



UNIVERSITY
of HAWAII®
SYSTEM

David Lassner
President

DEPT. COMM. NO. 247

December 23, 2020

The Honorable Ronald D. Kouchi,
President and Members of the Senate
Thirty-First State Legislature
Honolulu, Hawai'i 96813

The Honorable Scott Saiki, Speaker
and Members of the House of Representatives
Thirty-First State Legislature
Honolulu, Hawai'i 96813

Dear President Kouchi, Speaker Saiki, and Members of the Legislature:

For your information and consideration, the University of Hawai'i is transmitting one copy of the Report on the Evaluation of Energy Efficient Technology Projects (Section 304A-1893.1, Hawai'i Revised Statutes) as requested by the Legislature.

In accordance with Section 93-16, Hawai'i Revised Statutes, this report may be viewed electronically at: <http://www.hawaii.edu/offices/government-relations/2021-legislative-reports/>.

Should you have any questions about this report, please do not hesitate to contact Stephanie Kim at 956-4250, or via e-mail at scskim@hawaii.edu.

Sincerely,

A handwritten signature in black ink that reads "David Lassner".

David Lassner
President

Enclosure

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UNIVERSITY OF HAWAI‘I SYSTEM REPORT



REPORT TO THE 2021 LEGISLATURE

Report on the
Evaluation of Energy Efficient Technology Projects

HRS 304A-1893.1
(Act 15, SLH 2017)

December 2020

Report on the Evaluation of Energy Efficient Technology Projects

Act 15, SLH 2017, amended Act 234, SLH 2007, by revising the reporting requirement of the greenhouse gas emissions reduction task force (dissolved in 2010) by deleting the “every fifth year reporting” requirement to the Legislature. Also, Act 15 amended HRS 304A-1893.1 by redirecting the appointment of a two-person independent panel of independent energy and environmental technical experts from DBEDT to the University of Hawai'i Office of the Vice President for Research and Innovation (OVPRI). The panel is required to submit an initial evaluation beginning July 1, 2017 to the 2018 Legislature and every three years thereafter.

In compliance with the legislation, OVPRI appointed the following individuals to serve on the panel and to provide their expertise in evaluating the projects and activities funded by the energy systems development special fund:

Carl Imhoff manages the Electric Infrastructure market sector within Pacific Northwest National Laboratory's Energy and Environment Directorate. The market sector conducts advanced electric infrastructure research and product development with the U.S. Department of Energy, state governments, vendors, and commercial energy firms. In this role he is responsible for PNNL's research and development programs on innovations in the areas of advanced power transmission reliability concepts, demand response, development of improved integration concepts for renewable energy generation technologies, policy and strategy for smart grid concepts, and cross-cutting grid analytic tools in visualization and high-performance computing.

As leader of PNNL's Laboratory Objective for a Secure and Efficient Grid, Mr. Imhoff is accountable for Lab-level strategy and execution of strategic development for grid strategy, capabilities, and partnerships, ensuring continued leadership by PNNL in grid modernization over the next decade. In November 2014, Mr. Imhoff was selected by DOE as Laboratory Integrator Team Chair for the DOE Grid Modernization Laboratory Consortium. This Consortium is charged with increasing integration among DOE offices and national laboratories working to transform the U.S. power grid to meet the consumer, economic, environmental, and security priorities of the 21st century.

During his 30-plus years at PNNL, Mr. Imhoff has conducted and managed a broad range of energy research. His technical work emphasizes systems engineering and operations in the areas of power system reliability, smart grid, energy efficiency, energy storage and clean power generation. He has been actively involved in a number of electric power system organizations and bodies, including the North American

Synchrophasor Initiative, the GridWise Alliance, the Consortium for Electric Reliability Technology Solutions, and the Western Electric Coordinating Council.

Gerald A. Sumida is a Partner in Carlsmith Ball LLP's Honolulu office and a member of the firm's Business, Corporate & Finance practice group. He concentrates on business structuring and operations, including corporate, limited liability company, joint venture and partnership matters; business acquisitions; sales and mergers; securities law; start-up company and venture capital financing; administrative and public utilities law; energy law, including energy project development and project finance; antitrust and trade regulation law; federal, state and county legislative and administrative matters; and international legal matters.

Mr. Sumida has represented firms in developing energy, including renewable energy projects and facilities that sell power to electric utilities, including structuring organizational arrangements, negotiating power purchase arrangements, completing site acquisition, undertaking permitting and land use matters, negotiating financing, including project finance arrangements, engaging in public utilities commission proceedings relating to energy projects. Clients include Kalaeloa Partners (cogeneration), Puna Geothermal Venture (geothermal), First Wind (wind), Sea Solar International (OTEC), Oceanlinx (wave energy), and other solar photovoltaic, energy service, waste-to-energy and clean technology firms.

Mr. Sumida rejoined Carlsmith Ball LLP after serving from October 1999 to December 2002 as the General Counsel of the Asian Development Bank, a multilateral development bank established in 1966 to promote the economic and social development of the Asian and Pacific Region (ADB). ADB, based in Manila, Philippines, currently has 67 member countries, and provides development assistance to over 40 countries in this region. He led a group of 28 international lawyers, drawn from 25 countries, who handle ADB's international legal, financing, lending, borrowing, investment and development work, as well as ADB's institutional matters, and undertake their own law and policy reform projects in various countries, and he advised ADB's senior management and board of directors.

The independent reviews by Mr. Imhoff and Mr. Sumida follow, as part of this report.

December 11, 2020

Evaluation of Hawai'i Natural Energy Institute Activities
For the Period 2018 – 2020
Provided by Carl H. Imhoff
Manager of the Electric Infrastructure Market Sector
Pacific Northwest National Laboratory

The following review comments reflect my assessment of the Hawai'i Natural Energy Institute (HNEI) research portfolio and results reflected in the Summary Report prepared by the HNEI in November 2020. I binned my comments according to the HNEI charter as reflected in the following legislation from the State of Hawai'i:

- ACT 253, Session Laws of Hawai'i (SLH) 2007;
- HRS 304A-1891; and
- ACT 15, SLH 2017.

Were Energy Development Special Fund (ESDSF) resources adequately matched by federal and private sector funding for renewable energy resources research, development, and demonstration (RD&D)?

For the period 2018 -2020, the HNEI attracted approximately \$10,000,000 of extramural awards from federal and private funding sources. This amount was relatively consistent across the three-year period of review and reflects a very strong ratio of partner funding relative the typical ratios in public/private research efforts in DOE research portfolio.

The focus of the awards and extramural funds received was strongly aligned with the topic of renewable energy resources RD&D, both in the scope of the work addressing renewable energy adoption and in the breadth of efforts ranging from research, development and demonstration.

Do the HNEI investments focus on critical technologies with high potential to reduce Hawai'i's dependence on imported energy?

The primary policy outcome for the HNEI per the 2007 legislation (Act 253) was to coordinate with state and federal agencies to demonstrate and deploy renewable energy, energy efficiency and peak demand reduction technologies. The primary outcome expected was to reduce state dependence on imported oil.

Early in the review period Hawai'i experienced a significant shift in its generation mix with the consideration of an imminent retirement of a large fossil generator scheduled for 2023. This triggered a significant investment by HECO in solar generation linked with significant energy storage to firm these new renewable resources. This placed Hawai'i in a unique position relative to other US regions in terms of ultra-high penetration of variable generation sources firmed by battery energy storage.

This shift triggered six significant RD&D efforts developing advanced grid planning tools and conducting assessments of the specific situation facing Hawai'i. This portfolio of projects effectively addressed the grid capacity and reliability challenges posed by this unique situation, looking at optimal dispatch, consideration of system dynamics and reliability risks posed by the high

December 11, 2020

fraction of variable generation, and stochastic modeling of system security (voltage and frequency) to capture the uncertainty associated with high penetration of variable generation resources. This was a well-balanced portfolio of projects to address the critical state issues faced beginning in 2018.

The portfolio also included awards to examine alternate fuels to offset oil consumption in transportation, commercial/industrial processing. These efforts, in concert with those addressing electricity generation, combine to cover adequately the major opportunities to innovate to reduce Hawai'i use of imported oil, per the HNEI charter.

Is the project portfolio well-managed in terms of implementation, consistent with budgetary limits?

The portfolio appears to have adequate diversity in research providers and funders to ensure robustness and completeness in the results. Given the annual funding resources, the degree of provider diversity appears appropriate.

The DOE Laboratory providers reflect credible providers given the focus on renewable energy. HNEI has the opportunity to broaden its access to DOE innovation through future engagement with the Grid Modernization Laboratory Consortium which reflects DOE's efforts to better integrate grid modernization capabilities across the Lab system. The GMLC includes the current HNEI Lab partners and can bring additional relevant skills and perspectives to its portfolio in the future. This will better link Hawai'i challenges and leadership to the national agenda in grid modernization for a decarbonized energy future.

How useful are the HNEI research and technical/policy analyses? Do they have the capacity to shape important outcomes for key agencies and organizations?

The regulatory and policy projects appear to have addressed the challenge of integrated grid planning. This was vital as Hawai'i was addressing an extreme scenario of renewable integration thus it could not rely on traditional utility planning tools and approaches.

And a number of the projects addressed the need to provide decision support and data required by policy makers, which is a major gap across grid modernization activity in the U.S. In general, the pace of technology innovation and change is outpacing the availability of data and tools needed by state policy makers and regulators.

Does HNEI and its programs provide useful influence in transforming Hawai'i's energy system toward a more sustainable, resilience and affordable energy ecosystem?

While I have no access to primary data reflecting actual impact, I can reflect that the HNEI program has aligned with co-sponsors and procured research providers that are known to be credible leaders in the renewable energy and resilient grid design areas. This reflects well on the credibility of the delivered products as reflecting best practice from across the U.S.

I also confirm that the lessons learned in Hawai'i are frequently reflected in leading industry and government forums (conferences, peer reviews, etc.) and viewed as credible and important given that the Hawai'i situation is known to be unique and important to the nation's transition to a modern, flexible and resilient energy system.

Review of the Hawai‘i Natural Energy Institute’s Projects and Activities Funded by the Energy System Development Special Fund

Provided by
Gerald A. Sumida
Partner, Carlsmith Ball LLP

HNEI was originally created in 1974 but was formally established as a part of the University of Hawai‘i by Act 253, Session Laws of Hawai‘i (SLH) 2007. Act 253 also established the Special Fund to develop an integrated approach to, and portfolio management of, renewable energy and energy efficiency technology projects that will reduce Hawai‘i’s dependence on imported fossil fuel and other imported energy resources and move Hawai‘i toward energy self-sufficiency. It provided that the projects and activities funded by the Special Fund shall be evaluated every three years by an independent panel of two experts in accordance with Hawai‘i Revised Statutes (HRS) § 304A-1893.1. Subsequently, Act 73, SLH 2010, provided that 10 cents of the \$1.05 tax on each barrel of petroleum products (excluding aviation fuel) imported into Hawai‘i shall be deposited into the Special Fund. Act 253 was later amended by Act 15, SLH 2017, to designate the OVPRI as the appointing authority of the independent panel to evaluate the projects and activities funded by the Special Fund.

HNEI’s purposes, as stated in Act 253 (codified as HRS §§ 305A-1891 *et seq.* (2019)), are basically to:

- Conduct research, development, demonstration and deployment activities for renewable energy sources for power generation and transportation in coordination with state and federal agencies and the private sector;
- Demonstrate and deploy energy efficient technologies, including those that address peak electricity demands; and
- Aggressively seek matching funding from federal agencies and the private sector for its research, development and demonstration activities.

HNEI shall administer the Special Fund to fulfill the purposes described above by using Special Fund revenues for the following activities (codified at HRS § 304A-2169.1]:

- Obtaining matching federal and private funding for research, development and demonstration of renewable energy sources.
- Awarding contracts or grants to develop and deploy technologies that will reduce Hawai‘i’s dependence on imported energy resources and imported oil. The types of projects that HNEI might fund are listed in Annex A to this Review.
- Managing the portfolio of projects funded by HNEI.

Act 253 sets forth the general criteria to assess the degree to which the projects and activities conducted by HNEI comport with and achieve the stated objectives of the Special Fund. On this basis, this Review addresses the following questions:

1. To what degree were the Special Funds matched by federal and private sector funding to support research, development and demonstration of renewable energy resources?

2. Do the contracts and grants awarded by HNEI to develop and deploy technologies that will reduce Hawai‘i’s dependence on imported energy resources and oil focus on critical technologies to achieve these purposes?
3. Is the portfolio of projects commissioned and funded by the Special Fund well-managed in terms of implementation and within applicable budgetary limits?
4. To what extent are HNEI’s research and technical and policy analyses useful and influential to policy-making and decision-making agencies and organizations?
5. To what degree does the existence of HNEI and its programs and activities support and influence generally Hawai‘i’s efforts to transform its energy system toward a more sustainable, resilient and affordable energy ecosystem?

Before providing the evaluations under each of these questions, it would be important to outline in broad terms the extensive and intensive transformations occurring in Hawai‘i’s energy ecosystem, which provide in part the backdrop for conducting a review of HNEI’s programs and activities supported by the Special Fund. A fundamental vision underlying much of what is now occurring in Hawai‘i’s energy ecosystem was presented by the Public Utilities Commission (PUC) in its *Commission’s Inclinations on the Future of Hawaii’s Electric Utilities - Aligning the Utility’s Business Model with Customer Interests and Public Policy Goals* issued in August 2014. That document outlines a vision of Hawai‘i’s energy future, the transformed role of the electric utilities in that future, and the specific pathways that the PUC would be exploring to move toward that vision. Since then, specific legislative mandates have been enacted that build on previous mandates to reduce Hawai‘i’s dependence on imported fossil fuels and to develop Hawai‘i’s own indigenous renewable energy resources. The most recent such mandates are the 100% clean energy goal for electricity generation by 2045 and the attainment of a net zero carbon emissions goal by 2045.

Within this context, the Hawaiian Electric Companies, under PUC oversight, have issued two major requests for proposals (RFPs) for renewable energy generation (primarily solar and energy storage) resulting in numerous utility-scale solar projects, as well as other RFPs for non-wires alternatives to distribution systems, grid services, and community-based renewable energy projects (now called “shared savings” projects). The PUC has also undertaken major proceedings to transform the Hawaiian Electric Company’s business model to incorporate performance-based regulation, as well as to refine and incorporate an integrated grid planning process to guide the modernization of the utilities’ grid systems. Concurrently, the PUC is conducting proceedings to integrate increased distributed energy resources and other grid services into the utilities’ grids, adopt a microgrid tariff, and update the PUC’s competitive bidding framework. Many of these efforts and initiatives have included significant participation by developers of generation resources, distributed energy resources, other forms of ancillary and grid services, in PUC and other proceedings and utility working groups, and HNEI has been involved in most, if not all, of these initiatives.

At the same time, rapid and extensive technological changes are occurring in how energy is generated, distributed, regulated, used, and stored, all of which are supporting the integration of greater amounts of renewable energy into the utilities’ grid system, increasing the spread and use of distributed energy resources, and enhancing the use of energy efficient technologies.

Complementing, and supporting, all of these developments are important regulatory measures, as well as technological advances, affecting the greater use of alternative fuels for ground, marine and air transportation.

Many of these transformative changes are the result of legislative and regulatory actions in response to the policy goals of reducing the use of fossil fuels for energy generation and transportation and more recently of reducing greenhouse gas (GHG) emissions and seeking to mitigate adverse consequences of climate change. Other sources of change are the continuing plethora of technological advances in the generation, transmission and distribution, use, regulation, and storage of energy, and the dynamic interaction between policy mandates and supporting technological infrastructures and advances. This is the transformational energy ecosystem and context within which HNEI operates.

This Review addresses the questions stated earlier.

I. To what degree were the Special Funds matched by federal and private sector funding to support research, development and demonstration of renewable energy resources?

HNEI provided information to the reviewer that clearly evidenced HNEI's very effective leverage of Special Fund amounts to obtain extramural funding - primarily from the U.S. Government, including the Office of Naval Research (ONR), and the U.S. Department of Energy (DOE). During the Review period from 2018 to 2020, HNEI leveraged Special Funds in the amount of some \$3.33 million to obtain approximately \$29.88 million, for an almost 9 to 1 ratio, which is exceptional. In Fiscal Year 2020, some \$1.4 million of Special Funds leveraged almost \$9.8 million funds from extramural awards, for an almost 7 to 1 ratio. It should be noted that some of these projects were continuations of projects that had been developed working with federally-funded activities prior to this reporting period, and that some of the funding covers multiple years during this reporting period.

Several impressive examples of the effective leveraging of Special Fund amounts are the following:

- DOE Wave Surge Energy Converter, where some \$143,400 of Special Funds helped leverage some \$1.322 million of DOE funding.
- U.S. Navy Wave Energy Test Site, where \$500,000 of Special Funds helped leverage a total of some \$12.5 million from DOE, ONR and Navy Facilities Command (NAVFAC).
- DOE hydrogen fuel cell, liquid hydrogen carrier and hydrogen storage projects (combined for this purpose), where a total of some \$223,000 of Special Funds helped leverage a total of \$1.9 million from DOE.
- NELHA Hydrogen Station and Fuel Cell Electric Buses project - although most of this project was completed in the prior reporting period, an additional \$1.36 million from ONR supported the final installation and operation of this station during this reporting period. Overall for this project, some \$1.1 million of Special Funds helped to leverage a

total of some \$7.5 million from ONR, DOE and the Federal Transit Authority, plus \$2.5 million from the State's H2 Capital Investment Fund.

HNEI was clearly successful in working with especially DOE, ONR, the U.S. Navy and other federal departments and agencies in bring federal funds into the State to support Hawai'i's renewable energy programs and initiatives. In addition, it has obtained funding from other sources, as well as in-kind services, for its various projects.

II. Do the contracts and grants awarded by HNEI to develop and deploy technologies that will reduce Hawai'i's dependence on imported energy resources and oil focus on critical technologies to achieve these purposes?

The funds being disbursed by HNEI are fully consistent with the goal of reducing Hawai'i's dependence on imported energy resources, including fossil fuels, and conversely increasing the use of indigenous renewable energy resources in Hawai'i. These contracts and grants cover several areas that are of critical importance in the immediate term as well as longer term.

An urgent matter currently centers on the need to ensure the integration of significant amounts of utility-scale solar-plus storage projects, as well as a small number of wind energy projects, on all major islands in a manner that maintains safe, reliable and stable utility grid operations. These resources are variable or intermittent energy sources (solar energy is available only when the sun shines, and wind speeds vary) and energy storage is still limited to 4, or possibly 6, hours. HNEI's work includes exploring, including modeling, how to maintain grid stability and integrity in the face of increased integration of especially solar plus storage projects. A key issue is how to ensure grid stability on O'ahu when the 180-megawatt AES baseload power generation facility ceases operation in December 2022.

Part of these integration analyses involves the provision of grid services by distributed energy resources. HNEI plans to continue to work on battery storage scheduling issues, maintaining grid stability especially in "low grid strength" conditions (with decreased use of conventional power plants), and determining how effectively to use "grid-forming inverters" without the need for conventional power plants or synchronous condensers. These are all key factors for the effective integration of variable renewable energy sources.

HNEI participates in exploring the potential for the development of supply chains for alternative, renewable sustainable aviation fuel (SAF) production in Hawai'i, through the University of Hawai'i's participation in the Federal Aviation Administration's Aviation Sustainability Center (ASCENT) team of U.S. universities. This work has also reviewed the fuel properties of construction and demolition waste (CDW) as well as biomass feedstock crops. In light of international as well as national initiatives to reduce the use of petroleum-based aviation fuels to reduce GHG emissions, these activities are important preparatory work for potential future regulation of available fuel content.

HNEI continues to support research and testing of a wave energy conversion (WEC) concept to generate cost-effective renewable generated electricity for coastal communities, which is funded by the DOE and uses the U.S. Navy's wave energy test site on O'ahu.

With the rapidly increasing interest in the use of hydrogen, especially “green” hydrogen, for electricity generation but also for transportation, HNEI’s hydrogen production dispensing station on the Island of Hawai‘i at the Natural Energy Laboratory Hawai‘i Authority (NELHA) is an important demonstration. This project evaluates the technical and financial performance and durability of the equipment to support a fleet of three hydrogen fuel cell electric buses operated by the County of Hawai‘i’s Mass Transit Authority. This knowledge can be used to evaluate the deployment of zero emissions buses for public transportation. Other hydrogen fuel projects include development of platinum group metal-free catalysts for hydrogen fuel cell applications, liquid hydrogen carriers, and modified magnesium boride materials to improve hydrogen storage capacities that meet DOE targets.

Finally, HNEI is collaborating with the Department of Hawaiian Home Lands (DHHL) to help develop residential housing designs to improve comfort and energy efficacy. HNEI is also helping to develop a building energy analysis process to reduce energy use in buildings and increase energy security and resiliency. It is also working with the Hawai‘i Department of Education to design and implement a heat abatement program for use in schools and other buildings.

III. Is the portfolio of projects commissioned and funded by the Special Fund well-managed in terms of implementation and within applicable budgetary limits?

Normally this question would be assessed in terms of, for each funded project, the projected duration of the project, any interim timelines or deadlines, the nature (and quantity, if applicable) of the deliverable(s), the project budget, the staff allocations, and possibly additional criteria or special conditions attributed to that specific project. To the extent that performance under each of these criteria was accomplished satisfactorily or not, and if not, what were the causes for any such failures (e.g., force majeure, change of circumstances, unanticipated acceleration of deadlines, etc.), each project could be so assessed, and the portfolio of projects, on that basis, could be similarly assessed. No data or information was presented to the reviewer to conduct such an assessment, and the reviewer is not aware of any significant negative issues or outcomes related to HNEI’s project portfolio.

IV. To what extent are HNEI’s research and technical and policy analyses useful and influential to policy-making and decision-making agencies and organizations?

As initially described above, much of the dynamic changes occurring in Hawai‘i’s energy ecosystem have been influenced, and sometimes driven, by legislative actions and regulatory decisions. On other occasions, such decisions have been in response to new and emerging challenges. These latter include the mandates to reduce Hawai‘i’s continued dependence on imported fossil fuels, reduce GHG emissions and adverse consequences of climate change, and increase Hawai‘i’s resiliency in anticipation of extreme weather events have caused major disruption, havoc and loss in other geographic areas.

In this light, HNEI has played, and is playing, an increasingly significant role in assisting various policy bodies, including especially the PUC and the Hawai‘i State Energy Office (SEO), in providing targeted research and analyses to be used in decision-making. HNEI has also supported the Hawai‘i Energy Policy Forum in its programs, studies and outreach efforts.

The PUC is conducting numerous proceedings involving fundamental and significant energy issues. These encompass performance-based regulation of the Hawaiian Electric Companies, distributed energy resources (including demand response), grid services, community based renewable energy, microgrid tariff, competitive bidding framework for new generation (likely soon to be expanded to grid services), integrated grid planning, and RFPs for renewable energy resources and grid services, among others. The PUC is able to call upon HNEI, and its contractor Telos Energy, to provide independent third-party technical expertise to augment analyses conducted by the PUC, for both near-term as well as long-term questions. HNEI has also provided the PUC with analyses on the Renewable Portfolio Standards (RPS) goals, a preliminary assessment of the impact of COVID-19 on energy use, life-cycle analyses of GHG emissions for certain Hawai'i-relevant generation technologies, and an evaluation of the operations of the Schofield Barracks biodiesel generation project, among others.

HNEI is also a key participant in the Hawaiian Electric Companies Integrated Grid Planning (IGP) process, which is overseen by the PUC. The IGP seeks to integrate forecasting, grid services (including generation), transmission and distribution, and procurement into a comprehensive process with significant stakeholder involvement through the Stakeholder Council and IGP working groups. The IGP also includes a Technical Advisory Panel (TAP) comprised of experts to provide an independent review of the utilities' modeling and planning, and HNEI chairs the TAP.

The PUC is conducting an Electrification of Transportation (EoT) proceeding aimed at significant reductions in GHG emissions from the transportation sector. HNEI has conducted analyses of the implications of transition to electric vehicles (EVs) for GHG emissions.

The Hawai'i Energy Policy Forum (HEPF), founded in 2002 as a collaborate energy planning and policy group, seeks to enable informed decisions to advance Hawai'i's Clean Energy Goals. HNEI supports HEPF's various programs, including its Hawai'i Clean Energy Day, an annual Legislative Briefing, peer exchange program and other activities.

HNEI's activities thus range from directly providing the PUC and SEO with research, technical expertise, and analytical support, assisting the Hawaiian Electric Companies in the IGP process (including chairing the TAP and also working with others in the IGP Stakeholders Council and the various IGP working groups), and assisting HEPF to reach both energy and transportation community companies and members but also to facilitate outreach into the broader community. All of these activities and programs are in furtherance of HNEI's purposes.

Finally, HNEI helps to foster collaboration on smart grids, especially distribution systems and microgrids using solar photovoltaic (PV) and energy storage. The University of Hawai'i is part of a group of U.S. universities, major energy companies, several DOE national laboratories and peer organizations in India, and HNEI is part of this group. This group is working to develop and operate advanced equipment, controls and distribution systems as part of the smart grid, and HNEI is providing to this group the work of the HNEI Grid**START** project on Maui and Moloka'i that was previously funded by the Office of Naval Research. This continues HNEI's participation with international institutions engaged similar innovative energy projects.

V. To what degree does the existence of HNEI and its programs and activities support and influence generally Hawai‘i’s efforts to transform its energy system toward a more sustainable, resilient and affordable energy ecosystem?

The transformation of Hawai‘i’s energy ecosystem, including energy generation and conservation as well as transportation, has become more extensive and more rapid within recent years. Notwithstanding the severe constraints recently imposed by the COVID-19 pandemic, these transformations, and the need for the regulatory, electric utility sector, and private sectors to deal with these changing conditions continues at a strong and rapid pace. Assuming that the pandemic draws to a close toward the end of 2021, due in part to the anticipated widespread availability of the COVID-19 vaccine, the pace of activity within the renewable energy sector should very likely increase due to the State’s economic recovery goals. Hence, the results of the programs and activities that HNEI is currently conducting will be critically important for continuing progress toward achieving the State’s Clean Energy Goals.

HNEI, over a relatively short time, has become a unique resource and an integral part of Hawai‘i’s intellectual and knowledge resource base that is capable to providing relatively rapid, focused, deployable responses and products to address, and contribute to the solution of, fundamental challenges and barriers to the achievement of Hawai‘i’s Clean Energy Goals. In addition to those specific research, development, demonstration and deployment capabilities, HNEI also incorporates a critical human intellectual resource, both in its highly educated, trained and skilled core facility and staff as well as in its network of temporary faculty, staff and other professionals, and its network of similar resources throughout the State, and also nationally and internationally. Its program for interns and students significantly adds to the growing group of developing professionals who are already contributing to furthering the goals of HNEI. As a State comprised of several islands, each island must have its own electric grid and system, and this poses unique challenges for each island as it seeks to integrate greater amounts of variable renewable resources, plus storage, supplemented by energy efficiency and conservation measures. Issues of grid stability and how effectively to meet these issues have pushed Hawai‘i to the forefront of dealing with these challenges and devising effective solutions. Hawai‘i, and Hawaiian Electric Companies, have become nationally recognized for their pioneering work in dealing with this aspect, which generally has not occurred in U.S. mainland electric grids. As a result, HNEI’s work, in collaboration with Hawaiian Electric Companies, among others, has contributed to dealing with these issues from a utility operational standpoint, as opposed to primarily academically oriented research. Similarly, HNEI’s research and analytical contributions to organizations such as the PUC have provided timely, focused and critical support to the PUC and other organizations.

In summary, HNEI has become an integral partner with the State, the Counties, the electric utilities, and the private sector in contributing to the State’s pursuit of its clean energy goals. In the course of its operations, it has administered the Special Fund in a manner consistent with its purposes as set forth in Act 253, and the projects and activities that HNEI has funded using Special Funds as well as additional funds that it has obtained through leverage of the Special Fund are in furtherance of the purposes set forth in Act 253.

* * *

ANNEX A

CRITERIA FOR PROJECTS FUNDED BY THE SPECIAL FUND

Act 253 (codified at HRS § 304A-2169.1(c)(2)) states that projects may be commissioned by HNEI and funded by the Special Fund that:

- (A) Balance the risk, benefits, and time horizons of the investment to ensure tangible benefits to the Hawai'i consumer, with priority given to short-term technology development;
- (B) Emphasize innovative and renewable energy supply and energy efficiency end use technologies focusing on environmental attributes, reliability, and affordability;
- (C) Enhance transmission and distribution capabilities of renewable energy supply for electricity;
- (D) Enhance reliability and storage capabilities of renewable energy for electricity;
- (E) Ensure that research, deployment, and demonstration efforts build on existing programs and resources are not duplicated;
- (F) Address critical technical and scientific barriers to achieving energy self-sufficiency by reducing dependence on imported oil and imported energy resources;
- (G) Ensure that technology used and developed for renewable energy production and distribution will be commercially viable; and
- (H) Give priority to resources that are indigenous and unique to Hawai'i.