Part 1: Overview

“The department of business, economic development, and tourism shall develop and prepare a bioenergy master plan in consultation with representatives of the relevant stakeholders. The primary objective of the bioenergy master plan shall develop a Hawaii renewable biofuels program to manage the State's transition to energy self-sufficiency based in part on biofuels for power generation and transportation.”

Act 253, SLH 2007
1.0 Introduction

This Bioenergy Master Plan report was developed in accordance with Act 253, Session Laws of Hawaii (SLH) 2007, which called for a bioenergy master plan to “set the course for the coordination and implementation of policies and procedures to develop a bioenergy industry in Hawaii.” The State Department of Business, Economic Development and Tourism (DBEDT), tasked with preparation of the Plan, contracted with the University of Hawaii’s Hawaii Natural Energy Institute (HNEI) in mid-2008 to achieve the specifications of the legislation.

Importantly, Act 253 Part III states: “The primary objective of the bioenergy master plan shall [be to] develop a Hawaii renewable biofuels program to manage the State’s transition to energy self-sufficiency based in part on biofuels for power generation and transportation.” Thus, the objectives of the legislation - bioenergy industry and bioenergy program development - were overarching considerations in the examination of the specified issues and outcomes. These issues and outcomes were therefore studied in the context of the primary value chain components necessary for a successful bioenergy industry – feedstock production and logistics, conversion, distribution, and end use.

Several stakeholder events were held and a website was established to disseminate information, and to receive input from stakeholders during the project. Input, especially from the breakout session discussions at the April 2009 stakeholder meeting, is incorporated in the Issue Reports (Vol II).

A Hawaii bioenergy industry is a necessary component of a more secure and stable energy future for Hawaii and its development will require the sustained coordination, support, and commitment of industry, government, and the community.

1.1 The Case for Hawaii Grown Biofuels

1.1.1 Hawaii’s Energy Situation

Against the current backdrop of rising oil prices, a global recession, conflict in oil producing regions, and heightened anxiety over global warming, Hawaii’s long standing goal of energy independence has become a rallying cry for change. The State’s extreme over-reliance on imported petroleum as its primary energy source, increasingly from countries in politically unstable areas, is well known. Hawaii relies on imported oil to meet nearly 77% of its electricity needs, the highest percentage in the country. Without indigenous fossil fuels (petroleum, coal, and natural gas) and with isolated island-constrained utility grids, Hawaii imports nearly 50,000,000 barrels per year of crude and refined petroleum products to satisfy its need for electricity and transportation fuels. Hawaii’s reliance on imported fuels, burned to power ships, planes, vehicles and power plants, results in billions of dollars drained annually from Hawaii’s economy. Increasing global competition for diminishing petroleum reserves threatens the future stability of Hawaii’s oil-dependent energy economy. The higher the cost per barrel, the higher will be the negative economic and societal impacts on Hawaii’s businesses, environment, schools, and quality of life.
For decades, since the oil shortages of the 1970’s, Hawaii’s leadership has recognized Hawaii’s energy vulnerability and has acted to codify State priorities and, especially in the 1970s and 1980s, to fund research, development, and demonstration projects to transition the state to increased use of its indigenous renewable energy resources. These efforts have provided the groundwork for current efforts to move the state toward greater use of its wind, solar, geothermal, ocean wave, ocean thermal, and biomass resources. While “cheap” oil derailed the focus on renewable energy resources in the mid-1980s, the price shocks of 2008 have prompted renewed urgency and resolve to meet the challenges of Hawaii’s precarious energy situation.

This report has examined the wide range of components that must be in place for a bioenergy industry to succeed, many of which require a longer-term programmatic commitment to build. In order to reduce the state’s extreme vulnerability to off shore oil markets and supplies, and to achieve a more secure energy future, Hawaii must commit to sustained support for industry development.

1.1.2 The Role of Bioenergy in Hawaii’s Energy Mix

For generations, biomass-based energy, primarily waste from sugar cane production, bagasse, has been used in the state to produce electricity. In 1970, biomass energy provided nearly 12% of Hawaii’s electricity. However, with the decline of Hawaiian sugar operations and the increase in electricity consumption, biomass energy, other than from municipal solid waste, currently provides less than 1% of Hawaii’s electrical energy supply.

Nevertheless, biomass for electricity generation or transportation fuels is viewed as an essential part of a more secure energy future because it can be locally sourced, is renewable, can help to mitigate greenhouse gases, can support jobs diversification and economic development, and is a flexible and transportable fuel source. Biomass resources are generated by agricultural, forestry, and urban activities. Agricultural and forestry resources include residues from harvesting and processing operations, such as bagasse, saw mill slab wood, and crops and trees grown specifically for energy use. Urban biomass resources include the biogenic fraction of municipal solid waste, land fill gas, and biosolids and methane-rich gas generated from waste water treatment plant operations. Each of these resources can be converted into bioenergy products such as fuels, chemicals, heat, or electricity.

Regardless of the type of biofuel end product, however, biofuels are a form of energy that is transportable from source to the end-user, and from one island to another using conventional distribution systems. Unlike wind, solar, geothermal, or ocean energy, biofuels can be used in place of liquid fossil fuels like petroleum, solid fossil fuels like coal, or gaseous fuels, with relatively little technology modification by transportation and power generation end users. Especially for Hawaii’s industrial ground and marine transport, biofuels present the only nearer term opportunity for fuel substitution.

Additionally, unlike the variable generation of wind and sun, the energy stored in biofuels is available on demand. When used in combination with renewable resources such as wind
energy, the ability of biofuels to be available on demand can stabilize Hawaii’s utility grids to enable greater use of these variable resources.

The increased use of the state’s biomass resources for the production of fuels for transportation and electricity will diversify Hawaii’s energy supplies and increase energy and economic security and sustainability. Thus, with a bioenergy industry based on locally sourced biomass of sufficient size to displace a significant amount of imported petroleum, Hawaii could enjoy greater economic stability and retention of dollars spent on imported fuels. The development of a sustainable bioenergy industry can yield long-term benefits for Hawaii’s environment, while creating jobs and strengthening the state’s energy security.

1.2 Toward Development of a Hawaii Bioenergy Industry

1.2.1 State Policy Support

For a number of compelling reasons, the use of biomass as a locally available source for renewable energy is attractive. Consequently, key landowners, business entrepreneurs, advocates for the environment, and state leadership have enthusiastically supported the idea that the establishment of the industry will be beneficial for the state.

In 2006 and 2007, several significant legislative measures were implemented as tangible evidence of a heightened interest in renewable energy and in bioenergy’s integral role in the portfolio of potential renewable energy alternatives for Hawaii. Act 240 (SLII 2006) created an alternate fuel standard (AFS) for the State, with a goal to provide 10% of highway fuel demand from alternate fuels by 2010; 15% by 2015; and 20% by 2020. Act 159 (SLH 2007) established an energy feedstock program within the State Department of Agriculture. Act 162 (SLH 2006) strengthened and clarified Hawaii’s Renewable Portfolio Standard (RPS), including biofuels as a renewable energy source. In April 2006, Hawaii’s ten percent ethanol content requirement for gasoline established by Act 199 (SLH 1994) took effect.

The State also provides an investment tax credit for ethanol equal to 30% of nameplate capacity per year for the first 40 million gallons, a reduction in State and local fuel taxes, and a $0.05/gal State government procurement preference for biodiesel. These measures and incentives reflect a renewed interest in a targeted set of policies and initiatives toward bioenergy development that continues to the present.

However, despite substantial Federal, State and County incentives to support production and the use of biofuels, no ethanol plants have been constructed, and only two biodiesel plants are in operation, both for the conversion of waste cooking oil.

1.2.2 Bioenergy Activities and Act 253, SLH 2007

In recognition of the need for additional support for industry development, two statewide bioenergy events were convened in 2006, the Governor’s Biofuels Summit and the Ag Bioenergy Workshop. The meetings were held in acknowledgment of the benefits, the
complexity, and the challenges of Hawaii-based bioenergy industry development. Meeting participants represented all sectors of the bioenergy industry value chain – biomass production, conversion, distribution and storage, and end use – that are necessary elements of successful industry development. Participants in the 2006 meetings agreed that the development of a bioenergy industry in Hawaii poses significant challenges including limited land and water resources, adequacy of labor, lack of specialized production and distribution infrastructure, potential environmental impacts, and financial risk.

Separately, House Concurrent Resolution 195 (SLH 2006) required the Hawaii Energy Policy Forum (HEPF) to report to the 2007 State Legislature with recommendations “encouraging Hawaii’s landowners, investors, county governments, and regulated electric utilities to pursue development and conversion of fuel crops for electricity generation.” In its recommendations to the Legislature, HEPF called for the development of a Bioenergy Master Plan.

Consequently, HB 1003 HD3 SD2 CD1, Relating to Energy, was passed by the 2007 Legislature and signed into law as Act 253, SLH 2007 with Part III of the Act providing for the preparation of a bioenergy master plan by the State Department of Business, Economic Development and Tourism (DBEDT) to “set the course for the coordination and implementation of policies and procedures to develop a bioenergy industry in Hawaii.” DBEDT subsequently contracted with the University of Hawaii’s Hawaii Natural Energy Institute (HNEI) to prepare the master plan.

1.2.3 Hawaii Clean Energy Initiative

In January 2008, the U.S. Department of Energy and the State of Hawaii entered into a Memorandum of Understanding for the Hawaii Clean Energy Initiative (HCEI http://www.hawaiicleanenergyinitiative.org/). The goal of the initiative is to decrease energy demand and accelerate use of renewable, indigenous energy resources in Hawaii’s residential, building, industrial, utility, and transportation end-use sectors so that efficiency and renewable energy resources will be sufficient to meet 70% of Hawaii’s energy demand by 2030.

Related to HCEI, on October 20, 2008, the State of Hawaii and the Hawaiian Electric Companies signed an Energy Agreement (http://hawaii.gov/dcca/dca/HCEI/) that includes commitments to listed biomass projects.

1.3 Approach to the Hawaii Bioenergy Master Plan

1.3.1 Bioenergy Industry Value Chain

The bioenergy industry involves the production of biomass-based energy products, including solid, gaseous, or liquid biofuels, from raw materials for commercial sale. Products are passed through a series of essential business components, or chain of activities, on their way to the consumer. Planning for the development of a bioenergy industry requires an understanding of the chain of activities, often called the value chain.
A bioenergy value chain with five components is described in the National Biofuels Action Plan issued in October 2008 by the Biomass Research and Development Board. The Board, created by the Biomass Research and Development Act of 2000, comprises numerous Federal departments and agencies. The five value chain components are shown in the figure below.

![Bioenergy Value Chain Components](http://www1.eere.energy.gov/biomass/pdfs/nbap.pdf)

The components are:
1. Feedstock Production – Cultivation of biomass resources used as raw material inputs for biofuels production.
2. Feedstock Logistics – Harvesting or collecting of feedstock from the area of production, then storing and delivering it to conversion facilities.
3. Conversion – Transformation of the processed feedstock to gaseous, liquid or solid fuels.
4. Distribution – Transfer of the fuel from a conversion facility to the point of retail sale.
5. End Use – Purchase of biofuel by the consumer

Use of the value chain to frame the industry from feedstock production through end use forces examination of the interdependent components of the industry as they may apply to the many possible bioenergy production and use pathway alternatives. The concept can be flexibly applied to facilitate a deeper understanding of the synchronization involved in bioenergy industry development. For example, value chain conditions that must exist for the production of ethanol using sugarcane bagasse include certain bagasse supplies, economic delivery of bagasse to an ethanol facility, an operational ethanol facility, a distribution system, and a market. Similar conditions must exist to enable the use of forestry waste for utility power generation or the use of oil crops such as algae, jatropha, and oil palm for biodiesel for vehicles or power plants.

Planning from the value chain perspective identifies the components and linkages that need to be strengthened, and therefore points to measures, including partnerships, that can support continuity of industry processes from production to end use. Development of a bioenergy industry for Hawaii is thus both comprehensive and structured, with focus on understanding of component needs while at the same time maintaining a vision for the broader industry.

1.3.2 Industry Stakeholders

From feedstock production through end use, a bioenergy industry can have far reaching impacts on all members of Hawaii’s community. The cultivation of biofuel crops will require the use of
land and water resources, and agriculture labor will directly impact the economy of adjacent rural communities. Trucks to haul wood, bagasse, or other feedstocks to processing facilities may affect road and vehicle traffic. Barges to move biofuels or feedstocks between islands may require new harbors infrastructure. Biofuel mandates, such as the ethanol (E10) mandate that displaces fossil fuel use, will touch all users of the displaced fuel.

Besides these immediate impacts, the large scale production of biofuels has become a national conversation with the realization that biofuels choices have consequences that may impact the environment in ways that may be beneficial or harmful, depending on feedstock selection, production and conversion processes, and end products. The national and international experiences and Hawaii’s unique environment and culture as well as land and water constraints demand an inclusive approach to industry planning. Thus, while Hawaii’s needs for more dependable energy supplies are compelling, and bioenergy industry barriers are well documented as a result of the 2006 meetings, development of the industry must continue to consider a variety of viewpoints and needs.

Throughout the development of the bioenergy master plan, industry stakeholders were therefore provided with opportunities for input on the various issues. Recurring themes that were raised included the competition for agricultural water and land resources often expressed as “food vs. fuel” and the need for sustainable development.

1.3.3 Act 253, SLH 2007, Plan Requirements

Act 253 provides for development of a plan “that will set the course for the coordination and implementation of policies and procedures to develop a bioenergy industry in Hawaii.” Specifically, the Act requires the Department of Business, Economic Development and Tourism (DBEDT) to prepare the plan “in consultation with representatives of the relevant stakeholders”, and to provide an interim and a final report on the development of the plan.

The guidelines for the plan are provided in the Act as follows:

The “objective” establishes that the intent of the Act is for development of a plan that will address programmatic support for the state’s transition to energy self-sufficiency as a longer-term goal.

“The primary objective of the bioenergy master plan shall [be to] develop a Hawaii renewable biofuels program to manage the State’s transition to energy self-sufficiency based in part on biofuels for power generation and transportation.”

The expectations for the plan are established in the outcomes.

“The bioenergy master plan shall address the following outcomes:

(1) Strategic partnerships for the research, development, testing, and deployment of renewable biofuels technologies and production of biomass crops;

(2) Evaluation of Hawaii’s potential to rely on biofuels as a significant renewable energy resource;
(3) Biofuels demonstration projects, including infrastructure for production, storage, and transportation of biofuels;

(4) Promotion of Hawaii's renewable biofuels resources to potential partners and investors for development in Hawaii as well as for export purposes; and

(5) A plan or roadmap to implement commercially viable biofuels development.”

These outcomes are reordered in this report to achieve a smoother progression of workflow resulting in the first two outcomes as follows:

- Outcome I - Evaluation of Hawaii's potential to rely on biofuels as a significant renewable energy resource. This outcome considered the following task areas -
  Water resources;
  Land resources;
  Distribution infrastructure for both marine and land;
  Labor resources and issues;
  Technology to develop bioenergy feedstock and biofuels;

- Outcome II - A plan or roadmap to implement commercially viable biofuels development. This Outcome considered the findings from Outcome I as well as the following additional task areas -
  Permitting;
  Financial incentives and barriers and other funding;
  Business partnering;
  Identification and analysis of the impacts of transitioning to a bioenergy economy while considering applicable environmental concerns.

The specific issues, including pertinent policy requirements, were addressed by subject experts. The reports on these issues are in Vol II of this plan.

“The bioenergy master plan shall address the following issues:

(1) Specific objectives and timelines;
(2) Water resources;
(3) Land resources;
(4) Distribution infrastructure for both marine and land;
(5) Labor resources and issues;
(6) Technology to develop bioenergy feedstock and biofuels;
(7) Permitting;
(8) Financial incentives and barriers and other funding;
(9) Business partnering;
(10) Policy requirements necessary for implementation of the master plan; and
(11) Identification and analysis of the impacts of transitioning to a bioenergy economy while considering applicable environmental concerns.”

Plan development activities included assembling a team of subject experts to study the various issue areas, stakeholder outreach and engagement activities, planning for and conducting tasks, integration of task findings and recommendations, and preparation of the draft and final Plan.
Work on the Plan was conducted from the value chain perspective to ensure appropriate attention to the industry components along the value chain. This framework also allowed for multiple inputs and outputs and consideration of the impacts of technology choices on the development of the industry.

While much of the analysis conducted during the project focused on liquid and solid biofuels, all bioenergy products, including biogases, are components of a bioenergy industry and should be considered in the implementation of incentives or other industry support recommendations.

The public stakeholder outreach and engagement activities were conducted as follows:

- **Kickoff Meeting – May 21, 2008**
  An all-day kickoff meeting for the Bioenergy Master Plan was held to inform stakeholders of the project, initiate discussion of the issues involved in industry development, and survey their interests in the project.

- **A Conversation with Hawaii’s Agriculture Sector – September 5, 2008**
  A second stakeholder engagement event was held in conjunction with the biennial Hawaii Agriculture Conference at the Hawaii Convention Center.

- **Survey**
  A survey was distributed to participants at a variety of events and made available on-line at [http://hawaii.gov/dbedt/info/energy/renewable/bioenergy/index_html](http://hawaii.gov/dbedt/info/energy/renewable/bioenergy/index_html).

- **Stakeholder Meeting April 2, 2009**
  A meeting was held to present progress reports on the development of the bioenergy master plan and to capture stakeholder input during issue breakout sessions. The meeting agenda, breakout session questions, and participant list are provided at [http://www.hnei.hawaii.edu/bmpp/calendar.asp](http://www.hnei.hawaii.edu/bmpp/calendar.asp). Notes from the breakout sessions are included with the respective Issue Reports.

- **Continued Stakeholders Input**
  Stakeholder review comment on the draft bioenergy master plan was requested and incorporated in plan revisions.

- **Hawaii Clean Energy Day, June 6, 2009**
  HNEI staffed an exhibit booth for educational and outreach to stakeholders at the all day event featuring local and national speakers from government and the private sector.

- **Bioenergy Master Plan Website**
  A website was developed for stakeholder education and outreach at [http://www.hnei.hawaii.edu/bmpp/home.asp](http://www.hnei.hawaii.edu/bmpp/home.asp). An e-mail address was established for stakeholder communication.