions. We estimate that the diesel-powered equipment at Columbia Landfill generated 412 $MTCO_2e$ and 371 $MTCO_2e$ in 2014 and 2018, respectively. In 2018, Bainbridge Disposal reported 1,900 tons of yard waste were composted, which generated 192 $MTCO_2e$.

Figure 14. Solid waste emissions in 2018, by source.

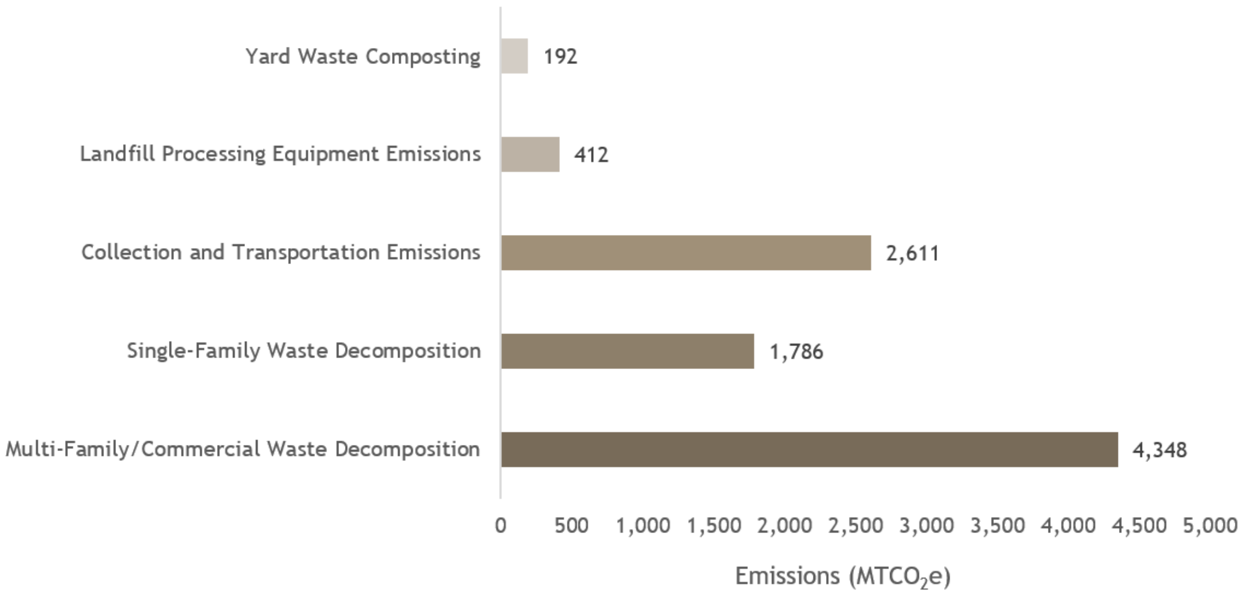


Table 7. Summary of solid waste emissions, by process.

Process	Emissions ($MTCO_2e$)		
	2014	2018	Difference
Solid Waste Disposal & Decomposition	5,527	6,134	+607
Yard Waste Composting	173	192	+19
Collection & Transportation to Landfill	2,352	2,611	+258
Processing with Equipment at Landfill	371	412	+41
Total	***8,423***	***9,348***	***+926***

Wastewater Treatment

The combined emissions from wastewater treatment (process and effluent emissions) and fugitive emissions[6] from septic sources contributed to 3% of communitywide emissions in 2018. This small proportion is despite an overall 8% increase in emissions from these sources, from 7,744 $MTCO_2e$ in 2014 to 8,331 $MTCO_2e$ in 2018 (see Table 8). This increase is due to population growth and the associated increase in waste generated and processed (calculations for emissions from septic tanks were scaled based on Bainbridge Island population trends and calculating emissions from WWTP also accounted for population growth).

[6] Fugitive emissions are from leaks.

Table 8. Emissions from wastewater treatment and septic tanks ($MTCO_2e$).

Source	Emissions ($MTCO_2e$)			
	2014	2018	Difference	% change
WWTP Process	18	19	+1	+8%
WWTP Effluent	47	50	+4	+8%
Septic Tanks	7,680	8,262	+582	+8%
Total	**7,744**	**8,331**	**+587**	**+8%**

Other Process & Fugitive Emissions

Emissions from other processes and fugitive sources—including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)–contributed 5% of Bainbridge Island's communitywide emissions in 2018.[7] Emissions from HFCs—a common refrigerant used in refrigeration and air conditioning—comprised nearly all of these emissions (99%; 13,234 $MTCO_2e$).

We estimate that emissions from HFCs and PFCs increased 10% between 2014 and 2018, from 12,061 $MTCO_2e$ to 13,237 $MTCO_2e$. This increase is driven by population growth, as emissions were scaled down by population from national-level emissions due to lack of locally available data.

Fugitive emissions from SF_6 that leaks from electricity transmission and distribution operating equipment declined an estimated 36%, from 147 $MTCO_2e$ in 2014 to 95 $MTCO_2e$ in 2018. Our calculations are based on data reported by PSE in their 2014 and 2017 GHG inventories, scaled down to the 1% of customers Bainbridge Island represents within PSE's service area.

Table 9. Summary of emissions from other processes and fugitive sources.

GHG	Emissions ($MTCO_2e$)			
	2014	2018	Difference	% change
HFC	12,058	13,234	+1,176	+10%
PFC	3	3	0	0%
SF_6	147	95	-53	-36%
Total	***12,209***	***13,332***	***+1,123***	***+9%***

Agriculture

Kitsap County Conservation District reported there were 196 landowners on Bainbridge Island with a total of 1,303 acres of land in 2014. That value increased in 2018 to 209 landowners with a total of 1,322 acres of land. While livestock accounts for more than two-thirds of Bainbridge Island's agricultural land, the number of acres devoted to livestock declined 9%, from 965 acres to 874 acres between 2014 and

[7] Fugitive emissions are those that are not physically controlled but result from the intentional or unintentional release of GHGs. They commonly arise from the production, processing, transmission, storage and use of fuels or other substances, often through joints, seals, packing, and gaskets. Examples include HFCs from refrigeration leaks, SF_6 from electrical power distributors, and CH_4 from solid waste landfills.

2018. Horses use most of the agricultural land but make up approximately 10% of the animal population (Table 10).

Based on estimates from Kitsap County data, the livestock population on Bainbridge Island also increased from 2014 to 2018. These increases account for both the increased emissions from enteric fermentation—the release of methane (CH_4) as livestock digest food—and manure management. The method used to process and decompose manure affects the amount of methane and nitrous oxide (N_20) released to the atmosphere; anaerobic and aerobic treatment result in no emissions, while storing manure in deep pits or burning it for fuel result in the most emissions.

Emissions from enteric fermentation increased 216%, from 1,200 $MTCO_2e$ in 2014 to 3,793 $MTCO_2e$ in 2018. Emissions from manure management increased 17%, from 120 $MTCO_2e$ in 2014 to 140 $MTCO_2e$ in 2018. These trends can be attributed to an overall increase in animal population without changes in manure management that could compensate for the increased GHG emissions from both enteric fermentation and increased amounts of manure generated.

Table 10. Agricultural acres and population trends, by livestock.

Animal	Acres			Population		
	2014	2018	% change	2014	2018	% change
Horses	60%	63%	+3%	368	417	+13%
Sheep	15%	11%	-4%	155	344	+122%
Ratitae	10%	5%	-5%	N/A	N/A	N/A
Goats	8%	5%	-3%	132	185	+40%
Cattle	3%	8%	+5%	347	341	-2%
Poultry	2%	4%	+2%	1,944	2,252	+16%
Swine	N/A	N/A	N/A	74	125	+69%
Total				***3,020***	***3,664***	***+21%***

DATA SOURCES AND METHODOLOGY

We followed the U.S. Community Protocol (Version 1.1) to complete the communitywide emissions inventory for 2014 and 2018, using the U.S. EPA's GHG Inventory Sources and Sinks Annexes for 2014 and 2019 and the IPCC's 5th Assessment Report (AR5) for updated GWPs and emissions factors where available. All emissions were calculated in ClearPath and were based on verified local data when it was available. When local data was not available, data inputs were scaled down from Kitsap County, King County, or national datasets. Most data were deemed medium quality due to assumptions about local data.

Completing this inventory involved acquiring the following data, summarized in Table 11 and detailed in the followed sections:

- **Activity data** that quantifies levels of activity that generate greenhouse gas emissions, such as vehicle miles traveled and tons of waste generated.
- **Emission factors** that translate activity levels into emissions.

Data quality is assessed and reported on a High (H), Medium (M), and Low (L) scale in accordance with GHG inventory best practices. A High rating indicates data are detailed and specific; a Medium rating indicates data are more general or modeled with robust assumptions; and a Low rating indicates data are highly modeled, uncertain, or a default value was used.

Table 11. Key data sources for the City of Bainbridge Island's communitywide inventory.

Sector	Activity Data (AD)	AD Quality	Emissions Factors (EF)	EF Quality
Residential Energy				
Electricity	• Overall kWh consumption from the three substations serving the Island • Residential proportion based on sample of customer data in 2014 and 2018	H	• PSE reported emissions factors (PSE Greenhouse Gas Inventory, 2014 & 2017, Table 7.1)	H
Stationary Fuel Combustion	• EIA's 2015 average household consumption of propane • Number of households using propane from 2014 and 2017 ACS	M	• Emissions factors provided in ClearPath program	M
Electricity Transmission & Distribution Losses	• See "Electricity" • eGRID Western region grid gross loss percentage (2014 and 2016)	H	• PSE-reported emissions factors (PSE Greenhouse Gas Inventory, 2014 & 2017, Table 7.1)	M
Non-Residential Energy				
Electricity	• kWh consumption from the three substations serving the Island • Non-residential proportion based on sample of customer data in 2014 and 2018	H	• PSE reported emissions factors (PSE Greenhouse Gas Inventory, 2014 & 2017, Table 7.1)	H
Electricity Transmission & Distribution Losses	• See "Electricity" • eGRID Western region grid gross loss percentage (2014 and 2016)	H	• PSE reported emissions factors (PSE Greenhouse Gas Inventory, 2014 & 2017, Table 7.1)	M

Sector	Activity Data (AD)	AD Quality	Emissions Factors (EF)	EF Quality
Transportation				
On-Road Vehicles	• Annual miles traveled, by vehicle and fuel type, provided by EPA MOVES analysis of travel model data, for proportion of Kitsap County VMT occurring in Bainbridge Island • Annual revenue miles traveled and fuel consumption by type provided by National Transit Database for Kitsap County, then scaled down to Bainbridge Island by population	**M**	• CO_2, CH_4, and N_2O emission factors are defaults from the U.S. Community Protocol	**L**
Off-Road Vehicles & Equipment	• Emissions by off-road sector and fuel type, along with days of use per year, provided by nonroad module of the EPA MOVES model, for proportion of Kitsap County activity occurring in Bainbridge Island	**M**	• CO_2, CH_4, and N_2O emission factors are defaults from the U.S EPA MOVES nonroad model	**L**
Air travel	• 2015 Jet fuel consumption from Port of Seattle, scaled to target years by total landings and to the Island by population/employment	**M**	• CO_2, CH_4, and N_2O emission factor defaults from ClearPath	**H**
Ferry travel	• Ferry fuel price, from EIA, and cost, from WSDOT	**M**	• CO_2, CH_4, and N_2O emission factor defaults from ClearPath	**H**
Solid Waste and Wastewater				
Solid Waste Generation	• Single-family waste tonnages from Bainbridge Disposal • Multi-family + commercial tonnages estimated from ratio of single-family to multi-family + commercial from 2015-2016 WA Waste Characterization Study, for Kitsap County • Landfill methane collection scenario confirmed "typical" by Columbia Landfill • Annual precipitation from National Weather Service, Arlington, OR	**M**	• Waste characterizations from 2015-2016 WA Waste Characterization Study, for Kitsap County • Waste characterization was comparable across Port Orchard samples and the Puget Sound-wide data from the aforementioned study; there was also little difference compared to King County compositions, which were assessed as a reference	**M**
Solid Waste Collection & Transportation	• Mass of solid waste from Bainbridge Disposal, with multi-family + commercial estimated from Kitsap County ratio of single-family to multi-family + commercial (see above) • Mileage from Google maps	**M**	• Default EF from ClearPath	**L**
Yard Waste Composting	• Yard waste tonnage from Bainbridge Disposal for 2018; extrapolated for 2014 using 2014:2018 single-family solid waste ratio	**M**	• Default EF from ClearPath	**L**

Sector	Activity Data (AD)	AD Quality	Emissions Factors (EF)	EF Quality
Landfill Processing	• Mass of solid waste from Bainbridge Disposal, with multi-family + commercial estimated from Kitsap County ratio of single-family to multi-family + commercial (see above) • Fuel type for equipment confirmed by Columbia Landfill	M	• Default EF from ClearPath	L
Wastewater Treatment Facility	• Wastewater treatment facility processes determined based on desktop research and confirmed with City staff • Population served by wastewater treatment facility estimated by Public Works staff	L	• Default EF from ClearPath • CH_4 emissions were not applicable since the system is aerobic	L
Septic Tanks	• Population data from ACS	L	• Default EF from ClearPath • Fugitive emissions calculated using Community Protocol WW.11 Alternative Method for Methane Emissions from Septic Systems if Only the Population is Known	L
Refrigerant Leakage				
Refrigerant Leakage from Building Heating and Cooling Equipment, and Fugitive Emissions from Electricity Generation & Transmission	• HFC and PFC tonnage from Annex 6 in U.S. EPA GHG Inventory Sources and Sinks, scaled down to Bainbridge Island population • SF_6 tonnage and customer data from PSE, scaled down to Bainbridge Island customers	L	• HFC and PFC GWP from IPCC 5th Assessment Report, with adjustment for climate-carbon feedback • SF_6 100-Year GWP from U.S. EPA GHG Sources and Sinks • Emissions calculated using Community Protocol Alternative Method BE.7.1.A	H
Agriculture				
Enteric Fermentation and Manure Management	• Animal population and pastureland from USDA Agricultural Census, for Kitsap County • Agricultural acres with livestock on Bainbridge Island and waste management system, from Kitsap County Conservation District • Typical animal mass and B_o from U.S. EPA GHG Inventory Sources & Sinks, 2017 Annexes • Volatile solids and excreted nitrogen from U.S. EPA GHG Inventory Sources & Sinks, 2014 and 2017 Annexes • Methane conversion factors from *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2017,* with annual average temperature from Climate Bremerton	M	• EF, 100-year GWP for CH_4 and N_2O, and volatilization nitrogen loss from U.S. EPA GHG Inventory Sources & Sinks, 2017 Annexes • EF for nitrogen volatilization and runoff/leaching from U.S. Community Protocol, Appendix G • Indirect N_2O emissions calculated using U.S Community Protocol, Appendix G	M

Residential Energy

- Data on **electricity** use were provided by the utility serving Bainbridge Island, PSE, and for transmission and distribution losses, by eGRID.
  - Stationary fuel combustion consisted of residential **propane,** with data from EIA and the number of households from ACS.

Non-Residential Energy

- Data on **electricity** use were provided by the utility serving Bainbridge Island, PSE, and for transmission and distribution losses, by eGRID. PSE does not track commercial and industrial energy separately, hence they were combined in this analysis.

Transportation

- **Vehicle miles traveled** were derived from Puget Sound Regional Council's MOVES analysis of travel model data and account for all mileage within the Kitsap County boundary regardless of trip origin or destination. Emissions for Bainbridge Island are assumed proportional to the share of Kitsap County VMT occurring in Bainbridge Island city limits. Share of average weekday VMT occurring in Bainbridge Island was calculated from 2014 travel model data and includes all vehicle types. Bainbridge Island VMT shares represents all trips to/from Bainbridge Island as well as those driving through the city boundaries. Year 2018 was extrapolated from the rates between 2014 and 2016. The PSRC data reported VMT and emissions for passenger vehicles, medium trucks, heavy trucks, and transit. In ClearPath, we reported medium trucks as light trucks.
- **Annual revenue miles** and **fuel consumption** data for Kitsap County were acquired from the National Transit Database from the Federal Transit Administration. These data were scaled down to Bainbridge Island by population.
- The Port of Seattle supplied **jet fuel consumption** data for SeaTac Airport for 2015, of which 0.5-1% was attributable to Bainbridge Island. We scaled 2015 jet fuel usage to 2014 and 2018 based on the total landings in those years.
- **Ferry fuel consumption** was derived from EIA data on diesel fuel price and from WSDOT data on the reported fuel cost for the Bainbridge Island route in fiscal year 2015.
- **Off-road emissions** were calculated from the nonroad module of the EPA MOVES model for 2014 and 2018. The model estimates emissions at the county level, which were then scaled down to Bainbridge Island by population. Emissions include common non-road equipment, including construction, agriculture, lawn/gardening, and recreational equipment.

Solid Waste and Wastewater

- Bainbridge Disposal single-family tonnages and Kitsap County waste characterization data, along with default emissions factors provided in ClearPath, were used to calculate emissions from **waste disposal and composting.** Multi-family and commercial tonnages were not directly available and were estimated using a single-family to multi-family + commercial ratio of 32:68, based on the transfer station survey data collected for the 2015-2016 Washington Waste Characterization Study. Waste characterization was comparable across Port Orchard samples and the Puget Sound-wide data from the aforementioned study; there was also little difference compared to King County compositions, which were assessed as a reference.

- **Landfill emissions** assumed an 82.5% capture rate, based on Columbia Landfill's confirmation of a "typical" collection scenario and ClearPath's associated capture rates.
- Wastewater emission calculations required data from Kitsap County Sewer District #7 and the City of Bainbridge Island **wastewater treatment plants**. City and County staff provided the data.
- Data required for higher quality calculations in ClearPath, such as BOD_5 or population specifically using septic systems, were not available. Therefore, **fugitive septic tank** emissions were estimated based on Bainbridge Island population.

Other Process & Fugitive Emissions

- Data on **fugitive refrigerant** HFC and PFC emissions at city scales is scarce. We used the U.S. EPA's 2019 Inventory of GHG Sources and Sinks and scaled the data to Bainbridge Island by population. GWP were adjusted to the latest available values in 2014 and 2018, which corresponded to the values in the 4th and 5th Assessment Reports, respectively.
- PSE's greenhouse gas inventories from 2014 and 2017 provided **fugitive electric transmission and distribution** emissions data for SF_6. We scaled the data to Bainbridge Island using PSE customer data.

Agriculture

- The USDA provides publicly available data on the number of animals by county, which was scaled down to Bainbridge Island according to the ratio of livestock to pastureland. Kitsap County Conservation District provided data on agricultural acres with livestock and manure management systems. The EPA provides national-level **animal enteric and manure** emissions factors, and state-level emissions factors for cattle.

Considerations

At the time of this inventory, not all communitywide data were available. Many calculations were scaled down from national or county estimates by a population ratio. ClearPath's default emissions factors were used in cases where local data were not available. A list of data limitations and other considerations is provided below.

- **Residential energy consumption:** Our calculations did not account for the 10% residential participation in PSE's Green Power Program, and emissions from residential energy use may be an overestimate. We recommend future inventories account for participation in this program.
- **Multi-family and commercial solid waste tonnage:** Since tonnage data was not available, we assumed a 32:68 ratio of single-family to multi-family and commercial waste, based on Port Orchard transfer station surveys in 2015.
- **Yard waste composting tonnage:** Bainbridge Disposal data was available for 2018. To derive 2014 yard waste composting tonnage, we calculated the 2018 ratio of single-family tonnage to yard waste composting tonnage and applied the same ratio to 2014 single-family tonnage.
- **2018 VMT:** PSRC data was available for 2014 and 2016. To derive 2018 VMT, we assumed a linear rate of increase from 2014 to 2016 to 2018.
- **2014 and 2018 Annual Revenue Miles:** We scaled Kitsap County data to Bainbridge Island according to population, which may not accurately reflect public transit ridership on Bainbridge Island.
- **Septic tank fugitive emissions:** In the absence of data on BOD_5 and households on septic, we used the U.S. Community Protocol WW.11 Alternative Method to calculate methane emissions when only total population is known.
- **HFC and PFC tonnage:** National data was available for 2014 and 2017 and was scaled down to Bainbridge Island by population. We assumed semiconductor manufacture, and the production of magnesium and aluminum, did not apply to Bainbridge Island and excluded contributions from those sources. The PFC-Substitution of ODS value provided was "does not exceed 0.05"; 0.04 was used as an estimate and may be an overestimate.
- **Air travel:** We were not able to obtain fuel use data for 2018, so the air travel emissions were estimated by using a scaling factor from 2015 fuel use data based on the total landings for 2014 and 2018.
- **Offroad vehicle and equipment:** We used the EPA MOVES model to estimate offroad vehicle and equipment emissions. The model estimates emissions at the county-level; we scaled Kistap County emissions to Bainbridge Island by population.

These considerations should be taken into account when interpreting findings from this inventory. We also recommend that future inventories seek to address these data limitations, if possible.

COMMUNITY CONTRIBUTION ANALYSIS

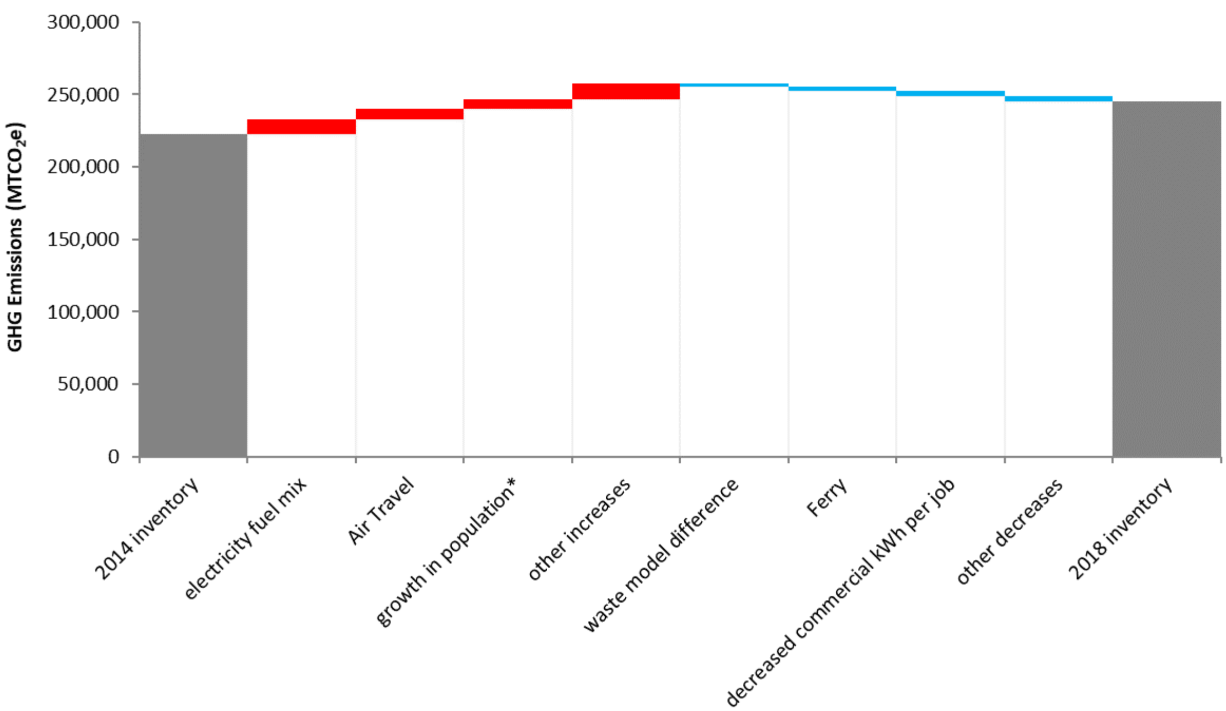
Introduction

In 2014, total community emissions were 222,463 $MTCO_2e$. In 2018, communitywide emissions increased to 245,234 $MTCO_2e$, resulting in a 10% (22,798 $MTCO_2e$) increase from the 2014 inventory. We utilized the *Analyzing Drivers of Change in Greenhouse Gas Emissions Inventories* tool available from ICLEI USA to attribute changes in the community inventories to the economic, social and technological forces that influenced them.[8]

Results

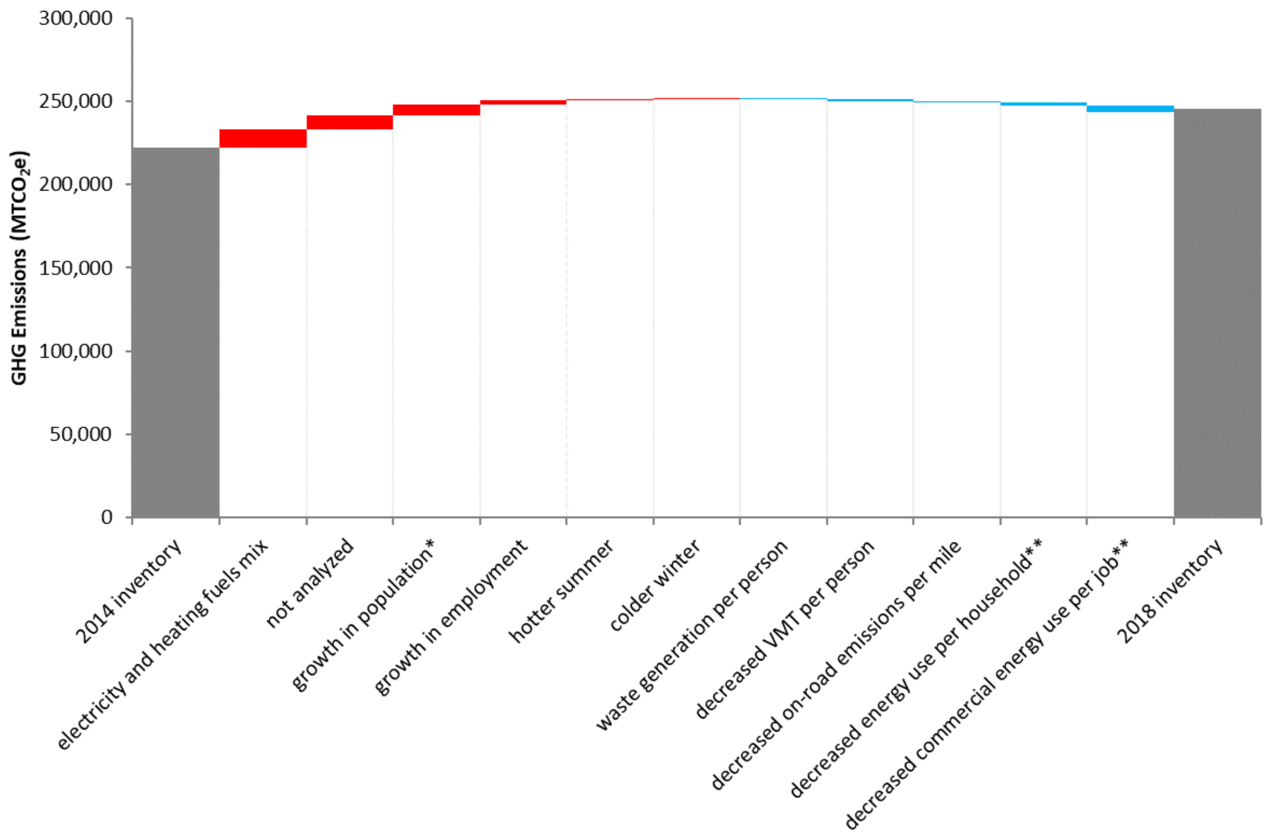
The communitywide contribution analysis highlighted factors that lead to the most significant changes in emissions between 2014 and 2018. The analysis revealed that changes to the PSE electricity fuel mix, increased activity at SeaTac airport (and, thus, higher estimated air travel emissions), and growth in population and employment all contributed to increases in emissions within the community. Downward forces on the emissions included decreased emissions associated with ferry travel and more efficient driving and energy use. Figure 15 below shows the influences of the top three drivers on the two inventory years, plus a category labeled "other"—a compilation of contributors illustrated in Figure 16.

Figure 15. High-level summary of major drivers of communitywide inventory increases and decreases.



[8] ICELI USA *Analyzing Drivers of Change in Greenhouse Gas Emissions Inventories* tool. http://icleiusa.org/ghg-contribution-analysis/ (Accessed July 1, 2019).

Figure 16. Detailed depiction of major drivers of inventory increases and decreases.



Contributors to inventory changes included the following, in order of highest increase to lowest decrease:

- **Electricity fuel mix (+10,525 / +47%)** describes changes to types of resources used to generate electricity for the community. For example, increased use of renewable sources such as hydroelectricity and solar and wind power would drive emissions *decreases* in the electricity fuel mix. For Bainbridge Island, changes in the PSE electricity fuel mix contributed to *increases* in electricity emissions.
- **Not analyzed (+10,012 / +44%)** describes the emissions from multiple sources—including increases in emissions from off-road vehicles, air travel, agriculture, wastewater, and refrigerant loss—that are not explicitly linked to a variable available in the tool. Due to the calculation methodology used to estimate emissions from these sources, many of these increases can be linked to population growth, which was used as a scaling factor to estimate emissions.[9]

[9] These sources are classified as "not analyzed" because population is used as a scaling factor to estimate emissions for these sources, and therefore population growth is already "baked into" the estimation. Thus, it would be inappropriate to group these sources with the "growth in population" driver.

- **Growth in population (+6,621 / +3%)** includes the impacts of increased housing, driving, and waste generation from Bainbridge Island's growing population. Population grew 7.1% from 23,135 in 2014 to 24,891 in 2018.

- **Growth in employment (+2,583 / +1.2%)** describes the effect of increased job growth and GDP per person on emissions. Economic growth leads to larger consumption of goods and services, therefore resulting in emissions increases.

- **Hotter summer (+499 / +0.22%)** is the increase emissions associated the enlarged strain on various systems due to hotter temperatures during the summer, such as increased electricity and energy consumption for residential and commercial cooling. The summer in 2018 was hotter than in 2014.

- **Colder winter (+366 / +0.16%)** is the increase emissions associated with the amplified strain on various systems due to colder temperatures during the winter, such as increased electricity and energy use for residential and commercial heating. The winter in 2018 was colder than in 2014.

- **Waste generation per person (-338 / -0.15%)** describes the impacts from change in the amount of waste disposed per person. In Bainbridge Island, the growth of waste generation was slower than that of population, which resulted in reduced per-person waste generation.

- **Decreased VMT per person (-924 / -0.42%)** describes changes from people driving more or less in the community. On average, each Bainbridge Island resident drove fewer miles, resulting in emissions decreases.

- **Decreased on-road emissions per mile (-1,058 / -0.48%)** represents changes in the amount of emissions per vehicle mile driven. These changes could be due to better driving behavior or more fuel-efficient vehicles.

- **Decreased energy use per household (-1,658 / -0.75%)** denotes a decline in the amount of energy used by the average Bainbridge Island household. This change could be due to more energy efficient behaviors or appliances.

- **Decreased commercial energy use per job (-3,754 / -1.7%)** incorporates the fact that job growth has increased, but a large conversion of energy efficient standards has been made throughout the commercial sector resulting in a decrease in emissions.

Municipal Operation Emissions

The municipal operation emissions inventory accounts for the GHG emissions resulting from Bainbridge Island City government operations. Bainbridge Island's government provides a range of municipal services including police, streets, planning, zoning, and general administration services. The City also operates the water and wastewater utilities for a portion of the island.

Table 12 below provides an outline of the various emissions sources included in the municipal inventory, paired with their respective Scope. The table also specifies which sectors are required by the *Local Government Operations Protocol.*

Table 12. Municipal inventory emissions and scope categories.

Emissions Type	Required?	Scope 1	Scope 2	Scope 3
Buildings and Facilities Energy				
Electricity	×		✓	
Stationary Fuel Consumption	×	✓		
Streetlights and Traffic Signals	×		✓	
Transportation				
On-Road Fleet Vehicles	×	✓		
Off-Road vehicles	×	✓		
Employee Commute				✓
Business Travel				✓
Solid Waste, Potable Water, and Wastewater				
Solid Waste				✓
Wastewater Treatment	×	✓		
Refrigerant Leakage	×	✓		

RESULTS

Overview

Bainbridge Island's 2014 municipal-based GHG inventory totaled 2,076 $MTCO_2e$. Municipal emissions in 2018 increased 11% to 2,300 $MTCO_2e$. Major emissions sources in 2018 included facility electricity consumption (60%) and on-road fleet vehicles (17%) (see **Figure 17** and Table 13).

Transportation and electricity also contributed the largest increases in emissions from 2014 to 2018. Municipal facility electricity and on-road fleet vehicles increased by 14% and 7%, respectively. Just four facilities accounted for 80% of all facility electricity use: Bainbridge Island Waste Water Treatment Plant (WWTP), City Hall, Fletcher Bay: Well Field, and Bainbridge Island Public Works Operations and Maintenance Yard. There were a few sectors with decreases in emissions, the largest coming from streetlights and traffic signals emissions.

Table 13. Emissions by year, sector, and scope.

		GHG Emissions ($MTCO_2e$)	
Sector	**Scope**	**2014**	**2018**
Building Propane	1	40	40
On-Road Fleet Vehicles	1	359	385
Off-Road Vehicles	1	77	63
Refrigerant Loss	1	18	18
Wastewater Treatment Plant	1	49	53
Electricity	2	1,212	1,383
Street Lights & Traffic Signals	2	103	91
Solid Waste Generation	3	59	84
Employee Commute	3	160	184
Business Travel	3	-	
Total		**2,076**	**2,300**

Figure 17. Municipal emissions, by source and scope, for 2018 (total = 2,300 $MTCO_2e$).

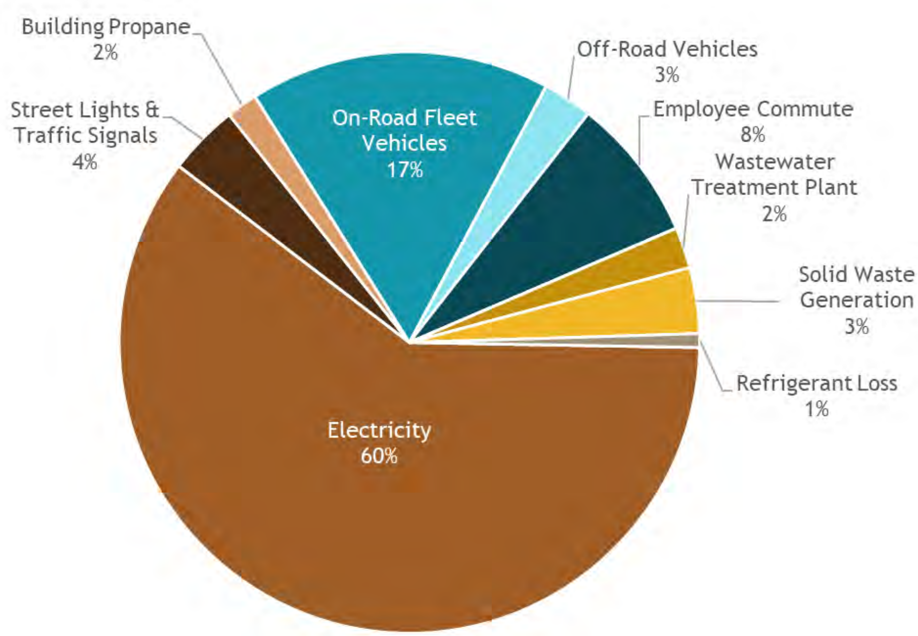
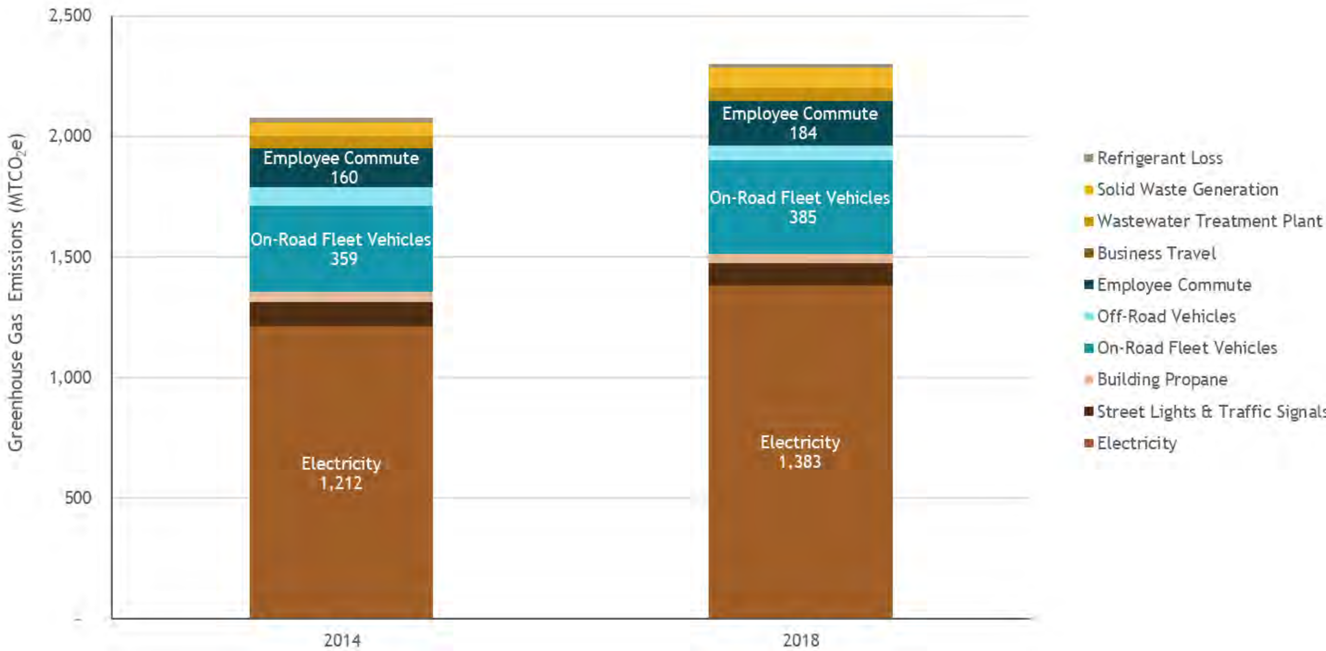


Figure 18. Bainbridge Island municipal emissions, by year and source.

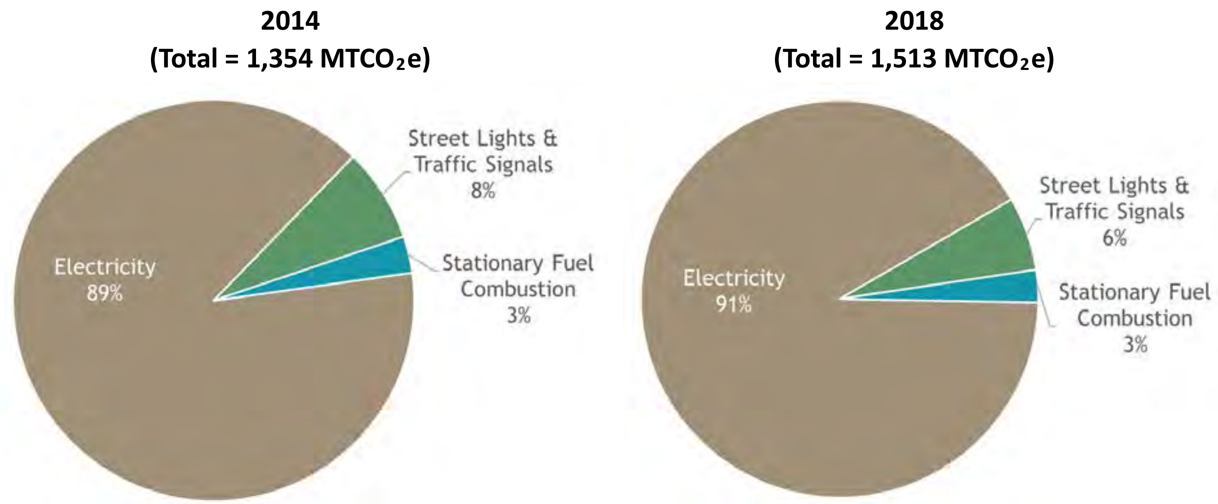


Buildings and Facilities Energy

The City of Bainbridge Island operates several government administration buildings, including City Hall, the Police Station, the Municipal Court, and a maintenance yard, as well as several community spaces, a wastewater treatment facility, and the streetlights and traffic signals throughout the City. This section details the GHG emissions resulting from the consumption of energy at these buildings and facilities. The types of energy consumed at these locations include electricity, provided by Puget Sound Energy, and propane, which is combusted in stationary equipment on-site.

In 2018, energy consumption at City of Bainbridge Island buildings and facilities accounted for 62% of total municipal GHG emissions. Building electricity usage accounted for the bulk of emissions, comprising 89% and 91% of sector emissions in 2014 and 2018, respectively (see Figure 19). From 2014 to 2018, building and facility electricity emissions grew by 14%, primarily due to fluctuations in the electricity utility fuel mix (see Electricity section below). The following sections provide greater detail on trends for the three sources of building and facility energy use: electricity, stationary fuel combustion, and streetlights and traffic signals.

Figure 19. Bainbridge Island municipal buildings and facilities energy emissions.



Electricity

Electricity usage contributed the largest portion of GHG emissions within the City's buildings and facilities sector, resulting in the emission of 1,212 $MTCO_2e$ in 2014 and 1,383 $MTCO_2e$ in 2018. Between 2014 and 2018, electricity emissions grew by 14%. However, electricity usage in kWh only grew by 4% within this same time period. This indicates that the growth in emissions between 2014 and 2018 was primarily due to fluctuations in the electricity utility fuel mix (i.e., changes in the proportion of fossil fuel sources used by the utility to generate electricity in a given year) rather than substantial increases in electricity usage.

The two facilities with the greatest electricity usage in both years were the wastewater treatment facility and City Hall. These two facilities also experienced the greatest *reductions* in electricity usage between 2014 and 2018, demonstrating that the City is continuing to make progress on energy efficiency and conservation in the most heavily-utilized facilities (see Figure 20 and Figure 21 below).

Figure 20. Top electricity-using facilities in 2018.

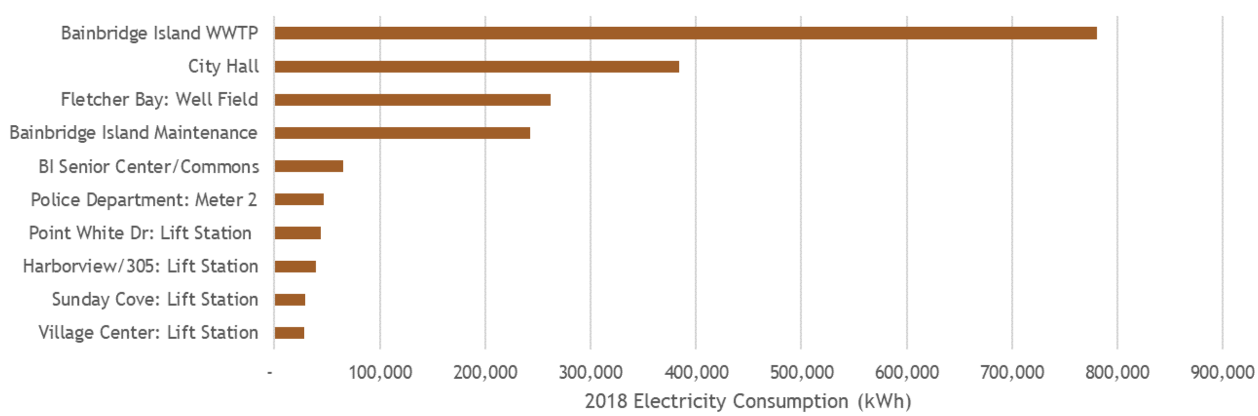


Figure 21. Facilities with the greatest electricity consumption *increases* between 2014 and 2018.

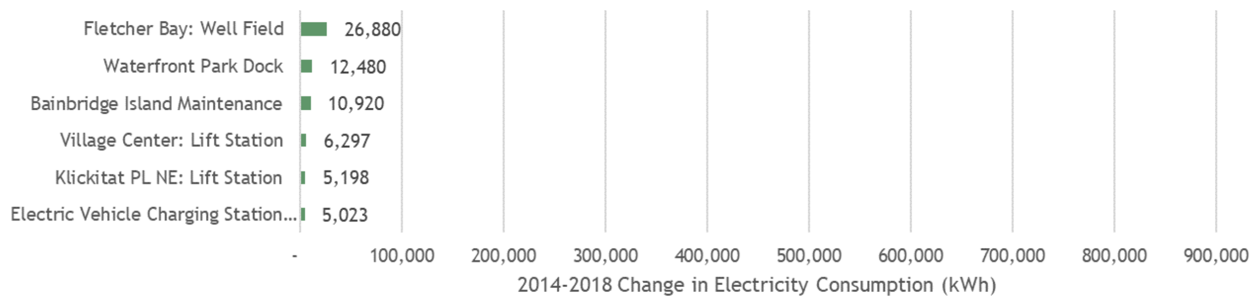
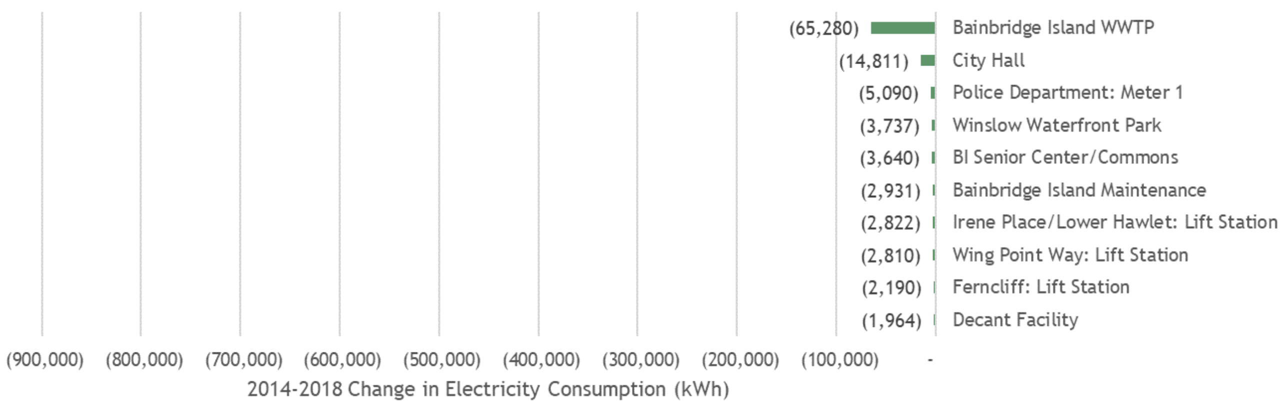


Figure 22. Facilities with the greatest electricity consumption *decreases* between 2014 and 2018.



Stationary Fuel Combustion

Stationary fuel (propane) combustion was the lowest contributor to municipal GHG emissions in both 2014 and 2018. Between both years, emissions remained constant at 40 $MTCO_2e$. The only source for stationary fuel combustion is the Public Works Operations and Maintenance shop, which consumed an estimated 7,077 gallons of propane for heating. The number of gallons consumed remained constant from 2014 to 2018 and therefore resulted in no change in emissions.

Streetlights and Traffic Signals

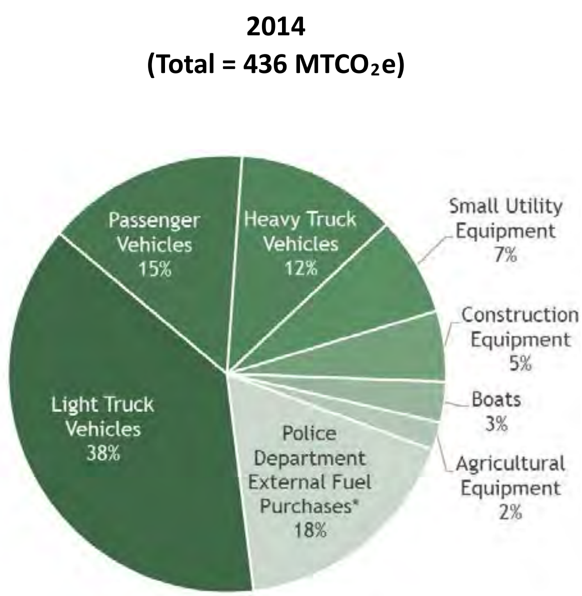
The second largest contributor to GHG emissions were streetlights and traffic signals. Between 2014 and 2018, the City of Bainbridge Island increased the number of streetlights from 328 to 343. However, the emissions produced and electricity consumed by the streetlights has decreased by 12%. This decrease can be attributed to the City's increased uptake of energy efficient lightbulbs resulting in a decrease in energy per streetlight or traffic signal.

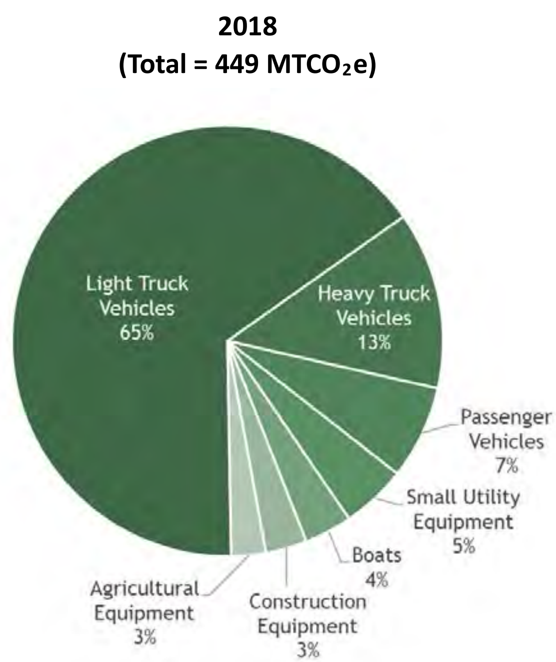
Transportation

Transportation sector emissions are the third largest contributor to the City of Bainbridge Island's emissions. This section details the GHG emissions resulting from the consumption of gasoline, diesel, biodiesel, and propane in various vehicles. These vehicles are a part of numerous city operations, such as emergency services, landscaping, and government travel.

In 2018, the transportation sector contributed 19% of all emissions, totaling 449 $MTCO_2e$. The City of Bainbridge Island utilizes fuel for different vehicles such as boats, pickup-trucks, dump trucks, construction equipment, and patrol vehicles (see Figure 22). Municipal fuel consumption and emissions increased between 2014 and 2018, and there was a small decrease in fuel economy. Between 2014 and 2018, average municipal fuel economy decreased from 13 mpg to 12 mpg (see Figure 23).

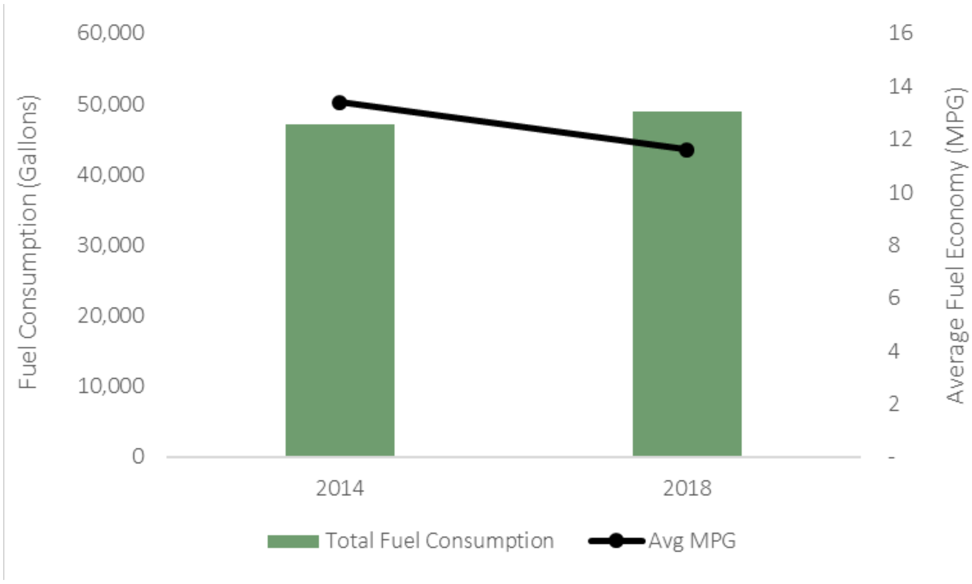
Figure 23. City of Bainbridge Island fleet vehicle emissions, by type.





* *Refers to police department fuel purchased outside of O&M. This data is not connected to specific vehicle types.*

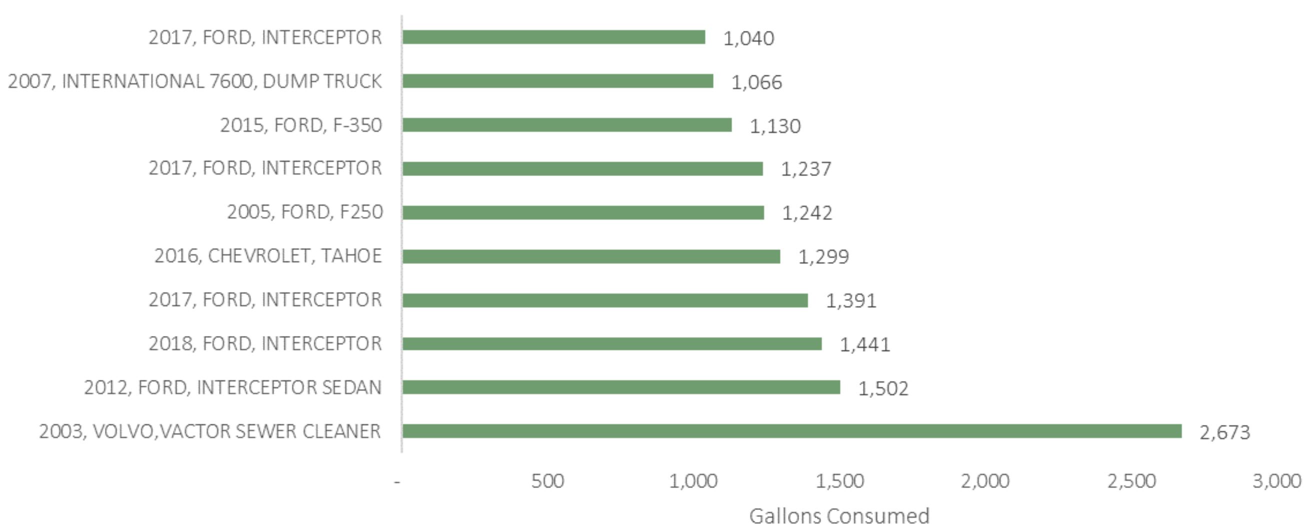
Figure 24. Municipal fleet fuel consumption and average fuel economies, by year.



On-Road Fleet Vehicles

On-road vehicles made up the majority of transportation emissions in 2014 and 2018. Emissions come from on-road fleet vehicles driving on roadways within the community. In 2018, on-road vehicles consisted of 85% of all transportation sector emissions. On-road vehicles produced 359 $MTCO_2e$ and 385 $MTCO_2e$ in 2014 and 2018, respectively. The 2003, Volvo Vactor Sewer Cleaner consumed the greatest amount of fuel both years. The Vactor Sewer Cleaner consumed 1,518 gallons of diesel in 2014 and 2,673 gallons in 2018. The Patrol/Interceptor vehicles sector contained the largest number of fuel-consuming vehicles. Figure 24 presents the top-10 fuel consuming vehicles in 2018.

Figure 25. Top 10 fuel-consuming fleet vehicles, 2018.



Off-Road Vehicles

Off-road equipment, such as lawnmowers, boats, and forklifts, contribute another 15% of transportation sector emissions. There was an 17% reduction in emissions between 2014 and 2018, from 77 $MTCO_2e$ to 63 $MTCO_2e$. Reductions in emissions are from reduced fuel consumption, decreasing from 7,730 gallons in 2014 to 6,474 gallons in 2018.

Employee Commute

Employee commute includes single-occupancy vehicles (SOV), vanpools and carpools. In 2014, employee commuting produced 160 $MTCO_2e$ from 486,922 VMT. There were 106 full-time equivalent municipal employees, resulting in 1.51 $MTCO_2e$ emitted per employee. The emissions increased in 2018 to 184 $MTCO_2e$. This was a consequence of an increase in VMT to 646,027. In 2018, there were 119 full-time equivalent employees for the city with only a small increase to 1.55 $MTCO_2e$ per person.

Solid Waste and Wastewater

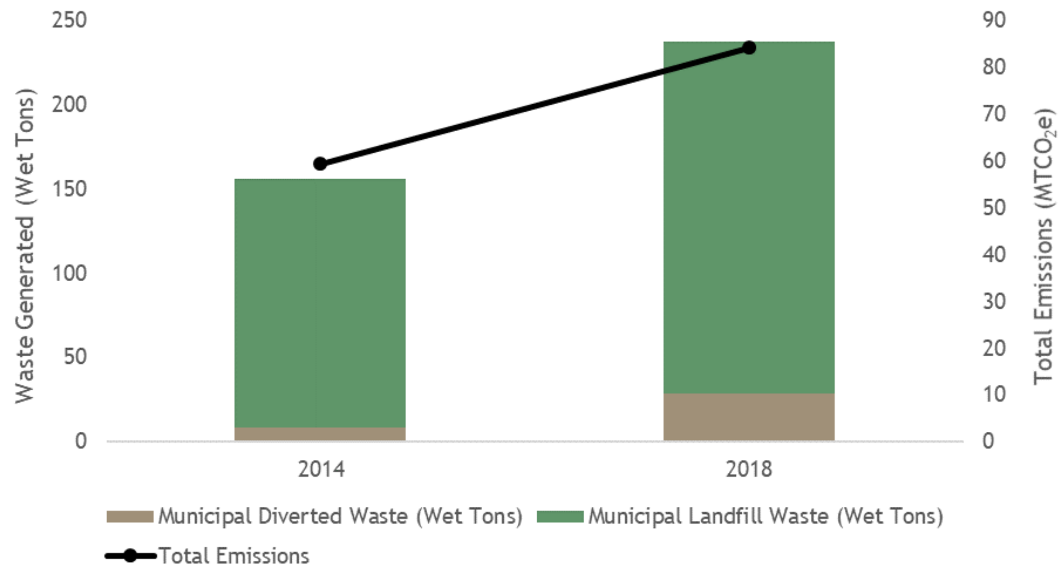
Waste sector includes emissions from solid waste incineration and biological process emissions related to wastewater treatment—detailed below.

Solid Waste

Solid waste is comprised of municipal landfill waste and municipal diverted waste (recycling, cardboard, and yard waste). We estimate that emissions from landfill waste increased from 59 $MTCO_2e$ to 84 $MTCO_2e$ in 2018. This trend is largely due to an increase in waste service for the City (e.g., number and size of trash bins). We estimate that 148 tons of waste were sent to the landfill in 2014, emitting 59 $MTCO_2e$, and that amount increased to 209 tons in 2018.

Between 2014 and 2018, the amount of diverted waste increased from 8.6 tons to 28.8 tons. Yard waste in particular, increased from 2.1 tons in 2014 to 3.9 tons in 2018. This increase in yard waste composting contributed to a slight increase in emissions within the diverted waste category, from 0.15 $MTCO_2e$ to 0.27 $MTCO_2e$ (Figure 25).

Figure 26. Municipal solid waste disposal trends.



Wastewater Treatment

The City owns and operates the Winslow Wastewater Treatment Plant and operates collection for the South Island Sewer System. The Winslow Sewer System serves the historic downtown Winslow area and the South Island Sewer System serves the Lynnwood Center, Point White, Pleasant Beach, Emerald Heights, Blakely School, and Rockaway Beach neighborhoods. The collection systems have a combined infrastructure that includes: emergency generators, manholes, residential grinder pumps and sewage pump stations.

In 2018, emissions from waste water treatment were 53 $MTCO_2e$. This was an 8% increase from 2014 where emissions were 49 $MTCO_2e$. This can be attributed to the increase in population served from 5,783 in 2014 to 6,223 in 2018.[10]

Refrigerant Leakage

Emissions result from refrigerant loss from leaks in refrigeration systems. This includes: domestic refrigeration, commercial refrigeration, industrial refrigeration, chillers, and residential/commercial air conditioning units. Refrigerant gases differ in their Global Warming Potential (GWP)—the amount of heat a greenhouse gas traps in the atmosphere relative to carbon dioxide. Emissions from R-22 leaks, for example, are especially impactful: they have a GWP 1,760, which means that they are over one thousand times more damaging than carbon dioxide. The City's heating and cooling systems largely use R-22, which we estimate produces 17 $MTCO_2e$ per year.

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[10] Service populations were estimated at 25% of the total Bainbridge Island population, as estimated by Bainbridge Island City staff.

DATA SOURCES AND METHODOLOGY

The municipal emissions inventory involved acquiring the following data types, summarized in Table 14 and detailed in the following sections:

- **Activity data** that quantifies levels of activity that generate GHG emissions, such as miles traveled, and kWh of electricity consumed.
- **Emissions factors** that translate activity levels into emissions (e.g., $MgCO_2e$ per kWh).

Data quality is assessed and reported on a High (H), Medium (M), and Low (L) scale in accordance with GHG inventory best practices. A High rating indicates data are detailed and specific, a Medium rating indicates data are more general or modeled with robust assumptions, a Low rating indicates data are highly modeled, uncertain, or a default value was used.

Table 14. Key data sources for the City of Bainbridge Island's municipal inventory.

Sector	Activity Data (AD)	AD Quality	Emissions Factors (EF)	EF Quality
Buildings and Facilities Energy				
Electricity	• kWh consumption compiled from PSE bills	H	• PSE reported emissions factors (PSE Greenhouse Gas Inventory, 2014 & 2017, Table 7.1)	H
Stationary Fuel Combustion	• Gallons of propane used for heating compiled based on municipal purchasing information provided by O&M	M	• Emissions factors provided in ClearPath program	M
Streetlights and Traffic Signals	• Quantity, type, and wattage of each streetlight and traffic signal transcribed from PSE bills • Installed wattage used to estimate electricity consumption in kWh	M	• PSE reported emissions factors (PSE Greenhouse Gas Inventory, 2014 & 2017, Table 7.1)	H
Transportation				
On-Road Fleet Vehicles	• Fuel volumes by vehicle and type, along with annual miles traveled, provided by Public Works staff • Where fuel volumes and miles traveled were unavailable for specific vehicles, the total quantity of fuel purchased was provided (with no vehicle information associated)	H	• CO_2 emission factors provided in ClearPath program • CH_4 and N_2O average emissions factors for each vehicle and fuel type were calculated based on the model year composition of the municipal fleet vehicles • Emissions factors used in these calculations were derived from the EPA (2017) Inventory of U.S. Greenhouse Gas Emissions and Sinks (Climate Leadership Resource)	H

Sector	Activity Data (AD)	AD Quality	Emissions Factors (EF)	EF Quality
Off-Road Vehicles	• Fuel volumes by vehicle and type, along with annual hours of use, provided by Public Works staff • Where fuel volumes were unavailable for specific vehicles, the total quantity of fuel purchased was provided (with no vehicle information associated)	H	• Emissions factors provided in ClearPath program • Emissions factors for off-road vehicle/equipment propane use were missing from the ClearPath program; these emissions were calculated separately using emissions factors derived from the EPA (2017) Inventory of U.S. Greenhouse Gas Emissions and Sinks (Climate Leadership Resource)	M
Employee Commute	• $MTCO_2e$ obtained from Commute Trip Reduction survey conducted by WSDOT	M	• N/A; value converted to $MTCO_2e$ by WSDOT	N/A
Solid Waste and Wastewater				
Solid Waste Generation	• Bin sizes, pickup frequency, and waste type were transcribed from solid waste bills • Estimated cubic yards of waste were then converted to tons using EPA solid waste weight conversions • This methodology assumes all waste pickup containers were full	L	• Waste characterizations from King County multifamily and commercial buildings used to estimate Bainbridge Island municipal waste composition • ClearPath default emissions factors used to estimate all future methane emissions resulting from the decomposition of each waste type	L
Wastewater Treatment Facility	• Wastewater treatment facility processes determined based on desktop research and confirmed with city staff • Population served by wastewater treatment facility estimated by Public Works staff	L	• Local Government Operations Protocol equations 10.8 and 10.10 used to calculate N_2O emissions • CH_4 emissions were not applicable since the system is aerobic	L
Refrigerant Leakage				
Refrigerant Leakage from Building Heating and Cooling Equipment	• List of heating/cooling equipment provided by city staff • Equipment categorized by type and refrigerant used	L	• Emissions calculated using Equation 6.35 and the default factors in Table 6.4 of the Local Government Operations Protocol	L

Buildings and Facilities Energy

- We acquired **electricity consumption** data by hand transcribing individual monthly PSE electricity bills for the City of Bainbridge Island's municipal operations. City staff photocopied and provided these bills.
- In 2018, gallons of **propane** used to heat the **maintenance shop** were tracked in City records. However, only cost information was tracked in 2014. Based on the comparison of cost information between the two years, City staff estimated the propane use at this facility was the same in 2014 and 2018.
- **Propane usage** in an emergency generator at the Senior Center was omitted from the 2014 and 2018 inventories. In 2014, the generator was not maintained by the City and in 2018 the generator was not used.
- We estimated the total **electricity usage of streetlights and traffic signals** operated by the City of Bainbridge Island by counting the number, wattage, and types of streetlights and traffic signals included in the individual monthly PSE electricity bills. We used Equation 6.15 in the *Local Government Operations Protocol* to convert wattage to estimated electricity consumption in kWh. We assumed an average daily operating time of 12 hours for streetlights and 8 hours for traffic signals.

Transportation

- We categorized the list of **on-road and off-road vehicles** and equipment into standard vehicle types (i.e., passenger car, light-duty truck, heavy-duty truck, etc.) based on provided vehicle descriptions and make/model information. We totaled fuel gallons and vehicle miles traveled by each vehicle category and type of fuel. CO_2 emissions were derived based on usage volumes by type of fuel and ClearPath default emissions factors. CH_4 and N_2O emissions were derived based on miles traveled by vehicle category and fuel type. We used CH_4 and N_2O emissions factors for each vehicle category-fuel type combination originally derived from the *EPA (2017) Inventory of U.S. Greenhouse Gas Emissions and Sinks* and modified these factors to reflect the municipal fleet age composition.
- One forklift within the municipal fleet used **propane**. However, propane is not an available fuel type for off-road equipment in the ClearPath program. Therefore, we calculated propane emissions outside of ClearPath using emissions factors derived from the *EPA (2017) Inventory of U.S. Greenhouse Gas Emissions and Sinks.*
- We obtained total emissions (in $MTCO_2e$) associated with **employee commuting** from the *Commute Trip Reduction Survey* conducted by WSDOT.

Solid Waste and Wastewater

- We acquired **waste generation** data by hand transcribing individual monthly Bainbridge Disposal bills for the City of Bainbridge Island's municipal operations. City staff photocopied and provided these bills.
- Waste bills generally indicated the disposal bin volume, the pickup frequency, and the waste stream (i.e., recycling, yard waste, trash, etc.). We assumed that waste bins were full at time of pickup and

that waste described as recycling or cardboard was recycled, waste described as yard waste was composted, and waste described as trash was landfilled. We converted annual volumes of waste by type into tons of waste by type using EPA solid waste weight conversions. We then used King County waste composition information and ClearPath default emissions factors to estimate emissions associated with **waste generation and composting.**

- We estimated **wastewater treatment N_2O emissions** using Equation 10.7 and 10.10 of the *Local Government Operations Protocol.* Population served was estimated by Bainbridge Island City staff. Default nitrogen load information was used since local data was not available.

Refrigerant Leakage

- We acquired a list of **heating/cooling equipment** used in municipal buildings from Bainbridge staff. We did an online search of the equipment models and serial numbers to determine how to best categorize each piece of equipment. Using these categorizations, we estimated emissions from refrigerant leakage using Equation 6.35 and Table 6.4 of the *Local Government Operations Protocol*.

Considerations

There is some degree of uncertainty in any GHG inventory. This uncertainty can come from incomplete data, but it can also result from uncertainty in the methodology or emissions factors used in calculating units of activity (e.g. gallon of fuel, kilowatt-hour of electricity, short ton of solid waste) into CO_2-equivalent emissions. These considerations should inform future inventory and reporting efforts, including prioritization of additional data collection, understanding of inventory results, and in the development of mitigation goals and monitoring systems.

Considerations for the municipal operations inventory include:

- **Electricity consumption:** The hand transcribing of electricity and waste bills introduces a greater potential for human error.
- **Streetlight and traffic signal daily operations:** Assumptions made on average daily operating time could affect electricity consumption amounts.
- **Employee commuting emissions:** WSDOT modeled the *Commute Trip Reduction Survey,* therefore the methodology, such as emissions factors assumed for passenger vehicles, could be different from those used for community passenger vehicles.
- **Municipal vehicle fleet:** Some municipal feel vehicles and equipment are fueled by bulk fuel purchases or mobile fueling tanks. In these instances, we had to estimate vehicle miles traveled and vehicle composition, potentially affecting the CH_4 and N_2O calculations.
- **Solid waste generation:** Disposal frequency can be difficult to determine from solid waste bills—which was the only data available to deduce solid waste disposal amounts. We also lacked data on the amount of waste included in each disposal bin at the time of pickup, we assumed all bins were full. The hand transcribing of waste bills introduces a greater potential for human error.
- **Solid waste characterization:** Bainbridge Island lacked a local waste characterization study, therefore, we applied King County waste characterization data to estimate the relative proportions of different materials in the waste stream. The waste composition for Bainbridge Island may be different than for King County.
- **Wastewater treatment:** Due to limitations in local data availability, the calculations used were default national values based on the treatment method.

MUNICIPAL CONTRIBUTION ANALYSIS

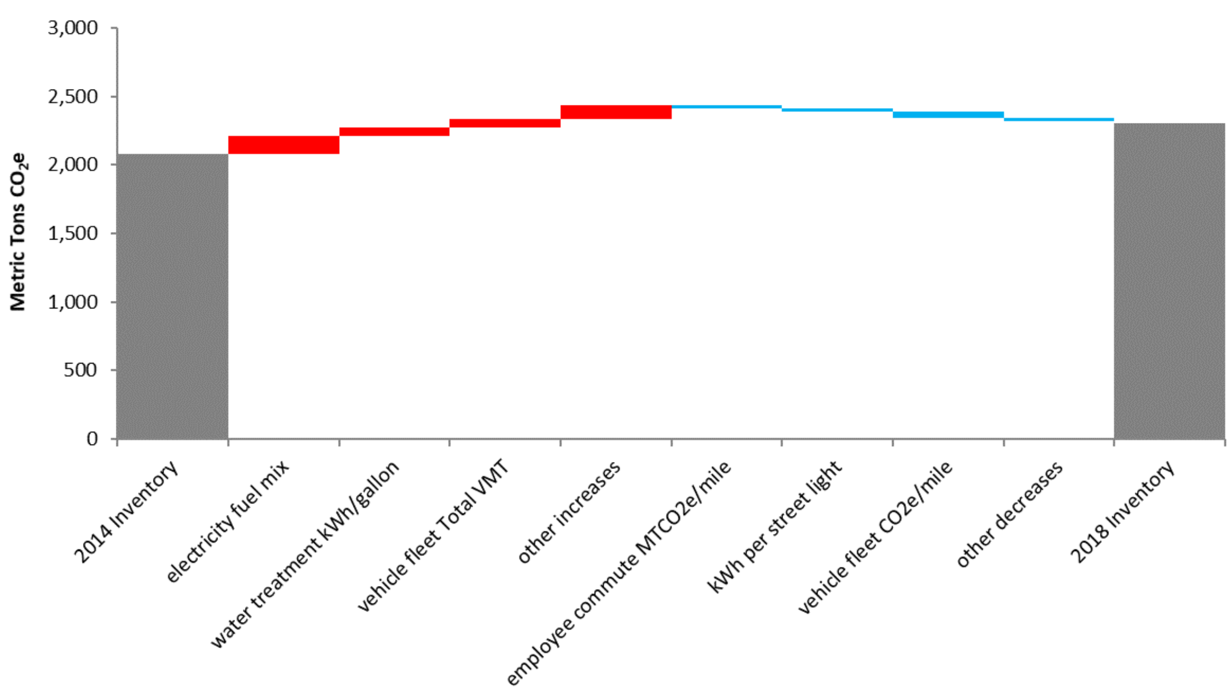
Introduction

In 2014, total municipal emissions were 2,076 $MTCO_2e$. In 2018, total emissions increased to 2,300 $MTCO_2e$, resulting in a 11% (224 $MTCO_2e$) increase from the 2014 inventory. We employed the *Analyzing Drivers of Change in Greenhouse Gas Emissions Inventories* tool available from ICLEI USA to attribute changes in the municipal inventories to the economic, social and technological forces that caused them.[11] The primary goal of this tool is to provide a methodology for discovering the drivers for change between the two inventory years.

Results

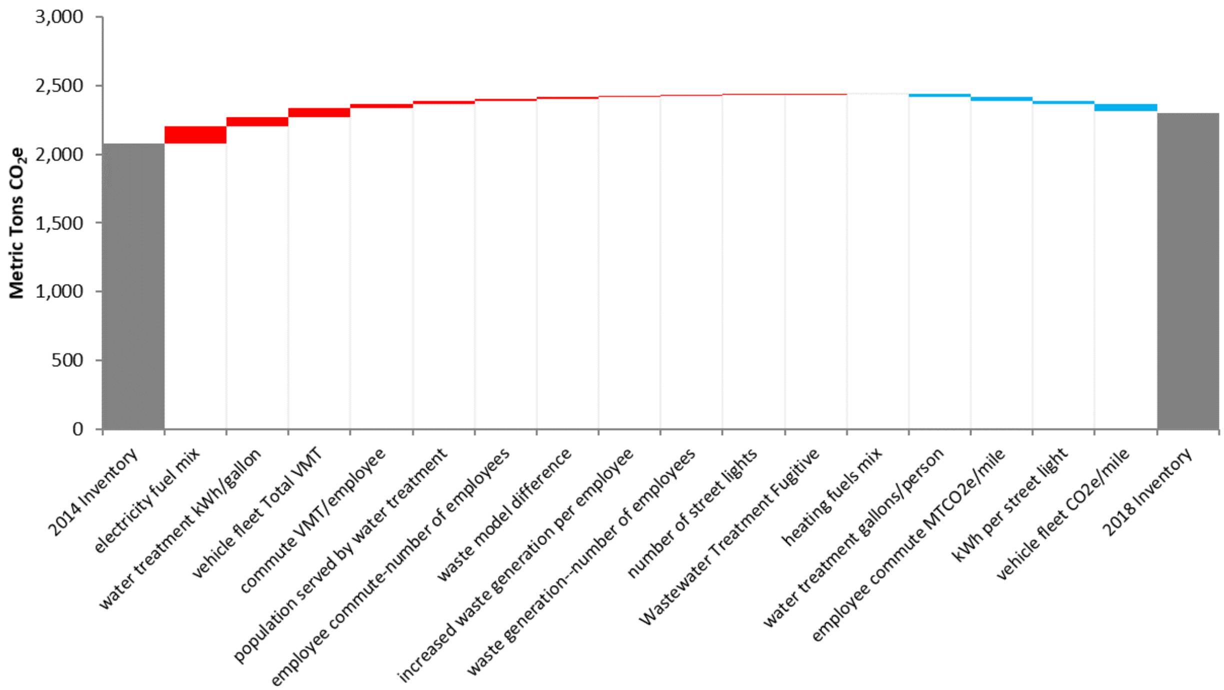
The contribution analysis revealed the factors that led to the net increase in emissions. In summary, a dirtier electricity fuel mix as reported by Puget Sound Energy, increased water treatment electricity use, and increased use of fleet vehicles all contributed to emissions increases. Reductions were due to more carbon-efficient employee commuting, more energy-efficient streetlights, and increased fuel economy of the vehicle fleet. Figure 27shows the influences of major forces on the inventory between 2014 and 2018, and Figure 28 presents a more detailed depiction.

Figure 27. High-level summary of major drivers of government operations inventory increase and decreases.



[11] ICELI USA *Analyzing Drivers of Change in Greenhouse Gas Emissions Inventories* tool. http://icleiusa.org/ghg-contribution-analysis/ (Accessed July 1, 2019).

Figure 28. Detailed depiction of contributions to change for Bainbridge Island government operations GHG emissions.



Contributors to inventory changes included the following, in order from highest increases to lowest decreases:

- **Electricity fuel mix** (+131 $MTCO_2e$ / +6.3%) describes changes to types of resources used to generate electricity for the community. For example, increased use of renewable sources such as hydroelectricity and solar and wind power would drive emissions *decreases* in the electricity fuel mix. For Bainbridge Island, changes in the PSE electricity fuel mix contributed to *increases* in electricity emissions.
- **Water treatment kWh/gallon** (+66 $MTCO_2e$ / +3.2%) includes changes in the energy efficiency of processing wastewater.
- **Vehicle fleet total VMT** (+61 $MTCO_2e$ / +2.9%) describes the increase emissions due to a rise in total vehicle miles traveled for municipally owned vehicles.
- **Other Increases** (+103 $MTCO_2e$ / +5.0%) is a compilation of changes in: population served by water treatment, number of employees commuting, waste generation per employee, and number of streetlights.
- **Employee commute $MTCO_2e$/mile** (-25 $MTCO_2e$ / -1.2%) represents more efficient commuting behaviors, possibly by changes in mode, distance, or vehicle efficiency.
- **kWh per street light** (-25 $MTCO_2e$ / -1.2%) incorporates the fact that streetlight and traffic signal numbers have increased, but a large conversion to LED prior to 2018 reduced electricity use and emissions.

- **Vehicle fleet CO_2e/mile** (-48 $MTCO_2e$ / -2.3%) is the reduction in emissions associated with reduced gasoline consumption in newer vehicles meeting more stringent federal standards, as well as the retiring of older, less fuel-efficient vehicles.
- **Other decreases** (-21 $MTCO_2e$ / -1.0%) includes decreased emissions from changes in the type of heating fuels used and less wastewater produced per-person.

Consumption-Based Emissions

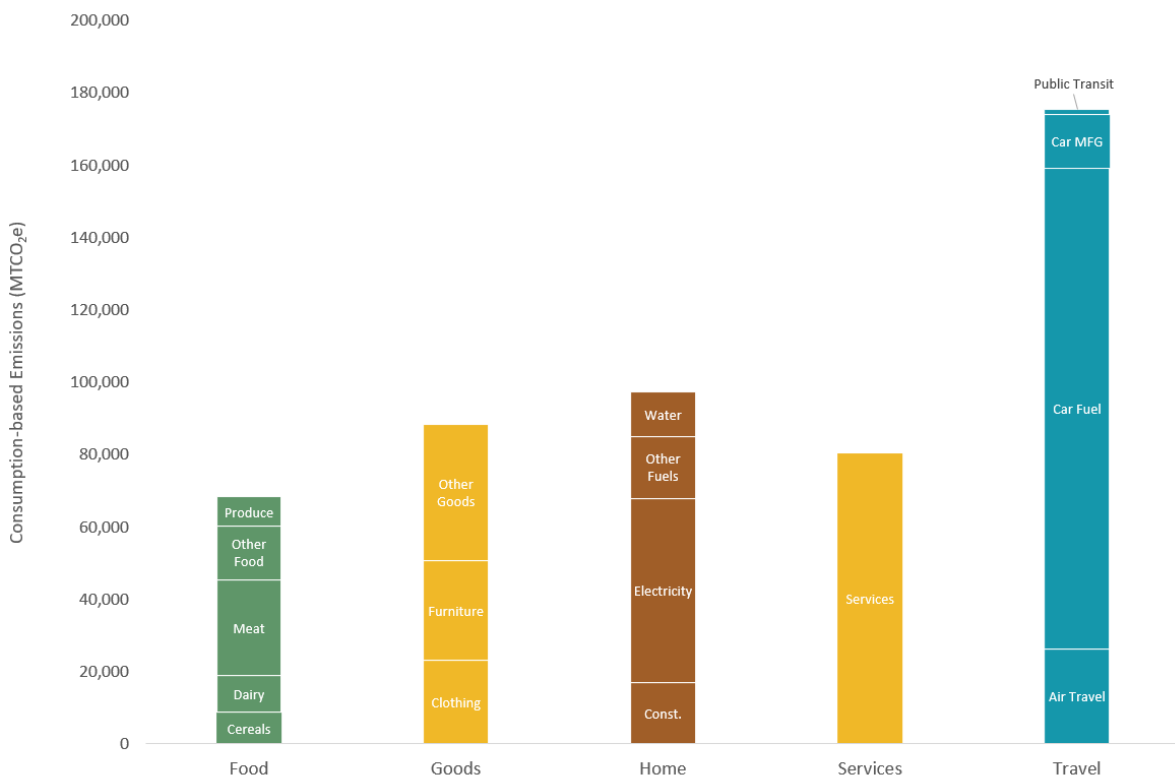
The purchasing decisions we make impact the environment. Some types of foods and materials, such as meat and furniture, can carry a significant GHG emissions burden. For example, meat and dairy cows emit methane—a potent greenhouse gas. Residents in Bainbridge Island who consume beef contribute to the emissions from these cows—even if the cows are raised outside the island. This section presents estimated emissions associated with the purchasing decisions made by Bainbridge Island households.

RESULTS

Overview

It is estimated that Bainbridge Island households each emit **52 $MTCO_2e$** a year through their purchasing behaviors—equivalent to 56,848 pounds of coal burned. Major drivers of this impact include the purchase of meat, furniture, clothing, home energy, and travel-related expenses such as car fuel and air travel (see Figure 27).

Figure 29. Estimated annual household consumption emissions for Bainbridge Island residents (total = 52 $MTCO_2e$/year).



DATA SOURCES AND METHODOLOGY

Because consumption-based inventories are inevitably coarse in scale compared to other inventory sectors, we used readily available sources to estimate Bainbridge Island's consumption-based emissions. Specifically, we used UC Berkeley's CoolClimate Calculator, which employs an Economic Input-Output Life Cycle Assessment model (EIO-LCA), designed by Carnegie Mellon University, and the Comprehensive Environmental Database Archive to calculate consumption-based emissions. This model employs an economy-wide model of cradle-to-grave emissions of all major greenhouse gases for over 400 economic sectors of the economy.

Considerations

The CoolClimate Calculator largely uses national-level data to estimate emissions associated with purchased goods and services. This means that more locally-specific emissions factors—such as those associated with the electricity we purchase—are not incorporated. For Bainbridge Island, that may mean that the calculator is slightly overestimating household emissions, since the Puget Sound Energy electricity fuel mix different than the national average. However, the calculator does use regionally-specific economic data to characterize spending habits.

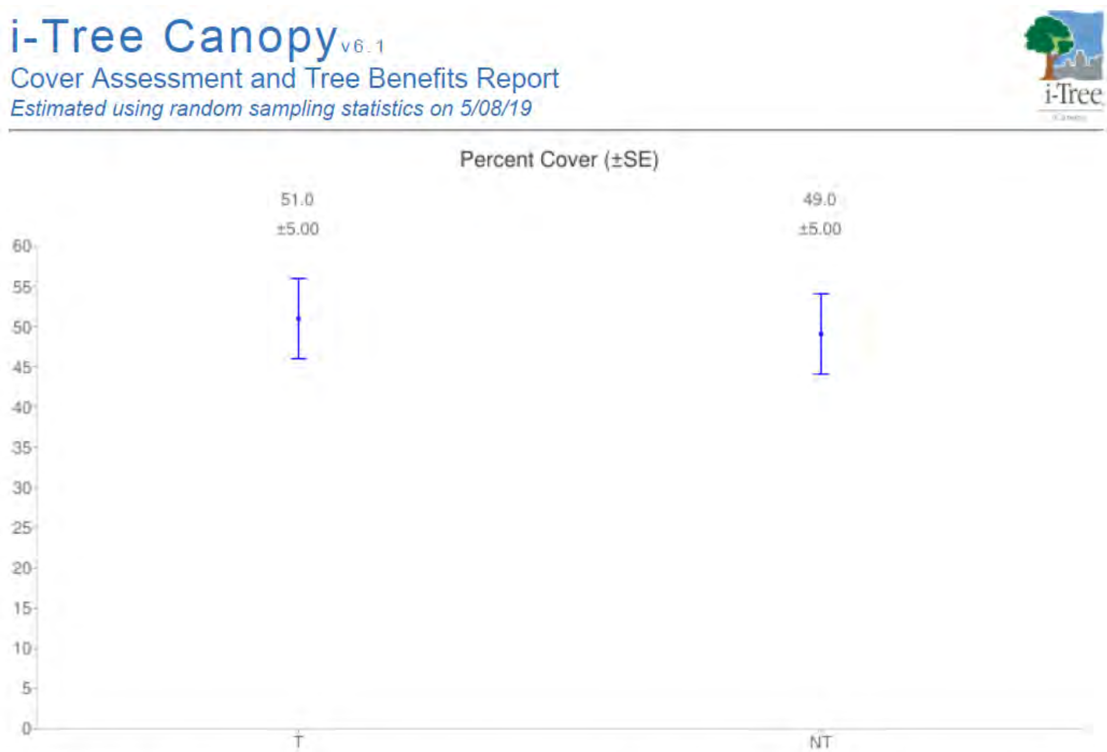
Tree Carbon Sequestration

While inventories focus on emissions of greenhouse gases *into* the atmosphere, vegetation across Bainbridge Island's landscape also sequesters—or absorbs—carbon dioxide *from* the atmosphere. Land use changes, such as development of open and working forest and agricultural lands, can affect this process. To illustrate and better understand this benefit, we sought to quantify the extent to which existing trees in Bainbridge Island sequester carbon from the atmosphere.

RESULTS

We estimate that in 2019 between 46% and 56% of the Bainbridge Island land mass is covered with trees. Those trees sequester an estimated **58,727 MTCO_2e** from the atmosphere every year—equivalent to over $2 million in carbon benefits.[12]

Figure 30. Estimated tree canopy cover on Bainbridge Island, using random sampling from the i-Tree Canopy software.[13]



Cover Class	Description	Abbr.	Points	% Cover
Tree	Tree, non-shrub	T	51	51.0 ±5.00
Non-Tree	All other surfaces	NT	49	49.0 ±5.00

[12] Assumes a sequestration rate of 10,010 lbs. CO_2/acre/year and a carbon benefit of $46.51/MT/year. Source: i-Tree Canopy v.6.1.

[13] https://canopy.itreetools.org/

DATA SOURCES AND METHODOLOGY

We utilized the i-Tree Canopy software to estimate annual tree carbon sequestration on Bainbridge Island. The software facilitates a supervised random sampling using Google Maps aerial photography. Specifically, the software walks users through the following steps:

- **Define the project area** using Google Maps aerial photography (see Figure 29).
- **Select project location** using dropdown menus. This step characterizes per-acre carbon sequestration based on anticipated vegetation types (e.g., types of trees) typical in that location. For Bainbridge Island, the selected location was Kitsap County (see Figure 30).
- **Conduct random sampling**. i-Tree Canopy shows a magnified image from the project area with a point identified with crosshairs (see Figure 31). The user then identifies whether the crosshairs are on a tree or "non-tree" area.
- **Repeat random sampling.** The tree/non-tree identification is repeated multiple times to increase statistical precision of the estimated percent tree canopy cover of the project area. For this exercise, we classified 100 random samples.
- **Analyze results.** i-Tree Canopy uses the random sampling to provide an estimate of overall percent tree canopy cover and resultant tree carbon benefits.

Figure 31. Defining the project area within i-Tree Canopy.

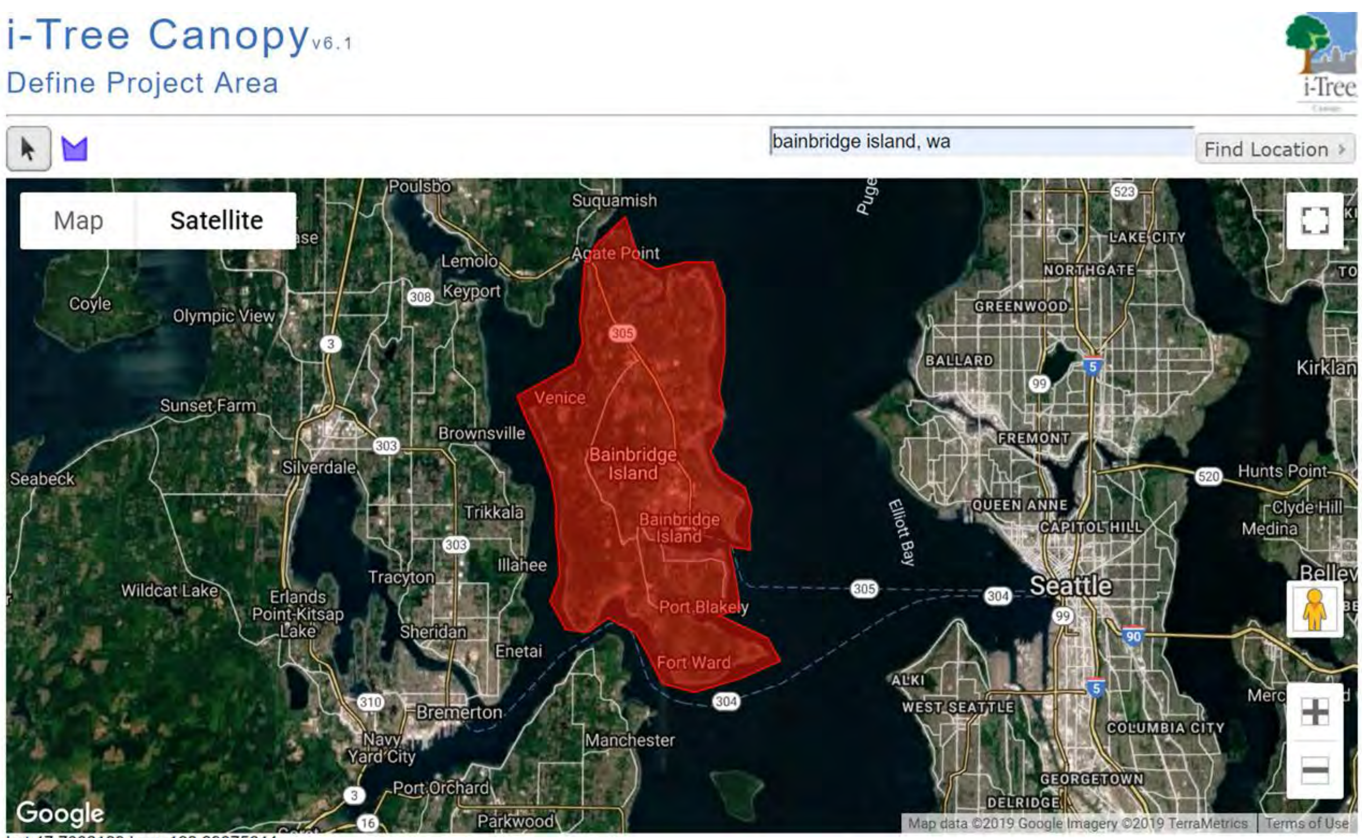
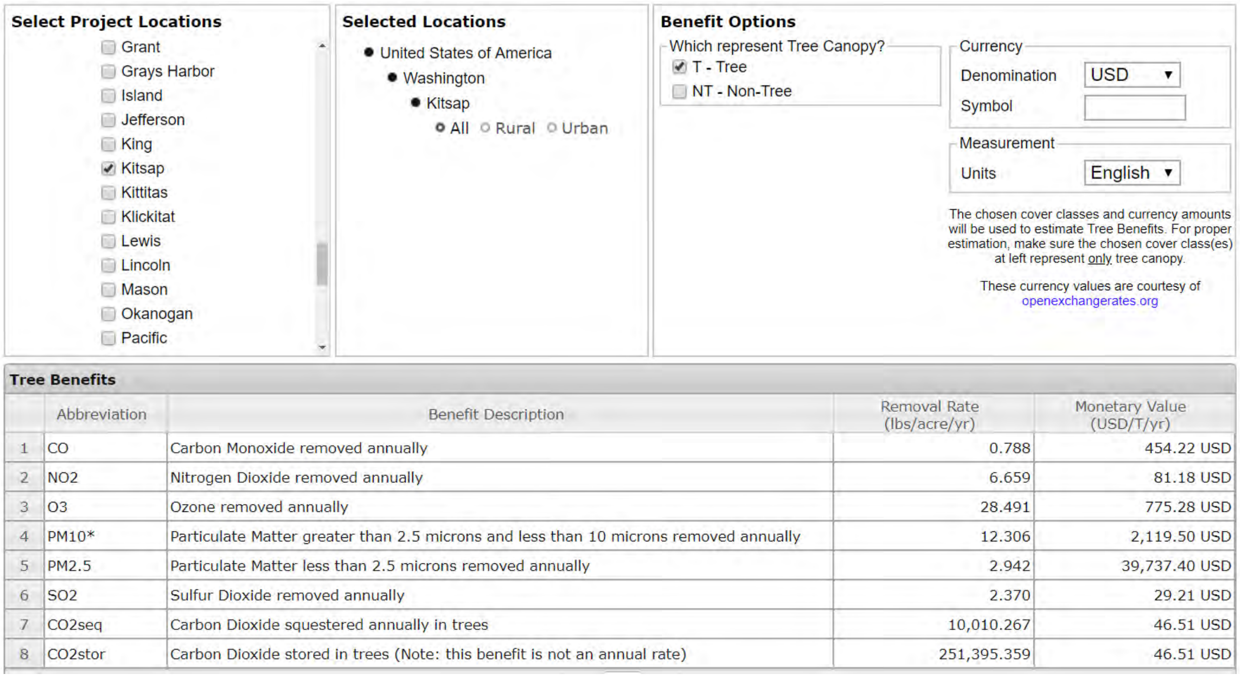
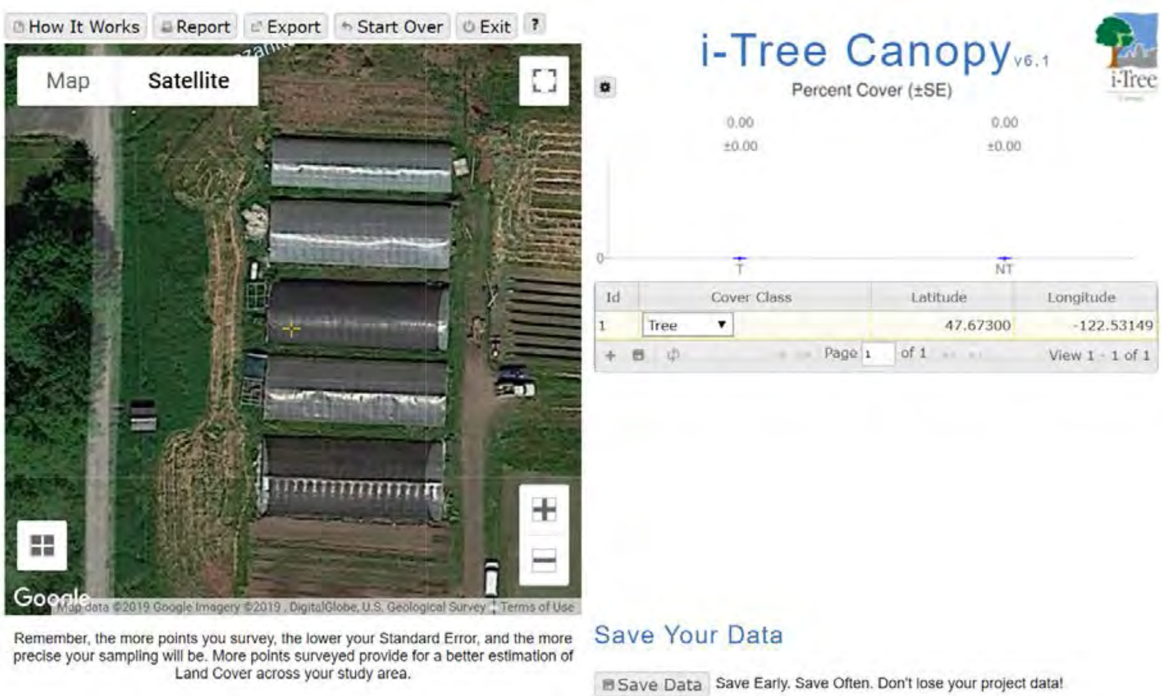


Figure 32. Selected project location for the Bainbridge Island study.



	Abbreviation	Benefit Description	Removal Rate (lbs/acre/yr)	Monetary Value (USD/T/yr)
1	CO	Carbon Monoxide removed annually	0.788	454.22 USD
2	NO2	Nitrogen Dioxide removed annually	6.659	81.18 USD
3	O3	Ozone removed annually	28.491	775.28 USD
4	PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	12.306	2,119.50 USD
5	PM2.5	Particulate Matter less than 2.5 microns removed annually	2.942	39,737.40 USD
6	SO2	Sulfur Dioxide removed annually	2.370	29.21 USD
7	CO2seq	Carbon Dioxide squestered annually in trees	10,010.267	46.51 USD
8	CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	251,395.359	46.51 USD

Figure 33. Example of random sampling classification exercise.



Considerations

This carbon sequestration analysis represents a high-level estimate of annual land carbon sequestration on Bainbridge Island. Data limitations and other considerations include the following:

- **Omission of non-tree vegetation:** This approach assumes that non-tree vegetation does not sequester carbon, which is not the case. This analysis does not include carbon benefits from non-tree vegetation such as agriculture, pasture, and shrubs.
- **Tree generalization:** This approach does not explicitly differentiate between tree types, but assumes that all trees sequester an average, representative amount of carbon every year.
- **Statistical sampling:** This approach extrapolates a statistical sampling of an area, rather than analyze the area in its entirety, which inevitably results in some level of statistical uncertainty and imprecision.

Conclusion and Next Steps

These GHG inventories provide a **solid and informative foundation** for taking climate action:

- The **Bainbridge Island community** now understands its major contributors of GHG emissions—residential electricity, non-residential electricity, on-road vehicles, and air travel—revealing major sectors to focus climate action efforts. Conducting inventories for two years also revealed emissions trends: a 10% increase between the two inventory years as well as increased emissions in almost all sectors. The community could consider approaches for addressing emissions sources that are increasing, such as increasing electric vehicle uptake, incentivizing alternatives to air travel, continuing to increase building use efficiency, and reducing growth. The contribution analysis also provided insight into the underlying drivers of these trends: we learned that continuing to push for lower-emissions electricity sources will be important for lowering Bainbridge Island's climate impact.
- The **City of Bainbridge Island** now understands its key drivers of greenhouse gas emissions—transportation, electricity, and wastewater treatment—which highlight key areas for reduction. The inventories for the two years demonstrated an upward trend in emissions, similar to the community inventory. Between 2014 and 2018, a 7% increase in emissions occurred. The municipal contribution analysis highlighted the drivers of these trends: changes in electricity fuel mix, water treatment operations, and vehicle fleet usage. The City of Bainbridge Island did see small reductions in streetlight and traffic signal use and fleet vehicle fuel economy. The City can consider actions for reducing emissions from increasing sources, such as transferring to a low-carbon electricity fuel mix and decreasing the amount of vehicle travel.
- **Bainbridge Island households** learned the impact of spending habits—an estimated 52 $MTCO_2e$ of emissions per year, on average. The consumption-based inventory also exposed key contributors to that footprint: meat consumption, travel expenses, and the purchase of furniture, clothing, and energy. Bainbridge households could consider behavior changes to lower these emissions, such as switching to a low-carbon diet-which includes more vegetables, fruits and whole grains; utilizing alternative forms of travel; and purchasing second-hand goods.
- **Bainbridge Island landowners** now understand the importance of tree carbon sequestration and its benefit to the climate. We estimate between 46-56% of Bainbridge Island is covered with trees, sequestering an estimated 58,727 $MTCO_2e$ from the atmosphere each year. Continued tree planting and conservation on Bainbridge Island can maintain and expand these carbon benefits.

This foundational work also illuminated opportunities for **improving and expanding future inventories**. We were not able to obtain data related to commercial propane use, for example. The City can continue to work with local propane vendors to start collecting these data and, eventually, begin incorporating this important emissions source into the city's inventory. These and other improvements will not only paint a fuller picture of the community's overall environmental impact but can also motivate businesses and individuals to better understand their personal carbon footprint and identify pathways for reducing that impact.

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UNDERSTANDING OUR IMPACT

Bainbridge Island’s Greenhouse Gas (GHG) Inventory Results

The City of Bainbridge Island (City) recently completed a comprehensive greenhouse gas (GHG) inventory. GHG inventories quantify the amount of climate pollution produced by an entity—in this case, from the Bainbridge Island community and municipal government operations. As the City continues to take action to reduce emissions, these inventories will serve as helpful tools for tracking progress and making improvements along the way.

What are our emissions?

We estimate that the Bainbridge Island community emitted 245,234 metric tons of carbon dioxide equivalent ($MTCO_2e$) in 2018—or 9.8 $MTCO_2e$ per resident. **Offsetting those emissions would require every Bainbridge resident to grow 11.5 acres of forestland for one year.** The biggest emissions contributors:

Electricity use by residential and commercial buildings

53% of our emissions come from building electricity use, residenatial fuels, and transmission & distribution losses.

Transportation, mainly on-road vehicles and air travel

33% of our emissions come from on-road and off-road vehicles, air travel, and ferry transportation.

2014
222,463
$MTCO_2e$
overall emissions

2018
245,234
$MTCO_2e$
overall emissions

Since 2014, our emissions have increased per person and community-wide.

9.6 $MTCO_2e$ per-capita

9.8 $MTCO_2e$ per-capita

Trends Over Time...

The 2018 emissions results showed a 10% overall increase over 2014 emissions, but only a 2% increase in per-capita emissions. **To meet our goals, we will need to decrease our overall emissions as well as our per-capita emissions.**

Emissions increases were driven by:

- Changes in **electricity fuel sources** (e.g., from renewables versus coal)
- Growth in **population** and employment

Emissions increases were limited by:

- Improvements in **vehicle fuel economy**
- Reductions in the **distance** each person drives
- Declining per-household and per-business **energy consumption**

GHG Inventory Quick Facts

Three inventory types

Communitywide
Emissions from community activities, like energy use, travel, and waste disposal.

City Government Operations
Emissions from everyday government activities.

Consumption-based
Emissions associated with our goods and services.

Three accepted protocols

The inventories were conducted using widely-accepted tools and protocols, including The Climate Registry’s **Local Government Operations Protocol**, the **U.S. Community Protocol**, and U.C. Berkeley’s **CoolClimate Calculator**.

Two representative years

Conducting inventories for both **2014** and **2018** allows us to see whether emissions are trending upward or downward over time.

See full inventory results on the back!

CITY OF
BAINBRIDGE ISLAND

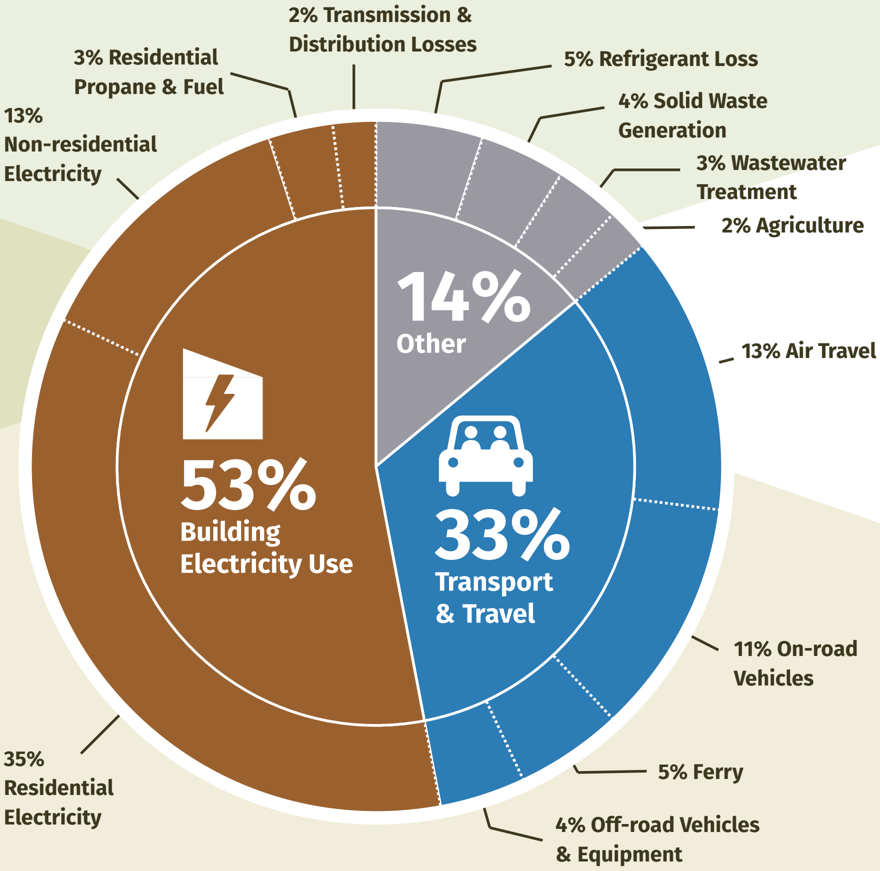
INVENTORY RESULTS

CITY OF BAINBRIDGE ISLAND

Community Overall Emissions

245,234 MTCO₂e

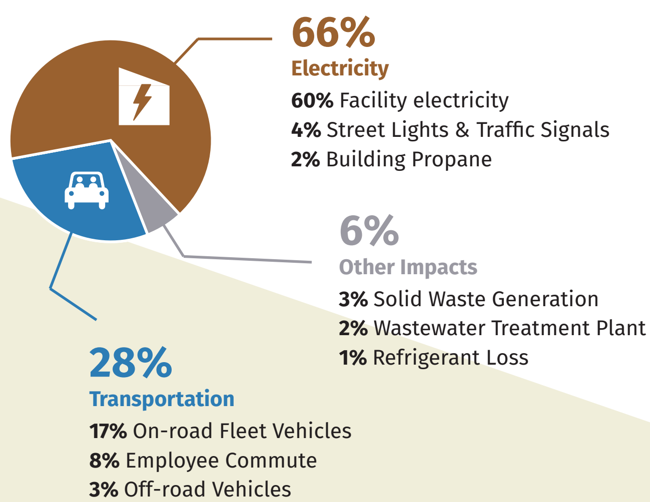
The Bainbridge Island community emitted an estimated 245,234 $MTCO_2e$ in 2018. That equates to 9.8 $MTCO_2e$ per person—or the equivalent of emissions from burning over 10,000 pounds of coal! The majority of those emissions are from consumption of electricity in homes and commercial buildings.

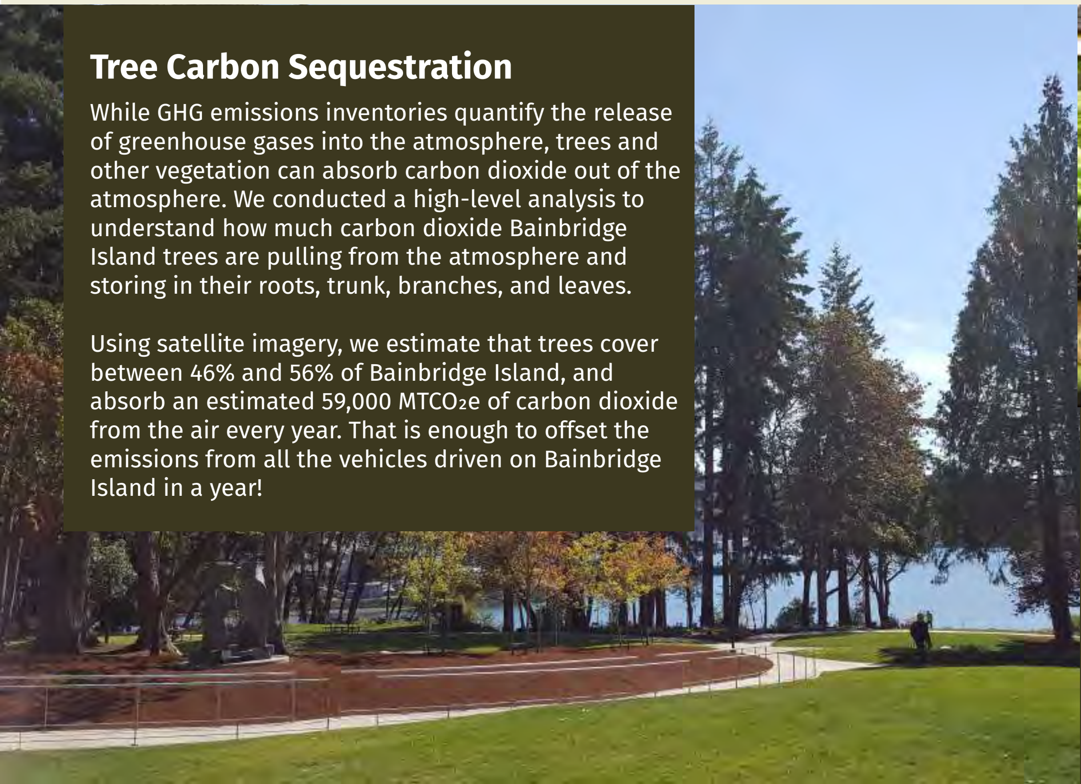


City Government Emissions

2,300 MTCO₂e

Emissions from City of Bainbridge Island activities—which only make up about 1% of the total community emissions—are largely from energy needed to power municipal buildings, equipment, and vehicles.





Tree Carbon Sequestration

While GHG emissions inventories quantify the release of greenhouse gases into the atmosphere, trees and other vegetation can absorb carbon dioxide out of the atmosphere. We conducted a high-level analysis to understand how much carbon dioxide Bainbridge Island trees are pulling from the atmosphere and storing in their roots, trunk, branches, and leaves.

Using satellite imagery, we estimate that trees cover between 46% and 56% of Bainbridge Island, and absorb an estimated 59,000 $MTCO_2e$ of carbon dioxide from the air every year. That is enough to offset the emissions from all the vehicles driven on Bainbridge Island in a year!

Be a part of the solution

Everyone has a role in reducing Bainbridge Island's greenhouse gas emissions. The things we buy, the way we commute to work, the food we eat, and the way we use energy in our home all have an impact.

To learn more about what you can do to be a part of the solution, contact X.

Bainbridge Island Climate Action Plan (CAP): Outline (7/27/2019)

Letter from Mayor/City Manager/Acknowledgements

Executive Summary

Tasks 1.1 - 1.7: Introduction (Lara Hansen and Mike Cox)

The Introduction explains why and how the CAP was developed and provides foundational information that informed the plan's goals, strategies, and actions.

1.1: Update BI Climate Change Impact Assessment
1.2: Results from Survey and Community Workshop
1.3: Why do a CAP?
1.4: Vision and Goals for CAP
1.5: Organization of CAP
1.6: City Actions (City Directives, Comprehensive Plan, and Ordinance establishing CCAC)
1.7: Relevant Federal, State, and County climate policy

Tasks 2.1 - 2.4: BI Greenhouse Gas Emissions Inventory (Gary Lagerloef)

This section provides results from the Cascadia GHG emissions inventory and provides the emission reduction targets along with plans for monitoring and tracking progress.

2.1: Overview
2.2: Results
2.3: GHG emissions reduction target(s) with interim milestones.
2.4: Monitor and track progress

Task 3.1 - 3.7: Strategies and Actions

The Strategies and Actions section presents the near- and long-term actions for meeting the CAP's goals, organized by focus area.

3.1: Energy (David McCaughey)
3.2: Transportation (Derik Broekhoff)
3.3: Land-Use (Derik Broekhoff)
3.4: Buildings (Jens Boemer)
3.5: Forests, Shorelines, and Agriculture (Deb Rudnick)
3.6: Waste Reduction and Consumption (Deb Rudnick)
3.7: Community Engagement and Citizen Action (Julie Matthews)

Each focus area would include the following.

- **Goals:** What are the goals for the focus area?
- **Challenges:** What are the challenges to meeting those goals?
- **Current Actions:** What actions is COBI or Community doing to help achieve the goals?
- **Strategies**: What are the strategies needed to achieve the goals/targets?
- **Mitigation and Adaptation Actions** What actions are needed to achieve the strategies?

- **Prioritize Actions:** What are the highest priority actions (the actions would be prioritized through an evaluation of cost, effectiveness, feasibility, and co-benefits). We could list the high priority actions or just identify those high priority actions by an asterisk
- **Targets/Benchmarks**: What are the targets/ benchmarks for assessing progress?
- **Timeline**: How long will it take to complete action(s) and what are the interim milestones?
- **City lead**: Who is the lead City Department and/or Responsible Staff?
- **CCAC and others Role:** What role will the CCAC play?
- Individual Action: Provide a separate page of ideas and as a handout.

Tasks 4.1 - 4.5: Implementation (Nora Ferm Nickum)

The Implementation section details steps the City and community will take to ensure successful CAP implementation. This will require active participation by the Council and City Staff.

4.1 Kickstarting Implementation
4.2 Leadership
4.3 Expanding Community Capacity
4.4 Accountability and Reporting
4.5 Funding

Implementation Summary and Schedule (Focus Area Writing Teams complete Example Table below)

Action	Adaptation or mitigation	Target or Benchmark	Lead department	CCAC role	Timeline	Individual action

References/Notes

Appendices

A: GHG emissions Inventory methods

SAMPLE TEMPLATE FOR FOCUS AREA WRITE-UPS

3.6 Waste Reduction and Consumption

Goals: *(2-4 high level goals per focus area, include at least 1 adaptation goal and at least 1 mitigation goal; if you end up with a longer list of goals, you may need to make them higher-level or turn some into strategies)*

1. Reduce City, residential, and commercial waste generation
2. Increase diversion of waste from the landfill
3. Optimize collection and disposal systems to minimize GHG emissions
4. [A resilience-related goal]

Challenges: *What are the challenges to meeting those goals? (1-2 paragraphs)*
State of recycling in this country; misaligned service provider incentives; contamination of recycling and compost streams & public confusion about what can be recycled/composted; challenges to setting up commercial composting (hard to access some locations, need to overcome concerns about pests, only biweekly pickup)

Current Actions: *What actions is COBI or Community already taking to help achieve the goals? (Bulleted list of existing programs and efforts)*

- Incorporate relevant notes from COBI Green Team meeting (e.g., sustainable purchasing policy)
- BISD efforts - District Green Team, sustainability leads for every campus
- BIZW, volunteers doing education and sorting at major community events, Styrofoam recycling, lending library, Drink like you live here campaign
- Major reuse opportunities at Rotary Auction, reducing what ends up going to landfills
- Do we get support from Kitsap County that we should mention here?
- HORSE still at the Pub?

Strategies
Goal A. Reduce City, residential, and commercial waste generation

Strategy A.1. Promote sustainable consumption
High priority actions

1. Enforce the City's sustainable purchasing policy
2. Ordinance to reduce use of single-use plastic food serviceware
3. Action 3

Other actions

4. Provide small grants to support lending library, tool libraries, repair cafes, etc.
5. Action 5

Strategy A.2. Reduce food waste

High priority actions

1. Action 1
2. Action 2
3. Action 3

Other actions

4. Provide small grants to support lending library, tool libraries, repair cafes, etc.
5. Action 5

Goal B. Increase diversion of waste from the landfill

Strategy B.1. Expand composting participation and operation.

High priority actions

1. Offer weekly instead of biweekly curbside compost pickup.
2. Require that all food service businesses participate in curbside composting.
3. Action 3

Other actions

4. Action 4
5. Action 5

In a table later, include for each action:

- **Targets/Benchmarks**: What are the targets/ benchmarks for assessing progress?
- **Timeline**: How long will it take to complete action(s) and what are the interim milestones?
- **City lead:** Who is the lead City Department and/or Responsible Staff?
- **CCAC and others Role:** What role will the CCAC play?

Individual Action: Provide a separate page of ideas and as a handout.

Commented [1]: This could be a separate page with a bunch of ideas, that could go in the plan and also be used as a handout... versus an individual action listed next to each strategy/action in the plan?

July 20th, 2019

TO: City Council
FROM: Design Review Board and Climate Change Advisory Committee
RE: COBI Green Building Code: Proposal for Moving Forward
CC: City Council
Design Review Board

Executive Summary

Buildings are large energy users: in the Puget Sound region, about 22% of the greenhouse gas emissions that contribute to global climate change are attributed to the building sector. Additional environmental impacts include contaminated storm water generated by continued creation of hard surfaces, and burdens on existing landfill space from construction and demolition debris generation. Green building techniques, coupled with upgrades and proper maintenance of existing buildings, can help reduce these impacts.

The Design Review Board and the Climate Change Advisory Committee feel strongly that development on Bainbridge Island should be exceptional at all levels and should be held to the highest levels of green building performance. By adopting a stringent and progressive green building code Bainbridge Island can take a leadership role in protecting and enhancing our community's unique natural and built environments. We will join countless communities in Washington State (e.g., Bellingham, Anacortes, Edmonds, Issaquah, and Redmond) and the country who have adopted Green Building Codes, in some cases decades ago, as in most of California.

The Climate Change Advisory Committee (CCAC) has established a target of reducing greenhouse gas (GHG) emissions on the Island by 90% by 2040 compared to 2013 levels. In order to achieve this target, we will need to make many changes including ensuring that our buildings are achieving the largest reduction in GHG possible. In addition, the Design Review Board (DRB) was tasked with responding to a Green Building Program proposal from then-City Building Official James Weaver; much of the content of this memo represents the DRB's response.

For these and other reasons associated with climate change and the urgent need to address this reality, both the DRB and CCAC urge the City Council to embrace its stated goal of establishing a Green Building Code by considering and acting upon the following recommendations as soon as possible:

1. COBI join the Regional Code Collaborative[1]

2. Adopt the Living Building Challenge[2] for all COBI Municipal Projects Now.

[1] A multi-jurisdictional group of planners and code officials from both within and outside of King County that works together to leverage economies of scale in developing and updating green codes
[2] The Living Building Challenge is an international sustainable building certification program created in 2006 by the non-profit International Living Future Institute.

3. Establish a Community Task Force to Develop Green Building Standards for all New Construction and Retrofits that Include Incentive Programs and an Outreach program to increase awareness of benefits of green building.

4. Work with COBI Affordable Housing Task Force to Develop Guidelines for Green Affordable Housing.

Discussion

Mandatory or Voluntary Green Building Standards or a Combination of Both?

A memo from then-City Building Official James Weaver memo (dated 07.13.18) to then-Planning Director Gary Christensen presented the basis for a COBI Green Building *Incentive* Program, thus making the incorporation of Green Building methods and materials into private residential development proposals optional.

However, we believe the case can be made for a Green Building Program that mandates a minimal level of green building code conformance for private residential development to obtain a building permit, with a choice of additional green building elements to obtain 1) expedited permit processing, 2) certification and 3) recognition. Such a program provides the developer/builder (applicant) with a range of options for reaching the required number of "points" to attain each level.

We believe that Bainbridge Island need not be concerned about attracting development to the island. Witness the apparent "boom" over the past few years. Our belief is that we should be attracting *quality* development and quality developers who will do what is necessary to qualify for the right to build in our community. Quality developers are those who wish to honor the City's comprehensive plan and its vision and who wish to leave a legacy project that demonstrates the highest standards and practices of sustainability. Such developers would not bristle at requirements that will likely exceed those of neighboring communities. Why should the Bainbridge Island community settle for anything less? Will development cease or diminish if we impose higher standards in terms of green building and design? We think not.

The Green Building Program we analyzed is from the City of Santa Cruz CA because of its simplicity as well as flexibility. It includes an ordinance, Guidelines and Checklist. It should be noted that the State of California has a mandatory Green Building Program called CalGreen. Thus, all new development and remodels must, by State law, conform, at a minimum, with the State Green Building code. Thus, the Santa Cruz Green Building Program adds requirements to the underlying State Code requirements.

We recommend adopting the structure used by the City of Santa Cruz Green Building Program: ordinance language as well as guidelines and an accompanying checklist. (See Attachments). The details of both the guidelines and checklist can be determined locally and possibly in collaboration with the Regional Code Collaborative.

A Powerful Local Resource for Code Development: The Regional Code Collaboration

Building on the success of King County's award-winning Sustainable Cities Program, a multi-jurisdictional group of planners and code officials from both within and outside of King County came together to leverage economies of scale in developing and updating green codes. The group had previously received several presentations on the proposed International Green Construction Code (IgCC) update in 2010 and

2011 and was inspired to collaborate, both to reduce the individual burden of research and development to change and update local codes, and to create a common regional vision for such changes.

The initial task was identifying common design tactics promoted by rating systems such as LEED, Built Green and The Living Building Challenge that have proven environmental success. The intent was not to adopt whole documents such as the IgCC, but to select a discrete package of elements that could be used to customize a green building code jurisdiction by jurisdiction.

The Weaver memo also references several green building code programs in the Puget Sound Region that are part of the Regional Code Collaborative including:

- City of Seattle
- City of Issaquah
- City of Redmond
- City of Shoreline

The King County Green Building Ordinance is a local municipal green building program that was not included, but we believe is a valuable reference standard. It requires all King County owned building projects to meet a minimum LEED Platinum target and provides for a process to evaluate higher levels of performance (Zero Energy Certification, Petal and Living targets under the Living Building Certification of ILFI). See resources link below.

We recommend that the City join this collaborative to keep abreast of the latest and most adaptable green building standards being developed and to possibly help shape COBI's Green Building Program. The Design Review Board reiterates the recommendation that the Bainbridge Island City Council adopt the Living Building Challenge for all municipal projects.

State Energy Code and Limitations on Local Jurisdictions to Exceed State Code for Residential Construction

Energy requirements are included in most of the Green Building Codes, the exception being the Water or Materials Petal Certification under the Living Building Challenge. In Washington, there is a State law (RCW 19.27A.020) that prohibits any local jurisdiction from imposing residential energy code requirements stricter than those currently found in the State Code. Exceptions can be made if a jurisdiction can make the case to the State Building Code Council for "unique" circumstances.

Adopting an ordinance similar to Santa Cruz which allows the applicant to select the green building strategies (without requiring more restrictive energy performance) may be a way to work around the Limitations on Local Jurisdictions to exceed State Energy Code for Residential Construction. Alternatively, residential projects could be mandated to achieve green building certifications that do not include energy performance guidelines, such as Water or Materials Petal Certification under the Living Building Challenge.

Recommendations for consideration:

1. **COBI joins the Regional Code Collaborative.**

2. **Adopt the Living Building Challenge for all COBI Municipal Projects**
   Adopt the highest levels of performance for all Bainbridge Island municipal projects under the Living Building Challenge, possibly modeled on the King County Green Building Ordinance which uses an alternatives analysis process to align mandated green building target options with the project specific goals. Include a Life Cycle Cost Assessment (LCCA) to support selected green building targets such as:
   - Zero Energy Certification – minimum target
   - Petal Certification (Water, Energy or Materials) – evaluate potential
   - Living Certification – evaluate potential

   Conduct comprehensive cost / benefit analysis for green building retrofits and new construction based on existing research showing significant savings from improvements to productivity, health and wellness.

3. **Establish a Community Task Force to Develop Green Building Standards for all New Construction and Retrofits that Include Incentive Programs and an Outreach program to increase awareness of benefits of green building.**

   The Community Task Force would consist of individuals from the Island representing a wide range of disciplines and interests. The Task Force would be charged with developing green building standards throughout the Island. The Task Force would provide recommendations the details on what would be in a green building code and possible incentive programs identified below.

   - <u>Green Building Code – required baseline for all projects:</u> Model Guidelines and Checklist after the City of Santa Cruz Green Building Program Guidelines and Checklist, working locally (COBI Task Force, Regional Code Collaborative) to develop the details of each. (See link to all at end of report).

   - <u>Green Building Incentive Program:</u> Provide incentive programs noted in Weaver memo, but only for projects that voluntarily seek the highest levels of performance. Below are the potential incentives recommended:
     - Increased Development Capacity – such as extra floor area or height, FAR, increased unit count, lot size reduction, alternate road standards and parking reductions
     - Expedited Permit Review – priority permit processing
     - Marketing - online and print recognition, City sustainable development awards program with outreach to organizations such as Urban Land Institute (ULI) for project recognition (see additional recommendations below).
     - Reduce Plan Check and Building Permit Fees – Permit fee reductions

Targets should be at the highest levels of performance:

- Zero Energy Certification – minimum level of achievement
- Passive House Certification – alternative minimum level of achievement
- Petal Certification (Water, Energy or Materials) – evaluate potential
- Living Certification – evaluate potential.

4. **Green Affordable Housing**
   Support the development of Green Affordable Housing in coordination with the COBI Affordable Housing Task Force recommendations and partner with local and regional organizations. Also, explore State of WA Department of Commerce Evergreen Sustainable Development (Version 3.0), a program for the development of Green Affordable Housing for possible inclusion in the COBI Green Building Program. Provide green design assistance for affordable housing projects.

5. **Marketing/Outreach**
   Develop a robust marketing/outreach/educational program, perhaps modeling after Kitsap-Mason Counties' "Shore-Friendly Project" materials and process. Information should include costs and benefits (both short- and long-term) of building green as well as an explanation of the carbon impacts of new construction vs. re-use/remodeling (the former being far larger than the latter).

6. **Building Official Position Description**
   Ensure that the Building Official position description calls for "experience in the development and application of green building codes/standards." The currently job description contains no reference to Green Building. Since a hiring process is currently underway for a new Building Official, the DRB requests that a DRB representative with Green Building expertise be included on the interview panel and participate in the development of interview questions.

Attachments

City of Santa Cruz CA Residential and Commercial Guidelines and Checklist on this website:
http://www.cityofsantacruz.com/government/city-departments/planning-and-community-development/services/building-safety/green-building-program

King County Green Building Ordinance:
https://kingcounty.gov/depts/dnrp/solid-waste/programs/green-building/county-green-building/green-building-ordinance.aspx

Power of Zero – cost study showing no correlation between green building performance and first costs:
https://issuu.com/bnim/docs/power-of-zero

Affordable Housing Framework, International Living Future Institute – sustainable building strategies for multifamily affordable housing projects:
https://living-future.org/affordable-housing/

WA Dept of Commerce's Life Cycle Cost Analysis tool:
https://www.ofm.wa.gov/sites/default/files/public/legacy/budget/capitalforms/lifecyclecosttoolinstructions.pdf

Building the Business Case: Health, Wellbeing and Productivity in Green Offices, World Green Building Council
http://www.worldgbc.org/news-media/building-business-case-health-wellbeing-and-productivity-green-offices