One Climate One Oʻahu

Accelerating Oʻahu's clean energy future for our **communities | ʻāina | economy**

CITY & COUNTY OF HONOLULU

CLIMATE ACTION PLAN 2020-2025

Foreword

The City and County of Honolulu ("Honolulu"), comprising the island of Oʻahu, is an island of natural beauty and contrasts. From its lush valleys nourished by moisture rich trade winds to its dryer regions with scant rain, the residents of Honolulu understand the need to prepare our diverse communities for a changing environment and eliminate carbon pollution through decarbonization.

The commitment of Honolulu's residents is already reflected in the nation's highest per capita rooftop solar penetration and one of the nation's highest rates of electric vehicle (EV) ownership. But Hawaii's commitment to 100% clean energy by 2045 requires more and Honolulu is committed to bold, transformative action in climate adaptation and carbon reduction.

The City and County of Honolulu's first-ever Climate Action Plan is a roadmap for collective action with practical, common-sense measures over the next five years aimed at Honolulu's biggest emitting sectors—our transportation networks, building operations, and waste systems.

On the path to a sustainable future, my commitment as Mayor is to leave Honolulu a better place for future generations to live. I invite you to join our cause!

My thanks to the thousands of community voices, the working group members and University of Hawaiʻi team, City Council members, and our City agencies for the vision and commitment.

Rick Blangiardi
Mayor
City and County of Honolulu

Cities and island communities are on the frontlines of climate change. Even while COVID-19 response and recovery dominated 2020 and carries forward into 2021, we have wrestled with sea level rise and erosion impacts to coastal roads and lifeguard towers, a hurricane near-miss, a period of drought, and also heavy rainfall and flooding. To build long-lasting resiliency and greater self-sufficiency for Oʻahu, we must address multiple challenges such as COVID-19 recovery, climate change, and affordability at the same time.

This plan outlines 9 distinct strategies and 47 actions that are measurable and meaningful, with guideposts we can follow to show progress in eliminating greenhouse gas emissions—the root cause of global heating and climate change–from efficiencies and savings across City affordable housing and rental units, to investing in clean and safe transportation options, to reducing waste and turning waste we do have into resources.

We are committed to centering equity and improving economic justice in our focus for implementing this plan and have outlined strategies and actions to keep the City accountable to these practices and goals. Our thanks to the many voices that helped shape this plan. We stand alongside you, committed to climate action.

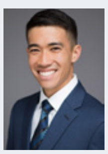
Matthew Gonser
Chief Resilience Officer & Executive Director
Office of Climate Change, Sustainability and Resiliency

Answering the call...

There is **HEREBY ESTABLISHED** a **Climate Action Policy** for the city to **transition to 100 percent renewable energy** within the city and achieve **net-negative carbon emissions** for emissions related to activities within the city **no later than 2045,** consistent with state law.

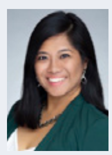
— Ordinance 20-47, Adopted by City Council in 2020

Transforming our built environment to be more resilient and efficient will not only reduce our contribution of carbon pollution, it will also boost the livability and prosperity of our island community.



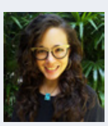
Brandon Elefante
City Council Member and Zoning and Planning Committee Chair

Climate change and a just transition needs to be at the forefront of how the City leads in recovery from the pandemic, how we provide inclusive City core services, and the building of resilient infrastructure to support the growth of our communities.



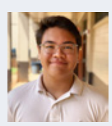
Radiant Cordero
City Council Member and Transportation, Sustainability and Health Committee Chair

Over 13,000 residents and 4,000 buildings on O‘ahu are facing flooding due to sea-level rise if we do not act quickly to abate greenhouse gas emissions and adapt to protect our communities. The longer we wait to act, the more costly the damage will be.



Victoria Keener
Climate Commission Chair

We need our leaders today to make decisions based on what will allow young residents to continue to live and thrive on O‘ahu in the next decade.

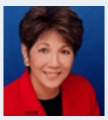


Kawika Pegram
Hawai‘i Youth Climate Coalition

The Climate Action Plan is a vital roadmap for Hawai‘i's energy and climate goals. The City is a critical partner in achieving a clean energy, resilient economy.

Scott Glenn
Hawai‘i State Energy Office

The more we collaborate among Oʻahu stakeholders to reduce carbon emissions, the fewer hardships we will face over rising seas, stronger storms and heatwaves.



Carol Fukunaga
City Council Member

There is much work to be done to address issues related to climate change in our island home including action to reduce carbon emissions.

Heidi Tsuneyoshi
City Council Member

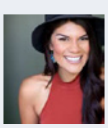
Business and markets depend on predictability — this shared plan will reduce our impact on climate change and create a more secure future.

Jeff Shonka
First Insurance Company of Hawaiʻi

We have a moral responsibility to care for our environment while also ensuring that the transition to a clean energy future is just and equitable for all.

Matt Geyer
Faith Action for Community Equity

This ambitious and forward-thinking plan exemplifies Oʻahu's continued leadership in climate action and environmental stewardship. Now is the time for us to actually act on the many promises and commitments we've made to a cleaner future.



Lauren Watanabe
Oʻahu Sierra Club

COVID-19 has taught us that we all rise or fall together — and climate change is no different. We need to act quickly and as one Oʻahu to protect our island.

Hiro Toiya
Department of Emergency Management

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available at www.resilientoahu.org

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Acknowledgments

University of Hawaiʻi at Mānoa Project Team

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The University of Hawaiʻi at Mānoa project team led technical and policy analysis, including assessment of strategies, island-wide survey and technical review.

Special thanks to Layla Kilolu for additional research assistance.

CCSR Project Team

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Lauren Holt: *Communications & Community Education Specialist, AmeriCorps VISTA Member*

Ryan Nakazaki: *Climate Advisor, American Cities Climate Challenge*

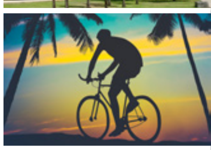
The CCSR project team led the GHG inventory, community engagement, and inter-departmental collaboration leading to the final climate actions.

Bloomberg Philanthropies' American Cities Climate Challenge

Climate Action Plan At-A-Glance

This Climate Action Plan (CAP) presents nine climate strategies and 47 actions for the City to pursue in the next five years to substantially reduce greenhouse gas (GHG) emissions from ground transportation, electricity, and waste sectors — a reduction of 45% by 2025 relative to 2015, an additional 16% relative to an estimated baseline. This CAP focuses on City actions over the next five years at a magnitude in line with reductions needed to reach the ultimate goal of carbon neutrality by 2045.

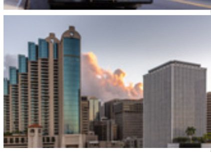
1 Encourage Density and Mixed Land Use in Strategic Areas



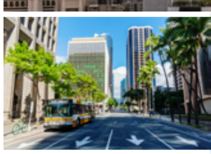
2 Enable and Provide Multiple Modes of Green Transportation

3 Encourage Mode Shift through Parking Efficiency

4 Electrify the City Fleet and Support High Efficiency Vehicles

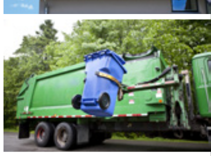


5 Reduce Energy Demand by Increasing Energy Efficiency

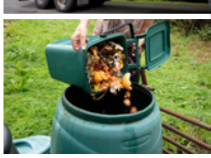


6 Maximize Energy Efficiency and Renewable Energy throughout City Operations and Assets

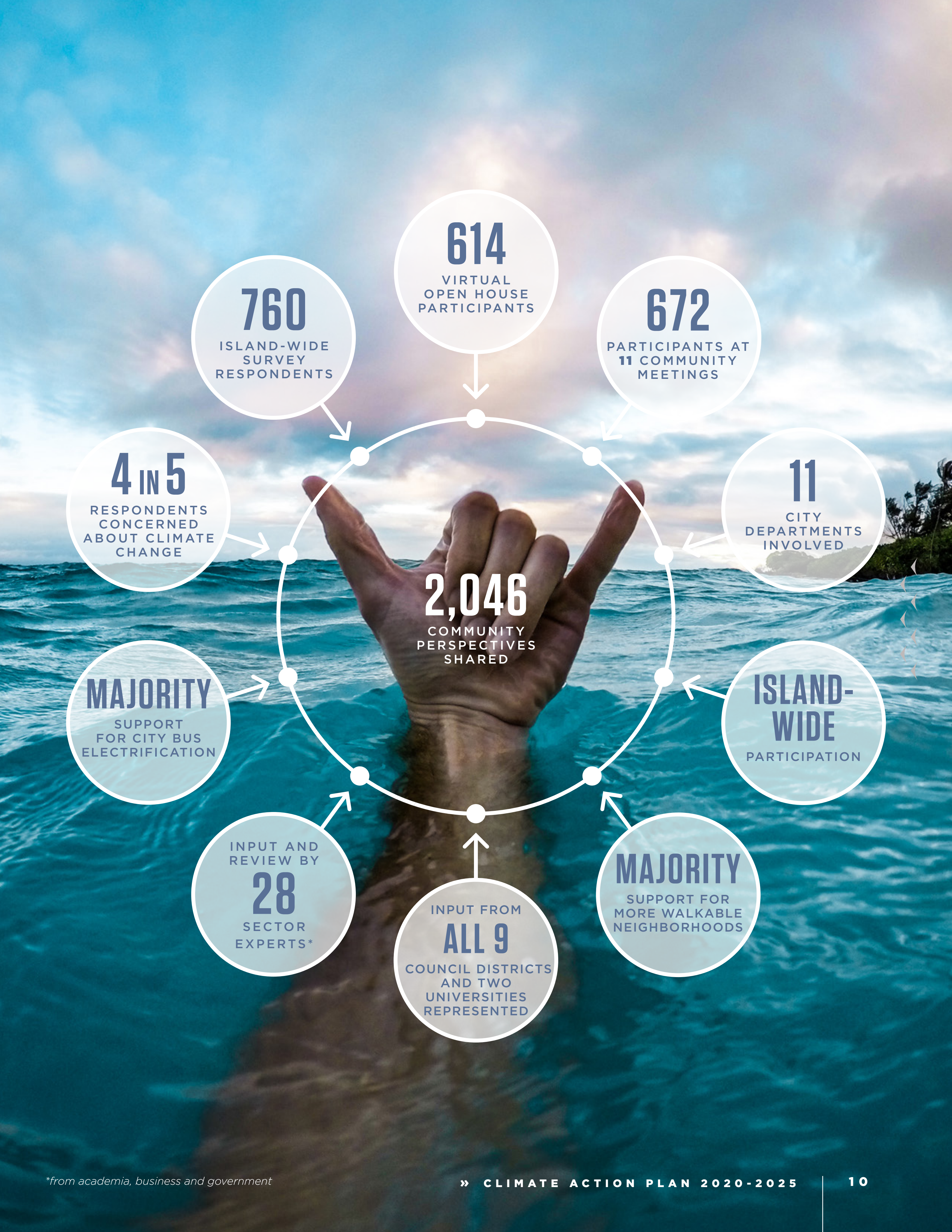
7 Expand Renewable Energy Planning and Expedite Permitting



8 Promote Waste Prevention



9 Maximize Waste Resource Efficiency



*from academia, business and government

The City & County of Honolulu (City) recognizes the need for Hawaiʻi, and the world, to dramatically reduce greenhouse gas (GHG) emissions to avoid the most catastrophic effects of climate change. Taking bold actions to address climate change is urgently needed across the world stage. As required by Ordinance 20-47, the City must develop a Climate Action Plan (CAP) to establish comprehensive milestones to transition Oʻahu to 100% renewable energy on the path to carbon neutrality by 2045. This is supportive of the State's goal of achieving net-negative GHG emissions no later than 2045.

DEFINITION

What are Greenhouse Gases (GHGs)?
GHGs are gases in the atmosphere that trap heat. The most abundant GHG is water vapor. The three primary GHGs released as a byproduct of human activities are carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O). Other GHGs include hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and other synthetic gases. GHG emissions are typically measured in metric tons of carbon dioxide equivalents (MTCO2 Eq.) based on the global warming potential of each gas.

With the Oʻahu Resilience Strategy as a foundation, this first-ever CAP provides a roadmap for Oʻahu of ambitious and achievable GHG emissions reduction strategies. While this plan puts the City on the path to reach a goal of carbon neutrality by 2045, it is by design short-term, outlining critical actions for the next five years (2020-2025) to reduce emissions due to buildings (primarily electricity), transportation, and waste. These strategies focus on immediately reducing carbon pollution in order to reverse the very causes of the climate crisis. This CAP complements the City's Climate Adaptation Strategy, which is being drafted to outline how we will adapt and defend against the climate impacts we already face.

In addition to slowing climate change, local climate actions can enhance the quality of life in communities with less local air pollution, create greater connectivity between neighborhoods and amenities, and transition to a clean economy with expanded green job opportunities. Moreover, ensuring an equitable transition is a core value of this CAP. With the public health and economic emergency caused by the COVID-19 pandemic, exacerbating the inequities and vulnerabilities of Oʻahu's diverse communities, the City acknowledges that addressing issues of climate must also be equitable. As such, in the midst of the COVID-19 pandemic, it is particularly important for the City to identify the important steps for climate action that can align with near-term recovery and stimulus efforts.

To lead by example, the City shall take steps to transform its own operations as well as enable the island's systems and people to lower GHG emissions. Collaboration among City departments and relevant state and federal agencies is important to meeting the local and state goals of carbon neutrality, and beyond, by 2045. This CAP takes an island-wide perspective while recognizing the necessity of working across jurisdictions to make meaningful progress.

SPOTLIGHT

Honolulu Is Committed to the Paris Climate Agreement

The Paris Agreement within the United Nations (UN) Framework Convention on Climate Change brings together 197 countries under a common framework for reducing GHG emissions with the goal of limiting global temperature rise to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels. The UN Environment Programme has estimated that to remain under the 2°C or 1.5°C target, global emissions must be reduced by 25% or 55%, respectively, by the year 2030.[i]

In June 2017, following President Trump's announcement that the U.S. would be pulling out of the Paris Climate Agreement, Governor Ige and Hawai'i's four county mayors came together to sign two state bills and a mayor's agreement committing that Hawai'i would meet the goals set forth in the ambitious global climate accord. The creation and adoption of a Climate Action Plan is a requirement for Honolulu to continue to be part of the subnational effort to meet the Paris Climate Agreement.

What is the scope of this CAP?

Whereas climate action broadly encompasses both reducing GHG emissions and adapting to the effects of climate change, this CAP focuses on reducing GHG emissions that occur within O'ahu. This CAP presents O'ahu's current community-wide GHG emissions footprint and forecasts island-wide GHG emissions to the year 2045 given current policies and trends. It focuses City actions on GHG emissions reductions from large-emitting sectors that the City can most effectively influence: ground transportation; electricity; and waste. These sectors account for 57% of O'ahu's current GHG emissions.

How will this CAP help the City reach its goals?

Informed by data and analysis, public input, and consultation with City departments, a total of nine City strategies containing 47 actions are identified to reduce O'ahu's GHG emissions over the next five years. These strategies put O'ahu on a pathway to reduce GHG emissions in ground transportation, electricity, and waste by 80% from 2015 levels by the year 2045. This is an additional 18% reduction in 2045 than would be likely achieved otherwise.[1] Reaching carbon neutrality requires additional actions, including federal and state policies, as well engaging in carbon offsets.

How will the City ensure progress?

City progress in meeting its GHG emissions reduction goals will be measured and published within the Annual Sustainability Report. As this is a five-year plan to spark near-term action, it will require an update by 2025. Every five years, the City can take stock of new technologies, state and federal policies, and approaches to GHG abatement. It can assess progress on GHG emissions reductions, evaluate the distribution of impacts across O'ahu households, and develop new actions toward the 2045 goal. Future updates to the CAP will expand in scope to incorporate considerations for land use change, GHG offsets, and out-of-boundary GHG emissions that occur due to activities within O'ahu.

[1] Relative to the estimated baseline representing current Federal and State policies.

DEFINITION

What does the goal of "Carbon Neutral" mean?
A carbon neutral O'ahu means that the island captures at least as much carbon from the atmosphere as its activities release through GHG emissions. To achieve carbon negativity, O'ahu would need to remove more carbon from the atmosphere than emitted. Carbon is naturally stored, or "sequestered," in organic material like trees, algae, and soil. The City can invest in "carbon offset" projects that are designed to capture carbon and reduce overall emissions in the atmosphere, though this is a difficult proposition in the absence of participating in carbon markets.[ii] Through offset projects, land use changes, and broader decarbonization efforts, O'ahu could become carbon neutral by 2045, and eventually, carbon negative.

Photo credit: Hawai'i Sea Grant King Tides Project

What is at Stake?

State of the Climate

The global climate is changing because of human activities that release GHGs into the atmosphere. These gases trap heat from the sun in the Earth's atmosphere, creating a greenhouse effect.

In 2020, carbon dioxide rose to new record high values of 417.1 parts per million (ppm). [iii] This concentration was the highest in ice core records dating back as far as 800,000 years. Because GHGs remain in the atmosphere for hundreds to thousands of years, past and present emissions will cause long-term changes to the climate system long after they are released into the atmosphere.[iv] These committed emissions will have profound consequences for local communities and ecosystems. The extent to which the worst expected impacts are realized, though, depends entirely on actions taken to reduce GHGs. As an island community, Hawai'i has much at stake.

In 2017, global warming[2] reached approximately 1°C above pre-industrial levels. Below are just some examples of how climate change is already and likely to impact O'ahu.

[2] Defined as an increase in combined surface air and sea surface temperatures averaged over the globe and over a 30-year period according to IPCC (2018) special report on the impacts of global warming of 1.5°C.

Introduction

In the absence of GHG abatement, global sea levels will likely rise by three feet or more by late century, causing more high tide flooding until it becomes a state of new normal.[v] On O‘ahu, three feet of sea level rise will impact over 9,400 acres of land, over 3,800 structures, and 17.7 miles of major roads, and puts at risk nearly $13B worth of land and structures.[vi] High-tide flooding can already be observed across O‘ahu in low-lying areas, particularly those that have been developed with fill, like Māpunapuna, or along chronically eroding shorelines, like the North Shore. Combined with coastal erosion, higher tides are threatening existing infrastructure as well as community access to and preservation of beaches. This is exemplified by the crumbling coastal highway along Ko‘olau Loa and the narrowing of coastal access in Kāhala and impassable road through Hau‘ula in 2019. The reach and devastation of sea level rise by the end of the century will depend heavily on actions taken today to reduce GHGs.

The average annual temperature for Hawai‘i in the years 1986-2016 was 0.7°C higher relative to 1925–1960.[vii] The trend of increasing temperatures is expected to continue.[viii] Higher temperatures, for example, change the geographical range of climate sensitive infectious diseases — such as malaria, dengue fever, and tick-borne diseases,[ix] — and thermal stress of native flora and fauna. Higher temperatures also lead to an increase in electricity demand and evaporation of water supply.[x]

Rainfall patterns for Hawai‘i are expected to change with wetter conditions in some areas and drier conditions in others.[xi] Overall, there will be a change in freshwater availability in certain areas. This will impact existing land uses such as agriculture and precipitate adverse conditions like frequent landslides (such as what was experienced on the Pali Highway in 2019).[xii]

Warming and acidification of the ocean, combined with existing environmental stressors, will devastate many coral reefs and their fish communities. Globally, coral reefs are projected to decline by 70-90% and more than 99% at a 1.5°C and 2°C increase in global warming, respectively.[xiii]

Native plants and animals, especially in high-elevation ecosystems, will be exposed to new invasive species, exacerbating the risk of extinctions.[xiv]

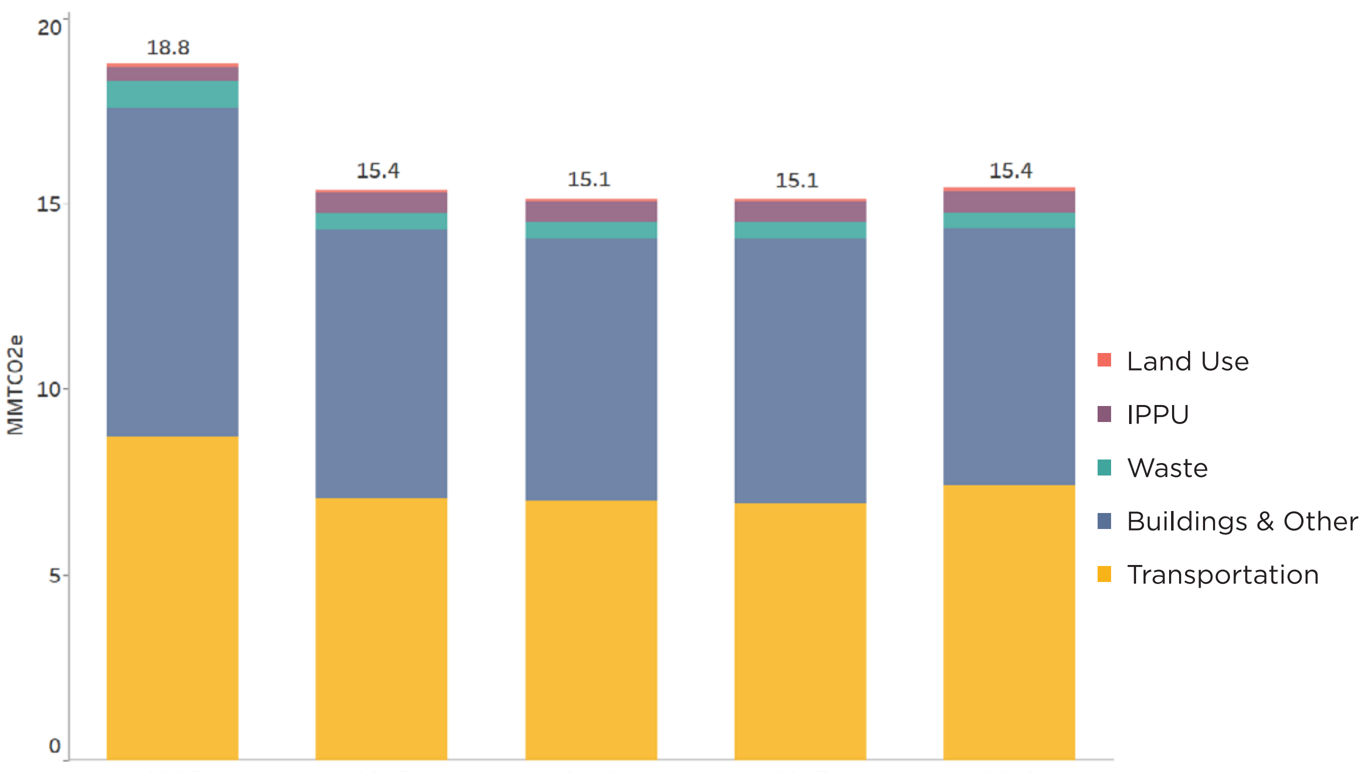
Increases in the strength of El Niño and La Niña events have been observed and climate modeling suggests that this trend will continue.[xv] In addition, it has been modeled that central Pacific tropical cyclone tracks are shifting northward, making Hawai‘i more vulnerable to a direct hit.[xvi]

For a more complete description of the impacts of climate change to O‘ahu, see the City & County of Honolulu Climate Change Commission (2018) "Climate Change Brief."

Oʻahu's GHG Emissions

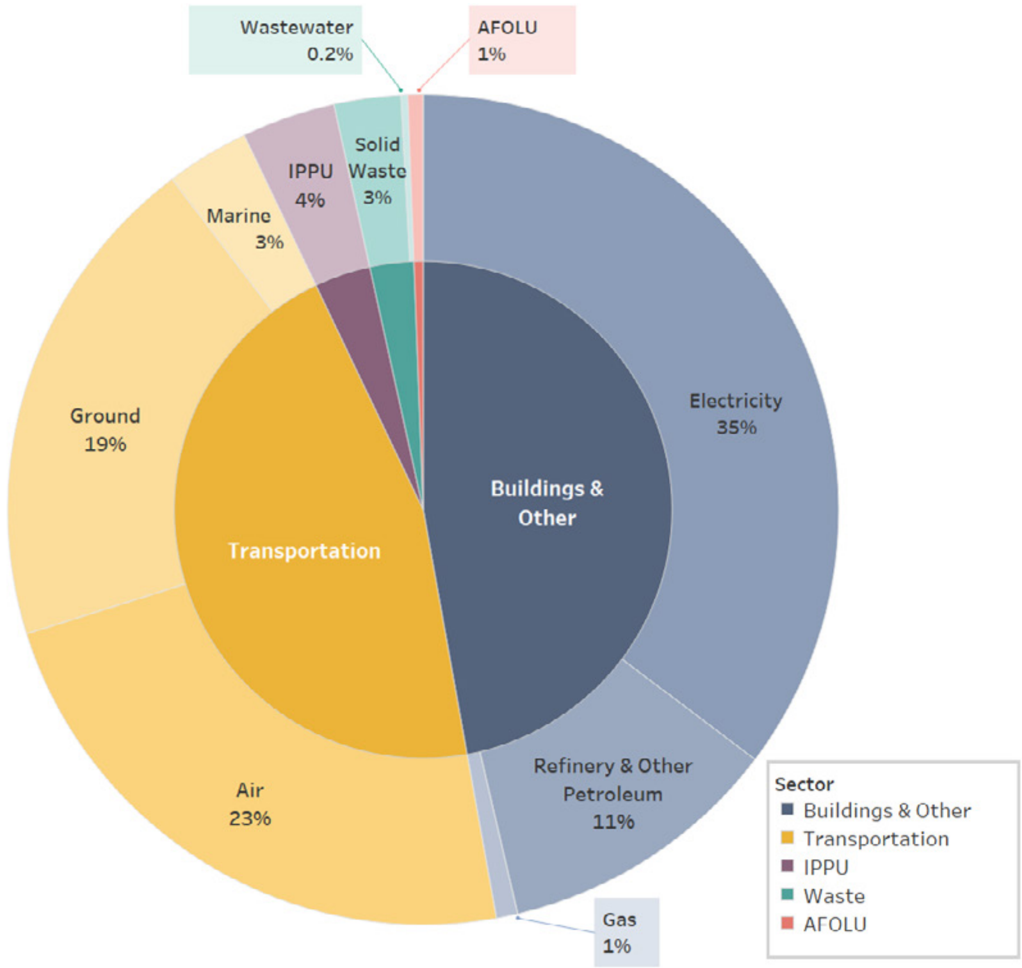
What are the sources of Oʻahu's emissions?
Oʻahu's emissions declined by nearly 18% between 2005 and 2018, from 18.8 to 15.4 MMTCO2 Eq., as shown in Figure 1. Increases in transportation-related emissions caused island-wide emissions to increase between 2017 and 2018. Figure 2 presents a detailed representation of Oʻahu's GHG emissions by sector for 2017. Inventory sectors include **Transportation** (ground, air and marine), **Buildings & Other** (stationary sources: including electricity, refinery operations and other petroleum outputs), **Waste** (solid waste and wastewater), **Land Use** (agriculture, forestry and other land use, or AFOLU), and **Industrial Processes and Product Use** (IPPU). For a methodological description of the inventory, see Appendix I.

Figure 1: Oʻahu's GHG Emissions by Sector for 2005, 2015, 2016, 2017, and 2018



*The analysis and forecasting for this CAP was done before the availability of 2018 figures and is therfefore based on 2005, 2015, 2016, and 2017 figures.

Figure 2: O'ahu's GHG Emissions by Detailed Sector, 2017



Transportation: Ground transportation alone (cars, motorcycles, off-road vehicles, trucks, buses, and other HDVs) is responsible for one-fifth of total island-wide emissions, or approximately half of total transportation emissions. Air travel accounts for the other half of transportation-driven emissions. It includes aviation with fuel on O'ahu, representing trips from O'ahu to the neighbor islands, domestic, and international destinations. Marine travel accounts for about 3% of emissions in the transportation sector.

Buildings and Other (Stationary Sources): Emissions from the generation of electricity to power homes, businesses, and increasingly, electric vehicles, make up 35% of total island GHG emissions. This is primarily because about 80% of O'ahu's electricity generation comes from fossil fuels.[xvii] Other emissions in this sector come from processes to refine oil, other petroleum demand, and gas use. There is one petroleum refinery located on O'ahu that is the primary provider of jet fuel, gasoline, and diesel. The gas supply comes predominantly (97%) from fossil fuels. The other 3% comes from methane capture at the Honouliuli Wastewater Treatment Plant.[xviii]

Industrial Processes and Product Use (IPPU): The vast majority of IPPU emissions on O'ahu are from the substitution of ozone depleting substances, though there is a small contribution from electrical transmission.[xix] IPPU accounts for 4% of total emissions.

Waste: Waste sector emissions come from solid waste sent to landfills as well as the treatment of wastewater. In addition, a large portion of the solid waste on O'ahu is sent to H-POWER where it is burned to create electricity. Those emissions are included in Buildings & Other.

Land Use (Agriculture, Forestry and Other Land Use or AFOLU): About 1% of island emissions come from livestock, agricultural soil management, fertilization, landfilled yard trimmings, field burning of agricultural residues, and forest fires. Only sources, not sinks, of land use emissions are included in this GHG inventory.

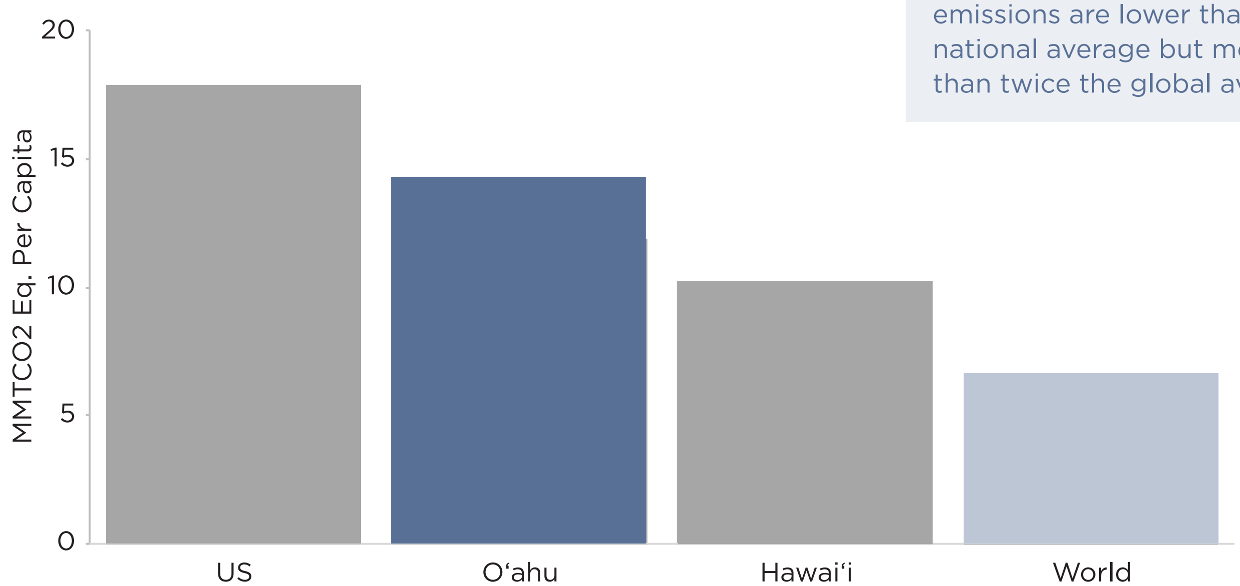
How do O'ahu's GHG emissions compare with others?

O'ahu's per capita GHG emissions are about twice the global average (Figure 3). The Intergovernmental Panel on Climate Change (IPCC) estimates that to remain under a 1.5°C or 2°C increase in average global temperature, cumulative global GHG emissions after the end of 2017 must be less than 420 or 1170 billion metric tons respectively.[3] Based on current population, O'ahu's approximate share of this carbon budget is 54 or 154 million metric tons of carbon dioxide equivalents (MMTCO2 Eq.) for 1.5°C or 2°C, respectively. With this concept and assuming O'ahu continues to emit 15.1 MMTCO2 Eq. annually (based on 2017), O'ahu's "carbon budget" will have been exhausted by the end of 2021 under the 1.5°C scenario and 2028 under the 2°C scenario.

[3] With medium confidence, meaning 66% probability of low to no overshoot of the 1.5°C target measured in terms of global mean surface temperature.

Figure 3: Comparison of 2016 Per Capita GHG Emissions

O'ahu's per capita GHG emissions are lower than the national average but more than twice the global average.



SPOTLIGHT

GHG Inventory Approach

The GHG emissions inventory was developed using the Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories (GPC)[4] and estimates of emissions that occur across Oʻahu.

The GPC is based on the IPCC Guidelines for National GHG Inventories and are adapted to consider local decision-making needs. In accordance with the GPC guidelines and as is common in most GHG inventories, only non-biogenic sources of GHG emissions are counted towards emissions totals. Biogenic emissions derive from materials that are produced with carbon sequestered from the atmosphere. When these materials are burned, they release CO^2 that was previously sequestered. Therefore, although there is no structural difference between biogenic and non-biogenic CO^2, these emissions are considered to be a part of the natural carbon cycle. The exception is the removal of carbon stored above- and below-ground biomass, dead organic matter, and soil organic matter due to land-use changes; for example, when parks or wetlands are converted to urban development. These emissions are reported in the AFOLU sector.

This accounting methodology is often referred to as a sector-based inventory, as it estimates emissions based on economic sectors in a given area. As such, the inventory includes emissions that occur when products are produced and consumed on Oʻahu, ignoring emissions that occur in other jurisdictions as a result of economic activity on the Island, such as upstream emissions related to imported goods. Other methodologies, like consumption-based GHG inventories or lifecycle analysis, are generally out of the scope of this CAP but are considered where appropriate.

[4] The GPC Protocol is a GHG accounting and reporting standard for cities and municipalities developed by the World Resources Institute, C40 Cities Climate Leadership Group, and ICLEI – Local Governments for Sustainability. GPC Protocol - https://ghgprotocol.org/green-house-gas-protocol-accounting-reporting-standard-cities; ICLEI - https://iclei.org/; World Resources Institute - https://www.wri.org/; C40 - https://www.c40.org/.

2001

The State adopts the Renewable Portfolio Standard requiring 9% of electricity sales from renewables by 2010 (Act 272).

2006

The City approves the Honolulu Rail as the locally preferred mass transportation alternative (Ord. 07-001).

2008

The City commits to Transit Oriented Development (Ord. 09-4).

2009

The State amends the Renewable Portfolio Standard to acquire 40% of net electricity sales by 2030 and adopts the Energy Efficiency Portfolio Standard requiring 4300 GWh of electricity savings by 2030 (Act 155).

2012

The City passes the Complete Streets Ordinance (Ord. 12-15).

2015

The State amends the Renewable Portfolio Standard to require 100% net electricity sales from renewable energy by 2045 (Act 97).

2016

The Honolulu Office of Climate Change, Sustainability and Resiliency and the Climate Change Commission are established by City Charter with overwhelming approval by O‘ahu voters.

2017

Mayor enters the Climate Mayors Network and signs on to the Chicago Climate Charter thereby committing to developing the City’s GHG inventory and this CAP. The four County mayors commit to 100% clean ground transportation, 100% renewable fuels for bus fleets and city-owned vehicles by 2035, and 100% renewable fuels for all ground transportation by 2045.

2017

The State enters the Paris Agreement committing to limiting global warming to 2°C (Act 32), and establishes a Carbon Net-Negative Target committing to sequester more atmospheric carbon and greenhouse gases than emitted by no later than 2045 (Act 15).

2019

The “Ola” O‘ahu Resilience Strategy is released, containing the first phase of the CAP. The City updates its Bike Plan and its Integrated Solid Waste Management Plan.

2020

The City updates building energy codes for energy efficiency, EV charging, and solar PV ready houses (Bill 25). The Office of Climate Change, Sustainability and Resiliency releases O‘ahu’s first CAP.

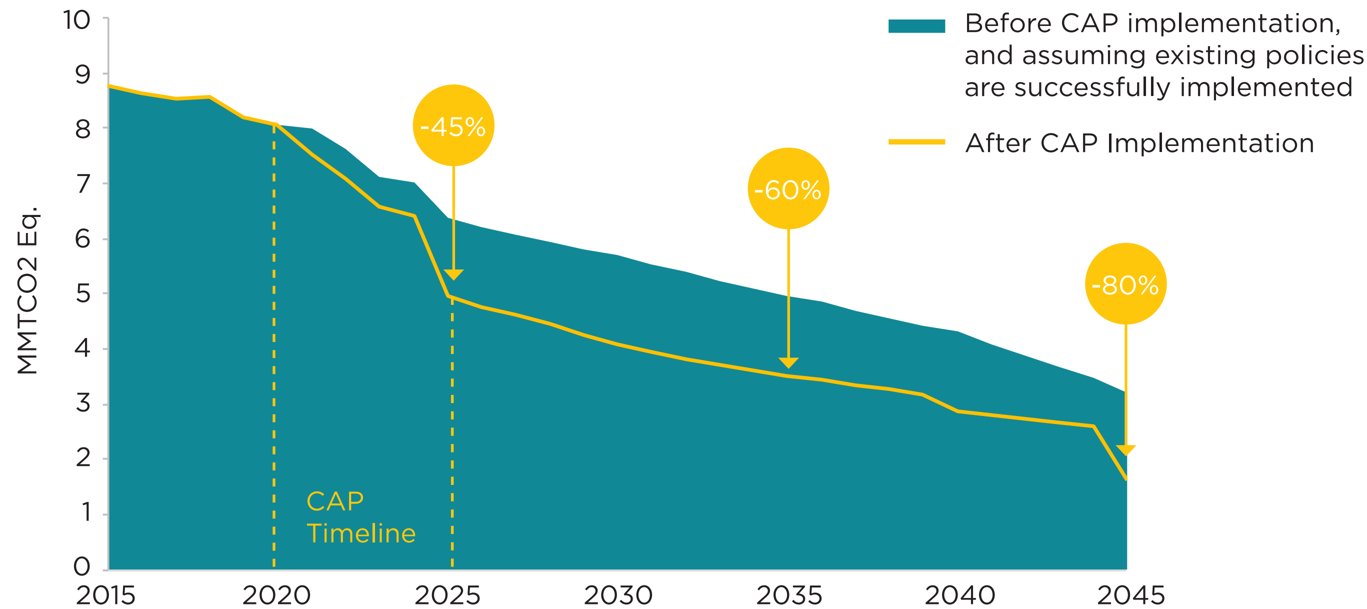
CAP GOAL:

45% reduction in targeted GHG emissions by 2025 relative to 2015

*(*An additional 16% reduction from the baseline)*

Building on initiatives and actions already underway and those discussed in the carbon mitigation section of the Oʻahu Resilience Strategy, this CAP establishes an aggressive 45% carbon reduction goal by 2025 (from 2015) to align Oʻahu with state law requiring carbon neutrality by 2045. This is an estimated additional 16% reduction than would be achieved otherwise. Further, by continuing implementation beyond 2025, this CAP puts the City on a pathway to reduce target sector emissions by 60% by 2035, and 80% from 2015 by 2045, as shown in Figure 4.[5] This is an additional 17% and 18%, respectively, relative to the estimated baseline.

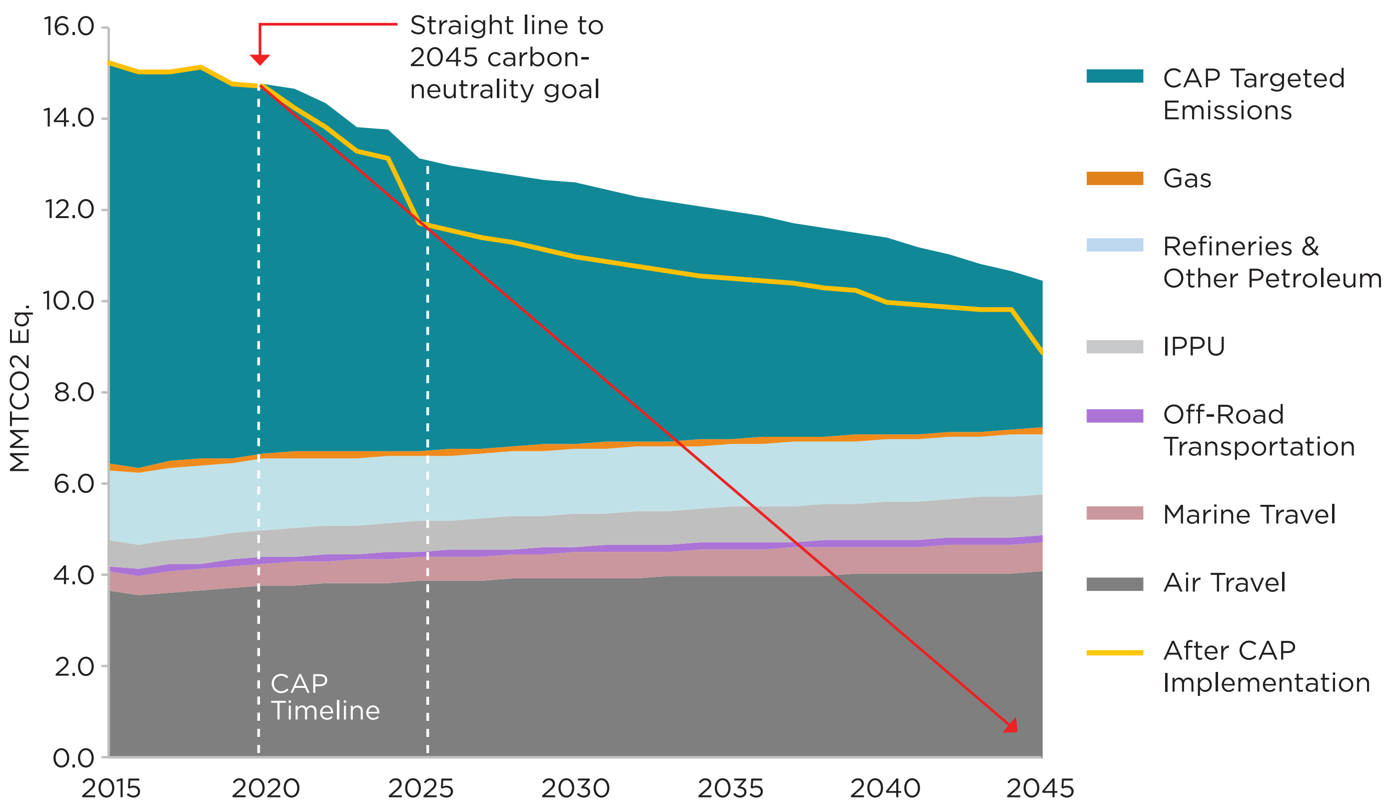
Figure 4: CAP GHG Emissions Baseline and CAP-Pathway Projections



[5] "Before CAP implementation, and assuming existing policies are successfully implemented" is the aggregated baseline from the pathway analysis for each sector and represents successful implementation of existing policies and trends. "After CAP Implementation" represents the impact of this CAP by way of the aggregation of "Ambitious Multimodal," "Electrify The Remaining City Fleet," "PSIP," and baseline waste sector emissions. These projections have not been adjusted for impacts due to COVID-19, which is likely to have resulted in a temporary drop of emissions.

Ground transportation, electricity, and waste accounted for 57% of island-wide emissions in 2015. Figure 5 presents the CAP pathway with a baseline forecast for O'ahu's other GHG emissions (that are not included in this CAP because they are largely outside of the City's sphere of direct influence). For a methodological description, see Appendix III.

Figure 5: O'ahu Island-wide GHG Emissions Projections to 2045



When including all types of island-wide GHGs, the strategies presented in this CAP have the potential to reduce emissions by 25% in 2025, relative to 2015 – an additional 10% to what would otherwise be achieved. ***This reduction is both aggressive yet insufficient.*** The residual portion of **CAP Targeted Emissions** by 2045 is predominantly from fossil fuel burning passenger cars and trucks, as current federal fuel economy standards (and GHG targets) require only moderate improvements[6] and are in place through 2026. Moreover, they work slowly due to the long duration of existing vehicles on the road.

Additional reductions must also come from sectors like air travel, which is almost entirely under federal jurisdiction. Though the baseline forecast for air travel

[6] Federal fuel efficiency standards scheduled to go into effect in 2021 only require 165 g CO2e/mile and 240 g CO2e/mile for light-duty cars and trucks, respectively, by 2026.

incorporates substantial energy efficiency measures based on current trends, travel reduction and fuel switching are required to achieve more meaningful GHG reductions. The other large-emitting sector **Refineries and other Petroleum** come mainly from petroleum refining and its byproducts, and its GHGs are a reflection of continued reliance on petroleum products in air, ground, and marine transportation. Lastly, GHGs from **Industrial Processes and Product Use** are mostly a reflection of substances used in refrigerants.[7]

In this CAP, the City focuses on what it can immediately affect. It is also engaging with other cities across the U.S. through the network of Mayors committed to the Paris Agreement and the Bloomberg American Cities Climate Challenge. Together, we can bring about momentum for more wide-scale reform at the federal level.

For O'ahu to become carbon neutral by 2045, it will require the City, State and Federal governments going many steps further than this CAP.

A national-level carbon tax (known more broadly as carbon pricing) has been widely found through research to be a first-best response to GHG pollution.[xx] A broad-based approach to carbon pricing would motivate, for example, technological and behavioral responses in important sectors like air and ground transportation. Through a structure where revenues are given back to the public, it offers the potential for being fair and even progressive compared to other energy policies. However, carbon pricing still needs to be met with complementary measures as it would not correct all market failures; in particular, policies related to enabling land use change and public investment in low-GHG shared transportation services would be needed. Lastly, getting to zero also requires engaging GHG sequestration opportunities from forestry projects to agricultural practices. Future versions of this CAP will consider land use in the pathway to carbon neutrality.

[7] The Kigali Amendment of the Montreal Protocol will influence the use of substitutes of ozone-depleting substances, mainly hydrofluorocarbons (HFCs), which have a high global warming potential.

SPOTLIGHT

How should GHG emissions and City GHG goals be understood, in the context of major uncertainty?

GHG emissions are a reflection of three primary factors: the level of carbon-based economic activities; the nature of these activities; and the technologies deployed to enable them. While uncertainty always exists in modeling future conditions, the COVID-19 crisis raises uncertainty to unprecedented levels.

The underlying economic conditions assumed in the GHG pathways analysis comes from the State's most recent long-range population and economic forecast (DBEDT, 2019) and is not updated for COVID-19 conditions. The GHG pathways presented illustrate the variety of GHG reduction levels and the magnitude of their impacts. As such, pathways should be viewed in comparison to one another rather than in isolation.

The State's most recent short-term forecast does not have Hawai'i's economy back to pre-COVID levels in the duration of its forecast to 2023.[xxi] Hawai'i specific evidence from the 2009 Great Recession shows that it took the state approximately five years to recover to pre-recession levels.[xxii] Globally, according to the International Energy Association, after dropping steeply in early 2020 due to the impacts of COVID-19 on economies, GHG emissions have rebounded strongly with global energy-related emissions being higher in December 2020 than they were in December 2019.[xxiii] Assessment of progress must be adjusted with hindsight to account for changing economic activities; hence the efficacy of the City's actions to reduce GHG emissions should be compared against a baseline in which the City takes no actions (i.e., before the CAP is implemented).

Community Voices

Reaching the goals set forth in this CAP is only possible by working with the community to shape priorities and take action. Oʻahu's people have been essential in shaping this plan with more than 2,000 perspectives shared at three key stages, including 672 participants at 11 early community education and engagement meetings, 760 respondents to an island-wide representative survey,[8] and 614 contributors at a virtual open house.[9] In addition, participants in focus groups, a technical working group, and engagements with other City departments helped refine technical analysis and city-based actions.

At the first stage, 11 community meetings were held island-wide in 2018, co-hosted by Honolulu City Council members, Hawaiʻi Pacific University, University of Hawaiʻi at Mānoa, and the Chamber of Commerce of Hawaiʻi. Participants played an interactive "climate game" that served to foster conversation on priorities for climate action. In follow up, a Climate Action Working Group made up of sector experts and stakeholders was formed, building on a steering committee of the Resilience Strategy. The Working Group served as a sounding board for technical analysis and proposed climate actions that were incorporated into an island-wide survey and virtual open house.

The island-wide representative survey was conducted in April 2020 to better understand how the City can enable its residents to reduce Oʻahu's GHGs. Four in five survey respondents were concerned or very concerned about climate change. Survey responses were also used throughout the CAP to provide baseline information on resident activities and preferences towards actions.

[8] Deployed online through random sampling in collaboration with SMS Research Hawaiʻi. The sample is with a 95% confidence level, representative of residents within the Primary Urban Center and East Honolulu, and those outside the Primary Urban Center and East Honolulu. This was done because of the distinct transportation options and patterns. See Appendix III for more methodological detail and summary survey results.

[9] Due to the outbreak of COVID-19, public outreach was altered and limited to online engagements to support social distancing measures.

2020 Island-wide Representative Survey Responses

April 2020, 760 respondents

73% I would like to have a mix of places such as restaurants, stores, and markets within walking distance in my neighborhood

NEARLY HALF

- I would support using public funds to provide electric vehicle charging stations at City facilities
- TheBus is affordable to me
- I do not use a bike to my destination because of concerns about traffic safety

62% I would support using public funds to replace City buses with electric buses that emit less tailpipe emissions

OVER 300 RESPONDENTS

- I am willing to give up some street parking for more safe walking and biking paths
- I would support higher buildings around Honolulu Rail Transit stations to increase housing supply near public transit

1 OUT OF 3

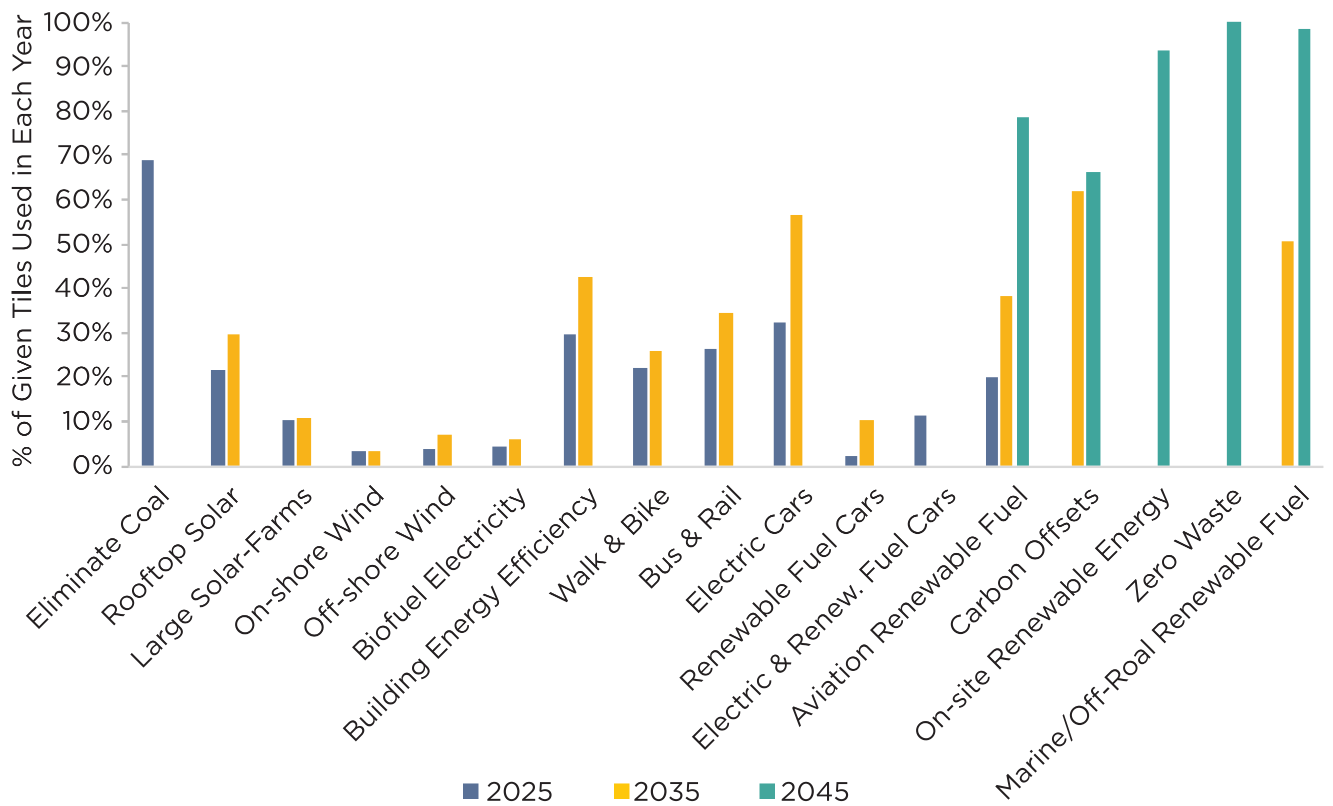
- TheBus is convenient for most of my destinations
- I would walk more to my destination if the streets had more shade trees
- Bikeshare programs (like Biki) are accessible to me
- I would support using public funds for energy efficiency retrofits for large existing private buildings
- I would use an electric scooter if it were publicly available to me
- I do not walk to my destination because of concerns about traffic safety
- I would be willing to pay to use roads that are less congested

Finally, a virtual open house was held from May to June 2020 and allowed participants to provide feedback on possible climate actions as well as open-ended input.

Climate Action Community Meetings, 2018-2019

As part of the process to develop this CAP, 11 meetings across O'ahu were held that were centered around a "climate game." The game was designed to give players the opportunity to show their preferences for types of GHG reduction actions on O'ahu, given the game's set of renewable energy and fuel switching technologies offered over time. Figure 6 provides a high-level summary of the game results played by 672 community participants. Results are both reflective of player preferences and the assumed technologies that they could select to make O'ahu carbon neutral by 2045.

Figure 6: Summary of Actions for GHG Emissions Reduction from the "Climate Game"



The results of the climate game show participants' interest in both on- and off-shore-based renewable energy, and elimination of particularly dirty fossil fuel-based energy sources, such as coal. It also shows people's interest in engaging alternative transportation technologies like electric vehicles and alternative fuels for ground transportation as well as aviation. Closer to 2045, preferences include further engagement with renewable energy as well as tackling waste and carbon offsets.

Major Themes from Public Input

The following section summarizes the major themes that emerged from these community forums. Appendix III provides quantitative responses and a description of the methodology.

Climate Change is a Pressing Issue. The vast majority (80%) of respondents agreed that they were concerned about climate change. This aligns with the results of a 2019 survey conducted by the American Cities Climate Challenge, which found that over 80% of Oʻahu voters think of climate change and its associated impacts — including coral bleaching, increasing storm severity, and extreme heat — as serious problems. Seventy-five percent of voters also expressed willingness to undertake personal action to address climate change, like using public transit, and support using taxpayer dollars towards clean energy proposals, like updating energy efficiency codes.

Make Equity a Priority. Participants expressed deep concerns that certain climate actions might disproportionally affect low-income households, particularly in transportation. For example, many opposed a gas tax increase out of equity concerns, although some recommended that its revenues be used towards equitable solutions, like improving island-wide transit, beyond the urban core. In addition, participants stated how pricing policies must be accompanied by a sufficient increase in the opportunities to work close to where you live through mixed-use zoning and reasonable-cost housing. Feedback also emphasized the need for adequate time to adjust to new policies. For example, viable multimodal options must be available before parking prices are changed.

How is equity prioritized? This CAP includes equity considerations within each strategy, included in the rubric (see Table 1), as well as establishes equity-focused actions as a principle in the implementation of this CAP. In response, the idea of a $0.05 increase to the gasoline tax was taken off the table as a financing mechanism after facing limited support in both the open house and island-wide survey (21%), especially as COVID-19 highlights ongoing economic hardships. A small magnitude gas tax is more of a climate-aligned financing mechanism than a true GHG reduction measure, particularly when considering interaction with federal GHG standards for vehicles.

Yes to Renewable Energy, if Done Right. The open house demonstrated strong support for the renewable energy transition through a range of technologies from solar PV to ocean thermal. However, there were also major concerns around how large scale projects impact land use and surrounding communities. Feedback from the virtual open house was consistent with the island-wide survey. Although 64% of respondents said that reducing GHG emissions was a positive outcome of renewable energy development, 38% said potential rate increases, 30% said visual impacts, 28% said habitat or species impacts, and 23% said that community impacts, were negative outcomes.

> **Being an island community,** we see the effects of climate change everyday, slowly deteriorating the place we love so much. I want to do everything in my power to preserve our island from climate change so that future generations can enjoy our home as well.
>
> **Kelsey**
> Virtual Open House Participant

Respondents recommended siting decentralized renewable energy generation on already developed spaces such as rooftops and parking lots where possible. Once again, open house participants voiced the importance of meaningful proactive community engagement.

How are renewable energy considerations incorporated? This CAP recognizes the need for the City to adopt strategies specific to expanding renewable energy planning and streamlining permitting for rooftop projects. It also calls for City lands with limited competing uses, such as right-of-ways, and co-benefits, such as places needing shade structures, to be identified and deployed for renewable energy. Lastly, it offers up ways for large City electricity loads to help integrate renewable energy sources, thus helping to reduce capacity and development requirements.

More EV Charging on a Renewable-Powered Grid. Open house participants expressed the desire for improved access to (more rapid) EV charging. However, they noted that pushing EVs while the electric grid runs primarily on fossil fuels will have limited impact on near-term GHG emissions. Respondents felt that public money should not go towards subsidizing privately owned EVs because higher income people are empirically more likely to purchase a non-used EV than lower income people given the upfront costs, and thus also more likely to benefit from operational cost savings. There was broad support for electrifying public vehicles, such as TheBus, at the rate to which they are normally retired. This was consistent with the island-wide representative survey where 62% of respondents said they support the use of public funds to replace City buses with electric buses.

How are electrification of transportation concerns considered? Given the expected equity issues around using public funds to subsidize EV ownership, this CAP proposes no financial incentives be given to support private EV ownership. Nonetheless, federal regulations[10] and global car markets make increased EV adoption likely. As such, it is critically important to ensure they can be readily charged and operated. Therefore, this CAP focuses on supporting an affordable charging infrastructure necessary for a larger scale EV transition. In support of this transition, 45% of island-wide respondents supported the use of public funds to provide EV charging stations at City facilities.

Make Public Transit a Viable Option, Particularly for Low-Income Residents. Participants called for substantially improving and modernizing the current bus system to be more efficient and convenient, especially given its importance to populations without private vehicles. Suggestions for improving TheBus service include bus-rapid transit lanes on major routes, improving frequency and timeliness, a transit app, bus-tracking technology at bus stops, and allowing for luggage and bikes on TheBus. Several respondents also stated the importance of completing the Honolulu Rail Transit all the way to Ala Moana Center.

[10] The federal Corporate Average Fuel Economy (CAFE) standards set fleet-wide fuel economy averages for automakers. Because EVs are counted towards the average, the standard is likely to result in an increase of EV manufacturing and sales.

How is public transit for low-income residents included? This CAP dedicates a major strategy to multimodal, public, and shared transportation, including fare-capping for public transit.

Make Biking and Walking Safe and Readily Available. Bike and pedestrian safety surfaced as an important issue in the open house; this is consistent with the island-wide survey where 32% and 47% of respondents said that they do not walk or bike to their destinations, respectively, because of concerns about traffic safety. Acknowledging that current bike path improvements like the King Street cycle track could help, there was a broader call to create a more interconnected grid of safe bike infrastructure, particularly among major destinations within the urban core.

How are bike and pedestrian safety considered? Actions related to multimodal transportation are a major component of this CAP. Safety will be improved through investing in separated (and connected) bike lanes, establishing car-free streets, and providing street amenities like widened sidewalks and improved crosswalks.

Increase Parking Efficiency Without Increasing Parking Difficulty. Open house perspectives diverged regarding parking policies. On one hand, equity concerns arose around eliminating parking or making it more expensive. On the other hand, there was a sentiment that current parking requirements create too many underutilized spaces on land that could be better used for other purposes. Participants were also familiar with "circling" or driving around looking for parking options due to parking pricing inefficiencies. Though statements acknowledged that parking pricing policies could drive behavioral changes, many felt that ensuring Oʻahu has viable mobility alternatives as well is essential.

How are parking concerns incorporated? Parking policies in this CAP have been adapted to consider how limited transportation options in the near term will make automobile commutes necessary, particularly for households outside the urban core and major transit corridors. Therefore, changes to parking pricing are recommended only within specific conditions, for example, within Transit-Oriented Development (TOD) areas, and City-owned lots; the timeline for more far-reaching reforms is pushed toward the outer years of this plan.

Focus on Consumption, Not Just Waste Management. While many recognize the importance of recycling, most participants preferred eliminating (or reusing) waste by moving towards more efficient and sustainable consumption. Respondents referenced "circular economy" concepts for resource management. A considerable number of participants cautioned that using long-term contracts for waste-to-energy treatment can disincentivize waste reduction initiatives.

How is waste consumption included? Waste prevention is an entire strategy of this CAP. It recommends five actions, ranging from exploring partnerships with nonprofits and businesses around waste prevention methods, to assessing the viability and side effects of a pay-as-you-throw policy.

Waste as a Resource. Statements expressed strong support of composting and anaerobic digestion facilities to productively manage waste and create fertilizer, though they also signaled a need for more research on how to best sort through waste items for anaerobic digesters. There was strong interest in expanding municipal and small-scale composting operations.

How is waste as a resource included? This CAP includes a strategy dedicated to exploring waste resource efficiency. Related actions include methane capture and planning for expansion of anaerobic digesters and composting facilities.

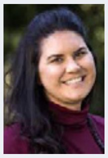
Green Spaces. There were numerous comments about the importance of green spaces island-wide and the value of trees and regenerative agriculture for carbon sequestration. These comments emphasized strong preferences for native species in tree planting efforts.

How are green spaces considered? Unfortunately, Agriculture, Forestry, and Other Land Use (AFOLU) is outside the scope of this CAP. It should be included in future updates. Where tree planting is considered for shade to improve active transportation options, this CAP recommends prioritizing native species.

Support State and Federal Level Policies and Programs. There were numerous mentions of several policies that would be more relevant to the state and federal governments. Primary among them were support for a carbon tax, as a more effective GHG reduction price signal than a gas tax. Similarly, there were comments on altering the State definition of renewable energy and modernizing the electricity grid. These actions are best spearheaded by the Hawaiʻi State Energy Office. In addition, there was interest in expanding composting operations, which is regulated by the State Department of Health (DOH). Other comments also focused on the importance of educational initiatives with K-12 partners, mainly through the State Department of Education. These are areas in which the City could support state actions.

How are state policies included? Although this CAP focuses on City actions, the City operates in relationship to state and national policies. As such, Appendix IV is dedicated to highlighting relevant state and national policies.

> **When I think about climate justice,** it's really about social strengthening, and reinforcing and retying our bonds together.



Dr. Kealoha Fox
Native Hawaiian Liaison at AlohaCare

> **The City and County can ensure that all communities** have a seat at the table while driving the systemic changes needed to address the disproportionate impacts of climate change.

Brent Kakesako
Hawaiʻi Alliance for Community-Based Economic Development

SPOTLIGHT

Oʻahu's Energy Costs and People

Low-income households generally spend a larger portion of their income on home energy costs. Hawaiʻi faces the highest electricity prices in the nation. The average price of residential electricity for Oʻahu in 2019 was $0.31/kWh[xxiv] in comparison to the national average of $0.13/kWh. However, high rates do not always translate into high energy burdens. Hawaiʻi's tropical environment means there is no need for heating, resulting in Hawaiʻi residents having a lower average energy burden in comparison to other places on the U.S. continent. The average energy burden in Hawaiʻi is about 2% of household income, which is similar to California and other West Coast states.[xxv] Households with low income in Hawaiʻi (those making less than 80% of the Area Median Income) spend three to four times more than the average Oʻahu resident on household energy relative to their income.[xxvi] Hawaiʻi Energy has identified reaching low-income households as a priority goal, partnering with community groups to incorporate energy savings practices into financial literacy education.[xxvii] Targeted outreach is an area of collaboration for the City, particularly with tenants of City-managed properties.

Transportation energy costs must be considered with housing costs to fully understand this cost burden to households. Households are generally considered "burdened" if they spend more than 30% of their annual income on housing; adding transportation costs tips this sum to about 50%. The Center for Neighborhood Technology estimates that housing plus transportation costs for Oʻahu are 52% of income: 33% for housing and 19% for transportation. There is considerable spatial variation across the island. For example, an average Waiʻanae household is characterized by a joint housing and transportation burden of 43%; ʻEwa Beach, 54%; Kailua, 57%; Kahuku, 49%; Haleʻiwa, 50%; and Waikele, 55%.[xxviii] In comparison to other municipalities across the U.S., Honolulu scores a 67, where 100 represents the lowest cost burden (a larger number means better). These characterizations do not necessarily capture cost burdens specific to households with low income. Making low-cost public transportation options available in currently underserved areas as well as for the 8% of Oʻahu's people who depend on public transit for mobility is critically important to ensuring an equitable transportation system.[xxix]

GHG REDUCTION PATHWAYS TO 2045

▶ For each sector considered in this CAP, a current snapshot of activities is provided as well as an analysis of pathways of future GHG emissions to 2045. The baseline pathway illustrates the impact of existing trends and policies, including federal and state. Additional pathways are shown to help isolate and illustrate the impact of intervention, some of which are in the City's control and some of which require cross-jurisdictional collaboration. The pathways analysis shows the importance of sub-sectors (e.g., passenger cars and trucks versus heavy-duty vehicles), as well as the relative contribution of activities and technologies to achieve GHG emissions reduction. Assumptions made in the pathways analysis were presented and vetted with the Climate Action Working Group.

**A Note About Data: For more detail about methods and calculations, see Appendix II. For more detail about the public input into the CAP, see Appendix III. Data are otherwise cited in-text.*

Ground Transportation

Ground transportation accounts for 19% of Oʻahu's GHG emissions and its trend has remained flat over the last decade. Ground transportation is dominated by the personal automobile; passenger cars and trucks[11] are responsible for an estimated 90% of ground transportation GHG emissions. In 2018, there were 1.1 registered passenger cars and trucks per eligible driver on the island. About 10% of Oʻahu's households have no car, and another 34% have only one car. The remainder own two or more vehicles. The remaining 10% of ground transportation GHG emissions are attributable to HDVs, which include the City's bus fleet, garbage trucks, other large City-owned vehicles, as well as privately owned large trucks, trailers, and buses. In total, there were 119,630 registered HDVs on Oʻahu in 2018. HDVs mainly run on diesel.

Tackling GHG emissions from ground transportation is challenging, yet necessary, given the City's roles, responsibilities, and influence in the sector. That is why all four county mayors committed in 2018 to a goal of 100% renewable-fueled by 2045, and for the island of Oʻahu, a full City fleet transition to renewable fuels by 2035. This CAP looks at means currently available to put the City on a pathway to achieve this goal.

[11] This includes motorcycles and mopeds.

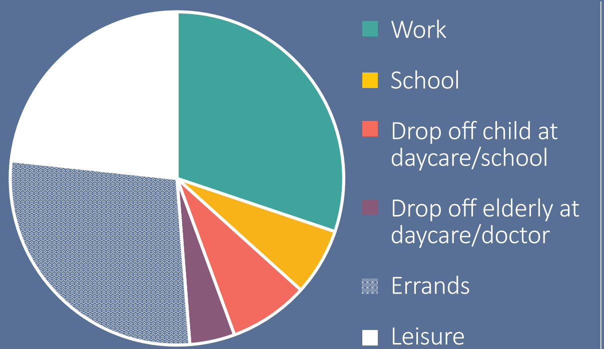
SPOTLIGHT

The Effect of Vehicle Automation on GHGs

In the transformation to full automation, autonomous vehicles (AVs) have the most potential to reduce GHGs if they rely on low carbon fuels and are used as "smart" shared vehicles that minimize the need for vehicles to idle and circle through efficient pick-ups and drop-offs. These vehicles can be particularly effective in reducing GHGs if they are deployed as a "first and last mile" solution to transit hubs. On the other hand, if they follow the path of private ownership and burn fossil fuels, AVs could lead to a substantial increase (estimated nationally at over 200%) in GHGs.[xxx] As such, the introduction of full AVs will also require intervening climate policy.[12]

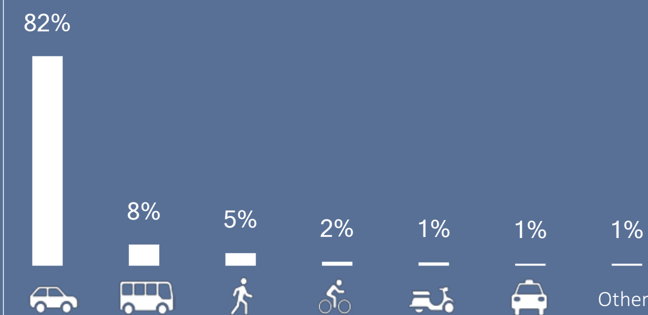
[12] For a more thorough presentation of AVs specific to Hawai'i, see State of Hawai'i Department of the Attorney General (2019).

Ground Transportation



Work commutes and errands each make up about 30% of trips among O'ahu residents, while leisure trips make up about 23%. For the most part, people make work trips on a daily basis, while they make leisure and errand trips one to three days a week.

Cars and light-duty trucks are the most common modes of travel for O'ahu residents, accommodating over 80% of trips. About 15% of these car trips are made as a passenger. Active transportation modes, including biking and walking, make up at least 7% of trips. Biki, O'ahu's largest bikeshare, supported 1.4 million rides in 2019, with 1,300 bikes in 130 bikeshare stations, supporting a 6.25-mile service area.



64% of O'ahu drivers use a gasoline car as their primary vehicle.

31% of drivers use a gasoline truck, van or SUV as their primary vehicle.

1% of drivers use an electric vehicle (EV) as their primary vehicle.[xxxi]

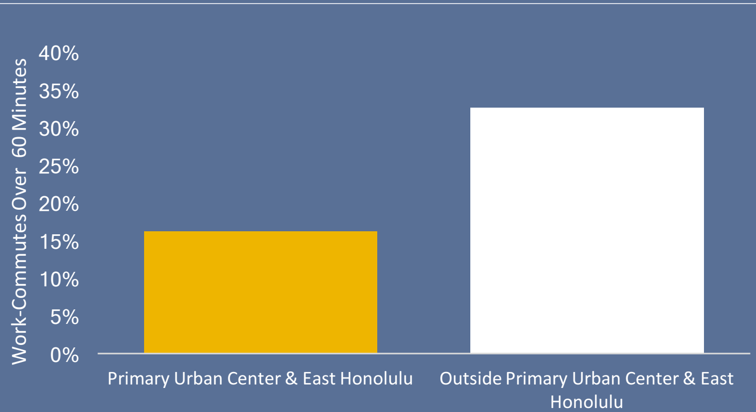
Each eligible driver drove about

11,000

miles in 2018, the equivalent of

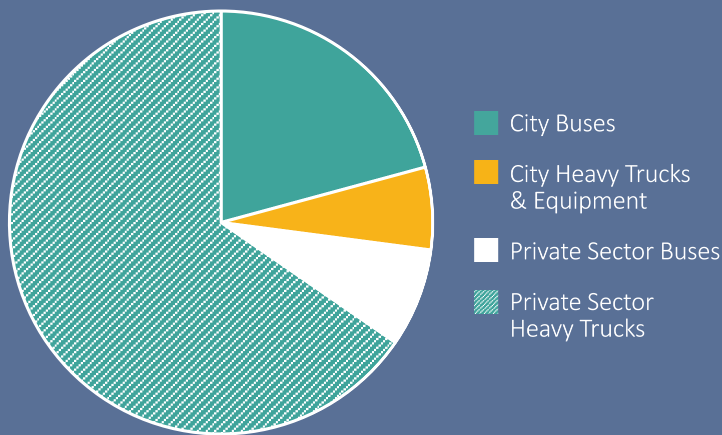
200

trips between O'ahu and Moloka'i.[xxxii]



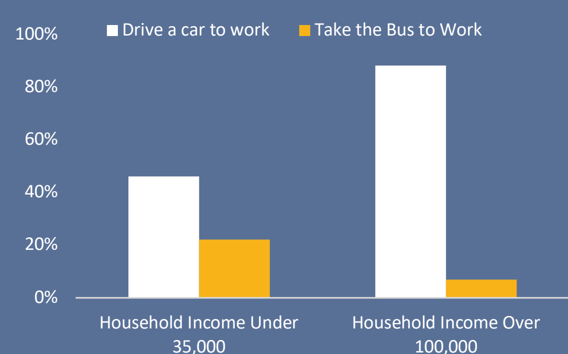
Twice as many people outside the Primary Urban Center and East Honolulu have work-commutes that are longer than one hour (round-trip), and three times as many have work-commutes that are longer than two hours. The most common trip length for work, leisure, or errands is between 15 and 30 minutes for the whole island.

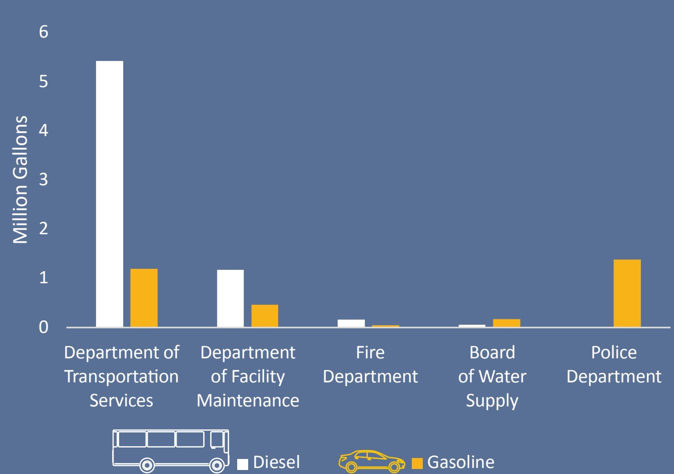
HDVs contribute about 10% of emissions from ground transportation. The majority (73%) of GHG emissions from HDVs on O'ahu come from privately owned buses and trucks. The remainder of GHG emissions (27%) come from City owned HDVs, of which the majority is emitted from the public bus fleet.



The City owns 543 buses, 3 of which are electric. In 2018 these buses drove 22 million miles in total with three passengers per mile on average.[xxxii] The same year TheBus had the 7th highest ridership in the U.S. Yet average weekday ridership of TheBus has decreased by 5% since 2014.[xxxiii]

O'ahu households earning less than $35,000 annually are significantly more likely to take TheBus and significantly less likely to drive a car to work.





Five departments made up 97% of the City's diesel and gasoline use in 2018. For the most part, diesel is used to fuel heavy-duty trucks and buses, while gasoline is used to fill light-duty cars and trucks. The Department of Transportation Services (DTS) was responsible for 77% of the City's total diesel consumption, used to run City buses. The Honolulu Police Department is the largest user of gasoline at 42% of total gasoline use.[xxxiv]

SPOTLIGHT

Transportation & COVID-19

There is great uncertainty in how COVID-19 will ultimately affect transportation systems, among other elements of everyday life. It is possible that more people will be willing and able to telecommute. Island-wide survey results indicate that 39% of employees worked from home during the April 2020 COVID-19 stay-at-home orders, compared to just 3% who were working at home prior to the pandemic. As many as 38% of respondents would like to continue to work remotely after COVID-19 passes, at least for some days of the week. This experiment in telecommuting has forced businesses and government alike to think about their technological capacity to support remote work and their ability to collaborate from afar, potentially affecting both ground and air transportation GHG emissions.

It is also possible that ridership for shared transportation will remain low. Although the future of this "new normal" is highly uncertain, it is imperative public transit remain viable for the many who rely on it as a lifeline to mobility. In the near term, keeping public transit as a safe option means deploying sanitation measures and reducing the number of passengers to allow for physical distancing, which increases costs and undermines relative GHG benefits.

On the whole, stay-at-home orders drove down transportation demand, leading to dramatic reductions in daily GHG emissions and local air pollution. By confining people to local walks and bike rides, these orders also changed the way people interact with their communities. Across the country, bike sales have been at record levels.[xxxvi] On O'ahu, the City piloted car-free Sundays on Kalākaua Avenue and nights in Chinatown to allow for activity along some of Honolulu's most famous streets. Leveraging opportunities to more permanently transform public spaces is required in order to make these positive shifts endure.

GHG Pathways for Passenger Cars and Trucks

In Summary

- Passenger cars and trucks (including motorcycles and mopeds) account for about 90% of O'ahu's GHG emissions in ground transportation.
- In the baseline, GHG emissions from passenger cars and trucks are forecasted to decline by 43% by 2045, relative to 2015, due to federal fuel economy standards and large scale EV adoption (over 50% of new vehicles sales are forecasted to be EVs).
- The introduction of Honolulu Rail Transit will reduce GHG emissions to the extent that drivers of single-occupancy vehicles shift to the Honolulu Rail Transit and connect to multimodal options.
- The City plays a critical role in integrating complementary multimodal efforts and land-use strategies involving the realignment of Honolulu Rail Transit with other major transit routes that can stimulate additional GHG emissions reductions.
- To achieve near zero emissions from passenger cars and trucks in the long-term, almost all vehicles need to be zero emitting. The City can accelerate this transition by improving EV charger access where people work and live, and leading the charge by electrifying its own fleet.

The pathways for future tailpipe GHG emissions[13] from passenger cars and trucks, shown in Figure 7, are based on a vehicle turnover model, which represents the rate and type of new passenger cars and trucks replacing older ones. Major changes to GHG emissions result from actions affecting vehicle miles traveled (VMT), federal fuel efficiency standards, and the further adoption of EVs. See Appendix II for a methodological description.

Overall GHG emissions from passenger cars and trucks are projected to decline between 2020 and 2045. In Figure 7, 2015 GHGs are shown as a reference historic year. The top pathway (Baseline: Corporate Average Fuel Economy [CAFE] + Moderate EV) shows the impact of federal CAFE standards[14] as well as additional EV adoption beyond the national average.

The second pathway isolates the additional impact of VMT reduction due to the Honolulu Rail Transit project (+Rail VMT Reduction). The next pathway adds an approximately 30% decrease in per capita VMT by the year 2045 (++Ambitious Multimodal).[15] The last pathway shows the impact of electrification of all vehicle sales, effectively starting today (+++All EVs on the Road). This pathway gives a sense of what it would take to truly decarbonize the passenger car and truck sub-sector. Beyond state and county

[13] Discussions about emissions from the transportation sector account only for tailpipe emissions, and hereto forward are referred to as emissions. Emissions from the generation of electricity for EVs are included in the electric sector.
[14] The Baseline scenario incorporates the updated CAFE standards, the Safer Affordable Fuel-Efficient (SAFE) Vehicle Rule, issued March 31, 2020.
[15] It is important to note that the rail and multimodal-focused pathways do not account for the generated and induced demand for vehicle travel as a result of lower congestion. Strategies 2 and 3, however, take this into consideration and highlight the need for more efficient parking pricing as well as repurposing roadways. Overall pricing signals are necessary to address such "rebound effects."

efforts, decarbonization at this scale requires swift and ambitious federal action coupled with other technologies, such as hydrogen fuel vehicles.

See Table 1 for assumptions about VMT and EVs in each pathway.

Figure 7: Illustrative GHG Emissions Pathways for Passenger Cars and Trucks

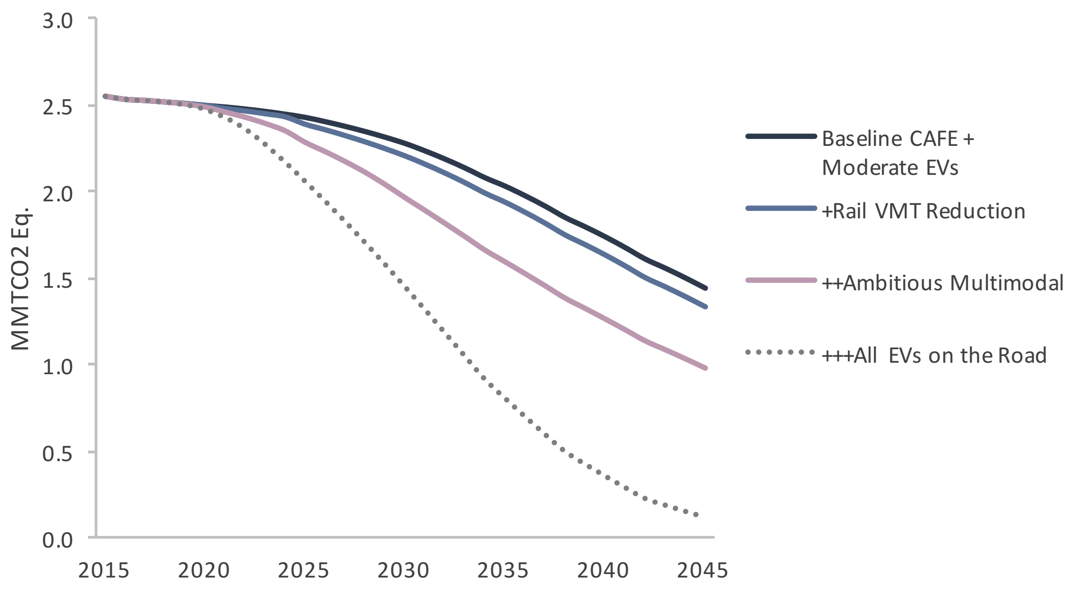


Table 1: Passenger Cars and Trucks Pathway Descriptions

	VMT	EV Adoption	GHG Emissions Change from 2015 by 2045	Cumulative Emissions Abated from the Baseline 2020-2045	GHG Reduction Potential of Individual City Strategy
Baseline: SAFE + Moderate EV	Grows at rate consistent with historic relationship to population. This yields a 11% increase in total VMT between 2020 and 2045. Per capita, VMT increases by 2% by 2025 and 4% by 2045 compared to 2020.	Continued adoption of EVs, faster than the national average, reaching 52% of vehicle sales by 2045	-44%	NA	NA
++ Rail VMT Reduction	Total VMT is 2% lower than the baseline the first year the Rail is fully operational and 8% lower than the baseline in 2045. Per capita, VMT decreases by 1% after operation and 4% by 2045 compared to 2020.	Same as above.	-48%	1.8 MMTCO2 Eq.	1.8 MMTCO2 Eq.
+++Ambitious Multimodal	Total VMT is 3% lower than the baseline in 2025 and 24% lower than the baseline in 2045. This means a 30% decrease in per capita VMT between 2020 and 2045.	Same as above.	-62%	8.2 MMTCO2 Eq.	8.2 MMTCO2 Eq., and cannot be separated from Rail VMT Reduction
+++All EVs on the Road	Same as above.	Vehicle sales are 95% EVs by 2025 and 100% EVs by 2030.	-95%[16]	23.1 MMTCO2 Eq.	NA, outside the City's jurisdiction

[16] Within +++All EVs on the Road, a small amount of GHG emissions still persist in passenger cars and trucks because there will still be a small number of internal combustion engine vehicles on the road in 2045 that were sold in the early 2020s.

SPOTLIGHT

The Role of Federal Fuel Economy Standards

While transportation patterns are a reflection of land use and economic activities, the kinds of passenger cars and trucks that people drive are largely influenced by federal policy. The safety and fuel efficiency of passenger cars and trucks are governed by the U.S. Department of Transportation, National Highway Traffic Safety Administration (NHTSA). NHTSA and EPA jointly developed GHG emissions standards for passenger cars and trucks, harmonized with fuel economy standards. Corporate Average Fuel Economy (CAFE) standards were enacted in 1975 and are designed to increase the efficiency of vehicles over time. Nationwide, automobile manufacturers must meet a fleet-wide average fuel efficiency target. As a nation-wide target, subnational policies strongly interact. Thus, pursuing subnational policies to increase EV adoption does not necessarily lead to overall GHG emissions reductions across the country, as it results in “leakage” of emissions between states.[xxxvii] Even states that have historically been granted waivers, based on local air quality, like California, are included in the overall CAFE standard. Current federal rulemaking has rolled back GHG emissions and fuel efficiency standards for passenger cars and trucks through the “SAFE Vehicle Rules.”[xxxviii] For O‘ahu, these rules are estimated to increase cumulative GHG emissions from passenger cars and trucks between the years 2020-2045 by 7% (from 50.8 to 54.3 MMTCO2 Eq. cumulative emissions). Lastly, CAFE standards are a suboptimal policy to reduce GHG emissions in transportation because they address only new car sales and ignore existing vehicles and how much people drive. The latter is exacerbated by relatively low gasoline prices across the U.S. Given these factors, this CAP strongly emphasizes VMT reduction as the first measure to reduce O‘ahu’s GHG emissions from passenger cars and trucks.[17]

[17] State transportation policy must be similarly aligned. The current statement of program objectives for O‘ahu’s highways focuses on the “rapid, safe, and economical movement of people and goods” with an underlying assumption of meeting an 11% growth in VMT. VMT reduction across O‘ahu requires a more coordinated approach with a focus on GHG reduction. See the Executive Biennium Budget - Department of Transportation” (State of Hawai‘i, 2018).

GHG Pathways for Heavy-Duty Vehicles

In Summary

- Heavy-duty vehicles (HDVs) account for about 10% of ground transportation GHG emissions.
- In the baseline, GHG emissions from HDVs are forecasted to increase by 20% due to an increase in VMT.
- The most important City action is to get diesel fuels out of its fleet through electrification or alternative fuels, to offset the GHG impacts of greater VMT.
- To maximize benefits, it is important to coordinate EV charging with electricity generated from renewable energy rather than fossil fuels.

The pathways for future GHG emissions in HDV ground transportation, shown in Figure 8, are based on an HDV turnover model. See Appendix II for a full methodological description. Major changes to GHG emissions result from actions affecting VMT and the electrification of HDV fleets.

The Baseline: Minimal EVs pathway assumes that there will be increasing VMT of bus transit (mirroring the rate of projected long-term economic growth). There are no City EVs and a small share of private buses that are assumed to convert to EVs by 2045 (20%). Variation in assumptions about electrification of HDVs leads to two alternative pathways. The +City Fleet Goes Electric estimates GHG emissions reductions from converting 100% of the City's bus and other HDV fleet to EVs by 2035. ++All Other EVs add to this electrification of the rest of private buses: 95% of private buses and other HDVs are assumed to be electric by 2045. This last pathway is shown to illustrate what would have to occur in fuel switching to get close to zero emissions from the HDV sub-sector. The major assumptions regarding VMT and EV adoption are in Table 2.

Figure 8: GHG Emissions Pathways for Heavy-Duty Vehicles

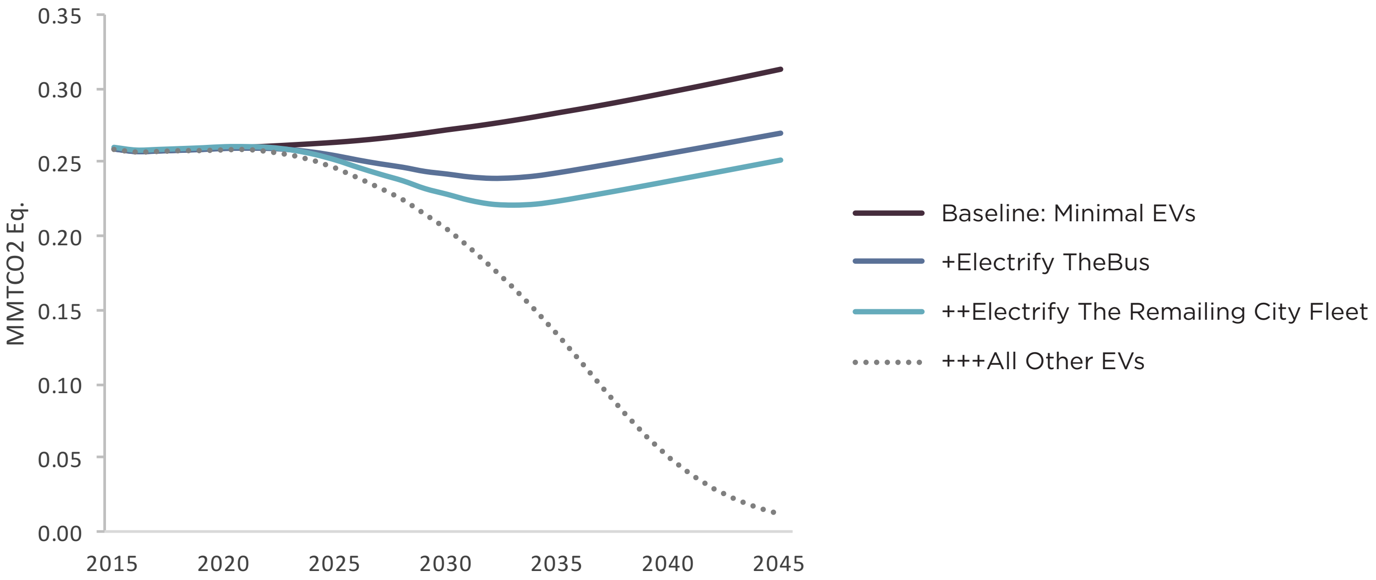


Table 2: Heavy-Duty Vehicles Pathway Descriptions

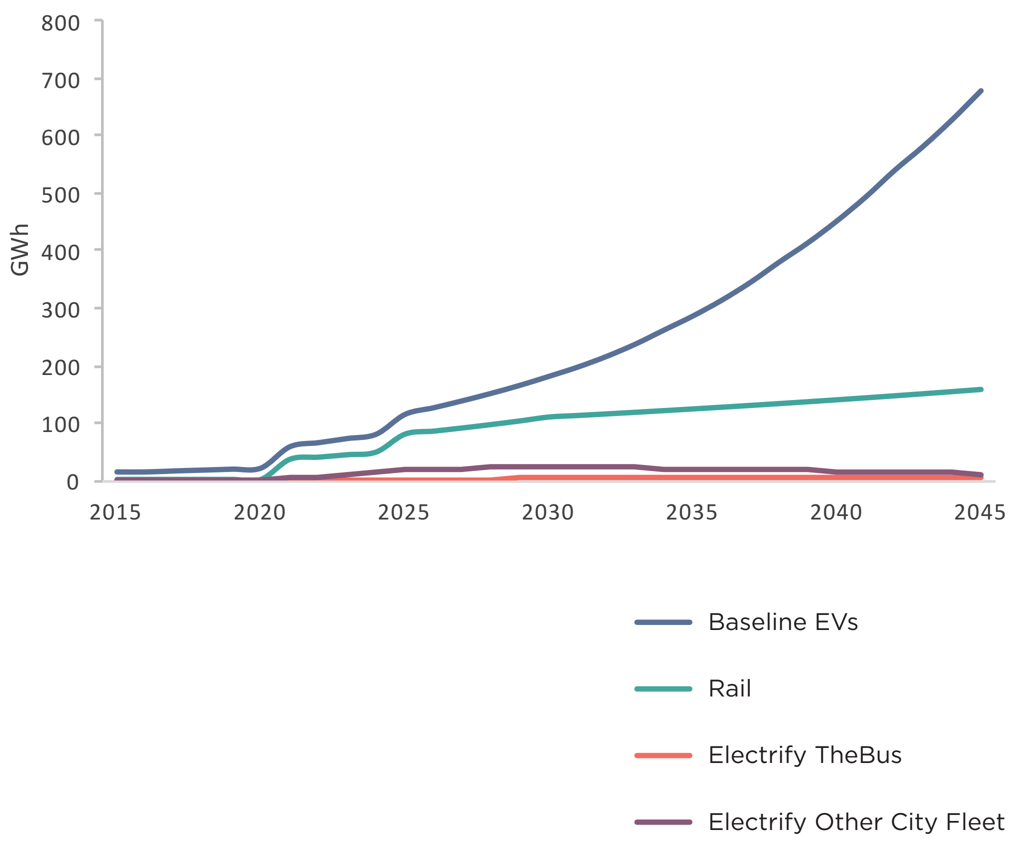
Pathway	VMT	EV Adoption	GHG Emissions Change from 2015 by 2045	Cumulative Emissions Abated from the Baseline 2020-2045	GHG Reduction Potential of Individual City Strategy
Baseline: Minimal EVs	Grows at rate consistent with historic relationship to population, a 63% increase in VMT between 2020 and 2045.[18]	0% of the City's fleet and 20% of private buses and other HDVs are EVs by 2045.	21%	N/A	N/A
+Electrify TheBus	Same as baseline.	100% of City buses electric by 2035.	4%	0.7 MMTCO2 Eq.	0.7 MMTCO2 Eq.
++Electrify the Remaining City Fleet	Same as baseline.	100% of the City fleet is electric by 2035.	-3%	1.1 MMTCO2 Eq.	0.3 MMTCO2 Eq
+++All Other EVs	Same as baseline.	100% EVs in the public fleet by 2035. Private buses and other HDVs reach 95% EV penetration by 2045.	-95%	3.3 MMTCO2 Eq.	N/A, outside the City's jurisdiction

[18] Based on DBEDT's most recent long-range population forecast.

New Sources of Electricity Demand from Transportation

For passenger cars and trucks, rail, and HDVs, the electrification of transportation creates additional electricity demand. Below shows estimated annual electricity demand for EVs (in the Baseline), the Honolulu Rail Transit, EV buses (in Electrify TheBus), and other City HDVs (in Electrify the Remaining City Fleet). As shown in Figure 9, these are pathways used to account for GHGs in the electricity sector.

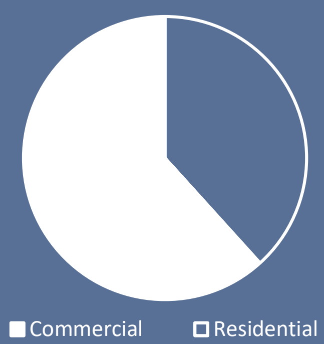
Figure 9: Transportation Sector Electricity Demand Forecasts



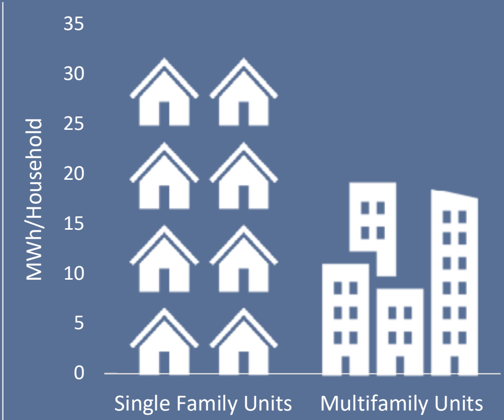
Electricity

Electricity generation contributes to 35% of O‘ahu’s GHG emissions. In 2019, 80% of electricity was produced from fossil fuels. There are State efforts to achieve 100% of electricity from renewable sources by 2045. The City plays a major role in achieving this goal through policies that guide building energy use, the City’s own energy efficiency and renewable energy projects, and permitting renewable energy installations. By working with the State, utility, private sector, and community to achieve the State’s goals, the City can help drive continued investment and innovation in decarbonizing the electricity sector.

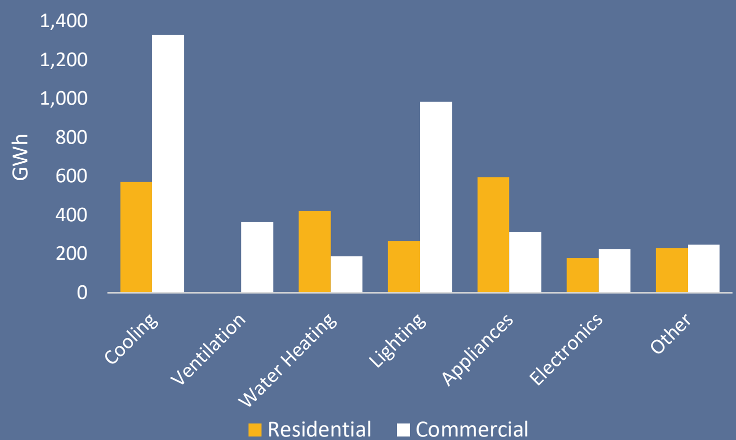
Electricity



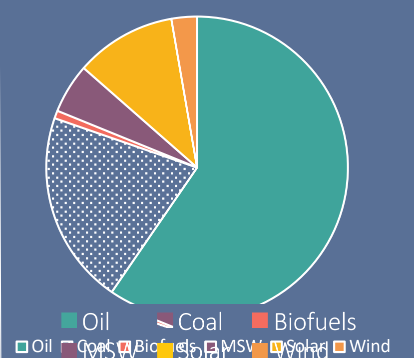
62% of electricity on O‘ahu is consumed in the commercial sector which includes restaurants, stores, hotels, schools, and other businesses. The other 38% is consumed in homes.[xxxviii]



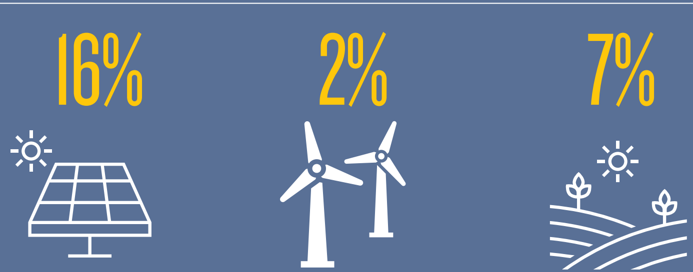
Multifamily households on O‘ahu use 40% less electricity than single family households.[xxxix]



Most of the electricity usage in the commercial sector comes from cooling and lighting (63%). Cooling, water heating and, use of appliances such as refrigerators, clothes dryers, and ovens make up almost 70% of residential electricity consumption.[xl]



Oil and coal contribute 59% and 21% of electricity generation on O‘ahu respectively. Another 5% of generation comes from waste-to-energy plants (of which 60% is assumed to be biogenic) and 15% comes from other renewable sources.[xli]



18% of electricity generation on O‘ahu came from renewables in 2018, including from solar PVs, wind turbines, biodiesel, and biomass (the biogenic portion of waste).[xlii]

Over half of renewable generation on O‘ahu in 2018 came from customer sited rooftop solar.[xliii]

SPOTLIGHT

What are renewable sources of electricity and what are the targets for O‘ahu?
The requirements for and definition of renewable energy differs across U.S. states. The State of Hawai‘i's Renewable Portfolio Standard (RPS; HRS § 269-92) sets statewide targets over time that each utility must meet: 30% of its net electricity sales by 2020; 40% by 2030; 70% by 2040; and 100% by 2045. Eligible technologies that are commercially deployed and available on O‘ahu include: Solar Photovoltaic (PV); Wind; Biomass; Municipal Solid Waste (MSW); Combined Heat & Power; Landfill Gas; and Anaerobic Digestion. Being classified as renewable energy does not necessarily imply it is GHG-free. The burning of MSW, for example, is still GHG-intensive. Even after adjusting for biogenic sources of emissions, MSW has an emissions-intensity about 75% of coal and 90% of oil.[xlv]

Because Hawaiian Electric and its sister companies Maui Electric and Hawai‘i Electric Light supply the electricity needs for the City and County of Honolulu, Maui County, and Hawai‘i County, respectively, the RPS can be met via a combined renewable energy source. One stated reason that releases the utility from complying with the mandate is the "Inability to obtain permits or land use approvals for renewable electricity energy projects," emphasizing the important role of the City in this effort.

For the purpose of this CAP, the State RPS policy and O‘ahu's electric utility's generation plan to deploy renewable energy on O‘ahu (currently the Power Supply Improvement Plan or PSIP) serve to guide the pathways that decarbonization of the electricity sector might take. The pathways focus on GHG emissions rather than the percentage of renewable energy in generation ("GHG-free Renewable Generation").

Photo credit:
Honolulu Board of Water Supply

GHG Pathways for the Electric Sector

In Summary

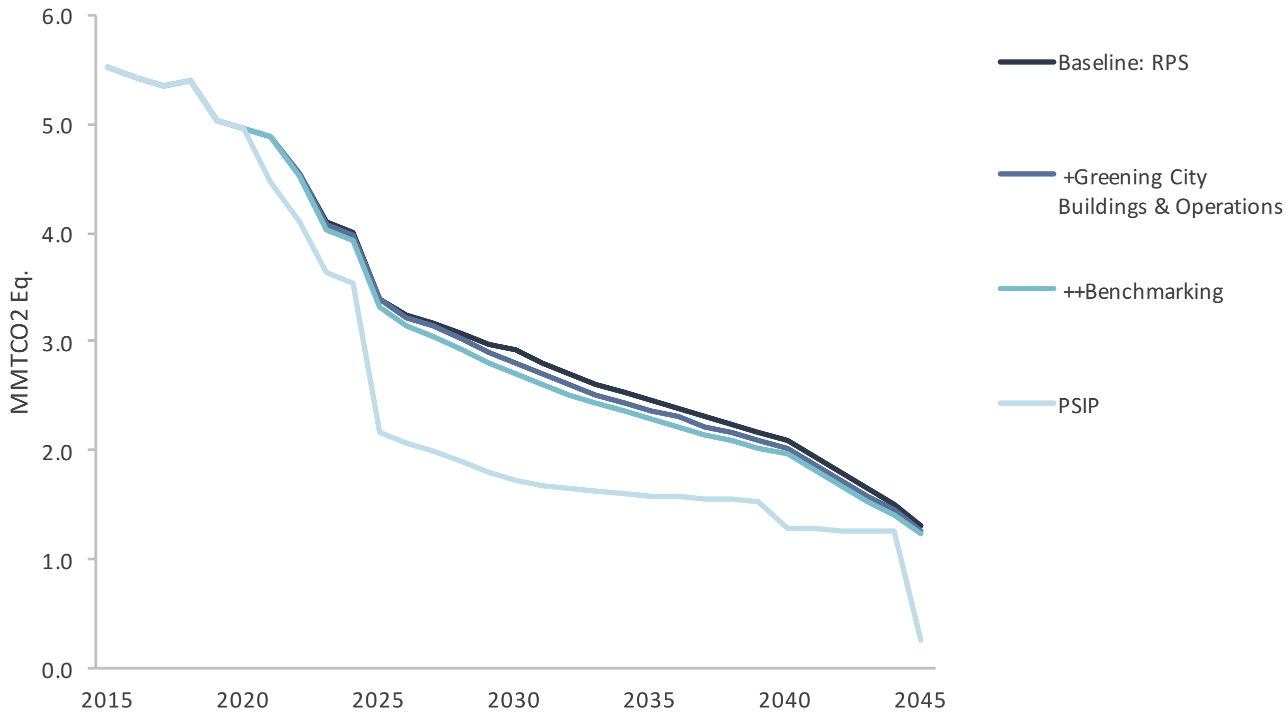
- Implementation of the State's RPS goal of 100% of net sales of electricity through renewable sources by 2045 will continue to substantially reduce electricity sector GHG emissions.
- Though state law is the driving policy, the City plays an important role in implementation. There are planning, permitting, and land use requirements for renewable energy deployment at the scale presented in the State's RPS goal and considerably more to achieve the utility's plan for 100% generation through renewable sources by 2045.
- The City can reduce its impact through energy efficiency and renewable energy for its own operations, contributing to the overarching goal.
- To ensure that communities are the ones who benefit from clean energy advancements, the City should involve communities early and actively in the renewable energy permitting process. Planning should be guided by shared community benefits and equity-enhancing measures.

The pathways for GHG emissions in the electric sector are based on assumptions about the way in which the RPS policy is met, as well as the current utility generation plan to 2045, the Power Supply Improvement Plan (PSIP). [19] The electricity demand forecast is based on utility plans,[xlvi] with adjustments based on forecasted electricity demand due to EVs as well as the Honolulu Rail Transit Project.

[19] The PSIP was released in 2016. Adjustments are made to the PSIP E3-Generation Modernization to 2020 based on actual renewable energy projects.

The three pathways shown in Figure 10 are: (1) Baseline RPS assumes the RPS is met including the phase-out of the 180 MW coal-fired power plant after 2022, (2) +Greening City Buildings by 2030 assumes that electricity demand from the City buildings and operations are zero in 2030 through energy efficiency and behind-the-meter renewables,[20] (3) ++ Benchmarking layers on energy efficiency from City building benchmarking and transparency programs and, (4) PSIP assumes that 100% of generation is met through renewable energy by 2045, as presented in the PSIP (though not all is GHG-free). This pathway stands alone, from a GHG perspective, meaning it is not "in addition to" prior pathways.

Figure 10: GHG Emissions Pathways for the Electric Sector



[20] In actuality any City renewable energy would count within the RPS target. It is parsed out from the baseline RPS to illustrate the magnitude of GHG emissions reductions related to City actions.

The RPS pathway is estimated based on the requirement of "net sales," which implies through state rules the double-counting of behind-the-meter solar PV. As such, estimates for distributed solar PV are taken from the PSIP. Table 3 compares the State RPS law with GHG-free renewable energy generation within the Baseline RPS.

Table 3: Comparison of State RPS Law and GHG-Free Renewable Generation in Baseline: RPS

Year	State RPS Target for Renewable Energy	GHG-free Renewable Generation in Baseline: RPS
2020	30%	25%
2030	40%	32%
2040	70%	52%
2045	100%	72%

The PSIP pathway presents the GHG outcome of the preferred utility plan. [21] The estimates of unit heat rates as well as capacity factors are also taken from PSIP-provided data [xlvii] and are further explained in Appendix II. The necessary layout of renewable energy projects embedded in the PSIP pathway is provided in Table 4.

Table 4: Installed Renewable Capacity Assumed in PSIP Pathway (MW)

Year	Grid-Scale Solar	Grid-Scale Wind	Distribution Solar PV
2020	194	123	606
2025	646	333	867
2030	646	333	1,175
2035	646	333	1,484
2040	926	333	1,793
2045	2,106	363	2,101

[21] "E3 with Generation Modernization."

In addition to electricity consumption in the built environment, all electric sector pathways include projected baseline electricity consumption from light and heavy-duty EVs, including electricity consumed by the Honolulu Rail Transit once it comes online. Major assumptions within the electricity pathways are given in Table 5.

Table 5: Description of Electric Sector GHG Emissions Pathways

Pathway	% Renewables	Electricity Demand	% GHG Emissions Change from 2015 by 2045	GHG Reduction Potential of City Strategy 2020-2045
Baseline: RPS	29% in 2025 and 72% in 2045	6640 GWh in 2025 and 6400 GWh in 2045	-85.3%	54 MMTCO2 Eq. (cumulatively relative to 2020)
+Greening City Buildings by 2030	Same as RPS (assuming only demand changes)	6610 GWh in 2025 and 6130 GWh in 2045	-85.8%	1.5 MMTCO2 Eq. (relative to Baseline)
++Benchmarking	Same as RPS (assuming only demand changes)	6460 GWh in 2025 and 5910 GWh in 2045	-86.2%	1.7 MMTCO2 Eq. (relative to Baseline)
PSIP	58% in 2025 and 100% in 2045[22]	Same as baseline	-97.1%	76 MMTCO2 Eq. (cumulatively relative to 2020)

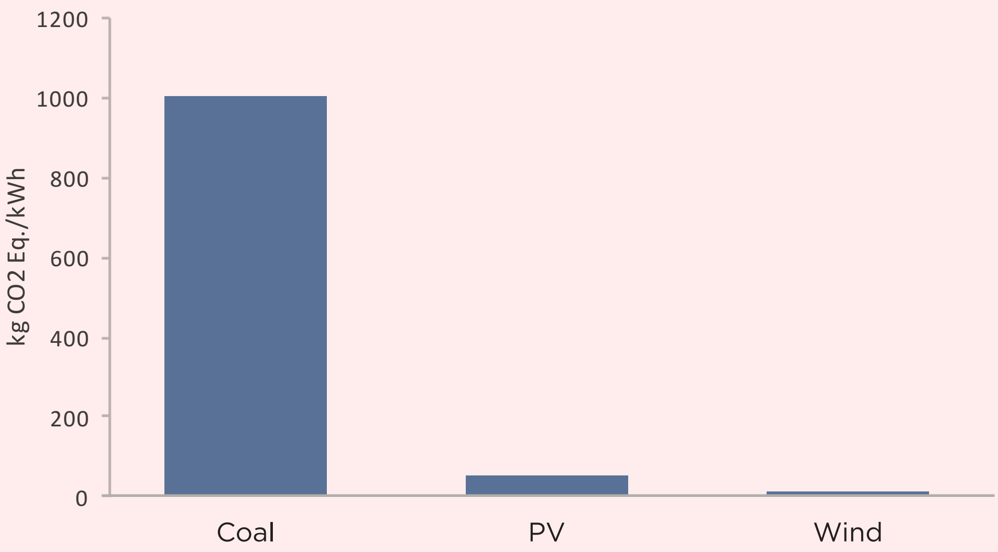
[22] Though 100% renewable energy in 2045, there are still GHG emissions because it includes waste-to-electricity. There are also biofuels, but these are discounted entirely per state GHG accounting rules.

SPOTLIGHT

Lifecycle Emissions of Electricity Generation

Although renewable sources of energy may have no emissions associated with them during use, all have some emissions on a lifecycle basis. As demonstrated in Figure 11, lifecycle emissions associated with electricity generation are generally much lower for renewable energies than that of fossil fuels.[xlviii] Most lifecycle emissions from renewable energies come from fossil fuel use during production of materials. For example, the production of PV panels accounts for 84% of total lifecycle emissions.[xlix] In comparison, 94% of lifecycle emissions related to coal-fired generation occurs during electricity generation.[l] Lifecycle emissions from various forms of bioenergy vary widely depending on land use implications and production methodology. While in some cases bioenergy is net GHG reducing, in others it has greater lifecycle emissions than petroleum.[li] Specific to Hawai‘i, renewable energy from solar PV or wind is also less transportation-intensive in terms of relating to one-time capital shipment rather than repeated fuel delivery.

Figure 11: Lifecycle Emissions of Fuels/Technology per kWh of Electricity Generated. Adapted from NREL (2013).

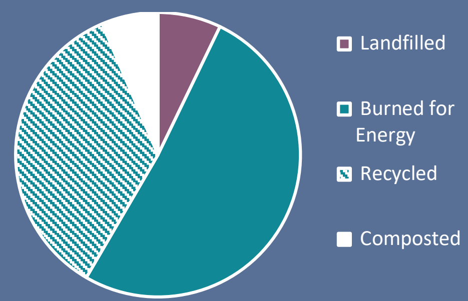


Waste & Wastewater

Emissions from waste and wastewater disposal and management are 3% and 0.2% of O‘ahu’s GHG emissions, respectively. These totals may appear small due to the diversion of waste to H-POWER for electricity generation, but in reality, waste has a significant carbon footprint. Landfills create methane emissions that end up being flared, and plastic-based goods are made using fossil fuels. As the sole manager of O‘ahu’s waste and wastewater disposal, the City has an opportunity to reduce waste at the source and utilize byproducts as resources themselves.

Waste & Wastewater

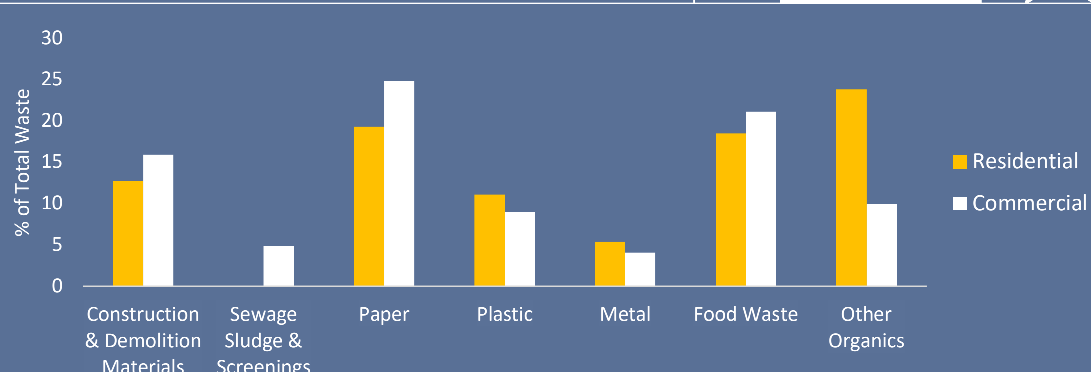
In 2018 Oʻahu generated nearly 2 million tons of waste from residential, commercial, and industrial sources. This includes almost 0.9 million tons of construction and demolition waste and over 1 million tons of municipal solid waste (MSW), more commonly known as trash. Assessed by each resident and visitor on Oʻahu this amounts to about 2,300 pounds of trash in a year or about 6 pounds daily. Some 60% of this trash is generated from commercial operations.[li]



About 93% of untreated MSW is diverted from the landfill. About half of MSW on Oʻahu is sent to H-POWER where it is burned to produce electricity. 35% is sent to recycling facilities out of State and 7% is composted on Oʻahu. The remaining 7% is sent to Waimanalo Gulch Landfill.[lii]

In 2019 municipal wastewater plants on Oʻahu received an average of 110 million gallons of wastewater per day, or 105 gallons per resident and visitor. This includes wastewater from businesses and industries but not wastewater treated at private wastewater plants or disposed of in cesspools.[liii]

In 2018, 532,000 tons of waste (51% of all MSW) was sent to H-POWER[liv], where it was burned to generate about 400 GWh of electricity.[lv] 176,000 tons of ash and residue left over after incineration was sent to the landfill in the same year and made up about 70% of total landfill tonnage.[lvi]



The composition of solid waste is substantially different in the residential and commercial sector and from business to business. Food waste and yard trimming are major waste sources in homes, paper in offices, cardboard in retail stores, and food waste in restaurants.[lvii] From a GHG perspective, organic waste that becomes methane is the driver of landfill emissions. When waste is incinerated at H-POWER, emissions largely come from products containing fossil fuels, such as plastics.

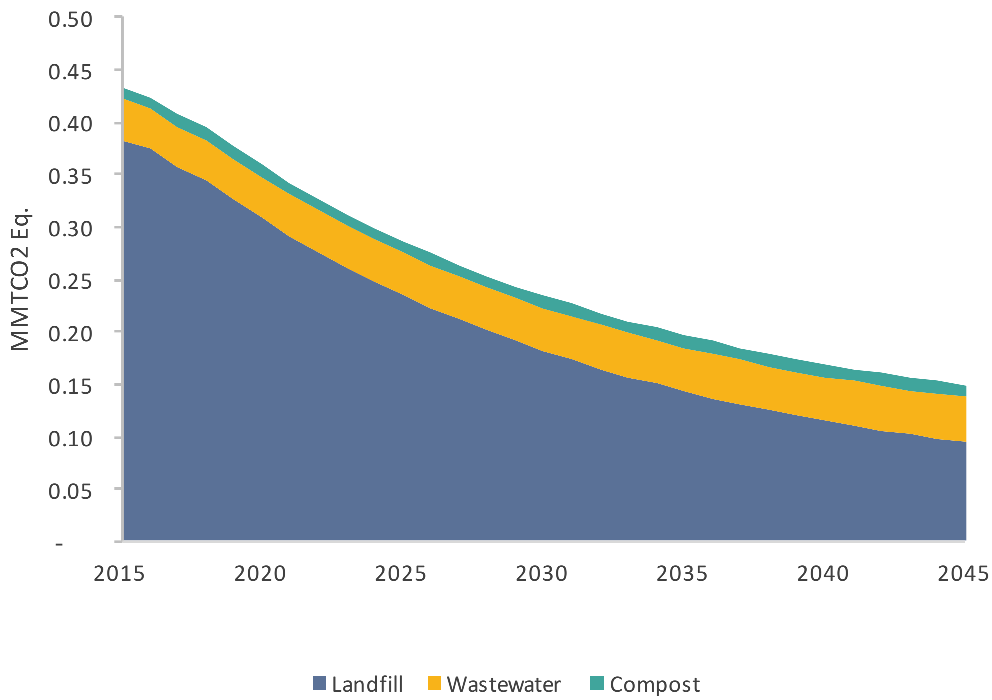
GHG Pathways for the Waste Sector

In Summary

- Waste sector GHG emissions are estimated to be approximately 0.15 MMTC02 Eq. in the year 2045, a 66% reduction from 2015.
- Waste sector GHG emissions are predominantly from landfills and are overall relatively small due to successful large-scale diversion efforts.
- The majority of waste stream GHG emissions on O'ahu occur at H-POWER, which is less GHG-intensive than either fossil-fuel burning or landfilling.
- Waste stream reduction serves to reduce GHG emissions outside of O'ahu, which is important as GHGs are a global scale pollutant.

The pathway analysis for waste sector GHG emissions is distinctly different from other sectors, for several reasons. The first is that there is a long delay between the disposal of solid waste and subsequent GHGs due to the time for decay. Second is that the waste sector has a relatively small GHG footprint, and there are limited ways to influence waste sector emissions as estimated in a sector-based GHG inventory. As such, only one pathway is shown. The pathway illustrates the City's 25% waste source reduction goal and its impact on GHGs from waste-to-energy processes that are attributed to the electric sector. As shown in Figure 12, GHG emissions from landfills are projected to decline. GHG emissions from composting and wastewater treatment are projected to increase slightly due to assumptions for population growth.

Figure 12: Waste Sector GHG Emissions Projections

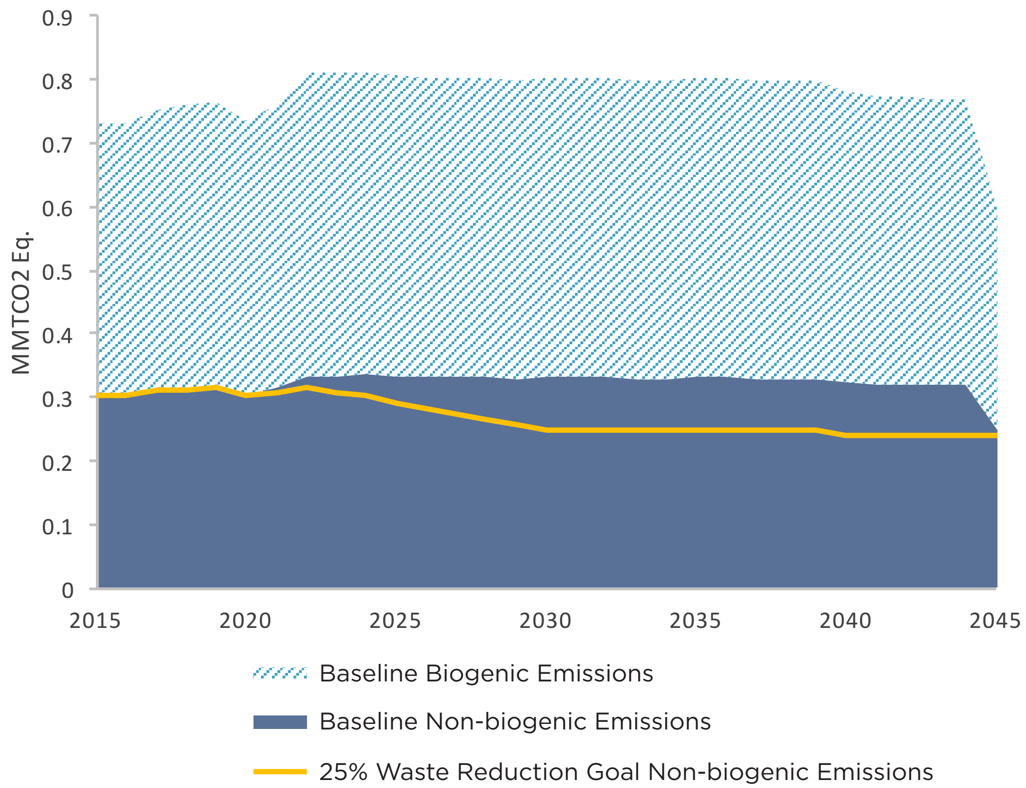


The Landfill GHG emissions pathway is determined by both the composition (types of waste) and total tonnage of MSW sent to the landfill. It is based on a first order decay model, presented in Appendix II. MSW on O'ahu generates GHG emissions in two ways: (1) through generation of methane (CH^4) as a result of decay of organic matter under anaerobic conditions either at the landfill or at composting facilities; and (2) as a result of incineration at H-POWER, O'ahu's waste-to-energy facility. Although GHG emissions from H-POWER are counted in the electric sector, it is influenced by reduction strategies in the waste sector. The projected decline in landfill GHG emissions is due to a shift, beginning in 1997, in emissions from landfilling to recycling and energy recovery. By 2015, 51% of MSW was diverted to H-POWER where it was incinerated to produce electricity.[lix] Another 42% of municipal solid waste was diverted to recycling and composting facilities, leaving only 7% of MSW sent to the landfill. However, H-POWER activities create ash and residue, which have been a growing portion of materials sent to the landfill. Ash and residue have a very small methane generation potential at the landfill and thus is not included in landfill emissions estimates. There is one active landfill on O'ahu and three closed sites that still generate methane that is managed by flaring.[lx]

In its 2018 Integrated Solid Waste Management plan, the City established a 25% per capita waste reduction goal by 2030. The GHG implications of this goal for O'ahu are primarily experienced in H-POWER. The vast majority of materials put in the landfill are ash from H-POWER. As such, Figure 13 shows the GHG impacts of the waste reduction strategy, assuming constant waste composition and excluding biogenic sources. Net emissions impacts are dependent on substituting lost generation from H-POWER with low carbon sources of energy. In the near term, if offset by existing firm sources of electricity (i.e., oil), the action actually increases GHG emissions. This difference in emissions will change with the increasing addition of low carbon sources of electricity.[23]

[23] The utility's PSIP assumes that H-POWER will ramp down generation to 338 GWh in 2045, an 18% reduction from 2016.

Figure 13: H-POWER Emissions Comparison Between the PSIP Pathway & the City's 25% Waste Reduction Goal



Composting GHG emissions only include what occurs at large facilities and are expected to grow based on population. GHG emissions from composting occur because of the creation of methane, where carbon dioxide is considered biogenic.

Wastewater GHG emissions are generated based on the amount of organic matter, predominately protein, that is converted into nitrous oxide and released with effluent from wastewater treatment plants. A smaller amount of methane is also released during the decay process in anaerobic digesters at wastewater treatment plants. When methane is flared, it is categorized under biogenic emissions, which are not included in this CAP's GHG inventory methodology. This omission is the subject of notable scientific debate, and the City is considering policies that will still account for, monitor, and mitigate these emissions sources as well. There are approximately 100 million gallons a day of wastewater on Oʻahu that is processed through a 2,100-mile network of sewer pipelines, 70 pump stations, and nine wastewater treatment plants.[lxi]

SPOTLIGHT

Lifecycle GHG Emissions of Consumer Products

The scope of this CAP accounts for emissions associated with consumer products by tracking them through municipal landfills and H-POWER, but it does not capture the full lifecycle emissions of product consumption. Thus, this sector-based analysis inevitably underestimates these emissions. For example, consider the total lifecycle emissions of a polypropylene plastic container: 43% occur during extraction of raw materials; 37% during production; and only 13% during waste processing.[lxii] By reducing unnecessary waste, the City can drive down demand for products designed to be thrown away and subsequently reduce upstream emissions. To this end, the Honolulu City Council approved a phase-out of single-use plastics by passing Bill 40 in 2019, an important step towards reducing GHG emissions as well as ocean plastic pollution.

Downstream emissions from waste also occur outside of the County. In 2019, the City collected approximately 450,000 tons of paper, aluminum, plastic, and glass for recycling that were shipped out of the State to be recycled. In a well-functioning system, recycling is generally net GHG reducing due to energy savings related to extraction and mining of virgin materials.[lxiii] For instance, according to the EPA, using recycled aluminum cans to produce new cans uses 95% less energy than using bauxite ore, the raw material aluminum is made from, while recycling a ton of paper saves up to 17 mature trees and reduces water consumption by 50% compared to using virgin wood products.[lxiv] The efficiency of recycling is, however, an increasing issue due to the lack of capacity at processing facilities in countries where most recyclables are exported.

CAP Strategies & Actions 2020-2025

The following section presents strategies with specific actions for the City to reduce GHG emissions from ground transportation, electricity, and waste. The City can effect emissions reductions from ground transportation by reducing VMT from passenger cars and trucks, as well as by improving City and island-wide vehicle fuel efficiency. The City can influence GHG emissions reductions from the electric sector by reducing electricity consumption through energy efficiency and conservation, and by supporting island-wide renewable energy goals. The City's own facilities and operations play an important role in both of these strategies. Lastly, the City can reduce emissions associated with the waste sector by reducing product and material generation, and through waste repurposing to reduce the amount of waste going to end-of-life processing.

How are strategies assessed? Coupled with the pathways analysis, feedback from the public outreach and City departments was used to inform overarching strategies, representing critical approaches to GHG reduction to 2045. Nine strategies are presented and assessed based on the rubric in Table 6.[24] Lastly, 47 specific actions for the City to take in the next five years (2020-2025) are presented.

[24] Where possible, given data and methodological constraints of the scope, GHG reduction estimates are quantified. More detailed primary analysis of specific actions, including costs, are out of scope of this work and should be expanded upon in future iterations. Aside from GHG quantification through "pathways," the scope of work for this CAP included secondary literature review.

Table 6: How are GHG Reduction Strategies Evaluated?

Key Questions	Approach/Considerations
GHG reduction potential?	The overall potential for GHG emissions reductions is quantified where possible, and discussed qualitatively otherwise.
Is it equitable?	*"Frontline communities"* are defined as those that are disproportionately exposed and vulnerable to climate-based health and economic risks while having fewer resources, safety nets, or political agency to respond to and withstand these risks. Especially on our islands, these communities often include Native Hawaiians, Pacific Islanders, refugees, low-income residents, people experiencing housing insecurity, people with disabilities, the LGBTQ community and communities of color, as well as women, keiki, and kupuna or anyone at the intersection of these identities. Policies and programs should be designed to dually achieve GHG reduction while protecting O'ahu's frontline communities from bearing the largest burdens.
Is it cost-effective?	It is important to prioritize actions that effectively reduce GHGs and deliver multiple co-benefits while remaining affordable to the City and the public.
Is it in the City's jurisdiction?	This is a community-wide CAP with a primary and preliminary focus on the City's ability to directly or indirectly influence actions to reduce GHG's across O'ahu.
GHG Synergies	Actions towards reducing GHG emissions are like a spiderweb, where one strand touches another to mutually reinforce the structure. This criterion describes the other GHG outcomes that a strategy can affect.
Other Co-Benefits	Strategies to reduce GHG emissions often result in additional community-wide benefits, from reducing air pollution to creating more local jobs and vibrant streetscapes.
Avoidances	The introduction of interventions can also result in unintended consequences, such as distributional impacts negatively affecting broader scale issues or unwanted environmental impacts. These can often be avoided or controlled with careful design.
Existing Commitments	The City has pre-existing ordinances, plans, and policies that will influence O'ahu's GHG emissions. This section highlights City commitments related to the CAP Strategy. When a strategy corresponds to or supports an existing commitment, it is marked by one of the icons described in Table 7 below.

Table 7: Existing City Commitments with GHG Reduction Potential

Plan Title	CAP Icon	Plan Description
General Plan		The Oʻahu General Plan sets forth a direction and framework to guide the programs and activities of the City. This CAP advances many of the long-range objectives and policies within the General Plan related to energy; transportation and utilities; economic activity; and physical development and urban design to support coordinated planning towards GHG abatement across and in alignment with the City's Sustainable Communities Plans, Development Plans, and functional plans.
Resilience Strategy	Ola	The Ola: Oʻahu Resilience Strategy was released in 2019. Amongst many climate resilience strategies, it proposes eight actions to reduce GHG emissions on Oʻahu.
Transit-Oriented Development Plan		Transit-Oriented Development (TOD) is a pattern of different land uses that maximizes the amount of residential, business, and leisure space within walking distance of public transport. The Department of Planning and Permitting began the planning process for neighborhood TOD Plans in 2007 and has since engaged in community planning for the planned Honolulu Rail Transit stations in Waipahu, East Kapolei, ʻAiea-Pearl City, the Hālawa area, the Airport area, Kalihi, Downtown, and Ala Moana.
Complete Streets Ordinance		The City and County of Honolulu passed a Complete Streets policy (Ordinance 12-15) in 2012 and the Complete Streets Design Manual in 2016, committing the City to a transportation and design approach that promotes safe and convenient mobility for all ages and abilities, and accommodates all modes of transportation including foot, bicycle, transit, and automobile. In accordance with this policy, the City updated the Oʻahu Bike Plan in 2019 and is in the process of producing the first Oʻahu Pedestrian Plan.
Integrated Waste Management Plan		The City updated its integrated solid waste management plan in 2019, which outlines various aspects of waste management, including the collection, storage, and disposal of waste, source reduction, recycling and composting, and facility management.

Strategy 1

Encourage Density and Mixed Land Use in Strategic Areas

Land use change is perhaps the most impactful tool within the City's jurisdiction to reduce GHG emissions. Reducing per capita VMT from passenger car and trucks by 30% by 2045 is estimated to reduce O'ahu's GHG emissions by 8.2 MMTCO2 Eq. (cumulatively from 2020 to 2045) or 0.5 MMTCO2 Eq. in 2045 relative to the baseline.[25] Putting the City on this trajectory would entail reducing per capita VMT by 3% within the 2020-2025 CAP timeline. Lessening automobile dependence through land use can be done by enabling and encouraging denser development, mixed land-use zoning, and transit-oriented development.[26] Strategy 1 is complementary to Strategies 2 and 3, which also focus on VMT reduction.

Reducing the distance between activities reduces the length and number of trips made by car, thereby reducing GHG emissions.[lxv] Denser development also increases access to and makes more feasible alternative modes of transportation like biking, walking, and public transit, especially when accompanied by safe pedestrian and biking infrastructure (see Strategy 2). Moreover, focusing on increasing density in strategic areas releases growth pressures from other areas (such as lands classified agricultural), which is important to maintaining open space and other more rural community characteristics.

GHG reduction potential?	Potentially high in urban areas. A 30% reduction in per capita VMT by 2045 reduces cumulative GHGs by 8.2 MMTCO2 Eq (from 2020 to 2045). Strategies 1-3 target VMT reduction and are most effective when done together.
Is it equitable?	It depends. Must be accompanied with mixed-income housing and other measures to combat existing resident and business displacement. Reducing transit distance can lower transportation costs for households.
Is it cost-effective?	Highly cost-effective to the City through zoning; cost-effective to the public if allows for greater flexibility and market response, while supporting GHG reduction.
Is it in the City's jurisdiction?	Yes, through zoning and land use.
GHG Synergies	Increased viability of bicycle and pedestrian infrastructure and mass-transportation systems. Density also supports building energy efficiency.
Other Co-Benefits	Increased access to neighborhood amenities and services. Health benefits from increased walking and biking.
Avoidances	Possible increase in urban heat, reduced access to natural light, need for supportive infrastructure, like sewer capacity. New development should also avoid increased density in otherwise vulnerable areas.
Existing Commitments	

[25] The assumption of a 30% reduction in per capita VMT, a 24% reduction in overall VMT, corresponds closely to the "Station Area Plan" scenario of the Honolulu TOD Study conducted by Calthorpe Associates in 2013 (Calthorpe, 2013). The scenario in this report builds upon the City's TOD planning efforts and focuses growth along the Honolulu Rail corridor.

[26] Doubling density has been associated with a 4-19% reduction in affected households VMT (Boarnet and Handy, 2013); a 10% increase in mixed land use has been associated with a 1-17% reduction in affected households VMT (Spears et al., 2014); and increasing proximity to transit by one mile has been associated with a 1-6% reduction in affected households VMT (Tal et al., 2013). Adopting complementary policies together likely make them more impactful.

National estimates of reductions in transportation GHGs from compact development relative to the status quo are as great as 10% when averaging across rural and metropolitan areas.[lxvi] This reduction almost doubles when only looking at metropolitan areas.[27, lxvii] Land use change for GHG emissions reductions is a long-term strategy, and measurable outcomes should not be expected for about a decade.[lxviii] The City will continue to promote dense and mixed-use development in strategic areas[28] by implementing the policies in Table 8.

[27] Relating GHG emissions reductions from land use is incredibly difficult given the relationship between actions and VMT reduction is often indirect (thus hard to identify a treatment versus control group) and with a long time lag (Salon et al., 2012). There are a number of studies that quantify the elasticity of density and mixed land use on VMT reduction. A 1% increase in residential density has been found to reduce VMT by 7-19%, and a 1% increase in "land use mix" has been found to reduce VMT by 2-10% (Salon et al. 2012).

[28] They need not be the same areas. Places appropriate for mixed-use are not necessarily identical to places appropriate for greater density.

Table 8: Actions That Will Support Strategy 1

Actions	Additional details
1.1 Continue to adopt policies that support greater housing affordability located near transit and in areas in proximity to job centers and key destinations.	This action enables residents to live closer to their work and/or key transit nodes thereby shortening trip distances and supporting multimodal transportation. This action will include a variety of forms of density, including infill development. 40% of island-wide survey respondents agreed that buildings should be more dense around Honolulu Rail Transit stations.
1.2 Continue revising the City's land use and zoning regulations to allow for mixed-use development across O'ahu to support "complete communities."	Land use and zoning revisions will be oriented towards creating "complete communities" that allow residents to live, work, play, and access basic day-to-day needs – as a rule of thumb, within a 15-minute walking distance of their home. 73% of island-wide survey respondents agreed that they would like to have a mix of uses within walking distance in their neighborhood. Another 17% were neutral and few disagreed (8%). There were similar levels of support by residents across O'ahu.
1.3 Work with private sector to provide connectivity and streetscape infrastructure in new developments to support complete streets principles.	For example, through sidewalk widening, shade trees, space for bike/alternative transport parking, and contributions for bike lanes.

Strategy 2

Enable and Provide Multiple Modes of Green Transportation

GHG reduction potential?	Infrastructure for active transportation can reduce GHG emissions if trips are switched from cars. Overall impact is potentially large if implemented strategically with density (see Strategy 1).
Is it equitable?	It depends. Providing high quality multimodal transport options and supporting infrastructure is paramount to having a more equitable transportation system; however, it depends on how costs are passed to users.
Is it cost-effective?	It depends. Multimodal projects vary widely in cost and GHG benefits depend on the level of use.[29] Repurposing existing infrastructure is likely considerably more cost-effective than new construction projects.
Is it in the City's jurisdiction?	Yes, through multimodal transportation infrastructure. Partnerships with multimodal transportation providers are important.
GHG Synergies	With Strategies 1 and 3.
Avoidances	There can be a rebound effect from lower vehicular congestion, reducing otherwise gained GHG abatement. Should be coupled with other supportive approaches, like carbon pricing and "road diets." New construction can also contribute to GHGs, undermining potential benefits if infrastructure is underutilized. Emphasis should be placed on repurposing existing infrastructure like vehicle lanes.
Co-benefits	Improved health of active transportation users, improved air quality, and low-cost travel to jobs.
Existing Commitments	Ola

Current transport systems have been largely geared toward the private automobile, with severe outcomes for GHG emissions and other local air pollution. Reducing car-travel requires providing infrastructure and complementary incentives that enable people to choose alternative modes of transportation such as walking, biking, carpooling, and use of high occupancy transit (TheBus, and Honolulu Rail Transit once operational). The concept of multimodal transportation is that people have the ability to easily move between low-carbon modes of transport that best meets their mobility needs. Currently, 38% of island-wide survey respondents agreed that TheBus is convenient for most of their destinations. Active transportation, like walking and biking, has important additional health benefits. High-occupancy transit can reduce overall VMT and, at efficient levels of ridership, can also reduce GHG emissions, particularly if powered by renewable energy. Once fully operational, 24% of island-wide survey respondents said that they would be likely to ride the Honolulu Rail Transit at least three days a week. Respondents under age 40 had a higher likelihood rate — up to 50%.

Enabling a shift to cleaner forms of travel requires connecting and streamlining multiple mobility options. Because the private automobile is so flexible, substitution requires multiple modes with comparable levels of convenience. Moreover, having a diverse set of transportation options is important to support a wide range of mobility needs and constraints. As such, it is also imperative that transit options remain affordable. In the island-wide survey, 20% of respondents said that TheBus was unaffordable to them.

[29] Average cost of GHG abatement from new bike lanes estimated at $190/ MTCO2 Eq.

We are making significant strides towards electrifying our bus fleet, but we cannot electrify our way out of the climate crisis. We must also work towards a transportation future with clean, affordable, and convenient alternatives to driving by prioritizing sustainable transit: biking, walking, and smarter land use within our growing transportation networks.

Jon Nouchi
Department of Transportation Services

The cost of GHG abatement from multimodal transportation varies widely and depends on levels of use as well as the mode from which a shift is realized. For example, there are greater GHG emissions reduction gains if a person switches from driving a gasoline powered car to walking or biking than switching from TheBus to walking or biking. Geographic information on potential users, as well as their current commute mode, could help increase the likelihood that improved biking infrastructure will result in GHG reductions.

Currently only 5% of Oʻahu commuters bike or walk to work, and 6% to school. A total of 32% and 47% of island-wide survey respondents said that they do not walk or bike to their destinations, respectively, because of concerns about traffic safety. Between 2003-2012, 21% of all traffic fatalities in Hawaiʻi were pedestrian deaths. The City's Vision Zero program sets a goal to eliminate traffic fatalities through strong implementation of safe, people-centric design practices by 2035. Providing biking and pedestrian infrastructure to form a network of safe streets is an important part of achieving this vision.

A practice gaining popularity in a number of cities is the establishment of car-free zones, particularly within the city center and frequent destinations. This enables new spaces for walking and biking, where adequate bike lanes and connecting public transport are important to public acceptance.[lxix] These kinds of zones and connected corridors can be important gateways for people interested but timid about cycling due to safety concerns.

Overall, VMT management strategies can be productively implemented through a range of mechanisms, including public-private partnerships. The Waikīkī Business Improvement District, for example, runs a City-enabled Transportation Management Association that helps implement transportation management programs in Waikīkī. Biki, the bikeshare service, has substantial City and State support, and operates through a nonprofit organization. These kinds of implementation tools can be further leveraged.

Oʻahu's experience with COVID-19 laid bare the need for fast-tracking construction of safer cycling and walking infrastructure. Bike sales soared and bikeshare continued to serve essential workers who rely on public bike transportation 24/7, even as many other transit systems around the world closed.

Todd Boulanger
Bikeshare Hawaiʻi

Table 9: Actions That Will Support Strategy 2

Actions	Additional details
2.1 Implement the O'ahu Bike Plan and continue to build out protected bikeways for all ages and abilities with safe connections between existing bike lanes.	There are a total of 88 miles of proposed bikeways within the City and another 103 for the State. Bike lanes are prioritized, amongst ridership criteria, on the equity of the network to meet the needs of communities often underserved in transportation services.
2.2 Develop a City-focused Transportation Demand Management (TDM) program and consider updating the telework policy.	Using lessons from remote work during COVID-19, the City will explore telework policy options to continue to enable employees to work from home as appropriate. This will be part of a broader transportation demand management program for City employees, including subsidizing multimodal options and eliminating free long-term parking.
2.3 Complete the O'ahu Pedestrian Plan and implement high priority pedestrian projects.	The plan is under development.
2.4 Plan and plant trees as part of roadway rehabilitation projects to provide shade for pedestrian, bicycle, and transit infrastructure and promote comfort for frequent trips.	Of the island-wide survey respondents, 35% agreed that they would walk more often to destinations if the streets had more shade trees. This is consistent with the City's 2017 commitment to increase tree canopy to 35% in urban areas by 2035. Through a mapping of existing urban trees, CCSR found that the Monkeypod was the most common tree species planted. Trees should be native species where possible.
2.5 Repurpose general travel and parking lanes for multimodal and active transportation use.	The City's Complete Streets program is an asset to implement this action in building both long-term projects as well as "quick-build" pilots to transform our streets for shared uses by cars, buses, bikers, pedestrians and other mobility options. The community also showed a lot of interest in the City's "car-free" zones piloted during the summer of 2020 in response to COVID. Lanes separated from vehicle traffic for active transportation can help "interested but concerned" cyclists to feel more comfortable with bicycle trips, and have also been shown to improve pedestrian safety. Quick-build approaches can make this a relatively low-cost action, and the City's street rehabilitation funding provides an important source of funding for more permanent complete streets improvements.
2.6 Increase non-vehicular mode share in new multi-family housing and commercial developments through TDM programs.	Working through the permitting process, identify opportunities to implement ongoing TDM programs with the aim to reduce GHGs.
2.7 Identify candidate projects and develop dedicated bus lanes along high-occupancy transit corridors.	Trip duration is a major factor in the decision on whether to take public transit or drive a personal vehicle. Dedicated lanes give priority to transit vehicles and separate them from other modes of travel, increasing travel speed and enhancing reliability.
2.8 Launch integrated transit fare card (Holo) to include a fare-capping program for relevant daily, monthly, and annual rates.	There are currently a variety of alternative bus fares for students and senior citizens, though 20% of island-wide survey respondents did not agree that TheBus is affordable to them. Fare capping is a more equitable approach because it does not require riders to produce the entire value of, for example, an annual pass, at one time. It assures riders that their cost will not exceed the rate maximum, even if they are unsure of their usage up front. Fare capping was recommended by the Honolulu Rate Commission.[lxx] Allowing for online fare payment increases ease of entrance and continued use of TheBus system.
2.9 Hire a Mobility Manager to leverage opportunities to increase micromobility services.	With the introduction of bikeshare, a number of other micromobility options like scooters and dockless bikes are becoming increasingly available. 35% of island-wide respondents agreed that bikeshare is accessible to them. The mobility manager will focus on new mobility options that can be integrated with existing transportation systems and programs.
2.10 Create a universal trip planning and fare app to improve the connectivity of multimodal transportation options.	This app is particularly important with the operation of Honolulu Rail Transit, making first and last mile connections substantially easier for riders.
2.11 Seek innovative business solutions to deliver VMT reduction services.	For example, the Waikiki Business Improvement District runs a City-enabled Transportation Management Association. The City will leverage similar kinds of partnerships to implement localized transportation programs as opportunities emerge.

Strategy 3

Encourage Mode Shift through Parking Efficiency

GHG reduction potential?	Potentially high if parking demand managed efficiently and as a complementary strategy to Strategies 1 and 2.
Is it equitable?	It depends. Yes, if accompanied by ample access to affordable transit and alternative mode infrastructure, and if parking access is maintained for persons with disabilities.
Is it cost-effective?	Cost-effective if it provides for greater flexibility or better use of currently underutilized space; parking policies generally shift cost burdens from providers to users.
Is it in the City's jurisdiction?	Yes, for City parking meters, lots, and street parking.
GHG Synergies	More space for bicycle and pedestrian infrastructure and urban trees.
Other Co-Benefits	Reduced congestion and "circling." If on-street parking is repurposed with green infrastructure, reduced surface runoff.
Avoidances	Spillover effects between on-street and off-street parking, as well as pushing parking to new, unmanaged areas.
Existing Commitments	

Parking availability and cost are often included in people's decision-making around mode choice, destination, and timing of travel. Low parking prices and high parking availability are more likely to induce private automobile ownership and travel.[lxxi] Parked cars also occupy a significant amount of land, making "free" parking far from actually free.[lxxii] Most cars are parked about 96% of the time and the number of parking spaces per automobile range from three to five. Public and private parking in the Honolulu urban core has an occupancy rate of 71% during peak hours with about 13,000 vacant parking spaces.[lxxiii] Thus, reducing the amount of space allocated to parking, and better managing parking that exists, can free up significant amounts of public space that can be used, for example, for affordable housing.

Parking policies are generally divided into those targeting off-street and on-street requirements. Eliminating minimum off-street parking requirements has been shown to increase housing affordability.[lxxiv] Separating the purchase or rent of a housing unit from parking can also give consumers more flexibility in right-sizing their actual parking needs. Such policies should also be accompanied by management of on-street parking created in residential neighborhoods by minimum street width standards.

In commercial areas, as much as 30% of downtown traffic can be vehicles that are searching for parking.[lxxv] Parking pricing can be an important element of reducing circling, but efficient parking prices must be coupled with sufficient alternative modes of transport. 74% of island-wide survey respondents currently do not pay for monthly parking.[30]

[30] Asked under "normal," non-COVID-19 conditions.

Table 10: Actions That Will Support Strategy 3

Actions	Additional details
3.1 Allow for flexibility in the provision of parking by eliminating minimum off-street parking requirements.	This allows developers and owners flexibility to determine market conditions and parking needs.
3.2 Encourage unbundling of the sale or rent of multi-dwelling housing units from parking in TOD and other suitable neighborhoods.	This provides consumers flexibility in determining and acting upon their actual parking needs. One out of four O‘ahu-wide survey respondents said they would be interested in renting or buying a home that costs less but has parking for rent instead of a dedicated stall.
3.3 Develop curb management systems within TOD and other high-demand areas.	This makes off-street parking changes more effective as well as manages the spillover of private parking needs to public space.
3.4 Maximize efficiency of public parking at City-owned lots and parking spaces in destinations with high transportation alternatives. Implement dynamic metering rates.	Dynamic rates should reflect real-time parking costs to reduce demand and manage congestion at peak locations during peak hours. Information must be made readily available via an app.
3.5 Repurpose underutilized public parking in preference to multimodal transportation infrastructure, urban greenery, and public-serving spaces.	Increasing use of transportation alternatives (like car share) will continue to support the ability to remove costly parking spaces and open up opportunities to repurpose public space for public benefit.

SPOTLIGHT

O‘ahu Electric Vehicle Ready

With the current level of renewable energy on O‘ahu’s grid, electric vehicles (EVs) are much less polluting than traditional gasoline vehicles over their lifetime. If an EV driver has solar panels on their roof at home, an EV can even be a nearly zero emission mode of transport. As we progress towards our 2030 RPS target, EVs will only become cleaner and more affordable for O‘ahu residents.

In June, 2020, the City took a strong step towards enabling O‘ahu to be EV ready — by requiring new parking spaces to be pre-wired with the necessary electrical capacity to add EV charging without a costly retrofit. Through an update to the City’s energy conservation code, the City now requires newly-constructed multi-family residential and commercial buildings to provide Level 2 EV-ready parking facilities (Ordinance 20-10) for 25% of new parking stalls. It also establishes a point-based system where developers have flexibility to choose between speed of charge (i.e. Level 3 fast charging), the location of the EV-ready stalls in common areas, and the number of installed chargers. The new code also requires new single-family homes and townhomes under three stories to provide a dedicated Level 2 EV-ready plug for each enclosed and attached garage.

As of December 2020, there were nearly 11,000 electric vehicles on O‘ahu.[lxxvi] Demand for EVs — and thus the ability to charge them quickly and conveniently — is expected to continue to grow as the price of new and used EVs continues to drop. In addition to saving their owners money on gas, EVs also cost less in annual maintenance fees, thanks to their improved efficiency and reliability. O‘ahu’s moderate temperatures and relatively low road speeds are also some of the best conditions for optimal EV performance and battery range.[lxxvii] Updating O‘ahu’s building code to expand home and public charging infrastructure will be particularly important to meeting future EV charging demand and lowering the island’s emissions. There is overwhelming support (over 90% of respondents) for increased EV charging infrastructure, with nearly half of respondents supporting the use of public funds to provide EV charging stations at CIty facilities. One out of every three respondents pushed for these charging infrastructure expansions in public places, like grocery stores and schools. Respondents further called for the ability to charge in homes and workplaces. Daytime charging at work can help reduce drivers’ transportation costs and supports more PV systems on island.

Strategy 4

Electrify the City Fleet and Support High Efficiency Vehicles

GHG reduction potential?	0.7 MMTCO2 Eq. cumulatively from 2020 to 2045 for City buses; 0.3 MMTCO2 Eq. for all other City HDVs; small for City cars but potential catalyst for car sharing programs more broadly.
Is it equitable?	It depends on how costs are passed to users.
Is it cost-effective?	Generally, high efficiency vehicles are cost-effective over their lifetimes. The cost to the City of electrifying TheBus fleet will depend heavily on the rate of replacement.
Is it in the City's jurisdiction?	Yes.
GHG Synergies	Potential synergies with renewable energy integration if HDV charging can occur intermittently, matching renewable energy supply.
Avoidances	In the near-term, should avoid peak or nighttime, coal-intensive HDV charging.
Co-benefits	Immediate health benefits from improved local air quality from fuel-switching away from diesel.
Existing Commitments	Ola

Though fuel efficiency standards for passenger vehicles are within the jurisdiction of the federal government, the City can contribute to reducing transportation GHG emissions by electrifying its heavy-duty vehicle (HDV) fleet. This would also have tremendous co-benefits in reducing other sources of air pollution resulting from the current burning of diesel. There is an upfront premium to purchase an electric bus in comparison to a diesel bus of approximately $400,000 based on a recent solicitation. There are additional investment costs to develop the charging infrastructure.[lxxviii] This premium is expected to decline as electric buses are readily commercially available and entering markets within the U.S.

Car sharing programs are another potentially important means to increase the fuel efficiency of vehicles and help residents save money by avoiding the cost of owning a car.[lxxix] The City can support car sharing by providing car sharing companies that use highly fuel efficient vehicles preferential parking arrangements. Car sharing programs must be able to reach a critical mass where point-to-point drop-off (i.e., not having to make a round trip) is viable if it is to integrate into a broader multimodal transportation strategy.

Table 11: Actions That Will Support Strategy 4

Actions	Additional details
4.1 Develop and adopt an electric bus purchasing policy for the City's bus fleet to reach 100% renewable-powered city fleet goal by 2035.	62% of island-wide survey respondents agreed that the City should use public funds to replace City buses with electric buses. Another 21% was neutral. In the near term, the City will replace diesel buses that have reached the end of their useful economic life. With increasing levels of available sources of renewable energy and with the cost decline of electric buses, this will be reassessed. Other types of renewable-fueled buses may be necessary to maintain system reliability in case of emergency or electricity outages.
4.2 Develop a plan and implement City passenger vehicle fleet transition to achieve 100% clean fleet goal by 2035.	Starting with the motorpool, transition remaining city fleet to high-efficiency vehicles through electrification and car/rideshare.
4.3 Develop, for EV buses and other City-owned EVs, charging protocols such that it facilitates integration of intermittent renewable energy.	Electrification of transportation, in general, offers the opportunity to strategically use renewable energy and support grid services — meaning helping to smooth the intermittency of renewable energy sources like wind and solar PV. The City will seek opportunities to work with the electric utility on maximizing HDV and other EV charging such that it optimizes GHG reduction potential.
4.4 Expand EV charging infrastructure for the City EV fleet by tripling public charging capacity on City facilities; enable electricity cost recovery.	Supporting the transition of the City fleet requires investment in multiple types of chargers at different locations. This investment should be made in partnership with industry members, particularly to provide public fast charging on City properties. Cost recovery would require the adoption of a new policy to allow concessionaires to charge customers for use of public charging.
4.5 Provide private car sharing with high fuel efficiency vehicles priority access parking to enable point-to-point service in high usage areas.	By serving multiple users each day, car share vehicles can spend less time parked relative to a privately owned vehicle. Successful car share programs depend on having a sufficient number of users and readily available parking such that point-to-point trips are supported.

Strategy 5

Reduce Energy Demand by Increasing Energy Efficiency

There are multiple ways that the City can enable energy efficiency across Oʻahu. The most important long-term measure is to influence new construction by regularly updating building energy codes to the highest national and state standards. In 2020, the City updated its electrical building and energy conservation codes, which also adopted standards specific to tropical climates. However, even in the update of building energy codes, only 2015 standards were adopted rather than the most up-to-date 2018 standards. With adoption of the 2021 code on the horizon, the new standards will be quickly outdated. Newer codes present opportunities for even greater energy and cost savings, especially given new International Code Council rules that require an increase in efficiency in every code cycle and add net zero 2030 stretch code options into the code standards. Ensuring regular code updates that keep buildings on track towards energy efficiency improvements is critical for driving down emissions in the long term.

To address existing buildings, cities across the U.S. have adopted benchmarking and transparency requirements for large commercial and multi-unit residential buildings. Building benchmarking involves regular tracking of building energy metrics and reporting within a publicly available platform, which may be particularly useful to inform buyers or renters of commercial space or apartments of their energy costs.

Large commercial and multi-family buildings (over 30,000 square feet) account for 66% of the total floor space on Oʻahu.[lxxx] It has been estimated that implementing benchmarking standards can reduce electricity consumption of buildings within the program by nearly 7% by 2030.[lxxxi] Within the island-wide survey, 34% of respondents supported using public funds to retrofit existing large private buildings. A growing number of cities including New York, St. Louis, and Washington D.C. have gone beyond by adopting incrementally increasing energy-saving targets for buildings to ensure increasing energy savings over time. The City can begin to replicate these efforts by implementing its own municipal benchmarking program for covered City buildings over 10,000 square feet.

GHG reduction potential?	1.7 MMTCO2 Eq.cumulatively from 2020 to 2045 from existing building benchmarking. Potentially large impacts from new buildings over time.
Is it equitable?	Energy efficiency investments accrue cost savings. Energy efficiency reduces the high energy burden for residents, but paying for high upfront investments needs to be managed.
Is it cost-effective?	Energy efficiency can be highly cost-effective in the long term. Cost-effectiveness of benchmarking depends on the cost of data transparency measures and subsequent commercial sector response.
Is it in the City's jurisdiction?	Yes, mainly through building codes.
GHG Synergies	Reduces the capacity requirement related to renewable electricity generation. Efficiency measures that address air conditioning also reduce high global warming potential GHGs.
Avoidances	Investment in energy efficiency can have a rebound effect if not coupled with other pricing or structural measures.
Co-benefits	Reduction in local air pollutants.
Existing Commitments	Ola

Table 12: Actions That Will Support Strategy 5

Actions	Additional details
5.1 Put in place a system to regularly update relevant building code ordinances, adopt state codes as required, and consider adopting further local standards to reduce greenhouse gas emissions over time.	Updating building energy codes to 2015 standards was achieved in 2020 through Bill 25 (2020). Moving forward, the City will ensure timely local code updates as required after new state codes are adopted. Future updates, for example, could address high global warming potential GHGs used within air conditioning systems as there are substitutes.
5.2 Develop a "lead by example" municipal energy and water benchmarking program for covered City facilities along with data transparency, reporting, and building performance standards. Develop internal and publicly-available dashboard with energy and water data reporting protocols.	In order to achieve deep decarbonization goals in the existing buildings sector, which accounts for 35% of our jurisdiction's GHG emissions, we need to measure energy usage, evaluate it against peers and other sectors, and then identify opportunities for energy and water conservation. Establishing a data transparency and benchmarking program is a foundational step that will open up opportunities for investment in greener and cleaner living. The City will lead by example and first establish these policies for its own facilities before collaborating with industry partners on a community-wide benchmarking effort.
5.3 Develop a building energy benchmarking program, building performance standards, and transparent reporting mechanisms for large covered commercial and multi-family buildings.	After benchmarking City facilities, the benchmarking program should be expanded to a community-wide program. Additionally, the City will work with partners in the public and private sectors to develop consistent data standards and protocols for aggregating, anonymizing, and providing access to utility and other energy data (e.g, Green Button Connect).
5.4 Deploy a Healthy and Resilient Buildings program in response to COVID-19.	The COVID-19 pandemic revealed the importance of indoor air quality and healthy indoor environments for work and commerce. It also revealed the connection between energy efficiency and indoor air quality as some air filtration and treatment technologies may require increases in energy usage. It is important to offset increased energy load with energy conservation measures, renewable energy generation and energy storage. The City will work with Hawai'i Energy, UH, and other partners in the public and private sector to administer a program to simultaneously invest in public health and energy conservation.

Strategy 6

Maximize Energy Efficiency and Renewable Energy throughout City Operations and Assets

GHG reduction potential?	1.5 MMTCO2 Eq. cumulatively from 2020-2045
Is it equitable?	Yes, City-wide Energy Service Provider Contracts (ESPCs) will reduce taxpayer expense. Strategic investment in City-owned housing will lower tenant energy burdens.
Is it cost-effective?	Potentially high depending on the terms of financing.
Is it in the City's jurisdiction?	Yes.
GHG Synergies	Reduces the electricity capacity requirement and helps integrate renewable sources of electricity.
Avoidances	Misaligning energy efficiency with renewable energy resources and grid integration.
Co-benefits	Energy cost savings to taxpayers and tennants of City-owned housing.
Existing Commitments	Ola

Approximately 3% of Oʻahu's electricity demand is from municipal buildings, City services, and facility energy use. The City can pursue cost-effective retrofits of buildings and operations by entering into energy savings performance contracts (ESPC), a public-private partnership with an energy service company (ESCO). The ESPC provides the upfront investment for energy efficiency retrofits and assumes the technical and performance risks associated with the building improvements. An ESCO can help the City find, design, and implement energy conservation and renewable energy opportunities at City facilities that will be paid back through savings in energy bills.

The City has already successfully entered into several ESPCs in the past, including an island-wide LED retrofit of 53,500 streetlights, the installation of solar PV at the Kailua Wastewater Treatment Plant for the Department of Environmental Services, and a department-wide energy efficiency program for the Board of Water Supply (BWS). In addition to installing on-site solar PV systems, BWS is also pursuing opportunities to support integration of renewable energy in collaboration with Hawaiian Electric. The BWS pilot project is testing communication and integration protocols with the operation of a sample of BWS water systems to see if existing assets can be used to achieve desired changes in energy demand and load shifting. This program could provide lessons that the City could apply to other operations.

Energy savings would also ease the utility burden for occupants of City-owned public housing properties. The City owns and operates, or is finalizing acquisition of, a total of 2,508 affordable rental housing units. The aim of these properties is to help meet affordable housing needs. Electricity costs can be a burden on tenants, where a 10% savings for the average resident would result in an annual savings of $180 per year.[31] The City should be sure to design these investments in building energy efficiency retrofits such that the energy cost savings accrue directly to tenants.

[31] Presented in Action 20 and calculated based on the work incorporated into the Ola: O'ahu Resilience Strategy.

Table 13: Actions That Will Support Strategy 6

Actions	Additional details
6.1 Retrofit City buildings, facilities, and operations to be more energy efficient.	The City will complete City-wide energy efficiency retrofits, identifying new opportunities for energy efficiency and conservation. The City can continue to pursue retrofits through ESPCs as a way to make implementation more achievable from a cost perspective. Initial estimates suggest that the City could achieve up to a 50% reduction in electricity consumption for facilities covered by these ESPCs, though final outcomes are still to be determined.
6.2 Leverage City rooftops, parking lots, and other previously developed lands to increase on-site and City-owned renewable energy generation by 200%.	The City will continue to identify low-impact locations for deployment of renewable energy production and storage, such as over parking lots, rooftops, and retired landfills. Preference will be given to projects that maximize co-benefits while limiting competing uses in urban green spaces; for example, providing shade over parking lots. Utilizing already developed space alleviates pressure on valuable agricultural land, habitats, and rural communities. The Hawaiʻi Brightfields Initiative identifies previously developed, disturbed, or contaminated lands that are suitable for renewable energy development.[lxxxii] The City can pursue renewable energy development through ESPCs in order to make implementation achievable from an up-front cost perspective.
6.3 Continue to pilot and implement flexible energy demand response programs for City operations.	Water pumping is a flexible source of energy demand, which can be leveraged to integrate intermittent sources of renewable energy. By engaging in meaningful demand response programs with Hawaiian Electric, as well as encouraging pricing structures that incentivize such engagement, the City's energy usage can contribute to providing grid services that support overall decarbonization of Oʻahu's electricity sector.
6.4 Facilitate and invest in energy efficiency for City-owned housing.	Though possible to bundle into an ESPC, it is most important that energy savings accrue to tenants to lower their electricity cost burden. The City will first facilitate investment through partnership with Hawaiʻi Energy but will likely also have to finance some of the up-front costs.

Strategy 7

Expand Renewable Energy Planning and Expedite Permitting

GHG reduction potential?	Up to 76 MMTCO2 Eq., attributing all GHG reductions from the power sector between 2020-2045, assuming PSIP pathway is met.
Is it equitable?	It depends, requires rate restructuring.[32]
Is it cost-effective?	High — this strategy has the largest GHG reduction potential while renewable energy costs are declining rapidly.
Is it in the City's jurisdiction?	Partially, through permitting.
GHG Synergies	Supports low carbon electrification of transportation.
Avoidances	Competing land uses, negative impacts to communities and habitat impacts.
Co-benefits	More stable electricity rates through long-term contracts.
Existing Commitments	

The City in 2012 made great strides in streamlining the permitting process for residential rooftop solar PV. The online permitting processing provides for fast approvals of routine residential projects. Similar strides could also be made for commercial, multifamily, and townhome rooftops, and distributed battery storage. This action would support implementation of the utility's power supply improvement plan (PSIP), which assumes building three and half times more distributed solar PV than currently exists. This means having solar PV on the vast majority of rooftops. As such, rooftop and land-based solar PV are not substitutes to achieving the goal of 100% renewable sources of electricity but rather both are required.

Though renewable energy is a much "greener" way of producing electricity than fossil fuels, it still has a range of land, habitat, and community impacts.[lxxxiii] The 27.6 MW Wai'anae Solar farm, situated on 198 acres of land, is currently the largest utility-scale solar project in the state. Meeting the goals of the PSIP means building approximately 75 more projects akin to the Wai'anae Solar farm by 2045. Assuming the same land use intensity as Wai'anae Solar for these projects would require approximately 14,000 acres of land.

Achieving the GHG emissions reductions of the PSIP also assumes a 330% increase in wind energy. In order to meet these renewable energy goals, the City must work proactively with communities and installers to site projects in the right places. This involves advocating for benefits and compensation for the residential communities that host a disproportionate share of our renewable energy infrastructure. It also involves recognizing where wind farms were sited without the full support of nearby residents, or where projects have led to fatalities of the endangered ʻōpeʻapeʻa (Hawaiian Hoary Bat). The California Desert Renewable Energy Conservation Plan (DRECP) provides a good example of proactive collaboration among multi-jurisdiction government agencies,conservation and energy professionals, tribal and nearby communities, to inform siting of large-scale renewable energy projects. The plan is intended to provide habitat and natural resource protection, preservation of recreational areas, scenic values, cultural and historic resources.[lxxxiv]

[32] With current rate structures, based on the average cost of electricity provision, any grid or load defection from distributed technologies that are behind the meter, push cost onto other rate payers. People who have the ability to invest in distributed technologies tend to be homeowners, or relatively higher income earners.

Table 14: Actions That Will Support Strategy 7

Actions	Additional details
7.1 Proactively engage with state partners in land use and community planning for large-scale renewable energy projects and assess City lands and facilities for additional utility-scale energy projects.	The City will add capacity to land use planning and permitting staff and, in the short-term, actively participate in state land use decision-making processes through the Powering Past Coal coalition. In the longer-term, the City will engage with state partners in the development of a coordinated process and plan that creates criteria for renewable energy and land use using the California DRECP as an example. Though 64% of island-wide survey respondents said that GHG reduction is a positive outcome of renewable energy development, 23% said that community impacts, 28% habitat or species impacts, 30% visual impacts and 38% potential rate increases, were negative outcomes. Amongst respondents, the negative effect in regard to habitat and species impacts as well as visual impacts was significantly stronger for those outside the primary urban center and East Honolulu. This is perhaps the most valuable City action from the perspective of GHG reduction potential.
7.2 Streamline permitting for solar PV (including distributed battery technologies) on commercial, multifamily, and townhome rooftops through use of online platforms.	Permitting will target connections for uncomplicated rooftop projects (i.e., not in the Special Management Area or a project that triggers Environmental Assessment), similar to the existing online permitting system for residential projects. The process will include the same standards of review and inspections.
7.3 Continue to advocate before the PUC for fair and efficient regulation around the renewable energy transition.	Following up on its intervention in the pioneering Performance-Based Regulation investigatory proceeding before the Public Utilities Commission, the City will continue to advocate before the PUC on matters of utility regulation and system-wide renewable energy transformation. Aligning utility and third-party investments in the electric grid with public policy priorities will become increasingly important as we pursue the simultaneous electrification of the vehicle fleet and overall decarbonization of the economy.
7.4 Launch a Solarize O'ahu pilot to increase residential solar access for low- to moderate-income households.	"Solarize" campaigns aim to improve solar access for residents with low- to moderate-income by leveraging a strategy of community bulk-purchasing to reduce costs and address outreach barriers. By leveraging economies of scale and eliminating marketing costs for solar providers, they can reduce rooftop PV system costs by about 20% for residential participants. The Solarize Kaua'i project was able to use a $5,000 grant to install rooftop solar on 180 homes in Kekaha, helping kupuna and longtime residents offset disproportionate energy cost burdens. The City will partner with trusted community-based organizations and leaders to deliver solar PV to O'ahu residents through a Solarize pilot.

> **Renewable energy will lower our bills, reduce pollution, and create jobs** — but finding the right sites paired with the right technologies for our resilient energy future will require deep collaboration with communities, the City, and the state.

Shelee Kimura
Hawaiian Electric

Strategy 8

Promote Waste Prevention

GHG reduction potential?	0.1 MMTCO2 Eq. from H-POWER, though net GHG emissions unknown. Primarily to GHG emissions outside of O'ahu from production and recycling.
Is it equitable?	It depends on the relative cost of materials and how these costs are passed on to households with low income.
Is it cost-effective?	Cost-effective to the extent that there are readily available and cost-comparable low carbon material substitutes.
Is it in the City's jurisdiction?	The City manages waste disposal and has the authority to limit the use of harmful materials, like single-use plastics, but waste prevention from all sources will also require collaboration with the private sector.
GHG Synergies	In the long term, a reduction in GHG emissions from waste-to-energy.
Avoidances	In the near term, waste-to-energy is an important firm source of electricity so reducing output can result in fossil fuel burning.
Co-benefits	Considerable local environmental benefits, particularly from products that do not biodegrade.
Existing Commitments	

Preventing waste by stopping it at the source is often considered one of the most important solid waste management practices for minimizing environmental damage. Waste prevention includes reusing or donating items, buying in bulk, reducing packaging, redesigning products, and reducing toxicity.[lxxxv] Purchasing and handling products according to these principles can result in source reduction with associated GHG benefits. The City has established a goal to reduce per capita waste generation by 25% by 2030. Current waste reduction efforts by the City focus on providing public education to increase awareness of existing source reduction resources and encourage residents and businesses to prevent waste at the source. In the island-wide survey, 33% of respondents stated they are willing to pay a fee based on the amount of trash they produce.[33]

However, because the City already diverts most MSW from the landfill (93% in 2018) to recycling facilities and H-POWER, reducing per capita waste generation will have limited impact on waste sector emissions (as measured in a sector-based GHG inventory). H-POWER provides a baseload source of electricity and is classified as a renewable source of energy under the State RPS. However, H-POWER is also responsible for 5.5% of O'ahu's emissions from electricity generation. To realize these emissions reductions requires reconceptualizing the current minimum tonnage terms of the City's contract with the H-POWER operator upon renegotiation, such that source reduction is encouraged rather than penalized. However, renegotiation must also be taken in consideration with available renewable energy technologies on the grid.

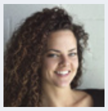
The City has an opportunity to further reduce waste stream GHG emissions through its own consumption by developing a low GHG materials practice within procurements. Developing a low GHG procurement policy for City operations has the potential to reduce emissions along the entire lifecycle of products from material extraction to end-of-life waste processing.

33 Respondents said on average $38 was a reasonable price to pay for weekly trash pick-up (median was $10).

Table 15: Policies That Will Support Strategy 8

Actions	Additional details
8.1 Continue to eliminate single-use plastics and expand multiple-use foodware and serviceware in food distribution and sale.	As substitute products become more available, continue to phase out single-use plastics and polystyrene. This effort will build on the collaboration among stakeholders that led to the passage of Ordinance 19-30 (2019) that limits the use of single-use plastics in grocery stores and other food retail. Support efforts for multiple-use containers in food distribution and sale.
8.2 Establish a Sustainable (Low GHG) Procurement Policy for the City.	There are many examples of sustainable procurement policies. The Australian government provides a strong list of criteria.[lxxxvi] A sustainable procurement policy will reduce O'ahu as well as upstream emissions associated with production of imported goods and materials. This will serve as a starting point for considering carbon pollution reduction as a factor in all City decision-making.
8.3 Strengthen infrastructure and partnerships for edible food recovery.	The City will support food waste reduction by engaging with food generators to expand and track the recovery of edible food and distribution to those in need and invest in storage, collection and distribution facilities, vehicles, and equipment.
8.4 Advance development of a volume-based residential refuse pickup program that appropriately prices refuse pickup services for customers.	33% of island-wide survey respondents were willing to pay a fee for curbside trash pickup, where it could be reduced based on waste reduction. 21% didn't know. The viability of a pay-as-you-throw program has been studied by the City and recommended for action. This would make O'ahu the second island in Hawai'i to adopt this kind of program, after Kaua'i. Implemented in 2015, Kaua'i's households pay $18/month for a 96 gallon trash can and $10/month for a 32 gallon trash can. Per concern voiced by virtual open house participants, considerations should also be made regarding mitigation of illegal dumping.
8.5 Expand the location of public drinking water fountains and retrofit existing public drinking fountains to include devices capable of refilling reusable water flasks, cups and containers.	All new water fountains will be designed to enable easy bottle filling.
8.6 Establish a building deconstruction reuse and recycling program; enable reuse, recycling, and repair systems.	While buildings, especially historic buildings, should be preserved where possible, when necessary, buildings can be dismantled and salvaged to enable reuse and recycling. A building deconstruction program could incentivize or require that applicants show a deconstruction estimate before qualifying for a deconstruction permit. Additionally, opportunities for reuse, repair, and donation should be supported and expanded through programs like a grant for reuse / repair startups or expanded bulky item pickup. The City could increase public awareness around these opportunities by creating educational resources via a website.
8.7 Develop end-of-life requirements for solar PV and other relevant renewable energy technologies, including battery storage.	Residential solar panels can currently be disposed of through "metals" bins for recycling; however, additional requirements that ensure landfill diversion (for example, manufacturer take-back requirements) and optimal reuse are important with new technologies.

We've worked hard at Kamehameha Schools to implement waste diversion strategies as stewards of ʻāina on behalf of current and future generations of keiki. We continue to learn and improve alongside other businesses and the City to transition O'ahu to zero waste.



Amy Brinker
Kamehameha Schools

Strategy 9

Maximize Waste Resource Efficiency

GHG reduction potential?	0.6 MMTCO2 Eq. (cumulatively between 2020-2045) for methane capture, only if it replaces other fossil fuel energy. Zero otherwise.
Is it equitable?	Only if cost-effective and serves to reduce GHGs.
Is it cost-effective?	Potentially high for methane capture when used to produce renewable energy, depending on the financing structure.
Is it in the City's jurisdiction?	Yes.
GHG Synergies	As an energy efficiency measure.
Avoidances	Methane leakage.
Co-benefits	City energy cost savings.
Existing Commitments	Ola

The act of disposing of material goods generates greenhouse gas emissions at the end of products' lives. The transportation of waste and recycling processes both require significant energy inputs; wastewater treatment plants and landfills also generate methane emissions. Because there are no recycling facilities on the island of Oʻahu, the City's current recycling program — which covers almost 90% of single-family homes on Oʻahu — involves shipping recyclables overseas or burning them to generate electricity at H-POWER. While waste source reduction can minimize the need for disposal, repurposing remaining waste can reduce both upstream and end-of-life emissions.

For example, methane produced at Oʻahu's landfill and municipal wastewater plants could be more productively repurposed as a waste-to-energy resource. Current practices call for flaring this methane, thus converting it to carbon dioxide that is accounted for as biogenic emissions from organic matter. Using this methane for waste-to-energy, instead, would be GHG reducing (rather than neutral) as long as it offsets other fossil fuel resources servicing City electricity demand.

The City can also continue to leverage its organic waste to produce renewable fuels. For the past 15 years, the City has reduced emissions and lowered fuel taxes by using nearly 3.6 million gallons of locally produced biodiesel in its fleet of vehicles, including nearly 1,000 pickup trucks, dump trucks, ambulances, and garbage trucks. The City also operates a biogas project in collaboration with Hawaiʻi Gas at the Honouliuli Wastewater Treatment Plant. The $5M project produces enough raw biogas annually to fuel nearly 1,000 passenger cars for a year. A similar project could be expanded to the Sand Island Wastewater Treatment Plant that has the potential to generate twice as much biogas annually and offset 0.6 MMT CO2 cumulatively by 2045.

Another productive byproduct of wastewater treatment is organic fertilizer (via a pelleted bio-solid) that is used for City landscaping. This fertilizer can be dried using solar energy or on-site methane to displace demand for other petroleum-based fertilizers.

Finally, food waste is another common yet low-efficiency input to H-POWER for energy. The City currently publishes educational materials on proper composting, which can be better circulated through broader food waste management programs. Food waste could also be processed by anaerobic digestion or aerobic composting, which create products that local farms can use to increase the organic content of their soil while limiting the use of fertilizers made from fossil fuels.

Table 16: Policies That Will Support Strategy 9

Actions	Additional details
9.1 Implement methane collection systems at landfill and wastewater treatment facilities, where feasible, that would allow the City or others to benefit from methane capture and reuse.	The process for an ESPC can help determine resource adequacy and cost efficiency. The energy can either be used internally or sold to an off-taker; however, the action will only be GHG reducing if this substitutes rather than adds to sources of GHG-intensive energy. Methane capture is likely feasible at larger wastewater treatment facilities and should start with Sand Island, the largest facility on O'ahu. There is opportunity to incorporate learning from the Honouliuli project.
9.2 Explore the feasibility of adding an anaerobic digester capacity or other resource recovery project to the City's solid waste and wastewater processing and treatment infrastructure.	There are multiple technologies and processes for anaerobic digestion; for example, research includes consideration for the role of biochar. Anaerobic digesters could expand upon current operations at wastewater treatment facilities, as well as be stand alone. The output is both energy (ideally for on-site City usage) and the creation of soil amendments to support local agricultural practices.
9.3 Based on lifecycle GHG analysis, assess the benefits of flow of materials to out-of-state recycling instead of H-POWER.	Study feasibility of multiple alternatives for reducing GHG emissions associated with long distance transportation of recyclables versus utilizing low-value recyclables locally as renewable energy at H-POWER. Choosing these alternatives should be based on lifecycle GHG analysis, including transportation and GHGs created during the recycling or reuse process, in comparison to the waste-to-energy process. Future recycling and waste management decisions will be made on the basis of minimizing greenhouse gas emissions.
9.4 Explore new public-private partnerships to increase the diversion of food and other organic materials from the waste stream through composting and/or other solutions.	Composing facilities that maximize aerobic conditions greatly minimize emissions from food waste compared to the landfill. In addition, using compost as a nutrient-rich soil amendment can have additional GHG benefits by reducing the need for chemical fertilizers and promoting carbon sequestration.

Implementation & Next Steps

Climate change presents severe threats to communities and ecosystems in Hawaiʻi and across the globe. Avoiding the most catastrophic impacts requires restructuring fundamental systems, from electricity provision to transportation networks. This section lays out the 2020-2025 plan – the first five years of this CAP — for implementing the nine decarbonization strategies. Within these years, the City will also be prepared to react to changing conditions and new technological advancements.

The City commits to three guiding principles in implementing these climate actions, which emphasize 1) taking an equitable and inclusive approach, 2) devoting adequate funding and capacity to see actions through, and 3) adopting an ongoing process that is adaptive and transparent.

To have the most benefit for Oʻahu's people, these opportunities for climate action must support an equitable transition away from today's GHG-intensive systems. From stronger storms to stresses on aging infrastructure, climate change compounds the existing economic challenges our island residents face. Through implementation of this CAP, the City will find opportunities to maximize co-benefits, prioritizing those actions that serve to lower our carbon emissions and simultaneously secure a more affordable future.

In 2019, CCSR hired a Climate Resilience and Equity Manager to support this focus, and to deepen City connections to existing community-based climate action efforts. Implementation of this CAP cannot be done by the City alone, and the City is committed to finding opportunities to partner with community organizations and seek federal funding for implementation of actions to support and enhance existing local efforts to achieving our collective climate goals.

To keep the City on track with its 2025 goal for 45% emissions reductions from 2015 levels, each action is presented with a start date as well as a measurable metric to assess performance.

Table 17: Guiding Principles for Implementation

Principle	Measure	Additional details
A. Center environmental and economic justice in implementation.	A.1 Convene a set of community ambassadors to advise on plan implementation.	Convene, on a regular basis, a multi-cultural, cross-sector set of community leaders who represent frontline communities whose experiences can offer the City unique insights into how to maximize benefits from, and equitable implementation of, the CAP.
	A.2 Design and implement an equity decision-making framework to guide City implementation of actions and tracking of results.	An equity decision-making framework can be used to improve how implementation of climate actions will leverage co-benefits, reduce historical disparities in outcomes, engage and empower communities through capacity building and partnership, support workforce development, and increase accountability of actions through reporting.
	A.3 Offer training on innovative and online public engagement, facilitation, cultural relevancy, and social and economic justice to staff working on plan implementation.	COVID-19, as well as the recent reckoning of a collective national history of systematic racial injustice, has increased the need for government to be creative and bolder in outreach strategies to better shape policies, actions and programs with community. The City can better leverage existing tools or expand access to new training opportunities for City staff working to implement the diverse actions in this plan.
B. Build capacity across City departments for implementation.	B.1 Continue cross-departmental coordination to manage actions and prioritize appropriate budget and staffing for implementation.	Successful implementation of the CAP will require allocation of specific financial and administrative capacity. Some capacity can be achieved through cross-departmental coordination, such as through the existing City Resilience Team meetings among department leadership, and collectively leveraging existing City funds for implementation in annual budget processes. Several new positions are highlighted as needs in this CAP.
	B.2 Seek out grants to leverage limited City funds.	The City can build on success to date in bringing in external funds from international, national, state, or philanthropic resources.
C. Cultivate an ongoing, adaptable, and transparent process.	C.1 Report on progress annually and update the City's CAP every five years.	There must be regular reporting on, and discussion of, progress of the CAP to community - formalized on an annual basis through the City's Annual Sustainability Report. The City will update the CAP every five years to ensure progress toward long-term goals, as well as adapt to changes in technology, finances, and community priorities.
	C.2 Provide online, interactive ways for community to see progress.	Create a digital version of CAP strategies and actions where progress can be tracked, and actions amended as lessons are learned. This could be done as part of the CCSR's energy dashboard under development.
	C.3 Increase public awareness, education resources, and partnerships for climate action and CAP implementation.	While this CAP positions the City to lead in meeting O'ahu's GHG reduction goals, we will rely on continued innovation from and partnerships and collaboration with the private sector, nonprofits, community-based organizations, and residents. The City will continue to expand partnerships and proactively seek opportunities to dialogue with community about how residents can take action, accelerate CAP implementation, or get involved with and improve future plan updates.

Table 18 summarizes the climate actions prioritized by this plan. The Timeline represents when the action will be initiated and its duration over the 2020-2025 time period. Many actions will be ongoing past 2025. Lead & Implementing Partners identify the many collaborators necessary to make good on this CAP (City and State agency acronyms are listed at the end of this CAP). To implement actions requires collaboration between City departments as well as with State agencies and non-governmental partners. This includes parties like the electric utility (Hawaiian Electric), public utilities commission (PUC), the state energy-efficiency provider Hawai'i Energy, Biki and other shared mobility providers. These collaborations are important to ensuring that City actions indeed lead to GHG emissions reductions. The City lead is shown in bold. Lastly, the Progress Indicator identifies metrics by which to assess success.

Table 18: Climate Actions with Implementation Approach

47 City Climate Actions, 2020-2025	Timeline for Action	City Lead and Implementing Partners	Progress Indicator(s)
1. Encourage Density and Mixed Land Use in Strategic Areas			
1.1 Continue to adopt policies that support greater housing affordability located near transit and in areas in proximity to job centers and key destinations	2020-2025	**DPP**, HOU, DLM, OER	Adoption of TOD Plans; Number and share of affordable housing units to total units in PD-T, IPD-T, and 201H projects developed in TOD areas
1.2 Continue revising the City's land use and zoning regulations to allow for mixed-use development across O'ahu to support "complete communities"	2020-2025	**DPP**	Changes in Land Use Ordinance
1.3 Work with private sector to provide connectivity and streetscape infrastructure in new developments to support complete streets principles	2020-2025	**DTS**, DPP, DDC, DFM	Share of new developments with improved connectivity and streetscape amenities

2.	Enable & Provide Multiple Modes of Green Transportation			
2.1	Implement the O'ahu Bike Plan and continue to build out protected bikeways for all ages and abilities with safe connections between existing bike lanes.	2020-2025	**DTS,** DDC, DFM, BFS	Miles of bikeways, bike counts
2.2	Develop a City-focused Transportation Demand Management Program, including updating the telework policy.	2020-2021	**DTS,** DPP, CCSR	Program studied and launched, filling a Parking Program Manager position, number of commutes reduced
2.3	Complete the O'ahu Pedestrian Plan and implement high priority pedestrian projects.	2020-2025	**DTS,** DDC, DFM, BFS	Miles of new walkways, corridor pedestrian safety improvements, number of crossing pedestrian safety improvements
2.4	Plan and plant trees as part of roadway rehabilitation projects to provide shade for pedestrian, bicycle and transit infrastructure and promote comfort for frequent trips.	2020-2025	**DTS,** DDC, BFS	Number of urban trees planted in strategic areas
2.5	Repurpose general travel and parking lanes for multimodal and active transportation use.	2020-2025	**DDC,** DPR, DPP, DFM, BFS	Miles of repurposed vehicle lanes, bike and pedestrian counts
2.6	Increase non-vehicular mode share in new multi-family housing and commercial developments through TDM programs.	2020-2023	**DTS,** DPP	TDM program created
2.7	Identify candidate projects and develop dedicated bus lanes along high-occupancy transit corridors.	2020-2024	**DTS,** DDC, DFM	Priority areas identified with at least one major route complete
2.8	Launch integrated transit fare card (Holo) to include a fare-capping program for relevant daily, monthly, and annual rates.	2021	**DTS,** Rate Commission, BFS	New fare and caps developed and offered, number of program participants
2.9	Hire a Mobility Manager to leverage opportunities to increase micromobility services.	2021-2022	**DTS,** DPP, CCSR	Identify and launch micromobility options, number of trips
2.10	Create a universal trip planning and fare app to improve the connectivity of multimodal transportation options.	2022-2025	**DTS,** DIT	App developed and launched, number of users tracked
2.11	Seek innovative business solutions to deliver VMT reduction services.	2020-2025	**DTS**	Number of solicitations and awards, public-private partnerships established, VMT-reducing programs implemented

3.	**Encourage Mode Shift through Parking Efficiency**			
3.1	Allow for flexibility in the provision of parking by eliminating minimum off-street parking requirements.	2020-2021	**DPP,** DTS	Change in Land Use Ordinance
3.2	Encourage unbundling of the sale or rent of multi-dwelling housing units from parking in TOD and other suitable neighborhoods.	2020-2024	**DPP**	Change in Land Use Ordinance
3.3	Develop curb management systems within TOD and other high-demand areas.	2023-2025	**DTS,** DPP, DDC, DFM, DIT, HPD	Study developed and pilot implemented
3.4	Efficiently manage and price public parking at City-owned lots and parking spaces with high transportation alternatives and implement dynamic metering rates.	2023-2025	**DTS,** DFM, DES, DPR, BFS	Study developed and pilot implemented
3.5	Repurpose underutilized public parking in preference to multimodal transportation infrastructure, urban greenery, and public-serving spaces.	2020-2025	**DTS,** DPP, DFM, DES, DPR	Number of underutilized parking spaces converted
4.	**Electrify the City Fleet & Support High Efficiency Vehicles**			
4.1	Develop and adopt an electric bus purchasing policy for the City's bus fleet to reach 100% renewable-powered City fleet goal by 2035.	2020-2022	**DTS,** BFS, DDC, HSEO	Bus purchasing policy updated, share of fleet that is electric
4.2	Develop a plan and implement City passenger vehicle fleet transition to achieve 100% clean fleet goal by 2035.	2020-2025	**DFM,** DTS, BFS, DDC, HSEO	EV purchasing and ride share policy developed, share of City vehicles (excluding buses) that are EVs
4.3	Develop, for EV buses and other City-owned EVs, charging protocols such that it facilitates integration of intermittent renewable energy.	2021-2022	**DDC,** DTS, DFM, CCSR, BFS, HSEO, Hawaiian Electric	Renewable energy used for charging relative to the grid at large
4.4	Expand EV charging infrastructure for the City EV fleet by tripling public charging capacity on City facilities; enable electricity cost recovery.	2021-2025	**DDC,** DFM, DPR, HPD, HFD, BFS, Hawaiian Electric	Number of public chargers on City land, percent of public chargers on City land with fast-charging capabilities; number of City EVs supported by added charging infrastructure
4.5	Provide private car sharing with high fuel efficiency vehicles priority access parking to enable point-to-point service in high usage areas.	2021-2022	**DTS,** DPP, DFM, DES	Available high fuel efficiency car sharing vehicles

5.	**Reduce Energy Demand by Increasing Energy Efficiency**			
5.1	Put in place a system to regularly update relevant building code ordinances, adopt state codes as required, and consider adopting further local standards to reduce greenhouse gas emissions over time.	2023	**DPP,** CCSR, HSEO	Ordinance update
5.2	Develop a "lead by example" municipal energy and water benchmarking program for covered City facilities along with data transparency, reporting, and building performance standards. Develop internal and publicly-available dashboard with energy and water data reporting protocols.	2021-2022	**CCSR, DPP**	Necessary ordinances and bills passed
5.3	Develop a building energy benchmarking program, building performance standards, and transparent reporting mechanisms for large covered commercial and multi-family buildings.	2022-2023	**CCSR,** DPP, Hawai'i Energy, HECO, HPUC	Necessary ordinances and bills passed
5.4	Deploy a Healthy and Resilient Buildings program in response to COVID-19.	2020-2021	**CCSR,** DPP, DDC, Hawai'i Energy, HNEI, Hawaiian Electric	Ordinance adoption for Energy Efficiency Coordinator and implementation of first phase audits and installations using CARES Act and State mandated ratepayer funds
6.	**Maximize Energy Efficiency and Renewable Energy throughout City Operations and Assets**			
6.1	Retrofit City buildings, facilities, and operations to be more energy efficient.	2020-2023	**DDC,** DPR, BFS, CCSR, ESCO	kWh towards a 50% reduction by 2025 in electricity consumption for facilities covered by ESPCs, as reported by the City utility bill
6.2	Leverage City rooftops, parking lots, and other previously developed lands to increase on-site and City-owned renewable energy generation by 200%.	2020-2025	**DDC,** DFM, DPR, ENV, DLM, BFS, CCSR, HSEO, Hawaiian Electric	MW of renewable energy installed on City lands
6.3	Continue to pilot and implement flexible energy demand response programs for City operations.	2020-2025	**DDC,** DFM, BWS, DTS, Hawaiian Electric, PUC, BFS	Demand response program developed, rates established
6.4	Facilitate and invest in energy efficiency for City-owned housing.	2022-2025	**DLM,** DFM, BFS, Hawai'i Energy	Number of impacted units, kWh energy consumption reduction

7.	Expand Renewable Energy Planning and Expedite Permitting			
7.1	Proactively engage with state partners in land use and community planning for large-scale renewable energy projects and assess City lands and facilities for additional utility-scale energy projects.	2021-2025	**DPP,** CCSR, BWS, PUC, BFS, Hawaiian Electric, Independent Power Provdiers, HSEO, DLNR, DOA, OP, U.S. Fish and Wildlife Service	Land use planning and permitting staff hired; coordinated action with state on land use planning for utility-scale renewable energy projects, with an emphasis on habitat and community mitigations
7.2	Streamline permitting for solar PV (including distributed battery technologies) on commercial, multifamily, and townhome rooftops through use of online platforms.	2020-2023	**DPP,** HSEO	MW of renewable energy permitted through online platform
7.3	Continue to advocate before the PUC for fair and efficient regulation around the renewable energy transition.	2021-2025	**CCSR,** PUC	Number of proceedings formally and informally participated in
7.4	Launch a Solarize Oʻahu pilot to increase residential solar access for low- to moderate-income households.	2020-2022	**CCSR,** Homestead Community Development Corporation, DHHL	Number of rooftop PV systems installed through campaign
8.	Promote Waste Prevention			
8.1	Continue to eliminate single-use plastics and expand multiple-use foodware and serviceware in food distribution and sale.	2021-2023	**ENV,** CCSR	Updated Ordinance regarding single-use plastics
8.2	Establish a sustainable (Low GHG) procurement policy for the City.	2021	**CCSR,** BFS, DFM, DDC, DTS	Policy developed and adopted
8.3	Strengthen infrastructure and partnerships for edible food recovery.	2020-2025	**CCSR,** ENV	Public-private partnerships established, additional waste prevention
8.4	Advance development of a volume-based residential refuse pickup program that appropriately prices refuse pickup services for customers.	2022-2024	**ENV,** BFS	Establish program guidelines
8.5	Expand the location of public drinking water fountains and retrofit existing public drinking fountains to include devices capable of refilling reusable water flasks, cups, and containers.	2022	**DFM,** DPR, DES, HPD, HFD	Establishment of a new City Standard and Specification mandating reusable water flask, cup, or container refilling capability for all new and replacement public drinking fountains in all City facilities
8.6	Establish a building deconstruction reuse and recycling program; enable reuse, recycling and repair systems.	2021-2025	**ENV,** DPP, CCSR	Program development, ton of reusable materials diverted to reuse facilities, launching of an online map resource showing location of reuse and repair facilities
8.7	Develop end-of-life requirements for solar PV and other relevant renewable energy technologies, including battery storage.	2024-2025	**ENV,** DPP, DOH	End-of-life requirements developed and additional options for disposal established

9.	Maximize Waste Resource Efficiency			
9.1	Implement methane collection systems at landfill and wastewater treatment facilities, where feasible, that would allow the City or others to benefit from methane capture and reuse.	2020-2023	**ENV**, BFS, CCSR	ESPC awarded if viable, methane captured for energy
9.2	Explore the feasibility of adding an anaerobic digester capacity or other resource recovery project to the City's solid waste and wastewater processing and treatment infrastructure.	2022-2023	**ENV**, BFS, DOH	Study completed with recommendations, possible changes to Ordinance 9-3.5.
9.3	Based on GHG lifecycle analysis, assess the benefits of the flow of materials to out-of-state recycling instead of H-POWER.	2021-2022	**ENV**, CCSR	Study completed and recommendations implemented
9.4	Explore new public-private partnerships to increase the diversion of food and other organic materials from the waste stream through composting and/or other solutions.	2022-2025	**ENV**, CCSR	Percent of food and organic waste diverted; volume received at composting facilities

List of Acronyms

AFOLU	agriculture, forestry and other land use
AV	autonomous vehicle
CAFE	Corporate Average Fuel Economy (standards)
EPA	Environmental Protection Agency (U.S.)
EV	electric vehicle
ESCO	energy service companies
ESPC	energy service performance contract
GPC	Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories
GHG	greenhouse gas
HWWTP	Honouliuli Wastewater Treatment Plant
HDV	heavy-duty vehicle
IPPC	Intergovernmental Panel on Climate Change
IPPU	industrial processes and product use
kWh	kilowatt hour
MMTCO2 Eq.	million metric tons carbon dioxide equivalent
MSW	municipal solid waste
MTCO2 Eq.	metric ton carbon dioxide equivalent
MW	megawatt
NHTSA	National Highway Safety Administration (U.S.)
OahuMPO	Oʻahu Metropolitan Planning Organization
PPM	parts per million
PSIP	power supply improvement plan
PUC	Public Utilities Commission
RPS	renewable portfolio standard
SAFE	Safer Affordable Fuel Efficient (Vehicle Rules)
Solar PV	solar photovoltaic
SIWWTP	Sand Island Wastewater Treatment Plant
TOD	transit-oriented development
VMT	vehicle miles traveled

City & County of Honolulu Departments

BWS	Board of Water Supply
BFS	Department of Budget and Fiscal Services
CCSR	Office of Climate Change, Sustainability and Resiliency
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DLM	Department of Land Management
DPR	Department of Parks and Recreation
DPP	Department of Planning and Permitting
DTS	Department of Transportation Services
ENV	Department of Environmental Services
HART	Honolulu Authority for Rapid Transportation
HOU	Office of Housing

State of Hawaiʻi Agencies

DBEDT	Department of Business, Economic Development and Tourism
DLNR	Department of Land and Natural Resources
DOA	Department of Agriculture
DOT	Department of Transportation
HNEI	Hawaiʻi Natural Energy Institute, University of Hawaiʻi at Mānoa
HSEO	Hawaiʻi State Energy Office
OP	Office of Planning

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