CITY OF BAINBRIDGE ISLAND

Climate Change Advisory Committee
Regular Meeting
November 15, 2023
5:30 PM
Council Conference Room
280 Madison Avenue N
+ Zoom Webinar

The Climate Change Advisory Committee will hold this meeting
in person and using a virtual, Zoom webinar platform

Members of the public will be able to attend at City Hall
or by calling in to the Zoom webinar

Please click the link below to join the webinar:
https://bainbridgewa.zoom.us/j/91390380790
Or Telephone: 1-253-215-8782
Webinar ID: 913 9038 0790

AGENDA

5:30 Call meeting to Order/Roll Call/Accept of Modify Agenda/Conflict of Interest Disclosure

5:35 Approve Minutes from October 18th, 2023, meeting.

5:40 Public Comment

5:45 Presentation and Discussion on Energy Transitions Initiative Partnership Project (ETIPP Community Technical Assistance Program)

6:15 Presentation and Discussion of Sustainable Transportation and Greenhouse Gas Emissions (Fehrs and Peers)

7:15 December Meeting

7:30 Adjourn

Materials

1. October minutes
2. Slides ETIPP
3. Slides Fehr and Peers
4. Sustainable Transportation and Greenhouse Gas Emissions – final report
5. Appendix: Strategy Evaluation Methodology
6. Sustainable Transportation and GHG Emissions Story map

Climate Change Advisory Committee
Meeting Minutes
October 18, 2023

Meeting called to order at 5:31 PM by Michael

Roll call:

- Committee members: Derik Broekhoff, Julie Matthews, Jens Boemer, Steve Richard, Sanjay Bhat, Ray Victurine, Michael Cox, Kevin Thomas (online)
- City Staff: Autumn Salamack
- City Council: Leslie Schneider (liaison)

Agenda: No additions. Julie moved to adopt, seconded by Michael. Unanimously adopted by those present.

Conflicts of Interest: Jens offered standard disclosure that he works for an institute that serves the utility industry.

Minutes from last meeting: Approved, with addition of Michael to the list of attendees. (Motioned by Steve, seconded by Julie, approved by majority with those not present at the meeting abstaining.)

Public comment

- John Grinter expressed concern about non-motorized transportation options developed under previous efforts getting dropped from city's current sustainable transportation plan, including more separated pathways for pedestrians, Core 40 options and other non-motorized options. CCAC members and councilmember Schneider discussed, noting upcoming meeting with sustainable transportation coordinator (new position created at city); Fehr & Peers presentation in November; and (briefly) question of establishing a new sustainable transportation committee (separate or in conjunction with CCAC).

Introductions

- New committee members Ray Victurine and Sanjay Bhat were introduced to existing members

Climate Manager Updates

- **Heat pump installation pilot program**. RFQ going out. City would do education/outreach; consultant would be hired for installation/implementation. Authorization for solicitation on City Council consent agenda for the coming Tuesday.
    - Leslie proposed to pull this out on the agenda to highlight it at council meeting
    - Discussion:
        - Pilot would cover ~15 homes
        - Idea is to possibly identify barriers to uptake
        - Looking at other ways to identify opportunities, combine w/ weatherization, coordinate with other organizations
        - Will undertake Before & after monitoring

- **Carbon offset project for the police building**

    - Contractor has been selected to identify viable project site & determine costs
    - Multiple potential sites identified; could also lead to further development based on ETIPP work

- **Comprehensive plan climate lens**
    - Committee recommendations were presented at earlier task force meeting
    - The city is working with committee to ensure climate lens tools are being utilized

- **Annual report for Climate Action Plan**
    - Targeting end of January for publication
    - CCAC members to review (incl. Julie) – let Autumn know if interested by end of month.

- **Quarterly CAP updates**
    - Next quarterly report to be published on forthcoming Tuesday

- **Waste reduction ordinance**
    - Autumn discussed new amendments that have been adopted

- **Community engagement opportunities**
    - Reminder of open surveys related to comprehensive plan

- **Other reminders**
    - Committee members should inform Autumn if they have taken ethics training

Other Updates

- **PSE franchise.** Meeting on Friday to get input into partnership agreement, to prepare for meeting with PSE.

- **Achieving near-term climate plan goals.** Leslie discussed idea of a carbon budget for households to achieve near-term 25% reduction in emissions, and whether that might be role for PSE in this. It was noted that the 2025 target could largely be met through PSE's withdrawal from Colstrip.

- **Sustainable transportation request.** CCAC members agreed to invitation for someone from UW come to discuss findings on successful sustainable transportation efforts.

- **Upcoming meetings**
    - Fehr & Peers to present at November meeting
    - December 20 meeting – orientation & planning meeting/workshop

- **Groundwater management plan.** Meeting coming up; Mike will report back

- **Upcoming events**
    - Climate Café
    - Electrification and Home Efficiency Fair

- **Climate Smart Bainbridge update. S**till going, may consider future engagement activities

- **Other.** Leslie discussed idea for a voluntary program to track people's transportation carbon footprint, and whether a program could be adopted on BI.

Meeting was adjourned at 7:18 PM.

ENERGY TRANSITIONS INITIATIVE
U.S. Department of Energy

Partnership Project

Bainbridge Island

November 2023

Presentation to CCAC

Pacific Northwest NATIONAL LABORATORY

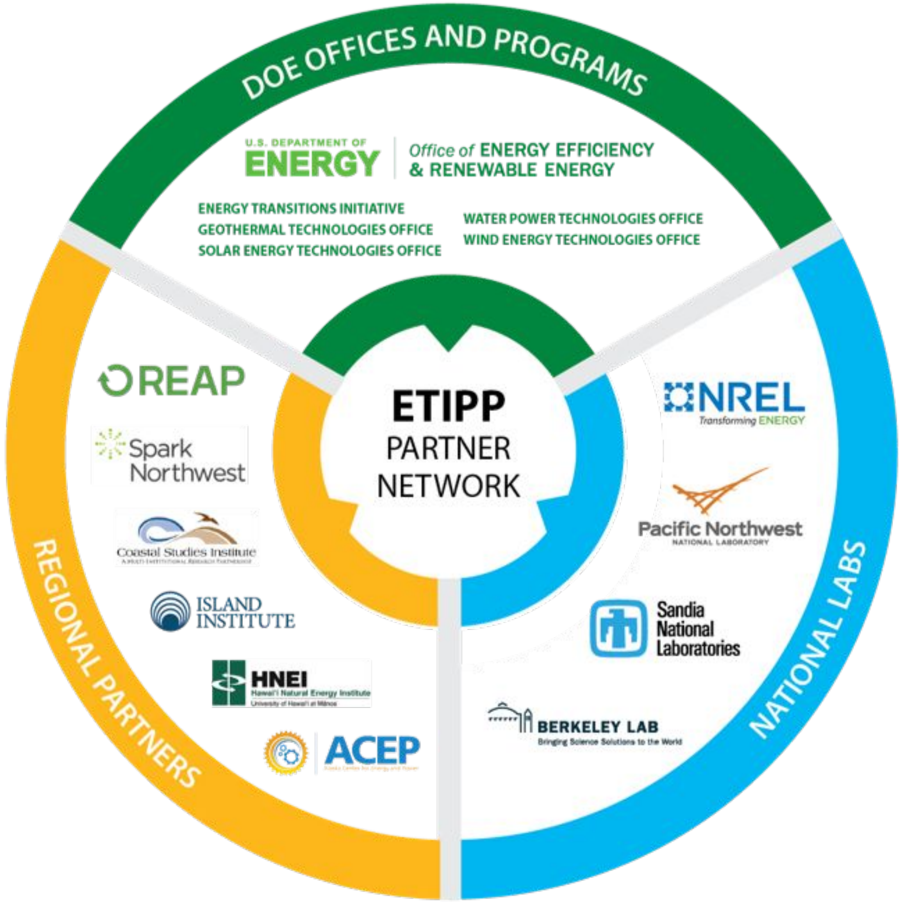
Spark Northwest

NREL NATIONAL RENEWABLE ENERGY LABORATORY

City of Bainbridge Island Goals

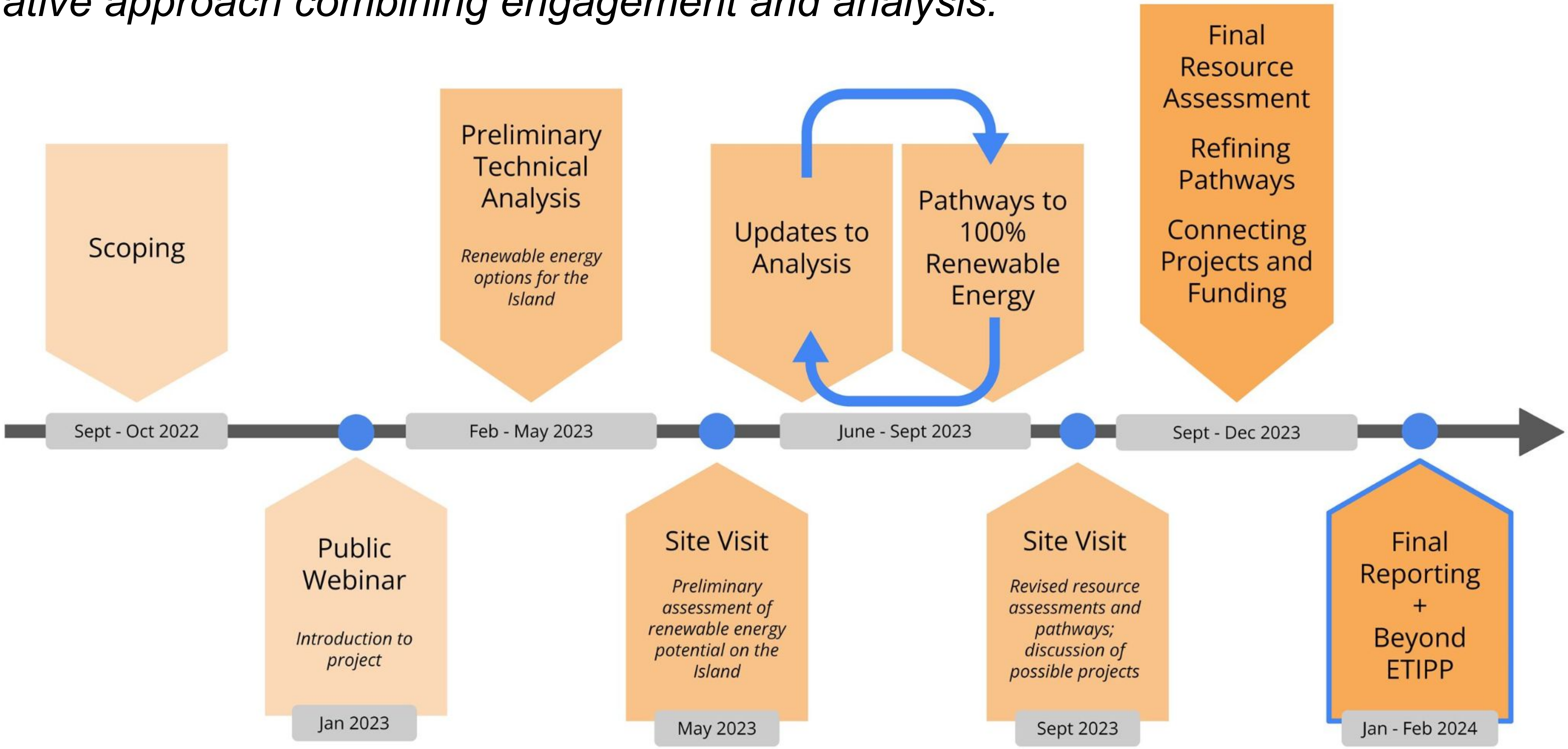
- **100% Renewable Energy by 2040**
- **Increased Energy Resilience for Emergencies and Climate**

The ETIPP technical assistance will help Bainbridge Island meet these goals by analyzing pathways to 100% renewable energy and exploring and developing options for increasing energy resilience in the face of natural hazards.



Process and Timeline

Iterative approach combining engagement and analysis.



Engaged Partners

- Bainbridge Island School District
- Bainbridge Prepares
- Bainbridge Island Fire Department
- Bainbridge Island Parks & Recreation
- Climate Change Advisory Committee
- Kitsap County Sewer District #7
- Puget Sound Energy
- Utility Advisory Committee
- Washington State Ferries
- Washington State Department of Transportation

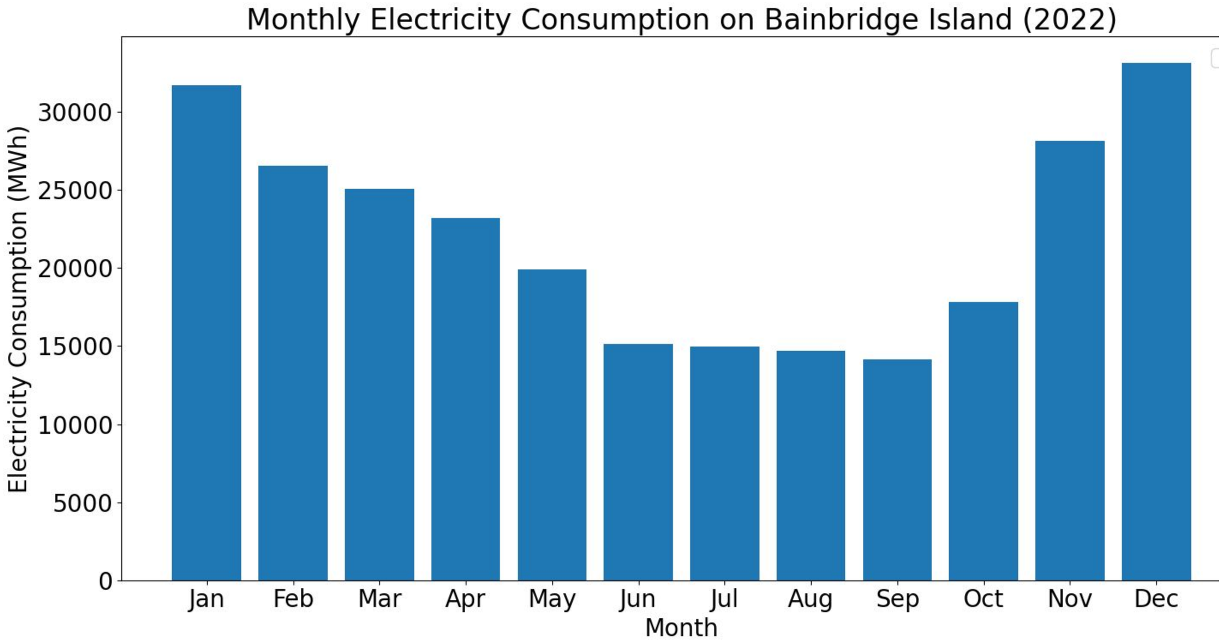
More information is available on the City of Bainbridge Island ETIPP Website: https://www.bainbridgewa.gov/1431/2023-ETIPP-Renewable-Energy-Program, as well as in the recorded public webinar from January 2023!

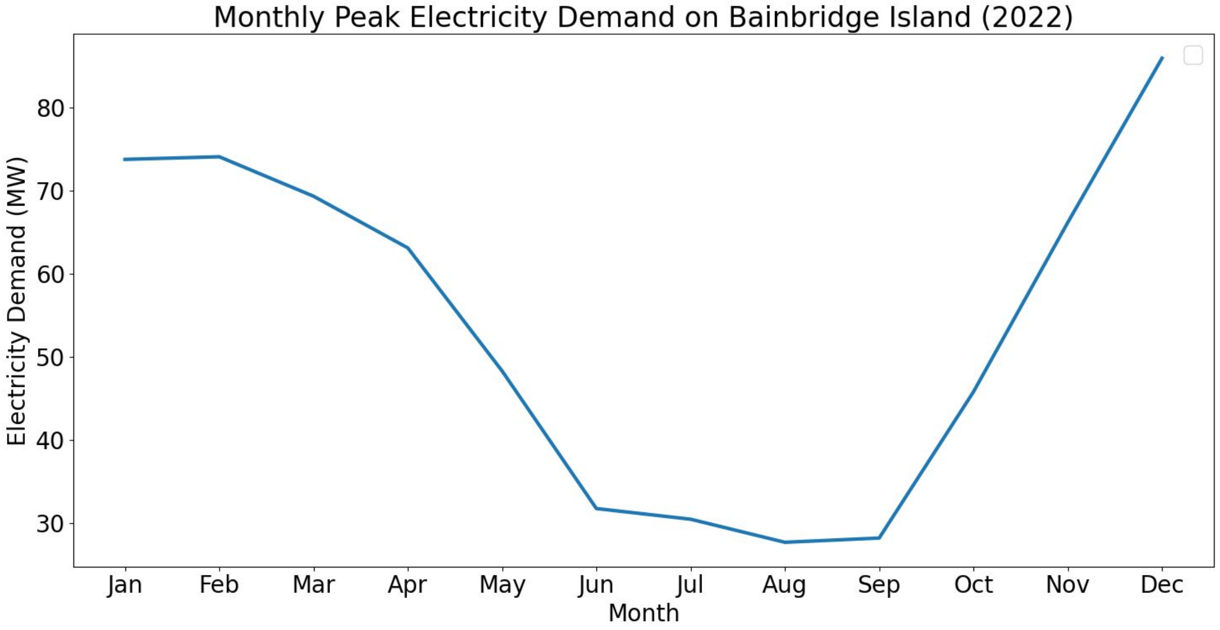
Pathways to 100% Renewable Energy

Questions for Technical Analysis

- How much electricity will be needed by 2040?
- What technologies are available, and how much electricity could each feasibly generate?
- What combinations of technologies would get us towards 100%?
  - On island vs. off island
  - Experimental vs. tried and tested
- Where should the City focus their efforts in the near-term, and what might be better to continue to explore as opportunities arise?

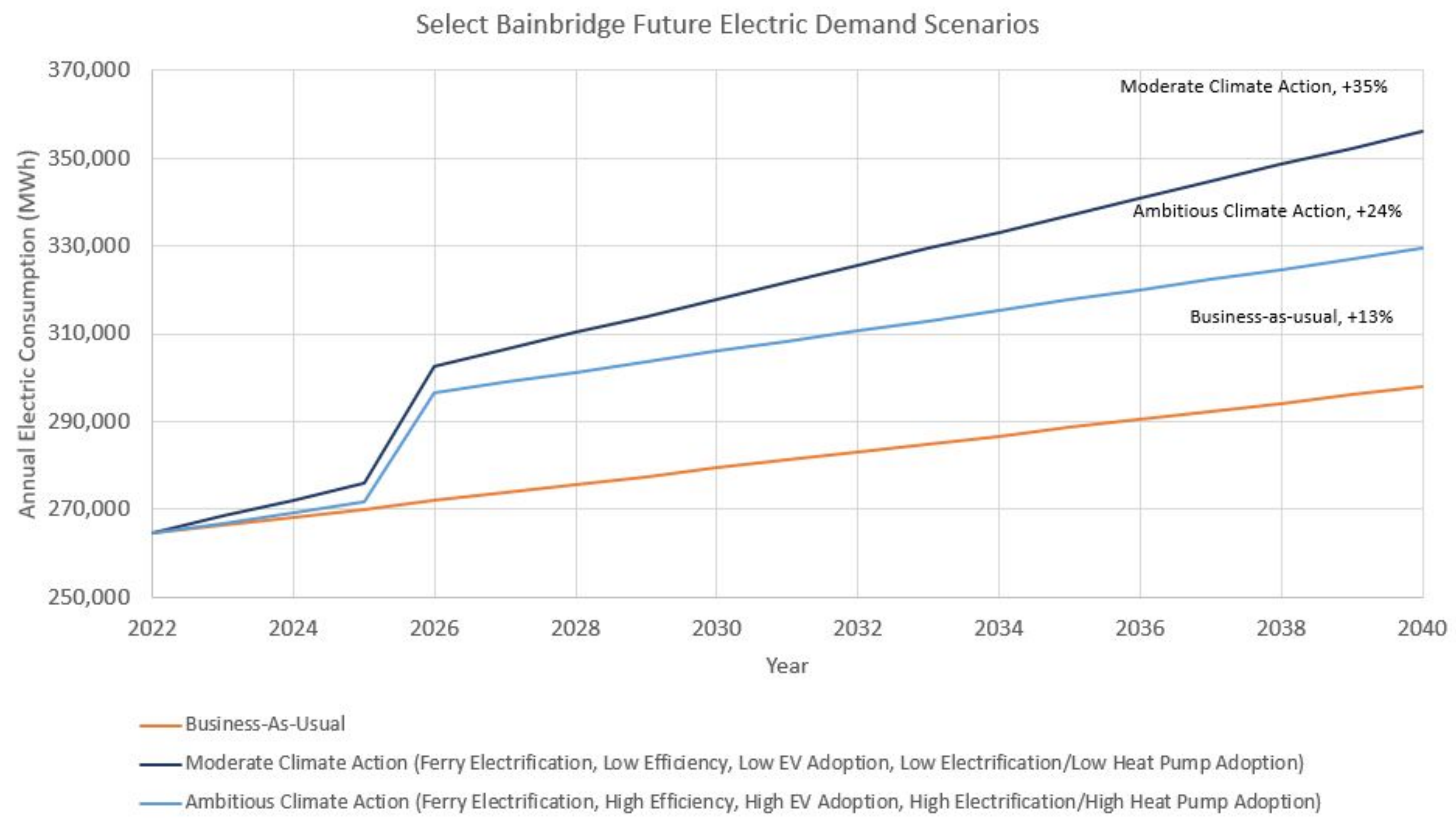
Current Bainbridge Island Electric Load





Total Annual Electric Load: 264,566 MWh
Peak Load: 86 MW
Source: Puget Sound Energy

Future Electric Needs on Bainbridge



Pathways to 100% Renewable Electricity

#1 - City-led solar on-island

All reasonable public properties are developed for solar (rooftop, ground-mount, carport). Then, COBI shares lessons learned, spark interest, explores incentive programs, etc. to engage other non-residential property owners to install solar to generate 100% of BI electricity.

#2 - Community-led solar on-island

All reasonable public and private properties (residential and non-residential) are developed for solar in the near term.

#3 - Solar + Biodigester + Buy the rest

All reasonable city properties are developed for solar. An anaerobic biodigester of the size to match existing Bainbridge waste stream is installed. Additional power needed to meet goals is purchased from PSE Green Power, Solar Choice, or Community Solar if generation is not sufficient.

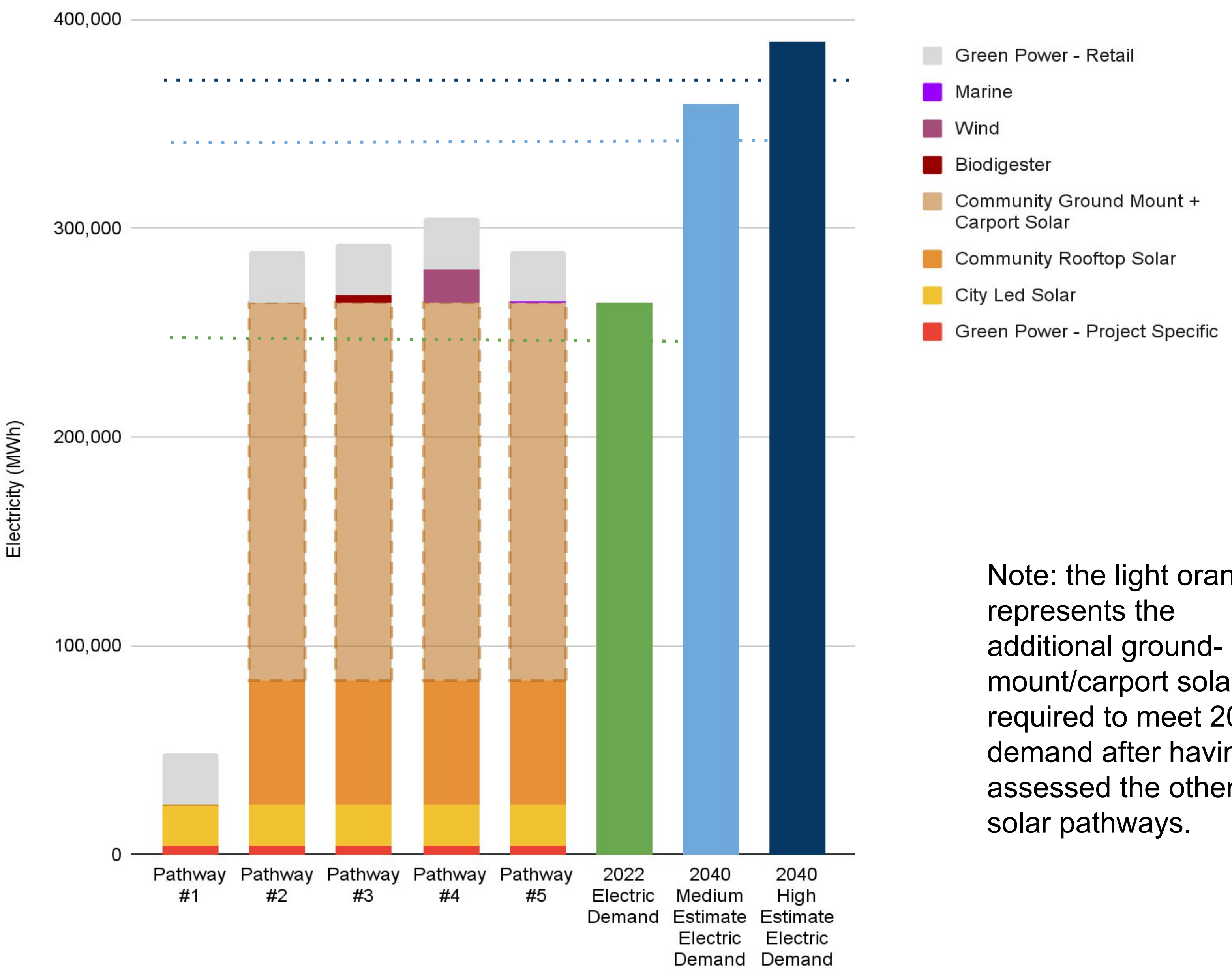
#4 - Solar + Wind + Buy the rest

All reasonable city properties are developed for solar. The permitting process for one wind turbine is started. Additional power needed to meet goals is purchased from PSE Green Power, Solar Choice, or Community Solar until generation is sufficient.

#5 - Solar + Marine + Buy the rest

All reasonable city properties are developed for solar. The permitting process for one marine energy converter is started. Additional power needed to meet goals is purchased from PSE Green Power, Solar Choice, or Community Solar until generation is sufficient.

Pathways to 100% Renewable Electricity - Results of Technical Analysis



Note: the light orange represents the additional ground-mount/carport solar required to meet 2022 demand after having assessed the other solar pathways.

Cost Comparison Estimates

	Rooftop Solar	Ground mount Solar	Carport Solar	Biodigester	Wind	Marine
Potential Generation (MWh/yr)	83,602 (Pathway #1 and #2)	7,143 (Pathway #1)	3,175 (Pathway #1)	3,485 (Impact Bioenergy estimate)	15,969 (one 2MW turbine at 3 sites)	132 (one turbine)
Reasonable % of Bainbridge 2022 Load	31.6%	2.7% (potentially scalable with Pathway #2)	1.2% (potentially scalable with Pathway #2)	1.2%	6%	<1%
Cost estimates	Residential: ~$2,682/kW Community: ~$1,761/kW	$1,161/kW	~$3,000 - $10,000/kW	Impact Bioenergy - $70k low estimate, other commercial examples range from $5-50M	Small distributed: $7,850/kW Midsize distributed: $3,333/kW Utility scale: $1,370/kW	~$6,500 - $26,000/kW Few commercial technologies, but significant government funding likely available

Solar Analysis

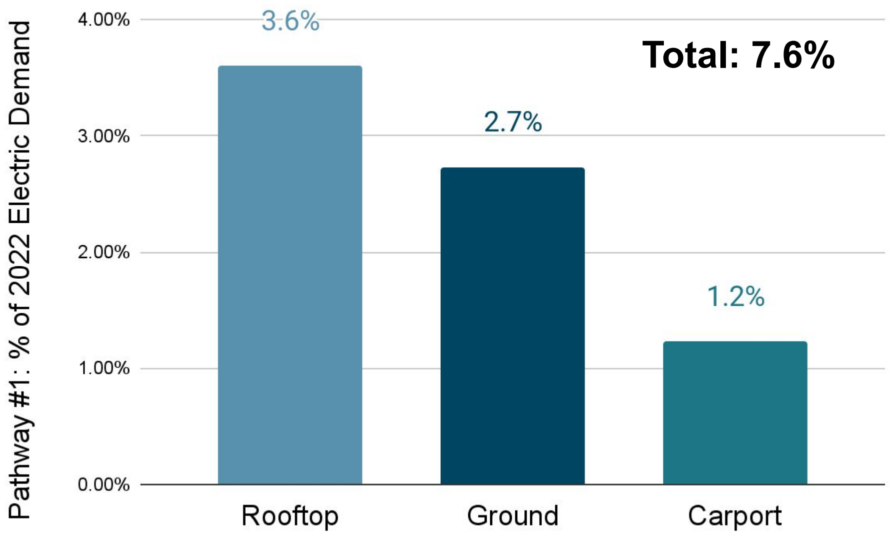
Alisha Piazza, Malcolm Moncheur de Rieudotte

Pathway #1: Solar Estimation Methods

- Estimated available area based on satellite images for key locations (list available)
- Used NREL PVWatts to estimate solar potential
- Consider this estimate as an upper limit
  - Some areas will not be appropriate for solar (shading, mechanical equipment, conflicting use, etc.).
  - Does not include space needed between panels for other equipment or areas that cannot fit rectangular panels
  - Roof angles are not available from satellite images. Actual tilt, orientation, and roof area may vary.
  - Solar irradiation may vary by year. PV panel performance may vary by type and maintenance.

Pathway #1: Solar Estimation Results

Ownership	Properties	Acres	Annual Electric Output (MWh/yr)	% of 2022 Electric Demand
City-Owned	O&M Yard, Police Stations	0.8	505	0.2%
Other Public Entity	Schools, Fire Stations, Recreation Center, Parks	13.1	8,969	3.4%
Private For-Profit	Lynwood Center, Downtown Winslow, Safeway, Pavillion/Movie Theater, Copper Top, Transfer Station	13.0	8,973	3.4%
Private Non-Profit	Churches	2.2	1,530	0.6%
	Totals:	**29.1**	**19,977**	**7.6%**



Appendix A: Scenario 1 Potential Locations and Estimated Solar Potential (1/2)

Solar Type	Location	Ownership	Area (m2)	Acre (Acre)	DC System Size (kW)	AC Energy (kWh/yr)
Rooftop	**O&M Yard**	City-Owned	1,706	0.4	273	250,840
Carport	**New Police Station/Operations Center**	City-Owned	724	0.2	116	126,150
Carport	**Existing Police Station**	City-Owned	737	0.2	118	128,415
Rooftop	**Bainbridge High School**	Other Public Entity	10,637	2.6	1,702	1,843,223
Rooftop	**Woodward Middle School**	Other Public Entity	5,805	1.4	929	911,054
Rooftop	**Sonoji Sakai Intermediate School**	Other Public Entity	2,075	0.5	332	300,792
Rooftop	**Commodore Options School**	Other Public Entity	4,373	1.1	700	757,667
Rooftop	**Captain Johnston Blakely Elementary School**	Other Public Entity	3,410	0.8	546	590,798
Rooftop	**Ordway Elementary School**	Other Public Entity	3,423	0.8	548	593,137
Rooftop	**Xalilc Elementary School**	Other Public Entity	3,963	1.0	634	686,709
Rooftop	**Fire Station 21**	Other Public Entity	1,237	0.3	198	214,347
Rooftop	**Fire Station 22**	Other Public Entity	939	0.2	150	137,755
Rooftop	**Fire Station 23**	Other Public Entity	345	0.1	55	59,782
Rooftop	**Recreation Center**	Other Public Entity	2,093	0.5	335	313,852
Carport	**Battle Point Park Parking**	Other Public Entity	1,474	0.4	236	256,830
Carport	**Fay Bainbridge**	Other Public Entity	3,239	0.8	518	564,407

Appendix A: Scenario 1 Potential Locations and Estimated Solar Potential (2/2)

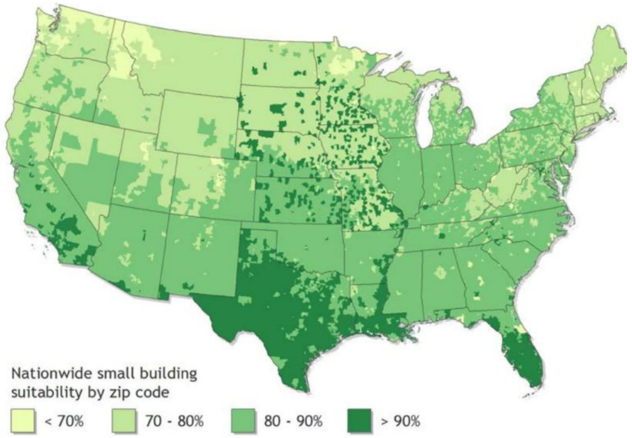
Solar Type	Location	Ownership	Area (m2)	Acre (Acre)	DC System Size (kW)	AC Energy (kWh/yr)
Carport	**Ferry Terminal Parking Lot**	Other Public Entity / Private For-Profit	9,979	2.5	1,597	1,738,741
Rooftop	**Lynwood Center**	Private For-Profit	3,515	0.9	562	542,304
Rooftop	**Downtown Winslow**	Private For-Profit	939	0.2	150	145,537
Rooftop	**Safeway**	Private For-Profit	3,713	0.9	594	643,389
Rooftop	**Pavillion/Movie Theater**	Private For-Profit	1,832	0.5	293	317,449
Rooftop	**Copper Top**	Private For-Profit	6,270	1.5	1,003	960,603
Ground	**Bainbridge Transfer Station**	Private For-Profit	24,344	6.0	3,895	4,241,699
Ground	**Vincent Road Triangle**	Private For-Profit	9,702	2.4	1,552	1,690,476
Carport	**Lynwood Center Parking Areas**	Private For-Profit	2,474	0.6	396	431,070
Rooftop	**Grace Episcopal Church**	Private Non-Profit	1,001	0.2	160	146,850
Rooftop	**St. Cecilia Parish**	Private Non-Profit	631	0.2	101	101,703
Ground	**Bainbridge First Baptist Church**	Private Non-Profit	7,353	1.8	1,176	1,281,187

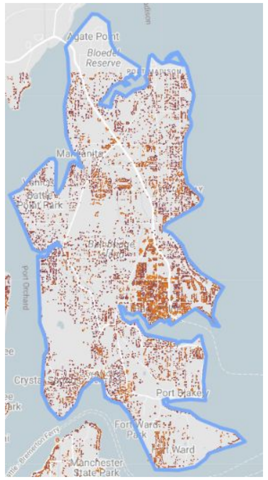
Pathway #2: Residential and Non-Residential Rooftop Solar

Methods:

- Used existing studies that estimated rooftop solar potential based on satellite and lidar data
- Used NREL's "Rooftop Solar Photovoltaic Potential in the U.S." to estimate potential based on building area from Census and Tax Data
- Validated results by comparing to Google's Project Sunroof
- Subtract rooftops from Pathway #1 to avoid double counting

Results:



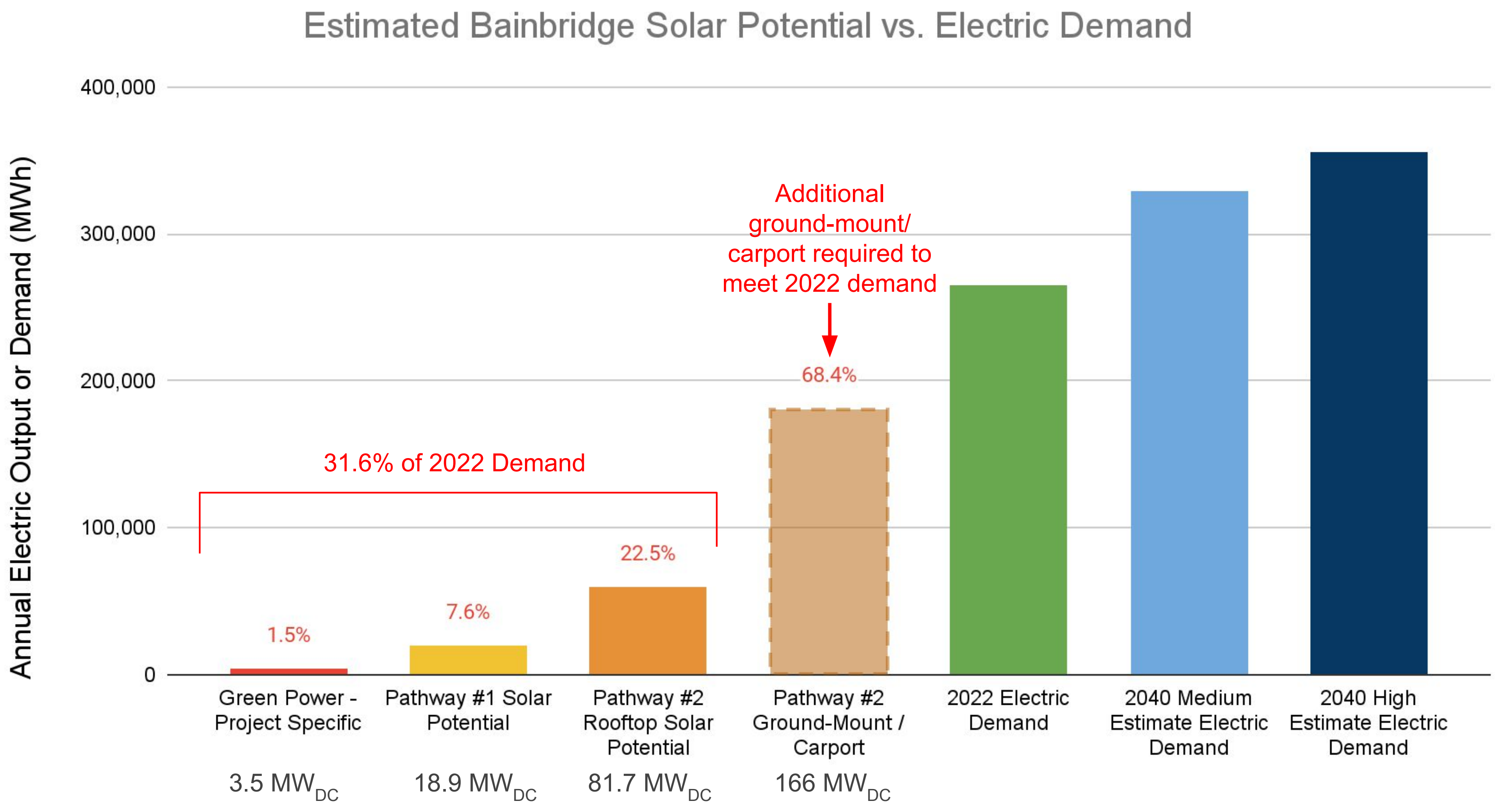


NREL: 73,036 MWh/yr

Google: 77,200 MWh/yr

Solar on Bainbridge Island

Pathway #1 and Pathway #2

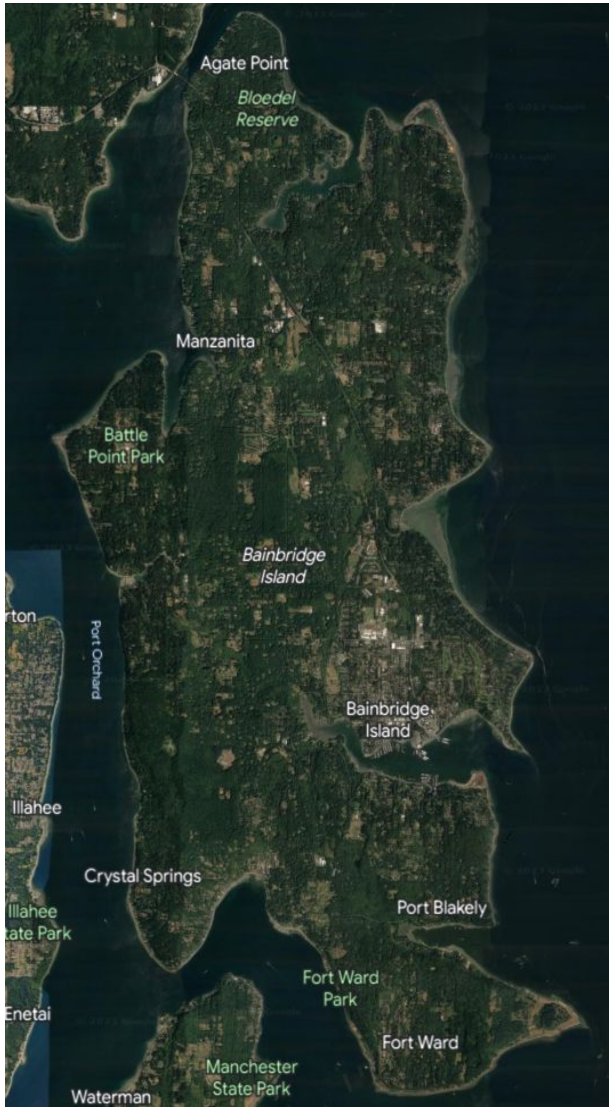


Pathway #2: Ground-Mount / Carport Solar

- Meeting the remaining 68.4% of BI's 2022 demand would require at least 166 MW_{DC} of ground-mount or carport PV
  - At least~ 475 acres of ground-mount PV
  - At least ~345 acres of parking spots
- Need community input to identify potential locations

~ 345 acres

~ 475 acres



Biodigester

Amy Solana, Orlando Garayburu Caruso, Pavlo Bohutskyi

Pathway #3 - Biodigester

Feasibility of waste-to-energy (WTE) using organic waste (biomass) as the primary feed

- WTE: energy recovery from waste by the conversion of non-recyclable waste materials into usable heat, electricity, or fuel through a variety of processes
- Anaerobic digestion (AD): specific WTE process in which microorganisms break down organic material in the absence of oxygen, producing biogas and digestate (nutrient-rich solid/liquid mix)

Industry on Bainbridge	Probable Waste Types
Wastewater treatment	Biosolids/sludge
Fisheries	High water content fish waste
Hotels	Food waste from restaurants, other non-organic waste
Restaurants	Food waste
K-12 schools	Paper and food waste
Supermarkets	Food waste
Farms	Farm waste (agricultural, manure)
Vineyards	Cultivation waste
Brewery	Food waste slurry
Wineries	Grape seeds and other grape based organic waste
Distilleries	Distillery stillage

Bainbridge Feedstock Availability Estimate

- PSE funded Impact Bioenergy study (2016-2017)
  - Estimated total usable amount of waste on Bainbridge is 8,750 tons/yr
  - Estimated potential generation of up to 3,485 MWh/yr (1.2% of 2022 demand)
- 100% electricity from biomass is not feasible; insufficient feedstock available
  - Annual biomass requirement to meet consumption: 963,000–2,644,000 tons/yr
- Biodigester could support Bainbridge's goals in combination with other energy options - to balance peak demand, or provide baseload heat/power for critical facilities
- Detailed waste characterization study is needed to validate assumptions on quantity and type

Image from: Bekon

Bekon makes AD units that process 3,000-10,000 tons/yr and produce 100-300 kWe

One 20ft bioQUBE processes 183 tonnes food waste/yr and generates 6 kWe + 8kWth

Image from: Qube

Wind Energy

Lindsay Sheridan

Pathway #4: Wind

Small
(≤100 kW)

- Homes
- Farms
- Businesses
- Remote applications (e.g., water pumping, telecom sites)

Midsize
(101 – 1,000 kW)

- Village and community power
- Small commercial, industrial, institutional, and government applications

Large-scale, land-based
(1 – 5 MW)

- Community power
- Large commercial and industrial deployments
- Utility-owned projects connected to the distribution grid

What makes a good distributed wind energy project?

★ Good wind resource (annual average wind speed exceeding minimum thresholds according to the height of the turbine):
  - 4.0 m/s at 30 m
  - 5.0 m/s at 50 m
  - 6.5 m/s at 80 m

★ Close distance to the where the energy is needed

★ Far enough distance from obstacles such as buildings and trees

Distributed Wind Case Studies

Maui County Landfill, Hawaii

Three small wind turbines offset between two-thirds and 90% of the Central Maui Landfill Refuse and Recycling Center's annual energy consumption, saving the municipal Hawaiian facility approximately $18,000 annually.

Cliff Ryden, Blue Pacific Energy

3 Bergey Excel 10 kW turbines

20 m hub height

27-45 MWh annual energy generation

5-6 m/s annual average wind speed at 50 m

Coastal Energy Wind Project, Grayland, Washington

The community of Grayland was economically impacted by the decline of the timber industry.

Through the Coastal Community Action Program, wind energy produced by the Coastal Energy project is sold to a local utility with all revenue going to the Grayland community.

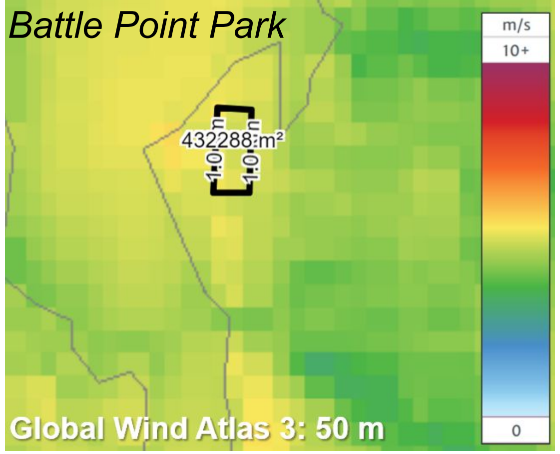
GE

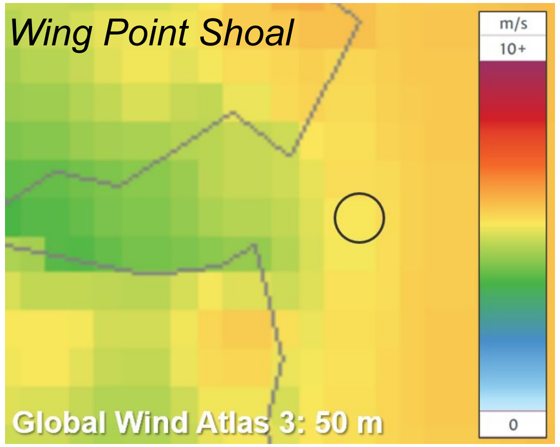
4 GE 1.5 MW turbines

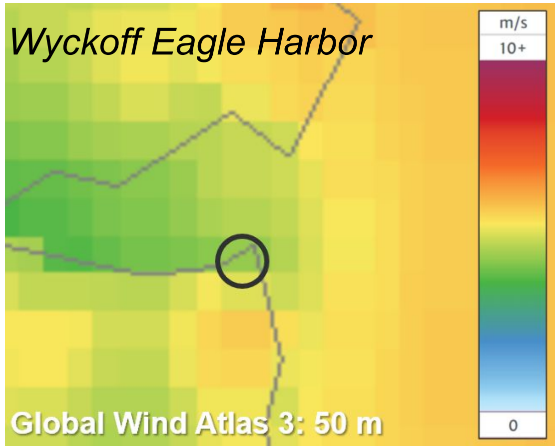
80 m hub height

12,000-16,000 MWh annual energy generation

5-6 m/s annual average wind speed at 50 m





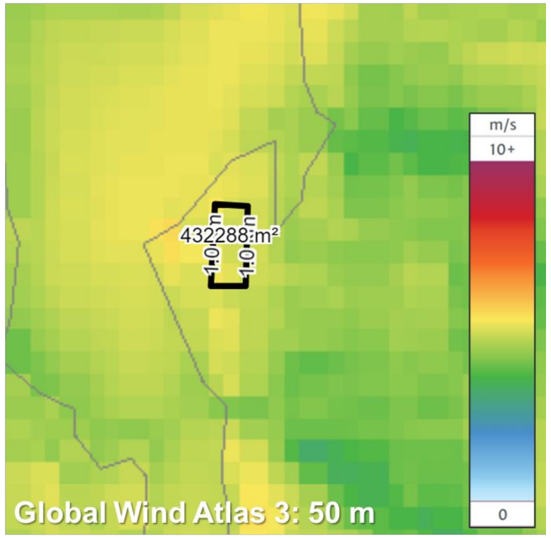


Site-Specific Wind Generation Estimates (Single Turbine)

Turbine Manufacturer and Model	Bergey Excel 15	Eocycle EOX S-16	NPS 100C-28	EWT DW 54-900	GE 2 MW-116
Nameplate Capacity	15 kW	25 kW	100 kW	900 kW	2.3 MW
Hub Height	37 m	24 m	37 m	50 m	80 m
Tip Height	42 m	32 m	51 m	77 m	138 m
	recommended setback radius from property lines				
Battle Point Park: Annual Energy Estimate (MWh) (19% loss included)	**17 – 27** *<0.1% total demand*	**33 – 51** *<0.1% total demand*	**135 – 194** *<0.1% total demand*	**854 – 1363** *<1% total demand*	**4000 – 5638** *2% total demand*
Wing Point Shoal: Annual Energy Estimate (MWh) (19% loss included)	**18 – 27** *<0.1% total demand*	**39 – 55** *<0.1% total demand*	**153 – 213** *<0.1% total demand*	**883 – 1324** *<1% total demand*	**4260 – 5796** *2% total demand*
Wyckoff Eagle Harbor: Annual Energy Estimate (MWh) (19% loss included)	**14 – 16** *<0.1% total demand*	**24 – 27** *<0.1% total demand*	**120 – 133** *<0.1% total demand*	**758 – 856** *<1% total demand*	**4136 – 4535** *2% total demand*

The most advantageous scenario for wind on Bainbridge Island is likely serving a specific local load (school, public facility, industrial site, etc)

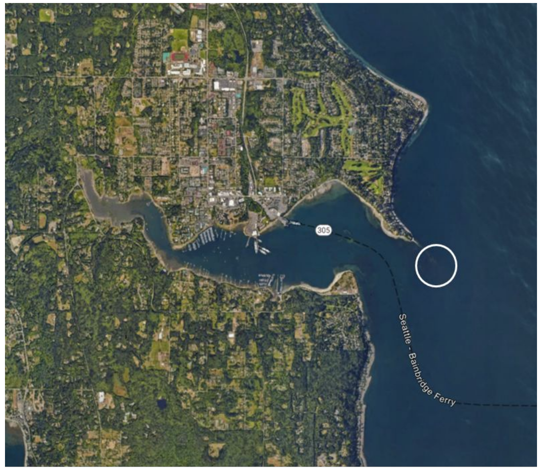
Site-Specific Wind Generation Estimates: Battle Point Park

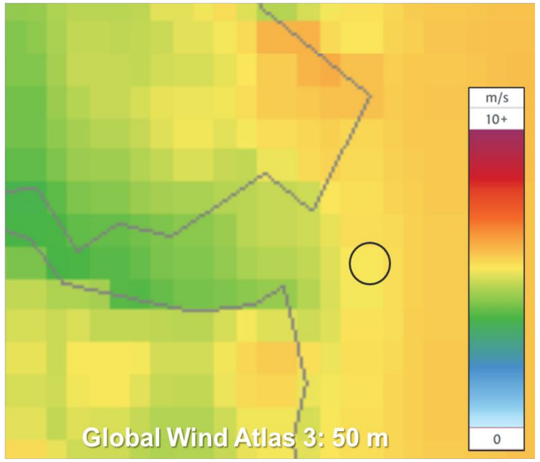


Turbine Manufacturer and Model	Bergey Excel 15	Eocycle EOX S-16	NPS 100C-28	EWT DW 54-900	GE 2 MW-116
Nameplate capacity	15 kW	25 kW	100 kW	900 kW	2.3 MW
Hub height	37 m	24 m	37 m	50 m	80 m
Tip height (recommended setback radius from property lines)	42 m	32 m	51 m	77 m	138 m
Annual average wind speed at hub height (m/s)	4.0 – 5.0	3.7 – 4.6	4.0 – 5.0	4.3 – 5.3	4.8 – 5.9
Annual energy estimate (MWh) (19% loss included)	17 – 27	33 – 51	135 – 194	854 – 1363	4000 – 5638
% of Bainbridge load (264,566 MWh) a single turbine would meet	<0.1	<0.1	<0.1	0.3 – 0.5	1.5 – 2.1

The most advantageous scenario for wind on Bainbridge Island is likely serving a specific local load (school, public facility, industrial site, etc)

Site-Specific Wind Generation Estimates: Wing Point Shoal

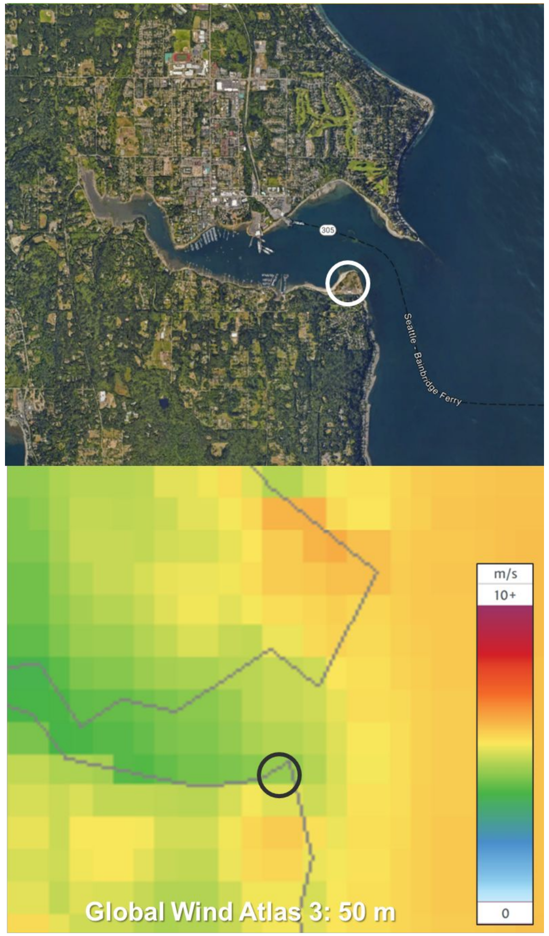




Turbine Manufacturer and Model	Bergey Excel 15	Eocycle EOX S-16	NPS 100C-28	EWT DW 54-900	GE 2 MW-116
Nameplate capacity	15 kW	25 kW	100 kW	900 kW	2.3 MW
Hub height	37 m	24 m	37 m	50 m	80 m
Tip height (recommended setback radius from property lines)	42 m	32 m	51 m	77 m	138 m
Annual average wind speed at hub height (m/s)	4.5 – 5.3	4.2 – 4.9	4.5 – 5.3	4.7 – 5.5	5.1 – 6.0
Annual energy estimate (MWh) (19% loss included)	18 – 27	39 – 55	153 – 213	883 – 1324	4260 – 5796
% of Bainbridge load (264,566 MWh) a single turbine would meet	<0.1	<0.1	<0.1	0.3 – 0.5	1.6 – 2.2

The most advantageous scenario for wind on Bainbridge Island is likely serving a specific local load (school, public facility, industrial site, etc)

Site-Specific Wind Generation Estimates: Wyckoff Eagle Harbor



Turbine Manufacturer and Model	Bergey Excel 15	Eocycle EOX S-16	NPS 100C-28	EWT DW 54-900	GE 2 MW-116
Nameplate capacity	15 kW	25 kW	100 kW	900 kW	2.3 MW
Hub height	37 m	24 m	37 m	50 m	80 m
Tip height (recommended setback radius from property lines)	42 m	32 m	51 m	77 m	138 m
Annual average wind speed at hub height (m/s)	4.0 – 4.2	3.5 – 3.7	4.0 – 4.2	4.4 – 4.6	5.0 – 5.2
Annual energy estimate (MWh) (19% loss included)	14 – 16	24 – 27	120 – 133	758 – 856	4136 – 4535
% of Bainbridge load (264,566 MWh) a single turbine would meet	<0.1	<0.1	<0.1	0.3	1.6 – 1.7

The most advantageous scenario for wind on Bainbridge Island is likely serving a specific local load (school, public facility, industrial site, etc)

Areas of High Relative Wind Resource, but High Forest and/or Infrastructure Density

Agate Point, *Forest*

Bergey Excel 15 kW: 15 – 27 MWh → GE 2.3-116 2.3 MW: 4,297 – 6,319 MWh

Rolling Bay, *Forest & Infrastructure*

Bergey Excel 15 kW: 17 – 29 MWh → GE 2.3-116 2.3 MW: 4,543 – 6,575 MWh

Yeomalt Point, *Forest & Infrastructure, only open space at golf course*

Bergey Excel 15 kW: 17 – 33 MWh → GE 2.3-116 2.3 MW: 4,160 – 6,763 MWh

Bill Point, *Forest & Infrastructure*

Bergey Excel 15 kW: 15 – 27 MWh → GE 2.3-116 MW: 4,368 – 6,449 MWh

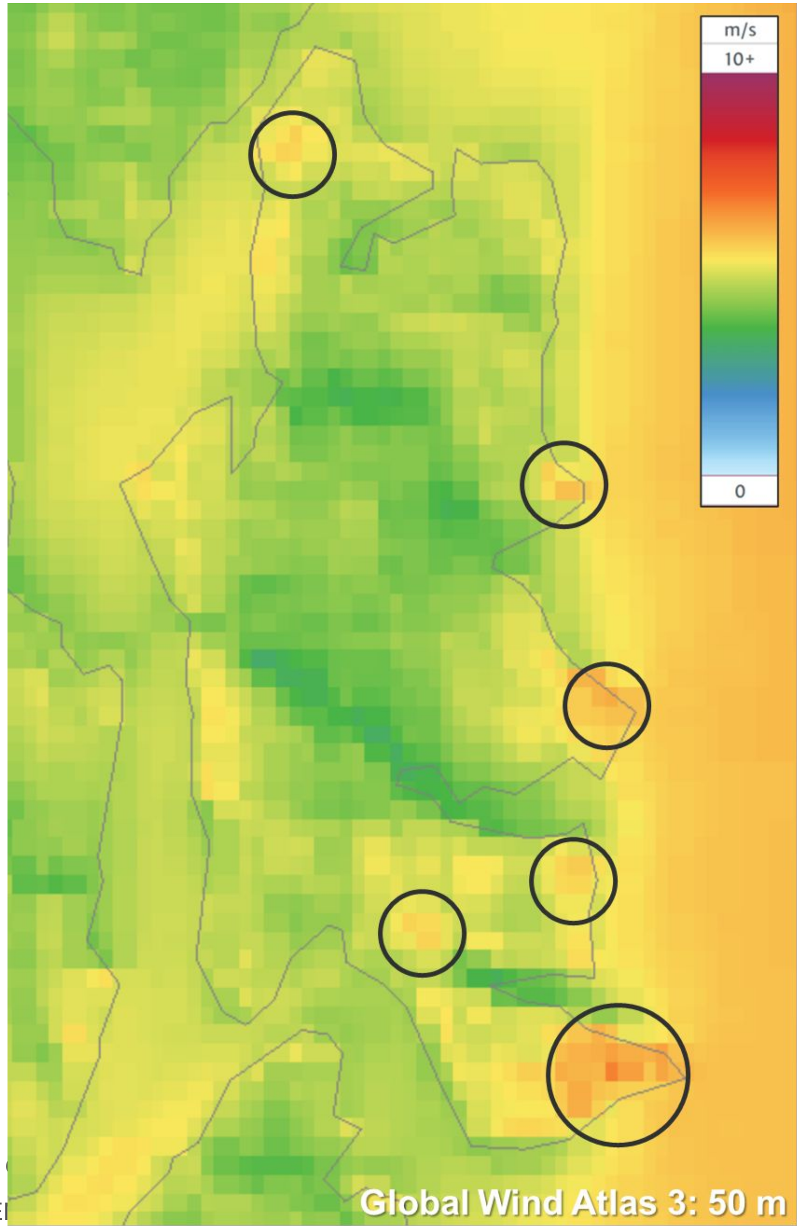
Between Lynwood Center & Port Blakely, *Forest & Infrastructure*

Bergey Excel 15 kW: 14 – 27 MWh → GE 2.3-116 2.3 MW: 4,077 – 6,228 MWh

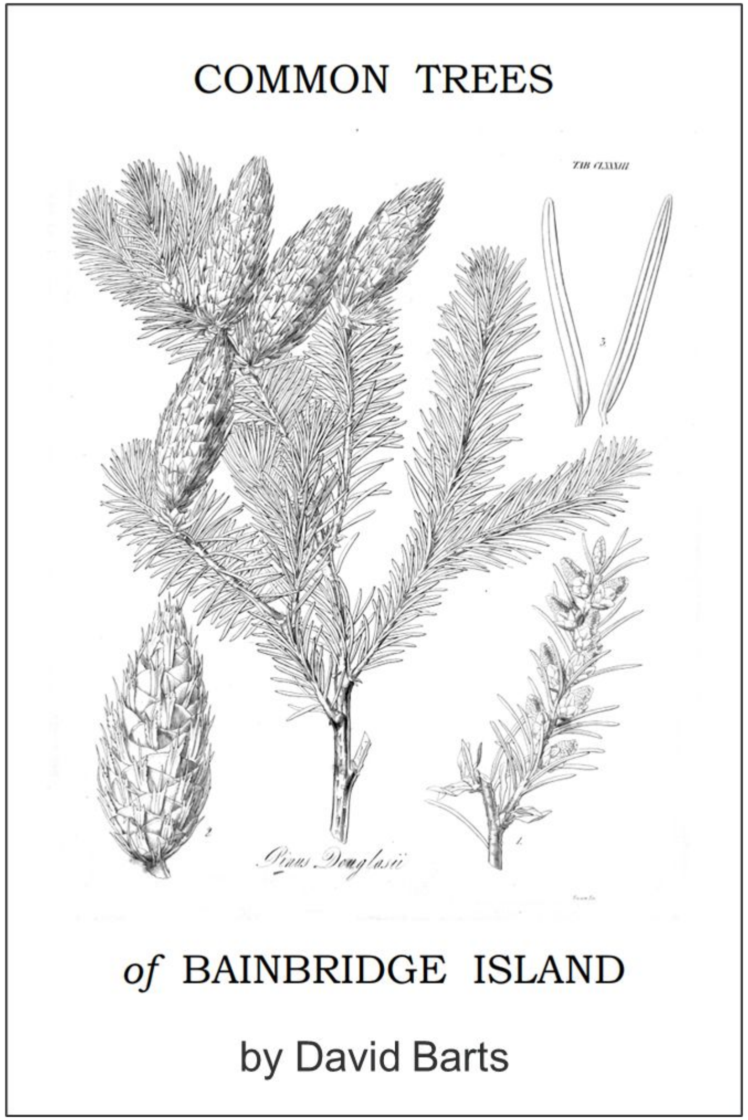
Restoration Point, *Forest & Infrastructure*

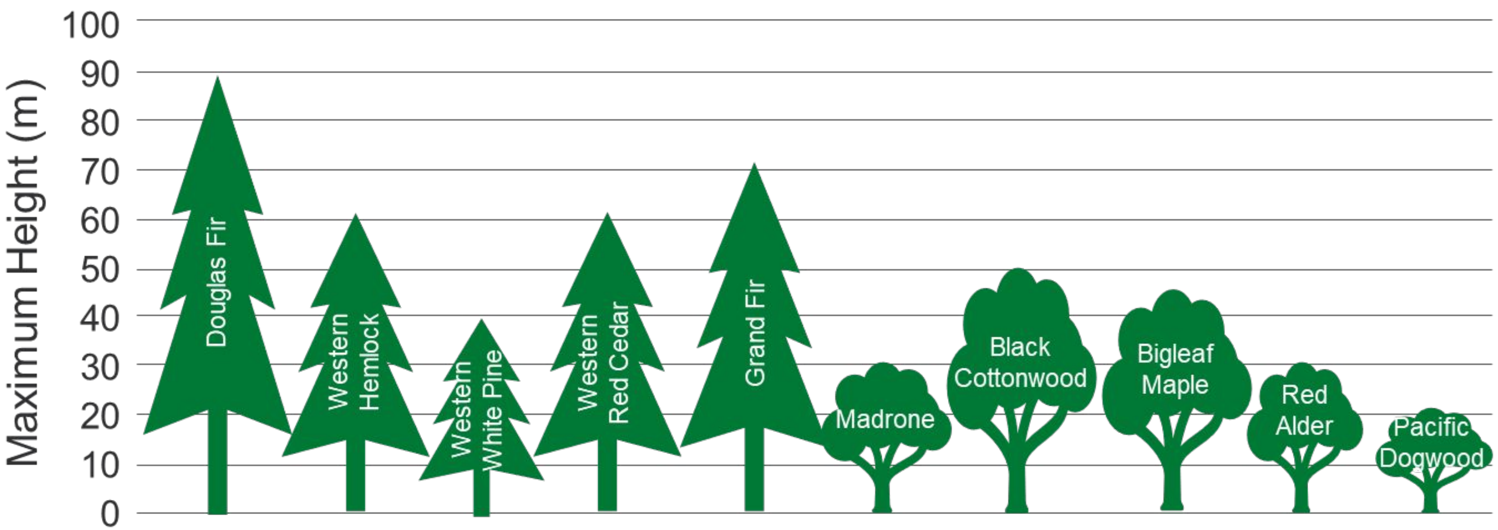
Open space at golf course and higher terrain clearings

Bergey Excel 15 kW: 16 – 39 MWh → GE 2.3-116 MW: 4,230 – 7,891 MWh



Wind Turbine Siting Considerations





Turbine Manufacturer and Model	Bergey Excel 15	Eocycle EOX S-16	Northern Power Systems 100-28	EWT DW 54-900	GE 2 MW-116
Nameplate capacity	15 kW	25 kW	100 kW	900 kW	2.3 MW
Hub height	**37 m**	**24 m**	**37 m**	**50 m**	**80 m**

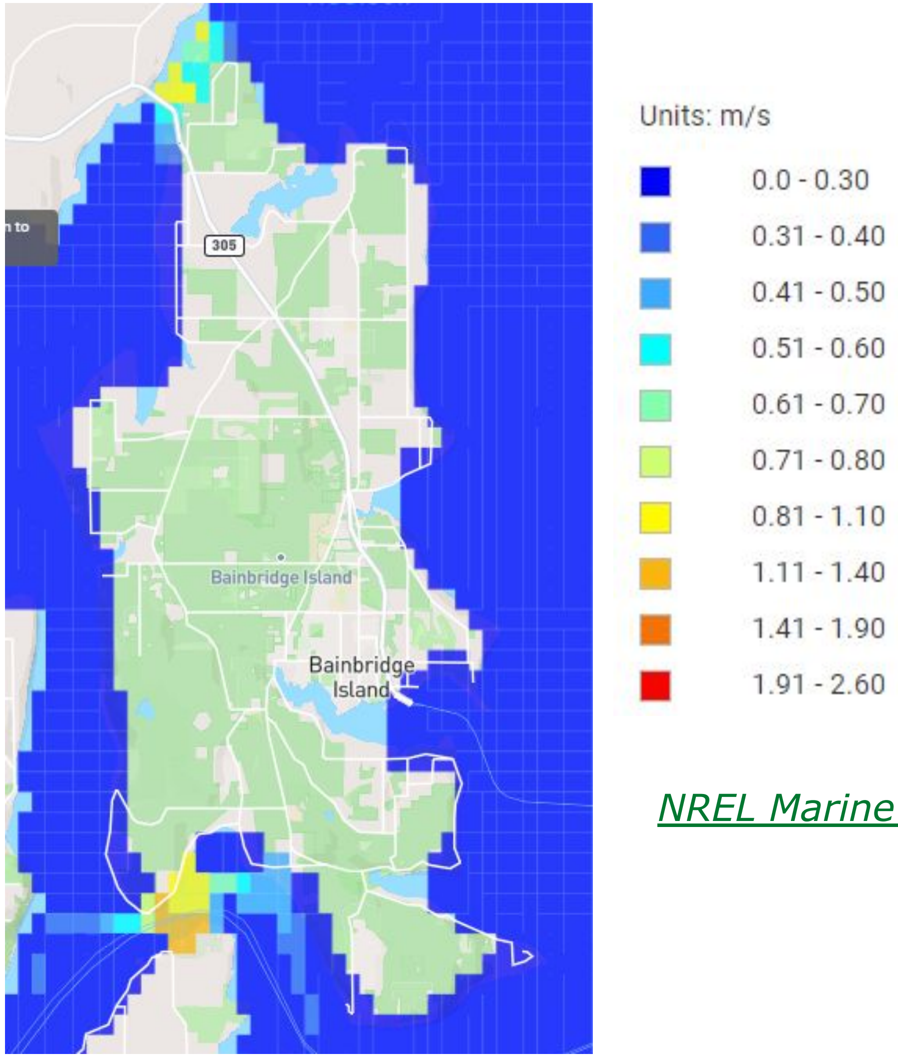
PNNL recommends that the turbine hub height be at least 10 m above the height of any obstacles (trees, buildings) within a 150 m radius.

Marine Energy

Molly Grear

Marine Energy

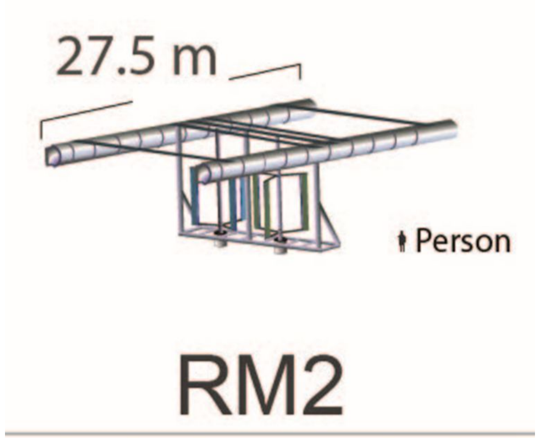
- Bainbridge Island has more tidal resources than wave, so that is where we focused analysis
- Agate Passage has about 1 m/s mean currents
- Rich Passage has higher currents, but is not be appropriate for development based on competing usage - not considered further in analysis.



NREL Marine Energy Atlas

Applying Reference Model to Agate Passage

- This turbine is a 100kW rated “reference model” which is a generic turbine that has data about how much energy it produces, called Reference Model 2 (RM2)
- Applying actual velocity measurements at two depths can generate monthly kWh of power or hourly data
- We assume tidal power is the same over each month



https://tethys-engineering.pnnl.gov/signature-projects/reference-model

- Yearly production at 8.7 ft depth: 132 MWh (0.05% of total 2022 electric demand)
- Yearly production at 21.9 ft depth: 79 MWh (0.03% of total 2022 electric demand)

Improving Resilience:

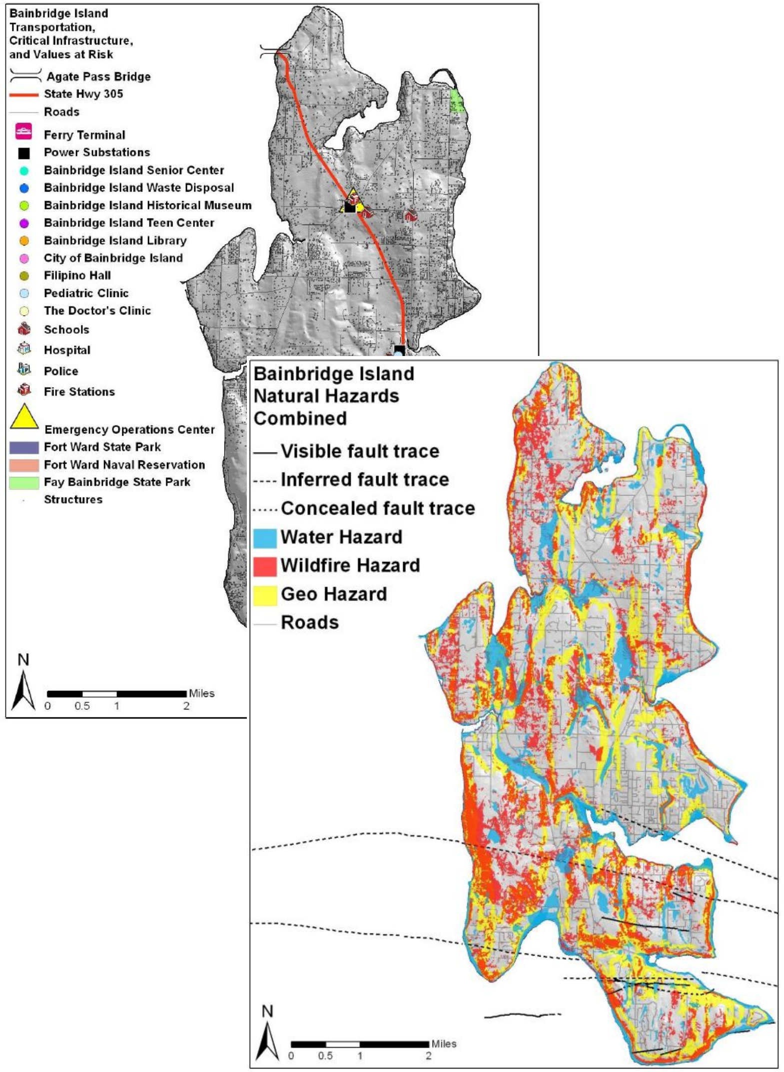
Critical Energy Infrastructure and Vulnerabilities Analysis

Approach

1. Identify critical energy infrastructure locations and characterize energy needs
   - Consultation with COBI
   - Public information and estimates for emergencies
2. Spatial overlap with hazards
   - GIS
3. Calculate risk

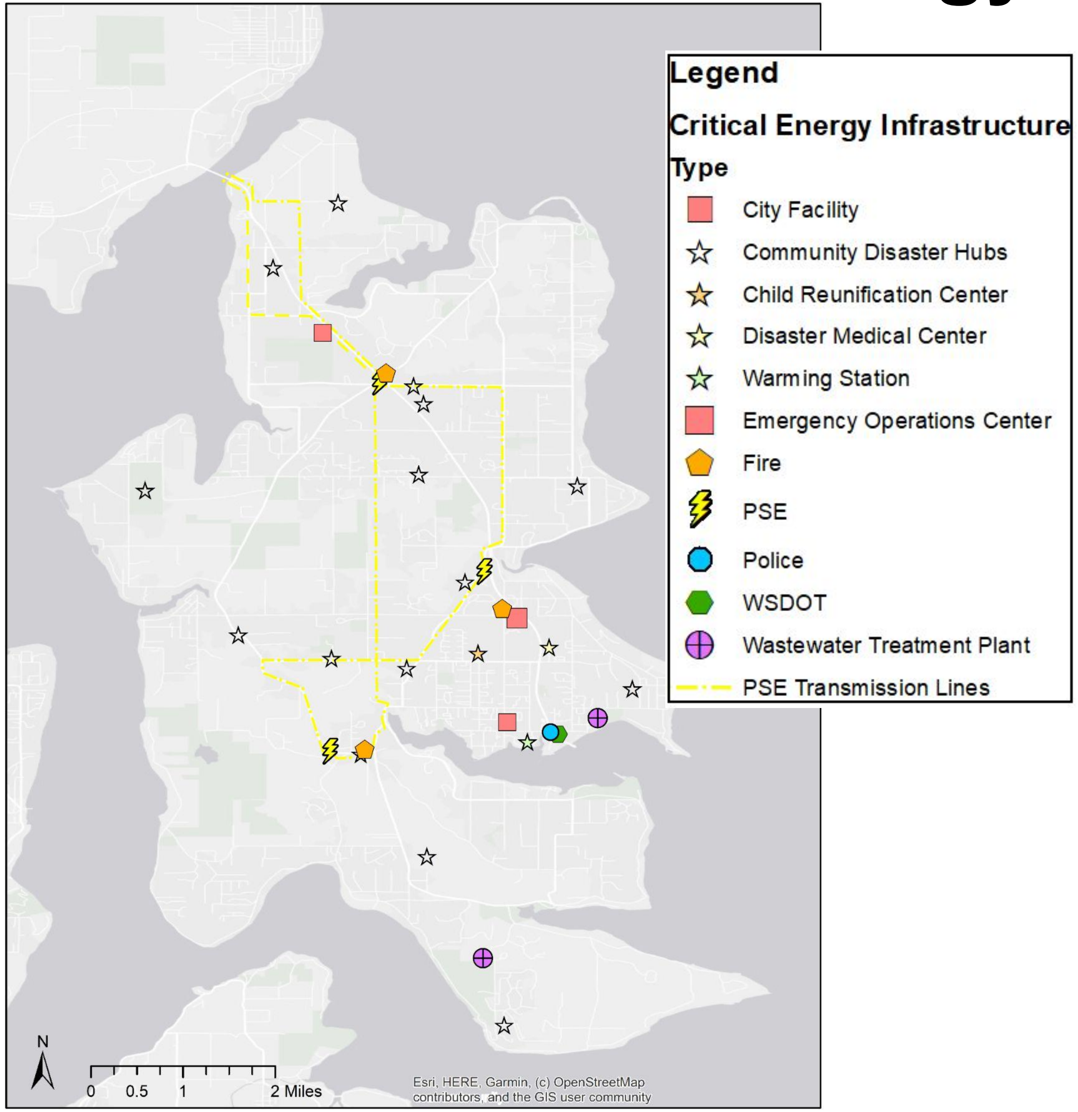
Probability	X	Vulnerability	X	Consequence

4. Make recommendations for priority sites



[2012 BI Hazard Identification and Vulnerability Analysis]

Identifying and Characterizing Critical Energy Infrastructure



- 34 locations
- Sample:

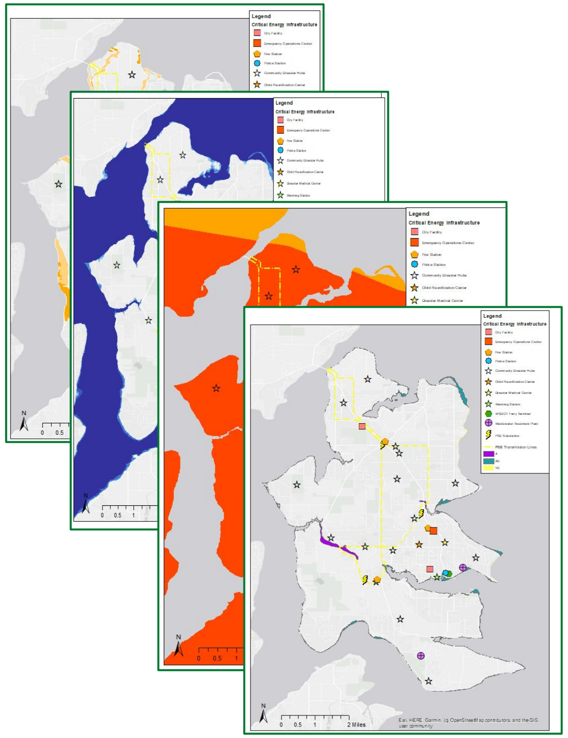
Location	Energy Needs (for Emergency Operations)
Winslow Wastewater Treatment Plant	Power needs still need to be quantified, but operations are required 24/7 and already supported by redundant backup systems.
Senior Center	6,200 sq ft, functions as a cooling and warming center

List of Critical Energy Infrastructure

- PSE transmission lines and substations
- Community Disaster Hubs
  - Child Reunification Center at Bainbridge High School
  - Disaster Medical Clinic at Virginia Mason Clinic
  - Warming Station and Senior Community Center
- New police/court building (which serves as the city's emergency operations center)
- Public Works O&M Yard (including charging stations for City fleet EVs)
- Winslow Wastewater Treatment Plant
- Kitsap County Sewer District #7 Wastewater Treatment Plant
- Winslow Ferry Terminal
- City Hall
- Police Department
- Fire Stations 21, 22, 23

Identifying and Characterizing Hazards

- Severe storm
- Flood
- Sea level rise
- Tsunami
- Earthquake
- Erosion, landslide
- Wildfire
- Extreme temperatures
- Terrorism, vandalism



Information from previous studies

Assessing Risk

Chance of hazard occurring at location *(High, Moderate, Low)*

Susceptibility of energy infrastructure to harm/damage from occurrence *(High, Moderate, Low)*

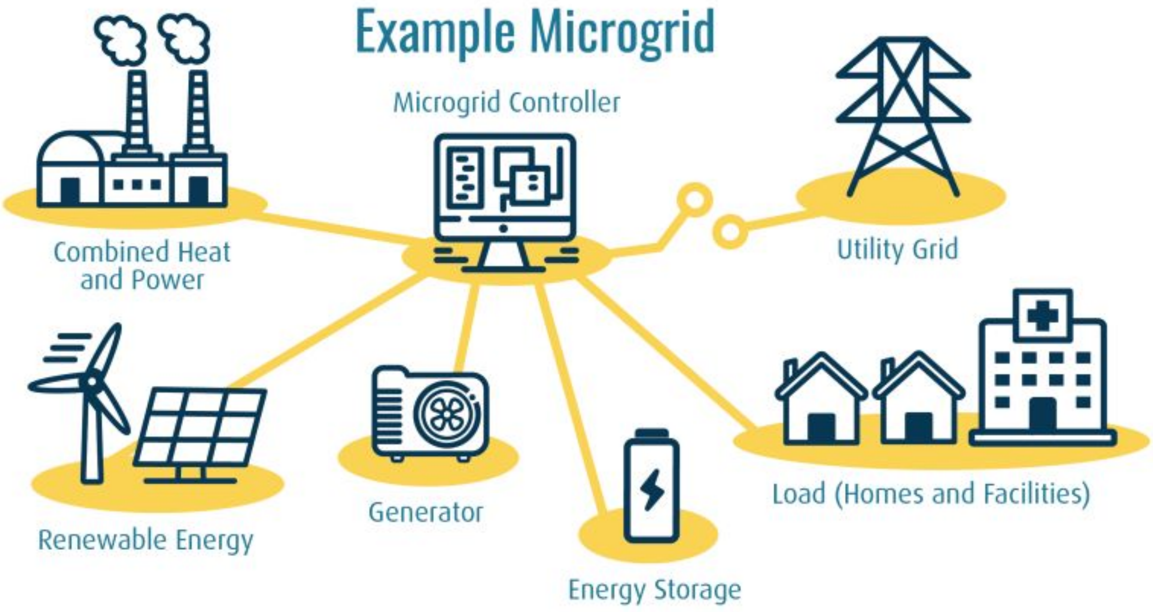
Severity of harm/damage *(High, Moderate, Low)*

Probability
X
Vulnerability
X
Consequence

Location	Hazard(s)	Probability	Vulnerability	Consequence	Risk
Winslow Wastewater Treatment Plant	Flood	High - 1% annual	Low - 13 emergency generators	High	Moderate
	Sea Level Rise	High - partially inundated with 1ft rise by 2060	High - flooding mitigated with generators, but long term submersion is not operationally feasible	High	High
	Earthquake	High	High - severe shaking intensity, damage predicted by WA DNR	High	High
	…	…	…	…	…
Senior Center	Extreme Temperatures	Moderate	Low - extreme temps on their own don't cause power outages, but timing is critical	Moderate - High	Moderate

Typical Resilience Recommendations

- Undergrounding of transmission lines
- Installation of earthquake straps
- Purchase of backup diesel generator(s)
- Relocation of key facilities
- Adding storage
- Development of microgrid for critical energy infrastructure



https://www.naseo.org/issues/electricity/microgrids

Microgrid Analysis

- For sites that have been identified in critical infrastructure and vulnerability analysis that could increase resilience with a microgrid
- A high level solar assessment will be conducted for the sites to determine the area available for rooftop / ground-mount / carport solar.
- NREL's REopt tool will be used to estimate the combination of solar, energy storage, and backup generation required to survive a specified grid outage, given the amount of available space for solar.
- At the very least, this analysis would require annual electricity consumption for the building / site. Ideally, hourly electricity consumption would used.

Next Steps for Resilience

- Finishing energy characterizations
- Identifying high risk locations
- Identifying priority resilience investments for relevant hazards
  - Considering microgrid analysis
- Cross checking with existing and planned improvements
- Documenting in report and available GIS layers

Discussion

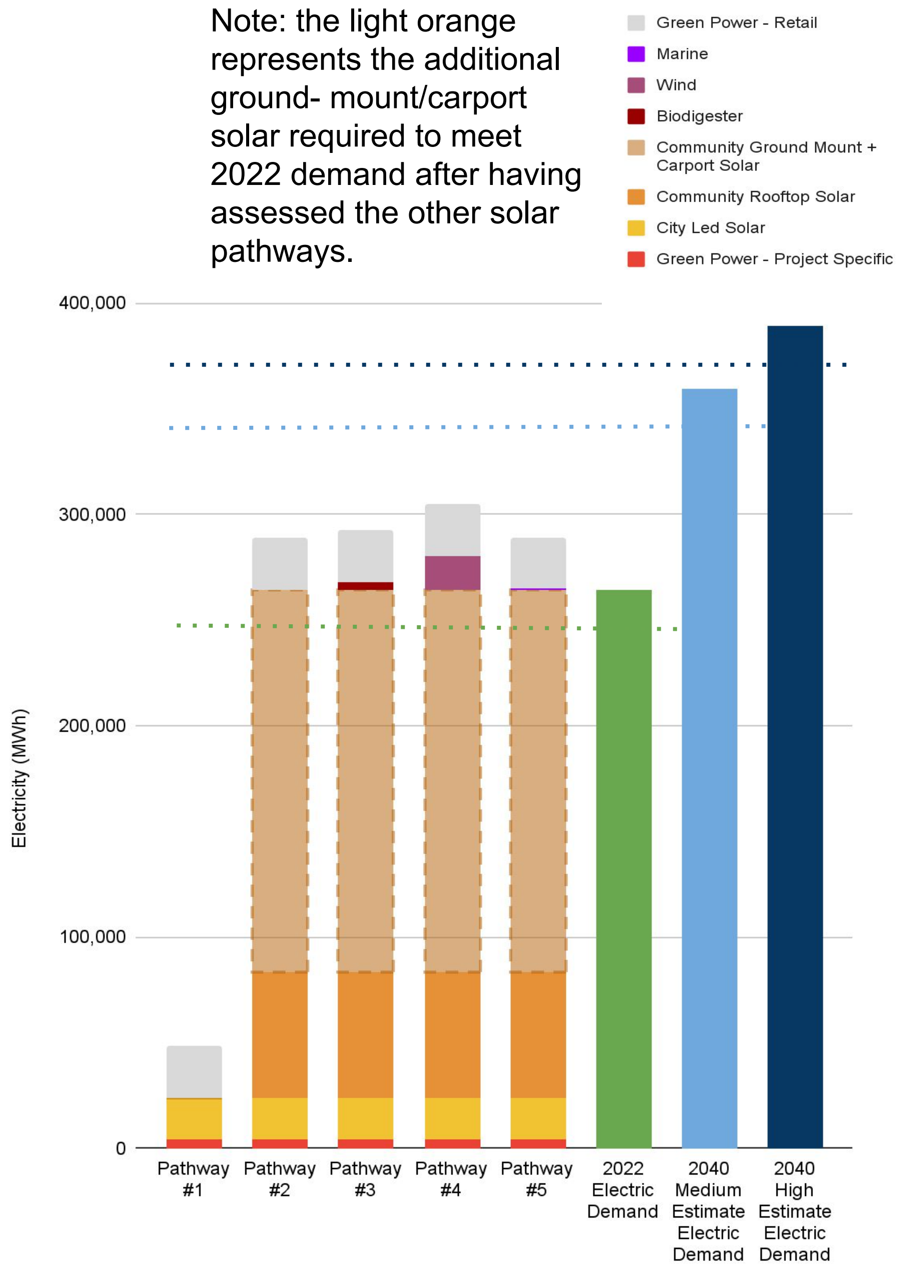
Advancing Resilience

- Are we missing any critical energy infrastructure in our list?
- Are there particular recommendations you are interested in us considering further as part of the resilience analysis?

Pathways to 100% Renewable Electricity

- Do you have any questions or reflections about the technology results for the different pathways?
- Who might be interested in engaging around future solar projects and locations?

Note: the light orange represents the additional ground- mount/carport solar required to meet 2022 demand after having assessed the other solar pathways.



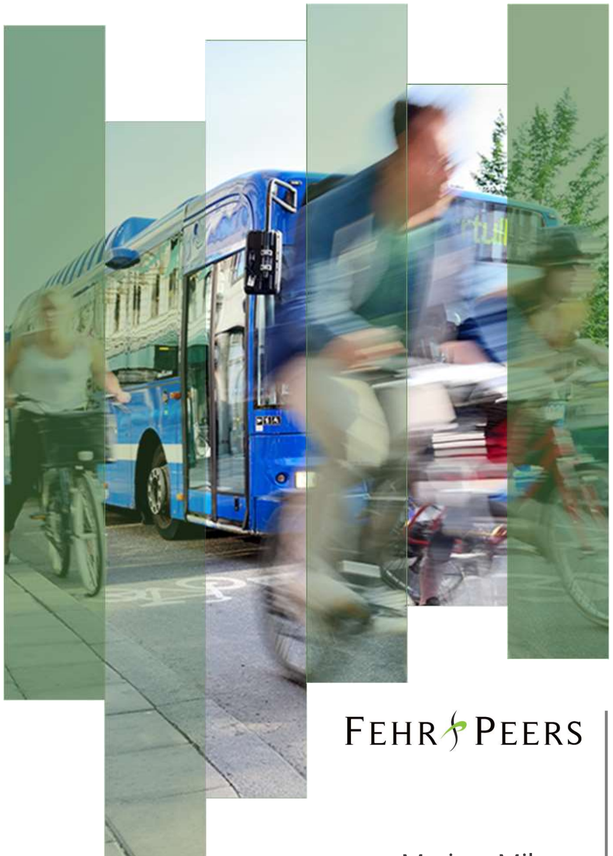
ENERGY
TRANSITIONS
INITIATIVE
U.S. Department of Energy

Partnership Project

Thank you!

katie.arkema@pnnl.gov

OFFICE OF STRATEGIC PROGRAMS | SOLAR ENERGY TECHNOLOGIES OFFICE
WATER POWER TECHNOLOGIES OFFICE | OFFICE OF ELECTRICITY



FEHR PEERS

Bainbridge Island – Sustainable Transportation

Marissa Milam

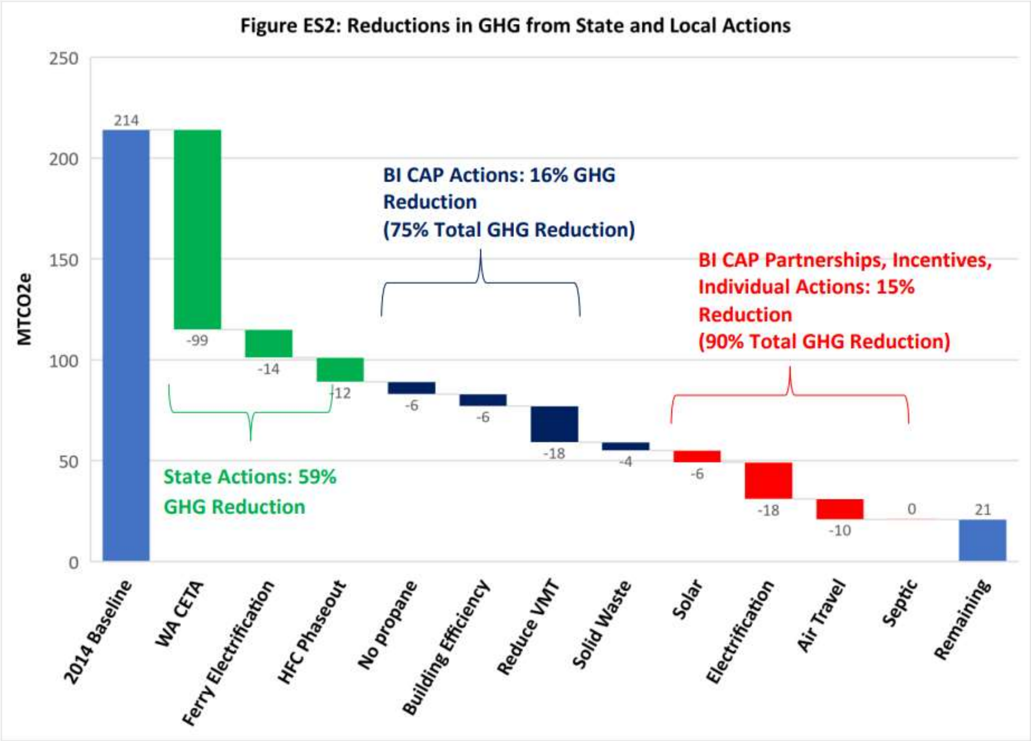
November 15, 2023

Agenda

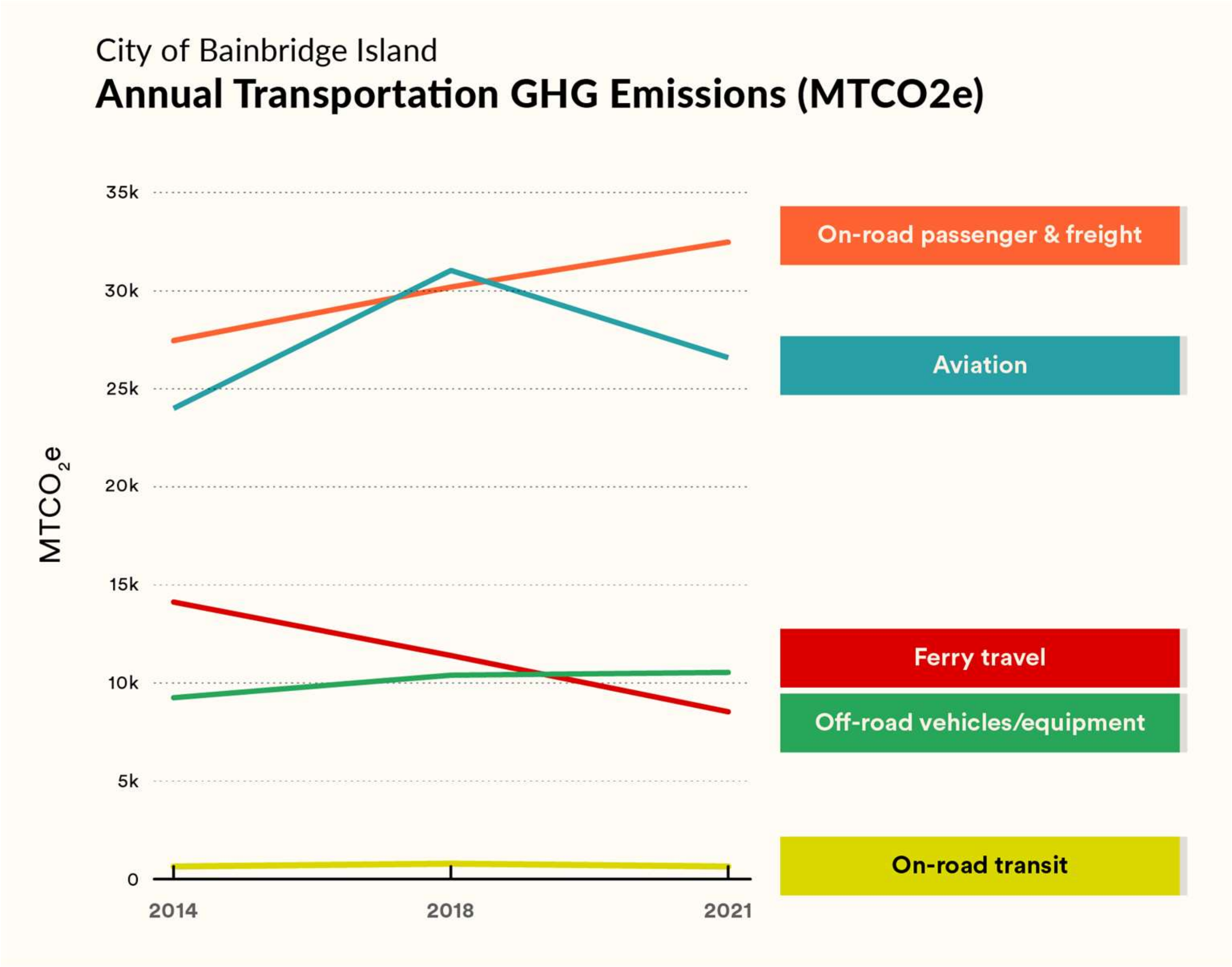
1) Greenhouse Gas Emissions (GHG) Inventory
2) Sustainable Transportation Plan (STP) Evaluation
3) Additional Strategies Evaluation
4) Findings and Recommendations

Bainbridge GHG Reduction Goals

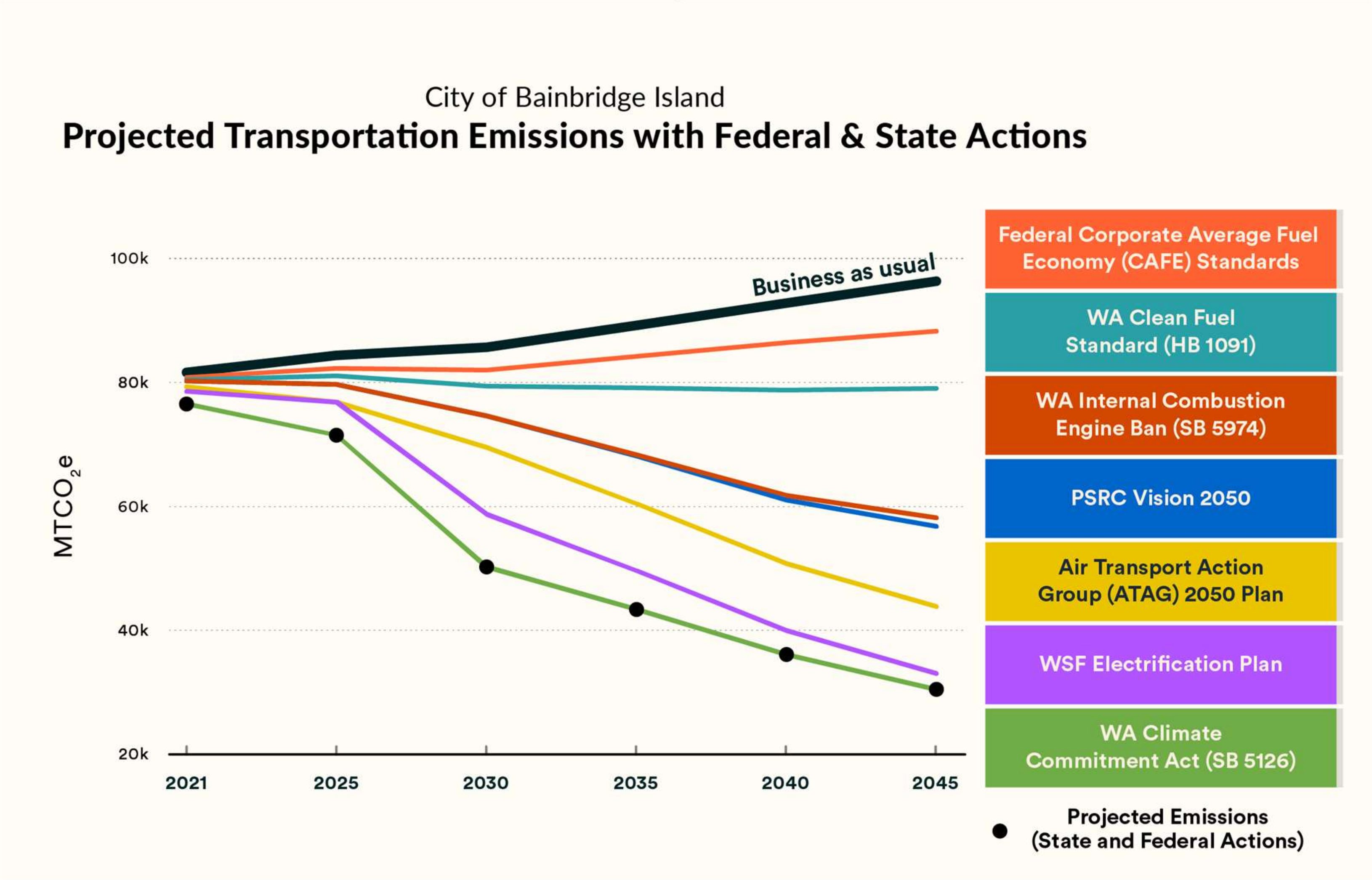
- Reduce *community greenhouse gas emissions* **25% by 2025**, **60% by 2035**, and **90% by 2045** compared to 2014 levels
- Reduce *VMT per capita* **25% by 2030**, and **50% by 2045**
- Increase *public transit mode share* from **2% to 5% by 2030**, and to **10% by 2045**
- By 2045, *electric vehicles* should be **80% of total vehicles**



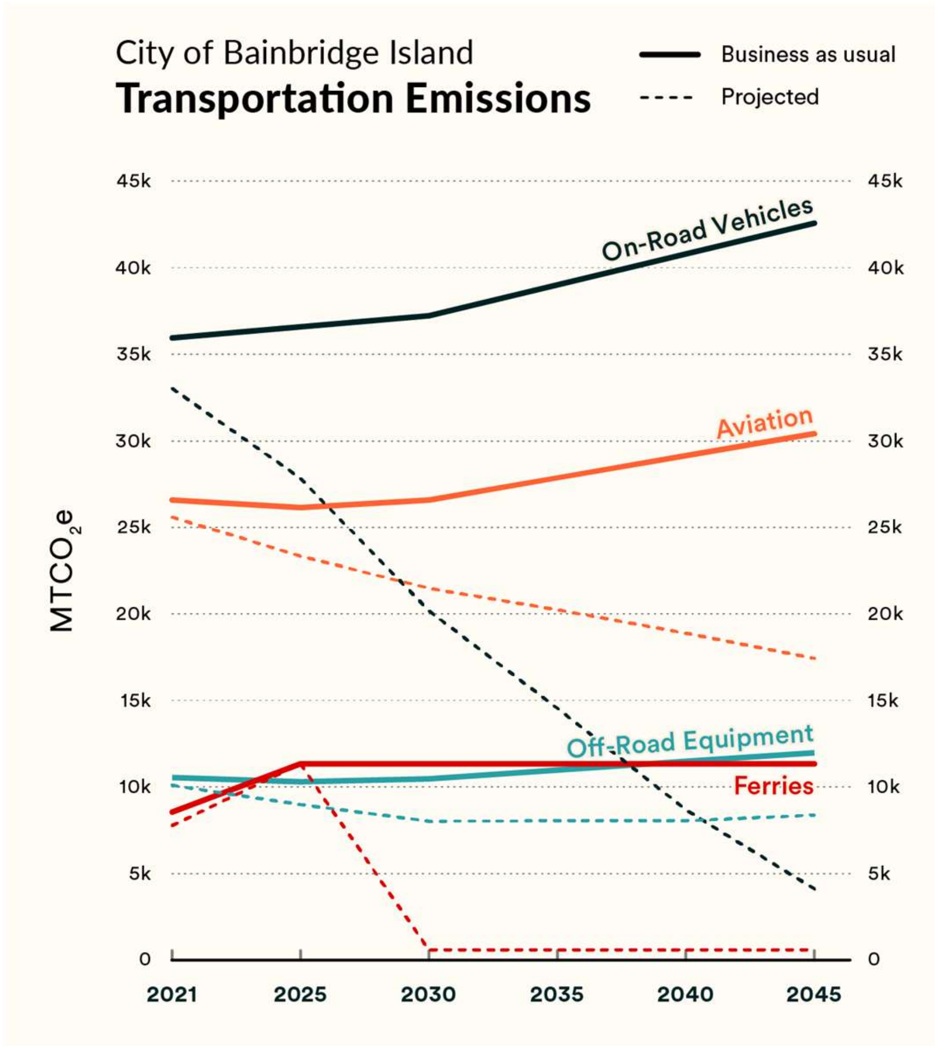
2021 GHG Inventory



Business as Usual vs Projected Emissions



Business as Usual vs Projected Emissions



Estimated Reduction in Annual GHG Emissions from Federal, State, and Regional Actions

Action	Reduction in Greenhouse Gas emissions by 2045 from 2014 Baseline ($MTCO_2e$)	
	Climate Action Plan Goal	Reductions from Federal, State, and Regional Actions
VMT reduction	-18,000	0
On- & off-road vehicle electrification	-18,000	-25,000 ✓
Ferry electrification	-14,000	-13,400 ✓
Air travel reduction and improved fuel efficiency	-10,000	-6,000

Federal, State, and Regional Actions do not address CAP goals of reducing VMT or mode share shift

Sustainable Transportation Plan

City of Bainbridge Island

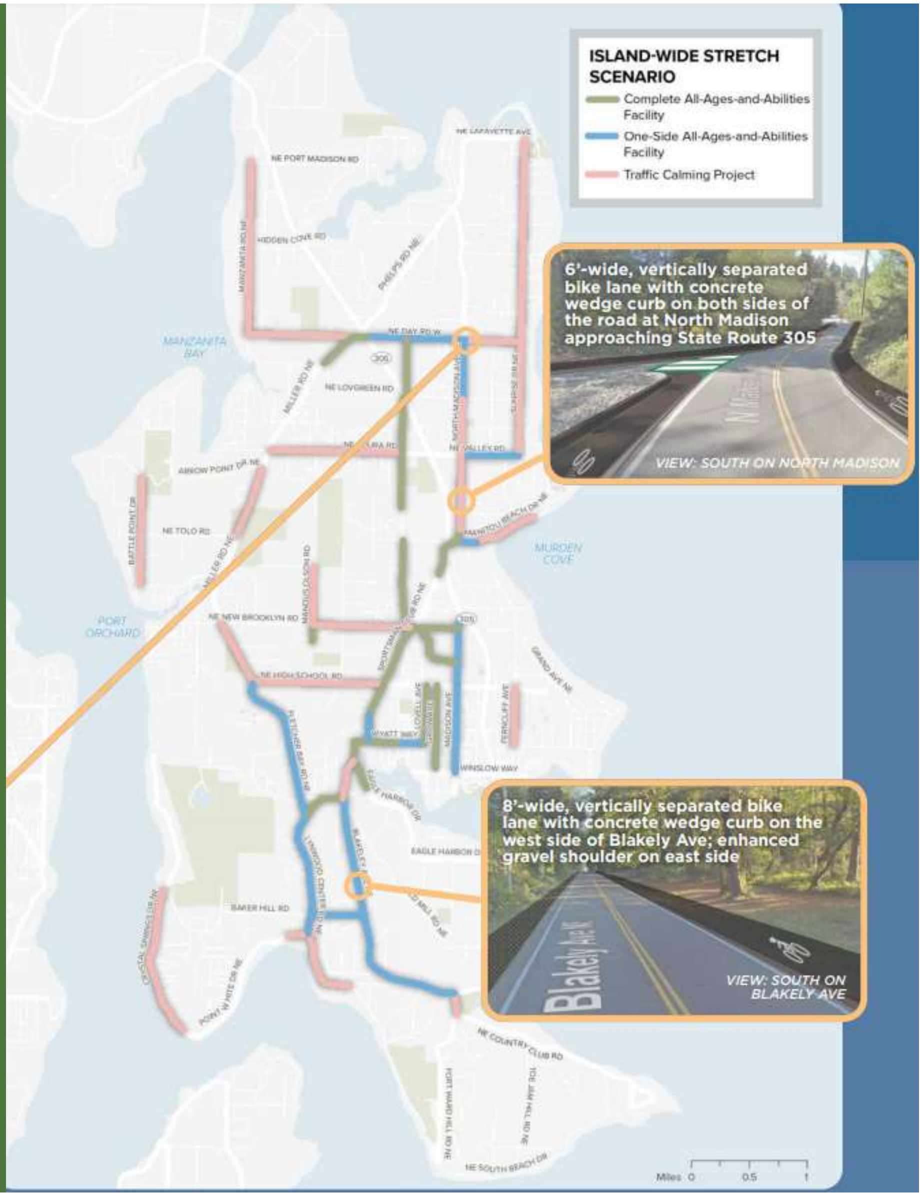
SCENARIO 2:
Connecting Centers

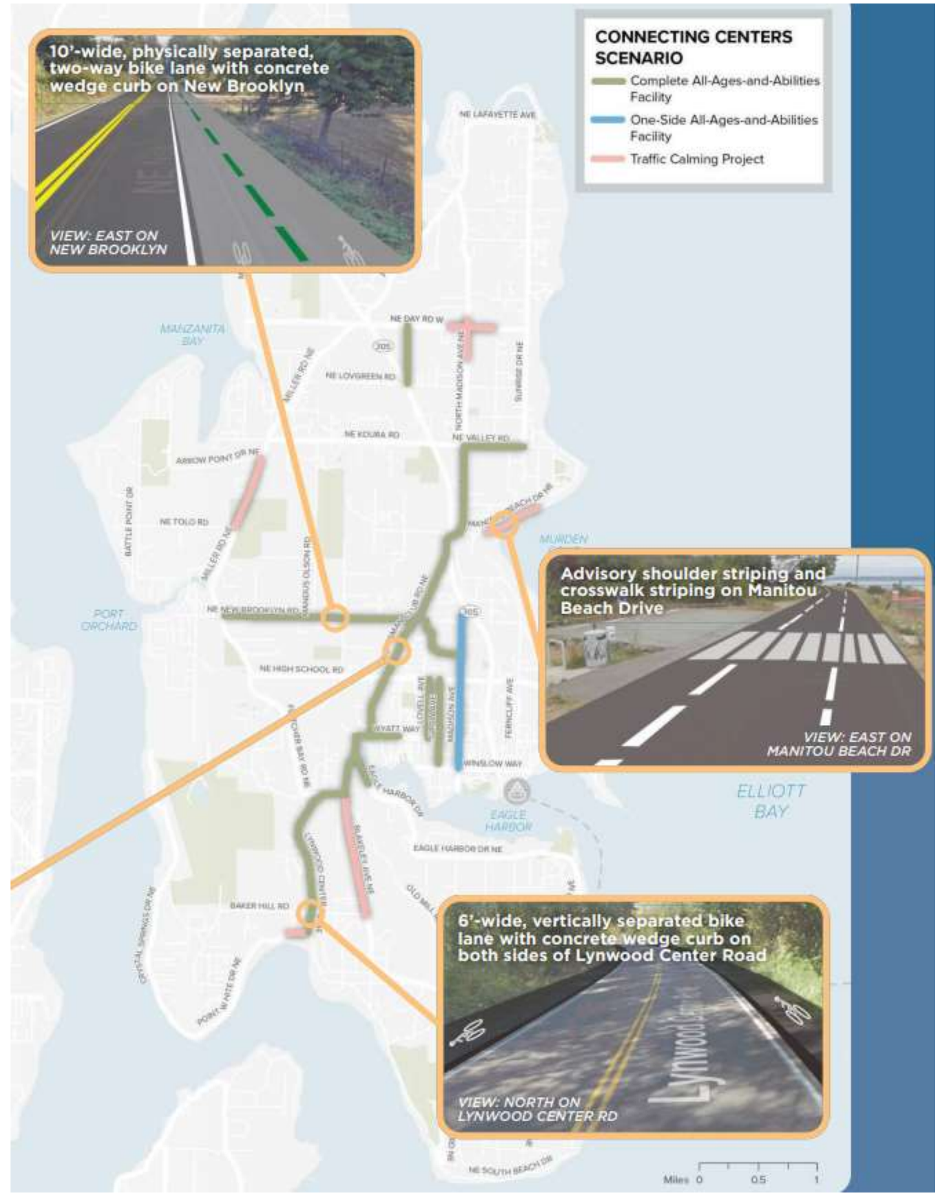
$31 MILLION OVER 6 YEARS

The Connecting Centers Scenario begins with the same existing funding sources included in the Status Quo Scenario and adds $16 million in additional funding. It is geared toward encouraging the City to make new investments in transportation projects and programs, with potential voter-supported funding as a complement early on or midway through implementation. With nearly $31 million available over 6 years, this scenario focuses on rapid implementation and delivery of a marquee "Connecting Centers" project that would provide a complete all-ages-and-abilities spine, as well as traffic calming projects on key routes.

The Connecting Centers Scenario:

- Addresses the top ***13 priority traffic calming locations*** on the Island
- Completes ***5 planned projects*** and ***8 "quick win" Island-wide projects***
- Advances ***6 mobility projects***
- Delivers the ***Connecting Centers project***
- Includes funding for ***1 year of the electric shuttle pilot***
- Supports ***12 programs and policies***
- Gives us ***4 new staff positions***


ISLAND-WIDE STRETCH SCENARIO
Complete All-Ages-and-Abilities Facility
One-Side All-Ages-and-Abilities Facility
Traffic Calming Project
6'-wide, vertically separated bike lane with concrete wedge curb on both sides of the road at North Madison approaching State Route 305
VIEW: SOUTH ON NORTH MADISON
8'-wide, vertically separated bike lane with concrete wedge curb on the west side of Blakely Ave; enhanced gravel shoulder on east side
VIEW: SOUTH ON BLAKELY AVE
MANZANITA BAY
MURDEN COVE
PORT ORCHARD
Miles 0 0.5 1


CONNECTING CENTERS SCENARIO
Complete All-Ages-and-Abilities Facility
One-Side All-Ages-and-Abilities Facility
Traffic Calming Project
10'-wide, physically separated, two-way bike lane with concrete wedge curb on New Brooklyn
VIEW: EAST ON NEW BROOKLYN
Advisory shoulder striping and crosswalk striping on Manitou Beach Drive
VIEW: EAST ON MANITOU BEACH DR
6'-wide, vertically separated bike lane with concrete wedge curb on both sides of Lynwood Center Road
VIEW: NORTH ON LYNWOOD CENTER RD
MANZANITA BAY
PORT ORCHARD
ELLIOTT BAY
EAGLE HARBOR
Miles 0 0.5 1

Sustainable Transportation Plan Evaluation

- Construction of all capital projects in Scenario 2 would create a strong active transportation network that connects key destinations across the island, including schools, neighborhood centers, and downtown Winslow
- Resulting mode shift could generate **600,000 new walk trips, and 1,000,000 new bike trips annually**
- Total Vehicle Miles Traveled (VMT) for Bainbridge Island could be reduced by **6%**
- Additional strategies required to further reduce VMT and achieve city's climate action goals

Additional Strategies

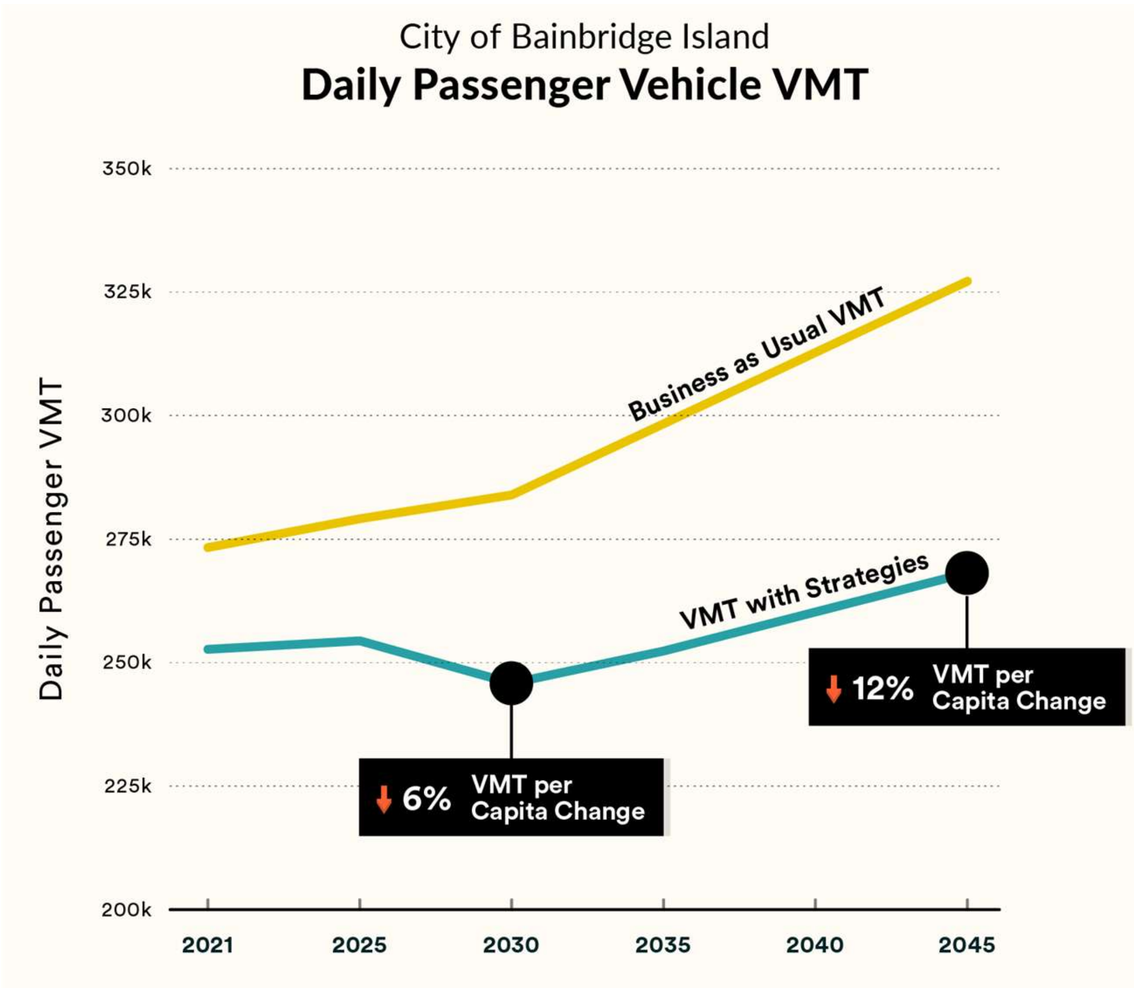
Additional strategies to reduce VMT were chosen because they:

- can be directly implemented by the City, or
- are already planned or are funded, or
- are well suited to mitigate longer vehicle trips on/off island, which contribute substantially to the city's VMT, or
- have started to emerge as a result of social and technological change

Strategy Detail

Strategy	Notes and Assumptions
STP Connecting Centers	Implement the projects and programs listed in the Connecting Centers Scenario of the STP
Transit	Increase transit options through implementation of Kitsap Transit's Long Range Plan, including new fixed-route and expanded on-demand service across the island
Telework	Maintain the increase in teleworking observed during the pandemic
Land Use – Workforce Housing	Build more multifamily housing in Winslow, with a subset of developed units designated as workforce housing
Land Use – Retail Trips	Support recent trends in ecommerce to reduce off-island single-occupancy vehicle retail trips
Parking Pricing	Charge a fee for on-street parking spaces in Winslow
Car Share	Develop a fleet of electric carshare vehicles in Winslow
E-Bike Subsidies	Provide a subsidy or rebate to households for e-bike purchases

Strategy Evaluation – Vehicle Miles Traveled



Electric Vehicle Adoption Rates

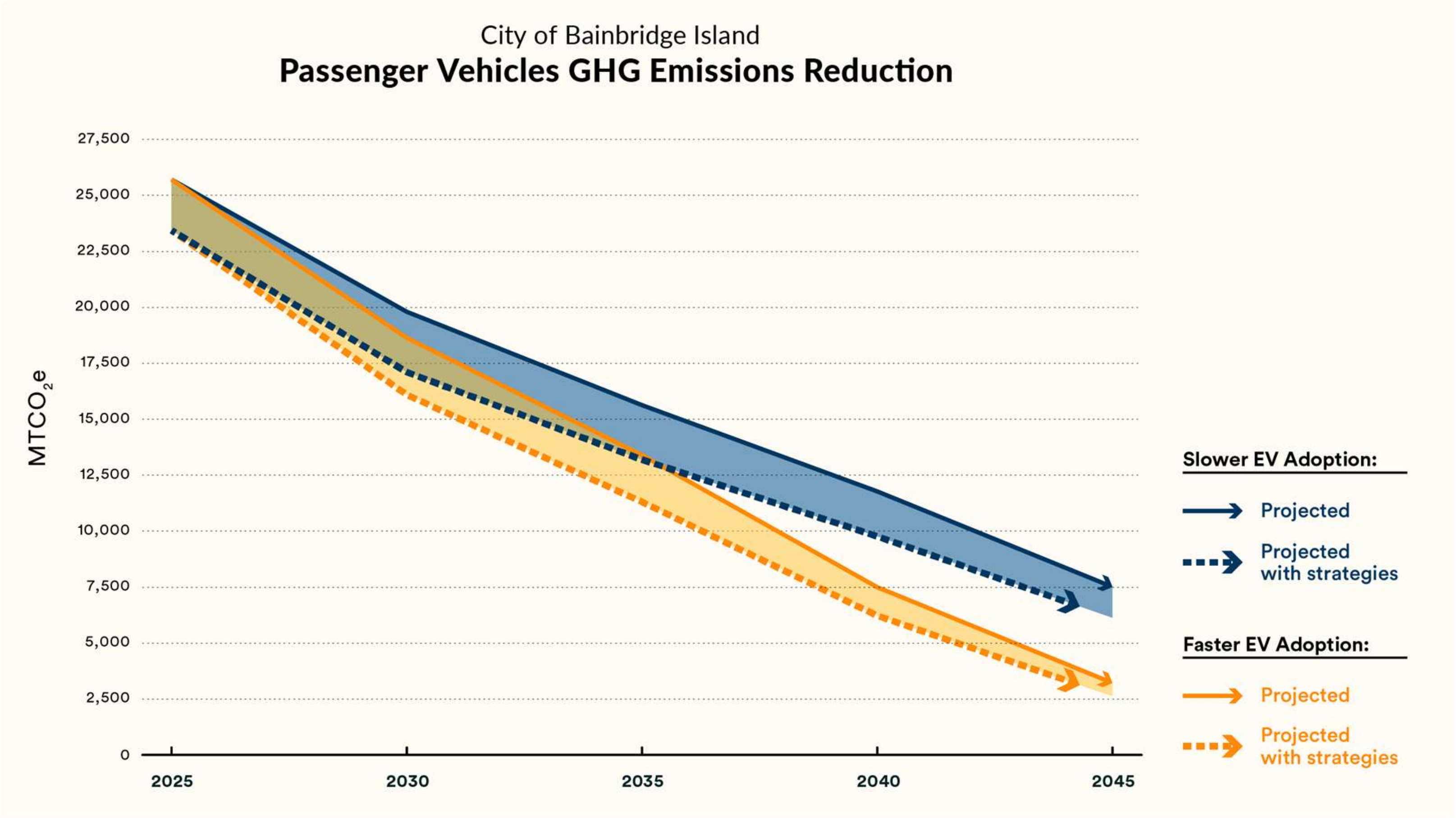
- Bainbridge has a strong foundation for rapid EV adoption, with ~3% EV passenger vehicles as of 2021, compared to <1% for Kitsap County

- WA Internal Combustion Engine Ban sets target that 100% of new vehicles sales should be EV by 2030
  - For analysis, more conservative approach used: 65% EV sales by 2030, 100% by 2035
  - Could result in ~40% EV share by 2035, and 85% by 2045

- Given uncertainties in vehicle turnover and adoption rates, we analyzed two different GHG emissions scenarios

Strategy Evaluation – GHG Emissions Reduction

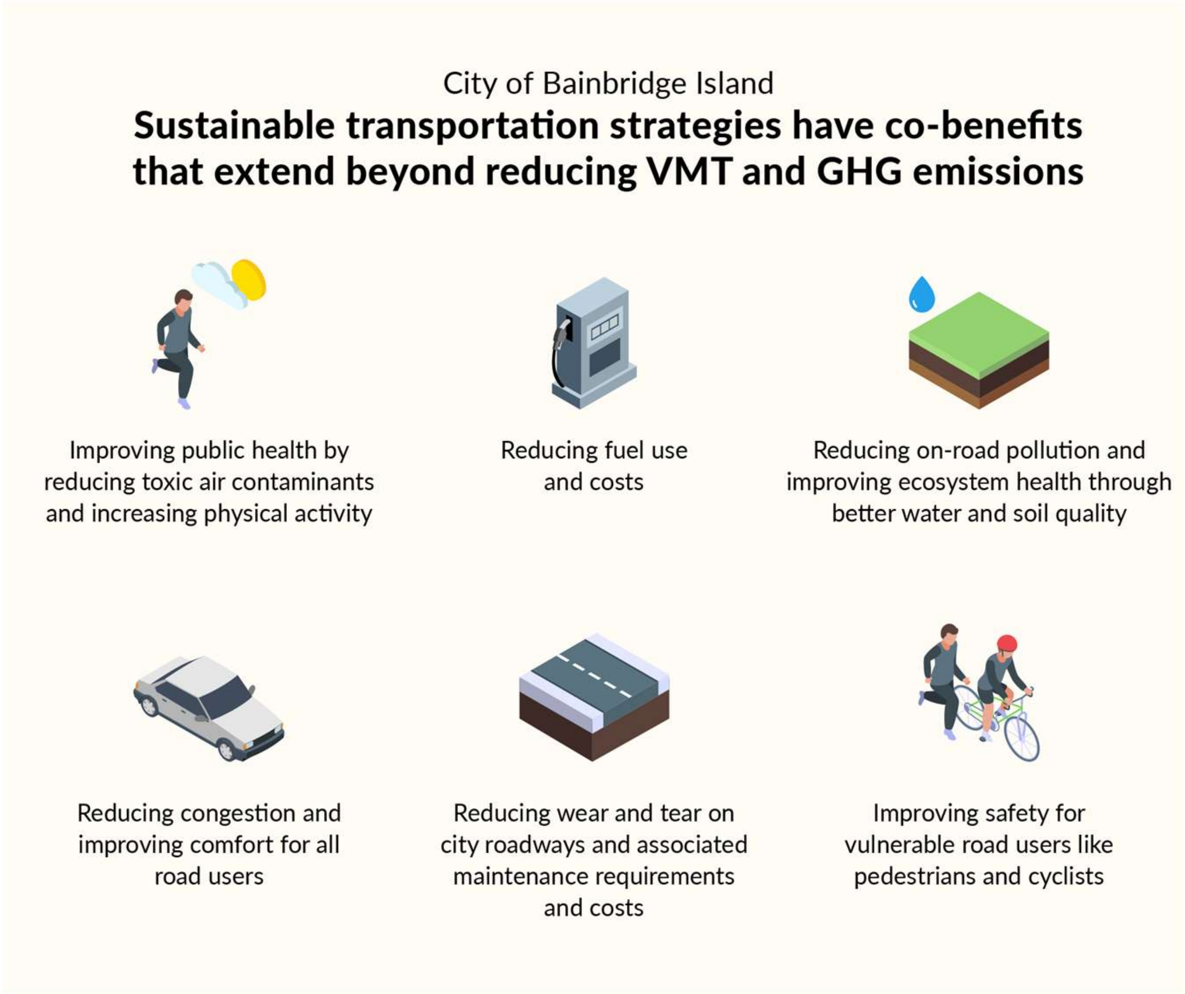
Slower EV adoption results in a greater share of internal-combustion engine vehicles within the vehicle fleet, and therefore any VMT reduction will result in a greater GHG emission reduction than a more aggressive EV adoption scenario



Transportation GHG Emissions

Action	Reduction in Greenhouse Gas emissions by 2045 from 2014 Baseline ($MTCO_2e$)	
	Climate Action Plan Goal	Estimated Reduction
VMT reduction (all strategies)	-18,000	-600 $MTCO_2$ to -1,400 $MTCO_2$
On- & off-road vehicle electrification	-18,000	-25,000 ✓
Ferry electrification	-14,000	-13,400 ✓
Air travel reduction and improved fuel efficiency	-10,000	-6,000
Total	**-60,000**	**-40,000**

Why VMT Reduction?



Bridging the gap to Climate Action Plan goals

Aggressively pursue funding and implementation of planned strategies

- STP projects & programs, Kitsap Transit investments

Begin to pursue funding and planning to implement effective strategies

- E-Bike subsidies are a strong candidate for a pilot program

Consider additional land use strategies that can reduce VMT

- Including the development of retail and housing that have the potential to reduce off-island travel

Invest in public electric vehicle charging infrastructure to meet projected demand

Continue to track VMT over time to measure progress

Executive Summary

https://arcg.is/1ffK5i

Sustainable Transportation & Greenhouse Gas Emissions

Prepared for:

The City of Bainbridge Island

August 2023

FEHR PEERS

Table of Contents

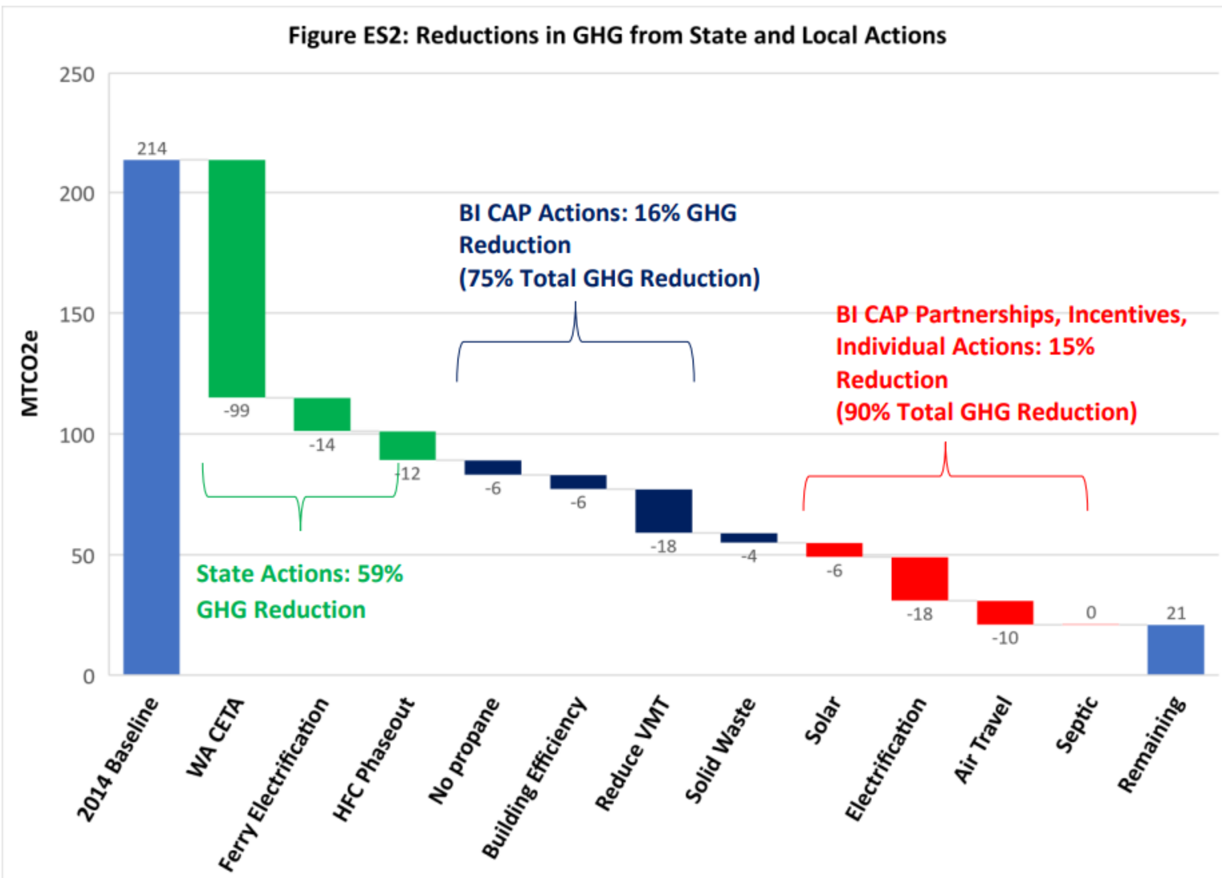
List of Figures

List of Tables

Background

In 2020, Bainbridge Island adopted their first Climate Action Plan (CAP), which is a comprehensive roadmap to reducing the City's greenhouse gas emissions (GHG) and increasing the island's resiliency against climate change.[1] The CAP outlines specific actions that the City and community should undertake, and sets specific targets for GHG emissions reduction based on a 95% reduction from the 2014 baseline, shown in **Figure 1**. Transportation, including on-road and off-road vehicles, air travel, and ferry travel, contributed over a third of Bainbridge Island community emissions in 2018, making it the second-largest contributor to the community's greenhouse gas emissions.

Figure 1: City of Bainbridge Island Climate Action Plan GHG Emissions Reduction Goals



In alignment with CAP goals to reduce Vehicle Miles Traveled (VMT) and reduce drive-alone mode share, the City completed a Sustainable Transportation Plan (STP) in 2022 to establish the long-range vision for providing a transportation system (streets, transit, trails, etc.) that improves mobility and safety for all

[1]City of Bainbridge, Climate Action Plan, https://www.bainbridgewa.gov/DocumentCenter/View/14354/Final-Bainbridge-Island-Climate-Action-Plan-November-12th-2020

users while respecting the character of neighborhoods and maintaining a climate resilient environment.[2] Scenario 2, Connecting Centers, in the STP was adopted by City Council as the preferred implementation plan.

Building on these recent plans completed by the City, Fehr & Peers has undertaken an analysis to establish 2021 VMT and associated GHG emissions for the City of Bainbridge Island and measure the GHG emissions reduction potential of the Connecting Centers scenario from the STP. Fehr & Peers' work builds on prior work completed by Cascadia Consulting Group that established a GHG inventory for the City of Bainbridge Island for two representative years – 2014 and 2018. This report covers the methodology for creating the 2021 VMT and GHG emissions inventory, and evaluation of different scenarios to determine which strategies and transportation projects will provide substantial progress towards reducing GHG emissions.

[2] City of Bainbridge, Climate Action Plan, November 2020. https://www.bainbridgewa.gov/DocumentCenter/View/15850/VISION_Sustainable-Transportation-Plan_20220204_reduced

Inventory Methodology

The scope of the 2021 inventory is limited to VMT and GHG emissions from on- and off-road transportation sources that travel within Bainbridge Island's city limits. Fehr & Peers coordinated with Cascadia Consulting Group to confirm the methodologies used in the 2018 inventory to maintain consistency in the 2021 update; any differences in methodology are explained in the sections below. 2021 is the base year for the updated inventory since it is the most recent year for which a full year of data is available.

VMT

In the 2018 inventory, the Puget Sound Regional Council (PSRC) provided VMT (scaled to the City of Bainbridge from Kitsap County totals) for passenger vehicles and medium and heavy trucks from the PSRC trip-based travel demand model.[3] This data, along with transit VMT (scaled down from annual Kitsap Transit revenue miles), is shown in the first column of **Table 1** below.

To provide a point of comparison between the previous inventory and this update, Fehr & Peers coordinated with PSRC to analyze 2021 VMT from the updated PSRC model, shown in the third column of **Table 1** below. Kitsap Transit provided 2021 annual revenue miles, which were scaled to Bainbridge Island by the same adjustment factor as the 2018 inventory for the 2021 transit VMT. This methodology assumes that the proportion of Kitsap Transit trips serving Bainbridge Island remained consistent between 2018 and 2021.

Table 1: City of Bainbridge Island Annual VMT

Source	2018 VMT[1]	Updated 2018 VMT[2]	2021 VMT[2]
Passenger Vehicle	69,543,900	69,958,200	71,942,900
Medium Truck	2,993,800	2,492,600	2,569,200
Heavy Truck	708,100	243,300	253,600
Transit	397,600	397,600	389,200
Total	**73,643,400**	**73,091,700**	**75,155,000**

Notes: PSRC provided VMT data for passenger vehicles, medium- and heavy-duty trucks. Kitsap Transit provided annual vehicle revenue miles for transit. All VMT was scaled down from Kitsap County totals to the City of Bainbridge.
1. Source: 2018 Bainbridge Island GHG Inventory.
2. Source: PSRC trip-based model, 2022.

Overall, Bainbridge saw an increase in annual VMT between 2018 and 2021, with the bulk of the VMT increase attributed to passenger vehicles. There was a large drop in heavy truck VMT between 2018 and 2021 because PSRC updated the methodology used to calculate heavy truck trips. PSRC acknowledged that the 2018 data was based on best available data at the time and provided an updated 2018 dataset based on the new methodology to compare against 2021, shown in the second column of **Table 1**.

[3] PSRC Trip-Based Travel Model: https://www.psrc.org/trip-based-travel-model-4k

Because the transit VMT is calculated from Kitsap Transit data, it remains consistent between both 2018 VMT datasets.

The difference between the two 2018 VMT totals is less than 1%; for comparison purposes, the updated 2018 VMT shown in **Table 1** will be used as the baseline since it represents the best available data. Bainbridge Island's CAP uses 2014 as the citywide baseline for their GHG mitigation goals, so slight changes to the 2018 inventory did not impact the observed trend of GHG emissions for the city.

StreetLight Data VMT

For the 2021 inventory, Fehr & Peers explored new sources of data that the City could use to track VMT changes and to provide more granular data than the PSRC model for on-road vehicles. StreetLight Data was chosen for the ability to analyze VMT from custom geographies within the island, as well as provide data from 2019 and 2021. The 2019 data was selected as a comparison against the 2018 inventory for a pre-COVID-19 validation.[4]

StreetLight Data provides the origin and destination of all vehicle trips that start or end on Bainbridge Island, so the VMT was calculated by multiplying the total vehicle trips by the average trip length observed in the data. The trip length was adjusted to account for the portion of the trip that traveled on Bainbridge roads. **Table 2** shows the comparison between the 2021 VMT provided by PSRC and the 2021 VMT calculated from StreetLight Data.

Table 2: City of Bainbridge Island 2021 Annual VMT (PSRC and StreetLight Data)

	2021 PSRC VMT	2021 StreetLight VMT
Passenger Vehicle	71,942,900	81,997,500

Source: Fehr & Peers, 2023.

The PSRC VMT is an estimate for Bainbridge Island scaled down from the VMT for all of Kitsap County in the regional trip-based model, whereas the StreetLight Data VMT is an estimate based on observed vehicle trip activity occurring on the island.[5] Therefore, the higher VMT estimate from the StreetLight Data is reasonable given the difference in data sources. By establishing the 2021 VMT inventory with StreetLight Data, the City can continue to track VMT changes over time using "Big Data". The benefits of using Big Data to track VMT include:

- Big Data is updated more regularly, and includes the ability to select specific date periods or time frames.

[4] https://www.streetlightdata.com/

[5] StreetLight Data combines Location-Based Services (LBS) data with machine learning algorithms to understand travel behavior across the country. Each month, StreetLight Data processes approximately 40 billion anonymized location records from smart phones and navigation devices in connected cars and trucks and uses machine learning to transform these records into aggregated and normalized route-based travel patterns. Vehicle trips are created from the location records by starting a trip once a device is traveling at a reasonable speed, snapping records to road network data to estimate the trip route, and establishing a trip end once the device stops moving. Data is validated using permanent traffic counters and embedded sensors, and normalized with multiple data sources, including parcel data, digital road network data, and census information to calculate vehicle volume estimates.

- Provides a greater sample size than traditional count data.
- Provides flexibility for using custom geographies and zones instead of single location counts.
- Provides ability to track entire trip and understand origin-destination patterns on and off-island.
- Data is typically cheaper than collecting traditional counts.

Transportation GHG Emissions

GHG emissions are inventoried by multiplying annual activity data (e.g., VMT) by emission factors (greenhouse gas emissions produced per mile traveled) and average fuel economy data. Emissions were calculated for on-road passenger & freight, on-road transit, air travel, ferry travel, and off-road transportation sources.

On-Road Passenger & Freight Emissions

In the 2014 and 2018 inventories, on-road passenger and freight emissions were calculated using emissions factors and fuel economy from the US Community Protocol, shown in **Table 3** and **Table 4**.[6]

Table 3: 2018 US Community Protocol Emissions Factors

Fuel Type	Emissions Factors (g CO_2/gallon)
Diesel	10,210
Propane	5,590
Gasoline	8,780

Source: Cascadia, 2018.

Table 4: 2018 US Community Protocol Fuel Economy

Vehicle Type	Fuel Economy
Gasoline Car	23.8
Gasoline Medium Truck	9.33
Diesel Medium Truck	13.81
Diesel Light Truck	17.4
Diesel Heavy Truck	6.06
Transit Bus	4.88

Source: Cascadia, 2018.

The US Community Protocol default emissions data was the best available at the time of the 2018 inventory but does not reflect changes on a year-by-year basis. Therefore, the emissions were updated for the 2021 GHG inventory using region-specific emissions data from the Puget Sound Regional Emissions Analysis (PSREA) work that Cascadia completed in August 2022.[7] The PSREA analysis calculated emissions by vehicle type by applying the PSRC activity-based travel model data[8] to the EPA's Motor Vehicle

[6] ICLEI, Greenhouse Gas Protocols, https://icleiusa.org/ghg-protocols/

[7] Cascadia, King County Countywide Geographic GHG Emissions, https://your.kingcounty.gov/dnrp/climate/documents/2022/king-county-geographic-ghg-emissions-inventory-and-wedge-report-09-2022.pdf

[8] PSRC Activity-Based Travel Model: https://www.psrc.org/activity-based-travel-model-soundcast

Emission Simulator (MOVES) model for Kitsap, King, Snohomish, and Pierce County.[9] The PSREA emissions factors and fuel economy data used in this inventory are shown in **Table 5** and **Table 6**.

Table 5: PSREA Emissions Factors

Fuel Type	2018 Emissions Factors (g CO_2/gallon)	2021 Emissions Factors (g CO_2/gallon)
Diesel	10,210	9,770
Propane	5,590	5,590
Gasoline	8,780	8,400
Electricity[1]	0.00053	0.00035

Source: Cascadia, 2022. Data derived from PSRC and MOVES model outputs.
1. Measured in $MTCO_2e$/kW, and assumed that EVs use 0.3 kW/mi.

Table 6: PSREA Fuel Economy for Kitsap County

Vehicle Type	2018 Fuel Economy (miles per gallon)	2021 Fuel Economy (miles per gallon)
Gasoline Passenger Car	22.01	22.48
Gasoline Medium Truck	10.85	11.03
Diesel Medium Truck	11.83	12.02
Diesel Passenger Truck	25.67	26.22
Diesel Heavy Truck	5.19	5.28
Transit Bus	1	1

Source: Cascadia, 2022. Data derived from PSRC and MOVES model outputs.

The PSREA data includes county-level summaries for vehicle fuel types. The passenger vehicle data was adjusted to account for a greater share of electric vehicles (EVs) registered in Bainbridge Island than Kitsap County as a whole. This breakdown of vehicles by fuel type for 2018 and 2021 is shown in **Table 7**.

Table 7: PSREA Vehicles by Fuel Type for Bainbridge Island

Year	Vehicle Type	Gasoline	Diesel	EV
2018	Passenger Vehicle	97.4%	1.1%	1.5%
2021	Passenger Vehicle	95.9%	1.1%	3.0%
2018 & 2021	Medium Trucks	67.6%	32.3%	0.0%
2018 & 2021	Heavy Trucks	0.0%	100.0%	0.0%

Source: Fehr & Peers, 2023.

From the data in **Table 5** - **Table 7**, on-road emissions for 2021, measured in metric tons of carbon dioxide equivalent ($MTCO_2e$) were calculated using the formula below:

[9] EPA MOVES: https://www.epa.gov/moves

$$VMT_{fuel\ type} \times Emission\ Factor_{fuel\ type} \times \frac{1}{Fuel\ Economy_{fuel\ type}} \times 10^{-6}$$

For 2021 GHG emissions calculations, the activity data source is:

- StreetLight Data VMT was used for passenger vehicles (from **Table 2**)
- PSRC VMT was used for freight (from **Table 1**)

On-road GHG emissions were also re-calculated for 2018, using the new VMT data from **Table 1**, and the PSREA emissions data from **Table 5** - **Table 7** to understand the impact of the new methodology on the 2018 inventory.

Table 8: On-road Passenger & Freight Emissions

Vehicle Type	Updated 2018 Emissions ($MTCO_2e$)	2021 Emissions ($MTCO_2e$)
Passenger Vehicle	27,655	29,977
Medium Truck	2,058	1,997
Heavy Truck	479	470
Total	**30,191**	**32,443**

Source: Fehr & Peers, 2023.

Based on this updated information, on-road GHG emissions increased by about 10% between 2021 and 2018 because VMT increased for passenger vehicles and medium- and heavy-duty freight on Bainbridge Island.

Transit Emissions

Kitsap Transit provided data on 2021 transit fuel consumption by fuel type (diesel/propane/gasoline). Annual fuel consumption was scaled to Bainbridge Island based on the City's population relative to Kitsap County.[10] PSREA emissions factors were then applied to fuel consumption for Kitsap County to calculate total transit emissions. The results of this analysis are shown in **Table 9.**

Table 9: Transit Emissions

Fuel Type	2021 Kitsap Transit Annual Consumption (gallons)	Emissions Factors (g CO_2/gallon)	2021 Emissions ($MTCO_2e$)
Diesel	39,187	10,210	383
Propane	18,492	5,590	100
Gasoline	14,357	8,780	121
		Total	**604**

Source: Fehr & Peers, 2023.

[10] Scaled by a factor of 0.05.

Air Travel

While air travel is not within City limits, emissions from Bainbridge Island residents flying in/out of Seattle Tacoma Airport are a significant portion of overall transportation emissions, and therefore are included in a GHG emissions inventory. Through the PSREA analysis, total emissions from air travel at Seattle Tacoma Airport were allocated to individual jurisdictions by a scaling factor based on population.

The 2018 Bainbridge Island Greenhouse Gas Emissions Inventory determined that emissions from Bainbridge Island residents' air travel were 31,002 $MTCO_2e$ in 2018. For the 2021 inventory, air travel emissions were determined by applying the percent change in total landings at Seattle Tacoma Airport between 2018 and 2021.

Total landings decreased 14% by 2018 and 2021, falling from approximately 216,000 total landings in 2018 to approximately 185,000 total landings in 2021. Applying the 14% decrease in total landings to 2018 emissions results in 2021 emissions of 26,581 $MTCO_2e$. The emissions factor for jet kerosene (9.75 kg CO_2/gal) was obtained from ClearPath.

Ferry Travel

Ferry emissions were determined by analyzing the change in fuel consumption between 2018 and 2021. To calculate fuel consumption, the total cost of fuel for the Seattle-Bainbridge Island Ferry route in 2021 was divided by the average price of diesel per gallon for west coast states (excluding California) from the U.S. Energy Information Administration, as shown in **Table 10**. Between 2018 and 2021, total fuel consumption decreased by 25% due to fewer trips on the Seattle-Bainbridge Island Ferry route during COVID-19.

Table 10: Seattle-Bainbridge Island Ferry Fuel Consumption

	2018	2021
Total Fuel Cost	$7,382,000	$5,771,000
Average Cost per Gallon	$3.36	$3.48
Fuel Consumed (Gallons)	2,200,950	1,659,605
CO_2 emissions factor (MT/MMBTu)	0.0739	0.0739

Source: Fehr & Peers, 2023.

The 2018 Bainbridge Island Greenhouse Gas Emissions Inventory determined that emissions from ferry travel were 11,334 $MTCO_2e$ in 2018. Applying the same emissions factors to 2021 fuel consumption results in total GHG emissions of 8,550 $MTCO_2e$.

Off-Road

Off-road emissions (including emissions from agriculture, construction, lawn/gardening, and recreational vehicles) were scaled from the 2018 Bainbridge Island Greenhouse Gas Emissions Inventory by the change in the population on Bainbridge Island between 2018 and 2021.

The 2018 Bainbridge Island Greenhouse Gas Emissions Inventory determined that off-road emissions were 10,331 $MTCO_2e$ in 2018. Between 2018 and 2021, Bainbridge Island's population increased by 2.1% from 24,060 to 24,556. Applying the 2.1% increase to 2018 emissions results in 2021 emissions of 10,544 $MTCO_2e$.

Total GHG Emissions

Emissions are measured in $MTCO_2e$ and are shown in **Table 11** below.

Table 11: City of Bainbridge Island Total Transportation Emissions

Source	2014 Emissions – Baseline ($MTCO_2e$)	2018 Emissions ($MTCO_2e$)	Updated 2018 Emissions ($MTCO_2e$)	2021 Emissions ($MTCO_2e$)
On-road Passenger & Freight	27,448	27,330[1]	30,191[2]	32,443
On-road Transit	590	781	781	604
Air Travel	24,023	31,002	31,002	26,581
Ferry Travel	14,051	11,334	11,334	8,550
Off-road	9,204	10,331	10,331	10,544
Total	**75,316**	**80,778**	**83,639**	**78,723**

1. Source: 2018 Inventory
2. Uses new 2018 VMT from PSRC, and PSREA emissions factors

Source: Fehr & Peers, 2022.

Since 2014, total transportation-related GHG emissions have been increasing on Bainbridge Island. In 2020, the COVID-19 pandemic severely restricted travel across all modes. Across the region, the transit service was cut by all agencies, including Kitsap Transit and Washington State Ferries, and vehicle mode share increased as travel demand began to rebound in late 2020 and into 2021. Because of these factors, total GHG emissions for transportation on Bainbridge Island are less than 2018, primarily because of reductions in air and ferry travel, but still represent an increase from the 2014 baseline.

VMT & GHG Emissions Reduction Evaluation

Travel Markets

To identify the most effective recommendations to reduce VMT and GHG emissions, Fehr & Peers conducted a travel market assessment to identify the key travel markets for trips into and out of Bainbridge Island. Understanding the travel markets helps to identify which trip types would be most affected by VMT reduction strategies and projects. Fehr & Peers used StreetLight Data to understand the origin-destination patterns of the following travel markets:

- Residents
- Employees
- Local visitors (non-ferry trips)
- Ferry visitors & thru-travel

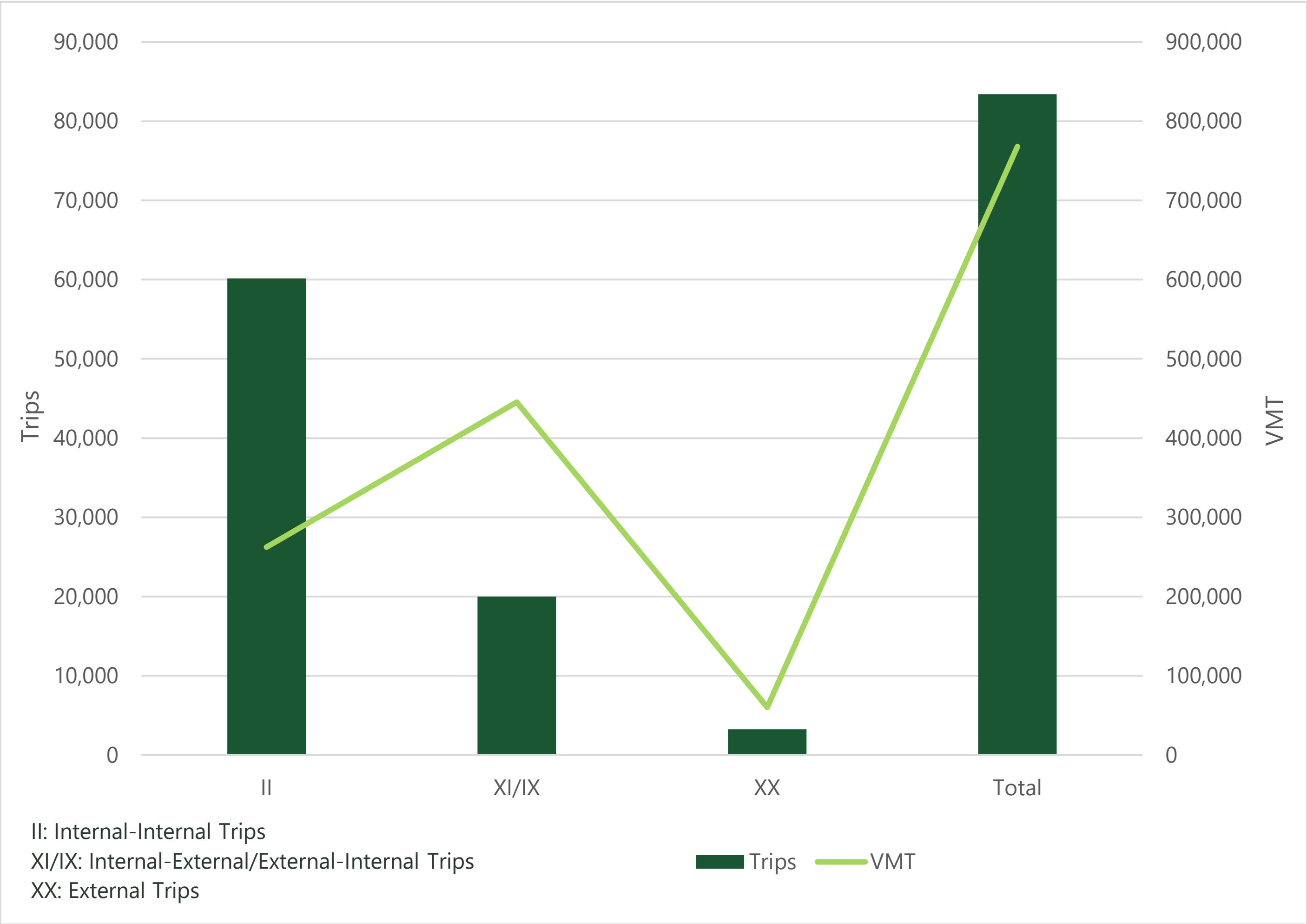
City staff provided input on defining the input geographic zones used in StreetLight's origin-destination analysis, shown in **Figure 2** (one additional zone was drawn around the Seattle Ferry Terminal).

Figure 2: Input StreetLight Zones

Fehr & Peers summarized the average total weekday vehicle trips on Bainbridge Island using Tuesday, Wednesday, and Thursday as representative days from 2021 for each zone shown in **Figure 2**. Leveraging the origin-destination data for each zone, Fehr & Peers calculated total VMT by multiplying the average trip length from a zone by the total average vehicle volume. **Figure 3** breaks out vehicle trips and VMT on Bainbridge Island based on their start and end location, where internal-internal trips start and end on Bainbridge Island, external-internal trips either start or end on Bainbridge Island, and external-external trips are visitor thru-trips to/from the ferry that pass-through Bainbridge Island.

The majority of vehicle trips on Bainbridge Island are short distance internal-internal trips; internal-internal trips are almost 70% of total trips but contribute to less than 50% of total VMT. Moreover, XI/IX trips are the greatest contributor to total VMT as the average trip length is much longer than most internal trips.

Figure 3: Average Daily Vehicle Trips & VMT (2021)



Validation Data

To create the City's travel markets from the StreetLight origin-destination data, multiple datasets were referenced, including:

- American Community Survey (ACS) 2021 Population and Household Estimates[11]
- Longitudinal Employer-Household Dynamics (LEHD) OnTheMap Employment Data[12]
- Puget Sound Regional Council (PSRC) 2017-2019 Household Travel Survey[13]
- Washington State Ferry (WSF) Data
    - Passenger Origin-Destination Survey[14]
    - 2021 Seattle-Bainbridge Island Ridership Data[15]

The sections below describe the methodology used to create each travel market, and how the data sources above were applied. The travel markets were analyzed in the order described below, using the total trips shown in **Figure 3**. All vehicle trips from each subsequent travel market were subtracted from the total. Therefore, the total vehicle trips are equal to the ferry trips + employee trips + resident trips + local visitor trips.

Ferry Trips

Using the ferry zones defined in the StreetLight analysis, total vehicle trips to/from the Bainbridge Island Ferry Terminal were scaled based on the average daily vehicle boarding data for the route from WSF's ridership data.

Ferry Thru-Travel

Ferry thru-trips are vehicle trips that take the Seattle-Bainbridge Island Ferry and have origins and destinations outside of the city (e.g., travelers that get on the ferry in Seattle, get off on Bainbridge Island, and continue on SR 305 to the Olympic Peninsula). These thru-trips are the sole contributor to external-external vehicle trips for the city and were included in the city's travel market inventory to understand the portion of total VMT contributed by thru-travelers. The external-external VMT is less than 10% of the average daily total, and **because the City does not have control over this travel market, it will be excluded from the VMT reduction evaluation**.

Ferry thru-trips were identified by analyzing the origins and destinations of vehicle trips from both the Bainbridge Island and Seattle Ferry Terminals. StreetLight characterizes a "trip end" when a device is generally stationary for more than 5 minutes; therefore, all vehicle trips "end" at each ferry terminal. Therefore, trips that start elsewhere in Kitsap County or on the Olympic Peninsula, and end at the Bainbridge Island Ferry Terminal, are thru-trips that are destined for Seattle. The WSF Passenger Origin-Destination Survey provided a calibration source, which summarized passenger survey origin-destination data for the Seattle-Bainbridge Island route. The survey results indicated that about 30% of trips on the

[11] https://data.census.gov/
[12] https://lehd.ces.census.gov/applications/help/onthemap.html#!what_is_onthemap
[13] https://www.psrc.org/our-work/household-travel-survey-program
[14] https://wsdot.wa.gov/sites/default/files/2021-10/WSF-2013OriginDestinationSurvey-FullReport.pdf
[15] https://wsdot.wa.gov/travel/washington-state-ferries/about-us/washington-state-ferries-planning/traffic-statistics

ferry route end outside of Bainbridge Island, a value used to factor the StreetLight data to normalize to total vehicle volumes.

Local Ferry Travel

After subtracting the ferry thru-trips from the total ferry-related vehicle trips on Bainbridge Island, the remaining vehicle trips were classified as "internal-internal", since the trips start and end on the island. The local ferry trips were then split out into resident, employee, and local visitor trips, which are described in more detail in the following sections.

Employee Trips

Bainbridge Island has two unique components to their employee travel market: most people who live on Bainbridge Island work elsewhere, and most employees who work on Bainbridge Island live elsewhere. Therefore, these two populations were kept separate for analysis, and added together for total employee trips and VMT.

Employment data from LEHD OnTheMap was used to identify where residents of Bainbridge Island work (majority of residents worked in Seattle/Bellevue metro area, or on Bainbridge Island), and where employees of Bainbridge Island live (majority of employees commuted from elsewhere in Kitsap County, like Poulsbo or Silverdale).

For any employee with a job destination accessible by the Seattle-Bainbridge Island Ferry, a ferry terminal-specific mode split was applied to understand the number of vehicle trips to the terminal each day. This mode split was determined by the number of available parking spaces, Kitsap Transit ridership data, and citywide mode share data from the PSRC Household Travel Survey. Then, the employee trips taken by vehicle to/from the Bainbridge Island Ferry Terminal were subtracted from the local ferry trips, previously calculated above.

All other employee trips pertained to employees that either lived and worked on Bainbridge Island, or commuted from elsewhere in Kitsap County. Employee trips within Bainbridge Island or to the ferry terminal were multiplied by the distribution of internal-internal trip lengths to get VMT. For employees commuting from off-island, trips were multiplied by the average distance to the cities identified in the LEHD data.

Figure 4 shows the total daily employee vehicle trips and associated VMT, and **Figure 5** shows the distribution of these trips by trip length. From Figure 4 and Figure 5, the bulk of employee VMT is due to employees commuting from off-island.

Figure 4: Employee Vehicle Trips & VMT (2021)

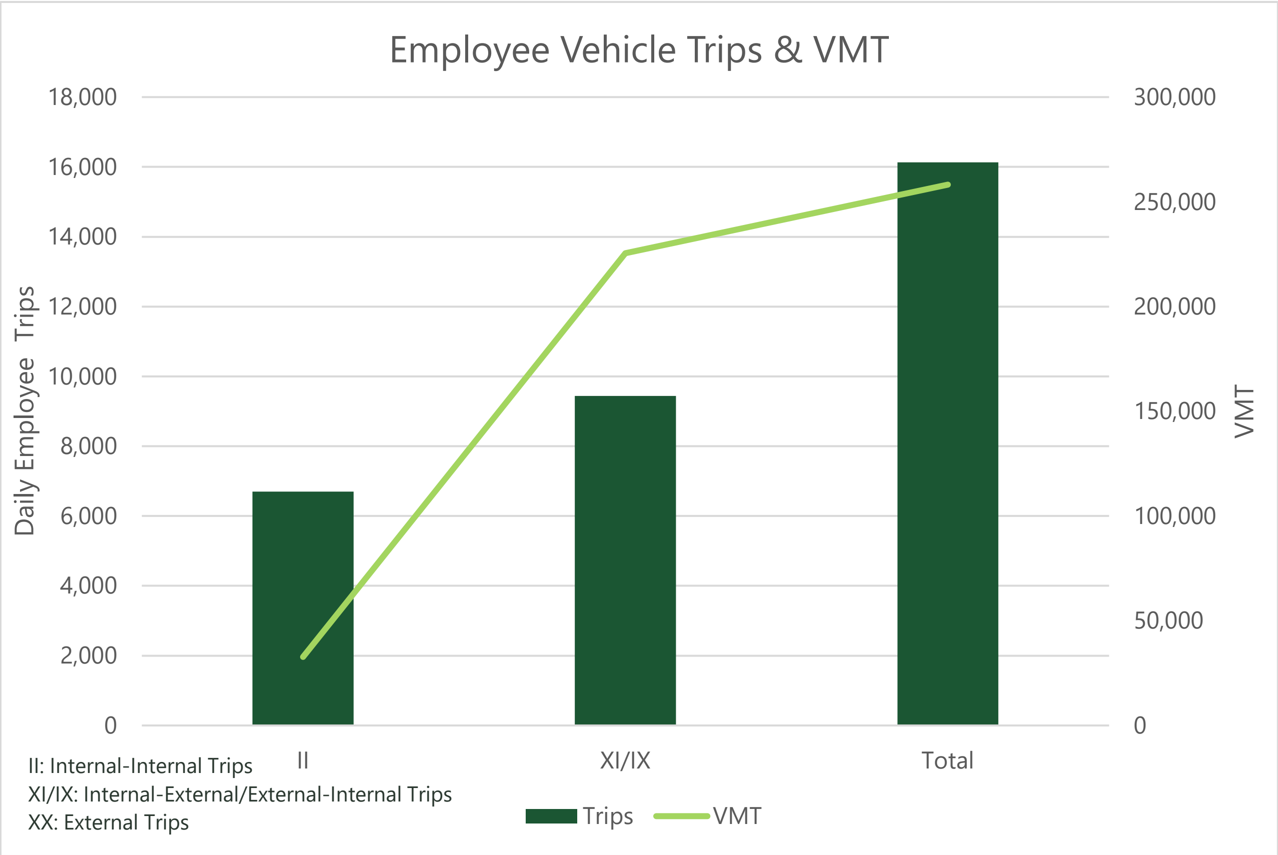
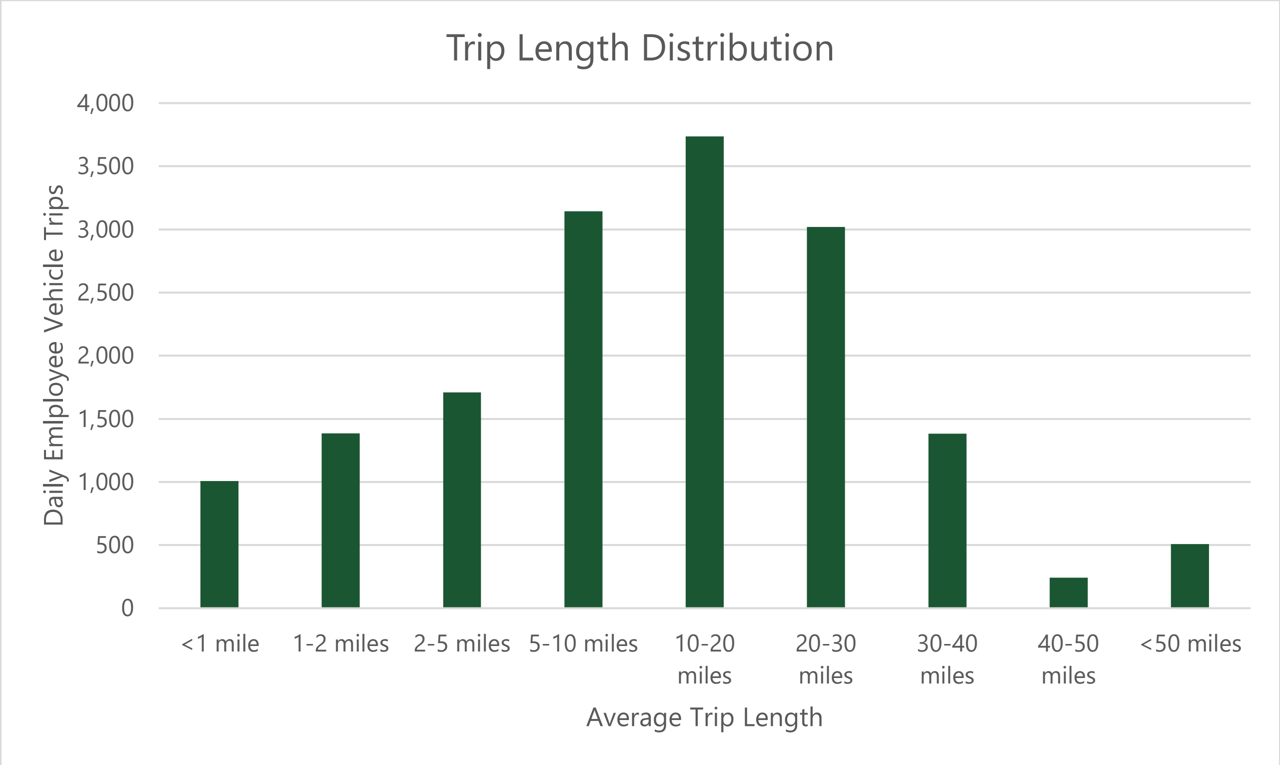


Figure 5: Employee Vehicle Trips by Trip Length



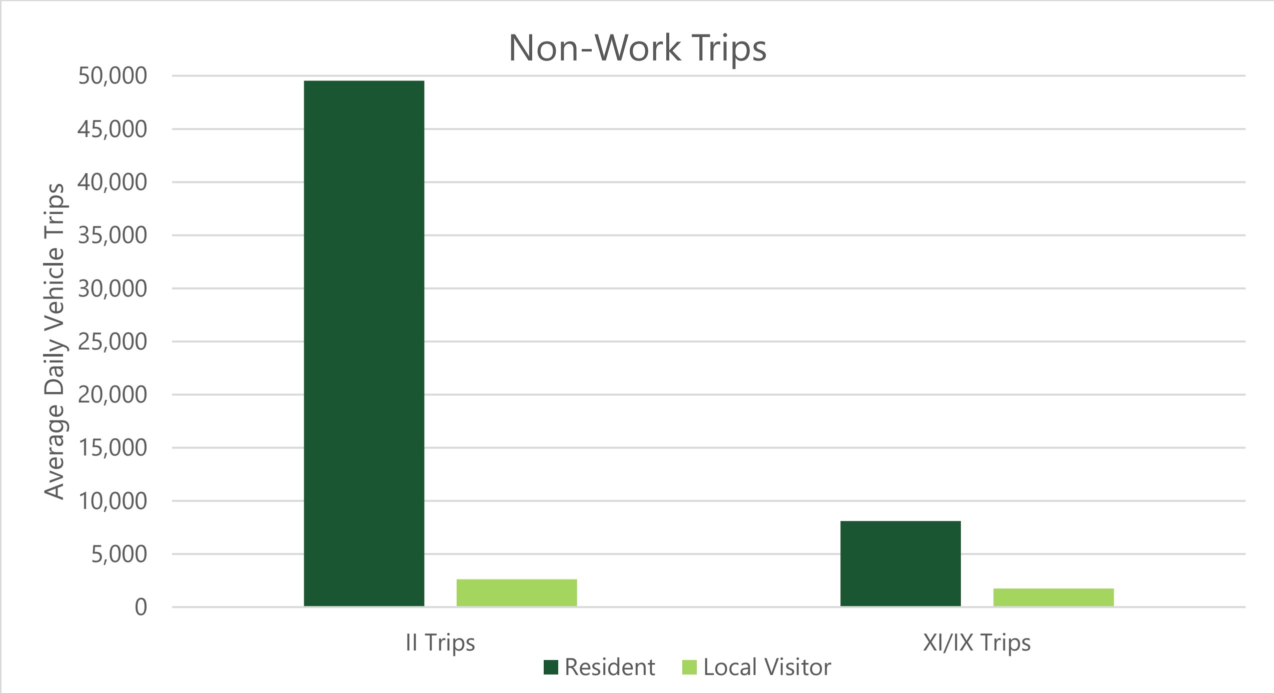
Remaining Ferry Trips

After subtracting the ferry thru-trips and employee vehicle trips from the overall total vehicle trips associated with the Bainbridge Ferry Terminal, the remaining trips were assumed to be from residents and local visitors. WSF's Passenger Origin-Destination Survey also includes information about trip purpose, such as school trips and social/recreation trips. From this data, along with mode share information from the PSRC Household Travel Survey for residents of Bainbridge Island, about 80% of the remaining ferry-related vehicle trips could be attributed to residents (this includes pick-up/drop-off and parking at the ferry terminal), and about 20% to visitors (many visitors do not bring their car onto the ferry, and therefore are a much higher proportion of walk-on ferry passengers).

Resident and Non-Ferry Local Visitor Trips

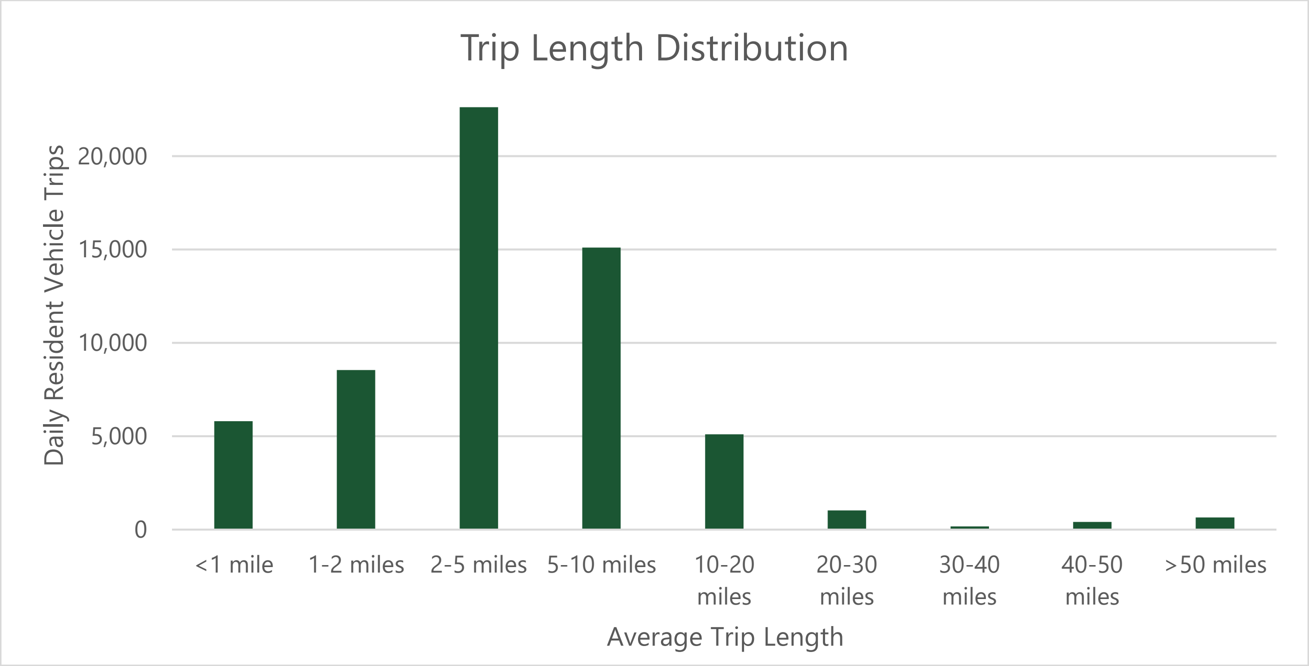
After subtracting the leftover ferry trips from the total, all remaining vehicle trips are from residents and local (Kitsap County) visitors. To analyze the trip split between residents and visitors, the PSRC Household Travel Survey was used to understand both vehicle trip rates and trip length by trip purpose. The PSRC data showed that on average, a person took approximately two non-work vehicle trips per day. This trip rate was multiplied by the 2021 Bainbridge Island population to split out the resident non-work trips from a combined non-work resident/visitor total. **Figure 6** shows the breakdown of resident and local visitor vehicle trips.

Figure 6: Resident and Local Visitor Non-Work Vehicle Trips (2021)



The PSRC survey data was used to calibrate the trip lengths for the vehicle trips taken by residents and visitors to/from Kitsap County. Since this travel market excludes work trips, Fehr & Peers filtered the trips by trip purpose from the PSRC survey, and only included school, errand/shopping, and social/recreation trips to/from Bainbridge Island. The trip length data was then used to calculate VMT for the resident and local visitor travel market. **Figure 7** shows resident (non-work) vehicle trips by trip length.

Figure 7: Resident Vehicle Trips by Trip Length

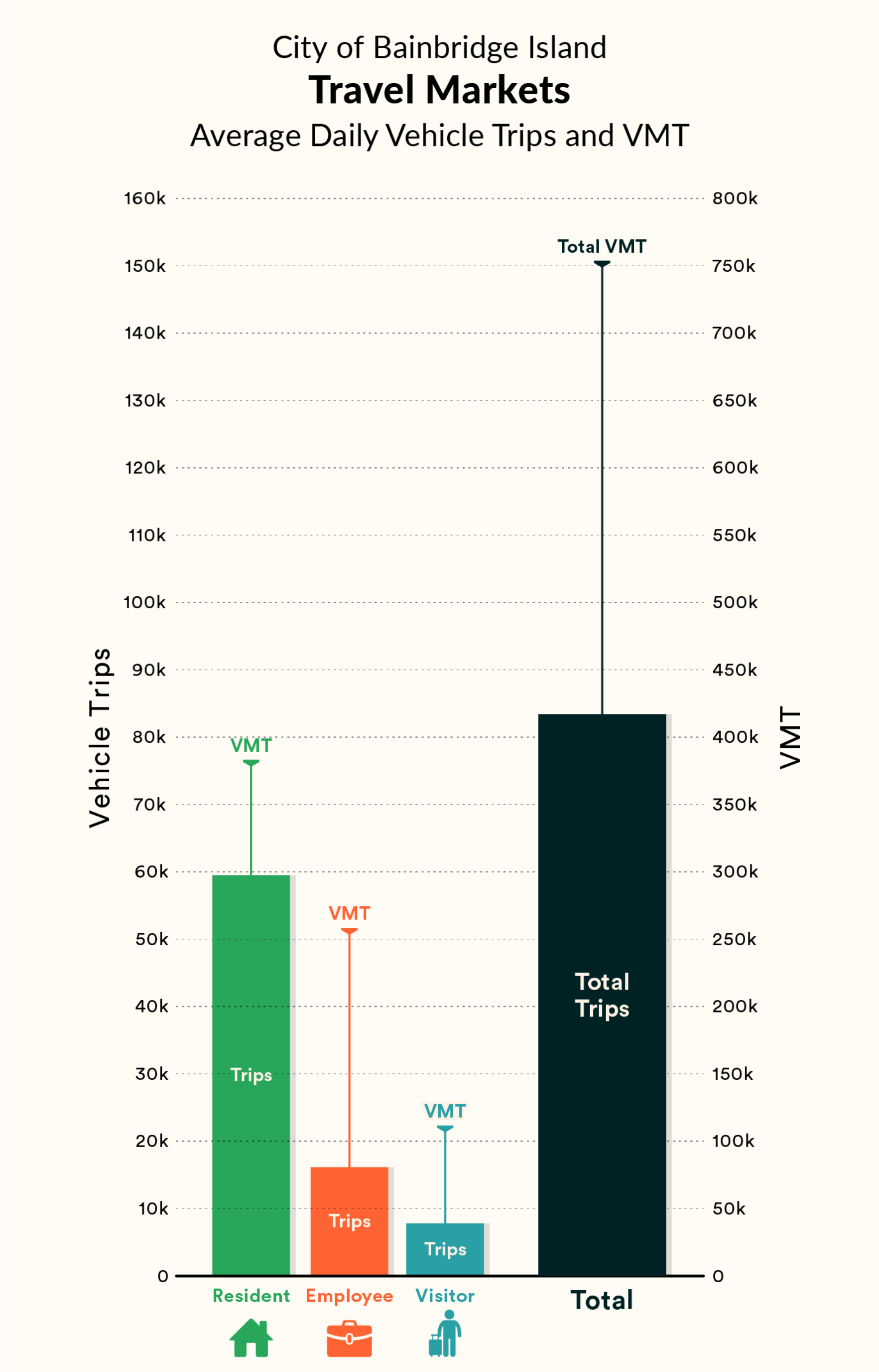


As an additional source of validation, Fehr & Peers obtained average daily traffic (ADT) data from WSDOT for the Agate Passage Bridge to calibrate the total number of XI/IX/XX trips to/from Bainbridge Island in 2021. The 2021 ADT was about 21,000, which is consistent with the sum of XI/IX/XX trips across all travel markets.

Travel Market Summary

Figure 8 combines vehicle trips and associated VMT across all the city's travel markets. **This summary identifies the travel markets that contribute the most to VMT, and subsequently, which travel markets should be prioritized for VMT reduction strategies.** The greater level of detail of the markets and their impact on VMT informed the evaluation of potential VMT reduction strategies. For example, strategies like teleworking would only influence employee VMT, whereas e-bike subsidies would most impact resident VMT.

Figure 8: Travel Market Summary



GHG Emissions Wedge Analysis

New state and federal transportation-related legislation has been passed since GHG emissions were last measured for the Island in 2018, including legislation targeted at reducing GHG emissions through improved fuel standards, reduced fuel carbon intensity, and electrification targets. A "wedge analysis" evaluated the impact of these policies on future transportation emissions in Bainbridge Island. The analysis developed GHG emissions estimates under a "Business-as-Usual" scenario, where no action is taken to reduce emissions, and a "Projected" scenario, that accounts for future emissions based on implementation of Federal, State, Regional, and sector-specific policies.

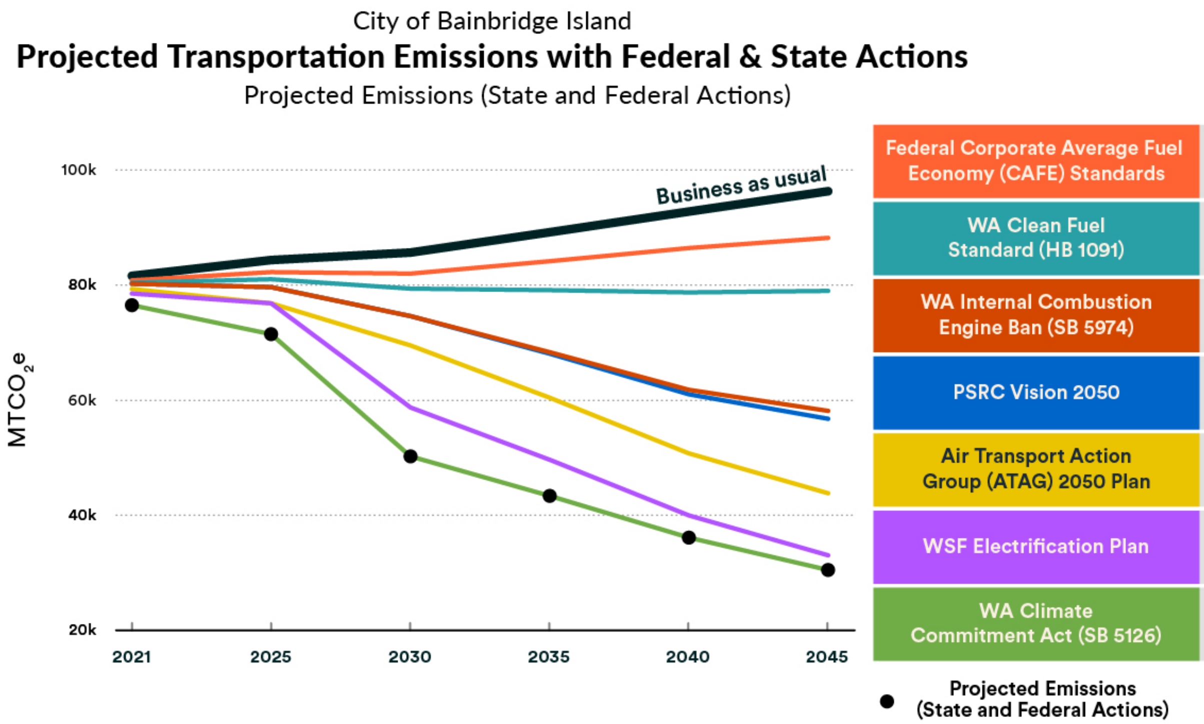
The Business-as-Usual and Projected emissions scenarios were developed using the PSREA analysis provided by Cascadia Consulting Group that forecasts future emissions for King, Kitsap, Pierce, and Snohomish counties based on a 2014 baseline across five sectors – built environment, transportation and other mobile sources, solid waste and wastewater, land use, and refrigerants.

The wedge analysis considers the following state and federal policies as well as industry specific plans that are expected to impact GHG emissions from transportation sources:

- **Federal Vehicle Regulations (CAFE standards)** mandate improved fuel economy standards for passenger cars and light trucks and require an industry-wide fleet average of approximately 49 mpg for passenger cars and light trucks by 2026.
- **WA Clean Fuel Standard (HB 1091)** requires a 20% reduction in carbon intensity of transportation fuels by 2038 as compared to a 2017 baseline.
- **WA Internal Combustion Engine Ban (SB 5974)** establishes a target that 100% of new vehicle sales are electric by 2030.
    - Because this is a current target, not a mandate, the PSREA work defined a more conversative approach, which assumes 65% of new vehicle sales are EV by 2030, and 100% by 2035.
- **WA Climate Commitment Act (E2SSB 5126)** places an economy-wide cap on carbon to meet the State's GHG emissions reduction targets. The act impacts transportation emissions by regulating transportation fuels.
- **Air Transport Action Group 2050 Plan** aims to achieve net zero aviation operations by 2050 through efforts that include technology advancements, infrastructure improvements, and sustainable aviation fuels.
- **Washington State Ferry (WSF) System Electrification Plan** will electrify the WSF system, including the ferry between Bainbridge Island and Seattle, which is anticipated to be electrified by 2027.
- **Puget Sound Regional Council (PSRC) Vision 2050** is the blueprint for the region's transportation vision, programs, and infrastructure projects over the next 30 years and provides future VMT estimates for the region.

The cumulative impact of each of these policies to reduce transportation emissions below the 2021 baseline of 80,000 $MTCO_2e$ is shown in **Figure 9.**

Figure 9: Impact of state and federal policies and regional/industry plans



PRSEA developed emissions estimates under "Business-as-Usual" and "Projected" scenarios for cities and counties in the Puget Sound region through 2050. Fehr and Peers worked with Cascadia Consulting to update the Kitsap County Business-as-Usual and Projected scenarios for Bainbridge Island using emissions inventory data specific to Bainbridge for 2014, 2018, and 2021.

To determine future emissions for Bainbridge Island under the "Business-as-Usual" and "Projected" scenarios, Fehr & Peers calculated the percentage change in emissions for Kitsap County for each transportation subsector between 2021 and each horizon year, as shown in **Table 12** and **Table 13,** and applied that percentage change to the Bainbridge Island inventory.

Table 12: Change in Emissions vs. 2021 Under Business-as-Usual Scenario

Transportation Subsector	2021 Emissions ($MTCO_2e$)[1]	2025		2030		2035		2040		2045	
		Pct Change	$MTCO_2e$	Pct Change	$MTCO_2e$	Pct Change	$MTCO_2e$	Pct Change	$MTCO_2e$	Pct Change	$MTCO_2e$
On-Road Vehicles	35,960	1%	36,600	3%	37,240	8%	39,030	13%	40,820	18%	42,580
Off-Road Equipment	10,540	1%	10,300	3%	10,480	8%	10,980	13%	11,480	18%	11,980
Aviation	26,580	1%	26,160	3%	26,610	8%	27,890	13%	29,170	18%	30,430
Ferries	8,550	1%	11,330	0%	11,330	0%	11,330	0%	11,330	0%	11,330

1. 2021 emissions under the business-as-usual scenario do not consider any improvements to fuel efficiency or electric vehicle adoption.

Source: Fehr & Peers, 2023

Table 13: Change in Emissions vs. 2021 Under Projected Scenario

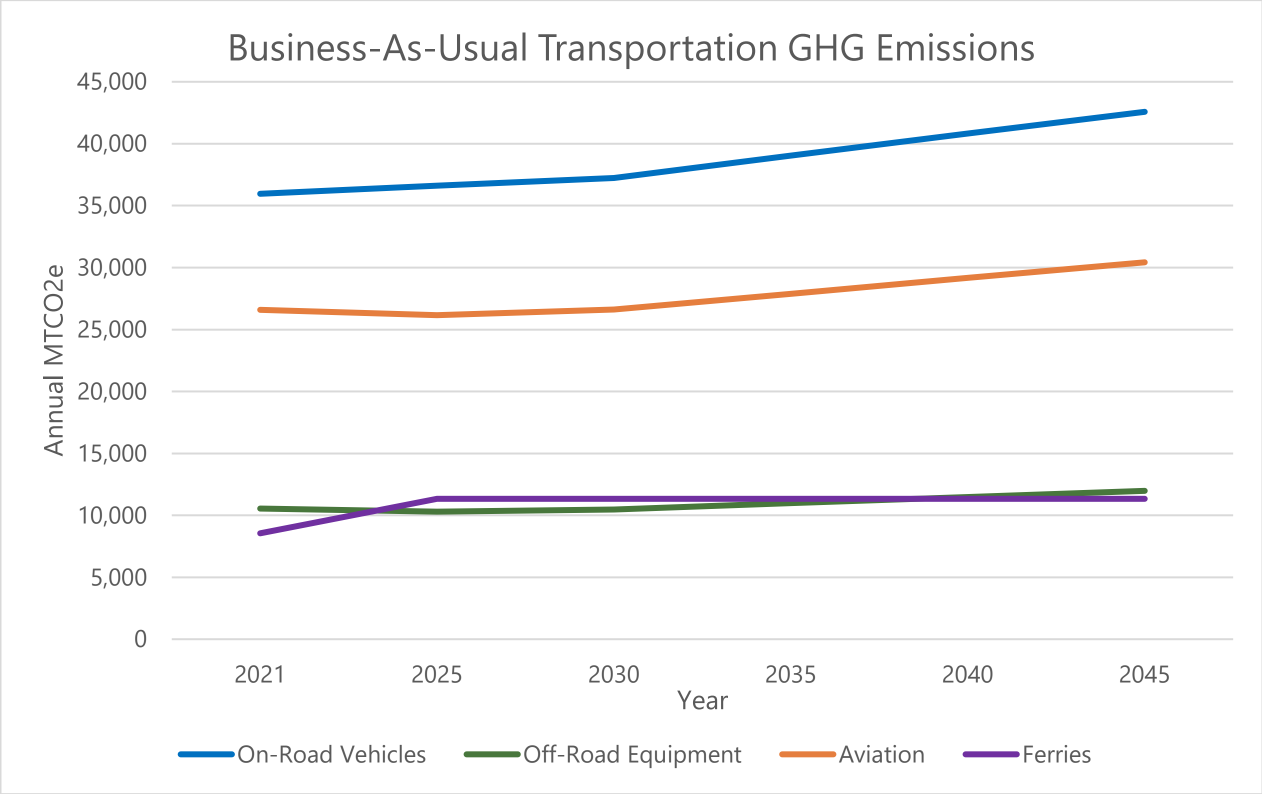
Transportation Subsector	2021 Emissions ($MTCO_2e$)[1]	2025		2030		2035		2040		2045	
		Pct Change	$MTCO_2e$	Pct Change	$MTCO_2e$	Pct Change	$MTCO_2e$	Pct Change	$MTCO_2e$	Pct Change	$MTCO_2e$
On-Road Vehicles	33,050	-14%	27,860	-36%	20,180	-52%	14,530	-68%	8,660	-95%	4,120
Off-Road Equipment	10,090	-8%	8,980	-18%	8,010	-17%	8,040	-17%	8,040	-14%	8,380
Aviation	25,610	-6%	23,340	-14%	21,470	-19%	20,220	-24%	18,870	-30%	17,430
Ferries	7,780	10%	11,330	-95%	570	-95%	570	-95%	570	-95%	570

1. 2021 emissions under the projected scenario are slightly lower than emissions under the 2021 business-as-usual scenario because the projected scenario accounts for existing actions that reduce emissions, including improved fuel efficiency and electric vehicle adoption.

Source: Fehr & Peers, 2023

Figure 10 illustrates future transportation emissions under the Business-as-Usual scenario.

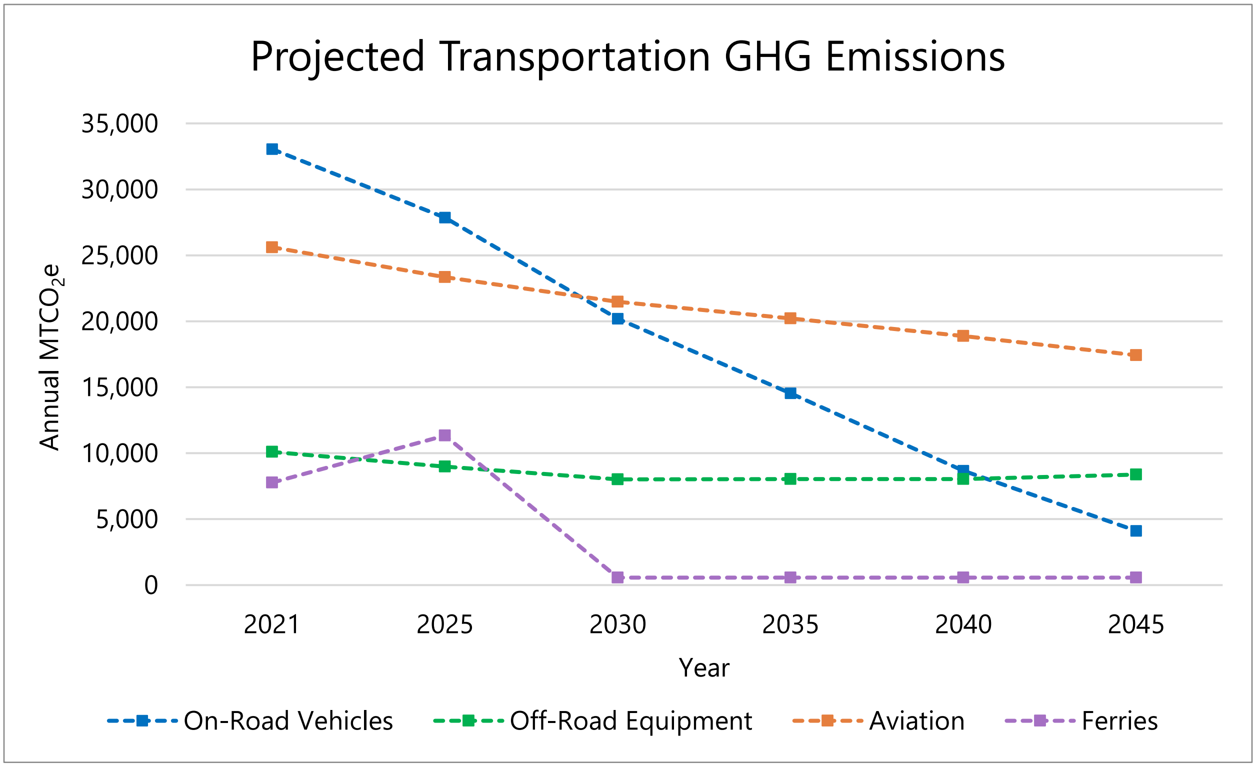
Figure 10: Transportation Emissions Under Business-as-Usual Scenario



Under this scenario, emissions from on-road vehicles, aviation, and off-road equipment are all projected to increase through 2045. The Business-as-Usual Scenario assumes that ferry service and fuel efficiency remain fixed at 2018 levels, and as a result ferry emissions are projected to level off in 2025. A dip in transportation emissions across all modes was observed in 2021 due to Covid-related declines in travel.

Figure 11 illustrates future transportation emissions under the Projected Scenario.

Figure 11: Transportation Emissions under Projected Scenario



Under the Projected scenario, emissions from on-road vehicles, aviation, off-road equipment and ferries are expected to fall below 2021 levels by 2025. Ferry emissions are projected to fall about 95% by 2030 with the expected electrification of the Bainbridge Island-Seattle Ferry in 2027.

The decrease in emissions from **on-road vehicles** is driven by three factors, outlined below:

- **Improved fuel economy:** Fuel economy for gas- and diesel-powered passenger vehicles improves 25% between 2021 and 2045. Fuel economy for both gas- and diesel-powered freight vehicles also improves about 20% between 2021 and 2045.
- **Cleaner fuel sources:** Assumes a 30% reduction in CO_2 emissions intensity for on-road fuel sources between 2021 and 2040.
- **Electrification:** Assumes about 85% of passenger vehicles are electric by 2045; electrified freight VMT increases from 5,000 miles in 2021 to 1.5M miles in 2050.

The decrease in emissions from **off-road equipment** is driven by the assumption that off-road equipment (such as lawn equipment and construction) will also utilize cleaner fuel sources with a 30% reduction in CO_2 emissions intensity between 2021 and 2040.

The decrease in emissions from **aviation** is driven by two factors:

- **Cleaner fuel sources:** Assumes a 32% decarbonization of jet fuel and aviation gasoline by 2045 as compared to a 2021 Business-as-Usual Scenario.
- **Innovation:** Assumes a 16% reduction in jet fuel consumption by 2045 as compared to the 2045 Business-as-Usual Scenario from improvements in technology, operations, and infrastructure.[16]

The decrease in emissions from the **ferry** is driven by the assumption that the Bainbridge Island-Seattle Ferry will be electrified by 2027. Consequently, GHG emissions from the ferry are projected to fall about 95% by 2030.

The wedge analysis shows that while federal and state policies will significantly reduce transportation-related GHG emissions over the next 20 years, additional local efforts are needed to meet the City's emissions reduction target. Furthermore, these policies rely on aggressive electric vehicle adoption rates that may not be feasible given vehicle costs, charging constraints, and range limitations.

Bainbridge Island has high rates of electric vehicle adoption compared to Kitsap County[17], which provides a strong foundation for rapid EV adoption, a key component of projected reductions in transportation emissions for the city. However, other CAP goals, such as a 25% reduction in VMT per capita by 2030 and a 50% reduction by 2045, cannot be addressed by electrifying passenger vehicles. Recognizing the additional benefits from VMT reduction beyond GHG emissions (improved safety, expanded options, etc.), Fehr & Peers analyzed the recently adopted Sustainable Transportation Plan to understand the VMT and GHG reduction potential and to identify additional strategies to achieve the CAP goals. A description of the methodology and results of the analysis is described in the next section.

[16] Based on actions identified in the Airport Transport Action Group 2050 Plan.

[17] Approximately 3% of passenger vehicles on Bainbridge Island were electric in 2021, compared to less than 1% all vehicles in Kitsap County

Sustainable Transportation Plan

Building on actions outlined in the CAP, the City developed a Sustainable Transportation Plan (STP) in 2022, which identifies transportation projects that support the City's GHG emission reduction goals, improve transportation safety, and expand mobility options for people traveling on Bainbridge Island. The projects in the adopted STP[18] were classified into three categories: walking/rolling/biking projects, transit and mobility projects, and non-infrastructure (programmatic) support. Fehr & Peers evaluated the potential VMT reduction from the STP projects and identified additional strategies that could further support the City's climate action goals.

Evaluation of Infrastructure Improvements

Fehr & Peers used mode share data to determine the VMT and GHG emissions reduction potential of walking, rolling, and biking projects in the STP. **Table 14** shows the existing mode share in Bainbridge Island, which is heavily skewed towards private vehicle trips. Because of the island's geographic size and development patterns, most vehicle trips are between two to six miles. These shorter vehicle trips are well suited to be replaced by walking or biking trips, provided the City continues to build out a more comprehensive multimodal network.

Table 14: Existing Citywide Mode Share

Mode	Existing Mode Share[1]
Drive	84%
Transit[2]	7%
Walk	8%
Bike	1%
Total	**100%**

1. PSRC Household Travel Survey 2017-2019, includes all trips that start or end on Bainbridge Island
2. Includes bus, vanpool, and ferry trips

Fehr & Peers used Geographic Information Systems (GIS) files provided by the City to map and determine the length of new bikeways, sidewalks, and roadways with traffic calming projects that would be added to Bainbridge's multimodal network after construction of the STP Connecting Centers, shown in **Table 15**.

Table 15: Existing and Future Multimodal Networks

Network	Existing Miles	STP Project Miles	Future Miles
Bicycle Network	23	23	46
Pedestrian Network	50	14	64
Traffic Calmed Roads	23	13	36

Source: Fehr & Peers, 2023

[18] Scenario 2: Connecting Centers

The STP projects will more than double the city's existing bikeway network and increase the sidewalk network by almost 30%. The traffic calming projects focus on improvements near schools and parks, and many of these projects provide shoulder enhancements to improve comfort for people biking.

The pedestrian and bicycle projects are located on arterial and collector streets and connect important points of interest across the Island, including schools, neighborhood centers, shopping, and parks. Using mode share data from other cities that were similar in terms of weather, topography, and infrastructure, construction of the STP projects to build out a strategic multimodal network could result in a future active mode share around 16% by 2035 (shown in the second column of **Table 16**).

Table 16: Future Potential Citywide Mode Share (2035)

Mode	Existing Mode Share[1]	Potential Mode Share
Drive	84%	77%
Transit[2]	7%	7%
Walk	8%	11%
Bike	1%	5%
Total	**100%**	**100%**

1. PSRC Household Travel Survey 2017-2019, includes all trips that start or end on Bainbridge Island
2. Includes bus, vanpool, and ferry trips
Source: Fehr & Peers, 2023

This change in mode share could realize up to 600,000 new annual walk trips and 1,000,000 new annual bike trips citywide. To estimate the associated VMT reduction, the change in walk trips was multiplied by an average walk distance of 1 mile, and the change in bike trips multiplied by an average bike distance of 2.5 miles. The reduction in VMT from new walk and bike trips was then divided by the total internal-internal VMT, for a total VMT reduction of about 5% from bike improvements, and 1% for pedestrian improvements.

Safe Routes to School

Safe Routes to School programs aim to reduce school related vehicle trips by making it easier for students and their families to walk or bike to school. To determine the VMT and GHG emissions reduction potential of implementing a Safe Routes to School program, Fehr & Peers drew on research compiled by the California Air Pollution Control Officers Association (CAPCOA).[19] It was determined that Safe Routes to School programming would reduce school-related VMT by 4% since Safe Routes to School programs are similar to Commute Trip Reduction Marketing (CAPCOA Measure T-5).[20]

The 4% potential VMT reduction from Safe Routes to School programming was applied to the share of school-related vehicle trips on Bainbridge Island to determine the potential trip reduction from Safe Routes to School programs. About 5% of vehicle trips on Bainbridge Island are directly related to school

[19] Transit, mobility projects, and programmatic elements are not quantified because they are not currently funded. These programmatic elements are included in the Strategy VMT evaluation in the section that follows.

[20] Defined by CAPCOA as programs to discourage single-occupancy vehicle trips and encourage alternative modes of transportation such as carpooling, taking transit, walking, and biking, thereby reducing VMT and GHG emissions.

transportation; consequently, Safe Routes to School programming has the potential to reduce total vehicle VMT in Bainbridge Island by 0.2%.

Total VMT Reduction

As shown in **Table 17**, implementing strategies from the adopted STP scenario could reduce total and per capita on-island VMT by about 6%, a value below the CAP target of 25% reduction in per capita VMT by 2030. If the City continues to expand the multimodal network and implement supporting strategies to get people traveling out of their personal car, this VMT reduction would continue to increase over time.

Table 17: VMT Reduction from STP Strategies

STP Strategy	VMT Reduction
Bike Network Improvements & Traffic Calming	-5.1%
Pedestrian Network Improvements	-0.8%
Safe Routes to School	-0.2%
Total	**-6.1%**

Source: Fehr & Peers, 2023

This estimated VMT reduction is dependent on construction of the "all ages and abilities", or low stress, multimodal network identified in the adopted STP scenario. As shown in **Figure 12**, for a bicycling network to truly support users of all ages and abilities, its most fundamental attribute should be low stress connectivity, that is, providing routes between people's origins and destinations that do not require cyclists to use roadways with undue traffic stress, such as high vehicle volumes or speeds. Building out this infrastructure is vital to supporting the mode share shift and associated VMT reductions from the additional strategies analyzed below.

Figure 12: Designing Bicycle Facilities for All Ages and Abilities[21]

All Ages & Abilities Bike Facilities are ...

Safe

More people will bicycle when they have safe places to ride, and more riders mean safer streets. Among seven NACTO cities that grew the lane mileage of their bikeway networks 50% between 2007–2014, ridership more than doubled while risk of death and serious injury to people biking was halved.[6] Better bicycle facilities are directly correlated with increased safety for people walking and driving as well. Data from New York City showed that adding protected bike lanes to streets reduced injury crashes for all road users by 40% over four years.[7]

Comfortable

Bikeways that provide comfortable, low-stress bicycling conditions can achieve widespread growth in mode share. Among adults in the US, only 6–10% of people generally feel comfortable riding in mixed traffic or painted bike lanes.[8] However, nearly two-thirds of the adult population may be interested in riding more often, given better places to ride, and as many as 81% of those would ride in protected bike lanes.[9] Bikeways that eliminate stress will attract traditionally under-represented bicyclists, including women, children, and seniors.

Equitable

High-quality bikeways expand opportunities to ride and encourage safe riding. Poor or inadequate infrastructure—which has disproportionately impacted low-income communities and communities of color—forces people bicycling to choose between feeling safe and following the rules of the road, and induces wrong-way and sidewalk riding. Where street design provides safe places to ride and manages motor vehicle driver behavior, unsafe bicycling decisions disappear,[11] making ordinary riding safe and legal and reaching more riders.

---

[21] 'Designing for All Ages & Abilities', https://nacto.org/wp-content/uploads/2017/12/NACTO_Designing-for-All-Ages-Abilities.pdf

VMT and GHG Emissions Reduction Strategies

Introduction

By 2045, it is expected that on-road GHG emissions on Bainbridge Island will decrease about 85% compared to the 2014 baseline, largely as a result of passenger vehicle and freight electrification. However, that assumes aggressive vehicle electrification targets are met over a long period of time (i.e., 65% of new vehicle sales are electric by 2030). Actions taken now to reduce VMT can help achieve the shorter-term CAP goal to reduce emissions 60% by 2035 and provide a strong foundation for long-term GHG emissions reduction (90% reduction by 2045).

Implementation of the STP projects will provide Bainbridge Island with a strong multimodal network, but additional strategies are required to get motorists out of their personal vehicles, and substantially reduce VMT and GHG emissions on the island. This analysis presents strategies that build on the STP to reduce GHG emissions below the levels estimated under the Projected scenario.

Reducing VMT will require strategies that shift travel away from single occupancy vehicles. These strategies are expected to have co-benefits that extend beyond reducing emissions, including:

- improving public health by reducing toxic air contaminants and increasing physical activity,
- reducing fuel use and costs,
- reducing on-road pollution and improving ecosystem health through better water and soil quality,
- reducing congestion and improving comfort for all road users,
- reducing wear and tear on City roadways and associated maintenance requirements and costs, and
- improving safety for vulnerable road users like pedestrians and cyclists.

With limited resources to commit to address climate change, the purpose of this analysis is to assess which strategies will have the most emission reduction benefit. The most desirable strategies to reduce GHG emissions are those that are cost effective, offer a large potential to reduce emissions, are achievable in the near-term and can be independently implemented by the City.

VMT Reduction Strategies

Bainbridge Island has distinct travel patterns that are well suited to travel by non-auto modes. The **Travel Markets** analysis using StreetLight Data showed that over 60% of resident vehicle trips are under five miles in length; these short trips are well suited towards alternate modes, particularly biking as e-bikes have become more commonplace. Similarly, while land use patterns on Bainbridge Island are well established and predominantly residential, there are opportunities to situate future residential and commercial development within or near existing transit and activity centers, which can reduce the need for vehicle travel.

Fehr & Peers quantified the potential reduction in VMT and GHG emissions from eight strategies that ranged from land use changes, such as additional workforce housing, to incentive programs, such as subsidies for electric bicycles. The evaluated strategies were selected based on their suitability and feasibility for implementation on Bainbridge Island. Some strategies, such as parking pricing, e-bike subsidies, and electric car-share, can be directly implemented by the City, while strategies such as expanded transit service and the bike and pedestrian projects from STP are already planned and partially or fully funded. Other strategies, such as developing workforce housing, were selected because they are well suited to mitigate employee trips from off-island, which contribute substantially to the city's VMT. Finally, the analysis also considers strategies that have started to emerge as a result of social and technological change, including increased telework and ecommerce, which may decrease the frequency of off-island work trips and shopping trips.

In alignment with the City's CAP goals, the analysis assumes that strategies will be implemented over a 25-year period, between 2021 and 2045 as shown in **Table 18**. Some strategies, such as workforce housing, are expected to take many years to implement as they will require coordination across many public and private stakeholders. Other strategies have established implementation timelines. For example, STP projects are expected to be rapidly constructed over the next ten to twelve years and could be complete by 2035.

Table 18: Assumed Phasing of Strategies over Time

Strategy	Start Year	Description
STP Projects	2025	The STP projects refer to the capital improvements detailed in the "Connecting Centers" scenario of Bainbridge Island's Sustainable Transportation Plan. The analysis assumes 25% of project miles are built by 2025, 75% by 2030, 100% by 2035.
Enhanced Transit	2025	The 2022 – 2024 Long Range Transit Plan (LRTP) for Kitsap Transit plans for three new transit lines to serve Bainbridge Island including a Bainbridge Intra-Island line, a circulator in Downton Winslow, and a new Bainbridge-Poulsbo-Viking line. The LRTP also plans to expand existing on-demand service on Bainbridge Island. The analysis assumes one new route is in service by 2025, and the remaining routes are in service by 2030.
Land Use – Workforce Housing	2030	The City of Bainbridge Island plans to accommodate more than 400 units of muti-family housing in Winslow by 2036. This strategy assumes that 50% of units would be dedicated to affordable and/or workforce housing. The analysis assumes that 50% of housing could be built by 2030.

Strategy	Start Year	Description
Land Use – Retail Trips	2025	This strategy focuses on reducing the number of off-island retail trips by developing infrastructure to support deliveries and provide an alternative to off-island retail trips. It is assumed 10% of retail trips shift to ecommerce by 2025 and increase linearly thereafter based on post-pandemic trends.
Telework	2021	This strategy assumes that the increase in remote work noted during the COVID-19 pandemic is maintained throughout all horizon years.
Parking Pricing	2030	This strategy prices parking in downtown Winslow at $2/hour beginning in 2030 and increases with inflation thereafter.
Car Share	2025	Under this strategy, five electric car share vehicles would be deployed by 2025, 10 by 2030, and 20 by 2035.
E-Bike Subsidies	2025	This strategy would provide $3M to an e-bike rebate program between 2025 and 2045. A $1,000 subsidy would be made available to 200 households in 2025, 400 households in 2030, and 800 households in 2035, 2040, and 2045.

Key Takeaways

Some strategies show high potential to reduce VMT and GHG emissions and, if expanded in scale, could move the city closer towards meeting the CAP goals. The expected contribution of each strategy to reducing VMT is described under 'Impact of VMT Reduction Strategies.'

Building on Kitsap Transit's Long-Range Plan that envisions **new fixed route and expanded on-demand transit service**, Bainbridge Island's STP recommends implementing additional transit and mobility programs that will support mode shift and reduce VMT. Some strategies include developing mobility hubs at key locations across the island (including the ferry terminal and other neighborhood centers) to connect multi-modal transportation options and support the use of non-auto modes. The STP also contains programmatic elements, including education and outreach, that are not expected to directly reduce VMT on their own, but are fundamental to the success of planned investments in multi-modal infrastructure and transit service in supporting VMT reduction. Therefore, the City should prioritize securing funds for implementation of the **STP's programmatic elements** and continue coordination with Kitsap Transit on execution of the Long-Range Plan.

Beyond telework, the analysis shows e-bike subsidies can play a key role in reducing VMT on an ongoing basis. Current, successful e-bike subsidy programs, such as the City of Denver's program, provide a subsidy between $400 - $1,200 depending on household income and type of e-bike.[22] The City should prioritize securing funding for an initial **e-bike subsidy pilot program** structured similar to the City of

[22] City of Denver, E-Bike and E-Cargo Bike Instant Rebates, https://denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-Resiliency/Sustainable-Transportation/Electric-Bikes-E-Bikes-Rebates

Denver's program. If the pilot program were to be expanded, and more households had access to the subsidy, the city could see additional VMT reductions, especially when implemented with supportive strategies, such as the bicycle infrastructure projects from the STP that make it more attractive to bike around Bainbridge Island.

Employee trips are another source of on-island VMT that can be addressed through several of the VMT reduction strategies. Remote work became widespread during Covid-19; in 2021, remote work reduced employee VMT by 22% as compared to 2019 and reduced all VMT 9% below the 2014 baseline. While the precise future characteristics of remote work are uncertain, it is unlikely that employee trips will return to pre-2020 levels. Employee trips can be further reduced through strategies like workforce housing development that enable more people to live and work on Bainbridge Island. This analysis assumes that a portion of expected multifamily housing growth could be dedicated to workforce housing by 2030, reducing VMT by 1%. Additional **workforce or affordable housing development** have the potential to substantially further reduce VMT.

Since retail on Bainbridge Island is limited, many residents travel off-island to shop. **Shifting existing retail trips to e-commerce** can reduce VMT by reducing off-island personal vehicle trips without reducing access to daily essentials and other goods. Home shopping and deliveries have increased steadily over the past ten years and experienced a significant increase during the COVID-19 pandemic. The City can support these recent trends by developing adequate delivery infrastructure, such as consolidated delivery locations and loading zones.

Although not considered within this study, policy changes to facilitate the **development of commercial and retail establishments on Bainbridge Island** have a high potential to reduce VMT. Currently, restrictions in the City's building code limit the construction of select commercial and retail establishments. In 2022, developers withdrew a project that would have created two new buildings with businesses, market rate housing, and affordable housing in Downtown Winslow because of density restrictions and parking requirements mandated by the City's Comprehensive Plan.[23] Since development has historically proved challenging, residents must drive to Poulsbo/Silverdale to access additional retail and services, which is a large contributor to the city's VMT.

Implementing **parking pricing** is expected to have a small impact on VMT, since proposed charges are expected to be low relative to the overall cost of driving, reflecting the contentious and political nature of pricing parking and VMT. On the other hand, adopting a pricing structure for VMT that reflects the actual cost of vehicle use could substantially reduce VMT beyond what Fehr & Peers has modeled.

Telework is expected to play a large role in reducing VMT and associated GHG emissions. However, there are minimal actions that can be taken at the municipal level to encourage teleworking, and it is unlikely that the prevalence of telework will expand beyond levels observed at the height of the Covid-19 pandemic between 2020 and 2021.

---

[23] Bainbridge Review, Gateway to Winslow project withdrawn, https://www.bainbridgereview.com/business/gateway-to-winslow-project-withdrawn/

Cost Comparison

The VMT reduction strategies also vary in cost, both on an absolute basis and when normalized to the amount of VMT reduced. **Table 19** shows the cost of reducing VMT on a cost per VMT basis for three strategies which are directly implementable by the City. E-bikes have the lowest cost per VMT eliminated, however the effectiveness of e-bikes as a tool to reduce VMT is dependent on the sufficient provision of bike infrastructure as envisioned in the STP. Cost per VMT eliminated decreases over time for the STP strategies and car share because both involve up-front capital expenditures. Cost per VMT eliminated decreases over time for e-bike subsidies because it is assumed that households will continue to replace vehicle trips with e-bikes in subsequent years.

Table 19: Cost per VMT Eliminated

Strategy	2025	2030	2035	2040	2045	Average
STP Strategies	$3,200	$2,000	$700	$0	$0	**$700**
Car Share*	$1,400	$700	$700	$400	$400	**$600**
E-Bike Subsidies	$400	$150	$100	$100	$50	**$100**

Source: Fehr & Peers, 2023
*For carshare, this is the Cost/VMT shifted to zero-emission sources.

Impact of VMT Reduction Strategies

Table 20 shows the potential VMT reduction associated with each strategy, and the total percent reduction for each horizon year compared to the Projected scenario.

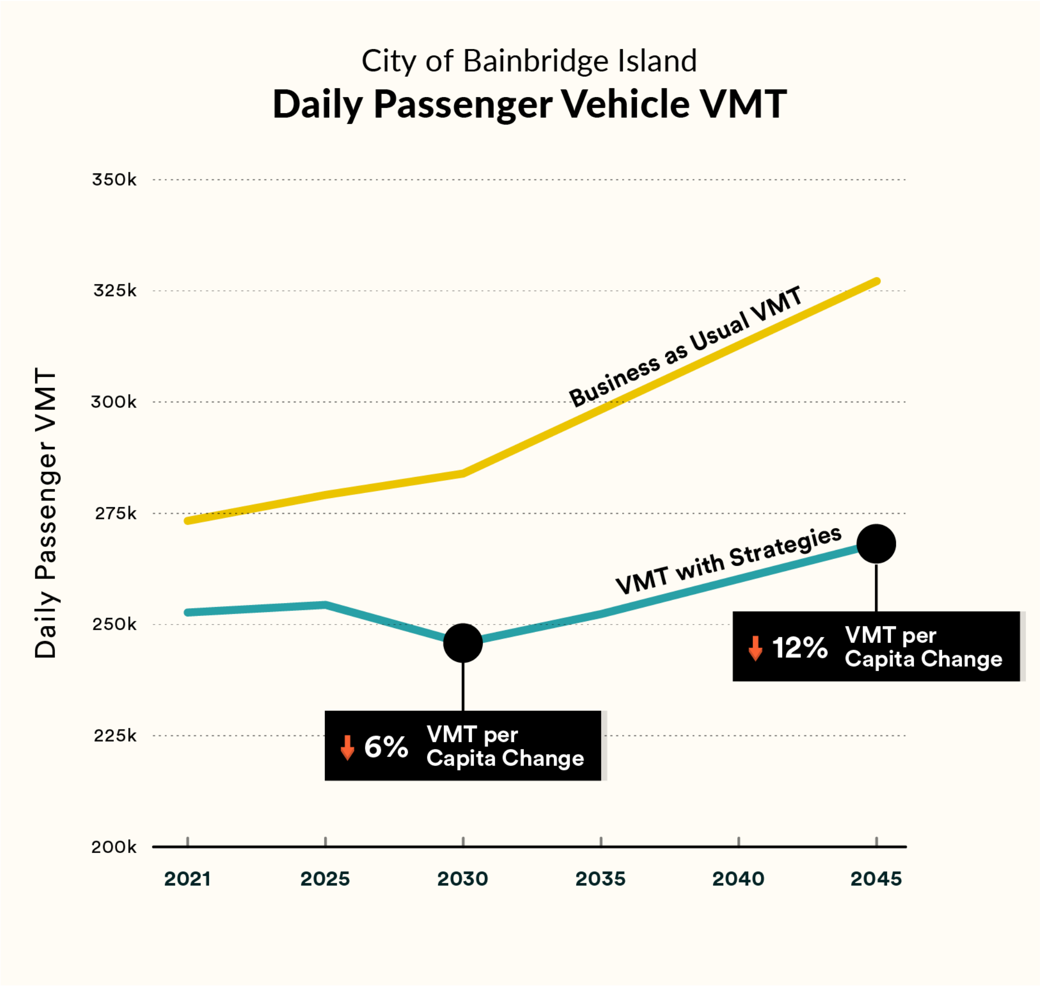
Table 20: Daily VMT Reduction from Strategies

Strategy	2025	2030	2035	2040	2045
STP Strategies	-960	-3,050	-4,280	-4,510	-4,760
Enhanced Transit	-480	-2,210	-2,350	-2,500	-2,650
Land Use – Workforce Housing	0	-2,040	-2,140	-2,260	-2,380
Land Use – Retail Trips	-1,060	-2,250	-2,960	-3,740	-4,210
TDM (Telework)	-21,580	-22,810	-24,040	-25,330	-26,700
Parking Pricing	0	-2,900	-2,920	-2,920	-2,910
Car Share*	0	0	0	0	0
E-Bike Subsidies	-510	-3,080	-7,180	-11,280	-15,390
Total Reduction	**-24,590**	**-38,340**	**-45,870**	**-52,540**	**-60,000**
Projected Future VMT	**279,160**	**284,140**	**298,250**	**312,790**	**327,300**
Percent VMT Reduction	**-9%**	**-14%**	**-15%**	**-17%**	**-18%**

Source: Fehr & Peers, 2023
*Limited evidence to support that VMT is reduced through car share, therefore while electric car share can reduce GHG emissions, it is less evident that electric car share can reduce VMT.

The selected strategies are expected to reduce total VMT by 14% by 2030 and 18% by 2045, as shown in **Table 20** and **Figure 13**. While total VMT continues to increase as population and jobs grow on Bainbridge Island, VMT per capita could be reduced about 6% by 2030 and 12% by 2045 compared to the 2014 baseline.

Figure 13: Estimated Daily VMT Reduction



The CAP goal related to VMT is to reduce VMT per capita by 50% in 2045, compared to the 2014 baseline. Based on this analysis, the city is not on track to meet this goal. However, it is important to understand this goal in relation to the rest of the region. PSRC recently completed their modeling work for VISION 2050 and estimated a 20% reduction in VMT per capita across the 4-county region by 2050. While PSRC has not yet released VMT per capita targets for communities within their jurisdiction, Fehr & Peers anticipates that Bainbridge Island's goal of a 50% VMT per capita reduction is more ambitious than what is projected by PSRC.

GHG Emissions Reduction

Fehr & Peers combined the estimated VMT reduction rates from the strategy analysis with average emissions factors for each horizon year to project the GHG emissions. Given the uncertainty around EV adoption rates, Fehr & Peers analyzed the GHG emissions reduction potential of all strategies under two EV adoption scenarios:

- PSREA (faster EV adoption): used EV adoption assumptions from the Projected scenario from the wedge analysis, which assumes 65% of new vehicle sales are EV by 2030, and 100% by 2035.
- Slower EV adoption: used a more conversative EV adoption rate than the Projected scenario, with 50% of new vehicles sales EV by 2030, and 100% by 2040.

Figure 14 shows the expected GHG emissions reduction from the selected strategies under both scenarios.

Figure 14: Estimated GHG Emissions Reduction

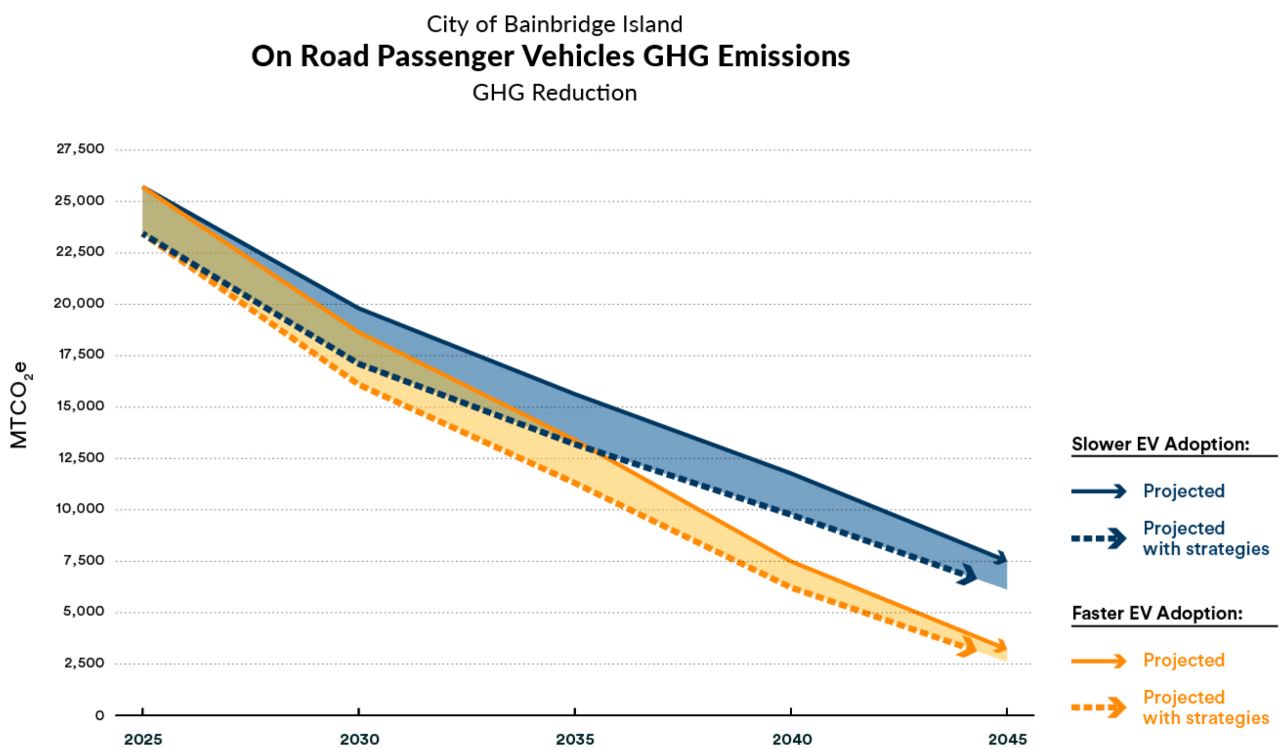


Table 21 summarizes the estimated GHG emissions reduction associated with both EV adoption scenarios, highlighting how each individual strategy contributes to the total GHG emissions reduction over time. With the slower EV adoption scenario, strategies to reduce VMT have a greater emissions benefit in the long-term because the share of internal combustion engine (ICE) vehicles is higher under this scenario and results in VMT that is more carbon intensive. However, as shown in **Figure 14**, the faster EV adoption scenario results in lower overall emissions because there are fewer ICE passenger vehicles on the road and the absolute quantity of GHG emissions eliminated due to the VMT reduction strategies decreases as horizon years extend further into the future.

Table 21: Annual GHG Emissions Reduction (Share of Reduction by Strategy)

Strategy	2025	2030	2035	2040	2045
STP Strategies	4%	8%	9%	8%	8%
Enhanced Transit	2%	6%	5%	5%	4%
Land Use – Workforce Housing	0%	5%	5%	4%	4%
Land Use – Retail Trips	4%	6%	6%	7%	7%
TDM (Telework)	87%	59%	52%	48%	45%
Parking Pricing	0%	8%	6%	5%	5%
Car Share*	1%	1%	2%	1%	2%
E-Bike Subsidies	2%	8%	15%	21%	26%
Estimated $MTCO_2e$ Reduction from the Strategies (assuming faster EV adoption)	**-2,280**	**-2,540**	**-2,090**	**-1,280**	**-600**
Estimated $MTCO_2e$ Reduction from the Strategies (assuming slower EV adoption)	**-2,280**	**-2,700**	**-2,450**	**-2,010**	**-1,400**

Source: Fehr & Peers, 2023

Recommendations

The selected VMT reduction strategies could reduce on-road GHG emissions by 600 to 1,400 $MTCO_2e$ annually in 2045, which falls short of the CAP goal to reduce GHG emissions by 18,000 $MTCO_2e$ through VMT reduction. However, this gap is largely offset by GHG reductions from a faster rate of vehicle electrification compared to what was anticipated when the CAP was developed. The updated analysis from this study shows electrification could reduce transportation emissions by about 25,000 MTCO2e by 2045 as shown in **Table 22**.

Table 22: Estimated Emissions Reduction as Compared to Climate Action Plan Goals

Action	Reduction in GHG emissions by 2045 from 2014 Baseline ($MTCO_2e$)	
	Climate Action Plan Goal	Estimated Reduction
VMT reduction (all strategies)	-18,000	-600 $MTCO_2$ to -1,400 $MTCO_2$
On- & off-road vehicle electrification	-18,000	-25,000 ✓
Ferry electrification	-14,000	-13,400 ✓
Air travel reduction and improved fuel efficiency	-10,000	-6,000
Total	**-60,000**	**-40,000**

Source: Fehr & Peers, 2023

As demonstrated above, to substantially reduce near- and long-term on-road GHG emissions, the City needs to pursue additional VMT reduction strategies that build on the STP projects while supporting a citywide transition to electric vehicles.

Consequently, the City should continue to move forward on implementing strategies that have been planned and funded through the city's impact fee programs, focusing first on construction of the capital improvements from the STP. For unfunded strategies, such as e-bike subsidies, the City should begin to identify funding sources for the program. The Washington 2023-2025 State budget has $2M for employers, governments, tribes, or non-profits to establish e-bike lending libraries; while funds could not be used for an e-bike rebate program, an e-bike lending library could support a future e-bike program by building interest in e-bikes among Bainbridge Island residents.[24]

Bainbridge Island could also explore expanding the scale of proposed strategies to further reduce VMT and GHG emissions. Specifically, the City could take the following actions:

- Consider securing additional funding to support a larger e-bike subsidy program than what was analyzed so more households can benefit from the program.
- Consider implementing regulatory changes or incentives to expedite the development of additional multifamily housing.
- Consider pricing parking in Downtown Winslow at a rate that is commensurate with the actual cost of driving to encourage travel to Downtown Winslow by alternate modes.

In addition, the City could consider land use policy changes that have the potential to alter travel patterns to further reduce VMT and emissions. Specifically, the City could take steps to reduce off-island vehicle travel by encouraging the development of mixed-use retail and commercial land uses in Downtown Winslow. This has a high potential to reduce VMT since the travel market analysis shows that many off-island vehicle trips are for shopping or errands. While off-island trips are a smaller proportion of total trips, the average trip length is longer and therefore these trips contribute disproportionately to VMT.

Finally, the analysis shows that the electrification of passenger and freight vehicles will play a central role in reducing emissions from transportation sources on Bainbridge Island. The City should begin to consider the level of public investment that will be required to develop an electric vehicle charging network including the number of chargers needed, the type of chargers needed, and where chargers should be located to ensure equitable access for people who may not have access to charging at home.

Implementation

The City has started to take action to implement emissions reduction strategies, and additional actions that could be taken are presented in **Table 23**. Newer strategies, such as e-bike subsidies, actions may include planning and policy development, while other strategies, such as the STP strategies, could be ready for design and construction. While many strategies can be spearheaded by the City, local and

[24]Washington State Legislature, HB 1125, https://lawfilesext.leg.wa.gov/biennium/2023-24/Pdf/Amendments/House/1125-S.E%20AMC%20CONF%20S3376.1.pdf

regional coordination is vital to successful implementation, especially among key stakeholders including Bainbridge Island residents, local community groups and businesses, and Kitsap Transit.

Table 23: Recommended Implementation Actions for VMT Reduction Strategies

Strategy	Action	Source (If Applicable)
All	Secure funding sources for implementation actions, including reauthorizing Transportation Benefit District Fees and adopting the City's updated Transportation Impact Fee Program.	City of Bainbridge Island, Sustainable Transportation Plan, 2022
STP Strategies	Implement policies to support multimodal travel including a Safe Routes to School program, continuing to monitor speed limits across the island, and a gravel shoulder maintenance program.	City of Bainbridge Island, Sustainable Transportation Plan, 2022
	Move forward with implementation by establishing oversight groups to guide prioritization, sequencing, and spending levels, as described in the Sustainable Transportation Plan.	City of Bainbridge Island, Sustainable Transportation Plan, 2022
	In coordination with implementing a mobility hub at the ferry terminal, launch an outreach campaign targeted at visitors on how they can visit Bainbridge Island without their personal vehicle.	
Enhanced Transit	In consultation with Kitsap Transit, develop a robust marketing, outreach, and educational program to inform Island residents and those who traverse the Island from outside about public transit options, including park and rides and BI ride.	City of Bainbridge Island, Sustainable Transportation Plan, 2022
Land Use – Workforce Housing	Continue to advance recommendations in the City of Bremerton & Kitsap County Affordable Housing Recommendations Report aimed at developing more affordable and workforce housing.	Kitsap County Affordable Housing Recommendations Report
Land Use – Retail Trips	Require land use planning that explicitly incorporates walking and bicycling networks, promotes greater density, and optimizes space to minimize the distance people have to travel by car.	City of Bainbridge Island, Sustainable Transportation Plan, 2022
TDM (Telework)	Continue to monitor levels of remote work to understand how remote work is influencing VMT.	
	Develop policies to facilitate remote work for Bainbridge Island residents, such as providing incentives for flexible use spaces that can be used for coworking space.	

Strategy	Action	Source (If Applicable)
	Develop guidelines for remote work for City employees to maintain levels of remote work observed following the Covid-19 pandemic.	
Parking Pricing	Evaluate increasing the price of parking at the ferry to encourage people to take public transportation, bike or walk.	City of Bainbridge Island, Climate Action Plan, 2020
	Reevaluate data from the 2018 Downtown Parking Strategy and revisit the recommendation to keep parking unpriced in Downtown areas.	
Car Share	Evaluate options to expand the current electric carsharing pilot program (ZEV Co-op[25]), including direct municipal ownership and operation as well as partnership opportunities.	
E-Bike Subsidies	Explore funding opportunities at the Federal, State, Regional, and Local levels for e-bike subsidies.	
	Evaluate opportunities to establish a municipal e-bike lending library leveraging funding made available in the 2023-2025 WA State budget.	
EV Readiness	Increase electric charging infrastructure through public private partnerships and pursue state grant funds for electric vehicle infrastructure along major highways.	Community Based Strategies to Reduce GHG Emissions, Western Washington University, June 2019
	Partner with utility companies to provide rebate programs for electric vehicle supply equipment.	
	Pass an ordinance requiring new multi-family residential developments to require EV ready infrastructure.	

[25] https://zev.coop/

Appendix: Strategy Evaluation Methodology

This appendix documents the methodology used to evaluate the GHG emissions reduction impact of each strategy.

The Projected scenario from the wedge analysis, which includes existing state and federal actions related to fuel efficiency and electrification, was assumed to be the starting point for scenario evaluation. As a result, the absolute quantity of GHG emissions eliminated decreases as horizon years extend further into the future as it is assumed that vehicles are more fuel efficient, fueled by cleaner energy sources, and EVs comprise a larger share of the vehicle fleet. A summary of the total VMT and GHG emissions reduction from the analyzed strategies is shown in **Table 20** and **Table 21** in the report.

The following assumptions are consistent across all VMT reduction calculations for all strategies:

Universal Assumptions:

- Population will increase by 1.2% annually based on City-provided population projections that estimate Bainbridge Island residential population will grow from 24,556 in 2021 to 28,660 by 2036.
- Total VMT increases in line with population growth.
- The cost of owning and operating a vehicle in 2019 was $0.62 per mile. Future costs assume an annual inflation rate of 1.4% based on observed data between 2009 and 2019.[1]
- All VMT reductions are calculated based on observed daily trip rates and are annualized to determine GHG emissions reductions by horizon year.
- The travel market analysis provides the basis for how residents, employees, and visitors contribute to existing VMT on Bainbridge Island. As described in the travel market summary, trips in each travel market are split into the following categories:
    - Internal-Internal (II): trips that start and end on Bainbridge Island
    - External-Internal (XI): trips that start elsewhere and end on Bainbridge Island
    - Internal-External (IX): trips that start on Bainbridge Island and end elsewhere

Emissions factors from the PSREA analysis were applied to VMT to translate future VMT reductions into GHG emissions reductions. These emissions factors, and assumptions around EV adoption rates are shown in **Table 24** below. All subsequent sections use the PSREA assumptions regarding aggressive EV adoption rates.

[1] BTS, Per-Mile Costs of Owning and Operating a Vehicle (Current Dollars), https://www.bts.dot.gov/content/mile-costs-owning-and-operating-automobile

Table 1: Emissions Factors and Assumed EV Adoption Rates

	Gasoline		Diesel		EV	
	Share of VMT	gCO_2/gal	Share of VMT	gCO_2/gal	Share of VMT	gCO_2e/kW
2014	99%	8,780	1%	10,210	0%	530
2018	97%	8,780	1%	10,210	2%	530
2021	96%	8,400	1%	9,770	3%	350
2025	93%	7,650	1%	8,900	6%	160
2030	79%	6,720	1%	7,810	20%	0
2035	59%	6,430	1%	7,480	40%	0
2040	40%	6,150	0%	7,150	60%	0
2045	15%	6,150	0%	7,150	85%	0

Sources: PRSEA, Fehr & Peers, 2023

The methodology used to calculate the VMT reduction from each strategy is described below.

STP Strategies

As noted above, the shift in mode share from implementing all infrastructure improvements in the STP could result in a 6% decrease in On-Island (II) VMT as compared to a scenario where no projects are constructed. To determine the VMT impact of STP strategies in future horizon years, it was assumed that 25% of projects would be constructed by 2025, 75% by 2030, and 100% by 2035.

The expected VMT reduction is shown in **Table 25**.

Table 2: Daily VMT Reduction from STP Strategies

	2021	2025	2030	2035	2040	2045
Bainbridge Population	24,560	25,730	27,190	28,660	30,210	31,830
On-Island Daily II VMT	60,160	63,030	66,620	70,210	74,000	77,990
Total II VMT reduction	0%	-1.5%	-4.6%	-6.1%	-6.1%	-6.1%
Daily VMT reduction	**0**	**960**	**3,050**	**4,280**	**4,510**	**4,760**

Source: Fehr & Peers, 2023

Enhanced Transit

The 2042 Long Range Transit Plan (LRTP) for Kitsap Transit plans for three new transit lines to serve Bainbridge Island, including a Bainbridge Intra-Island line, a circulator in Downton Winslow, and a new Bainbridge-Poulsbo-Viking line by 2040. The LRTP also plans to expand existing on-demand service on Bainbridge Island; this service is also referenced in the Sustainable Transportation Plan's planned programs. Planned service changes are shown in **Table 26** below.

Table 3: 2042 LRTP Service Overview and Forecast Ridership Demand

Line	New Vehicles	Annual Revenue Hours	Riders per Revenue Hour[1]	Annual Incremental Trips	Scaling Factor[2]	New Daily Transit Trips
Bainbridge Intra-Island	4	23,400	9.5	222,300	0.50	370
Winslow Circulator	1	6,500	9.5	61,750	0.25	50
Bainbridge-Poulsbo-Viking	6	34,900	9.5	331,550	1	1,110
BI Ride (On Demand)	2	3,100	2.6	8,060	1	30

Source: Fehr & Peers, 2023, Kitsap Transit 2022-2042 LRTP, Kitsap Transit 2022 -2042 LRTP Existing Conditions analysis

1. Based on 2022 Kitsap Transit averages as reported in the 2022 3rd Quarter Performance Report.
2. Scaling factor based on population within service area.

It was assumed that the Bainbridge Intra-Island line would begin service in 2025, and that 100% of new service would be effective by 2030. About 50% of the estimated daily incremental transit trips would be shifted from II/XI/IX vehicle trips, resulting in the VMT reduction shown in **Table 27**.

Table 4: Daily VMT Reduction from New Transit Service

	2025	2030	2035	2040	2045
Daily trips using new transit service	370	1,560	1,640	1,730	1,830
Daily VMT generated by new transit service	130	370	370	370	370
Passenger VMT reduced by new transit service	-610	-2,580	-2,720	-2,870	-3,030

Source: Fehr & Peers, 2023

Land Use

There is also the potential for the City of Bainbridge Island to reduce VMT through land use policies that reduce the need for lengthy vehicle trips. Two strategies are considered in this analysis: workforce housing strategies that would allocate housing for a subset of people who currently commute to Bainbridge Island, as well as strategies to reduce the number of retail/shopping trips made by Bainbridge Island residents to destinations such as Poulsbo and Silverdale on the Kitsap County Peninsula.

Workforce Housing

The City of Bainbridge Island plans to accommodate more than 440 units of muti-family housing on the island by 2036.[2] This strategy assumes that 50% of units would be dedicated to affordable and/or workforce housing, which could be made available to households earning up to 120% of AMI. This could reduce VMT from employees who drive from neighboring jurisdictions to work on Bainbridge Island by providing affordable housing near their jobs.

[2] Bainbridge Island 2016 Comprehensive Plan, Housing Element

Data from the Longitudinal Employment-Household Dynamics (LEHD) program estimates that approximately 4,000 people employed on Bainbridge Island in 2021 live in another jurisdiction.[3] StreetLight data indicate that this group generates around 6,400 daily trips, and that the average on-island trip length is 6 miles. The analysis assumed a 1.2% annual growth rate in the number of people employed on Bainbridge who live elsewhere, in line with population growth. Based on these inputs, it is expected that in 2030, workforce housing could eliminate 360 daily vehicle trips and reduce daily VMT by 2,140 as shown in **Table 28**. This strategy could eliminate 400 daily trips by 2045 and reduce daily VMT by 2,380.

Table 5: Daily VMT Reduction from Workforce Housing

	2021	2025	2030	2035	2040	2045
Off-Island Employees	3,930	4,120	4,360	4,590	4,840	5,100
Daily IX/XI Off-Island Employee Vehicle Trips	6,400	6,710	7.090	7.470	7.880	8.300
Cumulative Number of New MF Units for Workforce Housing	0	0	210	220	230	240
On-Island Trip Length	6	6	6	6	6	6
Daily Trips Eliminated	**0**	**0**	**340**	**360**	**380**	**400**
Daily VMT reduction	**0**	**0**	**-2,040**	**-2,140**	**-2,260**	**-2,380**

Source: Fehr & Peers, 2023

Retail Trips

Since retail on Bainbridge Island is limited, many residents travel off-island to shop. Shifting existing retail trips to ecommerce has the potential to reduce VMT by reducing the number of off-island personal vehicle trips without restricting residents access to daily essentials and other goods. Home shopping and deliveries have increased steadily over the past ten years and experienced a significant increase during the first two years of the Covid-19 pandemic. Levels in 2022 were still well above 2019 levels and will likely continue to increase.

While the City cannot directly shift retail trips to ecommerce, the City can take steps to develop adequate infrastructure for deliveries, such as loading zones or consolidated delivery locations. Policy changes to facilitate the development of commercial establishments on Bainbridge Island could also help reduce off-island shopping trips.

[3] Seattle residents were excluded from this total since it was assumed that the majority of these workers would commute by ferry instead of private automobile.

As shown in **Table 29**, assuming that 25% of all existing off-island non-work resident trips are retail trips and that the average on-island retail trip length is 5 miles, shifting one third of all retail trips to ecommerce could eliminate 840 daily vehicle trips by 2045 and reduce daily VMT by 4,210.[4]

Table 6: Daily VMT Reduction from Shift to Ecommerce

	2021	2025	2030	2035	2040	2045
2021 Bainbridge Residents	24,560	25,730	27,190	28,660	30,210	31,830
Daily IX/XI Non-Work Resident Trips	8,110	8,500	8,980	9,470	9,980	10,510
Daily IX/XI Non-Work Retail Trips	2,030	2,120	2,250	2,370	2,490	2,630
IX/XI Non-Work Resident trip length	5	5	5	5	5	5
Percent of IX/XI retail trips shifted to ecommerce	0%	10%	20%	25%	30%	32%
Daily Trips Eliminated	**0**	**210**	**450**	**590**	**750**	**840**
Daily VMT reduction	**0**	**-1,060**	**-2,250**	**-2,960**	**-3,740**	**-4,210**

Source: Fehr & Peers, 2023

Travel Demand Management (Telework)

The unanticipated shift to remote work from the Covid-19 pandemic is expected to reduce employee trips and associated VMT below 2014 baseline conditions, and therefore is considered a substantial piece of the City's VMT reduction strategies.

The 2019 and 2021 StreetLight datasets were used to estimate the number of employee trips with and without telework, respectively, and both datasets were scaled to future years by the expected rate of population growth. For IX/XI trips, trips were further broken down into trips to Seattle via ferry, and north to Kitsap County via SR 305.

The total expected trip and VMT reduction for each travel market (II, XI, IX) are shown in **Table 30** and **Table 31**, and the total trip reduction is shown in **Table 32.** In 2021, telework resulted in a total daily on-island VMT reduction of 19,070 and is expected to result in an on-island daily VMT reduction of 24,720 by 2045. StreetLight data indicated that the largest reduction in on-island employee VMT was from a reduction in on-island trips (a substantial portion of these vehicle trips are to/from the ferry terminal), followed by VMT from trips to/from Seattle, and finally, trips to/from Kitsap County.

[4] The analysis did not consider the potential impact of increased delivery on net VMT. However, research suggests that VMT is reduced by 95% for every retail trip substituted with a delivery. From the Chicago Metropolitan Agency for Planning, Assessing the E-Commerce Effect: Parcel Delivery vs. Household Shopping, February 2020. https://www.cmap.illinois.gov/documents/10180/1109463/Argonne_Stinson_Ecommerce_2020_02_24.pdf/15898068-e3a5-91b1-4df0-3e27dd741e2b

Table 7: Daily VMT Reduction from Telework (II Trips)

	2019	2021	2025	2030	2035	2040	2045
Bainbridge Residents	24,490	24,560	25,730	27,190	28,660	30,210	31,830
Daily employee trips w/o telework	10,900	10,930	11,460	12,110	12,760	13,450	14,170
Daily employee trips w/ telework	0	6,700	7,020	7,420	7,820	8,240	8,680
Trip length (miles)	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Daily trips eliminated	**0**	**4,230**	**4,440**	**4,690**	**4,940**	**5,210**	**5,490**
Daily VMT reduction	**0**	**-19,070**	**-19,980**	**-21,120**	**-22,260**	**-23,460**	**-24,720**

Source: Fehr & Peers, 2023

Table 8: Daily VMT Reduction from Telework (XI & XI Trips)

	2019	2021	2025	2030	2035	2040	2045
Bainbridge Residents	24,490	24,560	25,730	27,190	28,660	30,210	31,830
Daily employee trips w/o telework	9,740	9,760	10,240	10,820	11,400	12,020	12,660
Daily employee trips w/ telework	0	9,440	9,880	10,460	11,020	11,620	12,240
Share of trips to Seattle	68%	68%	68%	68%	68%	68%	68%
Trip length to Ferry Terminal (miles)	4	4	4	4	4	4	4
Share of trips to Kitsap County	32%	32%	32%	32%	32%	32%	32%
Trip length to Kitsap County (miles)	6	6	6	6	6	6	6
Daily trips eliminated	**0**	**320**	**340**	**360**	**380**	**400**	**420**
Daily VMT reduction	**0**	**-1,520**	**-1,600**	**-1,680**	**-1,780**	**-1,880**	**-1,980**

Source: Fehr & Peers, 2023

Table 9: Daily VMT Reduction from Telework across all Travel Markets

	2019	2021	2025	2030	2035	2040	2045
Daily trips eliminated	0	4,570	4,780	5,060	5,330	5,620	5,920
Total change in VMT	0	-20,590	-21,580	-22,810	-24,040	-25,330	-26,700

Source: Fehr & Peers, 2023

Pricing Parking

Pricing parking could also reduce vehicle trips by increasing the cost of driving. Within the City, priced parking strategies would likely be most effective in Winslow as there are many attractions and activity centers, but limited parking supply.

In 2018, the City developed a downtown parking inventory as part of the Downtown Parking Strategy. The inventory found that there are 387 on-street parking spaces in Downtown Winslow that are utilized for

1,264 unique daily vehicle trips.[5] From this, it was assumed that 1,264 vehicle trips represents the maximum number of trips that can park on-street on any given day, and represents the number of trips that would pay for parking if the City chose to price on-street parking. The analysis assumes that the City would begin pricing parking in 2030.

Table 35 shows the total potential impact that pricing parking in Winslow could have on daily trips and VMT. At a flat rate of $2 per hour adjusted for inflation in future years, priced parking has the potential to eliminate over 700 vehicle trips and 2,900 VMT per day in 2045. The number of trips to Winslow was determined using StreetLight data and consists of resident trips, shown in **Table 33** and visitor trips, shown in **Table 34**. Trips are scaled to future horizon years by population growth. Resident trips are more impacted by parking fees because resident trips are shorter and therefore lower cost. As a result, the additional cost of parking is a higher share of the total trip cost and more effectively disincentivizes vehicle trips.

Table 10: Daily VMT Reduction from Pricing Parking (On-Island Trips)

	2030	2035	2040	2045
Daily Trips to Winslow	2,500	2,635	2,777	2,926
Percent of trips parked on street	0.36	0.34	0.33	0.31
Number of trips parked on street	900	900	900	900
Per-mile cost of automobile ownership	$0.72	$0.77	$0.82	$0.88
Trip distance to Winslow (miles)	3.8	3.8	3.8	3.8
Average trip cost w/o priced parking	$2.73	$2.93	$3.13	$3.36
Cost of parking (2 hours)	$4.00	$4.30	$4.60	$4.90
Average trip cost/ priced parking	$6.73	$7.23	$7.73	$8.26
Elasticity				
Percent change in trip cost	146%	146%	146%	146%
Price elasticity of vehicle trips[1]	-0.5	-0.5	-0.5	-0.5
Percent change in vehicle trips	-73%	-73%	-73%	-73%
Daily trips eliminated	**660**	**660**	**660**	**660**
Daily VMT reduction	**-2,520**	**-2,520**	**-2,520**	**-2,520**

Source: Fehr & Peers, 2023
Notes
1. Based on research from Traveler Response to Transportation System Changes Handbook (TRPC Report 95, 2004); Transit Price Elasticities and Cross-Elasticities (Victoria Transport Policy Institute, 2021) indicating price elasticity of demand for park and ride facilities ranges from -0.2 to -0.5. It was assumed that II trips would be more elastic since Bainbridge Island residents may have more choice for mode of travel to Downtown Winslow.

[5] Bainbridge Island, Downtown Parking Strategy Strategies Report 2018, https://www.bainbridgewa.gov/DocumentCenter/View/11294/BI-Downtown-Parking-Strategy-Report-2018

Table 11: Daily VMT Reduction from Pricing Parking (Trips with an Off-Island Origin or Destination)

	2030	2035	2040	2045
Daily Trips to Winslow	1000	1050	1110	1170
Percent of trips parked on street	0.36	0.34	0.33	0.31
Number of trips parked on street	360	360	360	360
Per-mile cost of automobile ownership	$0.72	$0.77	$0.82	$0.88
Trip distance to Winslow (miles)	6.5	6.5	6.5	6.5
Average trip cost w/o priced parking	$4.67	$5.01	$5.36	$5.74
Cost of parking	$4.00	$4.30	$4.60	$4.90
Average trip cost w/ priced parking	$8.67	$9.31	$9.96	$10.64
Elasticity				
Percent change in trip cost	86%	86%	86%	86%
Price elasticity of vehicle trips[1]	-0.2	-0.2	-0.2	-0.2
Percent change in vehicle trips	-17%	-17%	-17%	-17%
Daily trips eliminated	**60**	**60**	**60**	**60**
Daily VMT reduction	**-400**	**-400**	**-400**	**-400**

Source: Fehr & Peers, 2023

1. Based on research from Traveler Response to Transportation System Changes Handbook (TRPC Report 95, 2004); Transit Price Elasticities and Cross-Elasticities (Victoria Transport Policy Institute, 2021) indicating price elasticity of demand for park and ride facilities ranges from -0.2 to -0.5. It was assumed that IX/XI trips would be less elastic since visitors could have few options other than paying for parking once they have arrived in Downtown Winslow.

Table 12: Daily VMT Reduction from Pricing Parking across all Travel Markets

	2030	2035	2040	2045
Daily trips eliminated	720	720	720	720
Daily VMT reduction	-2,920	-2,920	-2,920	-2,920

Source: Fehr & Peers, 2023

E-Bike Subsidies/Incentives

The City can also reduce VMT by subsidizing non-auto modes to promote their use. Cities such as Denver, Colorado have developed programs to subsidize up to $1,200 of an e-bike purchase to encourage residents to shift trips to non-auto modes. The average rebate per e-bike purchase is approximately $1,000 and the size of the rebate varies by household income, with lower-income households eligible for a $1,200 rebate as compared to $400 for other households. The rebate size also varies by type of bike purchased, and higher rebate amounts are available for cargo e-bike purchases.

As shown in **Table 36**, a $3M investment in e-bike subsidies between 2025 and 2045 could subsidize approximately 3,000 e-bike purchases on Bainbridge Island.

Table 13: Daily E-Bike Subsidy Cost between 2025 and 2045

	2025	2030	2035	2040	2045	Cumulative
Average Subsidy Size	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000
Program Cost	$200,000	$400,000	$800,000	$800,000	$800,000	$3,00,000
Households with a subsidy	200	400	800	800	800	3000
Cost/VMT Eliminated	**$390**	**$130**	**$111**	**$71**	**$52**	**$390**

Source: Fehr & Peers, 2023

At this scale and as shown in **Table 37**, by 2045 an e-bike rebate program could eliminate 4,640 daily vehicles trips and 15,390 daily VMT. The analysis assumes that 15% of On-Island (II) vehicle trips could be shifted to e-bikes in 2025 and that 30% of vehicle trips are substituted by e-bikes by 2030 as bike facilities are improved through construction of STP projects. Recent research analyzing the impacts of similar rebate programs in Colorado and California indicate that recipients of e-bike subsidies replaced about 1.5 – 2.7 VMT per day with an e-bike. [6,7]

Table 14: Daily VMT Reduction from E-Bike Subsidies

	2021	2025	2030	2035	2040	2045
Bainbridge households	10,870	11,390	12,040	12,690	13,370	14,090
Daily On-Island (II) resident vehicle trips	56,090	58,770	62,120	65,460	68,990	72,710
Average trip length (miles)	3.3	3.3	3.3	3.3	3.3	3.3
Daily trips/household	5.2	5.2	5.2	5.2	5.2	5.2
Households with a subsidy	0	200	600	1,400	2,200	3,000
Percent of vehicle trips substituted by e-bike	10%	15%	30%	30%	30%	30%
Daily Trips Eliminated	**0**	**160**	**930**	**2,170**	**3,410**	**4,640**
Daily VMT Reduction	**0**	**-510**	**-3,080**	**-7,180**	**-11,280**	**-15,390**

Source: Fehr & Peers, 2023

Carsharing

Carsharing may reduce VMT by offering people alternatives to personal vehicle ownership, and deploying electric vehicles in the program could further reduce GHG emissions by shifting VMT to a less carbon intensive fuel source. The degree to which personal vehicle ownership might be reduced by a carsharing program was not quantified as part of this study since existing research into this area is limited, however the potential of carsharing programs to reduce personal vehicle ownership should not be discounted.

[6] https://www.denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-Resiliency/News-Events/News/2023/Denver-E-Bike-and-E-Cargo-Bike-Rebate-Returns-January-31
[7] https://escholarship.org/uc/item/5kb4b8jx

As shown in **Table 38**, by deploying 20 electric vehicles in Downtown Winslow, the City could shift 600 VMT from conventional vehicles to electric vehicles by 2045, reducing daily GHG emissions by 0.02 $MTCO_2e$. The analysis assumes that carsharing vehicles would be used to complete two round trips per day, and that each round trip is 15 miles.[8] The analysis assumes that the number of vehicles deployed would increase from 5 in 2025 to 20 in 2045. Baseline improvements in emissions factors as noted in **Table 24** are assumed in this analysis; as a result the volume of $MTCO_2e$ reduced decreases over time.

Table 15: Daily VMT Electrified through Carsharing Program

	2021	2025	2030	2035	2040	2045
Number of EV car share vehicles	0	5	10	20	20	20
Daily roundtrips/car share vehicle	2	2	2	2	2	2
Average round trip length (miles)	15	15	15	15	15	15
Daily VMT Shifted to EVs	**0**	**150**	**300**	**600**	**600**	**600**
Total change in $MTCO_2e$	**0.00**	**-0.05**	**-0.07**	**-0.09**	**-0.06**	**-0.02**

Source: Fehr & Peers, 2023

The estimated investment that would be required to launch and manage an electric car sharing program is shown in **Table** 39**.** The program is expected to cost approximately $1.3M in total between 2025 and 2045, assuming an initial vehicle cost of $40,000, a useful life of 15 years, and an operating/maintenance cost of $0.15 per trip. On a cost per VMT eliminated basis, and electric vehicle car share program is less cost effective than an e-bike subsidy.

Table 16: EV Carshare Cost between 2025 and 2045

	2025	2030	2035	2040	2045	Cumulative
Number of EV car share vehicles	5	10	20	20	20	20
Estimated subsidy	$207,650	$215,300	$430,600	$230,600	$230,600	$1,314,750
Approximate Cost per VMT shifted	**$1,380**	**$720**	**$720**	**$380**	**$380**	**$580**

Source: Fehr & Peers, 2023

Results

Potential daily VMT reductions from the selected strategies are shown in **Table 40** and the corresponding GHG emissions reductions are shown in **Table 41**. As noted above, the total amount of GHG emissions reduced decreases as in later horizon years based on more widespread use of cleaner fuels and electrification.

[8] It was assumed that most people renting car share vehicles would travel off-island; therefore, the analysis assumes a maximum on-island trip length of 15 miles.

Table 17: Daily VMT Reduction from GHG Emissions Reduction Strategies

Strategy	2014	2021	2025	2030	2035	2040	2045
STP Strategies	0	0	-960	-3,050	-4,280	-4,510	-4,760
Enhanced Transit	0	0	-480	-2,210	-2,350	-2,500	-2,650
Land Use – Workforce Housing	0	0	0	-2,040	-2,140	-2,260	-2,380
Land Use – Retail Trips	0	0	-1,060	-2,250	-2,960	-3,740	-4,210
TDM (Telework)	0	-20,590	-21,580	-22,810	-24,040	-25,330	-26,700
Parking Pricing	0	0	0	-2,900	-2,920	-2,920	-2,910
Car Share*	0	0	0	0	0	0	0
E-Bike Subsidies	0	0	-510	-3,080	-7,180	-11,280	-15,390
Total Daily VMT Reduction	**0**	**-20,590**	**-24,590**	**-38,340**	**-45,870**	**-52,540**	**-60,000**
Projected VMT	**222,040**	**273,330**	**279,160**	**284,140**	**298,250**	**312,790**	**327,300**
Percent VMT Reduction	**0%**	**-8%**	**-9%**	**-14%**	**-15%**	**-17%**	**-18%**

Source: Fehr & Peers, 2023
*Limited evidence to support that VMT is reduced through car share, therefore while electric car share can reduce GHG, it is less evident that electric car share can reduce VMT.

Table 18: Daily GHG Reduction GHG Emission Reduction Strategies ($MTCO_2e$)

Strategy	2014	2021	2025	2030	2035	2040	2045
STP Strategies	0.00	0.00	-0.30	-0.67	-0.64	-0.36	-0.16
Enhanced Transit	0.00	0.00	-0.15	-0.48	-0.35	-0.20	-0.09
Land Use – Workforce Housing	0.00	0.00	0.00	-0.47	-0.32	-0.18	-0.08
Land Use – Retail Trips	0.00	0.00	-0.33	-0.49	-0.44	-0.30	-0.14
TDM (Telework)	0.00	-7.46	-6.62	-4.99	-3.60	-2.02	-0.88
Parking Pricing	0.00	0.00	0.00	-0.63	-0.44	-0.23	-0.10
Car Share*	0.00	0.00	-0.05	-0.07	-0.09	-0.05	-0.02
E-Bike Subsidies	0.00	0.00	-0.16	-0.67	-1.08	-0.90	-0.50
Total	**0.00**	**-7.46**	**-7.60**	**-8.47**	**-6.96**	**-4.25**	**-1.96**
Baseline GHG (2014)	**99.92**	**-**	**-**	**-**	**-**	**-**	**-**
Percent Reduction from 2014 GHG	**0%**	**-7%**	**-8%**	**-8%**	**-7%**	**-4%**	**-2%**

Source: Fehr & Peers, 2023
Note: Uses the Projected EV adoption scenario

Bainbridge Island Sustainable Transportation & GHG Emissions

Key takeaways and findings on travel behavior and transportation-related greenhouse gas (GHG) emissions for the City of Bainbridge Island.

Created by Fehr & Peers

August 9, 2023

Background

In 2020, Bainbridge Island adopted their first Climate Action Plan (CAP), which is a comprehensive roadmap to reducing the City's greenhouse gas emissions (GHG) and increasing the island's resiliency to climate change. The CAP outlines specific actions that the City and community should undertake to help reduce emissions 95% by 2045 compared to a 2014 baseline.

Transportation, including on-road and off-road vehicles, air travel, and ferry travel contributed over a third of Bainbridge Island community emissions in 2018. The CAP includes a goal to reduce transportation-related GHG emissions by 60,000 metric tons of carbon dioxide equivalent ($MTCO_2e$) by 2045 primarily through a reduction in Vehicle Miles Traveled (VMT) on the island and the electrification of public and private vehicles. Efforts to electrify the ferry system and reduce air travel by Island residents will also help reduce transportation emissions.

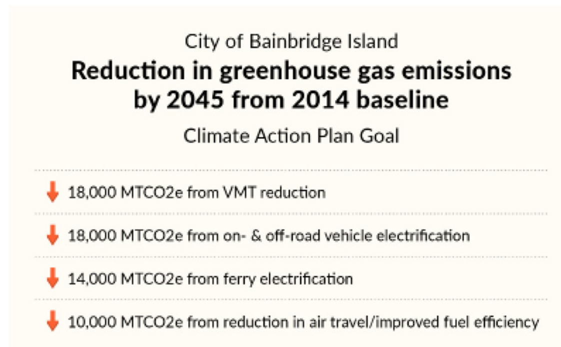


Figure 1 - GHG Emissions Reduction Targets by 2045

(Click image to view a larger copy)

Sustainable Transportation Plan Alignment

The City completed a Sustainable Transportation Plan (STP) in 2022. This plan aligned with CAP goals to reduce transportation-related emissions and support safe mobility for all Island residents and visitors. The STP establishes the long-range vision for a comprehensive transportation system (streets, transit, trails, etc.) that improves mobility and safety for all users while respecting the character of neighborhoods and maintaining a climate resilient environment. Scenario 2, Connecting Centers, in the STP was adopted by City Council as the preferred implementation plan.

Click to View the STP (2022)

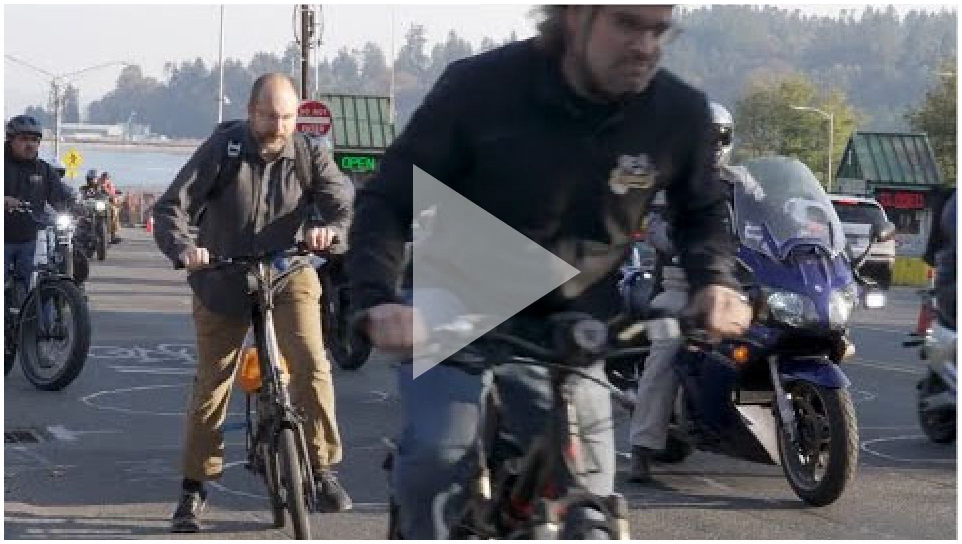
Figure 2- City of Bainbridge Island Sustainable Transportation Plan Connecting Centers

(Click image to view a larger copy)

To better understand the impact of the STP on reducing transportation-related emissions on the Island, the City worked with the firm Fehr & Peers to:

- Update the GHG inventory for a 2021 base year that includes the most recent data for transportation activity on Bainbridge Island
- Analyze the impact of federal and state policies and legislation on future transportation emissions
- Measure the GHG emissions reduction potential of the Connecting Centers scenario from the STP
- Evaluate additional scenarios to determine which strategies and transportation projects could provide substantial progress towards reducing GHG emissions on Bainbridge Island

To learn more about the STP, click the link below to watch a short video:



The Sustainable Transportation Plan on Bainbridge Island

Travel Behavior on the Island

Fehr & Peers used StreetLight Data to estimate passenger vehicle travel and VMT for 2021. This allows the City to consistently track changes in VMT over time.

munity? Use Stre
unity moving — safely

What is StreetLight Data?

StreetLight Data combines Location-Based Services data with machine learning algorithms to understand travel behavior across the country.

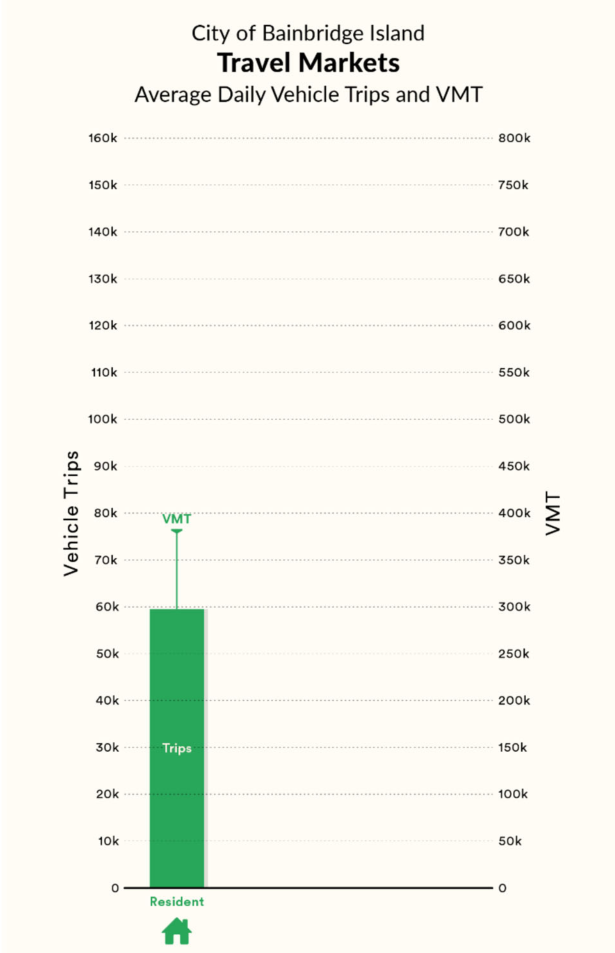
Each month, StreetLight data processes approximately 40 billion anonymized location records from smart phones and navigation devices in connected cars and trucks and uses machine learning to transform these records into aggregated and normalized route-based trips. Data is validated using permanent traffic counters and embedded sensors, and normalized with multiple data sources, including parcel data, digital road network data, and census information. This validated data is then used to calculate vehicle volume estimates and understand the existing travel patterns within a study area.

Utilizing StreetLight Data

StreetLight Data was also used to identify how people are traveling across the island. Understanding how people currently travel helps identify what types of VMT reduction strategies would have the most benefit for different types of travel.

Travel behavior was analyzed for four different types of travelers (referred to as travel markets) on the island:

- Residents
- Employees
- Local visitors (non-ferry trips)
- Ferry visitors & thru-travel



Resident Travel Market:

Key Takeaways

The following charts show the number of vehicle trips and associated VMT across all the City's travel markets.

Residents (which excludes any work travel) contribute the most to overall vehicle trips and VMT on Bainbridge Island; however, many of these trips are short trips on the island that are between 2-6 miles in length. Short vehicle trips are well suited for travel via alternative modes, such as biking. Resident trips account for 70% of total vehicle trips on the island, but only contribute to about 50% of total VMT.

Employee Travel Market:

Key Takeaways

While **employee** work travel contributes fewer trips per day than resident trips on Bainbridge Island, this travel market contributes substantially to total VMT. Many people who live on Bainbridge Island commute off-island, and many employees who work on the island live elsewhere, such as in Poulsbo or Silverdale on the Kitsap County Peninsula. Employee trips that start or end off-island have long trip lengths, and result in a high share of VMT for this travel market (employee trips account for about 20% of total vehicle trips, but account for 35% of total VMT).

Bainbridge Island City Hall

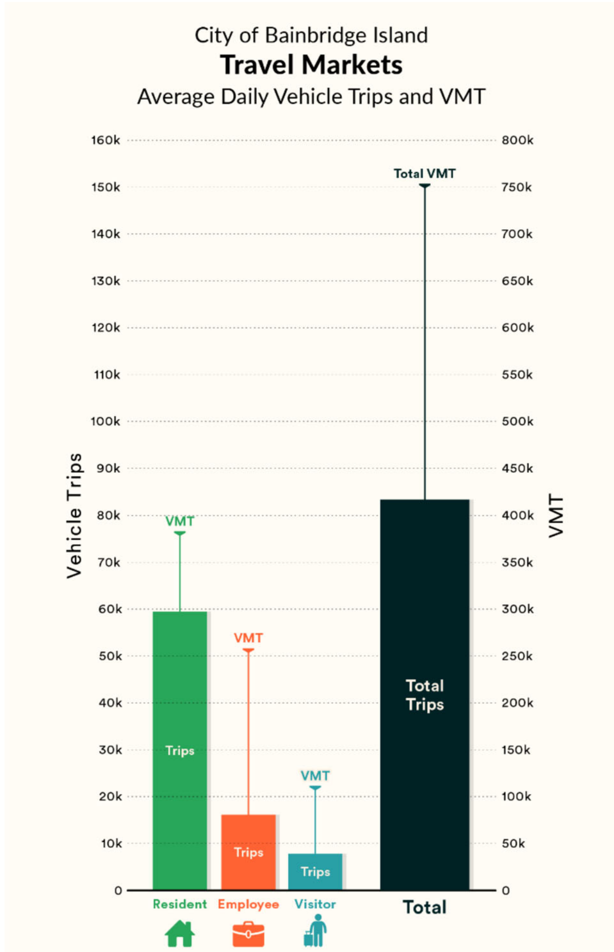
Visitor Travel Market:

Key Takeaways

There are two separate categories within the visitor travel market: local visitor trips and ferry thru-trips.

Local visitor trips include ferry trips that start or end on Bainbridge Island (e.g., travelers that get on the ferry in Seattle for the purpose of visiting Winslow), as well as vehicle trips to/from Kitsap County or the Olympic Peninsula. These local visitor trips contribute to about 10% of total vehicle trips and VMT on Bainbridge Island and were included in the analysis of potential VMT reduction strategies since the City is able to influence travel options on the island.

Ferry thru-trips are vehicle trips using the Seattle-Bainbridge Island Ferry that have origins and destinations outside of the city (e.g., travelers that get on the ferry in Seattle, get off on Bainbridge Island, and continue on SR 305 to the Olympic Peninsula). These ferry thru-trips were included in the City's travel market inventory to understand the portion of total VMT contributed by thru-travelers. The VMT from ferry thru-trips is less than 10% of the average daily total. Because the City does not have control over this travel market, it was excluded from the VMT strategy evaluation.



The Travel Markets summary helps to identify the travel markets that contribute the most to VMT, and therefore should be prioritized for VMT reduction strategies.

GHG Inventory

GHG emissions are measured by multiplying annual activity data (e.g., VMT) by emission factors (such as GHG emissions produced per mile traveled) and average fuel economy data. Emissions were calculated for on-road passenger and freight, on-road transit, air travel, ferry travel, and off-road transportation (which includes sources such as lawn equipment, boats, and construction equipment).

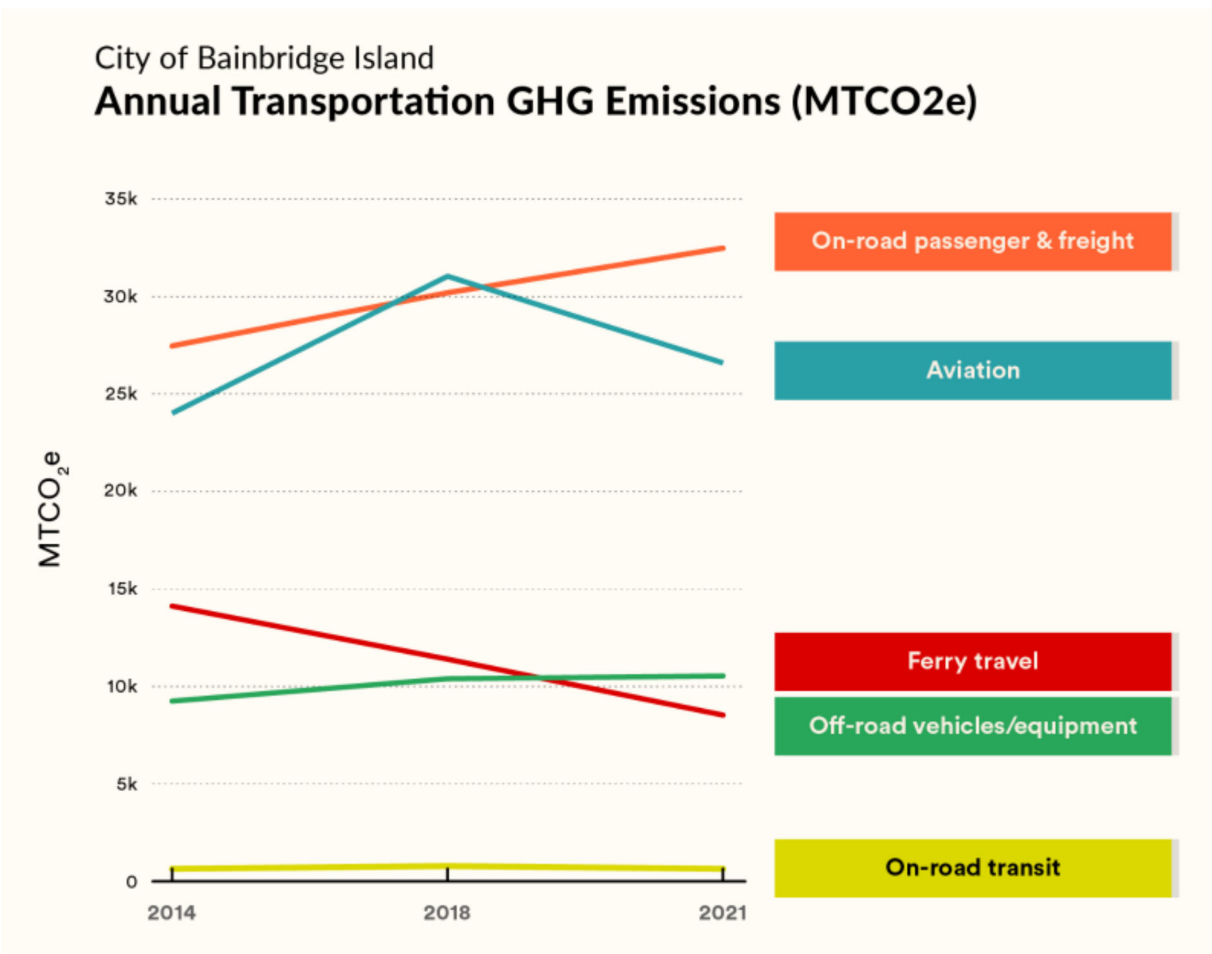
In 2019, Cascadia Consulting Group completed a comprehensive GHG inventory for Bainbridge Island for two representative years -

2014 and 2018. The community-wide geographic GHG emissions inventory quantified the annual emissions produced within the city due to community activities, such as on-road transportation. For this 2021 inventory update for transportation-related emissions only, Fehr & Peers coordinated with Cascadia Consulting Group to confirm the methodology and maintain consistency in evaluating GHG emissions on Bainbridge Island.

City of Bainbridge Island Greenhouse Gas Em...

FINAL FINDINGS REPORT 2019 CASCADIA CONSULTING GROUP, INC.

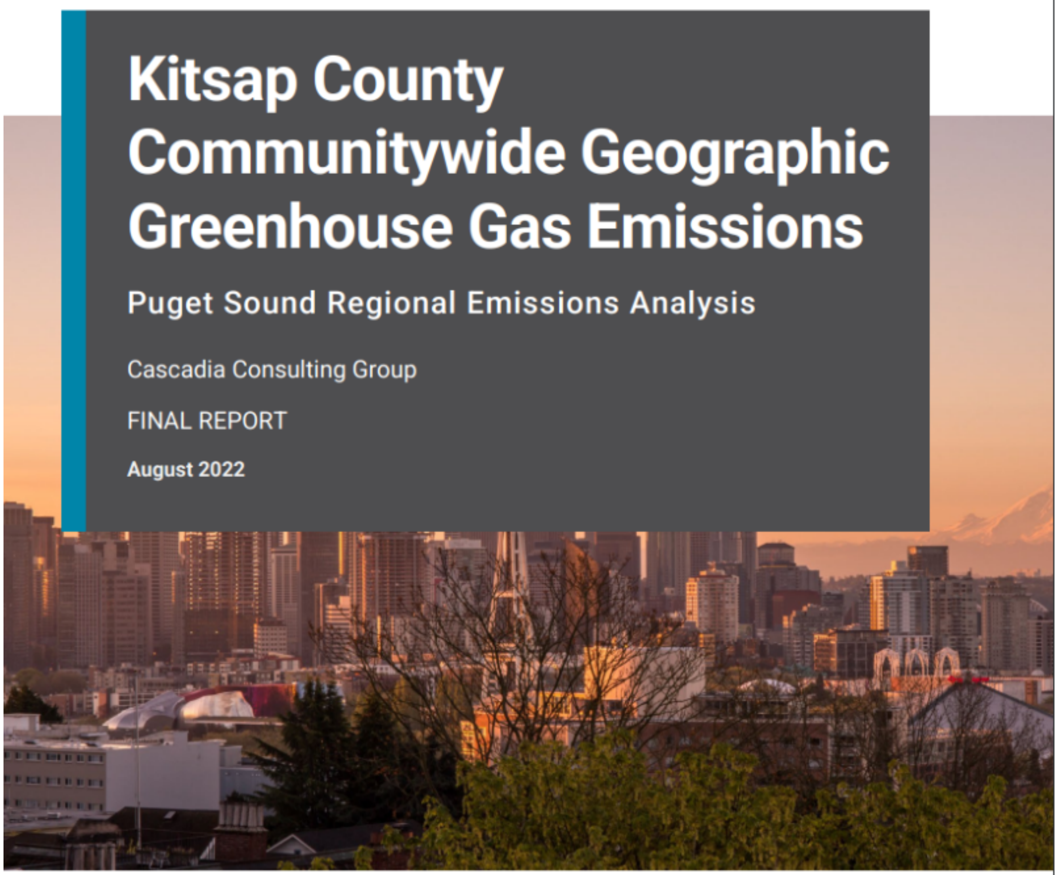
https://www.bainbridgewa.gov/DocumentCenter/View/12811/Bainbridge_GHG-Inventory-Report_FINAL_20191122



Since 2014, total transportation-related GHG emissions have been increasing on Bainbridge Island. In 2020, the COVID-19 pandemic severely restricted travel across all modes. Transit service was cut by all agencies across the region, including Kitsap Transit and Washington State Ferries, and vehicle mode share increased as more people began driving again in late 2020 and into 2021. These pandemic-related factors resulted in a decrease in total GHG emissions from 2018 to 2021 (primarily because of reductions in air and ferry travel), but an overall increase from 2014 to 2021.

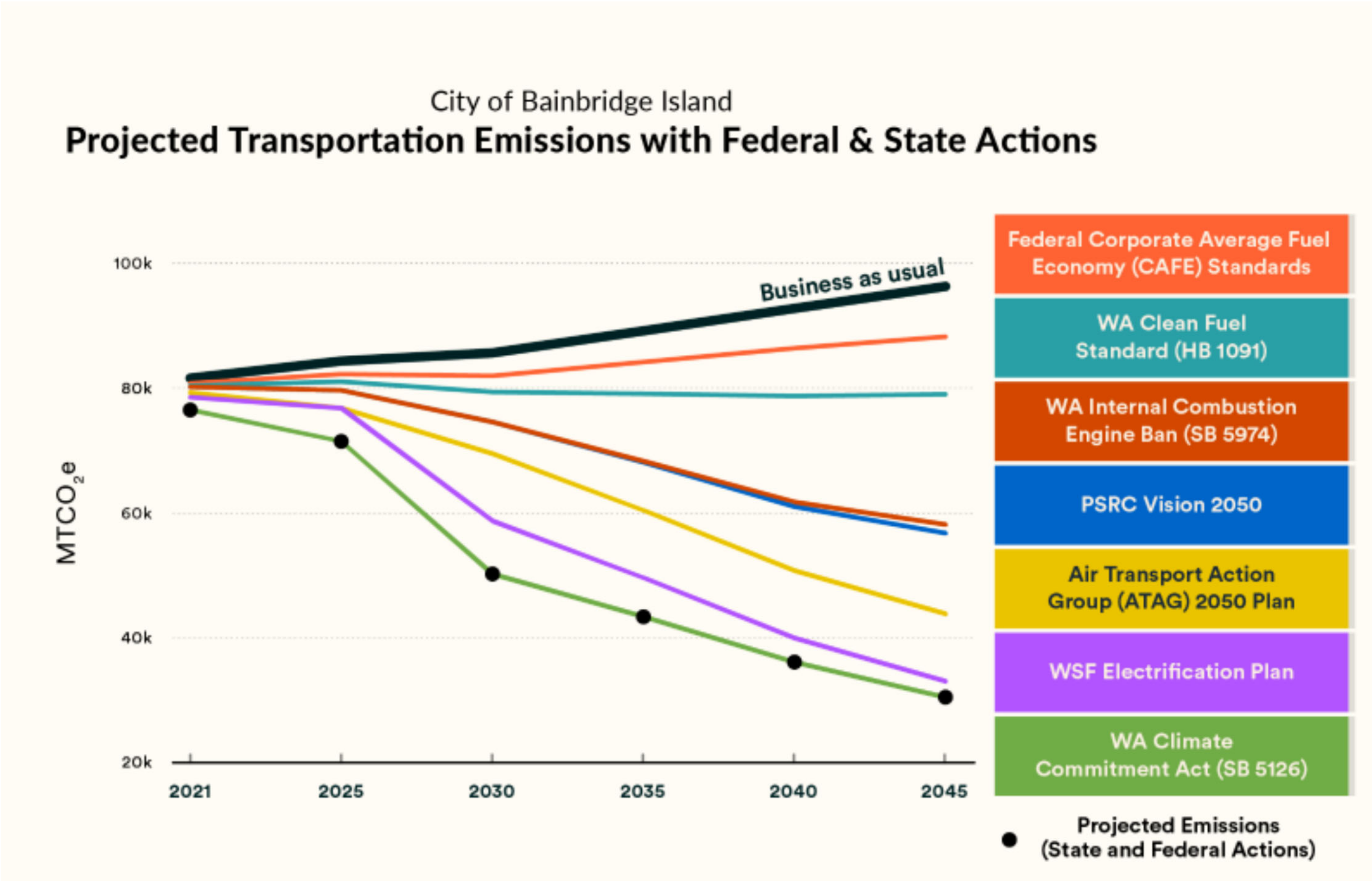
GHG Wedge Analysis

New state and federal transportation-related legislation has been passed since GHG emissions were last measured for the Island in 2019, including legislations targeted at reducing GHG emissions through improved fuel standards, reduced carbon intensity, and vehicle electrification targets. The impact of these policies on future transportation emissions on Bainbridge Island were analyzed through a wedge analysis. A wedge analysis develops GHG emissions estimates under a “Business as Usual” scenario, where no action is taken to reduce emissions from the 2014 baseline, and a “Projected” scenario that accounts for reduced emissions in the future based on federal, state, regional, and sector-specific policies.



Wedge Analysis Methodology

The methodology used for this wedge analysis is consistent with work completed in 2022 for the Puget Sound Regional Emissions Analysis (PSREA) Project; this project provided comprehensive GHG emissions data to advance local climate action for central Puget Sound communities across King, Kitsap, Pierce, and Snohomish counties. This project was led by Cascadia Consulting Group and supported by Fehr & Peers.



Cumulative Policy Impact

The wedge analysis considers the following state and federal policies, as well as industry-specific plans that are expected to impact GHG emissions from transportation sources:

1. Federal Vehicle Regulations (CAFE standards)

2. WA Clean Fuel Standard (HB 1091)

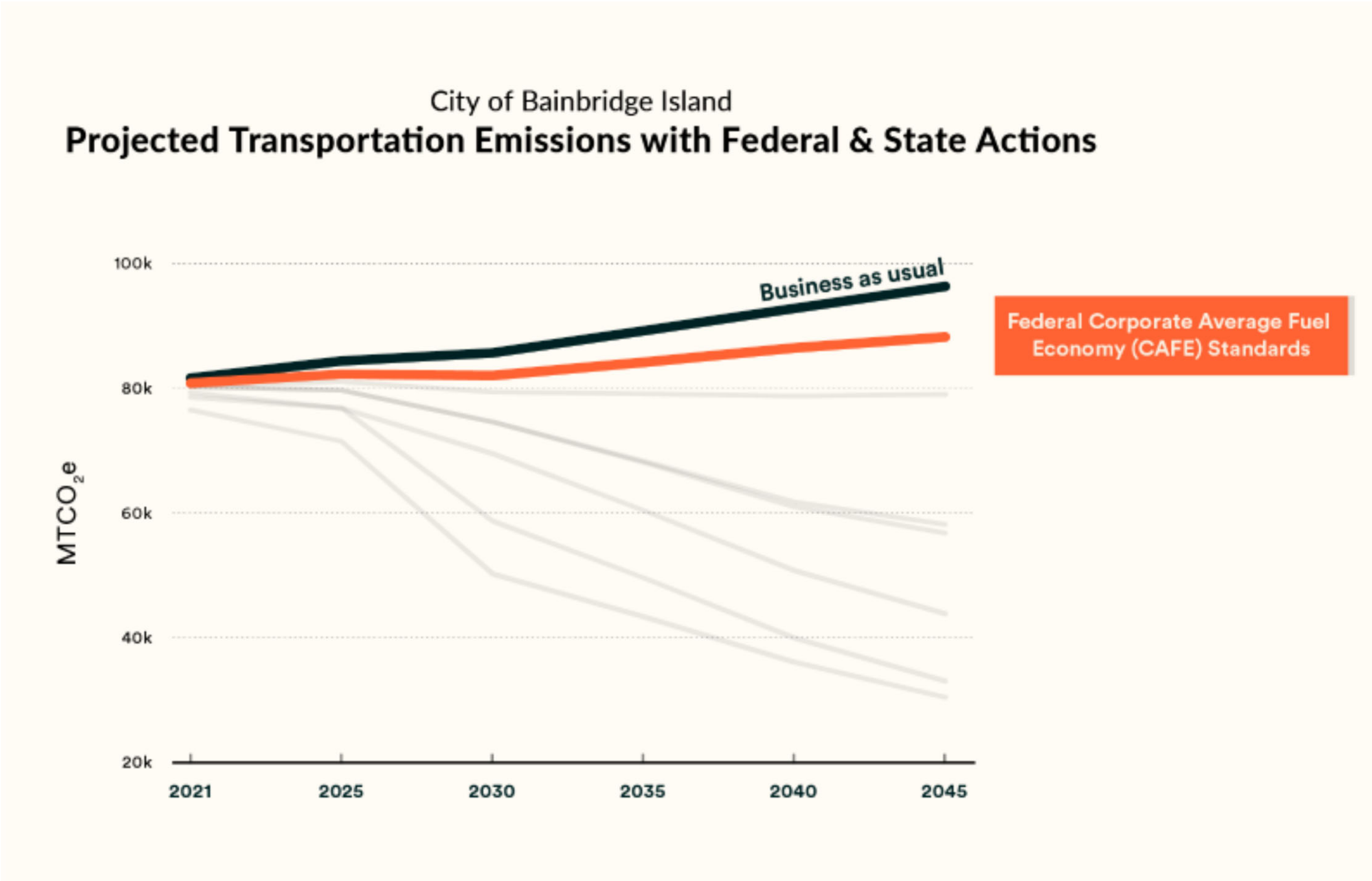
3. WA Internal Combustion Engine Ban (SB 5974)

4. Puget Sound Regional Council (PSRC) Vision 2050

5. Air Transport Action Group (ATAG) 2050 Plan

6. Washington State Ferry (WSF) System Electrification Plan

7. WA Climate Commitment Act (E2SSB 5126)



Policy Impact: #1

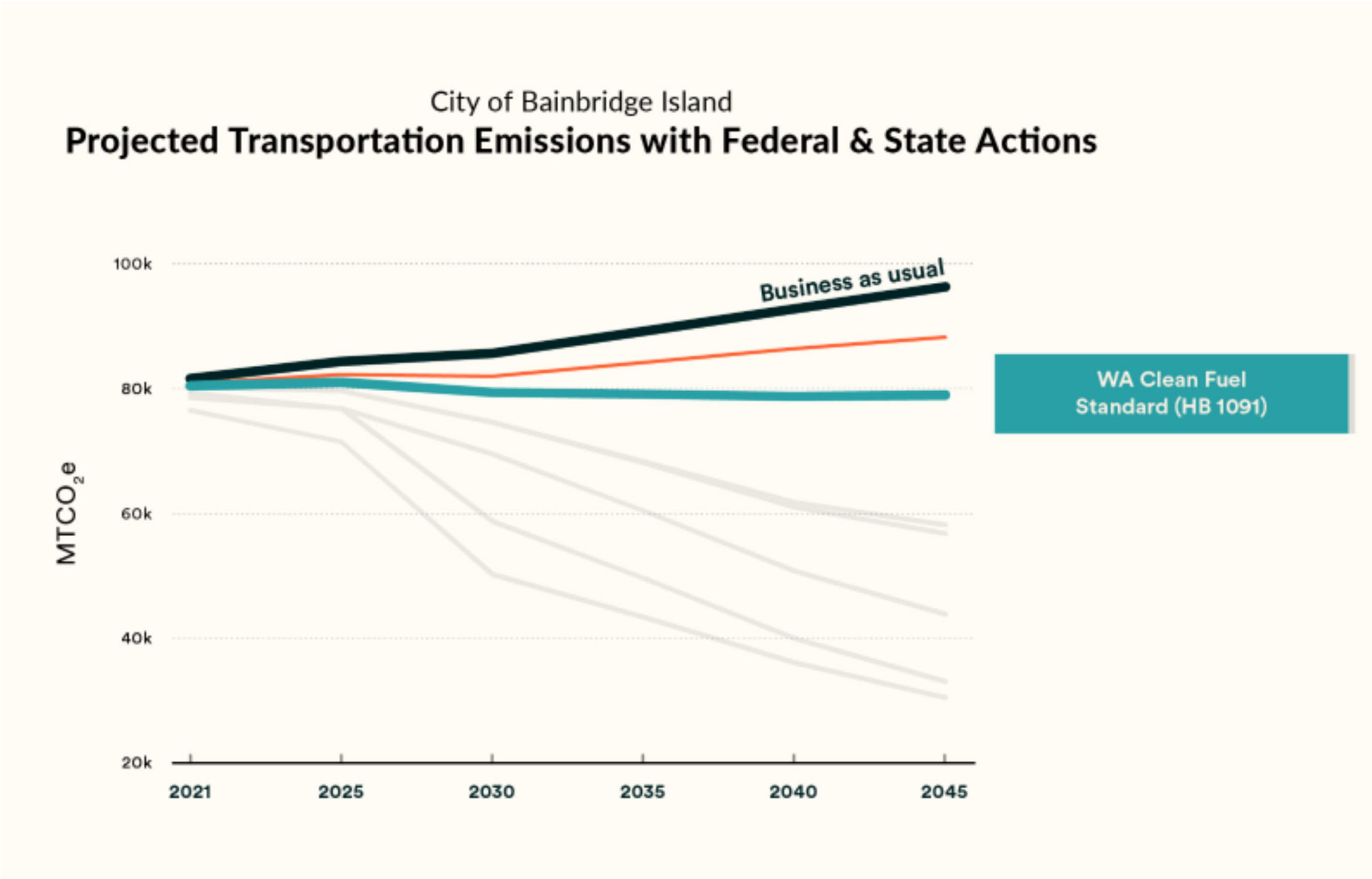
1. Federal Vehicle Regulations (CAFE Standards)

Mandate improves fuel economy standards for passenger cars and light trucks and require an industry-wide fleet average of approximately 49 mpg for passenger cars and light trucks by 2026.

Corporate Average Fuel Economy | NHTSA

Corporate Average Fuel Economy standards regulate how far vehicles must travel on a gallon of fuel. Learn more...

https://www.nhtsa.gov/laws-regulations/corporate-average-fuel-economy#:~:text=NHTSA%27s%20Corporate%20Average%20Fuel%20Economy,heavy%2Dduty%20trucks%20and%20engines.



Policy Impact: #2

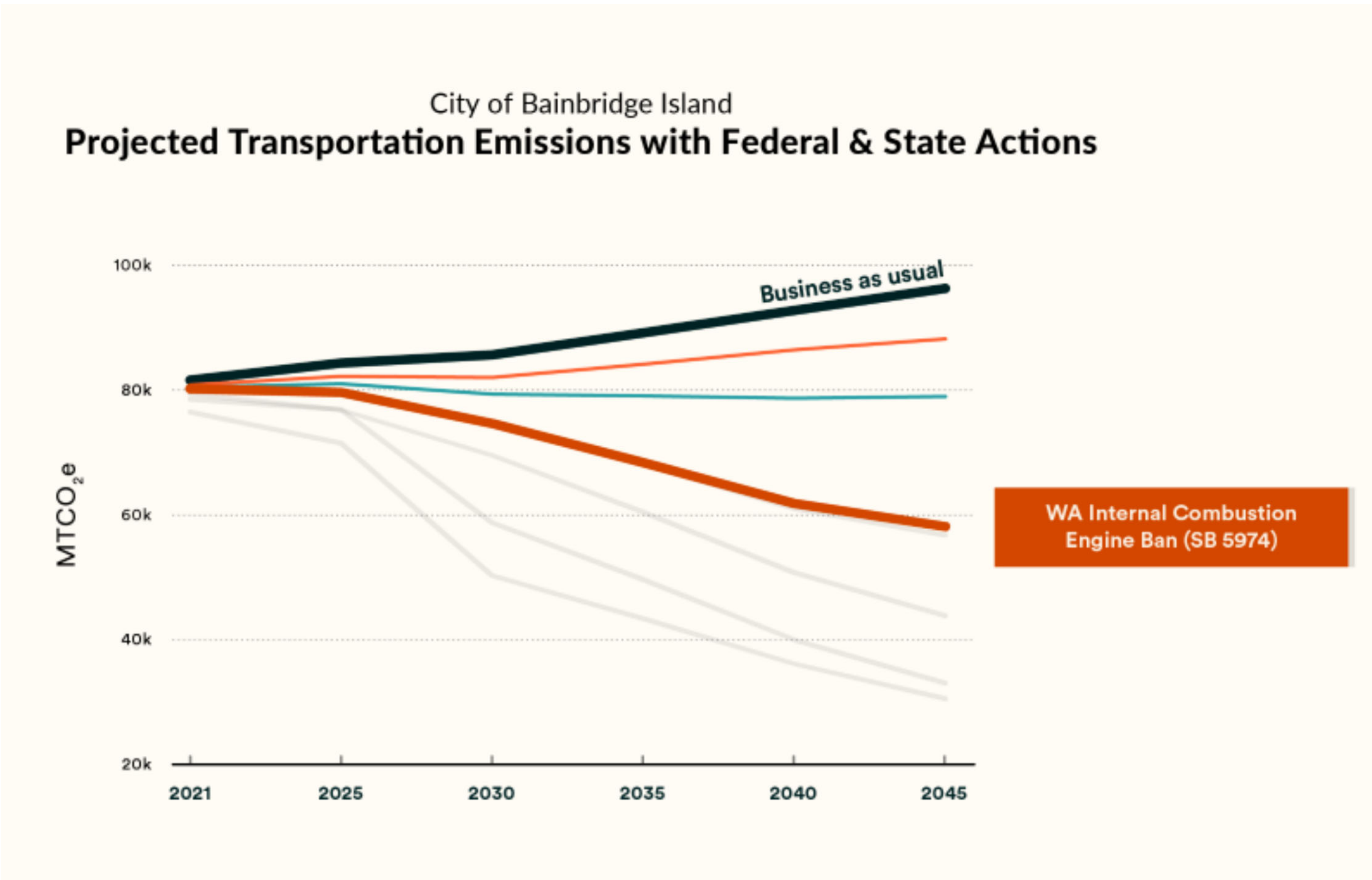
2. WA Clean Fuel Standard (HB 1091)

This Standard requires a 20% reduction in carbon intensity of transportation fuels by 2038 as compared to a 2017 baseline.

Clean Fuel Standard

Important dates Jan. 1, 2023 - Registration started for the program July 1, 2023 - Quarter 2 reporting in WFRS...

https://ecology.wa.gov/Air-Climate/Reducing-Greenhouse-Gas-Emissions/Clean-Fuel-Standard



Policy Impact: #3

3. WA Internal Combustion Engine Ban (SB 5974)

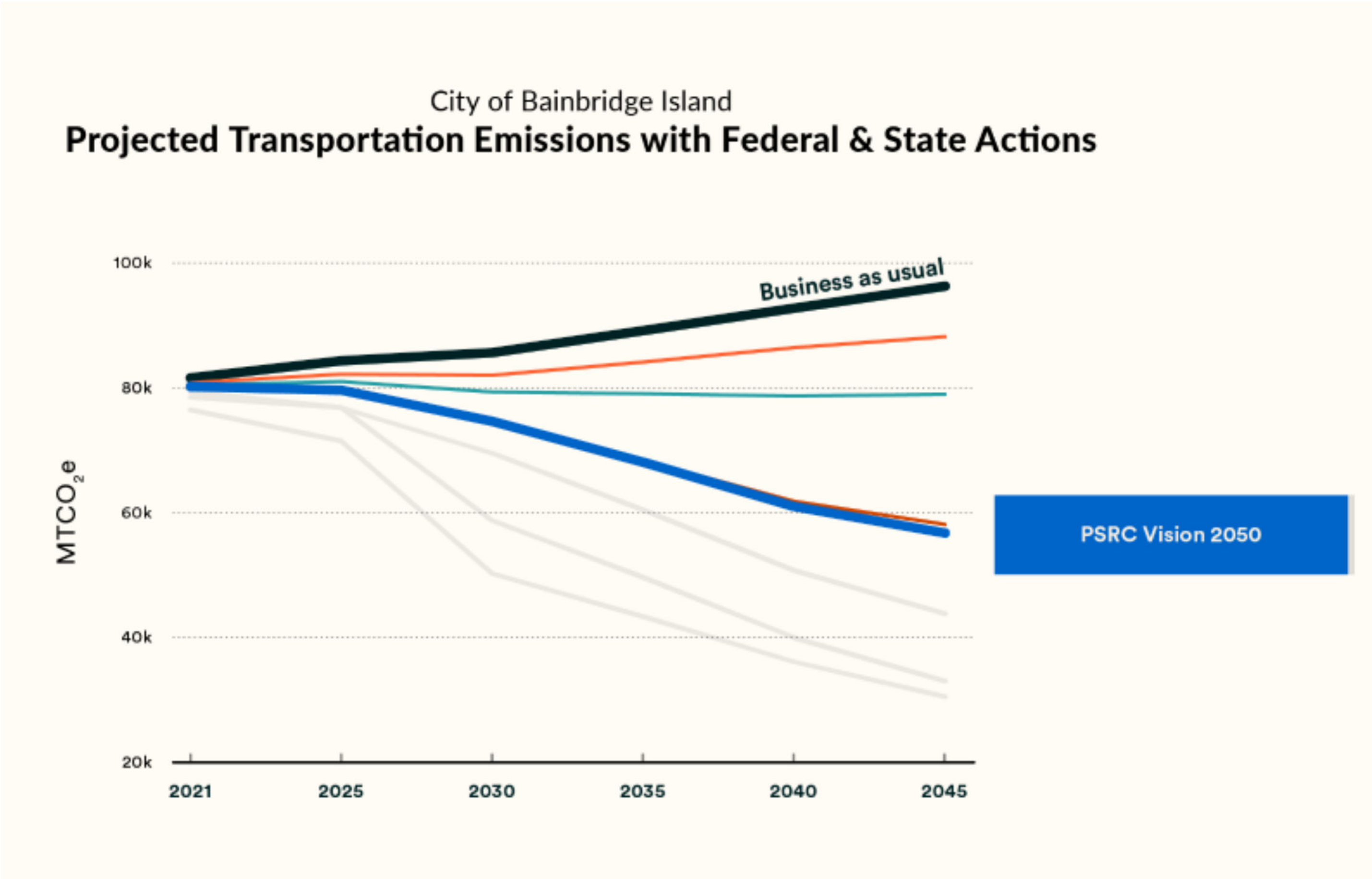
Establishes a target that 100% of new vehicle sales are electric by 2030.

Because this is a current target, not a mandate, the PSREA analysis uses a more conversative approach, which assumes 65% of new vehicle sales are EV by 2030, and 100% by 2035.

WA Internal Combustion Engine Ban (SB 5974)

Senate meeting notes and updates on SB 5974

https://lawfilesext.leg.wa.gov/biennium/2021-22/Pdf/Bills/Senate%20Bills/5974.pdf



Policy Impact: #4

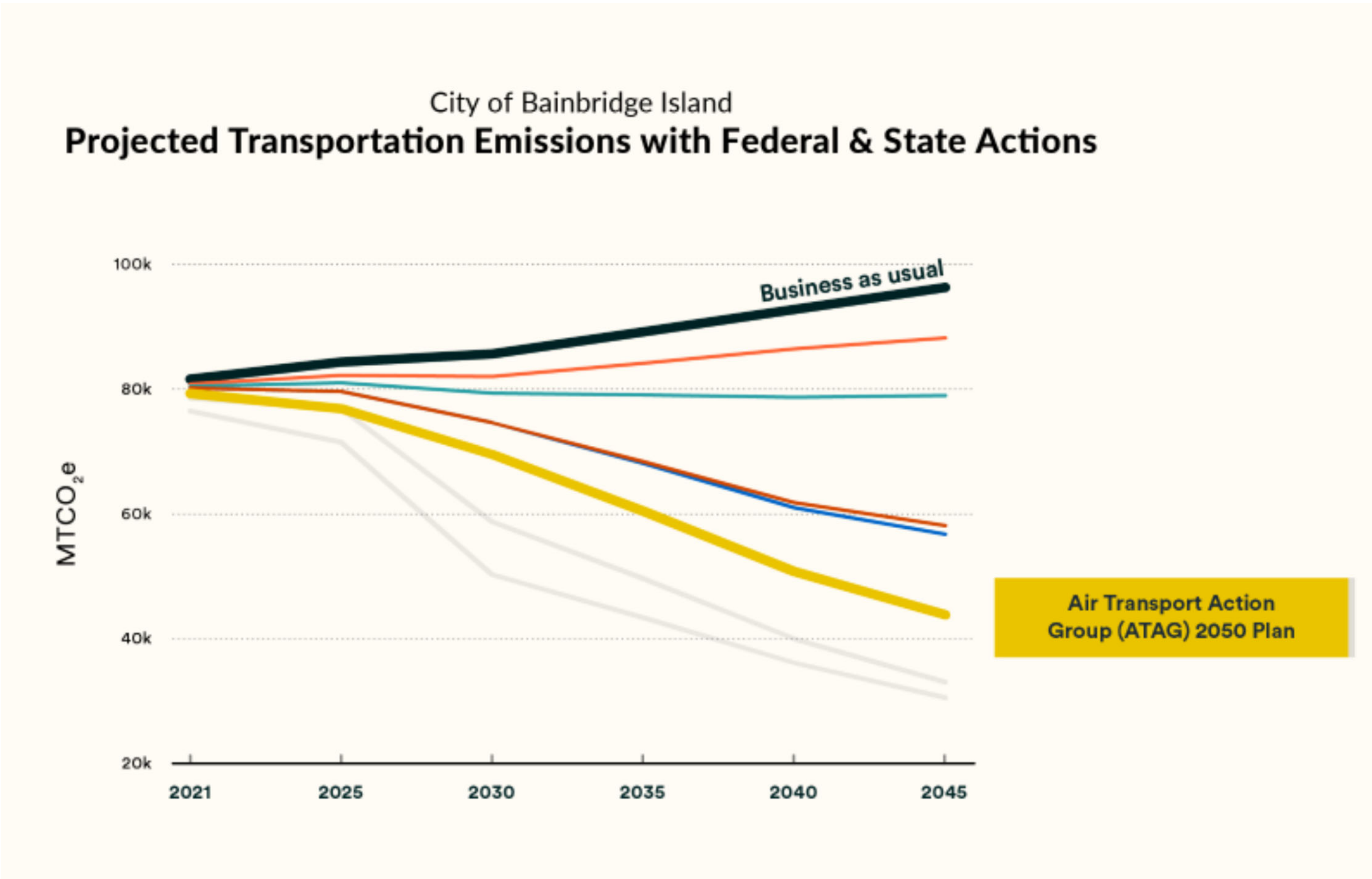
4. Puget Sound Regional Council (PSRC) Vision 2050

The blueprint for the region's transportation vision, programs, and infrastructure projects over the next 30 years and includes future VMT estimates for the region.

VISION 2050

The region's vision for 2050 is to provide exceptional quality of life, opportunity for all, connected communitie…

https://www.psrc.org/planning-2050/vision-2050



Policy Impact: #5

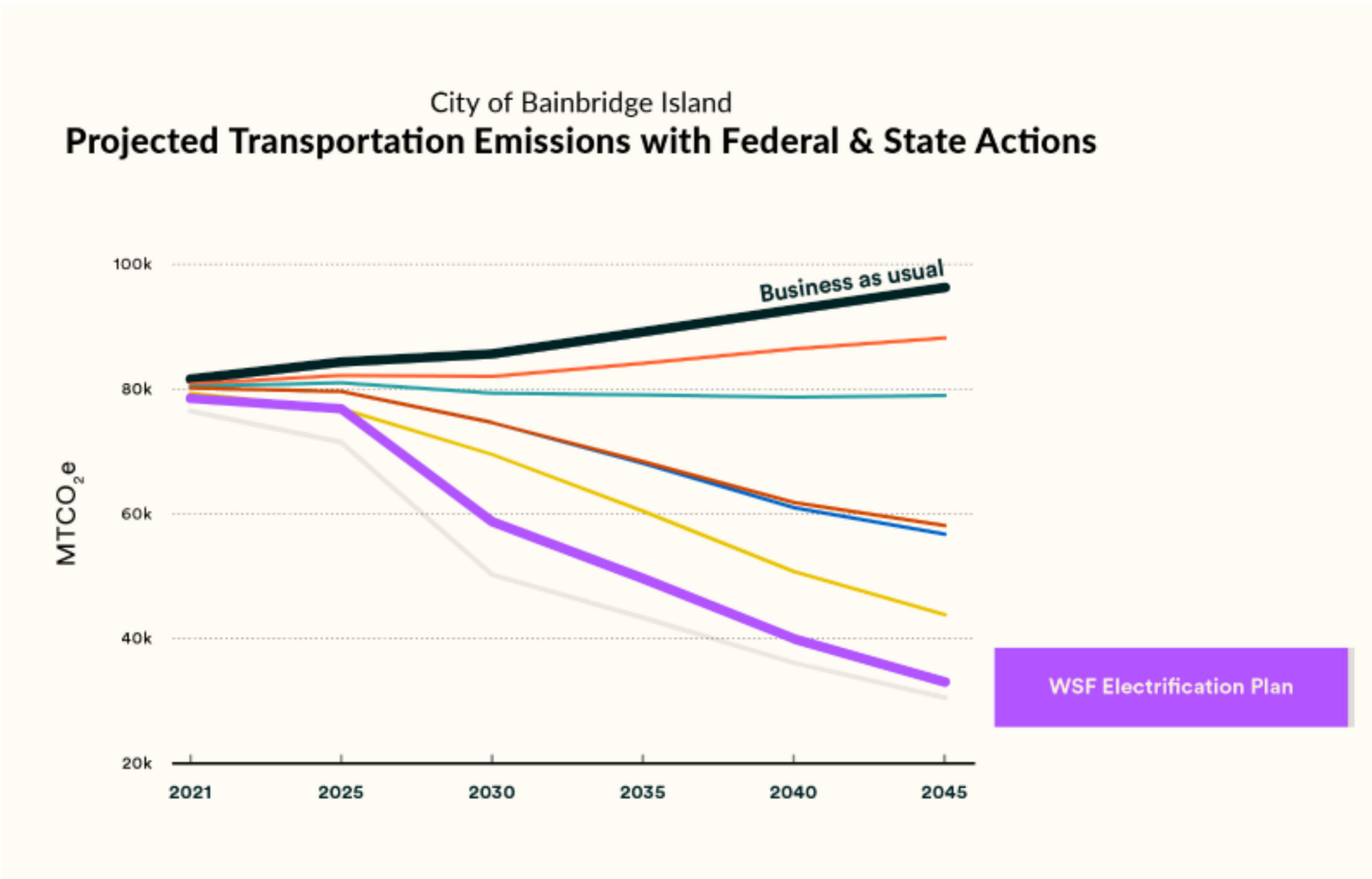
5. Air Transport Action Group (ATAG) 2050 Plan

This Plan aims to achieve net zero aviation operations by 2050 through technology advancements, infrastructure improvements, and sustainable aviation fuels.

ATAG 2050 Plan

Balancing growth in connectivity with a comprehensive global air transport response to the climate emergency.

https://aviationbenefits.org/media/167187/w2050_full.pdf



Policy Impact: #6

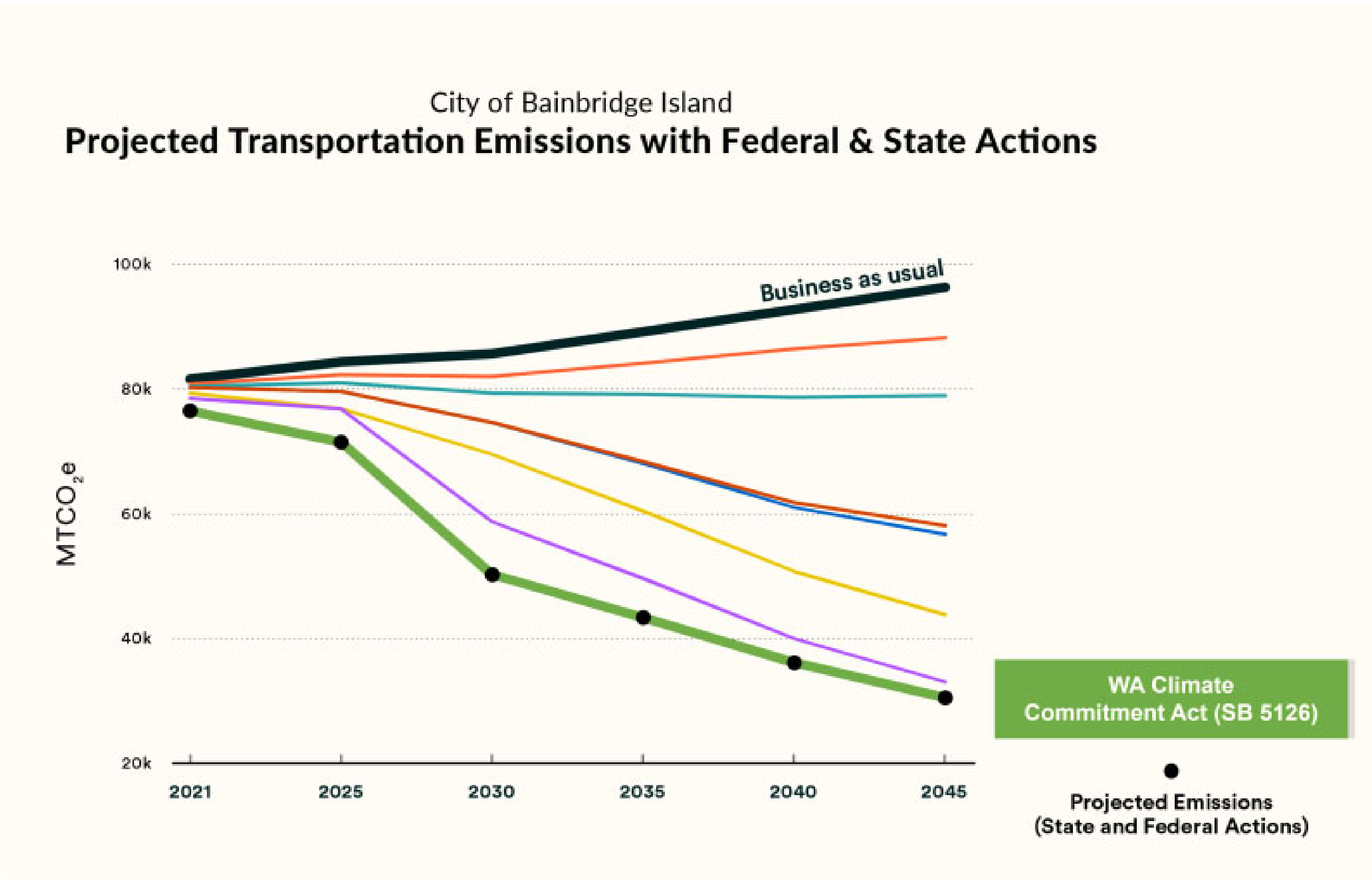
6. Washington State Ferry (WSF) System Electrification Plan

This Plan will electrify the WSF system, including the ferry between Bainbridge Island and Seattle, which is anticipated to be electrified by 2027.

Ferry System Electrification

Hybrid electric Olympic Class vessels WSF will post a draft of the design-build Request for Proposal (RFP) for…

https://wsdot.wa.gov/construction-planning/major-projects/ferry-system-electrification



Policy Impact: #7

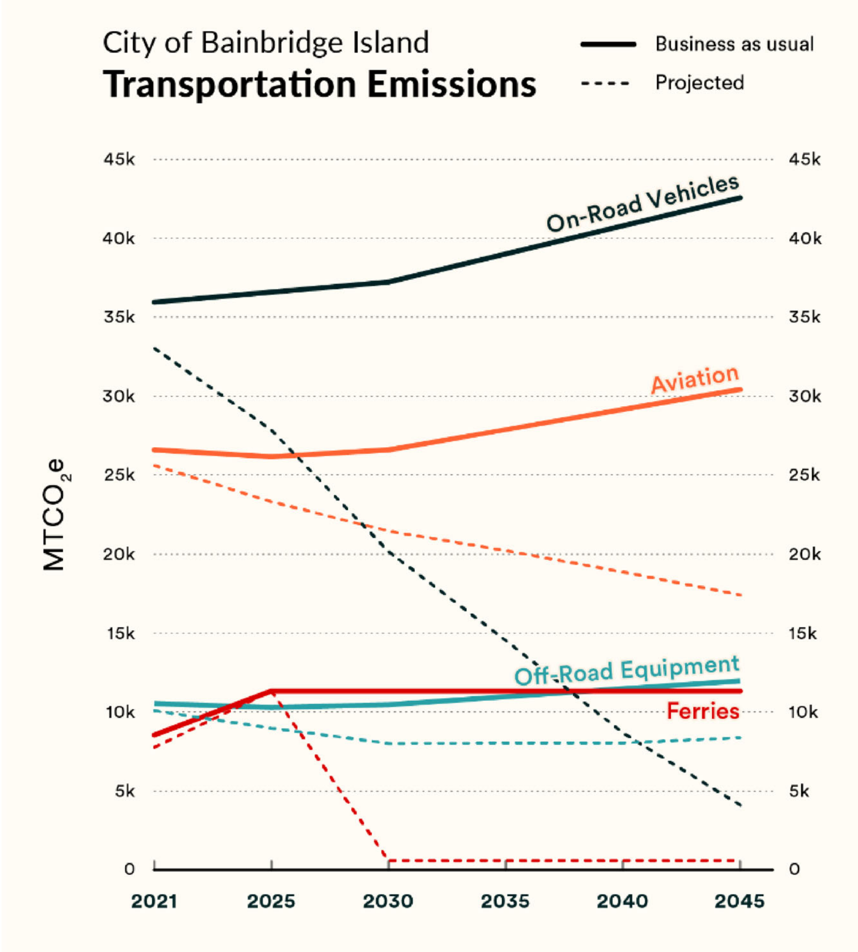
7. WA Climate Commitment Act (E2SSB 5126)

Places an economy-wide cap on carbon to meet the State's greenhouse gas emissions reduction targets. The act impacts transportation emissions by regulating transportation fuels.

Climate Commitment Act

The Climate Commitment Act (CCA) caps and reduces greenhouse gas (GHG) emissions from Washington's...

https://ecology.wa.gov/Air-Climate/Climate-Commitment-Act



Business as Usual Compared to Projected Transportation Emissions

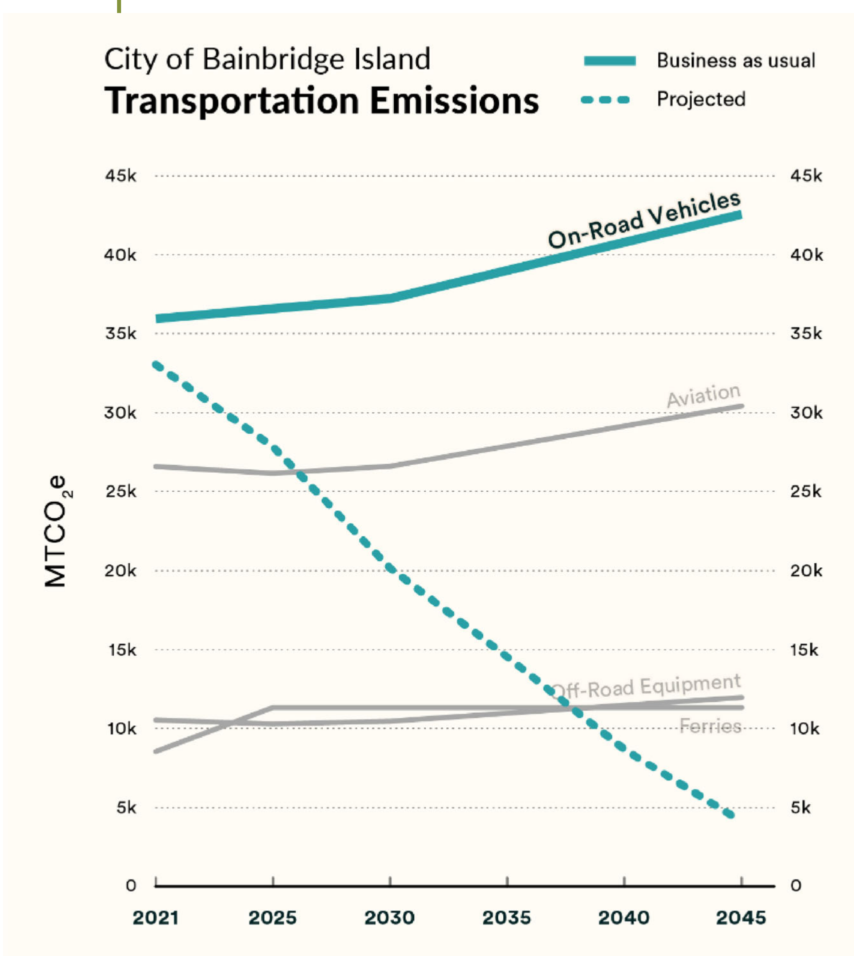
The Projected emissions in each transportation category represent the cumulative impact from the state and federal policies and industry-specific plans.

1. On-Road Vehicles

2. Aviation

3. Off-Road Equipment

4. Ferries

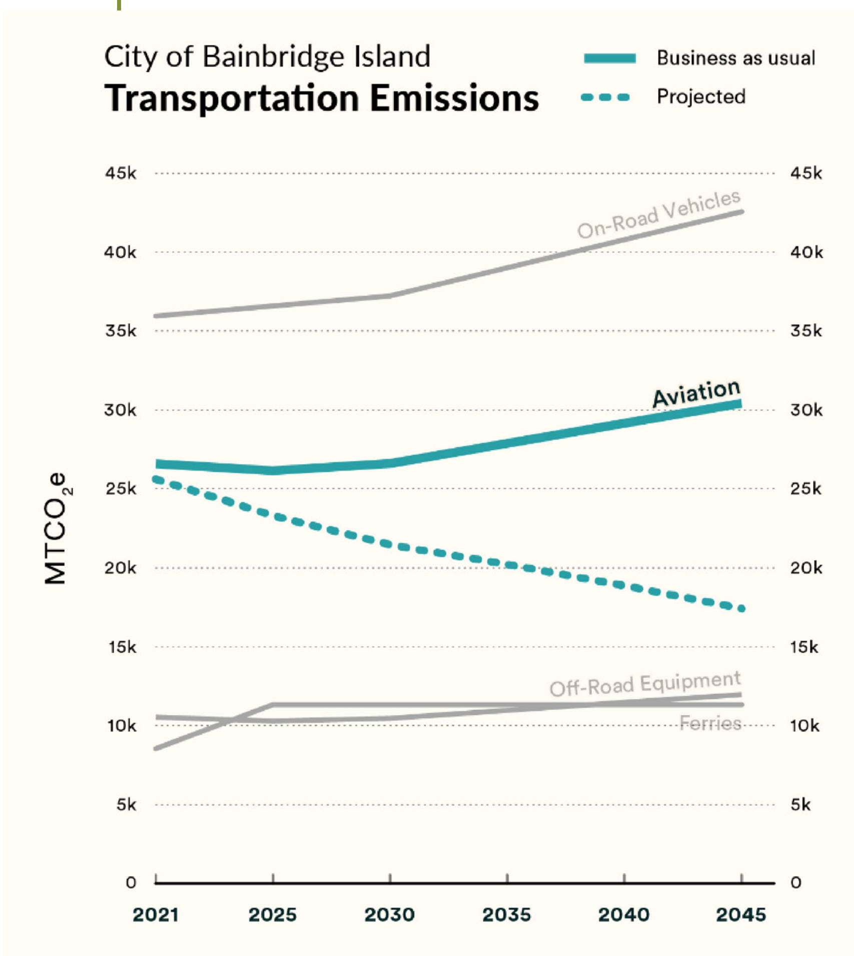


Business as Usual Compared to Projected Transportation Emissions

1. On-Road Vehicles

The decrease in emissions from **on-road vehicles** is driven by three key factors:

- **Improved fuel economy**
- **Cleaner fuel sources**
- **Electrification of passenger, freight, and transit vehicles**



Business as Usual Compared to Projected Transportation Emissions

2. Aviation

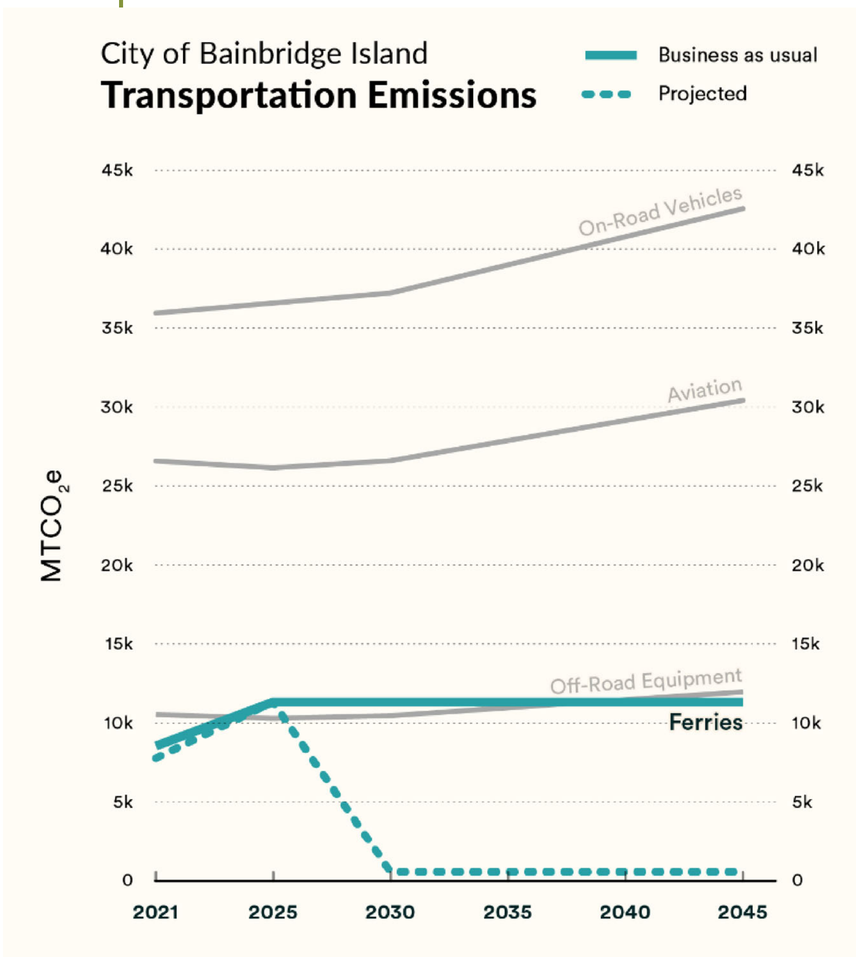
The decrease in emissions from **aviation** is driven by three key factors:

- **Cleaner fuel sources**
- **Infrastructure improvements**
- **Innovation in technology and operations**

Business as Usual Compared to Projected Transportation Emissions

3. Off-Road Equipment

The decrease in emissions from **off-road equipment** is driven by cleaner fuel sources.



Business as Usual Compared to Projected Transportation Emissions

4. Ferries

The decrease in emissions from **ferry travel** is driven by the assumption that the Seattle-Bainbridge Island Ferry and terminal will be electrified by 2027. Consequently, GHG emissions from the ferry will fall about 95% from 2018 levels by 2030.

Wedge Analysis Summary

The wedge analysis shows that while federal and state policies will significantly reduce transportation-related GHG emissions over the next 20 years, additional local efforts are needed to meet the City's emissions reduction target. Furthermore, these policies rely on aggressive electric vehicle adoption rates that may not be feasible given vehicle costs, charging constraints, and range limitations.

Bainbridge Island has high rates of electric vehicle adoption compared to Kitsap County and the region as a whole (approximately 3% of passenger vehicles on Bainbridge Island were electric in 2021, compared to less than 1% of Kitsap County vehicles), which provides a strong foundation for rapid electric vehicle (EV) adoption, a key component of projected transportation emissions reduction for the city. However, other CAP goals, such as a 25% reduction in VMT per capita by 2030 and a 50% reduction by 2045, cannot be addressed by electrifying passenger vehicles.

Reducing VMT will require strategies that both reduce single occupancy vehicle trips and help people travel without a personal car. The VMT reduction strategies outlined in **Table 1** below are expected to have co-benefits (shown in **Figure 3**) that extend beyond reducing emissions.

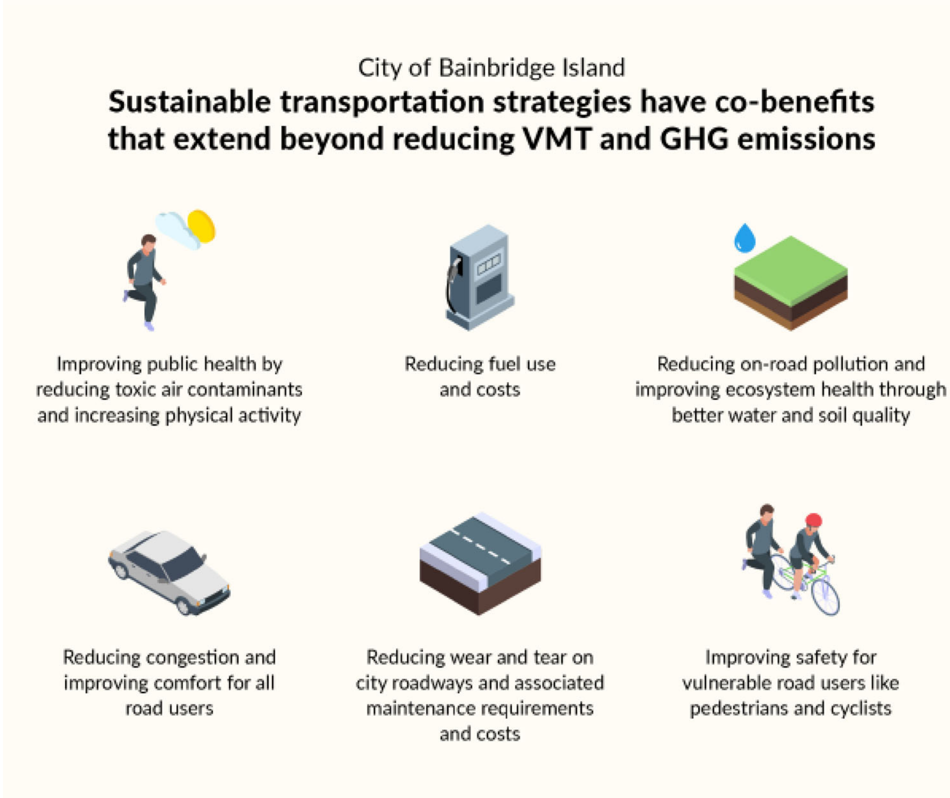


Figure 3 - Sustainable Transportation Strategies Co-Benefits

(Click image to view a larger copy)

Strategy Evaluation

By 2045, on-road GHG emissions on Bainbridge Island are projected to decrease about 85% compared to the 2014 baseline, largely as a result of passenger vehicle and freight electrification. However, that assumes the aggressive vehicle electrification targets are met over a long period of time. Actions taken now to reduce VMT can help achieve the shorter-term CAP goal to reduce emissions 65% by 2035 and provide a strong foundation for long-term GHG emissions reduction. Taking steps to both support vehicle electrification and reduce VMT can help provide co-benefits for all Island residents both now and in the future.

The most desirable strategies to reduce GHG emissions are those that are cost effective, offer a large potential to reduce emissions, are achievable in the near-term, and can be independently implemented by the City. This analysis evaluates eight key VMT reduction strategies to help reduce transportation-related GHG emissions on Bainbridge Island.

Sustainable Transportation Plan (STP)

The adopted Connecting Centers scenario of the STP includes over 40 walking, rolling, and biking projects, as well as non-infrastructure elements such as transit and mobility hubs, and Safe Routes to Schools programs. This evaluation measured the VMT reduction potential of the capital infrastructure projects, which would more than double the city's existing bikeway network and increase the existing sidewalk network by almost 30%. Many of the STP projects are located on arterial streets, and connect important points of interest across the island, including schools, neighborhood centers, shopping, and parks.

Figure 4 - Connecting Centers Scenario Projects

(Click image to view a larger copy)

Construction of the STP projects to build out a strategic multimodal network could result in up to 600,000 new annual walk trips and 1,000,000 new annual bike trips citywide and could reduce VMT on Bainbridge Island by about 6%. The estimated VMT reduction is dependent on construction of the "all ages and abilities", or low stress, multimodal network identified in the STP Connecting Centers scenario. For a bicycling network to truly support users of all ages and abilities, the most fundamental attribute is low stress connectivity, that is, providing routes between people's origins and destinations that do not require cyclists to use roadways with excessive traffic stress, such as high vehicle volumes or speeds. While implementation of the STP projects will provide Bainbridge Island with a strong foundational multimodal network, additional strategies are required to get motorists out of their personal vehicles, and substantially reduce VMT and GHG emissions on the island. Building out this infrastructure is vital to support the VMT reduction strategies analyzed below.

Additional Strategies

Eight strategies (**shown in Table 1**) were evaluated for the potential to help reduce VMT and GHG emissions on the Island. These strategies were selected based on their suitability and feasibility for implementation on Bainbridge Island, including strategies that:

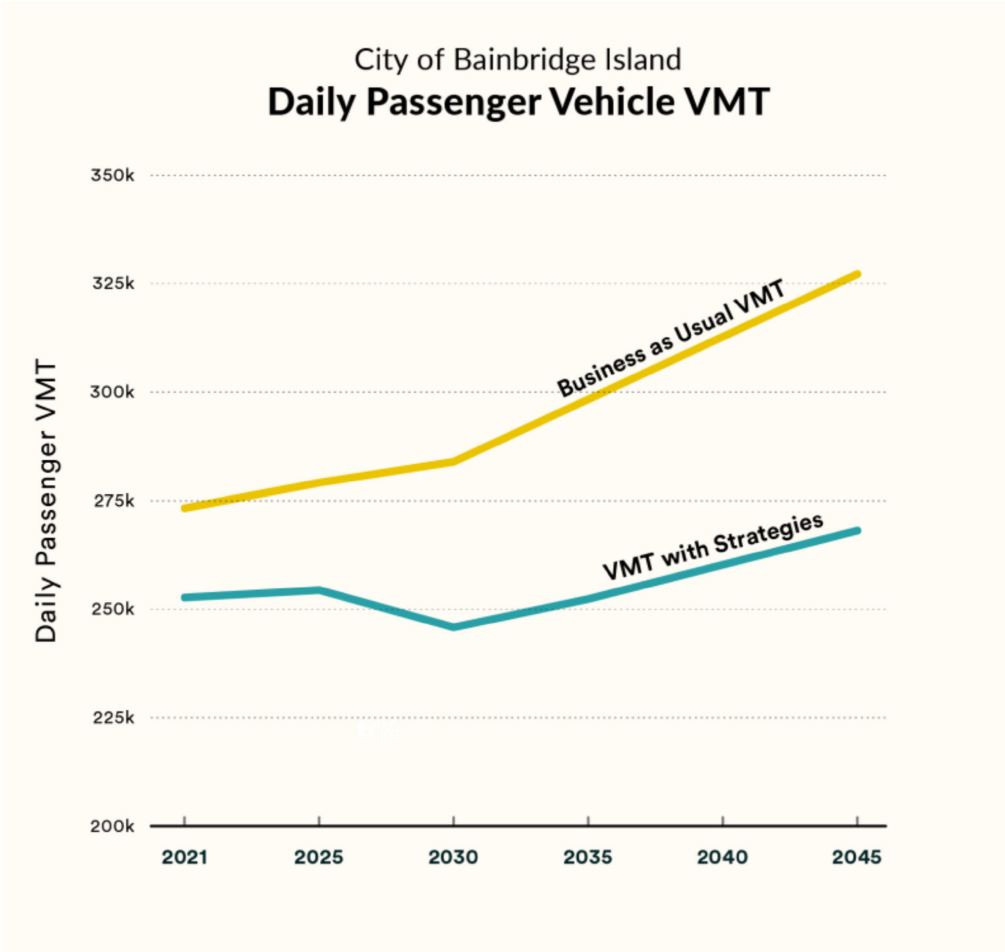
- Can be directly implemented by the City, such as parking pricing, e-bike subsidies, or electric car share
- Are already planned and partially or fully funded, such as expanded transit service and the programmatic elements in the STP
- Are well suited to mitigate employee trips from off-island, which contribute substantially to the city's VMT, such as workforce housing
- Have started to emerge as a result of social and technological change including shifts towards telework and ecommerce, which may decrease the frequency of work or shopping trips respectively

Strategy	Assumptions
STP Projects	Implement the projects and programs listed in the Connecting Communities Scenario of the STP
Transit	Increase transit options through implementation of Kitsap Transit's Long Range Plan, including new fixed-route and expanded on-demand service across the island
Telework	Maintain the increase in teleworking noted during the pandemic
Land Use – Workforce Housing	Build more multifamily housing in Winslow, with a subset of developed units designated as workforce housing
Land Use – Retail Trips	Support recent trends in ecommerce to reduce off-island single-occupancy vehicle retail trips
Parking Pricing	Charge a fee for on-street parking spaces in Winslow
Car Share	Develop a fleet of electric carshare vehicles in Winslow
E-Bike Subsidies	Provide a subsidy or rebate to households for e-bike purchases

Table 1 - VMT and GHG Emissions Reduction Strategies

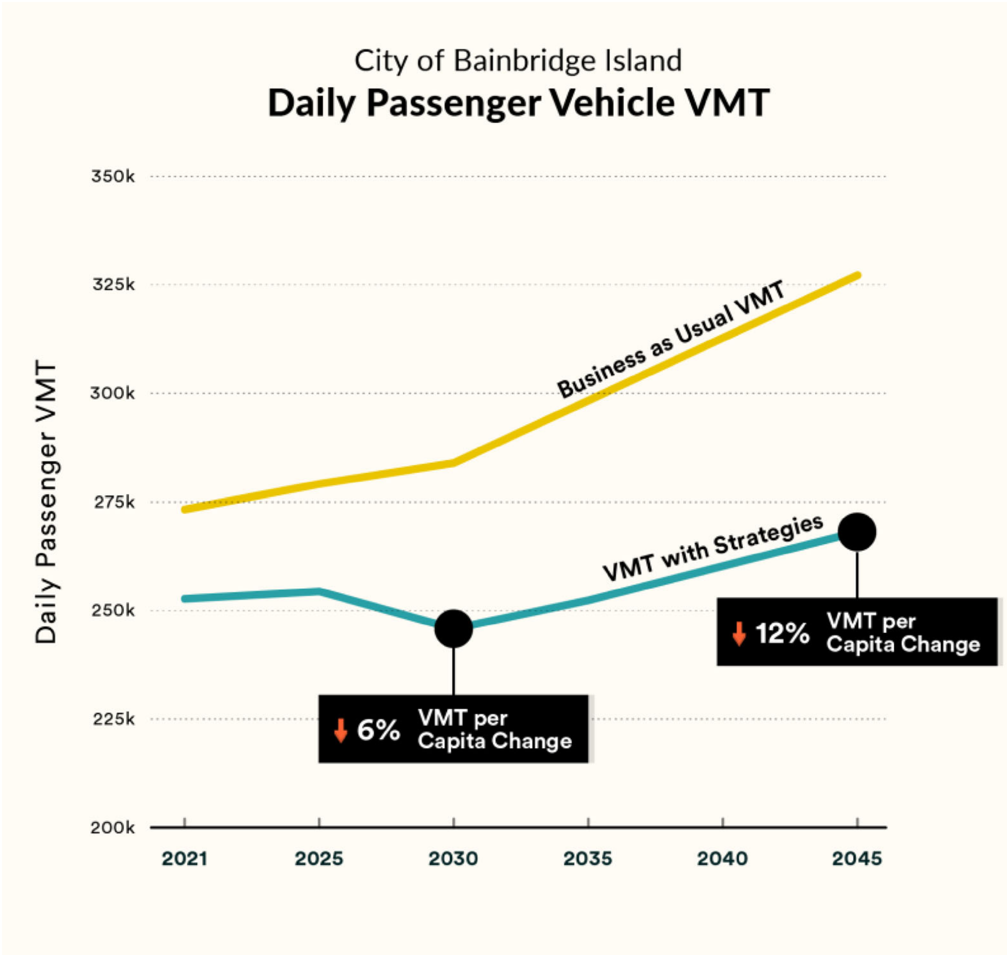
(Click image to view a larger copy)

In alignment with the City's Climate Action Plan goals, the analysis assumes that strategies will be implemented over a 25-year period. Some strategies, such as workforce housing, are expected to take many years to implement. Other strategies have well-established implementation timelines. For example, STP projects are expected to be funded through the City's impact fee program and constructed over the next ten to twelve years. The following sections describe the results of the VMT and GHG emissions reduction evaluation.



VMT Reduction

The selected VMT reduction strategies are expected to reduce VMT by 14% by 2030 and 18% by 2045 compared to the Business-as-Usual scenario. While total VMT will likely continue to increase as population and jobs grow on Bainbridge Island, VMT per person (also described as VMT per capita) could be reduced from the 2014 baseline by implementing these strategies.

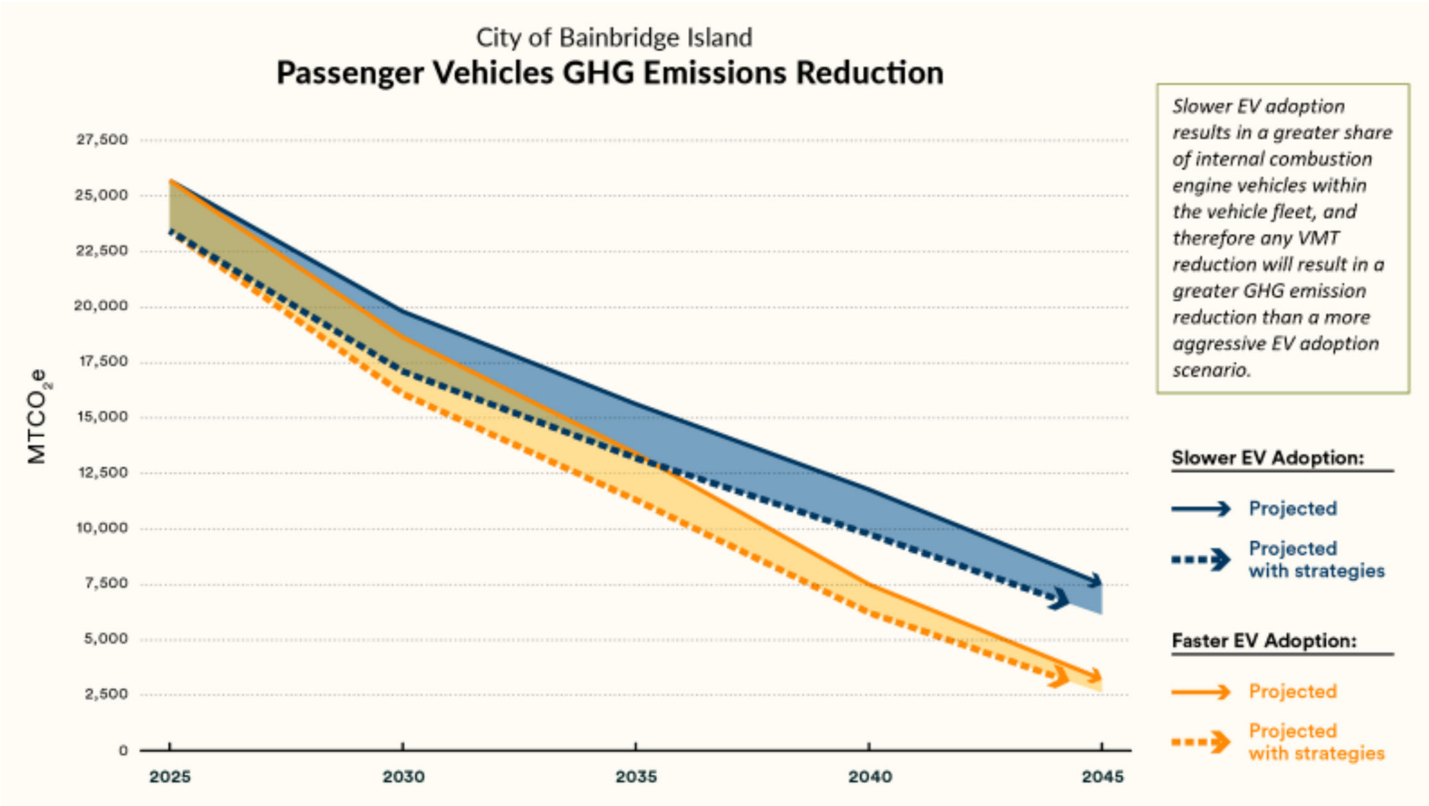


What is VMT Per Capita?

VMT refers to the total number of miles driven (in this case, in passenger vehicles). As population increases, total VMT generally also increases, which makes it difficult to understand how travel patterns may be changing.

To compare how much people drive on the island, it is useful to look at VMT per capita, which is the number of miles driven by each person. VMT per capita can then be compared over time to understand the potential change in vehicle travel for an average person living on Bainbridge Island.

The Daily Passenger VMT graph shows **VMT per capita could be reduced by about 6% by 2030 and 12% by 2045 compared to the 2014 baseline with implementation of the eight proposed strategies.**



On-Road GHG Emissions Reduction

Given the uncertainty around electric vehicle (EV) adoption rates, the analysis considered the GHG emissions reduction potential of all strategies under two EV adoption scenarios:

- **Slower EV adoption**: 50% of new vehicles sales are EV by 2030, and 100% by 2040
- **Faster EV adoption**: 65% of new vehicle sales are EV by 2030, and 100% by 2035

The provided chart shows the expected GHG emissions reduction from the selected strategies under both scenarios.

Under the slower EV adoption scenario, there are fewer EVs on the road, so the VMT reduction provides a greater GHG emission reduction than if there were more EVs on the road. However, total GHG emissions reductions, from both VMT reduction and electrification, are greatest under the faster EV adoption scenario. While electrification clearly provides a substantial benefit over the long term, this graph shows the necessity of near-term VMT reduction to achieve the 2035 CAP goals and provide a hedge against uncertainty around EV adoption.

Action	Reduction in Greenhouse Gas emissions by 2045 from 2014 Baseline ($MTCO_2e$)	
	Climate Action Plan Goal	Estimated Reduction
VMT reduction (all strategies)	-18,000	-600 $MTCO_2$ to -1,400 $MTCO_2$
On- & off-road vehicle electrification	-18,000	-25,000 ✓
Ferry electrification	-14,000	-13,400 ✓
Air travel reduction and improved fuel efficiency	-10,000	-6,000
Total	**-60,000**	**- 40,000**

Table 2 – GHG Emissions Reduction

GHG Emissions Reduction

The selected VMT reduction strategies could reduce on-road GHG emissions by 600 - 1,400 MTCO2e by 2045. While the estimated total GHG emissions reduction from transportation is less than the goals outlined in the CAP, the recent policies and legislation related to vehicle electrification have dramatically increased the share of the reduction associated with electrification, and at the same time, reduced the amount of remaining emissions that VMT strategies can target.

The selected VMT strategies reduce about **20% of remaining on-road GHG emissions in 2045**. Even greater VMT reductions are possible through:

- Faster strategy implementation
- Greater scale of investment, such as a larger e-bike subsidy program
- Changes to land use policy
- Strong political and public will for strategies that increase the price and/or difficulty of single occupancy vehicle trips across the island, such as parking pricing, or reallocating existing roadway capacity for multimodal travel

The bulk of remaining transportation emissions in 2045 come from aviation, off-road equipment, and freight, which the City has less influence over.

Key Takeaways from the Strategy Evaluation

(Click on the arrow to begin)

1) Building on the capital infrastructure projects from the Sustainable Transportation Plan, as well as Kitsap Transit's Long-Range Plan that envisions new fixed route and expanded on-demand transit service, the STP recommends developing mobility hubs at key locations (including the ferry terminal and other neighborhood centers) to connect multi-modal transportation options and support walking, biking, and transit trips. The STP also contains education and outreach programs that are not expected to directly reduce VMT on their own, but are fundamental to the success of planned investments in multi-modal infrastructure and transit service in supporting VMT reduction. Therefore, the City should prioritize construction of the STP capital projects, securing funds for implementation of the STP's programmatic strategies, and continue coordination with Kitsap Transit on execution of the Long-Range Plan.

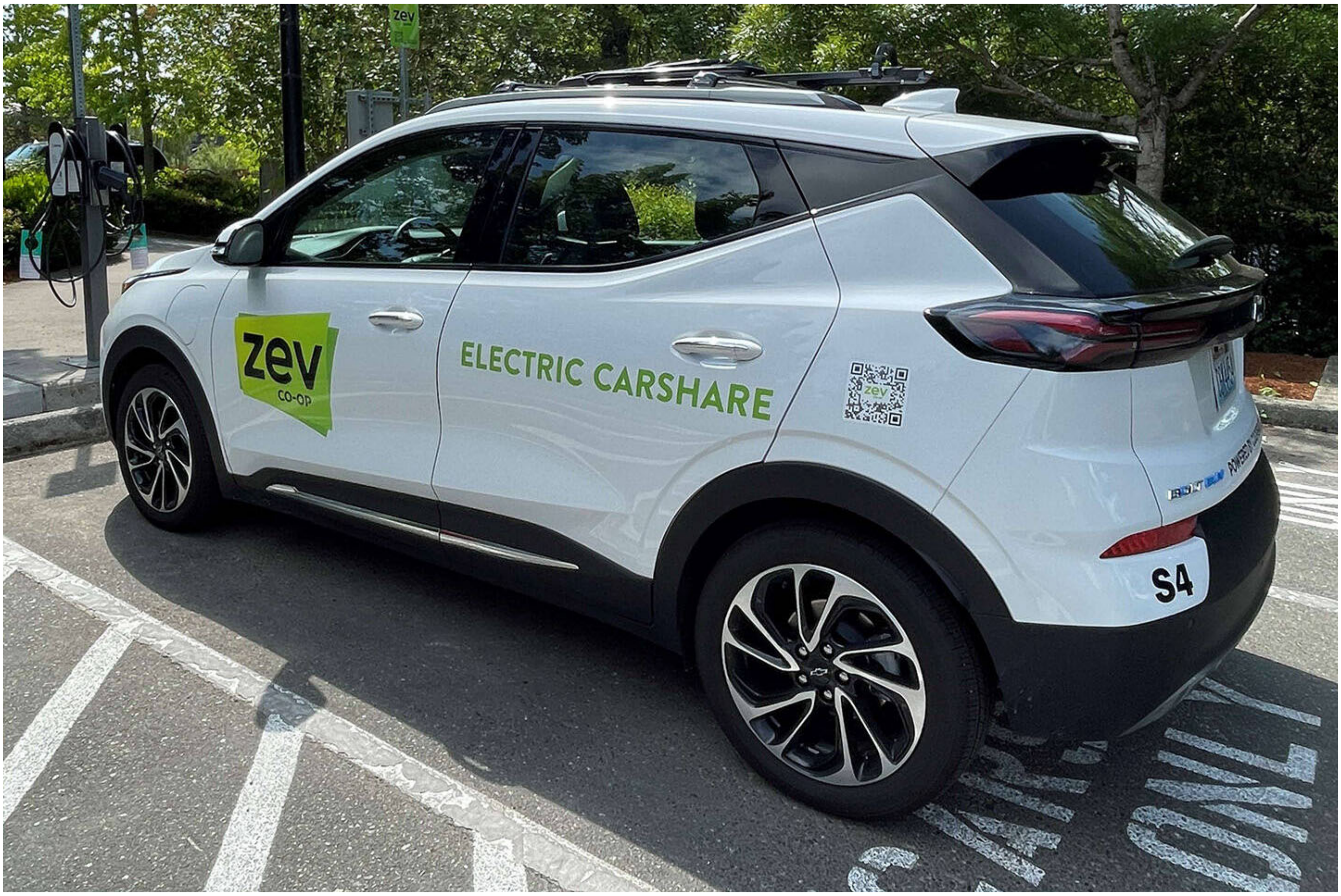
2) The electrification of passenger and freight vehicles will play a key role in reducing emissions from transportation sources on Bainbridge Island. The City should begin to consider the level of public investment that will be required to ensure an EV charging network that can support the aggressive vehicle electrification targets. This includes an assessment of the number, type and location of chargers needed to ensure equitable access for people who may not have access to charging at home.

3) E-Bike subsidies can play a key role in reducing VMT on an ongoing basis. Current successful e-bike subsidy programs, such as the City of Denver's program, provide a subsidy between $400 - $1,200 depending on household income and type of e-bike. The City should prioritize securing funding for an initial pilot program. If the pilot program were to be expanded, and more households had access to the subsidy, the city could see additional VMT reductions, especially when implemented with supportive strategies such as the bicycle infrastructure projects from the STP that make it more attractive to bike around Bainbridge Island.

4) Since retail on Bainbridge Island is limited, many residents travel off-island to shop. Shifting existing retail trips to e-commerce can reduce VMT by reducing off-island personal vehicle trips without reducing access to daily essentials and other goods. Home shopping and deliveries have increased steadily over the past ten years and experienced a significant increase during the COVID-19 pandemic. The City can support these recent trends by developing adequate delivery infrastructure, such as consolidated delivery locations and loading zones.

To further reduce VMT, the City should consider implementing regulatory changes to land use policy. Specifically, the City could take steps to reduce off-island vehicle travel by encouraging the development of mixed-use retail and commercial land uses across the Island. Allocating new multifamily housing as affordable or workforce housing also has the potential to reduce long vehicle trips from off-island for employees who work on Bainbridge Island.

5) The City should consider charging for parking in Downtown Winslow to encourage travel by alternative modes.



6) The City should evaluate the options to expand the current electric carsharing pilot program to provide an alternative to private vehicle ownership for Island residents.

7) Telework is expected to play a large role in reducing VMT. Based on trends from the COVID-19 pandemic, the prevalence of teleworking will likely continue, even without municipal actions to further encourage telework.