

## Final Progress Report

**Project Title:** "Hawaii's Clean Energy Transformation and Grid Connection"

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**Recipient:** State of Hawaii Department of Business, Economic Development, and Tourism ("SOH/DBEDT")

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**Project Objective:** To reduce market barriers and costs of greater renewable energy penetration under the Hawaii Clean Energy Initiative ("HCEI"), the Hawaii State Energy Office in SOH/DBEDT is pursuing a two-fold path over the course of three years focusing on a higher acceptable reliability threshold for interconnection standards and streamlined permitting processes, tools, and technical assistance. The first year features technical assistance on regulatory, financial, and utility solutions, particularly focused on adoption of a variety of grid reliability and interconnection standards. The second and third years are focused on: (1) developing resources to streamline the permitting of high impact solar and other renewable energy solutions; (2) disseminating the Hawaii Solar Integration Study ("HSIS"); and, (3) determining best management practices to interconnect solar and other renewables onto electrical grid clusters.

This project will provide the necessary funding to enable SOH/DBEDT to engage technical consultants and to commission any analysis and studies as may be necessary to support the successful outcome of the Reliability Standards Working Group ("RSWG") process. SOH/DBEDT plays a necessary role in assisting and ensuring that the RSWG process is carried out in a timely manner and results in removing or minimizing the grid barriers to interconnecting the maximum amount of renewable

energy generation in Hawaii's islands' grid. This process is considered by Hawaii policymakers as a key part of meeting the State's transformation to a clean energy economy by 2030.

**Background:** Hawaii is the most fossil fuel dependent state in the nation, importing over 85% of its energy needs. In 2008, the State of Hawaii in partnership with the USDOE, launched the Hawaii Clean Energy Initiative which established the goal to reduce Hawaii's dependence on imported fossil fuels by 70% by 2030. Following the launching of HCEI, the State of Hawaii signed an Energy Agreement with the local utilities which propelled the Hawaii Public Utilities Commission ("PUC") to initiate certain energy policy related proceedings such as the Feed-in tariffs ("FITs") docket to evaluate the implementation and design of the FITs program to promote and accelerate the adoption of renewable energy resources in the Hawaii's generation portfolio.

On September 8, 2011, the PUC initiated the RSWG docket with the purpose of developing and establishing reliability standards, metrics, criteria, and procedures to help determine how we can interconnect the maximum amount of renewable energy while preserving grid reliability. The RSWG docket will help determine or identify mitigation measures which address grid reliability issues resulting from high penetration of variable or intermittent renewable energy such as wind and solar energy on Hawaii's small island grids. The outcome of the RSWG process, which was one of the recommendations that resulted from the FITs docket, is critical in the success of Hawaii's transformation to a clean energy economy.

To support the RSWG process, the recently completed HSIS will help stakeholders (e.g., the State of Hawaii, utilities, installers) understand the costs and operating impacts of significant amounts of solar power on the Oahu and Maui grids, and the impacts of interconnecting these island grids via undersea cable. In partnership with the National Renewable Energy Laboratory ("NREL") and other key stakeholders, the distribution and implementation of the HSIS will support future planning to integrate more intermittent renewable energy resources onto our island grids.

In addition, SOH/DBEDT will work with Hawaiian Electric Company ("HECO") to develop a reliability-based cluster evaluation study for high penetration distributed generation on a select utility grid cluster and circuit(s). This evaluation will identify best management practices to interconnect solar systems onto HECO grid clusters/circuits using the "Proactive Approach" concept unanimously recommended by the RSWG PV-DG Subgroup. This evaluation will support the roll-out and application of the Proactive Approach as a viable pathway for utilities and the solar industry to proactively address distributed generation impacts on the electrical grid. Lessons learned from this analysis can be implemented by HECO and other utilities looking to safely and quickly integrate high volumes of distributed solar systems.

The State of Hawaii has placed a priority on expediting the permitting and siting of solar and other renewable energy projects. The Hawaii State Energy Office ("HSEO") within SOH/DBEDT will expand upon existing resources that identify and provide guidance on the permitting requirements for renewable energy projects in Hawaii. These resources

guide project planning and better prepare applicants for the expected permitting processes, thus saving time and money for developers and regulatory agencies.

One SOH/DBEDT permitting tool selected for improvement under this project is the Renewable Energy Permitting Wizard (<http://wizard.hawaiiicleanenergyinitiative.org/>). The Permitting Wizard is an online tool that identifies the federal, state, and county permitting requirements for site-specific renewable energy projects in Hawaii based on answers to a series of questions inputted by the user. It also links to resources that provide information on obtaining over 160 permits required for solar and renewable energy projects in Hawaii. The Wizard has garnered positive feedback from local agencies, the U.S. Department of Defense, NREL, the National Association of State Energy Officials (“NASEO”), and other agencies. SOH/DBEDT will improve the functionality of the Permitting Wizard, convert it to a platform in compliance with the Open Source Initiative, and update the Permitting Wizard content (i.e., permits identified, permit processes, permitting agencies, etc.).

In addition to the Permitting Wizard upgrades, key permitting projects will include significant edits to the existing Guide to Renewable Energy Facility Permits in the State of Hawaii, content upgrades to the HSEO Developer & Investor Center, and updating the existing Permit Briefs for 160+ federal, state, and county permits possibly needed for renewable energy facilities in Hawaii. All upgrades and enhancements to these Hawaii-specific resources will be geared to provide information and examples for other states looking to publish similar information to assist rapid renewable energy facility permitting and deployment.

### **Significant Accomplishments Under this Award:**

#### **Budget Period 1 – Hawaii Grid Reliability and Interconnection Standards**

As part of the initial Reliability Standards docket (Docket No. 2011-0206) with the PUC, SOH/DBEDT through its contractor, Duncan, Weinberg, Genzer & Pembroke, PC, provided comments and policy recommendations on numerous issues impacting the development of reliability standards for the Hawaiian Electric Companies (“HECO Companies”). This effort culminated in PUC Order No. 32053 (April 28, 2014), which provides comprehensive guidance on distributed generation (“DG”) integration issues and trends, and directs the implementation of several RSWG-proposed improvements to the interconnection process. Further information on this proceeding is described in relevant sections below.

SOH/DBEDT emphasized throughout the RSWG process that the State’s policy is clear—it is strongly supportive of a diverse portfolio of renewable and distributed generation to be implemented expeditiously. Accordingly, SOH/DBEDT’s principal objectives throughout the RSWG process have been to ensure: (1) that the State’s renewable energy policy serves as the driving force underlying the each of RSWG’s activities; and (2) swift implementation of actions that forward the State’s renewable energy policy. Based on its review of the Technical Review Committee (“TRC”) Report,

DBEDT continues to believe that the TRC can play a critical role in assisting with the swift implementation of the State's renewable energy policies. SOH/DBEDT highlights the following specific recommendations set forth by the TRC in its TRC Report (May 15, 2013), and provides the current status of each action:

*Reliability Standards*

In pertinent part, the TRC Report contains three recommendations relating to Reliability Standards. First, the TRC recommended that the PUC take steps to implement all ten RSWG-proposed reliability standards, with the exception of HI-BAL-502, through an expedited implementation process. Second, the TRC recommended that, prior to implementing the proposed HI-BAL-502, the performance metric be developed, the issue of capacity value of variable generation be resolved, and the implications of the RIM process be resolved. Third, the TRC recommended that work continue on the other Reliability Standards identified by the RSWG's Reliability Standards Drafting Group.

SOH/DBEDT agreed with these recommendations and urged the PUC to act quickly in adopting Reliability Standards.

In response to comments from parties/interveners, the PUC "decided to open a new docket focused on further evaluation and final approval of the reliability standards. Consistent with the recommendation of TRC, the commission will start the new docket with the final versions of the proposed standards approved by the RSWG, with the exception of HI-BAL-502, which requires further study." Such docket is No. 2014-0192 ("Instituting a Proceeding to Investigate Distributed Energy Resources Policies"), Order No. 32269, filed on August 21, 2014. Once the PUC sets the procedural schedule for this order, interveners (including SOH/DBEDT) will have an opportunity to further comment on the interconnection standards and their implementation.

*Hawaii Electricity Reliability Administrator*

The TRC recommended that the PUC establish and implement the function of the Hawaii Electricity Reliability Administrator ("HERA") to assume and carry forward responsibilities from the RSWG process along with other statutory HERA responsibilities and those assigned by the PUC. The TRC also recommended that the PUC consider the suggestions and recommendations of the Standards Development Framework Proposal in developing the HERA's charter and directing participation and support from HERA staff and stakeholders.

SOH/DBEDT agreed with this recommendation and respectfully asked the PUC to promptly establish the HERA in order to assist the PUC in its efforts to establish and enforce the Reliability Standards that are necessary to ensure that the maximum amount of renewables can be interconnected to the grid on a reliable basis. As part of Order No. 32053, Docket No. 2011-0206, filed on April 28, 2014, the PUC stated that it intends to open a new HERA docket and propose the HERA Framework in that proceeding as a starting point to establish the issues for the docket and receive

stakeholder input.” Further, it stated that the “development of the HERA will require time to conduct the aforementioned HERA proceeding, to retain potential contractor to perform HERA functions and secure a funding for HERA. In the interim, the commission will continue to effectively serve as HERA, until formally established.” As of the timing of this report, the PUC has not yet opened the HERA proceeding.

#### *Minimum Load and Curtailment*

The TRC recommended that the PUC direct the HECO Companies to implement the findings and the recommendations from the Electric Power Systems (“EPS”) Cycling Study, which evaluated possible alternatives to the existing generation operations to increase use of renewable energy, while minimizing cost and maintaining reliability.

SOH/DBEDT concurred, and respectfully asked the PUC to require accelerated analysis and approval of the findings from the HECO Companies’ consultant EPS, which was conducted for the Minimum Load and Curtailment Subgroup, and which revealed that measures can be taken to eliminate or substantially reduce excess energy curtailments of renewable generation.

The EPS Cycling Study recommendations continue to offer valuable guidance and direction in the development of Reliability Standards in Hawaii.

#### *Generator Interconnection Procedures*

Citing the recommendation contained in the PV-DG Subgroup report, the TRC recommended that the PUC open a new docket to expeditiously implement revisions to Rule 14H. However, given the differing proposals forwarded by the HECO Companies and the Minimum Load and Curtailment Subgroup, the TRC recommended that the PUC consider a new docket to finalize and adopt generator interconnection procedures. Further, the TRC recommended that other issues, such as the Proactive Approach, be considered in a separate proceeding so as not to delay implementation of revisions that garner broad support.

SOH/DBEDT agreed that implementing, in short order, the revisions to Rule 14H will reliably permit greater photovoltaic (“PV”) penetration into the HECO Companies’ systems. SOH/DBEDT also supported initiation of a new “Interconnection Procedures” docket to comprehensively consider the following interrelated issues: (1) the PV-DG Subgroup’s recommendations for revisions to Rule 14H and other related revisions needed to Rules 14H, 18, 19, the Feed-in Tariff and other tariffs and procedures; (2) the draft Generator Interconnection Procedures that were developed by the HECO Companies at the very end of the RSWG process and the pending items outlined in the PV-DG Subgroup Final Report related to the Generator Interconnection Procedures; and, (3) the Proactive Approach process and related issues identified in the PV-DG Subgroup Final Report. SOH/DBEDT also recommended that the PUC consider how to best facilitate a collaborative process that enables interested parties to fully vet the generator interconnection process and resulting standard interconnection agreement and procedures.

As it pertains to generator interconnection procedures, on April 28, 2014 the PUC filed Order No. 32053 under Docket No. 2011-0206 requiring the following items, amongst others:

- HECO Companies to file a Distributed Generation Interconnection Plan (“DGIP”), which ultimately got transferred to Docket No. 2014-0192 (“Instituting a Proceeding to Investigate Distributed Energy Resource Policies”) as part of Order No. 32269. At a minimum, the DGIPs were to include: a Distributed Generation Interconnection Capacity Analysis, an Advanced Distributed Energy Resources (“DERs”) Technology Utilization Plan, and a Distribution Circuit Improvement Implementation Plan. The DGIPs would also take into consideration the work performed under the Proactive Approach.
- HECO Companies and KIUC to submit an ongoing distribution circuit monitoring program to measure real-time voltage and other power quality parameters. The purpose of the program is to establish a baseline technical data regarding distribution circuit performance on both light and high penetration distribution circuits in order to ascertain whether and to what extent, if any, high circuit penetration of PV is or may create safety, power quality or reliability problems.
- Establishment of a Distributed Energy Resources Technical Working Group to address the distribution system and interconnection technical issues associated with high penetrations of DERs.
- HECO Companies to file an action plan for improving efficiencies in the interconnection requirements study (“IRS”) process, taking into consideration the efforts and suggestions already initiated under this (RSWG) and other dockets. PV-DG Subgroup to file a stipulation in this docket that sets forth areas of agreement that can be reached on their various work products and any areas where agreement could not be reached.

Since the PUC’s order, the above required filings have been made. We are now awaiting PUC’s order with procedural next steps.

#### *Ancillary Services*

The TRC recommended that the PUC direct the HECO Companies to proceed with an analytical process to define the ancillary service requirements that are necessary for the reliable and efficient operation of the distribution systems.

SOH/DBEDT submits that establishing ancillary service requirements is imperative. Thus, SOH/DBEDT agreed with the TRC’s recommendation. SOH/DBEDT recommended that a new docket be opened in the very near future to address the types and amounts of ancillary services that can be acquired by various means to enhance such capabilities. Related issues that should be considered include the operating characteristics of existing and future generation and demand resources, the costs and benefits of the various ancillary services recommendations in the various subgroup work products, the system reliability thresholds and levels associated with the provision of these services, and the technical capabilities and cost effectiveness of other means of

providing ancillary services such as energy storage and demand response to support increased penetration of renewable resources.

Regarding the treatment of ancillary services moving forward, there are several ongoing related proceedings most notably Docket No. 2007-0341, which requires the HECO Companies to file an Integrated Demand Response Portfolio Plan, Docket No. 2014-0192 (described above), and Docket No. 2014-0183 "Instituting a Proceeding to Review the Power Supply Improvement Plans" which deals with the utilities' overall power system management and planning. SOH/DBEDT is an intervener on all of these proceedings and as such, has provided comments on each proceeding. At this juncture, we are awaiting PUC's order with procedural next steps.

#### Budget Period 2 – Proactive Approach Grid Interconnection Study

SOH/DBEDT through its contractor, HECO, completed 7 tasks under this initiative:

1. Work Plan
2. Report on cluster/Circuit Identification, including the representative attributes of the circuits considered for evaluation
3. Report on the Recommended Evaluation Criteria and Data Requirements for Selecting Eligible Cluster(s) and Circuit(s)
4. Draft Report on the Results of the Completed Cluster/Circuit Study and Analysis
5. Final Report on the Study Results
6. Executive Summary
7. External Training and Outreach Materials, including a presentation for the RSWG PV-DG Subgroup

HECO continues to utilize the Proactive Approach as one method to assess its grid clusters and circuits.

The Proactive Approach incorporates geographic information systems ("GIS")-based modeling enhancements, local solar resource (irradiance) measurements, and high resolution data analysis techniques to better account for DG characteristics and performance attributes. Project goals are to: (1) proactively assess change impacts from DG on system reliability; (2) holistically address mitigation solutions; and, (3) implement more streamlined, uniform utility interconnections and scenario-based planning processes. The objective of this project is to successfully apply the newly developed Proactive Approach, which looks to address key modeling and grid integration challenges that have accompanied the exponential growth of distributed PV generation on Hawaii's island grids. Traditional transmission and distribution models used by utilities for grid integration still treat DG or behind-the-meter resources as negative load. At small DG penetration levels (<15% of maximum circuit load), the risks of impacts at the system level are minimal. However at high penetration levels (>50% of

maximum circuit load), these resources must be modeled and treated as generating resources for purposes of planning, operations, protection and contingency analysis.

Due to the limited availability of data relating to high penetration PV and other DG resources at the distribution level, the industry in general has been slow to adapt and modify traditional models to address these challenges. For the HECO Companies and a number of smaller utility operators on the mainland, the recent exponential growth of DG has had an extreme impact on feeder circuits. This rate of growth currently is outpacing the utilities ability to effectively manage and study penetration impacts on the feeder circuits, let alone system wide level impacts.

The new Proactive method for assessing the high growth and penetration of DG on distribution systems was developed as part of collaborative efforts between the HECO Companies and the Sacramento Municipal Utility District ("SMUD") as part of a California Public Utilities Commission funded California Solar Initiative ("CSI") grant initiative. The Proactive Approach leverages recent improvements to the most common PV inverter models developed by DNV KEMA for the Western Electric Coordinating Council ("WECC") for application in the western interconnect. The Proactive Approach considers a new layering technique incorporating a 3-D perspective modeling versus the traditional 2-D electric infrastructure approach. By factoring in solar resource (irradiance) information into the models, distributed attributes relevant for capturing regional smoothing effects and cloud impacts of DG resources can be assessed.

Project funding to support the roll-out and application of the Proactive Approach for Hawaii to capture modeling techniques and lessons learned from this effort is applicable to all utilities contending with challenges (planning, operating & mitigating) of future high penetration issues related to DG.

#### Budget Period 2 – Upgrade the Renewable Energy Permitting Wizard

SOH/DBEDT through its contractor, Hawaii Information Consortium, LLC, completed and deployed all planned software upgrades to the Renewable Energy Permitting Wizard, which can be viewed at: <http://wizard.hawaiiicleanenergyinitiative.org/>.

Key upgrades include:

- Conversion to an open source software platform (GNU Public License 3.0), which can be accessed at: <https://github.com/DBEDT/renewable-energy-permitting-wizard>.
- Automatic generation of a permit plan Gantt chart at the end of each evaluation, which can be exported, saved, and printed.
- New ability for users to add notes during the evaluation, and separate questions for which users need to obtain additional information and revisit during another session.



- Modified appearance of the evaluation, background, and individual features (e.g., evaluation navigation, Tool Tips, graphics).
- New ability to navigate back and forth from subsets of each evaluation, including ability to save user inputs.
- Improved user security.
- New ability to insert sub-questions to questions in the evaluation.
- Updated user manual.

The upgraded Wizard is now live and ready for use. SOH/DBEDT plans to continuously update the information in the Wizard in line with current permitting requirements, and pursue additional software upgrades to further enhance this tool.

#### Budget Period 3 – Hawaii Solar Integration Study (National Renewable Energy Laboratory)

SOH/DBEDT has posted the “Hawaii Solar Integration Study: Executive Summary” and the “Hawaii Solar Integration Study: Solar Modeling Developments and Study Results” on its Publications website under Solar: <http://energy.hawaii.gov/resources/hawaii-state-energy-office-publications>.

NREL has completed the following activities to disseminate the HSIS using the \$45,000 funds previously provided directly from USDOE to NREL for this purpose:

- Published the HSIS Executive Summary.
- Assisted General Electric (“GE”) in publishing a technical summary report by facilitating peer reviews, and conducting a 3-day meeting in which GE responded to peer review comments, gathered additional feedback on the responses, and produced the technical summary report.
- Established and coordinated the Technical Review Committee (“TRC”) and facilitating 5 HSIS TRC in depth meetings to guide the direction of the HSIS project. NREL presented the HSIS project at a RSWG meeting on March 19, 2012, and a representative of the RSWG participated in the HSIS TRC meetings in which detailed results of the HSIS project were presented.
- Presented its findings to the HCEI Steering Committee (including the Hawaii PUC Chair, Hermina Morita) on June 7, 2013.
- Produced and presented a conference paper at the *2nd Annual International Workshop on Integration of Solar Power into Power Systems Conference* and can be found on NREL publications website at <http://www.nrel.gov/docs/fy13osti/56311.pdf>.
- A journal article for the IEEE special publications was published in the Nov-Dec 2013 edition of *Power and Energy Magazine* (Volume 11, Issue 6).

### Budget Period 3 – Upgrade Existing SOH/DBEDT Permitting Resources

SOH/DBEDT through its contractor, Tetra Tech, Inc., has completed the following updates and revisions to its permitting resources designed to reduce project soft costs:

- Conducted outreach meetings with 36 federal, state, and county permitting agencies integral to the siting and permitting of renewable energy projects in Hawaii to obtain input on and support for the improvements to SOH/DBEDT permitting resources.
- Updated and revised 50 permits in the Permitting Wizard.
- Provided SOH/DBEDT a Wizard Input Sheet with updated process information on 207 permits to enable SOH/DBEDT to conduct additional Permitting Wizard and Permit Brief updates not within the contracted budget and scope of work.
- Updated and revised 40 Permit Briefs.
- Updated and revised the Guide to Renewable Energy Facility Permits in the State of Hawaii.
- SOH/DBEDT submitted its Final Action Plan to the 2015 Hawaii State Legislature as part of its Periodic Report to the Legislature on Renewable Energy Facility Activities & the Renewable Energy Facility Siting Process, which can be found at: [http://energy.hawaii.gov/wp-content/uploads/2011/10/Act-208-201N-Facilitator-Report\\_11-20-14\\_FINAL.pdf](http://energy.hawaii.gov/wp-content/uploads/2011/10/Act-208-201N-Facilitator-Report_11-20-14_FINAL.pdf). This Report describes the renewable energy facilitation activities conducted by SOH/DBEDT in 2014, including the revised permitting resources under this award.

The updated SOH/DBEDT permitting resources can be found at: <http://energy.hawaii.gov/developer-investor/project-permitting-assistance-and-resources>. SOH/DBEDT plans to continuously update the information in these resources in line with current permitting requirements.

**Patents:** None.

**Publications/Presentations/Travel:** SOH/DBEDT P.I., Cameron Black, attended the SunShot Peer Review Summit in May 2014 to present on SOH/DBEDT's award activities to date. SOH/DBEDT's overall SunShot Peer Review score is 4.3325.