# Harnessing Energy on Hawaii

## Geologic Map Day

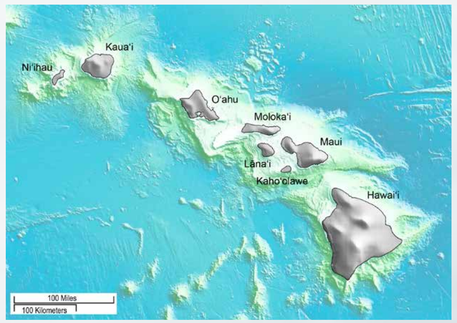
Friday, October 17, 2025

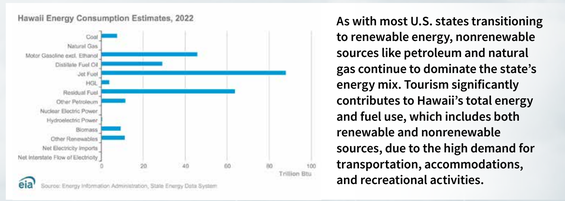
Hawaii*, with its diverse landscapes and abundant natural resources, is at the forefront of renewable energy development in the United States. The state's volcanic mountains, consistent trade winds, and ample sunlight make it an ideal location for a range of sustainable energy technologies. With the goal of transitioning to 100% renewable energy by 2045, Hawaii is focused on reducing its reliance on imported fossil fuels, utilizing its natural geologic and environmental features to power its future.

Each Hawaiian Island has its own energy grid that utilizes a combination of renewable energy sources, with the specific energy mix depending on local resources and infrastructure. The island of Hawai'i* (a.k.a., the "Big Island") is a leader in geothermal energy, thanks to its volcanic activity, particularly around Kīlauea and Mauna Loa. Maui, Hawaii's second-largest island, relies on both wind energy and solar power, with projects like the Kaheawa Wind Power facility contributing to the island's clean energy mix. O'ahu, the most populated island, relies heavily on rooftop solar installations to provide solar power, supported by oil and natural gas for backup generation. Kaua'i has made significant strides in solar energy, with one of the largest solar-plus-storage systems in the state, while also utilizing wind power.

While Hawaii commits resources to expanding the use of renewable energy, the state continues to rely on nonrenewable resources for its energy needs. Petroleum has been, and continues to be, a major source of energy, primarily for transportation and electricity generation. This includes a significant reliance on jet fuel due to Hawaii's remote location and its dependence on air travel for both passengers and freight. Additionally, natural gas is imported and used in certain power plants to ensure backup energy supply when renewable sources cannot meet demand.

*Note the name of the state is Hawaii, while the name of the island of the same name is Hawai'i (with the 'okina).



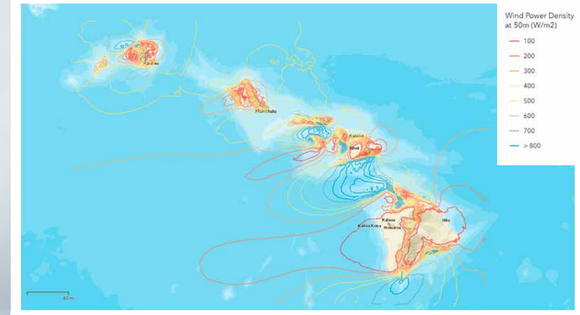

As with most U.S. states transitioning to renewable energy, nonrenewable sources like petroleum and natural gas continue to dominate the state's energy mix. Tourism significantly contributes to Hawaii's total energy and fuel use, which includes both renewable and nonrenewable sources, due to the high demand for transportation, accommodations, and recreational activities.

## Evaluating Renewable Energy Potential

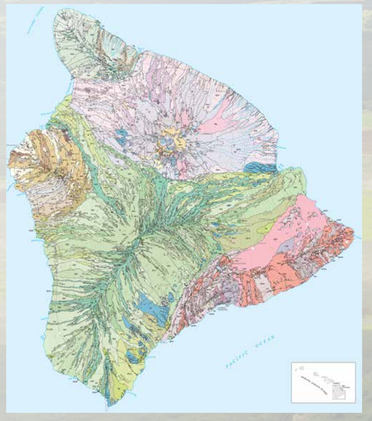
The Hawaii State Energy Office has developed the Renewable EnerGIS mapping tool, an interactive platform designed to evaluate the renewable energy potential of specific sites across the state. This tool provides geospatial data layers for a variety of energy resources, including biomass, geothermal, hydroelectric, solar, wind, ocean thermal energy conversion, and wave energy. By offering detailed information on the distribution of these resources, the platform helps identify areas with the highest energy potential, supporting informed decision-making for energy development.

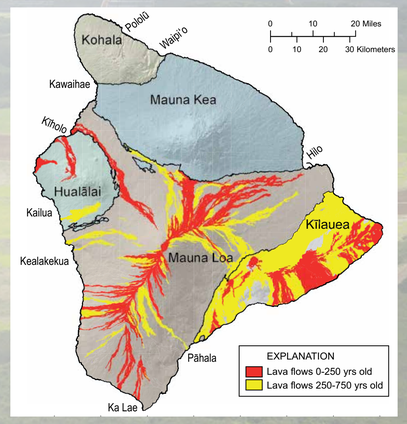
While high energy output is a key factor in site selection, city planners and developers must also consider land use restrictions. These include proximity to National Parks, indigenous lands, and other protected areas. The Renewable EnerGIS tool incorporates additional layers, such as critical habitats, reserves, and special management areas, which help identify regions where energy installations may not be feasible due to environmental or legal protections. This comprehensive approach ensures that renewable energy projects are both effective and respectful of land use concerns, fostering sustainable development.

Explore the Renewable EnerGIS platform at:
https://energy.hawaii.gov/renewable-energis-mapping-tool/




This map from Renewable EnerGIS shows wind power density at 50 meters above ground, highlighting areas with the highest wind energy potential. The map uses contours to represent varying wind power densities, with red indicating lower wind power and cooler colors signifying higher wind power. Areas with higher wind power density are better for wind turbine installations, making it easier to identify optimal locations for harnessing wind energy.



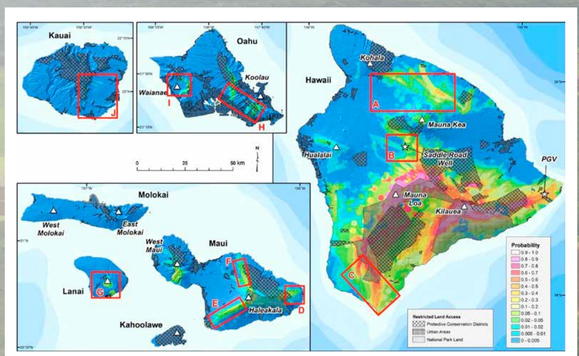

## Volcanic Activity on Hawai'i

Hawai'i Island's geologic history is deeply influenced by its volcanic activity, particularly from Kīlauea and Mauna Loa, which sit above a mantle hotspot where magma erupts, forming new volcanic land as the lava cools and solidifies. Of the island's five volcanoes, only three—Hualālai, Mauna Loa, and Kīlauea—have erupted in the past 750 years. In that time, lava flows have resurfaced 11% of Hualālai, 24% of Mauna Loa, and 91% of Kīlauea, underscoring Kīlauea's remarkable activity and influence on the island's landscape.

A geologic map of the island reveals the distribution of young volcanic rock formations, crucial for identifying geothermal energy reservoirs. A recent play fairway analysis study by the U.S. Department of Energy (DOE) expanded on this mapping, assessing geothermal potential by evaluating features such as heat flow, rock permeability, and fluid availability. The analysis identified regions, especially near active volcanic zones like Kīlauea, as ideal sites for geothermal energy production. These findings help guide future geothermal exploration, with the goal of expanding Hawai'i Island's geothermal capacity and contributing to the state's renewable energy goals.

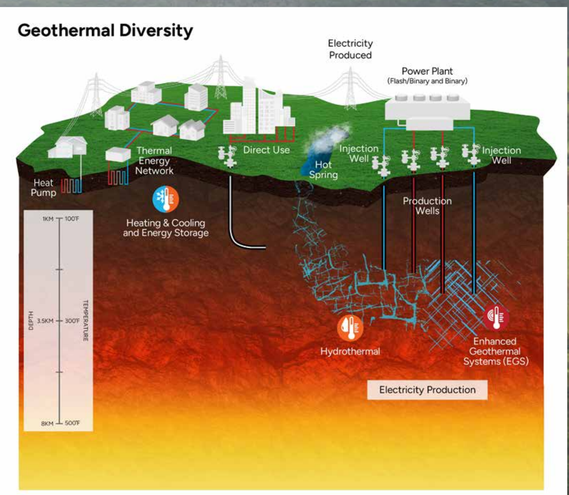
Explore the USGS's interactive map of Kīlauea online at:
https://www.usgs.gov/volcanoes/kilauea

In May 2018, the Puna Geothermal Venture (PGV) on Hawai'i faced a significant threat when lava from the Kīlauea eruption reached the facility. PGV proactively shut down operations, capping all 11 wells to prevent pressure from building in the wells, potentially causing explosions. Despite these precautions, lava flows damaged two wells, a substation, and a warehouse. The plant's access road was also blocked, delaying recovery efforts. PGV remained offline until November 2020. This incident emphasizes the importance of emergency preparedness, risk assessments, and quick restoration strategies to ensure geothermal energy's continued contribution to Hawaii's renewable energy goals.




## Identifying Geothermal Resources

Results of the DOE Phase 1 geothermal play fairway probability analysis for the State of Hawaii. Probabilities of a geothermal resource are colored. Areas with restricted land access are shown in stippled and crosshatch patterns (e.g., National Park lands, protective conservation districts, and urban areas). Red boxes outline areas proposed for Phase 2 study. White triangles indicate the calderas of the main shield volcanoes. White stars mark the locations of the Saddle Road well and Puna Geothermal Ventures. Read the full report at
https://bit.ly/PlayFairwayAnalysis




Geothermal resources are found in the earth's subsurface, a few feet deep to thousands of feet or even miles down. Differing techniques and technologies are needed to recover and use these resources—from low-temperature shallow resources used for heating and cooling to higher-temperature, deeper resources that can be used for electricity generation. This figure illustrates three of the ways geothermal resources can be accessed and used – geothermal heat pumps, hydrothermal, and enhanced geothermal systems.


### IMAGE CREDITS

Labeled map of Hawaii: John Sinton; Wind Power Density Map: Hawaii State Energy Office; Satellite image of Hawai'i: NASA; Geologic map of Hawai'i: USGS; Lava flow map of Hawai'i: John Sinton; Kīlauea's 2018 lower Puna eruption: USGS; Aerial view of PGV which was encroached: U.S. Air National Guard/Tech. Sgt. Andrew Jackson; Play Fairway Analysis: U.S. Department of Energy Geothermal Technologies Office; Geothermal Diversity: U.S. Department of Energy Geothermal Technologies Office.

### ACKNOWLEDGEMENTS

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