

UNIVERSITY OF HAWAI‘I SYSTEM ANNUAL REPORT



REPORT TO THE 2010 LEGISLATURE

ANNUAL REPORT FROM THE
HAWAI'I NATURAL ENERGY INSTITUTE

HRS 304A-1891

November 2009

Report to the 2010 Legislature
Annual Report on
The Hawai'i Natural Energy Institute

HRS 304A-1891

**Hawai'i Natural Energy Institute (HNEI)
School of Ocean and Earth Science and Technology
UH Mānoa**

SUBJECT: Annual Report on Activities, Expenditures, Contracts Developed, Advances in Technologies, Its Work in Coordination with State Agencies and Programs, and Recommendations for Proposed Legislation, required in accordance with HRS 304A-1891 (Act 253, SLH 2007).

SUMMARY: Section 304A-1891 passed by the Hawai'i State Legislature in 2007 established the Hawai'i Natural Energy Institute (HNEI) in statute, defined duties of the institute and its director, and required an annual report to the legislature on its activities, expenditures, contracts developed, advances in technologies, coordination with State agencies and programs, and recommendations for proposed legislation. A summary of HNEI activities is appended.

Summary of Activities, 2009
Hawai'i Natural Energy Institute
School of Ocean and Earth Science and Technology
University of Hawai'i at Mānoa

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Staffing:	Permanent Faculty (FTE)	9
	Other permanent staff (APT)	3
	Temporary Faculty	20
	Other temporary staff (APT, RCUH)	9
	Training (a)	45

(a) Includes post-doctoral fellows, graduate and undergraduate students, and visiting scientists.

Summary of Activities and Contracts: Between 2001 and 2008, the Hawai'i Natural Energy Institute (HNEI) experienced significant growth in its extramural funding from under \$2 million per year to over \$5 million per year. In 2009, extramural funding increased again to over \$14 million. Among the programs contributing to this large increase was the award of a National Marine Renewable Energy Center from the U.S. Department of Energy (USDOE), award of a Smart Grid project from the USDOE, expanded activity for development of hydrogen infrastructure on the Big Island, and expansion of our partnership with the Office of Naval Research (ONR) to utilize Hawai'i as a testbed for alternative energy deployment in the Pacific region. HNEI is a nationally acknowledged leader in research activities in areas such as hydrogen, fuel cells, biofuels and ocean resources. In accordance with HRS 304A-1891, HNEI has undertaken a pivotal role within the state, consistent with its mandate from the legislature to reduce dependence on fossil fuels while contributing to the development of advanced energy technologies and systems aimed at finding solutions to energy shortage problems. While continuing efforts directed toward development of renewable energy and ocean resource technologies, HNEI is also serving as the implementing partner for several major public/private partnerships to deploy and demonstrate renewable energy systems to meet Hawai'i's energy needs. In addition, HNEI has initiated two major efforts directed toward solving the technical issues associated with very high penetration of renewable energy technologies onto the electrical grid. Although funded outside the Hawai'i Clean Energy Initiative (HCEI), these efforts do provide substantial support to HCEI goals and programs.

A brief synopsis of select HNEI activities follows:

Hawai'i Distributed Energy Resource Technologies for Energy Security: This program, managed by HNEI and conducted in partnership with GE Global Research, the Hawaiian Electric Company (HECO), Maui Electric Company (MECO) and the Hawaii Electric

Light Company (HELCO), addresses technical issues associated with increased penetration of intermittent renewable and distributed energy technologies in the electrical grid. Analytic models developed under this program are being used to identify near-term energy-transforming projects for implementation. To date, models have been developed and validated for Hawai'i, Maui, and O'ahu. Scenarios for modification of the Hawai'i energy system have been analyzed using these models and results have been presented to the USDOE and the utilities. New work has been initiated to examine utility practices to manage grid stability and reliability in the face of increased as-available renewable energy systems.

Other ongoing efforts include the commencement of additional scenario evaluations that will address the potential for large-scale insertion of new wind resources and solar energy systems to meet Oahu electricity demand. This work directly supports the objectives of HCEI.

This program also supports the deployment and testing of emerging distributed energy technologies and solutions to end-use energy efficiency issues. In this regard, HNEI is working with a consultant and with Forest City to determine the causes of excessive electricity use and solutions leading to greater cost-effective approaches to significantly reducing electricity use in Navy housing.

Hawai'i Hydrogen Power Park: With funding from the USDOE and from the State's Hydrogen Investment Capital Special Fund through the Department of Business, Economic Development and Tourism (DBEDT), HNEI is the implementing partner for the installation of a hydrogen fueling station on the island of Hawai'i at Hawai'i Volcanoes National Park (HAVO). A hydrogen fueling station with capacity to produce 12 to 20 kg of hydrogen (12 to 20 gallons gasoline equivalent) is expected to become operational in the spring of 2010. In support of this effort, HNEI worked with HAVO to secure separate funding from the U.S. Department of Transportation to convert two conventional diesel shuttle buses to hydrogen-fueled plug-in hybrid electric vehicles (PHEV) to transport tourists at the park. HNEI is seeking additional USDOE support to provide an internal-combustion-engine-powered hydrogen shuttle bus for this project. The Office of Naval Research is also participating in this project, providing funding to augment the development of hydrogen production and air filtration systems for the buses, due to the high level of sulfur compounds in the air.

Maui Smart Grid: This very significant HNEI-led USDOE demonstration project was formally started on October 17, 2008. Our partners include General Electric, MECO, HECO, Sentech, and First Wind, among others. This is a four-year, \$15 million project designed to demonstrate reduction of peak electricity demand by at least 15% through the use of advanced smart grid and demand-side-management technologies. Additionally, the project is intended to assist MECO in providing reliable and stable electricity with increasing percentages of as-available renewable resources. In 2009, the project team completed the preliminary engineering design for the project. In 2010, the team will finish detailed design for the project, continue product development for the advanced smart grid technologies, and begin factory acceptance tests for the new technologies. We expect to begin installing these technologies on the MECO system in 2011, after successful testing.

Energy Analysis for Renewable Portfolio Standards: As called for by Act 95, passed by the 2004 Hawai‘i State Legislature, HNEI, under contract to the State of Hawai‘i Public Utilities Commission (PUC), provided technical evaluations to the PUC to assess current renewable portfolio standards. HNEI submitted the draft final report to the PUC in October 2008. Although this contract terminated in December 2008, HNEI has offered our assistance (under other funding) to continue providing information to the PUC for determination of ways to enhance renewable portfolio standards.

Hawai‘i Energy and Environmental Technologies Initiative (HEET): Initiated in 2001, the HEET Initiative, funded by the Office of Naval Research (ONR), focused on the development and testing of fuel cells and seabed methane hydrates. A key activity under HEET was the development of the Hawai‘i Fuel Cell Test Facility (HFCTF) located on HECO property on Cooke Street. Today this facility has, in addition to ONR funding, several awards active or pending from the USDOE, the National Renewable Energy Laboratory, and various companies. In 2009, as part of the ONR effort to work in Hawai‘i to validate alternate energy technologies for deployment in the Pacific region, HEET was expanded to include additional activities in biofuels and to support testing of critical heat exchanger technology in support of Ocean Thermal Energy Conversion (OTEC). We anticipate further expansion of these efforts in 2010, including new programs in energy efficiency technology and implementing technologies in support of high penetration of renewables on the electrical grid.

Hawai‘i National Marine Renewable Energy Center (NMREC): In March 2009, USDOE executed a five-year contract with UH - HNEI to establish a new Center to facilitate the development and implementation of commercial wave energy converters (WECs) and to assist the private sector in developing OTEC systems for use in Hawai‘i and around the world. The NMREC has already established industry-driven partnerships between WECs and OTEC developers, utility companies, engineering and environmental support companies, university researchers, federal and state government agencies, and other non-government organizations (NGOs). The NMREC coordinates engineering and science efforts to address industry needs and leverage U.S. Department of Defense (DOD) interest in Hawai‘i energy projects. USDOE recently informed HNEI that the first-year federal funding already approved at \$978,048 will be augmented with \$2,333,379 for the second and third years of the five-year contract. The state’s utilities and industrial partners are expected to provide in-kind cost share matching.

Solar Initiatives: HNEI is the primary subcontractor to MVSystems, a mainland solar energy company, for development of technology for the solar production of hydrogen. HNEI has critical patents in this field and is currently negotiating with industry for licensing and further development. HNEI is also providing technical support, data acquisition, and analysis services to the Hawai‘i Department of Education for the installation of \$5 million in solar systems on selected schools. In addition, HNEI is working with USDOE and ONR to conduct additional resource assessments and testing of emerging solar technologies, and with commercial photovoltaics manufacturers in the research and development of thin-film solar cell technologies.

The Flash Carbonization™ process: Under this technology development effort, HNEI has developed a patented process for the rapid and efficient production of charcoal from biomass. Charcoal is a renewable replacement for coal, which is burned in Hawai‘i for power generation and is the biggest contributor to global warming. To assist licensees of our patents, HNEI is now seeking permits to enable the commercial operation of the technology in Hawai‘i. The most recent work involves an exploration of the use of this technology for producing charcoal from Honolulu sewage sludge.

Algal Bio-Oils for Biodiesel Production: Under this technology development effort, HNEI is working with various industry partners to contribute to the development of technology for the production and extraction of oils from biomass. HNEI efforts focus on the production of biodiesel from waste streams and downstream separation processes which will be essential for cost-effective production of algal oils.

Expenditures:

- General Funds \$ 1,281,383**
- Tuition and Fees S Funds \$ 54,255**
- Research and Training Revolving \$ 186,970**
- Extramural Awards \$ 14,282,945**

All funds were expended in support of research and training activities described above. We anticipate 2010 extramural funding levels to be comparable to that of 2009. No funds specific to HB1003 HD3 SD1 CD1, SLH 2007, have been received or expended by HNEI.

Contracts Developed: To date, no funds have been appropriated into the Energy Systems Development Special Fund, and thus no contracts specific to HB1003 HD3 SD1 CD1, SLH 2007, were developed. HNEI has contracted support services from various partners under federally funded programs, as summarized above.

Advances in Technology: HNEI continues to conduct research to advance renewable energy technologies. HNEI has patents in the areas of battery charging, conversion of biomass to charcoal, solar production of hydrogen, and conversion of waste streams to valuable bioplastics in the processing of ethanol. Licensing discussions are ongoing in all of these areas.

Coordination with State Agencies: HNEI works closely with DBEDT and other agencies on a variety of renewable energy projects and continues to seek new opportunities and means to do so. Projects initiated or ongoing in 2009 which involve strong collaboration/coordination with DBEDT include the following:

- **Hawai‘i Hydrogen Power Park:** The hydrogen power park is funded in part by USDOE and in part by the Hydrogen Investment Capital Special Fund through

DBEDT. HNEI is the implementing partner and works closely with DBEDT in the execution of this project.

- ***Hawai'i Hydrogen Plan:*** HNEI, via Kolohala Ventures, is developing the State Hydrogen Plan as called for as part of the Hydrogen Investment Capital Special Fund. HNEI is working closely with DBEDT to insure that this plan is consistent with State objectives in this area.
- ***Hawai'i Bioenergy Master Plan:*** HNEI efforts to develop the Bioenergy Masterplan for the state were initiated in May 2008 with the first stakeholder workshop, held at the Capitol. Several drafts of the plan have been prepared and submitted to DBEDT and a broad group of stakeholders for review and comment. The final plan will be submitted to DBEDT no later than December 12, 2009 for subsequent submission to the State legislature.
- ***Utility Scale Clean Energy Capacity Project:*** HNEI provided substantive assistance to DBEDT in the development of this award from the USDOE. HNEI remains available to support this effort as it gets underway.
- ***National Marine Renewable Energy Center:*** DBEDT is a cost-share partner in the recently awarded National Marine Renewable Energy Center. HNEI is working closely with DBEDT to attract technology providers to the state to participate in this project and to provide assistance in the permitting process.

Recommendations for Proposed Legislation: Generally, HNEI does not initiate legislation, but HNEI does recommend funding the Energy Systems Development Special Fund. As high oil prices continue to pressure the consumer and energy providers, this fund would accelerate the acceptance and deployment of pre-commercial energy and energy-efficiency technologies expected to have near-term impact on Hawai'i's energy infrastructure. HNEI is a member of the Hawai'i Energy Policy Forum and works closely with this group to review legislative initiatives in the energy area.