

# Research & Development Overview

Further details can be reached immediately by clicking on any of our following Research and Development areas: [Biomass](#), <sup>[1]</sup>[Bio-Renewable Resources](#) <sup>[2]</sup>, [Energy Storage](#) <sup>[3]</sup>, [Fuel Cells](#) <sup>[4]</sup>, [Grid Systems](#) <sup>[5]</sup>, [Hydrogen](#) <sup>[6]</sup>, [Ocean Resources](#) <sup>[7]</sup>, [Photovoltaics](#) <sup>[8]</sup> and [Transportation](#) <sup>[9]</sup>. For an overview of each of these areas, see the paragraphs below.

## [Biomass](#) <sup>[1]</sup>

Work under this element includes attention to crop potentials, biomass-to-energy technologies, high-value co-products, and production of fuels and chemicals from biomass. Important efforts are underway in the [Biomass and Fuels Processing Laboratory](#) <sup>[10]</sup> and the [Renewable Resources Research Laboratory](#) <sup>[11]</sup>, where pursuit of [biocarbons \(charcoal\)](#) <sup>[12]</sup> is a crucial research focus.

## [Bio-Renewable Resources](#) <sup>[2]</sup>

This element consists of five subareas, all of which are concerned with the utilization of various kinds of bio-renewable resources to produce fuels, chemicals, or different types of other valuable products. The specific subareas are: [Algal Systems](#) <sup>[13]</sup>, [Biocarbons](#) <sup>[12]</sup>, [Biofuels](#) <sup>[14]</sup>, [Biomass](#) <sup>[1]</sup>, and [Bioplastics](#) <sup>[15]</sup>. Click on any of these for details.

## [Energy Storage](#) <sup>[3]</sup>

This research area focuses on two aspects of energy storage technology. One aspect involves research concerning advanced battery storage systems for use in transportation applications and to assist in electric grid management issues. The other aspect explores the concept of operating electrolyzer technology via renewable energy sources to produce hydrogen which can be stored and subsequently used in a variety of beneficial ways.

## [Fuel Cells](#) <sup>[16]</sup>

Under the Hawaii Energy and Environmental Technology Initiative, a multi-million-dollar partnership with the Office of Naval Research, HNEI constructed and began operation of the Hawaii Fuel Cell Test Facility (HFCTF) in 2003, while simultaneously initiating its fuel cell technology development efforts. The HFCTF was established as a state-of-the-art test facility to characterize fuel cell performance and reliability. This facility now houses eleven test stands, including eight for up to 100 cm<sup>2</sup> single cells and three able to handle full size (up to 600 cm<sup>2</sup>) single cells or small stacks. One of the smaller stands is a test station for high-speed hardware-in-loop (HiL) testing to characterize dynamic performance of small fuel cell systems for autonomous vehicle applications. Specific fuel cell research activities include testing, modeling and

system optimization.

### [Grid Systems](#) <sup>[17]</sup>

The Institute's work concerning renewable energy sources has included assessing the feasibility of increasing the use of renewable energy in electricity grids of the Hawaiian Islands. As a result of this work, HNEI has become involved more and more with studies and analyses of such grids. The Institute has, therefore, interacted with the various utilities involved and has collaborated with subcontractors having the required special expertise. This element consists of three subareas which deal with various aspects of the problems facing electric utilities. The specific subareas are: [Grid Modeling and Analysis](#) <sup>[18]</sup>, [Grid Storage Systems](#) <sup>[19]</sup> and [Smart Grids](#) <sup>[20]</sup>. Click on any of these for details.

### [Hydrogen](#) <sup>[6]</sup>

HNEI is a pioneer in the hydrogen field, with hydrogen research being conducted at HNEI since 1983. From that beginning work, HNEI continues to conduct research aimed at developing technologies for renewable hydrogen production through direct solar splitting of water, biological techniques and gasification of biomass. These efforts were recognized by DOE when HNEI was designated a University Center of Excellence for Hydrogen Research and Education, and continues to be funded today. In addition, HNEI has been active in the development of Hydrogen Power Parks, involving integrated systems for the production, storage, and dispensing of hydrogen. Prototype systems have been implemented on Oahu and the Big Island of Hawaii.

### [Ocean Resources](#) <sup>[7]</sup>

The oceans of the world present huge potentials for yielding energy sources. Two important elements are wave energy systems and systems using ocean thermal energy conversion (OTEC). Both of these elements are being addressed under HNEI's [National Marine Renewable Energy Center in Hawaii](#) <sup>[21]</sup>. Another important element is the presence of enormous quantities of methane in deep ocean sediment on continental margins throughout the world. HNEI is pursuing a research program to investigate the energy and environmental aspects of seabed [methane hydrates](#) <sup>[22]</sup>.

### [Photovoltaics](#) <sup>[8]</sup>

HNEI is engaged in the installation and analysis of a number of photovoltaic (PV) systems on several of the Hawaiian Islands. These [PV installations](#) <sup>[23]</sup> are portions of larger HNEI contracts dealing with a variety of renewable energy systems. In addition, HNEI has developed a state-of-the-art laboratory that is used for the fabrication and characterization of thin film semiconductor devices for [solar hydrogen production](#) <sup>[24]</sup>, thin film photovoltaics, and imaging applications.

### [Transportation](#) <sup>[9]</sup>

As a portion of several HNEI renewable energy awards, attention has been given to the operation of various vehicles using hydrogen as a fuel source or advanced batteries to run an electric motor. In addition, there have been activities including electric vehicle field trip data collection and subsequent analyses to assist the understanding of how driving and usage patterns affect vehicle and power source performance.

Source URL: <http://www.hnei.hawaii.edu/research>

**Links:**

- [1] <http://www.hnei.hawaii.edu/research/biomass>
- [2] <http://www.hnei.hawaii.edu/research/bio-renewable-resources>
- [3] <http://www.hnei.hawaii.edu/research/energy-storage>
- [4] <http://www.hnei.hawaii.edu/research/fuel-cells>
- [5] <http://www.hnei.hawaii.edu/research/grid-systems>
- [6] <http://www.hnei.hawaii.edu/research-development/hydrogen>
- [7] <http://www.hnei.hawaii.edu/research/ocean-resources>
- [8] <http://www.hnei.hawaii.edu/research/photovoltaics>
- [9] <http://www.hnei.hawaii.edu/research/transportation>
- [10] <http://www.hnei.hawaii.edu/facilities/epandclab>
- [11] <http://www.hnei.hawaii.edu/facilities/r3lab>
- [12] <http://www.hnei.hawaii.edu/node/450>
- [13] <http://www.hnei.hawaii.edu/research/bio-renewable-resources/algal-systems-overview>
- [14] <http://www.hnei.hawaii.edu/research/bio-renewable-resources/biofuels-overview>
- [15] <http://www.hnei.hawaii.edu/research/bio-renewable-resources/bioplastics-overview>
- [16] <http://www.hnei.hawaii.edu/research-development/fuel-cells>
- [17] <http://www.hnei.hawaii.edu/research-development/grid-studies>
- [18] <http://www.hnei.hawaii.edu/research/grid-systems/grid-modeling-and-analysis>
- [19] <http://www.hnei.hawaii.edu/research/grid-systems/grid-storage-systems>
- [20] <http://www.hnei.hawaii.edu/node/217>
- [21] <http://hinmrec.hnei.hawaii.edu/>
- [22] <http://www.hnei.hawaii.edu/research/ocean-researches/methane-hydrates>
- [23] <http://www.hnei.hawaii.edu/research/photovoltaics/photovoltaic-pv-installations>
- [24] <http://www.hnei.hawaii.edu/research/photovoltaics/solar-hydrogen-production>