Study of Renewable and Unconventional Energy in Hawaii
Executive Summary

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This Executive Summary includes: (1) a summary of the study objectives, key outputs and approach, (2) the key results and conclusions, and (3) recommendations.

Summary of Study Objectives, Key Outputs and Approach

The primary objective of this study was to develop and evaluate a working database of potential *wind, solar* and *biomass* projects and other commercial activities for the generation of electricity in Hawaii over the next 30 years, and to examine possible frameworks for evaluating the resulting economics impacts. The key outputs were the preparation of a strategy to phase in renewables into the electric utility grids, an evaluation of the potential for alternative public policy options to facilitate the implementation process, and a preliminary assessment of the overall economic impacts to the state.

The approach started with the assembly of an initial working database of about 108 *candidate projects* utilizing the Global Resource Assessment (GRA) prepared by the Hawaii Natural Energy Institute (HNEI) as the reference point. The GRA incorporated results from precursor studies conducted by Robert Lynette and Associates (RLA) on the Hawaii Energy Strategy (HES) for the Department of Business, Economic Development and Tourism (DBEDT) and by GDS in support of the Renewable Portfolio Standards (RPS) initiative also for DBEDT. Performance and cost estimates of wind, solar and biomass projects from these studies were reviewed and updated. The candidate projects were evaluated in a three-step process:

- Project Screening. The candidate projects were screened to determine which projects were realistic candidates for development or could reasonably be expected to be during the 30-year timeframe. The screening process included evaluation of utility integration, land use and community acceptance issues. A total of 26 projects survived the screening process and were selected for further analysis;
- Preliminary Phasing Strategy. Future performance and costs estimates were prepared for the 26 projects and two biomass projects were added, bringing the total to 28. Future project costs were compared with estimates of future utility market prices for electricity. A preliminary strategy was initially developed for phasing the projects and activities on our island grids and to meet our energy needs over the next 30 years, assuming today's economics, government policies, and utility and business practices ("business as usual" scenario). The 30-year period was broken down into three sub-periods:
    - o near-term (2003 to 2008),
    - o mid-term (2008 to 2018), and
    - o far-term (2018 to 2033).

  Finally, an assessment was made of the business-as-usual scenario in terms of the implementation of renewables under our state PURPA law.
- Public Policy Options. Alternative public policy options were identified and evaluated for the potential to facilitate the phasing strategy. In conjunction with the evaluation of public policy options, a preliminary assessment was made of the potential overall economic impacts associated with a shift towards renewables. Specifically, with support from Tom Loudat and Associates, a preliminary assessment was made of several potential frameworks for conducting such an analysis of the overall economic impacts to the state. One approach was selected and a preliminary analysis was conducted for Oahu.

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Key Results and Conclusions

The key results are discussed below by key study area.

Identifying and Characterizing the Renewable Technologies Appropriate for Hawaii

- The primary wind, solar and biomass technologies studied and evaluated as being the most appropriate for Hawaii's wholesale and retail electricity markets are:
  - Wholesale (Supply-side)
    - Windfarms,
    - Parabolic troughs,
    - Photovoltaics, and
    - Biomass Gasification.
  - Retail (Demand-side)
    - Solar hot water,
    - Photovoltaic, and
    - Solar Air Conditioning.
- Obtaining accurate data and information the technologies was a challenge. The level of detail and certainty was directly proportional to the maturity of the technology, which fell roughly in the same order as the technologies are listed above. In addition, developers and the utility were not eager to share data and information that were not public.
- Analysis and comparison of the past 9 years of utility avoided cost data and the consumer price index (CPI) showed that the avoided costs have been increasing at a compounded rate of 3% above the CPI. Given that, the avoided costs will more than double during the 30 year timeframe.
- During the same period, renewable costs will continue to drop, and market opportunities will open up, based on the readiness of the specific technologies, the market price, and the ability of developers to overcome implementation issues and finance projects.
- It is believed that the approach used to characterize the performance and costs of the technologies is valid, but is subject to the accuracy of input data and information. Thus, the evolution of the working database is considered a "work in progress."

Development of Commercial Projects

- The screening process revealed a number of important issues, the sum of which, are directly relevant to determining viability of specific projects. These include:
  - Utility-Integration Issues:
    - firm power sources have the highest value to the utility, as they can be depended on and can defer new generation needs,
    - intermittent sources have less value and currently face requirements (performance standards and fault-ride through) to protect the reliability and integrity of the grid,
    - system operational constraints, due to system emergencies and low, night-time loads when intermittent sources may be curtailed, and
    - increasing levels of intermittent sources can be facilitated with the addition of storage, such as pumped-hydro, to the grid.
  - Land-Use Issues:
    - Restrictions on land-use vary significantly with ownership and zoning,
    - Projects on government land and/or land zoned conservation require permits and developers must prepare an Environmental Assessment, as a minimum, to show compliance with state land use and environmental laws, and

- Projects on private land face less permitting requirements, e.g., windpower is considered a pre-permitted use on private, agricultural land.

➢ Community Acceptance Issues:

- The community generally views renewable projects positively,
- However, specific projects may have visual, environmental (e.g., impacts to birds or their habitat and noise) and/or cultural impacts, and
- Community acceptance, in part, will be subject to full disclosure and discussion of project plans and details by the developer.

❖ A number of projects currently in development, primarily windfarms, had been studied previously on the GRA and looked like excellent development candidates given the utility's current avoided costs. However, developers were failing to reach agreement with the utility on power purchase agreements and project financial viability was in question. A brief analysis, utilizing two separate lifecycle costing models, revealed that actual:

➢ Project development costs are higher than predicted in previous estimates, due to the longer time and extended effort required to negotiate PPAs,

➢ Equipment costs are higher, primarily due to utility interconnect requirements not anticipated and included in previous cost estimates, and

➢ Fixed operating costs are projected to be much higher, due, in part, to taxes and insurance costs not accounted for in earlier studies

❖ In parallel, an assessment was made of the implementation of PURPA in "business as usual" scenario with the following overall findings:

➢ No new renewable projects have been constructed in the past 10 years,

➢ Negotiation of power purchase contracts has taken five years or more with HECO, and approval by the PUC up to an additional year,

➢ Developers sometimes share the responsibility in project delays, and, at least in one case, a project has died during a company transition, and

➢ At a minimum, one could conclude that implementation of renewables in Hawaii has not lived up to the intent and spirit of PURPA.

❖ WSB-Hawaii concludes that a more proactive, constructive approach to the implementation of PURPA is needed, referred herein as the BAU-Plus (BAU^{+}), that would include, as a minimum, the following characteristics:

➢ The contracting process with the utility and PUC is expedited via standard offer contracts, such that contracts can be negotiated, signed and approved by the PUC within one year;

➢ Developers are treated as partners and work closely with the utility to provide reliable power to the grid while maintaining the integrity of the grid;

➢ Developers and the utility share the cost of resolving new grid integration issues. Recent experience shows that IPPs and the utility continue to face new technical challenges, and it is appropriate for the utility both to share added costs as we seek to increase our use of renewables, while maintaining the safety and integrity of our electric grids;

➢ Developers and the utility provide full disclosure to each other and to landowners and the community; and

➢ All stakeholders assist developers in securing support for projects.

Developing a Project Phasing Strategy

- Moving forward, a phasing strategy was developed for the 28 selected projects and other commercial activities initially for the business-as-usual scenario with these results:

  - Near Term (2003 to 2008). 9 wind and biomass projects and, on the demand-side, solar hot water and PV systems, were determined to be feasible in the near-term (2003 to 2008). Implementation of these projects and activities was estimated to bring the statewide renewable fraction by the end of 2008 to 11.7%,[2] with the following breakouts by island:
    - Hawaii: 36.9%
    - Maui: 15.9%
    - Oahu: 6.9%
    - Kauai: 25.5%
  - Mid-Term (2008 to 2018). 19 wind, parabolic trough, PV and biomass, and, on the demand-side, solar hot water and PV systems, were determined to be feasible in the mid-term (2008 to 2018). Implementation of these projects and activities was estimated to bring the statewide renewable fraction by the end of 2018 to 28.6%.
    - Hawaii: 66.9%
    - Maui: 44.5%
    - Oahu: 19.5%
    - Kauai: 55.5%
  - Far-Term (2018 to 2033). A detailed analysis was not conducted, in large part, due to the challenge and uncertainty of predicting that far into the future. Instead, the trends and factors that will impact the phasing strategy in the far-term were evaluated as each of our islands moves towards a 100% renewable future. Specifically:
    - As renewables become cheaper than conventional fossil energy and on-shore sites for large projects are exhausted, off-shore windfarms will be considered, along with other technologies not studied (e.g., wave, OTEC). The people of the outer islands, especially Molokai and Lanai, will have many options to consider, including energy crops, such as biodiesel, to fuel generators, and combinations of wind, parabolic trough, and PV in conjunction with storage;
    - The remaining energy needs, especially on Oahu, will be met by demand-side options, including technologies not studied, e.g., deep ocean water air conditioning. By 2033, there could be 200,000 solar hot water systems, off-setting 2.85% of our total statewide electrical demand; and more than 140,000 residential and small-commercial PV systems supplying 3.1%.

- **Evaluation of Public Policy Options**

  - A limited analysis was conducted of two alternative public policy options, market reform and increased incentives, in order to evaluate the potential for accelerating the implementation of renewables.
  - The market reform options, which would be paid for by the ratepayer include:
    - opening the market and reducing the barriers to entry, e.g, standard offer contracts;
    - setting a requirement (or mandate) for renewables, e.g., RPS;

[2] Based on the estimated renewable fraction of 6.2% for 2003.

- increasing the price of renewable electricity the utility is willing to pay above existing avoided costs, e.g., an "adder" for increased system reliability, energy security and environmental protection or an electricity feed law; and
- lowering the price of renewable electricity to the customer, e.g. via retail wheeling agreements.

- Market reform options can serve to accelerate the implementation of renewables by effectively increasing the market price, which would allow projects currently over the market price to be competitive.
- Incentives serve to create a stronger market pull for renewables by lowering the installation costs of projects. The approach on this study was to evaluate the impacts of a $4M/year incentive fund, which would be paid for by the taxpayer.
- This fund could be used to:
  - Pay for the market reform adders discussed above;
  - Pay for a state Production Tax Credit (PTC) to mirror the federal PTC, which effectively pays projects via a tax credit to the investors approximately 1.8 cents/kWh for the electricity actually delivered during the first 10 years of the projects;
  - Enhance the state tax credit law to increase or remove the CAP (currently at $250K) on 20% tax credit for commercial wind and 35% tax credit for solar projects; and
  - Expand the credit to include certain biomass technologies.
- Qualitatively, it would appear that a 2 cent adder or a state PTC would accelerate implementation by 2 to 5 years, depending on the technology.
- Tom Loudat and Associates conducted a preliminary analysis utilizing the WADE model of Oahu's incremental power demands through 2023 to illustrate the potential benefits of meeting Oahu's future needs with a 100% distributed generation (DG). Specifically, while the results show that a greater capital investment, compared to the 100% central generation (CG) approach, there would be an incremental power cost savings of 2.18 cents/kWh (or 22%)with DG compared to CG.
- The WADE model appears to be an excellent tool for evaluating Hawaii's energy transition to distributed generation, which would include renewables.

❖ **Brief Assessment of the Potential Impacts of Known Factors ("Wild Cards")**

The important factors, some of which might be called "wild cards," that will influence and possibly modify the trends and pace of our energy transition include:

- Maturation process of the renewable technologies: the process is closely related to the level of government support for R&D and market incentives. Government support will be especially important for the technologies in this order: PV, biomass gasification, parabolic troughs and wind;
- Structure of the market: renewables will do best in open markets that have a mandate for renewables, such as a RPS. In monopoly markets, such as in Hawaii, RPS may also work, but may require incentives for investor-owned utilities;
- Fossil Fuel Prices: fluctuations in fossil fuel prices, and especially for oil, which is the most volatile and on which Hawaii most heavily depends, work both ways. While there are experts on both sides of this issue, recent history validates a continuous increase over time in the market price for electricity in Hawaii. More importantly, Hawaii needs to address the issue of the export of our dollars to import fossil energy. Reducing our dependence on imports will provide overall economic benefits to the state;

- Role of Renewables in the Utility Grid. Initially, renewables serve to save fuel, especially from intermittent sources like wind and solar. The value of renewables increases with their ability to defer and new conventional generation needs, and, ultimately, to replace all conventional generation. This process will need to be planned and managed carefully so that conventional generation is not stranded;
- Energy Use Trends. One of the real wild cards might be a long-term warming trend in Hawaii's weather and/or an increase in our average humidity. Either one would likely trigger a greater need for air conditioning our homes. However, this need could be met by solar, as described herein; and
- Environmental Mandates: mandates will most likely come on a separate track from conventional government policy, but could be consistent with renewably-friendly policies already in place or contemplated. For example, if the U. S. were to agree to a Kyoto-style requirement to reduce emissions, a transition to renewables along with other fossil-fuel saving measures, would be the order of the day. Many, if not most, observers of the Kyoto-process would agree that a protocol will come. It is only a matter of time, and most certainly within our 30 year timeframe.

- **Overall Conclusions:** the study results show that there is a ladder of realistic projects and commercial activities, and a phasing strategy for implementing them, such that Hawaii could double its renewable use in the near-term (2003 to 2008) and double it again in the mid-term (2008 to 2033). The key implementation issues have been identified and considered in developing the phasing strategy. The phasing strategy, however, does assume that there is a proactive, constructive implementation under our state PURPA law. Public policy options are needed to support the process, and accelerate the process if desired.

Recommendations

A ladder of realistic projects and commercial activities has been identified that can move us down the implementation path towards achieving our state goal to reduce our dependence on imported fossil energy. The time has come to focus on an implementation plan. The following are recommendations in support of that objective:

- An implementation plan needs a specific goal or a set of goals that quantify Hawaii's Energy Transition to preferred, sustainable energy future, such as the Governor's Goal of 20% of our electricity from renewables by 2020;
- The plan should also look beyond a specific period by establishing a planning goal to continue to update the goals and the plan, e.g., every three to five years;
- The structure of the utility system is important. The results of this study suggest that a transition towards distributed generation, which is a paradigm shift, is needed. This transition should be considered as another key goal or result of the plan;
- In addition to distributed generation, which includes renewables, the plan should also look at how we promote and use other distributed energy resources, such as energy efficiency (including efficient lighting, appliances and load management), energy conservation (including solar hot water and air conditioning systems), and storage;
- The detailed approach to how the transition will be implemented is perhaps the most important aspect of the plan. The approach will benefit from innovation (to overcome technical and administrative challenges) and competition (to achieve the plan's goals in the most efficient and cost-effective manner). With our current monopoly structure, the results of this study indicate that we need a proactive, constructive implementation of PURPA, and we need to establish and maintain vibrant competition for energy services. Thus, the approach should include the market reform and incentive measures that would best support the plan's goals and approach; and
- Finally, the plan is only a plan until it gains stakeholder and public support and recommended public policy measures are implemented. More importantly, and it has already been said: "We need sustainable policy for sustainable energy."