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U.S. DEPARTMENT of ENERGY | Office of Energy Efficiency and Renewable Energy

Lahaina Energy Partnership: Community Priorities and Technical Assistance Scope of Work

Presented by National Renewable Energy Laboratory (NREL) and Local Partners Lāhainā Strong, Hā Sustainability, and Shake Energy Collaborative

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This presentation was produced when the laboratory operated as the National Renewable Energy Laboratory (NREL). The laboratory is now the National Laboratory of the Rockies (NLR).

Agenda

- Welcome and project overview
- Lahaina community energy priorities: presented by local partners Lāhainā Strong, Hā Sustainability, and Shake Energy Collaborative
- NREL technical assistance (TA) scope of work: presentations and discussion with NREL task leaders
- General Q&A
- Next steps and adjourn.

Project Overview

Lahaina Energy Partnership

PROJECT OVERVIEW

The U.S. Department of Energy (DOE) and NREL initiated a multiyear, community-led project for Lahaina to:

1. **Identify energy questions** related to rebuilding Lahaina.
2. **Conduct technical analysis** to support informed, community-led decision-making.

Community Role:

Local partners convene the Lahaina community to identify energy solutions of interest and inform a scope of TA.

National Lab Role:

National labs conduct analysis to assist the Lahaina community in assessing opportunities for energy planning and rebuilding.

Learn more (click or scan):

Lahaina Energy Partnership Local Partners

Lāhainā Strong

- Grassroots organization focused on resilience, recovery, and rebuilding efforts in Lahaina.
- Movement includes efforts to restore housing, infrastructure, and the local economy
- Based in Lahaina, Maui
- https://wearelahainastrong.org/.

Hā Sustainability

- Sustainability consulting firm dedicated to supporting community-driven initiatives
- Relevant experience in developing impactful energy education programs and facilitating meaningful community engagement
- Headquartered on Maui
- www.hasustainability.com.

Shake Energy Collaborative

- Community-based renewable energy developer
- Relevant experience working with Molokaʻi community energy projects
- Based on Oahu
- www.shake-energy.com/.

Project Phases

Completed

Scoping

January–June 2024

- **Virtual stakeholder interviews** (January–February 2024)
- **NREL staff person on Maui** (March–May 2024)
- **Workshop** with local energy stakeholders (March 2024)
- **Opened subcontracting notification.**

Project Launch

June–August 2024

- **Executed subcontracts** with local partners
- **Announced project** at weekly community update meeting
- **Small convening of Lahaina community leaders.**

Community Engagement

August 2024–April 2025

- Three **community co-design workshops**
- **Community leader (Hui) meetings**
- **Targeted stakeholder engagement** (HECO,* HSEO,** Maui County)
- Develop and disseminate **energy education** content
- Technical insights and **guidance from NREL**
- Partners prepare ***Community-Identified Energy Pathways*** report.

Ongoing

TA and Community Engagement

April 2025–January 2027

- **NREL TA** to address community energy priorities
- **Ongoing community engagement** to inform TA
- Partners develop **Implementation Plan** for results of TA.

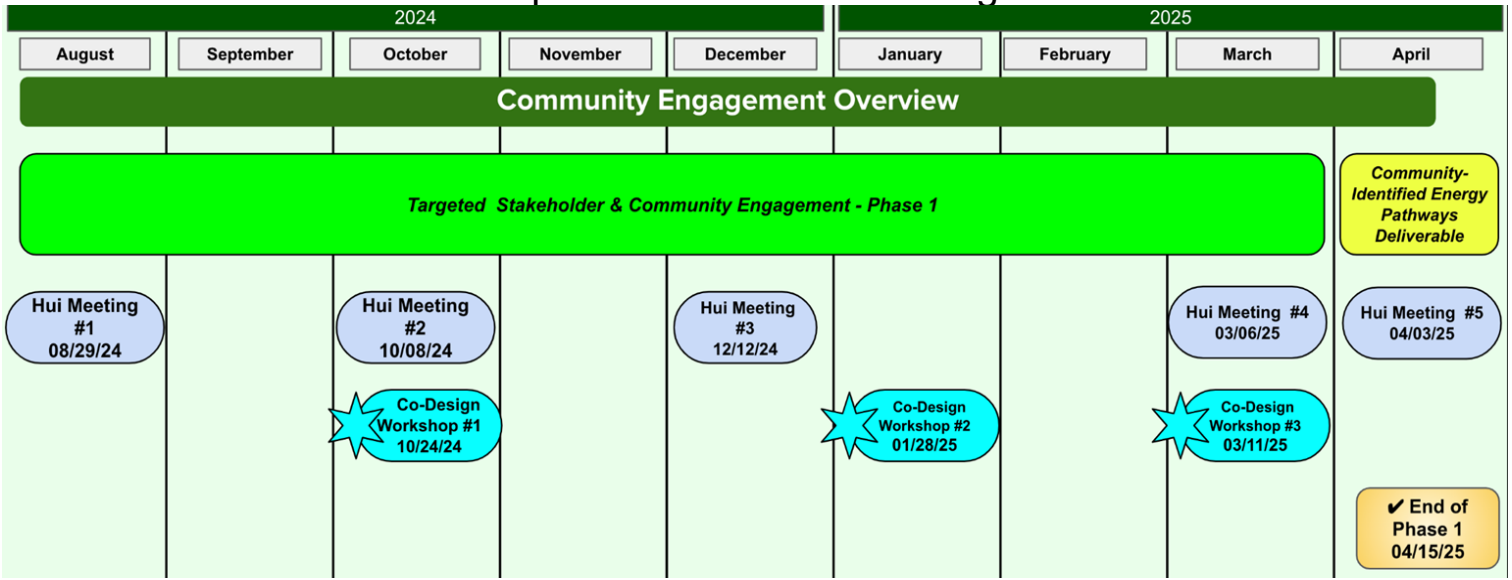
* Hawaiian Electric Company
** Hawai‘i State Energy Office

Lahaina Community Energy Priorities

Presented by Lāhainā Strong, Hā Sustainability, and Shake Energy Collaborative

Community Engagement in Phase 1

- Local partners conducted stakeholder and community engagement (phase 1) from August 2024 to April 2025.
- In March 2025, energy topic prioritization activities were conducted in-person during a Hui meeting and a community workshop, and in an online form.
- Results of these activities are presented on the following slides.



Top Five Community Energy Priorities

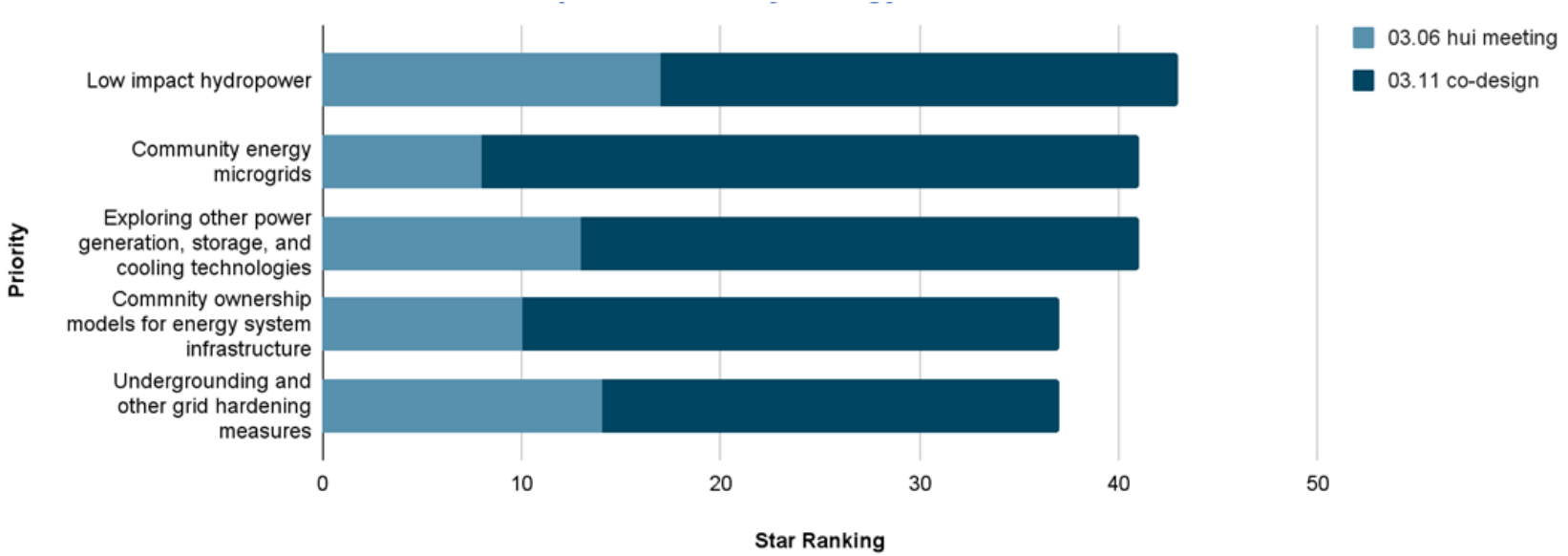


Figure from Hā Sustainability, Shake Energy Collaborative, and Lāhainā Strong

Low-Impact Hydropower Priorities from Community Meetings

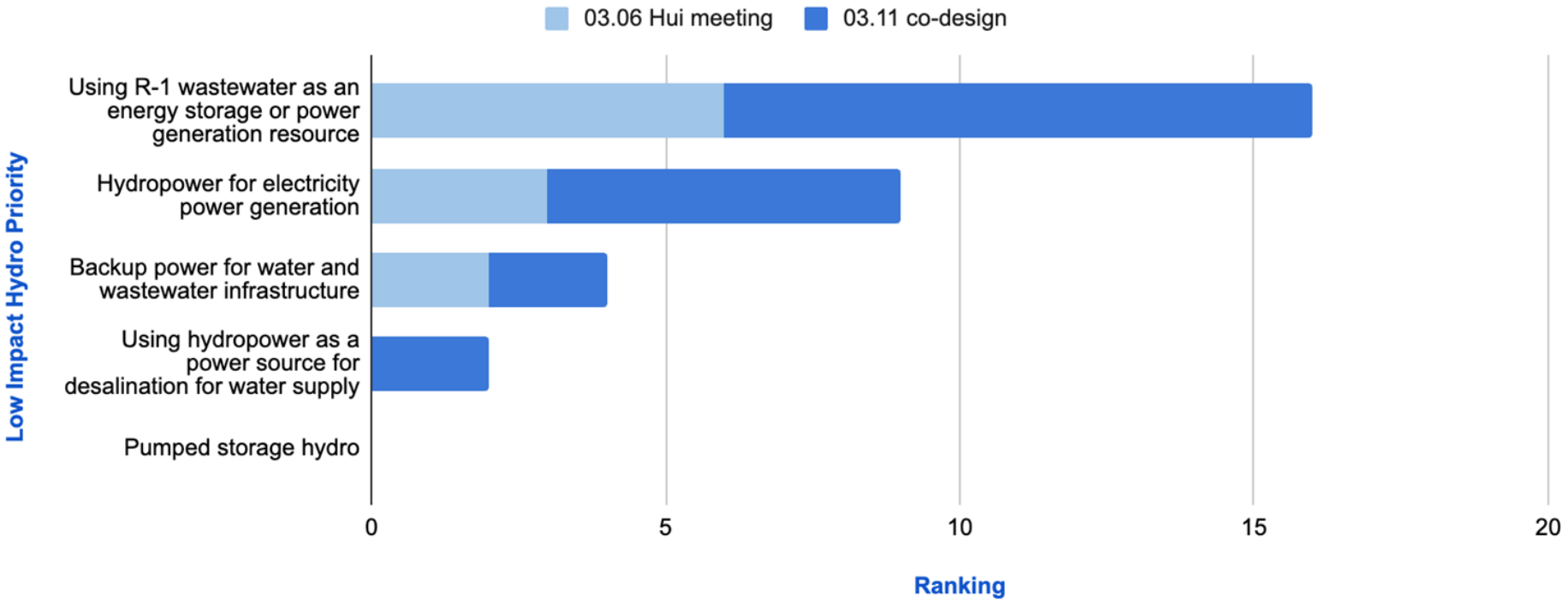


Figure from Hā Sustainability, Shake Energy Collaborative, and Lāhainā Strong

Power Generation, Storage, and Cooling Priorities from Community Meetings

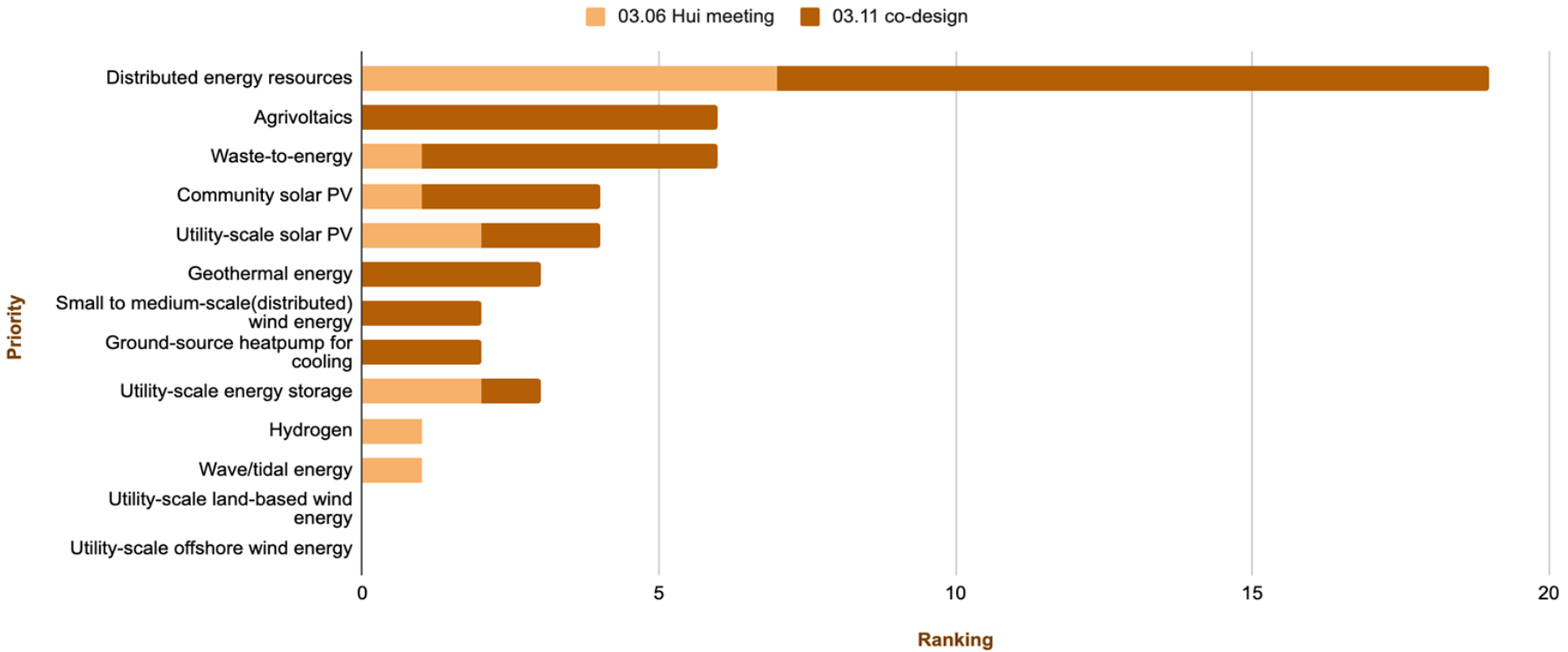


Figure from Hā Sustainability, Shake Energy Collaborative, and Lāhainā Strong

PV = photovoltaics

Undergrounding and Other Grid Hardening Measures Priorities from Community Meetings

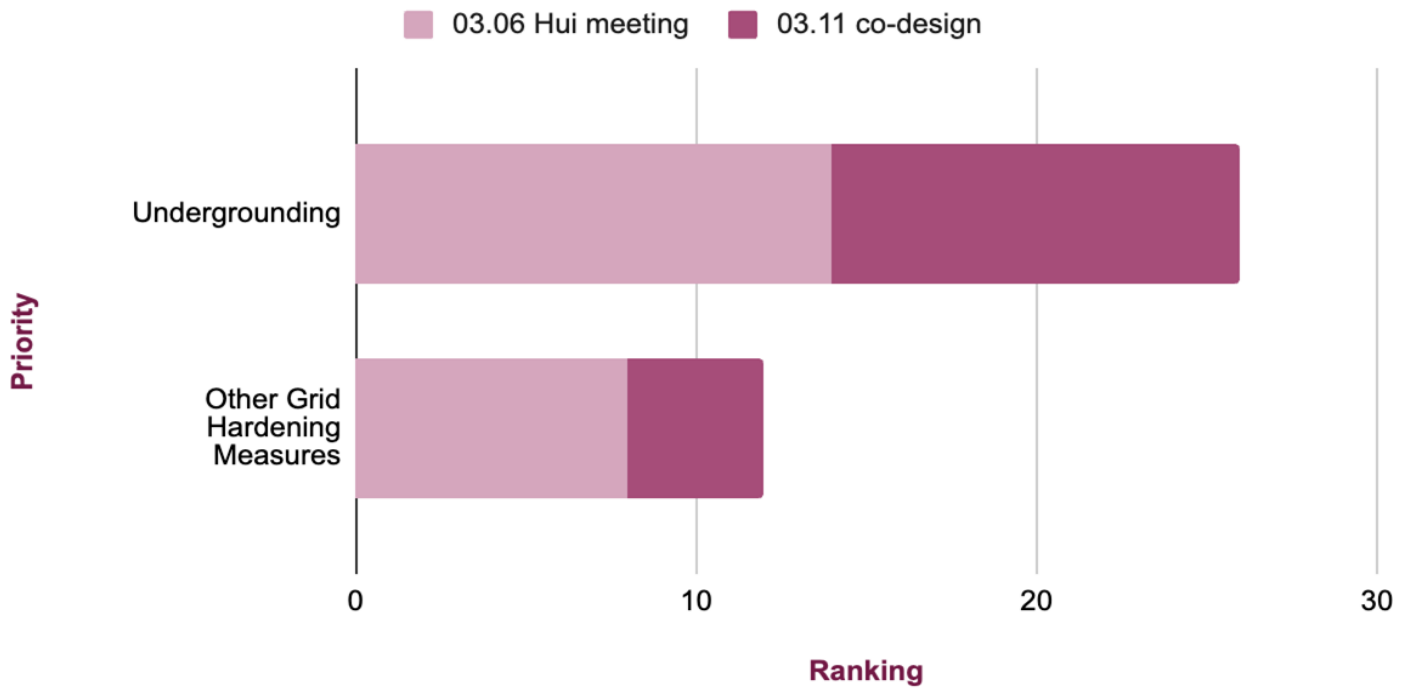


Figure from Hā Sustainability, Shake Energy Collaborative, and Lāhainā Strong

Energy Priority Trends Over Community Meetings

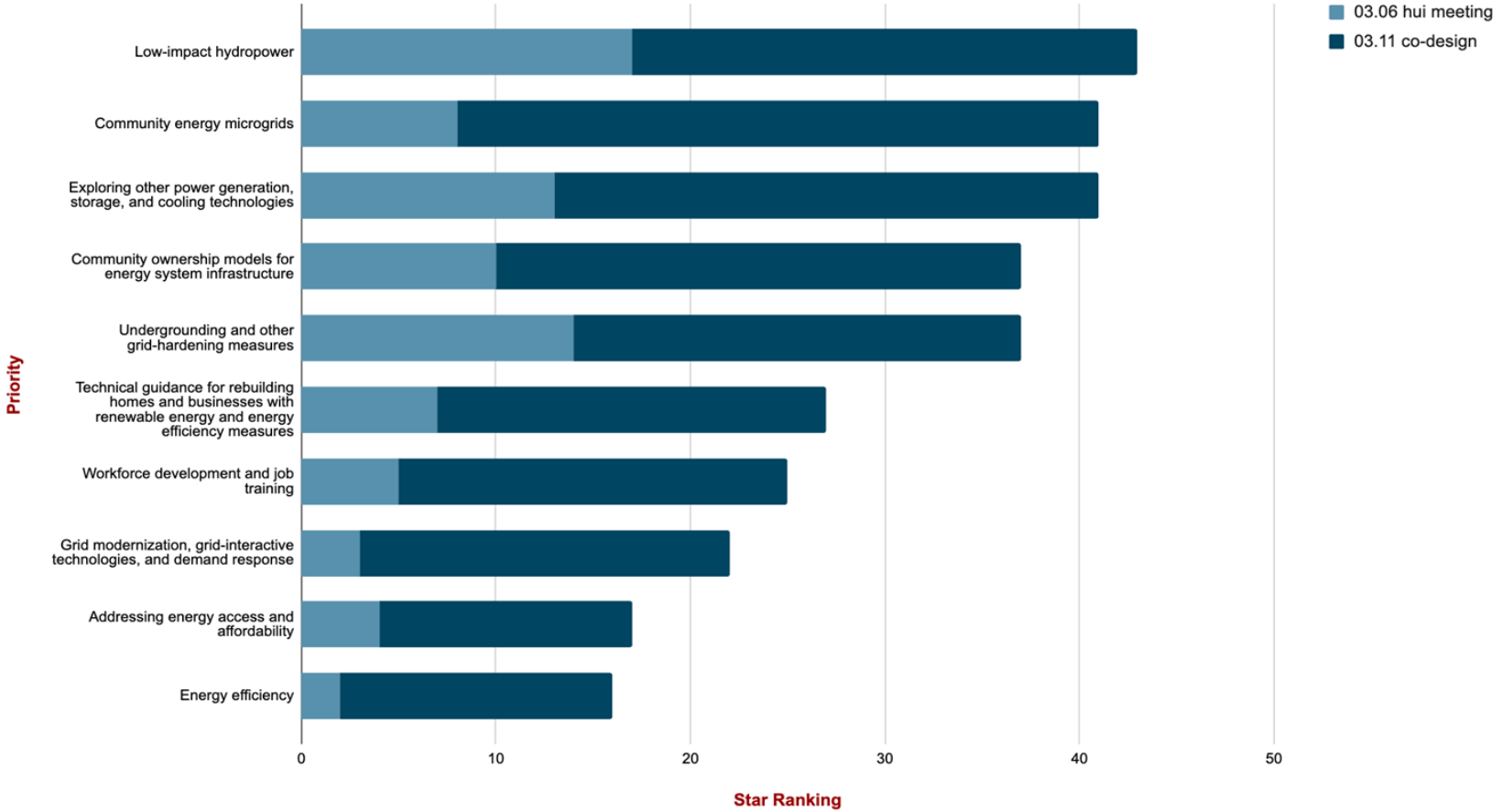


Figure from Hā Sustainability, Shake Energy Collaborative, and Lāhainā Strong

Overall Online Feedback Rankings (All Responses)

Based on total responses across all ZIP codes, the top-ranked community energy priorities were:

- **Undergrounding and other grid hardening measures:** The highest-ranked priority, reflecting strong public support for safer, more fire-resilient infrastructure.
- **Community energy microgrids:** A close second, highlighting interest in decentralized neighborhood-scale solutions.
- **Low-impact hydropower:** Participants saw value in small-scale hydropower tied to existing infrastructure.
- **Technical guidance for rebuilding with renewable energy and efficiency:** Reflects the community's desire for practical support in recovery.
- **Community ownership models:** Support for local control and keeping energy revenues in the community.

Results from Hā Sustainability, Shake Energy Collaborative, and Lāhainā Strong

Lahaina Community Higher Priorities for TA

Low-Impact Hydropower	Community Energy Microgrids	Undergrounding and Other Grid Hardening	Distributed Energy Resources	Community Solar (aka Shared Solar or CBRE)	Community Ownership Models for Energy System Infrastructure
• Assess feasibility of leveraging recycled (R-1) water distribution for community-owned energy generation and storage. • Stakeholders include Maui County, current R-1 users (hotels, resorts, and golf courses), the Hawai'i Department of Health, the U.S. Environmental Protection Agency, etc.	• Explore technical and policy options for microgrids to allow portions of Lahaina to maintain power during grid outages and potentially reduce dependence on power transmitted from other parts of Maui. • Understand the community's energy profile to inform effective planning.	• Assess costs, benefits, and best practice examples of undergrounding and other grid hardening measures to support rebuilding a more resilient electrical system in Lahaina.	• Assess rebuilding the distribution grid to accommodate high levels of rooftop solar photovoltaics (PV) and enable virtual power plants. • Assess maximum generation potential of rooftop solar if all residential and commercial roofs installed solar.	• Assess appropriate sizing for community solar projects serving Lahaina (known in as community-based renewable energy [CBRE]). • Research possible sites, including brownfields.	• Develop in-depth case studies of cooperative and municipal ownership of (1) a generation project, (2) a grid-tied microgrid, and (3) the West Maui grid. • Provide technical guidance for steps or approaches the Lahaina community could take to pursue community ownership of energy infrastructure.

From Community-Identified Energy Pathways *report*

Lahaina Community Lower Priorities for TA

Workforce Development and Job Training	Grid Modernization, Grid-Interactive Technologies, and Demand Response	Waste-to-Energy	Agrivoltaics

• Identify jobs most in need to meet Lahaina's energy workforce needs.
• Determine the training and experience needed by a local workforce to meet these needs.
• Assess whether there are existing training resources available to train the required local workforce:
  ○ If yes, identify what they are.
  ○ If no, recommend how these could be developed/offered to the community to develop its local energy workforce.
	• Develop recommendations for infrastructure or operation of the rebuilding of the distribution grid in Lahaina to allow for rooftop solar and possible aggregation (e.g., virtual power plants).	• Determine which waste-to-energy (WTE) technologies would be most appropriate for Lahaina.
		• Analyze pros and cons of various WTE technologies compared to other possible generation options, considering:
		  ○ Environmental impacts
		  ○ Economic factors
		  ○ Resilience benefits.
			• Conduct an analysis of agrivoltaics for Lahaina.

From Community-Identified Energy Pathways *report*

NREL TA Scope of Work

Approach to Addressing the *Community-Identified Energy Pathways* Report

NREL has assembled a team of experts on topics prioritized in the report.

While all content provides valuable context and insight, we paid special attention to these sections when developing this scope:

- Within Section 4. Community Engagement Results
  - Section 4.1. Lahaina's Community Energy Vision and Guiding Principles
  - Section 4.3. Recurring Energy Questions
- Section 5. Community Energy Priorities
- Section 6. Priorities for Technical Assistance.

NREL TA Scope Tasks

1. Renewable Energy Resource and Technology Assessments
2. Building Modeling for Enhanced Affordability and Resilience
3. Microgrid Planning and Modeling for Energy Resilience
4. Distribution System Undergrounding and Grid Planning/Optimization
5. Crosscutting Topics
   - 5.1 Workforce Development and Job Training
   - 5.2 Policy and Regulatory
   - 5.3 Funding and Financing Options.

Note: Resilience is inherent in all tasks and integrated throughout the scope.

COMMUNITY TA PRIORITIES

HIGHER TA PRIORITIES

- Low-Impact Hydropower
- Community Energy Microgrids
- Undergrounding and Other Grid Hardening
- Distributed Energy Resources
- Community Solar (aka Shared Solar or CBRE)
- Community Ownership Models for Energy System Infrastructure

LOWER TA PRIORITIES

- Workforce Development and Job Training
- Grid Modernization, Grid-Interactive Technologies, and Demand Response
- Waste-to-Energy
- Agrivoltaics

NREL TA TASKS

- Task 1. Resource Assessment
- Task 2. Building Modeling
- Task 3. Microgrids
- Task 4. Distribution Grid/ Undergrounding
- Task 5. Crosscutting Topics
  - Workforce Development
  - Policy and Regulatory
  - Funding and Financing

Mapping Community TA Priorities to NREL TA Tasks

Task 1. Resource Assessment

- Low-Impact Hydropower
- Distributed Energy Resources
- Community Solar (aka Shared Solar or CBRE)
- Waste-to-Energy
- Agrivoltaics

Task 2. Building Modeling

- Community Energy Microgrids
- Undergrounding and Other Grid Hardening
- Distributed Energy Resources
- Grid Modernization, Grid-Interactive Technologies, and Demand Response

Task 3. Microgrids

- Community Energy Microgrids
- Distributed Energy Resources
- Community Solar (aka Shared Solar or CBRE)
- Community Ownership Models
- Grid Modernization, Grid-Interactive Technologies, and Demand Response

Task 4. Distribution Grid/Undergrounding

- Community Energy Microgrids
- Undergrounding and Other Grid Hardening
- Distributed Energy Resources
- Community Solar (aka Shared Solar or CBRE)
- Grid Modernization, Grid-Interactive Technologies, and Demand Response

Task 5. Crosscutting Topics

Workforce Development	Policy and Regulatory	Funding and Financing
Workforce Development and Job Training	Community Energy Microgrids	Community Energy Microgrids
	Undergrounding and Other Grid Hardening	Undergrounding and Other Grid Hardening
	Distributed Energy Resources	Distributed Energy Resources
	Community Solar (aka Shared Solar or CBRE)	Grid Modernization, Grid-Interactive Technologies, and Demand Response

COMMUNITY PRIORITIES

- Higher
- Lower

Task 1. Resource Assessment

Task Lead: Evan Rosenlieb

Task 1. Resource Assessment Overview

Description: Conduct a resource assessment of generation technologies of interest to the community; primarily low-impact hydropower opportunities with a focus on the potential to use R-1 treated wastewater and distributed PV generation on rooftops and over parking lots. Other energy and storage technologies may be explored if an early no-go decision is made on one of the primary technologies.

Data tools: The Renewable Energy Potential (reV) model, System Advisor Model™ (SAM), and NREL's rooftop PV and pumped storage hydropower assessment geospatial algorithms.

Data required: Attributes of wastewater treatment plant and distribution system, such as time series flow rates and geospatial data on conveyance networks. Any available data on building attributes (size, height, etc.) on buildings that have been or are planned to be rebuilt as part of fire recovery. Other subtasks can rely on publicly available data such as NREL's solar and wind resource datasets.

Key stakeholders: Maui County Department of Water Supply with a focus on wastewater treatment plant contacts, HECO, large energy users, and community groups.

Target audience: Community planners, policymakers, county wastewater treatment plant, and analysts of other TA tasks.

Pathway to implementation: For hydropower, the next step would be the decision to request a proposal for a full engineering feasibility study. The approach for other technologies will depend on results of downstream analysis and community response. For example, results of other tasks may help show where potential parking lot PV should be prioritized.

Task 1. Resource Assessment Subtasks, Deliverables, and Timeline

Subtask	Deliverables	High-Level Timeline
1.1: First-order bracketing analysis	Informational presentations and first-order analysis to evaluate technology trade-offs and reveal any obstacles that would cause a no-go decision on analysis.	Months 1–4
1.2: Wastewater treatment plant hydropower assessment	Site assessment of hydropower capacity and generation potential at a local wastewater treatment facility and distribution network.	Months 3–8
1.3: Other low-impact hydropower assessment	Pre-feasibility estimates of hydropower potential and cost based on available data and public information on other hydropower project opportunities.	Months 5–8
1.4: Rooftop and parking lot distributed solar assessment	Capacities, generation, and cost estimates of rooftop PV and parking lot solar potential. Projections of potential in the future under low, medium, and high scenarios of potential after fire recovery estimates.	Months 5–13
1.5: Assessment of other renewable generation opportunities	High-level resource potential and cost assessments of other technologies if a no-go decision is made for Subtasks 1.2, 1.3, or 1.4 at the end of Subtask 1.1, such as WTE, agrivoltaics, distributed wind, floating solar, etc.	Months 5–8

Subtask 1.1. First-Order Bracketing Analysis

- The goal of a bracketing analysis is to establish the limits or possible range of outcomes of an analysis to understand if any options should be excluded from consideration and to more efficiently prioritize efforts of a full detailed analysis.
- An example for this project could be addressing a question such as, “how much parking lot PV potential is there if every single parking lot was completely covered in PV panels?" with no other criteria. While this number may be very far off from the realistic potential, if it is unexpectedly low it can still give useful information about the viability of parking lot PV to meet community energy needs.
- This subtask will perform a bracketing analysis on the priority energy technologies of rooftop PV, parking lot PV, and low-impact hydropower opportunities including a specific focus on the potential use of R-1 treated wastewater for hydropower generation or storage.
- If analysis of any technology yields outcomes that suggest the nonviability of a technology to meet community goals, a no-go decision can be made on further analysis and time and effort can be allocated to analysis of other technologies.

Subtasks 1.2. and 1.3. Low-Impact Hydropower Opportunities

- "Low-impact hydropower" here is defined as having minimal to no impact on water quantity and quality to end users and no significant environmental impact.
- Subtask 1.2 will focus on the possibility of using R-1 treated wastewater for hydropower generation or storage at the wastewater plant or its associated water conveyance networks. This is an attractive option as the recycled water will have no impact on freshwater usage and there is potential to leverage existing infrastructure.
- Subtask 1.3 will focus on any other low-impact hydropower opportunities in Lahaina, which would include any in-conduit options in other existing water conveyance infrastructure (pipe or canals), or potentially "drop-in" hydrokinetic turbines in natural waterways that do not require dam or diversion weirs.
- Any pumped storage hydropower option for storage will focus on tanked, completely closed loop options that would not impact existing water usage after original filling.

Subtasks 1.4. Rooftop and Parking Lot Distributed Solar Assessment

- Potential for rooftop solar in the area will be assessed using NREL's PV rooftop algorithm on the newest available United States Geological Survey lidar data, which detects layout, slope, and azimuth of available roof planes with high spatial precision to determine the area available for rooftop PV and estimate generation.
- At this time, the newest data available is from 2023, shortly before the fire, which poses the need to project how potential will change in the future compared to the preexisting infrastructure.
- The algorithm will assess the potential for the entire area to know potential in buildings that still exist as well as cases where rebuilt buildings will have similar attributes for rooftop PV potential (for instance, even if a new building has many material internal differences, if it has a similar plan layout it may still have similar rooftop PV potential).
- Future rooftop PV potential will be calculated for a range of assumptions that may negatively or positively affect potential to understand the range of values that may be expected after recovery.
- Parking lot solar assessment will identify available area using cadastral and remote imagery and calculate capacity and generation estimates given typical system configuration assumptions.

Subtasks 1.5. Assessment of Other Renewable Energy Technologies

- Subtask 1.5 will be pursued if Subtask 1.1 reveals any no-go decisions that significantly cut back or eliminate further analysis planned for Subtasks 1.2, 1.3, and 1.4.
- The exact scope will be determined given the amount of time and effort available.
- Two likely candidates for further examination would be WTE, which could supply firm energy, or agrivoltaics. Other options to further examine would include, but are not limited to, floating PV, small distributed wind, or marine hydrokinetics.

Task 1. Resource Assessment Task Interdependencies

Resource data, costs, and system specifications will be used across other tasks in many ways.

Microgrids: Resource data will inform microgrid potential and viability.

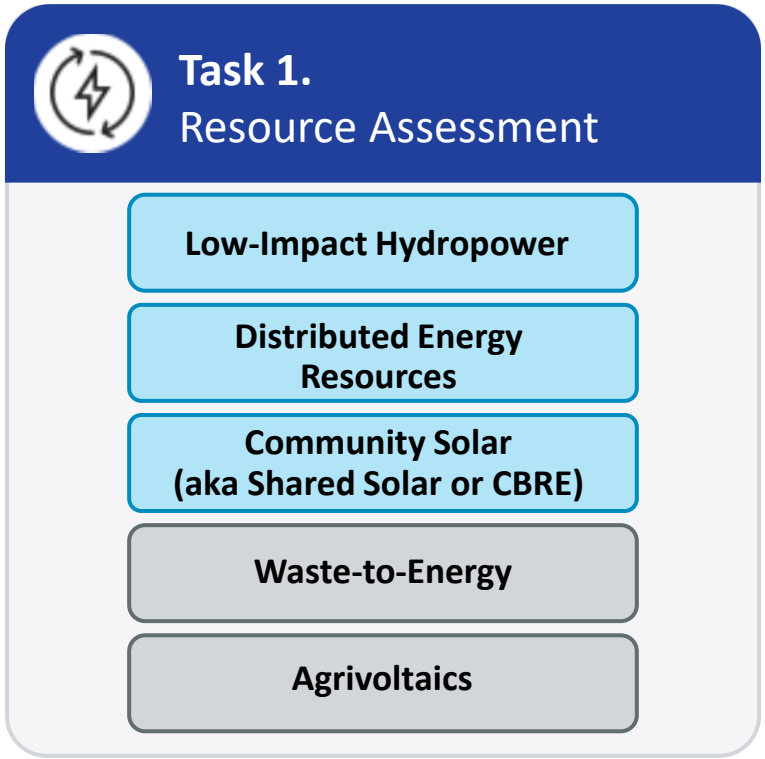
Grid Hardening: Resource data will inform transmission and distribution needs.

Workforce Development and Job Training: Resource data showing greatest deployment potential can inform jobs and skills assessments and workforce development needs.

Policy and Regulatory: Policy and regulatory constraints inform resource potential and project feasibility assessment.

Funding and Financing Options: Known financing terms and constraints can inform cost assessment, which influences analysis of project feasibility.

Mapping Community TA Priorities to NREL TA Task 1



Task 2. Building Modeling

Task Lead: Ben Polly

Task 2. Building Modeling Overview

Description: Developing high-efficiency and solar/microgrid-ready building prototype design to benefit Lahaina community members and organizations in their reconstruction efforts. Develop Lahaina building load profiles necessary for Tasks 3 (Microgrid) and 4 (Distribution Grid/Undergrounding).

Data inputs: Information about local energy codes, design guidelines, utility rates, incentives, etc. General information about Lahaina's reconstructed buildings (general known plans for reconstruction, number of buildings by type, square footage, number of stories, etc.).

Planned tools: OpenStudio®/EnergyPlus™ and URBANopt™/REopt® workflows for prototype design modeling; sampling from ResStock™ and ComStock™ datasets for load profile development.

Key stakeholders: Project partners, American Institute of Architects (AIA) Maui, local builders, building code office/officials, HECO, Hawai'i Energy, Hawai'i Green Infrastructure Authority, and potentially more.

Target audience: Community residents, businesses, and stakeholders/organizations affecting the energy-related affordability and resilience of reconstructed buildings in Lahaina (identified in Subtask 2.1).

Pathway to implementation: Lahaina high-efficiency and solar/microgrid-ready building prototype design provides key technical strategies and considerations for rebuilding homes and businesses with energy efficiency, distributed energy resources, and grid interactivity/demand response-ready building technologies, to directly inform/benefit Lahaina building reconstruction efforts.

Task 2. Building Modeling Subtasks, Deliverables, and Timeline

Subtask	Deliverables	High-Level Timeline
2.1: Assess Lahaina building reconstruction landscape	• Short **presentation** describing task findings regarding what requirements (e.g., codes and design standards), processes, organizations, etc. are affecting the energy-related affordability and resilience of reconstructed buildings in Lahaina. • **Go/no-go for Subtask 2.2: Proposed scope updates and refinements for Subtask 2.2 based on findings from Subtask 2.1.**	Months 1–2 (deliverable 2 months from start)
2.2: Lahaina high-efficiency and solar/microgrid-ready building prototype design	• **NREL-published Lahaina high-efficiency and solar/microgrid-ready building prototype design** documenting (1) energy-related technical strategies for enhanced affordability and resilience of Lahaina building prototypes (with illustrative modeling results) and (2) related strategies being employed in lighthouse project. The deliverable audience includes community residents, businesses, and stakeholders/organizations affecting the energy-related affordability and resilience of reconstructed buildings in Lahaina (identified in Subtask 2.1).	Months 3–10 (deliverables: partner draft at 6 months; final 10 months from start)
2.3: Develop Lahaina building load profiles necessary for Tasks 3 and 4	• **Preliminary modeled building load profiles** for use in Tasks 3 and 4. • **Final modeled building load profiles** for use in Tasks 3 and 4. • Document building load profile sampling methodology in deliverable/publication led by Task 4 team.	Month 1–6 (deliverables 4 and 6 months from start)

Subtask 2.1. Assess Lahaina Building Reconstruction Landscape

- Engage with local stakeholders, businesses, and organizations to assess the status of building reconstruction efforts and what requirements (e.g., codes and design standards), processes, organizations, etc. are affecting the energy-related affordability and resilience of reconstructed buildings. Engage HECO specifically to understand how they plan to support reconstruction of buildings.
- Key stakeholders: Project partners, AIA Maui, local builders, building code office/officials, HECO, Hawai‘i Energy, Hawai‘i Green Infrastructure Authority, and potentially more.
- Based on findings from Subtask 2.1, work with project partners to ensure timeline and deliverable(s) for Subtask 2.2 benefit Lahaina community members and organizations in their reconstruction efforts.

Subtask 2.2. Lahaina High-Efficiency and Solar/ Microgrid-Ready Building Prototype Design

- Identify/define one to two common prototype buildings representing a large portion of Lahaina reconstruction efforts. Work with key stakeholders from Subtask 2.1 to develop prototype assumptions based on Lahaina construction practices, efficiency codes, HECO utility time-of-use rates, available rebates/incentives, etc. Perform physics-based building energy modeling for the following scenarios to develop **Lahaina high-efficiency and solar/microgrid-ready building prototype energy designs** based on quantitative analysis results.
- Identify at least one actual building reconstruction project for one of the building prototypes, where building owners/occupants are interested in and committed to rebuilding with high energy performance, enhanced resilience, and improved affordability/cost-effectiveness. Develop more specific building models; analyze and document potential "lighthouse project" specific benefits based on the actual building designs, applying cost-effective, above-baseline prototype assumptions to **demonstrate what is possible and improve the understanding and confidence of Lahaina residents, businesses, and organizations to pursue advanced building performance.**
- Potential tools: OpenStudio and BEopt™/OpenStudio-HPXML.

Subtask 2.3. Develop Lahaina Building Load Profiles Necessary for Tasks 3 and 4

- This task will generate data outputs used as inputs by the Microgrids (Task 3) and Distribution Grid (Task 4) tasks. In so doing this task will directly support efforts to address two of the top five community priorities identified at the co-design and Hui meetings: community energy microgrids (in coordination with Task 3) and underground and other grid hardening measures (in coordination with Task 4).
- Assumes modeled building load profiles are needed to represent reasonable load profiles for most rebuilt buildings, which may be similar to pre-fire buildings in terms of their footprints, massing, etc., but will likely differ in terms of their energy performance.
- A simplified approach will be used to develop building load profiles to represent post-fire reconstructed buildings by sampling from ResStock and ComStock datasets that model the existing building stock in Hawai‘i and potential upgrades to those buildings. ResStock and ComStock datasets will be sampled to obtain a dataset of load profiles for common building types with efficiency characteristics that approximate the anticipated new construction efficiency levels in Lahaina.

Task 2. Building Modeling Task Interdependencies

Task 3. Microgrids and Task 4. Distribution Grid

- Inputs: Modeled building load profiles feed into Microgrids and Distribution Grid tasks.
- Outputs: Align behind-the-meter distributed energy resource assumptions with Microgrid Task.

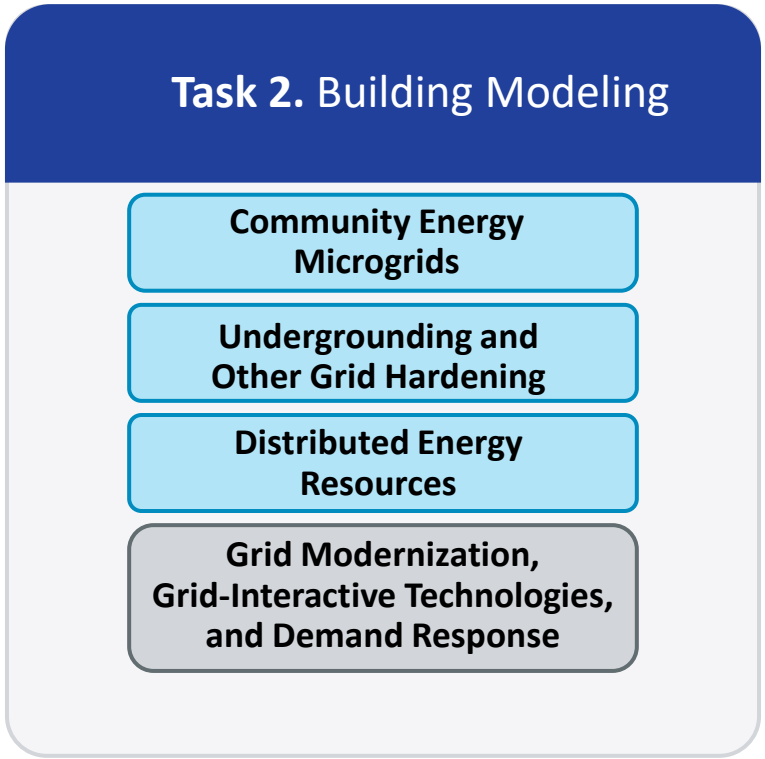
Subtask 5.1. Workforce Development and Job Training

- Inputs: Understanding of relevant building practices and technologies.
- Outputs: Critical jobs and skills needed to build, operate, and maintain resilient buildings and training programs to support workforce development.

Subtask 5.2 Policy and Regulatory and Subtask 5.3. Funding and Financing

- Consider local building-related policies/regulations (e.g., codes) in modeling.
- Task 2 and the Task 5 financing team will coordinate on any research or discussions pertaining to incentives, financing programs, etc., for new construction.

Mapping Community TA Priorities to NREL TA Task 2



Task 3. Microgrids

Task Leads:

Amanda Farthing
Ian Baring-Gould

Task 3. Microgrids Overview

Description: Preliminary microgrid designs and implementation guidance for select use cases and projects across Lahaina.

Data inputs and tools: REopt for microgrid modeling (data inputs on subsequent slide).

- Linkages to building and distribution grid modeling tools.

Key stakeholders: Project partners (Hā Sustainability, Shake Energy Collaborative, and Lāhainā Strong), Lahaina community, microgrid developers, HECO, HSEO, and Maui County.

Target audience: Lahaina community, developers/planners, HECO, and HSEO.

Pathway to implementation: Supports high-level energy planning informed by costs and benefits of microgrids at varying scales, informs plans for specific microgrid projects (pursuing funding/financing, developing requests for proposals), and provides information to support near-term development needs. Identify policy, regulatory, and business model challenges to microgrid development and consider potential alternatives.

Task 3. Microgrids Subtasks, Deliverables, and Timeline

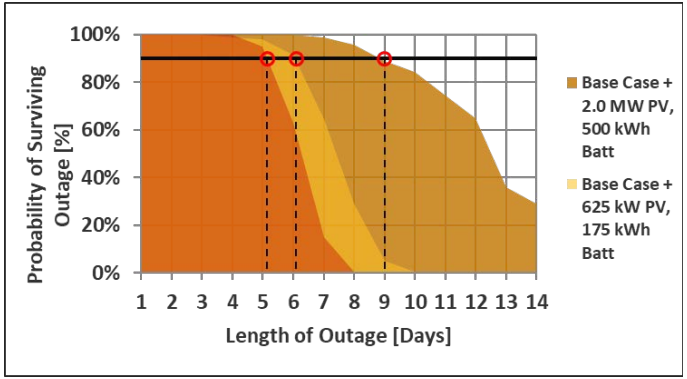
Subtask	Deliverables	High-Level Timeline
3.1: Policy and regulatory review, community mapping, and information gathering *(closely connected to Task 5)*	• Summary of relevant policy, regulatory, and business model landscapes. • Resilience hub mapping, siting, and benefits analysis. • Meeting materials with lists of questions for specific stakeholders. • Microgrid FAQ document (draft).	Months 1–4 (4 months)
3.2: High-level (bracketing) microgrid analyses	• Reporting on identified loads and general microgrid designs called for within the *Community-Identified Energy Pathways* report. • Comparison of costs, benefits, sizing, and community services for microgrids at select priority scales and scenarios.	Months 2–8 (7 months)
3.3: Detailed microgrid analyses	• For two sites: cost-optimized microgrid system design assessment including performance, a high-level one-line diagram, conceptual sequence of operations, cost estimates, and anticipated community benefits.	Months 6–13 (8 months)
3.4: Implementation considerations and microgrid development TA	• Detailed technical implementation guide for a consumer-level microgrids (home or business-scale), including guidance on technology, siting as applicable, and general sizing to support solar-ready construction. • Provision of limited microgrid-related technical support to community organizations.	Month 10–17 (8 months)

Subtask 3.1. Policy and Regulatory Review, Community Mapping, and Information Gathering

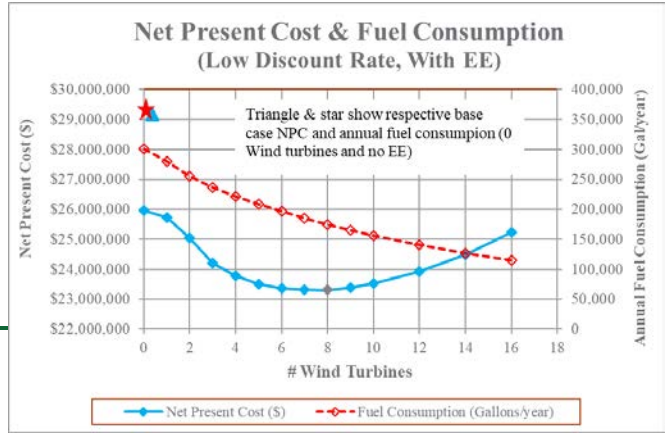
- Landscape review of relevant policies, regulations, and existing microgrid business frameworks in support of Task 5 (Crosscutting Topics).
- Map potential microgrid locations (and services) across the community to better understand area risks and how microgrids could support overall community resilience.
- Compile and share remaining questions to fill team gaps in understanding of community needs for microgrids and desire for microgrids in specific locations.
- Confirm potential microgrid scenarios for use in Subtasks 3.2 and 3.3.
- Draft an FAQ document answering community questions from the *Community-Identified Energy Pathways* report and scoping process.

Subtask 3.2. High-Level "Bracketing" Microgrid Analyses for Select Use Cases

- High-level analyses of **microgrid sizing, costs, and benefits** (financial and resilience) for select scenarios.
- Expected to provide initial answers to questions for microgrids under various assumptions, e.g.,:
  - Individual loads vs. neighborhoods
  - Grid-connected vs. fully islanded microgrids
  - Increasing outage durations
  - Varying policy and business model assumptions.
- Obtain historical consumption data, including for specific areas required in the *Community-Identified Energy Pathways Report.*



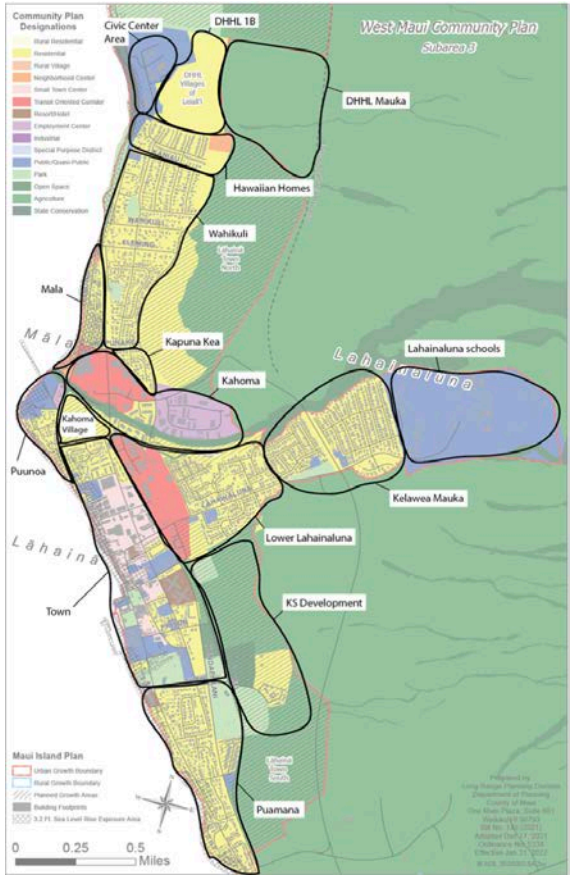
Bracketing examples: Impacts of microgrid size on resilience and loss of service probability for a specific location in Hawai'i (top) and impacts comparison of costs, renewable energy contribution and fuel savings for an isolated microgrid in Alaska (bottom)



Graphics by NREL.

Subtask 3.3. Detailed Microgrid Analyses for Two Potential Microgrid Sites

- Conduct **two detailed assessments** for microgrids serving specific areas/facilities of varying scales identified through community consultations.
- Assessments should inform initial design, costs, and benefits of microgrids serving, for instance:
  - Residential neighborhood and small-scale community use
  - Resilience hubs
  - Individual or grouped critical facilities.
- Outcomes will include projected electric loads for blue-sky and emergency operations, cost-optimal microgrid system capacities to meet resilience goals, expected capital and ongoing microgrid costs, and expected avoided utility costs.



Map of Lahaina Neighborhoods identified for community microgrid analysis in the *Community-Identified Energy Pathways* Report. *Graphic from County of Maui*

Subtask 3.4. Implementation Considerations and Microgrid Development TA

- Building on previous subtasks and work completed in Task 5, provide specific detailed technical implementation considerations for consumer-level microgrids, including for technology, siting as applicable, and general sizing to support microgrid-ready construction.
- Limited technical support to organizations looking to implement community-level microgrids.

Microgrids for Energy Resilience: A Guide to Conceptual Design and Lessons from Defense Projects

Samuel Booth,[1] James Reilly,[1] Robert Butt,[1] Mick Wasco,[2] and Randy Monohan[2]

1 National Renewable Energy Laboratory
2 United States Marine Corps

Example output: Lahaina-specific considerations on microgrids, building on analysis efforts and previous work, such as this guide for microgrids for military applications at defense projects.
Source: NREL, https://docs.nrel.gov/docs/fy19osti/72586.pdf

Task 3. Microgrids Task Interdependencies

Task 1. Resource Assessment and Task 2. Building Modeling

- Inputs: Updated resource data, locational availability, and future building energy use.

Task 4. Grid Distribution

- Outputs: Potential microgrid development scenarios impact on grid layout.

Subtask 5.1. Workforce Development and Job Training

- Inputs: Microgrid technologies with the greatest potential for development.
- Outputs: Jobs, skill sets, and programs needed to build, operate, and maintain microgrids.

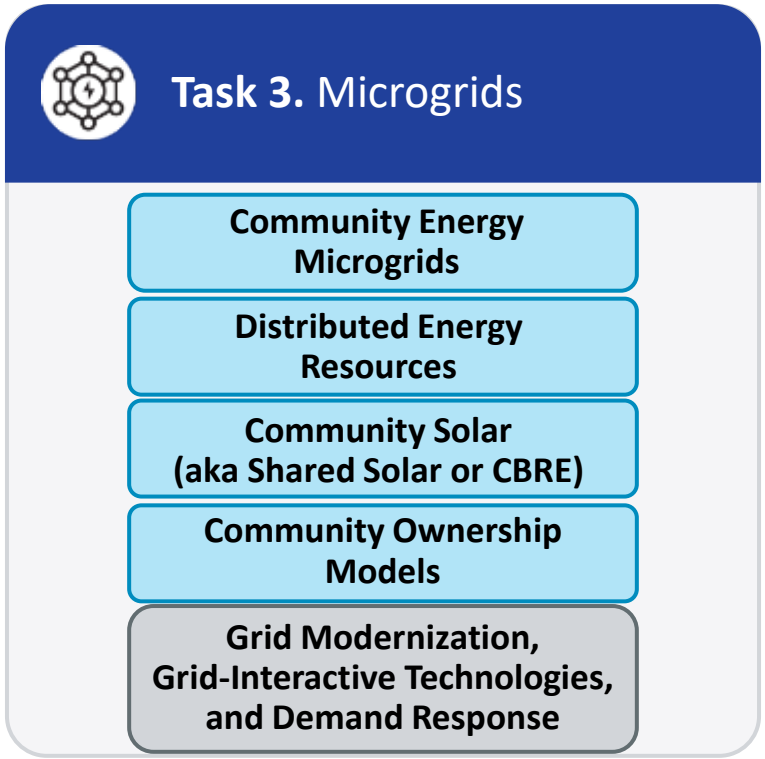
Subtask 5.2. Policy and Regulatory

- Inputs: Consideration of value streams and policies while bounding potential grid service values, assessing policy and regulatory barriers can focus modeled scenarios.
- Outputs: Least-cost microgrid modeling will be informed by existing and potential future policies and regulations.

Subtask 5.3. Funding and Financing

- Inputs: Microgrid system sizing and anticipated costs can be used to assess potential funding and financing options.
- Outputs: Microgrid modeling will depend on financing and business model assumptions.

Mapping Community TA Priorities to NREL TA Task 3



Task 4. Distribution Grid/ Undergrounding

Task leads:

Lawryn Kiboma
Bryan Palmintier

Task 4. Distribution Grid/Undergrounding Overview

Description: This task ensures the project has a careful look at the electric grid. This effort directly ties to the Lahaina community-identified, high-priority interest in undergrounding and grid hardening, and the community-identified priority around grid modernization (e.g., microgrids and/or additional power generation and storage to enable a more flexible, safe, and resilient energy system) and related technologies. The completion of this task will provide the Lahaina community and utility stakeholders with information to make grid-informed decisions on grid hardening and microgrid placement for their community.

Data tools: NREL-developed Capacity Expansion Decision Support tool for Distribution Networks (CADET) and Energy Resilience Analysis for Distribution (ERAD) tools for distribution systems.

Data required: HECO grid planning models, unit cost data, load profiles, city planning (GIS) data, etc. (See data input slide.)

Key stakeholders and target audience: Community and utility partners (HECO), public utility commission, and HSEO.

Pathway to implementation: Support grid investment decision-making in coordination with HECO.

Task 4. Distribution Grid/Undergrounding Subtasks, Deliverables, and Timeline

Subtask	Deliverables	High-Level Timeline
4.1: Coordination with HECO	• Regular technical grid discussions with HECO. • Notes from hardening working session(s) with HECO.	Throughout project (emphasis on first 3 months for data).
4.2: Grid hardening and undergrounding analysis	• Summary, case studies, and rough costs for hardening approaches. • Siting options to maximize benefit of limited undergrounding. • *(Optional) Simulated performance of grid hardening techniques.*	Summary of hardening strategies: first 4–6 months. Siting: months 6–12. *Additional simulations: end of project.*
4.3: Grid baseline and planning support for reliability and affordability	• Grid model representation for Lahaina. • Spatial value streams for microgrids and building flexibility. • Report (map?) of opportunities for front-of-the-meter (FTM) solar and storage to provide locational value to the distribution grid.	Electrical model(s) in months 3–6. Identify optimal siting for distribution equipment and FTM distributed energy resource in months 9-15. Update evaluation based on results of Subtasks 4.2 and 4.4 in months 15–17.
4.4: Grid interactions with microgrid sites and building technologies	• Grid impacts/planning implications for microgrid sites, including opportunities for using flexible service footprints to support more loads. • Siting opportunities for distributed energy resources and other grid equipment location estimates to support full-community microgrid scenarios. • *(Optional) Analysis on microgrid integration into HECO Integrated Grid Plan (IGP) Request for Proposal (RFP).*	Iterative collaboration with Subtask 4.3 and Task 3 efforts. Work with microgrid and cross-cutting teams in months 3–9. Collaborate with microgrid and building efforts in months 12–17. *Additional simulations: end of project.*

Subtask 4.1: Coordination with HECO

- Coordination, data, and technical meetings with utility stakeholders to ensure alignment and identify synergies.
- Identifying areas in HECO's undergrounding and grid hardening efforts where Lahaina community members have significant influence.
- Hold virtual stakeholder briefing(s) with a subset of NREL grid hardening experts and HECO, HSEO, and others as relevant and available. The goal of this briefing is to gain an understanding of HECO's current efforts toward grid hardening as well as share expert research in this area that could be beneficial to Lahaina's unique situation.

Subtask 4.2. Grid Hardening and Undergrounding Analysis

- Undergrounding and hardening strategies: summary and case studies based on existing HECO wildfire mitigation plans.
- Siting strategies and cost estimates for undergrounding and hardening to maximize impacts with limited deployment.
- Support the Lahaina community in understanding and giving input on HECO's grid hardening and undergrounding plans.
    - Work with the community and planners to identify the optimal locations for the planned two miles of undergrounding to support Lahaina community needs, enhance resilience for the grid and critical services, and reduce impacts for evacuation routes.
- *Optional:* Simulated impact of hardening approaches (core tool: ERAD).

Subtask 4.3. Grid Baseline and Planning Support for Reliability and Affordability

- Develop grid model representation for Lahaina (for use by other subtasks).
- Estimate grid locational values for microgrids and building technologies.
- Identify opportunities for FTM storage and solar for grid modernization.
- Perform grid analysis that aligns with HECO's goals but is not duplicative or could not be performed by HECO themselves. Conduct analysis that reflects the community's needs and relay to HECO.
- *Core tool*: CADET.

Subtask 4.4. Grid Interactions with Microgrid Sites and Building Technologies

- Analyze grid impacts for microgrid scenarios (Task 3) and building profiles (Task 2).
- Siting and configuration for distributed energy resources and flexible microgrid footprints.
- *Optional*: Analysis on islandable microgrids integrated into HECO IGP RPF procurement for utility-scale distributed energy resources, if directed by the public utilities commission or HECO.
- *Core tool*: CADET.

Task 4. Distribution Grid/Undergrounding Data Inputs

- Grid planning models (as available) for entire area (e.g., Synergi) from HECO.
  - Both distribution and connections to larger grid (e.g., substation[s]).
- HECO unit cost data for cables (including undergrounding and other grid hardening techniques), transformers, PV, battery energy storage systems (BESS), distributed energy resources, etc. ($/mi, $/kW, $/kWh, etc.).
- Additional load, DER, and rate data, similar to microgrid list but for entire community at a parcel level.
- Microgrid locations and configurations (from Microgrids task [Task 3]).
- Outputs on load and generation from other tasks.
  - Building profiles (multiple scenarios), hydropower and other resource generation profiles, and microgrid blue-sky operation.
- City planning data: e.g., road system and critical services (GIS).
- Qualitative data on ability/interest in islanding entire community vs. parts and reliability scenarios.
- Fragility curves as a function of equipment design (e.g., pole types).

Task 4. Distribution Grid/Undergrounding Task Interdependencies

Data Interactions with Other Tasks:

Task 1 (Resource Assessment): Customer distributed energy resource integration levels and other generation (e.g., hydropower).

Task 2 (Building Modeling): Time series for individual-building-level models, simulated for reconstructed buildings and historic for surviving buildings.

Task 3 (Microgrids): Multiway exchange with microgrids task.

- Design/siting objectives and values from a grid perspective.
- Microgrid scenarios (site vs. community-oriented) including capacities, net profiles, island ability, etc.
- Ensuring best practices and proposed designs align with and support grid needs.

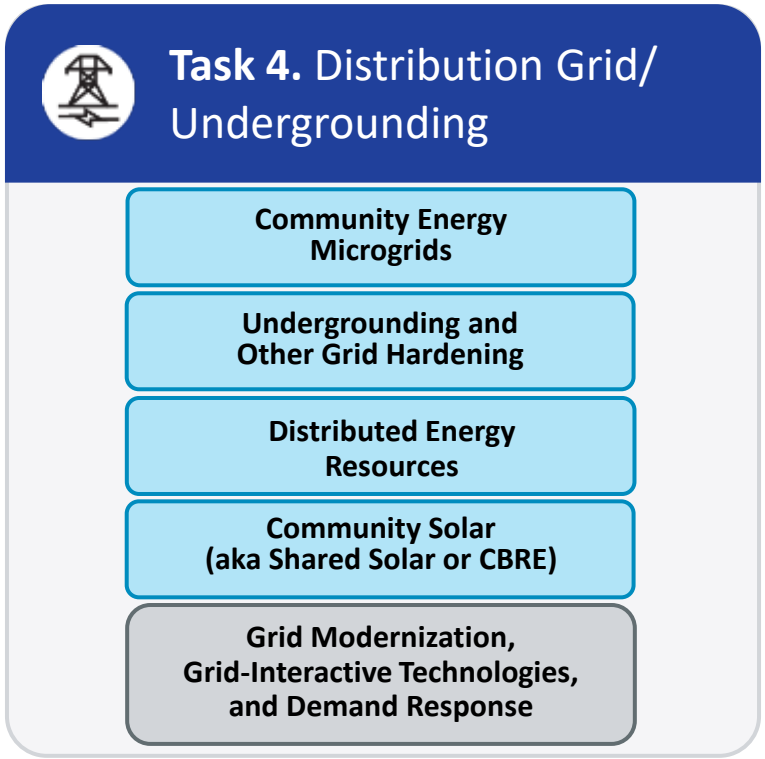
Interactions with Crosscutting Efforts (Task 5):

Subtask 5.1 (Workforce Development and Job Training): Assess critical jobs and skill sets needed to support grid hardening and related efforts. Identify training programs to support related workforce development.

Subtask 5.2 (Policy and Regulatory): Status and opportunities to update interconnection rules and tariffs for microgrids, distributed energy resources, and grid modernization.

Subtask 5.3 (Funding and Financing): Coordinate on funding or financing for grid hardening, including exploring alternate models to HECO rate basing for grid investments.

Mapping Community TA Priorities to NREL TA Task 4



Task 5. Crosscutting Topics

Subtask leads:

Jennifer Daw (Workforce Development and Job Training)
Aaron Levine (Policy and Regulatory Analysis)
Bethany Speer (Funding and Financing)

Task 5. Crosscutting Topics

Task 5 addresses **community-identified priorities** critical to implementing resilient, community-owned energy systems and will provide **cross-cutting insights** to strengthen and align with Tasks 1–4:

- **Subtask 5.1. Workforce Development and Job Training**
- **Subtask 5.2. Policy and Regulatory Analysis**
- **Subtask 5.3. Funding and Financing.**

Subtask 5.1. Workforce Development and Job Training

Description: Building local workforce capacity is critical to support community ownership of energy systems and economic opportunities in Lahaina. This task will assess existing energy workforce development programs in Hawai‘i; identify gaps and local education, training, and partnership needs for Lahaina; and provide guidance and resources to support Lahaina’s local workforce needs for the new energy systems.

Data: Hawai‘i energy workforce development program scope, status, and partners. Knowledge, skills, and abilities needed to perform jobs associated with new energy systems. Workforce development and training programs that support training and upskilling for energy jobs. Type and format of relevant local and remote education and training programs.

Tools: Interviews and discussions with Hawai‘i energy workforce development partners and Lahaina Energy Partnership; online research on workforce development programs, relevant education and training programs, and potential partner organizations that can help Lahaina with local workforce development needs. NREL data and best practices from previous energy workforce development projects.

Key stakeholders: Lahaina Energy Partnership, HSEO, University of Hawai‘i, Hawai‘i Energy, Clean Energy Sector Partnership, AmeriCorps Vista/Kupu internships, Clean Energy Wayfinders, relevant labor union/trade apprenticeship programs, Lahaina community, and Maui County Workforce Development Board.

Target audience: Stakeholders (above), developers/planners, and state/local workforce organizations that support recruiting and job entry for energy sector workers.

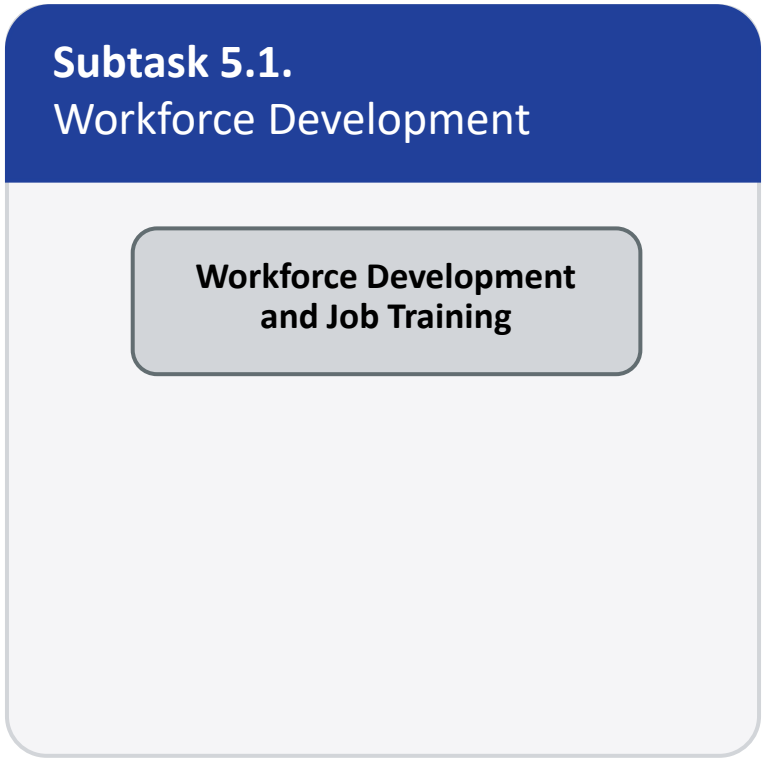
Pathway to implementation: Education and training programs, partners, and information resources that Lahaina can leverage to supplement Hawai‘i's energy workforce development programs and strengthen Lahaina’s ability to build the workforce needed to locally own and operate energy systems.

Subtask 5.1. Workforce Development and Job Training

Subtask	Deliverables	High-Level Timeline
5.1.1: Energy workforce development gaps assessment	• Assess Hawai‘i energy workforce development programs through interviews and online research to the extent possible within budget. • Develop understanding of energy workforce development program scope, status, areas of focus, partners, and benefits to Lahaina’s energy workforce. • Understand the community’s ability to leverage existing workforce development efforts and additional education and training needed at a local level for Lahaina to own and operate the proposed energy projects.	4 months
5.1.2: Workforce development guidance	• Provide guidance on education, training, and partnerships that can address gaps identified in workforce development for the new energy systems (identified in Subtask 5.1.1). • Provide guidance on existing education and training programs and resources that can support job training for proposed energy systems and augment existing Hawai‘i workforce development efforts at a local level.	4 months

- Timelines for Subtasks 5.1.1 and 5.1.2 are overlapping and the work can be completed in 6 months for both.
- This work will be informed by—but is not contingent on—the outcomes of Tasks 1–4.

Mapping Community TA Priorities to NREL TA Subtask 5.1



Subtask 5.2. Policy and Regulatory

Description: This cross-cutting topic will research existing statutes, regulations, and policies at the federal, state, local, and utility levels associated with developing identified energy solutions (e.g., microgrids, community/rooftop solar, and small/low-impact hydropower), conduct research on implementation opportunities and challenges (as requested) for the identified energy solutions, and summarize the findings in a final task memo.

Data and tools: The Regulatory and Permitting Information Desktop (RAPID) Toolkit, available at rapidtoolkit.org. Westlaw, database of legal sources and pending legislation, available at Westlaw.com.

Key stakeholders: Project partners (Hā Sustainability, Shake Energy Collaborative, and Lāhainā Strong), Lahaina community, microgrid developers, HECO, HSEO, and Maui County.

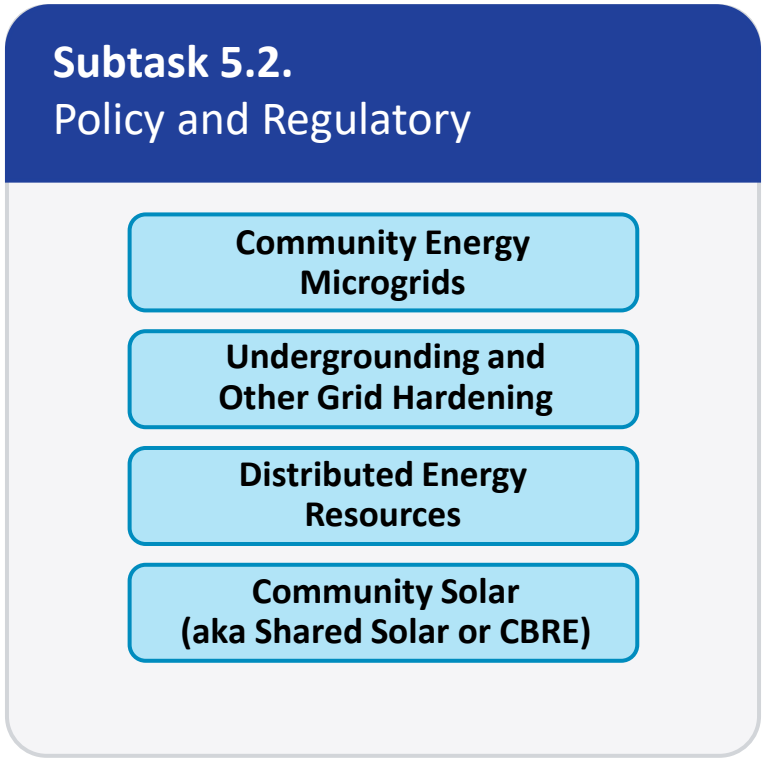
Target audience: Lahaina community, developers/planners, HECO, and HSEO.

Pathway to implementation: Support high-level energy planning informed by existing laws, regulations, and policies and identify opportunities and/or challenges that exist to implementing identified energy solutions, community ownership models, and microgrids.

Subtask 5.2. Policy and Regulatory

Subtask	Description	Deliverables	High-Level Timeline
5.2.1 Literature and Policy Review	Literature and policy review of existing statutes, regulations, and policies for identified energy solutions (e.g., microgrids, community/rooftop solar, small/low-impact hydropower).	Literature and policy review memo summarizing review of existing regulations and policies in Hawai‘i, Maui County, and Lahaina related to energy solutions identified by Task 1 and Task 3.	4–6 Months
5.2.2 Implementation Analysis	Implementation analysis of identified energy solutions (as requested).	Policy and regulatory opportunities/ challenges memo summarizing the potential policy and regulatory pathways for implementing identified energy solutions.	9–12 Months

Mapping Community TA Priorities to NREL TA Subtask 5.2



Subtask 5.3. Funding and Financing

Description: This task will build the Lahaina Energy Partnership stakeholders' awareness of and capacity to access financing and funding to support development of priority energy projects for Lahaina, with a focus on community ownership models.

Data: Currently available state and federal funding programs (e.g., Hawai'i Home Energy Assistance Program, Hawai'i Green Infrastructure Authority, and Powering America Together), utility rebates/incentives, local grant opportunities, private and impact investment, federal programs for community development and disaster recovery, developers offering financing solutions. Evidence of financing of existing or planned projects and assessment of sources and partners. Qualitative insights based on discussions with state and local energy businesses, financial institutions, and developers.

Tools: N/A

Key stakeholders: Financial institutions, developers, and other private sector representatives active in energy development in the state and preferably on Maui. Examples include Hawai'i Green Infrastructure Authority, Shake Energy Collaborative, HSEO, HECO, and Kauai Island Utility Cooperative.

Target audience: Lahaina Energy Partnership partners, local- and state-level energy planners, community energy champions, energy businesses, and local foundations.

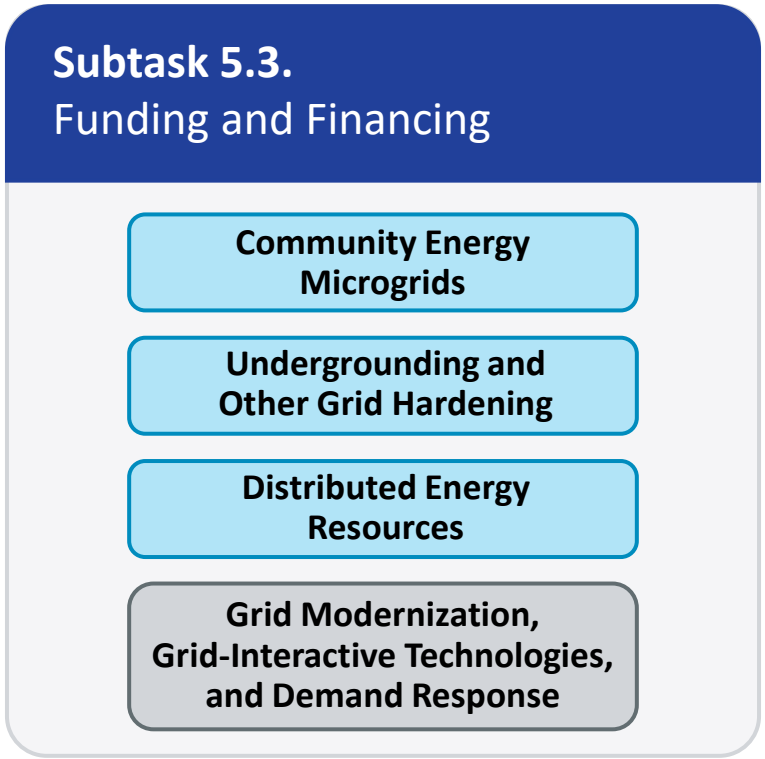
Pathway to implementation: Lahaina Energy Partnership stakeholders have a shared understanding of the leading financing mechanisms, incentives, and funding programs that can be leveraged to support development of their priority energy projects.

Subtask 5.3. Funding and Financing

Subtask	Deliverables	High-Level Timeline
5.3.1. Baseline assessment	Summary of baseline assessment of current finance and funding options and barriers for four to five priority technologies/applications.	Month 8
5.3.2. Virtual peer exchanges	Two to three virtual peer exchanges for capacity building on potential financing models and programs.	Ongoing
5.3.3. Funding and financing toolkit	Finance and funding toolkit focusing on four to five priority technology areas.	Month 14

- Timelines for Subtasks 5.3.1 and 5.3.2 are overlapping and the work can be completed in 6 months for both.
- This work will be informed by—but is not contingent on—the outcomes of Tasks 1–4.

Mapping Community TA Priorities to NREL TA Subtask 5.3



General Q&A and Discussion

Next Steps

- NREL and partners present and discuss community priorities and TA scope during stakeholder briefings and community meetings (June-July 2025).
    - Incorporate additional feedback (July 2025).
- NREL begins TA work (August 2025).
- NREL and partners engage with community and stakeholders with requests for information and to present interim results and products (ongoing).

Mahalo!

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