Hawaiʻi Energy Security and Waste Reduction Plan FINAL

A Plan to Increase Hawaiʻi's Energy Security and Access Options, and Reduce Emissions in the Transportation Sector 2025-2029

Hawaiʻi Department of Transportation

October 15, 2025

Executive Summary

As an island chain experiencing severe coastal erosion, wildfire, drought, flooding, rockfall, and frequent storms and being 2,400 miles from the continental United States, Hawaiʻi has a critical need to strengthen its energy security and community resilience. The State of Hawaiʻi Department of Transportation (HDOT) recognizes its responsibility to provide a sustainable and equitable transportation system. This commitment is reflected in HDOT's mission statement "*To provide a safe, efficient, accessible, and sustainable inter-modal transportation system that ensures the mobility of people and goods and enhances and/or preserves economic prosperity and the quality of life.*" A sustainable and just intermodal transportation system is one that is largely powered by clean and locally sourced power, including electricity fueled by renewable energy, low-carbon fuels, and people walking or rolling. HDOT also recognizes that Hawaiʻi's quality of life noted in HDOT's mission is dependent on a healthy environment.

Background

To serve this goal, HDOT has developed a plan for reduction of transportation-related greenhouse gas (GHG) emissions in the state. This Energy Security and Waste Reduction Plan ("Plan" or "Energy Security Plan") is written to fulfill the requirements of the Navahine Settlement Agreement and of State statutes, including Hawaiʻi Revised Statutes (HRS) § 225P-5, establishing the 2030 and 2045 statewide emissions reduction targets; HRS § 225P-7, calling for the decarbonization of the transportation sector; HRS §196-9-c-11, requiring all State agencies to plan for all State fleet passenger cars to be zero-emission vehicles by 2030 and all light-duty State fleet vehicles to be zero-emission vehicles by 2035; and HRS § 225P-8, establishing the statewide goal of zero emissions across all transportation modes, including across the sectors of (1) Ground transportation and (2) Sea and air interisland transportation. The Plan sets out to chart a course to comply with the state law targets to reduce GHG transportation emissions 50 percent by 2030 (from 2005 levels) and achieve net-negative transportation emissions by 2045, meaning that Hawaiʻi's transportation sector removes more carbon from the atmosphere than it emits and will thus support broader climate goals including carbon sequestration.

Process

The Plan uses a "baseline scenario," which refers to the estimated quantity of GHG emissions that would be released into the atmosphere in the years leading up to 2045 assuming the strategies outlined in the Plan were not implemented. The impact of GHG mitigation strategies is quantified as reductions against the baseline scenario versus as a comparison to a prior "base year," with the understanding that such quantifications are projections that will be continually revised and updated when additional data are available, and alongside the Plan updates. Current total Hawaiʻi transportation-related emissions in 2025 are estimated at 10.7 million metric tonnes per year of carbon dioxide equivalent (CO2e). Based on current policies and programs, transportation-related emissions are projected to decrease annual emissions only to 10.2 million metric tonnes of CO2e by 2045, and therefore the additional strategies identified in this Plan must be implemented to achieve decarbonization requirements, including meeting the terms of the Navahine Settlement Agreement.

HDOT took a commonsense approach to creating this Plan. We recognize both that change is needed AND that change is difficult. For the emission reduction strategies to be supported by the public, approved, and actually implemented, they must not be so economically extreme upon implementation that they make Hawaiʻi unaffordable for its residents, including the Native Hawaiian community. The Hawaiʻi State Legislature has recognized the inequities of the current transportation system, particularly on low-income households and communities. The lack of cheaper and cleaner transportation choices raises the cost of living, impairs safety, and diminishes our quality of life. For example, vehicle ownership in Hawaiʻi (including purchasing and financing, fuel, insurance, depreciation, and maintenance and operation) has been estimated at around $9,000 per vehicle annually. Some suggested emission reduction strategies may provide near-term options to reduce costs for residents; these include better access to bike, pedestrian, and transit infrastructure. Other strategies require a greater upfront investment but are considered to stabilize and reduce transportation costs in the long term.

We must acknowledge the realities of suggested emission reduction strategies on businesses and the market, as well as the indirect effect on consumer prices in our state. To set Hawaiʻi up for long-term success in powering our transportation system in a changing political and physical environment, we must also decrease our dependence on imported energy and food and embrace the growth of local industry. Therefore, we have three pillars for this Plan that act as check and balances to develop and prioritize this Plan's strategies: 1) Emissions Reduction, 2) Energy Security, and 3) Affordability.

Meeting the State's goal of net-negative emissions by 2045 requires eliminating GHG emissions from numerous sources. Therefore, this Plan identifies strategies for all transportation emission sources, large and small, and notes that longer periods of time may be necessary to reduce or compensate for sources that are difficult to decarbonize, such as long-haul aircraft, inter-state and intra-state marine vessels, and legacy light-duty and heavy-duty internal combustion engine (ICE) vehicles and equipment. As with projecting future baseline emission scenarios, it is challenging to predict the future benefits of each strategy with high certainty, and it is therefore not the intent of this Plan to do so. Some strategies will prove to be more effective than estimated here, and some will be less effective. This Plan identifies HDOT's best estimate of the combination of strategies to put Hawaiʻi's transportation sector on a trajectory towards achieving the State's GHG emissions targets. The strategies in this Plan lay the groundwork for Annual Action Plans to be developed in the 2026 revision of this Plan, which will provide updates and adjustments on the specific actions, actors, and timelines to implement each strategy as more is learned.

Recognizing that no single strategy can achieve these goals, the Plan promotes a suite of actions such as scaling up electric vehicles and charging infrastructure, transitioning planes and ships to cleaner fuels, modernizing ports and airports, promoting low-carbon alternatives to vehicle travel, and using the input of stakeholders—including Hawaiʻi's youth—on the implementation of the decarbonization strategies identified in this Plan.

A critical component to many of the strategies, across all modes, is electrification. An early transition from fossil fuels to electricity-powered transportation will require grid modernization and the successful transition to renewable energy sources by the energy sector, as discussed in the Hawaiʻi Pathways to Decarbonization Act 238 Report and required by State law (HRS § 269-92).

Cost and Economic Impact

The Plan includes emissions reduction strategies to implement at varying times through 2045 and beyond. The Plan also highlights the immediate strategies to be implemented in the next 5 years (2025-2030). HDOT is not recommending a strategy be implemented unless the implementer knows the strategy's cost or economic impact. For some of the Plan's immediate strategies, HDOT knows the anticipated implementation cost and impact on affordability, such as the cost to build the Priority Multimodal Network, which will increase the number of people bussing, walking, and biking and directly lower their transportation costs. These forms of transportation are critical to the most vulnerable populations in Hawaiʻi who cannot afford to drive or who are unable to drive due to age or disability.

For the immediate strategies where the cost impact is unknown, HDOT is recommending analysis be done as the next step. For example, a Clean Fuel Standard (CFS) is identified in this Plan as an immediate Administrative strategy to incentivize the production and distribution of cleaner fuels, but our state does not have a Hawaiʻi-specific CFS economic analysis. Therefore, HDOT believes the State should better understand the cost implications to local households, especially disadvantaged and rural communities, prior to implementing a CFS. HDOT is poised to start a CFS Feasibility Study in late October 2025.

In the 2026 revision of this Plan, HDOT will prioritize analyzing the costs, where unknown, for the other immediate (2025-2030) strategies.

The first iteration of this Plan presents decarbonization strategies and includes cost implications for the strategies presented in the marine sector. HDOT intends to build on this analysis and expand the cost implications analysis to the aviation, ground transportation, and administrative strategies in the next revision of this Plan. Toward that end, in the next iteration of the Plan, HDOT expects to have feedback from professional organizations and sister agencies such as the University of Hawaiʻi; Department of Business, Economic Development & Tourism (DBEDT); and Hawaiʻi Tourism Authority to inform these economic evaluations. We may revise the prioritization of strategies once costs and affordability to residents are better understood, and we will consider how to periodically update those analyses as financial conditions and available technologies change in the future.

Key Findings

Decarbonizing the transportation sector will require the active collaboration and participation of everyone in Hawai'i – private industry, government, nonprofits, and all residents. In particular, a number of immediate legislative actions will be required to enable implementation of this Plan's proposed strategies. Detailed analysis of each possible strategy (including the roles and responsibilities of various parties) and required activities is organized by transportation mode and presented in Chapter 3.

Hawaiʻi can significantly lower its transportation emissions by 2030 through adoption of all the immediate strategies. However, even with implementation of all the immediate strategies, Hawaiʻi will fall just short of reaching the 2030 statewide emission reduction target in the transportation sector. Likewise, with implementation of the short-, mid-, and long-term strategies, Hawaiʻi will dramatically lower its transportation emissions by 2045 but will fall short of reaching the net-negative 2045 statewide target. Therefore, the Plan identifies strategies and opportunities to increase carbon removals as a supplement to transportation sector emission reductions. With carbon sequestration from native reforestation, coastal wetland restoration, regenerative agriculture, and other methods, Hawaiʻi's transportation sector is predicted to fall just short of the 2030 target to cut emissions in half but can achieve the 2045 net-negative target. Hawaiʻi needs to make significant investments from 2025-2030 into carbon removals and sequestration to compensate for anticipated residual GHG emissions and meet its 2045 net-negative emissions target.

Certain actions are considered key strategies based on large emission reduction potential and/or their ability to quickly make a meaningful difference. The following summarizes priority action items over the next 5 years for each mode (that is, Aviation, Marine, and Ground Transportation) and prerequisite actions at the administrative level:

- Aviation
  - Create a sustainable aviation fuel (SAF) tax credit to incentivize the import, production, and use of SAF for long-haul and interisland flights.
  - Deploy electrification strategies for airfield and ground access, including rental fleets.
  - Adopt a ramp efficiency optimization plan with a focus on resource planning, standardization, technology, and collaboration.
  - Support the electrification of interisland aviation.
  - Continue advancing Airport Carbon Accreditation (ACA) levels, through renewable energy projects, operational efficiency improvements, and expanded partnerships with airlines and ground transportation providers.
- Marine
  - Complete a comprehensive port emissions inventory across all nine commercial ports, evaluate lifecycle carbon intensity (CI) and infrastructure requirements for alternative fuels, assess long-term economic and workforce implications, and prepare port-specific roadmaps for fuel.
  - Adopt CI reduction requirements for cruise vessels, cargo carriers, and tug-and-barge services by 2030, mandate full renewable diesel adoption for commercial harbor craft (CHCs) by 2030, and implement a compliance framework with annual reporting verified through port call records.
  - Establish a market-based mechanism to incentivize the use of clean marine fuels and discourage the use of fossil fuels.
  - Invest in renewable diesel supply for CHCs and tug-and-barge fleets, initiate Hawaiʻi's first liquified natural gas (LNG) bunkering capability (with future compatibility for renewable LNG), and launch early demonstration projects for methanol bunkering and zero-emission harbor craft.
- Ground
  - Increase the use of electric vehicles (EVs) statewide by expanding public charging infrastructure, converting transit vehicles to electric, and providing financial incentives for EV adoption.
  - Complete the 5-Year Priority Multimodal Network in partnership with the counties.
- Administrative
  - HDOT to conduct a feasibility study and work to implement a Hawaiʻi-specific clean fuel standard or alternate legal framework or market-based mechanism to incentivize the use of and access to clean fuels across aviation, marine, and ground transportation and discourage the use of fossil fuels.
  - HDOT, Hawaiʻi State Energy Office, and other agencies to work with the Hawaiʻi State Legislature to pass multiple bills supporting decarbonization of transportation as recommended by this Plan.

- HDOT, metropolitan planning agencies, counties, airlines, and harbor users to incorporate GHG reduction measures at the start of project planning (all transportation modes) and prioritize GHG reduction in project scoring, selection and funding.
- HDOT to convert fleet (all transportation modes) to electric or clean fuels.
- HDOT and existing industry coalitions, working groups, and commissions, to actively engage and work through barriers with industry, involved agencies, and stakeholders in a coalition model.
- HDOT to host quarterly meetings of the Hawaiʻi Youth Transportation Council to get feedback on prioritization and implementation of the decarbonization strategies identified in this Plan and to find ways for youth to be meaningfully involved at every step.
- HDOT to develop a tool to estimate GHG emissions and vehicle miles traveled (VMT) for each project and produce an annual report compiling the individual project report and detailing its progress in reducing GHG and VMT, including quantitative analyses.
- HDOT to review and revise policies and processes to support decarbonization and equitable transportation access, provide regular staff training and continuing education, hire staff as needed to support the decarbonization transition, and implement measures and incentives to reduce staff transportation emissions.
- HDOT, the State Department of Land and Natural Resources, University of Hawaiʻi, and other conservation and agriculture partners to study carbon capture rates of Hawaiʻi's diverse native ecosystems, plan strategic investments to increase carbon removals and sequestration, prevent the loss of existing native ecosystem carbon sinks from invasive species or land use changes, and increase local food and energy security.

The intent of this Plan is not to merely reduce GHG emissions, it is to provide an opportunity to partner, innovate, and invest right here in Hawaiʻi. This Plan promotes bold, coordinated action to increase mobility, energy security, and economic activity by building a more efficient and equitable transportation system in Hawaiʻi for generations to come. It is the collective action across all sectors, public and private, that will enable the achievement of these ambitious targets.

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Acronyms and Abbreviations

A4A	Airlines for America
AAAE	American Association of Airport Executives
ACA	Airport Carbon Accreditation
ACC II	Advanced Clean Cars II
ACERT	Airport Carbon and Emission Reduction Tool
ACI	Airports Council International
ACT	Advanced Clean Trucks
ADA	Americans With Disabilities Act
AI	Artificial Intelligence
AIP	Airport Improvement Program
AIS	Automatic Identification System
ALICE	Asset Limited, Income Constrained, Employed
APU	Auxiliary Power Unit
ATCMTD	Advanced Transportation and Congestion Management Technologies Deployment
ATO	Air Traffic Organization
B	Billion(s)
BCA	Benefit-Cost Analysis
BECCS	Bioenergy With Carbon Capture and Sequestration
BEV	Battery-Electric Vehicle
CAFE	Corporate Average Fuel Economy
CAGR	Combined Annual Growth Rate
CARB	California Air Resources Board
CCH	City And County of Honolulu
CDOT	Colorado Department of Transportation
CDR	Carbon Dioxide Removal
CFPC	Clean Fuel Production Credit
CFS	Clean Fuel Standard(s)
CH_4	Methane
CHC	Commercial Harbor Craft
CHE	Cargo Handling Equipment
CI	Carbon Intensity

CII	Carbon Intensity Indicator
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CO2e	Carbon Dioxide Equivalent
CONRAC	Consolidated Rent-A-Car [Facility]
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CRP	Carbon Reduction Program
CSPI	Carbon Sequestration Potential Index
CVRP	Clean Vehicle Rebate Project
CY	Calendar Year
DAC	Direct Air Capture
DBEDT	Department of Business, Economic Development & Tourism
DC	Direct Current
DCCA	Department of Commerce and Consumer Affairs
DCFC	Direct Current Fast Charging
DLNR	Department of Land and Natural Resources
DMV	Department of Motor Vehicles
DOE	U.S. Department of Energy
DOH	State Of Hawaiʻi Department of Health
DOT	Department of Transportation
DTS	City And County of Honolulu Department of Transportation Services
EEXI	Efficiency Existing Ship Index
EF	Emission Factor
eGRID	[EPA] Emissions & Generation Resource Integrated Database
eGSE	Electrical Ground Support Equipment
EIA	Energy Information Administration
EJ	Environmental Justice
EPA	U.S. Environmental Protection Agency
EPR	Extended Producer Responsibilities
eSAF	SAF Made Using Renewable Energy
ESPC	Energy Savings Performance Contract
ESR	Emissions Sharing Regulation
EU ETS	European Union Emissions Trading System

EV	Electric Vehicle
EVaaS	EV Charging Infrastructure as a Service
EVSE	Electric Vehicle Supply Equipment
EVI-Pro Lite	Electric Vehicle Infrastructure—Projection Tool Lite
FAA	Federal Aviation Administration
FCEV	Fuel Cell Electric Vehicle
FEMA	Federal Emergency Management Agency
FFY	Federal Fiscal Year
FGP	Fixed Ground Power
FHWA	Federal Highways Administration
FS	Feasibility Study
FTA	Federal Transit Administration
FY	Fiscal Year
g/kWh	Gram(s) Per Kilowatt-Hour
g/mi	Gram(s) Per Mile
GET	General Excise Tax
gCO2e/MJ	Gram(s) of CO_2 Equivalent per Megajoule
GHG	Greenhouse Gas
GIS	Geographic Information System
GPS	Global Positioning System
GREET	Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies
GSE	Ground Support Equipment
GSP	Gross State Product
GWP	Global Warming Potential
HART	Honolulu Authority for Rapid Transportation
HB	House Bill
HDOT	State Of Hawaiʻi Department of Transportation
HECO	Hawaiian Electric Company
HFO	Heavy Fuel Oil
HI	Hawaiʻi
HiMA	Highly Modified Asphalt
HiRUC	Hawaiʻi Road Usage Charge [Program]
HNL	Daniel K. Inouye International Airport

HOV	High-Occupancy Vehicle
HRS	Hawaiʻi Revised Statutes
HSEO	Hawaiʻi State Energy Office
HSTP	Hawaiʻi Statewide Transportation Plan 2045
HUD	U.S. Department of Housing and Urban Development
HVAC	Heating, Ventilation, And Air Conditioning
ICAO	International Civil Aviation Organization
ICE	Internal Combustion Engine
IHS	IHS Maritime & Trade
IIBT	Interisland Barge Terminal
IIJA	Infrastructure Investment and Jobs Act
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Process and Product Use
IRA	Inflation Reduction Act
ITO	Hilo International Airport
ITS	Intelligent Transportation System
KCT	Kapālama Container Terminal
kg	Kilogram(s)
KIUC	Kauaʻi Island Utility Cooperative
KJF	Kerosene Jet Fuel
KOA	Ellison Onizuka Kona International Airport
KPI	Key Performance Indicator
kW	Kilowatt(s)
kWh	Kilowatt Hour(s)
L2	Level 2 [charging]
LCFS	Low-Carbon Fuel Standard [California program]
LED	Light Emitting Diode
LEED	Leadership In Energy and Environmental Design
LEP	Limited English Proficiency
LEV	Low Emission Vehicle
LIH	Līhuʻe Airport
LNG	Liquified Natural Gas

LSFO	Low-Sulfur Fuel Oil
LSMGO	Low-Sulfur Marine Gas Oil
LTAG	Long-Term Global Aspirational Goal
LTO	Landing And Takeoff
M	Million (Dollars)
MaaS	Mobility-As-A-Service
MDO	Marine Diesel Oil
MGO	Marine Gas Oil
MMSI	Maritime Mobile Service Identity
MnDOT	Minnesota Department of Transportation
MOU	Memorandum Of Understanding
MOVES	Motor Vehicle Emission Simulator
MPO	Metropolitan Planning Agency
MRTP	Mid-Range Transportation Plan
MWh	Megawatt-Hour(s)
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NATCA	National Air Traffic Controllers Association
NCDOT	North Carolina Department of Transportation
NEVI	National Electric Vehicle Charging Infrastructure
NGO	Non-Governmental Organization
NHC	Native Hawaiian Community
NHO	Native Hawaiian Organization
NHS	National Highway System
NOx	Nitrogen Oxide
NPV	Net Present Value
NSG	National Service Group
O&M	Operations And Maintenance
OahuMPO	Oahu Metropolitan Planning Agency
OCAMC	Office of Climate, Adaptation, Mitigation, And Culture
OCR	Office of Civil Rights
ODOT	Oregon Department of Transportation

OEM	Original Equipment Manufacturer
OGG	Kahului Airport
OGV	Ocean-Going Vessel
OPSD	Office of Planning and Sustainable Development
PCA	Preconditioned Air Supply
PDA	Personal Device Assistant
PFC	Passenger Facility Charge
PHEV	Plug-In Hybrid Electric Vehicle
PIʻI Tool	Project Island Impact Tool
PMA	Polymer-Modified Asphalt
POLB	Port of Long Beach
PROWAG	Public Right-of-Way Accessibility Guidelines
PUC	Public Utilities Commission
RFS	Renewable Fuel Standard
RMI	Republic of the Marshall Islands
RNG	Renewable Natural Gas
RoRo	Roll-On/Roll-Off
RPS	Renewable Portfolio Standards
RTG	Rubber-Tired Gantry
RUC	Road Usage Charge
SAF	Sustainable Aviation Fuel
SAFPC	Sustainable Aviation Fuel Purchase Credit
SEDS	State Energy Data System
sHNL	SustainableHNL [program]
SIT	State Inventory Tools
SMA	Stone Mastic Asphalt
SOV	Single-Occupancy Vehicle
SOx	Sulfur Oxide
SRTS	Safe Routes to School
SSTI	State Smart Transportation Initiative
STIP	Statewide Transportation Improvement Program
STP	Statewide Transportation Planning [Office]
TAF	Terminal Area Forecast

TBD	To Be Determined
TDM	Transportation Demand Management
TEU	Twenty Foot Equivalent Unit
TFMSC	Traffic Flow Management System Counts
TNC	Transportation Network Company
TOD	Transit-Oriented Development
TOE	Ton Oil Equivalent
TSMO	Transportation System Management and Operations
USDOT	U.S. Department of Transportation
VALE	Voluntary Airport Low Emissions
VMS	Variable Message Sign
VMT	Vehicle Miles Traveled
VRM	Vehicle Revenue Miles
WEF	World Economic Forum
WTW	Well-to-Wheel
ZEV	Zero Emission Vehicle
ZEVIP	Zero Emission Vehicle Incentive Program

1. Context and Background

The Navahine Settlement Agreement between Youth Plaintiffs (represented by Earthjustice and Our Children's Trust), the State of Hawaiʻi Department of Transportation (HDOT), and the State of Hawaiʻi, entered into law in May 2024, requires HDOT to prepare and implement a plan for the State to achieve net-negative transportation greenhouse gas (GHG) emissions by 2045, with an interim goal in 2030 of a 50 percent reduction from 2005 GHG transportation emission levels. This 2025 Energy Security and Waste Reduction Plan ("Plan" or "Energy Security Plan") lays out the framework for achieving the trajectory towards zero emissions in the transportation sector, using the best information available at this time, and will be updated annually.

HDOT plans to update this Plan annually for 5 years to allow for additional analysis and integration of new technologies as they become available, and to reflect on the progress made by HDOT and other stakeholders. In the next revisions, HDOT plans to incorporate technical updates, additional GHG inventory data, annual work plans, benefit-cost analysis (BCA), and the year's progress made further incorporating equity in HDOT processes, will be incorporated in the next revision. HDOT expects the Plan to be improved each year as it is the groupwork of large, diverse teams focused on specific challenges for each transportation mode, with a comprehensive view that aims to lead the state to net-negative emissions by 2045 and ultimately zero emissions in the transportation sector as soon as possible.

Many existing federal, state, and local regulations, policies, and programs have bearing on GHG emissions from transportation within Hawaiʻi. Key existing HDOT programs designed to reduce emissions include the State of Hawaiʻi Transportation Carbon Reduction Strategy and National Electric Vehicle Infrastructure (NEVI) Hawaiʻi State Plan. A comprehensive list of existing federal, statewide, regional, and local plans that are relevant to reducing transportation emissions is provided in Appendix A.

Commitments, policies, and programs of private companies and nonprofits working in Hawaiʻi have also contributed to lowering transportation emissions, such as the Hawaiian Electric Company (HECO) installing and maintaining public electric vehicle (EV) chargers, Par Hawaiʻi and Pono Pacific growing *Camelina* for sustainable aviation fuel (SAF), Young Brothers participating in the Signol Fuel Savings Pilot Project to reduce fuel use by 5,000 gallons per month, Matson installing liquified natural gas (LNG) tanks on vessels, and many Hawaiʻi-serving airlines committing to the SAF Grand Challenge and investing in new technologies. These existing public and private efforts should be commended, expanded, and emulated.

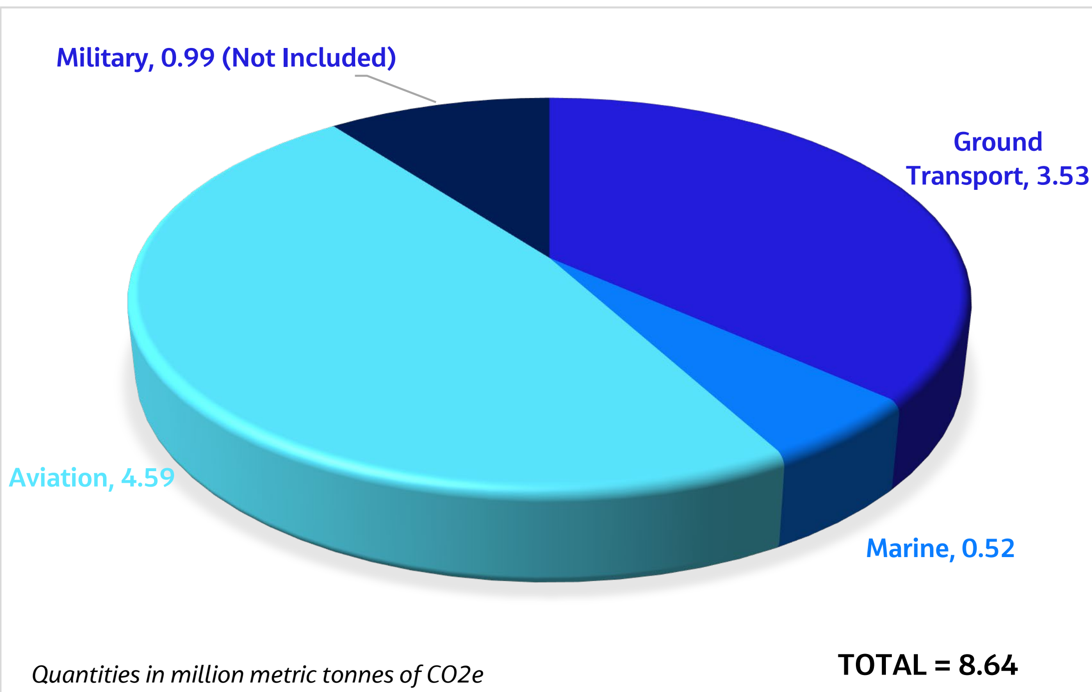
As illustrated on Figure 3-1 and as noted further in Chapter 3, existing programs lead to only a modest decrease of the projected future baseline emissions. To reach zero, existing emissions reduction efforts must continue and expand, new strategies laid out in this Plan must be adopted and implemented, and all stakeholders must contribute. Decarbonizing the transportation system will require a commitment to change and take action by all agencies, private companies that impact transportation, kamaʻāina (residents), and visitors.

As managed by HDOT, the State of Hawaiʻi's transportation system is divided into three modes: Airports (air transport), Harbors (marine transport), and Highways (ground transport). The emissions from each of these modes vary significantly and are tracked separately. Reduction strategies are designed with these differences in mind.

The State of Hawaiʻi Department of Health (DOH) completed a GHG inventory in 2021 (DOH 2024) that is referenced extensively in this Plan. The DOH updated the Hawaiʻi GHG Inventory Report for 2022 (released in April 2025 while the initial Plan was nearly fully developed), and the update has been included in this revised Plan. The most significant changes in the 2022 inventory are the inclusion of emissions for biodiesel in the transportation sector, the subtraction of vehicle miles traveled (VMT) from EVs from ground transport calculations, and the separate reporting of an estimate of electricity emissions from EVs.

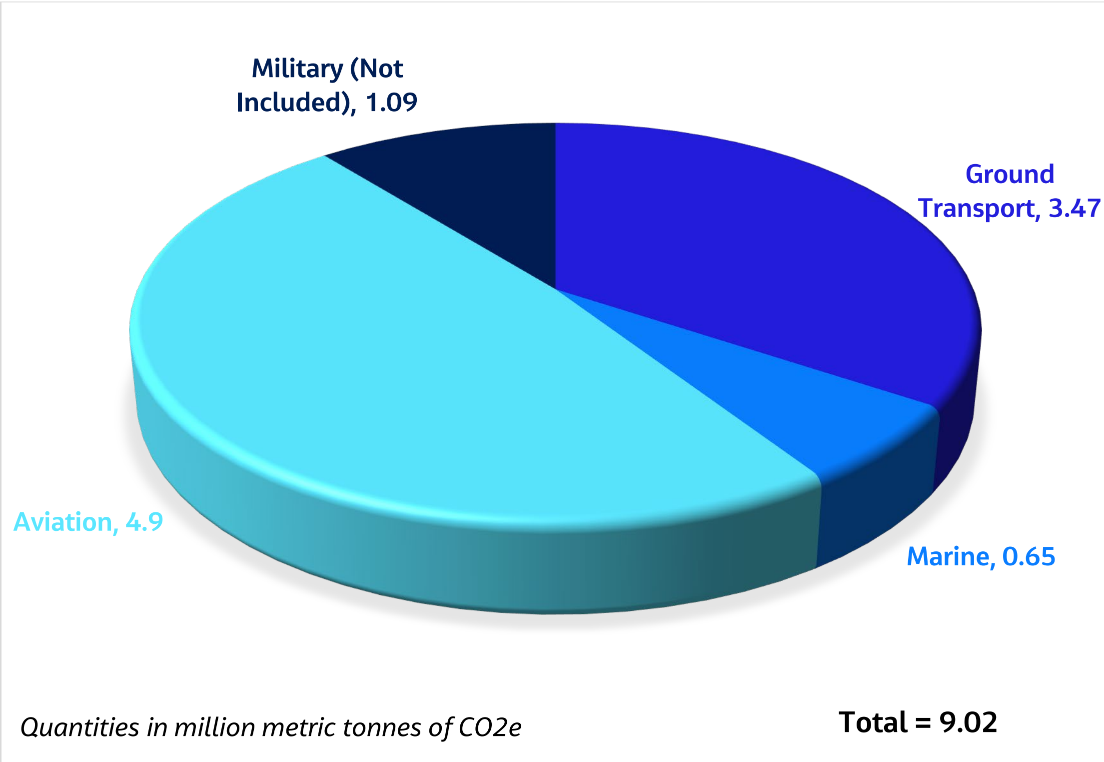
According to the 2022 inventory, transportation (excluding military), which includes air, marine and ground transportation, comprises 50 percent of total energy emissions. The total statewide energy emissions comprise 88 percent of the overall emissions (excluding carbon sinks) for the State of Hawaiʻi. This includes 9.02 million metric tonnes of carbon dioxide equivalent (CO2e) from the transportation sector, excluding military. The inventory further breaks down the transportation emissions into the three modes. The 2021 emissions from the statewide inventory report are displayed in Figure 1-1. The resulting split between the three transportation modes in the 2022 statewide inventory report is shown on Figure 1-2. As described in detail in Appendix B of this Plan, HDOT made some slight revisions and enhancements to the data compiled by DOH, resulting in slight differences to the emissions totals reported. The emissions totals calculated and used as the basis of emissions modeling for this report are displayed on Figure 1-3.

Figure 1-1. Hawaiʻi Transportation GHG Emissions (2021 DOH Inventory)



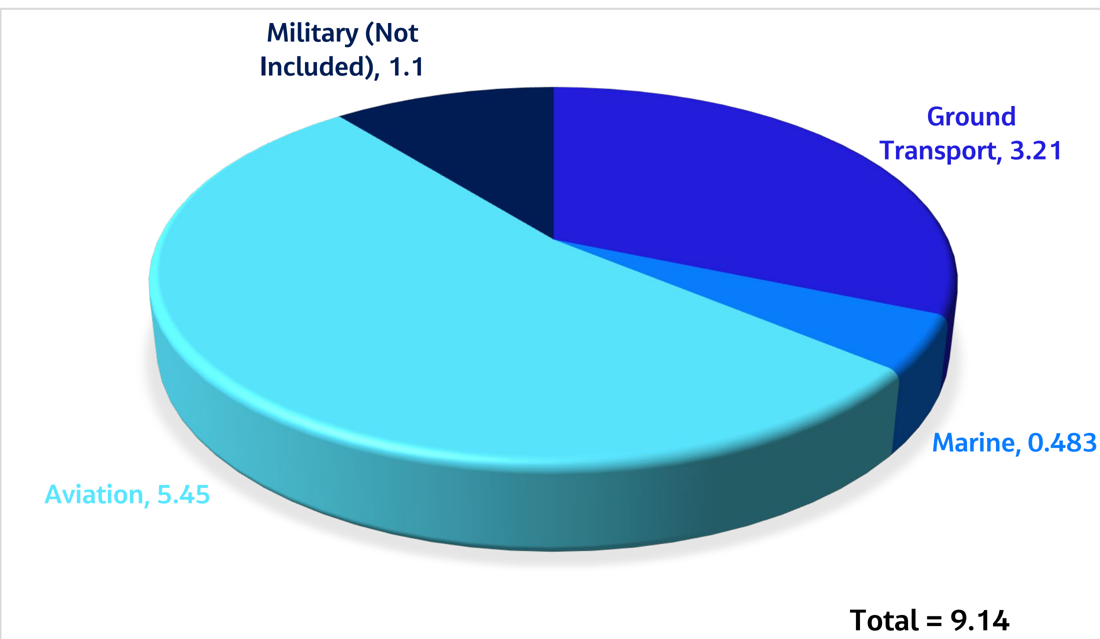
Source: DOH 2024

Figure 1-2. Hawaiʻi Transportation GHG Emissions (2022 DOH Inventory)



Source: DOH 2025

Figure 1-3. Hawaiʻi Transportation GHG Emissions (2022 DOH Inventory)



These values inform the baseline GHG emissions used for modeling the emission reduction benefits of the mitigation strategies and benchmarks in this Plan.

This Plan relies on the previous work done by other State entities, including the Hawaiʻi State Energy Office (HSEO) *Pathways to Decarbonization Report* (2023) and the HECO *Electrification of Transportation Strategic Roadmap 2.0*. The statewide inventory provides data for the 2005 base year and estimates of current emissions that are used as the basis for projecting the impact of various emissions reduction strategies in this Plan. The inventory's estimates of transportation emissions are largely based on records of fuel imports to Hawaiʻi as reported by the Hawaiʻi Department of Business, Economic Development & Tourism (DBEDT) to the U.S. Energy Information Administration (EIA). More accurate and detailed estimates of GHG emissions by source category are needed to more precisely assess reduction strategies and track progress towards interim reduction goals. This Plan is developed and based on a hybrid of the DOH GHG Inventory emissions and additional research performed to date on State marine and aviation sector emissions. It is the intent of HDOT to continually improve upon these data with future updates. Specific data sources for each division are described in Appendix B. HDOT will continue be an active participant in the DOH's GHG Emissions Inventory Review Committee and will continue to share data with DOH.

1.1 Scope of HDOT Activities

HDOT has authority for the planning, design, construction, operation, and maintenance of state facilities for all modes of transportation inclusive of air, marine, and ground. The department has facilities and infrastructure on all six of the major islands. The mission of HDOT is *"to provide a safe, efficient, accessible, and sustainable inter-modal transportation system that ensures the mobility of people and goods and enhances and/or preserves economic prosperity and the quality of life."*

HDOT has three modal divisions (Airports, Harbors, and Highways, referred to in this document as HDOT--Airports, HDOT-Harbors, and HDOT-Highways, respectively). The Administration Division (Support Services) and Statewide Transportation Planning (STP) Office coordinate and support the three modal divisions. Each division is led by a deputy director. The four programs manage and budget for nearly 35 branches and plans. The divisions also work closely with federal counterparts including the Federal Aviation Administration (FAA), United States Coast Guard, Federal Highways Administration (FHWA), and Federal Transit Administration (FTA). In addition, the divisions work with the individual counties, with work including planning commissions, departments of public works, and rural transit agencies, to identify needs and priorities of said counties.

HDOT maintains operational and maintenance responsibility for the following assets:

- 11 commercial service airports
- 4 general aviation airports
- 9 commercial harbors
- 485 acres of harbor yard area
- 20 acres of harbor shed space
- 47,000 linear feet of berth space
- 925 vehicular centerline miles (2,433 lane miles) of state facilities
- 152 bicycle facility miles (24 bicycle lane miles and 128 signed shared roadway miles) along state vehicular facilities

- 151 sidewalk miles along state vehicular facilities
- 257 raised crosswalks across state vehicular facilities
- 25 shared-use path miles

HDOT is funded and is able to pay for its activities and projects through a mix of grants, legislature appropriations, and self-sustaining modal units. HDOT is required by law to generate its own monies to fund its programs and projects. Independent special funds were established for each of three modal units' (that is, Highways, Harbors, and Airports) major programs. Each fund is expected to generate enough revenue to pay for the programs' operation and maintenance costs and to contribute a fee to the State General Fund for central services. This fee is set at 5 percent of each special fund's gross revenues after debt service.

These special funds must also provide a higher level of cash financing in the Capital Improvement Program to ease the burden on debt service. Because the Capital Improvement Program is large, HDOT continues to rely on reimbursable General Obligation Bonds and federal aid (largely through the U.S. Department of Transportation [USDOT]) to help fund our programs and projects. Even with this robust funding structure, HDOT acknowledges that they will not be able to independently fund implementation of the strategies in this Plan; they will require the collaboration and financial support of many key stakeholders.

1.1.1 Aviation

Hawaiʻi has eleven commercial service airports and four general aviation airports across the six islands. Total airport operations (takeoffs and landings) in 2023 were just under a million, as reported in the FAA Terminal Area Forecast (TAF) report (FAA 2025). The following lists the state's top five airports, which contribute to 99 percent of the airport enplanements and emissions in the state. The majority of emissions for the aviation sector come from flights between these airports and from these airports to the U.S. mainland.

- Daniel K. Inouye International Airport (HNL)
- Ellison Onizuka Kona International Airport (KOA)
- Hilo International Airport (ITO)
- Kahului Airport (OGG)
- Līhuʻe Airport (LIH)

1.1.2 Marine

Hawaiʻi's isolated island geography underscores the significance of ocean cargo transport as a lifeline and the only viable means to serve and support every facet of the local economy, including tourism, construction, national defense, agriculture, and all other industries. An estimated 85 percent of all goods consumed in Hawaiʻi are imported, and 91 percent of the imported goods arrive through the commercial harbor system. Hawaiʻi's residents heavily depend on the state's commercial harbor system, and a disruption of ocean transport services and the delay of movement of cargo from the harbor to a final destination will severely impair the state economy and impact residents greatly.

Port Hawaiʻi, the collective state commercial harbors system, includes nine harbors on six islands. This harbors system operates on the MH-1 Daniel K. Akaka Marine Highway as a hub-and-spoke system with Honolulu Harbor on the island of Oʻahu (where 68 percent of Hawaiʻi's 1.4 million residents live) as the hub and primary entry point for incoming cargo from the continental United States and foreign countries.

The two harbors located on Oʻahu generate 81 percent of the system's operating revenue. From Honolulu, cargo is distributed to five other islands, served by seven commercial harbor facilities on those islands.

1.1.3 Ground Transportation

HDOT oversees the state's ground transportation system and related assets, including bridges, tunnels, vehicular lanes, signed shared roadways, bicycle lanes, sidewalks, shared-use paths, crosswalks, raised crosswalks, culverts, traffic signals, signage, and adjacent vegetation that facilitate the movement of people and goods throughout the state. HDOT is responsible for the condition and performance of approximately 971 (linear) miles of highways on six islands within the state. The effective management of the National Highway System (NHS) is an important priority for HDOT because of its vital contributions toward energy security, economic vitality, connecting communities, and overall mobility.

1.2 Hawaiʻi Transportation-Related GHG Reduction Targets

1.2.1 Zero Emissions

Ultimately, HDOT's goal is for the entire statewide transportation system across all transportation modes to achieve absolute zero emissions as soon as possible, consistent with the statewide targets detailed in Hawaiʻi Revised Statutes (HRS) § 225P-8. There are some sectors of the transportation system that will be harder to decarbonize than others, and thus there is a need for interim solutions that are designed to reduce emissions while zero-emission solutions continue to be innovated and developed.

Sectors of the state's transportation system that will be hardest to decarbonize include long-haul aircraft, inter-state and intra-state marine vessels, and legacy light-duty and heavy-duty internal combustion engine (ICE) vehicles. The critical factors for decarbonizing these areas are discussed in Chapter 3 and hinge on the viability of clean fuels for aircraft and marine vessels and the ability to retire legacy ICE vehicles in favor of EVs and other forms of clean transportation. In addition, zero-emission alternatives for some types of medium- and heavy-duty vehicles still need to be developed.

1.2.2 Net-Negative Target – 2045

The requirements of HRS § 225P-5 state that by no later than 2045, the State of Hawaiʻi must reach net-negative carbon emissions, meaning it must sequester more atmospheric carbon and GHGs than emitted within the state. As detailed throughout this Plan, a combination of GHG reduction and carbon removal strategies will be leveraged to achieve the 2045 target of net-negative emissions.

The Navahine Settlement Agreement requires HDOT to set interim 5-year GHG reduction targets through 2045 (5-Year GHG Targets). The GHG reduction strategies detailed later in this Plan include more details on the proposed benchmarks to meet the 5-Year GHG Targets shown in Table 1-1.

1.2.3 Short-term Target – 2030

HRS § 225P-5 states that by 2045, the State of Hawaiʻi must cause the sequestration of more atmospheric carbon than is emitted as GHG in the state, with a 50 percent reduction of emitted annual GHG by 2030 compared to a 2005 baseline. Per the statute and Navahine Settlement Agreement, measurement of progress towards interim targets will be referenced to a 2005 base year. To the best extent possible, HDOT intends to align its workings and Plan with the statewide 50 percent reduction 2030 target, but there are clear obstacles to meeting this target on an absolute basis for aviation, marine, and total transportation emissions. Only ground transportation is expected to meet or better the 50 percent target. Consequently, the wedge diagrams presented in Chapter 3 of this Plan depict the carbon removals that would be required to compensate for the excess emissions.

1.2.4 Interim Targets – 2035, 2040

Between 2030 and 2045, HDOT intends to set progressive, "stepping stone" reduction targets to achieve net-negative carbon emissions no later than 2045 and absolute zero emissions in transportation as soon as possible. These targets will be measured against 2005 emission values consistent with the requirements of HRS § 225P-5 and the Navahine Settlement Agreement. HDOT intends to continue developing a comprehensive granular "bottom-up" GHG inventory building on the Harbors' bottom-up approach that will better inform target setting for 2035 and 2040. These interim targets will be specifically defined in future revisions to this Plan and will be updated as necessary. Key benchmarks for each division during the interim years are detailed in Table 1-1.

The Navahine Settlement also requires the following specific benchmarks to be included in this Plan:

- Interim targets to reduce VMT and the number of single-occupancy vehicles (SOVs) in the state's mode share
- Interim targets to expand multimodal transportation options such as public transit, pedestrian pathways, and bikeways
- Interim targets to improve safety for pedestrians and cyclists and meet the Vision Zero Policy
- Interim targets to electrify transportation and support expansion of public charging infrastructure across the state
- Interim targets to reduce petroleum use from ground transportation and increase the use of zero-carbon alternative fuels and EVs in the ground, air, and marine transportation sectors
- Interim targets to convert zero-emission technologies (whether electric or otherwise) to all ground equipment at airports and harbors in the state

Table 1-1. GHG Targets 2030, 2035, 2040, and 2045

Mode	Sub Sector	2030	2035	2040	2045
Aviation	Landside	Explore rental car company partnerships to ensure convenient charging infrastructure at places such as airports, hotels, and tourist attractions.	50% of rental cars available at airport are EVs.	50% of parking spaces have access to EV charging (access defined as anywhere that has the ability to "plug in").	100% of rental vehicles are EV.
	Aircraft	Industry stakeholder working group established and SAF infrastructure assessment completed with plan for blending and delivery to airports.	50% SAF uplifted/ dispensed into aircraft.	75% SAF uplifted/dispensed into aircraft.	100% SAF uplifted/dispensed into aircraft.
	Terminal	Comprehensive assessment of existing electrical infrastructure to support electrification of gates, equipment, and vehicles.	Ramp efficiency optimization plan complete.	First phase of ramp efficiency optimization plans complete.	100% of GSE electrified.
Marine	Non-Homeported Cruise Vessels [a]	75% reduction in call-weighted average fuel CI from the 2023 baseline,[b] which equates to a CI of 25 gCO2e/MJ or lower. No fossil fuel, except for LNG, may be used to meet this compliance target.	85% reduction in call-weighted average fuel CI from the 2023 baseline, which equates to 15 gCO2e/MJ or lower. No fossil fuel may be used to meet this compliance target.	90% reduction in call-weighted average fuel CI from the 2023 baseline, which equates to 10 gCO2e/MJ or lower. No fossil fuel may be used to meet this compliance target.	95% reduction in call-weighted average fuel CI from the 2023 baseline, which equates to 5 gCO2e/MJ or lower. No fossil fuel may be used to meet this compliance target.
	Ocean-Going Cargo Carriers	65% reduction in call-weighted average fuel CI from the 2023 baseline, which equates to 35 gCO2e/MJ or lower.	80% reduction in call-weighted average fuel CI from the 2023 baseline, which equates to 20 gCO2e/MJ or lower.	90% reduction in call-weighted average fuel CI from the 2023 baseline, which equates to 10 gCO2e/MJ or lower.	95% reduction in call-weighted average fuel CI from the 2023 baseline, which equates to 5 gCO2e/MJ or lower.

Mode	Sub Sector	2030	2035	2040	2045
	Interisland Tug and Barge Services	100% bio- or renewable diesel adoption for tug-and-barge cargo operations.	80% reduction in call-weighted average fuel CI from the 2023 baseline, which equates to 20 gCO2e/MJ or lower.	90% reduction in call-weighted average fuel CI from the 2023 baseline, which equates to 10 gCO2e/MJ or lower.	95% reduction in call-weighted average fuel CI from the 2023 baseline, which equates to 5 gCO2e/MJ or lower.
	CHCs operating within port boundaries	100% bio- or renewable diesel adoption for commercial harbor crafts operated within port boundaries.	30% transition of commercial harbor crafts to zero-emission technology.	80% transition of commercial harbor crafts to zero-emission technology.	100% transition of commercial harbor crafts to zero-emission technology.
Ground Transportation		5% VMT reduction compared to projected baseline or business-as-usual scenario for 2030.	10% VMT reduction compared to projected baseline or business-as-usual scenario for 2035.	15% VMT reduction compared to projected baseline or business-as-usual scenario for 2040	20% VMT reduction compared to projected baseline or business-as-usual scenario for 2040.
		BEVs represent 80% of new light-duty vehicle sales.	BEVs represent 100% of new light-duty vehicle sales.	BEVs represent 100% of new light-duty vehicle sales.	BEVs represent 100% of new light-duty vehicle sales.
		Low-carbon fuel program launched.	Low-carbon diesel and gasoline available statewide.	100% of remaining fuel sales are low-carbon during phase out of ICE vehicles.	100% of remaining fuel sales are low-carbon during phase out of ICE vehicles.

Notes: The benchmarks above and throughout this Plan provide tangible and measurable goals to meet the existing State emissions reduction targets. Actions including enacting legislation can be taken right away to begin making significant progress toward these benchmarks. However, an economic analysis of the benchmarks will be conducted in the future to better quantify the impact on affordability and cost of living for residents and businesses. HDOT will continue to refine the selected strategies in this Plan to incorporate new information as it is available.

[a] Homeported vessels are excluded from these requirements.

[b] Baseline reflects 2023 marine fuel use, assuming heavy fuel oil/marine gas oil (HFO/MGO) with a well-to-wake CI of approximately 100 gCO2e per megajoule. "Well-to-wake" includes both upstream (fuel extraction, processing, and transport) and downstream (combustion) GHG emissions. This baseline value is consistent with widely used lifecycle emission factors for residual and distillate marine fuels. CI values can be calculated using methodologies developed by the International Maritime Organization (IMO), particularly the lifecycle assessment (LCA) guidelines for marine fuels (IMO Resolution MEPC.376(80), adopted 7 July 2023), which provide a standardized framework for deriving well-to-wake GHG intensities across different fuel pathways.

BEV = battery-electric vehicle
CHCs = commercial harbor craft
CI = carbon intensity
gCO2e/MJ = gram(s) of CO_2 equivalent per megajoule
GSE = ground support equipment

2. Greenhouse Gas Emissions Inventory and Forecast

2.1 Background

A preliminary GHG emissions inventory assessment was developed for this initial Hawai‘i Energy Security and Waste Reduction Plan and is largely based on the DOH 2021 statewide GHG inventory (DOH 2024). The statewide inventory is currently the most representative emissions data available, because it is primarily based on quantities of fuel consumed that are aggregated in the EIA State Energy Data System. The statewide inventory also closely aligns with the 2006 International Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, a standard that is both respected and applied worldwide. A more comprehensive bottom-up inventory for all HDOT operations will be further developed in future iterations of this Plan. Please refer to Appendix B for further discussion of GHG inventory methodology and how it can be improved in the future.

2.2 Boundary

The boundary of a GHG emissions inventory delineates what activities and equipment are included. Boundaries can be drawn several ways, including geographic/physical, operational, and financial. The terms of the Navahine Settlement Agreement indicate that the focus of emission reductions efforts should be within the State of Hawai‘i, while providing infrastructure to facilitate the decarbonization of inter-state and international marine and aviation activities. The DOH GHG Inventory also quantifies emissions for “domestic” activities. As such, in line with the Navahine Settlement Agreement and the DOH inventory, the boundary for this Plan has been drawn to focus on domestic transportation, which excludes emissions to and from international destinations. Specifically, domestic transportation is defined as follows:

- All transportation activities that occur within Hawai‘i (on-island and intra-state ground, marine, and aviation transportation)
- Domestic inter-state (one state to another) transportation activities originating in Hawai‘i

The Hawaiian airports emission boundary is displayed on Figure 2-1. The domestic marine emission boundary is illustrated on Figure 2-2.

2.2.1 International Emissions Excluded from This Plan

The exclusion of emissions from trips to and from international destinations and international bunkering activities represents a significant portion of GHG emissions that are not accounted for in this report. As described earlier, this exclusion is in line with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, which direct states and nations to exclude emissions from international bunker fuels when reporting GHG inventories. However, while this approach is appropriate for official state-level emissions accounting, it does not capture the full scope of emissions reductions that could result from Hawai‘i’s clean fuel and decarbonization strategies.

For example, as Hawai‘i develops clean marine fuel infrastructure, international vessels bunkering at commercial ports may also use these lower-carbon fuels, leading to further global emissions reductions beyond what is reflected in the State’s GHG inventory. Given these considerations, future updates to this Plan should carefully evaluate the broader impact of Hawai‘i’s GHG marine and aviation activities, ensuring that the global benefits of the policies in this Plan are acknowledged even if they are not formally accounted for in the State's emissions inventory.

Note however that many of the policies and actions needed to incentivize low-carbon fuels in domestic aviation and marine travel will lay the groundwork for decarbonization of international travel. It is also acknowledged that the Navahine Settlement Agreement requires this Plan include "…consideration of plans and investments for infrastructure that may be necessary at harbors and airports to accommodate the full decarbonization of international aviation and marine transportation to the Hawaiian Islands. "

Figure 2-1. HDOT Airport Locations

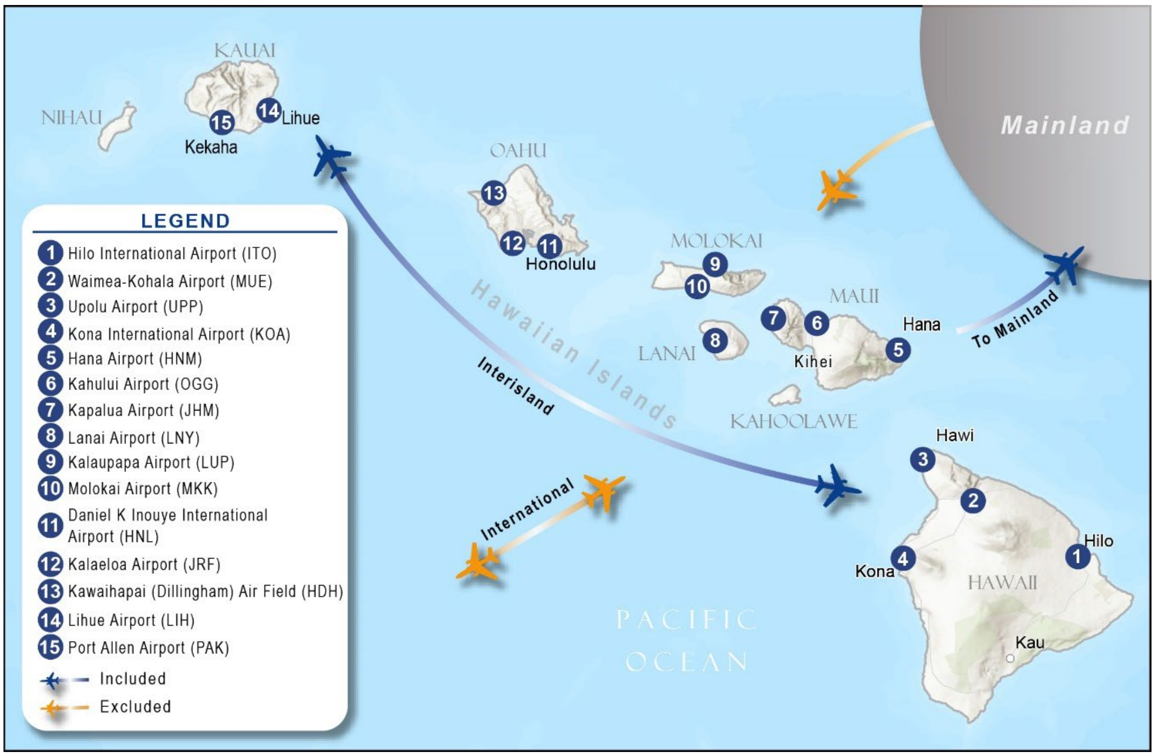
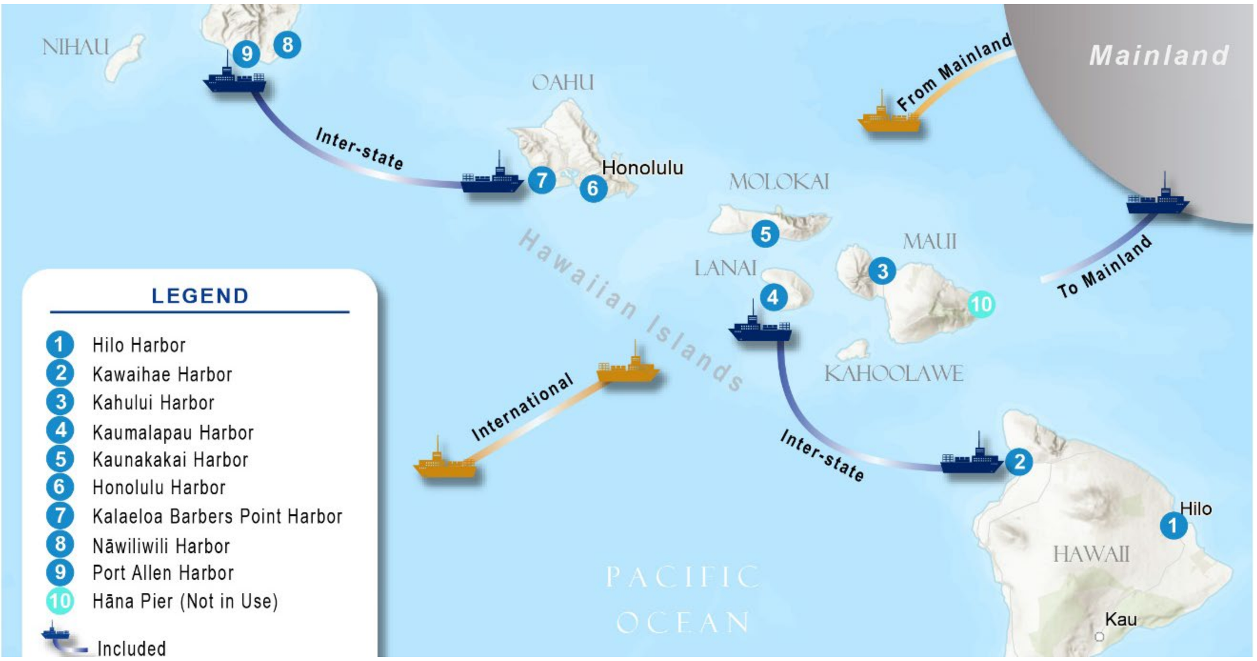


Figure 2-2. Domestic Marine Emissions Inventory Geographic Extent



2.2.2 Emission Sources

Pollutants

The baseline emissions include estimates of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) emitted from sources operating within the HDOT's GHG emissions inventory boundary, which is largely focused on tailpipe emissions.

HDOT acknowledges that there are other GHG pollutants such as hydrofluorocarbons and perfluorocarbons being emitted as a result of transportation, for example, through leakage from vessel and vehicle air conditioning systems. However, these are outside the boundary of the emissions inventory and are also expected to be minimal compared to combustion emissions from aviation, marine, and ground transportation vehicles and equipment

Using global warming potentials (GWP), emissions from these gases are converted to CO2e in this report. Only CO2e values are presented, as they account for all three GHGs in a standardized measure, with CO_2 comprising the largest share of emissions from the included source categories. All GHG emissions are reported in metric tonnes.

2.2.3 Data Sources

The Hawaiʻi statewide DOH GHG Inventory was developed for implementing policy, and references widely accepted, relevant GHG guidelines. The primary data source for the DOH GHG Inventory is the EIA State Energy Data System (SEDS). EIA SEDS largely aligns with the DBEDT State of Hawaiʻi Databook, especially for fuel consumption quantities. For this initial Plan, these top-down GHG emissions from the statewide DOH GHG Inventory, were used to develop agency-wide baseline emissions for HDOT. In addition, where easily accessible, publicly available data for marine and aviation were used to supplement and/or replace the estimates from the DOH inventory. However, much more granular and accurate data are needed to assess and implement the strategies developed in this Plan. Data quality and inventory accuracy in the HDOT inventory will be continually improved into the future.

In addition to the statewide GHG inventory, other data sources consulted include those discussed in the following sections; sources are also shown in Appendix B.

Emission Sources by Mode

Consistent with the DOH GHG Inventory, this initial version of the HDOT inventory focuses primarily on direct emission sources. This includes vehicles or equipment where emissions come directly from the tailpipe or stack of vehicles, vessels, aircraft, and associated fuel-burning mobile support equipment.

Indirect emissions are those where the emissions physically occur in a different place than where the activity is taking place or energy being consumed. This GHG inventory boundary includes the following two sources of indirect emissions:

- Emissions from EV electricity consumption until the electricity grid becomes 100 percent renewable
- Upstream emissions from the production of alternative fuels

The inclusion of emissions from electricity production transportation emissions is one deviation from the statewide DOH inventory approach. Because of the carbon-intensive electrical grid in Hawaiʻi, it would be disingenuous for this Plan to assume zero GHG emissions from EVs. Therefore, electricity emissions from EVs and other electric non-road equipment are quantified in this Plan.

The other deviation is the inclusion of upstream emissions from the production of alternative fuels. Clean fuels and other alternative fuels vary widely on lifecycle GHG impacts, and it is very important that this Plan not incentivize use of alternative fuels with high upstream emissions, assume all clean fuels result in zero anthropogenic emissions, or ignore any shift of GHG emissions from Hawaiʻi tailpipes to international fuel production and processing. Therefore, similar to the approach with electricity, the reduction pathways in Chapter 3 include pro-rated reductions to account for the estimated lifecycle impacts of fuels. For example, a shift of a group of vehicles from petroleum diesel to biodiesel is not illustrated as a 100 percent reduction in emissions in this roadmap.

Please refer to Appendix B for key emission sources by sector—Aviation, Marine, and Ground Transportation—including the methodology, DOH GHG Inventory, and emission sources excluded from this Plan's inventory.

Fuel Carbon Intensity

One of the most significant strategies for achieving the 2045 net negative target that cuts across all three modes is the replacement of fossil fuels with cleaner fuels. To accurately quantify the emission reductions associated with this displacement, HDOT is assessing the differences in lifecycle carbon intensity (CI) of each fuel. The lifecycle CI of each fuel measures total GHG emissions per unit of energy across the entire fuel production and use cycle. CI values vary widely depending on the feedstock and production method. Fuels produced from waste or renewable electricity, such as used cooking oil biodiesel or green hydrogen, can have very low CI values when compared to the avoidance of a baseline case where additional methane or carbon dioxide (CO_2) would be released to the atmosphere. In contrast, fuels derived from conventional crops or fossil-based energy can have much higher emissions, reducing their climate benefit. Therefore, depending on the feedstock source and development pathway of the cleaner fuels, the emissions benefit can vary quite widely. Obtaining proper documentation on the source and pathway for the cleaner fuels used will be critical to emission reduction quantification. While the known sources of cleaner fuels for use in Hawaiʻi are uncertain at this time, as many of them are still in pilot phases, HDOT has applied conservative emission reduction values for emissions modeling purposes in this version of the Plan. These emission reduction assumptions (percent reduction in emissions compared to fossil fuel) are summarized as follows.

Cleaner Fuel	HDOT Assumed Reduction (% reduction compared to fossil fuel)
Biodiesel	65%
Renewable Diesel	65%
Ethanol	45%
Renewable Gasoline	80%
Renewable LNG	80%
Sustainable Aviation Fuel	65%
E Sustainable Aviation Fuel	100%
Bio-Energy Carbon Capture and Storage Sustainable Aviation Fuel	100%
e-Methanol	90%
e-Ammonia	100%
Green Hydrogen	100%

Note that SAF is assumed to start with a 65% emission reduction in 2028 but projected to increase to 80% emission reduction by 2045.

2.2.4 Baseline Estimations for Ground Transportation, Aviation, and Marine

Baseline emissions were taken from the 2022 statewide DOH GHG Inventory and adjusted as described in Appendix B to more comprehensively reflect statewide transportation activities in 2023. HDOT acknowledges that these adjusted methodologies applied in this inventory will likely result in different values than what is published by DOH for 2023 emissions for the reasons described in Section 2.2.3 and Appendix B. Table 2-1 summarizes emissions totals from base year 2005 and the most recently reported year, 2023. The percent change shows progress toward the 50 percent reduction target in 2030. Forecasts for reduction strategy effectiveness are detailed in Chapter 3, Roadmap to Decarbonize Transportation.

Table 2-1. Emissions Totals Summary from 2005 to 2023

Division	2005 (million metric tonnes of CO2e)	2023 (million metric tonnes of CO2e)	% Change
Aviation	6.53	5.46	-16%
Harbors	0.37	0.48	30%
Ground Transport	5.04	3.21	-36%
Total	11.94	9.15	-23%

The results indicate that there was an overall reduction in statewide transportation emissions during the reporting period. The significant increase in marine emissions between 2005 and 2023 may be due to inconsistent data available for marine traffic from the EIA since the agency started reporting fuel consumption data. For ground transportation, there was a significant decrease in emissions since 2005 due to substantial improvements in overall fuel economies driven by new federal vehicles emissions requirements. In addition, the introduction and adoption of hybrid vehicles and EVs contributed to reduced emissions. Aviation emissions remained relatively consistent, with emissions rebounding back to more typical operations following a significant drop in 2020 and 2021 as a result of the COVID-19 pandemic.

Aviation

Total baseline emissions for 2023 for the domestic aviation sector are estimated to be 5.46 million metric tonnes of CO2e. This includes aircraft activities; auxiliary power units (APUs); maintenance, repair, and overhaul; GSE; and landside ground access. Figure 2-3 shows that aircraft emissions comprise 94 percent of total aviation emissions. The remaining 6 percent is largely dominated by landside ground access emissions sources. This includes the transportation of passengers, employees, tenants, and tenant visitors. The significant fraction of aviation emissions represented by aircraft operations underscores the need for applying more specific flight data to determine aircraft emissions. This also justifies the decision to use the FAA TAF reports as a forecasting basis instead of the economic/visitor sources applied in the DOH GHG Inventory. Figure 2-4 shows the split between intra-island flights and flights from Hawaiʻi to the U.S. mainland.

Figure 2-3. Aviation 2023 Baseline Emissions

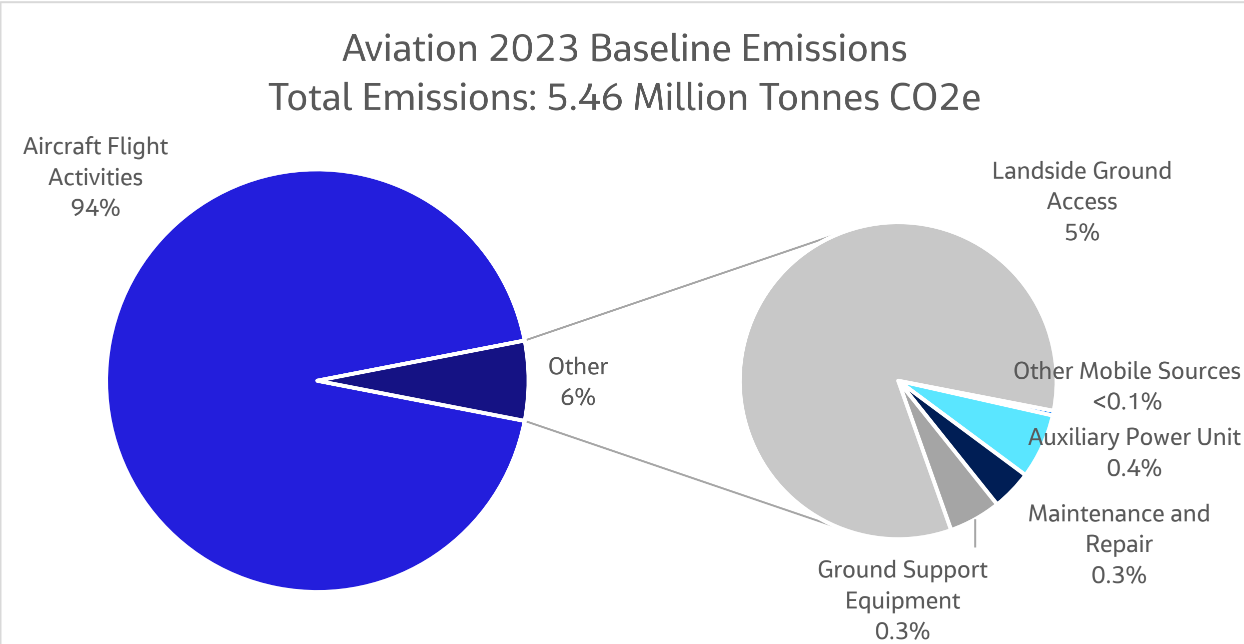
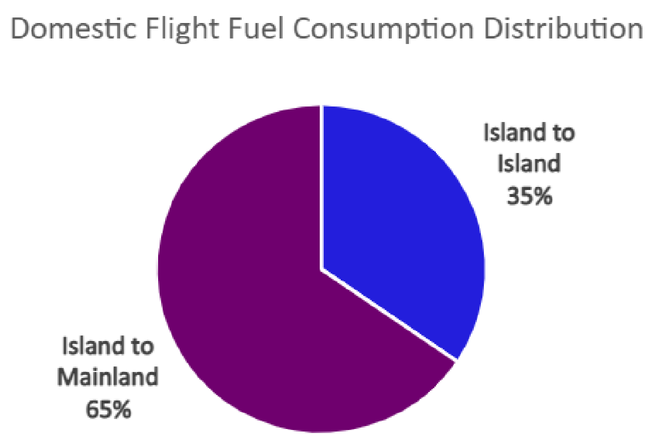


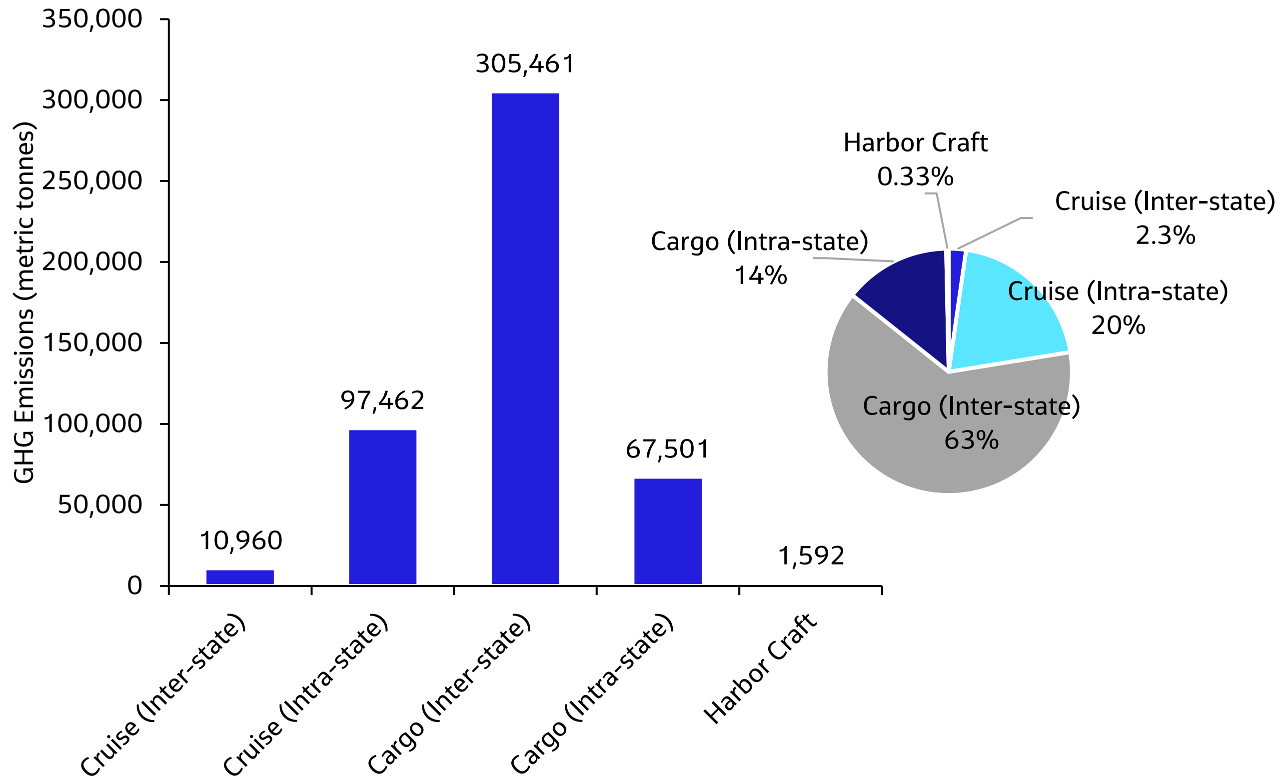
Figure 2-4. Domestic Flight Fuel Consumption Distribution



Marine

HDOT estimates that the annual GHG emissions in the domestic marine sector in Hawaiʻi is approximately 482,976 metric tonnes of CO_2e in total. This includes intra-state marine activities plus voyages departing from Hawaiʻi to a U.S. mainland destination. As shown on Figure 2-5, approximately 63 percent of the emissions are from inter-state cargo ships (also known as ocean-going vessels or OGVs). Intra-state cruise ships and intra-state cargo ships are responsible for around 20 percent and 14 percent of the domestic marine GHG emissions in Hawaiʻi respectively

Figure 2-5. Estimated Domestic Marine Emissions in Hawaiʻi, 2023



Ground Transportation

According to the DOH GHG Inventory, the transportation sector accounted for 10.12 million metric tonnes of CO2e and ground transportation represented 34.3 percent of that total, or 3.47 million metric tonnes of CO2e in 2022 (the most recent year for which a full inventory has been developed). Ground transportation includes passenger cars, light trucks, motorcycles, trucks, and buses). The 2022 inventory was used as a baseline for measuring the reduction of ground transportation emissions in Hawaiʻi achieved through the strategies outlined in this Plan. For the purposes of this Plan, reductions in carbon emissions are based on the following:

- Transportation electrification
- An increase in the use of clean fuels
- A reduction in VMT through various strategies, including active transportation, mode shift including transit
- Other land use strategies designed to assist in reducing the number of trips

Due in large part to federal fuel efficiency standards, the baseline assumption for 2045 sees GHG emissions for the ground transportation sector drop by almost half to 1.76 million metric tonnes of CO2e across all vehicle types.

3. Roadmap to Decarbonize Transportation

This section presents the projected plan for achieving the GHG reduction targets, including net-negative emissions no later than 2045. It includes an overview of the process, detail on the highest priority actions for each transportation mode, wedge diagrams and analysis to depict the proposed mix of strategies for each mode, and finally, detailed analysis of each strategy and the actions needed to achieve it. The implementation of each strategy at the planned effectiveness level depends on many factors, including but not limited to, the following:

- The pace of development and commercialization of new technology for hard-to-decarbonize sectors
- Available public and private funding
- Legislative support
- Education about the benefits to the public that will result from implementation of this Plan as well as acceptance and support by residents of and visitors to the state
- Active support by other federal, state, and local agencies
- Realization of laws, policies, and plans to replace all fossil-powered electricity with renewable sources
- Population growth or contraction

There could be multiple combinations and weighting of strategies included in this forward-looking Plan; in other words, there are multiple ways to visualize the roadmaps presented in the wedge diagrams in this chapter. The intent here is to identify all strategies that should be considered and begin to prioritize the actions needed to implement those strategies that are the most important, practical, and cost effective.

3.1 Emissions Reduction Planning Process

Development of a 20-year emissions reduction roadmap is a multistep, iterative, and evolving process. Baseline emissions estimates have been developed and projected using the best data available at this time. The baseline will continually be updated as more granular data becomes available to better inform estimates. Following the definition of baseline, a comprehensive list of emission reduction strategies has been developed, keeping in mind that decarbonizing the transportation sector will require an "all of the above" approach. All available technologies must be implemented and there is no one quick answer or silver bullet. The emissions reductions associated with each strategy are then estimated. Specific strategies and the overall path to zero emissions will be updated as more information becomes available regarding technology advances, policy changes, and the other assumptions underlying this Plan. This process can be visualized in a wedge diagram that depicts the emissions reductions and timeline for the State to be net-negative by 2045 (Figure 3-1). Emissions reduction wedge diagrams by transportation mode (Figures 3-2 through 3-4) are presented in Section 3.3.2.

3.2 Key Action Items

For each transportation mode, this Plan identifies immediate, short-term, medium-term and long-term actions necessary to achieve the emission reduction targets. The timelines are defined as follows:

- Immediate: Action to be implemented between now and December 2029.
- Short Term: Action to be implemented between 2030 and December 2034.
- Medium Term: Action to be implemented between 2035 and December 2039.
- Long Term: Action to be implemented in 2040 and beyond.

Section 3.5.2 of this Plan provides in-depth detail of all the strategies proposed to meet both HDOT and State targets. Tables 3-1 through 3-4 identify the immediate actions to be implemented before 2030 to pave the way for achievement of the 2045 net-negative goal. The actions are organized into the following three categories:

- ***Studies***: Actions requiring Information collection, market analysis, and further review of current states to inform decision-making and longer-term actions moving forward
- ***Investments***: Actions requiring allocation of funds and/or time by HDOT and key stakeholders to implement
- ***Regulatory Actions***: Actions requiring support and/or approval by the legislature to enable emission reduction activities

The full list of necessary actions for each division, including short-, medium- and long-term actions, are detailed in Appendix I. Note that the longer-term action plans presented in Appendix I should be considered draft because they are subject to change based on factors outside of HDOT's immediate control.

Table 3-1. Immediate Actions for Administration

Strategy Category	Studies	Investments	Regulatory Actions
Legislation	▪ **Clean Fuel Standard (CFS) feasibility assessment[a]**		▪ **Draft of/support for CFS legislation[a]** ▪ **Draft of/support for legislation for 1) SAF tax credit, 2) Youth Transit program, 3) multimodal networks, and 4) EV support[a]**
Emission Reduction Considerations		▪ **Expansion of Project Island Impact (PI'I) tool and incorporation into early decision-making[a]**	
State/County Fleet Transition	▪ Assessment of state/county fleets and electrification needs	▪ **$40 million (M) in public charging infrastructure to support state/county fleet electrification[a]** ▪ EVs for state/county fleets	
Low-Carbon Materials	▪ **Low-carbon materials research[a]**		
Increase Sequestration	▪ Carbon capture data collection for sequestration estimates	▪ **Implementation of sequestration techniques such as native forest restoration[a]**	
Improve Public Communications		▪ **Planning and launch of public education campaigns[a]**	
Youth Involvement		▪ **Quarterly meetings with Hawai'i Youth Transportation Council[a]**	
HDOT Policies		▪ **Update of HDOT internal policies to prioritize decarbonization and equitable transportation access[a]**	
Renewable Electricity	▪ **Renewable Electricity feasibility study[a]**	▪ Installation of renewable electricity generation equipment and microgrids	▪ **Exploration of policy and process changes if barriers or missed opportunities are encountered during the feasibility study[a]**
Green Financing	▪ **Green Financing feasibility assessment[a]**		

[a] **Bold** text indicates actions led by HDOT.

Table 3-2. Immediate Actions for Aviation

Strategy Category	Studies	Investments	Regulatory Actions
SAF Policy	▪ **Benchmark assessment of SAF tax credit policies and SAF Coalition**[a]	▪ Collaboration with key stakeholders to establish SAF supply and distribution pipelines ▪ **Facilitation of SAF working group meetings to decide on structure and goals**[a]	▪ **Support for adoption of SAF tax credit legislation**[a]
Electric and Hydrogen Powered Aircraft	▪ High-level market study of electric and hydrogen aircraft		
Airport Electric and PCA Infrastructure	▪ Power grid demand assessment with HECO ▪ **Assessment of low hanging fruit for ground power, GSE, and light emitting diode (LED) lighted areas**[a]	▪ **Installation of Preconditioned Air Supply (PCA) and ground power for airport gates**[a] ▪ **Installation of charging infrastructure for GSE electrification**[a] ▪ **LED lighting upgrades**[a]	▪ **Identification of funding path for electrification upgrade at airport for gates and terminal and ground equipment**[a]
Airspace Modernization and Ramp Efficiency	▪ **Collaborate with FAA on pending airspace modernization and ramp efficiency efforts**[a]	▪ Implementation of airspace modernization and efficiency measures	▪ **Identification of funding for ramp tower analysis**[a]
Onsite Renewable Power Assessment	▪ **Feasibility assessment for renewable electricity generation opportunities on airport property**[a]		▪ **Identification of funding for renewable electricity assessment and implementation**[a]
Landside Electrification	▪ **Feasibility assessment for addition of electric bus/shuttles and medium/heavy-duty vehicles**[a] ▪ **EV charging infrastructure adequacy assessment**[a] ▪ Pilot program with Taxi/ transportation Network Company (TNC)/rental car companies for EV adoption	▪ **Acquisition of electric service vehicles and buses**[a] ▪ **Level 2 (L2) and direct current fast charging (DCFC) infrastructure for all airport vehicles**[a]	▪ **Legislation to incentivize electrification of EVs**[a] ▪ **Identification of funding for airport charging structure/charging hub**[a]

[a] **Bold** text indicates actions led by HDOT

Table 3-3. Immediate Actions for Marine

Strategy Category	Studies	Investments	Regulatory Actions
Clean Marine Fuel Adoption	▪ **Comprehensive Port Emissions Inventory**[a] ▪ **Feasibility analyses of Clean Fuels**[a] ▪ **Economic and Workforce Impact Studies**[a] ▪ **Clean Marine Fuel Roadmap Study**[a]	▪ Construction of first LNG bunkering facility in Hawai'i ▪ **Establishment of renewable diesel supply chains for 100% coverage for tug and barge and CHCs**[a] ▪ **Securement of funding and development of finance models for alternative fuel bunkering**[a]	▪ **Introduction of legislation to establish carbon intensity (CI) limits for cargo carriers, cruise vessels, and interisland tug and barge services**[a] ▪ **Introduction of legislation to establish a compliance and reporting system to track marine fleet carbon intensity**[a] ▪ **Support for legislation that establishes regulatory measures that require CHCs to fully transition to renewable diesel short term**[a]
Zero Emission Technology	▪ **Grid Readiness Assessments**[a]	▪ **Initiation of pilot projects for small-scale methanol bunkering, zero-emission harbor craft pilots and zero-emission ferries**[a]	▪ **Support for legislation that establishes regulatory measures that require CHCs to fully transition to zero emission long term**[a]

[a] **Bold** text indicates actions led by HDOT.

Table 3-4. Immediate Actions for Ground

Strategy Category	Studies	Investments	Regulatory Actions
EV Adoption	▪ Support of acceleration of ICE vehicle turnover to EV by designing and launching pilot program for vehicles more than 20 years old ▪ **Monitoring of effectiveness of EV purchase incentive legislation**[a]	▪ **Full implementation of National Electric Vehicle Infrastructure (NEVI)** [a] ▪ Support of implementation of new EV Purchase Incentive legislative package ▪ Support of HSEO in development of EV Battery Recycling/Disposal program statewide	▪ Support legislation to incentivize EV purchases with mix of fees, rebates and tax relief
5-Year Multimodal Network	▪ **Completion of existing Bicycle and Pedestrian Infrastructure Network Gap-analysis**[a] ▪ **Completion of bicycle and pedestrian initiative analysis and implementation plan document**[a] ▪ Collaboration with counties to implement pilot of Safe Youth Transit Access program	▪ **Mapping of 5-Year Priority Multimodal Network and consensus from state and counties**[a] ▪ **Implementation of 5-year multimodal network Implementation plan**[a] ▪ **Alignment of 5-year multimodal network with Mid-Range Transportation Plan (MRTP) and Statewide Transportation Improvement Program (STIP)**[a]	▪ **Support legislation to create Safe Youth Transit Access program including funding**[a] ▪ **Request of additional funding for full implementation of Safe Youth Transit Access program**[a]
Carpool, Rideshare and Parking	▪ **Analysis of approaches to support rideshare programs**[a] ▪ **Support for Employer Commuter Programs and Implementation Plans**[a] ▪ Support for counties/local governments for review/revisions of parking permitting requirements	▪ Collaboration with counties, MPOs and transit providers for deployment of Mobility-as-a-Service (MaaS) technologies such as bikeshare and autonomous EVs ▪ Collaboration with counties, metropolitan planning organizations (MPOs) and employers to support rideshare programs ▪ Collaboration with counties to expand Safe Youth Transit Access program	
Compact and Transit-Oriented Design		▪ Collaboration with state and county agencies, the Office of Planning and Sustainable Development (OPSD), and developers to support compact and transit-oriented design	

[a] **Bold** text indicates actions led by HDOT.

3.3 Overall Roadmap

3.3.1 Strategies Included in Zero-Emissions Pathway

Various strategies are needed for each mode to reach net-negative emissions by 2045. Table 3-5 introduces key strategies for each mode.

Section 3.5.2 of this Plan includes detailed tables for all GHG reduction strategies for ground transportation, harbors, aviation, and administration, with each strategy including recommended actions, proposed roles and responsibilities, and timelines.

Table 3-5. Strategies Included in Zero-Emissions Pathway, by Mode

Mode	Strategy
Marine	Adoption of Clean Marine Fuels on Non-homeported Cruise Voyages
	Adoption of Clean Marine Fuels on Ocean-Going Cargo Carriers Ships
	Adoption of Clean Marine Fuels on Tug-and-Barge Interisland Service
	Adoption of Biodiesel/Renewable Diesel/Zero-Emissions Technology for Commercial Harbor Craft (CHCs) Operated within Port Boundaries
Aviation	Expanded use of Sustainable Aviation Fuel (SAF)
	Promotion of Airspace Modernization
	Expand Preconditioned Air Supply (PCA) and Fixed [Electrical] Ground Power (FGP)
	Electrify Ground Support Equipment (GSE)
	Airport/Passenger Vehicle Conversions
	Transition to Zero-Emission Aircraft Technology
	Optimize Ramp Aircraft Emissions
	Passenger Vehicle Partnerships
	Incentivize Low and No Carbon Vehicles
Ground Transportation	Converting to Electric Vehicles (EVs)
	Use of Clean Fuels
	Reducing Fuel Demand and Expanding Alternative Ground Transportation Modes/Infrastructure (transit, bicycle, pedestrian ways)
	Boosting Vehicle Capacity Utilization and Efficient Use of Existing Roadways, While Eliminating Further Road Expansions

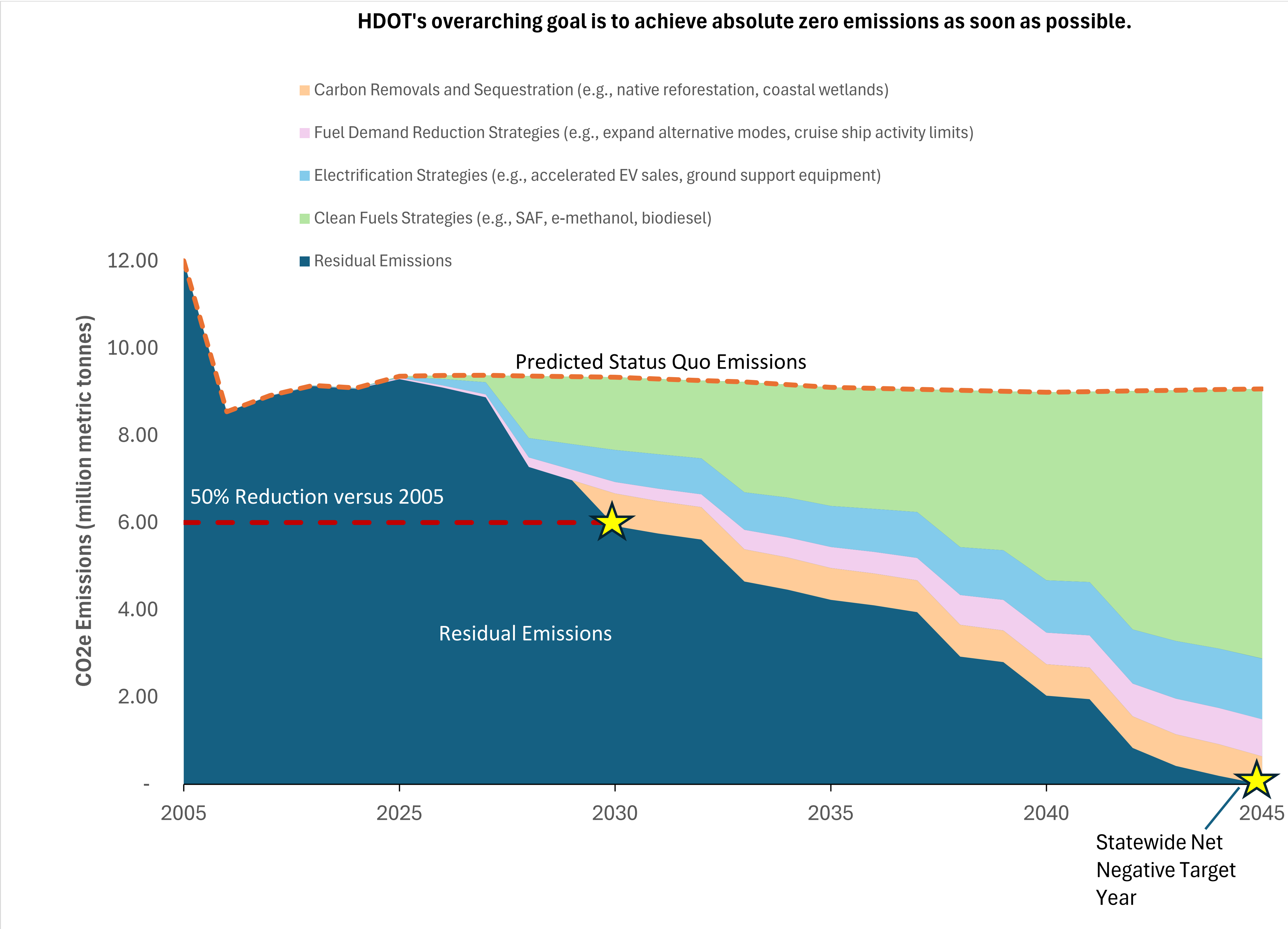
Note: Alternative fuels for aviation and marine comprise the largest share of emissions reductions, significantly dominated by the adoption of SAF in the aviation division. Vehicle and equipment electrification represent the next largest share of reductions across both aviation and ground transport divisions. Following closely behind are the fuel/energy reduction measures, including optimization of aircraft movements for aviation, the expansion of multimodal transport, and the demanding of management to reduce VMTs for highways.

The roadmap to net-negative emissions by 2045 is illustrated on Figure 3-1. Each wedge represents one reduction strategy, and the size of the wedge indicates the contribution to overall emissions reductions based on estimated impacts from aggressive implementation of the strategy, with the exception of the sequestration and carbon removal wedges which are based on the remaining gap which must be met to achieve short- and long-term targets. The wedge becomes visible in the year that it becomes effective.

Strategies in like categories are represented in the same color family; more specifically, clean fuel strategies are displayed in green, electrification strategies are displayed in blue, and fuel reduction/technology strategies are displayed in purple.

The remaining emissions after application of each strategy based on current projections are shown in dark blue. The overall size or area of this wedge also represents the overall impact of Hawaiian transportation-related GHG emissions on climate change; because CO_2 remains in the atmosphere for hundreds of years, the 2045 impact on climate is caused by past and current emissions leading up to that time and not specifically by whether new emissions are brought to zero or net-negative by then. This Plan therefore includes use of carbon removals and sequestration over interim years as well as 2045 to achieve needed targets.

Figure 3-1. Transportation 2045 Net-Negative Emissions Strategy



The combined strategies are projected to achieve a 90 percent reduction of baseline emissions in 2045, with the remaining 10 percent reduction coming from hard-to-decarbonize sectors addressed by future carbon removal projects.

The emission reduction totals projected for each mode in benchmark years leading up to 2045 is detailed in Table 3-6. The methodologies employed to quantify these emission reductions are detailed in Appendix B.

Table 3-6. Projected Emission Reduction Totals (million metric tonnes of CO2e)

Year	Aviation	Highways	Marine	Total
2025	0.007	0.045	0.016	0.068
2030	1.36	1.01	0.27	2.67
2035	2.49	1.29	0.34	4.15
2040	4.21	1.61	0.37	6.24
2045	6.19	1.85	0.40	8.43

3.3.2 Graphic Illustrations and Tabular Data

This roadmap and timeline can best be visualized using the wedge diagrams shown on Figures 3-2 through 3-5. These diagrams begin with the baseline GHG emissions for each mode, then forecast future emissions based on current HDOT initiatives, and finally apply the proposed reduction strategies within this Plan to bring emissions to net zero.

Because of the significant contribution of aviation emissions and current uncertainty regarding the ability to quickly scale and incentivize adoption of SAF, two scenarios are presented for Aviation. The first aviation scenario (A-1) follows a more ambitious SAF adoption trajectory, with 25 percent SAF uplift in 2030, 50 percent in 2035, 75 percent in 2040, and 100 percent SAF for 2045. This scenario shows HDOT achieving the 2045 statewide net-negative target. The second aviation scenario (A-2) follows the trajectory of the SAF Grand Challenge, assuming 10 percent SAF uplift in 2030, 30 percent in 2035, 50 percent in 2040, and 100 percent by 2050. The second scenario does not show HDOT achieving the statewide mandate of net-negative emissions by 2045.

Figure 3-2. Aviation (A-1) Ambitious Net-Negative Emissions Strategy

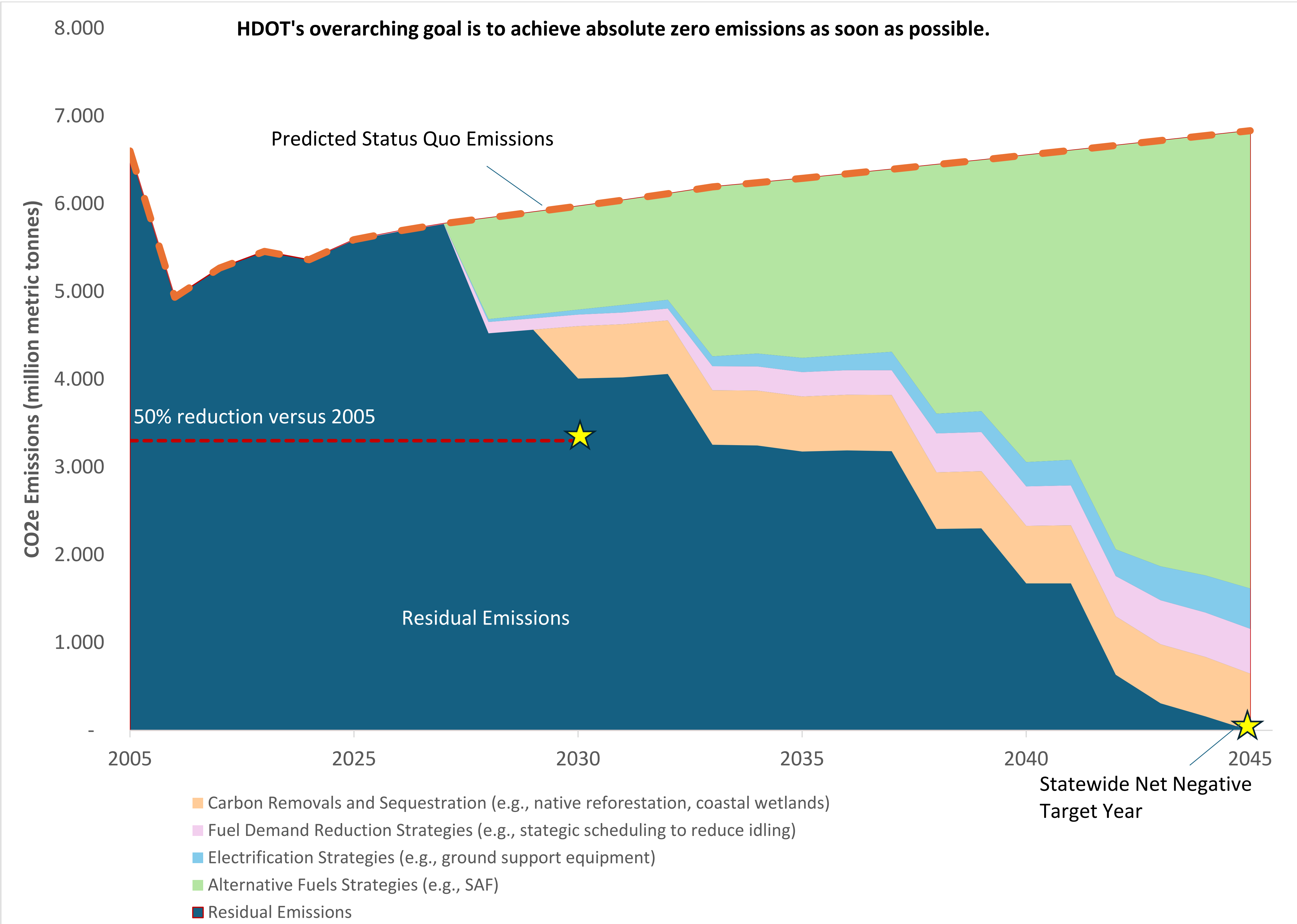


Figure 3-3. Aviation (A-2) SAF Grand Challenge Net Negative Emissions Strategy

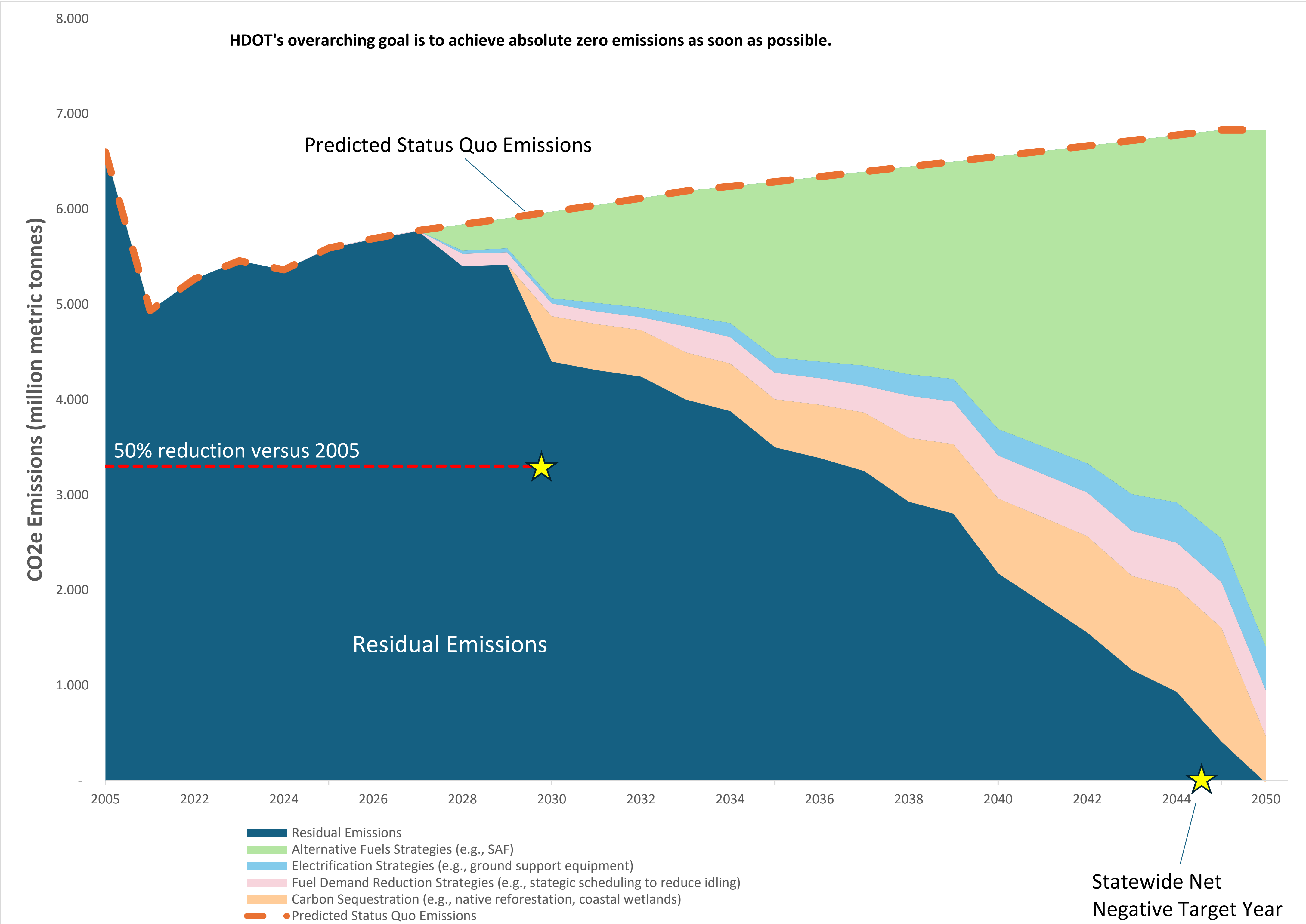


Figure 3-4. Marine Net-Negative Emissions Strategy

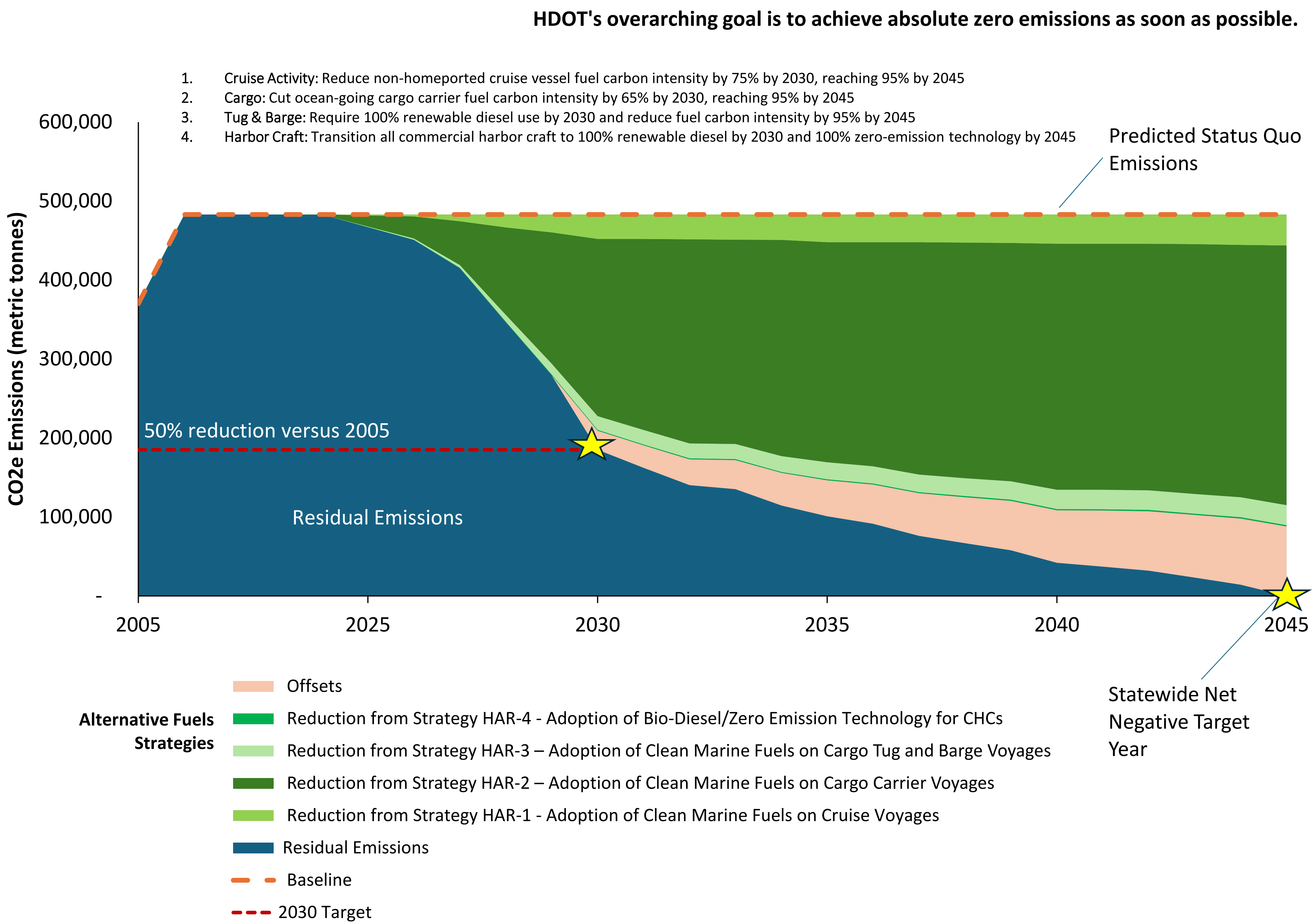


Figure 3-5. Ground Transportation Net Negative Emissions Strategies

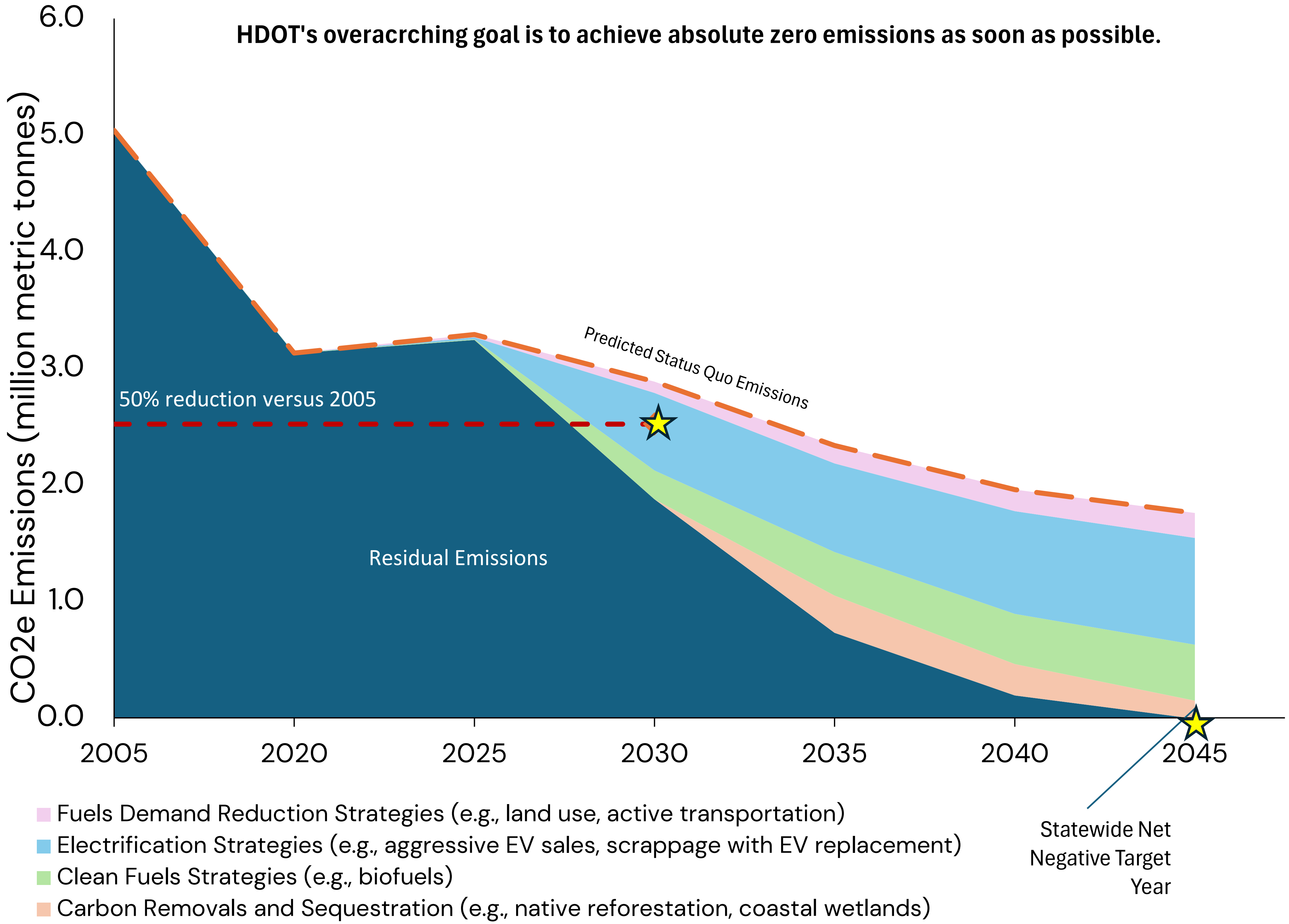
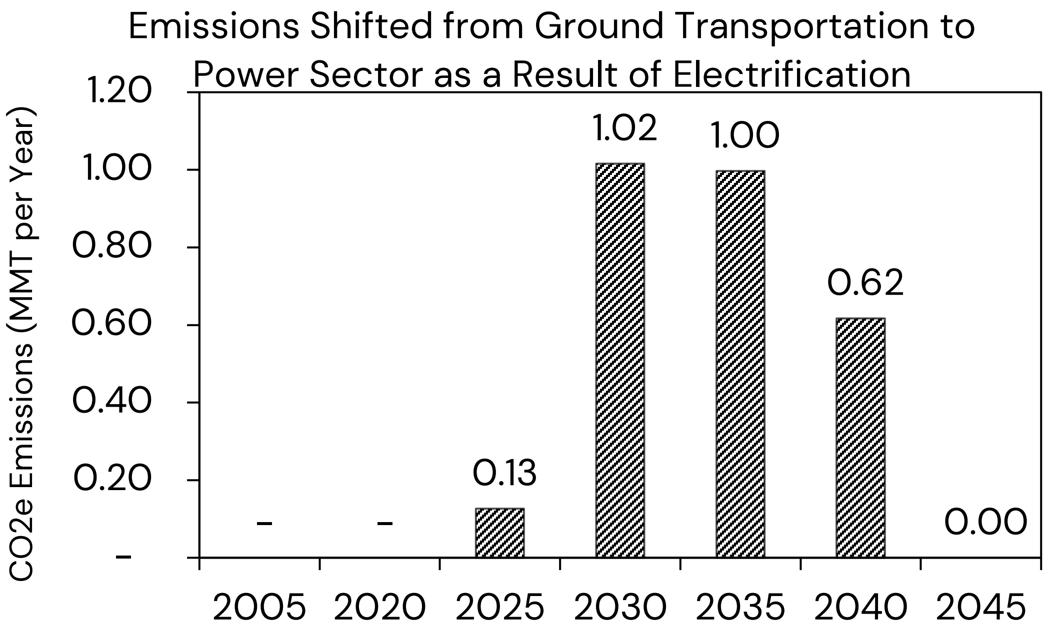
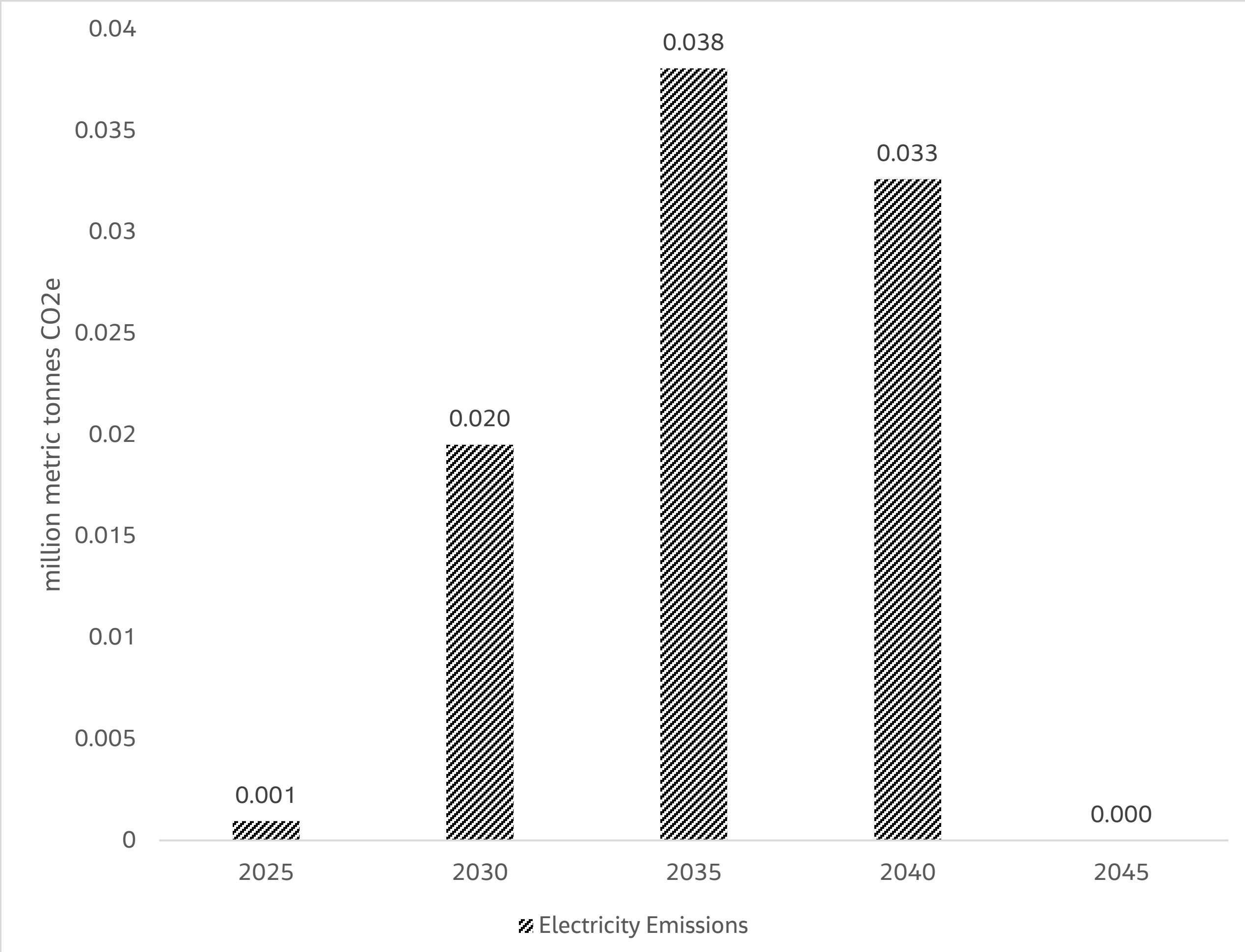


Figure 3-6. Electricity Emissions Resulting from Electrification of Ground Transportation



While transportation electrification reduces emissions in the transportation sector, it shifts some to the power sector. In this analysis, EVs are assumed to have zero emissions in transportation, but some emissions resulting from electricity generation are temporarily shifted to the power sector. Those emissions will move to zero as the grid moves toward achieving 100 percent renewable energy by 2045 consistent with state requirements. Figure 3-5 illustrates the electricity emissions resulting from electrification of terminal and land side equipment in the aviation sector and Figure 3-6 summarizes the emissions resulting from electrification of all ground transportation.

Figure 3-7. Electricity Emissions Resulting from Electrification of Terminal and Landside Equipment (Aviation)



3.3.3 Gaps to Meet Interim or Final Targets

Each wedge diagram and each mode's strategies include carbon removal projects. With current technologies and assumptions about the rate of implementation of these strategies, there are projected gaps in the ability to reach net-negative GHG emissions by 2045, especially when considering upstream impacts of fuel production. The ultimate requirement and goal is that the strategies identified in this Plan will achieve more significant emission reductions than currently projected based on existing data, and that the technology will develop to accelerate decarbonization of all modes of transportation, allowing achievement of net-negative transportation emissions. By definition, carbon removal and sequestration projects are required to achieve net-negative emissions.

This Plan therefore includes the use of carbon removal projects as a means to compensate for residual GHG emissions and achieve the net-negative 2045 goal. **As noted, the removal and sequestration wedges in the diagrams are depicted based on the emission reduction gaps that must be met; additional work is required to determine whether nature-based strategies alone can meet these gaps or if technological options would be required as well.** The sequestration need is based on the removals needed to achieve net-negative emissions in 2045, the shortfall in reductions needed to achieve 50 percent reduction by 2030 compared to 2005, and with a similar steady level of removals in the interim years.

The challenges in achieving large-scale, credible, permanent, and effective carbon removals are as daunting as the challenges in minimizing or eliminating transportation emissions at the source. The process of developing carbon removal projects must start as soon as possible because of the magnitude of removals necessary to meet these targets and the years or decades that will be needed for nature-based removal projects to mature and for technological options to be proven and pilot tested. Refer to Appendix C for more on carbon removals.

3.4 Intermodal Synergies

HDOT is already working together across modes to reduce GHG emissions. The following provides several examples of intermodal synergies already in progress between the various modes:

- **Airports and Highways:** Clean vehicle and electrification strategies implemented by each division may have overlapping and beneficial effects to the other. For example, construction of an EV charging hub on airport property at HNL could be used for rental car companies, bus fleets, or the general public.
- **Highways and Harbors:** Freight transport in Honolulu Harbor traditionally relies on Class 8 drayage trucks to move goods between Pier 51 and the Interisland Barge Terminal (IIBT) at Piers 39-40. There are about 600 drayage trips over a 2-mile route on Sand Island Parkway twice every week. With the establishment of the Kapālama Container Terminal (KCT), containers can now be transported between KCT and IIBT using Class 8 terminal tractors. By reducing the one-way trip distance to 0.3 mile, this initiative can result in annual savings of over 170 metric tonnes of GHG emissions.
- **HDOT:** HDOT-Harbors is working with HDOT-Highways and stakeholders to reduce non-productive emissions related to truck queueing by using advanced gating technologies. For instance, HDOT is working with Matson on the Sand Island Terminal Gating Project to replace gating technology and create a separate queueing area for truck exceptions that currently congest the flow of trucks on Sand Island Parkway. This project is expected to reduce delays by 24 minutes per truck, which would lead to the reduction of 142 metric tonnes of GHG emissions during the first 10 years.
- The Kalaeloa Barbers Point Harbor Access Road project showcases another example demonstrating the long-term collaborative efforts between HDOT and the private sector to improve port infrastructure and reduce emissions. This new roadway being constructed by HDOT and the James Campbell Company will reduce the distance connecting the H-1 Freeway and Kalaeloa Harbor from 2.87 miles to 1.5 miles. In addition to nearly a 50 percent reduction due to the shorter freight corridor distance, the new roadway will also provide improved access to job opportunities and high-quality employment in the Kapolei, Nānākuli, and Wai‘anae areas.
- **Harbors and Airports:** Importing SAF and taking delivery on the Islands will require coordination between HDOT-Harbors and HDOT-Airports, for example, in moving fuel from Barbers Point to Honolulu Harbor.

3.5 Other HDOT Efforts to Reduce GHG Emissions

HDOT has several initiatives underway that, while not included in the wedge diagram or strategies for ground transportation, are part of its commitment to sustainable operation of the agency. Although the following initiatives are not included in this Plan’s GHG inventory, HDOT continues to support and drive progress on other aspects of GHG emission reductions associated with transportation. Some of these initiatives are presented in Section 3.5.1.

3.5.1 Current HDOT Initiatives

Low-Carbon Design and Sustainable Landscaping and Maintenance

HDOT has a program to test asphalt mixes using recycled plastic polymers and concrete mix, both of which are designed to reduce the carbon footprint associated with road construction materials. In addition to exploring the use of sustainable construction materials, HDOT is also exploring sustainable approaches to landscaping and maintenance, including hydro-mulching to revegetate bare land by spraying water, seeds, fertilizer, and mulch to maintain landscaped land.

In 2019, HDOT began testing a concrete mix injected with waste CO_2 as a sustainable transportation initiative. This test allowed HDOT to do a side-by-side comparison of two mixes to determine specifications for the use of carbon-injected concrete for road projects in the future (HDOT 2019).

In 2022, HDOT was awarded a grant towards construction of a plastic recycling research facility. The grant award is part of the FHWA Climate Challenge Initiative to support the efforts of state departments of transportation in carbon reduction and sustainable construction materials. HDOT plans to establish a plastic recycling research facility to allow the conversion of waste plastic into new products that can be used in transportation infrastructure (HDOT 2022c).

Also in 2022, HDOT began testing an asphalt mix with recycled plastic polymer as part of its sustainable transportation initiatives. The amount of plastic modified asphalt used in this pilot—1,950 tonnes—will keep the equivalent of 195,000 plastic bottles out of the landfill. Using plastic in asphalt has the potential to make roads in Hawaiʻi stronger and upcycle material that would be otherwise headed for a landfill (HDOT 2022b).

Systems Reliability: Materials and Methodologies

HDOT is using a wide array of innovative construction materials to improve pavement durability and sustainability. These include polymer coating, ultra-thin white topping; trackless tack coat; highly modified asphalt (HiMA), stone mastic asphalt (SMA), polymer-modified asphalt (PMA), and plastic asphalt; high reclaimed asphalt pavement; carbon-injected concrete; precast concrete panels; and porous/permeable pavements. HDOT is also employing improved maintenance techniques, such as micro-surfacing using PMA emulsion and rotor eradication to refresh stripping while minimizing environmental impact and project disruption.

Tree Canopy Coverage

HDOT has a tree planting initiative underway with the Hawaiʻi Department of Land and Natural Resources (DLNR). Tree canopies can help achieve sustainability goals by providing shade for the pedestrian and bicycle infrastructure networks and helping reduce temperatures at the ground transportation level. In addition, vegetation and groundcover planted in highway medians that require minimal upkeep and mowing can help lower GHG emissions. Identified native species that are less susceptible to burning can be planted along ground transportation facilities to help mitigate wildfire risks. At a minimum, under the Navahine Settlement Agreement, HDOT has committed to planting at least 1,000 trees per year. Progress and key metrics for species planting can be found on the HDOT website at https://highways.hidot.hawaii.gov/stories/s/Tree-Planting-Public-Page/w327-azg3. In 2024, HDOT surpassed its initial goal of supporting 1,000 trees by 300 percent.

Fire Mitigation

HDOT has actively pursued wildfire resilience through both access and vegetation management. Emergency access roads have been constructed and improved in areas including Mililani Mauka (Central O‘ahu), Lahaina Schools (Maui), Kolekole Access Road (West O‘ahu), and Pa‘akea Road (West O‘ahu). In 2024 alone, HDOT cut six fire breaks in Central O‘ahu at Waiawa Prison Road, totaling 1.4 miles in length and 10 feet in width.

Renewable Energy Integration and Energy Savings Improvements

HDOT, as a land holder, can increase the amount of solar, wind, and other clean energy facilities present in the state to produce energy available for charging vehicles and operating facilities, as well as to sell to the grid. HDOT properties include base yards, rights-of-way, and lots, as well as buildings, and could support potential microgrid projects across the state. HDOT will build upon the more than 4,000 solar panels currently deployed on the Terminal 1 parking garage at Daniel K. Inouye International Airport.

HDOT also has an Energy Savings Performance Contract in place to help install energy-saving improvements, including 20,000 highway and tunnel light fixtures and 5,000 interior parking lot lights replaced with light emitting diode (LED) equipment (HDOT 2025). These improvements help support HDOT efforts to achieve energy efficiency goals.

The SustainableHNL (sHNL) program has inventoried GHG emissions annually since 2011 and has achieved Airport Carbon Accreditation (ACA) since 2016, renewing annually for Level 2 Reduction, and achieving Level 3 Optimization for calendar year (CY) 2023. An Annual Sustainability Report created through sHNL inventories energy, carbon, water and waste. Neighbor island airports achieved ACA for CY2023: KOA and LIH at Level 3 Optimization and OGG and ITO at Level 1 Mapping. The Level 3 accreditation requires third-party verification of the emissions inventory, ensuring transparency and accuracy. ACA, administered by Airports Council International, is the global standard for carbon management in the airport industry. By achieving accreditation, HDOT demonstrates its commitment to gathering transportation emissions data and reporting its carbon outputs.

HDOT also proactively partners with airlines, ground handlers, and tenants on decarbonization activities. In the last couple of years, these efforts have included the advancement of clean transportation through the autonomous electric shuttle bus pilot program, displacement of internal-combustion fleet vehicles with EVs and installation and expansion of EV charging infrastructure to support increased adoption of EVs and equipment.

Electrification and EV Infrastructure

HDOT continues to expand electrification infrastructure across its transportation facilities. Ongoing efforts include procurement of EV vehicles at HNL, KOA, ITO, OGG, and LIH; procurement of Wiki-Wiki EV buses and chargers; installation of EV chargers at HNL parking structures, rideshare and taxi lots, and various airside operations; and construction of EV bus charging and maintenance facilities at HNL and the Consolidated Rent-a-Car (CONRAC) Facility. In addition, HDOT is building a parking structure with EV chargers and photovoltaic panels and has completed a feasibility study for net-zero airport operations at the Kahului (OGG) and Kona (KOA) airports.

Biodiesel Performance Management

Currently, the most commonly available biodiesel blends are B5 (5 percent biodiesel and 95 percent petroleum diesel), B10 (10 percent biodiesel and 90 percent petroleum diesel), and B20 (20 percent biodiesel and 80 percent petroleum diesel). This Plan forecasts biodiesel use to increase steadily, supplanting conventional diesel, eventually reaching 100 percent or transitioning to alternative fuels and remaining constant after that. Increased concentrations of biodiesel can present challenges with reduced engine power and fuel efficiency, voided warranties, and variability in quality that may result in engine clogging. These challenges may be managed through engine calibrations, regular maintenance, and ensuring high quality standards through improved biodiesel refining. Despite the drawbacks, biodiesel use remains a short-term component to this Plan and HDOT will continue to evaluate the challenges and management strategies. HDOT is currently collaborating with equipment manufacturers to support future use of biodiesel.

3.5.2 Statewide Strategies

Ground Transportation (Highways)

Discussion of Significant GHG Sources and Current Trends

Providing safe and reliable ground transportation is a core mission for HDOT and is essential to maintain and support people's lives and the economy. Ground transportation is also a significant contributor to overall GHG emissions through the prevalence of vehicles with internal combustion engines that use petroleum-based fuels (gasoline and diesel). This section describes key strategies for HDOT to leverage to achieve net-negative emissions by 2045 and absolute zero emissions in transportation as soon as possible.

Ground Transportation Strategy Description

The described strategies are grouped into the following three key categories:

- Vehicle Electrification
  - Encouraging the switch from ICE vehicles to EVs will be the most effective strategy for reducing overall ground transportation GHG emissions. If the current ground transportation infrastructure remains unchanged, current federal regulations will spur increasing sales of EVs, and by 2045, 38 percent of vehicles in the state would be EVs. A rapid deployment of EVs in the state will require a combination of financial incentives and an accelerated retirement of older gasoline and diesel vehicles. The growing EV population will necessitate a large increase in public EV charging stations. Other elements of this strategy include the transition to EVs of the State's fleet, including HDOT's own fleet vehicles (as required by HRS § 196-9(c)(6)(11) (2021), which requires planning for EV charging stations and that 100 percent of light-duty vehicles that are passenger vehicles in the State's fleet be zero-emissions vehicles [ZEVs] by December 31,2030, and 100 percent of all light-duty vehicles in the State's fleet be ZEVs by December 31, 2035); public transit fleet electrification; and measures to require clean TNC (also known as rideshare) and rental car fleets.
  - Electrification of the on-road vehicle fleet in Hawaiʻi is the single most effective strategy for reducing surface transportation GHG emissions. BEVs have zero tailpipe emissions, and as renewable energy sources are increasingly used for electricity generation, BEVs will further contribute to the reduction of GHG emissions. The purchase price of a new EV is currently higher

than similar ICE vehicles in most cases; however, as battery costs decline and more used EVs enter the market, EV prices are expected to be comparable to ICE vehicles within the next 5 to 7 years. Today, more than 50 EV models are available for purchase in the United States, with many more models expected in the next few years. In addition, the overall total cost of ownership for EVs can be lower than ICE vehicles due to lower costs associated with fuel/electricity and vehicle maintenance.

  - While EVs can contribute significantly to Hawaiʻi's GHG emission reduction goals for the ground transportation sector, they cannot eliminate all ground transportation vehicle tailpipe GHG emissions by 2045, as some vehicles will remain in use for more than 15 years in Hawaiʻi. If every new vehicle sold in Hawaiʻi was an EV starting in 2030, some gasoline vehicles could remain on the road in 2045. In addition, heavy-duty vehicles will be slower to be replaced by EVs, as fewer EV heavy-duty vehicle options are currently available, and EVs may not meet the operational needs for some heavy-duty truck applications. Appendix G contains scenarios that further explore on-road vehicle electrification as a GHG emission reduction strategy through the purchase of new ZEVs and through further implementation of public charging infrastructure.

- Low-Carbon Fuels
  - For gasoline and diesel vehicles remaining on the roads in 2045, the State can promote the use of low-carbon fuels including ethanol, biodiesel, and renewable diesel.
- Fuel Demand Reduction
  - Reducing fuel demand and VMT will contribute to additional GHG emission reductions with significant co-benefits. Specific strategies include multimodal (public transit, bicycle, and pedestrian) network improvements and expansion, multimodal initiatives, rideshare and vanpool programs, employer commuter programs, compact and transit-oriented land development patterns, parking policy revisions, and transportation system management and operations, as well as limiting roadway expansion projects that have been shown to induce demand and increase GHG emissions. These strategies work in combination to reduce the demand for fuel and support robust multimodal alternatives to driving vehicles. Multimodal alternatives improve ground transportation accessibility and affordability for Hawaiʻi's residents and visitors. An increase in active transportation (bicycling and pedestrian travel) would also have public health benefits.

The details of the three multimodal components [public transit (intra-city and inter-city), bicycle, and pedestrian] of the 5-Year Priority Multimodal Network and the 2045 Unconstrained Multimodal Network are discussed in their respective VMT reduction strategies.

The 5-Year Priority Multimodal Network required in the Navahine Settlement Agreement encompasses the public transit, bicycle, and pedestrian priorities of the next 5 years, which include the following:

- Bicycle lanes, shared roadways, and buffered bicycle lanes
- Sidewalk and shared-use paths
- New or relocated bus stops, bus stop improvements, transit priority lanes and signals, and other improvements for Bus Rapid Transit

The evaluation and selection of projects is key to implementing the ground transportation emission reduction strategies outlined in this Plan. HDOT, in partnership with the Oahu Metropolitan Planning Organization (OahuMPO), Maui Metropolitan Planning Organization (Maui MPO), City and County of

Honolulu, County of Hawaiʻi, County of Maui, and County of Kauaʻi, selects projects to advance for funding and implementation subject to approval by FHWA and FTA.

The recently created Mid-Range Transportation Plan (MRTP) evaluates proposed projects against set criteria to assess project alignment with HDOT goals, objectives, and priorities. The Statewide Transportation Improvement Program (STIP) will use the evaluation completed in the MRTP to identify and prioritize projects for federal funding. Funding for projects programmed in the first 4 years of the STIP is subject to approval by FHWA and FTA. The current Federal Fiscal Year (FFY) 2025-2028 STIP includes total funding of approximately $4.5 billion (HDOT Highways Division 2025).

HDOT is updating its project evaluation processes to account for the need to both reduce GHG emissions and VMT. The use of evaluation and emissions reduction tools for the MRTP and projects in the STIP will provide comprehensive insights into the environmental impacts of various projects and looking to alternatives. These tools help planners and policymakers assess emissions, energy use, and sustainability, so that maintenance programs, highways, transit systems, pedestrian, and cycling infrastructure are reviewed for funding based in part on their GHG emissions.

In response to this need, HDOT has developed the Project Island Impact (PIʻI) Tool to help evaluate and prioritize transportation projects based on their GHG and VMT reduction potential. Created as part of the Navahine Settlement Agreement and aligned with planning efforts like the MRTP and STIP, this spreadsheet-based tool provides HDOT the ability to estimate project-level emissions impacts, VMT reductions, and cost-effectiveness with minimal input. Designed for planners, analysts, and grant writers, the PIʻI Tool offers a user-friendly interface and built-in guidance, enabling consistent and credible emissions analysis across a range of project types.

Vehicle Electrification Strategies

To significantly boost the adoption of ZEVs and expand public charging infrastructure, a multifaceted approach is essential. Key implementation actions include enhancing federal and state incentives for EV purchases, implementing public–private partnerships to speed the deployment of charging infrastructure, and increasing investments in renewable energy sources to power these stations. Hawaiʻi's electric utilities, including Hawaiian Electric (HECO) and Kauaʻi Island Utility Cooperative (KIUC), along with the Public Utilities Commission (PUC), are critical actors in ensuring the grid capacity and renewable energy integration needed to support this electrification. Their coordinated planning and regulatory oversight will be foundational to achieving statewide ZEV goals.

In addition, expansion of public awareness campaigns and educational programs already in use in Hawaiʻi will play a crucial role in informing consumers about the benefits of EVs and the availability of public charging infrastructure. Collaboration between government agencies, private sector stakeholders, and local communities is important to ensure a cohesive and effective strategy.

Vehicle Electrification Strategies (HWY-E: Highways Electrification)	
Strategies	**Description**
HWY-E-1	**Build Additional Public EV Charging Infrastructure to Support 100% EV Sales:** HDOT will lead the expansion of Hawaiʻi's EV charging network by implementing the NEVI Plan and working with HECO, KIUC, HSEO, the Hawaiʻi State Legislature, and counties **to** install chargers on public lands, rights-of-way, and in key destinations. This effort will make EVs more practical for drivers statewide, helping cut emissions and meet the state's 100% EV sales goal by 2035. **Proposed Implementation Timeline:** **December 2026:** Full implementation of HDOT NEVI Plan that includes 13 stations is currently on track (federal NEVI Program funding currently in place through September 2026, and the Program is currently under review by the new federal administration). **Proposed Roles and Responsibilities:** • **HDOT:** Full implementation of NEVI Program. HDOT to seek funding to invest $40M into public charging stations and infrastructure for State and county vehicles by 2030. • **Electric Utilities:** As the state's electricity providers, both HECO and KIUC are responsible for pursuing efforts towards 100% renewable energy generation by 2045; the mandate for renewable energy generation by these electric utilities will need to account for increased electricity load from EVs. • **HECO:** Successful alignment and implementation of HECO's Electrification of Transportation Strategic Roadmap, where possible. HECO to upgrade and add chargers where needed and feasible. HECO to support HDOT and other EV charging station owners on EV charging infrastructure deployment (for example, site identification and technical reviews, or service connection). This work supports HECO's obligation under HRS § 269-92, which establishes Hawaiʻi's Renewable Portfolio Standards and requires 100% of electricity sales to come from renewable energy sources by 2045. • **Public Utilities Commission (PUC)**: Review and approve utility across actions related to EV charging infrastructure and ensure alignment with state energy goals. The PUC regulates HECO and KIUC and is a critical decision-maker in enabling infrastructure and rate design. • **Public–Private Partnership:** Should be leveraged, such as with firms that provide transportation infrastructure as a service, to explore additional opportunities to speed deployment of the network, including on-street charging options that tap into public infrastructure (for example, public buildings and streetlights). **Proposed Benchmarks:** **2030:** HECO estimates ~3,600 public charging stations and ~46,000 private charging stations are needed by 2030. Thirteen NEVI-compliant stations will achieve "Fully Built Out" status under NEVI and will cost more than the allotted $17.7M ($3M per site). So far, eleven sites have been identified: two each on Maui, Oʻahu, and Kauaʻi, and five on Hawaiʻi Island. The first two NEVI-funded EV charging stations opened on Maui at the Kahului Park & Ride and at Aloha Tower on Oʻahu in 2024. Both locations feature four 150-kilowatt (kW) chargers. HDOT continues to design and build out the remaining sites that are strategically located to ensure accessibility and compliance with NEVI requirements, such as being within 1 mile of designated Alternative Fuel Corridors and having 24-hour public accessibility.
HWY-E-2	**Enact Financial Incentives for EV Purchase:** The Hawaiʻi State Legislature, with support from HDOT, HSEO, and original equipment manufacturers (OEMs), will establish tax credits, rebates, and feebate policies to make EVs more affordable and speed up their adoption statewide. These incentives, paired with an expanding charging network, will help Hawaiʻi reach its goal of 100% EV sales by 2035 while cutting transportation emissions.

Vehicle Electrification Strategies (HWY-E: Highways Electrification)	
Strategies	**Description**
	Proposed Implementation Timeline: **2026:** Develop EV purchase program legislation including a mixture of fees, feebates, and tax relief to incentivize EV sales. **2028:** Implement new program and fees/rebates. **Proposed Roles and Responsibilities:** • **Hawaiʻi State Legislature**: Enact EV purchase tax incentives. • **HDOT:** Complete NEVI infrastructure network. • **HSEO:** Co-lead passage of law, support implementation of law/regulatory action. • **OEMs**: Ensure supply of vehicles to meet demand associated with tax incentive/subsidy program. • **Counties and HDOT**: Remove barriers to public–private partnerships for Level 2 (L2) on-street EV chargers powered by adjacent buildings and infrastructure. **Proposed Benchmarks:** **2035:** Increased new sales of EVs to 81% by 2030 and 100% by 2035.
HWY-E-3	**Promote Incentive Programs to Accelerate the Turnover of ICE Vehicles to EVs**: The Hawaiʻi State Legislature, HDOT, HSEO, and community partners will launch an incentive program to retire older ICE vehicles and replace them with EVs, prioritizing low-income and underserved households. By targeting vehicles 15 years or older, this program cuts emissions from high-polluting cars while making clean transportation more accessible and equitable statewide. **Proposed Implementation Timeline:** **2026:** Program planning and pilot design. **2027-2029:** Pilot phase with focus on priority communities and vehicles over 20 years old. **2030+** Program scaling to statewide implementation and vehicles over 15 years old. **Proposed Roles and Responsibilities:** • **Hawaiʻi State Legislature**: Allocate funding, approve program structure, and authorize funding mechanisms. • **Counties' Solid Waste Programs**: Administer the program, including vehicle verification and scrappage. • **HSEO/HDOT**: Co-develop program guidelines, conduct outreach, track performance. • **HECO:** Successfully implement HECO Electrification of Transportation Strategic Roadmap for expansion of the HECO fast-charging network. • **Community-Based Organizations**: Assist with application support and community engagement. • **EV Dealers**: Provide access to qualifying new and used EVs as well as ability to access financial incentives at the time of purchase. **Proposed Benchmarks:** **2027:** Launch of pilot. **2030:** By 2030, retirement of 5,000+ ICE vehicles aged 15+ as part of the pilot program. **2030-2045:** Statewide program resulting in 250,000+ ICE vehicle replacements between 2030 and 2045.
HWY-E-4	**Establish EV Battery Recycling and Disposal System:** HDOT, HSEO, the Hawaiʻi State Legislature, and the recycling industry partners will create a system that ensures batteries are collected, transported, and processed responsibly. This strategy establishes a statewide framework for safe and equitable disposal and recycling of EV lithium-ion batteries. By expanding battery collection infrastructure, introducing

<table>
<tr><th colspan="2">Vehicle Electrification Strategies
(HWY-E: Highways Electrification)</th></tr>
<tr><th>Strategies</th><th>Description</th></tr>
<tr><td></td><td>Extended Producer Responsibilities (EPR) policies, and launching public education campaigns, Hawaiʻi aims to minimize fire and environmental hazards while supporting a sustainable EV market.
Proposed Implementation Timeline:
2025-2026: Legislative development and enactment of EPR laws, initiation of partnerships with recyclers, and infrastructure planning.
2027-2028: Construction and certification of battery drop-off centers and launch of public education.
2029-2030: Full operationalization of the program statewide; ongoing monitoring and evaluation.
Proposed Roles and Responsibilities:
• Hawaiʻi State Legislature: Draft and enact EPR laws while enabling funding mechanisms.
• HDOT (with Environmental Compliance Oversight): Lead program coordination, oversee infrastructure planning, and manage transport logistics.
• HSEO: Support legislative design and oversee public education.
• Certified battery recyclers: Process and recover materials from EV batteries.
Proposed Benchmarks:
2030: Establish certified battery drop-off centers in all counties.
2035: Achieve 90% proper disposal and recycling rate for end-of-life batteries statewide.</td></tr>
<tr><td>HWY-E-5</td><td>Clean TNC and Rental Car Fleets: HDOT will partner with the TNCs, rental car companies, and charging providers to accelerate the shift to electric fleets by offering airport access incentives and building centralized charging infrastructure at hotels, among others. Electrifying these high-mileage vehicles will cut emissions cost-effectively while easing highway and airport pollution. This strategy builds on public charger expansion efforts in HWY-E-1 and targets 100% fleet electrification by 2045.
Proposed Implementation Timeline:
5 to 15 years for full electrification of TNC, taxi, and rental car fleets, consistent with typical fleet turnover cycles.
Proposed Roles and Responsibilities:
• TNC operators: Develop and implement fleet electrification transition plan.
• Ridesharing service companies: Develop and implement fleet electrification transition plan.
• Public charging network operators: Ensure adequate charging infrastructure network to support fleet electrification.
• Rental car companies: Develop and implement fleet electrification transition plan.
• Counties: Ensure adequate chagrining infrastructure network to support fleet electrification.
• HDOT: Install charging infrastructure and identify and implement incentives for fleet conversions (refer to AIR-L-3).
Proposed Benchmarks:
25% fleet conversion by 2030; 100% fleet conversion by 2045.</td></tr>
<tr><td>HWY-E-6</td><td>Enact Preferential EV Registration Legislation: The Hawaiʻi State Legislature, HDOT, HSEO, and county departments of motor vehicles (DMVs) will work together to pass legislation that raises registration fees for new gas-powered vehicles while lowering them for EVs and to set a statewide target to end new ICE vehicle registrations by 2035. This strategy encourages cleaner transportation choices, raises funds to support EV infrastructure and equity programs, and helps Hawaiʻi meet its zero-emissions goals.</td></tr>
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Vehicle Electrification Strategies (HWY-E: Highways Electrification)	
Strategies	**Description**
	Proposed Implementation Timeline: **2026:** Develop legislation. **2026-2034:** Gradually increase ICE registration fees and reduction. **2035:** Target year-end new ICE vehicle registrations. **Proposed Roles and Responsibilities:** • **Hawaiʻi State Legislature**: Enact laws setting the ICE registration target and revising vehicle registration fee structure. • **HDOT:** Support development of legislation with Legislature and partners; implement and administer new registration fee structure. • **HSEO**: Support legislative strategy development; monitor implementation and emissions impacts. • **County DMVs**: Enforce new registration guidelines and fee structures. **Proposed Benchmarks:** Increasing sales of EVs to 81% by **2030** and 100% by **2035.**
HWY-E-7	**Support Sales Tax Exemption for EVs:** The Hawaiʻi State Legislature, Department of Taxation, HSEO, and automobile dealers will work together to pass and implement a sales tax exemption for EV purchases. This policy lowers upfront cost for consumers, making EVs more affordable and accelerating adoption to reduce transportation emissions statewide. **Proposed Implementation Timeline:** **2026:** Develop legislation. **2026-2030:** Monitor and report on the effectiveness of the exemption in increasing EV. adoption. **Proposed Roles and Responsibilities:** • **Hawaiʻi State Legislature**: Enact the General Excise Tax (GET) exemption for EVs. • **Hawaiʻi Department of Taxation:** Implement and administer the tax exemption. • **HSEO:** Support legislative efforts and promote consumer awareness. • **HDOT:** Support legislative efforts and promote consumer awareness. • **Automobile Dealerships:** Educate customers about the tax exemption and adjust pricing accordingly. **Proposed Benchmarks:** Increasing new sales of EVs to 81% by **2030** and 100% by **2035.**
HWY-E-8	**Transit Fleet Electrification:** Local transit agencies, with support from HDOT, HECO, and FTA, will transition bus and paratransit fleets to electric fleets by securing federal grants, upgrading infrastructure, and developing route-based transition plans. This strategy lowers transportation emissions in communities statewide and aligns with Hawaiʻi's goal of a 100% clean transit fleet by 2045. **Proposed Implementation Timeline:** **2030:** City and County of Honolulu is tracking towards a goal of fleet electrification by 2030. Other islands will need substantial planning and funding to achieve a full fleet transition within that time frame. **Proposed Roles and Responsibilities:** • **County/Local transit agencies:** Develop electrification or clean fuels fleet transition roadmap or planning study to apply for, and obtain, Lo-No and Bus Facilities grant funding from FTA. **HECO:** Upgrade power capacity and service connections.

Vehicle Electrification Strategies (HWY-E: Highways Electrification)	
Strategies	**Description**
	• **HDOT**: Supporting planning efforts for electrification and advocating for engagement from State government officials to ensure alignment with statewide mandates such as HRS § 269-92, which requires 100% of electricity sales to come from renewable sources by 2045. • **FTA:** Provide grant programs and funding to local Hawaiian transit agencies through programs like Lo-No. FTA grants provided electric buses as follows: Kauaʻi (4), Hawaiʻi Island (6), and Maui (4). **Proposed Benchmarks:** **2045:** 30% fleet conversion by 2030, 100% fleet conversion by 2045. **December 31, 2035:** Hawaiʻi House of Representatives Bill (HB) 552 mandates that all State agencies transition their light-duty motor vehicle fleets to 100% ZEVs by December 31, 2035.
HWY-E-9	**Efficient and Clean Freight:** HDOT will work with counties, freight operators, and logistics companies to transition medium- and heavy-duty trucks to electric models and pilot zero-emission and last-mile delivery solutions in urban centers. The strategy includes assessments of truck trips, charging needs, and economic impacts, aiming to cut freight emissions while improving air quality near busy routes. With coordination and smart planning, Hawaiʻi can modernize its freight systems to be cleaner, safer, and more efficient. **Proposed Implementation Timeline:** Developing implementation strategies and studies are needed to deploy this strategy, including the use of pilot projects to test feasibility of select actions. This work should be coordinated with HWY-E-1. **Proposed Roles and Responsibilities:** • **HDOT:** Review current programs for zero-emission Class 7 and 8 truck adoption, ensure that public charging infrastructure can also be adapted to service the heavy-duty truck market, study possible economic impacts and potential subsidy programs that would ensure timely transition. • **Counties and HDOT**: Consider new strategies for zero-emission, last-mile, and urban freight, adopting best practices from other cities. **Proposed Benchmarks:** **2027:** Complete analysis of last-mile delivery opportunities. **2030:** 2% to 4% increase of use of clean freight vehicles. **2045:** 100% use of clean freight by 2045.

Fuel Demand Reduction/Multimodal Strategies

Reducing fuel demand and VMT will contribute to additional GHG emission reductions with significant co-benefits. Specific strategies include multimodal (public transit, bicycle, and pedestrian) network improvements and expansion, multimodal initiatives, rideshare and vanpool programs, employer commuter programs, compact and transit-oriented land development patterns, parking policy revisions, and transportation system management and operations, as well as limiting roadway expansion projects that have been shown to induce fuel demand and increase GHG emissions.

Fuel Demand Reduction/Multimodal Strategies (HWY-M: Highways Multimodal)	
Strategies	**Description**
HWY-M-1	**Plan & Implement 5-Year Priority Multimodal Network:** HDOT, in coordination with counties and communities, will plan, assess, and implement a contiguous pedestrian, bicycle and transit infrastructure that connects residential areas, schools, businesses, and key destinations across Hawaiʻi. This strategy supports mode shift from cars to pedestrians, bikes, rollers, buses and rail, thereby reducing VMT while improving access, especially for youth and kūpuna who do not drive, as well as disadvantaged communities, and enabling safety for all road users. **Proposed Implementation Timeline:** **2025:** Map the 5-Year Priority Multimodal Network, which includes critical projects that fill gaps in the pedestrian, bike, and transit networks. Secure State and county agreement on the network and begin programming and requesting funds. **2026-2029:** Follow Implementation Plan to program, fund, plan, design, and construct all projects. **2030:** Complete construction of the 5-Year Priority Multimodal Network. **Proposed Roles and Responsibilities:** • **HDOT**: Lead the creation of the [geographic information system] GIS 5-Year Priority Multimodal Network map and corresponding documents, and implement in coordination with the counties. • **Counties**: Provide HDOT with their priority projects and continuously communicate and partner with HDOT to seek funds, program projects, and move projects forward depending on particular project needs. **Proposed Benchmarks:** **2030**: Benchmarks to be established within the 5-Year Priority Multimodal Network and Implementation Plan and may include the following: • The percentage increase of centerline miles of HDOT and county/community ground transportation facilities that support bicycle travel. • The percentage increase of centerline miles of HDOT and county/community ground. transportation facilities that support bicycle travel that will meet the applicable Complete Streets (CCH 2016) multimodal infrastructure design and maintenance thresholds. • For public transit facilities, public school bus facilities, and key land uses, the percentage increase of residences within 1.5, 3, and 5 miles with direct contiguous access. • Increased bicycle safety, support of Vision Zero, and alignment with the Hawaiʻi Strategic Highway Safety Plan.
HWY-M-2	**Planning and Completion of Bicycle and Pedestrian Infrastructure Network:** HDOT, in coordination with counties and communities, will develop and implement statewide bicycle and pedestrian networks that connect schools, neighborhoods, commercial areas, transportation infrastructure, and ultimately supports active transportation. This strategy reduces VMT by enabling safe, convenient biking as a daily travel option, while promoting equity, public health, and access to cleaner transportation across Hawaiʻi. **Proposed Implementation Timeline:** **2030:** Update to the Hawaiʻi Statewide Bicycle and Hawaiʻi Statewide Pedestrian Plans to include implementation of the Bicycle and Pedestrian Infrastructure component of the 5-year Priority Multimodal identified as the Unconstrained Network by 2030. **2030:** Implementation Activity of the Bicycle and Pedestrian Infrastructure components of the 5-Year Priority Multimodal Network complete before 2030. **2045:** Implementation Activity of the Bicycle and Pedestrian Infrastructure component of the Unconstrained Network complete before 2045.

Fuel Demand Reduction/Multimodal Strategies (HWY-M: Highways Multimodal)	
Strategies	**Description**
	Proposed Roles and Responsibilities: • **HDOT**: Lead the creation of the documents and implementation in coordination with the counties and communities of Hawaiʻi. **Proposed Benchmarks:** **2030**: Benchmarks are established within the 5-Year Priority Multimodal Network and Implementation Plan. The 2035, 2040, and 2045 benchmarks are established within the Updated Statewide Bicycle Plan and the Updated Statewide Pedestrian Plan and may include the following: • The percentage increase of centerline miles of HDOT and county/community ground transportation facilities that support bicycle and pedestrian travel. • The increase in percent mode share for bicycling and walking. • For public transit facilities, public school bus facilities, and key land uses, the percentage increase of residences, within 0.25 and 0.5 mile, with direct access to contiguous Americans with Disabilities Act (ADA)/Public Right-of-Way Accessibility Guidelines (PROWAG) accessible pedestrian infrastructure facilities. For public transit facilities, public school bus facilities, and key land uses, the percentage increase of residences within 1 and 2 miles with direct access to contiguous bicycle facilities. • Increased Bicycle and Pedestrian safety, support of Vision Zero, and alignment with the Hawaiʻi Strategic Highway Safety Plan.
HWY-M-3	**Transit Expansion:** HDOT will partner with counties, MPOs, and transit providers to expand bus, rail, and inter-city transit services; improve stations and stops; and prioritize road designs that enhance access for people walking, biking, or using mobility devices. This strategy supports a shift away from car dependence by reducing VMT and emissions while improving equitable access to affordable, reliable transportation and essential services across communities. **Proposed Implementation Timeline:** **2025:** Complete 5-Year Priority Multimodal Network and Implementation Plan. **2030:** Complete implementation of transit-related projects on the 5-Year Priority Multimodal Network. **Proposed Roles and Responsibilities:** • **HDOT**: In cooperation with counties and transit providers, HDOT will support public transit operations through infrastructure improvements such as queue-jump lanes, signal prioritization, and upgrades to transit stations and stops. HDOT will also provide funding support where appropriate. • **Counties:** In cooperation with HDOT, counties will lead or coordinate implementation of these improvements and ensure access to transit stops by all modes of travel. In cooperation with HDOT, when applicable, counties will support the public transit operations through infrastructure improvements such as queue-jump lanes and signal prioritization. • **Transit providers:** In cooperation with HDOT, transit providers will identify routes for expansion, improvement, or conversion, and will work with HDOT and local jurisdictions to locate and enhance transit stations and stops. **Proposed Benchmarks:** The Transit component of the 5-Year Priority Multimodal Network and Implementation Plan will include the 2030 benchmark projects to be completed. HDOT will coordinate with counties, MPOs, and transit providers to support planning for future transit projects beyond 2030. This coordination will guide long-term investments and inform future updates to the multimodal network.

Fuel Demand Reduction/Multimodal Strategies (HWY-M: Highways Multimodal)	
Strategies	**Description**
	To evaluate and prioritize future transit projects, HDOT will work with partners to develop performance benchmarks that may include the following: • Decrease in travel times. • Increase in ridership. • Increase in access to public transit via bicycle and travel as a pedestrian and for people with disabilities [measured in contiguous ADA/PROWAG accessible sidewalks, ramps, shared-use paths, and bicycle lanes to public transit stops from 0.25 mile away]. • Increase in secure bicycle parking at public transit stops (measured as the percent of high frequency public transit stops with secure overnight bicycle parking) and service benchmarks (service levels and coverage, ridership, and similar) will be set as part of a discussion among HDOT, transit agencies, the **Hawaiʻi** State Legislature, local governments, transit users, and members of the general public. It is vital to have all parties (and particularly the transit agencies) be responsible for implementing proposed improvements and be active participants in this discussion.
HWY-M-4	**Intermodal Network Review and Implementation:** HDOT, in collaboration with the counties, schools, transit providers, and community partners, will establish a Quick-Build toolbox and program and assess first- and last-mile gaps between public transit, walking, biking, and school bus services to create an inclusive, multimodal network. This strategy improves mobility options and equitable access to them by identifying and addressing barriers that limit access to affordable housing, jobs, and essential services. **Proposed Implementation Timeline:** **2027:** Complete statewide Quick-Build Toolbox and Program guidelines. **2027:** Complete First-Mile-Last-Mile Intermodal Connection Analysis Document. **2029:** Complete existing Bicycle and Pedestrian Infrastructure Network Gap-Analysis. **Proposed Roles and Responsibilities:** • **HDOT**: Lead the creation of the document in coordination with transit operation businesses, the counties and communities of Hawaiʻi, Safe Routes to School (SRTS), the State of Hawaiʻi Department of Education Student Transportation Services Branch, and public school bus operation contractors. **Proposed Benchmark:** The implementation of the results of this analysis (and therefore the benchmarks) falls into the 2045 Unconstrained Multimodal Network and Implementation Plan.
HWY-M-5	**Bicycling and Pedestrian Initiatives:** HDOT will lead the development of a statewide Bicycle and Pedestrian Initiative Implementation Plan by 2027, identifying opportunities for HDOT to support, integrate, or lead programs that promote safe and accessible active transportation. This strategy complements infrastructure investments by encouraging mode shift, improving resident health outcomes, and expanding mobility options for underserved communities. **Proposed Implementation Timeline** **2028:** Complete Bicycle and Pedestrian Initiative Analysis and Implementation Plan Document. **2045:** Complete Implementation Activity of the Bicycle and Pedestrian Initiative Implementation Plan. **Proposed Roles and Responsibilities:** • **HDOT**: Lead the creation of the document and its implementation in coordination with other State departments and the counties and communities of Hawaiʻi.

Fuel Demand Reduction/Multimodal Strategies (HWY-M: Highways Multimodal)	
Strategies	**Description**
	Proposed Benchmarks: **2030, 2035, 2040, and 2045** benchmarks for the bicycle and pedestrian initiatives are established within the Statewide Bicycle and Statewide Pedestrian plans.
HWY-M-6	**Compact and Transit-Oriented Development (TOD):** HDOT will collaborate with State and county agencies, the Office of Planning and Sustainable Development (OPSD), and developers to support compact and TOD by reviewing land use policies and advancing projects that prioritize multimodal access and a reduced reliance on driving. Over time, this approach will shorten trips, lower emissions, and promote more efficient land use that aligns with other state housing, transportation, and/or climate goals. **Proposed Implementation Timeline:** Long-term to realize the full GHG benefits of TOD/compact development; immediate in terms of identifying partners and opportunities for this type of development. **Proposed Roles and Responsibilities:** • **HDOT:** Work closely with partner agencies to promote TOD and compact development and provide comments on land use projects calling for alternatives to driving, designs that prioritize active transportation, and reduced parking requirements. HDOT is to clearly express support for TOD and compact development to the Hawaiʻi Land Use Commission and OPSD, emphasizing the need to leverage the existing State transportation system and multimodal networks and emphasizing the reduction of the construction of new high-VMT developments far from existing jobs and services. • **Counties**: Review and revise building permitting ordinances and development regulations to optimize TOD and compact development. • **OPSD**: Key partner in the review of projects, advancing integrated planning for the state, including the promotion of TOD and sustainable development. **Proposed Benchmark** Number of new ordinances adopted (county and state level) that substantially advance TOD or compact development.
HWY-M-7	**Innovative Mobility Solutions:** HDOT, in partnership with counties, MPOs, and transit providers, will support the rapid deployment of innovative mobility technologies, such as Mobility-as-a-Service (MaaS), bikeshare, and autonomous EVs, by funding programs and advancing planning integration. These solutions will enhance multimodal activity; reduce SOV trips; and continue to lay the groundwork for scalable, tech-driven transportation systems across Hawaiʻi. **Proposed Implementation Timeline:** These programs can be launched quickly. **Proposed Roles and Responsibilities:** • **HDOT**: Support solutions with funding and be included in future planning efforts. Support development of public–private partnerships to deploy mobility innovations that reduce single-occupancy car trips. • **Counties, MPOs, transit providers**: Promote MaaS through communication strategies and leverage existing rideshare fleets, and mobility hubs. **Proposed Benchmarks:** **2030:** 5% increase from a 2025 baseline of bikeshare innovative mobility solutions (including bikeshare) use by 2030. **2045:**10% increase from a 2025 baseline of innovative mobility solutions (including bikeshare) use by 2045.

Fuel Demand Reduction/Multimodal Strategies (HWY-M: Highways Multimodal)	
Strategies	**Description**
HWY-M-8	**Ridesharing**: HDOT, in collaboration with county agencies, will expand carpool and vanpool programs by improving ride-matching tools, promoting HOV benefits, and piloting incentives like managed lane access and subsidies. These efforts aim to reduce SOV trips, lower emissions, and provide more affordable commuting options statewide. **Proposed Implementation Timeline:** **2025**: Identify ways to continue to support and further encourage rideshare programs. **2026**: Implement ways identified. **2027-2045**: Further revise and implement. **Proposed Roles and Responsibilities:** • **HDOT:** Continue investing in carpooling resources; plan for addition of vanpooling in select markets; improve online ride-matching tools and conduct online advertising. • **County agencies:** Identify locations suitable for park-and-ride lots and develop them for public use. **Proposed Benchmarks:** **2030**: 2.5% of commute trips converted from SOV to rideshare, from a 2025 baseline. **2035:** 5% of commute trips converted from SOV to rideshare, from a 2025 baseline. **2040:** 7.5% of commute trips converted from SOV to rideshare, from a 2025 baseline. **2045:** 10% of commute trips converted from SOV to rideshare, from a 2025 baseline.
HWY-M-9	**Employer Commuter Programs:** HDOT, in partnership with the counties, MPOs, and HSEO, will support and promote employer-based programs through a statewide implementation plan; encouraging transit, carpool, vanpool, and active commuting options. These programs aim to reduce commute-related VMT, lower emissions, and provide equitable, lower-cost travel choices for Hawaiʻi's workforce. **Proposed Implementation Timeline:** **2026:** Complete HDOT Support of Employer Commuter Programs and Implementation Plan document. **Proposed Roles and Responsibilities:** • **HDOT:** Promote/communicate with public. • **HSEO:** Leverage transportation decarbonization efforts to promote/communicate about program. • **Counties/MPOs:** Engage employers to expand use of the service. **Proposed Benchmarks:** 2030, 2035, 2040, and 2045 benchmarks for the types of employee commute programs and the employer percentage participation by county will be established in the HDOT Support of Employer Commuter Programs and Implementation Plan.
HWY-M-10	**Revised Parking Standards:** HDOT will support counties in revising parking policies by reducing minimum parking requirements and promoting dynamic pricing strategies that discourage solo driving and encourage the use of public transit, biking, and walking. These reforms aim to reduce VMT, improve land use efficiency, and support more sustainable, multimodal urban development. **Proposed Implementation Timeline:** **1 to 3 years**: Review and revise permitting requirements for parking and study the location and use of parking meters. **Proposed Roles and Responsibilities:** • **HDOT**: Leader effort and support local governments. • **Counties**: Reduce or eliminate mandatory parking requirements for new developments; implement dynamic pricing and parking management strategies like the "85% utilization rule"

Fuel Demand Reduction/Multimodal Strategies (HWY-M: Highways Multimodal)	
Strategies	**Description**
	that adjust prices to maintain 15% vacancy, which reduces circling for parking, decreases traffic congestion, and lowers emissions. **Proposed Benchmark:** Number of new ordinances/regulations adopted to optimize TOD or compact development adopted by counties.
HWY-M-11	**Congestion Pricing:** HDOT will support counties and the Hawaiʻi State Legislature in studying and implementing strategies such as cordon pricing and tolling to reduce congestion, emissions, and VMT. These tools will be deployed after multimodal alternatives are established and are designed to generate funding for sustainable transportation while incentivizing carpooling, transit use, and active mobility. **Proposed Implementation Timeline:** **5-10 years**: Deployment would take 5 to10 years of study and alternatives analysis based on nationwide examples (such as New York or San Francisco); it also requires deployment of the multimodal network to support alternatives to driving prior to the launch of any program(s). **Proposed Roles and Responsibilities:** • **Hawaiʻi State Legislature:** Take legislative action in support of each initiative. • **Counties:** Lead study and implementation. • **HDOT:** Support all parties with staffing, data, analysis, and funding. Partner with sister agencies to develop a workplan and advance needed legislation. Continued implementation and Reporting of the HiRUC (Hawaiʻi Road Usage Charge) Program as a revenue neutral replacement of gas taxes. The transition starts by applying the road usage charge (RUC) to EVs on July 1, 2025. The state is targeting to extend the RUC to all light-duty vehicles by 2033. **Proposed Benchmarks:** Board approval of revised studies; completion of capital and funding plan; Board approval of funding requests.
HWY-M-12	**Safe Youth Transit Access:** Enact legislation that provides a funding mechanism (possibly using revenues from a Clean Fuel Standard [CFS]) to incentivize counties to provide free public bus access to youth (under 18) and improve safety for youth on buses. This strategy aims to remove transportation barriers for youth—especially those from low-income or underserved communities—and reduce single-rider vehicle use. Washington State's Youth Ride Free Program provides a model to follow and demonstrates that the program must be supported by a sustainable funding source so as not to create financial strain on local transit agencies. **Proposed Implementation Timeline:** **2025:** Collaborate with county transit agencies and State legislators to draft funding strategy and legislative proposal(s). **2026:** Introduce and support legislation to fund the program. Begin developing agreements with county transit agencies. **2028:** Launch funding program to support Safe Youth Transit Access. **2029:** Launch a pilot of Safe Youth Transit Access programs in select counties. Include safety strategies such as designating seating in the front of the bus/rail for keiki in addition to kūpuna and those with disabilities. Begin tracking youth ridership and safety outcomes. **2030:** Expand to all counties with identified funding and proven safety measures in place, incorporating knowledge learned from the previous pilot program. Track youth ridership and safety metrics with county transit reports. **Proposed Roles and Responsibilities:** • **HDOT:** Coordinate research, planning, and outreach.

Fuel Demand Reduction/Multimodal Strategies (HWY-M: Highways Multimodal)	
Strategies	**Description**
	• **Hawaiʻi State Legislature:** Pass legislation that includes a funding mechanism. • **Counties:** Implement fare-free access and consider youth safety improvements. • **City Councils:** May provide local policy support or match funds if needed. **Proposed Benchmarks:** **2026:** Sustainable funding plan approved. **2027:** Pilot program launched in at least one county. **2030:** Youth ride free statewide.

Marine (Harbors)

To reduce emissions from the maritime sector, the following three key approaches can be considered:

- Reducing maritime activity by reducing the number of vessel trips
- Enhancing vessel efficiency through technological improvements
- Transitioning to lower-carbon or zero-emission fuels (including hydrogen and electric where feasible) to minimize emissions per unit of activity

Hawaiʻi Commercial Port Emissions Inventory Baseline Study

It is important to note that while this Plan has provided some high level estimates on the GHG emissions associated with domestic marine services, HDOT-Harbors is currently undertaking a 2-year study to develop a detailed port emissions inventory for marine vessels, cargo handling equipment (CHE), and CHCs across Hawaiʻi's nine commercial ports. This study will provide a comprehensive estimate of air pollutants and GHG emissions, with inventory boundaries that differ from those used in the State DOH GHG emissions inventory. In addition to quantifying emissions, the study will also assess feasible and economically viable strategies to achieve zero-emission port operations, identifying practical solutions for emission reductions. The findings from this study will inform future updates to the State's GHG reduction plan, refining existing strategies and identifying new opportunities to further advance Hawaiʻi's clean transportation and port decarbonization goals.

Discussion of Significant GHG Sources and Current Trends

As Hawaiʻi is heavily reliant on imported goods, there are limited alternatives to reduce cargo shipping without significantly increasing in-state production. Until local production and manufacturing can replace imports at scale, cargo shipments will remain essential for economic stability. Besides cargo operations, the cruise ship industry brings about 300,000 visitors to Hawaiʻi annually, supporting the local economy and creating jobs and opportunities for small businesses and Neighbor Islands. Maintaining current vessel activities also supports the ongoing employment and training of a fully qualified pilot workforce in Hawaiʻi. This workforce supports the ongoing demand for pilotage services, ensures that qualified pilots are available to guide vessels in and out of Hawaiʻi harbors, and facilitates safe movement of large vessels across the state. Therefore, this plan focuses on facilitating the adoption of clean marine fuels while retaining business-as-usual vessel operations throughout the state.

In terms of vessel efficiency improvements, international regulatory bodies, particularly the International Maritime Organization (IMO), have already implemented and are continuing to develop global standards aimed at reducing emissions from ships. Two key IMO regulations currently in effect are the Energy

Efficiency Existing Ship Index (EEXI)[1] and the Carbon Intensity Indicator (CII),[2] both of which set mandatory efficiency and emissions performance requirements for existing vessels. The EEXI establishes a baseline energy efficiency standard for ships, requiring compliance through engine modifications, power limitations, or other retrofits, while the CII introduces a continuous performance assessment that mandates annual efficiency improvements. Ships that fail to meet the required ratings must take corrective actions to improve their fuel efficiency. These measures ensure that vessels calling at commercial ports, particularly those engaged in inter-state and international shipping, will naturally become more efficient over time, regardless of state policies. Beyond current regulations, the IMO is also actively exploring future policies to further decarbonize the maritime sector. These include carbon pricing mechanisms, more stringent efficiency standards, and incentives for zero-emission vessels.

The third and most critical category of emissions reduction strategies is transitioning to low-carbon or zero-carbon fuels, which is a key focus area of this strategy. Clean marine fuels include biofuels (such as biodiesel or renewable diesel), methanol, ammonia, hydrogen, and bio-LNG, each of which has different technological requirements and operational impacts. Renewable biodiesel offers a drop-in solution for existing diesel engines with minimal modifications, making them an attractive early-stage emissions reduction strategy. In contrast, LNG, methanol, ammonia, and hydrogen require engine modifications or entirely new vessel builds, making them longer-term solutions.

Marine Decarbonization Strategy Description

Given the diverse scope of Hawai'i's maritime operations, the marine decarbonization strategy categorizes clean fuel and zero-emission technology adoption into four key areas: non-homeported cruise vessels, ocean carrier cargo vessels, tugboats that transports cargo between islands, and CHCs that operate within port boundaries.

- **Strategy HAR-1, Adoption of Clean Marine Fuels for Non-Homeported Cruise Vessels**: The strategy calls for aggressive fuel carbon intensity (CI) reduction targets:[3] 75 percent below the 2023 baseline by 2030 (less than or equal to [≤] 25 gCO2e/MJ), 85 percent by 2035 (≤15 gCO2e/MJ), 90 percent by 2040 (≤10 gCO2e/MJ), and a 95 percent CI reduction by 2045 (≤5 gCO2e/MJ) by 2045. In meeting these targets, the use of fossil fuels is prohibited with the sole exception of fossil LNG, which is permitted only through 2034. From 2035 onward, only biofuels, renewable fuels (such as renewable LNG and renewable diesel), or e-fuels such as e-methanol, ammonia, or green hydrogen may be used

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[1] The EEXI is a regulatory framework established by the IMO to improve the energy efficiency of existing ships. It sets a minimum energy efficiency performance requirement for vessels based on their engine power, speed, and fuel consumption relative to their cargo-carrying capacity. Ships must comply by implementing technical modifications, such as engine power limitation, hull optimization, or energy-saving technologies, to meet the required efficiency levels.

[2] The CII is an operational IMO regulation that measures and rates the carbon intensity of ships based on their carbon dioxide (CO_2) emissions per unit of transport work. Ships are assigned a rating from A to E, with A being the most efficient and E the least. Vessels rated D for 3 consecutive years or E in any year must submit a corrective action plan to improve performance. The CII framework encourages continuous improvements in operational efficiency through optimized routing, slow steaming, and the use of cleaner fuels to reduce overall emissions.

[3] To ensure consistency and transparency, the well-to-wake CI of marine fuels should be determined using standardized lifecycle assessment methods. The IMO has recently adopted MEPC.376(80), the Guidelines on Life Cycle GHG Intensity of Marine Fuels (IMO 2023), which establish a harmonized framework for calculating CI values from production through combustion, including upstream ("well-to-tank") and downstream ("tank-to-wake") emissions. In alignment with these IMO guidelines, HDOT recommends applying the same standardized methodology to evaluate marine clean fuels. This approach ensures that all fuels are assessed on a comparable basis, supports industry alignment with global standards, and provides confidence that the fuels deployed in Hawai'i's maritime sector contribute to meaningful and verifiable GHG reductions.

for compliance. This pathway reflects both the near-term operational realities of the industry and the investments already underway by major lines such as Matson and Pasha Hawai'i, while ensuring a complete transition to clean fuels in line with state climate commitments.

- **Strategy HAR-2, Adoption of Clean Fuels on Cargo Carrier Ships**: The strategy requires a 65 percent CI reduction by 2030 (≤35 gCO2e/MJ), 80 percent by 2035 (≤20 gCO2e/MJ), 90 percent by 2040 (≤10 gCO2e/MJ), and a 95 percent CI reduction by 2045 (≤5 gCO2e/MJ) by 2045. These reductions can be achieved initially through drop-in biofuels and bio-LNG, with a longer-term shift to advanced clean fuels including e-methanol, ammonia, and green hydrogen.
- **Strategy HAR-3, Adoption of Renewable Fuels on Tug-and-Barge Voyages**: The strategy first calls for the full transition to renewable diesel or biodiesel by 2030. This requirement ensures an immediate shift away from petroleum-based fuels but does not establish a specific CI target in 2030.[4] Instead, to provide the sector with sufficient time to plan and invest in cleaner fuels and technologies, the strategy sets longer-term benchmarks of an 80 percent CI reduction by 2035 (≤20 gCO2e/MJ), a 90 percent CI reduction by 2040 (≤10 gCO2e/MJ), and a 95 percent CI reduction by 2045 (≤5 gCO2e/MJ). These targets could be met through the phased adoption of fuels such as advanced biofuels, e-methanol, ammonia, or green hydrogen, depending on the pace of technological readiness and vessel turnover.
- **Strategy HAR-4, Adoption of Biodiesel (Near-Term) and Green Hydrogen (Long-Term) for Commercial Harbor Crafts**: The strategy calls for 100 percent adoption of bio- or renewable diesel by 2030, followed by a 30 percent transition to zero-emission technologies by 2035, an 80 percent transition by 2040, and 100 percent transition by 2045. This phased trajectory ensures near-term emission reductions while creating a pathway for the widespread deployment of zero-emission vessels as technologies become commercially viable. It should be noted that the technology pathway for zero-emission harbor craft is still emerging. Battery-electric tugs are among the most advanced options, with early pilots such as Crowley's eWolf at the Port of San Diego capable of performing up to four ship-assist jobs per day. However, commercial port operations in Hawaiʻi and elsewhere may demand up to eight jobs per day, highlighting potential service limitations without further advances in battery storage and charging capability. Hydrogen fuel cell vessels represent another promising pathway, offering both higher energy density and greater resilience as hydrogen can be stored for extended periods, which could provide advantages during natural disasters when grid-based charging systems may be disrupted. Nevertheless, both options face significant infrastructure challenges. Battery-electric tugboats require megawatt-scale charging systems, which could strain local grid capacity and require major electrical upgrades, while hydrogen requires new bunkering infrastructure and continued reductions in fuel costs.

It should be noted that the four strategies identified for the marine sector represent a refined selection from a broader list of strategies that HDOT initially considered. However, due to feasibility challenges, technological limitations, and infrastructure constraints, the strategy list was narrowed down to the four core approaches outlined in this document. Several other potential strategies were explored but ultimately not included due to implementation barriers. For example, shore power deployment at key ports,

[4] The rationale for not establishing a 2030 CI target is that tug-and-barge operations face unique challenges compared with ocean carriers and cruise lines. Transitioning this sector requires significant investments in both fueling infrastructure and vessel retrofits or replacements, which are best achieved over time.

especially those that receive large cargo and cruise ships, was assessed but ultimately not prioritized due to Hawaiʻi's grid constraints and high CI of the electrical grid.[5]

While shore power can help reduce emissions from vessels while at berth, it was not included as part of the final strategy list for Hawaiʻi. The primary reason is the significant capital investment required both to upgrade port infrastructure and to retrofit or build vessels with shore power compatibility. In addition, Hawaiʻi faces uncertainty around the availability of low-carbon electricity at the scale needed to supply multiple large vessels at berth simultaneously. These factors make shore power a less viable near-term decarbonization strategy for the state.

International Marine Emissions

The strategies and emission reductions presented in this report are based on domestic marine emission boundaries as defined by the State DOH GHG Emissions Inventory. This means the analysis only considers emissions from intra-state marine operations and vessels departing from Hawaiʻi to the mainland. However, it does not account for emissions from international vessels, including those traveling to or from international destinations or vessels arriving in Hawaiʻi from the mainland.

When factoring in international marine emissions, the impact becomes significantly larger, particularly due to the long distances traveled by these vessels—even though they represent fewer total calls, their emissions are substantial. This is especially evident in the cruise sector, where international operations contribute a considerable share of emissions.

Therefore, in future updates to this Plan, it will be critical to assess the impact of these strategies on international operation and bunkering activities, ensuring a comprehensive approach to reducing maritime emissions.

Furthermore, the strategies in this Plan place a strong emphasis on the adoption of clean and low-carbon marine fuels, which provide emissions reductions across all phases of vessel activity, transit, maneuvering, anchorage, and while at berth. By contrast, shore power would address only emissions during the limited period when vessels are docked. As a result, the incremental emissions reduction benefit from shore power, when layered on top of a clean-fuels strategy, is minimal compared with the very large costs of infrastructure investment, grid upgrades, and vessel modifications that would be required. In this context, prioritizing clean marine fuels over shore power provides a more effective, system-wide approach to decarbonization, ensuring that emissions reductions occur not only at the port but also throughout the entirety of vessel operations.

Another strategy that was explored but ultimately removed was cargo shipment consolidation, or transitioning intra-state freight movement from tug-assisted barges to larger cargo ships to improve fuel efficiency and reduce emissions per ton-mile. However, Hawaiʻi's commercial port system, aside from Honolulu Harbor, is not currently designed to accommodate larger cargo ships. Significant port facility upgrades would be needed to support this transition, making it a costly and complex undertaking. In addition, HDOT carefully evaluated zero-emission vessel technologies and took a cautious approach based on technological readiness. While zero-emission vessels such as battery-electric and hydrogen-powered ships may become viable in the future, their deployment for large cargo and cruise ships is not expected before 2040 or 2045. As a result, the adoption of zero-emission fuels for

[5] According to the EPA eGRID (Emissions & Generation Resource Integrated Database) model, which provides detailed data on the environmental characteristics of electric power generation in the U.S., Hawaiʻi's electricity grid in 2023 had an average emissions intensity of 1,384 pounds of CO_2 per megawatt-hour (MWh), significantly higher than the U.S. average of 771 pounds of CO_2 per MWh. Among all 50 states, Hawaiʻi ranks 43rd in terms of electricity-related GHG emissions, meaning only seven states have a higher emissions intensity than Hawaiʻi.

these vessels was delayed until beyond 2040, while smaller vessels such as CHCs and tugboats were prioritized for post-2030 zero-emission adoption.

The Near-Term Role of Fossil LNG

As noted, the marine strategies allow for continued use of fossil LNG through 2034 provided that both cargo and passenger carrier fleets continue to meet the required fleet-wide, call-weighted average CI targets. Beginning in 2035, only renewable fuels (including bio-LNG and other advanced alternatives) may be used to comply. The rationale for allowing fossil LNG in the near term is rooted in both fuel availability and ongoing industry investments. At present, large-scale supply of renewable natural gas (that is, RNG or bio-LNG) remains limited, while several carriers, including Matson, Pasha Hawaiʻi, and multiple cruise operators, have already invested heavily in LNG-powered vessels and are expanding their fleets. Maintaining the option to use fossil LNG through 2034 enables Hawaiʻi to leverage this existing momentum by accommodating the LNG vessels that are already being purchased, delivered, and deployed.

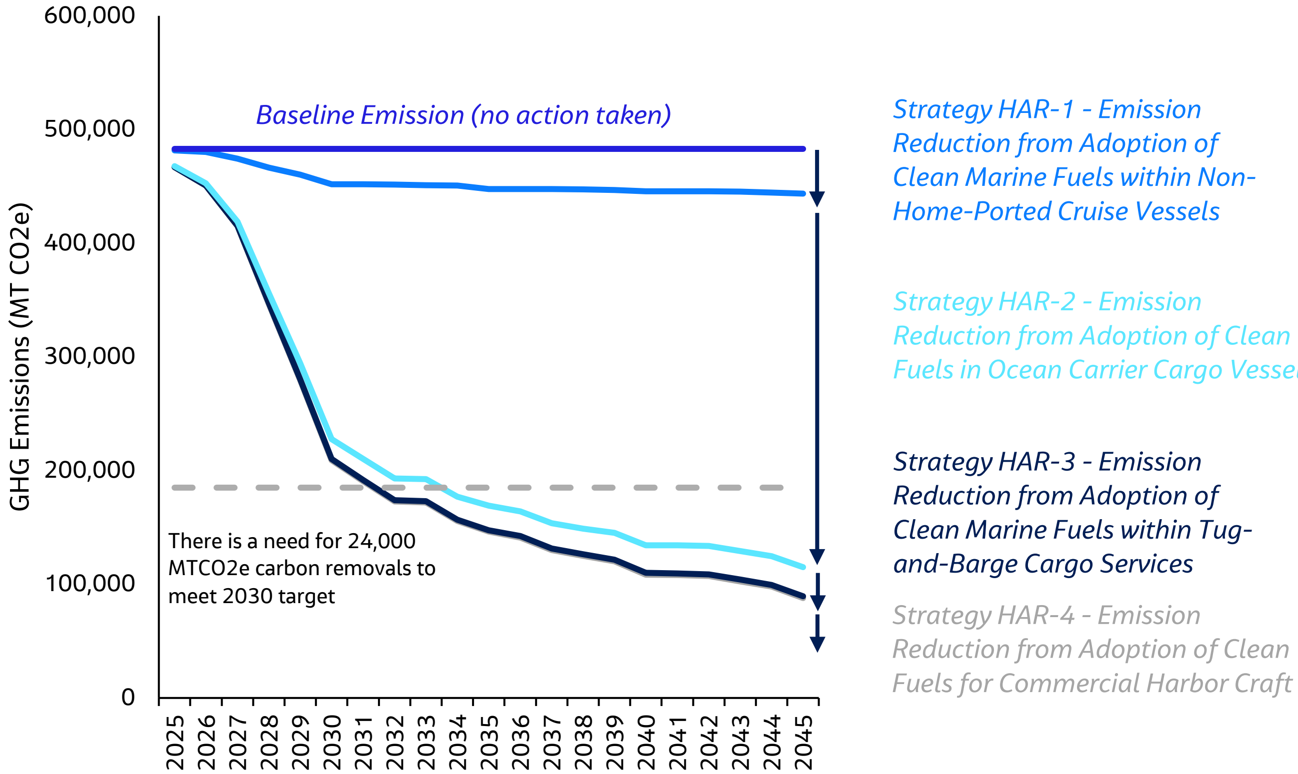
The use of fossil LNG also facilitates near-term emissions and air quality benefits. Compared with conventional marine fuels, LNG vessels produce no diesel particulate matter or sulfur oxides (SO_x) and significantly lower nitrogen oxides (NO_x), providing immediate improvements to air quality and reducing health risks for Hawaiʻi communities. In addition, fossil LNG use helps support the development of LNG bunkering infrastructure, which will be equally critical for renewable LNG once supply scales. This avoids the risk of stranded assets by ensuring that carriers investing in LNG today can fully use their vessels and associated infrastructure during the transition period.

It is important to emphasize that the temporary allowance of fossil LNG does not weaken the CI requirements. All fleets, cruise and cargo alike, remain subject to call-weighted average CI targets that steadily decline toward 2030, 2035, and 2040. Fossil LNG is permitted only as a bridging fuel to maintain operational continuity until renewable fuel supply becomes more widely available. By 2035, the expectation is that renewable LNG and other advanced fuels such as e-methanol, ammonia, and green hydrogen will be sufficiently available to allow for a complete shift away from fossil LNG.

Emissions Reductions Across Maritime Sector

As shown on Figure 3-5, through emissions quantification methodology, HDOT finds that reducing CI for non-homeported cruise ships (Strategy HAR-1) can help lower GHG emissions in the domestic marine sector by 6 percent by 2030 and 8 percent by 2045. Adopting clean marine fuels for cargo carrier ships (Strategy HAR-2) is projected to reduce emissions by 46 percent by 2030 and 67 percent by 2045. Similarly, the adoption of clean fuels for tug-and-barge operations (Strategy HAR-3) is expected to achieve a 4 percent reduction in emissions by 2030 and 5 percent by 2045. In addition, Strategy HAR-4, which focuses on clean fuel adoption for CHCs, is expected to result in a 0.2 percent reduction in GHG emissions by 2030 and 0.3 percent by 2045.

Figure 3-8. Estimated GHG Emissions from Four Strategies in Domestic Marine Travel



MT CO2e = metric tonnes of CO2e

The maritime sector presents some of the most significant challenges for near-term decarbonization. Ocean carriers and cruise vessels are widely recognized as hard-to-decarbonize sectors, primarily due to the lack of commercially ready zero-emission technologies and the absence of fueling infrastructure in Hawaiʻi. While low- and zero-carbon fuels such as green hydrogen, e-methanol, ammonia, and advanced biofuels are under development, they remain in the very early stages of commercialization. Production methods often carry high lifecycle CIs today, and Hawaiʻi currently has no alternative fuel bunkering infrastructure in place. Developing this infrastructure, as well as converting or replacing vessels to use new fuels, requires long lead times and major capital investment.

Compounding these challenges is the slow turnover of ocean-going fleets, where vessels are typically operated for decades. This makes rapid adoption of zero-emission technologies infeasible within the 5-year window leading up to the 2030 target. Early demonstrations, such as electric or hydrogen-powered harbor craft, are promising but not yet available at the scale or level of reliability needed for large ocean carriers or cruise ships. As a result, deep near-term reductions from the maritime sector are not technically or operationally achievable, even under aggressive strategies.

Another critical factor is the role of homeported vessels, most notably Norwegian Cruise Line's Pride of America. This vessel provides continuous interisland service and plays an indispensable role in Hawaiʻi's maritime economy. Its operations bring stability and predictability to the cruise market, generate a steady stream of revenue for ports, and help maintain the long-term financial health of the state's port system. Because of this central role, the Pride of America is excluded from the immediate requirements of the proposed strategy. However, this exclusion significantly constrains the state's ability to reach its 2030 emissions reduction target, as the vessel's year-round operations contribute substantially to Hawaiʻi's overall maritime emissions.

While the exclusion is pragmatic, the HDOT remains committed to pursuing opportunities to decarbonize homeported vessels as pathways become viable. If low-carbon fuels, retrofit options, or new vessel technologies emerge, HDOT will work closely with Norwegian Cruise Line to support their adoption and take necessary actions to accelerate emission reductions from these critical vessels.

Taken together, the lack of commercial zero-emission technologies, the absence of fueling infrastructure in Hawaiʻi, and the slow pace of fleet turnover make it unrealistic for the maritime sector to achieve the State's 2030 emissions reduction target of 50 percent below 2005 levels. Instead, the most meaningful reductions are expected to occur closer to 2035 and 2040, as alternative fuels mature, infrastructure is deployed, and new vessel technologies become commercially viable.

Technological and Economic Feasibility

The strategies presented in this Plan for the maritime sector are intended primarily as a framework to guide Hawaiʻi's approach to reducing maritime emissions in pursuit of the State's GHG reduction targets for 2030 and 2045. They are based on the best available data at this time and reflect how the State is envisioning a transition pathway for ocean carriers, cruise vessels, tug-and-barge services, and CHCs. As the State moves forward with designing and implementing policies to operationalize these strategies, it is committed to conducting detailed assessments of their technological viability, operational practicality, and economic feasibility. These assessments will ensure that the proposed targets and their associated stringencies are achievable with available technologies, can be integrated into vessel operations, and are economically reasonable for both the industry and the State.

While this Plan provides rough economic estimates in Appendix D, including preliminary analyses of transition costs for ocean cargo carriers and tug-and-barge services expressed in terms of incremental costs per container, more robust and detailed economic analysis will be required as implementation advances. Such analysis will evaluate the full range of costs, benefits, and industry impacts, and will be developed in close coordination with maritime stakeholders, including the Hawaiʻi Harbor Users Group.

Required Activities

Successfully implementing Hawaiʻi's marine sector emissions reduction strategies require a coordinated effort across State agencies, legislators, port authorities, fuel suppliers, shipping lines, and other stakeholders. The transition to clean marine fuels and lower-emission operations will not happen automatically; it demands targeted actions, policy interventions, infrastructure investments, technological development, and industry partnerships to drive progress toward 2030 and 2045 climate goals. While each strategy outlined in this Plan addresses a specific emissions reduction pathway, many of the required actions span across multiple strategies, such as building fueling infrastructure, establishing market-based incentives, securing fuel supply chains, and supporting fleet transitions.

The State of Hawaiʻi, through HDOT and other key agencies, must take proactive steps in the areas of regulatory development, financial incentives, infrastructure planning, and stakeholder collaboration. Actions such as expanding bunkering facilities for clean fuels, supporting shipping companies in their fleet transition, and ensuring fuel cost parity through incentives will be essential in making clean marine fuel adoption feasible. In addition, strong partnerships with shipping lines and formal agreements (that is, memorandums of understanding [MOUs]) will play a crucial role in ensuring that industry players align with the state's decarbonization efforts. The following action items outline the key steps that the state must take to enable a successful and sustainable transition toward a low-carbon maritime sector, while balancing economic viability, infrastructure readiness, and environmental benefits:

- **Establish Market-Based Incentives for Alternative Marine Fuels:** Given the higher costs of biodiesel, bio-LNG, e-methanol, ammonia, and hydrogen, financial incentives are critical to encourage adoption. The Legislature should allocate funding or grant agencies the authority to implement market-based mechanisms, such as a CFS, to subsidize cleaner fuels for the maritime sector. These incentives can help reduce the cost gap between fossil fuels and alternative fuels, ensuring cost parity and preventing fuel switching from imposing excessive costs on shipping operators and consumers. Direct subsidies, tax credits, and carbon pricing mechanisms are strategies that should also be explored to accelerate fuel transition efforts.
- **Build Out Fueling Infrastructure for Clean Marine Fuels**: The transition to clean marine fuels requires significant infrastructure investments, including the development of bio/renewable diesel storage, LNG bunkering, and hydrogen refueling facilities at commercial ports. Currently, LNG-powered ships bunker on the mainland, but achieving meaningful emissions reductions will require the availability of clean fuels in Hawaiʻi. HDOT should lead infrastructure planning and investments, working with fuel producers and private investors to construct and expand bunkering facilities. In the short term (by 2030), efforts should focus on LNG infrastructure followed by bunkering infrastructure for methanol by 2035 and ultimately, ammonia and hydrogen infrastructure post-2040 depending on the demand on such fuel.
- **Ensure Stable Supply Chains for Alternative Marine Fuels:** The availability of clean fuels is a major barrier to adoption, as most alternative fuels are not currently produced at scale in Hawaiʻi. HDOT should work with fuel suppliers, energy agencies, and shipping lines to develop a reliable, local supply chain for biodiesel, bio-LNG, methanol, ammonia, and hydrogen. Public–private partnerships will be necessary to secure fuel imports, explore local production opportunities, and establish long-term contracts for clean fuel procurement. Research into locally produced biofuels, using sustainable feedstocks, should also be encouraged to enhance state energy independence and agricultural production.
- **Support Fleet Transition and Vessel Upgrades for Alternative Fuels:** Most alternative fuels, except bio- and renewable diesel, require vessel modifications or new ship builds, making the transition capital-intensive for shipping lines. To facilitate fleet transitions, financial support programs should be developed to assist shipping companies, tugboat operators, and harbor craft owners in upgrading or replacing vessels to run on alternative fuels. Grants, low-interest financing, and tax incentives can help reduce the financial burden of fleet operators.
- **Establish Partnerships with Shipping Lines and MOUs for Clean Fuel Deployment:** To accelerate clean fuel adoption, HDOT should establish MOUs with major shipping lines, including Matson, Pasha Hawaiʻi, and cruise lines, to ensure that their fleet transitions align with the state's emissions reduction goals. These agreements should outline commitments for fuel adoption, infrastructure development, and collaborative efforts in testing and piloting new clean fuel technologies. In addition, partnerships with international shipping companies can help align Hawaiʻi's fuel transition with broader global efforts under IMO and regional decarbonization policies. Establishing formal agreements will provide a structured approach to tracking progress, securing industry buy-in, and ensuring that investments in clean fuel technologies and infrastructure are effectively used.
- **Coordinate Stakeholder Engagement and Public–Private Partnerships**: Successfully implementing these strategies requires collaboration across multiple stakeholders, including State agencies, port tenants, fuel suppliers, shipping lines, and local communities. HDOT should establish a stakeholder working group to facilitate ongoing dialogue, align priorities, and address implementation challenges.

Public–private partnerships should be leveraged to mobilize maritime private sector investments in fueling infrastructure, fleet upgrades, and workforce training programs.

Phased Roadmap for Marine Decarbonization

To provide a clear roadmap for HDOT and the State of Hawaiʻi in achieving the goals outlined in this report, a structured set of actions has been developed in 5-year increments between 2025 and 2045. The first phase (2025-2030) focuses on foundational efforts such as emissions inventory assessments, feasibility studies, infrastructure planning, and the early adoption of clean fuels. The second phase (2031-2035) shifts toward scaling up alternative fuel deployment, expanding bunkering infrastructure, and integrating more advanced low-carbon fuels like green methanol. Finally, the long-term phase (2036-2045) outlines a 10-year period of full-scale decarbonization, including the introduction of hydrogen as a fuel, the full transition of all vessels to zero-emission fuels, and the completion of supporting infrastructure.

- 2025-2030: Foundational Analysis and Early Deployment
  - **Initiate Comprehensive Port Emissions Inventory**: Conducting a detailed emissions inventory for port and marine activities to establish a baseline and track reductions over time.
  - **Feasibility and Economic Analysis**: Conducting a comprehensive study to assess the economic viability of various clean marine fuels, focusing on fuel availability, infrastructure requirements, and total cost of ownership. This will also include viability assessment of transitioning commercial harbor crafts such as tugboats to electric or hydrogen in the longer term.
  - **Develop Clean Marine Fuel Roadmap**: Outlining necessary investments for alternative fuel bunkering facilities, including LNG, methanol, ammonia, and hydrogen.
  - **Adopt Clean Fuels for Short-Term Emission Reductions**: By 2030, transitioning all tug-and-barge operations and CHCs to bio- and renewable diesel.
  - **Establish Market-Based Incentives**: Collaborating with legislators to introduce financial incentives such as tax credits, fuel subsidies, and a CFS to encourage clean fuel adoption.
  - **Develop Near Term Alternative Fuel Infrastructure**: Building out LNG bunkering facilities to support near term transition to clean marine fuels for both cruise and cargo vessels.
- 2031-2035: Scaling Clean Fuel Adoption
  - **Develop Alternative Fuel Infrastructure**: Building out methanol bunkering facilities followed by more advanced fuels such as hydrogen and/or ammonia depending on the demand.
- 2036-2045: Full Decarbonization of the Marine Sector
  - **Expand Hydrogen Adoption:** By late 2030, introducing green hydrogen as a fuel for OGVs, tugboats, and other CHCs.
  - **Achieve Full Transition to Near Zero-Emission Fuels:** By 2045, target fuel CI for Hawaiʻi's marine sector achieving a 95 percent reduction for cruise ships (excluding homeported), ocean carrier cargo vessels, and tug-and-barge cargo operations. In addition, for CHCs operating within the port boundaries, the expectation is full transition to zero-emission technology. This transition could also include the electrification of smaller vessels such as tugboats in specific applications where operational needs, charging infrastructure, and vessel design make such a transition feasible and appropriate.
  - **Finalize Clean Fuel Infrastructure Development:** By 2045, making alternative fuel bunkering facilities fully operational at key ports.

Marine Strategies (HAR: Harbors)	
Strategy	**Description**
HAR-1	**Adoption of Clean Marine Fuels for Non-Homeported Cruise Vessels**: Cruise lines, in partnership with HDOT and fuel producers, will reduce fleet average (call-weighted) cruise ship fuel CI (excluding homeported cruise ships) by 75% by 2030, 85% by 2035, 90% by 2040, and 95% by 2045. The short-term reduction of fuel CI could be achieved through adoption of biofuels and bio-LNG, followed by a phased transition to more advanced alternative clean marine fuels such as e-methanol, ammonia, and green hydrogen in the later timeframe. In meeting these targets, the use of fossil fuels is prohibited, with the sole exception of fossil LNG, which is permitted only through 2034. From 2035 onward, only biofuels, renewable fuels (such as renewable LNG and renewable diesel), or e-fuels such as e-methanol, ammonia, or green hydrogen may be used for compliance. **Proposed Implementation Timeline:** **2030**: All non-homeported cruise ships transition to either biodiesel or bio-LNG, achieving a total CI reduction of 75%. **2035**: Begin transitioning from biodiesel and bio-LNG to other alternative fuels, further reducing average CI to 85%. **2045**: Targeted fuel mix achieving a 95% CI reduction. **Proposed Roles and Responsibilities:** • **Hawaiʻi State Legislature**: Pass legislation to provide direct incentives for clean marine fuels or grant State agencies the authority to establish market-based mechanisms, such as CFS, to subsidize the use of these fuels. • **HDOT:** Lead planning and investments for the necessary bunkering facilities and infrastructure needed to support clean marine fuels, as well as ensure a stable supply of these fuels. • **Cruise lines:** Collaborate with the State to develop a long-term transition plan for upgrading or replacing their fleets to operate on clean marine fuels, aligning with emission reduction goals. **Proposed Benchmarks:** **Adoption of Biodiesel and Bio-LNG in the Near Term:** Measure the percentage of cruise ship call operating on 100% biodiesel or bio-LNG **Phased Transition to Cleaner Marine Fuels:** Track the adoption rates e-methanol, ammonia, and green hydrogen, monitoring vessel conversions, new builds, and infrastructure developments to support these alternative fuels.
HAR-2	**Adoption of Clean Fuels on Cargo Carrier Ships**: Ocean-going cargo carriers in coordination with HDOT will transition their cargo vessel to clean marine fuels, starting with bio- and renewable diesel, and LNG and phasing in more advanced clean marine fuels such as e-methanol, ammonia, and green hydrogen through 2045. Targeting roughly 67% of the marine sector's emissions, this strategy leverages current LNG investments, enabling a long-term shift to lower-carbon fuels as vessels and fueling infrastructure advance. **Proposed Implementation Timeline:** **2030**: Average fuel CI for ocean-going cargo carriers achieves a 65% reduction. **2035**: 100% of ocean-going cargo carriers operate on clean fuels, with a net CI reduction target of 80%. **2045**: Targeted fuel mix achieving a 95% CI reduction.

Marine Strategies (HAR: Harbors)	
Strategy	**Description**
	Proposed Roles and Responsibilities: • **Hawaiʻi State Legislature**: Pass legislation to provide direct incentives for clean marine fuels or grant State agencies the authority to establish market-based mechanisms, such as CFS, to subsidize the use of these fuels. • **HDOT:** Lead planning and investments for the necessary bunkering facilities and infrastructure needed to support clean marine fuels, as well as ensure a stable supply of these fuels. • **Shipping lines:** Collaborate with the State to develop a long-term transition plan for upgrading or replacing their fleets to operate on clean marine fuels, aligning with emission reduction goals. **Proposed Benchmarks:** **Adoption of Biodiesel or Bio-LNG for Near-term Emission Reductions**: Track the percentage of cargo carrier voyages that transition to biodiesel or bio-LNG. **Development of Supporting Infrastructure for Clean Marine Fuels**: Track the number of commercial ports upgraded with LNG bunkering facilities in the near term, measure the progress in infrastructure development for use of e-methanol, ammonia, and green hydrogen for the longer term. **Implementation of Financial Incentives & Policy Support**: Monitor the adoption of incentives or market-based policies that help offset the higher costs of alternative fuels and encourage fleet transitions.
HAR-3	**Adoption of Renewable Fuels on Tug-and-Barge Voyages**: Harbor users, in partnership with HDOT and fuel producers, will transition all tug-and-barge operations to 100% bio- and/or renewable diesel by 2030, with a phased shift to alternative clean marine fuels such as bio-LNG, e-methanol, ammonia, and green hydrogen by 2045. **Proposed Implementation Timeline:** **2030**: All tugboats used for cargo transport operate entirely on bio- and renewable diesel. **2035**: Begin transitioning from bio- and renewable diesel to alternative clean fuels, introducing bio-LNG, e-methanol, and ammonia into the fuel mix, and achieving a fleet average CI reduction of 80%. **2045**: Targeted fuel mix achieving a 95% CI reduction. **Proposed Roles and Responsibilities:** • **Hawaiʻi State Legislature:** Pass legislation to provide direct incentives for clean marine fuels or grant State agencies the authority to establish market-based mechanisms such as CFS to subsidize these fuels. • **HDOT:** Lead planning and investments for the necessary bunkering facilities and infrastructure to support clean marine fuels, as well as ensure a stable supply of these fuels. • **Shipping lines:** Collaborate with the State to develop a long-term transition plan for upgrading or replacing their fleets to operate on clean marine fuels, aligning with emission reduction goals. **Proposed Benchmarks:** **Adoption of Bio- and Renewable Diesel in the Near Term:** Measure the percentage of tug-and-barge call operating on 100% biodiesel **Phased Transition to Cleaner Marine Fuels:** Track the adoption rates of LNG, methanol, ammonia, and green hydrogen, monitoring vessel conversions, new builds, and infrastructure developments to support these alternative fuels.

Marine Strategies (HAR: Harbors)	
Strategy	**Description**
HAR-4	**Adoption of Biodiesel (Near-Term) and Green Hydrogen (Long-Term) for Commercial Harbor Crafts:** HDOT, in collaboration with legislators and harbor craft operators, will shift all commercial harbor crafts at Hawaiʻi's ports to 100% biodiesel by 2030 and gradually phase in zero-emission fuels like green hydrogen by 2042. While CHCs account for a small share of emissions, their proximity to communities across the state makes this transition crucial for improving air quality near coastal communities while supporting Hawaiʻi's clean energy goals and reducing state reliance on imported fossil fuels. **Proposed Implementation Timeline:** **2030**: 100% of harbor craft operate entirely on bio- and/or renewable diesel. **2031-2041**: Phased transition to zero-emission technologies, including green hydrogen. **2042**: Full adoption of zero-emission technologies **Proposed Roles and Responsibilities:** • **HDOT:** Lead planning and investments for the necessary bunkering facilities and infrastructure to support biodiesel in the near term and green hydrogen in the longer term. • **Hawaiʻi State Legislature:** Pass legislation to provide direct incentives for biodiesel or grant State agencies the authority to establish market-based mechanisms such as CFS to subsidize these fuels. • **CHC operators:** Collaborate with the State to develop a long-term transition plan for upgrading or replacing their fleets to zero-emission technology **Proposed Benchmarks:** **Adoption of Biodiesel in the Near Term:** Measure the percentage of harbor crafts operating on biodiesel, ensuring a steady transition away from conventional fossil fuels. Shift to Zero-Emission Technologies: Track the introduction and expansion of zero-emission technologies, such as hydrogen-powered vessels, by monitoring fleet upgrades and new vessel deployments.

Emission Benefits of Harbor Strategies

Emissions Benefit of Strategy HAR-1

Because cruise ship schedules are typically planned 2 years in advance, any clean fuel adoptions that necessitate new vessels or vessel modifications will likely not be implemented before 2027. For cruise ships, bio- and renewable diesel and bio-LNG will serve as a transitional fuel to achieve immediate GHG emission reductions, helping to meet the 2030 target. It is assumed that by 2030, the call-weighted average CI of non-homeported cruise vessels calling at Hawaiian ports is 75 percent below the 2023 baseline. The CI reduction is expected to increase to 85 percent by 2035, 90 percent by 2040, and 95 percent by 2045. This strategy is projected to reduce emissions by 31,000 metric tonnes of CO2e by 2030 and 39,000 metric tonnes by 2045. Specific equations for these calculations are detailed in Appendix B.

Emissions Benefit of Strategy HAR-2

For cargo carrier ships, bio-LNG will play a key role in both immediate and long-term emissions reductions, aligning with the interests of major shipping lines such as Matson and Pasha Hawaiʻi, which are already investing in LNG-powered ships. By 2030, it is assumed that the average fuel CI for cargo carrier ships will reduce by 65 percent, with a further reduction anticipated to reach 80 percent by 2035 and

95 percent by 2045. This strategy is expected to cut emissions by 221,000 metric tonnes of CO2e by 2030 and 329,000 metric tonnes by 2045.

Emissions Benefit of Strategy HAR-3

For tug-and-barge operations, biodiesel will serve as a transitional fuel to achieve immediate GHG emission reductions, helping meet the 2030 target. It is assumed that by 2030, 100 percent of tugboats used for cargo transport will operate on bio- and/or renewable diesel, with a gradual phase out beginning by 2040 in favor of cleaner alternative fuels. The adoption of alternative clean fuels is expected to start after 2030, with a net CI reduction of 80 percent by 2035 and 95 percent by 2045. This strategy is projected to reduce emissions by 18,000 metric tonnes of CO2e by 2030 and 26,000 metric tonnes by 2045.

Emissions Benefit of Strategy HAR-4

While harbor craft emissions represent only 0.3 percent of total marine emissions, their constant operations in port areas impact local air quality and community health. The strategy calls for 100 percent bio- and renewable diesel adoption by 2030, followed by a phased transition to zero-emission technology by 2042. This shift is expected to reduce emissions by 1,000 metric tonnes of CO2e by 2030 and 1,600 metric tonnes by 2045 while also significantly improving local air quality and reducing particulate matter pollution in Hawaiʻi communities near ports.

Areas for Further Development in Next Plan

Future updates and refinements of this Plan will require a more detailed cost analysis that assesses the economic impacts of electrification and clean fuel strategies on Hawaiʻi's economy. Understanding potential fuel costs, shipping expenses, environmental co-benefits, and broader economic effects will provide policymakers with a more comprehensive view of the financial implications associated with these strategies.

In addition, given the significant role HDOT plays in developing the necessary fueling infrastructure, such as bunkering facilities for alternative fuels, a more detailed cost breakdown of these infrastructure investments is needed. This would help both the government and private sector estimate the level of investment required for building and deploying alternative fuel bunkering facilities. While the current Plan assumes fueling infrastructure costs are embedded within fuel prices, future analyses should separate fuel production and delivery costs from infrastructure costs to provide greater transparency and clarity on the required capital investments within the State of Hawaiʻi.

Beyond cost considerations, future updates to the Plan should also expand the emissions analysis to include other port equipment. The current Plan focuses solely on marine vessels, including tugs and OGVs, but excludes CHE and other type of CHCs. The primary reason for this exclusion is that the DOH GHG emissions inventory categorizes CHE as part of the ground transportation sector, rather than specifically recognizing it as part of the maritime sector. However, because CHE is an integral part of port operations, it should be included in future emission reduction strategies. Zero-emission technologies for CHE are already advancing rapidly, making it feasible to incorporate zero-emission and clean fuel solutions for these vehicles. Future iterations of this Plan should acknowledge existing efforts to decarbonize cargo handling operations while identifying additional opportunities to reduce emissions from this sector.

Aviation (Airports)

Discussion of Significant GHG Sources and Current Trends

Aviation currently accounts for 2.5 percent of global GHG emissions and 23 percent of emissions in Hawaiʻi (excluding military aviation). The 41st International Civil Aviation Organization (ICAO) Assembly adopted a long-term global aspirational goal (LTAG) for international aviation of net-zero carbon emissions by 2050 in support of the United Nations Framework Convention on Climate Change Paris Agreement. At the last Airports Council International (ACI) World General Assembly in May 2024, ACI airport members unanimously adopted a resolution urging governments and aviation stakeholders to prioritize SAF adoption, along with investment in new technologies like hydrogen, electric, and hybrid electric aircraft to lead the industry to zero-emissions aviation. When market-ready, these new technologies could hold promise for interisland air travel. Support from the airlines and regulators will be essential to the successful adoption of these technologies.

The scale-up and use of SAF is seen as a key tool in the near-term decarbonization toolbox to meet industry goals and reduce Scope 3 emissions. SAF can be produced from various sources, including waste oil, fats, green and municipal waste, and non-food crops, and can also be produced synthetically by capturing carbon directly from the air. In addition, alternative propulsion technologies such as hybrid electric, electric-powered, and hydrogen flight are anticipated to produce up to 15 percent GHG reduction by 2050 according to the World Economic Forum (WEF). While aircraft emissions are the highest sources of carbon, airports can also take step airside and landside to reduce emissions.

Why Can't We Mandate SAF?
Federal pre-emption poses a significant barrier to states requiring airlines to use SAF for intra-state flights because aviation is primarily regulated at the federal level through FAA and the Airline Deregulation Act.
California's recent attempt to mandate SAF usage through the Clean Transportation Program reauthorization bill (Assembly Bill [AB] 1322) failed in 2022 partly due to these pre-emption concerns. The bill would have required gradual increases in SAF usage for flights within California, but federal pre-emption principles established in cases like Northwest, Inc. v. Ginsberg prevent states from regulating airline services, routes, and prices—even for flights entirely within state boundaries. This federal framework ensures nationwide consistency in aviation regulations but significantly limits states' ability to impose their own environmental standards on air carriers, regardless of their environmental goals.
The Airline Deregulation Act prevents states and local governments from interfering with the national aviation market, if they take action "related to" prices, routes and services. A mandate for blending lower-carbon fuels into fossil jet is on its face not "related" to these specific economic features of a national aviation market. Appendix F provides more detail on this federal pre-emption.

Electric Aircraft: A Case Study
Ampaire partnered with Mokulele Airlines to pilot electric aviation in Hawaiʻi. Terrain in Hawaiʻi makes surface transport extremely challenging. The electric technology will enable faster and more frequent travel across the island of Maui. The pilot test project uses the testbed Electric EEL Aircraft, which is a modified Cessna 337 (Skymaster), The EEL Aircraft is hybrid electric with a range of 400 miles and can accommodate three passengers or 450 pounds of cargo. Estimated fuel cost savings compared to standard jet fuel is 50 to 70 percent, with maintenance savings of 25 to 50 percent.

Aviation Strategy Description

Various opportunities and solutions exist to reduce GHG emissions regardless of airport size, location, operating environment, or resources. Mitigation strategies are available for all airports, whether they are in the initial stages of implementing GHG mitigation or already have some GHG emission reduction activities under way. HDOT has begun work on many of the strategies, with five airports achieving accreditation under the ACA program, the only institutionally endorsed global carbon management standard for airports. It provides airports with a common framework to approach net-zero carbon.

Daniel K. Inouye International Airport (HNL), Ellison Onizuka Kona International Airport (KOA) and Līhuʻe Airport (LIH) have both achieved ACA Level 3 (Optimization), recognizing their efforts in reducing airport-controlled carbon emissions and engaging operational partners in sustainability initiatives. Hilo International Airport (ITO) and Kahului Airport (OGG) have attained ACA Level 1 (Mapping), marking their first step in quantifying and managing their carbon footprint.

The strategy tables in this section detail the steps required to implement and fund each aviation emissions reduction strategies, which fall under these broad categories:

- Aircraft/airlines (referred to throughout this section as AIR-C)
- Airfield design and operations (AIR-D)
- Landside operations (AIR-L)
- Airport terminals (AIR-T)

This Plan recommends the following strategies:

- **Scale-up of SAF to reduce emissions in the short-term, while zero-emissions solutions become market-ready:** California, Oregon, and Washington state have been successful in creating and administering CFS for the aviation sector. For example, Washington state continues to advance the opportunities to further incentivize local production of SAF with policies and tax credits. Illinois' Sustainable Aviation Fuel Purchase Credit (SAFPC) gives a credit of $1.50 per gallon to airlines purchasing SAF in the state. Table 3-7 provides a complete list of existing state-level SAF tax credit programs in the United States. For SAF to be deployed in Hawaiʻi at the scale needed to achieve significant strides towards decarbonization, similar policies are essential.

Table 3-7. State SAF Tax Credit Programs

State/Region	Applicable Fuel(s)	Base Credit ($/gallon)	Additional Credit ($/gallon)	Total Budget allocated to SAF Tax Credit
Oregon	SAF	$1.25	$0.01	Base credit applies to all SAF that achieves at least 50% lifecycle GHG reduction compared to jet fuel. Additional credit is for each percent the GHG benefit exceeds 50% up to $2.00. This seems to be a trading scheme instead of a state-funded budget.

State/Region	Applicable Fuel(s)	Base Credit ($/gallon)	Additional Credit ($/gallon)	Total Budget allocated to SAF Tax Credit
California	SAF	$1.25	$0.01	Base credit applies to all SAF that achieves at least 50% lifecycle GHG reduction compared to jet fuel. Additional credit is for each percent the GHG reduction exceeds 50% up to $0.50 per gallon. This seems to be a trading scheme instead of a state-funded budget.
Illinois	SAF	$1.50	N/A	Base credit applies to all SAF that achieves at least 50% lifecycle GHG reduction compared to jet fuel. By 2028, all feedstocks must be derived from domestic biomass resources. Low-interest loans available for SAF development and encourages offtake agreements between SAF producers and buyers.
Washington	SAF	$1.00	$0.02	Additional credit is for each percent the GHG reduction exceeds 50% up to $2.00/gallon. Additional Preferential B&O tax rate of 0.275 on manufacturing and wholesaling of SAF. Base credit activates when production capacity is >20 million gallons of SAF at facilities producing SAF.
Minnesota	SAF	$1.50	N/A	SAF must be used in aircrafts departing from an airport in Minnesota. SAF must be derived from biomass that does not originate from palm fatty acid distillates. SAF must achieve at least 50% lifecycle GHG emissions compared to traditional jet fuel. SAF pathway achieves 50% reduction of aggregate attributional core lifecycle emissions and positive induced land use change (ILUC) values under lifecycle methodology for SAF (per ICAO).

State/Region	Applicable Fuel(s)	Base Credit ($/gallon)	Additional Credit ($/gallon)	Total Budget allocated to SAF Tax Credit
Nebraska	SAF	$0.75	$0.01	Base credit applies to all SAF that achieves at least 50% lifecycle GHG reduction competed to jet fuel. Additional credit is for each percent of emissions reduction, up to $0.50 for a fuel with 100% total reduction. SAF must not be derived from coprocessing or from palm/palm derivatives.
New York	SAF	$1.25	N/A	Legislation is proposed, not passed. Credit increases to $150 for SAF produced from domestic corn and/or soybeans. Available from 2027 through 2032. Capped at $2.4 million per taxpayer annually.
Federal Renewable Fuel Standard	Biomass-based diesel Cellulosic biofuel Advanced biofuel Total renewable fuel	$1.25 to $1.75	N/A	Amount of credit is based on fraction of carbon reduction in the fuel compared to conventional fossil fuel equivalent. Federal incentive can be stacked with state program incentive to achieve more than $3.00 per gallon incentive in some states (such as Illinois).
Range of Stacked Credits (Federal + State)	N/A	$2.00 to $3.25	N/A	State-specific additional incentives apply.

N/A = not applicable

- **Deploy electrification strategies for airfield and ground access:** Airfield and ground access equipment are primarily powered by fossil fuels. Decarbonizing these emissions will require electrification of this equipment.
- **Airspace modernization and optimization:** Optimizing the efficiency of aircraft operations both on the ground and during flight will reduce overall fuel consumption, resulting in emissions reductions needed to achieve net-negative.
- **Incentives:** This encourages the creation of incentives and planning for the infrastructure that will be needed as aviation moves toward new technologies like green hydrogen and electric and hybrid electric aircraft.

<table>
<tr><th colspan="2">Aircraft Emission Strategies
(AIR-C: Airports Aircraft)</th></tr>
<tr><th>Strategies</th><th>Description</th></tr>
<tr><td>AIR-C-1</td><td>Pass Sustainable Aviation Fuel Tax Credit: HDOT, the Hawaiʻi State Legislature, fuel producers, and airlines will implement a Hawaiʻi-specific SAF tax credit to support the production, blending, and import of SAF in the state. This shift to cleaner jet fuel will cut pollution from planes, protect communities surrounding the airport, and create clean energy jobs across the state.
Proposed Implementation Timeline:
2026: Pass enabling proposal. After passage, develop internal implementation team, possibly under Department of Commerce and Consumer Affairs.
2026-2027: Collaborate with producers, airlines and local stakeholders to establish supply and distribution pipelines.
2026-2027: Appropriate agency sets up administering office (TBD – possibly HSEO, Department of Commerce and Consumer Affairs [DCCA]).
Proposed Roles and Responsibilities:
HDOT/HSEO: Work with the Hawaiʻi Renewable Fuels Coalition and airline partners to review, revise bill(s) and, with DCCA and Department of Taxation, refine and support legislative passage.
Hawaiʻi Renewable Fuels Coalition: Update bills to address stakeholder concerns and push through Legislature.
Hawaiʻi State Legislature: Approve SAF Tax Credit Program and complementary CFS (lower carbon), and/or Cap and Trade bills.
Proposed Benchmarks:
The Legislature should pass bills to allow importers to start bringing in SAF as soon as possible. It will take several years for local fuel producers to convert operations and be able to produce SAF.</td></tr>
<tr><td>AIR-C-2</td><td>Build a Diverse SAF Working Group & Establish Hawaiʻi SAF Benchmarks: HDOT will lead a statewide working group of airlines, fuel producers, farmers, non-governmental organization (NGOs), and government agencies to build a shared roadmap for producing, importing, and using SAF in Hawaiʻi. By working together through regular meetings, this group will align on policies, infrastructure, and targets needed to grow SAF production and use statewide and cut aviation emissions.
Proposed Implementation Timeline:
August 2025: HDOT finalizes working group members and internal resources.
October 2025: First working group meeting held.
December 2025: HCR70 Report Submitted
HCR70: HCR70 is a resolution passed in the 2025 session of the Hawaiʻi State Legislature in which HDOT is called upon to collaborate with industry leaders, producers, airlines, and other stakeholders in Hawaiʻi's SAF space. Recognizing the requirements set by the Navahine v. Hawaiʻi Department of Transportation settlement, as well as the State's commitments to net-neutrality in 2045, HCR70 requests that HDOT integrate plans for the increased production and use of SAF in their State Greenhouse Gas Reduction Plan. HDOT is required to submit a report on the latter to the Hawaiʻi State Legislature no more than 20 days prior to the convening of the 2026 session.
January 2026: First official SAF Coalition meeting held. Coalition meetings in conjunction with the American Association of Airport Executives (AAAE) Aviation Issues Conference in Kona to solidify SAF incentive workplan and benchmarks.</td></tr>
</table>

Aircraft Emission Strategies (AIR-C: Airports Aircraft)	
Strategies	**Description**
	Proposed Roles and Responsibilities: • **HDOT:** Work in collaboration with the HSEO, major airlines serving Hawaiʻi, fuel producers, and other stakeholders to establish policies, incentives, and infrastructure to support the production, distribution, and use of SAF in the state. HDOT to submit a report on the progress made in facilitating the adoption and acceleration of sustainable aviation fuels, including any proposed legislation to further support this effort, to the Legislature prior to 2026 Legislative Session. • **HSEO:** Work with HDOT, the Hawaiʻi Renewable Fuels Coalition, and airline partners to support legislative passage. • **Hawaiʻi Renewable Fuels Coalition:** Facilitate the adoption and acceleration of sustainable aviation fuels. • **Hawaiʻi State Legislature:** Approve SAF Tax Credit Program, CFS (lower carbon), and/or Cap and Trade bills. **Proposed Benchmarks:** **2025-2026**: Collaborate with producers, airlines, and local stakeholders to support the production, distribution, and use of SAF in the state. **2026**: HDOT submit first report consistent with requirements of HCR70.
AIR-C-3	**Airspace Modernization**: HDOT and FAA will work together to improve flight paths, taxiing, and descent procedures across Hawaiʻi's airspace. These upgrades will cut aircraft emissions and noise while improving air quality for communities surrounding the airport. **Proposed Implementation Timeline:** 5 to 7 years. Dependent on scoping work, staffing and community/stakeholder engagement process. **Proposed Roles and Responsibilities:** • **HDOT:** Collaboration with FAA on pending airspace modernization efforts. **Proposed Benchmarks:** FAA is responsible for the Hawaiʻi Airspace Initiative. HDOT's role is to monitor and provide collaboration as needed. **2025**: Initial meeting with FAA to understand progress and plans for airspace modernization efforts **2026:** Follow up with the Air Traffic Organization (ATO) Regional Administrator on FAA's schedule and next steps. Given the uncertainty about funding and personnel changes in Washington, schedule and progress will be difficult to determine with certainty at this time.
AIR-C-4	**Hydrogen Aircraft:** HDOT, airlines, fuel suppliers, and aircraft manufacturers will collaborate to introduce hydrogen-powered aircraft for intra-island flight, supported by local hydrogen production and fueling infrastructure. While this is a long-term effort, it has the potential to eliminate jet fuel emissions entirely and improve air quality across Hawaiʻi. **Proposed Implementation Timeline:** 15 to 25 years. Dependent on new and emerging technology. **Proposed Roles and Responsibilities:** • **HDOT and Airlines for America (A4A):** HDOT to work with A4A to better understand when hydrogen aircraft will be viable in Hawai'i. • **HDOT and Hawaiʻi State Legislature:** Identify funding path for infrastructure upgrades. • **Airlines:** Purchase hydrogen aircraft and provide flight training.

Aircraft Emission Strategies (AIR-C: Airports Aircraft)	
Strategies	**Description**
	• **HDOT:** Provide infrastructure for green hydrogen storage and re-fueling. • **Fuel Suppliers:** Develop green hydrogen processing locally. **Proposed Benchmarks:** Given the nascent nature of hydrogen aircraft technology in addition to the currently limited supply of locally developed green hydrogen, zero-emission aircraft is only expected to comprise up to 10% of intra-island flights by 2045. For zero-emission aircraft to fully replace jet fuel by 2045 for intra-island flights, there would need to be a very fast scale-up of hydrogen aircraft technology for larger jets (minimum 100 passengers). In addition, the airlines and Part 135 operators would have to agree to fully turn over their fleets to include hydrogen or electric planes so that all intra-island flights would be serviced using these aircraft.[6] Finally, HDOT and airline partners would need to contract with local fuel producers and/or electricity providers to ensure there is sufficient supply of locally developed green hydrogen and/or zero-emission electricity.
AIR-C-5	**Electric Aircraft**: HDOT, airlines, manufacturers, and electric utilities work together to certify electric aircraft, upgrade fleets, and build airport charging infrastructure needed to support zero-emission intra-island flights. Over time, this shift will help eliminate jet fuel use, reduce aviation emissions, and improve air quality for Hawaiʻi's communities. **Proposed Implementation Timeline:** 15 to 25 years. Dependent on new and emerging technology. **Proposed Roles and Responsibilities:** • **Manufacturers:** Finalize proof of concepts, prototypes and obtain certification. • **Airlines and aircraft operators**: Include electric aircraft in fleet modernization plans. Provide flight training. • **HDOT:** Provide charging infrastructure. This work supports HECO's obligation under HRS § 269-92, which establishes Hawaiʻi's Renewable Portfolio Standards and requires 100% of electricity sales to come from renewable energy sources by 2045. • **HDOT and Airlines for America:** HDOT to work with A4A to better understand when electric aircraft will be viable in Hawai'i. • **HDOT and Hawaiʻi State Legislature:** Identify funding path for infrastructure upgrades. • **Battery suppliers:** Work with government partners, manufacturers and industry to ensure safety, range, weight, and cost in latest innovations. **Proposed Benchmarks:** Given the nascent nature of electric aircraft technology in addition to the currently limited supply of zero-emission electricity, zero-emission aircraft is only expected to comprise up to 10% of intra-island flight operations by 2045. For zero-emission aircraft to fully replace jet fuel by 2045 for intra-island flights, there would need to be a very fast scale-up of electric battery aircraft technology for larger jets (minimum 100 passengers). In addition, the airlines would have to agree to fully turn over their fleets to include electric planes so that all intra-island flights would be serviced using these aircraft. Finally, HDOT and airline partners would need to contract with local fuel producers and/or electricity providers to ensure there is sufficient supply of zero-emission electricity.

[6] FAA Part 135 regulations apply to all charter/on-demand and commuter flights in which either the operator of the aircraft or the pilot of the aircraft earns a fee for providing transport services. Corporate airliners and helicopters, as well as aircraft that are connected to the government, can all be classified under Part 135's regulations and specifications

Airfield Design and Operations Reduction Strategies (AIR-D: Airports Design)	
Strategies	**Description**
AIR-D-1	**Continue Providing Preconditioned Air (PCA) Supply and Fixed Electrical Ground Power**: HDOT, in coordination with airlines and airport tenants, will expand the use of PCA and Fixed Ground Power (FGP) systems at airport gates by identifying needed upgrades and securing funding. These systems allow planes to shut off jet-fuel engines while parked, cutting emissions, saving fuel, and improving air quality for surrounding communities. **Proposed Implementation Timeline:** Continuous. **Proposed Roles and Responsibilities:** • **HDOT and Hawaiʻi State Legislature:** Identify funding path. • **HDOT/airlines:** Identify gates to be upgraded. • **HDOT:** Install PCA and FGP. **Proposed Benchmarks:** Efforts are ongoing.
AIR-D-2	**Electrification of Ground Service Equipment and Airfield Vehicles**: HDOT, in partnership with the Hawaiʻi State Legislature and airlines, will incentivize and support electrification of GSE by installing EV chargers near gates and setting up smart billing systems with software providers. This shift will cut emissions on the tarmac, protect the health of airport workers and nearby communities, and support Hawaiʻi's energy independence goals. **Proposed Implementation Timeline:** 3 to 5 years. **Proposed Roles and Responsibilities:** • **HDOT and Hawaiʻi State Legislature:** Identify funding. • **HDOT/airlines:** Identify equipment for replacement/electrification upgrade and commit to purchasing power from HECO/HDOT. • **HDOT:** Install charging infrastructure for electrical ground support equipment (eGSE). **Proposed Benchmarks:** **2025-2027:** Airline eGSE pilot program setup with partnering core airlines (such as Japan Airlines, Hawaiian/Alaska, and Delta) and industry partners (software and hardware providers for chargers). In addition, publish as a request for information to the industry looking for novel approaches to installing eGSE (mobile charging and gate power sharing). **2026–2028**: Establish commercial terms with partnering airlines covering billing systems and purchase pricing agreements dictating how airlines will purchase power from airports, emissions reduction requirements, cost sharing of infrastructure development, and local community engagement/marketing campaign. **2027-2029:** Electrify all baggage and aircraft tugs and small equipment with partnering airlines. **2030-2032**: Expand to other airlines, leveraging existing infrastructure developed with core airline tenants and opening charging infrastructure to other airlines via shared-use agreements.
AIR-D-3	**Ramp Efficiency**: HDOT, in collaboration with airlines and FAA, will improve how planes move around gates by exploring tools like ramp towers, metering systems, and artificial intelligence (AI) technology. As a first step, HDOT has already completed a hot spot analysis so can work with FAA to address the highest traffic areas. These upgrades will reduce fuel use, improve air quality for airport workers and communities nearby, and support Hawaiʻi's push for energy independence.

Airfield Design and Operations Reduction Strategies (AIR-D: Airports Design)	
Strategies	**Description**
	Proposed Implementation Timeline: 5 to 8 years. **Proposed Roles and Responsibilities:** • **HDOT/airlines/FAA:** Collaborate on analysis and implementation. • **HDOT and Hawaiʻi State Legislature:** Identify funding. **Proposed Benchmarks:** **2025:** Collaborate with FAA and consulting company to complete hot spot analysis and identify low hanging fruit for improvement. **2026**: Plan specific activities to include in the budget for future years and assign roles and responsibilities for action plans. Work with Hawaiʻi State Legislature to identify funding for ramp tower analysis, with possible federal funding. **2027**: Conduct assessment of ramp management system as a pilot project and possible emissions-savings technologies. **2028:** Implement ramp efficiency measures statewide. **2032:** Evaluate technologies and make additional upgrades as needed.
AIR-D-4	**Maintain Efforts to Install LED Apron, Runway, and Taxiway Lighting:** HDOT will continue replacing traditional airfield lighting with energy-efficient LED systems powered by electric, solar, or battery power sources in compliance with FAA standards. While emissions impacts are minimal, this effort supports energy independence and reduces long-term electricity and maintenance costs. **Proposed Implementation Timeline:** 3 to 8 years. **Proposed Roles and Responsibilities:** • **HDOT and Hawaiʻi State Legislature:** Identify funding. • **HDOT:** Install LED lighting. **Proposed Benchmarks:** **2026:** Benchmarking effort with AIR-E to inventory non-LED airfield lighting. **2027-2028:** Work with Legislature to fund replacement of non-LED inventory. **2029-2035:** Implement projects upgrading airfield lighting.

Airport Terminal Reduction Strategies (AIR-T: Airports Terminal)	
Strategies	**Description**
AIR-T-1	**Energy-Efficient Updates:** HDOT, in coordination with the Hawai'i State Legislature, airline partners, and other tenants, will upgrade terminal buildings with energy-efficient improvements like LED lighting and energy-efficient equipment. These upgrades help lower electricity use, reduce operating costs, and support Hawai'i's net-negative emission and energy independence goals. **Proposed Implementation Timeline:** 3 to 5 years. **Proposed Roles and Responsibilities:** ▪ **HDOT and Hawaiʻi State Legislature:** Identify funding. ▪ **HDOT/airlines/tenants:** Identify equipment for replacement/electrification upgrade. ▪ **HDOT:** Contract with an energy savings performance contractor. **Proposed Benchmarks:** **2025:** Set up tracking system of current progress. Create targets for each airport and funding needs (for example, % of airports audited). **2026-2030**: Continue work under Energy Savings Performance Contract (ESPC), review and implement measures until all targeted conversions are complete.
AIR-T-2	**Onsite Renewable Power Generation Feasibility Assessment:** HDOT, alongside the Hawaiʻi State Legislature and public and private partners, will study the potential for installing renewable power sources like solar panels or RNG systems at airport facilities. This helps Hawai'i cut fossil fuel use, lower emissions, and build a more self-reliant energy system for the future. **Proposed Implementation Timeline:** 5 to 10 years. **Proposed Roles and Responsibilities:** • **HDOT and Hawaiʻi State Legislature**: Identify renewable power feasibility study funding. • **HDOT:** Identify land availability and operational impacts. • **HDOT:** Install renewable energy to support HECO's obligation under HRS § 269-92, which mandates 100% renewable electricity sales by 2045. **Proposed Benchmarks:** **2025**: Start planned feasibility study (expected 18-month duration). **2027**: Review progress, identify further funding for potential pilot airport. **2030-2045:** Consider replacing aging renewable energy systems with latest technology.
AIR-T-3	**Tenant and Concessions Emission Reduction Policies:** HDOT, the Hawai'i State Legislature, tenants, and concessionaires will create policies to cut terminal waste and emissions through better recycling, composting, and cleaner daily operations. These efforts support Hawai'i's net-negative goals by making commercial spaces in airports more sustainable and energy-smart. **Proposed Implementation Timeline:** 3 to 5 years. **Proposed Roles and Responsibilities:** • **Hawaiʻi State Legislature:** Identify funding. • **HDOT:** Install infrastructure and collaborate with tenants/concessions and composting/recycling companies. • **Tenants and concessionaires:** Procure services for hauling recyclable/compostable waste.

Airport Terminal Reduction Strategies (AIR-T: Airports Terminal)	
Strategies	**Description**
	Proposed Benchmarks: **2026**: Survey tenants and concessionaires to create awareness of current practices and gather projections of volume. Survey waste haulers capable of meeting tenant and concessionaire projections. Facilitate discussions between parties to reach a commitment. **2026-2030**: Create a policy for tenants and concessionaires for composting and recycling. Track progress.
AIR-T-4	**Implement Sustainable Design and Construction Practices:** HDOT, in collaboration with contractors and FAA, will include low-carbon materials, solar-reflective surfaces, and energy-efficient designs in new airport buildings and renovations. This approach lowers long-term emissions, improves building performance, and supports healthier, more sustainable spaces for travelers and surrounding communities. **Proposed Implementation Timeline:** 3 to 5 years. Dependent on design and construction timelines. **Proposed Roles and Responsibilities:** • **HDOT:** Identify opportunities for sustainable design in construction in concert with contractors, given their experience as applicable. • **Contractors:** Design per requirements. **Proposed Benchmarks:** **2026:** Determine construction or renovation needs; develop policy to incorporate sustainable design using a checklist of applicable parameters developed in partnership with contractors. **2026**: Incorporate sustainable design in construction or renovation per policy. **2030:** Update design checklist with new parameters as needed.

Airport Terminal Reduction Strategies (AIR-L: Landside Operations)	
Strategies	**Description**
AIR-L-1	**Conversion of Vehicles for Airport Workforce:** Explore implementation of additional electric bus and shuttle service from airport to strategic Skyline rail stations for airport employees, reducing emissions and parking spaces. Continue to transition ground transportation such as service vehicles to electric and provide electric charging stations in employee parking areas. **Proposed Implementation Timeline:** 3 to 5 years. **Proposed Roles and Responsibilities:** • **HDOT and Hawaiʻi State Legislature**: Identify funding if needed. • **Airports:** Identify locations and assess electrical capacity for additional EV chargers. • **HDOT:** Install charging infrastructure for electric buses, as well as develop new bus routes based on employee worker feedback to support HECO's obligation under HRS § 269-92, which mandates 100% renewable electricity sales by 2045. Obtain grant funding through FAA. **Proposed Benchmarks:** **2026**: Deployment of new employee shuttle routes with either EV or ICE buses. **2027-2030**: Conversion of all employee shuttle buses to electric.

Airport Terminal Reduction Strategies (AIR-L: Landside Operations)	
Strategies	**Description**
AIR-L-2	**EV Charging Infrastructure Adequacy Assessment**: Continue to assess adequacy of EV charging infrastructure at the airports and other means of landside emission reductions. Specifically focus on planning and modeling of strategic placement of both L2 charging and direct current fast charging (DCFC) within the airport's properties and parking facilities. **Proposed Implementation Timeline:** 3 to 5 years. **Proposed Roles and Responsibilities:** • **HDOT and Hawaiʻi State Legislature**: Identify funding. • **Airports/airlines**: Identify equipment for replacement/electrification upgrade. • **HDOT**: Install charging infrastructure for eGSE, shuttles, other fleet vehicles, and publicly accessible stations to support HECO's obligation under HRS § 269-92, which mandates 100% renewable electricity sales by 2045. **Proposed Benchmarks:** **2026:** Complete a strategy study to deploy EV charging infrastructure at HDOT airports. Focus of the study should be to develop an energy master plan of the facilities, as well as engage community and industry to develop specific strategies to spur local EV adoption. **2027:** Obtain public funding for the opportunities and private investment into privately funded charging infrastructure. **2028:** Deploy dedicated L2 charging areas at short- and long-term parking areas.
AIR-L-3	**Taxi and Rideshare Partnership Opportunities**: Explore partnership opportunities with TNCs/rideshare companies (such as Uber and Lyft) and local taxi companies to incentivize the adoption of EVs to serve customers going to and from the airports. Example ways to encourage adoption via policy include preferred parking and pickup areas, along with priority access to charging stations for registered rideshare EV owners. In addition, while HDOT lacks authority to require conversion to EVs, it can evaluate the opportunity to contractually require the conversion to EVs or other means to drive conversion. Given that Uber and Lyft have recently backed off of their commitments to 100% EVs by 2030, it is difficult to model the percent conversion to EVs for TNCs. However, it is expected that successful implementation of Ground Transportation Strategy HWY-E-1 for adequate charging infrastructure and Strategy HWY-E-2 and associated benchmarks for EV sales, in combination with the feasibility assessment in AIR-L-2 in this section, will significantly contribute to the conversion of airport TNC and taxi vehicles to EVs. While the focus of this aviation strategy is the development of partnership relationships with the TNC and taxi companies and pilot projects with each, it is conservatively estimated that electrification will follow the projection in Ground Transport Strategy HWY-E-5 with benchmarks of 25% electrification by 2030 and 100% by 2045. HDOT will also review the feasibility of a Green Curb program that would provide preferred parking for taxis and TNCs that are EVs, taking into consideration similar programs at other U.S. airports. **Proposed Implementation Timeline:** 3 to 5 years. **Proposed Roles and Responsibilities:** • **HDOT and Hawaiʻi State Legislature**: Identify funding for charging and incentivizing EV conversion. • **Airports/TNC companies/taxi companies**: Perform electrification upgrade. • **HDOT**: Install charging infrastructure and identify and implement incentives for TNC/taxi vehicle conversion to EV. Identify staff to track progress and identify challenges to be addressed.

Airport Terminal Reduction Strategies (AIR-L: Landside Operations)	
Strategies	**Description**
	Proposed Benchmarks: **2026**: Meet with TNC and taxi companies to begin discussions. Identify a minimum of one partnership each to pilot. Enter formal MOUs, if appropriate. **2027**: Implement pilot with tailpipe emission reduction goal of 5% each across TNC fleet and taxis. **2028:** Evaluate pilot results and determine next steps.
AIR-L-4	**Private Medium- to Heavy-Duty Vehicle Operator Partnerships**: Explore developing partnership programs with private medium- and heavy-duty vehicle operators who serve the tourist industry and who come and go from the airport premises. Development of a charging hub with pull-through medium- to heavy-duty vehicle parking adjacent to the airport could facilitate adoption of EVs given that they start and end many of their routes from airport facilities. <u>Prioritize underused State-owned lots for development of charging infrastructure for vehicles that are close to airports or connections to airports via roadways.</u> Hybrid buses could be a first step, as could low/zero-emission fuels such as biofuels and hydrogen. **Proposed Implementation Timeline:** 3 to 5 years. **Proposed Roles and Responsibilities:** • **HDOT and Hawaiʻi State Legislature**: Identify authority. • **Private bus operators**: Procure battery-electric buses. • **HDOT**: Install charging infrastructure and develop programs to encourage hybrid and electric bus adoption for fleets that frequent the airport fleets, supporting HECO's obligation under HRS § 269-92 to achieve 100% renewable electricity sales by 2045. **Proposed Benchmarks:** **2026:** Enter into MOUs with private bus operators to purchase buses and install charging infrastructure. **2026**: Co-apply federal and state grant funding programs to deploy charging infrastructure. **2027:** Deploy ten electric coach bus pilot at a major airport. Evaluate results. **2030:** Evaluate adoption, availability, and determine what zero-emission fuel type the private operators are pursuing for their medium and heavy-duty vehicles.
AIR-L-5	**Rental Car Company Partnerships**: Explore partnership opportunities with rental car companies to develop a centralized rental car charging facility to encourage the growth of EVs or hybrids within the rental car fleets, as well as for rental car shuttle buses. While larger rental car companies like Hertz have recently been selling off large numbers of their EVs, it is expected that successful implementation of Ground Transportation Strategy HWY-E-1 for adequate charging infrastructure and Strategy HWY-E-2 and associated benchmarks for EV sales, in combination with the feasibility assessment in AIR-L-2, will significantly contribute to the conversion of airport rental cars to EVs. The conversion of rental car EVs at the airport will depend significantly on successful rollout of HWY-E-1 with sufficient charging infrastructure in convenient places for tourists and visitors, such as hotels, streets, and tourist attractions. While the key objective of this strategy is to build relationships with the rental car agencies, once the charging infrastructure is in place, given the relatively quick turnover of rental car vehicles, with 100% of vehicle sales being electric in 2035, it is anticipated that rental car EVs will represent 60% to 70% of total fleets in 2035 and will achieve full electrification closer to 2040. **Proposed Implementation Timeline:** 3 to 5 years.

Airport Terminal Reduction Strategies (AIR-L: Landside Operations)	
Strategies	**Description**
	Proposed Roles and Responsibilities: • **HDOT and Hawai‘i State Legislature**: Identify funding. • **Airports/rental car companies**: Purchase and maintain EVs and develop training programs and labor to cycle EVs to and from charging infrastructure. • **HDOT**: Lead the development of centralized shared charging infrastructure adjacent to, or in the area of, the CONRAC facilities, supporting HECO's obligation under HRS § 269-92 to achieve 100% renewable electricity sales by 2045. **Proposed Benchmarks:** **Ongoing**: Establish working groups with major rental car companies at each airport. Gather interest and magnitude of planned electrification for each company. **2026:** Perform an electrical demand study and capacity model for future growth of each company. Develop a basis of design for a shared charging facility that all companies can use and pay for. **2027**: Sign commercial agreements with rental car companies for the usage and development of a shared charging facility. **2028**: Begin construction. **2035**: 50% of rental cars available at airport are EVs. **2040:** 50% of parking spaces have access to EV charging (access defined as anywhere that has the ability to plug in).
AIR-L-6	**Low Emission Construction Equipment Incentives**: Develop a program to encourage use of all-electric, hybrid, and low emission off-road construction equipment on HDOT projects at airports. **Proposed Implementation Timeline:** 5 to 10 years. Dependent on availability of electric construction equipment. **Proposed Roles and Responsibilities:** • **HDOT and Hawai‘i State Legislature**: Identify funding. • **Construction companies**: Identify possible electric equipment types that are available and procure them. • **HDOT**: Require zero-tailpipe-emission equipment as part of future construction and development procurements. **Proposed Benchmarks:** **2026:** Formulate funding plan and requests for 2027 legislative session. Estimate emissions reduction ranges. **2028:** Award points to contractors in the procurement process who have EVs and have electrified or zero-emission equipment (owned and rented). **2030:** Minimum amount of zero-emission equipment. **2035:** Further requirements for zero-emission equipment. **2040:** All construction equipment is zero-emission.
AIR-L-7	**Preferred Parking for Low and No Carbon Vehicles**: Continue to provide priority parking for hybrid and EVs for passengers and ensure at least 50% of parking spaces have access to EV charging services by 2040. **Proposed Implementation Timeline:** 5 to 7 years. **Proposed Roles and Responsibilities:** • **HDOT and Hawai‘i State Legislature**: Identify funding, if needed.

Airport Terminal Reduction Strategies (AIR-L: Landside Operations)	
Strategies	**Description**
	• **Airports**: Identify locations and access electrical capacity for additional EV chargers. • **HDOT**: Install charging infrastructure for EV charging. **Proposed Benchmarks:** **2025:** Take inventory of number of spaces and frequency of use. Use HDOT social media to communicate availability. Assess needs for additional chargers. **2026-2029:** Monitor effectiveness of communication, use of chargers, and areas for improvement. **2030-2035:** Upgrade old chargers with latest fast-charging technology.

The total emissions reductions associated with each strategy and its proposed implementation date is detailed in Table 3-8.

Table 3-8. Total Emissions Reductions Associated with Each Strategy (million metric tonnes of CO2e)

Strategy	Proposed Implementation Date	2030	2035	2040	2045
AIR-C-1, Traditional SAF	2028	1.18	1.77	2.46	3.86
AIR-C-1, eSAF	2035	--	0.28	0.55	0.85
AIR-C-1, BECCS SAF	2040	--	--	0.27	0.28
AIR-C-3, Airspace Modernization	2028	0.08	0.18	0.28	0.32
AIR-C-4 and AIR-C-5, Zero-Emission Aircraft Technology	2040	--	--	0.21	0.22
AIR-D-3, Optimize Ramp Movements	2028	0.04	0.09	0.15	0.16
AIR-D-1, Preconditioned Air Supply and Electric Ground Power	2025	0.006	0.01	0.02	0.03
AIR -D-2, Electrification of Ground Support Equipment	2028	0.004	0.01	0.02	0.03
AIR-L Strategies – Vehicle Conversion and Incentives	2028	0.05	0.15	0.25	0.43
Total Reductions		1.36	2.49	4.21	6.18

BECCS = bioenergy with carbon capture and sequestration

eSAF = SAF made using renewable energy

Emissions Benefits of Aviation Strategies

This section summarizes the methodology leveraged to quantify emissions reductions associated with the most significant and impactful strategies described in this Plan. Many of the terminal strategies are focused on relationship and consensus building, so there is not sufficient information at this point to quantify anticipated emission reductions. In addition, many of the terminal strategies will have significantly smaller impacts on overall aviation emissions compared to the strategies focused on aircraft operations and ground vehicles.

This section includes a discussion of key assumptions, data sources, and calculations used to estimate reductions for each strategy. As much as possible, emissions reduction estimations followed the Airport Carbon and Emission Reduction Tool (ACERT) methodology and emission factors to be consistent with the methodologies applied in GHG inventories recently completed for the top five Hawaiian airports. Specific equations are detailed in Appendix B.

Lifecyle Emissions Analysis

This emission inventory considers the use of sustainable aviation fuel as a clean fuel. To determine the emission reduction potential of SAF, an emission reduction factor was established by comparing the emission factor SAF to that of kerosene jet fuel (KJF). For example, KJF has a baseline emission reduction factor of 0 percent and SAF has an emission reduction factor between 65 and 80 percent. Conservatively, SAF was assumed to start at 65 percent reduction in 2028 and scale up reduction by 5 percent every 5 years through 2045. **Note that these are some of the preliminary reduction factors assumed for this version of the report and they will be further refined in the final version.**

AIR-C-1: Implementation of Critical Stateside Policies, AIR-C-2: eSAF, and AIR-C-3: BECCS SAF Adoption of Sustainable Aviation Fuels. Two bills were considered at the Legislature in 2025 that would better incentivize the use of SAF. HDOT will build on these proposed bills by partnering with stakeholders to set SAF percentage goals of the total fuel demand with steps to reach up to a maximum of 80 percent reduction in 2045. SAF mixing is assumed to start at 50 percent but then will step up to 100 percent by 2045. eSAF is SAF made using renewable energy, resulting in a full 100 percent reduction from conventional fossil fuel emissions. BioEnergy Carbon Capture and Storage SAF is another type of SAF resulting in a 100 percent reduction of fossil fuel emission but still very much in development. Both were considered as SAF solutions with the assumption that eSAF would come to market in 2035, reaching a maximum of 15 percent of total fuel demand by 2045. BECCS would begin update in 2040, reaching a maximum of 5 percent of total fuel demand in 2045.

AIR-C-4 and AIR-C-5: Adoption of Zero-Emission Technology for Aircraft. Based on review of Traffic Flow Management System Counts (TFMSC) data, HDOT estimated that approximately 35 percent of aircraft fuel consumption is for intra-island flights. Given that electric and hydrogen technology is still in development but is anticipated to have shorter flight radiuses, HDOT conservatively assumed that starting in 2040, zero-emission aircraft would be leveraged for up to 10 percent of total intra-island flights.

AIR-D-1: Conversion to Preconditioned Air Supply and Fixed Electric Ground Power. Many of the gates at HNL, OGG, and LIH have been equipped with ground power. HDOT assumed that by 2045, all airlines and gates would be converted to provide PCA and ground power to all aircraft to negate the need for turbine engine on the APUs. HDOT is estimating that after several years of planning, this would begin to be implemented in 2028 and would increase every 5 years or so until 2045, when all flights are assumed to use PCA and ground power. Accounting for engine efficiency, HDOT also estimated the electricity emissions that would result from the conversion of APU engine power to ground power. To be fully transparent and accurate, these emissions were netted out of the emissions savings associated with reducing fossil fuel consumption.

AIR-C-3: Airspace Modernization and AIR-D-3: Optimization of Ramp Aircraft Movements. Energy demand can be reduced through airspace modernization and optimization of ramp movements. Reviewing flight procedures and aircraft movements will allow for identification of opportunities to improve the efficiency of aircraft operations. These efficiencies will reduce overall fuel consumption during idling. HDOT estimated that fuel efficiencies from these improvements will begin in 2028, reaching 18 percent of total idling fuel flow due to airfield modernization and 10 percent of idling fuel flow due to ramp aircraft movement optimization.

AIR-D-2: Electrification of Ground Support Equipment and Airfield Vehicles. HDOT is estimating that all GSE will be electrified by target year 2045. It is estimated that it will take several years of budgeting and capital improvement project planning to find funding to accelerate electrification of this equipment. Therefore, it is estimated that emissions savings will begin to be realized in 2028, with a 5-year waiting period before the next conversion. For transparency, emissions from electricity consumption by the converted equipment was estimated using engine efficiencies, and the emissions were netted out of the reductions associated with reduction in fossil fuel demand.

The Carbon Offset and Reduction Scheme for International Aviation

The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) is the first global market-based scheme that applies to a sector. It complements other aviation in-sector emissions reductions efforts such as technological innovations, operational improvements and sustainable aviation fuels to meet the ICAO aspirational goal of carbon neutral growth. CORSIA is administered by ICAO.

Climate change is a global problem that requires global efforts to mitigate. CORSIA is a global scheme for the global international aviation industry. **The more states join CORSIA, the more emissions are covered by the offsetting requirements of the scheme and the higher its environmental effectiveness becomes**. Each participating state brings ICAO closer to meeting its global aspirational goal of carbon neutral growth. For a state that does not have an operator attributed to it (and therefore no compliance cost is incurred), its participation in the scheme will add those routes operated by foreign operators between the state and other participating states, thus increasing the overall emissions coverage of CORSIA. For states with particular interest in eco-tourism, participation in CORSIA provides the additional benefit of **greening air transport connections** to the rest of the world. As of 2025, 129 states (that is, countries) are voluntarily participating in CORSIA, along with 670 airplane operators or airlines.

AIR-L-1 through AIR-L-7: Electrification of Landside Ground Access Equipment. As described in the HWY-E strategies under Ground Transportation, electrical conversion of on-road vehicles will be essential to meet net-negative 2045 targets. Conversion of EVs was modeled consistent with the assumptions used in Ground Transportation both for light-duty passenger vehicles and heavy-duty commercial vehicles (such as delivery trucks and vans), with 2 percent increase in EVs per year for rental, rideshare, and private bus companies; 5 percent for airport employees and tenants; and 1 percent for commercial vehicles. Emissions associated with electricity consumption by the newly converted EVs were estimated using the average thermal efficiency of passenger vehicles. Electricity emissions were netted out of the emissions reductions associated with the elimination of fossil fuels.

Areas for Further Investigation in Next Plan

Further Plan updates should examine development and progress in the SAF industry, with particular focus on both supply chain dynamics and production capacity. A detailed assessment of Par Hawaiʻi's potential role in local SAF production could reveal opportunities to strengthen Hawaiʻi's energy independence while reducing aviation emissions. In addition, further updates could evaluate underused HDOT airport property for power generation potential through renewable energy systems. The ongoing progress of the Hawaiʻi Airspace Initiative also warrants close examination, particularly regarding its potential to optimize flight paths and reduce fuel consumption through more efficient routing and approach procedures.

Administration or Support Services

The Administration or Support Services Division comprises the following eight staff offices:

- Office of Special Compliance Programs
- Office of Civil Rights
- STP Office
- Personnel Office
- Business Management Office
- Computer Systems and Services Office
- Contracts Office
- Planning, Programming, and Budgeting Office

The Support Services Division supports the other three divisions by providing overall coordination on matters that affect more than one division, by providing a uniform review on matters that affect all divisions, or by providing a special or unique service to the other divisions.

Discussion of Significant GHG Sources and Current Trends

Direct GHG emissions sources specific to the Administration or Support Services Division are mainly operational emissions associated with the buildings that house the eight staff offices. In addition, this division will provide coordination on division and workforce engagement initiatives, creating awareness and responsibility for driving positive sustainability and climate action for all employees, regardless of their role.

Administrative Strategy Description

Several administrative strategies that are common across HDOT or involve broader engagement with other agencies have been identified. These strategies are likely to be led by the Administrative or Support Services Division, even if the strategies are not directly related to emissions caused by their activities. Recommended administrative strategies are as follows:

- Advance CFS (lower carbon) legislation. To incentivize the production or importation of clean fuels in Hawaiʻi, the State needs clean fuels production, blending, and import incentives similar to the ones in California and Washington state to be competitive in the market. Clean fuel incentives are also critical to secure financing to build clean fuel refineries. HDOT will work with state and federal agencies, industry partners, and/or academia to produce a Hawaiʻi-specific low-carbon fuel incentive program including enactment of a CFS (lower carbon) for the production, blending, and importing of clean fuels and clean fuel feedstocks and will actively engage stakeholders, business partners, and industry coalitions to develop new policy frameworks and technologies.

- Evaluate opportunities and feasibility to adopt and integrate clean fuels within the transportation sector, including identification of areas for fuel switching, and infrastructure upgrades. Because ZEV adoption will be gradual and some ICE vehicles are expected to remain in use, low-carbon fuels can further reduce overall transportation sector emissions.
- Create awareness in the workforce of decarbonization priorities. Introduce measures to conserve electricity and water and require reuse and recycling. Consider incentives for low-carbon commuting options such as priority parking for hybrid and electric personal vehicles, providing secure bicycle storage, offering e-bike purchasing incentives, and installing charge points for EVs and e-bikes.
- Formalize a Green Procurement Program that includes specifications for sustainable products, contract terms, and training.
- Evaluate and implement energy efficiency best practices in office space.
- Identify opportunities to add renewable electricity to HDOT facilities such as airports and harbors to support the charging demand of EVs and equipment. This may be done through a renewable electricity feasibility assessment and coordination with HECO to understand the charging demand at locations across the state and strategically target higher demand locations.
- Increase the real, permanent, and verifiable removal of atmospheric CO_2 in Hawaiʻi as necessary to neutralize hard-to-abate sources of GHG emissions and achieve net-negative. Near-term activities to achieve this goal include reestablishing the Greenhouse Gas Sequestration Task Force, identifying new forest and wetland projects, updating forest carbon removal estimates of the existing statewide inventory, and evaluating barriers and opportunities for high-durability carbon removal approaches in Hawaiʻi.
- Reduce the embodied carbon emissions of purchased goods and materials used to construct transportation systems through further investigation of options for lower-carbon materials (Clean Materials Grant), pilot studies, and a Green Procurement Program. The footprint associated with these goods and critical infrastructure materials can be significant, especially for carbon-intensive products such as concrete and asphalt that are used in large quantities for infrastructure projects.
- Engage with external stakeholders on the Plan and implementation through public education, outreach, public–private partnerships and other engagement. Successful implementation of the Plan strategies requires collaboration across multiple stakeholders.

Administrative Emission Reduction Strategies (ADMIN: Administrative)	
Strategies	**Description**
ADMIN-1	**Enact and Implement a Clean Fuel Standard or Alternative Legal Framework:** Many of the strategies in this Energy Security Plan are dependent on Hawaiʻi's transition to clean fuels. However, increasing local production and/or importation of clean fuels will not happen at the rate needed without financial incentives for low-carbon fuels and disincentives for high carbon fuels. A CFS (also known as a Low-Carbon Fuel Standard or LCFS) is a program that encourages fuel companies to produce and sell cleaner, lower-carbon fuels by offering financial incentives. A CFS is predicted to decrease the CI of Hawaiʻi's transportation fuel pool and provide low-carbon and renewable alternatives that would reduce petroleum dependency. To incentivize the production or importation of clean fuels in Hawaiʻi, the state needs clean fuels production, blending, and import incentives similar to the ones in California and Washington state to be competitive in the market. By increasing the % of ethanol, biodiesel, and renewable diesel blended into Hawaiʻi's fuel supply, Hawaiʻi could replace full fossil diesel by 2045 (500,000 metric tonnes in ground transportation). Significant reductions will also be seen in aviation (6.2 million metric tonnes) and marine (395,000 metric tonnes) with switching to SAF and e-fuels,

Administrative Emission Reduction Strategies (ADMIN: Administrative)	
Strategies	**Description**
	respectively. At the same time, these blending increases and fuel switches will advance Hawaiʻi's goals for energy independence, local fuel production, and economic resilience. Clean fuel incentives are also critical to secure financing to build clean fuel refineries, or upgrade facilities to produce clean fuel. However, given Hawaiʻi's far distances from primary fuel sources and high cost of living, HDOT will complete a feasibility study to understand how enactment of the CFS or alternative legislation would impact fuel prices for Hawaiʻi residents and visitors. Various legislation has been proposed in past years to create a legal and programmatic framework to incentivize low-carbon fuels and/or disincentivize high carbon fuel. The feasibility study would also compare the CFS to one or more of the other strategies, such as a carbon tax, to understand the barriers to implementation and effect on prices for residents. If the study shows the CFS or alternative will reduce emissions without making Hawaiʻi unaffordable for residents, HDOT, HSEO, and the Hawaiʻi State Legislature will work together to create and pass the necessary legislation and ensure sufficient staffing. The agency chosen to implement the program will then hire staff and run the program. **Proposed Implementation Timeline:** The Legislature should pass the bill(s) right away with an implementation timeline of 2 to 3 years before the program is required to commence. Local fuel companies will need time to start importing clean fuels and converting their operations to produce clean fuels. **Proposed Roles and Responsibilities:** • **HDOT:** Conduct feasibility study. • **HDOT and HSEO:** Work with legislators and fuel industry partners to draft and support legislation as recommended by HDOT's feasibility study; decide which agency will run CFS or alternative program and build a team to run program. • **Hawaiʻi Renewable Fuels Coalition:** Partner with HDOT, HSEO, and legislators to draft and revise bills and advocate for passage. • **Hawaiʻi State Legislature:** Draft and approve CFS and/or other legislation that incentivizes clean fuels. **Proposed Benchmarks:** **2026-2027:** Complete feasibility study and pass legislation. **2027-2028:** Implementing agency (HDOT/HSEO) hire dedicated program leader; work with fuel producers and local partners to set up supply and distribution systems. **2028-2029:** Implementing agency (HDOT/HSEO) hire dedicated program staff and establish program administration office, conduct rulemaking, set CI standards, define compliance frameworks, and ensure alignment with Hawaiʻi's broader energy and climate objectives. **2029**: Commence CFS. Quantitative fuel switch and blending benchmarks will be developed once the carbon intensities and other parameters are set in the CFS.
ADMIN-2	**Collaboratively Pass Legislation to Support Energy Security Strategies:** The Hawaiʻi State Legislature, HDOT, HSEO, Hawaiʻi Climate Change Mitigation and Adaptation Commission, other state and county agencies, industry, youth, and stakeholders will work collaboratively to pass multiple bills supporting decarbonization of transportation as recommended by this Plan. **Proposed Implementation Timeline:** HDOT expects to put forward a legislative package in the 2026 Legislative Session that includes multiple legislative proposals described in the strategies of this Plan. Passing key legislation in 2026 will be critical to meeting the 2030 legislatively created emissions reduction target.

Administrative Emission Reduction Strategies (ADMIN: Administrative)	
Strategies	**Description**
	Proposed Roles and Responsibilities: • A collaborative approach is needed by all parties listed above to understand how these proposals may impact emissions reduction, local energy security, cost of living for Hawaiʻi residents, and the wellbeing of children, as well as the feasibility and cost of implementation. **Proposed Benchmarks:** **2026**: Enact key legislation from clean transportation legislative package. **TBD:** Pass all critical legislation to enable the transportation sector to meet the state emission reduction targets for 2030 and 2045 (HRS § 225P-5) and to reach zero emissions in transportation as soon as possible (HRS § 225P-8).

ADMIN-3	**Incorporate Emissions Reduction Early in Planning & Prioritize in Project Scoring and Funding:** The day-to-day work of HDOT is building and managing transportation systems and infrastructure. This is carried out via project management and delivery. By implementing a framework aimed at reducing emissions in our project management and delivery, HDOT will meaningfully change its core operations. Estimating proposed project emissions at the start of a project provides the opportunity to adjust the initial project idea, scope of work, and budget to ultimately lower emissions. Prioritizing funding today for projects that reduce emissions is consistent with State goals and will reduce Hawaiʻi's long-term extreme weather risks and associated expenses.
	Proposed Implementation Timeline:
	Immediate focus on Highways modal unit and then expand to Airports and Harbors modes.
	Proposed Roles and Responsibilities:
	• **HDOT:** All HDOT modal units (Administration, Highways, Harbors, Airports) to incorporate emission reduction strategies wherever possible into the early stages of program and project planning. HDOT to prioritize emissions reduction in its project evaluation and scoring, selection and funding.
	• **HDOT partners and lessees:**
	  - MPOs and counties will incorporate emissions reduction early in planning and will prioritize in project scoring and funding through participating and proposing projects in HDOT's Long Range Plans, MRTP, and STIP.
	  - Airport and harbor industry users and lessees may be able to support this strategy by incorporating GHG reduction measures at the start of their own project planning for Hawaiʻi airports and commercial ports, and in their own project prioritization and budgeting.
	Proposed Benchmarks:
	2025: Prioritization of emissions reduction as a primary goal and objective of the MRTP and STIP. Create tool/methodology to estimate emissions and VMT per ground transportation project (PIʻI [Project Island Impact] Tool).
	2026-2028: Expand tool/methodology to estimate emissions and VMT (where applicable) to airports and harbors projects. Incorporate into planning and project scoring and funding processes.

ADMIN-4	**HDOT and State and County Agency Fleet Transition to EV and Clean Fuels:** HDOT and other state and county agencies will transition their light-, medium-, and heavy-duty vehicles to electric or clean fuels by assessing fleet needs, installing charging infrastructure, and leveraging HDOT's statewide contract with sustainability partners and other procurement contracts. For agencies with medium- and heavy-duty vehicles where EV replacements may not be available or affordable, agencies will secure clean fuel supply and install needed clean fuel infrastructure upgrades. This effort reduces emissions from State operations while supporting statewide goals under Act 74 for a zero-emission government fleet.

<table>
<tr><th colspan="2">Administrative Emission Reduction Strategies
(ADMIN: Administrative)</th></tr>
<tr><th>Strategies</th><th>Description</th></tr>
<tr><td></td><td>Proposed Implementation Timeline:
Immediate planning and budgeting at the agency level to establish benchmarks and timeline for fleet conversion to EV and clean fuels. Immediate planning to secure clean fuel supply for ICE vehicles in fleet that cannot be replaced by EVs in the short term, and to provide sufficient EV charging and/or clean fuel infrastructure.
Proposed Roles and Responsibilities:
• HDOT: Develop charging infrastructure, continue to share master contract for procurement of EVs with other state agencies and HDOT fleet conversion.
• State Climate Commission and/or HSEO: Coordinate agency conversion benchmarks and progress; provide guidance and resources.
• State and county agencies: Develop their own benchmarks for fleet conversion, and convert. Look for opportunities on agency property to provide easy and shared access to EV charging and clean fuel supplies.
• Electric utilities: As the state's electricity providers, both HECO and KIUC are responsible for pursuing efforts towards 100% renewable energy generation. This responsibility is guided by HRS § 269-92, which establishes Hawaiʻi's Renewable Energy Portfolio Standards requiring 100% of electricity sales to come from renewable energy resources by 2045. The mandate for renewable energy generation by these electric utilities will need to account for increased electricity load from EVs.
• Public–private partnerships: Anticipate increased demand and provide supply. Leverage for quicker fleet conversion.
Proposed Benchmarks:
2030: HDOT will invest $40M into public charging stations and infrastructure for State and county EVs.
2030: For all State agencies (including HDOT),100% light-duty vehicles in State's fleet that are passenger cars shall be zero- emission vehicles per HRS § 196-9(c)(11)(A).
2035: For all State agencies (including HDOT), 100% light-duty vehicles in State's fleet shall be zero-emission vehicles per HRS § 196-9(c)(10)(B).</td></tr>
<tr><td>ADMIN-5</td><td>Continue to Use and Expand Use of Low-Carbon Materials: Reduce the embodied carbon emissions of purchased goods and materials used to construct transportation systems through further investigation of options for lower-carbon materials (Clean Materials Grant), pilot studies, and contract requirements for clean materials. The footprint associated with these goods and critical infrastructure materials can be significant, especially for carbon-intensive products such as concrete and asphalt that are used in large quantities for infrastructure projects. Longer-lasting materials may also decrease emissions because they need to be replaced less often.
Proposed Implementation Timeline:
Currently underway at HDOT in the Highways Lab, and within private industry.
Proposed Roles and Responsibilities:
• HDOT: Continue the program and actively look for grant and research opportunities. Consider implementing clean material standards into contracts with construction contractors. Update the PIʻI Tool with new low-carbon materials as they come into use.
• State and county agencies: Consider low-carbon material options when project planning. HDOT's PIʻI Tool includes material options and is available for other state and county agencies to use to calculate estimated emissions per project.
• Industry partners: Continue innovating and bringing best practices learned elsewhere to Hawaiʻi.</td></tr>
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Administrative Emission Reduction Strategies (ADMIN: Administrative)	
Strategies	**Description**
	Proposed Benchmarks: TBD. In setting benchmarks, it is important to calculate the lifecycle emissions of materials.
ADMIN-6	**Study Carbon Capture Rates, Protect Carbon Sinks, & Increase Sequestration:** Increase the real, permanent, and verifiable removal of atmospheric carbon dioxide in Hawaiʻi as necessary to neutralize hard-to-abate sources of GHG emissions and achieve net-negative; also to protect existing nature-based carbon sinks, including sequestration from agricultural land and compost, and avoid loss of natural removal capacity or emissions of stored carbon as a supplemental action for short- and long-term climate protection. HDOT, DLNR, the University of Hawaiʻi, and other conservation and agriculture partners will study carbon capture rates of Hawaiʻi's diverse native ecosystems and plan strategic investments to increase carbon sequestration, prevent the loss of existing native ecosystem carbon sinks from invasive species or land use changes, and increase local food and energy security. **Proposed Implementation Timeline:** Immediate study of the carbon capture rates of at least one unstudied native ecosystem, and immediate investment into proven sequestration techniques such as ungulate fencing and native forest restoration through planting native and invasive species removal. Long-term strategy to be developed through collaborative model. **Proposed Roles and Responsibilities:** • **DLNR**: Lead sequestration strategy and planning efforts. • **Hawaiʻi State Legislature**: Fund immediate investment into proven sequestration techniques such as ungulate fencing and native forest restoration through planting native and invasive species removal. Possible biosecurity investments to safeguard Hawaiʻi's existing carbon sinks and any to-be-restored native forests, coastal wetlands, and regenerative farms. • **DOH:** Revise GHG inventory as needed. • **DOA**: Lead biosecurity strategy. • **Farmers and ranchers:** Implement regenerative practices to capture carbon and share data. • **HDOT**: Implement strategies in partnership with DLNR and other relevant stakeholders including representatives of regenerative agriculture, continue planting at least 1,000 native trees per year and tracking native planting contributions, hire landscape architect knowledgeable about native Hawaiian plants. • **Fuel producers**: Explore engineered carbon capture options to retrofit facilities. **Proposed Benchmarks:** **2026:** Study carbon capture rates of at least one unstudied Hawaiʻi native ecosystems (only ʻōhiʻa dominant forest has been studied and was found to have high carbon capture rates). Immediate and significant investment in proven strategies: ungulate-proof fencing of intact native forest, native forest planting and restoration, native coastal wetland restoration, and safeguarding of existing regenerative farms. **2027-2028:** Update forest carbon removal estimates of existing statewide GHG inventory. Improve mapping and assessment of potential new forest and wetland projects. Develop strategies for advancing the carbon removal and sequestration strategies that are best suited to Hawaiʻi's goals and context, and evaluate barriers for high-durability carbon removal approaches.
ADMIN-7	**Use Diverse Coalition Model to Improve Public Communications & Reach Energy Security Goals:** HDOT and existing industry coalitions, working groups, and commissions will actively engage and work through barriers to reducing emissions in transportation with industry, involved agencies, nonprofits,

Administrative Emission Reduction Strategies (ADMIN: Administrative)	
Strategies	**Description**
	youth, Native Hawaiian community organizations, and stakeholders in a coalition model. Expand HDOT's public communication on emissions reduction progress, and collaboratively launch public education campaigns to encourage public adoption of this Plan's strategies. **Proposed Implementation Timeline:** This strategy represents HDOT's chosen approach to implement the strategies in this Plan. It is already underway with HDOT engaging key stakeholders to consult on this Plan prior to its release and regularly communicating and collaborating with Earthjustice, Our Children's Trust, and Hawaiʻi Youth Transportation Council. **Proposed Roles and Responsibilities:** • **HDOT:** Improve public information sharing by producing an annual report compiling the individual HDOT project reports and detailing its progress in reducing GHG and VMT, including quantitative analyses. Collective wins toward reducing emissions may also be shared in this annual report. • **HDOT, Earthjustice, Our Children's Trust, and possible other partners:** Plan and launch public education campaigns to support the many strategies in this Plan. Successfully inspiring public behavior changes is critical to meet the state's emissions reduction, health, and quality of life goals. • **HECO and KIUC:** The public utilities will be important partners in this effort. • Many other partners to be added. **Proposed Benchmarks:** **November 2025**: Youth engagement about this Plan's strategies and how to inspire public behavior change at the Climate Future Forum. **2026**: Public outreach with partners around HDOT's planned clean transportation legislative package.
ADMIN-8	**Consistent Youth Involvement and Leadership:** Uplift youth voice and involve youth in every step of progress made on this Plan's strategies as they will inherit the transportation system we create. Incorporate in-agency polices, processes, and forms checks to ensure that decisions, programs, and projects are mindfully prioritizing the health and wellbeing of Hawaiʻi's children. **Proposed Implementation Timeline:** Immediate and through the life of this Plan. **Proposed Roles and Responsibilities:** • **HDOT:** Host quarterly meetings of the Hawaiʻi Youth Transportation Council to get feedback and assistance on prioritization and implementation of the decarbonization strategies identified in this Plan, and find ways for youth to be meaningfully involved at every step. Continue providing staffing, travel, and meeting support to the Hawaiʻi Youth Transportation Council. • **State and county agencies:** TBD. • **Youth:** Participate in public consultation opportunities for transportation and carbon sequestration planning and implementation. • **Teachers/schools:** Connect students with opportunities for engagement. **Proposed Benchmarks:** **2025:** HDOT and other agencies, groups, and youth to participate in the annual Climate Future Forum.

Administrative Emission Reduction Strategies (ADMIN: Administrative)	
Strategies	**Description**
ADMIN-9	**Revise Policies to Reduce Emissions and Increase Staff Education, Capacity, and Program Participation:** HDOT to review and revise internal policies and processes to support decarbonization and equitable transportation access, provide regular staff training and continuing education, hire staff as needed to support the decarbonization transition, and implement measures and incentives to reduce staff transportation emissions. Incentives to evaluate include priority parking for EVs, bike storage, EV/e-bike charging to encourage employees to commute sustainably and reduce waste, free or discounted transit passes, and/or telework. Once implemented, HDOT should launch awareness campaigns to encourage and incentivize employee and tenant ownership and participation in programs and policies needed to meet targets. These efforts help build a greener workplace and support Hawaiʻi's emissions reduction goals by making everyday choices more climate-friendly. HDOT may also explore energy-saving upgrades in its facilities—like better lighting, equipment, and insulation—working closely with electric utilities. **Proposed Implementation Timeline:** Immediate and ongoing through life of this Plan. **Proposed Roles and Responsibilities:** • **HDOT:** Lead strategy. **Proposed Benchmarks:** **2025:** Internal presentation on this Energy Security and Waste Reduction Plan to create awareness in the workforce of decarbonization priorities and share out existing HDOT carpool program. Continue telework program to decrease VMT and emissions. **2026:** Revise existing policies and evaluate any additional policies needed to reduce emissions and VMT and increase resilience and equitable transportation. Launch regular staff education trainings that support this Plan's strategies and goals. **2026-2028:** Review incentives for low-carbon commuting options such as priority parking for hybrid and electric personal vehicles, providing secure bicycle storage, offering e-bike purchasing incentives, offering discounted or subsidized transit passes, and installing charge points for EVs and e-bikes. Evaluate energy efficiency in office spaces, and introduce measures to conserve electricity and water, and require reuse and recycling.
ADMIN-10	**HDOT Efforts to Increase Renewable Electricity Generation:** Continue to increase renewable energy generated at HDOT facilities such as solar, which is already used at HDOT-Highways baseyards and airports. Support renewable electricity projects that decarbonize the grid through meeting transportation infrastructure needs where possible. **Proposed Implementation Timeline:** Ongoing and continuous through life of this Plan. **Proposed Roles and Responsibilities:** • **HDOT:** Identify opportunities to add renewable electricity to HDOT facilities including highway rights-of-way, airports, and harbors to reduce emissions and support the expected increased charging demand from EVs and equipment. If barriers or missed opportunities are encountered, explore policy and process changes. • **HECO and KIUC:** Coordinate as partners on any renewable electricity feasibility assessment to understand the charging demand at locations across the state and strategically target higher demand locations. **Proposed Benchmarks:** **2025:** HDOT conduct right-of-way solar analysis. HDOT begin to use PIʻI Tool in evaluating and commenting on environmental review documents for land use development projects.

Administrative Emission Reduction Strategies (ADMIN: Administrative)	
Strategies	**Description**
ADMIN-11	**Green Budgeting, Green Procurement, & Emerging Administrative & Green Financing Strategies:** HDOT to assess feasibility and create benchmarks and timelines for the possible implementation of Green Budgeting, Green Procurement, and emerging administrative and green financing strategies such as lease terms found to reduce emissions, and private–public partnerships for financing and construction of low emissions or emissions-reducing projects. **Proposed Implementation Timeline:** These are tools that can assist to implement the other strategies of the Plan and should be used when helpful. One or more of these tools may rise in priority in future iterations of this Plan. **Proposed Roles and Responsibilities:** • **HDOT:** Assess and use tools as is helpful to progress this Plan's goals and strategies. • **Tenants, consultants, and suppliers**: Work with HDOT to meet required specifications, which may evolve over time to improve sustainability. **Proposed Benchmarks:** **2026**: Assess incorporating Green Budgeting with the support of Governor Green, possibly as a state pilot. **2027:** Assess incorporating Green Procurement, which other states are exploring concurrently. A Green Procurement Program prioritizes buying eco-friendly products and materials and partnering with suppliers and tenants to meet clear sustainability standards and specifications. Where locally produced products are specified, it helps lower shipping emissions and supports local businesses, contributing to a state's emissions reduction and economic goals. Metrics are kept on the number of low-carbon certified products identified and procured and the number of tenants and vendors engaged on green procurement. **2026-2030:** Assess emerging administrative and green financing strategies as they arise.

3.5.3 Mitigation Strategies – Other Transportation Emissions

There are several indirect GHG emission sources associated with transportation activities that are not yet included in this Plan. HDOT is working to improve data collection to be able to quantify and address more indirect emissions. As these sources are added into the inventory and Plan, a discussion of additional mitigation strategies will be incorporated.

Low-Carbon Electricity Supply

Emissions from EV electricity consumption will be included in this Plan until the electricity grid becomes 100 percent renewable. Knowing that a clean electricity grid will be key to achieving zero emissions as more of HDOT's vehicles and equipment electrify, HDOT is engaged with HECO and HSEO, coordinating strategies to incentivize EV integration, deploy infrastructure, and scale up the renewable energy supply needed.

International Marine and Aviation

While international marine and aviation activities are not included in this Plan, through the implementation of strategies for reducing emissions from domestic marine and aviation, HDOT is also working to ensure there is adequate infrastructure in place (such as SAF tanks, clean marine fuel bunkering, ground power, and similar) for international flights and carriers to further reduce emissions.

Other Marine Traffic

Other marine activities across the Hawaiian Islands, specifically fishing vessels, commercial fishing boats, and passenger ferries operating from harbors not managed by HDOT-Harbors, are relatively small emissions compared to ocean-going cruise and cargo ships and harbor craft. However, these activities still play a role in the overall emissions footprint of the marine sector. There are limited data currently available on these vessels, making it challenging to estimate their emissions with confidence. To address this, HDOT intends to collaborate with DLNR, which oversees these vessels and their operations, to gather the necessary data to account for and manage these emissions.

Construction and Embodied Carbon

This Plan does not include embodied carbon emissions associated with purchased goods or critical infrastructure materials. These emissions can be significant, especially for carbon-intensive products using concrete and asphalt that are in large quantities for infrastructure projects. HDOT recognizes this and has applied for and received a Clean Materials Grant to further investigate options for lower-carbon materials used in infrastructure projects. The results of these investigative activities may be used to inform strategies for reducing carbon emissions at the infrastructure level.

This Plan also does not account for the construction activity emissions associated with HDOT's infrastructure projects. Because these emissions can vary widely from year to year depending on vehicle/equipment purchases and the quantity/size of infrastructure construction projects, the quantification of said construction emissions are challenging without robust data collection processes. This is another area of GHG emissions that may need further evaluation.

In addition to the exceptions noted in this section, a significant number of assumptions were made in the assessment, mostly with respect to boundaries and included activities. Please refer to Appendix B for a detailed outline of key assumptions and areas identified for continual improvement.

4. HDOT Equity Approach

Achieving Net Negative by 2045 must not come at the expense of more local families being priced out of paradise. Currently, the overall cost of transportation for Hawaiʻi residents is far above the national average, on a system powered primarily by imported fossil fuel. 45 percent of Hawaiʻi households live below the ALICE [Asset Limited, Income Constrained, Employed] Threshold, meaning they earn more than the federal poverty level but not enough to afford the basics where they live (United for ALICE 2023). As of 2020, more Native Hawaiians now live on the U.S. continent (53 percent) than in Hawaiʻi (47 percent) (U.S. Census Bureau n.d.). State leadership recognizes that change is needed, and HDOT is committed to a just transition that does not leave the most vulnerable in our community behind. That is why Affordability, Island Energy Security, and Emissions Reduction are the equal pillars of this Plan, and must be balanced.

As HDOT, with feedback and partnership from sister agencies, the Hawaiʻi Legislature, industry, the public, and Hawaiʻi's youth, refines the strategies in this initial Plan, we are committed to an equitable approach that consistently evaluates and prioritizes the following:

1) Affordability for Kamaʻāina – local residents and businesses
2) Vulnerable and Disadvantaged Communities
3) Place-Based Knowledge and Realities - solutions tailored to specific local contexts, recognizing the unique challenges and opportunities of different communities

HDOT's Equity Approach will be further defined in the next revision of this Plan.

HDOT's current equity work is largely based in federal and state compliance. In addition to complying with all federal Title VI and Environmental Justice (EJ) guidelines, HDOT implements HRS § 264-143, which includes providing equity for all communities and users (Goal 5) and accounting for investments in its Act 131 annual reports to the Legislature. HDOT has established the following goal to provide equity for all communities and users:

> *HDOT considers projects that have the potential to create jobs and economic opportunities or otherwise benefit disadvantaged or underserved communities*

(Over the next few years, HDOT will create additional equity goals and integrate those goals into policy and procedures.) An important component of the HDOT Title VI Program is the commitment to developing and implementing EJ strategies (HDOT n.d.). The HDOT FHWA FFY 2025 Title VI Program Plan (HDOT 2024) outlines the following current strategies to advance equity:

- Data Collection: HDOT statistical data on race, color, national origin, sex, age, disability, and income level of participants in and beneficiaries of HDOT's programs (such as relocatees or affected populations) is gathered and maintained by the Department to determine the transportation investment benefits and burdens to the eligible population, including minority and low-income populations.
- Public Engagement: HDOT conducts public engagement during the development of statewide plans through community engagement efforts. HDOT seeks to inform residents about transportation planning and funding decisions under review. The public involvement plan for the update of the STIP is designed to maximize public outreach and address Title VI. Consistent with HDOT's Public Involvement Policy (HDOT 2012) and Public Involvement Guide (HDOT Highways Division 2012), the STIP public participation program is composed of several elements that include public meetings and information

dissemination strategies. Appendix J includes the complete list of organizations and individuals who provided comments on this Plan.

- Planning: HDOT staff conduct a wide variety of planning studies covering all modes and counties. For example, both the Hawaiʻi Statewide Transportation Plan 2045 (HSTP) and the Statewide Long Range Land Use and Transportation Plan include goals that support underserved communities during planning. HDOT's planning responsibilities for long and short-range transportation plans include the following:
  1. Making special effort to contact and involve ethnic minorities and low-income populations in planning studies, meetings and hearings
  2. Using the input of low-income populations and ethnic minorities to improve proposed projects and to mitigate negative impacts of planned and proposed projects
  3. Collecting, analyzing and using data on ethnic minority populations and low-income populations to determine impacts of plans, programs and projects
  4. Establishing advisory committees as needed to ensure adequate representation by low-income populations and ethnic minorities in the planning of projects and programs
  5. Involving representatives from affected groups on citizen advisory committees when disproportionate impacts on low-income populations are possible

  HDOT staff developed the HDOT Climate Insights for Infrastructure Platform planning tool, which includes multiple data sets to identify concentrations of disadvantaged communities in the state.
- Design: HDOT's responsibilities during the design phase (preliminary design, development of alternatives, selection of options, and final design) include the following:
  1. Ensuring that public involvement activities during the design phase provide opportunities for minority and low-income populations to receive information on the project, and an opportunity to comment and participate in public forums.
  2. Maintaining required statistical data by race/national origin and sex of participants and beneficiaries of the programs and projects. In some areas, data related to low-income populations need to be acquired and maintained for projects that bypass the planning phase.
  3. Using the project scoping process to collect pertinent minority and low-income data to determine whether Title VI and/or limited English proficiency (LEP) or other associated issues are likely to be present.
  4. Ensuring all project designs incorporate ADA-compliant features, including accessible routes, curb ramps, and pedestrian facilities, to provide equitable access for individuals with disabilities.
- Environmental: It is HDOT's policy to evaluate the environmental and historic preservation benefits and consequences of its activities and implement practices that minimize environmental and cultural impacts using a systematic interdisciplinary approach to identify and evaluate environmental issues and problems. HDOT's responsibilities during the environmental process include the following:
  - Consulting with the Office of Civil Rights (OCR) when Title VI issues are raised at public hearings/meetings.
  - Submitting environmental documents for major transportation projects to OCR for review.

    Ensuring compliance with any associated standards and guidelines including HDOT's *Addendum #2 - Environmental Justice Compliance* and with HRS Chapter 6E, Historic Preservation

Additional current strategies employed by HDOT include the following:

- Funding: HDOT identifies the location of disadvantaged communities (Title VI and EJ communities) in relation to the transportation system using publicly available data for mapping purposes. An analysis was conducted to compare the number of projects and amount of funding for an area against the concentration of Title VI and EJ populations present.
- Training: HDOT conducts Title VI/EJ Program Implementation training for HDOT managers, program officers, suppliers, vendors, contractors, local governments, and other HDOT subrecipients of federal funds (HDOT n.d.).[7]
- Infrastructure: HDOT encourages infrastructure support for affordable housing, including TOD.
- Hawaiʻi Youth Transportation Council: HDOT provides financial and administrative support to the Hawaiʻi Youth Transportation Council and views the Council as a critical partner in the transition to a clean transportation system. Youth voices and opinions should be included at all critical decision points as they will inherit the transportation system that we are building together.

Strategies in development by HDOT include the following:

- Nature-Based Solutions: In partnership with local communities, HDOT is currently exploring solutions to Hawaiʻi transportation issues that are rooted in nature and indigenous knowledge systems. This includes reef restoration to dissipate wave energy and protect shorelines and coastal highways, Hawaiian fishpond restoration, and native planting for erosion control and fire mitigation. All of these potential solutions are community-driven and government-supported.
- Native Hawaiian Consultation Protocol: In partnership with FHWA, HDOT is developing a Native Hawaiian Consultation Protocol to improve consultation on its transportation projects and strengthen and maintain relationships with Native Hawaiian Organizations and communities for better transportation outcomes.

4.1 Energy Affordability

Hawaiʻi has the highest electricity costs in the nation, largely due to its reliance on low-sulfur fuel oil (LSFO) for power generation. The transition to renewable energy sources, such as solar and wind, is expected to reduce electricity costs over time. For example, Kauaʻi's shift to 60 percent renewable energy has resulted in lower electricity rates compared to other islands. The proposed switch from LSFO to LNG is also projected to lower energy costs. LNG is less expensive and has lower price volatility compared to LSFO. As discussed in the HSEO Alternative Fuels Study Final Report (HSEO 2025), the transition to renewables and alternative fuels in the energy sector that this Plan relies on could also result in significant energy affordability.

4.2 Equity Criteria for Reduction Strategies

The next iteration of the Plan will include an equity discussion for each strategy. That discussion will likely result in assigning each a positive, neutral, or negative score based on the impact the strategy would have on Hawaiʻi's disadvantaged communities.

[7] Administration | Title VI/Environmental Justice/Language Access Programs

5. Legislative Actions for Plan Implementation

Many of the strategies in this Plan require legislative action. The Hawaiʻi State Legislature is a critical partner for HDOT to achieve the zero-emissions target. The required actions from the Legislature include new vehicle standards, funding sources, and tax incentives. In addition, State agencies need the authority to create market-based mechanisms that incentivize clean fuels. Table 5-1 identifies new legislative needs by mode. This list is intended to create a set of legislative priorities to be pursued to enable Plan implementation.

Table 5-1. Legislative Requirements by Mode for Plan Implementation

Category	Strategy	Energy Plan Strategy #
Electrification	Increase Electric Vehicle Sales (Build Additional Public EV Charging Infrastructure to Support 100% EV Sales)	HWY-E-1
	Enact Financial Incentives for EV Purchase	HWY-E-2
	Promote Incentive Programs to Accelerate the Turnover of ICE Vehicles to EVs	HWY-E-3
	Establish EV Battery Recycling and Disposal System	HWY-E-4
	Enact Preferential EV Registration Legislation	HWY-E-6
	Support Sales Tax Exemption for EVs	HWY-E-7
	Electric Aircraft	AIR-C-5
	Hydrogen Aircraft	AIR-C-4
Clean Fuels	Enact and Implement a Clean Fuel Standard	ADMIN-1
	Pass Sustainable Aviation Fuel Tax Credit	AIR-C-1
	Adoption of Clean Marine Fuels on Non-Homeported Cruise Voyages	HAR-1
	Adoption of Clean Marine Fuels on Ocean Cargo Carriers	HAR-2
	Adoption of Clean Marine Fuels on Intra-State Tug-Barge Services	HAR-3
	Adoption of Biodiesel/Zero-Emissions Technology for Commercial Harbor Craft	HAR-4
Adequate Funding/ Other	Adequate Funding for Electrification, Decarbonization & Carbon Sequestration	ADMIN-2
	Compact and Transit-Oriented Development	HWY-M-6
	Free/Safe Youth Transit Access	HWY-M-12
	Increase Carbon Sequestration	ADMIN-6

Across all modes, strong incentives are needed to encourage adoption of clean fuels and address the cost parity between biodiesel and fossil diesel. State funding or market-based mechanisms such as subsidization of cleaner fuels, tax credits, grants, and utility partnerships encourage local production, research, and the broader use of advanced biofuels. Other regulatory legislative measures may include

CFS, blending mandates, and streamlined permitting for clean fuel infrastructure. Although a lower priority than policies that increase production of renewable energy, it is also recommended that the State implement a policy that prioritizes the use of locally produced renewable fuels for transportation purposes over stationary combustion purposes. Together, these actions spur investment, reduce reliance on petroleum, and help Hawai‘i meet its carbon reduction targets. HDOT will continue to work with HSEO and other parties to analyze what mechanisms are most effective and least costly and support a common set of policies to incentivize low-carbon fuel use across all modes.

6. HDOT Conservation Measures to Promote Positive Land Use and Carbon Dioxide Removal

Even with successful implementation of the aggressive decarbonization measures proposed in this Plan, preliminary analysis indicates that there will be 800,000 metric tonnes of CO2e or more of “residual” GHG emissions in 2045. As indicated throughout this document, there are numerous technical, financial, legal, and political barriers that will limit the pace of progress. For example, projected residual emissions include legacy ICE vehicles still projected to be on the road in 2045, as well as the reality that currently available SAF has significant remaining lifecycle GHG emissions. Because of these hurdles, despite HDOT’s and stakeholders’ expected best efforts to reduce GHG emissions, it is anticipated that achievement of absolute zero GHG emissions will occur after 2045.

Therefore, achievement of the 2045 net-negative target will require additional removals of CO_2 from the atmosphere, such that the quantity of CO2e removed each year is equal to or greater than the quantity of CO2e emitted in 2045 and beyond. Furthermore, because the CO_2 emitted today will remain in the atmosphere for hundreds of years, achieving net negative by 2045 alone will not prevent the worst impacts of climate change, and mitigation and removals in earlier years are vitally important to achieving global goals. All available removal options will take years to develop, and it is therefore necessary and prudent to begin rapid action on these strategies in parallel with reducing emissions at the source. The protection and restoration of forest and wetlands in Hawaiʻi will be prioritized but may not alone be adequate, and additional options are needed.

Appendix C provides information on available strategies for protecting existing carbon sinks and increasing carbon removals to meet Hawaiʻi’s 2045 net-negative goal. In addition, ADMIN-6, detailed in the strategies tables in Section 3.5.2, provides additional information and outlines the short-term activities required to achieve these targets.

7. Reporting

HDOT reports on requirements associated with the various pieces of legislation that address all of HDOT's mission, including resiliency. The following sections summarize the various reporting requirements that are relevant to HDOT's decarbonization efforts.

7.1 GHG Inventory

The DOH-led GHG inventory has been updated annually since 2017. While the DOH inventory helped to inform the GHG baseline and projections for much of this first iteration of the Plan, moving forward HDOT will be formalizing data collection processes to enable more detailed and accurate calculation of transportation emissions across the state (bottom up instead of top down). Annually, HDOT will calculate and report on GHG emissions totals as well as progress toward reduction targets. Forward-looking projections will also be updated annually as more data are collected and technology continues to improve and advance.

7.2 Target and Benchmark Achievement Progress

The targets and benchmarks set forth in this Plan will be evaluated on an annual basis, and progress towards completion will be reported on an annual basis in a report published November 16 of the year following the issuance of the Plan or annual update to this Plan. The first target and benchmark progress report will be due November 16, 2026, and will be based on this first version of this Plan.

7.3 Energy Security and Waste Reduction Plan Document Update

Per the Navahine Settlement Agreement, *"The GHG Reduction Plan will be updated on an ongoing basis, with a comprehensive review and update approximately every five (5) years, under the principle of continual performance feedback and improvement. Specifically, HDOT will review and reassess actions and strategies for ground, air, and marine transportation based on the best scientific information available, the progress to date, and the necessary adjustments to meet the upcoming five-year interim target."*

HDOT plans to update the plan annually for the first 5 years after the issuance of the first plan. This will allow for additional analysis as needed and integration of new technologies as they become available, and will reflect progress made by HDOT. Technical updates and corrections will be incorporated into the next annual update.

7.4 Energy Security and Waste Reduction Plan Progress Update

Per the settlement agreement, *"HDOT will provide an annual update to the public, with notice specifically provided to Youth Plaintiffs through their counsel, on its progress in implementing the GHG Reduction Plan, achieving GHG emission reductions, and moving toward the upcoming GHG reduction interim target.*

The public and Youth Plaintiffs will have at least thirty (30) days after receipt of each annual update to provide comments and feedback to HDOT. Upon request by Youth Plaintiffs, they shall have the opportunity to have an in-person or virtual meeting with the Climate Change Mitigation and Culture Manager to discuss their comments and feedback."

Annual updates to the public and to the Youth Council will be provided through the following methods:

- A special Youth Council meeting will be held annually for both the Council members and Navahine plaintiffs to view the annual updates from HDOT and have time to provide feedback and comments to HDOT for incorporation.
- An email notification will be sent to all persons on the mailing list with a link to the website on which the update will be posted.
- Virtual meetings will be hosted to provide updates to the public.
- In-person meetings will be hosted to provide updates to the public, being inclusive of different islands and regions.

7.5 Act 100 and Act 131 Updates

Hawaiʻi Act 100 (1999) requires every State agency to submit annual reports outlining goals, objectives, and policies to provide a basis for determining priorities and allocating limited public funds and human resources. HDOT produces annual reports for the ground, air, and marine sectors.

The Act 100 reports can be found online at https://highways.hidot.hawaii.gov/stories/s/cn5s-zh7q.

Hawaiʻi Act 131 (2021) is intended to modernize Hawaiʻi's ground transportation infrastructure by providing additional metrics, considerations, and assistance to HDOT to move Hawaiʻi forward into the twenty-first century by reducing transportation costs to local residents, minimizing injuries and fatalities, improving public health and quality of life, and addressing GHG emissions.

The Act 131 2024 report can be found online at https://highways.hidot.hawaii.gov/stories/s/Act-131-Report-2024-Overall-Summary-Report/66f5-ajtw.

7.6 Availability and Accessibility of Reports and Documentation

All of these reports are required to be published on the HDOT website and made publicly available. In addition, HDOT intends to host public meetings and webinars to inform the public and solicit feedback and comments on the reports and progress being achieved by HDOT.

Reports and updates will be shared to the public through the website, meetings, and webinars in the following ways:

- The HDOT website will be updated regularly (at least quarterly) with all relevant information, links, and documents available to the public.
- Public meetings will be hosted in-person and virtually to inform the public and solicit feedback.
- An email notification will be sent to all persons on the mailing list with a link to the website to which the update will be posted.
- Virtual webinars for the public will be hosted.

7.7 Feedback and Comment Collection

Collecting input from all interested stakeholders is essential to delivering on the letter and spirit of the settlement agreement. Feedback and comment collection will occur using a structured process using an online form. This form will be widely distributed and available on the project website.

Comments will be collated and addressed after the public comment period ends. The project team will consider and address comments, integrating feedback into strategies and implementation as possible.

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Energy Security & Waste Reduction Plan
Appendices
FINAL

October 15, 2025

Appendix A
Existing Federal, State, and Local Strategies and Plans to Reduce GHG Emissions

Federal, State, and Local Strategies and Policies

The following sections describe federal, state, and local greenhouse gas (GHG) guidance applicable to this document. A comprehensive list of federal GHG reduction policies is available at https://afdc.energy.gov/laws/fed_summary?sort=Category.

Federal

- The U.S. National Blueprint for Transportation Decarbonization is a strategy developed by the U.S. Environmental Protection Agency (EPA), Department of Energy (DOE), Department of Transportation (USDOT), and Department of Housing and Urban Development (HUD) that aims to cut GHG emissions form the transportation sector by 2050.
- The Renewable Fuel Standard (RFS) is a federal program that requires a minimum amount of renewable fuel in transportation fuels sold in the United States. The EPA implements the RFS program in consultation with the Department of Agriculture and the DOE.
- The Clean Fuel Production Credit (CFPC) enacted in the Inflation Reduction Act (IRA) offers tax credits for the production and sale of low emission transportation fuels, including sustainable aviation fuel (SAF).
- The Diesel Emissions Reduction Act provides grants and rebates to retrofit and replace older diesel engines, including those in ports.
- Corporate Average Fuel Economy (CAFE) Standards are regulations aimed at improving the average fuel economy of cars and light trucks to reduce energy consumption and GHG emissions.
- The Infrastructure Investment and Jobs Act (IIJA) provides significant funding for infrastructure projects, including roads, bridges, broadband, and clean energy initiatives.
- The Inflation Reduction Act (IRA) is a federal law aimed at reducing the budget deficit, lowering prescription drug prices, and investing in clean energy initiatives.
- The Alternative Fuel Infrastructure Tax Credit offers a tax credit of up to 30 percent for the cost of installing alternative fueling infrastructure, including EV charging stations.
- The Carbon Reduction Program (CRP) provides funding to states and localities for projects that reduce transportation-related carbon emissions, such as public transit enhancements and infrastructure for non-motorized users.
- The Clean Hydrogen Production Tax Credit (Section 45V) introduces a tax credit for the production of clean hydrogen, incentivizing low-carbon hydrogen production methods.
- The Advanced Technology Vehicle Manufacturing Loan Program offers loans to support the manufacture of advanced technology vehicles and qualifying components that improve fuel economy performance.

Aviation Specific

- The SAF Grand Challenge is a collaboration of the USDOT, DOE, and the U.S. Department of Agriculture to support the expansion of SAF production in the United States. The goal of the effort is to achieve 3 billion gallons per year of domestic SAF production by 2030, with a minimum of a 50 percent reduction in lifecycle GHG emissions compared to conventional fuel. By 2050, the target is 100 percent of projected aviation jet fuel use, or 35 billion gallons of annual SAF production.

- The EPA has finalized regulations effective for new type design airplanes starting in 2028. These regulations establish fuel efficiency certification requirements, aligning with the International Civil Aviation Organization (ICAO) carbon dioxide (CO_2) emission standards for subsonic jet and propeller-driven airplanes.
- The ASCENT program is a coalition of 16 leading U.S. research universities and over 60 private sector stakeholders committed to reducing the environmental impact of aviation. ASCENT also works in partnership with international research programs, federal agencies, and national laboratories to create an all-inclusive research capability for whatever environmental impact obstacle the aviation industry faces. Also known as the Center of Excellence for Alternative Jet Fuels and Environment, ASCENT is funded by the Federal Aviation Administration (FAA), National Aeronautics and Space Administration (NASA), EPA, Department of Defense, and Transport Canada.
- The USDOT Federal Aviation Administration (FAA) Zero Emissions Airport Vehicle and Infrastructure Pilot Program provides funding to airports for up to 50 percent of the cost to acquire zero-emission vehicles (ZEVs) and install or modify supporting infrastructure for acquired vehicles.

Ground Transport Specific

- The Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles (EPA 2024a) were set to reduce GHG emissions and encourage adoption of advanced technologies in vehicles to meet new emissions requirements. This rule is currently under review and could potentially be rolled back.
- The National Electric Vehicle Infrastructure (NEVI) Formula Program established under the IIJA provides $5 billion in funding to states to strategically deploy electric vehicle (EV) charging infrastructure and create an interconnected network of EV chargers across the United States.
- The EPA Clean School Bus program provides funding to eligible applicants for the replacement of existing school buses with clean, alternative fuel school buses or zero-emission school buses. EPA may award up to 100 percent of the cost of the replacement bus, charging equipment, or fueling infrastructure. Alternative fuels include electricity, natural gas, hydrogen, or propane.
- The Commercial Electric Vehicle (EV) and Fuel Cell Electric Vehicle (FCEV) Tax Credit offers tax credits for businesses purchasing commercial EVs and FCEVs, encouraging the adoption of clean vehicles in commercial fleets.
- The USDOT Federal Highway Administration (FHWA) EV Charger Reliability and Accessibility Accelerator Program offers funding for the repair and replacement of existing, non-operational publicly accessible Level 2 (L2) and direct current (DC) fast chargers. Funding is available for up to 80 percent of eligible project costs.

Marine Specific

- The Clean Ports Program funds cleaner technologies and operations at ports.
- The Port Infrastructure Development Program funds projects that reduce GHG emissions.

FHWA issued a guidance document and website detailing climate strategies that work that are implementable by departments of transportation across the country. This is based on the U.S. National

Blueprint for Transportation Decarbonization (DOE 2023). These resources can be found at the following links:

- Website: https://climate-strategies-that-work-usdot.hub.arcgis.com/
- Portable document format (PDF) version of the Climate Strategies report: https://rosap.ntl.bts.gov/view/dot/79318

State

The State of Hawaiʻi has enacted several legislative measures to manage GHG emissions from transportation, in particular, and address the climate crisis. These aim to achieve zero-emissions transportation, support technological advances, and create a connected network for vehicles (with a priority for public transit), bicycles, and pedestrians to ensure safe and accessible routes for all.

Table A-1 summarizes selected relevant legislation.

Table A-1. Relevant State of Hawaiʻi Legislation

Legislation	Description
Hawaiʻi Act 226 (2023)	▪ Set the long-term goal for zero-emissions transportation in Hawaiʻi and requires agencies to take steps to reduce and eliminate transportation emissions. ▪ Commits state support to emerging companies and creation of working groups of government agencies and experts to develop plans and recommendations for achieving zero emissions.
Hawaiʻi Act 100 (1999)	▪ Requires every State agency to submit annual reports outlining goals, objectives, and policies to provide a basis for determining priorities and allocating limited public funds and human resources. HDOT produces annual reports for the ground, air, and marine sectors.
HRS §103D-412	▪ Mandates the State to incorporate energy efficiency and environmental sustainability criteria into its procurement processes. This includes purchasing energy-efficient products and services, as well as considering the environmental impact of goods and services.
Hawaiʻi Revised Statutes (HRS) § 196-9(c)(6), (11) (2021)	▪ Requires planning for EV charging stations and one hundred percent of light-duty vehicles that are passenger cars in the State's fleet to be zero-emissions by December 31, 2030; and one hundred percent of light-duty motor vehicles in the State's fleet shall be zero-emission vehicles by December 31, 2035. It prioritizes the procurement of ZEVs, plug-in hybrid electric vehicles, and other alternative fuel vehicles for State agencies.
HRS § 196-42	▪ Provides support for achieving statewide alternative fuels standards and clean transportation goals.
HRS § 264-142	▪ Requires planning and implementation of a connected network for motor vehicles, bicycles, and pedestrians, prioritizing public transit and ensuring pathways shall be separated and protected from vehicular traffic.

Legislation	Description
	▪ Requires state and county agencies to create a connected active transportation network linking schools, libraries, commercial areas, and residential zones, with dedicated pathways for exercise, managed by state and county authorities.
HRS § 225P	▪ HRS §225P-4 requires the Office of Planning in partnership with the GHG Sequestration Task Force to investigate and establish a framework for a carbon offset program, through which revenues realized from the sale of carbon credits may be invested into projects to generate further carbon offset credits to enhance the State's mitigation and adaptation to climate change. ▪ HRS § 225P-5 establishes statewide net-negative 2045 and 2030 50% reduction targets below 2005 level for GHG emissions (including airplane emissions). ▪ HRS § 225P-7 establishes a statewide goal of reducing greenhouse gas (GHG) emissions across all sectors, including decarbonizing the transportation sector. ▪ In addition, HRS § 225P-7 directs State agencies to manage their fleets to achieve decarbonization goals. ▪ HRS § 225P-8 establishes a State goal to achieve zero GHG emissions across all transportation modes, including ground transportation, marine, and air. ▪ HRS § 225P-8 directs each department, board, and commission to incorporate these goals into their plans and take actions necessary to achieve the goals of this section. ▪ HRS § 225P-8 establishes that the Department of Transportation, Office of Planning and Sustainable Development, and Hawaiʻi State Energy Office will implement plans and policies to support the adoption of EVs.
HRS § 264-143	▪ Mandates the Department of Transportation to prioritize objectives such as reducing vehicle miles traveled, lowering GHG emissions, enhancing equity, improving safety, and increasing multimodal throughput in all ground transportation projects. ▪ Requires detailed reports for each project, outlining how these goals are addressed, any deviations, and justifications for such deviations. ▪ Obligates the department to submit an annual report to the Legislature, detailing project statuses, implementation of goals, and overall progress in meeting the outlined objectives. ▪ Ensures transportation planning aligns with broader state policies, including the Complete Streets policy and Vision Zero goals, aiming for a zero-emissions clean economy by 2045.
HRS § 264-20.5	▪ Requires the adoption of a complete streets policy to ensure convenient access and mobility for all users, including pedestrians, bicyclists, transit users, and motorists, across urban, suburban, and rural areas.
HRS §269-92	▪ Establishes Hawaiʻi's Renewable Portfolio Standards (RPS) to reduce emissions from the power sector and promote sustainable energy development (wind, solar, geothermal). It sets progressive targets for the percentage of electricity sales that

Legislation	Description
	must come from renewable energy sources, with a 15 percent share in 2015 leading up to 100 percent by 2045.
HRS § 226-17	▪ Defines State policy to achieve an integrated, multimodal transportation system that meets statewide needs, promotes efficient and safe movement of people and goods, and aligns with planned growth objectives. ▪ Further defines policy that the State will design and coordinate transportation systems with state, county, federal, and private entities; encourage reasonable distribution of financial responsibility among government and private parties; improve access to shipping and storage; promote mass transportation; support economic growth; and encourage non-polluting, energy-efficient and diversified transportation options.
HRS § 226-18	▪ Defines State policy to develop dependable, efficient, and economical energy systems; increase energy security and self-sufficiency through reduction and ultimate elimination of Hawaiʻi's dependence on imported fuels for electrical generation and ground transportation; diversify energy generation; reduce GHG emissions; and prioritize the interests of utility customers. ▪ Defines state policy to support renewable energy research and development; promote energy conservation and efficiency; ensure least-cost energy supply options; encourage alternate fuels; reduce GHGs; prioritize renewable energy permits; and develop indigenous geothermal resources.
HRS § 286-7.5	▪ Requires adoption of a Vision Zero policy that seeks to prevent and ultimately eliminate all traffic fatalities through a combination of engineering, enforcement, education, and emergency response strategies that focus on equity.
HRS §291-71	▪ Requires public parking lots with at least one hundred parking spaces available for use by the public have at least one EV charging system.
Hawaiʻi Senate Concurrent Resolution 44, 31st Leg. (2021)	▪ Declares a climate emergency, urging statewide collaboration for an immediate transition to a decarbonized economy. The resolution emphasizes investments in clean energy, EVs, energy efficiency, and reforestation efforts.
Multi-State Medium- and Heavy-Duty Zero-Emission Vehicle MOU (2020)	▪ Commits to a goal where 30% of new medium- and heavy-duty vehicle sales are zero-emission by 2030, progressing to 100% by 2050. This initiative aims to expand the market for electric trucks and buses, enhancing air quality and supporting clean energy objectives.
HRS § 36-42	▪ Mandates State agencies to identify and assess energy efficiency program contracts, including those related to vehicle fleets. Agencies are authorized to enter multiyear performance contracts to implement energy efficiency programs, acquire EVs, install necessary charging infrastructure, and adopt renewable energy systems supporting these initiatives.

Local

- The Mayoral Commitment to 100 percent Renewable Ground Transportation is a commitment to transform Hawaiʻi's public and private ground transportation to 100 percent renewable fuel sources by 2045 (CCH 2018).
- The Energy Conservation and Emissions Reduction Plan for Transportation for Honolulu (CCH 2024) provides different strategies and methods to meet City and statewide GHG targets.
- The Integrated Climate Action Plan for the Island of Hawaiʻi (County of Hawaiʻi 2023) outlines the County of Hawaiʻi's strategic roadmap for climate action, detailing government-led initiatives to ensure accountability and achieve aligned State and County goals.
- Resolution 21-105 Honolulu adopts the 2020-2025 Climate Action Plan for the City and County of Honolulu.
- Ordinance 20-47 Honolulu describes the duties and responsibilities of the Office of Climate Change, Sustainability and Resiliency.
- The Maui County Climate Action and Resilience Plan (County of Maui 2022) outlines resilience and mitigation strategies for climate change by incorporating concepts of self-sufficiency, nature-based solutions, resilient infrastructure, and strategic relocation.
- The Maui County Renewable Energy Goals outline how the county will adapt to climate change, transition to 100 percent renewable energy, and achieve net-negative emissions (Rawlins-Fernandez 2024).
- The Kauaʻi County Energy Goals (County of Kauaʻi 2025) focus on the reduction of energy use and carbon emissions.

Hawaiʻi Plans Relevant to GHG Reduction

The documents in Table A-2 were reviewed and considered in the development of this Hawaiʻi Energy Security and Waste Reduction Plan to ensure consistency across statewide efforts. Additional information on these plans can be found in Chapter 8, References.

Table A-2. Literature Reviewed

Agency	Plan	Description
HDOT Plans	Hawaiʻi Highways Climate Adaptation Action Plan	▪ Outlines specific actions and a multiyear implementation strategy to ensure the resilience and viability of Hawaiʻi's highways against climate-related impacts, benefiting residents, visitors, and businesses. Identifies state highway assets that are exposed to rockfall and landslides, sea level rise, coastal erosion, storm surge, tsunami, wildfire, and lava flows.
	State of Hawaiʻi Transportation Carbon Reduction Strategy (Highways)	▪ Supports efforts to reduce transportation emissions and identify projects and strategies to achieve this, including promoting alternatives to single-occupancy-vehicle trips, facilitating lower-emission travel modes, and adopting lower-emission construction approaches.

Agency	Plan	Description
		▪ Supports state-level emission reduction efforts, optionally quantifies carbon emissions from construction materials, and is tailored to the state's population density and context.
	Hawaiʻi Statewide Transportation Plan	▪ Provides policy level guidance to system-level and master plans of the three primary modes of transportation used in Hawaiʻi—the air, water, and land systems—as well as the connections between these modal systems.
	Airport Master Plans	▪ Comprehensive studies that guide future airport development, considering factors like aviation demand, funding, environmental requirements, and community needs. Review of each individual airport master plan identifies updates and changes.
	Statewide Long Range Transportation Plan 2035	▪ Guides land transportation decisions for federal-aid highways through 2035.
	National Electric Vehicle Infrastructure (NEVI) Hawaiʻi State Plan	▪ Maps out the vision and goals for HDOT to deploy EV charging infrastructure through the NEVI program included in IIJA.
	Hawaiʻi Statewide Freight Plan	▪ Addresses various challenges such as congestion, poor pavement conditions, and climate change impacts to ensure the efficient movement of goods, meeting federal requirements and supporting the state's survival and economic health.
	Statewide Pedestrian Master Plan	▪ Evaluates ways to enhance pedestrian safety, mobility, and accessibility to help create a multimodal transportation system.
	Bike Plan Hawaiʻi Master Plan	▪ Outlines how the state intends to integrate, accommodate, and promote bicycling.
Regional Plans	City and County of Honolulu Energy and Emissions Reduction Plan for Transportation	▪ Suggests that Honolulu should adopt a hybrid parking pricing model tailored to the city's context, incorporating new technology to enhance user experience and support social equity, economic health, environmental sustainability, and climate goals while also addressing budget shortfalls and improving travel access.
	Honolulu Harbor 2050 Master Plan	▪ Provides guidance on harbor-wide and pier-specific strategies to ensure the resilience of port facilities to climate change.
	Hawaiian Electric Company (HECO) Electrification of Transportation Strategic Roadmap 2.0	▪ Is designed to support EV adoption, expanding availability of public charging infrastructure. ▪ Engages disadvantaged communities, rideshare, and transit partners. ▪ Pilots new charging technologies to encourage off-peak charging for grid efficiency.

Agency	Plan	Description
Statewide Plans	Hawaiʻi Pathways to Decarbonization – Hawaiʻi State Energy Office	▪ Outlines Hawaiʻi's aggressive emission reduction targets and strategies to mitigate climate change. ▪ Highlights the need for energy efficiency, renewable energy projects, and transportation sector improvements to achieve net-negative carbon emissions by 2045. ▪ Complies with Hawaiʻi Pathways to Decarbonization (Act 238, 2022).
	Investing in Transportation Choices: Recommendations for Safe, Sustainable, Affordable, and Reliable Mobility	▪ Recommends statewide targets to lower VMT. ▪ Outlines clear responsibilities for state and county agencies to lead and coordinate VMT reduction policies, strategies, and programs. ▪ Prioritizes funding for projects that enhance pedestrian, bicycle, and transit options.
	Hawaiʻi Greenhouse Gas Emissions Report for 2022 (prepared for DOH)	▪ Estimates statewide GHG emissions across all sectors for 2022, as well as updated GHG inventories between 1990 and 2021. ▪ Projects statewide GHG emissions for 2025, 2030, 2035, 2040, and 2045.
Federal Plans	U.S. Department of Transportation Strategic Plan	▪ Outlines priorities for federal transportation agencies for FY 2022 – 2026. ▪ Key strategies include securing a path to net-zero emissions by 2050 and infrastructure resilience. ▪ Performance measures associated with these strategies can be found in the Annual Performance Plan and Report: FY 2023 – 2025.

HECO Electrification of Transportation Strategic Roadmap

The Hawaiian Electric Company (HECO) Electrification of Transportation Strategic Roadmap 2.0 (HECO 2024) outlines the company's commitment to leading vehicle electrification efforts through utility-provided electrification of transportation programs. Key actions include planning for electric transportation on the grid; enabling charging for personal mobility, public fleets, and commercial vehicles; encouraging managed charging; supporting community resiliency; and promoting workforce development.

HECO's existing programs include implementing the eBus Make-Ready Infrastructure Pilot, developing EV service rates, implementing the Charge Ready Hawaiʻi Pilot to provide make-ready infrastructure for commercial customers, implementing the Integrated Grid Planning process, and owning and operating public direct current fast charging (DCFC) stations.

HECO will play a pivotal role in electrifying the state's vehicle population by providing local industry expertise. This includes maintaining and repairing utility-owned public chargers and electrifying its own vehicle fleet to incorporate learnings into customer programs, workforce development actions, and planning. Ongoing collaboration with state and local agencies is essential to ensure a robust public charging network. In addition, coordinating with state and county agencies will help simplify and accelerate charger installations and energization timelines.

HRS § 269-92 details the renewable portfolio standards that are required for electric utilities. These standards indicate that all utility providers that sell electricity on the island will need to have a renewable portfolio of 40 percent by 2030, 70 percent by 2040, and 100 percent by 2045. HECO's ability to meet these standards will be critical to transition to EVs for achievement of the 2045 net-negative target.

The Roadmap 2.0 expands on HECO's existing work in a number of ways. The utility plans to expand the Charge Up eBus Pilot Program and Charge Up Commercial Pilot Program to support make-ready installation for commercial charging. Another planned initiative involves supporting harbors and airports in developing the charging infrastructure necessary to electrify their land-based equipment. HECO plans to address the length of time it takes to install EV charging stations by standardizing the permit review process and coordinating with state and county agencies. The utility also plans to develop an expanded make-ready charging program with incentives to support sites such as multifamily housing, workplace charging, public charging, and residential charging in disadvantaged communities.

Analysis included in the roadmap indicates significant economic benefits from EV adoption. The Plan summarizes research from Atlas Public Policy that shows the economic benefits of driving an EV. The total cost of ownership for a gasoline-powered sedan such as a Toyota Corolla was estimated to be $11,000 more over 7 years than an electric sedan like the Chevrolet Bolt. Light trucks like Ford F150s also have a lower total cost of ownership. These estimates assume that EV owners are charging during peak hours. Hawaiian Electric lays out several plans to encourage EV drivers to shift charging to off-peak hours, which benefits the grid and further reduces consumer costs.

For example, the utility recently launched Smart Charge Hawaiʻi and Shift and Save to gather and share information about shifting charging times to off-peak hours and restructure rates to incentivize off-peak charging. The utility is also piloting charge management technology to allow customers and aggregators to manage the power draw and timing at a site directly. Medium-term innovations planned include piloting vehicle-to-grid technologies and charging customers for charging at a fixed subscription rate rather than per kilowatt-hour (kWh) to simplify pricing structures.

Appendix B
In-depth Discussion of GHG Data, Inventory, Methodology Inventory, and Recommendations to Improve

Baseline Estimates

Long-term projections of emissions enable policymakers and stakeholders to evaluate how different measures will impact emissions over time and determine whether they align with the 2030 and 2045 emission reduction targets. This appendix contains a description of how future year baselines were estimated. The future year baseline values represent the estimate of emissions if no action were taken by the State of Hawaiʻi Department of Transportation (HDOT) to reduce emissions and if existing policy and market mechanisms were to remain in place.

Aviation

Initially, HDOT considered the State of Hawaiʻi Department of Health (DOH) greenhouse gas (GHG) emissions inventory, which projected an average of 1.5 percent year-on-year growth rate in emissions from the aviation sector between 2022 and 2045. This assumption was based on an estimated visitor growth index (visitor travel) and forecasts for gross county product (residential travel and freight). However, in reviewing the projections from the FAA Terminal Area Forecast (TAF) reports, HDOT recognized that the DOH forecasts were low. Over the same period, TAF reports showed average growth in operations to be approximately 4.5 percent every 5 years. Because these forecasts are being reported by the airlines, this was determined to be the most verifiable source of forecasts for this Plan at this time. The projections for aircraft activities/fuel consumption were determined by applying the annual growth rate of total airport operations estimated in the TAF reports to the baseline 2022 values.

Projections for mobile sources; auxiliary power units (APU); maintenance, repair, and operations ground support equipment (GSE); and landside ground access emissions were made assuming that these sources would comprise approximately the same percentage of total baseline emissions as they did in the 2023 inventory total.

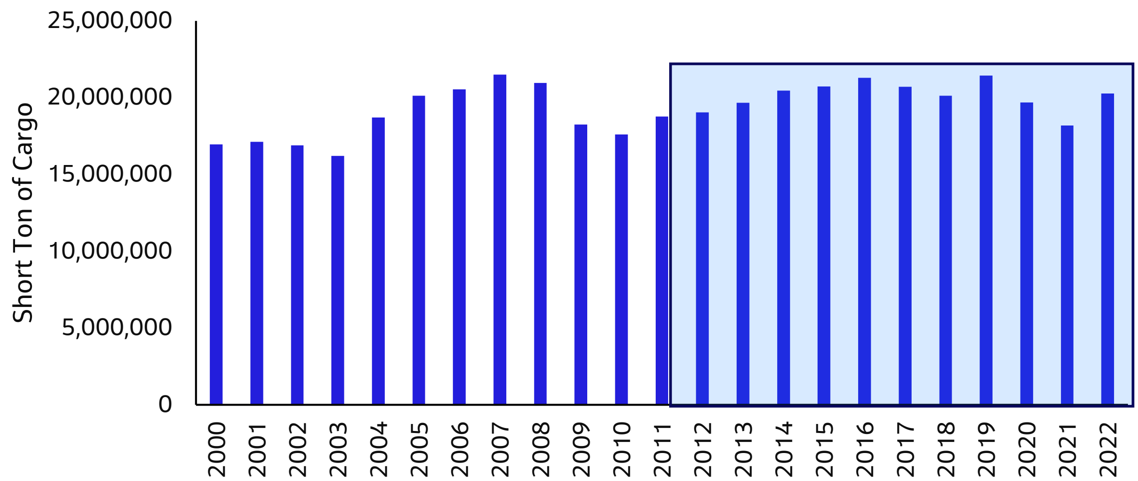
Given that the airlines are likely to have a more informed understanding of future aircraft activities, HDOT determined that this was a more verifiable data source for developing projections for evaluating the emissions impact of reduction measures against.

Marine

Again, HDOT began with the DOH GHG emissions inventory, which projected an average of 2.1 percent annual growth rate in emissions from the marine sector between 2021 and 2045. This assumption was based on an expected combined annual growth rate (CAGR) similar to that of the overall Gross State Product (GSP). However, upon closer examination of historical data, this assumption appears overly optimistic and does not align with actual trends observed in Hawaiʻi's maritime sector.

A review of the past 10 years of tonnage, as published by the HDOT Harbors Division (HDOT-Harbors) (Figure B-1), reveals that cargo growth has remained relatively flat. Similarly, discussions with port staff confirm that cruise activity has not experienced significant growth over the same period. These observations suggest that both cargo and cruise activity within the state are likely to remain stable through 2045, making a flat or zero percent growth rate a much more appropriate assumption for emissions modeling, rather than the high growth rate used in the DOH emissions inventory.

Figure B-1. Hawaiʻi Statewide Harbor System Historical Cargo Volume



Source: HDOT Harbors Division 2023

The implications of this revised assumption are relatively significant. Under DOH's 0.7 percent assumed annual emissions growth, emissions from the marine sector would increase, requiring the implementation of more aggressive emission reduction measures. However, if cargo and cruise activity remain stable, the overall emissions baseline remains relatively constant, meaning that fewer reductions are required to meet the State's GHG reduction targets. Specifically, Hawaiʻi's mandate to reduce GHG emissions by 50 percent from 2005 levels would be easier to achieve under a zero-growth scenario compared to one with high emissions growth.

Given the more accurate and granular data used in this exercise, HDOT determined that adopting a no-growth assumption provides a more reliable foundation for evaluating the emissions impact of the strategies outlined in this document.

Ground Transportation

Ground transportation emissions are calculated using a combination of methods and data sources. These include vehicle miles traveled (VMT), which records the total miles traveled by all vehicles within the state, and emission factors that represent the average emissions produced per mile by different types of vehicles. Fuel consumption data, detailing the types and amounts of fuel used, is also crucial. Modeling tools like the U.S. Environmental Protection Agency (EPA) MOVES [Motor Vehicle Emission Simulator] model support emissions estimates based on VMT, emission factors, and fuel consumption.

For a projection of ground transportation emissions, HDOT modified the DOH GHG Inventory to account for the impacts of current motor vehicle emission standards. These regulations include the following federal emissions standards adopted in 2024, which vehicle manufacturers are required to comply with:

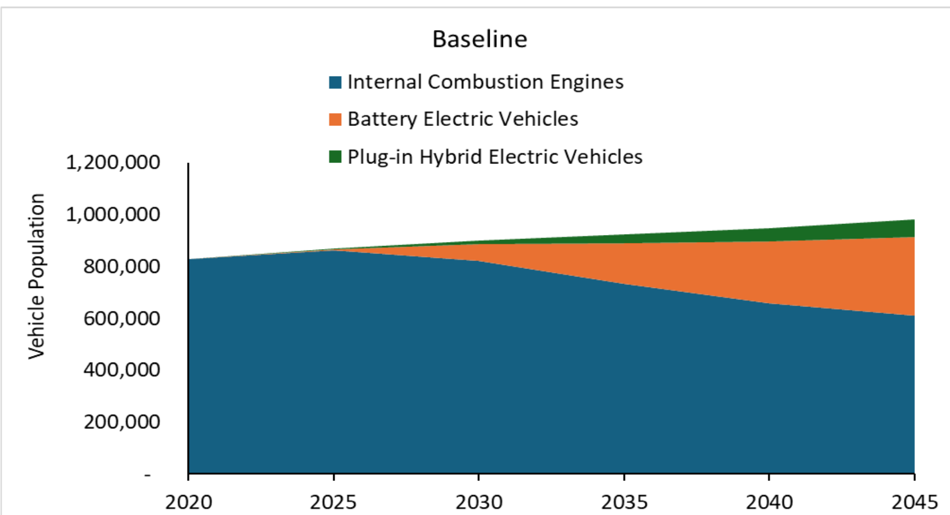
- 2024 Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles
- Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles ‑ Phase 3

The former rule implements a phased industry average target for GHG emissions, including 85 grams per mile (g/mi) of carbon dioxide (CO_2) for light-duty vehicles and 274 g/mi of CO_2 for medium-duty vehicles by model year 2032. While manufacturers have flexibility with how they comply with these standards, EPA has estimated a most-likely compliance scenario. It assumes that EV sales increase and that by 2035, 59 percent of new light-duty autos and 49 percent of new light-duty trucks sold will be zero-emission vehicles (ZEVs), with those levels remaining constant through 2045. Similarly, for compliance with the Heavy-Duty Vehicle Rule, EPA estimates that, by 2032, 51 percent of new vocational trucks, 44 percent of short-haul tractor trucks, and 25 percent of long-haul tractor trucks sold will be ZEVs, with those sales fractions remaining constant through 2045. The baseline projection tracks these assumptions.

Characteristics of Hawaiʻi's vehicle fleet were obtained from the EPA's MOVES5 model. This includes data on vehicle population and VMT by model year, calendar year, vehicle type, and fuel type. The VMT assumptions used in the MOVES model reflect total statewide travel across all public roadways, not just state highways. This includes VMT from local, county, and other non-state roads. The source of this data is the Federal Highway Administration's Highway Performance Monitoring System (HPMS), which provides a comprehensive estimate of total VMT within each state. Figure B-2 shows the changing composition of the vehicle fleet under the baseline scenario. Approximately 38 percent of Hawaiʻi's vehicle population would be ZEV by 2045, including battery-electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), with the remaining vehicles being internal combustion engine (ICE) vehicles, which include both gasoline and diesel-powered vehicles.

Note that the vehicle population shown may differ from the total number of registered vehicles in Hawaiʻi because it is an output of the EPA's MOVES model, which uses national vehicle registration data from the Federal Highway Administration that has been allocated to states and counties using internal geographic allocation factors. Because this allocation method relies on VMT distributions rather than actual registration counts, it can lead to discrepancies between estimated vehicle population and outputs of the MOVES model.

Figure B-2. Vehicle Population Distribution under Baseline Scenario



Methodology

The HDOT emission inventory calculates baseline GHG emissions for the year 2023 and projects emissions through 2045. 2023 was selected as the first reporting year because it is the most recent year where complete data sets were available for quantification of baseline emissions (quantification efforts for this Plan began in late 2024). This section outlines the methodology and key assumptions used to calculate emissions for the three modes.

Aviation

For the purposes of this inventory, all aviation emissions are due to combustion of fuels in different types of vehicles and equipment. GHG emissions are calculated by multiplying fuel consumption totals in units of kilograms (kg) or liters by an emission factor that is measured in kg carbon dioxide equivalent (CO2e) per kg of fuel (kg CO2e/kg) or kg CO2e per liter (kg CO2e/l), depending on the fuel type. Emissions were calculated consistent with methodologies and emission factors in the ACERT tool, to maintain consistency with GHG emissions totals reported in support of Airports Council International Airport Carbon Accreditation (ACA) for the top five airports.

Emissions from aircraft activities for 2005 and 2022 were assumed to be consistent with the emissions reported in the DOH GHG Inventory. Public flight data were assessed to better understand fuel consumption distribution through different stages of the flight as well as distribution between intra-island flights and flights to the U.S. mainland. The DOH GHG Inventory is approximately four times the carbon emissions than in the ACA detailed inventories. This is largely due to the state inventory considering all jet fuel dispensed in Hawaiʻi rather than the ACA emissions that account for only taxi and landing and takeoff (LTO) emissions.

Emissions associated with the operation of the APU were assumed to be consistent with those reported in the ACA inventories. APU emissions for the smaller airports were estimated by assuming a direct relationship between operations and APU activities. Maintenance, repair, and overhaul activities were similarly determined. Emissions from landside ground activities were totaled from the ACA inventories and also scaled based on airport operations to estimate emissions from landside operations from the smaller airports.

Comparison with the DBEDT State of Hawaiʻi Data Book

For the aviation sector, for 2005 and 2022, the team used the total combined jet fuel and aviation gasoline emissions for non-military domestic travel that was reported in the DOH Statewide GHG inventory. In the statewide inventory, the source data for jet fuel and aviation gasoline consumption quantities are from the Energy Information Administration (EIA) State Energy Data System (SEDS). SEDS provides total fuel quantities consumed in the state for both aviation gasoline and kerosene jet fuel. The Hawaiʻi Department of Business, Economic Development & Tourism (DBEDT) provides some data on aviation fuels but does not have disaggregated data on aviation gasoline and jet fuel consumption. In addition, the fuel consumption data provided in DBEDT (2022) are sourced from EIA SEDS. To determine the proportion of fuel that was used for military purposes, the statewide inventory relies on data collected by DBEDT in 2008 for 2007 total miliary fuel usage. This percentage was applied to the raw fuel consumption data from SEDS.

To determine the fraction of fuel consumed for domestic flights, the statewide inventory estimated fuel usage for all domestic and international flights that departed Hawaiʻi during the given time period. Flight data and fuel economy values from the Bureau of Transportation Statistics were used to convert total miles to fuel consumption. The fraction of total domestic flight fuel consumption was applied to the total statewide fuel consumption (minus military use) to determine total fuel use to be allocated to domestic aviation. To forecast baseline aviation fuel emissions beyond 2022, the team reviewed the terminal area forecast reports for all the Hawaiian airports. These reports include projections for total operations out to year 2045. Baseline aviation fuel consumption emissions were estimated by applying the same year-on-year percent change observed in the TAF report projections. Finally, total emissions from ground support equipment and other fuel combustion equipment at the airports were added to the baseline. These emission totals were sourced from the third-party verified 2023 ACA GHG inventories from the top five Hawaiian airports.

Marine

To calculate GHG emissions for the state's marine sector, the DOH 2022 GHG emissions inventory was initially considered. However, this inventory lacked the necessary level of detail required for effective scenario modeling. Specifically, it did not distinguish between vessel types, nor did it differentiate intra-state from inter-state emissions or account for commercial harbor craft (CHCs) separately. Given the need for these granular details to develop and evaluate various GHG reduction strategies, a bottom-up GHG emissions inventory was necessary. Beyond simply improving the inventory's accuracy, HDOT also identified discrepancies in the DOH projections, particularly in the estimated growth of marine GHG emissions. Historical activity data from the Hawaiian commercial port system over the past decade indicated that the growth rate assumed in the DOH GHG Inventory was likely overestimated. This misalignment further reinforced the need for a new inventory to ensure a realistic foundation for scenario modeling and strategy development.

In general, GHG emissions are estimated based on vessel power demand, with energy consumption expressed in kilowatt-hour (kWh) and multiplied by an emission factor (EF) that is measured in grams per kilowatt-hour (g/kWh). Emission estimates vary depending on vessel type and activity mode. The formulas used for GHG emissions estimation are summarized in the tables that follow.

According to the DOH GHG emissions inventory, as of 2022, Hawaiʻi's total GHG emissions were 17.95 million metric tonnes of CO2e. Of that, 3.62 percent was attributed to the domestic marine sector, which translates to approximately 650,000 metric tonnes of CO2e. However, as previously mentioned, the DOH GHG Inventory was estimated using statewide fuel consumption, distinguishing marine emissions from ground transportation but introducing uncertainties, particularly regarding how international bunkering was separated. In contrast, the bottom-up emissions inventory developed in this effort estimated total emissions at 482,976 metric tonnes of CO2e—a value remarkably close to the DOH estimate despite the use of different methodologies and assumptions. This similarity provides reassurance that the bottom-up approach closely aligns with DOH estimates, even though it was built using detailed vessel-specific data rather than high-level fuel consumption estimates. However, it is important to note that the 482,976 metric tonnes of CO2e estimated in this study corresponds to 2023 while DOH's 650,000 metric tonnes of CO2e estimate is for 2022, creating a 1-year gap between the datasets. The latest baseline available from the DOH GHG Inventory is for 2022, limiting direct year-to-year comparisons.

Comparison with the DBEDT State of Hawaiʻi Data Book

For the marine sector, the project team developed a detailed bottom-up emissions inventory using granular data on vessel calls and voyages, including both interisland and inter-state trips. This approach allowed for a more accurate estimation of emissions from marine vessels visiting Hawaiʻi's harbors. Based on this analysis, the total marine emissions for 2023 were estimated at 0.48 million metric tonnes of carbon dioxide (CO_2). In comparison, the State of Hawaiʻi's official GHG emissions inventory published by DOH reported 0.65 million metric tonnes of CO2e for the marine sector in 2022. The difference between the two—approximately 0.17 million metric tonnes—is minimal and considered acceptable, especially given the uncertainties and assumptions involved in calculating marine emissions in the state GHG inventory. Given the high-resolution data and methodology used, the project team opted to rely on the bottom-up inventory developed for this Plan, as it offers greater specificity while maintaining alignment with the overall magnitude of emissions reported in the official inventory.

Ground Transportation

The DOH GHG emissions inventory included an assessment of on-road vehicle fossil fuel consumption, VMT, fuel efficiency of vehicles, and considered types of vehicles (light-duty, medium-duty, heavy-duty). Light-duty passenger vehicles represent the majority of emissions in ground transportation. For that reason, understanding the composition of the passenger vehicle fleet including fuel efficiency and VMT.

VMT estimates by functional class (such as inter-state, local, other freeways and expressways, other principal arterial, or minor arterial) for the State of Hawaiʻi were obtained from the FHWA Annual Highway Statistics (FHWA 2005, 2010, 2015–2021). The distribution of annual VMT by vehicle type for each functional class for the State of Hawaiʻi, which was also obtained from FHWA (2005, 2010, 2015–2021), was then used to calculate VMT by vehicle type. For 1990 and 2007, VMT estimates by vehicle type were provided by HDOT

(HDOT 2008). Vehicle age distribution by model year, as well as control technologies and emission factors by vehicle type for all years, were obtained from the U.S. Inventory (EPA 2024b). Hybrid, plug-in hybrid, and EVs are not included in these calculations, in alignment with the methodology used by the U.S. Inventory of GHG emissions and sinks and the EPA State Inventory Tools (SIT) (EPA 2024b).

The ground transportation emissions described in the Plan are based on the latest version of the EPA MOVES model for the State of Hawaiʻi. The MOVES model calculates emissions using a bottom-up methodology. It estimates emissions based on registered vehicle population data multiplied by annual VMT per vehicle and the corresponding CO_2 emission factors for different vehicle types and fuel types. Because of this bottom-up approach, the CO_2 emissions generated from the MOVES model do not always align exactly with the top-down CO_2 emissions estimates included in the State's official GHG emissions inventory for ground transportation, which is based on statewide fuel sales data.

To address this, the MOVES model output was calibrated. Specifically, because both the MOVES model data and the State's official GHG inventory data were available for the year 2022, the GHG emissions output from MOVES was calibrated to align with the 2022 ground transportation emissions reported in the State's inventory. The State's inventory relies on ground transportation fuel use data from the U.S. Energy Information Administration (USEIA), further refined using confidential data from DBEDT to separate marine and ground transportation fuel use. This calibration step ensures consistency between the MOVES model output and the State's official GHG inventory for 2022.

Data Sources

Aviation

Table B-1 describes GHG emissions sources in the aviation sector.

Table B-1. Emissions Sources

Emission Source	Description
Aircraft Operations	Emissions are quantified for all commercial and general aviation flights for all aircraft types. This includes fuel consumed by jet engines during all stages of flight: idling, takeoff, climb, cruise, and approach. Aircraft operations are included for all flights between the Hawaiian Islands and from Hawaiʻi to the U.S. mainland. Military operations, international flights, and flights not originating in Hawaiʻi are excluded.
Auxiliary Power Unit	An APU is a small turbine engine that helps to power aircraft air conditioning and lighting functions when an aircraft is parked at the airport gate.
Maintenance Repair and Overhaul	Maintenance and repair activities associated with jet engines or turbine engines often require engine runups that consume small amounts of jet fuel or aviation gasoline.
Ground Support Equipment	This represents small GSE and air support equipment that support aircraft operations, such as baggage handling equipment, forklifts, and similar, that consume small quantities of diesel, gasoline, and propane.
Landside Ground Access [a]	This represents emissions resulting from the operation of all passenger and commercial vehicles that support airport operations, including transportation of passengers, tenants, and airport employees.

[a] It is noted that these emissions may overlap with transportation emissions quantified in ground transportation emission totals. However, Airport Carbon and Emission Reduction Tool [ACERT] certification requires that HDOT quantify these emissions for each airport. For consistency with ACERT, these emissions are included in the Aviation baseline.

Aviation data were obtained from the sources listed in Table B-2. Table B-3 briefly summarizes calculation methodology for aviation related emissions.

Table B-2. Aviation Data Sources

Data Source	Coverage	Information Included
Airport Carbon Accreditation (ACA) FY2023 GHG Inventories for HNL, ITO, KOA, LIH, and OGG Airports	2023 GHG emissions totals for HNL, ITO, KOA, LIH, and OGG airports	▪ Airport-owned vehicle fuel consumption ▪ Ground support equipment fuel consumption ▪ Passenger counts ▪ Tenant and employee counts ▪ Estimates on ground travel distances
Terminal Area Forecast Reports	2023 total operations (commercial and general aviation) for all airports in Hawaiʻi	▪ Historical operations for all airports ▪ Current operations for all airports ▪ Forecasted operations through 2045 for all airports
Traffic Flow Management Counts Reports for FY 2023	Flights to/from all Hawaiʻi airports in 2023	▪ Flight dates/times ▪ Aircraft types ▪ Departure/Destination Airports ▪ Number of flights per route
FAA Flight Times	Flight times for most routes with Hawaiʻi as a departure or destination	▪ Flight routes ▪ Flight time

FY = fiscal year
HNL = Daniel K. Inouye International Airport
ITO = Hilo International Airport
KOA = Ellison Onizuka Kona International Airport
LIH = Līhuʻe Airport
OGG = Kahului Airport

Table B-3. GHG Emission Estimate Equation for Aviation Equipment

GHG Emission (metric tonnes)	Equation for Emission Estimation
Aircraft	= Fuel consumption (flight time x fuel consumption rate) x Aircraft EF
Ground Support Equipment	= Equipment Fuel consumption x Fuel EF
Stationary Combustion Equipment	= Equipment Fuel Consumption x Fuel EF
Auxiliary Power Unit	= Number of minutes per Landing/Take Off x Fuel consumption rate per landing/take off * Fuel EF
Landside Vehicles	= Fuel consumption x Fuel EF + Mileage * Mile EF

Marine

Various vessel types are included in this emission estimates, including ocean-going vessels (OGVs) such as cruise and cargo ships, as well as CHCs. Cruise ship emissions are estimated separately from other cargo

OGVs, which include auto carrier, bulk/general cargo, containerships, RoRo,[8] and tankers. Tugboats are categorized into assist tugboats and push-and-tow tugboats, where assist tugboats are considered as CHCs, and push-and-tows are categorized as OGVs for the purpose of this emissions inventory. Emissions for OGVs and CHCs are estimated using the sources listed in Table B-4. Each vessel trip can be further categorized into different vessel activities, depending on the vessel type (Table B-4).

Table B-4. Emission Sources for Ocean-going Vessels and Commercial Harbor Craft

Ocean-going Vessel (OGV)	
Main Engine	The primary propulsion system that drives the vessel forward, consuming significant amounts of fuel, especially during transit operations. It is typically a large, slow or medium-speed diesel engine designed for maximum efficiency at sea.
Auxiliary Engines	Secondary engines that generate electrical power for onboard systems such as lighting, navigation, communication, refrigeration, and equipment like thrusters and winches. Their load varies depending on the vessel's activity, with higher demands during maneuvering and at berth.
Boilers	Steam-generating systems used for heating heavy fuel oil, providing steam for fuel treatment and purifiers, and supporting auxiliary operations. On cruise ships, they also provide steam for passenger-related services like heating, ventilation, and air conditioning (HVAC), hot water, and laundry systems.
Commercial Harbor Craft (CHC)	
Main/Propulsion Engine	The primary propulsion engine of a CHC, responsible for driving the vessel through water.
Auxiliary Engines	A secondary engine used for powering onboard systems such as electrical generation, hydraulics, and other auxiliary functions, but not for propulsion.

Table B-5. Vessel Activity Modes for Ocean-going Vessel and Tugboat

Ocean-going Vessel (OGV)	
Transit	Main engine drives propulsion; auxiliary engines supply power for navigation, lighting, and onboard systems, while boilers provide steam for fuel heating and operational needs.
Maneuvering	Main engine runs at low load; auxiliary engines power thrusters and navigation systems, while boilers continue to support fuel heating and standby steam requirements.
Anchorage	Main engine inactive; auxiliary engines power crew accommodations, lighting, and cargo systems, while boilers maintain fuel heating and provide steam for auxiliary operations.
At Berth	Main engine off; auxiliary engines power cargo handling equipment (CHE) and onboard systems, unless shore power is available. Boilers provide steam for hoteling functions or fuel management. Boilers cannot be replaced by shore power.

[8] A RoRo (Roll-on/Roll-off) vessel is a type of cargo ship designed to transport wheeled cargo, such as cars, trucks, trailers, and heavy machinery. Unlike traditional cargo ships that require cranes for loading and unloading, RoRo vessels allow vehicles and equipment to be driven directly onto and off the ship via built-in ramps.

Tugboats	
Movement	Main engine drives propulsion; auxiliary engines supply power for navigation, lighting, and onboard systems.
Hoteling	The period when the vessel is docked at port and continues to run its auxiliary engines to supply power to onboard systems for essential services such as lighting, heating, cooling, and other amenities.

The estimation of GHG emissions from the marine sector relies on multiple data sources. Table B-5 lists those sources, categorized based on vessel type.

Table B-6. Marine Data Sources

Data Source	Coverage	Information Included
Portcall (public, available upon request)	Data available for the years 2019 to 2025	▪ Traffic schedules, vessels in port, and cruise schedules ▪ Distance between ports is sourced from Sea-Distance and ShipAtlas, both public online tools for calculating distances between seaports
IHS Maritime & Trade (IHS) (private, available for purchase)	Cargo ship data available for the year 2023	▪ Vessel arrivals and departures ▪ Vessel details (name, ship type classification, gross tonnage, deadweight, International Maritime Organization [IMO] and Maritime Mobile Service Identity [MMSI] numbers, and twenty foot equivalent unit [TEU] capacity) ▪ Geographic data for berth locations (latitude/longitude) ▪ Facility classifications based on cargo types ▪ Vessel origins and destinations ▪ Departure and arrival timestamps (available for OGVs and used to estimate hoteling activities)

For tugboats, specific departure and arrival timestamps were not available in the IHS dataset. Therefore, assumptions were made to estimate their hoteling activities.

Table B-7 provides equations for estimating emissions from ocean-going vessels and tugboats.

Table B-7. GHG Emission Estimate Equation for Ocean-going Vessel and Tugboat

GHG Emission (metric tonnes)	Equation for Emission Estimation
OGV at Berth	= Number of vessel visits × Time at berth × (Auxiliary engine load × Auxiliary engine EF + Boiler load × Boiler EF)
OGV Maneuvering	= Number of vessel visits × Time during maneuvering × (Main engine load × Propulsion engine EF + Auxiliary engine load × Auxiliary engine EF + Boiler load × Boiler EF)
OGV in Transit	= Number of vessel visits × Time during transit × (Main engine load × Propulsion engine EF + Auxiliary engine load × Auxiliary engine EF + Boiler load × Boiler EF)
Tugboat in Movement	= Number of vessel visits × Time during movement × (Propulsion engine load × Propulsion engine EF + Auxiliary engine load × Auxiliary engine EF)
Tugboat at Hoteling	= Number of vessel visits × Time at hoteling × (Auxiliary engine load × Auxiliary engine EF)

For estimating OGV emissions across all three activity modes (that is, at berth, maneuvering, and in transit), emission factors for auxiliary engines and boilers are based on assumptions used for OGVs at the Port of Long Beach (POLB). Similarly, auxiliary engine and boiler loads across these modes align with the POLB emission inventory assumptions. When calculating OGV emissions during maneuvering and transit, the load factor is determined using the propeller law.[9] The assumed speed for maneuvering is 5 knots, while transit speed is set at 75 percent of the engine's maximum speed. The maneuvering distance is assumed to be 5 nautical miles, whereas transit distance is based on actual origin-destination measurements obtained from Sea-Distance (Sea-distance.org n.d.).

For tugboat emissions, assumptions for main and auxiliary engine loads, emission factors, average speed, and hoteling activities follow the methodology used by the California Air Resources Board. For tugboats operating intra-state (traveling between islands), transit distances were determined using Sea-Distance to estimate emissions during movement mode. For tugboats operating within a single port, which primarily assist in docking, undocking, and maneuvering large vessels, it was assumed that they travel for 1 hour per call at a speed of 12 knots. Using these assumptions and methodologies, the GHG emissions for the domestic marine sector in 2023 were estimated. As previously mentioned, emissions are expected to remain constant through 2045 unless additional mitigation measures are introduced.

Ground Transportation

The emissions inventory focused on tailpipe emissions from gas- and diesel-fueled vehicles driven on Hawaiʻi public roads. Data for the calculation included the types of vehicles driven, the average distance driven, and fuel source (Table B-8).

Table B-8. Ground Transportation Emissions

Parameter	Description
Vehicle Number and Types	Analysis of emissions includes motorcycle, gasoline passenger cars and light-duty trucks, gasoline medium and heavy-duty vehicles, diesel passenger cars and light trucks, diesel medium and heavy-duty trucks, and diesel medium and heavy-duty buses.
Average Distance	Trip distances are estimated based on statewide projections, national models, and data from HDOT counters. Forecasts are tailored to account for increased transit service and changes in population and jobs.
Fuel Type	Emissions from both diesel and gasoline vehicles are forecasted based on past consumption trends and the forecasted changes to the future vehicle fleet mix.

The GHG emissions estimates for ground transportation came from a variety of sources, as shown in Table B-9.

[9] The relationship between a vessel's power demand and speed follows a cubic equation, where the required power at a given speed is proportional to the cube of the vessel's actual speed relative to its maximum speed. This is expressed as **$Power/Power_{max}$ = (Vessel Speed/Maximum Vessel Speed)^3**. This equation is based on the physics of fluid resistance and propulsion, where power demand increases exponentially with speed. It is commonly used to estimate fuel consumption and emissions at different operational speeds.

Table B-9. Ground Transportation Data Sources

Data Source	Coverage	Information Included
HDOT (traffic counts)	January 2024 – September 2024	▪ Road segments. ▪ Travel mode. ▪ Average monthly emissions for road segment and mode combination. ▪ Average monthly VMT for the zone and mode combination. ▪ Percentage of EVs and PHEV of total vehicles based on local vehicle registration data (only light-duty vehicles). ▪ Estimated VMT by electric vehicles and by plug-in hybrid electric vehicles operating on electric range. This metric assumes that 50% of the VMT from PHEVs is powered by gas, and 50% is powered by electricity. ▪ Avoided tailpipe emissions from EVs and PHEVs (metric tonnes of CO2e), the estimated emissions that would have occurred (due to VMT) if the EVs and PHEVs were vehicles with internal combustion engines. This metric assumes that EVs replaced vehicles with the average fuel economy for the target zone.
Current Fleet Composition (light-, medium-, and heavy-duty)	2022	DBEDT; FHWA Table VM-1 - Highway Statistics 2022
Estimates of Current and Future Travel in Hawai‘i	2024	Hawai‘i Greenhouse Gas Emissions Report for 2020 and 2021
Streetlight Data	2024	Connected vehicles and traffic counts, emissions calculations per road segment

Exclusions

This Plan is written with the assumption that, for purposes of tracking against net-negative and interim GHG reduction targets, transportation emissions are defined using a similar basis as the DOH GHG Inventory. In that inventory, transportation emissions are limited to the fuels consumed by ground vehicles, aircraft, and watercraft. The following briefly describes excluded sources:

- Upstream impacts of fuel production, which are included in the Industrial Process and Product Use (IPPU) sector or excluded entirely for fuels produced outside Hawai‘i.
- Like fuels, production of concrete, asphalt, and steel is covered under IPPU or excluded for materials from outside Hawai‘i.
- Electricity generation, which is a portion of the Energy sector.
- Per the settlement agreement, international marine and aviation activities are not included in the calculations and strategies identified in this Plan, which is also consistent with the DOH GHG Inventory.

- Emissions associated with facilities and buildings that HDOT owns, manages, or leases. These facilities and buildings have some operational Scope 1 and 2 emissions (although this will improve as the Hawai‘i electricity grid converts to renewables).
- Emissions from fishing vessels, commercial fishing boats, and passenger ferries operating from small boat harbors not managed by HDOT-Harbors. Unfortunately, limited data are currently available on these vessels, making it challenging to estimate their emissions with confidence. To address this, HDOT will collaborate with the Department of Land and Natural Resources (DLNR), which oversees these vessels and their operations, to gather the necessary data and ensure their emissions are properly accounted for in future inventories.

Emission Reduction Estimation Methodologies

HDOT applied best practice methodologies and assumptions to estimate the emission reduction quantities associated with the proposed strategies in each mode. The equations used for each strategy type are detailed in the mode tables that follow. The results of each equation are summed to determine total emission reductions in a given year. The key assumptions used are discussed in the subsequent sections.

Table B-10. Aviation Emission Reduction Equations

Strategy	Equation	Notes
SAF Displacement	= jet fuel quantity x Jet Fuel EF x SAF reduction %	SAF assumed to be able to comprise 50% of total fuel uplifted in 2023 and expected to increase to 100% by 2045. SAF reduction % detailed in Chapter 2.
Hydrogen/Electric Aircraft	= fuel quantify (interisland flights) x % fuel displaced by hydrogen/electric x Jet Fuel EF	By 2045, Electric/Hydrogen assumed to displace 10% of fuel for interisland flights.
Airspace Modernization and Ramp Movement Optimization	= fuel quantity (idling) x % reduction x Jet Fuel EF	Idling estimated to comprise 25% of total fuel consumption. By 2045, up to 18% reduction assumed from modernization. By 2045, up to 10% reduction assumed from ramp movement optimization.
Pre-Conditioned Air and Fixed Electrical Ground Power	= fuel quantity (aux. power unit) x Jet Fuel EF x % of gates electrified	By 2045, assume that 100% gates will be electrified with renewable electricity.
Ground Support Equipment Electrification	= fuel quantity (GSE) x fuel EF/Energy Efficiency Ratio x % of equipment electrified	By 2045, assume that 100% of GSE will be electrified with renewable electricity.
Vehicle Electrification	= [fuel quantity x fuel EF]/Energy Efficiency Ratio x % equipment electrified	By 2045, assume that 20% of vehicles will be electrified.

Table B-11. Marine Emission Reduction Equations

Strategy	Equation	Notes
Clean Fuels Displacement	= baseline emissions (from fossil fuel) x % carbon intensity reduction (from cleaner fuel)	Baseline emission equations detailed in Table B-7. Carbon intensity reduction factors detailed in Chapter 2. Emissions reductions from each fuel summed for total emission reduction.

Table B-12. Highways Emission Reduction Equations

Strategy	Equation	Notes
Electrification	= [fuel quantity x fuel EF]/Energy Efficiency Ratio x % equipment electrified	By 2045, assume that 20% of vehicles will be electrified.
VMT Reduction	= miles reduced * miles EF	Depending on vehicle type, mileage may also be converted to fuel using an average fuel economy factor for the specific fuel type and a fuel-specific EF applied.
Cleaner Fuels	= baseline emissions (from fossil fuel) x % carbon intensity reduction (from cleaner fuel)	Carbon intensity reduction factors detailed in Chapter 2. Emissions reductions from each fuel summed for total emission reduction.

Key Assumptions

Given the limited activity data available for quantifying emissions, a significant number of assumptions were made in the assessment, mostly with respect to boundaries and included activities, aside from the exceptions noted in the methodology section above. As noted, historic on-road vehicle emissions were obtained from the DOH GHG Inventory. A new baseline projection to 2045 was developed using the EPA MOVES5 model, which reflects Hawaiʻi's vehicle population and federal emission standards adopted in 2024. As previously stated, the DOH GHG Inventory report is limited to tail pipe emissions, so does not include the upstream emissions impact from processing of fossil fuels and production of carbon-intensive construction materials such as concrete and steel. However, the baseline emissions projection includes emissions from electricity generation needed to charge EVs. As detailed in the GHG mitigation plan presented in Chapter 5, electricity grid emissions from EVs and equipment were considered in assessing the impact of electrification on the HDOT emissions inventory. Additional key assumptions used in development of HDOT's baseline emissions include the following:

- Aviation
  - FAA TAF reports/forecasts were more representative of future aircraft activities than the DOH GHG Inventory forecasts.
  - GSE and landside ground access at smaller airports were assumed to have the same ratio of operations to emissions as the larger airports with existing ACA GHG inventories (HNL, ITO, KOA, LIH, OGG).
- Marine
  - Marine traffic would stay relatively steady for the duration of the 20-year target period.
- Ground Transportation
  - The baseline assessment of emissions assumes the fuel efficiency of new passenger cars and trucks based on the EPA CAFE standards for cars and light trucks.
  - Population, job, and visitor growth for the forecast were drawn from the Population and Economic Projections for the State of Hawaiʻi, completed by the DBEDT's short and long-run forecasts.
  - Personal vehicle ownership rates remain unchanged during the study period.

Areas for Continual Improvement

It is acknowledged that the GHG emissions presented in this initial Plan, though largely based on the DOH GHG Inventory, are still highly estimated. As such, HDOT intends to improve the robustness of data collection processes to allow for more granular and focused emissions quantification, reducing the level of uncertainty.

Aviation

For aviation emissions quantification, because of the large fraction of overall aviation emissions represented by the aircraft flight activities, more comprehensive flight and fuel consumption data from each of the airports should be collected. Assumed fuel consumption rates of aircraft at different stages of the flight drive the total fuel quantities that will be used for emissions quantification. To improve the accuracy of these consumption rates, engaging with airline partners to better understand how the aircraft really function may help to optimize these rates to be more consistent with actual aircraft operations.

Marine

There are several areas for continual improvement for marine in future iterations of the emissions inventory. One key area is the estimation of transit emissions for OGVs, which currently contribute the most to the total inventory. At present, transit emissions assume that ships operate at 75 percent of their maximum speed, with distances derived from Sea-Distance. However, this method could be significantly improved using Automatic Identification System (AIS) data, which provide real-time Global Positioning System (GPS) tracking for vessels, including both cruise and cargo ships operating globally. With AIS data, actual speeds, voyage distances, and routes could be tracked, leading to more precise emissions calculations. AIS-based methodologies are widely considered the gold standard for OGV emissions inventories; however, due to time constraints and data availability, this initial inventory relied on approximations for transit distances and speeds. Future efforts could enhance accuracy by integrating AIS data, provided that sufficient time and resources are allocated.

Another critical area for improvement is harbor craft emissions estimation. Harbor craft data were not currently readily available, so vessel movement data from IHS were used to determine the number of trips made, with assumptions regarding travel distance and speed. This approach, while reasonable given the data limitations, could be significantly refined by either leveraging AIS data for CHCs or by obtaining detailed operational data from the ports on vessel characteristics, operational patterns, and fuel consumption.

A third area for improvement is the treatment of dual-fuel ships. Companies like Matson and Pasha Hawai’i are now operating liquified natural gas (LNG)-diesel dual-fuel ships in commercial ports. Because LNG combustion produces lower emissions than diesel, the current inventory (which assumes all vessels use diesel) does not fully capture the emissions benefits of LNG usage. If more time and resources were dedicated to this effort, the inventory could differentiate between LNG and diesel-powered vessels, improving its accuracy.

Finally, another area for refinement involves future emissions projections. The current inventory assumes that emissions remain constant over time, as it is directly correlated with vessel activity under the assumption of flat growth from 2023 to 2045. However, this does not account for the expected efficiency improvements driven by IMO regulations, such as the Energy Efficiency Existing Ship Index (EEXI) and Carbon Intensity Indicator (CII) standards, which will require ships to become more fuel-efficient over time. As newer vessels enter the fleet and existing ships comply with stricter efficiency standards, emissions are likely to decline even without changes in activity levels. Future iterations of this emissions inventory could incorporate IMO regulatory impacts to create more dynamic and realistic emissions projections through 2045.

Ground Transportation

The assessment of tailpipe emissions based on recent and past travel patterns gives a very strong indication of future trends, given the reasonable planning assumptions outlined. Changes in fuel mix and vehicle types based on new or possible changes at the state and federal level can be forecasted.

The assessment of the VMT reduction strategies is more complicated. The strategies rely on each other to meet the goals of this Plan, seeking to increase multimodal trips over time by promoting compact, walkable development and reduced amounts of free parking. Strategies that increase travel options by public transit, bicycling, and traveling as a pedestrian are most effective when deployed together with strategies that encourage those choices.

Future assessments of the VMT reduction strategies and HDOT’s internal practices offers the opportunity to review and assess these strategies individually and as a suite of strategies as done in this Plan. Conducting a household travel survey statewide would allow for more clarity about how the diverse communities of Hawaiʻi travel and ensure that strategies are deployed most effectively depending on the community and availability of multimodal options.

Carbon Removal and Sequestration

The DOH GHG Inventory includes estimates of sources and sinks of Agriculture, Forestry, and other Land Use (AFOLU) emissions for historical years and future projections. Consistent with Intergovernmental Panel on Climate Change (IPCC) guidelines for national GHG emission inventories, which are referenced in the Hawaiʻi inventory, estimated carbon sequestration in AFOLU sinks are netted against transportation and other emission sources for determining statewide totals. Additional work is needed to refine these estimates, including obtaining growth rate data more specific to Hawaiʻi tree species, and determining which forest areas have growth that is "additional" to sequestration that occurred before human influence.

Appendix C
Carbon Removals

Overview

This section describes available strategies for forestry and other means of carbon dioxide removal (CDR), as necessary for the State of Hawaiʻi Department of Transportation (HDOT) and Hawaiʻi to meet 2045 net-negative targets. These options are presented in three categories: forestry-related strategies, marine carbon dioxide removal (mCDR), and other long-term carbon storage technologies.

The strategies vary in cost, maturity of the technologies, co-benefits, and durability of the carbon they remove. Durability refers to how long the carbon removed from the atmosphere stays out of the atmosphere before being re-released. It also is reflective of the fact that nature-based carbon removals are at risk of catastrophic "reversals"; for example, trees planted in a reforestation effort may burn in a wildfire, negating removals and mitigation that were claimed against greenhouse gas (GHG) emissions in a prior year. Low durability strategies such as reforestation can be expected to remove carbon from the atmosphere for a length of time between a few decades to over 100 years. In contrast, some high-durability strategies provide greater certainty that the removed carbon will remain sequestered for centuries to millennia.

Forestry-related strategies tend to be lower cost at current prices and have ecological co-benefits, but they can have low durability. mCDR strategies have the potential to remove very large amounts of carbon from the atmosphere at high durability and have co-benefits like deacidifying the ocean. However, they are in an early phase of their technological development. The additional long-term carbon removal strategies vary in their maturity, cost, and co-benefits, but are more durable forms of carbon removal than the forestry-related strategies.

The following sections provide a brief description of possible removal options. Details on the proposed action items to assess feasibility and implement selected technologies are provided in Chapter 3 of the Energy Security and Waste Reduction Plan.

Forestry-Related Strategies

Protection and restoration of Hawaiian forest is prioritized in this Plan for many reasons, including carbon removal, biodiversity, watershed protection, and cultural value. Strategies in this category include protection of forests from continued deforestation and degradation, reforestation of land where native habitats have been lost, and expansion of agroforestry as a traditional method of food production in harmony with nature.

Table C-1. Forestry-Related Carbon Removal Strategies

Strategy	Explanation	Examples
Protection of existing forests	Hawaiʻi's forests are being degraded due to land use change, invasive species, and climate change. Protection strategies can include ungulate exclusion, removing invasive species, and monitoring for Rapid ʻŌhiʻa Death.	Hawaiʻi Volcanoes National Park built 170 miles of fencing to keep out ungulates and found reduced mortality for ʻōhiʻa trees (Perroy et al. 2021).
Restoration of native ecosystems	Many native forest areas in Hawaiʻi have undergone land use change and could be restored to forest, sequestering carbon.	The Ola Hou Forest Carbon Project is a State-led effort to restore 390 acres of former koa and ʻōhiʻa forest (DLNR n.d.).

Strategy	Explanation	Examples
	Restoration techniques include ungulate exclusion, invasive species management, and planting native trees.	
Expansion of agroforestry	Establishing agroforestry systems in areas that currently have low aboveground carbon density (such as degraded former plantations) sequesters carbon while improving food security and providing jobs.	Scholars estimate over 1,200 square kilometers of fallow agriculture land in Hawaiʻi is suitable for transition to agroforestry with significant carbon sequestration benefits (Bremer et al. 2025).

Marine Carbon Dioxide Removal

mCDR is an emerging set of strategies that use the ocean to remove carbon dioxide (CO_2) from the atmosphere, helping to address climate change. Some mCDR strategies remove CO_2 by reducing climate-change-related ocean acidification, benefiting marine organisms. mCDR strategies highlighted here include ocean alkalinity enhancement, electrochemical alkalinity enhancement, and ocean CO_2 extraction.

Table C-2. Marine Carbon Dioxide Removal Strategies

Strategy	Explanation	Examples
Ocean alkalinity enhancement	Alkaline materials such as quicklime, lime, basalt, and olivine are added to the ocean. The materials can be added directly to ocean waters, put in wastewater treatment plant outfalls, or deposited on beaches.	Vesta is adding olivine to coastal protection projects. A pilot project in North Carolina is estimated to remove 5,000 metric tonnes of CO_2 (Vesta 2024).
Electrochemical alkalinity enhancement	Seawater is run through an electrodialysis system that removes acid from the seawater. Alkaline water is returned to the ocean, where it can absorb additional CO_2. The acidic stream can be used to balance alkaline wastewater or stormwater.	Ebb Carbon recently obtained a first-of-its-kind National Pollutant Discharge Elimination System (NPDES) permit for their first pilot outside of the lab (Ebb Carbon 2025).
Ocean CO_2 extraction	Seawater is run through membranes that extract CO_2 from the water. It is similar to the Direct Air Capture process but in the ocean. The extracted CO_2 needs to be used or stored to create the climate benefit.	Captura has a 1,000 metric tonnes of CO_2/year pilot plant in Kona as of February 2025 (Captura 2025).

Additional Durable Carbon Removal Strategies

This category includes relevant "engineered" approaches for carbon removal that are currently in development and likely to be available prior to 2045.

Table C-3. Additional Long-Term Carbon Removal Strategies

Strategy	Explanation	Examples
Biochar	Biomass is heated in a low-oxygen environment to create a stable, carbon-rich material. Biochar can enhance soil health and improve crop yields when applied to soil.	Hawaiʻi examples of biochar producers include Hamakua Group and Haleakalā Biochar.
Microalgae	Algae is grown in large systems, removing carbon via photosynthesis. To sequester the carbon in the algae, the algae needs to be stored. Options include burial, biochar, biofuels, and use in products.	Kauaʻi has one of the U.S.'s largest algae biofuel facilities (DOE 2016).
BECCS	BECCS applies Carbon Capture and Storage (CCS) technology to biomass-based energy production. If the biomass is sourced in sustainable ways, then the operation can produce renewable energy with a net-negative GHG footprint.	A team including the University of Hawaiʻi (DePaolo and Lautze 2024) is studying whether CO_2 would mobilize with geologic storage in Hawaiʻi, an important consideration for the viability of the technology in Hawaiʻi.
Construction materials	Once CO_2 is removed from the atmosphere, such as through Direct Ocean Capture or Direct Air Capture, it needs to be durably stored to achieve the climate benefit. CO_2 can be injected into concrete during mixing for long-term storage, which can enhance concrete's durability without increasing costs.	HDOT implemented a pilot of this technology in 2019 at the Kapolei Interchange Phase II (CarbonCure 2019).
Enhanced rock weathering	Enhanced rock weathering involves spreading crushed minerals over land to chemically react with CO_2 in the air and/or water, forming stable carbon compounds. This can provide co-benefits to soil and crop yields.	There are currently no examples in Hawaiʻi, but Hawaiʻi's basalt rock creates the potential for successful implementation of enhanced rock weathering. A pilot research study using crushed basalt in the U.S. Corn Belt found carbon sequestration benefits and enhanced crop yields (Beerling et al. 2023).
Direct Air Capture	Direct Air Capture uses fans and sorbents to bind CO_2 out of the air.	The company Climeworks has a plant in Iceland in operation since 2021 that captures 4,000 tonnes of CO_2 annually (Climeworks 2025).

Carbon Offsets vs. Carbon Removals

Carbon offsets and carbon removals are terms that are often used synonymously in the press and even with informed stakeholders. However, carbon offsets are a type of market instrument that allows claim to a GHG benefit to be transferred from one party to another, and which could be based on either GHG avoidance or carbon removal. This Plan presents carbon removal strategies for the purpose of compensating for residual GHG emissions but does not suggest the use of carbon offsets by the State of Hawaiʻi.

Carbon offsets are tradable commodities or credits that represent the avoidance or removal of GHG. Across the world, offsets are exchanged both in regulatory markets where companies must reduce GHG emissions under a mandatory cap and trade program, and in voluntary markets where companies and other entities purchase those claims for the purpose of reducing GHG emissions to meet sustainability goals or customer demand. The "methodologies" and protocols published by reputable programs such as Verra, American Carbon Registry, and Climate Action Reserve provide a good guide to available carbon removal technologies, where they have been successfully implemented in other locations, and the proper measurement and quantification of benefits.

In general, these programs have relatively high transactional costs, due in large part to the many "conservative" aspects to quantification of benefits and the requirements for independent third-party validation of protocols and projects and verification of project impact. Thus, it would be prohibitively expensive for HDOT to neutralize expected residual emissions using purchased offsets. There may also be legal and policy barriers to the purchase of offsets by a state agency, and the standards for additionality included in all reputable offset programs have proven problematic for development of projects by public agencies in other locations.

This Plan does **not** include plans for purchase of carbon offsets from other parties, nor does it suggest that state-supported projects be submitted to a voluntary offset program for certification. Rather, where similar carbon removal technologies will be implemented or supported by the State of Hawaiʻi to meet its net-negative goal, actions would be assessed and benefits quantified in accordance with reputable standards such as the GHG Protocol *Project Accounting Standard* and GHG Protocol *Land Use, Land Use Change, and Forestry (LULUCF) Guidance for GHG Project Accounting* (Greenhouse Gas Protocol 2005, 2006).

Appendix D
Cost Implications of Harbor Reduction Strategies

Implementing the four maritime decarbonization strategies will require careful consideration of cost impacts, ranging from fuel production and infrastructure investments to vessel upgrades.

The transition to low-carbon and zero-emission fuels in Hawaiʻi's maritime sector (Strategies HAR-1 through HAR-4) involves several major cost components, including the higher production costs of alternative fuels, the infrastructure investments needed for new bunkering facilities, and the vessel upgrade and fleet renewal expenses required for ships to operate on cleaner fuels. Each of these costs has different financial implications, some of which may be borne directly by the State of Hawaiʻi while others will be shared among multiple states, ports, or international shipping companies. It is essential to consider these cost distinctions when evaluating the economic impact of these strategies on Hawaiʻi's economy, maritime industry, and consumers.

One of the biggest cost drivers is the higher production cost of alternative fuels such as bio- or renewable diesel, bio- liquified natural gas (LNG), methanol, ammonia, and hydrogen, which are currently more expensive than traditional marine diesel due to limited production capacity, supply chain constraints, and the cost of renewable energy inputs. While fuel costs will decline over time as production scales up, they remain a major financial hurdle for adoption today. Some of these costs will impact Hawaiʻi directly, particularly if bio- and renewable diesel and other fuels are sourced locally or if the state implements financial incentives to subsidize clean fuels for vessels. However, for inter-state and international shipping lines, these fuel costs will be shared across multiple markets, meaning that not all fuel-related costs will be borne by Hawaiʻi alone.

Another major cost consideration is the investment required to develop new bunkering infrastructure for alternative fuels. Currently, Hawaiian ports are not equipped to store and distribute large-scale volumes of bio-LNG, methanol, ammonia, or hydrogen, meaning significant infrastructure upgrades will be needed to support these fuels. These investments will likely require state funding, public–private partnerships, and federal grants, as they directly affect Hawaiʻi's ability to provide clean fueling options for both intra-state and inter-state vessels.

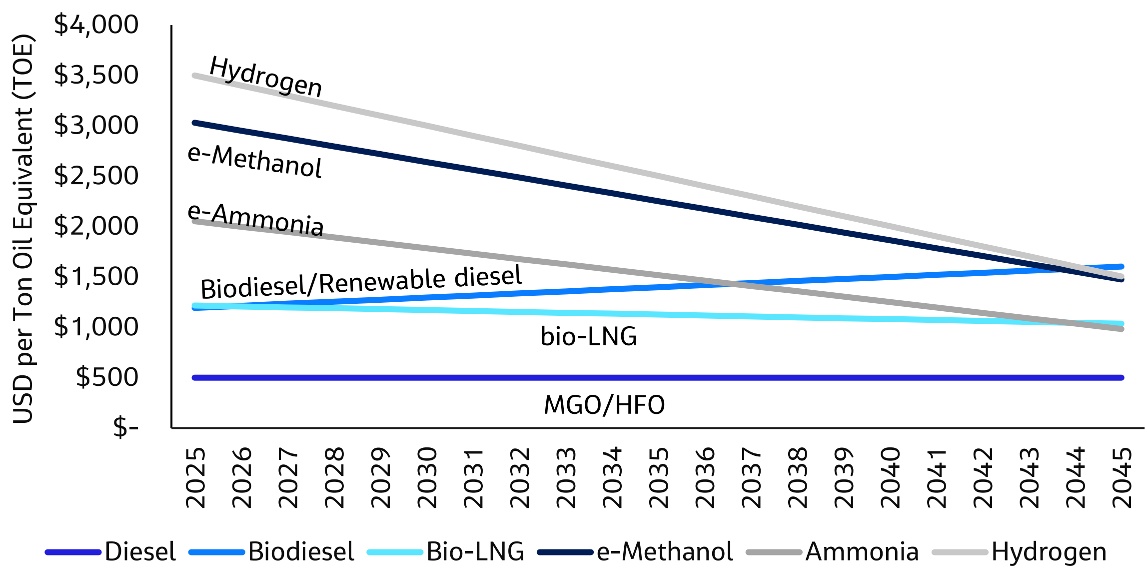
According to Solakivi et al. (2022), the projected costs of clean marine fuels are analyzed not only for current prices but also for future cost trends. The study estimates fuel costs from 2020 to 2050, using a combination of historical price data, regression analysis, and literature-based projections. Biofuels (for example, biodiesel, and renewable diesel) and bio-LNG costs are projected based on feedstock price trends, their share in total production costs, and anticipated efficiency improvements in production technologies. For electrofuels (e-fuels), the study uses a Total Cost model, accounting for capital expenditures on fuel synthesis and electrolysis, operational costs, electricity pricing, and carbon dioxide (CO_2) capture expenses. The analysis assumes a declining cost trajectory for renewable electricity and electrolysis technology, projecting substantial cost reductions for e-fuels by 2050, making them more economically competitive over time.

To assess the projected fuel prices relative to the current marine gas oil (MGO), the State of Hawaiʻi Department of Transportation (HDOT) compared them against the prevailing global MGO/heavy fuel oil (HFO) price, assuming it remains constant in the future. Currently, the average bunkering cost for MGO and HFO is approximately $500 per ton of oil equivalent (TOE). In contrast, bio-LNG and biodiesel are significantly more expensive at around $1,200 per TOE, while e-methanol is estimated at $3,000 per TOE, e-ammonia at $2,000 per TOE, and hydrogen at $3,500 per TOE. However, some of these alternative fuels are projected to experience substantial cost reductions by 2045. Bio-LNG is expected to maintain its current cost, while biodiesel could increase to $1,600 per TOE due to limited feedstock availability and growing demand across sectors. In contrast, e-ammonia is projected to drop to $1,000 per TOE, e-methanol to $1,500 per TOE, and hydrogen to $1,500 per TOE. Despite these projected reductions, alternative fuels will still be significantly more expensive than traditional MGO or HFO, implying considerable financial implications for fuel costs in the maritime sector. It is also important to note that these fuel prices are at the dock, meaning that infrastructure and bunkering costs are already factored into these estimates. Figure D-1 illustrates these fuel cost projections from the study.

Regional Fuel Price Disparity

The marine fuel price projections presented in this report are primarily based on global market trends and may not fully reflect regional price differences. Hawaiʻi has historically experienced higher fuel prices than both the continental U.S. and global averages due to factors such as transportation costs, supply chain constraints, and limited local production capacity. As a result, actual fuel prices in Hawaiian ports could be higher than the estimates shown in this report.

Figure D-1. Marine Fuel Price Projections



Source: Solakivi et al. 2022

Another significant cost factor in transitioning to clean fuels is the expense of either purchasing new vessels designed for alternative fuels or retrofitting existing vessels to operate on them. While biodiesel is a drop-in fuel that requires minimal modifications, transitioning to methanol, ammonia, LNG, or hydrogen requires significant engine and fuel system modifications or entirely new ship builds. This cost will not necessarily be borne by the State of Hawaiʻi, as international shipping lines and mainland-Hawaiʻi operators like Matson and Pasha Hawaiʻi will cover their own fleet transition costs as part of their global decarbonization efforts. However, local operators may require state-level financial assistance to transition their smaller intra-state fleet, making vessel conversion a key cost consideration for the state.

The majority of alternative fuel ship orders to date have been for large container vessels in the 15,000 to 19,000 twenty-foot equivalent unit (TEU) range, primarily ordered by major global shipping companies such as Maersk, COSCO, and Evergreen. These companies are investing in methanol and LNG ships as part of their long-term decarbonization strategies, with many of their new builds and retrofits focused on high-capacity vessels operating on global trade routes. Because these large shipping lines have the financial resources and operational scale to make early investments in alternative fuel technology, the majority of cost data available reflects these higher TEU vessels rather than smaller ships operating on regional or intra-state routes.

Due to this skewed data set, there is limited publicly available cost information for smaller TEU vessels such as those operating in intra-state or domestic trade routes, including those serving Hawaiʻi. Most alternative fuel cost estimates are based on high TEU vessels, making it difficult to assess the accurate costs for smaller cargo ships, tugs, and other local maritime operations. However, to provide a high-level overview of the potential cost for these new vessels, Table D-1 presents an approximate percentage increase estimate of the alternative fuel-powered vessels. As shown, diesel-powered vessels remain the most affordable option while methanol and LNG provide a moderate-cost transition, with 20 percent and 13 percent higher costs, respectively. Ammonia and hydrogen-powered vessels, however, require significantly higher investments, with costs increasing by up to 130 percent compared to diesel, making them the most expensive alternatives. Given these cost differences, methanol and LNG are more feasible near-term solutions, while ammonia and hydrogen may require substantial subsidies or policy incentives before becoming commercially viable.

Table D-1. Approximate Cost of Alternative Fueled Vessels (15,000 TEU Vessels)

Fuel Type	Cost Range (million $)	15,000 TEU Cargo Ship Cost	Incremental Cost	Relative Percent Increase
Diesel	$20M to $200M	$150M		
Methanol	$175M to $210M	$170M to $191M	$30M	20%
LNG	$140M to $210M	$170M	$20M	13%
Ammonia	50 to 130% higher than diesel	$225M to $345M	$135M	90%
Hydrogen	30% higher than diesel	$345M	$195M	130%

In addition to the higher costs associated with alternative fuel vessels, it is important to note that ships traveling between the mainland United States and Honolulu, as well as vessels homeported in Hawaiʻi, must comply with federal requirements that mandate they be U.S.-built, U.S.-owned, and U.S.-crewed. This factor must be considered in any discussions on transitioning vessels to alternative fuels and associated costs.

To provide a clearer understanding of the increasing costs associated with adopting clean marine fuels, HDOT conducted an analysis to estimate the additional fuel cost per voyage as well as the amortized cost of vessel upgrades required for alternative fuel adoption. This assessment considered both the rising cost of alternative fuel vessels and the impact on shipping expenses per voyage. In addition, HDOT examined how these increased costs would translate to container shipping rates, whether for voyages between the mainland United States and Hawaiʻi or for intra-state transport via tug-assisted barges.

Table D-2. Characteristics of the Example Inter-state Cargo Vessel Used for the Cost Analysis (Container Ship)

Ship Type	Container Ship
Cargo Capacity	2500 TEU
Route	Long Beach -> Honolulu
Number of Roundtrip Voyages	28
Assumed Lifetime	25 years
Fuel User Per Trip	594 TOE
Assumed Number of 40-foot Container	1,250
Cost of New Diesel Vessel	$200,000,000
Current Cost of Shipping 40-foot Container	$7,225

Source: Matson 2023

For this analysis, HDOT selected a representative cargo ship with a capacity of approximately 2,500 TEUs operating between Long Beach and Honolulu, making 28 round trips (or 56 single trips) annually. Because federal compliance requires these vessels to be built in the United States, an average vessel cost of $200 million was assumed. HDOT then calculated the increased fuel cost per trip for various alternative fuel options, as well as the amortized cost of the higher vessel price over a 25-year lifespan, spread across all voyages. The results of this evaluation are summarized in Table D-3, which shows the estimated cost increase per voyage due to fuel and vessel costs, the additional cost per container, and the potential percentage increase in container shipping rates. Given that the current shipping rate for a container transported via Matson from Long Beach to Honolulu is approximately $7,225, this analysis provides insight into the financial impact of transitioning to alternative marine fuels on both shippers and consumers.

As shown in Table D-3, the lowest cost increases are associated with bio-LNG and biodiesel, at approximately 5 percent and 6 percent, respectively, while the highest cost increases are linked to e-methanol and hydrogen, at 12 percent and 15 percent. These are estimated using the vessel characteristics noted in Table D-4. When analyzing the additional cost per container resulting from both fuel and vessel cost increases, it becomes clear that the rising fuel costs are the primary driver of the overall cost increase. For instance, in the case of e-methanol, while the additional vessel cost per container is only $23, the increased fuel cost accounts for roughly $832 per container. This underscores the need for policies that help offset fuel costs in the near term, providing financial incentives or subsidies to bridge the gap until these alternative fuels can achieve economies of scale.

Table D-3. Increase in Cost per Voyage and per Container for Inter-state Cargo

Fuel Type	Increased Fuel Cost per Voyage ($/Voyage)	Incremental Vessel Cost per Voyage[a] ($/Voyage)	Increased Fuel Cost per 40-foot Container ($/Container)	Increased Vessel Cost per 40-foot Container ($/Container)	Total Increased Cost per 40-foot Container ($/Container)	Percent Increase in Cost of Shipping
Bio-LNG	$371,772	$71,429	$297	$57	$355	5%
Biodiesel	$532,894	$0	$426	$0	$426	6%
e-Ammonia	$604,349	$128,571	$483	$103	$586	8%
e-Methanol	$1,040,489	$28,571	$832	$23	$855	12%
Hydrogen	$1,188,576	$185,714	$951	$149	$1,099	15%

[a] Amortizing the vessel incremental cost over lifetime number of voyages. In this case, assuming 25 years and 56 single trips, the vessel incremental cost is amortized over 1,400 voyages.

Table D-4. Characteristics of the Example Intra-state Cargo Vessel Used for the Cost Analysis (Tug)

Ship Type	Tug
Cargo Capacity	616 TEU
Route	Honolulu -> Kawaihae
Number of Roundtrip Voyages	86
Assumed Lifetime	30 years
Fuel User Per Trip	5.2 TOE
Assumed Number of 40-foot Container	308
Cost of New Diesel Vessel	$30,000,000
Current Cost of Shipping 40-foot Container	$1,412

HDOT also conducted a similar analysis for a representative tug-assisted barge with a capacity of 616 TEUs operating between Honolulu and Kawaihae with approximately 86 roundtrip voyages per year and an assumed vessel lifetime of 30 years. The estimated cost of a new diesel-powered vessel was set at $30 million. Following the same methodology as the cargo ship analysis, HDOT calculated the increased fuel and vessel costs per voyage for various alternative fuel options. Using the current shipping tariff of approximately $1,400 per 40-foot container, HDOT then determined the percentage increase in shipping costs due to the adoption of alternative fuels.

As shown in Table D-5, similar to the cargo ships, bio-LNG and biodiesel result in the lowest cost increases, at approximately 1 percent, while e-ammonia and e-methanol lead to cost increases of around 2.5 percent. Hydrogen, on the other hand, imposes the highest cost increase at roughly 4 percent. Given the relatively short distances of voyages between Honolulu and Kawaihae, the increased fuel cost per voyage is significantly lower compared to long-haul trips between the mainland and Hawai'i. As a result, the overall impact of fuel cost increases on container shipping rates for intra-state transport remains relatively modest when compared to the substantial cost implications seen in large cargo ships traveling between the mainland and Hawai'i.

Table D-5. Increase in Cost per Voyage and per Container for Intra-state Cargo

Fuel Type	Increased Fuel Cost per Voyage ($/Voyage)	Incremental Vessel Cost per Voyage[a] ($/Voyage)	Increased Fuel Cost per 40-foot Container ($/Container)	Increased Vessel Cost per 40-foot Container ($/Container)	Total Increased Cost per 40-foot Container ($/Container)	Percent Increase in Cost of Shipping
Bio-LNG	$3,284	$756	$10.7	$2.5	$13.1	0.9%
Biodiesel	$4,708	$0	$15.3	$0.0	$15.3	1.1%
e-Ammonia	$5,339	$5,233	$17.3	$17.0	$34.3	2.4%
e-Methanol	$9,192	$1,163	$29.8	$3.8	$33.6	2.4%
Hydrogen	$10,500	$7,558	$34.1	$24.5	$58.6	4.2%

[a] Amortizing the vessel incremental cost over lifetime number of voyages. In this case, assuming 30 years and 86 single trips, the vessel incremental cost is amortized over 2,580 voyages.

While the earlier analysis represents a worst-case scenario—assuming that all costs are passed directly to consumers—it is important to recognize that the economic impact of maritime decarbonization strategies will not be entirely borne by the State of Hawaiʻi or its residents. Certain costs, such as fuel incentives or investments in local bunkering infrastructure, will require support from state or federal funding. Meanwhile, other costs, like vessel upgrades for global shipping lines, will be absorbed outside of Hawaiʻi's economy, as shipping companies operating on international and mainland to Hawaiʻi routes make fleet transition decisions independently of State policies. This distinction is important because the cost of maritime decarbonization should not be assumed as a direct financial burden on Hawaiʻi's economy. Instead, it must be viewed as part of a broader, global transition to clean fuels, where responsibilities are shared across multiple stakeholders, including private shipping companies, international regulatory bodies, federal agencies, and regional port authorities.

Appendix E
Peer Review

Peer Review Section

In developing this Hawai'i Energy Security and Waste Reduction Plan, the State of Hawai'i Department of Transportation (HDOT) reviewed transportation-focused greenhouse gas (GHG) targets and strategies set by other states and international leaders. The list of entities was developed from subject matter expertise and familiarity with state and national transportation agencies that are either known leaders in decarbonization and/or have similar geographical challenges as HDOT, many of which have also been successful in implementation. The objective of this peer review was to consider lessons learned and best practices as the Hawai'i Energy Security and Waste Reduction Plan is developed and implemented. The results are presented here for context and to demonstrate that HDOT's proposed strategies are in line with other state transportation agencies. This appendix presents a detailed assessment. The following states, territories, and countries were included in this peer review assessment:

- State of Oregon
- State of Rhode Island
- State of Minnesota
- State of North Carolina
- State of Colorado
- State of Maine
- Territory of Puerto Rico
- Country of Iceland
- Republic of the Marshall Islands (RMI)
- Country of Costa Rica

GHG Reduction Targets

At the highest level, all reviewed entities have set long-term GHG reduction targets supported by robust strategies. Table E-1 summarizes long-term and intermediate GHG reduction targets.

Table E-1. Long-term and Intermediate GHG Reduction Targets

Entity	Sector	Target					
		2025	2030	2035	2040	2045	2050
HDOT	Transportation					Net-negative	
	Economy-wide		-50%			Net-negative	
Oregon	Transportation				-25%		
	Economy-wide			-45%			-80%
Rhode Island	Transportation		-45%		-80%		Net zero
	Economy-wide		-45%		-80%		Net zero
Minnesota	Transportation	-30%	-50%	-65%	-80%		Net zero
	Economy-wide	-30%	-50%	-65%	-80%		Net zero
North Carolina	Transportation						
	Economy-wide		50%				Net zero

Entity	Sector	Target					
		2025	2030	2035	2040	2045	2050
Colorado	Transportation						
	Economy-wide	26%	-50%	-65%	-70%	-90%	-100%
Maine	Transportation		-45%				-
	Economy-wide		-45%			CN	-80%
Puerto Rico	Transportation						
	Economy-wide	-50%					
Iceland	Transportation						
	Economy-wide		40%		CN		
RMI	Transportation						
	Economy-wide	-32%	-45%	-58%			Net zero
Costa Rica	Transportation						
	Economy-wide						Net zero

CN = carbon neutral

Except for Puerto Rico, each reviewed entity has a long-term target of economy-wide net zero or carbon neutrality. Therefore, all noted goals assume the use of carbon offsets, sequestration, and/or removals. Among the reviewed jurisdictions, Maine has the most aggressive timeline, aiming to be carbon neutral statewide by 2045. All other entities besides Iceland set 2050 as the target year for net-zero GHG emissions or carbon neutrality. No peer entities have an absolute zero GHG emissions target.

Hawaiʻi's inclusion of intermediate, linear GHG reduction targets aligns with peers such as Oregon, Rhode Island, North Carolina, Colorado, Maine, and RMI. Minnesota has transportation-specific intermediate targets guiding the state Department of Transportation to 80 percent reduction of transportation sector emissions by 2040, in addition to the statewide intermediate targets. Iceland's approach to GHG target setting is informed by their participation in the Paris Climate Accords. Intermediate targets are separated into emissions included under the European Union Emissions Trading System (EU ETS), and emissions included under the Emissions Sharing Regulation (ESR or Non-ETS).

Greenhouse Gas Calculation Methodology Examples from Peer Entities

There are multiple methodologies available to calculate GHG emissions for a state, territory, or country. On-road vehicle emissions are estimated by all benchmarked entities (Table E-2). Rhode Island, Minnesota, and North Carolina use the U.S. Environmental Protection Agency (EPA) Motor Vehicle Emission Simulator (MOVES) model. MOVES estimates emissions for highway vehicles using data on vehicle miles traveled (VMT) and types of vehicles within the state. Minnesota calculates VMT using the Minnesota Department of Transportation (MnDOT) Transportation Data and Analysis program, while Rhode Island and North Carolina use the EPA State Inventory Tools (SIT) to estimate VMT. Iceland, RMI, and Costa Rica estimate road transportation emissions using Intergovernmental Panel on Climate Change (IPCC) guidance, in alignment with Paris Climate Accords guidance. The state of Oregon stands out from its peers, as the Oregon Department of Transportation (ODOT) developed their own emissions model, the

GreenSTEP model. This new model estimates and forecasts the effects of various policies and influences on the amount of vehicle travel, types of vehicles and fuels used, and resulting GHG emissions.

Table E-2. GHG Reduction Methodologies Used

Entity	Methodology	Description
Minnesota	EPA MOVES	Estimates emissions for highway vehicles using data on VMT and types of vehicles within the state.
	MnDOT's Transportation and Data Analysis program	Includes cartographic maps, geographic information system data, traffic monitoring programs, and light rail system maintenance.
North Carolina	EPA MOVES	Estimates emissions for highway vehicles using data on VMT and types of vehicles within the state.
	EPA SIT	Estimates VMT.
Rhode Island	EPA MOVES	Estimates emissions for highway vehicles using data on VMT and types of vehicles within the state.
	EPA SIT	Estimates VMT.
Iceland	IPCC	Guidance that is in alignment with the Paris Climate Accord.
RMI		
Costa Rica		
Oregon	ODOT GreenSTEP	This new model estimates and forecasts the effects of various policies and influences on the amount of vehicle travel, types of vehicles and fuels used, and resulting GHG emissions.

Aviation emissions are included in emissions inventories for Rhode Island, North Carolina, Puerto Rico, and Iceland. The Rhode Island Airport Corporation (RIAC) calculates annual GHG emissions associated with the state's primary airport, T.F. Green International Airport, for use in the state inventory. North Carolina adjusted SIT's default jet fuel consumption data for aircrafts by applying the 1990-2010 trend in total North Carolina landing and takeoff operations for commercial and military aircraft to backcast North Carolina jet fuel consumption for the years 1990-2009. Estimates were developed to adjust the SIT's fuel consumption estimates for aircraft and boats to remove international bunker fuels (that is, fuels consumed outside of the United States). Because North Carolina-specific data were not available to perform this adjustment, emissions data from EPA's national GHG inventory were used to develop these adjustment factors. Puerto Rico's jet fuel use was sourced from U.S. Energy Information Administration (EIA) datasets. Iceland estimates both domestic and international aviation emissions. Domestic aviation emissions are calculated using IPCC Tier 1 methodology, multiplying energy use with a pollutant-specific emission factor. International aviation emissions are calculated using oil products sold to Keflavík Airport.

Iceland and Costa Rica include maritime emissions in their emissions inventories. Iceland estimates emissions associated with both domestic and international maritime activities. Domestic maritime emissions are calculated using fuel sales to vessels of all flags departing from and sailing to Icelandic harbors. Fishing vessels are not included in this category. International maritime emissions are based on fuel sales data from retail suppliers. The retail supplier divides their reported fuel sales between international navigation and national navigation based on whether the vessel is sailing to an Icelandic or a foreign harbor (regardless of flag). Costa Rica estimates domestic maritime and inland navigation emissions from fuels used by ships of all flags that depart and arrive within Costa Rica.

Vehicle Miles Traveled (VMT) Reduction

Three of the benchmarked entities have specific VMT reduction targets, as shown in Table E-3.

Table E-3. VMT Reduction Targets

Entity	Target
Oregon	Reduce passenger VMT per capita by 20% by 2050.
Minnesota	VMT per capita in Minnesota to be reduced by 14% by 2040 compared to the level in 2019.
Maine	Reduce VMT through improved transit options.

Maine's VMT target is not quantified like Oregon and Minnesota, but it still supports VMT reduction. Except for RMI, all of the other benchmarked entities have strategies in place that will lead to reduction in VMT but do not have explicit targets. Colorado's VMT reduction strategy is different from peers because it relies on the Colorado Department of Transportation (CDOT) GHG Transportation Planning Standard. Under the GHG Transportation Planning Standard, CDOT and the state's five metropolitan planning organizations (MPOs) are required to achieve individually set GHG reduction levels in 2025, 2030, 2040, and 2050. To determine compliance with the reduction levels, agencies must model their existing transportation networks and all future regionally significant capacity projects in their transportation planning documents. Overall, the standard encourages CDOT and the MPOs to develop long range transportation plans that support travel choices that reduce GHG emissions.

Electrification, Electric Vehicles, and Alternative Fuels

All benchmarked entities have targets related to electrification, electric vehicles (EVs), or alternative fuels. The four entities highlighted in Table E-4 have the most robust targets.

Table E-4. Electrification, Electric Vehicles, and Alternative Fuels Targets

Entity	Targets
Minnesota	▪ 100% of all new light-duty vehicles registered in Minnesota are electric or another type of zero-emission vehicle by 2035. ▪ Zero-emission vehicles (ZEVs) make up 65% of all light-duty vehicles registered in the state by 2040.
North Carolina	▪ Increase the sale of passenger ZEVs so that 50% of in-state sales are zero-emission by 2030. ▪ Accelerate a transition to ZEVs and electric heat pumps in buildings. ▪ Support commercialization of decarbonized fuels—at minimum—to green hydrogen for industry and large trucks and explore pilots for advancing biofuels using sustainable biomass feedstock. ▪ Reduce fuel combustion while decarbonizing the economy to create co-benefits for air quality improvement. ▪ Evaluate and deploy clean transportation infrastructure to support all types of fleet vehicles and applications.

Entity	Targets
	▪ Partner with utilities to promote clean transportation.
Costa Rica	▪ In 2035, 30% of the public transport fleet will be zero emissions and the Passenger Electric Train will be in operation, running 100% on electricity. ▪ In 2050, 85% of the public transport fleet will be zero emissions. ▪ By 2050, the country will have an extensive electric recharge network throughout the country and complementary infrastructure for zero-emission technologies (for example, hydrogen stations). ▪ By 2025, the growth of the motorcycle fleet will have stabilized and standards will be adopted to shift to a zero-emissions fleet. ▪ In 2035, 30% of the light vehicles fleet (private and institutional) will be electric. In 2050, 95% of the fleet will be zero emissions.
Colorado	▪ Deployment of at least 940,000 light-duty EVs and at least 1,000 transit vehicles by 2030, the full electrification of the light-duty fleet by 2050, and a 100% zero-emission medium- and heavy-duty fleet by 2050.

MnDOT's goal to have all new light-duty vehicles registered in Minnesota by 2035 is the most aggressive target and is coupled with a strategy to educate consumers about EVs. North Carolina takes a unique approach to promoting clean transportation by partnering with electric utilities. As part of the North Carolina Department of Transportation (NCDOT) Clean Transportation Plan (NCDOT 2023), an interagency task force will partner with electric utilities to promote clean energy and clean transportation options, support fueling infrastructure deployment, encourage consumer and fleet adoption, understand power capacity needs, manage peak loads and promote effective pricing.

Colorado has made substantial progress deploying EVs using funds from multiple enacted Colorado Senate Bills. Notably in 2021, Senate Bill 21-260, Sustainability of the Transportation System, dedicated hundreds of millions of dollars in funding over the next decade to electrify vehicles and give disproportionately impacted communities a larger voice in the transportation planning process. That same year, Senate Bill 21-230 provided $5 million (M) for the expansion of EV charging at state facilities and electrification of the state's fleets. In 2022, the Legislature passed Senate Bill 22-193, which allocated $65M to the new Colorado Electric School Bus Grant Program, while the 2023 legislative session saw the passage of House Bill 23-1233 to eliminate local government and property management association restrictions on EV charger installations as well as the approval of House Bill 23-1272, which both broadened and extended state tax incentives for the purchase and lease of EVs, electric bikes, and other technologies that support decarbonization. Further driving the adoption of EVs, the Colorado Air Quality Control Commission adopted a Low Emission Vehicle (LEV) Standard in November 2018 and subsequently adopted the Zero-Emission Vehicle (ZEV) Standard in August 2019.

Other Considerations

Other important aspects of a comprehensive Hawaiʻi Energy Security and Waste Reduction Plan are Complete Streets and equity considerations. Having explicit goals for these aspects is not common, as these are cross-cutting themes that are more effective when integrated across a Hawaiʻi Energy Security and Waste Reduction Plan. All ten benchmarked entities include Complete Streets and equity strategies.

Appendix F
Low-Carbon Fuels

1. Overview

This appendix supports the State of Hawaiʻi Department of Transportation (HDOT) Energy Security and Waste Reduction Plan by providing a technical overview of alternative clean fuels that could support deep greenhouse gas (GHG) reductions in the ground, aviation, and marine transportation sectors. The information is intended to help clarify what constitutes a "clean" fuel, explain how these fuels are produced, and evaluate their potential for in-state production and long-term climate impact. It serves as a reference to guide near- and long-term planning for decarbonizing transportation while maintaining fuel and energy resilience across Hawaiʻi. Table F-1 outlines estimated demand for each alternative fuel in 2030 and 2045, as well as the transportation sectors (that is, ground, marine, or aviation) where these fuels are expected to be deployed. Fuels such as biodiesel, renewable diesel, ethanol, renewable liquified natural gas (LNG), and sustainable aviation fuel (SAF) are expected to have near-term implications, as they are already commercially available and can be used with minimal changes to vehicles or infrastructure. These fuels will be critical in the early years of the transition, particularly in sectors where zero-emission options are not yet widely available. In contrast, green hydrogen, e-methanol, e-ammonia, SAF made using renewable energy (eSAF), and bioenergy with carbon capture and sequestration (BECCS) SAF represent longer-term solutions with the potential to decarbonize hard-to-electrify segments such as maritime transport, aviation, and heavy-duty freight. These fuels are currently limited by high production costs, infrastructure needs, or early-stage technology readiness but are projected to play a growing role by 2045 as the market matures and supportive policies and investments are put in place.

Table F-1. Projected Alternative Fuel Demand by Type, Year, and Sector

Fuel Type	Estimated Demand (2030)	Estimated Demand (2045)	Applicable Sectors
Biodiesel	20 million gallons	13 million gallons	Ground (heavy-duty)
Renewable Diesel	10 million gallons	52 million gallons	Ground and Marine
Ethanol	17 million gallons	6 million gallons	Ground (light-duty)
Renewable Gasoline	Not included	Not included	Ground (light-duty)
Renewable LNG	45 million therms	No demand in 2045	Marine
SAF	410 million gallons	600 million gallons	Aviation
eSAF	No demand in 2030	110 million gallons	Aviation
BECCS SAF	No demand in 2030	36 million gallons	Aviation
e-Methanol	No demand in 2030	54 million gallons	Marine
e-Ammonia	No demand in 2030	165 million kg	Marine
Green Hydrogen	No demand in 2030	1.6 million kg	Marine

The document covers all of the 11 clean fuels considered relevant to Hawaiʻi's decarbonization goals: biodiesel, renewable diesel, renewable gasoline, ethanol, regular SAF, eSAF, BECCS SAF, renewable LNG, e-methanol, e-ammonia, and green hydrogen.[10] For each fuel, the appendix describes the production

[10] This appendix focuses exclusively on green hydrogen because, within the broader plan, hydrogen is only assumed to be used in the marine sector, and that use is modeled to begin after 2040. For that sector and timeframe, only green hydrogen produced via

pathways, feedstocks, potential combustion characteristics (in cases where the fuel needs to be combusted), local production potential, and role in meeting the state's 2030 and 2045 emissions targets. These fuel briefs are developed to help decision-makers weigh trade-offs between fuels that are already commercially available and those that are emerging but potentially transformative.

A key focus of the analysis is the lifecycle carbon intensity (CI) of each fuel, which measures total GHG emissions per unit of energy across the entire fuel production and use cycle. CI values vary widely depending on the feedstock and production method. Fuels produced from waste or renewable electricity, such as used cooking oil biodiesel or green hydrogen, can have very low CI values when compared to the avoidance of a baseline case where additional methane or carbon dioxide (CO_2) would be released to the atmosphere. In contrast, fuels derived from conventional crops or fossil-based energy can have much higher emissions, reducing their climate benefit.

The California Air Resources Board (CARB) published carbon intensities of certified fuel pathways. For California, the alternative fuel's CI value is divided by its Energy Economy Ratio (EER) to obtain the EER-adjusted CI value, representing the emissions that occur from the use of alternative fuel per megajoule (MJ) of conventional fuel displaced. Figure F-1 shows a box-and-whisker plot illustrating the CI of various alternative fuels, expressed in grams of CO_2 equivalent per megajoule (gCO2e/MJ). This format offers a visual summary of the range and distribution of CI values for several fuels that are currently certified under the program. It is important to note that the chart is not comprehensive, as some of the fuels discussed in this appendix are not yet certified and therefore not represented in the data. Each green box represents the interquartile range (IQR), capturing the middle 50 percent of data points, with the lower and upper edges denoting the 25th and 75th percentiles, respectively. The horizontal line within the box indicates the median value, while the "X" symbol marks the mean. Whiskers extend to the minimum and maximum values within 1.5 times the IQR, and individual dots represent outliers or discrete observations. Fuels such as renewable LNG, hydrogen, and electricity exhibit a wider range of CI values, reflecting variability in production methods and feedstocks, while fuels like biodiesel and ethanol display relatively narrow distributions. Negative or lower CI values indicate greater GHG emission benefits, making these fuels more favorable from an emissions reduction perspective.[11]

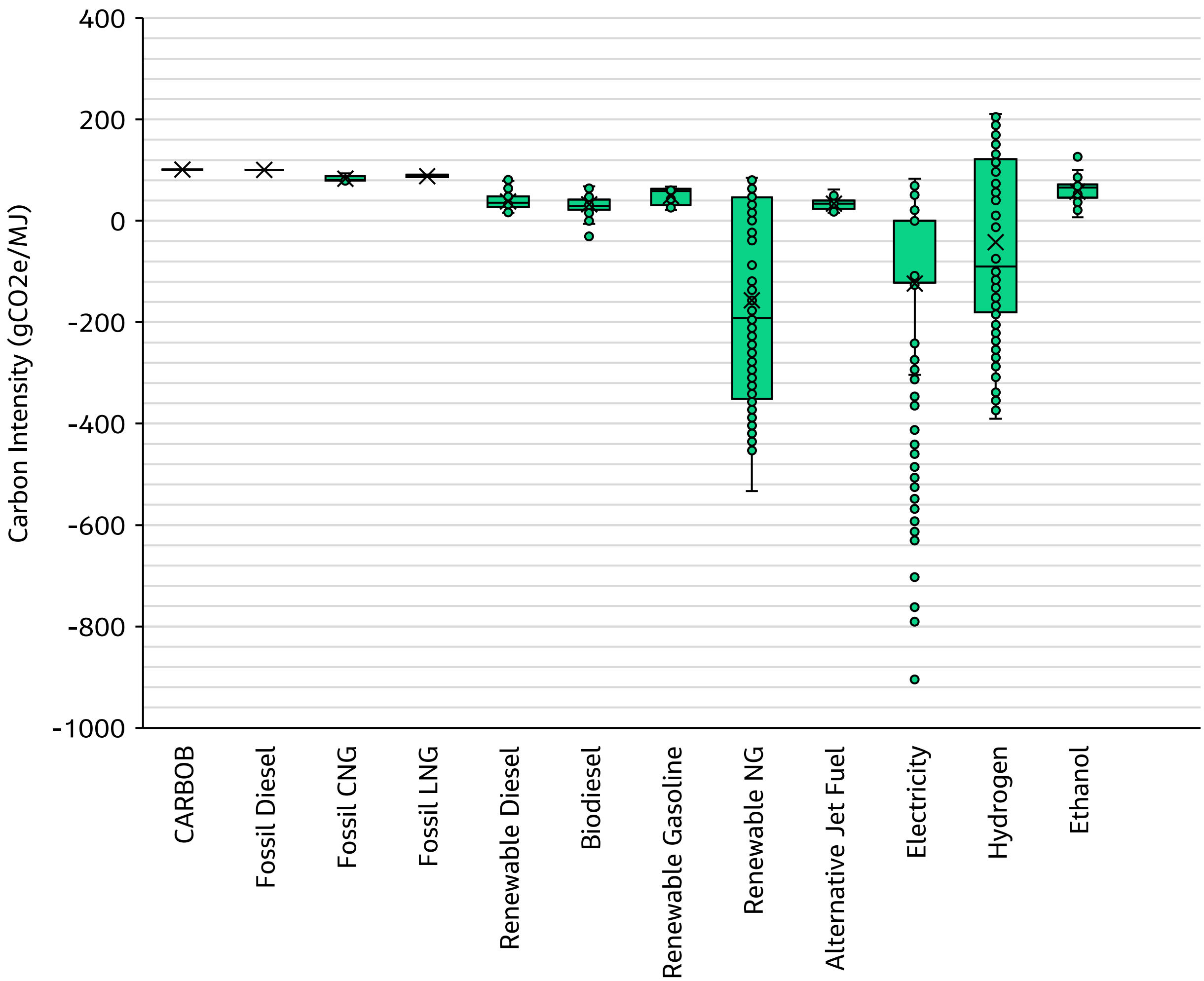
It is important to note that each point (or circle) on the chart corresponds to a specific certified pathway, not an indication of the volume currently produced or its future supply potential. It is important to note that often (and not at all times) fuels on the higher CI side of the chart generally represent more scalable pathways, with greater availability and price competitiveness in today's market. By contrast, pathways with very low or negative CIs often reflect niche or limited-volume fuels. For example, in the case of hydrogen, higher-intensity pathways represent "gray" hydrogen produced from natural gas through steam methane reforming, which is the most widely available form in the U.S. In contrast, pathways with near-zero intensities represent "green" hydrogen from renewable electricity, while the negative-intensity pathways correspond to hydrogen produced from renewable natural gas, particularly from dairy manure. These negative values occur because capturing and converting methane that would otherwise be released into the atmosphere (with a high global warming potential) results in a net reduction in GHG emissions when

electrolysis using renewable electricity was included in the modeling assumptions. As a result, other hydrogen pathways such as blue or turquoise hydrogen were not incorporated into the analysis or reflected in the demand projections presented in this document.

[11] CARB LCFS Pathway Certified Carbon Intensities: https://ww2.arb.ca.gov/resources/documents/lcfs-pathway-certified-carbon-intensities?keywords=2025. Negative emission values assume avoided emissions from a comparative baseline case.

that methane is instead combusted as CO_2.[12] However, as landfill gas and agricultural methane emissions become more tightly regulated, these avoided emissions may no longer be creditable, and the certified carbon intensities of these fuels could rise over time. Finally, this chart should not be used to calculate a simple average carbon intensity across fuels. While some pathways, such as certain hydrogen or electricity options, are shown with negative intensities, the majority of the fuel supply is delivered through higher-intensity pathways with greater production volumes. As such, the average real-world carbon intensity of these fuels is typically higher than what the scatter of individual data points might suggest.

Figure F-1. Carbon Intensity Values of LCFS-Certified Pathways



[12] Using the LCFS 100-yr GWP for methane (CH4 = 25), venting 1 metric ton of CH4 would equal 25 tCO_2e. If that methane is captured and used as renewable natural gas, combustion converts it to CO2 (CH4 → CO2), yielding (44/16) × 1 = 2.75 tCO2. The pathway then claims avoided 25 − emitted 2.75 = 22.25 tCO2e of net reduction (i.e., a negative carbon intensity). The same bookkeeping applies if the captured CH4 is reformed to hydrogen and used in a fuel cell. Its carbon ultimately becomes CO_2 of roughly the same mass (~2.75 t), so the net benefit is still dominated by the avoided methane. (If instead using IPCC AR5/AR6 values of ~28–30 for CH_4, the net reduction becomes ~25.25–27.25 tCO2e.)

2. Biodiesel

2.1 Fuel Description

Biodiesel is a renewable liquid fuel made from biological sources such as vegetable oils, animal fats, and used cooking grease. It is chemically classified as a fatty acid methyl ester (FAME) and is typically used in compression-ignition (diesel) engines. Because biodiesel closely resembles the combustion characteristics of petroleum diesel, it can be used in most existing diesel engines with little or no modification. In practice, biodiesel is most often blended with petroleum diesel in ratios such as B5 (5 percent biodiesel) or B20 (20 percent biodiesel) to take advantage of its environmental benefits while ensuring engine compatibility and performance.

Blending biodiesel is necessary due to some of its physical and chemical properties. Pure biodiesel (B100) can act as a solvent, potentially degrading older rubber components in fuel systems, and it has a higher cloud point, meaning it can gel in colder temperatures. These characteristics can pose operational challenges, particularly in vehicles not designed for high-biodiesel blends. Most engine manufacturers certify their equipment for blends up to B20, which balances emissions reductions and fuel system compatibility. As a result, B20 is commonly considered the highest acceptable blend for wide commercial use, enabling emission reductions while avoiding the infrastructure or equipment upgrades that might be required for B100.

2.2 Production Pathways

Biodiesel is primarily produced through a chemical process called transesterification, where oils or fats react with an alcohol (typically methanol) in the presence of a catalyst to form methyl esters (biodiesel) and glycerin as a byproduct. This process can use various feedstocks, including virgin plant oils, waste cooking oils, and animal fats. Each pathway results in a product that meets ASTM D6751 specifications for biodiesel, but the lifecycle emissions and sustainability of each pathway vary based on the feedstock source and production method.

Key biodiesel feedstocks include the following:

- Soybean oil-based production (the most common in the continental United States), where oil from soybeans is extracted and processed into biodiesel
- Used cooking oil recovery, where waste grease from restaurants and food processing is repurposed into fuel, offering strong sustainability benefits
- Animal tallow-based production, using waste from meat processing

Some producers use multi-feedstock technology to flexibly process a variety of these inputs. The chosen feedstock affects not only the environmental performance of the fuel but also its cost, availability, and physical properties.

2.3 Carbon Intensity of Biodiesel

The CI of biodiesel can vary widely based on the type of feedstock used, processing methods, and transportation logistics. According to the California Low Carbon Fuel Standard (LCFS), biodiesel pathways range from as low as -30 gCO2e/MJ to as high as 68 gCO2e/MJ with a median value of 30 gCO2e/MJ.

Used cooking oil and other waste-derived feedstocks tend to have lower CI values because they avoid the emissions associated with feedstock cultivation and could involve waste diversion from landfills. In contrast, virgin oils like soybean or canola oil carry higher CI due to the emissions associated with farming, fertilizer use, and land use change.

2.4 In-state Production Capability

Hawaiʻi currently supports in-state biodiesel production through only one operator: Pacific Biodiesel, which has an estimated production capacity of approximately 6 million gallons per year (EIA 2024b).[13] They use a mix of local and imported feedstocks, including used cooking oil. This existing infrastructure positions the state well to continue supporting biodiesel as a near-term decarbonization option, especially for hard-to-electrify sectors like heavy-duty transport and backup generators.

However, expanding production to meet longer-term climate targets would require more than just ramping up local production. It depends on expanding the feedstock supply chain, upgrading waste oils collection network, and potentially exploring dedicated energy crops cultivation. Given Hawaiʻi's limited arable land and competing priorities for food and housing, the capacity to scale biodiesel production locally is likely to be constrained. As such, strategic use of local production, supplemented with low-carbon imports, may be the most viable path forward for meeting statewide demand while supporting economic resilience and energy independence.

2.5 Pros and Cons of Biodiesel

In addition to GHG reductions, biodiesel offers several public health and air quality benefits compared to petroleum diesel. Combustion of biodiesel produces less particulate matter, sulfur oxides (SOx), carbon monoxide (CO), and unburned hydrocarbons. These pollutants are known to cause or exacerbate respiratory and cardiovascular diseases, particularly in communities located near freight corridors or port operations. In addition, biodiesel is non-toxic and biodegradable, meaning accidental spills pose less risk to the environment than conventional diesel fuel.

However, biodiesel's sustainability and equity impacts depend heavily on the feedstock used. Waste-based biodiesel, such as that from used cooking oil, generally has a favorable sustainability profile. In contrast, large-scale reliance on virgin crops like soybean or palm oil can contribute to deforestation, land use change, and competition with food production, which is especially sensitive in an island economy. There are also performance considerations such as increased nitrogen oxides (NO_x) emissions in some cases that may require engine calibration or after-treatment technologies to fully realize biodiesel's benefits without unintended trade-offs.

2.6 Estimated Demand to Meet 2030 and 2045 Targets

Based on modeling and pathway analysis in the HDOT Energy Security and Waste Reduction Plan, biodiesel is expected to serve a supporting role in achieving the state's 2030 and 2045 GHG reduction targets. By 2030, approximately 20 million gallons per year may be needed to meet demand for blended fuel in on-road diesel applications, especially where electrification is not yet viable. However, by 2045, biodiesel demand is projected to decline to around 13 million gallons annually, largely due to the

[13] U.S. EIA Biodiesel Plant Production Capacity data: https://www.eia.gov/biofuels/biodiesel/capacity/

expected transition of the heavy-duty vehicle sector to zero-emission technologies as well shifting the diesel use toward renewable diesel with the expected growth in production volumes of renewable diesel.

3. Renewable Diesel

3.1 Fuel Description

Renewable diesel is a drop-in, hydrocarbon-based fuel chemically similar to petroleum diesel but derived from renewable biomass sources such as vegetable oils, animal fats, and waste greases. Unlike biodiesel, which is an ester (that is, a chemical compound derived from an acid where at least one hydroxyl group is replaced by an alkoxy group), renewable diesel production includes hydrotreating processes and it is therefore chemically indistinguishable from conventional diesel, allowing it to be used at 100 percent concentration (R100) without blending or engine modifications. This makes it compatible with existing pipelines, storage tanks, and diesel engines, offering an immediate pathway to decarbonize diesel-reliant sectors.

The key appeal of renewable diesel lies in its fungibility: its ability to substitute for petroleum diesel across all transportation applications without impacting performance or infrastructure. Renewable diesel provides cleaner combustion than petroleum diesel, reducing emissions of particulate matter, NOx, and GHG, particularly when made from low-carbon feedstocks. These attributes make it especially valuable in heavy-duty transportation, construction equipment, backup generators, and even marine applications, where electrification may be slower to scale.

3.2 Production Pathways

Renewable diesel is typically produced via hydrotreating, a refining process where fats, oils, or greases react with hydrogen at high temperature and pressure in the presence of a catalyst to remove oxygen and saturate hydrocarbon chains. This process results in a pure hydrocarbon fuel that mimics the chemical structure of petroleum diesel, allowing for full compatibility in existing engines and distribution infrastructure.

Similar to biodiesel, there are several feedstock pathways for renewable diesel, including vegetable oils such as soybean oil, used cooking oil, and tallow. More advanced pathways under development include algae-based lipids and cover crops that produce oil as a secondary product, potentially increasing land use efficiency.

3.3 Carbon Intensity of Renewable Diesel

The CI of renewable diesel depends on the feedstock and production process. According to California's LCFS database, renewable diesel CI values range from 16 to 85 gCO2e/MJ with a median value of 36.5 gCO2e/MJ. The lowest CI values are achieved when using waste oils such as used cooking oil or animal fats, particularly when those feedstocks are processed using renewable electricity or low emission hydrogen. Higher CI values are typically associated with the use of virgin vegetable oils, especially when significant upstream emissions are involved such as land use change, fertilizer application, or long-distance transportation of feedstocks.

An equally important factor is the type of hydrogen used in hydrotreating. For example, Par Hawaiʻi plans to use hydrogen from current refining operations, which can impact the CI of the resulting fuel even if sustainable feedstocks are used (ParPacific 2023). This highlights that both feedstock selection and hydrogen sourcing are critical to achieving meaningful GHG reductions from renewable diesel.

3.4 In-state Production Capability

Hawaiʻi is actively developing renewable diesel production capacity. In 2023, Par Pacific announced plans to convert its Kapolei refinery to produce up to 61 million gallons per year of renewable fuels, including renewable diesel, SAF, and other products. The facility is expected to be completed by 2025 and could dedicate as much as 90 percent of its output to renewable diesel, depending on market conditions and feedstock availability.

This marks a significant milestone in Hawaiʻi's clean fuel landscape, as it positions the state to produce renewable diesel locally at scale for the first time. While local feedstock availability remains limited, the facility may rely on imported waste oils or other renewable inputs to meet production targets. This approach aligns with Hawaiʻi's energy security goals by reducing reliance on petroleum imports while supporting local jobs and infrastructure development in clean fuels.

A more practical strategy is to combine targeted domestic output with carefully curated low-carbon imports. For example, Neste's Singapore facility has a long history of supplying low-carbon diesel to California, and to a lesser degree, Oregon and Washington, making Hawaiʻi well-positioned to tap into that existing trade lane. Another example is that some California refiners are moving towards renewable diesel production. The facilities' conversions are coming online, and they could export the fuel to Hawaiʻi.

3.5 Pros and Cons of Renewable Diesel

Renewable diesel offers substantial air quality and health benefits, especially in dense urban and port-adjacent communities. It combusts more cleanly than petroleum diesel, reducing emissions of particulate matter, carbon monoxide (CO), and NO_x, all of which are linked to asthma, cardiovascular disease, and other public health risks. Its compatibility with existing diesel engines means that public agencies and private fleets can adopt it without retrofits, accelerating emissions reductions across hard-to-electrify sectors.

However, the sustainability of renewable diesel is largely dependent on feedstock sourcing. When produced from waste oils or animal tallow and grease, it presents minimal land use or food system impacts. But if virgin oils such as palm or soybean oil are used extensively, it can create tension with food supply and raise concerns about deforestation and agricultural expansion. Renewable diesel production is also energy-intensive, especially if the hydrogen used in the hydrotreating process is fossil-derived. Ensuring the use of low-carbon hydrogen and sustainable feedstocks is therefore essential to realizing its full environmental and climate benefits.

3.6 Estimated Demand to Meet 2030 and 2045 Targets

To meet Hawaiʻi's 2030 climate goals, renewable diesel is expected to be one of the primary clean fuels used in the on-road heavy-duty and marine sectors. Modeling suggests that the state would need 10 million gallons annually by 2030, of which 5 million gallons goes toward decarbonization of the marine sector and 5 million gallons is for the on-road heavy-duty sector to replace a significant share of petroleum diesel in these sectors, particularly in fleets that are not yet electrified. The availability of drop-in compatibility and potential for in-state production make renewable diesel a high-impact, near-term solution. By 2045, there will be a need of 52 million gallons of renewable diesel to achieve the transportation decarbonization goals.

4. Ethanol

4.1 Fuel Description

Ethanol is an alcohol-based renewable fuel produced from plant materials known as biomass. It is most commonly used as a blend with petroleum gasoline in concentrations such as E10 (typically 10 percent ethanol and 90 percent gasoline) or E15 (typically 15 percent ethanol and 85 percent gasoline); nearly all gasoline sold in the U.S. today is E10. Ethanol has a high octane rating, which makes it a valuable blending component in gasoline by increasing the overall octane level of the fuel. While this does not improve performance or efficiency in engines that are not designed for higher-octane fuels, it can enhance combustion efficiency and prevent engine knocking in high-compression or turbocharged engines that benefit from higher octane levels. As a liquid fuel, ethanol is widely used in light-duty vehicles and benefits from an extensive existing distribution network.

Unlike drop-in fuels such as renewable gasoline, ethanol cannot fully replace gasoline in all engines without modifications. Higher ethanol blends, such as E85, require flex-fuel vehicles specifically designed to tolerate higher alcohol content. Ethanol also has a lower energy density than gasoline, which can slightly reduce fuel efficiency.

4.2 Production Pathways

Ethanol is primarily produced through the fermentation of sugars or starches found in crops such as corn, sugarcane, or sugar beets. In the United States, most ethanol is derived from corn grain. The starch in the corn is broken down into sugars, which are then fermented into ethanol and distilled for fuel use. This process is well-established and supported by robust agricultural and industrial infrastructure.

Alternative production pathways use cellulosic feedstocks such as crop residues, forest waste, or dedicated energy crops like switchgrass. These pathways are more sustainable but are technically complex and expensive. Cellulosic ethanol production involves breaking down fibrous plant materials into fermentable sugars through enzymatic hydrolysis or other pre-treatment methods. Although these pathways offer lower lifecycle emissions, commercial deployment has been slow due to technological and economic barriers.

4.3 Carbon Intensity of Ethanol

The CI of ethanol varies significantly based on feedstock type, and production methods. According to lifecycle analysis data from CARB, ethanol can have a CI ranging from approximately 7 to 126 gCO2e/MJ with a median value of 65 gCO2e/MJ. Ethanol is mostly produced from corn starch but has been produced from sorghum and sugarcane.

Corn-based ethanol can have higher CI due to emissions associated with land use change, as well as the energy, water, and fertilizer required for crop cultivation and processing. Cellulosic ethanol, on the other hand, can offer substantial GHG savings compared to conventional fuels, especially when the feedstocks are agricultural residues or forest waste.

4.4 In-state Production Capability

Hawaiʻi does not currently produce ethanol. The ethanol used in the state is imported, primarily from the continental United States; Hawaiʻi repealed its ethanol blending mandate in 2015, although there may be military vehicles that use flex fuel.

There have been studies exploring the feasibility of producing ethanol locally using biomass feedstocks such as sugarcane, energy grasses, and forest debris. However, progress has been limited by challenges related to land availability, cost of production, water use, and processing infrastructure. In particular, the management of byproducts such as vinasse has been identified as a significant barrier to commercial ethanol production in Hawaiʻi. Without targeted investment and technological advancement, local ethanol production is unlikely in the short term.

4.5 Pros and Cons of Ethanol

Ethanol offers several environmental and public health benefits. It burns cleaner than gasoline, reducing emissions of carbon monoxide, particulate matter, and certain toxic air pollutants. Its use in gasoline blends has contributed to improved air quality in urban areas and reduced dependence on petroleum imports. In addition, ethanol produced from waste or cellulosic feedstocks can achieve significantly lower lifecycle GHG emissions compared to ethanol made from corn starch, and it offers substantial climate benefits relative to conventional fossil fuels.

However, ethanol also has limitations. Corn-based ethanol production can lead to increased fertilizer runoff, water consumption, and competition with food crops, raising concerns about long-term sustainability. Moreover, higher ethanol blends are not compatible with all engines, and increased ethanol content can contribute to evaporative emissions that affect ozone formation. These trade-offs suggest that while ethanol has a meaningful role in reducing emissions, especially in the near term, its long-term use should prioritize sustainable feedstocks and advanced production methods.

4.6 Estimated Demand to Meet 2030 and 2045 Targets

Under the Energy Security and Waste Reduction Plan, ethanol is expected to continue serving as a transitional blending fuel to help decarbonize Hawaiʻi's light-duty vehicle sector in the near term. By 2030, demand for ethanol in Hawaiʻi is projected to be approximately 17 million gallons, supporting continued use of internal combustion engine vehicles while zero-emission alternatives continue to scale. By 2045, ethanol demand is expected to decline to approximately 6 million gallons per year, driven by the significant electrification of the light-duty vehicle fleet and reduced reliance on liquid fuels overall. While ethanol will remain part of the fuel mix for residual gasoline-powered vehicles, its long-term role will diminish as the state transitions toward widespread adoption of electric vehicles and zero-emission transportation technologies.

5. Renewable Gasoline

5.1 Fuel Description

Renewable gasoline is a hydrocarbon fuel produced from renewable biomass feedstocks. Unlike ethanol, which must be blended with conventional gasoline, renewable gasoline is chemically similar to petroleum-based gasoline and can be used in existing gasoline engines without modifications. This compatibility with current vehicles and infrastructure makes renewable gasoline an attractive low-carbon alternative, particularly for light-duty vehicles that will remain in operation during the transition to zero-emission technologies.

Although renewable gasoline holds promise as a low-carbon substitute for petroleum gasoline, its production remains limited due to several key challenges. One primary factor is the relatively low level of technological maturity and commercial readiness of the production pathways. Renewable gasoline is produced through complex thermochemical processes such as catalytic fast pyrolysis, gasification followed by Fischer-Tropsch synthesis, or hydrotreatment of bio-oils (Section 5.2). These technologies require significant capital investment, operate under strict process controls, and have not yet been widely deployed at commercial scale.

From a market standpoint, there are also a lack of strong demand signals or policy mandates that would encourage large-scale investment in renewable gasoline. Most national and state-level transportation decarbonization strategies focus on promoting zero-emission vehicles, particularly battery-electric vehicles, rather than advancing alternative low-carbon liquid fuels for the light-duty sector. As a result, petroleum refineries that are being converted to produce renewable fuels have generally prioritized renewable diesel and SAF, which are supported by stronger policy drivers and market agreements. Without targeted investment, policy incentives, and long-term procurement commitments, renewable gasoline is unlikely to reach widespread commercial availability in the near future, particularly in regions like Hawaiʻi where refining infrastructure and feedstock conversion capacity remain limited.

5.2 Production Pathways

Renewable gasoline can be produced through multiple thermochemical and biochemical pathways. One common method involves hydrotreating fats, oils, and greases, in which biomass-derived lipids react with hydrogen under high pressure to remove oxygen and produce hydrocarbons chemically identical to gasoline. This process is similar to renewable diesel production but uses different refining cuts to produce a gasoline-range fuel.

Another production pathway is gasification followed by Fischer-Tropsch synthesis, where biomass (for example, forest residue, municipal solid waste, or agricultural waste) is thermally converted into syngas (a mix of CO and hydrogen [H_2]), which is then catalytically synthesized into hydrocarbons that can be refined into gasoline. A third approach involves catalytic fast pyrolysis, where biomass is rapidly heated in the absence of oxygen to produce bio-oil that can be upgraded into renewable gasoline. Each of these pathways varies in cost, scalability, and feedstock flexibility, influencing the fuel's commercial viability.

5.3 Carbon Intensity of Renewable Gasoline

The CI of renewable gasoline varies widely depending on the feedstock and production pathway. According to LCFS-certified fuel pathway data, renewable gasoline can range from 21 to 68 gCO2e/MJ with a median value of 59 gCO2e/MJ. The lower CI values are associated with the use of forest residue or waste biomass in pyrolysis or gasification-based pathways. These approaches avoid land use emissions and offer the potential for low-carbon outcomes when paired with carbon capture.

Higher CI values are generally associated with vegetable oil-derived renewable gasoline or fuels made from crops grown specifically for fuel use, such as corn or soybean. The CI of renewable gasoline can also be affected by energy inputs, transportation distances, and whether fossil-derived hydrogen is used in the refining process. Like other biofuels, minimizing CI requires careful sourcing of feedstocks, low emissions refining, and integration with renewable power where possible.

Similar to renewable diesel, the source of hydrogen used in fuel upgrading or synthesis is also critical. If hydrogen is produced using renewable electricity (green hydrogen), the overall CI remains low. In contrast, using fossil-derived hydrogen (for example, from natural gas) can significantly increase lifecycle emissions, reducing the climate benefits of the fuel. Hydrogen production is often energy-intensive, and the emissions from this step can make up a substantial portion of the total carbon footprint.

5.4 In-state Production Capability

At present, renewable gasoline is not produced commercially in Hawaiʻi, and there are no known large-scale facilities focused on its development. While the state does import ethanol, renewable gasoline is not included in current biofuel import strategies. The technology remains early in its commercialization phase in the United States, with very few refineries producing it at scale, even on the mainland.

Despite this, Hawaiʻi does have potential feedstock sources, such as forestry waste, green waste, and municipal solid waste, that could eventually be used in thermochemical processes like gasification. However, deploying renewable gasoline production locally would require significant capital investment, technology validation, and regulatory support. As a result, near-term use in Hawaiʻi would depend heavily on importing renewable gasoline from mainland producers or global markets if commercial supplies become more widely available.

5.5 Pros and Cons of Renewable Gasoline

Renewable gasoline offers clear air quality and emissions benefits compared to conventional gasoline. Its cleaner combustion profile results in lower emissions of particulate matter, SOx, and CO, all of which contribute to urban air pollution and adverse health effects. Because it is chemically identical to petroleum gasoline, it also avoids the volatility and evaporative emission concerns associated with ethanol-blended fuels. These features are especially beneficial for environmental justice communities located near high-traffic corridors or fueling infrastructure.

However, renewable gasoline faces several challenges related to sustainability and land use. If produced from food-based crops such as corn or palm oil, it can compete with local food systems, exacerbate deforestation, and undermine its environmental benefits. Production from waste biomass or forest residues avoids these issues but requires more complex and costly infrastructure. In addition, renewable gasoline is not yet commercially viable at scale, and feedstock collection, processing, and energy inputs may limit its widespread deployment unless addressed through policy support or innovation.

5.6 Estimated Demand to Meet 2030 and 2045 Targets

Currently, the Energy Security and Waste Reduction Plan does not include any assumptions for renewable gasoline in the fuel mix needed to meet the 2030 or 2045 targets. As a result, the role of renewable gasoline as a potential low-carbon, drop-in fuel remains unaccounted for in the current strategy, despite its potential to contribute to near-term emissions reductions and compatibility with existing vehicle fleets. This exclusion is primarily due to the limited commercial-scale production of renewable gasoline and the technical and economic complexities associated with its development as described earlier.

6. Renewable LNG

6.1 Fuel Description

Renewable liquefied natural gas, or renewable LNG, is a low-carbon alternative to fossil-derived LNG. It is produced by purifying and liquefying biomethane, which is generated from the decomposition of organic waste materials such as landfill gas, livestock manure, or wastewater sludge. Once processed, the resulting fuel has similar chemical and physical properties to conventional LNG and can be used in various transportation sectors, particularly in the marine sector. The liquefaction process involves cooling purified biomethane to below its boiling point, allowing it to be stored and transported in a liquid state. This increases its energy density and makes it more suitable for applications where compressed natural gas would not be feasible due to storage space limitations.

6.2 Production Pathways

Renewable LNG production begins with the creation of biogas through anaerobic digestion of organic materials such as animal manure, food waste, or wastewater sludge. Alternatively, gasification of solid biomass feedstocks can also be used to generate synthesis gas, which is then upgraded to biomethane. The biogas is purified to remove contaminants like hydrogen sulfide, CO_2, and moisture, resulting in pipeline-quality renewable natural gas (RNG).

Once purified, the RNG undergoes a cryogenic liquefaction process, where it is cooled to approximately negative 162 degrees Celsius. This transformation allows the gas to be stored and transported as a liquid, enabling its use in sectors that demand high energy density. The production pathway may vary depending on the source of organic material and the scale of the facility.

6.3 Carbon Intensity of Renewable LNG

The CI of renewable LNG varies significantly depending on the feedstock. According to lifecycle analysis from regulatory bodies such as CARB, the CI of renewable LNG ranges from approximately -370 to 80 grams of gCO2e/MJ with a median value of 53 gCO2e/MJ. The lower values are typically achieved when the fuel is produced from animal manure, where the biomethane that would otherwise escape into the atmosphere is instead captured and converted into useful energy. Higher CI values are associated with feedstocks that have less biomethane to avoid at baseline, such as wastewater sludge or certain agricultural residues. Additional emissions may also result from the energy used during the liquefaction process, particularly if the electricity or cooling systems rely on fossil-based energy.

6.4 In-state Production Capability

With respect to availability of bio-LNG, a 2021 study[14] by the University of Hawaiʻi's Natural Energy Institute assessed the state's potential to produce RNG[15] from a range of organic waste streams

[14] This comprehensive assessment evaluates the potential for RNG production from various feedstocks across the state (University of Hawaiʻi 2021). The full report is accessible here: https://www.hnei.hawaii.edu/wp-content/uploads/Resources-for-Renewable-Natural-Gas-Production-in-Hawaii.pdf

[15] Renewable natural gas (RNG) serves as the foundational fuel for bio-LNG, which is simply RNG that has been purified and liquefied for use in applications like heavy-duty transportation or off-grid energy.

(University of Hawaiʻi 2021). The study found that Hawaiʻi could generate over 84 million therms of RNG per year. This potential comes from several key pathways. Wastewater treatment plants, particularly on Oʻahu, could contribute around 1.9 million therms annually, with the Honouliuli facility already producing RNG from digested biogas. Landfill gas from six active collection systems across the state, including those at the Central Maui and Waimanalo Gulch landfills, could support production of approximately 6.2 million therms per year. Food waste, a sizable component of municipal solid waste, could supply an additional 5.1 million therms, assuming 50 percent recovery for anaerobic digestion. The combustible (non-food) portion of municipal solid waste, such as paper, cardboard, and textiles, represents a significant thermochemical conversion[16] opportunity, with an estimated 42.3 million therms of RNG potential. Moreover, construction and demolition waste, particularly in Honolulu, could yield up to 28.5 million therms annually. While agricultural and forestry residues are currently limited, the report also identifies a substantial opportunity to develop RNG from dedicated energy crops grown on underutilized agricultural lands, potentially adding millions of therms to the total.

6.5 Pros and Cons of Renewable LNG

Renewable LNG offers significant environmental benefits, particularly in terms of reducing GHG emissions and improving air quality. By capturing methane that would otherwise be released from landfills or livestock operations, renewable LNG helps mitigate one of the most potent GHGs. In transportation applications, it emits fewer pollutants such as particulate matter, NO_x, and SO_x compared to diesel, which can lead to improved public health outcomes, especially in urban or port areas.

However, renewable LNG also presents certain challenges. The infrastructure required for liquefaction, storage, and distribution is complex and expensive, especially in isolated markets such as Hawaiʻi. Furthermore, the climate benefits of renewable LNG hinge on minimizing methane leakage throughout the supply chain. If leakage is not well-controlled, the overall emissions savings can be significantly reduced. Rigorous engineering of production, liquefaction, transport, and storage systems, combined with continuous, high precision monitoring of methane emissions at each stage, is critical to achieving the lifecycle GHG reductions of renewable LNG.

6.6 Estimated Demand to Meet 2030 and 2045 Targets

In our marine scenario modeling, we project a demand of approximately 45 million therms of renewable LNG by 2030. While this represents a substantial energy need, we recognize that not all of this LNG would be sourced locally. A portion is expected to be imported from the mainland United States or other international suppliers. It is also important to note that marine vessels may not always bunker in Hawaiian ports. Depending on routing and logistics, a significant share of LNG bunkering may take place at mainland ports or other strategic refueling hubs.

[16] Thermochemical conversion is a process that uses high heat and limited oxygen to break down dry organic materials, such as wood, paper, and construction waste, into a gas mixture called syngas, which can then be converted into RNG through methanation. Unlike biological processes, it can handle a wider range of feedstocks and is well-suited for producing bio-LNG from dry, fibrous, or mixed waste materials.

7. Sustainable Aviation Fuel

7.1 Fuel Description

Sustainable Aviation Fuel, or SAF, is a low-carbon alternative to conventional jet fuel designed to reduce GHG emissions from the aviation sector. It can be produced from renewable feedstocks such as used cooking oil, fats, greases, municipal solid waste, woody biomass, and agricultural residues. SAF is chemically similar to petroleum-based jet fuel, allowing it to be blended with petroleum jet fuel and used in existing aircraft engines and fueling infrastructure without modification. This compatibility makes SAF a practical and immediate option for decarbonizing aviation operations.

Under ASTM D7566, most approved SAF production pathways allow up to a 50 percent blend with conventional Jet A/Jet A-1, though some pathways are limited to 10 percent. While current regulations limit its blending ratio, ongoing research and certification efforts are exploring ways to increase allowable SAF content. As one of the few viable options to reduce lifecycle emissions from long-haul and commercial aviation in the near term, SAF is gaining increasing attention from airlines, airports, and governments worldwide.

7.2 Production Pathways

SAF can be produced through several pathways, each relying on different renewable feedstocks and chemical processes. One of the most established methods is the Hydroprocessed Esters and Fatty Acids (HEFA) pathway, which uses fats, oils, and greases as input and hydrogen to remove oxygen atoms, producing a hydrocarbon fuel suitable for aviation. This process is nearly identical to the one used to produce renewable diesel, with the primary difference being the refining cut and fuel specification. In fact, many facilities, including Par Hawaiʻi's planned hydrotreater, are designed to produce both renewable diesel and HEFA SAF from the same feedstocks, using shared infrastructure. This method is commercially viable and currently accounts for the majority of global SAF production.

Other pathways include Fischer-Tropsch synthesis, where syngas derived from gasification of biomass or municipal solid waste is catalytically converted into liquid hydrocarbons. There is also the Alcohol-to-Jet (ATJ) pathway, which converts bio-based ethanol or isobutanol into jet fuel. Each pathway differs in feedstock availability, production cost, and lifecycle emissions, all of which affect scalability and deployment timelines.

7.3 Carbon Intensity of SAF

The CI of SAF depends on the feedstock and production process. According to data from the California Low-Carbon Fuel Standard, SAF can have a CI ranging from approximately 16 to 62 gCO2e/MJ with a median value of 34 gCO2e/MJ. In general, SAF produced from waste oils, fats, and residues tends to have low lifecycle emissions, especially when compared to fossil-derived jet fuel, which has a CI of around 89 gCO2e/MJ. However, the source of hydrogen used in the production process plays a critical role. SAF made with green hydrogen from renewable electricity will have a significantly lower CI than SAF made with fossil-derived hydrogen, which can substantially increase overall emissions.

The carbon savings from SAF come not only from biogenic carbon uptake but also from the avoidance of emissions associated with waste decomposition or deforestation.[17] However, emissions can increase significantly if the feedstock involves indirect land use change or if fossil-based energy is used in the production process. Transportation and refining also contribute to variation in SAF CI.

7.4 In-state Production Capability

Par Pacific is constructing Hawaiʻi's first large-scale renewable fuels facility at its Kapolei refinery and is reportedly on schedule for production to begin in 2025. The facility will produce SAF using the HEFA process and is expected to deliver a significant share of the state's renewable fuel output. The project is being supported through partnerships with stakeholders such as Hawaiian Airlines and Pono Pacific to identify suitable local feedstocks and secure supply chain reliability.

This investment marks a major step towards local SAF production and could reduce the need to import fuel from the mainland or overseas. While the refinery will rely partly on imported feedstocks, efforts are underway to explore local sources, including used cooking oil and agricultural residues. Hawaiʻi's SAF production potential will depend on the success of this facility, availability of renewable feedstocks, and continued alignment between public policy, infrastructure investment, and industry demand.

7.5 Pros and Cons of SAF

SAF offers substantial benefits for climate mitigation and air quality. SAF can reduce lifecycle GHG emissions by up to 80 percent compared to conventional jet fuel when produced from low-carbon feedstocks. Its use can also help reduce particulate matter and SO_x emissions, which contribute to poor air quality near airports. Importantly, SAF provides a realistic decarbonization strategy for long-haul aviation, which is not easily electrified or replaced with other propulsion technologies.

Despite its advantages, SAF faces several challenges. Production is still relatively expensive, and global supply remains limited. Most current SAF is produced from fats and oils, which are in high demand across multiple renewable fuel markets, potentially creating competition and feedstock constraints. In addition, not all feedstocks are equally sustainable. For example, using food-based crops could raise concerns about land use, food security, and deforestation. Ensuring that SAF supply chains are based on truly sustainable inputs will be critical to their long-term success and public acceptance.

7.6 Estimated Demand to Meet 2030 and 2045 Targets

Under the Energy Security and Waste Reduction Plan, SAF is expected to serve as a cornerstone in reducing GHG emissions from the aviation sector. The Plan estimates that Hawaiʻi will require approximately 410 million gallons of SAF by 2030 to meet its interim emissions reduction goals. This reflects both anticipated growth in SAF blending at major airports and the ramp-up of in-state production through new facilities like the one under development by Par Pacific.

By 2045, projected SAF demand increases to approximately 600 million gallons per year, aligning with the state's net-negative emissions objective. Achieving this level of uptake will require significant coordination

[17] SAF can avoid deforestation when it is produced from waste and residue feedstocks such as used cooking oil, animal fats, and agricultural or forestry byproducts that do not require the cultivation of new land. These feedstocks make use of existing waste streams, avoiding the need to clear forests or convert natural habitats for fuel production.

between airlines, fuel producers, and regulatory agencies, as well as long-term investment in feedstock supply chains and production infrastructure.

7.7 Federal Pre-Emption Preventing SAF Mandates

Federal pre-emption is a broad legal doctrine that prevents state and local governments from passing laws or imposing regulations in areas where the federal government has already acted, unless the state or local governments have explicit approval to proceed. With respect to the aviation industry, the pre-emption doctrine aims to promote safety and uniform, national standards, but also significantly limits a state's ability to impose their own environmental regulations on air carriers.

At least three major federal statutes present potential barriers to states requiring the use of SAF: the Clean Air Act, the Federal Aviation Act, and the Airline Deregulation Act.

For instance, Section 233 of the Clean Air Act states that "[n]o State or political subdivision thereof may adopt or attempt to enforce any standard respecting emissions of any air pollutant from any aircraft or engine thereof unless such standard is identical to a standard applicable to such aircraft under this part." In California v. Department of the Navy, 624, F.2d 885 (9th Cir. 1980), the court permitted state regulation of engine test cells. It found that the regulations at issue would not affect the airline engines, in contradiction to pre-emption principles. However, "[i]f the state regulations cannot be met without effect upon the engine, then they become a regulation of the engine itself and are preempted under Section 233."

Similarly, the Airline Deregulation Act includes an express pre-emption provision prohibiting a state from enacting or enforcing a law or regulation "related to a price, route, or service of an air carrier." This broad pre-emption provision has been interpreted to test whether a state law either "bears reference to rates, routes, or services," or "directly or indirectly binds the carrier to a particular price, route, or service and thereby interferes with the competitive market forces within the industry." See Bernstein v. Virgin Am., Inc., 990 F. 3d 1157 (9th Cir. 2021).

Discussions of whether to mandate SAF use for intra-island flights must consider these cited statutes and the recent decisions in California surrounding intra-state SAF mandates. The federal court decisions referenced, among many others, influenced California's Governor Newsom to veto AB 1322 in September 2022. That legislation that would have mandated SAF usage for flights within California through the state's Clean Transportation Program. (The Governor also reasoned that the bill would have overlapped with incentives to use SAF through the state's Low-Carbon Fuel Standard.) In general, SAF mandates that would impact airline services, routes, and prices—even for flights entirely within state boundaries—could run afoul of federal pre-emption prohibitions.

8. Electro-sustainable Aviation Fuel (eSAF)

8.1 Fuel Description

Electro-sustainable aviation fuel, commonly referred to as eSAF or power-to-liquid (PtL) fuel, is an advanced synthetic aviation fuel produced by green hydrogen with captured CO_2. Unlike conventional SAF, which is derived from biomass-based feedstocks such as fats, oils, and greases, eSAF is synthesized using renewable electricity to drive chemical reactions that generate hydrocarbons suitable for jet fuel. This synthetic fuel can be blended with or fully replace conventional jet fuel in existing aircraft, provided it meets ASTM certification standards.

What distinguishes eSAF is its potential for extremely low lifecycle carbon emissions, especially when the hydrogen is sourced from renewable electricity and the CO_2 is captured from biogenic or atmospheric sources. Because it does not rely on agricultural or waste-based feedstocks, eSAF is seen as a long-term solution to decarbonize aviation at scale, without the land use or feedstock competition concerns associated with bio-based fuels.

8.2 Production Pathways

The production of eSAF involves two key components: green hydrogen and captured CO_2. Green hydrogen is generated through the electrolysis of water using electricity from renewable sources such as solar or wind. Capture CO_2 could come from Direct Air Capture, industrial sources (such as power plants), or biogenic streams (such as ethanol plants). Hydrogen is then combined with CO_2 in a synthesis process (typically Fischer-Tropsch) or methanol-to-jet conversion to create hydrocarbon molecules that meet jet fuel specifications.

While the fundamental chemistry of eSAF is well understood, commercial deployment remains limited due to the high energy requirements, capital costs, and emerging nature of the technology. Ongoing research and pilot projects are exploring scalable methods of carbon capture and improved synthesis efficiencies. As renewable electricity becomes more affordable and widely available, and as hydrogen and carbon capture infrastructure matures, eSAF is expected to become more competitive and viable as a large-scale aviation fuel.

8.3 Carbon Intensity of eSAF

eSAF has the potential to achieve very low CI values, depending on the production process. When renewable electricity is used to produce green hydrogen, and CO_2 is sourced from sustainable sources such as Direct Air Capture or biogenic waste streams, the resulting fuel can yield lifecycle emissions that approach zero. According to early modeling and regulatory assessments, CI values for eSAF may range from zero to 60 gCO2e/MJ (Grim et al. 2022).

The variability in CI is influenced by the type of electricity used, the source of CO_2, and the efficiency of the fuel synthesis process. If grid electricity is used, the environmental benefit is significantly reduced. Therefore, the environmental integrity of eSAF hinges on strict control over feedstock inputs and process emissions, and regulatory frameworks may evolve to ensure the carbon benefits of electrofuels are accurately accounted for.

8.4 In-state Production Capability

Currently, eSAF is not produced commercially in Hawaiʻi. While the state has expressed interest in becoming a hydrogen hub and expanding its renewable electricity capacity, the infrastructure needed for large-scale eSAF production, including electrolyzers, carbon capture systems, and advanced fuel synthesis facilities, does not yet exist. Investments in green hydrogen development are underway, but further coordination and capital deployment will be required to support full eSAF production capability.

Despite these limitations, Hawaiʻi has the potential to produce eSAF in the future if it leverages its abundant solar and wind resources to generate green hydrogen and develops pathways for capturing CO_2

from local biomass or waste streams. The state's geography, energy goals, and aviation dependence position it as a strategic location for future pilot projects and technology demonstrations. In the near term, Hawaiʻi may rely on imported eSAF while laying the groundwork for local production beyond 2030.

8.5 Pros and Cons of eSAF

The primary advantage of eSAF lies in its exceptional decarbonization potential. When produced using renewable electricity and atmospheric or biogenic CO_2, eSAF can approach or achieve net-negative emissions, helping to significantly reduce the climate impact of air travel. It is fully compatible with existing aircraft and fueling systems, requiring no changes to airline fleets or airport infrastructure. In addition, because it does not rely on land or food-based feedstocks, eSAF avoids many of the sustainability concerns associated with other biofuels.

However, eSAF faces several practical challenges. It remains one of the most expensive renewable fuels to produce, primarily due to the high energy demands and limited scale of current production technologies. Furthermore, green hydrogen and carbon capture infrastructure are still in early stages of development, particularly in remote or island regions such as Hawaiʻi. These cost and infrastructure barriers will need to be addressed through innovation, policy incentives, and strategic investment for eSAF to become a scalable solution.

8.6 Estimated Demand to Meet 2030 and 2045 Targets

Under the Energy Security and Waste Reduction Plan, eSAF is identified as a long-term solution for achieving deep decarbonization in the aviation sector. While current production capacity is limited and costs remain high, the Plan recognizes the critical role eSAF could play as technologies mature and policy frameworks evolve. No demand is projected for eSAF in Hawaiʻi by 2030, reflecting the early stage of commercial viability and the need for substantial infrastructure development.

By 2045, however, eSAF demand is projected to grow significantly, reaching approximately 110 million gallons per year as part of the state's strategy to achieve net-zero transportation emissions. Meeting this level of adoption will require major investments in renewable electricity, green hydrogen production, and supportive regulations to facilitate fuel certification, procurement, and distribution.

9. Bioenergy with Carbon Capture and Storage SAF (BECCS SAF)

9.1 Fuel Description

BECCS SAF refers to sustainable aviation fuel produced from biomass-based feedstocks through a process that also incorporates carbon capture and storage (CCS). This fuel not only replaces conventional petroleum jet fuel with a renewable alternative, but it also captures and permanently stores a portion of the process-related CO_2 emissions underground, resulting in ultra-low or even net-negative lifecycle emissions. BECCS SAF is chemically similar to fossil jet fuel and can be blended with it up to approved limits under ASTM D7566, making it compatible with existing aircraft and fueling infrastructure.

9.2 Production Pathways

BECCS SAF is typically produced through thermochemical processes such as gasification followed by Fischer-Tropsch synthesis, or other biomass-to-liquid (BTL) pathways. Biomass, such as agricultural residues, forestry waste, or purpose-grown energy crops, is gasified into syngas (a mixture of CO and H_2), which is then converted into synthetic liquid fuels. During this process, a significant amount of CO_2 is released, which is then captured and either compressed for geologic injection or otherwise permanently stored through CCS technologies.

Successful implementation of BECCS SAF depends on several factors, including reliable biomass feedstock supply, access to carbon storage infrastructure, and integration of CCS systems into the fuel production facility. These integrated systems are currently under development at commercial demonstration scale, primarily in regions with supportive policy frameworks and existing geologic storage sites.

9.3 Carbon Intensity of BECCS SAF

The defining feature of BECCS SAF is its very low or negative lifecycle CI. Because the carbon in biomass originates from atmospheric CO_2 and a portion of it is permanently captured and stored during production, the net effect can be a carbon-negative fuel. According to recent modeling studies, BECCS SAF can achieve CI values as low as –122 gCO_2e/MJ, depending on feedstock and capture efficiency (Michaga et al. 2022). This makes BECCS SAF one of the most climate-beneficial liquid fuels currently known. However, achieving these ultra-low CI values requires strict feedstock sustainability criteria and the availability of long-term carbon storage solutions.

9.4 In-state Production Capability

At present, there is no commercial-scale BECCS SAF production in Hawaiʻi, and the state lacks the infrastructure for deep geological carbon storage essential for CCS deployment. While Hawaiʻi has biomass resources such as forestry and agricultural waste that could potentially support biofuel production, the absence of CCS infrastructure makes local BECCS SAF production technologically infeasible in the near term.

However, Hawaiʻi could still benefit from imported BECCS SAF produced in regions with suitable biomass supply and geologic storage formations, whether in the continental United States or internationally. In the longer term, if technological innovations or alternative carbon utilization pathways emerge, local production opportunities may become more viable.

9.5 Pros and Cons of BECCS SAF

The major advantage of BECCS SAF is its potential for carbon-negative emissions, making it a powerful tool for aviation decarbonization. It provides all the operational and safety benefits of conventional jet fuel while actively removing CO_2 from the atmosphere. BECCS SAF also leverages existing aircraft and fueling infrastructure, enabling immediate emissions reductions without requiring fleet turnover.

However, there are significant barriers to widespread deployment. The cost of BECCS SAF is currently much higher than conventional SAF or fossil jet fuel due to complex process integration and the capital costs of CCS infrastructure. In addition, CCS requires suitable geologic formations and long-term monitoring to ensure permanent storage, which limits site availability. Concerns about biomass sustainability and land use must also be carefully managed to avoid environmental trade-offs.

9.6 Estimated Demand to Meet 2030 and 2045 Targets

Under the Energy Security and Waste Reduction Plan, BECCS SAF is identified as a long-term solution to decarbonize the aviation sector and contribute to the state's 2045 net-negative targets. Due to current limitations in production technology, carbon storage infrastructure, and supply chain readiness, BECCS SAF is not expected to be used in Hawaiʻi by 2030, and no demand is projected for that year.

By 2045, however, BECCS SAF is projected to play a significant role, with estimated demand reaching 36 million gallons per year. This volume reflects its potential contribution as a carbon-negative fuel that can help offset residual emissions from hard-to-decarbonize aviation operations. Deployment by that time will depend on access to imported BECCS SAF from global producers and the development of procurement strategies or policies that prioritize fuels with the greatest climate benefit.

10. e-Methanol

10.1 Fuel Description

e-Methanol is a synthetic liquid fuel produced by reacting green hydrogen with captured CO_2, using renewable electricity as the primary energy source. It is considered a type of electrofuel, or "e-fuel," and is increasingly viewed as a promising low-carbon energy carrier for marine transportation and other hard-to-electrify sectors. e-Methanol has chemical properties similar to conventional methanol, which allows it to be handled using existing storage and fueling infrastructure with some modifications. Due to low cetane number, typically pilot fuel is needed to create the high-temperature, high-pressure conditions for methanol to burn.

In the transportation sector, e-methanol is particularly attractive as a marine fuel due to its lower lifecycle emissions compared to traditional heavy fuel oil and its ability to reduce SO_x and particulate matter emissions. It can also serve as a feedstock for other synthetic fuels, including e-gasoline or e-jet fuel, or be reformed into hydrogen for use in fuel cells. Because it is a liquid at ambient temperatures, e-methanol offers handling advantages over gaseous fuels such as hydrogen or RNG.

10.2 Production Pathways

The production of e-methanol begins with the generation of green hydrogen through electrolysis powered by renewable electricity. This hydrogen is then combined with CO_2 captured from industrial processes, biomass, or directly from the atmosphere. The two components are reacted in the presence of a catalyst to form methanol and water, resulting in a fuel that can be used directly or upgraded for other applications.

Compared to conventional methanol, which is typically produced from natural gas through steam methane reforming, e-methanol offers significantly lower lifecycle emissions. However, the production process is energy-intensive and capital-intensive, particularly due to the high cost of electrolyzers and the infrastructure needed for carbon capture. As renewable electricity becomes more affordable and carbon markets mature, the economic viability of e-methanol is expected to improve, especially in regions with abundant renewable resources.

10.3 Carbon Intensity of e-Methanol

The CI of e-methanol depends on the sources of electricity and CO_2 used during production. When produced using renewable electricity and captured biogenic or atmospheric CO_2, e-methanol can achieve near-zero CI values. This makes it a compelling option for emissions reductions in sectors that are difficult to decarbonize using direct electrification.

In contrast, if fossil-based electricity is used, the CI increases significantly and may negate the climate benefits. According to estimates, the CI of e-methanol can be as low as zero gCO2e/MJ, provided the inputs are entirely renewable. These outcomes are sensitive to the energy mix, efficiency of the production process, and lifecycle emissions associated with feedstock transport and processing.

10.4 In-state Production Capability

At this time, Hawaiʻi does not produce e-methanol commercially. While the state possesses the foundational elements for future production, including solar and wind resources and potential carbon sources from waste streams, the infrastructure needed to support large-scale e-methanol production is not currently in place. This includes electrolyzers for hydrogen production, carbon capture systems, and methanol synthesis reactors.

However, e-methanol production could become feasible in the long-term if Hawaiʻi expands its green hydrogen capabilities and identifies reliable sources of renewable CO_2. Future investment in port and industrial infrastructure, coupled with state and federal funding, could support demonstration projects or small-scale production. In the near term, any use of e-methanol in Hawaiʻi would likely depend on imports from other regions where production is more economically viable.

10.5 Pros and Cons of e-Methanol

e-Methanol offers several advantages as a low-carbon fuel. It can significantly reduce GHG emissions and local air pollutants when used in marine engines, helping to meet environmental standards and improve air quality near ports. Its liquid state at ambient temperature makes it easier to store, transport, and dispense than many other low-carbon fuels. In addition, it is biodegradable and less hazardous in the event of spills, making it a safer option for marine use.

However, e-methanol faces several challenges. It is currently more expensive to produce than conventional marine fuels, due to high capital costs and limited economies of scale. Moreover, while methanol combustion emits fewer pollutants than diesel or heavy fuel oil, it can still produce CO_2 unless carbon capture measures are in place. The adoption of e-methanol in shipping and other sectors will require further development of compatible engines, updated safety standards, and clear regulatory frameworks to ensure sustainable deployment.

10.6 Estimated Demand to Meet 2045 Targets

Under the Energy Security and Waste Reduction Plan, e-methanol is identified as a potential long-term solution for decarbonizing marine and industrial transportation applications. While the technology remains in the early stages of commercial adoption, the Plan anticipates that Hawaiʻi could begin integrating e-methanol as a demonstration or pilot fuel post 2030, with estimated demand reaching approximately 54 million gallons by 2045.

11. e-Ammonia

11.1 Fuel Description

e-Ammonia is a synthetic, carbon-free fuel produced by combining green hydrogen with nitrogen sourced from ambient air. It is generated through a well-established chemical process known as the Haber-Bosch reaction, using renewable electricity as the primary energy input. Unlike conventional ammonia, which is typically made from fossil-based hydrogen, e-ammonia relies on green hydrogen created through the electrolysis of water using renewable electricity, ensuring minimal lifecycle GHG emissions.

As a fuel, e-ammonia is gaining interest primarily in the marine and heavy industrial sectors. It contains no carbon atoms, meaning its combustion does not result in direct CO_2 emissions. In maritime applications, it can be used in internal combustion engines or fuel cells, offering a promising route to decarbonize large ocean-going vessels. It can also serve as an energy carrier for hydrogen and as a feedstock in energy-intensive processes like power generation or fertilizer production.

11.2 Production Pathways

The production of e-ammonia begins with the electrolysis of water to produce green hydrogen using renewable electricity. This hydrogen is then reacted with nitrogen extracted from ambient air through cryogenic separation or pressure swing adsorption. The reaction is carried out at high temperatures and pressures using a catalyst to produce ammonia, which is then cooled and liquefied for storage and transportation.

This process is identical to traditional ammonia production in terms of chemistry, but it differs significantly in energy sourcing. Conventional ammonia production uses hydrogen from fossil natural gas, which results in substantial carbon emissions. By substituting fossil-based hydrogen with green hydrogen, e-ammonia becomes a low-carbon fuel. However, the process remains energy-intensive and requires continuous access to large quantities of renewable electricity, making the location and scale of production critical factors for feasibility.

11.3 Carbon Intensity of e-Ammonia

e-Ammonia has the potential to achieve near-zero CI when produced using renewable electricity and green hydrogen. Because the molecule contains no carbon, it does not emit CO_2 when combusted. However, emissions from the production process, particularly if grid electricity or fossil-derived hydrogen is used, can significantly increase its lifecycle carbon footprint.

According to lifecycle assessments, conventional ammonia has a CI of approximately 100 gCO2e/MJ (Hatzell 2024). In contrast, e-ammonia produced entirely with renewable inputs can approach zero grams per megajoule. Still, non-carbon emissions such as NOx may be released during combustion, and appropriate control technologies must be used to minimize their impact. The environmental performance of e-ammonia is therefore highly dependent on energy sourcing and combustion practices.

11.4 In-state Production Capability

At present, Hawaiʻi does not produce e-ammonia, nor does it have the infrastructure in place to support its commercial production. Establishing an e-ammonia supply chain in the state would require large-scale investments in green hydrogen production, nitrogen extraction, ammonia synthesis, and associated storage and safety infrastructure. In addition, the potential need for desalinated water for electrolysis and the challenge of siting large industrial facilities pose further barriers.

Despite these challenges, Hawaiʻi has some of the key resources necessary for long-term e-ammonia production, including abundant solar and wind potential for generating renewable electricity. The state's strategic interest in hydrogen development could also serve as a foundation for future ammonia-related initiatives. In the short term, Hawaiʻi may explore the feasibility of importing e-ammonia while assessing the economic and technical requirements for eventual local production.

11.5 Pros and Cons of e-Ammonia

e-Ammonia offers several compelling advantages as a low-carbon fuel. It can be stored and transported in liquid form at moderate pressures and temperatures, making it easier to handle than hydrogen gas. Its use in marine engines or fuel cells allows for carbon-free propulsion, and its energy density makes it suitable for long-distance shipping and other applications where batteries are impractical. In addition, the infrastructure for ammonia storage and transport is already well established in the agricultural and chemical sectors.

However, there are important drawbacks to consider. Ammonia is toxic and corrosive, requiring careful handling and safety protocols to prevent exposure risks to workers and surrounding communities. When used as a combustion fuel, ammonia can produce NO_x, which are harmful air pollutants unless properly mitigated. Furthermore, the production of e-ammonia is energy-intensive, and unless powered by renewable electricity, the climate benefits can be compromised. These trade-offs highlight the need for rigorous planning, regulation, and technology development to ensure safe and sustainable deployment.

11.6 Estimated Demand to Meet 2030 and 2045 Targets

Under the Energy Security and Waste Reduction Plan, e-ammonia is identified as a potential long-term option for decarbonizing marine transportation and other high-emission industrial sectors. While commercial-scale deployment is not anticipated before 2030, initial pilot projects or feasibility studies could be launched within that timeframe. Estimated demand by 2045 is expected to be around 165 million kilograms of ammonia.

12. Green Hydrogen

12.1 Description of Green Hydrogen

Green hydrogen is a zero-emission fuel produced by splitting water into hydrogen and oxygen through electrolysis powered by renewable electricity, such as solar or wind energy. Unlike gray hydrogen, which is derived from fossil fuels, green hydrogen does not generate GHG emissions during production. As a result, it is considered a clean energy carrier that can play a central role in decarbonizing transportation, industry, and power generation.

In the transportation sector, green hydrogen can be used in fuel cell electric vehicles, which generate electricity onboard through a chemical reaction between hydrogen and oxygen, emitting only water vapor. It is particularly suited for medium- and heavy-duty applications such as buses, trucks, and port equipment, where battery-electric vehicles may face limitations in range, refueling time, or payload capacity. In addition, hydrogen can be used directly in combustion engines or serve as a building block for other synthetic fuels such as e-methanol, e-ammonia, and e-jet fuel.

In addition to green hydrogen, there are other types of hydrogen that offer lower-carbon alternatives to conventional fossil-based production. Blue hydrogen is produced from natural gas or other fossil fuels but incorporates CCS to significantly reduce associated GHG emissions. Turquoise hydrogen is an emerging pathway made through methane pyrolysis, where the carbon content of methane is converted into a solid carbon byproduct rather than CO_2, potentially avoiding direct emissions altogether. If methane used in this process is renewable (as from biomethane) or if the solid carbon is permanently stored or used in long-lived products, turquoise hydrogen can also have a low-carbon footprint. While these alternative hydrogen pathways are technically viable and may play a role in future decarbonization strategies, they are not fully discussed in this document because the modeling and analysis in the Plan specifically rely on green hydrogen to align with long-term climate goals. As such, the focus of this appendix remains on green hydrogen as the representative pathway included in the state's decarbonization assumptions.

12.2 Production Pathways

The most common method of producing green hydrogen is via water electrolysis, in which an electric current is applied to water to separate it into hydrogen and oxygen. When the electricity used comes entirely from renewable sources, the resulting hydrogen is classified as green and has no associated carbon emissions from production. This process requires purified water (typically obtained from fresh or desalinated sources) and large amounts of clean electricity to operate electrolyzers.

Other emerging methods of green hydrogen production include photoelectrochemical and thermochemical water splitting, which use solar and advanced materials to achieve similar outcomes with potentially higher efficiency. These technologies are still in the research and development stage. In contrast, commercial-scale electrolysis systems are already available and are being deployed in several hydrogen hubs worldwide. The scalability, location, and cost of green hydrogen production are highly dependent on access to affordable and abundant renewable energy.

12.3 Carbon Intensity of Green Hydrogen

Green hydrogen has one of the lowest possible carbon intensities among clean fuel production. When produced using 100 percent renewable electricity and without fossil fuel inputs, its production CI can be zero gCO2e/MJ. For the transportation applications, such as fuel cell trucks, the hydrogen supply chain logistics, specifically its transportation and distribution, can account for a substantial fraction of its lifecycle CI.

However, the environmental performance of green hydrogen depends heavily on renewable electricity. If grid electricity is used and includes fossil-based generation, the resulting hydrogen may carry a significantly higher CI, undermining its emissions benefits. Therefore, tracking and verifying the source of electricity is essential for ensuring the integrity of green hydrogen pathways. Policies and certification frameworks are increasingly focused on these factors to support hydrogen as a zero-emission solution.

12.4 In-state Production Capability

Hawai'i does not currently produce green hydrogen at commercial scale, but it has expressed strong interest in developing hydrogen as part of its broader clean energy strategy. The state possesses significant potential for renewable electricity generation from solar, wind, and geothermal resources, which could be used to power electrolysis systems. Several feasibility studies and pilot projects have explored opportunities for hydrogen production on Oʻahu, Maui, and Hawaiʻi Island, though none have yet advanced to full implementation.

Challenges to in-state production include the high cost of electrolyzers, the need for water supply and purification systems, and limited financial support for infrastructure development. In addition, large-scale storage, distribution, and end-use systems must be built out in tandem to create a viable hydrogen economy.

12.5 Pros and Cons of Green Hydrogen

Green hydrogen offers significant advantages as a clean fuel. It produces zero tailpipe emissions when used in fuel cells, improves energy resilience by enabling local production, and supports decarbonization in sectors where battery-electric solutions are not feasible. Hydrogen can also be stored for long periods and used to balance intermittent renewable energy, making it a valuable tool for energy system reliability. Furthermore, its versatility across multiple sectors, from transportation to industry, makes it a critical pillar in achieving deep decarbonization goals.

However, green hydrogen also presents challenges. Production is capital- and energy-intensive, and its cost remains higher than that of fossil-based hydrogen and other alternative fuels. Safe storage and transport require high-pressure systems or cryogenic infrastructure, which adds to the complexity and expense. In addition, the development of fueling networks and compatible vehicles is still in early stages in Hawaiʻi, limiting immediate deployment. Overcoming these barriers will require sustained investment, supportive policy frameworks, and market development strategies to achieve economies of scale.

12.6 Estimated Demand to Meet 2030 and 2045 Targets

According to the Energy Security and Waste Reduction Plan, green hydrogen is expected to play a significant role in Hawaiʻi's long-term decarbonization strategy, especially for the marine sector. By 2045, demand is expected to increase to approximately 1.6 million kilograms of hydrogen, as hydrogen adoption expands into inter- and intra-state marine as well as commercial harbor crafts sectors.

Appendix G
EV Scenario Discussion

The number of electric vehicles (EVs) registered in Hawaiʻi has quadrupled since 2018 to over 29,000, making up 11 percent of new passenger vehicle sales statewide. A growing number of EV models including medium- and heavy-duty options have helped increase adoption, as have decreasing purchase prices and maintenance costs. However, because Hawaiʻi lacks the authority to adopt California's requirements for new EV sales, the only mandates affecting vehicle manufacturers in Hawaiʻi are the federal regulations adopted in 2024. To achieve the EV sales projected in the aggressive electrification scenario described here, the State would need to offer incentives to offset the higher purchase price of EVs. Moreover, the State would also need to incentivize the scrappage of older vehicles.

For many years, some state and metropolitan areas with poor air quality have implemented voluntary scrappage programs (sometimes called "cash for clunkers"). These programs aim to encourage the retirement of older, highly polluting vehicles. In 2009, the federal government briefly operated such a program, providing vouchers for a new vehicle purchase valued at $3,500 to $4,500 for those who scrapped an eligible vehicle. During the approximately 1 month of program operation, 678,359 eligible transactions were made at a cost of $2.85 billion (Li et al. 2013).

More recently, some states and regions have initiated programs to incentivize the purchase of zero-emission vehicles (ZEVs). For example, from 2016 to 2023, California funded the Clean Vehicle Rebate Project (CVRP). In 2024, Washington state launched its Electric Vehicle Instant Rebates program. The San Diego region is also planning a zero-emission vehicle incentive program (ZEVIP) for both new and used EVs. Incentive levels vary for these programs but typically range from $1,000 to $4,000 per vehicle, with some incentives as high as $9,000 per vehicle. Often, incentives are higher for, or reserved exclusively for, low-income households. In the San Francisco Bay Area, the Metropolitan Transportation Commission has planned a combined vehicle buy-back and EV purchase incentive program; average incentive levels were assumed to be $6,000 per plug-in hybrid electric vehicles (PHEV) and $8,000 per battery-electric vehicle (BEV).

The cost to the State to implement a scrappage and/or EV purchase incentive program would be very large. For example, if the scrappage program removed 500,000 older vehicles from service over the period 2030-2045 and offered $4,000 per vehicle, the total incentive cost would be $2 billion.

The State of Hawaiʻi Department of Transportation (HDOT) has started to install public EV charging stations using funds from the National Electric Vehicle Infrastructure (NEVI) program. The program focuses on installing fast-charging stations along key highways and in underserved rural and urban areas to ensure equitable access. So far, eleven sites have been identified: two each on Maui, Oʻahu, and Kauaʻi, and five on Hawaiʻi Island. The first two NEVI-funded EV charging stations opened in 2024 at the Kahului Park & Ride on Maui and at Aloha Tower on Oʻahu. Both locations feature four 150-kilowatt (kW) chargers and mark the beginning of a broader effort to enhance EV infrastructure statewide. The State of Hawaiʻi Department of Transportation (HDOT) continues to design and buildout the remaining sites that are strategically located to ensure accessibility and compliance with NEVI requirements, such as being within 1 mile of designated Alternative Fuel Corridors and having 24-hour public accessibility.

To further encourage EV adoption, the State offers incentives such as the Hawaiʻi EV Charging System Rebate Program (HECO n.d.) and the Hawaiʻi Green Infrastructure Revolving Loan Fund (Hawaiʻi Green Infrastructure Authority n.d.), which will need to be expanded to meet the goals laid out in Strategy HWY-E-2 of the Energy Security and Waste Reduction Plan for 100 percent EV sales by 2035.

Local government agencies will need to enhance and support existing policies through stricter enforcement and a mix of incentives and disincentives. Furthermore, additional incentives should be provided to streamline the permitting process for public EV charging infrastructure and to encourage tourism operators (such as shuttle buses, rental fleets, and hotels) to adopt electric fleets or offer shared shuttle services to popular tourist destinations. Local jurisdictions will also help identify local charging locations and opportunities to deploy new curbside charging infrastructure and charging systems that leverage existing electrical systems supporting streetlights and other public infrastructure to speed Level 2 (L2) charger availability.

Hawaiian Electric (HECO) will play a pivotal role in electrifying the state's vehicle population by providing local industry expertise. This includes maintaining and repairing utility-owned public chargers and electrifying its own vehicle fleet to incorporate learnings into customer programs, workforce development actions, and planning. Ongoing collaboration with state and local agencies and private EV charging companies is essential to ensure a robust public charging network. In addition, coordinating with state and county agencies will help simplify and accelerate charger installations and energization timelines, while Hawaiʻi agencies continue to leverage existing and future public–private partnerships to ensure deployment options continue to be considered.

Electric Utilities. As the state's electricity providers, both HECO and the Kauaʻi Island Utility Cooperative (KIUC) are responsible for pursuing efforts towards 100 percent renewable energy generation. The mandate for renewable energy generation by these electric utilities will need to account for increased electricity load from EVs. Utility-led vehicle electrification programs such as EV rates, charging infrastructure programs, pilot programs, and community education and outreach will help anticipate and manage the growing electricity demand.

Hawaiian Electric Company. HECO's Electrification of Transportation Strategic Roadmap 2.0 outlines the company's commitment to leading vehicle electrification efforts through utility-provided electrification of transportation programs. Key actions include planning for electric transportation on the grid; enabling charging for personal mobility, public fleets, and commercial vehicles; encouraging managed charging; supporting community resiliency; and promoting workforce development (HECO 2024).

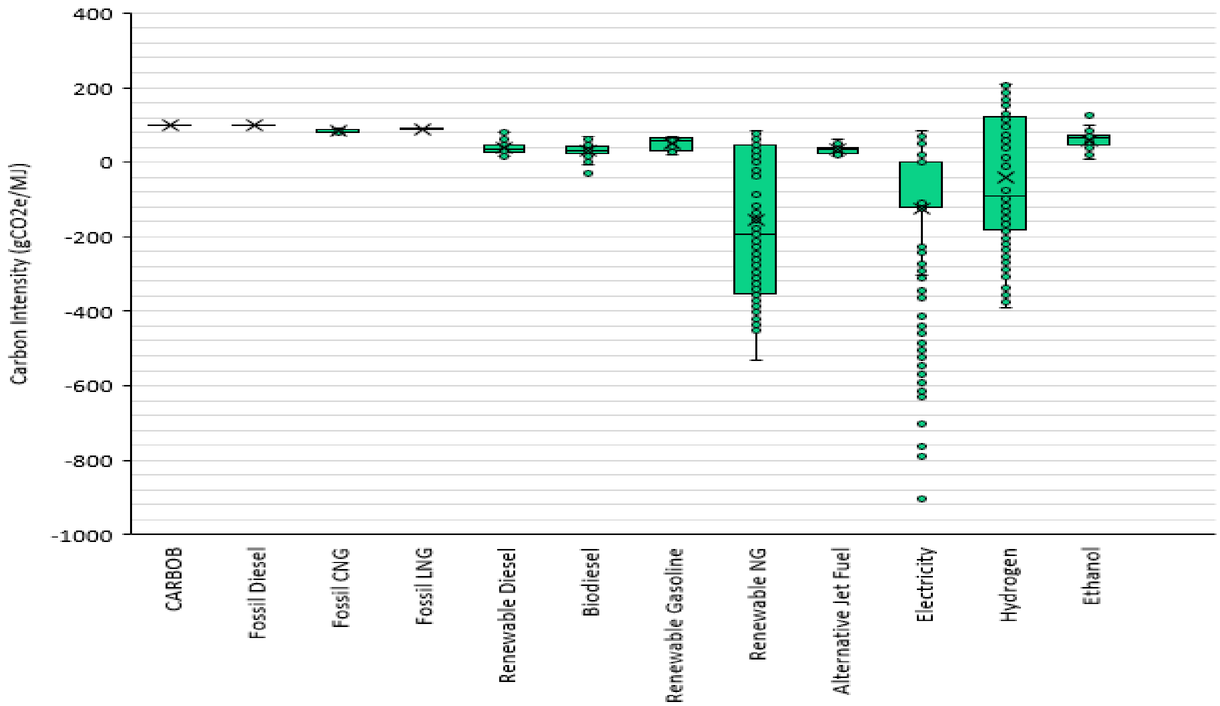
Kauaʻi Island Utility Cooperative. KIUC plays a critical role in vehicle electrification by actively promoting the adoption of EVs on the island of Kauaʻi through initiatives like offering rebates for EV chargers, developing charging infrastructure, and educating customers about the benefits of switching to EVs. KIUC provides financial incentives through rebates to residents and businesses who install L2 EV chargers at their homes or businesses. The utility company is actively working to expand the network of public EV charging stations across Kauaʻi by offering free EV charger site evaluations to commercial members and making recommendations for potential cost savings for the site owner. KIUC actively informs customers about the benefits of EVs and provides technical and financial support to facilitate vehicle electrification on Kauaʻi, focusing on programs and investments to minimize impacts on KIUC's electric grid (KIUC 2023).

Vehicle Electrification Discussion

The baseline scenario reflects Hawaiʻi's on-road vehicle fleet composition and corresponding greenhouse gas (GHG) emissions projected to 2045, given the current regulatory landscape.

Figure G-1 shows the changing composition of the vehicle fleet under the baseline scenario. Approximately 38 percent of Hawaiʻi's vehicle population would be ZEVs by 2045, including BEVs and PHEVs, with the remaining vehicles being internal combustion engine (ICE) vehicles, which include both gasoline and diesel-powered vehicles. Under the baseline scenario, annual on-road vehicle GHG emissions are expected to decline from 3.8 million metric tonnes carbon dioxide equivalent (CO2e) in 2025 to 1.9 million metric tonnes of CO2e in 2045.

Figure G-1. Vehicle Population Distribution under Baseline Scenario

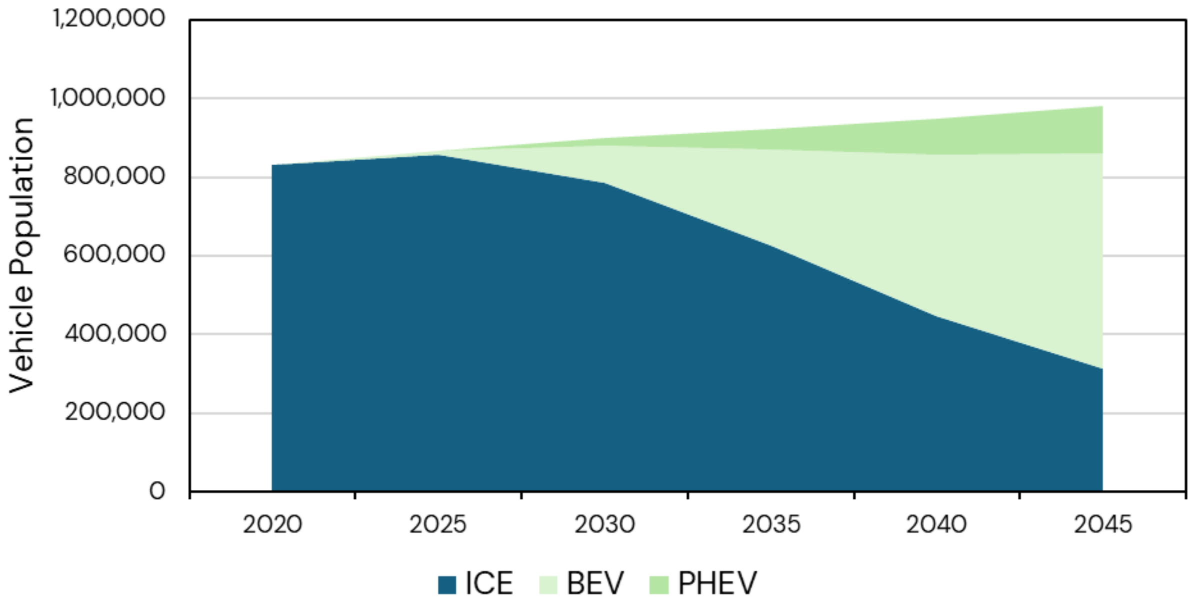


Aggressive Electrification Scenario

An aggressive electrification scenario envisions an accelerated sale and deployment of EVs, such that the on-road vehicle fleet in Hawai'i converts to EVs at a more rapid pace than currently required by federal law. This scenario is consistent with the pace of vehicle electrification expected under California's Advanced Clean Cars II (ACC II) and Advanced Clean Trucks (ACT) regulations. Under this scenario, 100 percent of light-duty vehicle sales are ZEVs by 2035, 75 percent of heavy-duty vocational truck sales are ZEVs by 2035, 40 percent of heavy-duty truck tractor sales are ZEVs by 2032, and 100 percent of heavy-duty transit bus sales are ZEVs by 2032.

Figure G-2 shows the changing fleet composition under the aggressive electrification scenario. Approximately 68 percent of Hawai'i's vehicle population would be ZEVs by 2045. Under the aggressive electrification scenario, annual on-road vehicle GHG emissions would decline to 1.2 million metric tonnes of CO2e in 2045.

Figure G-2. Vehicle Population Distribution with Aggressive Electrification Scenario



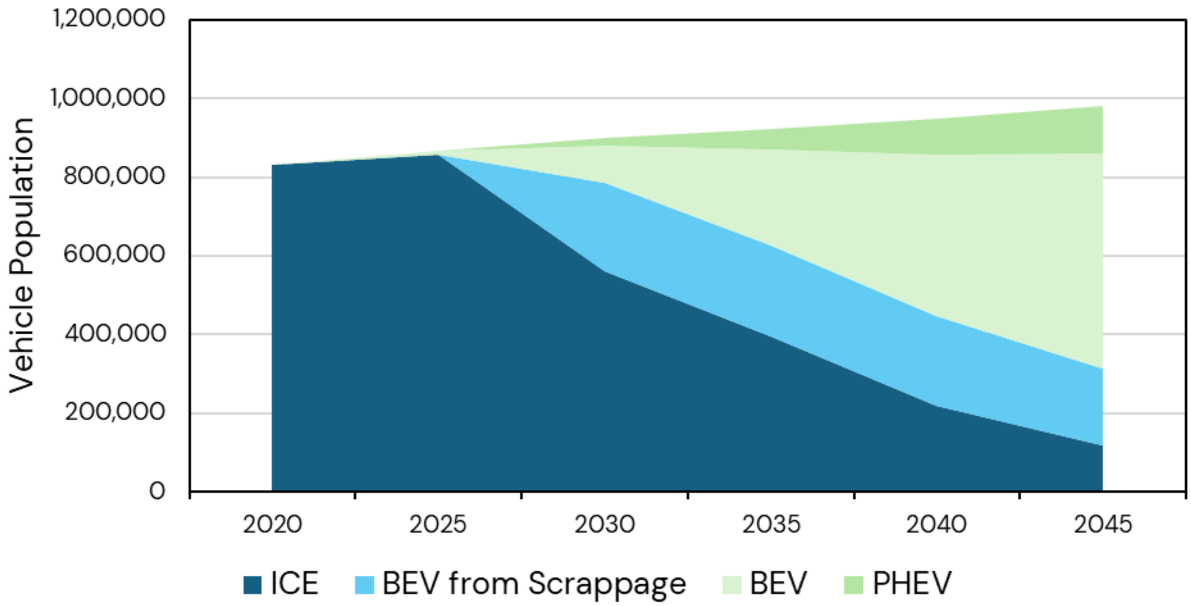
Aggressive Electrification with Vehicle Scrappage Scenario

With the aggressive assumption that all new light-duty vehicle sales will be ZEVs by 2035, nearly one-third of vehicles on the road in Hawaiʻi in 2045 will be gasoline or diesel-powered due to the long lifespan of vehicles. To encourage the retirement of older gasoline and diesel vehicles and accelerate the adoption of ZEVs, Hawaiʻi could implement a vehicle scrappage program whereby the State compensates owners of older vehicles to have them scrapped and removed from service, with a requirement that the replacement vehicle is an EV.

This scenario assumes that a statewide scrappage program is initiated in 2025 and ramps up to full implementation by 2030, targeting retiring all vehicles more than 15 years old. Such a program would need to be combined with EV purchase incentives to ensure that all scrapped vehicles can be replaced with EVs. Between 2030 and 2045, approximately 500,000 vehicles would be scrapped and replaced with an EV. Based on past recycling programs in Hawaiʻi, setting up the program will be a considerable lift and require the presence of offshore markets for the retired vehicles.

Figure G-3 shows the Hawaiʻi vehicle population under this scenario. By 2045, 85 percent of the vehicle fleet would be ZEV vehicles. Under the aggressive electrification plus scrappage scenario, annual on-road vehicle GHG emissions would decline to 0.8 million metric tonnes of CO2e in 2045.

Figure G-3. Vehicle Population Distribution with Aggressive Electrification + Scrappage Scenario



Strategy Implementation

To significantly boost the adoption of ZEVs and expand public charging infrastructure, a multifaceted approach is essential. Key implementation actions include enhancing federal and state incentives for EV purchases, streamlining the permitting process for installing charging stations, implementing public–private partnerships to speed the deployment of charging infrastructure, and increasing investments in renewable energy sources to power these stations. In addition, public awareness campaigns and educational programs already in use in Hawaiʻi will play a crucial role in informing consumers about the benefits of EVs and the availability of public charging infrastructure. Collaboration between government agencies, private sector stakeholders, and local communities is vital to ensure a cohesive and effective strategy.

Charging Infrastructure Needs

Charging of privately owned EVs will primarily occur at residences. However, a robust network of public EV charging infrastructure is needed to support the dramatic growth in the EV population as envisioned in the scenarios described here. In particular, public charging is needed for residents in multifamily dwellings who may not have access to charging at home, and also for EV owners who take long trips or incur high daily mileage.

According to the U.S. Department of Energy Alternative Fuels Data Center, there are currently 893 public EV charging ports in Hawaiʻi (DOE 2024a).[18] This figure includes 131 direct current fast charging (DCFC) stations and 761 L2 charging stations. Oʻahu has the majority of public EV charging ports (554 ports

[18] EV charging ports listed are either available or temporarily unavailable, which refers to charging ports that are anticipated to become available again shortly, as of February 2025.

[62 percent]), while there are145 ports (16 percent) on Maui, 105 ports (12 percent) on Hawaiʻi Island, and 70 ports (8 percent) on Kauaʻi. There are 17 ports on Lānaʻi and 2 on Molokaʻi.

To estimate the number of chargers needed to support the future EV population, the National Renewable Energy Laboratory's Electric Vehicle Infrastructure—Projection Tool Lite (EVI-Pro Lite) can be used. This tool yields the estimated total public EV charging infrastructure necessary to support electrification under scenarios for future EV populations. Each type of charger serves different needs, from daily commuting to long road trips. An EV charger supplies power to charge the vehicle's battery, while an EV charging port is the interface on the vehicle where the charger connects to deliver that power. The different EV charger types and charging speeds[19] assumed in the EVI-Pro Lite tool are as follows:

- L2: These chargers use a 240-volt outlet and are commonly found in homes, workplaces, and public charging stations. L2 chargers can fully charge an EV in about 4 to 8 hours.
- DCFC: These chargers are typically found at public charging stations along highways and are ideal for long-distance travel and quick top-ups. DCFCs come in different power levels, and their charging times can vary significantly based on the power output: 150 kW can typically add about 100 miles of range in approximately 20 to 30 minutes, 250 kW can add around 100 miles of range in about 15 to 20 minutes, and 350 kW represents the fastest chargers available and can add 100 miles of range in just 10 to 15 minutes.

Table G-1 shows the estimated number of public charging ports necessary to support the EV population in Hawaiʻi under the described scenarios. Light-duty vehicle charging demand was estimated using EVI-Pro Lite, while public charging ratios were used to estimate medium- and heavy-duty charging demand using 2023 figures from Coordinating Research Council (2023). Introducing a scrappage program to increase the share of EVs in Hawaiʻi would produce a significant increase in necessary charging infrastructure deployment as opposed to the baseline and aggressive electrification scenarios. However, the estimated necessary DCFC infrastructure is dwarfed by the estimated necessary L2 charging infrastructure in all three scenarios. Drivers using EVs for local errands and shorter trips would likely depend on lower-power infrastructure to support everyday charging needs, whereas higher-power charging is important to support longer-distance trips and medium- and heavy-duty traffic such as freight and public transportation.

Table G-1. Estimated Public Charging Ports Needed by Scenario

Scenario	2030		2045	
	L2	DCFC	L2	DCFC
Baseline Scenario	2,012	424	13,817	3,695
Aggressive EV Sales	3,157	872	32,843	6,097
Aggressive EV Sales + Scrappage	12,035	1,725	50,437	7,475

The net present value (NPV) of existing unit and installation costs per port can be used to estimate the costs associated with charging infrastructure deployment. Table G-2 shows the estimated costs associated with additional charging infrastructure deployment organized by low (NPV discount rate of 0.04) and high (NPV discount rate of 0.06) cost escalation assumptions. These figures do not include charging infrastructure already deployed. Most of the investment is made up of the escalating costs of more

[19] The actual charging time can vary depending on factors such as the vehicle's battery capacity, the state of charge, and the vehicle's maximum charging rate.

expensive, higher-power DCFC ports, as well as cheaper but more abundant L2 infrastructure designed to support charging in retail, community, office, educational, and recreational locations. Significantly fewer DCFC ports would be necessary to support a largely or fully electrified vehicle fleet, but the cost difference between L2 charging ports and DCFC ports make the total costs relatively comparable.

Table G-2. Estimated Costs Necessary to Support Charging Ports Needed by Scenario

Scenario	2030			2045		
	L2	DCFC	Total	L2	DCFC	Total
Baseline Scenario						
Low Escalation	$14.6M	$83.5M	$98.1M	$275M	$1.53B	$1.81B
High Escalation	$16.1M	$91.9M	$108M	$403M	$2.25B	$2.65B
Aggressive EV Sales						
Low Escalation	$28.1M	$182M	$210M	$677M	$2.58B	$3.26B
High Escalation	$30.9M	$200M	$231M	$990M	$3.78B	$4.77B
Aggressive EV Sales + Scrappage						
Low Escalation	$132M	$395M	$527M	$1.05B	$3.26B	$4.31B
High Escalation	$145M	$435M	$580M	$1.53B	$4.77B	$6.30B

B = billion (dollars)

M = million (dollars)

Appendix H
Fuel Demand Reduction Discussion including VMT Reduction

VMT Reduction Discussion

This report recommends 12 strategies to reduce vehicle miles traveled (VMT) and greenhouse gas (GHG) emissions. These strategies work in coordination to reduce the demand for fuel and support robust multimodal alternatives to driving vehicles. For example, higher density development patterns encourage bicycling, travel as a pedestrian, and public transit use. Barrier-protected bicycle infrastructure and separated pedestrian infrastructure encourage bicycling and pedestrian travel both as standalone modes of travel and in connecting to public transit. Parking policies encourage the consideration of alternatives to driving. Managed vehicular lanes that are free for high occupancy vehicles (and available for other vehicles at a cost) encourage carpooling and transit usage, which boosts throughput. For this reason, GHG reduction plans often consider the total potential reduction in VMT rather than estimate the VMT impacts of each individual strategy.

Electric bicycles (e-bikes) and other micromobility devices are used by residents and tourists in Hawaiʻi at a rapidly increasing rate. The assistance that these expensive motorized devices provide mitigates common barriers to bicycle travel such as variable terrain and long distances. In recognition of the important travel support role e-bikes and other micromobility devices play in VMT reduction, bicycle parking and secure bicycle parking are discussed, with the access area extended to 5 miles surrounding key land uses and significant public transit facilities.

Combined VMT Reduction from Other Plans

Several sources offer insights into the maximum potential VMT reduction that could be achieved in Hawaiʻi by 2045. One is the *Oʻahu Climate Action Plan* adopted in 2021, which was revisited as part of Honolulu's Energy Conservation and Emissions Reduction Plan in 2024 (CCH 2024). The Plan compared Honolulu with other cities to estimate the change in mode shares that would be needed for Honolulu to achieve a 10 percent, 20 percent, or 30 percent reduction in VMT as compared to current levels. To achieve a 10 percent VMT reduction, Honolulu would need transit and bicycle mode shares to reach the levels of Portland, Oregon (Multnomah County). To achieve a 20 percent VMT reduction, Honolulu would need its transit and pedestrian mode shares to reach the levels of San Francisco. To achieve a 30 percent VMT reduction, Honolulu would need a bicycle mode share like Portland, a pedestrian mode share like San Francisco, and a transit mode share that is 30 percent higher than San Francisco.

Another source to estimate total VMT reduction potential is the 2023 Hawaiʻi State Energy Office (HSEO) Hawaiʻi Pathways to Decarbonization Report. One of the decarbonization scenarios in this report assumes a maximum of 20 percent VMT reduction by 2045, which was based on a sketch-level analysis prepared by State Smart Transportation Initiative (SSTI) (McCahill et al. 2019). In reaching this reduction in VMT by 2045, the analysis makes a number of assumptions that include bold changes in land use, non-auto transportation options, and transportation pricing. These assumptions are contextualized against three area types that are categorized based on the average VMT per household, as follows:

- Low-VMT areas (<17,500 vehicle miles per year)
- Medium-VMT areas (17,500 to 22,500 vehicle miles per year)
- High-VMT areas (> 22,500 vehicle miles per year)

Given the three area types, key assumptions of the analysis include the following:

- No new homes will be added in high-VMT areas, while 70 percent of new homes will be infill development and occur in areas with low-VMT areas.
- Future growth will occur in compact, mixed-use development.

- Aggressive parking management policies are implemented in low-VMT areas.
- Subdivision ordinance reforms will be made to ensure new roads are highly connected by specifying maximum block lengths and increasing street connectivity by 20 percent in medium-VMT areas and by 10 percent in low-VMT areas.
- Transit enhancements will increase access to transit by 40 percent in Hawaiʻi and Kauaʻi counties and by 10 percent in Honolulu and Maui counties.
- Once improved transit, bicycle, and pedestrian networks are established, road pricing will increase the cost of driving 50 percent statewide. These changes accounted for almost half of the study's estimated VMT reduction.

A final source considered is the 2023 Washington State Department of Transportation (WSDOT) Carbon Reduction Strategy, which included a literature review and assessment of statewide VMT reduction potential. The WSDOT plan considered the following five mechanisms for achieving VMT reduction:

- Land use policies aim to create more compact, mixed-use, and walkable communities, reducing the distance between residential, commercial, employment, and recreational areas.
- Telework has the potential to reduce VMT by eliminating commuting trips.
- Transit network expansion includes investments in bus, light rail, and commuter rail systems.
- Active transportation focuses on complete sidewalk networks, walking trails, and bike-friendly infrastructure.
- Pricing mechanisms such as cordon pricing, parking pricing, and VMT fees leverage financial mechanisms to influence travel behavior.

Using published VMT reduction effectiveness for each mechanism, the Plan estimated the combined effects, with a low-end and high-end range, shown in Table H-1.

Table H-1. Combined VMT Reduction Effectiveness, Washington State

Effects	2030	2040	2050
Low End	4.4%	6.1%	7.8%
High End	22.2%	27.1%	32.0%

VMT Reduction Assumptions

For the purposes of this Plan, VMT is assumed to decline by a maximum of 1 percent per year, resulting in a 20 percent total VMT reduction by 2045, consistent with or exceeding statewide planning and analysis in Washington state and also North Carolina (5 to 20 percent reduction by 2045) (NCDOT 2024) and Vermont (15 percent reduction by 2050) (State of Vermont Agency of Transportation 2024). This is an aggressive reduction in VMT and likely represents the upper bound of what is possible across the state given the diverse land uses and travel patterns on each of the islands.

The 20 percent VMT reduction has been divided among three core strategies: transit and active transportation, land use strategies, and demand management. While all strategies outlined in this report must work together to achieve the necessary VMT reduction at the statewide level by 2045, the State of Hawaiʻi Department of Transportation (HDOT) conducted a high-level analysis to illustrate the effectiveness of each strategy in reducing emissions using the studies noted above.

The review identified a range of VMT reductions associated with each strategy, with feasibility levels set at the 25th and 75th percentiles of reported reductions in the literature. For example, pricing strategies showed a potential reduction of between 1.2 percent and 15 percent, land use changes between 8.8 percent and 30 percent, and telework between 2 percent and 4.5 percent. Transit expansion had a more modest estimated reduction of 2.2 percent, while active transportation projects showed VMT reductions between 0.13 percent and 0.68 percent.

Drawing from this research, HDOT leveraged the identified VMT reduction ranges associated with each strategy and made assumptions regarding their deployment and implementation over time. These assumptions accounted for the varying timelines required for different strategies to reach their full potential. For instance, land use policies inherently take longer to impact travel behavior because of housing turnover and gradual urban development. As a result, HDOT assumed that only 10 percent of the maximum potential VMT reduction from land use changes would be realized by 2030, with 40 percent achieved by 2045. In contrast, transit and active transportation projects can be implemented more quickly, allowing for 50 percent of their full potential impact to be realized by 2030 and 100 percent by 2045.

For future pricing strategies, such as congestion fees and parking pricing, a general gradual rollout was assumed because of equity considerations and their potential impact on the cost of living, as well as the need for more robust transit and active transportation networks to be in place before these changes are advanced. Some pricing strategies, especially those that serve to subsidize ridesharing or transit usage, are more feasible in the early stages of such efforts, as they do not raise the cost of using a car without providing a reasonable alternative travel mode. To ensure a fair and effective implementation, HDOT estimated a 20 percent efficacy by 2030, increasing to 60 percent by 2040 and reaching 100 percent by 2045. By combining these staged implementation assumptions with the maximum achievable VMT reductions from each strategy, HDOT developed a timeline illustrating how each strategy would contribute to overall the VMT reduction assumed in this Plan.

Public Transit and Active Transportation (Multimodal Network) Discussion

Robust multimodal travel options improve ground transportation accessibility and affordability for Hawaiʻi's residents and visitors. At a low cost to the traveler, public transit (intra-city and inter-city), bicycle, and pedestrian networks work together to support a significant range of travel purposes and distances. The usage of multimodal travel options and their associated VMT and emission reductions are experienced alongside powerful co-benefits including the public health benefits tied to increases in active transportation (bicycling and pedestrian travel).

5-Year Priority Multimodal Network

The 5-Year Priority Multimodal Network encompasses the public transit, bicycle, and pedestrian priorities of the next 5 years, which include the following:

- Bicycle lanes, shared roadways, and buffered bicycle lanes
- Sidewalk and shared-use paths
- New or relocated bus stops, bus stop improvements, transit priority lanes and signals, and other improvements for Bus Rapid Transit

The three components (public transit [intra-city and inter-city], bicycle, and pedestrian) of the 5-Year Priority Multimodal Network and Implementation Plan are discussed in their respective VMT reduction strategies as presented in the Energy Security and Waste Reduction Plan.

2045 Unconstrained Multimodal Network

Complementary to the efforts of the 5-Year Priority Multimodal Network, the 2045 Unconstrained Multimodal Network is intended to build upon the work of the previous master plans (and updates) of HDOT, counties, and communities to define an interconnected statewide public transit, bicycle, and pedestrian network. The 2045 Unconstrained Multimodal Network and Implementation Plan will lay out the implementation of the network through the creation of programs and construction of infrastructure facilities, which will do the following:

- Address safety concerns and hazards
- Connect surrounding areas to key land uses
- Support pedestrian- and multimodal- oriented populations
- Provide seamless intermodal travel connection
- Fill gaps within the statewide multimodal network

The three components (public transit (intra-city and inter-city), bicycle, and pedestrian) of the 2045 Unconstrained Multimodal Network and Implementation Plan are discussed in their respective VMT Reduction strategies.

Inter-City Public Transit Network Discussion

Inter-city bus services in Hawaiʻi play a crucial role in connecting communities across the islands, providing an essential mode of transportation for those who do not have access to a car or are unable or prefer not to drive. These services are particularly important in connecting communities among which other forms of alternative transportation such as traveling as a pedestrian or bicycling may not be feasible due to distance or geography.

Public Transit Ridership Discussion

Public transit ridership in Hawaiʻi is currently dominated by that of Honolulu, as shown in Table H-2. Honolulu also accounts for 75 percent of the state's transit revenue miles.[20]

Table H-2. Hawaiʻi Transit Agency Ridership and Revenue Miles

Transit Agency	Annual Unlinked Transit Trips		Annual Vehicle/Rail Car Revenue Miles	
	Number	Percent	Number	Percent
City and County of Honolulu	40,117,547	93%	24,865,344	75%
County of Maui	1,547,536	4%	2,478,802	7%
County of Hawaiʻi	1,046,888	2%	4,160,939	13%
County of Kauaʻi	647,841	1%	1,762,192	5%
Total	43,359,812	100%	33,267,277	100%

Source: FTA 2023

Table H-3 shows that transit riders currently account for 4 percent of commuter trips statewide and 5 percent of commuter trips in the City and County of Honolulu. Honolulu's transit mode share is

[20] These figures pre-date the opening of the Skyline.

comparable to or better than many cities but lags behind national leaders such as Seattle and San Francisco.

Table H-3. Transit Commute Mode Shares

Hawaiʻi Statewide	Honolulu	Portland	San Francisco	Seattle	Minneapolis
4.1%	5.3%	7.3%	21.4%	14.2%	7.0%

Source: U.S. Census Bureau 2023

TheBus, the City and County of Honolulu public transit bus service, currently covers an area of over 275 square miles. TheBus operates over 100 bus routes across the island of Oʻahu, consisting of frequent urban routes (offering frequencies of 20 minutes or less), major suburban routes (frequencies of 20 to 30 minutes), local routes (frequencies ranging from 30 to 60 minutes), and commuter routes (offering a select number of trips in the morning and evening). The Handi-Van also provides curb-to-curb paratransit services to areas located within 0.75 mile of a bus route.

The Honolulu Authority for Rapid Transportation (HART) Skyline rail system opened in 2023 and will feature 19 stations and 19 miles of track along Oʻahu's southern shore when fully complete. As of March 2025, 9 stations are in operation, with an additional 4 stations anticipated to be in operation by the end of the year. The remaining 6 stations are anticipated to be complete in 2031. The Skyline will be fully integrated with TheBus. Together, they are expected to provide service and future growth to rapidly developing areas and contribute to TOD along the rail alignment (HART n.d.).

The public transit network includes two complementary pieces: intra-city transit and inter-city transit. Intra-city public transit and travel is movement and routes within a city or community. Examples of intra-city public transit are the Wailuku Loop (run by Maui Bus) and the Skyline (run by HART). Inter-city public transit and travel is movement and routes among cities and communities; these are typically longer routes. Examples of inter-city public transit are Route 2 Kailua-Kona (run by Hele-On) and Route 400 Hanalei-Līhuʻe (run by The Kauaʻi Bus.)

As laid out in the 5-Year Priority Multimodal Network and Implementation Plan and the 2045 Unconstrained Multimodal Network and Implementation Plan, the creation of a robust public transportation network will be key to supporting the long-term success of alternatives to personal vehicle trips.

Key components of the public transit network will include the following:

- Improving transit performance. Improved performance by local transit agencies on key routes is necessary to increase the share of transit trips, which supports affordability, mobility, and the travel choices for keiki, kūpuna, and other riders. Improved transit travel speeds have the effect of reducing headways while improving travel time for existing and future transit riders.
  - Bus Rapid Transit operating on its own right-of-way with limited stops, fare payment prior to boarding, and multi-door boarding could be possible in more dense travel corridors.
  - Express bus service operating on regular streets but using enhancements such as queue-jump lanes and traffic signal priority could serve other, less-dense routes.
- Finishing the Skyline (under HART) to maximize ridership and the opportunities for transit-oriented development (TOD).

- Improving inter-city bus service provided by local transit agencies and supported by HDOT through the state highway system (captured in the Inter-City Public Transit Strategy, Strategy HWY-M-3 in Chapter 3 of the Plan).
- Enhancing coordination across various transportation modes and agencies (Act 131 mandates connections across government departments) to improve traveler experience lead by HDOT.

In addition to these key investments, public transit enhancements and expansion can include but are not limited to the following:

- Extending bus network coverage (access to transit) and hours, and increasing service frequency
- Implementing transit-supportive treatments such as queue-jump lanes or traffic signal priority for buses
- Improving bus stop or transit station amenities:
  - Adding benches, shelters, lighting, and real-time transit information
  - Enhancing connections to public transit, such as sidewalks and crosswalks, can also support increased transit ridership and mode shifts (captured in the First-Mile-Last-Mile Intermodal Connections Strategy)
- Introducing policies such as reducing transit fares or providing fare-free services with a focus on serving disadvantaged and transit dependent communities

Because public transit operates most efficiently where there is sufficient land use density, the use of and success of transit as a strategy to reduce GHG emissions depends on factors such as coordination with land use development (captured in the Transit-Oriented and Compact Development Strategy), first- and last-mile infrastructure (captured in the First-Mile-Last-Mile Intermodal Connections Strategy) and parking management (captured in the Revised Parking Standards Strategy), all of which are covered in the sections that follow.

First-Mile-Last-Mile Intermodal Connection Discussion

The **First Mile-Last-Mile Intermodal Connection Analysis** will be publicly available in 2027. It will include but is not limited to the following:

- The HDOT and county standards and guidelines for first mile-last-mile infrastructure and programs, by land use and typology of the bus stops (public transit and public school bus), harbors, and airports, including the following:
  - A review of the common and disparate elements of public transit stops, public school bus stops, harbors, airports, and mobility hubs.
  - A preferred and a maximum acceptable contiguous child travel path distance for a child traveling between their residence and their public school bus stop. These distances will be established in coordination with the Hawaiʻi Department of Education Student Transportation Services Branch.
  - The preferred elements that support transition between modes such weather protection (including shade), seating, lighting, bicycle parking, secure bicycle parking, and real-time transit information.

- Analysis for public transit stops, harbors, and airports as follows:
  - Location
  - Status of the existing facility (does or does not meet the standard, not applicable)
  - Population served within 0.5 and 1.5 miles (include 5 miles for significant public transit facilities, harbors, and airports)
  - Status of the contiguous surrounding access for Americans with Disabilities Act (ADA)/Public Right-of-Way Accessibility Guidelines (PROWAG) accessible pedestrian infrastructure facilities (from 0.5 mile) and bicycle infrastructure facilities (from 1.5 miles for general public transit stops, include from 5 miles for significant public transit facilities, harbors, and airports)
  - Quantity, type, and condition of bicycle parking infrastructure
  - Potential for secure bicycle parking infrastructure (for significant public transit facilities, harbors, and airports)
  - Potential for the deployment of mobility hubs
- Analysis for public school bus stops as follows:
  - Location
  - Status of the existing stop (does or does not meet the standard, not applicable)
  - Status of contiguous surrounding access for ADA/PROWAG accessible pedestrian infrastructure facilities and protected bicycle infrastructure facilities from the maximum acceptable contiguous child travel path distance away
  - Potential for shared purpose with a nearby public transit stop or mobility hub
- Identification and details of desire lines/paths created by the public in the immediate vicinity of public transit stops, public school bus stops, harbors, and airports, including routes identified as desired cut throughs in Safe Routes to School (SRTS) discussions.
- Proposed projects to bring all public transit stops, public school bus stops, harbors, and airports and their surrounding areas to meet the standards. This may include tactical urbanism strategies using the lessons learned by the State of Hawaiʻi Department of Health (DOH) through their Hawaiʻi Quick-Build Projects. Tactical urbanism efforts would be intended for immediate implementation by HDOT and other stakeholders, completed well before the first benchmarks of 2035.

Revision of the HDOT-Highways Complete Streets Policy Discussion

It is recommended the HDOT Highways Division (HDOT-Highways) Complete Streets Policy be amended and expanded to include but not be limited to the following:

- Revision of the language of the policy to emphasize that the support of multimodal travel for the most vulnerable users (pedestrians, bicyclists, transit riders, and users with disabilities) is fundamental to the purpose of the department. All language should be removed that characterizes multimodal infrastructure as bonus, additional, optional elements, or secondary in purpose. When multiple important purposes are present in a project or operation, it is an achievement of collaboration and recognition of the multiple responsibilities of HDOT.

- Revision of the exemptions from the Complete Streets Policy to do the following:
  - Define the responsibility of the exemption process.
  - Define the record keeping and public transparency of the exemption process.
  - Define the exemptions as solely those in Hawaiʻi Revised Statutes (HRS) § 264-20.5 (2024).
- Revision and definition of the responsibilities, nature, and public transparency of HDOT Complete Streets Checklists for operational functions and projects.
- Acknowledgement and definition of the HDOT conflicts and competing needs policies regarding projects and operations, including the following:
  - The safety of the most vulnerable users
  - Motor vehicle speed, flow, driver convenience
  - Freight vehicle speed, flow, driver convenience
  - Prioritization and allocation when space is a limiting factor, and vulnerable users are likely.
- Acknowledgement, a timeline, and clear direction for the amendment of guidance, standards, and procedures for HDOT operations and projects to fully integrate the Complete Streets policy, including but not limited to, the following:
  - Planning and Scoping: HDOT Asset Programs, Mid-Range Transportation Plan (MRTP), Statewide Transportation Improvement Program (STIP), Public Project Interface
  - Design: Design Standards and Guidance
  - Construction: Maintenance of Traffic
  - Operations: Safety, direction (signalization, signage, wayfinding), travel time reliability
  - Maintenance: Equitable maintenance for all ground transportation facilities
  - Administrative Operations
- Acknowledgement of the need for aligned institutional knowledge of Complete Streets and the definition for an internal initiative of education including but not limited to mandatory recurring employee training and public transparency of training compliance.
- Acknowledgement of projects that are beyond stages of planning, scoping, and design, with deadlines and details for transition to the updated policy.
- Deadlines and details for transition of the operational functions of HDOT to the updated policy.
- Deadlines and definitions for the public transparency and responsibility for the implementation of the Complete Streets Policy, including through the transition.

It is recommended that the revised HDOT-Highways Complete Streets Policy be publicly available in 2025.

Bicycle Network Discussion

Bicycling in Hawaiʻi currently has a mode share similar to peer jurisdictions with similar density but lags behind national leaders.

While information on the extent of bicycling for all trips is limited, the U.S. Census provides information on commute trips (journey to work). Table H-4 shows that bicycling currently accounts for approximately 1 percent of commute trips statewide and on Oʻahu. In contrast, cities known for their robust bicycling systems, such as Portland, San Francisco, Seattle, and Minneapolis, have bicycle mode shares that are two to three times higher.

Table H-4. Bicycle Commute Mode Shares

Hawaiʻi Statewide	Honolulu	Portland	San Francisco	Seattle	Minneapolis
0.9%	1.1%	3.7%	3.5%	2.7%	1.8%

Source: U.S. Census Bureau 2023

To achieve an aggressive total VMT reduction of 30 percent by 2045, Hawaiʻi will need to substantially increase its bicycle mode share. An appropriate mode share target is 4 percent, commensurate with Portland, Oregon.

The **Bicycle Infrastructure component of the 5-Year Priority Multimodal Network and Implementation Plan** that will be publicly available online in 2025 will include but is not limited to the following:

- The alignment of the existing statewide bicycle infrastructure network (HDOT, the counties, and communities)
  - As a story map, the existing status of the statewide bicycle infrastructure network specific to the applicable Complete Streets multimodal infrastructure design and maintenance thresholds
  - Indicating type of bicycle infrastructure including specifying the presence of a barrier or buffer as applicable (signed shared roadway, painted bicycle lanes, barrier-protected bicycle lanes, shared-use path, user-secured bicycle parking, secure bicycle parking, and similar)
- The alignment of the Bicycle Infrastructure component of the 5-Year Priority Multimodal Network
  - Descriptions of all future projects, including the following:
    - Type of bicycle infrastructure including specifying the presence of a barrier or buffer as applicable (signed shared roadway, painted bicycle lanes, barrier-protected bicycle lanes, shared-use path, user-secured bicycle parking, secure bicycle parking, and similar)
    - List of jurisdictional responsibility, noting any changes between planning, design, construction, and maintenance
    - Description of anticipated inter-jurisdictional coordination or inter-departmental coordination
    - The source of the project concept
    - Support of HRS § 264-142
    - Support of greater HDOT and State initiatives including but not limited to the following:
      - Vision Zero
      - SRTS
      - Safe Routes to Parks (potential DOH initiative)
      - Safe Routes for Seniors (potential HDOT initiative)
      - Nā Ala Hele Trail & Access Program
      - The Hawaiʻi Strategic Highway Safety Plan
    - Support of county or community initiatives

  - As a web page with maps and tables, the anticipated status of the Bicycle Infrastructure component of the 5-Year Priority Multimodal Network specific to the applicable Complete Streets multimodal infrastructure design and maintenance thresholds
  - An implementation plan that may include but is not limited to the following:
    - The sequence of the projects construction; that is, a phased approach with year timelines and map visuals to implement the proposed bicycle infrastructure components of the 5-Year Priority Multimodal Network.
    - Important interfaces between existing or future projects.
    - The programmed funding for each project through MRTP/STIP as line-items by funding year.
  - Statewide guidelines (applicable to pedestrian and bicycle infrastructure) for tactical urbanism, quick builds, and pilot projects.

The **Existing Bicycle Infrastructure Network Gap-Analysis** will be publicly available in 2026. This analysis of the existing statewide bicycle infrastructure network will identify locations and ground transportation facilities that can be integrated into future projects. It will note any that are currently part of the 5-Year Priority Multimodal Network. The analysis will include but is not limited to the following:

- Indication of type of bicycle infrastructure including specifying the presence of a barrier or buffer as applicable (signed shared roadway, painted bicycle lanes, barrier-protected bicycle lanes, shared-use path, user-secured bicycle parking, secure bicycle parking, and similar)
- The extents of the existing statewide bicycle infrastructure network
- Intersections and interfaces with infrastructure of a different jurisdiction
- Details of desire lines/paths created by the public not included in the Intermodal Connection Analysis
- Details of other routes that are not officially designated that are used by people traveling by bicycle, such as routes across parking lots or through building complexes
- Complete list of identified locations and ground transportation facilities, with indication of jurisdiction
- In coordination with the Pedestrian Infrastructure Network Gap-Analysis, a conduct gap-analysis of shade coverage and pedestrian-level lighting

The Bicycle Infrastructure component of the 2045 Unconstrained Multimodal Network and Implementation Plan that will be publicly available in 2027 will include but is not limited to the following:

- The history and context of the bicycle infrastructure planning and construction by HDOT, the counties, and communities
- The quantifiable 5-year (2035, 2040, and 2045) benchmarks of the goals of HDOT through the 2045 Unconstrained Multimodal Network, with specific reference to the following:
  - HRS § 264-142.
  - Quantity and percentage of residences with direct access to contiguous bicycle infrastructure facilities to significant transit facilities, and key land uses within 1.5, 3, and 5 miles. Key land uses include schools, tourist destinations, harbors, airports, stadiums, state and county beaches, state and county parks, hotels, libraries, medical facilities, police stations, government service buildings, high-density residential districts, and commercial districts.

  - Centerline miles of HDOT and county/community ground transportation facilities that support bicycle travel, indicating type of bicycle infrastructure including specifying the presence of a barrier or buffer as applicable (signed shared roadway, painted bicycle lanes, barrier-protected bicycle lanes, shared-use path, user-secured bicycle parking, secure bicycle parking, and similar).
  - Centerline miles of HDOT and county/community ground transportation facilities that support bicycle travel that will meet the applicable Complete Streets multimodal infrastructure design and maintenance thresholds.
  - Bicycle safety, support of Vision Zero, and alignment with the Hawaiʻi Strategic Highway Safety Plan.
- A comprehensive layering of the statewide bicycle infrastructure network, including the following:
  - Existing
  - Bicycle Infrastructure component of the 5-Year Priority Multimodal Network
  - Bicycle Infrastructure Network Gaps
  - First-Mile-Last-Mile Intermodal Connections
  - Additional bicycle infrastructure projects to meet the aforementioned network goals through the 2045 Unconstrained Multimodal Network
- A complete list of the additional bicycle infrastructure projects to meet the aforementioned network goals through the 2045 Unconstrained Multimodal Network, including the following:
  - Type of bicycle infrastructure, including specifying the presence of a barrier or buffer as applicable (signed shared roadway, painted bicycle lanes, barrier-protected bicycle lanes, shared-use path, user-secured bicycle parking, secure bicycle parking, and similar)
  - List of jurisdictional responsibility, noting any changes between planning, design, construction, and maintenance
  - Description of anticipated inter-jurisdictional or inter-departmental coordination
  - The source of the project concept
  - Support of HRS § 264-142
  - Support of greater HDOT and State initiatives, including but not limited to the following:
    - Vision Zero
    - SRTS
    - Safe Routes to Parks (potential DOH initiative)
    - Safe Routes for Seniors (potential HDOT initiative)
    - Nā Ala Hele Trail & Access Program
    - The Hawaiʻi Strategic Highway Safety Plan
  - Support of county or community initiatives
- An implementation plan that will include but is not limited to the following:
  - A tactical urbanism strategy for bicycle infrastructure using the lessons learned by the DOH through their Hawaiʻi Quick-Build Projects. Tactical urbanism efforts are intended for immediate implementation by HDOT and other stakeholders, completed well before the first benchmark of 2035.

- The sequence of the project's construction; that is, a phased approach with year timelines and map visuals to implement the proposed bicycle infrastructure components of the 2045 Unconstrained Multimodal Network.
- Important interfaces between existing or future projects.
- The programmed funding for each project through MRTP/STIP as line-items by funding year.

Pedestrian Network Discussion

In terms of the share of pedestrian trips, Hawaiʻi performs similarly or better than most peer jurisdictions with similar density, but like bicycling, Hawaiʻi lags behind national leaders. The U.S. Census provides information on commute trips (journey to work) by mode. Table H-5 shows that walking currently accounts for 3.9 percent of commute trips statewide and 4.9 percent of commute trips on Oʻahu. Honolulu is similar to Portland, Oregon, in walking mode share, but San Francisco and Seattle have significantly higher walking mode shares.

Table H-5. Walk Commute Mode Shares

Hawaiʻi Statewide	Honolulu	Portland	San Francisco	Seattle	Minneapolis
3.9%	4.9%	5.1%	10.3%	8.5%	6.0%

Source: U.S. Census Bureau 2023

To achieve an aggressive total VMT reduction of 30 percent by 2045, Hawaiʻi will need to increase its pedestrian mode share. An appropriate mode share target is 10 percent, commensurate with San Francisco.

The **Pedestrian Infrastructure component of the 5-Year Priority Multimodal Network and Implementation Plan** that will be publicly available online in 2025 will include but is not limited to the following:

- The alignment of the existing statewide pedestrian infrastructure network (HDOT, counties, and communities)
  - As a story map, the existing status of the statewide pedestrian infrastructure network specific to the applicable Complete Streets multimodal infrastructure design and maintenance thresholds
- The alignment of the Pedestrian Infrastructure component of the 5-Year Priority Multimodal Network
  - Descriptions of all future projects, including the following:
    - List of jurisdictional responsibility, noting any changes between planning, design, construction, and maintenance
    - Description of anticipated inter-jurisdictional coordination or inter-departmental coordination
    - The source of the project concept
    - Support of HRS § 264-142
    - Support of greater HDOT and State initiatives including but not limited to the following:
      - Vision Zero
      - SRTS
      - Safe Routes to Parks (potential DOH initiative)
      - Safe Routes for Seniors (potential HDOT initiative)

        - Nā Ala Hele Trail & Access Program
        - The Hawaiʻi Strategic Highway Safety Plan

    - Support of county or community initiatives

  - As a web page with maps and tables, the anticipated status of Pedestrian Infrastructure component of the 5-Year Priority Multimodal Network specific to the applicable Complete Streets multimodal infrastructure design and maintenance thresholds

  - An implementation plan that may include but is not limited to the following:

    - The sequence of the project's construction; that is, a phased approach with year timelines and map visuals to implement the proposed pedestrian infrastructure components of the 5-Year Priority Multimodal Network

    - Important interfaces between existing or future projects

    - The programmed funding for each project through MRTP/STIP as line-items by funding year

  - Statewide guidelines (applicable to pedestrian and bicycle infrastructure) for tactical urbanism, quick builds, and pilot projects

The **Existing Pedestrian Infrastructure Network Gap-Analysis** will be publicly available in 2026. This analysis of the existing statewide pedestrian infrastructure network will identify locations and ground transportation facilities that can be integrated into future projects. It will note any that are currently part of the 5-Year Priority Multimodal Network. The analysis will include but is not limited to the following:

- The extents of the existing statewide pedestrian infrastructure network

- Intersections and interfaces with infrastructure of a different jurisdiction

- Details of desire lines/paths created by the public not included in the Intermodal Connection Analysis

- Details of other routes that are not officially designated, that are used by people traveling as pedestrians, such as routes across parking lots or through building complexes

- Complete list of identified locations and ground transportation facilities, with indication of jurisdiction

- In coordination with the Bicycle Infrastructure Network Gap-Analysis, a conducted gap-analysis of shade coverage and pedestrian-level lighting

The Pedestrian Infrastructure component of the 2045 Unconstrained Multimodal Infrastructure Network and Implementation Plan that will be publicly available in 2027 will include, but is not limited to, the following:

- The history and context of the pedestrian infrastructure planning and construction by HDOT, the counties, and communities

- The quantifiable 5-year (2035, 2040, and 2045) benchmarks of the goals of HDOT through the 2045 Unconstrained Multimodal Network with specific reference to the following:

  - HRS § 264-142.

  - Quantity and percentage of residences with direct access to contiguous ADA/PROWAG accessible sidewalks, ramps, crosswalks, and shared-use paths to significant transit facilities, and key land uses within 0.25 and 0.5 mile. Key land uses include schools, tourist destinations, harbors, airports, stadiums, state and county beaches, state and county parks, hotels, libraries, medical facilities, police stations, government service buildings, high-density residential districts, and commercial districts.

  - Centerline miles of HDOT and county/community ground transportation facilities that support pedestrian travel.
  - Centerline miles of HDOT and county/community ground transportation facilities that support pedestrian travel that will meet the applicable Complete Streets multimodal infrastructure design and maintenance thresholds.
  - Pedestrian safety, support of Vision Zero, and alignment with the Hawaiʻi Strategic Highway Safety Plan.

- A comprehensive layering of the statewide pedestrian infrastructure network, including the following:
  - Existing
  - Bicycle Infrastructure component of the 5-Year Priority Multimodal Network
  - Pedestrian Infrastructure Network Gaps
  - First-Mile-Last-Mile Intermodal Connections
  - Additional pedestrian infrastructure projects to meet the aforementioned network goals through the 2045 Unconstrained Multimodal Network
- A complete list of the additional pedestrian infrastructure projects to meet the aforementioned network goals through the 2045 Unconstrained Multimodal Network, including the following:
  - List of jurisdictional responsibility, noting any changes between planning, design, construction, and maintenance
  - Description of anticipated inter-jurisdictional or inter-departmental coordination
  - The source of the project concept
  - Support of HRS § 264-142
  - Support of greater HDOT and State initiatives including but not limited to the following:
    - Vision Zero
    - SRTS
    - Safe Routes to Parks (potential DOH initiative)
    - Safe Routes for Seniors (potential HDOT initiative)
    - Nā Ala Hele Trail & Access Program
    - The Hawaiʻi Strategic Highway Safety Plan
  - Support of county or community initiatives
- An implementation plan that will include but is not limited to the following:
  - A tactical urbanism strategy for pedestrian infrastructure using the lessons learned by DOH through their Hawaiʻi Quick-Build Projects. Tactical urbanism efforts are intended for immediate implementation by HDOT and other stakeholders, completed well before the first benchmark of 2035.

- The sequence of the project's construction; that is, a phased approach with year timelines and map visuals to implement the proposed pedestrian infrastructure components of the 2045 Unconstrained Multimodal Network.
- Important interfaces between existing or future projects.
- The programmed funding for each project through MRTP/STIP as line-items by funding year.

Bicycle and Pedestrian Initiative Discussion

The Bicycle and Pedestrian Initiatives Analysis and Implementation Plan scheduled for 2027 will include but is not limited to the following:

- Analysis of opportunities for additional integration with State/HDOT initiatives including the following:
  - SRTS
  - Safe Routes to Parks (potential DOH initiative)
  - Rebate program for electric bicycle and electric moped eligible purchases
  - HSEO initiatives
  - Nā Ala Hele Trail & Access Program initiatives
- Review of additional HDOT activities, initiatives, and pilots to support bicycle and pedestrian travel, including but not limited to the following:
  - Safe Routes for Seniors.
  - HDOT lead or support of a pilot for ‘fietsvlonder,’ also known as bicycle parking platforms to efficiently implement bicycle parking in existing vehicle parking spaces, with an emphasis on supporting businesses and communities that are interested in trialing a change in the provided parking infrastructure.
  - Multimodal visitor travel, including initiatives to encourage the addition and promotion of multimodal options for visitors and tourists between the airport and lodging, and lodging and major tourism attractions. This will include collaboration with tourism stakeholders, public transit, and HDOT-Airports.
  - Electric mobility, using lessons learned elsewhere, including the NYC Electric Mobility Action Plan: Charge Safe, Ride Safe. This will include support for the storage and usage of electric bicycles and micromobility.
- Review of legislation and law enforcement policies with discussion of any conflict with the intention of supporting bicycle and pedestrian travel, including but not limited to the following:
  - A clarification and update of the Hawaiʻi laws relating to e-bikes and electric dirt bikes as requested by the Council of the City and County of Honolulu in Resolution 24-199, adopted 04 September 2024, which discusses penalties and enforcement for theft or damage of bicycles and micromobility devices
  - Penalties and enforcement of pedestrian behavior such as jaywalking
- Implementation plan with 5-year benchmarks (2030, 2035, 2040, and 2045) for the support of bicycling and pedestrian activities, initiatives, and pilots.

Innovative Mobility/Technology Solutions Discussion

Numerous technologies are changing the state's transportation system, and further development of technology can be harnessed to support the conversion of auto trips to alternatives modes, thereby reducing emissions. Mobility-as-a-Service (MaaS) can reduce emissions by integrating various transportation modes into a single, user-friendly platform, encouraging the use of public transit, shared mobility, and non-motorized options like bicycling and traveling as a pedestrian. By providing real-time information and seamless payment systems, MaaS makes it easier for people to choose sustainable travel options over personal vehicle use. MaaS can also optimize route planning and vehicle utilization, further enhancing the efficiency and environmental benefits of transportation networks. The deployment of MaaS will further support the public transit, pedestrian, and bicycling strategies outlined in this appendix, allowing for smoother transitions between modes and operators (such as bikeshare trip -> transit ride).

Autonomous electric vehicle (EV) shuttles can play a role in reducing emissions by providing efficient, zero-emission transportation options. These shuttles can operate on fixed routes or on-demand, optimizing travel patterns and reducing the need for personal vehicle use. By leveraging advanced technologies for route optimization and energy efficiency, autonomous EV shuttles minimize idle time and maximize battery performance. This leads to lower GHG emissions and improved air quality. The integration of autonomous EV shuttles into public transit systems can also enhance connectivity and accessibility, encouraging more people to choose sustainable transportation options over traditional, fossil-fuel-powered vehicles.

Bikeshare, currently available as Biki (Oʻahu) and HIBike (Hawaiʻi), supports the choice to travel via bicycle by mitigating the cost, maintenance, and relocation efforts of using a personal bicycle. The addition of electric bicycles to the rideshare fleet extends the distance and terrain that people could use for bikeshare. Strategic addition of bikeshare stations and fleet in coordination with the expansion of the surrounding bicycle infrastructure network can provide a viable travel alternative for visitors as well as Hawaiʻi residents.

Finally, technology and digital solutions can enhance the efficiency of freight movement and reduce emissions by optimizing logistics and operations. Advanced data analytics and real-time tracking systems enable precise route planning, reducing unnecessary travel and idle time. Automated and connected vehicle technologies improve fuel efficiency and allow for better coordination between trucks, minimizing congestion and delays. By leveraging these technologies, Hawaiʻi can support the goods movement industry to lower GHG emissions, reduce fuel consumption, and contribute to a more sustainable transportation system while transitioning to clean vehicles in the years to come.

Additional Strategy: Transportation System Management and Operations (TSMO)

Transportation system management and operations (TSMO) strategies are designed to improve traffic flow, reduce travel delays, and optimize transportation system performance. Stop-and-go conditions and vehicle idling at traffic signals or in congested delay cause conventional vehicles (powered by internal combustion engines) to consume more fuel and emit more emissions than vehicles traveling at a smoother rate between 35 miles per hour (mph) and 65 mph. It is recognized that these speeds for vehicular traffic are greater than 25 mph and therefore present a greater danger to the lives of the most vulnerable users in a collision. This strategy will always consider first the safety of the most vulnerable users. It is estimated that traffic incidents, weather conditions, special events, and poor traffic signal timing are responsible for about half of the delay on roadways, and so operational strategies that reduce delay can reduce emissions. Examples of TSMO strategies include traffic signal coordination, adaptive signal control (that is, signals that respond to real-time traffic conditions), ramp metering, variable speed limits, peak period shoulder use, electronic variable message signs, traffic incident management, multimodal traveler information, work zone management, and special events management. Use of traffic sensors to monitor traffic flow and operations centers to monitor and respond to traffic conditions are often foundational elements for implementing TSMO strategies.

It is estimated that vehicles in Hawaiʻi experienced 9.53 million vehicle hours of delay in 2019, and that of that delay, 45 percent was due to recurrent congestion (caused due to higher volumes than available capacity), while 55 percent was due in part to other causes, such as traffic signals, incidents, weather, work zones, or multiple causes (RITIS n.d.).

HDOT manages an Intelligent Transportation System (ITS) program. According to the Hawaiʻi ITS Strategic Plan, initiatives that have been implemented or planned under the program include the following (HDOT 2015):

- Adding ITS devices to support incident management and traveler information needs on Oʻahu
- Completing a robust communications network
- Replacing and installing new variable message signs (VMS)
- Supporting the Go Akamai traveler information website (www.goakamai.org)
- Implementing roving freeway service patrols
- Participating in operations of the Joint Traffic Management Center, in conjunction with the City and County of Honolulu

In 2020, HDOT received an Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) grant for its Implementing Cellular Vehicle-to-Everything (V2X) Technology to Improve Safety and ITS Management project (FHWA 2020).

TSMO strategies reduce GHG emissions associated with vehicle idling, excess vehicle travel time due to congestion, and poor fuel economy associated with stop-and-go travel. Overall, TSMO strategies would be expected to have modest impacts on transportation emissions across Hawaiʻi.

A meta-analysis of studies on traffic signal coordination and traffic incident management by the California Air Resources Board (CARB) estimated GHG reductions of 1 to 10 percent on most impacted segments (Rodier et al. 2014). While TSMO strategies improve the fuel efficiency of vehicle travel, reducing vehicle delay can lead to more vehicle travel (through shifts from transit and other options to driving or encouraging more trips), which can offset some of the efficiency savings. For instance, a simulation study of operational improvement strategies conducted in the San Francisco Bay Area, sponsored by the Federal Highway Administration, suggested that the impacts of a comprehensive package of strategies in 2015 would result in an overall reduction of vehicle hours of travel of 8.8 percent, a 2.3 percent increase in VMT, and yield about a 1.6 percent reduction in regional carbon dioxide (CO_2) emissions (FHWA 2014). Speed control and smoothing the flow of traffic through direct driver feedback (supporting “eco-driving”), in theory, could yield somewhat higher impacts. A range of studies suggest that drivers can reduce their fuel consumption and associated GHG emissions through smart driving principles by up to 18 percent, with many of the most rigorous studies demonstrating average fuel savings of 2 percent to 7 percent (ICF 2014). A meta-analysis of 17 studies involving eco-driving as a behavioral change technique, reinforced with in-vehicle feedback systems, found that eco-driving improved fuel economy by 6.6 percent on average (Sanguinetti et al. 2020).

That said, effects of traffic signals and other operations strategies are likely to be largest in the short-term and decline over time. The effects of speed and flow on vehicles differ for hybrid vehicles and EVs, compared to internal combustion vehicles; for instance, for hybrid vehicles, energy from braking charges the vehicle's battery, resulting in higher miles per gallon in city driving compared to freeway driving. As a result, the benefits of TSMO strategies on GHGs will be expected to decline as more of the fleet becomes electrified.

Implementation

TSMO strategy implementation will involve actions by HDOT along with regional and local transportation agency partners (for example, county departments of public works) responsible for traffic signals and other aspects of transportation system operations. Partnerships with other organizations, such as law enforcement (for example, for incident management), event venues (for example, for special events) are also important. HDOT could set milestones for implementation of adaptive traffic signals across roadway networks, along with benchmarks for incident management. Costs are associated with procurement and installation of ITS devices/signals and other technologies, along with staff time.

Ridesharing Discussion

The State of Hawaiʻi and HDOT have several components in place to support efficient and sustainable transportation. The rideshare webpage offers multimodal travel resources and information about transportation demand management (TDM) programs across the state. The Qualified Transportation Fringe Benefit allows employers to provide a portion of their employees' paychecks before tax deductions for alternative commuting. Transit resources include TheBus and the Oʻahu Vanpool Incentive Program. In addition, a carpool matching service is available through the rideshare website. HDOT encourages ridesharing by providing HOV and zipper lanes reserved for buses, carpools, and motorcycles. The TDM office within the HDOT-Highways Traffic Branch offers various programs and services to promote shared rides. As a result, Hawaiʻi and Oʻahu have relatively high carpooling commute mode shares of 17 percent and 21 percent, respectively.

Although the ridesharing mode share for work trips is relatively high in Hawaiʻi, there are additional policies and strategies that can be implemented to further support ridesharing, include the following:

- **Special Carpool/Vanpool Parking**. Parking facilities designate desirable parking spaces for carpool and vanpools only. On a broader level, state or local governments can offer discounted parking permits for qualified carpool and vanpools. Agencies also can encourage employers to establish designated carpool/vanpool parking spaces in convenient locations.
- **Enhanced Subsidies**. State programs and local jurisdictions can subsidize the cost of running a carpool or vanpool or can encourage employers to subsidize these programs. Some jurisdictions offer subsidies for vanpools with at least five riders, for those that operate a carpool or vanpool for more than six months, and for riders that take surveys on how to improve services.
- **Park-and-ride and HOV Facilities.** Additions of these facilities can potentially help to further facilitate the development of rideshare arrangements.
- **Employer Outreach.** Targeted employer-focused programs can help organizations to identify where their employees are coming from and help to establish carpool and vanpool programs. At a worksite level, research has shown that employer carpool programs can provide a reduction of up to 8 percent of work trip VMT, while vanpool programs can provide a reduction of up to 7 percent (note that work trips are only a portion of all trips) (California Air Pollution Control Officers Association 2024).

Employer Commuter Program Discussion

The HDOT Support of Employer Commuter Programs and Implementation Plan that will be publicly available in 2026 will include but is not limited to the following:

- The history and context of state and employer commuting programs in Hawaiʻi
- The quantifiable 5-year benchmarks (2030, 2035, 2040, and 2045) of the goals of HDOT through the HDOT Support of Employer Commuter Programs Plan with specific reference to the types of employee commute programs and the employer percentage participation, by county
- The alignment of the existing HDOT and/or State of Hawaiʻi programs with any programs created by counties or communities including but not limited to the following:
  - HOV lanes for carpools/vanpools
  - 511 GoAkamai
  - Vanpool Programs
  - Carpool Programs
  - Pre-Tax Transit Passes
  - Employer Subsidized Transit Passes
  - Blue Planet Foundation's Oʻahu Commute Challenge
  - Biki Employer Plans
  - Employer shuttles to transit stops
- Any programs or requirements created by counties (or anticipated) as a result of HRS § 46-16.2 (2024)
- Any existing commuting programs for State of Hawaiʻi employees and future anticipated programs as the result of initiatives or legislation
- The current and potential gaps in employer commuter support
- Review of potential additional initiatives including but not limited to the following:
  - Guaranteed Ride Home
  - Support of quarterly local employer roundtables moderated by the county or an MPO
  - Preferential or Designated parking for Carpools and Vanpools
  - Outdoor secure micromobility parking (with the potential for electricity charging) for standard bicycles, e-bikes, and scooters
  - Increased public transit
  - Support for the creation of lockers and shower facilities for commuters
- An equity lens of focus on employers that offer commute program benefits and the employees that can participate

The Implementation Plan will include but is not limited to the following:

- Sequencing of initiatives: A phased approach with year timelines and flow diagrams visuals noting jurisdictional coordination
- Important interfaces between existing or future initiatives
- The funding for each initiative

Transit-Oriented and Compact Development Discussion

Mixed-use development combines residential, commercial, and recreational spaces in close proximity, allowing people to accomplish multiple tasks in one trip. This reduces the overall number of vehicle trips and increases the number of trips by alternative modes. Compact development places homes, workplaces, and amenities closer together, reducing the need for long commutes and lowering VMT. In addition, compact development supports the creation of efficient public transit systems, making it easier for people to use buses, trains, and other forms of public transportation instead of personal vehicles. Promoting development that supports and enhances public transit use includes transit system integration and trip planning tools for better modal integration.

Compact neighborhoods are designed to be pedestrian and bicycle-friendly, encouraging residents to bicycle or travel as pedestrians for short trips instead of using their personal vehicles which can be expected to improve health outcomes. Furthermore, by focusing development in existing urban areas, smart growth helps preserve open spaces and natural habitats, which can otherwise be fragmented by sprawling development. This can increase rates of carbon removal, which could be accounted to offset residual GHG emissions. With lower VMT, traffic congestion is reduced, leading to shorter travel times and less idling, which also decreases emissions. Residents in compact, smart growth communities often spend less on transportation, as they rely more on public transit, bicycling, and traveling as pedestrians. Compact development also creates opportunities for more affordable housing types, including apartments and condominiums.

Compact development reduces the energy consumption associated with both housing and transportation, contributing to overall energy efficiency and sustainability. Smart growth fosters a sense of community by creating vibrant, walkable neighborhoods where residents are more likely to interact and engage with one another.

Road Pricing Discussion

In the near-term, the road user charge will be needed to collect funds to maintain county and state roadways. After community involvement, stakeholder input and a pilot project, the state replaced the $50 EV surcharge with a road usage charge (RUC). Starting on July 1, 2025, EV drivers will have the option to pay a per-mile RUC of $8 per 1,000 miles or a flat annual RUC of $50 when they renew their registration. HDOT will present a long-term road usage charge transition plan to the Legislature by the end of 2025; current legislation would grant the four counties the ability to establish their own RUC to support road repairs and maintenance work in line with the state RUC. Road pricing makes personal vehicle driving during peak hours more expensive, encouraging the consideration of public transit, bicycling, and traveling as a pedestrian. Higher costs for solo drivers promote carpooling and ridesharing, which reduces the total number of vehicles on the road. By varying charges based on the time of day, various road pricing methods encourage drivers to travel during off-peak hours, spreading out traffic demand and reducing peak-hour congestion.

By charging drivers to use congested roads, road usage pricing helps to reduce the number of vehicles on the road, leading to smoother traffic flow and shorter travel times. This reduction in vehicles also improves air quality, as fewer vehicles on the road mean lower emissions of pollutants, leading to better air quality and public health benefits. The funds collected from road usage pricing can also be invested in improving alternative modes of transportation, road maintenance, and other transportation infrastructure improvements.

Road pricing supports sustainable urban development by making it more costly to drive long distances, discouraging urban sprawl and promoting more compact and sustainable urban development. This approach not only reduces traffic congestion but also fosters a more efficient and environmentally friendly transportation system.

Appendix I
Immediate, Short-Term, and Long-Term Strategies

Table I-1. Immediate, Short-, Mid-, and Long-Term Actions for Administration

Timeframe	Studies	Investments	Regulatory Actions
Immediate (through December 2029)	**Clean Fuel Standard** 1. Conduct benchmarking and feasibility study of economic impact of CFS. **HDOT State/County Fleet Transition** 2. Assess fleet needs, charging infrastructure, and leveraging of HDOT's statewide contract with sustainability partners and other procurement contracts to prepare for electrification of state and county agency fleets. **Low-Carbon Materials** 3. Continue the clean materials research program and actively look for grant and research opportunities. Consider implementing clean material standards into contracts with construction contractors. Update the PIʻI Tool with new low-carbon materials as they come into use. **Increase Sequestration** 4. Immediate study of the carbon capture rates of at least one unstudied native ecosystem. **Renewable Electricity** 5. Complete feasibility study to identify opportunities to add renewable electricity to HDOT facilities including highway rights-of-way, airports, and harbors to reduce emissions and support the expected increased charging demand from electric vehicles and equipment. **Green Financing** 6. Assess incorporating green budgeting with the support of Governor Green possibly as a state pilot. Identify emerging green financing strategies (e.g., public-private partnerships).	**Emission Reduction Considerations** 1. Broad roll out and expansion of PIʻI Tool and revision of all related standard operating procedures to incorporate emissions reductions into project decision-making early in process. **HDOT State/County Fleet Transition** 2. Invest $40M into public charging stations and infrastructure for State and county electric vehicles. 3. Conversion of 100% of State agency passenger vehicles to zero emissions by December 31, 2030, consistent with HRS § 196-9(c)(11)(A). **Increase Sequestration** 4. Immediate investment into proven sequestration techniques such as ungulate fencing and native forest restoration through planting native and invasive species removal. **Improve Public Communications** 5. Plan and launch public education campaigns to support the many strategies in this Plan. Successfully inspiring public behavior changes is critical to meet the State's emissions reduction, health, and quality of life goals. **Youth Involvement** 6. Host quarterly meetings of the Hawaiʻi Youth Transportation Council to get feedback and assistance on prioritization and implementation of the decarbonization strategies identified in this Plan and find ways for youth to be meaningfully involved at every step. **HDOT Policies and Education** 7. HDOT to review and revise internal policies and processes to support decarbonization and equitable transportation access, provide regular staff training and continuing education, hire staff as needed to support the decarbonization transition, and implement measures and incentives to reduce staff transportation emissions. **Renewable Electricity** 8. Purchase and install renewable electricity generation equipment and microgrids.	**Clean Fuel Standard** 1. Draft and support legislation as recommended by HDOT's feasibility study; decide which agency will run CFS or alternative program and build a team to run program. **Legislation Supporting ESWR Plan** 2. Draft and support legislation for a) SAF tax credit, b) CFS, c) Youth Transit program, d) Multimodal network, and e) EV support. **Renewable Electricity** Explore policy and process changes if barriers or missed opportunities are encountered during the feasibility study.
Short Term (2030 to December 2034)	**Green Financing** 1. Assess incorporating Green Procurement, which other states are concurrently exploring.	**HDOT State/County Fleet Conversion** 1. Conversion of 100% of State agency light-duty vehicles (including SUVs and light-duty trucks) to zero emissions vehicles by December 31, 2035, consistent with HRS 196-9(c)(11)(B). **Increase Sequestration** 2. Immediate investment into proven and new sequestration techniques. **Youth Involvement** 3. Host quarterly meetings of the Hawaiʻi Youth Transportation Council to get feedback and assistance on prioritization and implementation of the decarbonization strategies identified in this Plan and find ways for youth to be meaningfully involved at every step. **Renewable Electricity** 4. Purchase and install renewable electricity generation equipment and microgrids.	**Renewable Electricity** Explore policy and process changes if barriers or missed opportunities are encountered during the feasibility study.
Mid Term (2035 to December 2039)		**Increase Sequestration** 1. Immediate investment into proven and new sequestration techniques. **Youth Involvement** 2. Host quarterly meetings of the Hawaiʻi Youth Transportation Council to get feedback and assistance on prioritization and implementation of the decarbonization strategies identified in this Plan and find ways for youth to be meaningfully involved at every step.	

Timeframe	Studies	Investments	Regulatory Actions
		Renewable Electricity 3. Purchase and install renewable electricity generation equipment and microgrids.	
Long Term (2040+)		**Increase Sequestration** 1. Immediate investment into proven and new sequestration techniques. **Youth Involvement** 2. Host quarterly meetings of the Hawai‘i Youth Transportation Council to get feedback and assistance on prioritization and implementation of the decarbonization strategies identified in this Plan and find ways for youth to be meaningfully involved at every step. **Renewable Electricity** 3. Purchase and install renewable electricity generation equipment and microgrids.	

CFS = Clean Fuel Standard

ESWR = Energy Security and Waste Reduction

EV = electric vehicle

HDOT = State of Hawai'i Department of Transportation

HRS = Hawai'i Revised Statutes

M = million [dollars]

PI'I = Project Island Impact [Tool]

SAF = Sustainable Aviation Fuel

SUV = sport utility vehicle

Table I-2. Immediate, Short-, Mid-, and Long-Term Actions for Aviation

Timeframe	Studies	Investments	Regulatory Actions
Immediate (through December 2029)	**Sustainable Aviation Fuels Policy** 1. Benchmark assessment of SAF Tax credit policies and SAF coalition best practices. 2. Report on progress made in facilitating adoption of SAF (HRC70). **Electric and Hydrogen-Powered Aircraft** 3. Complete high-level market study of electric and hydrogen aircraft, infrastructure needs, challenges and opportunities and time frame for introduction into airline fleets. **Airspace Modernization and Ramp Efficiency** 4. Collaborate with FAA on pending airspace modernization and ramp efficiency efforts. **Airport Electric and PCA Infrastructure** 5. Collaborate with HECO to complete power grid demand assessment accounting for potential electrification of all relevant equipment at the airport including aircraft, GSE, and rental vehicles/taxis/rideshare/heavy duty/general public vehicles. 6. Take stock of current inventory of gates with ground power, airlines with GSE and lighted areas; identify challenges, opportunities and starting points for continued electrification efforts. **Onsite Renewable Power Assessment** 7. Conduct feasibility assessment for renewable electricity generation opportunities on airport property. 8. Feasibility assessment for implementation of additional electric bus and shuttle service, charging for medium/heavy-duty vehicles, electric construction equipment. 9. EV charging infrastructure adequacy assessment - develop an energy master plan of the facilities including engagement of community and industry to develop specific strategies to spur local EV adoption. **Assess feasibility of L2 and direct current fast charging - central charging hub** 10. Pilot program with Taxis/TNC/rental car companies for EV vehicle adoption and charging infrastructure, discuss/research Green Curb program (as suggested by Uber).	**Sustainable Aviation Fuel** 1. Collaborate with SAF producers, airlines and local stakeholders to establish supply and distribution pipelines. 2. Facilitate first SAF coalition meeting to decide on a structure moiling forward for establishing policies, incentives and infrastructure to support the production, distribution and use of SAF in the state. **Airspace Modernization and Ramp Efficiency** 3. Implementation of airspace modernization and ramp efficiency measures. **Airport Electric and PCA Infrastructure** 4. PCA and ground power for airport gates. 5. Invest in needed infrastructure for GSE electrification. 6. Additional LED lighting upgrades. **Landside Electrification** 7. Acquisition of electric service vehicles and buses. 8. L2 and direct current fast charging infrastructure for all airport vehicles: general parking, buses, delivery vehicles, rental vehicles, ride share (pending feasibly assessment results).	**Sustainable Aviation Fuel** 1. Legislative adoption of SAF Tax Credit Bill. **Airport Electric and PCA Infrastructure** 2. Identify funding path for electrification upgrade at airport gates and GSE and for charging infrastructure at airports for all ground vehicles (taxis, rental cars, buses, medium/heavy-duty vehicles). **Airspace Modernization and Ramp Efficiency** 3. Identify funding for ramp tower analysis (possible federal funding available). **Renewable Electricity** 4. Identify funding for renewable electricity assessment and implementation. **Landside Electrification** 5. Legislation to require electrification of EVs (would impact rental cars/TNCs at airports). 6. Identify funding for airport charging infrastructure/charging hub.
Short Term (2030 to December 2034)	**Electric and Hydrogen Aircraft** 1. Update market study of hydrogen and electric aircraft, infrastructure needs, challenges and opportunities and design and construct projects identified for this time period. **Airspace Modernization and Ramp Efficiency** 2. Collaborate with FAA on pending airspace modernization and ramp efficiency efforts. 3. Evaluate airspace modernization and ramp efficiency technologies.	**Electric and Hydrogen Aircraft** 1. Planning and acquisition of infrastructure to facilitate use of electric and hydrogen aircraft (for interisland flights). **Airspace Modernization and Ramp Efficiency** 2. Additional airspace modernization and ramp efficiency technology investment. **Airport Electric and PCA Infrastructure** 3. PCA and ground power for airport gates. 4. Expand pilot program for GSE electrification to other airlines and invest in additional charging infrastructure. 5. Additional LED lighting upgrades.	**Electric and Hydrogen Aircraft** 1. Identify funding path for electric, hydrogen aircraft infrastructure upgrades at airports. **Landside Electrification** 2. Identify funding for use of electric construction equipment on HDOT airports.

Timeframe	Studies	Investments	Regulatory Actions
		Renewable Electricity 6. Renewable electricity equipment and installation. **Landside Electrification** 7. Charging infrastructure for medium/heavy-duty vehicles (per feasibility assessment).	
Mid Term (2035 to December 2039)	**Electric and Hydrogen Aircraft** 1. Update market study of hydrogen and electric aircraft, infrastructure needs, challenges and opportunities and design and construct projects identified for this time period.	**Electric and Hydrogen Aircraft** 1. Planning and acquisition of infrastructure to facilitate use of H_2 and electric aircraft (for interisland flights) - infrastructure upgrade. **Airport Electric and PCA Infrastructure** 2. PCA and ground power for airport gates. **Renewable Electricity** 3. Renewable electricity equipment and installation.	**Landside Electrification** 1. Legislation to require use of electric construction equipment.
Long Term (2040+)	**Electric and Hydrogen Aircraft** 1. Update market study of hydrogen and electric aircraft, infrastructure needs, challenges and opportunities and design and construct projects identified for this time period.	**Electric and Hydrogen Aircraft** 1. Planning and acquisition of infrastructure to facilitate use of H_2 and electric aircraft (for interisland flights) - infrastructure upgrade. **Airport Electric and PCA Infrastructure** 2. PCA and ground power for airport gates. **Renewable Electricity** 3. Renewable electricity equipment and installation.	

FAA = Federal Aviation Administration

GSE = ground support equipment

H_2 = hydrogen

HECO = Hawaiian Electric Company

L2 = Level 2

LED = light emitting diode

PCA = preconditioned air supply

TNC = transportation network company

Table I-3. Immediate, Short-, Mid-, and Long-Term Actions for Marine

Timeframe	Studies	Investments	Regulatory Actions
Immediate (2025-2030)	1. Comprehensive Port Emissions Inventory: Establish baseline GHG and criteria pollutant emissions from vessels, tug-and-barge, CHCs, and cargo handling equipment at all nine commercial ports. 2. Feasibility Analyses of Clean Fuels: Compare lifecycle C), costs, and infrastructure needs for biodiesel, renewable diesel, bio-LNG, e-methanol, ammonia, and hydrogen. 3. Economic and Workforce Impact Studies: Assess long-term costs of clean fuels, impacts on port competitiveness, and workforce training needs. 4. Clean Marine Fuel Roadmap Study: Identify port-specific infrastructure requirements, safety considerations, and sequencing for LNG, methanol, ammonia, and hydrogen bunkering facilities. 5. Grid Readiness Assessments: Evaluate current port grid capacity, interconnection options, and near-term demand from ZE harbor craft and charging pilots.	1. Build first LNG bunkering facility in Hawai'i (bridging role, compatible with renewable LNG later). 2. Invest in renewable diesel supply chains to guarantee 100% coverage for tug-and-barge as well as CHCs by 2030. 3. Secure funding and financing models: federal grants such as PIDP, and private partnerships for alternative fuel bunkering. 4. Initial pilot projects: small-scale methanol bunkering, ZE harbor craft pilots, and ZE ferries.	1. Regulatory action to establish CI limits for cargo carriers, cruise vessels, and interisland tug-and-barge services. 2. Establish compliance and reporting system: annual CI tracking by fleet, verified through port call records. 3. Establish regulatory measures to require CHCs to fully transition to renewable diesel by 2030 and zero emissions by 2045. 4. Adopt market-based mechanisms such as CFS to develop the supply chain of the clean fuels.
Short Term (2030 to 2035)	1. Alternative Fuel Infrastructure Assessments: Detailed technical and safety studies for methanol and other advanced clean marine fuel bunkering, including permitting pathways. 2. Mid-term Review of CI Compliance: Analyze progress toward 2035 targets and adjust 2040/2045 trajectories if gaps emerge. 3. Grid Upgrade Requirements: Study substation expansions, storage integration, and utility coordination to handle scaling electrical demand.	1. Construct methanol bunkering infrastructure (dedicated terminals or shared facilities). 2. Fuel supply partnerships: establish long-term contracts for renewable diesel, bio-LNG, and green methanol imports; explore local biofuel production.	1. Mid-term review (2033–2035): assess compliance progress and feasibility of 2040/2045 standards; adjust CI stringency only if needed. 2. Phase out fossil LNG: enforce the 2034 cutoff.
Mid Term (2035 to 2040)	1. Hydrogen Feasibility and Technology Readiness Studies: Assess performance of hydrogen-powered OGVs, tugs, and CHCs; identify infrastructure and safety requirements. 2. E-Fuel Supply Chain Analysis: Evaluate import logistics, local hydrogen/e-fuel production potential, and resilience needs across the islands. 3. Operational Performance Reviews: Longitudinal studies on ZE harbor craft performance, downtime, and maintenance.	1. Construct hydrogen bunkering facilities (liquid/compressed storage, pipelines, safety systems). 2. Scale up methanol & other potential advanced clean marine fuel capacity to meet OGV demand. 3. Develop resilient e-fuel supply chain (import terminals, local hydrogen production, storage/distribution hubs). 4. Grid-scale electrical upgrades to support MW charging for e-tugs and CHCs (if feasible).	1. Technology readiness review: check if ZE tugboats, hydrogen bunkering, and methanol/ammonia facilities are fully online. 2. Adjust policy tools: subsidies may be phased down; penalties for non-compliance may increase.
Long Term (2040+)		1. Finalize bunkering infrastructure at all key ports (methanol, ammonia, hydrogen). 2. Full e-fuel supply chain integration: ensure stable, diversified import + local production to guarantee availability. 3. Electrification of smaller vessels (tugs, ferries, CHCs) where feasible.	

CI = carbon intensity

CHC = commercial harbor craft

GHG = greenhouse gas

LNG = liquified natural gas

MW = megawatt

OGV = oceangoing vessel

PIDP = Port Infrastructure Development Program

ZE = zero emissions

Table I-4. Immediate, Short-, Mid-, and Long-Term Actions for Ground Transportation

Timeframe	Studies	Investments	Regulatory Actions
Immediate (2025-2030)	**EV Adoption** 1. Support acceleration of ICE turnover to EV Program planning and pilot design and launch with a focus on priority communities and vehicles over 20 years old. *2. Monitor effectiveness of EV Purchase Incentive legislation.* [a] **5-Year Multimodal Network** *3. Complete existing Bicycle and Pedestrian Infrastructure Network Gap-Analysis.* [a] *4. Complete Bicycle and Pedestrian Initiative Analysis and Implementation Plan document including a First-Mile-Last-Mile Intermodal Connection Analysis and statewide Quick-Build Toolbox and Program Guidelines for identified gaps between public transit, bicycling, walking, and school bus services.* [a] 5. Collaborate with counties to implement a pilot Safe Youth Transit Access program in select counties. **Carpool, Rideshare, and Parking** *6. Conduct and analysis and identify ways to support rideshare programs.* [a] *7. Complete HDOT Support of Employer Commuter Programs and Implementation Plan Document.* [a] 8. Support counties and local governments in a review and revisions of permitting requirements for parking and study the location and use of parking meters.	**EV Adoption** *1. Full implementation of NEVI (11 publicly available stations).* [a] 2. Support implementation of new EV Purchase Incentive legislative package once passed. 3. Support HSEO in development of EV Battery Recycling and Disposal program statewide; ongoing monitoring and evaluation. **5-Year Multimodal Network** *4. Map the 5-Year Priority Multimodal Network, including critical projects in the pedestrian, bike and transit networks. Secure State and county agreement and begin programming and requesting funds.* [a] *5. Follow 5-Year Multimodal Network Implementation Plan to program, fund, plan, design, and construct all projects in the network.* [a] *6. Program projects from the 5-Year Multimodal Network in the MRTP and the STIP.* [a] **Carpool, Rideshare, and Parking** 7. Collaborate with counties, MPOs, and transit providers to deploy MaaS technologies such as bikeshare and autonomous EVs. 8. Collaborate with counties, MPOs, and employers to support implementation of activities related to rideshare programs. 9. Collaborate with counties to expand Safe Youth Transit Access program to all counties with identified funding and proven safety measures in place. **Compact and Transit-Oriented Design** 10. Collaborate with State and county agencies, OPSD, and developers to support Compact and Transit-Oriented Design.	**EV Adoption** 1. Support legislation to incentivize EV purchases with a mix of fees, rebates, and tax relief. **EV Battery Disposal and Recycling** 2. Support HSEO and legislation to develop and enact Extended Producer Responsibility laws with program funding mechanisms. **5-Year Multimodal Network** *3. Introduce legislation to create a Safe Youth Transit Access program including funding.* [a] *4. HDOT to request additional funding from Legislature for full implementation.* [a]
Short Term (2030 to 2035)	**Cordon Pricing and Tolling** *1. Conduct a study and alternatives analysis based on nationwide examples (such as New York or San Francisco) related to cordon pricing and tolling.* [a]	**Multimodal Network** *1. Update Hawaii Statewide Bicycle and Hawaii Statewide Pedestrian Plans to include the complete multimodal network.* [a] *2. Finish implementation of the Bicycle and Pedestrian Infrastructure components of the 5-Year Priority Multimodal Network.* [a]	**EV Adoption** 1. Support legislation and actions to continue phased-in implementation of increased registration fees for ICE vehicles and lowering of EV registration fees.
Mid Term (2035 to 2040)		**Rideshare Programs** 1. Continue to revise and implement programs and actions designed to support rideshare programs hosted by HDOT and partner agencies.	**Cordon Pricing and Tolling** 1. Support legislation to support cordon pricing and tolling after completion of study and alternatives analysis.
Long Term (2040+)		**Multimodal Network** *1. Complete the Bicycle and Pedestrian Infrastructure component of the Unconstrained Network.* [a]	

[a] *Italicized* text indicates actions led by HDOT.
HSEO = Hawaiʻi State Energy Office
ICE = internal combustion engine
MaaS = Mobility-as-a-Service
MPO = metropolitan planning organization
MRTP = Mid-Range Transportation Plan
NEVI = National Electric Vehicle Charging Infrastructure
OPSD = Office of Planning and Sustainable Development
STIP = Statewide Transportation Improvement Program

Appendix J
Public Comment Summaries

Energy Security & Waste Reduction Plan Feedback

Mahalo to everyone who has voiced their opinion on the Draft Plan so far. In total, we have received the following feedback through our public meetings, online form responses, and email correspondences:

Number of Meeting Attendees	Number of Online Form Responses	Number of Other Comments
125	135	175

Master List – Commentors and Meetings

Table J-1. Aviation, Highways, and Administration Commentors

Name	Agency/Organization Affiliation
Elected Officials	
Representative Amy Perruso	Hawaiʻi State House, District 46
Representative Darius Kila	State of Hawaiʻi House of Transportation Committee
Agencies	
Larry S. Veray	Chairman, Pearl City Neighborhood Board No. 21
Greg Tsugawa	City and County of Honolulu
Christopher Agcanas	City and County of Honolulu Office of Climate Change, Sustainability, and Resiliency
Caroline Anderson	Hawaiʻi Tourism Authority
Kelvin Kohatsu	Hawaii Transportation Association
Mark Garrity	Oahu Metropolitan Planning Organization (OahuMPO)
Kyra Howe	Public Utilities Commission
Kathleen Yoda	Hawaiʻi Department of Transportation Highways Division Oʻahu
Tina Balubar	Volcano House in Hawaiʻi Volcanoes National Park
Organizations	
Sherry Pollack	350Hawaiʻi
Kealii Pang	ʻAhahui Mālama I ka Lōkahi
Sean Newsum	Airlines For America
Ariel Ferrer	Akua LLC
Jacob Aki	Alaska and Hawaiian Airlines
Brandon Buchanan	American Bus Association
Don Lefeve	American Car Rental Association

Name	Agency/Organization Affiliation
Mike Huberty	American Ghost Walks
Clayton Diamond	American Pilots' Association
Jim Walsh	Atlantis Adventures
Paul Bernstein	Carbon Cashback Hawaii
Carol Kwan	Carol Kwan Consulting LLC
Michelle Ramos	Chief Financial Officer, MC&A, Inc.
Tonga Hopoi	Chamber of Commerce Hawai‘i
Chelsey Miguel	Citizens Climate Lobby
Ronald Reilly	Citizens Climate Lobby Hawai‘i
Christina Kaser	County of Kaua‘i
Jethro Beck	Cruise Lines International Association (CLIA)
Melodie Aduja	Democratic Party of Hawai‘i - Environmental Caucus
Denise Clark	Denise Clark LLC
Donna Ambrose	Donna's Detours - Private Tours of O‘ahu, LLC
Maki Kuroda	E NOA Corporation
Mike Ewall	Energy Justice Network
Virginia Beck	Global Legacy ~ Pay it Forward, Strategic Solutions Consultant
Dave Mulinix	Greenpeace Hawai‘i
Abbey Seitz	Hawai‘i Appleseed Center for Law & Economic Justice
Melissa Pavlicek	Hawaii Automobile Dealers Association (HADA)
Eduardo Hernandez	Hawai‘i Bicycling League
Noel Morin	Hawaii Electric Vehicle Association
Hunter Heaivilin	Hawai‘i Farmers Union
Melissa Pavlicek	Hawai‘i Harbors User Group (HHUG)
Hanna Lesiak	Hawai‘i Harbors Users Group (HHUG)
Carla Kuo	Hawai‘i Island Chamber of Commerce
Sean Aronson	Hawai‘i Legislature
Jowell Rivera	Hawaii Logistic Services
Sinclair Brown	Hawaii Pilots Association
Capt. Ed Enos	Hawaii Pilots Association
Capt. David Thompson	Hawaii Pilots Association
Veronica Rocha	Hawai‘i Seaglider Initiative (HSI)
Aaron Paulk	Hawaii Tour Consultants
Derek Takeno/Luca Cuniberti	Hawai‘i Youth Transportation Council
Joshua Stanbro	Hawaiian Council
Aki Marceau	Hawaiian Electric

Name	Agency/Organization Affiliation
Jim Gomes	Hawaiian Cement - Knife River
Maxime Aymonod	Honolulu Ship Supply
Brandon Wolff	ILWU
Mary Albitz	Island Art Party
Mark Perriello	Kauaʻi Chamber of Commerce
Claire Ortega	Kauai Luxury Transportation
Fred Atkins	Kilohana Plantation
Nelisa Asato	Matson
Saman Dias	Maui Bicycling League
Garrett Marrero	Maui Brewing Co.
Mario Noble	Maui Snorkeling
Mark Napier	MC&A, Inc.
Bryan Matsumoto	MC&A, Inc.
Curtis Chee	MC&A, Inc.
David Le	MC&A, Inc.
Dawn Brenneman	MC&A, Inc.
Emily Phan	MC&A, Inc.
Gina San Agustin	MC&A, Inc.
Johan Marzuki	MC&A, Inc.
Leslie Brewster	MC&A, Inc.
Heather Bailey	MC&A, Inc.
Johan Marzuki	MC&A, Inc.
James Zane	McCabe, Hamilton & Renny Co., Ltd.
Matthew Guard	McCabe, Hamilton & Renny Co., Ltd.
Patricia Doersch	National Automobile Dealers Association (NADA)
Kaleohano Farrant	North Short Community Land Trust (NSCLT)
Sandra Weir	Norwegian Cruise Line Holdings Ltd.
Joanna Ziegler	Our Children's Trust and Earthjustice
Robert King / Joy Galatro	Pacific Biodiesel Technologies
Robert King	Pacific Biodiesel Technologies
Marc Inouye	Par Hawaii
Kelly Hudik	PATH - People for Active Transportation Hawaiʻi
Douglas J Hagan	Personal
Parbati Sunuwar	Phikkal Rural Municipality
Terry Fischer	Polynesian Adventure Tours
Clint Churchill	Practical Policy Institute

Name	Agency/Organization Affiliation
Christopher H Dean	Recycle Hawaiʻi, Clean the Pacific
B. A. McClintock	Respiratory and Environmental Disabilities Association of Hawaii
Michael P. Marsh	Responsive Caregivers of Hawaii
Nick Rose	Royal Caribbean Group
Wayne Tanaka	Sierra Club
Peter Sternlicht	Sustainable Energy Hawaiʻi
William F. Anonsen	The Maritime Group
Marc Paparelli	The Patisserie Inc.
Sleiman Kamal Salibi	True Blue Inc.
Derek Phelps	Twelve Benefit Corporation
Blake Oshiro	Uber Technologies
Kathleen Rooney	Ulupono Initiative
Lee Chamberlain	West Maui Greenway Alliance
Katra Cuskaden	Young Brothers
Luke Gee	Youth Council

Table J-2. Individual Commentors

Name	Comment Type
Individuals	
Aaron Bandmann	Email
Al C.	Email
Alexandra Matzkin	Email
Alvin Cabang	Online Form
Amanda Arnstrong	Email
Amanda Tompkins	Online Form
Amber Kanehailua	Online Form
Amy Maguire	Online Form
Amyg Yuen	Email
Andrew Feng	Online Form
Andrew Pereira	Online Form
Ann Horwath	Online Form
Ann Leighton	Online Form
Anna Mines	Online Form
Atlas Cook	Online Form
Barb Cluff	Email
Ben Pierce	Online Form
Blake Marks	Email
Bob Terek	Email
Bobbie Best	Email
Brandi Hoenicke	Email
Brant Tanaka	Online Form
Brenda Summers	Online Form
Brodie Lockard	Online Form
Capt. Edward Enos	Online Form
Carmen Saito	Email
Carol Thomas	Email
Catherine Kahookele	Online Form
Catherine Orlans	Email
Cayle Krikorian	Email
Chad K. Taniguchi	Online Form
Chelsie Counsell	Online Form
Christopher Tipton	Online Form
Claudia Parker	Online Form

Name	Comment Type
Clyde Chena	Email
Cori Meyers	Email
Dale Stubbart	Email
Danielle Vinson	Online Form
Debbi Terek	Online Form
Deborah Millikan	Online Form
Don Baluran	Email
Donald Hurzeler	Online Form
Donald R Elder	Online Form
Doreen Wong	Online Form
Douglas Miller	Email
Douglas White	Online Form
Dr. Marion Ceruti	Online Form
Dylan Barr	Online Form
Edwin Arcalas	Email
Elizabeth McCarthy	Email
Elliot Patterson	Email
Eric McCutcheon	Online Form
Eric Vansen	Online Form
Erin Kaohelaulii	Online Form
Ethan Landy	Email
Fawn	Email
Frank Lutz	Online Form and Email
Gary Ferrel	Email
Gary Li	Online Form
Georgine Flores	Online Form
Gerald Klappert	Email
Hannah S.	Online Form
Harriet Wilt	Email
Heather Bailey	Online Form and Email
Heidi Ho	Online Form
Ian Kow	Email
Jackie M.	Email
Jackson Hurst	Online Form
Jake Boggs	Email
James Bordine	Email

Name	Comment Type
James F.	Email
James Howe Jr.	Online Form
James Pennaz	Online Form
Jason Bousselaire	Email
Jeanette Esquivel	Online Form
Jeffrey Evangelist	Online Form
Jeffrey Wickens	Online Form
Jessica Kuzmier	Online Form
Joe Kaleo	Online Form
John Doe	Online Form
John Kawamoto	Email
John Rogers	Email
John S.S. Kim	Email
John Thorvaldson	Online Form
Jonathan Padwe	Online Form
Joni King	Email
Jorge Felix	Online Form
Joy Awakuni	Email
Joycelyn Lum	Online Form
K. H.	Online Form
Karen Berggen	Online Form
Karen M. Kimbrell	Online Form
Keith Neil	Email
Kenneth Zenker	Email
Kerry Mac Donald	Email
Kevin Mulkern	Email
Kirsten Turner	Email
Kurt Ganiko	Online Form
Laura Beth Brown	Online Form
Leilani Hicks	Online Form
Lisa Anderson	Online Form
Lisa Cates	Online Form
Logan Newbill	Email
Luke McKenney	Email
Mahealani Chang	Online Form
Manuel Kuloloio	Online Form

Name	Comment Type
Mara Wornan	Online Form
Mark Benson	Online Form
Mark Napier	Online Form and Email
Matthew Carnes	Online Form
Max H.	Email
Maxime	Email
Meghan Ganser	Email
Mich	Email
Michael A. Lilly	Online Form
Michael Brestovansky	Email
Michael D. Burns	Online Form
Mika Poppert	Online Form
Mike Feder	Email
Monica Medina	Online Form
Natalie Iwasa	Email
Noah Ragone	Online Form
Pat Choy	Online Form
Paul Montague	Online Form
Peter Amerling	Email
R. Public	Online Form
R. Y.	Online Form
Rajani Dhakhwa Morita	Online Form
Richard Tagore Erwin	Online Form
Richard Wallis	Online Form
Richville Fagaragan	Online Form
Rick Hill	Email
Robert Chesire	Email
Robert Prescott	Online Form
Robin Leachman	Online Form
Roger L. Morey	Online Form
Ronald Akiyama	Online Form
Ronald Reilly	Online Form and Email
Ross Isokane	Online Form
Ruth E. Robison	Online Form
Sara Perry	Email
Sequoya A.	Email

Name	Comment Type
Solomon Abdul	Online Form
Sophia Park	Email
Stephen Taylor	Online Form
Stuart Nishikawa	Online Form
Ted Metrose	Email
Theodore Kevin Metrose	Online Form
Theodore Metrose	Email
Tobias Koehler	Online Form
Todd Wilson	Email
Tom DiGrazia	Online Form
Yu Yang Fan	Email
Zoe Williams	Online Form

Table J-3. Marine Commentors

Name	Agency/Organization Affiliation
Agencies and Elected Officials	
Christina Kaser	County of Kauaʻi
Caroline Anderson	Hawaiʻi Tourism Authority
Sean Aronson	Hawaiʻi Legislature
Organizations	
Sherry Pollack	350Hawaiʻi
Kealii Pang	ʻAhahui Mālama I ka Lōkahi
Ariel Ferrer	Akua LLC
Mike Huberty	American Ghost Walks
Clayton Diamond	American Pilots' Association
Jim Walsh	Atlantis Adventures
Ronald Reilly	Citizens' Climate Lobby Hawaiʻi
Jethro Beck	Cruise Lines International Association
Denise Clark	Denise Clark LLC
Donna Ambrose	Donna's Detours, Private Tours of Oʻahu, LLC
Maki Kuroda	E NOA Corporation
Noel Morin	Hawaii Electric Vehicle Association
Melissa Pavlicek	Hawaiʻi Harbors User Group
Carla Kuo	Hawaiʻi Island Chamber of Commerce
Capt. Ed Enos	Hawaii Pilots Association
Sinclair Brown	Hawaii Pilots Association
Capt. David Thompson	Hawaii Pilots Associations
Veronica Rocha	Hawaiʻi Seaglider Initiative (HSI)
Aaron Paulk	Hawaii Tour Consultants
Jim Gomes	Hawaiian Cement, Knife River
Maxime Aymonod	Honolulu Ship Supply
Brandon Wolff	ILWU
Mary Albitz	Island Art Party
Mark Perriello	Kauaʻi Chamber of Commerce
Claire Ortega	Kauai Luxury Transportation
Fred Atkins	Kilohana Plantation
Nelisa Asato	Matson
Garrett Marrero	Maui Brewing Co.
Mario Noble	Maui Snorkeling
Bryan Matsumoto	MC&A, Inc.

Name	Agency/Organization Affiliation
Curtis Chee	MC&A, Inc.
David Le	MC&A, Inc.
Emily Phan	MC&A, Inc.
Gina San Agustin	MC&A, Inc.
Heather Bailey	MC&A, Inc.
Johan Marzuki	MC&A, Inc.
Leslie Brewster	MC&A, Inc.
Mark Napier	MC&A, Inc.
Michelle Ramos	MC&A, Inc.
James Zane	McCabe, Hamilton & Renny Co., Ltd.
Matthew Guard	McCabe, Hamilton & Renny Co., Ltd.
Sandra Weir	Norwegian Cruise Line Holdings Ltd.
Joanna Ziegler	Our Children's Trust and Earthjustice
Marc Inouye	Par Hawaii
Terry Fischer	Polynesian Adventure Tours
Christopher H. Dean	Recycle Hawaiʻi, Clean the Pacific
Nick Rose	Royal Caribbean Group
Peter Sternlicht	Sustainable Energy Hawaiʻi
William F. Anonsen	The Maritime Group
Sleiman Kamal Salibi	True Blue Inc.
Katra Cuskaden	Young Brothers

Table J-4. Ground Transportation Commentors

Name	Agency/Organization Affiliation
Agencies and Elected Officials	
Representative Kila	State of Hawaiʻi House Transportation Committee
Representative Amy Perruso	Hawaiʻi State House, District 46
Sean Aronson	Hawaiʻi Legislature
Christina Kaser	County of Kauaʻi
Kathy Yoda	State of Hawaiʻi Department of Transportation Highways Division Oʻahu
Christopher Agcanas	City and County of Honolulu Office of Climate Change, Sustainability and Resiliency
Greg Tsugawa	City and County of Honolulu Transportation Performance & Development Division
Mark Garrity	Oahu Metropolitan Planning Organization
Organizations	
Kealli Pang	ʻAhahui Mālama I ka Lōkahi
Brandon Buchanan	American Bus Association
Don Lefeve	American Car Rental Association
Paul Bernstein	Carbon Cashback Hawaii
Chelsea Miguel	Citizens Climate Lobby Hawaiʻi
Maki Kuroda	E NOA Corporation
Mike Ewall	Energy Justice Network
Dave Mulinix	Greenpeace Hawaiʻi
Abbey Seitz	Hawaiʻi Appleseed Center for Law & Economic Justice
Melissa Pavlicek	Hawaii Automobile Dealers Association
Eduardo Hernandez	Hawaiʻi Bicycling League
Noel Morin	Hawaii Electric Vehicle Association
Hunter Heaivilin	Hawaiʻi Farmers Union
Kelvin Khatsu	Hawaii Transportation Association
Tina Balubar	Hawaiʻi Volcanoes National Park
Jim Gomes	Hawaiian Cement, Knife River
Aki Marceau	Hawaiian Electric
Maxime Aymonod	Honolulu Ship Supply
Saman Dias	Maui Bicycling League
Mario Noble	Maui Snorkeling
Emily Phan	MC&A, Inc.
Heather Bailey	MC&A, Inc.
Johan Marzuki	MC&A, Inc.
James Zane	McCabe, Hamilton & Renny Co., Ltd.
Patricia Doersch	National Automobile Dealers Association

Name	Agency/Organization Affiliation
Joanna Ziegler	Our Children's Trust and Earthjustice
Marc Inouye	Par Hawaii
Marc Paparelli	The Patisserie, Inc.
Kelly Hudik	People for Active Transportation Hawaiʻi
Kyra Howe	Public Utilities Commission
Christopher Dean	Recycle Hawaiʻi, Clean the Pacific
Michael Marsh	Responsive Caregivers of Hawaii
Peter Sternlicht	Sustainable Energy Hawaiʻi
Sleiman Kamal Salibi	True Blue Inc.
Derek Phelps	Twelve Benefit Corporation
Blake Oshiro	Uber Technologies
Lee Chamberlain	West Maui Greenway Alliance

Table J-5. Aviation Commentors

Name	Agency/Organization Affiliation
Agencies and Elected Officials	
Christopher Agcana	City and County of Honolulu Office of Climate Change, Sustainability and Resilience
Christina Kaser	County of Kauaʻi
Sean Aronson	Hawaiʻi Legislature
Kathy Yoda	State of Hawaiʻi Department of Transportation Highways Division Oʻahu
Organizations	
Sherry Pollack	350Hawaiʻi
Kealii Pang	ʻAhahui Mālama I ka Lōkahi
Sean Newsum	Airlines for America
Jacob Aki	Alaska and Hawaiian Airlines
Ronald Reilly	Citizens' Climate Lobby Hawaiʻi
David Mulinix	Greenpeace Hawaiʻi
Noel Morin	Hawaii Electric Vehicle Association
Maxime Aymonod	Honolulu Ship Supply
Mario Noble	Maui Snorkeling
Joanna Ziegler	Our Children's Trust and Earthjustice
Christopher Dean	Recycle Hawaiʻi, Clean the Pacific
Peter Sternlicht	Sustainable Energy Hawaiʻi
Sleiman Kamal Salibi	True Blue Inc.
Derek Phelps	Twelve Benefit Corporation
Blake Oshiro	Uber Technologies

Table J-6. Administrative Commentors

Name	Agency/Organization Affiliation
Agencies and Elected Officials	
Representative Kila	State of Hawaiʻi House Transportation Committee
Sean Aronson	Hawaiʻi Legislature
Kathleen Yoda	State of Hawaiʻi Department of Transportation Highways Division Oʻahu
Christopher Agcanas	City and County of Honolulu Office of Climate Change, Sustainability and Resiliency
Mark Garrity	Oahu Metropolitan Planning Organization
Organizations	
Paul Bernstein	Carbon Cashback Hawaii
Tonga Hopoi	Chamber of Commerce Hawaiʻi
Denise Clark	Denise Clark, LLC
Maki Kuroda	E NOA Corporation
Mike Ewall	Energy Justice Network
Virginia Beck	Global Legacy - Pay it Forward
Dave Mulinix	Greenpeace Hawaiʻi
Abbey Seitz	Hawaiʻi Appleseed Center for Law & Economic Justice
Melissa Pavlicek	Hawaii Automobile Dealers Association
Noel Morin	Hawaii Electric Vehicle Association
Eduardo Hernandez	Hawaiʻi Bicycle League
Veronica Rocha	Hawaiʻi Seaglider Initiative (HSI)
Aaron Paulk	Hawaii Tour Consultants
Derek Takeno/Luca Cuniberti	Hawaiʻi Youth Transportation Council
Joshua Stanbro	Hawaiian Council
Aki Marceua	Hawaiian Electric
Saman Dias	Maui Bicycling League
Heather Bailey	MC&A, Inc.
John Marzuki	MC&A, Inc.
Mark Napier	MC&A, Inc.
Sherry Pollack	NGO
Joanna Ziegler	Our Children's Trust and Earthjustice
Clint Churchill	Practical Policy Institute
Christopher Dean	Recycle Hawaiʻi, Clean the Pacific
B.A. McClintock	Respiratory and Environmental Disabilities Association of Hawaii
Michael Marsh	Responsive Caregivers of Hawaii
Wayne Tanaka	Sierra Club
Peter Sternlicht	Sustainable Energy Hawaiʻi

Name	Agency/Organization Affiliation
Sleiman Kamal Salibi	True Blue, Inc.
Derek Phelps	Twelve Benefit Corporation
Kathleen Rooney	Ulupono Initiative
Lee Chamberlain	West Maui Greenway Alliance
Katra Cuskaden	Young Brothers
Luke Gee	Youth Council

Table J-6. Stakeholder Meetings

Date	Organization
11/26/2024	Interisland Clean Ground Transportation Group Objectives: 1. HDOT Youth Council and HDOT Greenhouse Gas Reduction Plan updates 2. Hawai‘i State Energy Office (HSEO) Clean Transportation updates Attendees based on Teams Invitation: ▪ Mary Alice Evans ▪ Leah J. Laramee ▪ Christina Kaser ▪ Masatomo Murata ▪ Rasmi Agrahari ▪ Gerald J. Schmitz ▪ Niko G. Salvador ▪ Traci H. Lum ▪ Abbey Mayer ▪ Doug Huxley ▪ Sam Pournazeri ▪ Carolyn Meisner ▪ Melissa Sabatine ▪ Jeffrey Ang-Olson ▪ Melissa Savage
1/17/2025	State of Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife and Division of Aquatic Resources (DLNR-DOFAW/DAR) Attendees: ▪ Doug Huxley ▪ Melissa Savage ▪ Kylie Wager Cruz ▪ Andre Rodgers ▪ Joanna Zeigler ▪ Emily Goetz ▪ Genevive Sullivan ▪ Abbey Mayer ▪ Stephanie Kong ▪ Susan Asam ▪ Isaac Moriwake ▪ Nick Ching ▪ Marti Townsend ▪ Natasha Soriano ▪ Doug Johnson

Date	Organization
	HDOT met with DLNR/DOFAW and Jacobs consultants to discuss incorporating DOFAW's reforestation and carbon sequestration plans into the Greenhouse Gas Reduction Plan. The meeting also explored how HDOT might support these efforts and ensure proper measurement of DOFAW's sequestration work.
3/1/2025	Hawaiʻi Youth Transportation Council Presentation on Navahine Settlement + Energy Security Plan with Earthjustice and Our Children's Trust. The Council meeting featured candidate presentations for Chair, Vice-Chair, Outreach Coordinator, and Social Media Coordinator roles. Candidates shared their qualifications, leadership experience, and ideas for outreach and engagement. Members asked questions about responsibilities, challenges, and strategies for statewide coordination. The meeting concluded with next steps for voting, reviewing the draft Energy Security and Waste Reduction Plan, and planning future meetings.
3/4/2025	Airlines Committee of Hawaii (ACH) Director Sniffen presented the Greenhouse Gas Reduction Plan during the HDOT Airports Division updates portion of the meeting.
3/20/2025	Harbor Users Group - attended by Deputy Kalili and ICF consultant Sam Pournazeri.
3/20/2025	Hawaiian Electric Company (HECO) Attendees: ▪ Aki Marceau ▪ Doug Huxley ▪ Sam Pournazeri ▪ Melissa Savage ▪ Melissa Sabatine ▪ Marc Asano HDOT requested a meeting with HECO to ensure alignment between HDOT's Energy Security and Waste Reduction Plan and HECO's Electrification of Transportation (EoT) Roadmap and Integrated Grid Plan. The meeting aimed to confirm HECO's input before HDOT releases its draft plan.
3/21/2025	Hawaiʻi Tourism Authority (HTA) ▪ DreanaLee Kalili ▪ Edwin Sniffen ▪ Kalani ▪ Veronica Fuentes ▪ Curt Otaguro ▪ Daniel ▪ Coraline ▪ Lindsay ▪ Carole Hagihara ▪ Angela Yamaguchi ▪ Amalia Clower

Date	Organization
3/28/2025	HSEO, identified as an early stakeholder and provided comments since early February via email. This meeting was a follow-up to continue the discussion before the first draft was published. Attendees: ▪ Mark B. Glick ▪ Monique Schafer ▪ Doug Huxley ▪ Melissa Savage ▪ Sam Pournazeri ▪ Nick Ching ▪ Abbey Mayer ▪ Kevin R. Moy ▪ Stephen Walls ▪ Jonathan Chin ▪ Robin Shiroma ▪ Christopher Zurcher ▪ Ionatana Tuitasi
3/31/2025	A4A (Airlines for America) - presentation about the Greenhouse Gas Reduction Plan by Director and facilitated by L. Kaakua. Attendees: ▪ Edwin Sniffen ▪ Curt Otaguro ▪ Angela Yamaguchi ▪ Diane Wakumoto ▪ Alanna James ▪ N. Parsons ▪ Paige Mucci ▪ Jacob Bryan Aki ▪ Danny Cup Choy ▪ Jen Poeppelmeier ▪ Steve
4/1/2025	Public Utilities Commission (PUC) - HECO's EoT RoadMap & HDOT's Energy Security Plan The Hawaii PUC hosted a Status Conference to review HECO’s updated EoT Strategic Roadmap. The session focused on transportation electrification goals, policy and regulatory considerations, and stakeholder engagement.
4/2/2025	Climate Commission – HDOT presented a high-level overview of the strategies we are currently planning for and will welcome feedback. Agreed to present to the Commission after the Plan is published. Attendees: ▪ Mary Alice Evans

Date	Organization
	▪ Kaʻāina Hull ▪ Nicole Lowen ▪ Kate Blystone ▪ Kenneth Hara ▪ Katie Lambert ▪ Nancy McPherson
4/4/2025	SubSTAC – Stakeholder meeting 1. Call to order/greeting 2. Energy Security and Waste Reduction Plan – Stakeholder Meeting 3. SubSTAC Agency Status Update 4. Wrap up and thank you.
4/4/2025	State Office of Planning and Sustainable Development (OPSD) - Transit-Oriented Development Program Meeting notes: OPSD Mtg Notes 4.4.25.docx Connectivity and Road Design: Concerns were raised about limited intersections and walkability in State facility areas. Past decisions restricted access along Kualakaʻi Parkway, limiting the potential for a connected, pedestrian-friendly street network. Planning Gaps: The East Kapolei Master Plan lacks street-level connectivity. Proposed intersections near University of Hawaiʻi West Oʻahu remain unconfirmed, and developments risk repeating pedestrian-hostile designs. Early Coordination: HDOT's late involvement in development approvals often leads to right-of-way delays. Early engagement at the regional planning level is needed to avoid such issues. Emergency Access and Resilience: Additional ingress/egress points were discussed for fire safety. OPSD also referenced managed retreat planning in coastal areas and upcoming North Shore planning efforts that include highway realignment.
4/6/2025	Hawaiʻi Youth Transportation Council The Council received an in-depth update on the draft Energy Security and Waste Reduction Plan, including strategies and benchmarks for reducing emissions in ground, air, and maritime transportation. Members asked questions about fuel alternatives, accessibility, military emissions, and public engagement. The Council also discussed outreach opportunities, reviewed their draft charter, and explored term limits and communication tools. Plans were made for future engagement, including potential participation in EarthFest and the Climate Future Forum.
4/9/2025	MAUI Metropolitan Planning Organization (MPO) Technical Advisory Committee (TAC) Maui MPO TAC Meeting Notes.pdf Members Present: ▪ Scott Forsythe, Chair, County of Maui Planning Department ▪ Rachel Roper-Noonan, Vice Chair, State of Hawaiʻi Department of Transportation ▪ Ty Fukuroku, designee for Annette Matsuda, State of Hawaiʻi Department of Transportation ▪ Ignacio Filippini, State of Hawaiʻi Department of Transportation

Date	Organization
	▪ Chico Rabara, County of Maui Department of Public Works ▪ Nolly Yagin, County of Maui Department of Public Works ▪ Phillip Anderson, County of Maui Department of Housing ▪ Scott Curran, County of Maui Planning Department ▪ Wesley Bradshaw, County of Maui Department of Parks and Recreation ▪ Excused: Ty Takeno, County of Maui Department of Public Works ▪ Darren Konno, County of Maui Department of Transportation ▪ Others: Kauanoe Batangan, Maui MPO Executive Director ▪ Wendy Nathan, Maui MPO Financial Specialist ▪ Nahulu Nunokawa, County of Maui Deputy Corporation Counsel ▪ Laura Kaakua, State of Hawaiʻi Department of Transportation ▪ Natasha Soriano, State of Hawaiʻi Department of Transportation ▪ Genevieve Sullivan, State of Hawaiʻi Department of Transportation ▪ Megan Weir, Nelson Nygaard ▪ Ezra Pincus-Roth, Nelson Nygaard HDOT presented the in-development Energy Security and Waste Reduction Plan, created under the Navahine Settlement, which aims to reduce transportation emissions and achieve net-negative greenhouse gas emissions by 2045. Strategies include electrification, clean fuels, expanded multimodal options, and investments in carbon sequestration. Members asked about funding, legal consequences for unmet targets, and alignment with county and inter-island transportation plans. While the 2030 benchmarks may not be met, the State is optimistic about reaching long-term goals through coordinated implementation and policy support.
5/9/2025	Kauaʻi County, Department of Public Works – Solid Waste Division Maui County, Department of Environmental Management – Environmental Protection and Sustainability Honolulu County, Department of Customer Service – Division of Motor Vehicles and Licensing Energy Security Plan with Counties 05.09.2025.docx Counties raised serious concerns about the lack of infrastructure and funding for safe and affordable electric vehicle (EV) and lithium battery disposal, with monthly fires and high off-island shipping costs reported. There is no statewide plan for battery recycling, and current scrappage programs are not linked to incentives or equipped to handle EVs. Equity issues were highlighted, including limited public charging in rural areas and behavioral barriers to EV adoption. Suggestions included creating an Extended Producer Responsibility (EPR) program, expanding charging infrastructure, and integrating disposal planning into EV transition strategies.
6/13/2025	Oahu Metropolitan Planning Organization (OahuMPO) TAC Oahu MPO TAC Meeting Minutes.pdf Members Present: ▪ Ian Crittenden (Chair)

Date	Organization
	▪ Masatomo Murata (Vice Chair) ▪ Ken Tatsuguchi ▪ Dennis Lovello ▪ Joey Manahan ▪ Eileen Mark ▪ Andy Yamaguchi ▪ Dina Wong ▪ Oscar Carvallo Valencia ▪ Aaron Setogawa ▪ Kimberly Evans ▪ Mary Nguyen ▪ Richard Yoneda ▪ Kelvin Kohatsu ▪ Tim Trang ▪ Paul La Farga HDOT presented ground transportation strategies from the Energy Security and Waste Reduction Plan, developed under the Navahine Settlement to reduce transportation-related greenhouse gas emissions. While the overall transportation sector may not meet the 2030 reduction target, ground transportation is projected to meet its benchmarks through electrification, clean fuels, and mode shift strategies. The presentation included emissions modeling, project planning integration, and carbon sequestration priorities. The committee discussed challenges related to electricity generation, EV battery disposal, and charging infrastructure in dense residential areas.
7/14/2025	HDOT Internal discussion Locations: ▪ Microsoft Teams Meeting ▪ DOT ADMIN 5th Floor Conference Room ▪ DOT.HWYDD.ROOM.CONFERENCE ▪ DOT.HWYDB.ROOM.CONFERENCE ▪ DOT HAR DEPC HUB ▪ DOT HAR Hilo HUB ▪ DOT HAR Kawaihae HUB ▪ DOT HAR Kauaʻi HUB ▪ DOT HAR Maui HUB ▪ DOT HAR Maui2 HUB ▪ DOT HAR Conference Room 2 ▪ DOT ADM Punchbowl HUB Draft Energy Security Plan Public July Presentations.pptx HDOT leadership presented the draft Energy Security and Waste Reduction Plan, outlining strategies to reduce transportation emissions across ground, aviation, and maritime sectors in

Date	Organization
	alignment with the Navahine Settlement and State climate goals. The presentation emphasized electrification, clean fuels, and carbon sequestration, while acknowledging that 2030 targets may not be met without additional investment and policy support. Staff raised questions about costs, infrastructure readiness, battery disposal, and the feasibility of sustainable aviation fuel and inter-island electric flights. The session concluded with a call for internal feedback before finalizing the plan in August and continuing with annual revisions.
7/25/2025	Presentation Slides - Navahine Presentation for Youth Council Informational Briefing Hearing - EEP/TRN/AEN/TCA Joint Info Briefing - Wed Jun 25, 2025 @ 9:30 AM HST Informational briefing will provide an update to legislators on plans to address the requirements of the Navahine Settlement, which includes the development of plans and implementation of policies to reduce greenhouse gas emissions and dependence on fossil fuels in the State's transportation system. Presentations given by: ▪ Hawaiʻi State Department of Transportation ▪ Earthjustice COMMITTEE ON ENERGY & ENVIRONMENTAL PROTECTION Rep. Nicole E. Lowen, Chair Rep. Amy A. Perruso, Vice Chair Rep. Cory M. Chun, Rep. Sean Quinlan, Rep. Kirstin Kahaloa, Rep. Lauren Matsumoto, Rep. Matthias Kusch COMMITTEE ON TRANSPORTATION Rep. Darius K. Kila, Chair Rep. Tyson K. Miyake, Vice Chair Rep. Elle Cochran, Rep. Trish La Chica, Rep. Luke A. Evslin, Rep. Christopher L. Muraoka, Rep. Tina Nakada Grandinetti, Rep. Elijah Pierick, Rep. Lisa Kitagawa COMMITTEE ON AGRICULTURE AND ENVIRONMENT Sen. Mike Gabbard, Chair Sen. Herbert M. "Tim" Richards, III, Vice Chair Sen. Lynn DeCoite, Sen. Brenton Awa, Sen. Karl Rhoads COMMITTEE ON TRANSPORTATION AND CULTURE AND THE ARTS Sen. Chris Lee, Chair Sen. Lorraine R. Inouye, Vice Chair Sen. Brandon J.C. Elefante, Sen. Samantha DeCorte, Sen. Dru Mamo Kanuha
7/21/2025	Non-Government Organizations (NGO) Meeting facilitated by Our Children's Trust and Earthjustice NGO Participants: ▪ Abbey Seitz ▪ Jodi Robinson ▪ Saman Dias ▪ Kathleen Rooney

Date	Organization
	▪ Eduardo Hernandez ▪ Travis Counsell ▪ Dave Mulinix ▪ Sherry Pollack ▪ Kalani Kaʻanāʻanā ▪ Joanna Zeigler ▪ Tiffany Huynh ▪ Trisha Yamato ▪ Kayli Ann Yoshioka ▪ Mariah Yoshizu ▪ Debbie Milikan ▪ Priyal Patel ▪ Kylie Cruz Participants raised concerns about the inclusion of liquified natural gas in the plan, citing scientific research that suggests it may be more harmful than coal, and emphasized the need for more EV charging infrastructure and solar deployment. Several attendees called for stronger alignment with existing safety and mobility plans, clearer roles for counties and NGOs, and more emphasis on equity and co-benefits of the transition. Questions were asked about accountability, implementation timelines, and how the plan would address public skepticism and infrastructure gaps. Suggestions included incentivizing public transit, improving multimodal networks, and ensuring transparent tracking of progress.
8/12/2025	Part of Senator DeCorte – District 22 Town Hall In-person Ark of Safety Christian Fellowship in Waiʻanae, Hawaiʻi; Watch Live on ʻŌlelo Channel 49 Town Hall Meeting Video - Senator Samantha DeCorte Town Hall Meeting: Ep - 1 8/12 Hui E Kamaʻilio Pū Kākou Panelists: ▪ Senator Brenton Awa ▪ Senator Tim Richards ▪ Director Mike Lambort ▪ Director Edwin Sniffen ▪ Malia Agustin
8/18/2025	City and County of Honolulu, Office of Climate Change, Sustainability & Resiliency: Fleet Modernization Working Group Meeting.
8/21/2025	Hawaii Green Growth briefing Q3 Measures Working Group by Our Children's Trust The Measures Working Group met to discuss updates to the Aloha+ Challenge Dashboard and statewide sustainability indicators, with a focus on transparency, accountability, and community-driven data. Key agenda items included the launch of the 2025 Hawaiʻi Voluntary Local Review Report and updates to natural resource stewardship metrics. Partners also shared updates on the Climate Action Pathways, HDOT's Energy Security and Waste Reduction Plan,

Date	Organization
	digital equity efforts, and economic indicators. The meeting emphasized cross-sector collaboration and the development of tools to support informed decision-making.
09/03/2025	OahuMPO Citizens Advisory Committee. Meeting Agenda: oahumpo.org/?wpfb_dl=3580 Presentation Slides: oahumpo.org/?wpfb_dl=3581
9/10/2025	Part of State Representative Darius K. Kila's Town Hall In-person at Nānākuli Public Library Conference Room; Watch Live on ʻŌlelo Channel 49 Town Hall Meeting Video: Rep Kila Town Hall: Ep - 10 9/10 Rep Kila Townhall Transportation Meeting