



HCEI Road Map

Introduction & Overview
2011 Edition

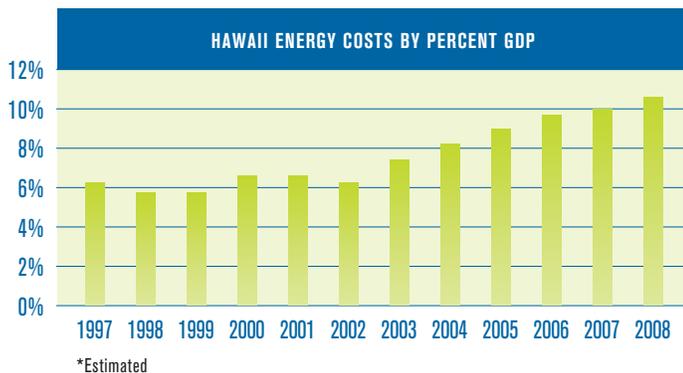
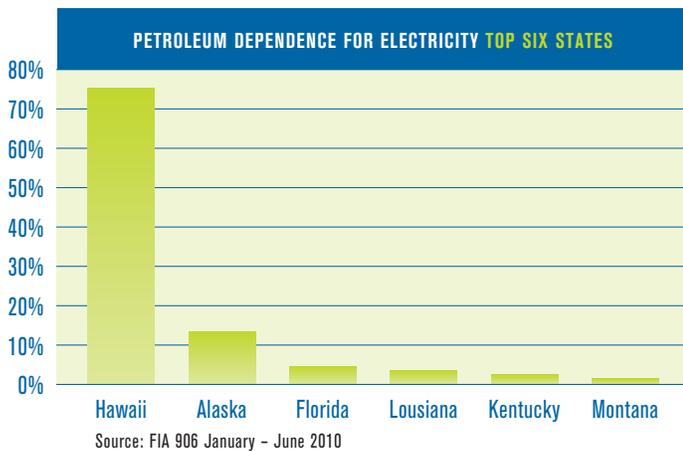
INTRODUCTION

Fueling Hawaii's future

Hawaii is the most petroleum-dependent state in the U.S. As a result, we have America's highest energy prices. Energy costs are 10% of our gross State product. Roughly 96% of the \$4 billion we spend on petroleum not only leaves the State, but goes to countries in Asia and Africa. Hawaii's economic vitality is reduced by approximately \$2.75 for every dollar that leaves our islands. This is a result of a multiplier effect that impacts local businesses as cash is taken out of circulation in the economy through import payments.

Clearly, we have to reduce Hawaii's dependence on imported oil and we must do it quickly for the benefit of future generations. High oil price volatility makes it crucial. Limited oil reserves around the world make it critical. Climate change makes it urgent. And most importantly—Hawaii's abundant renewable energy resources and energy efficiency technologies will make it possible within a relatively short period of time.

Clean, locally developed, renewable energy will, in the long run, boost Hawaii's economy because the land, the sea, the wind, and the sun are all capable of providing limitless amounts of indigenous energy—forever.





The Hawaii Clean Energy Initiative (HCEI) was launched to provide a framework to help realize this vision, with goals of (1) transforming Hawaii to a 70% clean energy economy by 2030, and reaping all the attendant economic and environmental benefits of such transformation including (2) increasing Hawaii's energy and economic security, (3) fostering and demonstrating Hawaii's innovation, (4) building the work force for the future, and (5) serving as a clean energy model for the U.S. and the world.

The HCEI Steering Committee and working groups have collaborated to create this detailed Road Map to help guide the journey to energy independence. In the following pages, we provide a summary of the Road Map. When viewed in conjunction with the complete document, they provide a clear picture of how much work has already been accomplished and how much lies ahead if we are to reach our goals. The Road Map represents a snap shot in time of the plan to reach HCEI's 70% clean energy goal. Research and development along with new and maturing technologies will influence the direction outlined in this document. With this in mind, the Road Map will continue to evolve as new information and opportunities present new efficient paths to reach our goal.

HCEI's goals are aggressive and it will take a determined effort to ensure that the State achieves this vision. Given Hawaii's history of innovation, collaboration, and goodwill, we believe the journey will be a transformative adventure which will ultimately improve the security and sustainability of the Hawaiian Islands.

OVERVIEW

Hawaii began proactively addressing energy issues in response to the 1973 energy crisis through a series of public and private actions. The State Legislature created the Energy Resources Coordinator in 1974, and in 1978 the Hawaii State Plan became law with goals to support Hawaii's energy needs through increased energy self-sufficiency. The State adopted numerous laws and policies to encourage development of Hawaii's renewable energy resources, and subsequent wind, geothermal and solar energy projects were undertaken and began to contribute electricity to Hawaii's electric utilities. The drastic reduction in oil prices in the mid-1980s, and perceptions that past energy crises would not recur, considerably slowed energy self-sufficiency initiatives. Nonetheless in 1990, the State formulated the Hawaii Integrated Energy Policy Development Program and subsequently issued detailed Hawaii Energy Strategies in 1995, 2000 and 2007. Subsequent hikes of oil prices and continuing price volatility brought renewed focus to Hawaii's energy dependency and vulnerability and heightened the need for concerted and sustainable action.

The Hawaii Clean Energy Initiative (HCEI) is built on the foundation of this innovative and vital set of initiatives undertaken by the State over several decades. The current effort is significant because of its unique partnership between the State and U.S. Department of Energy (USDOE), and the critical participation of the private sector, county governments and communities statewide.

HCEI is an unprecedented collaboration by the State of Hawaii and the USDOE initiated in January 2008 to transform the energy foundation of Hawaii's entire economy to clean energy, using Hawaii's own renewable and indigenous energy resources, within a single generation. Hawaii is thus a model, and this transformation could be replicated elsewhere by other island nations. In October, 2008, with HCEI as a foundation, the State of Hawaii, the Hawaiian Electric Companies and the State Consumer Advocate signed the Energy Agreement, the first of its kind in the Nation, with specific commitments and timetables to accomplish this transformation. Act 73, enacted in 2010, reaffirmed Hawaii's commitment to reaching HCEI's clean energy goals and formalized its program objectives, partnerships, resources and reporting requirements to the Legislature. Today, HCEI represents a vital collaboration of committed stakeholders from the federal, state and county governments, nonprofit organizations, academic institutions, the private sector—including utilities, refiners, project developers, builders, farmers, landowners, automotive industry, and military installations and many others—all working together to build a more sustainable energy future and enhanced economic base for Hawaii's future generations.



The overall strategy designed to achieve HCEI’s mission can be divided into three phases:

- Phase 1:** Identify the key sectors of the energy economy
- Phase 2:** Set clean energy goals in each sector
- Phase 3:** Create multi-faceted strategies for success in each sector by 2030

The transformation to a clean energy economy faces many complex challenges and issues. The HCEI strategy is based on a deployment process that supports each energy sector separately, as well as an integrated framework that coordinates the processes in a holistic fashion. To ensure that these interactions are addressed, an “Integration” working group (now the HCEI Steering Committee) was created, and tasked with coordinating between the groups, and making available to the groups all of the tools available to HCEI. These tools include policy and regulatory change, project development, outreach and education, and overall planning and management. The goal of the Steering Committee is to ensure that a comprehensive strategy is reached for the State where all energy sub-sectors are working together to achieve the 70% clean energy goal.

The HCEI has identified four key sectors of the energy economy. Each has a clear overall goal:

- 1. Electricity Generation:** achieve 40% from renewable energy sources.
- 2. End-Use Efficiency:** reduce 30% of electricity consumption
- 3. Transportation:** reduce 70% of petroleum used for ground transportation
- 4. Fuels:** develop locally produced renewable fuel for the electricity and transportation sectors

In the following pages, we highlight the specific goals and define strategies for each of the four energy sectors targeted by HCEI—in the short term (2011-2015) and in the mid-term (2016-2020). We also summarize HCEI’s accomplishments-to-date in each area. The Summary concludes with a look at what we expect to achieve by 2030.

The HCEI Road Map was developed by the HCEI Steering Committee, and its working group members. The current Steering Committee members are:

- Gerald A. Sumida (Chairman)
Carlsmith Ball
- Christopher J. Benjamin
Alexander & Baldwin
- Jeffrey T. Ono
State Consumer Advocate
- Ernest Nishizaki
Kyo-ya
- Estrella Seese
DBEDT, State of Hawaii
- George Kailiwai III
U.S. Pacific Command
- Jeffrey M. Kissel
The Gas Company
- Mary Werner
National Renewable Energy Laboratory
- Maurice Kaya
PICHTR
- Olin Lagon
Kanu Hawaii
- Paul Zorner
Hawaii BioEnergy
- Pono Del Shim
Enterprise Honolulu
- David Bissell
Kauai Island Utility Cooperative
- Ray Starling
SAIC
- Representative Denny Coffman
State House, State of Hawaii
- Richard Ha Jr.
Hamakua Springs
- Richard Lim
DBEDT, State of Hawaii
- Rick David Weyen
Tesoro Companies
- Rick Rocheleau
Hawaii Natural Energy Institute
- Riley M. Saito
Sun Power
- Robert Anthony Alm
Hawaiian Electric Company
- Robin Campaniano
Ulupono Initiative
- Senator Gerald Michael Gabbard
State Senate, State of Hawaii
- Steven Lindenberg
U.S. Department of Energy
- William John Rolston
Hawaii County

ELECTRICITY

Strategies, Goals, & Accomplishments

STRATEGY

The overall goal for the Electricity sector is to meet 40% of the State's electricity demand with renewable energy by 2030. In order to deliver "clean" electricity to Hawaii's residents, HCEI will (1) align government regulations and policies with clean energy goals, (2) increase certainty in the process for developing new renewable energy, (3) deploy renewable generation and grid infrastructure, and (4) explore next generation technologies and new applications of existing technologies.



MID-TERM GOALS: 2016-2020

By the end of 2020, renewable resources should meet at least 25% of electricity demand. Though the appropriate regulatory framework should be complete, many next-generation issues will have to be revisited. For example, it will be important to more fully evaluate the geothermal potential on Maui and the Big Island as well as ocean thermal and wave power technologies. HCEI also expects to explore the technical feasibility of expanding undersea cable connections between all the islands.

ACCOMPLISHMENTS TO DATE

(see Road Map document for a more complete list)

- The State Renewable Portfolio Standard was established at 40% by 2030
- The HECO Energy Agreement with the State of Hawaii includes energy commitments, measures to increase energy efficiency, and improvements to grid operation and infrastructure
- Kauai Island Utility Cooperative has set and is implementing aggressive renewable goals
- Construction has been completed on the 30MW Kahuku Wind Farm
- Hawaii is leading the nation in the growth rate of distributed generation photovoltaic (PV) installation
- Wind and solar power grid-integration and grid-impact studies have been completed for all islands

SHORT-TERM GOALS: 2011-2015

By the end of 2015, HCEI hopes to have 15% of electricity demand supplied via renewable energy. In addition to projects already completed, this will require a number of actions, including (a) the 400MW "Big Wind" project (wind farm, inter-island cable, and Oahu grid integration), (b) installation of solar technologies on a scale allowed by the Public Utilities Commission (PUC) (>80 MW), (c) the evaluation, and deployment of biomass/biofuel projects across all islands, and (d) the completion of a number of next-generation technology studies, including smart-grid demonstrations for each of the islands.



END-USE EFFICIENCY

Strategies, Goals, & Accomplishments

STRATEGY

The overall goal of the End-Use Efficiency sector is to meet the State's Energy Efficiency Portfolio Standard of 30% by reducing electricity demand by 4300 GWh by 2030. In order to reduce the use of electricity by end users—including homes, businesses, industrial and military sectors—HCEI will (1) align the efficiency regulatory policy and framework with clean energy goals, (2) support the retrofiting of residential and commercial existing buildings, (3) strengthen new construction policies and building codes, and (4) identify non-building related energy efficiency measures.



MID-TERM GOALS: 2016-2020

By the end of 2020, HCEI hopes to reduce energy consumption in existing buildings by 1400 GWh, and achieve energy savings in new building construction of 730 GWh. This will require continued focus on allowing Kauai Island Utility Cooperative and the Public Benefits Fund Administrator programs more flexibility in encouraging retrofiting of building energy efficiency technologies, integrated new construction design, and lowering cost barriers to generating deeper efficiency improvements.

ACCOMPLISHMENTS TO DATE

(see Road Map document for a more complete list)

- The Energy Efficiency Portfolio Standard (EEPS) has been set to 4300 GWh by 2030
- A Public Benefits Fund has been created and deployed to finance retrofiting of building energy efficiency technologies
- A State “Lead By Example” program has been deployed
- All Hawaii counties have adopted new, highly efficient building codes (IECC 2006 or higher)
- Utility revenue stream decoupled from kWh sales revenues

SHORT-TERM GOALS: 2011-2015

Within the first five years, HCEI hopes to reduce existing building energy consumption by 1,000 GWh and new construction energy consumption by 365 GWh. In addition to projects already completed, this will require a number of actions, including (a) gaining PUC approval to install and pilot smart meters, (b) implementing or expanding key policies and business models to leverage private capital, (c) expanding retrofit market outreach and education programs, and (d) updating building code levels to 2015 efficiency standards, as well as expanding training of building inspectors to improve enforcement of energy efficiency codes.



TRANSPORTATION

Strategies, Goals, & Accomplishments

STRATEGY

The overall goal for the Transportation sector is to reduce the consumption of petroleum in ground transportation by 70% or approximately 385 million gallons per year (MGY) by 2030. Unlike the more heavily regulated Electricity and Efficiency sectors, Transportation does not have goals mandated by statute so its strategies to reduce the use of petroleum fuel for ground transportation in Hawaii rely heavily on influencing personal behavior. HCEI will develop an expanded understanding of the needs of large buyers in the aviation and defense sector. In the future, marine and aviation biofuel alternatives may be substituted to help meet the goal by displacing the equivalent of 70% of ground transportation demand with non-fossil fuels. Primary areas of concern will be (1) improve the standard vehicle efficiency of the fleet, (2) reduce the overall number of vehicle miles traveled (VMT), (3) expand the use of renewable fuels in the transportation sector, and (4) accelerate the deployment of electric and hydrogen vehicles and related infrastructure.

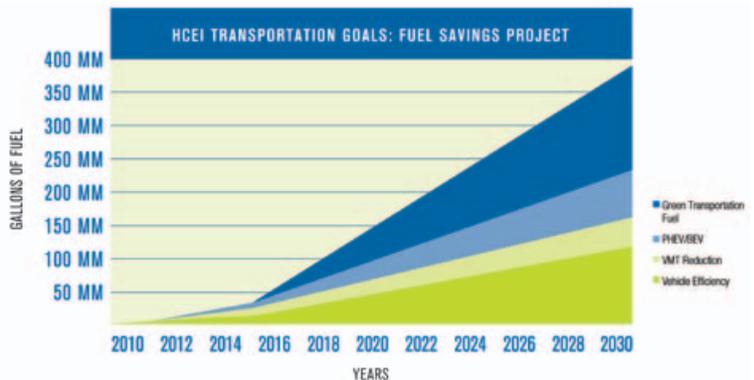
SHORT-TERM GOALS: 2011-2015

Within the first five years, HCEI hopes to increase on-road vehicle fleet efficiency to an average of 25 mpg for cars and 18 mpg for trucks. VMT should be reduced by 2% over current miles traveled and Hawaii drivers should be piloting 10,000 electric vehicles (with an extensive electric vehicle [EV] charging network deployed to support them). In addition to projects already completed, this will require a number of actions, including (a) promoting the purchase of more efficient vehicles, (b) promoting commute reduction options such as telecommuting and car/van pooling, (c) maintaining the current public transit system and renewable fuel blending standards, and (d) providing incentives for the purchase of electric vehicles.

MID-TERM GOALS: 2016-2020

By the end of 2020, HCEI is seeking to attain an average fleet efficiency for the state of 30 mpg across all standard cars and

22 mpg for all trucks. VMT should be reduced by 4%, approximately 50 MGY of renewable fuels should be blended into the fuel mix, and we should see at least 40,000 EV's on Hawaii highways. By the 2016-2020 time period, there will be a better understanding of electric and hydrogen vehicles and their supporting infrastructure so that a larger scale electric vehicle program can be implemented.



ACCOMPLISHMENTS TO DATE

(see Road Map document for a more complete list)

- Sales of Hybrid Electric Vehicles (HEV) reached approximately 3% of annual vehicle sales for a total of 9,000 HEVs
- Oahu Transit Services is operating 80 HEV transit buses in routine service
- The State is promoting vehicle industry participation through partnerships with automotive manufacturers, and EV equipment and infrastructure suppliers. The Hawaii EV-Ready Program will provide grants and rebates for the installation of EV chargers and the purchase of electric vehicles
- General Motors, the Gas Company, and other partners launched the Hawaii Hydrogen Initiative to develop hydrogen production distribution and fuel cell vehicles for Hawaii
- The City and County of Honolulu fleet continues to use locally-produced biodiesel

FUELS

Strategies, Goals, & Accomplishments

STRATEGY

Alternative fuels (including biofuels and hydrogen) play a critical role in Hawaii's successful attainment of 70% clean energy. Those that are direct substitutes for petroleum products (i.e., drop-in replacement biofuels) will be particularly important for areas where investment in additional transportation infrastructure is unlikely (e.g. aviation). Additionally, certain fuel technologies already in place in the State (e.g. biodiesel production) will need to be expanded upon to meet the renewable fuel targets set by HCEI. The shift to renewable fuels will also pave the way for the State to preserve traditional agricultural land and jobs. HCEI's Fuels Sector strategy includes (1) evaluating local agricultural potential and supporting its development, (2) investing in key logistical infrastructure, (3) evaluating and developing renewable fuel-processing infrastructure, and (4) matching potential fuel supply to sources of demand.

SHORT-TERM GOALS: 2011-2015

Advanced technologies for large-scale production of renewable fuels are approximately 5 years away from being commercially viable. Therefore, our short-term goals for the fuels sector are relatively conservative. The key goal is 45 MGY of green generation fuel (e.g., crude biofuel, biodiesel) used by HECO in 2015. In addition to projects already completed, this will require a number of actions, including (a) preservation of agricultural lands and water, (b) establishing work-force training programs to rebuild our agricultural and expand our refining knowledge base, (c) streamlining the permitting process from start (crop growth) to finish (fuel refining), and (d) developing long-term contracts for the use of biofuels in electricity generation and military transport.

MID-TERM GOALS: 2016-2020

By the end of 2020, the key goal will be 80 MGY of green generation fuel for HECO, 32 MGY of green jet and marine fuel for the Department of Defense, and 50 MGY of renewable fuels for the ground transportation sector. This will be facilitated by rapid development of the State's agricultural sector once the optimal business models for deployment have been fully understood.



ACCOMPLISHMENTS TO DATE

(see Road Map document for a more complete list)

- The Hawaii Bioenergy Master Plan has been completed
- HECO is running the only biofueled turbine generator in the world
- Biodiesel is being made and delivered on the four main islands
- Several small-scale crop trials are underway
- Several pilot, drop-in replacement fuel refinery projects are underway
- HECO has issued a RFP for 210 MGY of locally-produced biofuels and signed purchase contracts
- Gasoline sold in Hawaii for use in motor vehicles contains 10% ethanol by volume
- Department of Defense issued RFI for 32 MGY of renewable drop-in replacement fuel for use in Hawaii

YEAR 15 GOALS

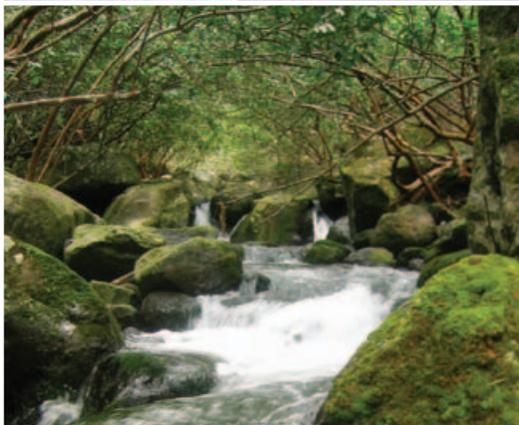
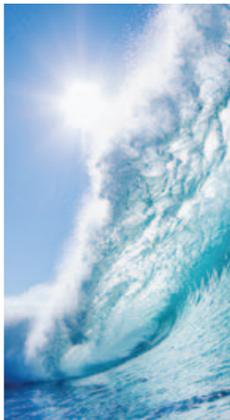
At this stage of the HCEI, significant progress will have been made, and many of our initial technology options replaced by next generation ones not in existence today. Therefore, all goals beyond 10 years are more general in nature. However, if steady progress is made based on all of our current options, by 2025, HCEI hopes to see 32.5% of Hawaii's electricity generated by renewable sources; end-use efficiency reductions in the area of 3500 GWh (subject to PUC revision); alternative ground transport options offsetting 300 MGY of petroleum fuel and overall domestic production of renewable fuels in the order of 350 MGY.

WHAT REMAINS TO BE DONE

If all of the goals of HCEI are realized by the review period of 2030, the State will have achieved a remarkable feat that will be an enduring legacy for future generations, and will likely attract international recognition. The State can then turn its attention to maintaining and enhancing this world-class energy economy. Until that time, it's important to remain on track in pursuit of our goals. We must work together to:

- Ensure that one or more of the islands are connected via undersea cable to allow greater resource flexibility
- Ensure that energy efficiency standards are met, alleviating the need for increased investment in fossil generation technology
- Build an in-State biofuel industry, large enough to provide a secure source of fuel for generation and transportation
- Support the aggressive deployment of EV technology and infrastructure, further reducing Hawaii's need for fossil fuels

No matter what the future holds, we must work together toward the common goal of energy independence and a vibrant, sustainable economy. The alternative is simply unacceptable.



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