

Expanding Accessibility of Energy Modeling in Hawaii

Effective, collaborative energy planning requires people of all skill sets and interests to access complex yet digestible energy information. The Hawaii State Energy Office (HSEO) faced this challenge when working to bring multiple viewpoints into long-term energy planning for the state. In collaboration with the U.S. Department of Energy's (DOE's) National Renewable Energy Laboratory (NREL), HSEO developed and leveraged two compatible energy system modeling tools: Engage and the Hawaii Advanced Visualization Environment Nexus (HAVEN). These tools were designed to navigate complex energy system data; develop a comprehensive, economy-wide perspective on energy system transitions; and expand modeling accessibility to a broader group of stakeholders. This use case provides an overview of Hawaii's use of Engage and HAVEN concurrently.

State and local governments can use Engage (which is currently being modified to include HAVEN's capabilities) to expand information access, collaborate with key stakeholders, and communicate complex strategies to reach energy goals. Engage users can model the planning scenarios a utility puts forward by inputting the data to allow for comparison and verification of outputs. Users can also evaluate new scenarios based on stakeholder input or on-the-ground data. Finally, Engage expands beyond the electricity sector to help users understand broader economic and energy system impacts of certain paths forward. Expanding stakeholder understanding of energy data by presenting it in a visual, easily comprehensible format enhances energy planning and policy development for jurisdictions.



What Is Engage?

Engage is a free, publicly available web application for energy system modeling. It has advanced capabilities for modeling power systems with high shares of variable generation and storage, and it also includes modeling capabilities for interconnected, diverse energy systems. Engage can augment the energy system planning process by empowering more stakeholders to understand energy system planning options.

Engage can help with:

- Planning energy generation and transmission assets
- Analyzing the cost, land, and infrastructure implications of energy decisions
- Communicating the impacts of specific pathways to energy goals
- Identifying the most economic path to achieving energy transitions.

Accessible

Engage is user-friendly and freely accessible as a web application hosted on the NREL cloud with no need for installation on users' computers. The application provides a powerful solver for the rapid optimization of larger system models. Engage is also open-source, modifiable, and installable on local computers for those who wish to host it locally, though local installations require a solver. Engage works with several commercial and open-source solvers such as CBC and FICO® Xpress.

Collaborative

Geographically separated team members can work on shared scenarios in real time, enabling collaborative energy planning. Models can also be published in a view-only format for the public or an exclusive set of users, so that non-modeler stakeholders may observe the process, data, and assumptions in full transparency while maintaining the model's integrity.

Communicative

Engage features graphical representations of model configurations as well as a visualization dashboard that allows users to display and interact with capacity expansion and economic dispatch results of alternative scenarios and better understand trade-offs and energy system transformations. These visualization capabilities translate the analytics of the model into more digestible and accessible decision-grade information.

Exploring Renewable Energy Options in Hawaii

In 2015, the State of Hawaii passed the country's first renewable portfolio standard (RPS) requiring 100% renewable energy in the Hawaii electricity sector by 2045. To achieve this, Hawaiian utilities and regulators needed to design a plan for transitioning the energy sector to accommodate a higher penetration of renewable energy. HSEO saw value in broader stakeholder access to energy planning information to explain the process; solicit input from a broader set of stakeholders; and develop long-term, co-developed, multiparty energy system solutions. The broader set of stakeholders allowed the energy system planning process to include discussion and resolution of challenges related to cost balancing, land use, and social equity.

The HSEO identified visualization of the energy system changes proposed in energy planning documents as an enabler of increasing understanding of energy options for a broader set of stakeholders. Energy planning documents can be dense, technical, and difficult for decision-making stakeholders to digest. For instance, the [2016 Power Supply Improvement Plan \(PSIP\)](#)—the state's integrated resource plan—issued by Hawaiian utility companies was nearly 2,000 pages long and covered 5 scenarios. Analyses for the PSIP considered over 170 scenarios.

Improving Accessibility in Modeling

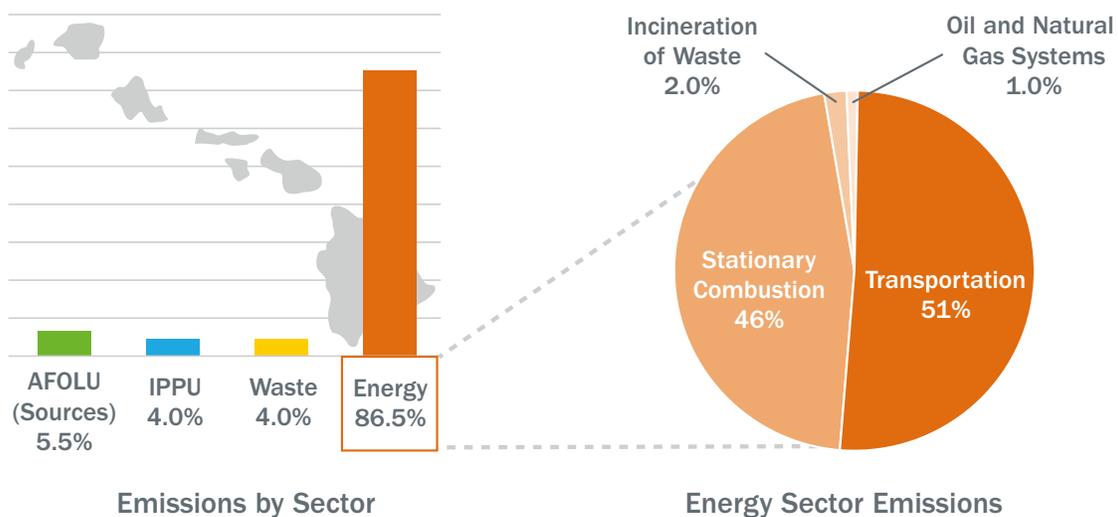
In 2018, the State of Hawaii was the first state to set a carbon-neutral goal. Achieving this goal requires policymakers to consider not only electric utilities, but also other

The Relationship between HAVEN and Engage

HAVEN and Engage are complementary tools for creating a comprehensive energy system planning workflow. HAVEN is an outputs-based application for rendering high-impact communicative visualizations of the complex data that are generated by utility integrated resource plans, capacity expansion models, and economic dispatch models. Therefore, HAVEN's compatibility with Engage allows users direct access to its modeling engine for generating alternative scenario results on-the-fly. HAVEN augments these analytical features of Engage by tailoring the presentation of its solutions to all stakeholders and offering an intuitive comparison between scenarios. The Hawaii State Energy Office developed HAVEN with funding from a U.S. Department of Energy State Energy Program (SEP) [competitive award](#).

The features and capabilities of HAVEN are currently being integrated into Engage so Engage users will be able to seamlessly visualize not only Engage analysis results but also results of analysis conducted outside of Engage (i.e., integrated resource planning).

carbon-emitting sectors like ground transportation, air transportation, and industry. The energy sector accounted for 86.5% of total Hawaiian emissions in 2016. Energy sector emissions include emissions from stationary combustion (electric power plants and petroleum refineries), transportation, incineration of waste, and oil and natural gas systems. Transportation activities accounted for the largest share of these energy sector emissions (Figure 1).



AFOLU: Agriculture, Forestry, Other Land Use. IPPU: Industrial Processes and Product Use
(Hawaii State Department of Health, 2019)

Figure 1: Greenhouse gas emissions in Hawaii, 2016.

To meet the state's energy goals, HSEO is currently using Engage to explore decarbonization strategies in the transportation sector and how different strategies may impact other sectors. For example, Engage can model transportation electrification scenarios to understand the electricity resources needed for a fuel-switching strategy for passenger vehicles. These electrification scenarios can be weighed against other decarbonizing transportation opportunities such as increased electrified mass transit. Comparing the costs of two different scenarios against one another provides insights into economic and community project values. Because the different variables are co-modeled, and changes in one variable can result in trade-offs with another, Engage allows for a more nuanced understanding of decision interactions.

Visualizing Outcomes for Multiple Audiences

In planning to meet its RPS, the HSEO uses HAVEN to assess energy system trade-offs and investments and communicate complex energy data sets, concepts, and goals to stakeholders. HSEO uses the tool to develop data visualizations that help the state's decision makers better understand the intersections between energy systems and the potential impacts of energy policies (Hawaii State Energy Office 2018), including the benefits of energy efficiency programs to the state's energy transition. Currently, the capabilities of HAVEN are being built such that they can be used through Engage by state and local governments (rollout of these visualization capabilities will begin in early 2021).

Engage & Energy Efficiency in Hawaii

Energy efficiency will play a role in Hawaii's energy future; the state has a statutory goal to reduce electricity consumption by 4,300 gigawatt-hours by 2030. To achieve this goal, the state will do the following: align the efficiency regulatory policy framework with clean energy goals, support building retrofitting, strengthen policies and building codes for new construction, and identify nonbuilding-related energy efficiency measures (Hawaii State Energy Office, 2020). Energy efficiency also plays an important role in the state's transition to renewables; it can not only mitigate energy costs for consumers and reduce emissions, but when properly targeted, can support flexibility in the siting and deployment of needed renewable resources. Engage and HAVEN can help the HSEO understand how different energy efficiency efforts may impact consumption, costs and other factors related to renewable energy targets.

The use of HAVEN to visually display options fosters engaged community discussion around complex trade-offs in achieving goals. For example, HSEO used HAVEN to compare the relationship between offshore wind and solar photovoltaic (PV) panels in meeting the state's RPS. As seen in Figure 2, the tool demonstrated that a proposed installation of 200 megawatts (MW) of offshore wind would require the state to also use approximately 2083 MW of solar PV to meet its renewable energy goals. HSEO then used HAVEN to identify areas on a map of the island of Oahu where PV panels could be installed to meet the state's RPS.

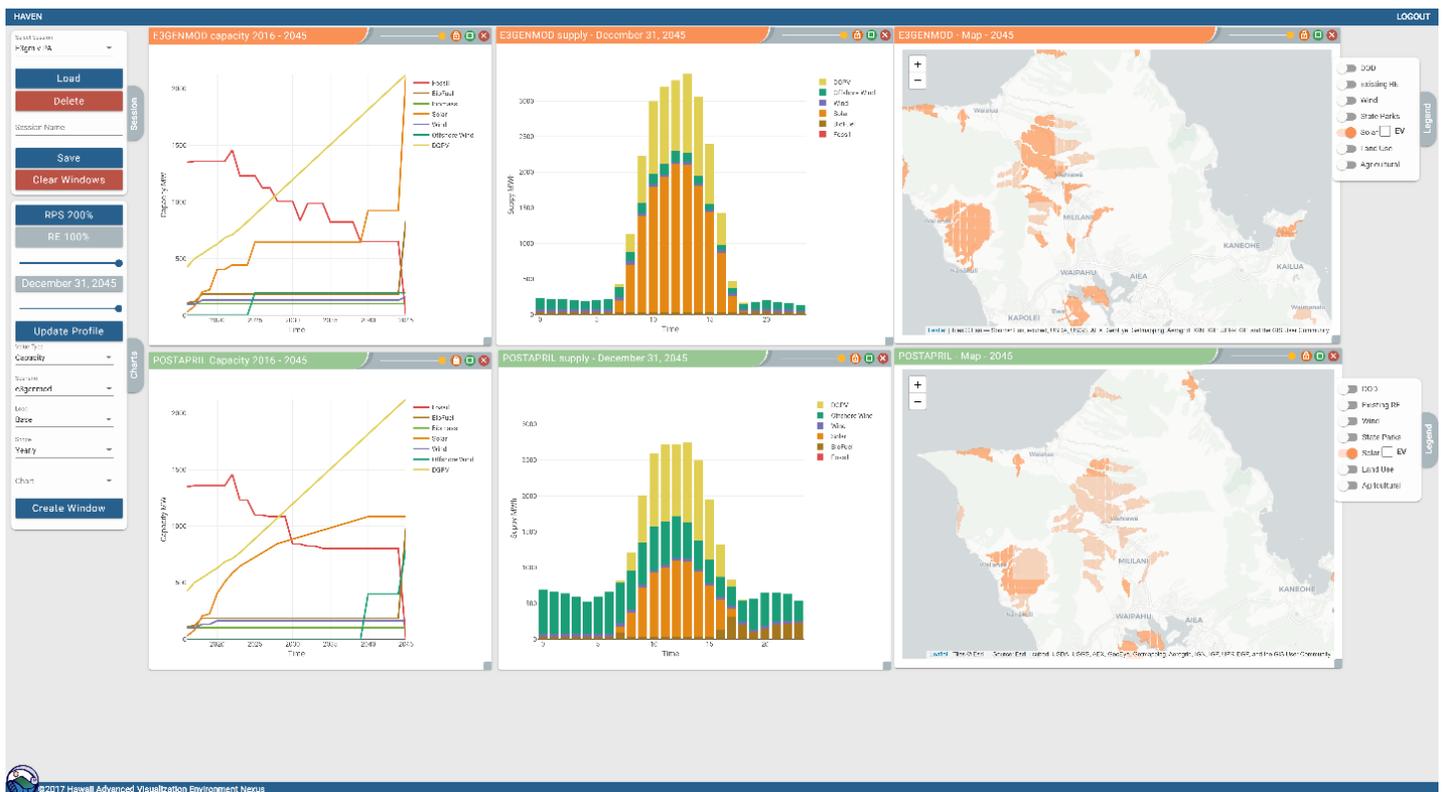


Figure 2: HAVEN allows users in Hawaii to compare pathways to achieving 100% renewable energy: 200 MW of offshore wind versus 800 MW. (Charts and maps generated in HAVEN using data from the Hawaii Electric Companies' Power Supply Improvement Plan).

During a community meeting in which HSEO staff presented HAVEN findings, a community member indicated that much of the land highlighted was used for pineapple groves. This demonstrates a land-use tension that Hawaii and other jurisdictions will face as communities are increasingly impacted by the transition to clean energy. HAVEN illustrated an alternative scenario that factors in the installation of 800 MW of offshore wind and therefore, would require less solar PV (approximately 1063 MW) than the 200 MW offshore wind scenario. This would diminish the potential land-use constraint; however, this scenario would create a new set of impacted stakeholders, including local fishermen, communities, businesses with impacted viewsheds, as well as state and federal agencies.

Applying Engage to Your Jurisdiction

By expanding accessibility of complex energy modeling to a wider audience, the development of HAVEN and Engage have enabled state decision makers to better participate in state energy planning efforts. It is essential to gather critical input from key stakeholders, including state energy office and other state agencies, businesses and nonprofits, as well as the general public, to ensure diverse perspectives and priorities from impacted communities are considered. In Hawaii and elsewhere such input is essential to ensure buy-in for costly, controversial, but ultimately transformative clean energy plans.

Today, a jurisdiction of any size, with minimal training, can use Engage to generate, present and communicate possible energy strategies to decision makers and the public. If done during the utility planning processes described previously, such efforts can help generate buy-in for transformative energy plans.

How to Use Engage

Jurisdictions can visit <https://engage.nrel.gov/> to get direct and immediate access to Engage's free, publicly available web application without any requirements for payment or installation. A simple online registration is required so that individuals can share models and collaborate in teams. Additionally, supporting information can be accessed on this site, such as example models and modeling documentation. Two simplified example models, National Scale and Urban Scale, are provided for educational purposes only and the modeling documentation offers tutorials on their configuration.

While Engage is designed to be inclusive of non-technical users, additional training will be needed for advanced users that intend to implement custom model configurations. NREL may be able to facilitate localized base-case model formulation and hands-on staff training with the Engage tool in support of a jurisdiction's energy planning efforts.

Contact

For more information or assistance using HAVEN/Engage, connect with NREL staff via email at: engage@nrel.gov

References

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AES Lawai Solar Project- Kauai. Photo by Dennis Schroeder, NREL 58006