SWITCHing the paradigm

Understanding the tradeoffs and benefits associated with adding more renewable energy to O‘ahu’s electric system and the potential impact on agricultural lands.

ulupono INITIATIVE®

A **white paper** by **Ulupono Initiative**

Based on an analysis by **Dr. Matthias Fripp**

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EXECUTIVE SUMMARY

There is a crossroad where two essential pathways to Hawai'i's sustainability goals meet — where what's needed for energy independence and food self-sufficiency coalesce. Too often, it is where, in many minds, polarizing choices have to be made.

On an island in the middle of the Pacific, land is not just limited. It also affects the availability and cost of everything else — from the food we put on the table to the electricity that powers our homes. It is understandable then, when faced with the choice of using limited lands to support local agriculture or the state's renewable energy needs, we pause to consider how best to achieve Hawai'i's declared goals to double local food production by 2030 and produce 100% of the state's electricity with renewable energy by 2045.

When framed as having to choose one goal over the other, the choice can become paralyzing. However, in reality, the development of renewable energy, specifically solar photovoltaics (PV), and protecting Hawai'i's agricultural land do not have to be at odds with each other.

The following analysis shows that the two can not only coexist but, at times, have a symbiotic relationship that allows us to achieve these ambitious goals simultaneously. When broadening our perspectives on available solutions, we find that the development of solar PV does not have to displace agricultural activities in our quest to move Hawai'i toward greater sustainability, self-sufficiency and resilience.

To make this happen, however, there must be thoughtful consideration of each sector, its opportunities and challenges, to determine how to employ land for both activities.

Agriculture makes up less than 1% of the state's overall economy. While access to agricultural land is an issue in Hawai'i, the greater challenge is a lack of sufficient infrastructure on these lands to support agricultural operations, including access to water. This and many other daunting challenges, make it difficult to sustain a viable agricultural operation in Hawai'i. Just as developers invest in renewable energy technologies, there must be public and private investment in new and emerging, but proven technology, to reduce Hawai'i's food imports and restore agriculture's contribution to the state's economy. It is therefore critical to ensure that Hawai'i's agricultural lands are meaningfully considered as we continue to make progress on our clean energy goals.

To better understand the impact on agricultural lands when adding more renewable energy onto O‘ahu’s electric system, Dr. Matthias Fripp, associate professor of electrical engineering at the University of Hawai‘i at Mānoa, used an electricity system planning model called SWITCH (Solar and Wind Energy Integrated with Transmission and Conventional Sources) to evaluate how different land-use assumptions would affect land availability, total electric generation costs, and the overall design of the electric system on O‘ahu. The land-use assumptions modeled by SWITCH include: (1) more restrictive use of the Land Study Bureau (LSB) Class B and Class C agricultural lands; and (2) higher slope limits for potential solar PV project sites.

Land Study Bureau Detailed Land Classification

The Land Study Bureau of the University of Hawai‘i prepared an inventory and evaluation of the state’s land between 1965 and 1972, grouping non-urban areas based on a five-class rating system for agricultural productivity. The resulting Detailed Land Classification used the letters **A, B, C, D and E**, with A representing the highest class of productivity and E the lowest. Factors considered for productivity included soil properties, topography, climate, and other factors like technology and crop type.

At a high level, the SWITCH analysis revealed that the use of some agricultural lands for solar PV results in lower costs for Hawaiian Electric and its customers. Moreover, in certain scenarios, the relatively low impact to customers’ electricity costs, also shows that it is possible to protect most, if not all, of O‘ahu’s most productive agricultural lands.[1]

However, if Class B and Class C agricultural lands are not protected beyond present measures, roughly 50% of Class B agricultural lands and approximately 15% to 20% of Class C agricultural lands could be utilized for future solar development.[2] This scenario may be unacceptable to farmers and local food advocates.

Further, as utility-scale solar PV is often under contract for at least 20 years, agricultural lands used for solar development may not be available for its intended use for an extended period, unless developers make committments to support the dual use of agricultural lands for both local food production and renewable energy generation.

These findings suggest a need for a reconsideration of the status quo — whether it’s current land-use laws or other policy directives — and the need for broader compromises, if both of the state’s food and energy goals are to be fulfilled.

We believe this analysis will support those efforts.

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1 The electricity production cost for the unlimited use of Class B and Class C agricultural lands at 20% slope is 11.7 cents per kWh. The electricity production cost when restricting Class B lands to 1.8% and Class C lands to 1.1% at 20% slope is 12.3 cents per kWh.

2 This assumes unrestricted use of Class B and Class C agricultural lands at both 15% and 20% slope variations.

KEY TAKEAWAYS

- When all of Class B and Class C lands are made available for solar development, at <15% slope, SWITCH estimates **51.1%** of Class B agricultural lands are likely to be selected (**13,218 acres**) for project development, while **16.1%** of Class C agricultural lands are likely to be selected (**2,419 acres**).

- When all of Class B and Class C lands are made available for solar development, at <20% slope, SWITCH estimates **49%** of Class B agricultural lands are likely to be selected (**12,696 acres**) for project development, while **14.9%** of Class C agricultural lands are likely to be selected (**2,239 acres**).

- More **restrictive land-use limits** for Class B and C agricultural lands will require an earlier transition to other renewable resources, like offshore wind and biofuels, which are presently more costly than other available renewable energy technologies.

- **A willingness to develop solar PV on higher-sloped lands**, regardless of the agricultural land-class limit, will result in a **lower-cost resource plan** for everyone, **despite potential increases in individual solar project development costs**.

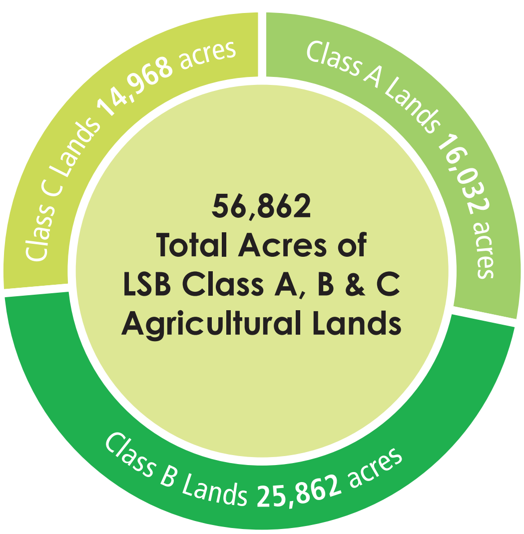
- The **electricity production cost difference** between the **Unrestricted Use** (unlimited use of Class B and C agricultural lands) and **Current Use** (no further development of solar facilities on Class B and Class C lands) scenarios at <15% slope is **1.1 cents per kWh**. At <20% slope, the cost difference is only **0.6 cents per kWh**.

- The lowest-cost energy resource plan is achieved when there is no limitation on the use of Class B and C agricultural lands, and solar developers are willing to build on sites with up 20% slope. The total net present value (NPV) cost of the lowest-cost resource plan for O‘ahu is **$26.1 billion** over the next 30 years.

Hawai'i is consistently taking ambitious steps toward a more sustainable and resilient island community, from local food production and clean energy generation, to necessary climate adaptation measures. Driven by strong legislative directives and innovative programs, progress made to date in many of these sectors is notable.

As a result of the State of Hawaiʻi's renewable portfolio standard (RPS), Hawaiian Electric reported that 34.5% of Hawaiʻi's electricity was generated by renewable energy resources in 2020.[3] Meanwhile, newly established legislation requiring at least 30% of the food served in public schools be locally sourced by 2030 will significantly help the state achieve its local food production goals — doubling local food production by 2030 and locally sourcing 50% food served in key state departments by 2050.

Land Study Bureau (LSB) Agricultural Lands O'ahu Land Budget (Total Acres — Class A, B & C)



Recognizing the momentum in both the renewable energy and local food sectors, concerns regarding the use of agricultural lands for renewable energy projects have been raised, noting the competition for suitable lands may affect the realization of each goal.

Currently, Hawaiʻi's land-use laws require energy developers to apply for a special-use permit if they intend to develop solar PV on Class B or C agricultural lands, provided that the land occupied by the solar PV project is also made available for compatible agricultural activities at a reduced lease rate.[4] While this measure is well intended, opportunities to better incent local food production on these lands are possible.

The good news is that this challenge is not insurmountable. Ultimately, it comes down to understanding the choices we, as a state, are willing to make to achieve the goals we've embraced. It then is critical to understand each choice before us, its costs and benefits, to better inform future decisions in each sector, all of which can significantly enhance the quality of life for the people of Hawaiʻi.

3 See *Hawaiian Electric's 2020 Renewable Portfolio Standard Status Report*. Ulupono notes that the reported RPS is not the corrected RPS, which is based on the total amount of renewable energy generation to the system divided by the total amount of electricity generation on the system, rather than the division by Hawaiian Electric's net electricity sales. Ulupono estimates the corrected RPS is closer to 30% versus the reported percentage of 34.5%.

4 See HRS Chapter 205, Section 4.5(a)(21).

CHALLENGING OUR ASSUMPTIONS

The genesis of this white paper is based on an analysis Ulupono Initiative (Ulupono) first presented to Hawaiian Electric and other stakeholders involved in the utility's Integrated Grid Planning (IGP) process on June 18, 2021. As an involved stakeholder in Hawaiian Electric's IGP process, Ulupono provides the utility and the Hawai'i Public Utilities Commission (PUC) with reliable data to make more informed decisions about its planning process.

The initial NREL Resource Potential Study assumed utility-scale solar could not be developed on sites with a slope greater than 10%, and allowed full use of Class B and C agricultural lands for renewable energy development.

What is Integrated Grid Planning (IGP)?

Electric utilities use resource planning to identify long-term investments to meet their electricity demand and public-policy goals at a reasonable cost for their customers. In response to dramatic changes in Hawai'i's electricity industry, Hawaiian Electric, in 2018, initiated a first-of-kind resource planning process, IGP, to more holistically evaluate the needs of the electric system to identify an optimal portfolio of power solutions to meet Hawai'i's future electric system needs and clean energy goals.

The analysis was in response to an initial Resource Potential Study, published by the **National Renewable Energy Laboratory (NREL)**, to inform the utility's long-term investments for O'ahu's power system. Ulupono provided the utility with modified assumptions to be used in a subsequent NREL study of which, addressed in part, the conservative assumption NREL used for the grade (slope) of land permissible for solar development. Upon further discussions with Dr. Matthias Fripp, Ulupono wanted to better understand how increases to the allowable slope of land would impact O'ahu's agricultural lands.

To address this issue, Ulupono contracted with Dr. Matthias Fripp, to conduct an independent analysis utilizing SWITCH, an open-source electricity planning model, to solve for *the most optimal and lowest cost energy resource portfolio*, using modified assumptions for (1) the slope of a project site, and (2) the use of Class B and C agricultural lands.

Since June 18, 2021, the SWITCH analysis has been updated. Discussions with a number of solar developers involved in project development throughout the United States and Hawai'i led Ulupono to revise the initial high-slope assumption from <30% to <20% while the initial low-slope of <15% remained the same. Both the <15% and <20% slope limits were then modeled in the analysis, as they appear to be reasonable thresholds based on current solar PV development throughout the industry.

LAND-USE SCENARIOS AND ANALYSIS

SWITCH modeled a range of land-use restrictions on Class B and C agricultural lands under **two slope limits — <15% and <20% —** with accompanying cost factors (see LSB Agricultural Land Class Scenarios table) and solved for:

(1) the lowest total generation costs[5] (net present value, or NPV, within a 0.5% margin) for 2020 through 2054; and

(2) resource capacity online in 2045 from each major class of generation (i.e., onshore and offshore wind, utility scale solar, thermal generation).

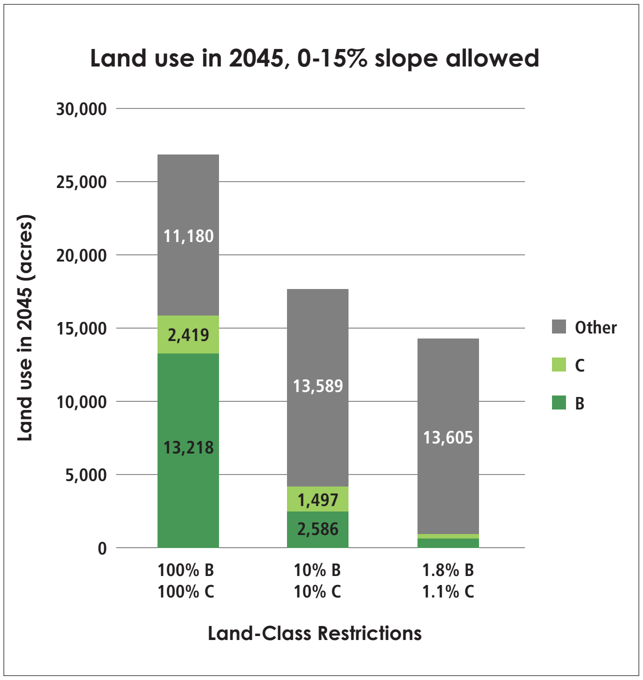
After applying the slope limits, only a portion of O'ahu's agricultural lands are suitable for solar development.

For purposes of this white paper, the following table illustrates three scenarios that were modeled in SWITCH. The Unrestricted Use Scenario allowed SWITCH to select **all Class B and C** agricultural lands for solar development. The 10% Use Scenario limited SWITCH to selecting only 10% of Class B and C agricultural lands for solar development. The Current Use Scenario (**1.8% of Class B and 1.1% of Class C agricultural lands**) restricted SWITCH from selecting any more of Class B and C agricultural lands for solar development than what is already in use.

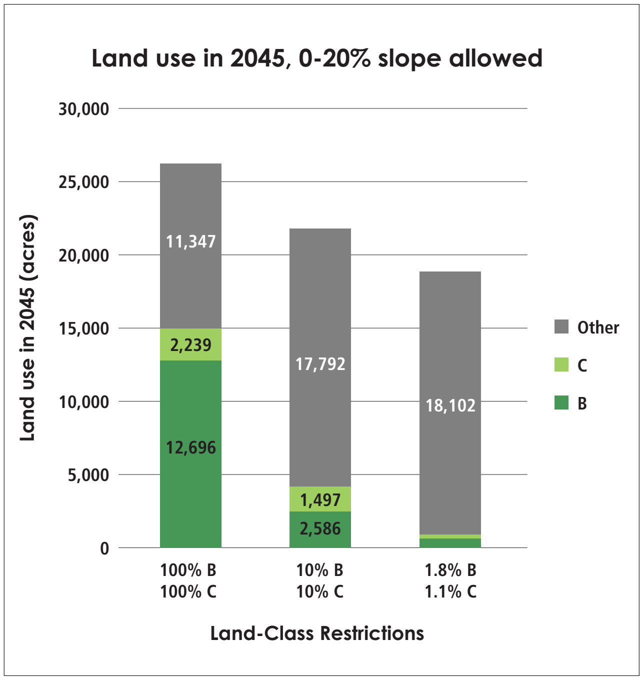
Land Suitability (Slope)[6]	LSB Agricultural Land Class Scenarios		
	Scenario 1 ("Unrestricted Use" Scenario)	**Scenario 2 ("10% Use" Scenario)**	**Scenario 3 ("Current Use" Scenario)**
<15% Slope Solar facility can be developed on land with up to 15% slope.	No restrictions on the use of Class B and Class C agricultural lands for solar development.	Use of Class B and Class C agricultural lands for solar development is restricted to 10%.	Use of Class B and Class C agricultural lands for solar development is restricted to 1.8% and 1.1%.
20% Slope Solar facility can be developed on land with up to a 20% slope.			

5 Total generation costs include fuel costs, capital recovery costs, and operations and maintenance (O&M) costs.

6 The following cost factors were applied for each slope variation: (1) no cost increase to project sites with up to 15% slope, (2) a cost factor increase of 6 cents per watt for project sites with 15% to 17.5% slope, and (3) a cost factor increase of 7 cents per watt for project sites with 17.5% to 20% slope. The cost factor is intended to account for additional costs to develop a solar facility on steeper slopes.



▲ *At <15% slope, Scenario 1 (Unrestricted Use), uses 26,817 acres of land for solar development, representing 8.2% of the total land on O'ahu. Scenario 2 (10% Use), uses 17,672 acres, representing 5.4% of the total land on O'ahu.*



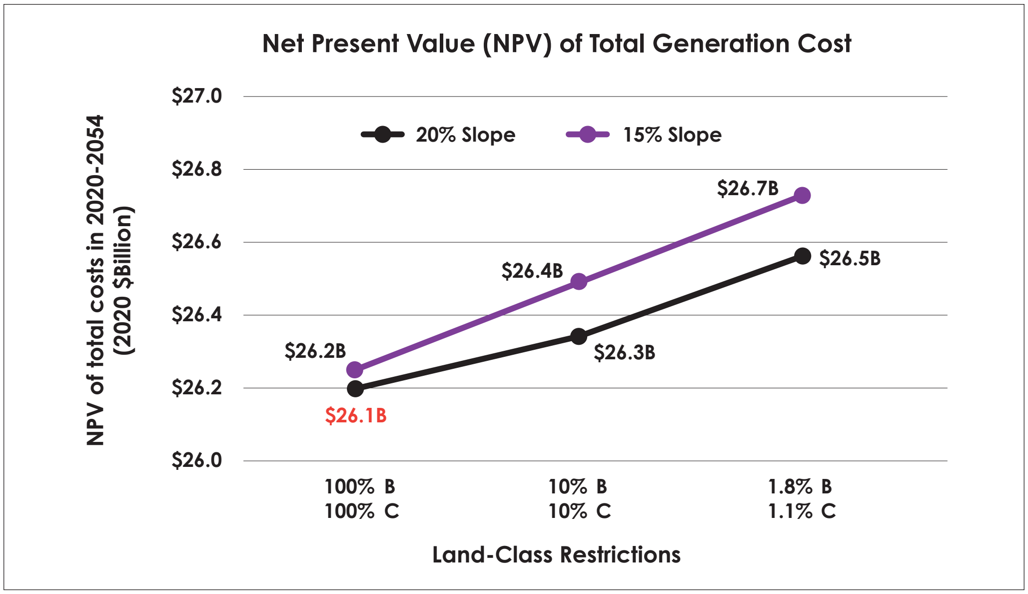
▲ *At <20% slope, Scenario 1 (Unrestricted Use), uses 26,282 acres of land for solar development, representing 8% of the total land on O'ahu. Scenario 2 (10% Use), uses 21,875 acres, representing 6.6% of the total land on O'ahu.*

In Scenario 1 (Unrestricted Use) using either slope variation, SWITCH selected a large portion of Class B agricultural lands (approximately 50%) to be used for solar development and only some of Class C agricultural lands (approximately 15%). As restrictions on Class B lands and Class C lands become tighter, SWITCH replaces both Class B and Class C lands with mostly "other" lands[7] as shown in all three Scenarios. This is most apparent in Scenario 3, when <20% slope is applied, where SWITCH selects 18,102 acres of "other" land.

While "other" lands make up 326,641 acres of O'ahu's land budget, at this level of use it is likely that many of the "other" land sites will be of lower quality, increasing development costs enough to outweigh the benefits of project development at those sites.

7 "Other" lands include any lands that are not LSB Class A, B or C agricultural lands. However, only a portion of "other" land is considered to be usable for solar development, as the land must meet the following criteria: (1) zoned for agriculture or country; (2) not a golf course; (3) not within 50 meters of a road centerline; (4) slope below 15% or 20%; and (5) part of a contiguous area of solar-suitable land that is larger than a 60-meter disk.

TOTAL GENERATION COST (2021-2054)



▲ *NPV of the total cost for the electric utility's generation system between 2021 and 2054 for each of the three scenarios.*

The least-costly generation plan SWITCH identified had a NPV cost of $26.1 billion, occurring when all of Class B and C agricultural lands are available for solar development and solar PV is placed on sites with <20% slope. As land-use restrictions are tightened, regardless of the slope, generation system costs will increase as land becomes unavailable.

While the chart above shows almost parallel increases in total generation costs between the different slopes, a more detailed chart which includes all of the land-use restriction scenarios reveals a relatively quick rise in total generation costs when solar PV is developed on <15% slope, and Class B lands are restricted beyond 25% while all of Class C lands remain available for development. **This is likely due to the restrictions on easy-to-develop, low-sloped lands, and will require an earlier transition to resources that are currently more costly, such as, offshore wind and biofuels.**

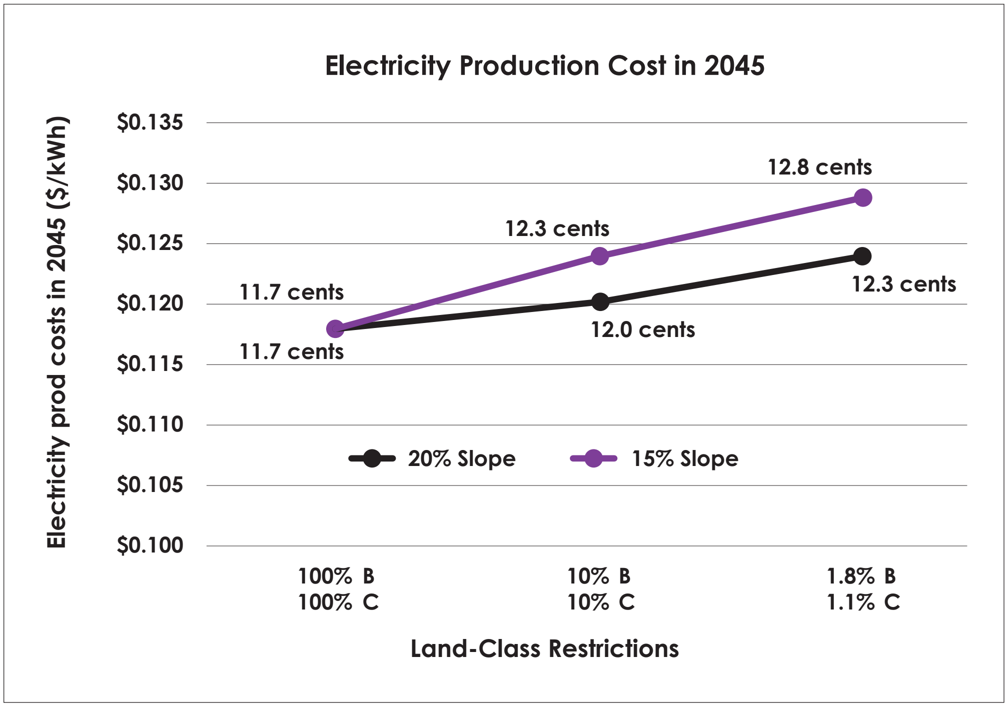
> ***The total NPV cost of an electric system is the present value of all the costs the system incurs over its lifetime. Costs include capital costs, replacement costs, operations and maintenance (O&M) costs, fuel costs, emissions penalties, and the costs of buying power from the grid.*** *HOMER Energy, HOMER Grid 1.8 – 'Net Present Cost'*

In the <20% slope scenario, total generation costs do not start to rise until Class B lands are restricted to current use (1.8%) and Class C lands are restricted to 10% use. Nevertheless, an important detail to note when looking at the overall trend of total generation costs between both slope limits is that the total generation costs in the <20% slope scenario are consistently below the <15% slope scenario NPV costs. **This reveals that a willingness to develop on higher-sloped lands, despite the increase in individual solar project development costs, will result in an overall lower-cost generation plan.**

ELECTRICITY PRODUCTION COSTS ($/KWH)

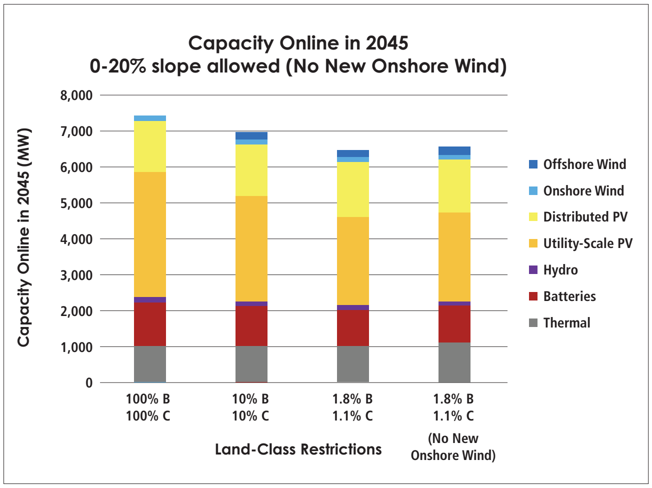
The chart below includes the same costs included in the NPV Total Generation Cost chart previously. However, costs were frozen in 2045 and divided by the total amount of energy delivered in that year to show the cost per kilowatt-hour ("kWh") as a result of each scenario. This allows for a greater understanding of the potential cost impact to an average customer (who uses roughly 500 to 600 kWh per month) for any cost increases for the overall electric system.

Similar to the NPV Total Generation Cost, the Electricity Production Cost shows that land-use restrictions have a small effect on electricity production costs in the <20% slope scenario until Class B agricultural lands are restricted to the current use and a more restrictive use case is applied for Class C agricultural lands. A comparison of the production costs ($/kWh) between the two-slope scenarios reveal a maximum cost difference of 0.5 cents per kWh.



This reveals that if solar development primarily occurs on low-sloped lands (<15% slope), customers are likely to experience higher electricity costs, as more expensive resources will be added to the system to make up for the capacity needs that could have otherwise been met by solar PV on higher-sloped lands. While solar developers may be apprehensive to developing on higher-sloped lands, the electricity production costs predicted by the SWITCH analysis suggest that a willingness to develop solar facilities on sites with <20% slope, at a slightly higher per project cost, will allow for most, if not all, of O'ahu's agricultural lands to be protected while also ensuring lower electricity rates for customers.

RESOURCE TRADEOFFS TO ACHIEVE 100% RPS BY 2045



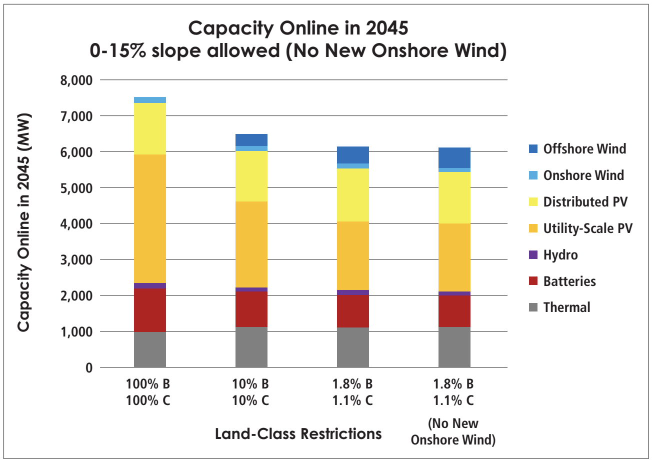
◄ *The "No New Onshore Wind" Scenario limits the amount of onshore wind resources to the current MW capacity of onshore wind generation online, which includes the MW capacity from the Nā Pua Makani Wind Facility, totaling 123 MW of onshore wind resources on O'ahu.*

To comprehensively round out the analysis, Ulupono also used SWITCH to analyze changes to O'ahu's 2045 resource portfolio when land-class restrictions and slope variations were applied. This part of the analysis provided additional insight on the amount of capacity from different energy resources needed to achieve Hawai'i's 100% RPS goal in each Land Use Scenario previously discussed. The findings are important to consider, as they demonstrate the need for a diverse renewable energy portfolio. The findings also suggest that Hawai'i may have difficulty meeting its renewable energy goals if certain renewable resources (wind, biofuels/biomass, etc.) are excluded from future development.

The figures and tables in this section detail each major resource type and the capacity, in megawatts (MWs), online in 2045 for each land-use scenario and slope limit.

In the <20% slope scenario, the resource portfolio is reasonable until onshore wind is constrained due to assumed community opposition. In this instance (Scenario 4), SWITCH forecasts the electric system to need **1,124 MW** of thermal generation, adding **301 MW** of new thermal generation to the **823 MW** of assumed existing thermal generation online in 2045. Scenario 4 also adds **299 MW** of offshore wind. Whereas, in Scenarios 1, 2 and 3, **151 MW** of new thermal generation is added to the system, totaling **973 MW** of thermal generation versus **1,124 MW**. In these scenarios, the amount of offshore wind varies between the three scenarios.

Scenarios (0-20% Slope)	2045 Resource Portfolio by Resource Type (MW)						
	Thermal	Batteries	Hydro	Utility-Scale Solar	Distributed PV	Onshore Wind	Offshore Wind
Scenario 1 ("Unrestricted Use")	973	1,235	150	3,504	1,432	150	0
Scenario 2 (10% Use)	973	1,235	150	2,917	1,432	150	201
Scenario 3 ("Current Use")	973	1,235	150	2,498	1,432	150	237
Scenario 4 ("Current Use" with No Additional Onshore Wind)	1,124	983	150	2,498	1,432	123	299



The resource tradeoffs are more controversial when the <15% slope is applied. According to SWITCH, if utility-scale solar is only developed on sites with <15% slope, the resource portfolio changes significantly. Not only does SWITCH anticipate adding **301 MW** of new thermal generation to the electric system in three of the four scenarios (Scenarios 2, 3 and 4)[8], but the reduced amount of capacity from utility-scale solar and batteries is also noticeable, particularly in Scenarios 3 and 4, and when compared to the <20% slope limit. Overall, the addition of thermal generation in certain scenarios is concerning, as thermal power generation is created by a variety of fossil fuels, including coal and fuel oil. Until thermal generation power plants switch to biofuels for energy production, Hawaiian Electric will continue to rely on fossil fuels to provide reliable service, sustaining the state's dependence on fossil fuel resources.

It is also worth noting the amount of offshore wind that is assumed for each slope limit. As noted above, the less restrictive slope limit (<20% slope), estimates that **200 to 300 MW** of offshore wind will be needed in all but the Unrestricted Use scenario. Whereas, the 15% slope limit reveals an estimate of **400 to 573 MW** of offshore wind needed in all but the Unrestricted Use scenario. While these estimates are not as concerning as the additions of thermal generation, if solar is not developed on land with a slope greater than 15%, substantial investments in other renewable resources such as offshore wind and biofuels will be needed, both of which are presently more expensive than stand-alone solar PV and solar PV plus storage projects.

Scenarios (0-15% Slope)	2045 Resource Portfolio by Resource Type (MW)						
	Thermal	Batteries	Hydro	Utility-Scale Solar	Distributed PV	Onshore Wind	Offshore Wind
Scenario 1 ("Unrestricted Use")	973	1,262	150	3,576	1,432	150	0
Scenario 2 (10% Use)	1,124	966	150	2,356	1,432	150	400
Scenario 3 ("Current Use")	1,124	897	150	1,898	1,432	150	549
Scenario 4 ("Current Use" with No Additional Onshore Wind)	1,124	849	150	1,899	1,432	123	573

8 SWITCH assumes that 823 MW of thermal generation is online in 2045, prior to the 151 and 301 MW additions of thermal generation added depending on the land use scenario and slope limit applied.

CONCLUSION

In order to create a future that serves the greatest good, we must take the opportunity to pause — and study the choices before us. Tension surrounding the use of Hawai'i's finite land, created by two of Hawai'i's ambitious sustainability goals, presents an opportunity to innovate.

In the case of O'ahu's agricultural lands, we must not forget their uniqueness and importance to island residents and their quality of life. Rather, we must ensure that our choices, and ultimately our decisions, appropriately consider how we can protect these valuable resources, while not squandering the potential to responsibly host clean, renewable energy and produce fresh, locally grown food for the people of Hawai'i.

Findings from this SWITCH analysis reveal:

- If no further actions are taken to protect Class B and C agricultural lands, O'ahu is likely to lose 50% of Class B and 15-20% of Class C agricultural lands to solar development.
- If more restrictive land-use limits for Class B and C agricultural lands are enforced, this choice will likely require an earlier transition to a renewable energy future that could include resources such as, offshore wind and biofuels, that are presently more costly than available renewable energy technologies.
- If solar PV is developed on higher-sloped lands, regardless of the land-use scenario limit applied, it will result in a lower-cost resource plan, despite the increase in individual solar project development costs.
- The electricity production cost difference between the Unrestricted Use and Current Use scenarios is 1.1 cents per kWh at <15% slope. At <20% slope, the difference is only 0.6 cents per kWh.
- If solar PV is developed on higher-sloped lands, most of the lower-sloped (flatter) Class B and C agricultural lands can be protected and may result in a lower overall cost for ratepayers.

The truth is, there is no single sweet spot. While more stringent land-use restrictions will protect local agriculture, it may also prevent us from tapping into Hawai'i's most optimal renewable energy future. On the other hand, the past is full of examples where we've failed to adequately consider the 'āina in both the short and long term. Instead, the solutions to this issue exist in subtle degrees rather than absolute terms.

As climate change continues to increase the pressure to "act now," we believe the tough choices Hawai'i faces about its diverse, yet, limited land resources can be turned into win-win scenarios for each sector, each developer, and each agricultural producer affected, so long as the desired outcomes and tradeoffs inherent to each scenario are carefully evaluated.

It is in this spirit that we at Ulupono Initiative offer this analysis, a starting point to continue a collective inquiry about the choices to best achieve two of Hawai'i's most important sustainability goals. ■

Dr. Mathias Fripp, Associate Professor of Electrical Engineering, University of Hawaiʻi at Mānoa
Dr. Fripp specializes in optimal design of power systems with large shares of renewable energy — up to 100% — particularly focusing on the potential for demand-side response to help balance these power systems, e.g., charging electric vehicles automatically during sunny or windy times of day. More information:
https://uhero.hawaii.edu/people/matthias-fripp/

SWITCH Analysis Data Tables (October 2021)
View and download the data spreadsheets:
https://www.ulupono.com/project-list/white-paper-switching-the-paradigm/

Docket No. 2018-0165, Instituting a Proceeding to Investigate Integrated Grid Planning
As requested by the State of Hawaiʻi Public Utilities Commission (PUC), Hawaiian Electric has filed its Integrated Grid Planning Report with the commission, describing the utility's new approach to power system planning. The PUC opened Docket No. 2018-0165 to investigate Hawaiian Electric's report and "to ensure that the planning process is conducted in a timely, transparent, and collaborative manner by providing guidance and directives where necessary and appropriate." Link to the docket:
https://dms.puc.hawaii.gov/dms/dockets?action=search&docketNumber=2018-0165

Hawaiʻi Land Study Bureau Class Locator
The University of Hawaiʻi Land Study Bureau (LSB) Detailed Land Classification rates non-urban areas for agricultural productivity using the letters A, B, C, D and E, with A representing the highest class of productivity and E the lowest. The State of Hawaiʻi Office of Planning's Hawaiʻi Statewide GIS Program maintains an LSB Class Locator map for visualization and information purposes. Link to the map:
https://histategis.maps.arcgis.com/apps/Viewer/index.html?appid=c3fbde94addc4e11bf0b768846f4a4a5

Ulupono Initiative
A mission-driven venture of The Omidyar Group, Ulupono Initiative was founded in 2009 to improve the quality of life for the people of Hawaiʻi by working toward sustainable solutions that support and promote locally produced food, renewable energy, clean transportation, and better management of freshwater and waste. More information:
https://www.ulupono.com/