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Stakeholder-based Scenarios for Hawaii's Electric Energy System

Overcoming structural barriers and lock-ins for Big Island's sustainable future

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Yes, there are many special people that made this studying experience unforgettable and my days lucky. But either it feels like the wrong place to mention them or I am too lazy to do it.

Abstract

Reliance on fossil fuels, in many parts of the world, represents a burden not only for economic reasons but also in terms of import dependency. The situation is particularly severe in islands that do not feature interconnected grids and use oil derivatives for electricity generation. The consequent high prices for electricity, though, translate into an increased economic viability for renewable energy and energy efficiency investments. In this context the economic appeal of clean energy solutions simplifies the costs-benefits discussion, allowing to better isolate the variables that deal with the interaction between stakeholders, their individual interests and strategies, and the rule-setting position of authorities. For this study a framework was developed to build an analysis on the inputs and drivers of stakeholders; the framework combines stakeholder analysis, SWOT analysis, scenario forecasting, scenario planning and multicriteria evaluation. The purpose is to address structural and system-level challenges for the achievement of sustainable configurations: their overcoming has the priority on narrower concerns, such as technology-specific ones. In the context of Hawaii Island, two scenarios have been sketched and evaluated qualitatively, to explore possible strategic choices and develop observations and recommendations. Findings indicate that priority should be given to comprehensive energy planning (nudged by public agencies), to investments in transmission infrastructures and, possibly, to the dismantling of the existing vertically integrated monopoly.

Executive Summary

Hawaii Island is striving to free itself from the burden of oil dependency, a very sensitive challenge for many islands around the world. At a State level, a partnership between the Department of Business, Economic Development and Tourism (DBEDT) and the US Department of Energy launched, in 2008, the Hawaii Clean Energy Initiative (HCEI), a programme meant to draw a pathway towards Hawaii's energy independency and sustainability. The HCEI acted as a catalyser to engage the legislator in the formulation of regulatory measures meant to foster the clean development of the State's energy system. Among these, a renewable portfolio standard of 40% and an energy efficiency standard of 30% were fixed for 2030's electricity sales (HELCO, 2010b).

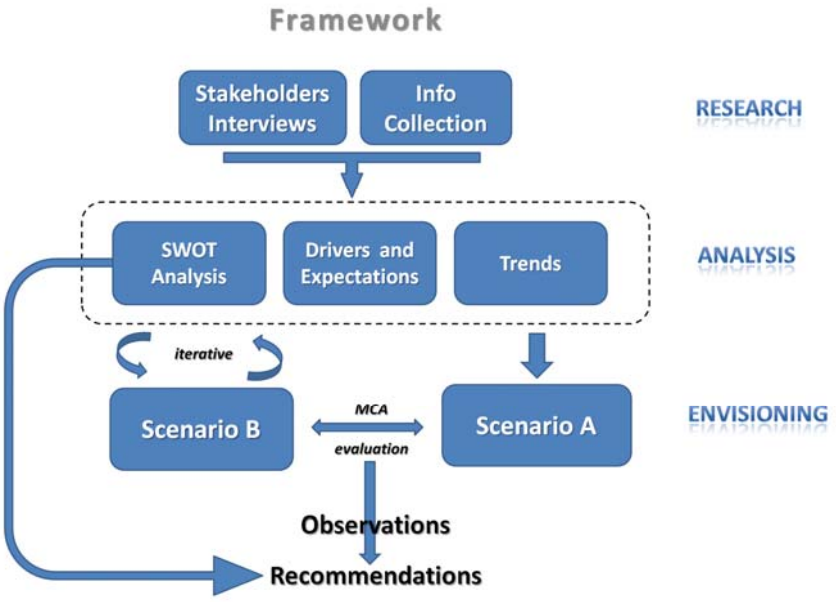
This study tries to offer a contribution for this course of action, differentiating itself from the many reports and publications already available in literature about the Hawaiian case. Concentrating on the perspectives and drivers of the different stakeholders, the study focuses on how the system can facilitate its evolution by overcoming the challenges that it's facing at a strategic and structural level. A framework has been developed to tackle the following research questions:

RQ 1 - What are the most challenging aspects that Hawaii is facing, and is likely to face in the near future, in concern with the development of a clean electric energy scenario?

RQ 2 - How could these challenges be adressed favouring the development of potentially more sustainable electric energy scenarios?

The framework, combining different research tools (stakeholder analysis, SWOT analysis, scenario casting and multicriteria evaluation) is schematized in the next figure.

Figure I – Scheme of the framework developed for this study



Interviews with stakeholders have been the building block of the study, and had three main purposes. The first purpose was to report the standpoint of the actors in *the energy system,* in concern with some strategic issues that are being faced in Hawaii. The second purpose was to gather the perceived strengths, weaknesses, opportunities and threats (SWOT) of the ongoing process meant to lead to the achievement of a clean energy scenario. Finally, I wanted to perform an analysis of the different actors' drivers to have a tool to test their satisfaction of possible future scenarios.

The findings from the SWOT analysis lead to the formulation of three approaches that can improve the capacity of *the energy system* to transform itself: information sharing, planning capacity and capital availability should be strengthened and prioritized, in order to enable Hawaii to dynamically approach the changes it is going to embrace. Independently from the direction it will decide to move towards.

Two scenarios have been then envisioned. *Scenario A* is a forecast of Hawaii's energy system near future, based on current trends, interviewees inputs and interests alignment. The findings suggest that Hawaii is going to rely significantly on bioenergy, starting from the very next years. This option is pushed by the utility, which can maintain control on generation at a low cost, achieving rapidly the renewable portfolio requirements, and is shared by the DBEDT, that expressed concerns about the current under-exploitation of ag-land. Under this option the study argues that grid strengthening, distributed generation and geothermal expansion would be sacrificed. *Scenario B,* is presented as an alternative option. It involves a restructuring of the market, more distributed generation and energy efficiency achievements thanks to grid strengthening prioritization and direct incentives for the transmission provider. A possibly slower expansion of the renewable portfolio in the short term can be expected in this scenario. In time geothermal expansion could take place, as well as a cautious introduction of biofuels in the system.

The qualitative comparison of the scenarios, under 15 sustainability criteria taken from literature, showed that *Scenario B* could bring along important benefits for Hawaii. In particular, beyond reduced environmental impacts, this scenario would allow the creation of revenue streams at a community level, reducing the needs to buy energy from foreign investors. *Scenario B* involves higher initial investments and the challenge of restructuring the market without compromising the system's reliability. An independent task force would need to address the feasibility of the option.

The scenarios have also been compared with the expected drivers of the actors (which had been deduced from interviews), and *Scenario B* proved to have the potential to meet a wider spectrum of stakeholders' expectations.

Overall, scenarios and scenario evaluation have been used to explore some possible strategic choices and develop observations and recommendations, rather than to compare defined (take or leave) alternatives.

The main observations can be interpreted as a response to the first research question. They report the excessive influence of the utility company in the field of energy planning (which has probably been strengthened by the HCEI), the lack of involvement of communities in the decision making processes, and a disproportion between the actual implementation of a bioenergy strategy and the level of preparedness to handle it. Information flows are also inadequate in the system.

The developed recommendations address the second research question and are almost consequential to the observations. Market restructuring (also in consideration of the utility's business strategy) seems the most comprehensive option to address the challenges. Recommendations (including the ones derived from the SWOT analysis) are summarized in the following table.

Table I – Final recommendations addressing some structural challenges of Hawaii's electric energy system

	Recommendations
1.	Strengthen the State and County energy offices and engage the public in the strategic planning process
2.	Improve the quality of information flows between the actors and to the public
3.	Increase Hawaii's appeal for federal and foreign investments
4.	Prioritize investments in transmission infrastructure upgrading
5.	Under a decoupling mechanism and in presence of energy efficiency aggressive programs, assist low-income segments of the population
6.	Slow down bioenergy implementation until a comprehensive plan is ready
7.	Restructure the electricity market by splitting the utility in a transmission-provider affiliate and a power-producer one, creating a dynamic and competitive arena
8.	Put in place real incentives for the transmission provider to increase energy efficiency savings (in first place) and renewable penetration (in second place)

Hawaii County is facing some strategic choices that could shape the future of its energy system. In the electricity sector, the local utility (HELCO), has achieved remarkable results, already counting the integration of 30% renewable energy in 2009. Nevertheless greater achievements are expected, in order to reach and exceed the 2030 70% clean energy goal (and to reduce the island's dependency on oil imports). The existing conditions allow Hawaii to take thought through decisions, without being tempted by shortcuts that might click the renewable counter, but do not represent an investment in a truly sustainable and independent future.

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Abbreviations

AFS: Alternative Fuel Standard

CESP: Clean Energy Scenario Planning

DBEDT: Department of Business, Economic Development, and Tourism (State of Hawaii)

DG: distributed generation

DoD: Department of Defence (US Federal)

DoE: Department of Energy (US Federal)

DWS: Department of Water Supply

EAC: Energy Advisory Commission

EE: energy efficiency

HECO: Hawaiian Electric Company (based on Oahu)

HEI: Hawaiian Electric Industries (parent company of HECO)

HELCO: Hawaii Electric Light Company (subsidiary of HECO on Hawaii island)

IRP: Integrated Resource Planning

MCA: multicriteria analysis

MECO: Maui Electric Company (subsidiary of HECO on Maui island)

PUC: Public Utilities Commission (State of Hawaii)

PGV: Puna Geothermal Venture

RPS: Renewable Portfolio Standard

SWOT: Strength, Weaknesses, Opportunities and Threats

UNECE: United Nations Economic Commission for Europe

Conventions adopted for brevity

the energy system: when in italics stands for "the electric-power energy system of Hawaii island"

the process: when in italics stands for "the ensemble of initiatives, events and activities in which Hawaii's actors are engaged and that are oriented at the achievement of a cleaner energy system"

1 Introduction

Energy systems are a building block of our society. Not only they are intertwined with the economic development of our countries, they also influence our living standards and habits. Furthermore, the exponential growth of mankind's energy demand increased the pressure on the planet's environment. In the last decades the scientific community has drawn attention towards the unsustainability[1] of current dominant practices, characterised by overexploitation of natural resources and critical levels of pollutants emissions, including greenhouse gasses. The finger is often pointed against fossil fuels dependency and consequently on countries, regions and companies that rely on them not only for transportation but also for supplying heat and electricity.

Oil dependency, in particular, does not only have environmental implications, but is also a political and economic issue. On a global level a great share of the oil reserves are located in a handful of countries (Energy Information Administration, 2009). Dr Fatih Birol, chief economist at the International Energy Agency (IEA) stated that the "Agency believes peak oil will come perhaps by 2020" and that "the world would have to find the equivalent of four Saudi Arabias to maintain production, and six Saudi Arabias if it is to keep up with the expected increase in demand between now and 2030" (Connor, 2009). One of the first implications is that as the available oil becomes scarcer it also becomes increasingly expensive to extract. Furthermore, the demand for oil derivates is rapidly expanding along with the upraise of developing countries. The combination of resource scarcity, the presence of few suppliers, the increasing demand and production costs, plus the tensions in the international political arena, result into market volatility and "expectations of high price levels in the future" (IEA, 2009).

In the State of Hawaii a combination of geological factors and political decisions determined the development of the islands' energy systems to depend on foreign oil. Currently the State relies on imported petroleum for about 90% of its primary energy (State of Hawaii, 2010). Under such premises the shift towards energy systems based on renewable and local energy sources becomes not only appealing but urgent as well.

The State of Hawaii has set the ambitious target of reducing its reliance on fossil fuels, for electric generation, and aims at meeting 70% of 2030 energy needs with clean energy (in particular with a combination of 30% energy efficiency savings and 40% renewable generation). Hawaii County (corresponding to Hawaii Island, which gives the name to the whole archipelago) has the same overall target but an extremely different scenario, with 30.4% of 2009 distributed electricity coming from renewable sources (HELCO, 2010a).

[1] "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations General Assembly, 1987)

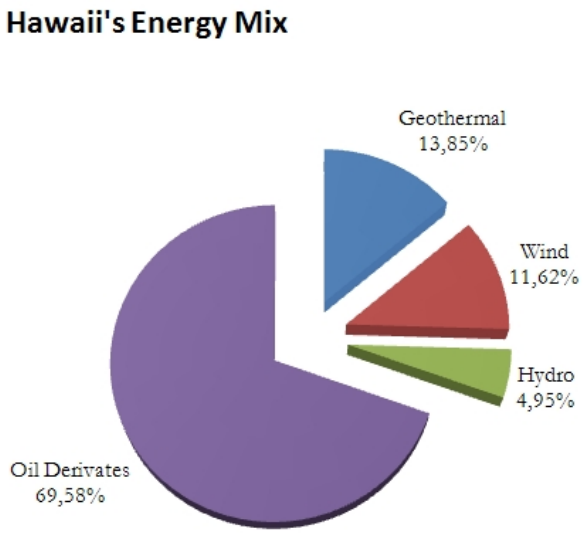

Figure 1-1 Hawaii County's electric energy mix, not accounting solar PV distributed generation[2]. Elaborated on 2009 official data (HELCO, 2010a)

In Hawaii county (Hawaii from now on, as opposed to Hawaii State) electricity prices are about 28.2 USD cents per kWh versus a US average of 11.9 USD cents per kWh (Department of Energy, 2010). This strong economic driver, though, is not sufficient to incentivize all actors of the energy system to jointly promote a further shift towards renewable energy sources, as interests can be split and contrasting.

In the international scene energy systems have been undergoing two relevant changes during the last years. On one hand the incorporation of the concept of sustainability in political agendas somehow redefines the purpose of energy systems, which could be now formulated as "supplying & using energy services *as sustainably as possible*". The discussion is more about what is "possible" and compatible with other interests (e.g. economic) and requirements (e.g. security of supply and service reliability), but decision makers are nowadays expected to address the sustainability issue (at least in public displays). On the other hand a major market restructuring has been taking place, approximately since the 1990s. I am talking about the liberalization of energy markets, which with sensible differences in the international arena, is heavily affecting the dynamics and functioning of energy systems. Although it could be argued that this ongoing restructuring process is a complication for the achievement of sustainable scenarios, it could also represent an opportunity. An opportunity to align the interests of actors and redesign energy systems, compatibly with the existing environmental expectations.

In this study I will analyze the current picture of the Hawaiian electric system, its stakeholders and their expectations, in order to formulate observations and recommendations, with the wish to contribute to the development of sustainable energy solutions for this enchanted island.

[2] The existing DG configuration is based on net metering agreements. The utility does not have the possibility to measure the actual energy supply of PV solar panels but just registers a non measurable load reduction on the grid. This explains why PV DG is not reported in these statistics.

1.1 Preliminary considerations

We can refer to a system when we encounter a set of interconnected elements brought together by a common function or purpose (Meadows, 2008). It is not hard to recognize these characteristics in an energy system. Energy sources, power plants, companies of suppliers and distributors, governmental bodies, users, appliances, grids and networks, contracts, requirements… all elements and interconnections serving the purpose of supplying energy and services to users. Of course different nested subsystems can be identified and studied or it is possible to focus on just some elements, while keeping in mind the whole picture. Complexity is a major challenge in studying systems. Energy systems can be extensive, involve many actors and processes and be characterized by delays in response (time lag between a variation in inputs or conditions and variations in outputs or behaviours).

For my research I desired to deal with a simplified system of reduced dimensions, which I could grasp as a whole and have direct contact with. Furthermore my specific interest is in understanding how, in a time in which energy systems are undergoing important changes, the different stakeholders can restructure their strategies and approaches. "Once we see the relationship between structure and behaviour, we can begin to understand how systems work […] and how to shift them into better behaviour patterns" (Meadows, 2008).

Hawaii represented an excellent candidate location for my approach, for several reasons. First of all it is served by an isolated grid and this means that it can not rely on stabilization and load-accomodating inflows from interconnected grids (nor it can export power to neighbouring areas). This makes it a simpler case to study, even if a more challenging system to manage. Secondly, the high penetration of renewables has reached challenging levels (as it will be explained in the next chapters) but there are still ambitious goals to achieve in the upcoming years. Finally, the context is characterized by extremely high electricity prices (approximately three times higher than US mainland prices), in which generation costs are actually lower for several renewable sources than for the existing utility's baseload. This peculiarity makes the Hawaiian case even more appealing to my interests. The economic viability of renewable energy suspends the typical cost-benefit barriers, allowing me to better isolate the variables that deal with the interaction between stakeholders, their individual interests and strategies, and the rule setting position of authorities.

In particular Meadows identifies a possible way out of "policy resistance traps" which are characterized by "various actors [who] try to pull a system stock towards various goals" (Meadows, 2008). Solutions can be found by bringing all the actors together and "use the energy formerly expended on resistance to seek out mutually satisfactory ways for all goals to be realized – or redefinitions of larger and more important goals that everyone can pull toward together" (Meadows, 2008).

But who shall facilitate this process? The delicate role of public bodies I believe to be crucial. On one hand they are in charge of resources planning and at the same time they create and regulate the playing field for the involved actors. The liberalization of energy markets does not make them unregulated arenas. Although an increasing number of players are accessing these markets, the distribution (and grid management) is an often regulated monopoly. This also means that power producers can only have one buyer.

In absence of a well functioning market the government's role becomes central, as through regulation (and incentives) it can steer the energy systems towards optimal solutions. And while the understanding of what is optimal is controversial, the importance of rule setting is arguable to a lesser extent. Monopolies in classic economic theories are identified as the

extreme market failures, where there is no dynamic interaction between demand and supply as the price is fixed by the one and only supplier. The case for electricity becomes even more critical in consideration of the ubiquitous reporting of the inelasticity of demand in such markets. Finally, only in a few countries users can actually choose their electricity supplier or the generating source of their supply, meaning that their preference can not be expressed in the market (the only available alternative is going off-grid). Nevertheless, up to now the technological environment did make electricity distribution systems natural monopolies and this can not be blamed on utilities. Furthermore the privatization of utilities in Western countries belongs to recent history. But as utilities become privately owned companies that have to respond to boards and shareholders, it is the governments' task to create the conditions that allow them to run their business in directions that are compatible with the collective interest.

At the same time governments can encourage behavioural improvements on the users' side. My position in this concern is very close to what Thaler and Sunstein call *libertarian paternalism*: "[…] we argue for self-conscious efforts, by institutions in the private sector and also by government, to steer people's choices in directions that will improve their lives […] *as judged by themselves*" (Thaler & Sunstein, 2008). The governments, directly or through the support of third party activities, are in the position to help individuals in making better informed choices and make them pay full attention to them.

Information flows are also analyzed in this paper as a key element of the system. This idea can still be framed in a system thinking logic. "Missing information flows is one of the most common causes of system malfunction […] it's an example of a high leverage point in the system. It's not a parameter adjustment […] it's a new loop, delivering feedback to a place where it wasn't going before" (Meadows, 2008).

Having defined some building blocks of the study I can proceed with the explanation of the methodology I used to perform it.

1.2 How was this case study performed?

The first research phase of this project was dedicated to the individuation of a specific focus area for the study. My goal was to perform a case study that could combine my desire to build up a better understanding of structural challenges, in a developed country's isolated energy grid (as a simplified learning field), and my wish to develop findings that could be useful for the local context. When representatives of Hawaii County opened up the doors to my project, allowing me to participate in working groups and facilitating meetings with strategic decision makers, I embraced the Hawaiian case. I started from an extensive review of reports and documents about Hawaii's energy system. In the last five years many studies have been performed in Hawaii. They include resource flows, recommendations for development, technological options, energy mixes... But as my insight increased I noticed the lack of a macro-analysis of the institutional and strategic aspects, in concern with the development of a cleaner electric energy scenario. Likewise, and surprisingly, only a small fraction of available publications seems to concentrate on stakeholders and their drivers as a focal element for strategic clean energy development. Given these challenges, I defined my thesis' purpose and scope, which is illustrated in paragraph 1.3.

The literature review narrowed its focus and so did the on-site information gathering process. Before I proceeded to the interviews with the main players identified in the electric energy

system, I tested and developed my understanding of the local context with some preliminary meetings with experts and researchers.

I decided to perform semi-structured interviews in order to be able to gather information that could be reorganized under my framework, but at the same time I did not want to rigidly limit the participants' contributions[3]. Also, as some topics are at the centre of public debate and several interviewees are in prominent positions, I tried to facilitate conversation and openness avoiding too direct questions and favoured a gradual flow of information and impressions.

In the days preceding the interviews I supplied information about my research project and my areas of interest in order to have a head start for the sessions. Most interviews have been recorded[4], under previous consent, to minimize the risks of misunderstandings and facilitate the conversations. The information and quotes that I extracted from the interviews have been reorganized and send back to the interviewees for approval.

The last phase of my study was dedicated to analysis, casting and evaluation of scenarios, and finalized with the formulation of observations and recommendations.

1.3 Purpose and Scope

The purpose of my thesis project is to supply Hawaii's decision makers (both in the public and private sector) with observations and recommendations for future strategies oriented at the achievement of a sustainable electric power energy system in Hawaii. In particular I focused this paper on structural constraints and opportunities and on how they can be overcome or grasped to enable the achievement of sustainable scenarios.

Let me now articulate this proposition. What I mean with electric energy system has been cleared in paragraph 1.1, and the adopted definition of sustainability can be found at page 1. It is yet to be defined what I refer to when I talk about "structural constraints and opportunities". Considering the different elements of the system, according to the Oxford Dictionary of English structure is "the arrangement of and relations between the parts or elements of something complex" (Soanes & Stevenson, 2005). In the energy systems case an arrangement that is also animated by the functions and drivers of the different elements (i.e. actors). To me, this configuration of functions, hirearchy (arrangement), relations and drivers is what determine the system's behavior, in relation to the surrounding context. This is why I believe that an ideal regulatory framework should put the actors of a market in the conditions to spontaneously cooperate (vertically) or compete (horizontally) in the pursue of a sustainable future, being backed up by the nudges of an active government.

Before I can formulate my research questions I will state what this study does not address. It is beyond my scope to explain *why* it is desirable to have an energy system with a higher penetration of renewables and greater savings from energy efficiency. The commitment of Hawaii is given and framed within the HCEI. Another issue I will not discuss is the appropriateness of the HCEI goals, in particular from a quantitative point of view.

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[3] This choice was greatly rewarded by the amount of knowledge sharing that took place during the sessions. In some cases I ran into aspect or issues I had not identified yet and had the chance to get back to previous interviewees for some additional inputs

[4] The recordings have been authorized for personal research use and are not to be considered publicly available media

The *what* question (i.e. what technologies and instruments are the best available solutions for Hawaii's goals?) is adressed only in part. I will face technology choice issues only in concern with renewable solutions that appear to be the strongest candidates for major roles in Hawaii's near future. In particular I will do a qualitative evaluation of possible scenarios that could unfold from the current context. Such section of the study shall be just considered an input for discussion, a suggestion of a possible approach to evaluate scenarios. I do believe that new technological solutions will play a major role, but I do not have the possibility to foresee their precise impact and this is why I am not including speculations on uprising technologies or optimal energy mixes for 2030. Just as I do not think that an energy mix formulated in 1990 could possibly be the optimal solution for our current (2010) situation.

This digression introduces the tempral scope of my work. The observations and recommendations have been developed on the basis of a "snapshot" taken in July 2010. In a couple months the scenario might have already significantly changed (also in consideration of upcoming elections for Governor). I do hope, though, that the approach and rationale behind this work can have a longer validity as a decision making approach. The geographical scope is clearly defined by the County of Hawaii, i.e. Hawaii Big Island. The study is in many ways intertwined with the whole State's case, but it is focused on the specific County. The overall scope is narrowed to the electirc power energy system of Hawaii County (for brevity *the energy system* from now on), meaning that issues related to transportation (for example) are not adressed in this thesis. I am not saying they are a separate matter, they are not, but I did not have the possibility to cover this area in my time frame (see paragraph 1.5).

Under such premises, these are my research questions:

RQ 1 - What are the most challenging aspects that Hawaii is facing, and is likely to face in the near future, in concern with the development of a clean electric energy scenario?

RQ 2 - How could these challenges be adressed favouring the development of potentially more sustainable electric energy scenarios?

The study thus focuses on *how* the system can facilitate its evolution and what are the challenges that it is facing, not at an issue specific level, but rather at a strategic and structural one. Concentrating on the perspectives and drivers of the different actors, the recommendations are meant to enable the creation of a system that will spontaneously strive for clean energy achievements under the oversight of a vigilant government.

1.4 Framework

In this paragraph I will summarize how the information, which was collected through a literature review and numerous interviews, has been processed to build up observations, recommendations and answer the research questions.

The selection criterion for the content of interviews (and for interviewees) is based on the intention to perform a stakeholder analysis. Stakeholders meaning the "individuals and organisations that are actively involved in the project or whose interests may be affected as the result of project execution or project completion" (Project Management Institute, 2004). Stakeholder analysis can be used for different purposes, most typically to structure a comprehensive level of participation in decision making processes. Ward & Chapman (2008) present an articulated review of approaches to identify and involve stakeholders in a project,

under the premise that "stakeholders are a major source of uncertainty in projects" and as such they must be carefully accounted in the management process.

In this case I adopted stakeholder analysis for three purposes, under a common approach. The bottom line of this approach is that, since information coming from a single source (in a complex network) can be affected by bias, collecting information from many different perspectives allows drawing more realistic pictures of an environment. Realistic not in the connotation of objective, but rather as comprehensive and articulated. The first purpose of my stakeholder analysis is to report the standpoint of the actors in *the energy system*, in concern with some strategic issues that are being faced in Hawaii, and meter their level of satisfaction about information flows. The second purpose is to gather the perceived strengths, weaknesses, opportunities and threats (SWOT) of the ongoing process meant to lead to the achievement of a clean energy scenario. Finally, I wanted to perform an analysis of the different actors' drivers to have a tool to test their satisfaction of possible future scenarios.

I first performed a SWOT analysis of the whole *process*[5], on the basis of interview findings. SWOT analysis in literature is defined as "a strategic management tool that helps to identify internal strengths and weaknesses and external opportunities and threats for any organization, project, or individual" (Dwivedi & Alavalapati, 2009). In this study the opportunities and threats are identified by a temporal dimension (i.e. upcoming issues), rather than by an external (vs. internal) connotation. This is also due to the fact that I am analyzing a whole *process* that involves many different actors, thus matters that are internal for one subject are external for the others. The observations from the SWOT analysis are used to formulate strategic approaches to improve the dynamic capacity of *the energy system* to transform itself.

I then used the information collected to cast the outline of a scenario (*Scenario A*) that appears to be likely for Hawaii's near future. I believe the expected scenario is consequential to the findings and does not involve a major use of creativity; it is almost the result of a trend analysis. Basically I suppose that if a critical level of actors is aligned behind some strategy, and these actors are powerful enough, this strategy is likely to be adopted. If a trend analysis typically involves the collection of a series of data and information, in order to identify a pattern or direction, in this case I also base myself on drivers and interests including some elements of scenario forecasting. A first set of observations is presented in concern with this expected scenario.

The final section of the study combines scenario planning, scenario evaluation through a Multi-Criteria Analysis (MCA) framework and scenario back casting. I am distinguishing scenario planning and back casting to emphasize that the scenario (*Scenario B*) that is presented in section 5.6 has been outlined in the following way:

- Step 1: given existing conditions and drivers an appealing future configuration was sketched
- Step 2: this configuration was compared to Scenario A through a qualitative MCA
- Step 3: the existing constraints that could prevent this scenario from coming true are

[5] From now on *process* (in italics) will stand for "the ensemble of initiatives, events and activities in which actors are engaged and that are oriented at the achievement of a cleaner *energy system"*

addressed. Recommendations for overcoming barriers are formulated and the scenario is revised if barriers appear insurmountable

This process therefore has an iterative nature, but in this study only the final *Scenario B* choice is presented, for brevity and clarity. The MCA evaluation of Step 2 is based on parameters taken from literature (Kowalski, Stagl, & Madlener, 2009) and will be more extensively illustrated in Chapter 5.

The framework used for this study has not been taken from literature but the different elements that compose it (stakeholder analysis, SWOT analysis, trend analysis, scenario forecasting, scenario planning and scenario back casting) have all experienced widespread application. The combination of different tools, including some of the mentioned, has also been proposed in literature, in particular a similar rationale is at the basis of Kowalski, Stagl, & Madlener (2009), Oliver & Donnelly (2007) and Terrados, Almonacid, & Perez-Higueras (2009). This last publication proposes, for a regional scale, a very similar methodology but does not include an assessment of stakeholders' drivers, even if it includes the inputs of actors in the planning phase. It is also more concentrated on strategies rather than scenarios. Even if the framework I developed has not been previously tested, I am more concerned that eventual shortcomings of this study will be linked to the information gathering, interpretation and analysis steps rather than to procedural handicaps.

The following image summarizes the developed framework.

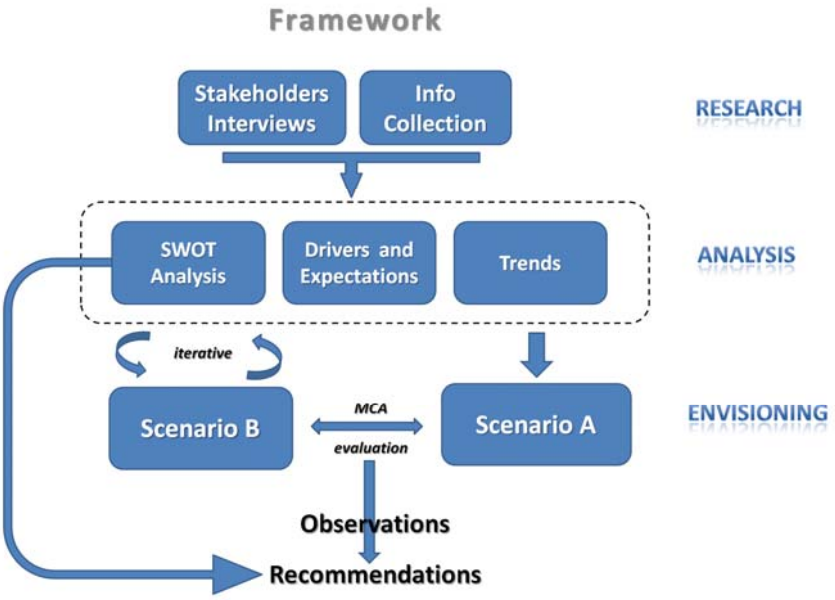


Figure 1-2 Schematic representation of the framework developed for this study.

1.5 Limitations

Time was the main constraint for this study. An extension of my 30 days stay on the island would have allowed more interviews and on-field information gathering. A full second round of interviews would have been beneficial too, especially to include a participatory evaluation of the outlined scenarios. A survey involving energy users would have given an informative

picture about the common perception of challenges in *the energy system,* but I lacked both of time and resources. Financial constraints also kept me from travelling to neighbour islands and from performing a more comprehensive State-wide study.

I am implicitly making the assumption that the selected interviewees can significantly represent the mainstream thinking of their agency or category, which might not always be the case. Internal divergences in companies or departments can not be excluded, but I did talk to professionals occupying the highest levels in their agencies. This should have reasonably reduced the risks of internal communication distortions. Still, given more time and resources I would have expanded the number of interviewees per office.

A generous scholarship from Lion's Club International covered my air-travel costs, while the rest of the expenses I covered with my own funds. I am stating this to underline that I faced no kind of pressure from interest groups and/or donors. I attempted to minimize the risks of influencing the findings with bias by separating in the text the paragraphs that include factual information from the ones that involve some subjective analysis.

The fact that the adopted framework has no precedent application does represent a risk, which I mentioned in paragraph 1.4. I want to stress, again, that chapter 5 must be regarded as an input for discussion, and does not claim to offer a comprehensive evaluation of scenarios. Nevertheless I do include the rationale of the qualitative assessments, in order to allow a higher transparency of results. Also, the *Scenario B* that is developed within the chapter is more a sketch of a possible alternative configuration of the system (given current technology) than a complete and thoroughly designed option. Any future reference to the content of Chapter 5, thus, must include these premises.

1.6 Outline

The purpose of this introductory chapter is to provide the preliminary information on how the study has been developed and what rationale it follows. Chapter 2 summarizes the findings from the international literature review, information that I believe to be useful for the analysis and understanding of Hawaiian local issues, but also valuable to identify some solutions that have been adopted elsewhere. Chapter 3 supplies background information on the Hawaiian context, including a summary of the legislative framework (concerning clean energy) and an introduction to the different players in the arena. Chapter 4 reports the findings of interviews, grouping them topically, and wraps up the strategic issues in a SWOT analysis. Chapter 5 contains most of the analysis (through scenario sketching and evaluation) and is concluded by a set of recommendations for the Hawaiian energy system. Chapter 6 summarizes the findings by answering to the research questions anticipated in Chapter 1.

2 Literature Review

The topics covered in this literature review have the purpose of supplying a background for the analysis performed in Chapter 5. The topics have been chosen with the logic of covering the essential elements of the electricity system: the supply side and its structure (electricity market), the interaction with users (energy efficiency and distributed generation) and the infrastructural interconnection (smart grid). The two last sections take a closer look at island cases and at the existing literature on Hawaii.

2.1 Liberalization of Electric Energy Markets

The evolution of electricity markets worldwide has been characterised by the presence of vertical monopolies, owned either by the state or by franchised and regulated companies (Joskow, 2008). In the last decades the sector has gone through a restructuring phase, in some cases started with a privatization process, which has been pushed to different levels across the world. The general purpose has been to "create new institutional arrangements for the electricity sector that provide long-term benefits to society and to ensure that an appropriate share of these benefits are conveyed to consumers through prices […] and service quality attributes" (Joskow, 2008).

Unbundling generation, distribution and retail has been the most common approach with the creation of Independent System Operators and, in presence of large interconnected girds, Reginal Transmission Organizations. New regulation did not require companies to divest from generation, but rather to run the two business (generation and distribution) separately to favour the creation of more open markets (Borenstein, Bunshell, & Wolak, 2002). Unbundling is in fact expected to address the inherent conflict of interests that is inevitable when utilities have to grant access to their network to new competitors entering the market. Retail competition so far did not meet the expectation it had created and there are few markets where it has been implemented succesfully (Defeuilley, 2008). Furthermore, research has pointed out that few customers actually exercise their right to change provider, when they are given the opportunity (Rowlands, Parker, & Scott, 2004).

Utilities did oppose resistance to these changes and the "transition to competitive wholesale and retail markets for electricity in the U.S. has been a difficult and contentious process" (Joskow, 2006). In the E.U. things have not been easier. The 2007 Sector Inquiry of the European Commission concluded that "most wholesale markets were national in scope, overly concentrated, and not transparent. In many cases, incumbents were able to use their vertical linkages to impede entry to the markets" (European Commission, 2007).

Resistance to change can be overcome only with decise intervention from the governments, according to some researchers. Sbertoli and Sigla (2006) highlight this concept. "One of the key issues to be reviewed is the relationship between the State as regulator and the companies and agencies in charge of actual services. Regulation is a 'natural' role of public authority […] acting at a distance (the magic) or 'acting without acting' (oriental philosophy) would represent the utopia […] it is only possible to act through 'intervention': the future of the model lies on the degree and success of such intervention".

In the U.S. a significant step was already taken in 1978, when the Public Utilities Regulatory Policies Act (PURPA) was approved. The PURPA, among other provisions, required utilities to buy power from independent power producers at avoided cost of generation rate.

Another milestone came in 1996 when Federal Energy Regulatory Commission pushed the liberalization process with Orders 888 and 889. Nevertheless "the U.S. has never enacted a mandatory comprehensive federal restructuring and competition law, leaving the most significant reform decisions to the states" (Joskow, 2008).

Joskow also outlines a set of key elements for the transition towards a well functioning liberalised energy market:

Table 2-1 Key elements of a liberalised energy market

Privatization to stimulate performance improvements
Vertical separation of potentially competitive segments (e.g. generation) from regulated segments (distribution, transmission, system operations) either structurally (through divestiture) or functionally (with internal 'Chinese' walls or 'ring fencing' separating affiliates within the same corporation)
Horizontal restructuring of the generation segment, to allow adequate number of competitors and mitigate market power
Horizontal integration of tranmission facilities and network operations, to preserve stability
Creation of voluntary public wholesale spot energy and operating reserve market agents to strengthen responsive demand and supply on the grid
Development of active demand-side institutions, so that these actions can be stimulated and integrated in the market
Implementation of rules and estabilishment of institutions capable of promoting efficient access to the transmission network (including efficient siting)
Where no retail competition is in place, the distributor shall still supply power purchased in competitive wholesale markets, or at least benchmarked with competitive markets
Independent regulatory agencies shall be created, disposing of good information about the cost, service quality and comparative performances. The expert staff of these agencies shall also be capable of monitoring the distributor's requirements to access the networks and the wholesale conditions and terms
Transition mechanisms shall also be implemented to pass to the new system

Source: Joskow, 2008

2.2 Energy Efficiency

There are several constraints that are reported in literature for the promotion of energy efficiency (EE). Beyond the several challenges on the user's side (upfront investment for efficient equipment, information and engagement…), the commitment of utilities plays an important role. Under typical revenue making mechanisms (i.e. energy sales) utilities are disincentived to promote energy efficiency as it translates in a reduction of sales. Researchers have been suggesting different strategies to tackle this problem.

A very comprehensive overview of early experiences is offered by a 1990 article by Schultz and Eto in *"Carrots and sticks: Shared-savings incentive programs for energy efficiency*". The authors summarize the available options to encourage a proactive attitude of utilities in concern with energy efficiency. Ranging from minimum performance standards to shared savings incentives, passing per cost recovery approaches, the article points out how a mix of approaches is always recommendable, in function of the specific contexts and implementation viability. In particular investments in EE with straightforward impacts (e.g. retrofits, energy efficient appliances…) are associated with shared savings incentives, while education and administration costs could be addressed with cost recovery and minimum performance requirements (for example number of audits…). An interesting argument is presented for the calculation of shares savings on the basis of total costs (utility and users) and not just on the utility's investments, as this approach can make customer engagement appealing for the utility. Overall the paper emphasizes how every aspect of energy efficiency programs should be addressed with incentives or requirements to push utilities towards the development of effective and comprehensive solutions (Schultz & Eto, 1990).

Decoupling a utility's revenues from its energy sales meets more consensus in available literature than a lost revenue approach (LRA). The main argument is that utilities should lose the overall incentive to sell more electricity, so that they can not be affected by behavior changes and new standards, which are complementary aspects of EE programs. Under a LRA utilities would only recover costs which can be reconducted directly to investments on EE, while under decoupling rates and adjustments are calculated to recover the running costs of the utility. The argument that utilities' risks are transferred to ratepayers is acknowledged, but this risk is considered symmetric and thus with potential beneficial effects (Moskovitz, Harrington, & Austin, 1992). Different decoupling schemes can also be designed, in function of the rate calculation mechanisms (Hirst, Blank, & Moskovitz, 1994).

The debate of course evolved under the restructuring of electricity markets, even if the core aspects have not been substantially affected. Nadely & Kusher (2000) emphasize the crucial role of Public Benefit Funds in this concern. One of the open questions concerns the management of the EE programs: who should be in charge? State agencies, non profit organizations, electricity suppliers or dedicated utilities? An overview presented by Blumstein, Goldman & Barbose (2005) presents no conclusive answer; the results are context specific. Five generic criteria are proposed to evaluate the choice: compatibility with public goals, effectiveness of the incentive structure, ability to realize economy of scale and scope, contribution to the development of energy efficiency infrastucture. The presence of active incentives for EE, as opposed to no-losses configurations, is still highlighted. Utilities, to meet clean energy standards, are likely to overinvest in renewable generation, and underinvest in energy efficiency, if no specifc incentives are offered (Cappers & Goldman, 2010). The discussion does not involve Demand Response programs, which are typically run with the direct interest of the utility to reduce peak loads and foster cooperation in load balancing.

2.3 Distributed Generation

As it is beyond the purpose of this study to address the benefits of specific technological solutions, I will just review in this section some of the reported benefits of distributed energy generation. I am talking about energy (and not just electricity) to include the water solar heating options, as they also impact electricity consumption.

Environmental benefits of DG are extensively reported, and some studies include the "conservation of resources for additional use" as a major environmental advantage in a time of ever-growing global consumption (Akorede, Hizam, & Pouresmaeil, 2010). Benefits of renewable DG are related to reduced GHG emissions and proximity between generation and consumption, but also to induced behavioral changes and attitude towards energy efficiency (Hondo & Baba, 2010). Social benefits, including communities strengthening and local development are commonly reported, especially in studies focusing on developing countries (Acker & Kammen, 1996; Jones & Thompson, 1996). Many of the reported benefits also apply to a context such as the Hawaiian one, in terms of empowerment and self determination. Social and environmental advantages of distributed generation can also be reconnected to the broader concept of distributed economies, and in particular in matter of value creation and regional development (Johansson, Kisch, & Mirata, 2005).

2.4 Smart Grids

"If Alexander Graham Bell was somehow transported to the 21st century, he would not begin to recognize the components of modern telephony – cell phones, texting, cell towers, PDAs, etc. – while Thomas Edison, one of the grid's key early architects, would be totally familiar with the grid" (Litos Strategic Communication, 2009)

Researchers report a disproportion between investments in generating facilities and investments in transmission capacity, with the latter being penalized (Hirst, 2004). If the upgrading of electricity grids has been linked for many years to the reduction of losses and outages, the recent developments in the area of renewable sources (with more challenging outputs) and user-interface technologies changed the scenario. Research on transmission infrastructure has received a great stimulus and the opportunities (also for investments) lead to the great momentum on smart grids. Smart grids' bottomline feature is that they are "automatically and multidirectionally controlled by interactive information technologies" (International Energy Agency, 2010). Smart grids promise to allow advancement of Demand Side Management and Demand Response programs, to accommodate the integration of more renewable energy (including intermittent sources) and to interact with new generations of vehicles, on top of increasing systems stability and reducing line losses (Chassin, 2010). Smart grids also behold the potential to allow real time bidding in deregulated electricity markets (Wang, Kennedy, & Kirtley, 2010).

2.5 Island cases

Islands have strong drivers for energy self sufficiency, as import dependency is not only costly but is also an issue of security. Nevertheless managing small non interconnected grids poses some additional challenges. In particular the stability of grids is harder to maintain, especially if intermittent or non responsive sources are installed, and economies of scale are harder to exploit (Perez & Ramos Real, 2008). Experiences can be quite different across the world, but, excluding rare exceptions, most islands around the globe are relying on electric energy coming from fossil fuels consumption. The outstanding performance of Samsø

(Denmark), with 100% of its electricity demand being covered by wind farms, is made possible by the interconnection with the larger Jutland grid. Power goes to Jutland when the wind is blowing, while power is supplied from Jutland when the wind slows down (Danish Energy Agency, 2007).

In the Mediterranean area Malta and Cyprus are struggling with the implementation of renewable energy strategies to shift to from a 100% oil dependency (European Commission, 2010). Azores (Portugal), starting from a primary energy consumption almost entirely covered by oil derivates (87%), want to achieve a 40% level of primary energy coming renewables by 2018 (with a mix of resources quite similar to Hawaiian case) (Domingues, 2010). Taiwan is covering 88% of its electricity needs with nuclear and fossil thermal power plants, 10% with hydropower, and is concentrating on the integration of wind energy (Taipower Company, 2010). Virgin Islands (U.S.) in March 2010 signed a Memorandum of Understanding with the Department of Energy to reduce by 60% reliance on fossil fuels by 2030 (Global Energy Network Institute, 2010). Options to reduce oil dependency in fifteen Pacific Island Countries were explored through a cooperation of the United Nations Development Program (UNDP), the Global Environment Facility (GEF) and the Secretariat of the Pacific Regional Environment Programme (SPREP) (Akker, 2006). Canary Islands counted on 6% renewables integration in 2004 (Gobierno de Canarias, 2004).

There are of course many more examples that exemplify the struggle of islands to free their economies from the economic burden of energy dependency. Although a comprehensive review of island experiences could lead to interesting outcomes, it was not prioritized for the purpose of this study, in consideration of the many different features that characterise the different systems and that include local resources, proximity to exporters, market structure, economic availability... Precedence has been given to the context specific features of Hawaii island.

2.6 Previous Studies on Hawaii

As mentioned in Chapter 1, there have been several reports and publications addressing Hawaii's energy future. At a State level the Department of Business, Economic Development and Tourism (DBEDT) commissioned the Rocky Mountain Institute (RMI) and extensive energy report, which was published in March 2008 (Rocky Mountain Institute, 2008). The study, as far as it concerns the electricity sector the study reports 12 main recommendations:

Table 2-2 Policy Recommendations for Hawaii's Energy Future

	Recommendations for Electricity Sector
1.	Shift Away From Traditional Rate of Return Regulation (decoupling + incentives)
2.	Seek Ratemaking Design and Ratemaking Policies to Encourage Greater DG Adoption
3.	Conduct System Integration Studies for Intermittent Renewable Energy
4.	Modify Renewable Portfolio Standard to Apply Only to Renewable Energy
5.	Create an Energy-Efficiency Resource Standard

6.	Encourage Bioenergy Use for Electricity Generation
7.	Conduct Additional Studies on Status and Strategies for Maximizing Distributed Generation and Combined Heat and Power (CHP)
8.	Continue to Update Model Energy Code (MEC)
9.	Develop "Whole-system" Comprehensive or Packaged Energy Efficiency Programs
10.	Aggregate Green-power Purchasing for State Facilities
11.	Combine Resource Efficiency Programs (e.g., Combined Electricity, Gas, and Water Use Efficiency)
12.	Extend Solar Water Heating Financing Program to Include Solar Photovoltaic

Source: National Renewable Energy Laboratory, 2010

The study also dedicates attention to the bioenergy opportunities, presenting some preliminary calculations and observations. The use of biofuels is also intertwined with the transport sector; going through the report is possible to notice that, just to meet the State requirements for Alternate Fuels Standards in 2015, between 27 000 and 42 200 acres out of the 45 200 acres available in Hawaii island will be needed (excluding land already used for food production). Interestingly this result is not pointed out clearly. Overall the RMI's researchers call for a comprehensive plan that shall include long term incentives, water scarcity management, but also coordination of cultivation, conversion, distribution and use (Rocky Mountain Institute, 2008).

At a County level, in 2007, another team from RMI presented the *Island of Hawaii Whole System Project. I*n this study bioenergy is mentioned as an opportunity to fill the gap left from the collapse of sugarcane cultivation, but at the same time the importance of agricultural diversification is stressed along with the benefits of local food production (Page, Bony, & Schewel, 2007). Researchers from Yale University presented their inputs for the Hawaii County Energy Sustainability Plan. The 65 presented recommendations cover the energy supply side (centralized, decentralized and fuel options) and the demand side (efficiency, codes and regulation, transports) and have a qualitative but issue-specific approach (Davies, Gagne, Hausfather, & Lippert, 2008).

A "sustainability task force" from the State of Hawaii, a mixed team of politicians and professionals including several State senators, presented *Hawai'i 2050 Sustainability Plan.* Defining itself as a "community-based planning effort" it summarizes principles and approaches towards a sustainable development of Hawaii, and advocates the creation of a State Sustainability Council. It does not address technical or quantitative issues, adopting a very holistic perspective backed by a bottom up approach that claims to have involved "thousands of residents through multiple rounds of community meetings on every island" (Sustainability Task Force - State of Hawaii, 2008).

A methodology to push the development of Hawaii's energy system is proposed by Johnsons & Chertow. After identifying 13 possible interventions for the energy system (ranging from energy efficiency programs to renewable energy integration) the researchers propose to proceed through the implementation of these thirteen stabilization wedges, with a

methodology inspired by Pacala and Socolow (Pacala & Socolow, 2004). The purpose is to facilitate the adoption of an effective action plan to achieve the clean energy goals (Johnsons & Chertow, 2009).

The study I am performing, as explained in the introduction chapter, tries to add a contribution in an area which I believe could be addressed further. I will in fact address the structural challenges that keep the energy system from achieving further accomplishments, in sustainability terms, basing myself on the stakeholders' perspectives and drivers .

3 Hawaii

In this chapter I will provide an introduction to Hawaii's electric power energy system. The main players in the arena will be briefly presented and an outline of the current energy context will be sketched, including most relevant legislation and regulation (in concern with the purpose of the study). Information for this section has been collected from direct sources (including interviews and meetings), when available.

3.1 A (very) short introduction to the Hawaiian context

Located in the central Pacific Ocean, Hawaii islands became a constituent State of U.S.A in 1959 after being annexed in 1898. The capital, Honolulu, situated on Oahu island, counts approximately 370 000 inhabitants, more than a fourth of the whole State and is also its main economic centre. Hawaii island (often referred to as Big Island) is the southeasternmost and biggest island of the archipelago, and constitutes a County (which is seated in Hilo) (Encyclopædia Britannica, 2010).

Hawaii island's GHG emission are mainly linked to the transportation sector (52% including road, air and maritime traffic) and to the electric sector (37%) (HECO, 2009). HELCO, the electric company serving the island, serves approximately 77 000 customers (HELCO, 2010b). In 2008 the island counted ca. 175 000 inhabitants and hosted more than 1 200 000 tourists. The population and the number of visitors, after experiencing a rapid growth at the beginning of the decade, have been fairly stable in the last 4 years (State of Hawaii, 2009).

3.2 The main actors in *the energy system*

3.2.1 Hawaii Electric Light Company (HELCO)

The Hawaii Electric Light Company (HELCO), serving the Big Island, is a subsidiary of Hawaiian Electric Company (HECO), which, in turn, is a subsidiary of Hawaiian Electric Industries (HEI). HECO, based in Honolulu, was founded in 1891 and incorporated HELCO (at the time called Hilo Electric) and Maui's utility, Maui Electric Company (now MECO) in 1970 (HECO, 2010a); it is now serving 95% of the State's population. The parent company (HEI), which is also controlling the American Savings Bank, is shareholder owned, with an operating income of $188 000 000 in 2009 (Hawaiian Electric Industries, 2010).

Table 3-1 HELCO's mission and vision reported from the company's website

Vision
We at Hawaii Electric Light Company will strive to become: · A customer-oriented and financially sound company providing reliable energy and related services · A team of people with a powerful commitment to respect our environment and improve the quality of life for everyone we serve · A model corporate citizen distinguished through hallmarks of integrity, superiority of service, and dedication to community, and · An employer of choice, recognized as a great place to work through our commitment to employees and quality of work life.

Mission
We are engaged in a competitive business in a changing world where energy is an essential but limited resource necessary to maintaining the quality of life we enjoy. Therefore, we are committed to: · Produce and deliver reliable sources of energy to our customers · Provide a range of energy products and services that meet our customers' needs and that are unmatched by any competitor, and · Achieve success through partnership, teamwork, continuous improvement, and innovation to help employees, stockholders, customers, and our communities grow and prosper.

Source: HELCO, 2010

Since 1963 the utility is given the franchise privilege (HECO, 2010a), meaning that the company has the monopoly of electricity distribution (across properties). HELCO also has the "obligation to serve", meaning that it is accountable for the reliability of supply (PUC, 2008). Such a responsibility, for example, authorizes the utility to refuse interconnection with installations that could compromise the grid's stability (the electric grid, by the way, is owned by the company).

HECO publishes its own sustainability reports since 2007, while annual reports can be retrieved for the parent company (HEI).

In 2009 HELCO generated 44% of the distributed electric power on the island, 95% of which came from oil derivates (HECO, 2010b).

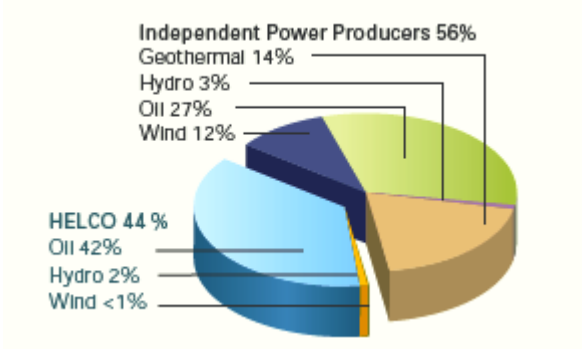


Figure 3-1 Hawaii's Energy Mix. Distinction between utility-owned plants, IPPs and internal renewable portfolio (HECO, 2010b)

3.2.2 The Independent Power Producers (IPPs)

56% of the island's electric energy mix is generated by Independent Power Producers who sell their energy to the utility through Purchase Power Agreements (PPAs) (HECO, 2010b).

Hamakua Energy Partners (HEP), with a 60 MW plant, accounted in 2009 for 27.2% of Hawaii's electricity generation. The power plant, located on the eastern side of the island, runs on naphtha fuel and cogenerates heat for an aquaculture facility. It was built in 1999 and accessed HELCO's grid in 2000. It was started as a partnership between two companies from Florida and North Carolina (PennWell, 2001).

The largest renewable supplier is Puna Geothermal Venture (PGV) who entered in the system back in 1993 and has a nominal generation of 30 MW which is now being increased

to 38 MW. Authorities have already accorded PGV permits to expand their facilities up to a total of 60 MW; nevertheless this expansion is not taking place since the market is saturated. It is owned by Ormat Technologies, a company based in Nevada whose 60% top holder is Ormat Industries Ltd (based in Yavne, Israel) (Puna Geothermal Venture, 2010; Ormat, 2010).

Wind farms cover 12% of Hawaii's energy mix. Out of the total 140 MWh wind net input, 111 MWh came from the 21 MW Pakini Nui Wind farm, located close to South Point (HELCO, 2010a). It is operated by Tawhiri Power LLC, a joint venture between the Apollo Energy Corporation and EFS-G LLC; its headquarters are in Foster City, California (Tawahiri Power LLC, 2010). The existing purchase power agreement was approved in 2005, after that the redevelopment project was completed (taking the place of ancient Kamoa Wind Farm, which had began operations in 1987) . The other main contributor (in terms of wind energy) is the farm indicated as Hawi Renewable Development, which gave a contribution of approximately 30MWh in 2009 (HELCO, 2010a). The plant is owned by enXco Inc., an affiliate of the EDF Group (84.5% shares in the hands of the French State) (AWEA, 2010; enXco, 2010; EDF Group, 2010).

Almost the totality of 2009 integrated hydropower (3% of the mix) came from the Wailuku River Hydroelectric Power Company (HELCO, 2010a); with an 11 MW of plate power it has been commercially active since 1993. The company is a subsidiary of Synergics Inc. (based in Maryland) (Barnes, 1993). Solar photovoltaic generation is not reported, as stated in chapter 1, because the current net metering agreements and the installed technology don't make it possible to calculate its contribution. From the utility's side the contribution of PV takes place, under current conditions, firstly as a reduction of demand, and secondly as a non measurable input on the grid. Estimates by the utility indicate that the PV generation is in the 5-6% range (Alm, 2010).

In the following map the location of the different power plants is indicated.

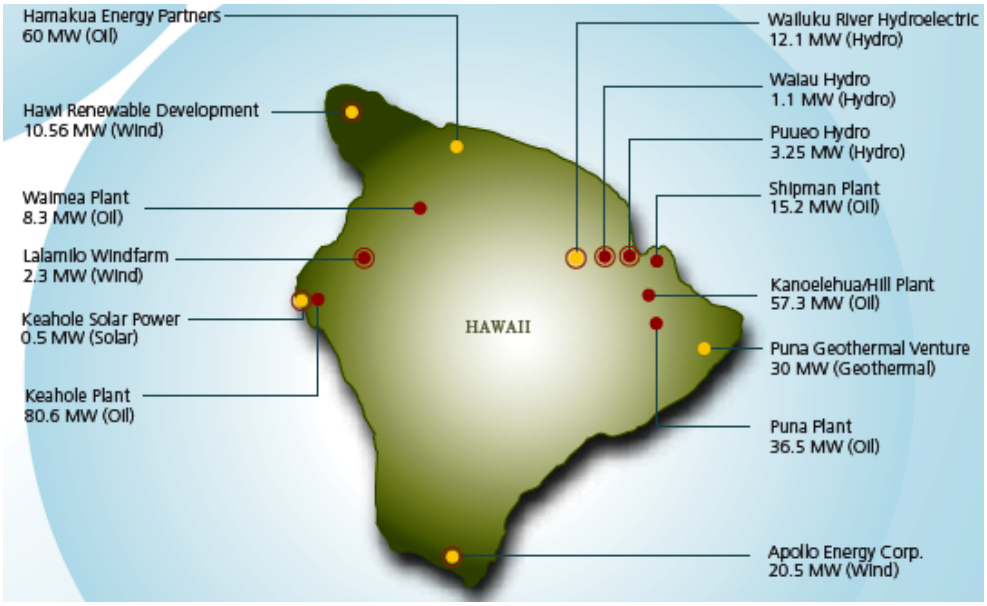


Figure 3-2 Hawaii's Electric Power generating facilities (HECO, 2010b)

3.2.3 The Public Utility Commission (PUC)

The Public Utilities Commission is a state agency that regulates and monitors "all franchised or certificated public service companies operating in the State" (State of Hawaii, 2010). Its activities include prescribing rates and authorizing acquisitions or infrastructural investments by utilities (State of Hawaii, 2010).

Three Commissioners (including the Chairman, appointed by the Governor) are at the head of approximately 40 people. The staff is divided in audit, compliance, engineering, legal, research and clerical support branches. The range of operations requires in fact a wide set of competences. If the electric utility, for example, requests approval for a rate increase because of infrastructural investments, the PUC is to analyze if the technological solution is beneficial, if the investment is tackled with an adequate strategy, if the rate increase is tolerable… These inquiries are typically handled through *dockets*, i.e. legally organized dialogues between admitted stakeholders, which have the opportunity to submit their entries. The Commission, through this procedure, is supplied with the relevant documentation and perspectives to formulate a final judgment.

Focusing on the electricity sector, in 2007 the PUC saw an extension of its authority. Beyond a consolidated role of supervision, it was given the possibility to "consider the need for increased renewable energy use in exercising its authority and duties" (Public Utilities Commission, 2008). This translates in a more active role that the PUC can play in the shift towards a cleaner energy system.

3.2.4 The Department of Business, Economic Development and Tourism (DBEDT)

Since when the role of Energy Resources Coordinator was defined in the State of Hawaii (1974), this position was held by the Director of the Department of Business, Economic Development and Tourism (DBEDT). The Energy Office is formally a branch of the strategic industries division. "The Director serves as cabinet-level energy coordinator and advisor to the Governor and all levels of government and industry. The Director is responsible for State energy planning and policy development." (Rocky Mountain Institute, 2008)

3.2.5 The County

Hawaii island's local administration handles its energy strategy through a branch of the Department of Research and Development. At the head of the Energy Program, this is the branch's name, is the Energy Coordinator. The Energy Advisory Commission (EAC) was established in 2003 with the purpose of counselling the Mayor on energy strategies and policies, in particular in concern with the Hawai'i County Energy Sustainability Plan (HCESP). To tackle its purpose the Energy Advisory Commission articulated itself in 5 committees (Water Supply and Use, Transportation/Biofuels, Buildings, Utilities, Planning Considerations). Dedicated Working Groups can also be created, involving different stakeholders, to address specific matters or opportunities[6].

[6] at the time of my visit, for example, a Geothermal working group was holding its meetings

3.2.6 Companies working with Distributed Generation

The peculiar economic drivers in Hawaii, combined with the existing incentives, make solar energy contracting a very appealing business on the island. On Hawaii Energy's website a list of 27 qualified solar water heating contractors is reported, screened under "stringent criteria" (Hawaii Energy, 2009). This is just a fraction of the whole, and does not include businesses dedicated just to photovoltaic installations, yet it is already possible to count a qualified contractor every 6500 inhabitants ca.

While solar heating systems do not suffer from specific constraints (actually new regulation demands that every new house build has a solar water heater installed) the PV category is challenged by the grid's capacity. The utility is in fact reporting that in many areas further integration of distributed generation could compromise service stability, and it is therefore authorized to refuse interconnection to PV systems.

Currently installing PV systems qualifies for a 35% federal tax credit and a 30% tax credit from the state (with $5 000 cap). Solar water heaters benefit of an additional state rebate of $750 which is directly discounted from the contractor who, then cashes in the rebate (Hawaii Energy, 2010). Grants are also available for low income families, and typically they are provided at a district level (Wilson, 2010)

3.2.7 SAIC - Hawaii Energy (Energy Efficiency Program)

In July 2009 the PUC passed the energy efficiency (EE) program, for the islands served by HECO, to an independent third party administration. Before this date the collected Public Benefit Fees (i.e. the energy efficiency dedicated funds collected through the energy bills) were managed by the utility. The bottom-line of this change was to assign the task to somebody who did not have an adverse incentive in reducing electricity sales. The competitive bid process to take over the EE program was won by Science Applications International Corporation (SAIC), a Fortune 500(r) company, based in Virginia, with more than 45 000 employees (SAIC, 2009). The first mandate will end in January 2013 and SAIC was awarded a $ 38 000 000 dollars contract for the first two years (SAIC, 2009). The goal for the energy efficiency program administrator is to create the conditions in Oahu, Maui and Hawaii to achieve HCEI's 30% energy efficiency goal for 2030.

The program, which runs by the name of Hawaii Energy (HE), takes care of encouraging energy efficiency by conveying information, mainly through the newly renovated website. It is not just an educational task, but it includes, for example, promoting rebates and energy efficient appliances (including solar water heaters). HE consultants are also available for free energy audits. Although the program includes energy solutions for home and businesses, it must be stressed that it does not cover Demand Response activities (i.e. solicitated or encouraged load shifting, rather than reduction, on the users' side). Demand Response initiatives are, quite naturally, still addressed by the utility.

3.2.8 Users

The average yearly residential use of electricity per capita in Hawaii is of 6 800 kWh as opposed to a national average of 15 200 kWh [7]. The daily load curve typically varies between 90 MW and 200 MW (Kaleikini, 2010) with a pattern that is shown in the next figure.

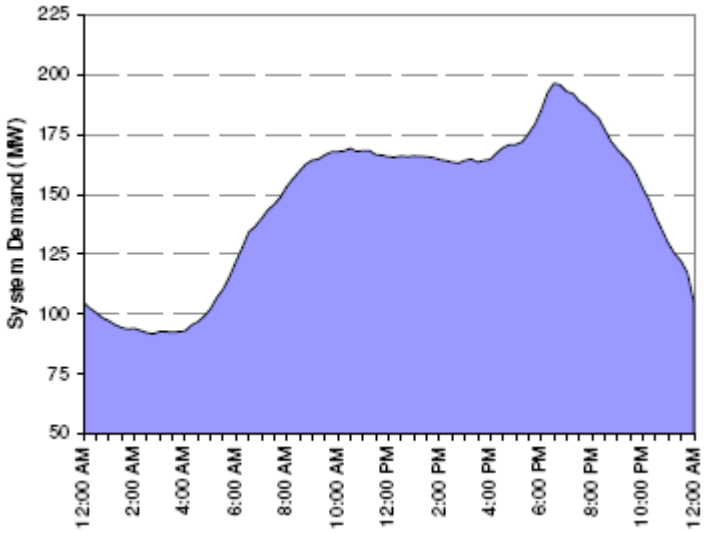


Figure 3-3 Highest daily load peak in 2005 for Hawaii County (Johnson, Leistra, Opton-Himmel, & Smith, 2007)

An important remark is that the very mild temperatures on the island minimize energy use for heating (with the exclusion of few communities living at higher altitudes). In some cases a solar boilers can reduce electricity bills by 40% (Dyal, 2010).

Overall exact statistics can hardly be expected for three main reasons. Firstly an increasing number of users is installing on site domestic generation (either PV or propane). Secondly the number of people going off grid (the only alternative to being served by the utility) is excluded by the surveys. Finally in the island the tourist flows significantly alter the number of users on the island and according to a study of the University of Hawaii, reported by HECO, "on a per person per day basis […] visitors account for higher petroleum demand than residents by a factor of 4.5" (HECO, 2009).

Communities and users on the island have been capable in time to raise their voice to oppose non welcomed projects on the island. The first Geothermal works met strong opposition as exploiting this resource was believed (by some natives) to be a sacrilege to the Goddess of the Volcano, Pele. Communication with native communities is not to be taken lightheartedly, and not just for the spiritual concerns, but also for historical ones. Hawaii was an independent kingdom until less than 100 years ago, and it is not possible to expect that the feeling of having been occupied has completely faded. As a matter of fact a Hawaiian sovereignty movement is quite active nowadays, trying to gather attention in the international arena; communities appear very concerned about the potential exploitation of local resources by alien investors (Wilson, 2010)

[7] This number has been simply obtained by dividing the yearly retail electricity sales (in KWh) of the U.S. (US EIA, 2010) and Hawaii (HELCO, 2009) by their number of inhabitants.

3.3 The framework for *the process*

3.3.1 Hawai'i Clean Energy Initiative

In 2008 a partnership between the U.S. Department of Energy (DoE) and DBEDT launched the Hawaii Clean Energy Initiative (HCEI), a programme meant to draw a pathway towards Hawaii's energy independency and sustainability. Although DoE and DBEDT are at the helm of it, the initiative involves different stakeholders like the State's PUC and legislators, the islands' utilities, some members of the business community and the Department of Defence (Hawaii's single largest energy user) (National Renewable Energy Laboratory, 2010). HCEI's purpose is defined through goals, objectives and priorities, which I summarize in the next table.

Table 3-2 HCEI's goals, objectives and priorities

Goals
- Conserve: Use What We Need Efficiently * Commit to a more energy-efficient lifestyle in our homes and on the road. * Establish energy-efficient building codes and lower our energy use at work and in our schools. - Convert: Harness What We Have Wisely * Stop building fossil fuel plants. * Generate locally 40% of our energy by 2030. * Harness energy from solar, wind, ocean, geothermal, and biomass resources. * Establish a sustainable alternative-fuel strategy. * Embrace hybrid and electric vehicles. * Modernize our power-grid system.
Objectives
* Define the new infrastructure needed to move Hawai'i to a clean energy economy. * Foster and demonstrate innovation in the use of clean energy technologies, creative financing, and public policy to accelerate our transition to clean energy. * Create economic opportunity at all levels of society by developing and diversifying Hawaii's economy so all of us reap the benefits of a sustainable energy policy. * Establish an "open source" learning model that supports other island communities seeking to achieve similar goals and makes Hawai'i a world model for clean energy-based economies. * Build our workforce with new skills that will form the foundation of an energy-independent Hawai'i.
Priorities
The Hawai'i Clean Energy Initiative is focused on three priorities that are critical to achieving our goal of 70% clean energy by 2030: * Transforming the regulatory environment to facilitate clean energy development * Collaborating with island utility companies to increase renewable energy generation * Integrating renewable energy into utility grids.

Source: National Renewable Energy Laboratory, 2010

HCEI is not a legislative or executive body; it is more of an institutionalized forum to develop guidelines and recommendations for the decision makers.

HCEI appears to be the reprise of Hawaii Energy Strategy, 1992 cooperation between DoE and DBEDT with analogue goals, which saw its last completed contribution in 2000 with the

publication of *Hawaii Energy Strategy 2000*. The proceedings for the realization of 2007 update seem to have been suspended in mid 2006 (State of Hawaii, 2006).

3.3.2 Hawaii Clean Energy Agreement

In October 2008, the Governor Lingle's Administration, the DBEDT, HECO (representing HELCO and MECO as well) and the Division of Consumer Advocacy signed the Hawaii Clean Energy Agreement (HCEA). It is a non-binding memorandum of understanding between the parties "to implement the Hawai'i Clean Energy Initiative with sweeping changes that are needed to reduce our dependence on imported fossil fuel and to achieve a more secure energy and economic future." (State of Hawaii, 2008). The 52 pages long agreement also address specific issues like renewables integration level, interisland cable, smart meters, retirement of fossil fueled plants and feed-in-tariffs. Milestones are also introduced in a time line, explaining that "any deviation from the milestones will need to be justified by the party and parties involved" (State of Hawaii, 2008).

3.3.3 Renewable Portfolio Standard

From a formal standpoint, renewable energy goals are defined under the Renewable Portfolio Standard (RPS). Enacted in 2001, it was significantly revised (practically doubling the targets) in 2009, under the influence of the HCEA. The Bill defines what sources can qualify as renewable energy and specifies that from 2015 the results of energy efficiency initiatives will not be accountable for the targets achievement. Every utility in Hawaii State must achieve the following percentages of renewable energy sales (Hawaii Revised Statute § 269-91 and House Bill 1464)

* 10% of its net electricity sales by December 31, 2010;

* 15% of its net electricity sales by December 31, 2015;

* 25% of its net electricity sales by December 31, 2020;

* 40% of its net electricity sales by December 31, 2030.

Utilities can aggregate the renewable portfolios of their affiliates on different islands to meet these targets. A penalty of $20 per MWh has been set by the PUC in case of non compliance.

Energy Efficiency Portfolio Standards interim goals are yet to be set.

The overall statutory "Objectives and policies for facility systems—energy" can be found in Hawaii Revised Statute, Chapter 226-1 (see Appendix 1).

3.3.4 Integrated Resources Planning and Clean Energy Scenario Planning

The Integrated Resources Planning "is an approach to regulated utility planning that evaluates all potential energy options" that shall be submitted to the PUC and periodically reviewed by utilities, presenting a 20 years time-horizon (HES 2000). The current framework for IRP was formalized by the PUC in 1992, under the overall goal of identifying "the resources or the mix of resources for meeting near and long term consumer energy needs in

an efficient and reliable manner at the lowest reasonable cost" (HES 2000). HELCO published its third IRP report in 2007.

In May 2009 the PUC opened a docket to address the revision of the existing framework (which is now 18 years old), as "in the Hawaii Clean Energy Initiative energy agreement the parties recognized that a more dynamic and responsive process is needed" (HECO, 2010c). The new framework, when defined, will go by the name of Clean Energy Scenario Planning.

3.3.5 Decoupling

In October 2008, and explicitly under the influence of HCEI (as mentioned in the background of the proceedings), the PUC initiated an investigation "to examine implementing a decoupling mechanism [...] that would modify the traditional model of rate-making for the HECO Companies by separating the HECO Companies' revenues and profits from electricity sales" (PUC, 2008). The purpose is of "encouraging the substitution of renewable resources, distributed generation and energy efficiency for the utility's fossil fuel production (by reducing a utility's disincentive […]) while simultaneously protecting a utility's financial health from erosion as these types of programs go into effect" (PUC, 2008).

Decoupling will allow the utilities to base no longer its revenues on energy sales, as rates will periodically be adjusted according to the following criteria:

- Revenue adjustments will be provided to cover "cost of operating the utility that is deemed reasonable and approved by the PUC" and "any changes in the State or federal taxes (PUC, 2008)

- Revenue adjustments will allow "return on and return of ongoing capital investment" (Public Utilities Commission, 2008)

- The revenue adjustment will not be based on customer count

At the time of this writing the docket is still open, therefore the final outcome of the proceeding has not be defined yet.

3.3.6 Purchase Power Agreements

Purchase Power Agreements (PPAs) are the legal contracts between the utility and the Independent Power Producers. Although they have to be approved by the PUC, they normally are not available to the public for consultation. In the agreements the price and the buying conditions are set. The typology of contract is also a function of the specific technology and of the grid services it can provide (for example intermittent vs. dispatchable generation).

In Hawaii County the only *firm* PPA is with Puna Geothermal Venture, while the utility buys power from the other IPPs as increases in the demand load require it. In the case of intermittent sources the *as-available* conditions applies: wind farms and PV installations will be able to supply power only under compatible meteorological conditions. The power that is generated by IPPs, but not integrated by the utility, is referred to as *curtailed power* or *curtailment*.

Up to date most PPAs have been based on avoided costs, meaning that the producer is paid a price that corresponds to the costs the utility would have faced to generate that power in its own facilities. As utility generation relies on fossil fuels the avoided cost fluctuates with the oil prices and this cost is transferred to ratepayers through the *Energy Cost Adjustment* in the electricity bill.

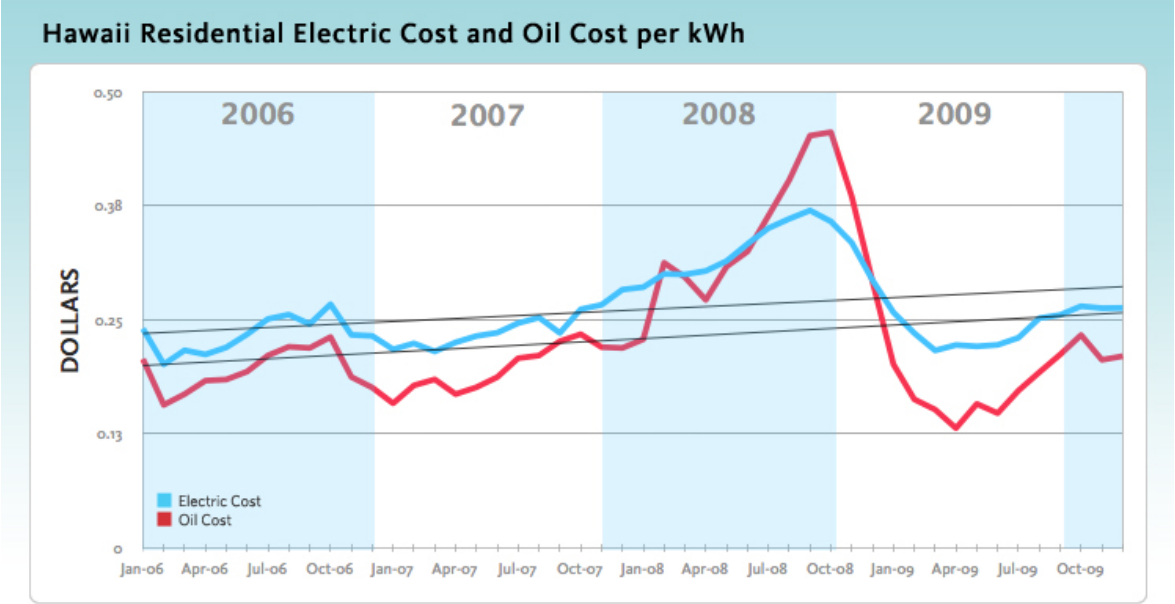


Figure 3-4 Link between oil prices and electricity prices in Hawaii (Hawaii Energy Efficiency Program, 2010)

Therefore, so far, the users could not benefit of the integration of cheaper generating technologies. The consequences are volatility of prices and reduced economic appeal of expanding renewable generation (from the users' side, the IPPs on the contrary have been doing very good business). This is the reason why the PUC will not be welcoming this kind of agreements and, in the words of the Chairman, contracts "should no longer be based on oil prices" (Caliboso, 2010).

The contracts do not only influence the users' bills, but also have an influence on how power is fed into the grids, as the demand for power increases during the day. The influence of these contracts on the functioning of the *Energy Management System* is quite debated and still unclear in the community, as interviewees highlighted.

4 Findings from Interviews and SWOT analysis

In this chapter the findings from the interviews are summarized and a SWOT analysis is performed to identify some approaches that can help to improve *the energy system's* ability to evolve. Interviews have supplied the raw material for this study and it is highly recommended to read through Appendix 2, where they are extensively reported, to have an easier understanding of the analysis presented in Section 4.4 and Chapter 5.

4.1 Preliminary information about the stakeholder analysis

The purpose of the interviews was to understand the strengths, weaknesses, opportunities and threats of *the process* (in the perception of the different stakeholders), to grasp the actors' drivers and to collect the information necessary to understand the dynamics of *the process*, in order to proceed with the analysis and have a basis for the scenario evaluation. Most typically a stakeholder analysis is used to address a specific policy or decision, while in this case it was used on a larger scale level, in particular to address the evolution of Hawaii's electricity system.

A list of identified stakeholders was drafted after the preliminary literature reviews about the Hawaiian context, and was then refined on site, during meetings with local experts. Unfortunately I did not manage to interview some actors, either because they were not available or due to time constraints. In particular I would like to mention the SAIC team, currently administrating the energy efficiency programs, and representatives from the Federal Government, in particular from the Department of Energy. I would have also liked to include more inputs from the demand side, given time and resources. There are many other professionals, expert and researchers I had the pleasure to talk to and that have given important inputs for my work. Nevertheless in the stakeholder analysis I decided to report only the inputs coming from the planned semi-structured interviews with the selected stakeholders.

Table 4-1 Interviewed Stakeholders

Name	**Position**	**Stakeholder**
Robbie Alm	HECO Vice-President	Utility – top management
Carlito Caliboso	Chairman of the PUC	Enforcement Office
Andrea Gill	Renewable Energy Specialist DBEDT	State Energy Office
Guy Toyama	Chairman of Hawaii County Energy Advisory Commission	County Energy Office
David Mattice	PUC Hawaii District Office	Enforcement – local office
Jose Dizon	Operations Manager at HELCO	Utility – island operations

Mike Kaleikini	Plant Manager of Puna Geothermal Venture	IPP - management
Kanoe Wilson	Program Coordinator at University of Hawaii – Native Hawaiian Studies – Relator of Cultural Interests at the Geothermal Working Group	Communities - Researcher
Cyndy Dyal	Sales Manager for residential DG technologies (retail and installation)	Distributed Generation
Julie Myhre	Energy Management Analyst Department of Water Supply County of Hawaii	Demand – Largest user on island
Tommy Goya	Retired- policy consultant, worked for HELCO for 30 years	Local Expertise
Energy Project Consultant	Electric utilities consultant with decennary experience on mainland who had the opportunity to cooperate with Hawaiian utilities	US expert

Stakeholder tables are sometime presented in literature to identify the actors' position, power and influence on the addressed issue. Most of these issues will be covered in the study in a discursive way. I actually wanted to perform a classification of the power influence of different actors using the inputs of interviewees; I had to give up the idea after the first interviews because of a common resistance to answer such politically sensitive questions. Furthermore *the process* involves a wide number of initiatives and decisions, in which stakeholders can have different interests and influence. A schematic stakeholder table would have risked being a misleading simplification. The "drivers" issue, though, does have relevance for this study: it is introduced in section 4.3 and recalled in the analysis sections.

The semi structured interviews (see paragraph 1.2 for more information) lasted typically 50 minutes, ranging between 40' and 70'. All the interviewees were asked the SWOT questions, while the rest of the interview was influenced and weighed on the basis of their specific area of competence. The content of interviews was established, according to the purpose of the study, to address the strategic issues and the building blocks of the energy system. The areas identified were: the energy planning competences, the strategic choices in the energy mix development, the contracts between power providers and utility, the possible evolution of the market structure, the energy efficiency management, the transmission infrastructure and the quality of information flows in the system.

4.2 Summary of findings

In the next paragraphs the main findings from the interviews have been be distilled, and the minimal information required to go through the analysis presented in this study is reported. A comprehensive report of the interviews can be found in Appendix 2, where inputs have been grouped per topic issue, as in the following telegraphic-style summaries. To ease the reading referencing of interviews has been suspended until the end of this chapter, as information can be promptly traced back in Appendix 2.

4.2.1 Strengths and driving factors in *the process,* up to now

The high oil prices (especially the 2008 peak) gave a strong incentive to develop alternative energy solutions, making them also more convenient (for the IPPs too). This context favoured the stabilization of a political agreement to develop clean energy and get all actors on-board. People became more receptive and aware, as witnessed by the growth of solar installations, which has also been helped by tax credits and incentives. The creation of the HCEI has been important to push the development of clean energy and at the same time strengthened the relations with the federal Government, which is investing in Hawaii also for strategic reasons. The PUC played an important role in balancing ratepayers' interests, utilities strategy, and RPS goals.

4.2.2 Weaknesses and challenging factors *the process,* up to now

Several actors acknowledged that the presence of a vertical monopoly represents a challenge. The utility, while facing the challenges of an isolated grid, is also trying to free itself from a negative reputation it has built in the past. Overall there is a conflictual working environment aggravated by the low quality of information flows and by a lack of transparency. Furthermore the public is left out from decision making processes. The PUC finds challenging handling the almost conflictual goals it has to face while there is a lack of a comprehensive plan guiding *the process*. The availability of capital for investments is a challenge both for the utility (little borrowing capacity) and the users (EE & DG upfront investments).

4.2.3 Opportunities that could help a further development of *the process*

Many interviewees insisted on the opportunity to engage communities and strengthen public education on clean energy issues. Technology development is of course an opportunity, and in particular in concern with the transmission infrastructure strengthening. Hawaii might have an opportunity to envision itself as a green-lab for environmental technologies, attracting investments and tourism.

4.2.4 Threats that could hinder a further development of *the process*

Stakeholders brought up quite different issues. The political influence on *the process* still encompasses some risks of instability in following a long term plan, just as oil prices fluctuations that don't ease investment conditions. The zero-sum thinking risks to compromise the creation of a collaborative environment, and slow down progresses. The lack of public involvement might translate into projects opposition and an accelerated off

grid movement, especially if communities feel exploited by project developers and foreign investors, or sacrificed by an Oahu-centred State planning.

4.2.5 Purchase Power Agreements

The conditions under which PPA have been signed, played an important role for IPP investments. Nevertheless they do represent a constraint nowadays, because they are long-term contracts (which will end almost approximately in 2030) that have been based on avoided costs, i.e. are linked to oil prices. They could be reviewed only with mutual consent of utility and IPPs, but it is not likely that investors will give up very convenient terms. New PPA will not be based on avoided costs and the utility can not profit on them. Thus new contracts will transfer the economic convenience of technologies to ratepayers. PPAs have to be approved by the PUC.

4.2.6 A New Utility Model

Federal regulation pushing for the liberalization of energy markets does not apply in Hawaii. Nevertheless the utility declares to be more interested in a future as distributor and retailer of electricity rather than maintaining a lot of activity in the generation business (that could thus become a more liberalized arena). A quota of generation, according to PUC and HECO, will remain in the utility's hands, which has the obligation to serve and must rely on its own infrastructure. This generating capacity would be used as a "back-up" for renewable energy, but this seems to be a controversial definition. Because of technological challenges, in fact, the combustion steam units that are used as a baseload while renewable energy backs them up when needed (i.e. as energy demand increases).

4.2.7 Institutional Capacity

The HCEI has been a driving instrument for change but does not have legislative or regulatory faculties. The Renewable Portfolio Standard (legally effective) is enforced by the PUC, which saw an expansion of its task recently. Typically the PUC would respond to utilities requests and proceed to economic enforcement of RPS, while now it has been allowed to take initiatives that can guide *the process*. There is no public body that is currently performing a long term energy planning, while the Integrated Resource Planning has been an instrument in the hands of the utility (subject to PUC approval). This 20 years old process might be reviewed and go under the name of Clean Energy Scenario Planning, which should prove to be more effective.

4.2.8 The Evolution of the Energy Scenario

Currently the system has already 46% reserve margins, meaning that no further generation is actually needed. There are two main technologies that seem to have the characteristics (dispatchability) to replace baseload generation: biofuels and geothermal. The latter could already be expanded from 30MW (soon 38 MW) to 60 MW but there is no further need as mentioned. If locations on the West side of the island were found for geothermal expansion the scenario might change. Geothermal requires quite high infrastructural investments but of course has really low running costs. The utility with a rather small investment could biofuel most of its plants, that at that point would become "green". DBEDT and HECO seem to agree that it is a viable solution to make the system stable and would give self-sufficiency to the island. Other stakeholders seem to be concerned about the land use (but at the moment

there is unexploited ag-land is the utility's and DBEDT argument) and the fact that biofuels would still need to be imported. Distributed Generation is facing some grid lock-ins that complicate integration of new installations (including the provision of expensive studies). Under the FIT agreements users have the tendency to oversize their panels, worsening the situation. As a result more and more users are contemplating the off the grid solution.

4.2.9 Strengthening the grid

There is common agreement on the fact that the distribution infrastructure must be upgraded. For any project though, the utility must seek PUC approval to recover the costs. And the low density of users makes interventions quite costly. There is a minor possibility of creating microgrid to cut off the system the most remote areas on the island. On the current grid smart meters could already be installed and time-of-day tariffs implemented. The possibility of an interisland cable from the Big Island appears to be remote.

4.2.10 Information Flows

Information flows are definitely improvable according to the majority of the actors. Administration does not know sensible information required for planning, actors, including the public, are not really satisfied. The communication between some providers and the utility seems quite satisfactory, on the other hand.

4.2.11 Energy Efficiency

The PUC assigned the management of the PBF to a third party administration in 2009, taking the energy efficiency programs away from the utility (because of the conflicting interests). Actors seem to have appreciated this change, while the utility (under the decoupling mechanism) would be ready to take them back. In the new scenario the utility's costs will be spread across the ratepayers, regardless of the total sales. More efficient users will pay less while the ones that will not be adopting energy efficiency measures will pay more. HELCO is still in charge of Demand Response activities.

4.3 Drivers for the actors

The inputs from interviews also allowed me to delineate the bottom-line drivers for the different stakeholders. Although they have not always been reported directly during the interviews, they are deducible from the actors' inputs and reflect the basic principle that players in a system want to maintain or strengthen their status.

Table 4-2 Expected drivers for the actors in the system

Actor	Expected Driver
Utility	Maximise return on investments
	Preserve ratepayers base
	Maintain direct control in system to respect "obligation to serve"
	Compliance
IPPs	Increase market accessibility
	Long Term Investments under Safe conditions
DG	Expand the customer base
PUC	Balance the interests to keep operating under multilateral approval
DBEDT	Set and achieve acknowledgeable goals, State-wide
County/EAC	Set and achieve acknowledgeable goals, at a local level
Communities	Lower price for electricity
	Self-determination
	Reliable service

These drivers will be used in Chapter 5 to test the potential appeal for the actors of the evaluated scenarios.

4.4 SWOT Analysis: the picture and three possible approaches

The following table summarizes the aspects that the interviewees brought up as strengths/success factors, weaknesses/challenging factors, opportunities and threats of *the process*. As explained in Chapter 1, the analysis differentiates the temporal dimension of

existing strengths/weaknesses versus future opportunities/threats. The SWOT analysis is developed with the intention of identifying approaches and strategies that can be coordinated, or at least shared, by all actors.

The elements reported in brackets are issues that have not been reported during the SWOT questions but were brought up during the prosecution of the interviews.

Table 4-3 SWOT table

Strengths/Success Factors	**Opportunities**
Strategic Position of Hawaii – HCEI cooperation with Government & push – Political Agreement – PUC role – Favourable conditions for investments (oil prices, tax credits, fixed prices...) - EE to SAIC – Community more receptive	Education to public - Community involvement – Technologies Development – Infrastructure Investments – Hawaii as Green Lab (CESP – Investments in Grid Strengthening)
Weaknesses/Challenging Factors	**Threats**
Monopolistic regime – PUC conflicting goals – Bad Reputation of Company and hard working environment – Bureaucracy – Public not involved – Lack of overall plan – not transparent system – Upfront investment barrier from users – Little borrowing capacity for utility – Isolated Grid (PPAs lock-in effect – Renewable energy replacing other renewable energy with DG)	Fluctuation of oil prices (uncertainty) – Off grid movement – Tourist engagement – Opposition from the public if not involved, or feels exploited – Political instability repercussions – Bad reputation for investments- Conflictual Environment – Oahu-centred planning

Based on this information three approaches have been identified that could improve the situation, by leveraging on strengths, tackling the weaknesses, grasping the opportunities and minimizing the threats.

1) Improve Education, Openness and Information Flows (Communities more receptive, Public not involved, Utility's bad reputation, Not Transparent System, Education of the Public and Community Involvement, Tourist Engagement, Public Opposition, Conflictual Environment, Off grid movement)

Also in consideration of the comments reported about information flows, there should be major efforts in communication between actors and to the general public. Communities have been mentioned in each SWOT: more receptive, but kept at the margin of planning, they are ready to push for clean energy but also could strongly react against imposed decisions. Not

only educational initiatives are part of the solution but also a systematic openness towards the public in decision making processes. Tourist must be addressed specifically in order to increase their commitment to reduce their share of impacts. The improvement of information flows (as seen in the dedicated paragraph) would also improve the working environment and its transparency, and at the same time tackle bureaucracy's nuisance. Ideas like an information clearing house can play an important role. The utility also has to recover from a bad reputation; developing a better corporate image might slow down the off-grid movement.

2) Strengthen Energy Planning (HCEI Push, Political Agreement, PUC Role, Monopolistic Regime, PUC Conflicting Goals, EE to SAIC, Lack of Overall Plan, Political Instability Risks, Oahu-centred planning)

The HCEI has been acknowledged as a driving force in adopting measures that promote clean energy. Nevertheless the reported political agreement could be used to go one step further and reduce the risks linked to a utility-centred planning. The PUC's important role is limited by the fact that it has to balance almost conflicting goals (more renewables, utility stability and affordable rates). The actors declared the lack of an overall vision for the islands, and a long term action plan leading to a shared scenario could push the legislation beyond the current RPS generic goals. In this context the development of the Clean Energy Scenario Planning represents a very good opportunity to introduce an effective tool. CESP might reduce the risks of political instability and has the chance of structuring community involvement. The planning process could be coordinated giving more space to a bottom-up approach; action plans for each island may well be managed at a county level.

3) Attracting Investments (Favourable conditions for investments, Strategic Position of Hawaii, Cooperation with Federal Government, Little Borrowing Capacity for Utility, Monopolistic Regime, Upfront Investment from Users, Tech Solutions, Hawaii as Green Lab, Fluctuation of Oil Prices, Bad Reputation for Investments)

The strategic attention that the Federal government seems to reserve to Hawaii, strengthened by the solid cooperation between DBEDT and DoE for the HCEI, may create a good channel for attracting investments on the island. This could at the same time address the limited borrowing capacity of the utility and could tackle, in part, the monopolistic regime; by directing the investments, the administration would have greater bargaining power in the energy system development. Major public investments would also reduce the potential opposition coming from communities fearing alien exploitation. High-end technology solutions would enable the "Hawaii as green lab" scenario.

Information sharing, planning capacity and capital availability are very broad features. Nevertheless they should be systematically addressed and prioritized in order to enable Hawaii to dynamically approach the changes it is going to embrace. These three approaches have the possibility to improve the system's capacity to evolve itself, independently from the direction it decides to move towards.

The next chapter will take a closer look at the strategic directions the system might decide to take.

5 Scenario Evaluation and Structural Concerns

Two scenarios will be outlined in this chapter, with the purpose of exploring the possible consequences of strategic choices, which Hawaii will need to take. *Scenario A* is a forecast based on current trends, interviewees' inputs and interests alignment. *Scenario B* is an explorative alternative, potentially satisfying the stakeholders. The scenarios are going to be analyzed through a Multi Criteria Analysis and from the related observations a set of recommendations will be drafted. The scenarios are mainly used as an input for discussion and for the evaluation of different approaches to clean energy strategies. In particular: "the aim of MCA is not so much to identify an optimal solution but rather to facilitate the identification of compromise solutions in a transparent and fair way" (Kowalski, Stagl, & Madlener, 2009). I do not expect to meet consensus on all the evaluations presented, but I think this does not compromise the importance of stimulating the discussion around some central choices.

5.1 Scenario A: a likely future?

Many signals in my research convinced me that Hawaii's energy system is going to rely significantly on biofuels combustion, starting from the very next years. Biofuels are first of all a welcome option for the utility, which can maintain control on generation at a low cost, achieving rapidly the RPS requirements. Secondly the DBEDT is giving way for this strategy, being concerned about the under-exploitment of ag-land. The utility and the DBEDT together have great influence in the HCEI forum (Energy Consultant, 2010). Political goals could be met rapidly and at low costs. The low infrastructural investments also lead to a feasible solution for the PUC. Geothermal expansion could come into place quite late, or even not be needed, if most of the utility's plants are biofueled. The system could approach 70% renewable integration and exceeding the RPS goals would be still convenient for the utility to balance the portfolio of other islands (mainly Oahu). Appendix 3 presents a short fact list that gives an idea of the bioenergy proceedings in Hawaii.

As far as it concerns grid restructuring there seem to be a quite broad agreement but no capital availability. It is a costly investment and if smart meters can be already installed and time of use tariffs put in place, the only further reason for advancing the grid would be to accommodate more distributed generation. But as it represents a tricky input to handle for the utility that would just replace other "green" electricity, the overall incentive would be pretty small. Incremental improvements seem to be the compromise, also in consideration of the fact that users would have to share the burden of major investments in transmission infrastructure.

The energy efficiency program (independently from who will run it) will have the characteristic of not affecting the utility's revenues. On one hand this will not disincentive the utility from promoting efficiency. The other side of the coin is that users, even if they become more efficient, will as a whole be saving little money. There will be efficient users who will benefit and laggards that will see their bills grow.

In terms of market structure, little changes can currently be expected. The challenges of an isolated grid justify, to many, the presence of what could be called a natural monopoly, in terms of distribution. But even the generation market will experience minor changes, with the utility in control of the baseload generation and IPPs that are in a waiting line, managed by the utility's EMS.

I do not have the possibility or capability to narrow and shape more precisely the scenario. Of course for a quantitative analysis it would be necessary to come up with a precise energy mix, investment plans, economic assumptions... Nevertheless I think that even a broadly defined scenario can offer the basis for macroscopic observations.

5.2 The criteria

Criteria for the qualitative evaluation have been taken from (Kowalski, Stagl, & Madlener, 2009) a study that combines scenarios and multicriteria evaluation in the context of renewable energy. The study uses the 15 criteria to compare 5 possible renewable energy scenarios for Austria in 2020. Interestingly, in the study the parameters have been evaluated with a participatory method, including stakeholders' evaluation, but time constraints did not give me the opportunity to do so. For my purpose I will simply use the parameters as a guideline to structure some observations on the forecasted scenario.

5.3 Qualitative evaluation under selected criteria

5.3.1 Climate change properties

A portfolio mix with something like 45%-72% renewables[8] is of course a very impressive result, and climate change impacts will definitely be reduced passing from oil derivates to bioenergy sources. The "renewable" quality of biofuels lies in the fact that the carbon dioxide emissions from combustion are compensated by the carbon uptake of the dedicated crops. It must be noticed, though, that if the dedicated crops take the place of a vegetated area the carbon cycle is only virtually closed. Pre-existent vegetation would be in fact absorbing CO_2 anyways. In this case the CO_2 emissions deductible from the fuel combustion should only be represented by the difference in uptake between the pre-existent vegetation and the adopted crop. On top of this consideration, emissions coming from direct and indirect energy use in the cultivation phase must be accounted, and a contextual life-cycle assessment would be necessary to perform a comprehensive evaluation.

The energy efficiency program will, of course, have positive impacts on this parameter (this applies also to 5.3.2, 5.3.3 and 5.3.4).

5.3.2 Air quality

Specific information would be required to understand what kind of biofuel will be burned and with what technology. In consideration of the fact that the air permits (and requirements) for the biofueled plants would not be changed, and that in Hawaii island the prevailing winds diminish local air pollution problems, it is possible to assume that this parameter will not be affected. New relevant impacts could arise if aircraft pesticide spraying techniques will be adopted for crops cultivation.

[8] Simplified calculation in which either only Keahole plant is biofueled (42%) or all the oil and diesel plants owned by the utility are upgraded to accept biofuels (72%), without affecting their power generation

5.3.3 Rational use of resources

This parameter is among the most controversial as it involves the land use issue. Under the assumption that only agricultural land that is currently not cultivated will be used for biomass growing, it is legitimate to believe that a more rational use of resources will take place[9]. According to DBEDT "If we can give incentive to preserve agricultural land we should. It is hard to understand what the scenario is going to look like when farmers will have to decide which kind of crop is a better investment. We are very from an understanding of how many acres we would need to produce a certain amount" (Gill, 2010). There are two implications:

1) Currently there is no precise indication on how much land will be used for energy crops

2) The new bioenergy market shall incentive the use of ag-land

Therefore it is very hard to exclude that food production will be sacrificed in favour of energy-crops. If the bioenergy market is expected to encourage the use of currently non exploited ag-land, it implies that (somehow) energy-crops will be a more appealing investment than food crops. Otherwise the ag-land will continue not being used. At this point a number of food cultivators will probably embrace the biomass business to make better business, in function of the existing demand. Available not cultivated ag-land (also according to the findings of RMI's report presented in 2.6) could be barely enough to produce the biofuels needed to meet the existing requirements of the transportation sector.

The open question now is: is it more rationale for Hawaii island to use its ag-land for food production or for biomass production? Another whole thesis paper wouldn't be conclusive. As a declared objective for Hawaii is to become more self-sufficient, I limit myself to this consideration: in the presence of other viable local renewable energy options a use of ag-land that reduces existent food dependency is probably more rational. The debate is thus shifted to the viability of the other energy options.

5.3.4 Influence on habitats

The evaluation of this criterion is again linked to how much land will be dedicated to biomass, and what is its current use. Impacts could be negative, if the land is currently covered by spontaneous vegetation, or even positive if the areas are experiencing a topsoil runoff. Negative environmental impacts are anyways expected because of the industrial agricultural activity. Fertilizers, pesticides could be disruptive agents for Hawaiian habitats.

5.3.5 Empowerment

Communities could benefit from a higher level of empowerment if the areas used will be locally owned. Distributed generation on the other hand is struggling in this scenario, while it could represent a great opportunity for users' empowerment.

[9] A further and not secondary implicit assumption is that regional planners destined an optimal amount of land to agricultural purposes

5.3.6 Social justice

It is not easy to foresee the working conditions in the biomass production business, while it is important to take a closer look to the effects of energy efficiency programs under the decoupling mechanism. I explained already that the economic benefits of energy efficiency are only in part transferred to the ratepayers. The benefits of reducing consumption that will be transferred to users, are the ones linked to decreased energy purchases from IPPs and to the decrease of fuel consumption. The fixed costs of the utility, its rate of return on investments, the operating costs of power plants (that are independent from power output) will not be affected. The utility will retrieve the money to cover the costs from the customers base, with the efficient users being rewarded by lower bills. The more the users will be efficient, the higher the price per kWh will become. PUC Commissioner Leslie Kondo argued that these "are truly transformational changes for the HECO Companies and the ratepayers, significantly altering the State's regulatory framework by shifting substantial risk from the HECO Companies to its ratepayers" (Kondo, 2010). Good communication will be needed to avoid protests. Furthermore there are redistributional risks of a regressive outcome: as energy efficiency measures often pass through behavioural changes but also require upfront investments, the lower classes have good chances of being the most inefficient ones, and could thus be paying the highest price. The situation could be aggravated if the off-grid movement keeps expanding. As the compensation accorded to the utilities is not based on the number of users, shrinking the ratepayer base will lead to even higher electricity prices. Efforts to protect low-income users are going to be needed.

5.3.7 Regional social cohesion

Improving regional social cohesion passes through the communication efforts of the authority and the utility. As for the *empowerment* criterion, local ownership of land is likely to make project better accepted, in consideration of the self-determination will of the inhabitants, which are now concerned about the exploitation from foreign investors. The penalization of distributed generation in this perspective has a negative impact.

5.3.8 Costs

As reported in the interviews, biofueling existing thermal power plants is a very inexpensive option. HECO, for the Kahe plant upgrade, estimated a cost of $35 per kW (Alm, 2010). Of course the cost to upgrade more and smaller units will be higher on a kW basis, but this gives an idea of the very low upfront investment required. The running costs will depend on the cost of biofuels on the markets, on the fuel choice, on the number of plants upgraded and on the power they will supply to the grid. The existing avoided-cost-PPAs, linked to oil prices, will keep electricity charges on the high end, as oil prices are expected to rise in the next years. Limiting DG keeps the costs down from an infrastructural point of view. The effect of energy efficiency measures, ceteris paribus, will be an increase of the cost per kWh as explained in 5.3.6.

Table 5-1 Expected impacts of the forecasted scenario on electricity prices

Component of the Energy System	Cost to the users
Biofueling Investment	Very Low
Biofuel Running Cost	Unknown
Unaltered PPAs	High
Limited DG	Low
Energy Efficiency	Profitable for Users

5.3.9 Regional economic development

A bioenergy strategy, if successfully implemented, would create opportunities in the island. Energy crops cultivation, treatment and preparation of biofuels have the potential of favouring local economy. The downside of this scenario is again linked to the constraints suffered by distributed generation: DG is an opportunity for local businesses but also a long term investment for users, with distributed benefits in the local context.

The impact on regional economic development is also linked to the destiny of the revenue streams. If the profits of biofuel industry will be reinvested locally then there is the opportunity to help local economy by reducing the outflow of money from the island (currently a lot of the Hawaiian bill revenues end up in the pockets of foreign investors). On the other hand if the biofuel business will, once again, be owned by foreign investors, then the shift to biofuels will have very little effect on the regional economic development.

5.3.10 Employment

As in 5.3.9 it is possible to foresee positive effects coming from the bioenergy business but negative impacts on the DG activity.

5.3.11 Diversity

The DBEDT during the interviews stressed how it has been important for Hawaii to invest on a diversity of energy sources (Gill, 2010). The portfolio diversity should not be threatened by a biofuel strategy implementation, at least on a plate level. But if biofueled plants will act as baseload, it is not hard to expect that they will be running first in the energy management system of a "generating and distributing" utility. Considering the ambitious goals of the energy efficiency programs, reducing the demand load translates into a curtailment of the other sources. Furthermore there are good chances that the also transport sector will be in need of biofuels, leading to a smaller diversification. Limiting the DG inputs of course also penalizes diversity, more in terms of spatial distribution of sources than in terms of diversity of technologies.

5.3.12 Adaptability

Under this scenario adaptability will be a function of the type of contracts in place with biofuel suppliers and participating IPPs. As existing PPAs witness, long term commitments act as lock-ins for the future evolution of energy system.

5.3.13 Import independency

Import independency is going to be achieved only if there will be sufficient local production of biofuels. Interviewees had remarkably different views on this issue. On the other hand, even if only a fraction of the biofuels will be locally produced there would be a relative improvement in comparison to the current oil-import dependency. Once again, DG capping limits the contribution to independency that PV and other distributed solutions can offer.

5.3.14 Quality of landscape

Industrial cultivation is likely to have negative impacts on the quality of landscape, especially if extensive areas will be devoted to monoculture. This parameter will also be influenced by the initial conditions, i.e. the current use of the agricultural lands involved. On the other hand opponents of PV installations will appreciate a deceleration in the increase of rooftop solar panels.

5.3.15 Security of supply

Using oil as a term of comparison, biofuels promise a greater security of supply. One of the concerns about oil imports is their origin from unstable regions. Biofuels could be produced locally or be imported from mainland US, thus reducing the risks linked to political tensions in the international arena. Nevertheless, a fuel supply will be needed and possibly it will still be covered with imports.

5.4 Scenario A: preliminary observations and recommendations

Biofuels do represent an incremental improvement from an oil-dependency situation, but they bring along some challenging aspects. Reading through paragraph 5.3 the reader will have encountered an annoying quantity of "if", "under the assumption", "it will depend on" and other hypothetic premises. I apologize for the formal nuisance, but the main reason behind these repetitions is that there is, among stakeholders, no precise idea on how a biofuels strategy will be implemented on the island. What is then the reason for talking about such a scenario without further information? Because decisions, more or less actively, are already being taken. There is a disproportion between the preparedness to embrace a biofuel strategy (and the planning behind it) and the actual implementation level. Combining the events reported in Annex 3 with the findings of interviews, I think there is little room for arguing against this statement. It is therefore interesting to understand how the system got to this situation, and I will suggest my interpretation in paragraph 5.4.2. In the next section some observations are presented in concern with the qualitative criteria evaluation of 5.3.

Environmental impacts are non negligible especially in delicate habitats like the Hawaiian ones. Biomass production is likely to come along with industrial agriculture practices and monocrops and the negative impacts of these practises are well known. In terms of climate change impacts biofuels do represent a better option than oil derivates, but they come along with local impacts, especially in the production phase. The overall sustainability of biofuels is

actually questioned by some interviewees (Energy Consultant, 2010; Goya, 2010; Toyama, 2010). Crop selection, requirements, and adopted agricultural technologies are variables that should be strategically addressed to reduce the potentially negative effects. In terms of global impacts, though, the adoption of bioenergy must be considered a relevant improvement from the current situation.

Social and economic impacts have three main dimensions.

The first one is linked to the food security issue. It is a hazard to incentive and then allow the spontaneous flourishing of energy crop cultivation. To minimize these risks, either the amount of land destined to biomass cultivation is capped or the possible sacrifice of food production is thought through, as a result of comprehensive evaluations.

A second socio-economic impact is connected to the fate of revenues from the economic activity: local ownership could be encouraged to favour social cohesion and regional development. The State and County could favour the development of cooperatives, for example. At the same time grid improvements should be promoted to allow further expansion of distributed generation to favour empowerment and regional economic development. Furthermore the competition with the prices of imported biofuels could be a major threat for local suppliers; high production costs are quite typical in Hawaii.

The final socio-economic challenge is linked to redistributional issues. The cost of energy efficiency will be bared by the least efficient users, but the need for upfront investments could act a barrier for the poorest segments. Rebates and tax credits on energy efficiency investments could be based on the income level, to reduce disparities.

The conclusive recommendation is to slow the implementation process of biofuel solutions for electricity sector until an adequate understanding of impacts is achieved and a community driven development strategy is outlined. Several of the existing reports advocate for a comprehensive plan (Johnson, Leistra, Opton-Himmel, & Smith, 2007; Page, Bony, & Schewel, 2007; Rocky Mountain Institute, 2008). Otherwise import independency, security of supply and sustainability (the goals of HCEI and the statutory requirements for energy policies) risk experiencing very little improvements in Hawaii.

Looking at the drivers expected for the actors in paragraph 4.6, it is possible to appreciate that the forecasted scenario satisfies mainly the utility (intact control over the system, return on investments, compliance) and the energy agencies (achievement of acknowledgeable targets). In terms of investments the utility would have an easier time with the existing assets and the investments on biofueling the power plants, while incrementally upgrading the transmission and distribution infrastructure. PUC, on the other hand, might discourage massive investments in the grid if they do not bring significant advantages. The distributed generation business and the communities are the most likely to be dissatisfied (the expectations are to expand customer base for DG, and self determination and low prices for communities). Taking into account the concerns of the communities in relation to the exploitation of the Island's resources for State-wide purposes (see A2.2.5), it is not hard to foresee opposition or tensions if Hawaii's ag-lands will end-up biofueling the whole State. Existing IPPs are not really affected in this scenario, meaning that the little space left for expansion is compensated by the opportunity of running contracts linked to oil prices, with benefits for IPPs prioritized by the EMS. The scenario does not appear to be challenging for the PUC, which would see the achievement of targets under minimal changes and surcharges.

Table 5-2 Satisfaction of actors' expected drivers under Scenario A

Actor	Expected Driver	Satisfied?
Utility	Maximise return on investments	Partially
	Preserve ratepayers base	?
	Maintain direct control in system to respect "obligation to serve"	Yes
	Compliance	Yes
IPPs	Increase market accessibility	No
	Long Term Investments under Safe conditions	Partially
DG	Expand the customer base	No
PUC	Balance the interests to keep operating under multilateral approval	Yes
DBEDT	Set and achieve acknowledgeable goals, State-wide	Yes
County/EAC	Set and achieve acknowledgeable goals, at a local level	Yes
Communities	Lower price for electricity	No
	Self-determination	No
	Reliable service	Yes

5.5 Overarching problems

I can now go back to the question of what structural challenges brought the system towards a scenario that proved to be far from an ideal one (under adopted criteria).

As seen in Chapter 3 the energy planning is in the hands of the DBEDT, as a public agency, and of the utility, at a local level, through the IRP process (now being reviewed). The major changes in related legislation have been pushed through the HCEI and enforced by the PUC. The HCEI is a forum of stakeholders held by the DBEDT and the DoE, with formal participation of utilities, Federal Departments and some representatives from the real estate

and tourism business community. There is no structured bottom up participation for the general public or the rest of the business community. The actual implementation happens through the PUC, but on a local level it is the IRP that is the real planning instrument, while the County is only inspired by a County Energy Sustainability Plan that has not been officially adopted, and stands as recommendation.

Under these premises it seems clear that the utility is very much in charge of the planning. The HCEI, in a way, has also strengthened its authority, giving the utility a chair at the table from which inputs to the legislator are given. I am not saying that the cooperation between the utility and the energy office is *per se* a bad idea. It is definitely not. The controversial aspect is that the HCEI could be a forum for stakeholders, but currently is a pretty exclusive arena. Looking at the *organization* page on the HCEI website it is possible to see that the *leadership* is in the hands of Doe and DBEDT with the *partnership* of PUC, HEI (the parent company of HECO), Kauai's utility, and a handful of players from the residential development and hotel businesses (National Renewable Energy Laboratory, 2010). Inputs have been given by researchers and consultants, but there seems to be an asymmetry in the treatment of stakeholders, which is visualized in the next images.

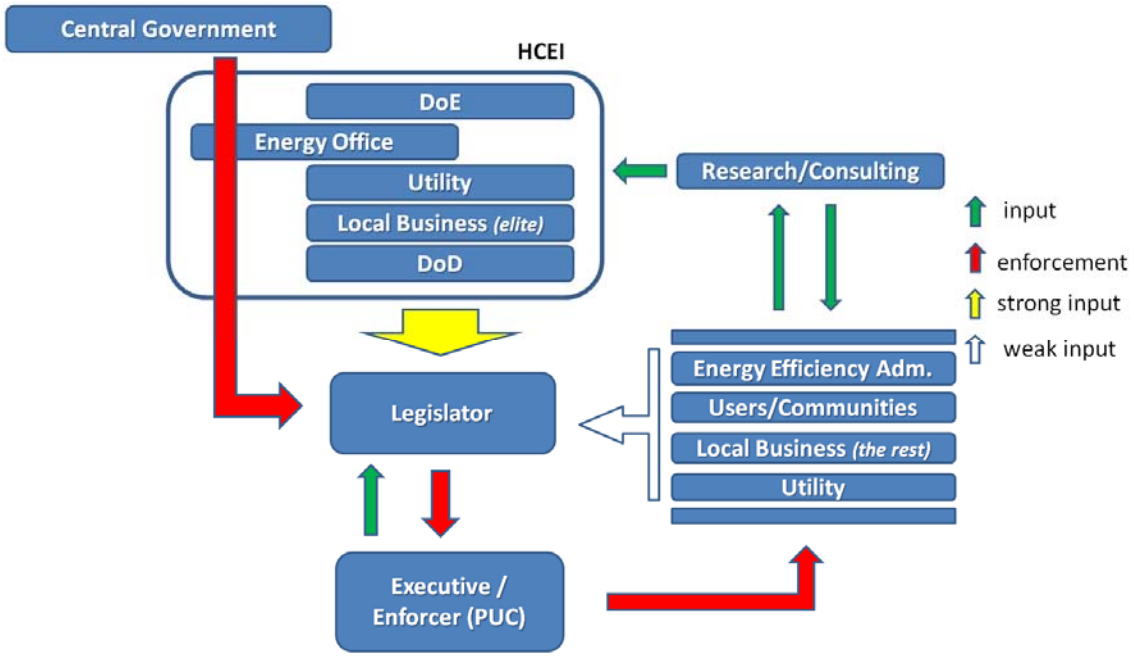
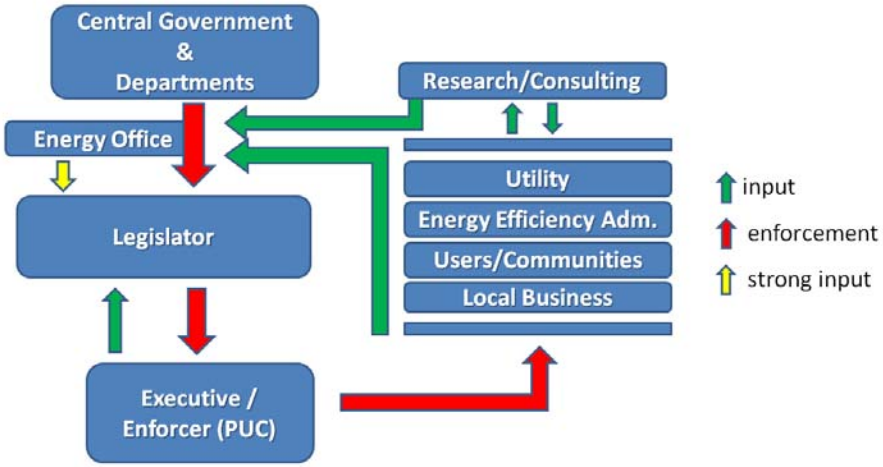


Figure 5-1 Visual schematization of the energy planning structure under HCEI in the State of Hawaii. The utility occupies a privileged position in the institutional process, besides disposing of its planning IRP tool at a County level



5-2 Visual schematization of a more symmetric institutional planning process.

Furthermore, the utility has a vertically integrated monopoly (generation, distribution and retail) in a system that is characterized by low quality of information flows, with ever-growing barriers to entry (think about the additional studies required for new installations). Far far away from a well functioning market[10].

The challenges of managing an isolated grid are acknowledged, and the obligation to serve is appreciated. But what is the incentive for the utility to integrate renewable energy? Currently none, as it can not possibly profit on power supplied by IPPs. It is not a matter of revenues, as the utility recovers its fixed costs anyways through the bills, but rather a "control" issue. Why should more generation coming from other plants be integrated by the utility, when it might cause complications in the management of the grid, and involve transactional costs? Why should the utility supply less power and reduce its range of operations? The only driver is the accomplishment of RPS goals, but what can be more appealing than accomplishing them without giving up its market power? I am not expressing a negative judgement on the utility's behaviour. On the contrary, the utility is behaving perfectly rationally and at the same time has achieved and exceeded the requirements so far. It is just not possible to ask them to spontaneously complicate their life. Even the underinvestment in the grid is quite logical in this perspective[11]. The Vice-President of HECO expressed a very open position towards a "distribution and retail" business-model for the utilities (Alm, 2010). It is the legislator's duty to redesign a more open and transparent system, in which there is an incentive for renewable (and "local") power and that can better accommodate the options that reflect the self-determination will of the community. The utility should be put in the conditions of running its business soundly, but can take care of itself, while the government is tasked to protect the citizens' interests, especially in presence of a single energy provider. This consideration highlights the importance of strengthening the capacity of the governament's energy offices: increasing their knowledge and the quality of information available enables them to play a

[10] Only two key elements out of the ten that should charaterize a liberalized market according to (Joskow, 2008), and intorduced in section 2.1, apply to the Hawaiian case: privatization of the sector and horizontal integration

[11] See Appendix 2, and in particular A2.2.7 for some insight on the grid strengthening debate and on opportunities that the utility has not grasped

more proactive role. If the utility's outweighs these bodies in terms of competencies, it is hard for the agencies to fully evolve from an endorsing to a planning position[12]. I am not saying that the public agencies shall manage the utility's investments. I do believe though that they should be fully engaged as the system faces strategic decisions.

Is it, at this point, possible to outline an appealing scenario for all actors with a better overall performance under selected criteria?

5.6 Scenario B: an alternative

Using the inputs from interviews and the findings from literature it is possible to sketch an alternative scenario (*Scenario B*) that might meet the stakeholders' expectations and accommodate most of their drivers.

The first step in this scenario is to unbundle the utility's generation and distribution services. This does not mean that the utility has to shut down at once its plants; on the contrary plants could still be online but would be competing on an equal playing field with other IPPs. There would then be a Transmission Provider – HELCO (TP-HELCO) and a Power Provider – HELCO (PP-HELCO). TP-HELCO would have a greater opportunity to openly run the system following the *Standards of Conduct for Transmission Providers* issued by the Federal Energy Regulatory Commission. The State, with a more accessible energy management system, could prepare direct incentives for the operator to integrate more renewable power. In such a system dispatch priority would openly be given on the basis of economic convenience, subordinate to grid requirements. This has two important consequences. The first one is that there would be a better functioning energy market, meaning clear signals for IPPs, which could see their dispatch level increase, and lower barriers to entry (or expansion); if there are projects that could compete with better prices for generation, why should they not be given the opportunity? The other major consequence is that PPAs would not be broken, but the existence of a transparent price-based supply competition would prioritize convenient sources, with immediate benefits for the users. If, as it has been reported, the greatest part of PPAs does not involve firm purchase power agreements, there should be no rule breaking of contracts. Of course if IPPs would like to review their contract with TP-HELCO to be more competitive, they could always do it. Somebody fearing that investments in Hawaii would be discouraged, by the creation of a historic case of administration intervention in the rules of an existent market, should be reassured by the fact that a more transparent arena would be created. The TP-HELCO would be naturally decoupled from electricity sales (it would just transfer its energy purchasing costs) and could receive not only incentives to integrate renewable but also stronger incentives to reduce its sales per ratepayer. At this point the price per unit of energy would have small increases, just to cover the service cost, unless compensation for EE is given to power producers (which, by the way, is only happening with HELCO in the existing scenario). Premium prices could still be paid for responsive grid services, that of course will still be needed to keep the system's reliability, and this would reward thermal power plants (so PP-HELCO and Hamakua Energy Partners, at the

[12] An abstract example. Let's suppose that the utility seeks the PUC's approval for an investment in a "technology Y" that will replace the existing "technology X". If the investment is sound, does not come along with a too heavy burden for ratepayers and it represents an improvement from an enevironmental standpoint, the PUC can be expected to approve it. Still there might be a "technology Z" that could outstand on the long run "technology Y" (and "technology X"). The new technology might not be familiar to the utility or it could require more efforts on the short and medium run. Exploring and proposing the "technology Z" as an alternative (which should still be viable for the utility) is something that only an agency with a high-level and research oriented staff could do.

moment). The difference is that for TP-HELCO it will be less convenient to integrate them until they become renewable sources, and they would be called in only when needed. Further opportunities for the utility could come from the participation of Hawaii in carbon markets, in order to create revenue streams from emission reductions (achieved either through energy efficiency or renewable energy). This additional income for the utility would reduce the electricity costs on the local market.

Given the local energy mix, there seems to be no rush to accelerate the process of renewable integration. If the County is satisfied with compliance it would have to increase from 30% to 40% its renewable mix in 20 years. Grid strengthening could be prioritized, under direct convenience of the TP-HELCO, to allow renewable integration and energy efficiency. More margins for cost recovery of these investments can be expected, because of the reduction of electricity prices (thanks to competitive market dynamics). With stronger grids, existing renewable sources could increase their dispatch and DSM & DR programs be more effective. Prioritizing energy efficiency in terms of goal achievement makes good sense. As stated by PUC and HELCO what is the purpose of adding generating capacity, if electricity demand will have to decrease by 40%? Relative increases of renewable energy integration will be magnified by the reduction of total sales.

In the meantime a more comprehensive plan for bioenergy could be outlined or possibilities for additional geothermal generation be explored, with the purpose of greening the baseload generation. Geothermal seems to have greater chances to be expanded, if more time is given for baseload replacement, while under *Scenario A* the short term biofueling of existing plants would reduce the incentives to further exploit this resource.

5.7 Comparative MCA of the two scenarios

The purpose of this section is to compare *Scenario A* and *Scenario B* in order to understand their different attributes under a qualitative evaluation of the selected criteria.

In lack of a deep or quantitative analysis of each parameter a comparative use of the MCA tool is also more valuable than a stand-alone analysis of a single option (like the one of section 5.3). More indications can in fact be expected from a comparison between alternatives than from an absolute, not relative, approach.

Scenario B can be summarized by saying that it involves a restructuring of the market, more distributed generation and energy efficiency achievements thanks to grid strengthening prioritization (also leading to a reduction of transmission losses) and direct incentives. A possibly slower expansion of the renewable portfolio in the short term can be expected. In time a development of geothermal generation could take place, as well as a cautious introduction of biofuels in the system.

5.7.1 Climate change properties

On the short run S*cenario B* might imply a slower abatement of GHG emissions, with thermal plants running on oil derivates, until a bioenergy strategy is in place or geothermal energy installations are completed. On the long run, though, this scenario could involve a lower dependency from thermal power plants, including biofueled ones, and thus lead to a less impacting energy system. The prioritization of renewable DG and energy efficiency, combined with higher penetration of intermittent sources (thanks to grid strengthening) would start giving results on the short run too (the same applies to 5.7.2) . The quantitative

comparison between *Scenario A* and *Scenario B* is not feasible without a more defined picture of both cases.

5.7.2 Air quality

As stated in 5.3.2 no major changes to local air qualities are likely to happen. On the long run, though, a diminished reliance on thermal plants would be beneficial. Impacts from aircraft pesticide spraying are less likely to take place, with a more cautious expansion of bioenergy crops intensive cultivation.

5.7.3 Rational use of resources

Scenario B would allow a more careful planning of biomass cultivation. It is legitimate to expect that in this scenario a more rational use of resources could take place, because of a more gradual development. In the long run the system is likely to develop a smaller dependence from biofuels, leaving more ag-land available for food production.

In terms of energy use, a strengthened grid with more effective DR programs could reduce the energy wastes linked to curtailment of dispatchable energy.

5.7.4 Influence on habitats

Same considerations of 5.7.2 and 5.7.3. Disturbance on Habitats is reduced in comparison to Scenario A.

5.7.5 Empowerment

As seen in the literature review, favouring DG and EE measures has beneficial impacts on individuals empowerment, by reducing their dependency and being more actively involved in the energy management.

5.7.6 Social justice

The situation is similar to *Scenario A*, meaning that the energy efficiency program would need to take care of low-income families to make sure they are not cut out from EE investments. A slight advantage for *Scenario B* might lie in the fact that the decoupled costs to be covered by energy bills would only involve TP-HELCO, while in *Scenario A* the utility would also spread its non-fuel generating costs. At a same level of energy efficiency achievements this should lead to smaller increases of price per energy unit. Increases would be even smaller if shareholder incentives are applied or the TP-HELCO could sell emission reductions in carbon markets. On the other hand *Scenario A* would see a slower escalation of EE investments, meaning that redistributional risks would have more time to be addressed.

5.7.7 Regional social cohesion

Similarly to 5.7.5, more DG and EE would help meeting the self-determination ambitions of communities, engaging them in the energy optimization on a local level.

5.7.8 Costs

The investments required for *Scenario B* are more demanding. Grid restructuring is an expensive practise especially in a low density context. If geothermal becomes the baseload replacement technology, in the medium term, it will be more capital intensive than biofueling existing power plants. On the long run, though, investments in energy efficiency and geothermal generation (no fuel-dependency involved) will pay back and eventually increase the wealth of the region. Transactional costs for the market restructuring could also be accounted for *Scenario B*, but it is hard to predict their impact.

Table 5-3 Expected costs of Scenario B in comparison with Scenario A

Component of the Energy System	Cost to the users
Geothermal vs. Biofueling Investment	Higher than *Scenario A*
No (little) fuels vs. Biofuel Running Cost	Lower than *Scenario A*
Competitive market vs. Unaltered PPAs	Lower than *Scenario A*
Limited DG (grid strengthening)	Higher initially – Paid back
Energy Efficiency	More savings than *Scenario A*

5.7.9 Regional economic development

The investment in DG and EE makes *Scenario B* preferable under this criterion. These options are in fact characterized by the creation of revenues on a regional scale, as they entail local value creation. The profits of small scale DG and EE are in fact reaped by the users and communities rather than rewarding foreign investors. This benefit could be even enhanced by giving stronger incentives and subsidies for small-medium systems (family-scale) rather than large commercial ones, compatibly with the financing capacity.

5.7.10 Employment

This scenario will favour the employment in the DG business but sacrifice the potential boost of a bioenergy economy.

5.7.11 Diversity

The creation of a dynamic electricity wholesale market could encourage portfolio diversification, while major investments in geothermal could "freeze" the situation, just like eventual major investments in biofueling in *Scenario A*. The DG part of the equation is a plus for *Scenario B* also in terms of spatial diversification. A stronger grid would also support more variegated mixes.

5.7.12 Adaptability

The advancement of grid infrastructure can be expected to increase the adaptability of the system in comparison with *Scenario A*. If geothermal energy will in the long run cover most of the energy demands than adaptability could be penalized.

5.7.13 Import independency

Energy Efficiency programs, pushed by an incentivized TP-HELCO, will reduce energy needs, while solar DG can reduce fuel dependency, not to mention eventual increases in geothermal generation. *Scenario A* could only compete if Hawaii island is proved capable of supplying bioenergy with local sources (for both transportation and electricity generation), without affecting food dependency. It is legitimate to affirm that *Scenario B* in any case reduces the risks of being import dependent.

5.7.14 Quality of landscape

Beneficial impacts are linked to the reduced risk of extensive monocultures occupying Hawaiian ag-lands, while negative impacts might be perceived by opponents of solar installations. If the strengthened grid could accommodate more wind power, the expansion of wind farms can not be excluded, with potential negative impacts on the landscape.

5.7.15 Security of supply

Scenario A poses less challenges by keeping the system tied to more responsive power units (thermal power plants). Also, in *Scenario A* a quota of generation would be under obligation to serve, which is reassuring in terms of security.

In *Scenario B* energy efficiency aggressive programs would reduce supply needs, thus indirectly increasing security. Solar DG and increased wind penetration should guarantee more energy security in principle, but expose the systems to the risks of energy shortages in function of weather conditions. Having back-up diesel plants would sensibly increase security of supply.

The risk of seismic or volcanic activity compromising the geothermal plants is often mentioned. It should be remembered though that the energy system is more exposed to risks only marginally; in particular proportionally to the likeliness of events capable of affecting geothermal plants but not striking alternative energy sources or towns and communities (demand basins).

5.8 Observations

Scenario B appears to be preferable under most of the criteria. In particular as far as it concerns the environmental and social dimensions.

Table 5-4 Summary of MCA comparison between Scenario A and Scenario B

Criteria	Preferable Scenario (A/B)
Climate Change Properties	B (medium-long term)
Air Quality	B
Rational Use of Resources	B
Influence on Habitats	B
Empowerment	B
Social Justice	-
Regional Social Cohesion	B
Costs	B on the long run / but higher investment
Regional Economic Development	B
Employment	-
Diversity	B
Adaptability	B
Import Independency	B
Quality of Landscape	-
Security of Supply	A

Nevertheless there are three central criteria that *Scenario A* might accommodate better, especially in the short term. The C*limate Change Properties* of *Scenario B* reflect a delay in the adoption of large scale renewable sources, as stated in 5.7.1. Nevertheless on the long run *Scenario B* has great chances of overwhelming the performance of *Scenario A*.

Scenario B still involves some economic and technical challenges. Higher investments in the short run would be required, especially for gird strengthening, and these costs would be shared by the users. The ratepayers, though, could benefit from a relative lowering of electricity prices allowed by the wholesale market competition; there would be a margin to cover further investments. The geothermal option is more capital intensive, but it would most likely be on the shoulders of private investors. The costs are recovered by electricity sales of course, but the investment would have reason to be only if the price was competitive with other energy sources. Investments in DG and EE have the important attribute of creating value in the region, reducing the energy dependency of the communities. Nevertheless major attention should be paid to redistributional issues: a fast expansion of EE

programs should be backed up by systematic attention towards low income sections of the population.

Security of Supply is a crucial parameter, and *Scenario A* guarantees a safer option, at least in the short run. Rather than safer, though, it is more correct to say *easier to achieve*. *Scenario B* comes along with more technical challenges, demanding continuous improvements and efforts, which would be rewarded by the incentives for renewable integration and energy efficiency. No incautious decisions would have to be taken; it is just a context in which the renewable integration is pushed forward. And while the grid improvements take place the system has more chances of becoming more responsive even on the demand side, thus increasing reliability. On the long run, finally, the reduction of dependency from fuels does increase the security of supply. As it has already been argued, the self-sufficiency of Hawaii bioenergy is at least debatable. Furthermore the high production costs on the island are likely to favour import of biofuels, potentially exposing and locking the island (and the State) to an import dependency that could be very close to the current oil case.

The fear of under-exploiting ag-land, to me, does not represent a strong argument for biomass cultivation for two reasons. First of all biofuels would still be needed to meet the current AFS standards and that demand could already cover the unexploited ag-land (according to existing reports), even more if biofuels become the choice for the transportation sector. Secondly, if there is a lack of incentives to stimulate agriculture, in a context where the local market share covers only 15% of the food demand (Page, Bony, & Schewel, 2007), it is a problem of agricultural policies, not of the electricity markets. Incentivizing energy-crops competitiveness in such a context is probably not the best idea.

The argument that there would be no generation under obligation to serve has to be integrated with two considerations. The first is that in liberalized wholesale electricity markets risk management can be shared across suppliers (and transmission provider). The second aspect is that grid stabilization and services would be rewarded and this can stimulate the investment in ancillary services from the providers' side; the case of PGV's 8MW expansion proves that R&D is undertaken by providers under the stimulus of expanding energy sales. The technical aspects of market restructuring, though, should not be oversimplified, and the issue needs to be addressed by an independent task force and evaluated by the PUC. The interviews brought to surface the current stall situation. The Chairman of the PUC stated that "[the utilities] always told us that they need to control a certain amount of baseload because they have obligation to serve and nobody else has it" (Caliboso, 2010); at the same time the Operations Manager at HELCO mentioned that "the PUC appreciates that we have the obligation to serve, we are required to serve users whether we lose money or not" (Dizon, 2010). Sounds a bit like buck-passing. The way out is offered by a thorough, third party evaluation.

It is now time to evaluate the satisfaction of actors in *Scenario B*. The utility would be giving up its control ambitions, but is more likely to preserve customers on the grid (better integration of DG and more energy efficiency options) and would have great revenue opportunities from investments in transmission infrastructures, possibly with the help of the State or the DoE. Grid strengthening would be the pathway to integrate more DG and energy efficiency, thus pleasing the expectations of DBEDT, County and PUC. In particular the PUC would see these investments as the option to meet the statutory goals, while under *Scenario A* the renewable portfolio would already be met by biofueling plants. In *Scenario A* further investments would just be a burden for users, which would still be paying oil-linked prices to IPPs. The most important achievement of *Scenario B*, though, is that it could meet

the expectation of communities, who would rather be investing money that they will one day profit from, rather than seeing an outflow of profits from the island, while depending on foreign investors' services. The reliability of service, as stated in the previous paragraph, is to be evaluated as a prerequisite.

Table 5-5 Satisfaction of actors' expected drivers under Scenario B and Scenario A

Actor	Expected Driver	Scenario B	Scenario A
Utility	Maximise return on investments	Partially/Yes	Partially
	Preserve ratepayers base	More likely	?
	Maintain direct control in system to respect "obligation to serve"	No	Yes
	Compliance	Yes	Yes
IPPs	Increase market accessibility	Yes	No
	Long Term Investments under Safe conditions	No	Partially
DG	Expand the customer base	Yes	No
PUC	Balance the interests to keep operating under multilateral approval	Yes	Yes
DBEDT	Set and achieve acknowledgeable goals, State-wide	Yes	Yes
County/EAC	Set and achieve acknowledgeable goals, at a local level	Yes	Yes
Communities	Lower price for electricity	Yes	No
	Self-determination	Yes	No
	Reliable service	?	Yes

Scenario B could be an appealing option for all actors.

5.9 Recommendations

On the basis of the explored scenarios and of the issues raised by the SWOT analysis, a short list of recommendations, leading to benefits for all stakeholders, can be presented for the decision makers in *the energy system*:

1. Strengthen the public-side of energy planning: the utility is at the same time given a too heavy burden and too much authority to design the energy future for Hawaii. The RPS numerical goals are important commitments but do not explore the different options available in terms of collective interest.

    a. At a State level strengthen the DBEDT and PUC offices (or create a dedicated energy department) to develop a public-agency electric energy planning, in which the utility is consulted (and given options) in a balanced stakeholder consultation process (as opposed to current HCEI approach)

    b. At a County level, expand the staff of the Energy Office and strengthen the Hawaii County Energy Sustainability Plan in order to activate a tool that can nudge and frame the IRP. The definition of the new CESP process, replacing the IRP, represents an important opportunity to review the planning dynamics. Strengthening the County's authority is also important to compensate the Oahu-centered planning at a State level.

    c. Monitor the composition of the Energy Offices, in order to obtain an appropriate balance of legal, economic and technical competencies. Technical capacity, in particular, is needed to better assist (and stimulate) the utility in the adoption of technological solutions. Technical capacity can be improved by hiring more experts but also by freeing employed experts from a too broad spectrum of tasks.

    d. Engage the public and communities in the planning process. The UNECE Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters could be of good reference. A bottom-up approach from a district level could be formalized through the Community Development Plans.

2. Improve the quality of information flows: many actors are not satisfied with the level of information exchange in the system.

    a. Improve information flows among actors: this would improve the planning capacity and allow a better functioning of the wholesale energy market, because of more transparent conditions

    b. Commission and stimulate aggressive educational programs: education is another major factor for the development of more sustainable lifestyles and the engagement of communities

    A website acting as an information clearing house, proposed by some actors, has the potential to offer a significant contribution.

3. Put in place real incentives for the utility to increase renewable penetration and energy efficiency savings. The implementation of decoupling has removed the

economic disincentive to promote them, but there currently seems to be no real incentive for a proactive attitude (beyond targets achievement). Performance-based instruments (also for the third party energy efficiency program) have the possibility to speed the process.

4. Prioritize investments in infrastructure upgrading (grid, control rooms). On top of being a good revenue opportunity for the utility, they enable further DG and EE programs, which create value at a local level and meet the self-determination will of communities.

5. Increase Hawaii's appeal to investors. Increased information flows in the system (point 2), a stronger planning capacity (point 1) and a transparent energy market (point 8), are already going to help the system. The State could also commit itself to facilitate some infrastructural investments (point 4) and overcome the problem of the reduced borrowing capacity of the utility.

6. In presence of aggressive energy efficiency programs, major attention shall be given to redistributional issues, especially under the decoupling mechanisms. Low income families who can not afford upfront investments in EE should be assisted so that they don't become the most heavily stroke segment.

7. Slow down the bioenergy implementation process until a comprehensive plan is in place. Although baseload replacement is a priority, the current renewable penetration on the island gives the opportunity to develop a thought through strategy. Speeding the process by biofueling existing plants risks to be a shortcut (for the utility and administrative agencies) that might lock-in Hawaii one more time. The bioenergy proceedings should also be comprehensively planned to avoid undesired outcomes such as import dependency (for fuel and food) or local environmental impacts.

8. Restructure the electricity market with the creation of a Transmission Provider. HELCO would not need to divest from transmission or generation, but should be formally split in two separate bodies. The Power Producer – HELCO would be competing on an open and transparent wholesale energy market managed by the Transmission Provider – HELCO, according to FERC's *Standards of Conduct for Transmission Providers*. Benefits would include:

    i. transparency on the market and a wholesale competition driving prices down, going around the existent PPAs linked to oil prices (or encouraging their renegotiation). Users could see their bills going down and more margin would be available for transmission investments (see benefits of point 4)

    ii. opportunities to introduce more effective incentives for TP-HELCO to integrate renewable energy and push energy efficiency. At the same time grid services could be rewarded by the utility, and this could stimulate IPPs investments in grid-serving technologies

    iii. the creation of a more appealing arena for investments (including expansion of existing IPPs)

    A high profile independent working group should explore the actual feasibility of this option and its possible consequences on the system's reliability.

6 Conclusions

Hawaii County is trying to find its way towards a sustainable and clean energy system. In the electricity sector, the local utility, HELCO, has achieved remarkable results, already counting the integration of 30% renewable energy in 2009. Nevertheless greater achievements are expected for the future, in order to reach and exceed the 2030 70% clean energy goal (and to reduce the island's dependency on oil imports).

In this study an analysis of the current *energy system* has been elaborated starting from the inputs of its main stakeholders. Particular attention has been given to the structural aspects of *the energy system* and to the drivers of the different actors, in order to understand the dynamics that could unfold under different scenarios. On the basis of this analysis I will try to answer the research questions posed in Chapter 1.

RQ 1 - What are the challenging aspects that Hawaii is facing, and is likely to face in the near future, in concern with the development of a clean electric energy scenario?

There are several challenging factors that emerged from the analysis. The privately owned utility seems to have most of the energy planning instruments in its hands (or on its shoulders, depending from the points of view). The Energy Offices at a State and County level could occupy a more dialectic position to stimulate and drive the change in a direction reflecting long-term collective interests. Numeric goals for energy efficiency and renewable energy do not represent a vision.

Ratepayers are experiencing, by far, the highest electricity prices in the U.S., with the profits being reaped by power producers, oil merchants and foreign investors. Very few of the profits created in the energy system actually stay on the island. The communities have experienced very little engagement in the decision making processes, and are also cut out because of the non satisfactory information flows in the system. The information exchange is inadequate even between players (including authorities).

The energy system, to substantially improve renewable penetration, needs to start substituting some baseload energy, as renewables are just taking away space from each other in the current energy management. For short term strategic reasons bioenergy seems to be the favourite candidate of the utility, backed up by the DBEDT. Nevertheless the lack of a comprehensive planning behind the bioenergy choice exposes the island to the hazard of extending its reliance on imports, on top of challenging food production and generating environmental impacts. Bioenergy could also reduce the incentives to strengthen distributed generation and other renewables, as it would allow a rapid achievement of RPS goals.

RQ 2 - How could these challenges be adressed favouring the development of potentially more sustainable energy scenarios?

The restructuring of the energy market seems to be the most comprehensive solution to address many of the issues, although it involves some technical challenges that should be thoroughly explored by an independent agency. Creating an open and transparent wholesale electricity market would allow passing more benefits to the ratepayers and facilitating renewable penetration. HELCO would separate its operations as transmission provider and power producer. The transmission operator should also be given direct incentives (beyond

target achievement) to integrate renewable sources and increase energy efficiency savings, in order to be engaged in a proactive role.

The Energy Offices of the State and the County, as well as the PUC, should be strengthened and expanded in staff, to cover more effectively their statutory planning and enforcement tasks. Communities could be engaged in decision making processes with a bottom-up approach, starting from district level meetings. A stronger planning authority would need to promptly coordinate a master plan for bioenergy development in Hawaii, before further steps are taken in this direction, as there is no urgency for shortcut-solutions. Furthermore, the new energy mix should be scaled to the future (curbed) energy demand, thus there is no rush to invest in generating capacity.

Energy efficiency programs and distributed generation represent opportunities to empower local communities, tackle the dependency from imports while reducing the outflow of profits from the island. This is one of the reasons why grid strengthening should be prioritized. It is an opportunity for all actors, creating revenues for the utility, accommodating renewable sources and enabling advanced demand side management and demand response programs. The low density on the island, though, is likely to make such an intervention quite expensive. The capacity to attract international investments, or the State's support to increase the utility's borrowing capacity, could come in help, but other options could be explored (such as the participation in carbon markets).

The previous interventions could come along with benefits for all the stakeholders in *the energy system.*

6.1 Final remarks

Hawaii is freeing itself from oil dependency, a turning point in its modern history, and faces many opportunities to do so, not only because of the plentiful options that the island offers. The electric company is abandoning a conservative mentality and declares itself to be ready to embrace a new course. Ready to focus on its electricity-distributor role rather than staying in the generation business; indirectly it is opening up for a major market restructuring that could come along with many benefits for the system and the community. It is the duty of the administration to push this process and assume a proactive role, nudging the utility in directions convenient for the communities it serves. Preserving the financial health of the utility is an important mean to ensure a reliable service, as the Renewable Portfolio Standard's goals are an essential element to stimulate the actors in the system towards a sustainable scenario. But means are not ends.

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Appendix 1 – Objectives and policies for facility systems-energy" - Hawaii Revised Statute, Chapter 226-1

(a) Planning for the State's facility systems with regard to energy shall be directed toward the achievement of the following objectives, giving due consideration to all:

(1) Dependable, efficient, and economical state-wide energy systems capable of supporting the needs of the people;

(2) Increased energy self-sufficiency where the ratio of indigenous to imported energy use is increased;

(3) Greater energy security in the face of threats to Hawaii's energy supplies and systems; and

(4) Reduction, avoidance, or sequestration of greenhouse gas emissions from energy supply and use.

(b) To achieve the energy objectives, it shall be the policy of this State to ensure the provision of adequate, reasonably priced, and dependable energy services to accommodate demand.

(c) To further achieve the energy objectives, it shall be the policy of this State to:

(1) Support research and development as well as promote the use of renewable energy sources;

(2) ensure that the combination of energy supplies and energy-saving systems is sufficient to support the demands of growth;

(3) Base decisions of least-cost supply-side and demand-side energy resource options on a comparison of their total costs and benefits when a least-cost is determined by a reasonably comprehensive, quantitative, and qualitative accounting of their long-term, direct and indirect economic, environmental, social, cultural, and public health costs and benefits;

(4) Promote all cost-effective conservation of power and fuel supplies through measures including:

(A) Development of cost-effective demand-side management programs;

(B) Education; and

(C) Adoption of energy-efficient practices and technologies;

(5) Ensure to the extent that new supply-side resources are needed, the development or expansion of energy systems utilizes the least-cost energy supply option and maximizes efficient technologies;

(6) Support research, development, and demonstration of energy efficiency, load management, and other demand-side management programs, practices, and technologies;

(7) Promote alternate fuels and energy efficiency by encouraging diversification of transportation modes and infrastructure;

(8) Support actions that reduce, avoid, or sequester greenhouse gases in utility, transportation, and industrial sector applications; and

(9) Support actions that reduce, avoid, or sequester Hawaii's greenhouse gas emissions through agriculture and forestry initiatives.

Appendix 2 – The Interviews

Name	Position	Tag
Robbie Alm	HECO Vice-President	HECO (R.A.)
Carlito Caliboso	Chairman of the PUC	PUC (C.C.)
Andrea Gill	Renewable Energy Specialist DBEDT	DBEDT
Guy Toyama	Chairman of Hawaii County Energy Advisory Commission	EAC
David Mattice	PUC Hawaii District Office	PUC (D.M.)
Jose Dizon	Operations Manager at HELCO	HELCO (J.D.)
Mike Kaleikini	Plant Manager of Puna Geothermal Venture	PGV
Kanoe Wilson	Program Coordinator at University of Hawaii – Native Hawaiian Studies – Relator of Cultural Interests at the Geothermal Working Group	WK
Cyndy Dyal	Sales Manager for residential DG technologies (retail and installation)	DG
Tommy Goya	Retired - policy consultant, worked for HELCO for 30 years	TG
Julie Myhre	Energy Management Analyst Department of Water Supply County of Hawaii	DWS
Energy Projects Consultant	Electric utilities consultant with decennary experience on mainland who had the opportunity to cooperate with Hawaiian utilities	EC

The extracts from the interviews included in this section contain some paraphrasing and editing in order to facilitate the reader. In particular the structure has been designed to group the answers of the different interviewees under the related question, creating a virtual discussion between stakeholders. In order to obtain this effect the transcriptions of the interviews have been adapted with minimal modifications. The adapted extracts have been send to interviewees for approval. Most of the interviewees have sent a positive feedback, and some presented some clarifications and corrections. Still, a minority has not replied while in one case the interviewee declared he wanted to review the extracts but didn't have time. In consideration of this, the extracts shall not be used as a primary source to quote the interviewees. Anybody that will make improper use of this material, and will not include such a disclaimer, shall also fully assume the connected legal responsibilities.

A2.1 Strengths, Weaknesses, Opportunities and Threats of the process according to the different actors

A2.1.1 What Are, According To You, The Driving Factors And The Strengths That Characterised The Process So Far?

PGV: When in 2008 the oil prices peaked to $150 a barrel, a lot of people started taking seriously the clean energy issue. Also at a user level people tried to back up on usage on their own initiative, being more efficient or installing PV systems.

HECO (R.A.): In a way the oil price is at the right level now ($70-$90), perfect to drive action but not killing off initiative. The $150 peak of course played its role in warning people, stimulating activities to reduce dependency.

DBEDT: A major advantage is the fact that we have naturally high prices for electricity because of our dependence on oil. We achieved grid parody before anywhere else in US (where they need strong incentives for promoting renewables); over here PV is by wide and far cheaper than utility power (possibly excluding Oahu). In 2008 we approached 50 cents/kWh and now we are at about 30 cents/kWh; on the mainland, in some States, they consider it expensive if it gets to 10 cents/kWh. High prices allowed some mature technologies to take off, but we are also trying to help with emerging ones.

TG: The driving factor is a definite need to reduce Hawaii's dependency on all imports. Hawaii's strength is it's climate and isolation in the middle of the Pacific Ocean, and not only for strategic military reasons. In recent years, Hawaii has been a very good location for energy research and development. Local government leaders continue to be encouraged by growing investments from the Federal government and foreign nations. This will hopefully lead to the diversity of sources and resources that Hawaii will need to reduce import dependence and to sustain its economy.

DBEDT: With the HCEI the cooperation with the Department of Energy has become much deep and broad. It's really an effective collaboration, while before they were basically checking if the State's goals matched the Federal indications.

HECO (R.A.): Furthermore, the clean energy issue now meets a political agreement that is unprecedented. We overcame the political risks and are now working at regulatory level. This also allows longer term planning.

PUC (C.C.): Giving the PUC the authority and discretion to implement policy directives is something that has worked, I would say.

PUC (D.M.): The presence of the PUC is extremely valuable; it helps to prevent the situation from spinning out of control. Consumers could be taken advantage of by the utility, but consumers sometimes are also naïve and expect that because the technology is there the change is just going to happen "like that". There is a regulator watching out for the ratepayers and stability, that's the good thing. Commissioners are concerned in protecting the stability of the system, and even if might take longer for the process they make sure that thinks are sensibly done. Not adding too much of something at one time.

PGV: The HCEI initiative itself created a pressure that gave us and other renewable IPPs more chances to be integrated.

PUC (D.M.): In general, the possibility of having fixed prices probably helped IPPs.

PGV: We're in the negotiation of a new contract, and a part that helped us (PGV) to come to an agreement is the fixed pricing portion, even if it's not really a specific feature of HCEI.

DBEDT: At the beginning actors were questioning where that HCEI 70% clean energy goal came from, while everybody now seems to be onboard; they have realized that is an achievable target.

PUC (C.C.): As far as it concerns energy efficiency it has been successful to have a third party administration handling the programs. Because if you ask the utility to take care of this you are asking them to sell less of their product, and that's how the utility makes money.

DWS: The SAIC staff has been more proactive in promoting energy efficiency, in my perception.

HECO (R.A.): Another driving element have been tax credits, which in combination with the high prices of oil, made it very convenient to invest in renewable energy, actually it's kind of crazy not going with renewable in such a context.

DG: Tax credits so far have helped very much. We know the Federal incentives are in until 2017, we hope that the State tax credit will be extended too. There are so many companies out there pushing for solar heaters and PVs, and this also got more information and education out there, as companies promote themselves.

WK: The community is more receptive toward the go-green movement; people are becoming aware also because of media attention on events like the Louisiana oil spill in the Gulf of Mexico. And more and more people are trying to become self-sustainable and, for example, go off the grid. The same applies to the construction of new homes. Grants have been very important for low-income families; there recently has been one from the Department of Housing and Urban Development. There also was really good communication handed out by the department of Hawaiian Home Lands (HHL) statewide. HHL passed on the information to the community level organizations (non profit) and they made the information trickle down.

A2.1.2 What are, according to you, the challenging factors and the weaknesses that characterised the process so far?

KW: A challenge that is perceived from the grassroots, in my experience, is that a lot of power concentrated in the hands of HECO and its subsidiaries. It is basically a monopoly in terms of distribution but the utility is also the gatekeeper: IPPs always have to pass from their approval to come into the grid.

DG: Working here with our electric company has been a bit of a challenge, slowing the growth of DG…

HECO (R.A.): There is a dynamic tension between an industry that is heavily tax incented, and would install one of everything in every place it could, and the challenges of an isolated grid. There is a level at which further integration of intermittents is really hard to handle. The solar industry views us as a barrier; maybe we have been too cautious, but when they say that there are no issues with integration that is equally not true, because integrations does represent some challenges.

PUC (D.M.): A constant criticism that the PUC receives is that we are in bed with the electric company. This is because people perceive a tendency to approve the requests of the utility. It's unusual to get a complete denial on a major company, so that's always there on the newspaper. But there is a general misperception; few people do understand what we are actually doing and how detailed and extensive the analysis of proposals is.

PUC (C.C.): The fact that we have to be concerned about the utility's rate of return while at the same time trying to keep costs to customers at a reasonable level and trying to implement policy changes is a challenge. I am not saying it is a bad thing, but it requires us to make balanced decisions that need to consider competing values, in order to preserve the utility's financial health and the service reliability.

HECO (R.A.): One of the challenges is that our company was, for many years, a barrier, a very significant barrier. This is when we had an old line way of thinking. The company is making moves to reform itself, but I am afraid that to a lot of people we will never change. And so there is a continuing fight with the utility that's a product of history and to some degree people have the right to be sceptical, and should definitely hold us accountable to make sure we do change. I am not saying they should lay down their weapons, but keep their swords in the sheath, so that we don't spend all this time fighting. Come after us only if we don't do what we should.

PUC (D.M.): The hard part seems to be that in Hawaii the situation is quite unique, there is no competition, and that's how business works. The monopoly is regulated to protect the rate payers, this is the bottom line. If there was more competition with an open market, not only for generating power, but also delivering it, maybe there would be more incentives to speed changes. And also the utility has the power to decide if they are going to buy energy from a new IPP.

PGV: Well the bottom line is that they are the only market, right? But HCEI did help IPPs in this context.

EC: The fact that there is no transparency and that newcomers have to perform expensive additional studies, are all things that act as barriers. It could be called anti-competitive behavior.

DBEDT: We are also concerned that many PPAs are linked to oil prices, so the benefits of renewable energy are not passed on to the consumers... but what can we do about the existing contracts?

PUC (D.M.): For every change or initiative there are so many procedural steps, every decision becomes really slow, dockets are huge documents, and they are not so easy to access for the general public. They are there, which is very important, but giving so much information that makes is hard to grasp the essential.

PGV: Even the procedural steps you have to go through with the utility are really time-consuming. The process itself takes a lot of time.

EAC: All these things have been done without involving the general public. People don't have a clue of what is happening. There has to be more mainstream involvement. HCEI, in this sense, has been going backwards. DBEDT hired very expensive consultants and worked with HECO and DoE, and then told the public "this is what we are going to do". And by the way they did not address how they are going to achieve those energy goals, or who is going to pay for their achievement. And nobody has set out a real action plan so far. That is what we need. I would like to see our County to be different from the State. Have an initiative that includes a detailed plan and involve the communities.

EC: Even the press doesn't help to get the information out there. People basically don't have a clue of what's going on. Journalists should do more than just printing press releases.

TG: The current process lacks an updated general plan for Hawaii. When is our economy going to improve? What are the economic drivers of the future? Where are the jobs? How do people incorporate change into their living styles? These questions should be addressed before some of the specific target energy goals are thrown out there. For the process to be successful, people need a long-term vision that they believe in, but if it starts lacking in continuity and consistence it will not work. The process will require more education, integrity and leading by example from the government. The most challenging factor is a major void of champions of a "Greener Hawaii" on all levels of decision-making.

EAC: Under the previous administration, there never was a goal created for the mandate timeframe. There was some ambiguity on what he wanted us to do. Probably some research and put together some recommendations. But without precise goal setting it is very difficult to achieve something.

HECO (R.A.): A complicating factor is that we are a relatively small utility and this limits our borrowing capacity. As we have analyzed it there is no way that we can do everything including owning that much renewable generation and restructuring the grid, and we need to focus on areas which are uniquely our responsibility like the grid.

DBEDT: The growth of solar installations has been very good, but people have a hard time with the upfront investments, we will try to help with that.

DG: There is not enough openness for large projects bids. Developers normally have their providers. Even for County projects that involve PV or solar heaters I would go in and ask for a bidding process, more than a year before they even start working on it, and they would already have selected their provider. The same applies to grants and incentives, only some

people get the information timely. And it's not that I don't know this community, I've been here for 20 years.

PUC (D.M.): In this State politics are very big. Everybody who lived enough time here knows it.

A2.1.3 Do you see upcoming opportunities that could help a further development of the process?

DG: Education, it's all about education. Now we're having a hard time because of the bad economy. But if people could see a rate of return on their investment it would be different. People are becoming more energy conscious, and playing their part in saving the planet. But people are more interested in saving money, in my experience. Sometimes I tell customers how many trees they can save and they are like "Yes, but what's the bottom line?" and want to know how much they can save. So education. There actually are good educational initiatives but more people should be reached. People have to understand that they can combine an economic opportunity with good citizenship.

DBEDT: We can not underestimate the power of education and community-buy influence. We have also seen the general public being able to oppose non welcomed projects. Their voice is important. Not only in blocking initiatives but also in developing opportunities, the public is on the front line with the Distributed Generation uprise.

KW: Involve the community from the start, give visible information about meetings, projects, request for proposals… I would like to see even the utility being more proactive in getting to their costumers. An example: when the Hawaiian Telecom company was laying down new fiber optic lines it came to each of the houses brochures and explaining what they were doing. The community access channel is important here. Decision makers would welcome community input and feedback. Communities must feel that they are there to listen and perhaps they can't write the plan themselves, but it's important that they can access it and are there ready to be listened to.

PGV: The community from a grassroots level could have a very powerful influence this transition. So people should be well informed to make aware decisions and create pressure. It's up to the users to tell them we don't want to burn oil anymore. People can have a lot of influence. When the oil prices peaked, people were shocked; some considered staying at home and getting the unemployed benefits rather than spending money on fuel to go to work. I think that's were the influence can come. Public pressure.

EAC: There is a big difference between Hawaii and mainland. Here as long as it is for the greater good, people will support it. This is the "socialist" dimension of Hawaii. And if people are informed and involved they will push for initiatives. If the public is told at the last minute about a project or measure, people will most likely oppose it.

EAC: It is important at a very early stage to create an outline for a policy and then go out to the public. And at each district in the island. Getting feedback and explaining what the policy is about. I think the forums should be done through the representatives in the County's Council of the 9 district we have on the island. In each district there is a Community Development Plan. For each of these CDP there is a steering committee. So we would work with these steering committees to arrange for the community to come up ad give us feedback and input so we can make sure we are all going in the right and desired direction. The county

with us commissioners would head in every district and have a forum. My experience with the public is that they want renewable energy, and actually the typical question is "Why is it taking us so long?"

PUC (C.C): Having a greater market for renewable sources would hopefully reduce the costs and help to make those resources more cost-effective.

EC: Functional unbundling of the utility, with the creation of an independent transmission operator, would greatly increase the transparency of the system and give clear price signals to providers.

PGV: Technological solutions that make geothermal power supply dispatchable (as our last 8 MW) are a great opportunity. Not just for us, but also for HELCO or someone else who could develop a geothermal project!

PUC (C.C.): The development of technology will be a crucial element. Storage, generation, but also technology, that allows the utility to ramp up or down its generators more quickly.

HECO (R.A.): Investments on infrastructure strengthening are a great opportunity for us. They give us the same rate of return of generation projects, plus we don't generally have to fight for their approval, as people actually want us to develop them.

EAC: Involving the communities could also be a good leverage point to convince the Federal government to make investments in Hawaii, for example to become the true laboratory for smart grids. That is really what I would love to see. This island as the laboratory. Tourism, even if we should become less dependent on it, still is a great economic engine. Tourists are becoming more sensitive on environmental issue, so if Hawaii becomes a green island or a sustainable island, with high end technologies, it is going to do wonders.

A2.1.3 Do you see upcoming threats that could hinder a further development of the process?

PUC (C.C.): Fluctuations of oil price make it hard to evaluate the cost-effectiveness of solutions. In summer of 2008 when oil was over $140 per barrel, some things made a whole lot of sense, but then in spring of 2009 they would not be as appealing. But people have to be aware that the prices might go up again in the near future and that we need to be ready.

DG: People under the FIT might oversize their systems and this is cause problems with integration. Already now we have to do studies if we want to install PV in some areas. And the study, depending on the size of the system, can cost from $2 500 to $30 000 to the client. Then you kind of block the growth of DG but at the same time more and more people are going off-gird, which is the tendency I see.

PUC (D.M.): We also have to protect the grid and allow the utility to provide a stable service. A lot of that has to do with the rules that the Utility sets for interconnection. HELCO proposed a rule change that required an independent producer (or user) to supply an additional study to prove that the connection does not make the grid unstable; PUC would approve that to protect the grid but at the same time it discourages people from connecting to the grid. It could at the same time hurt HELCO because then people are encouraged to just go off the grid and they lose customers. I was talking to this woman running a restaurant short time ago. She was installing a 50 kW PV panel and received a request from HELCO to

provide an additional study, worth $25 000, because she wants to remain connected to the grid, so that if there is no sun she can still get power. HELCO said it was a big system for that area. Now she might consider putting an extra panel or buy storage and just go off the grid.

DG: It is going to be a challenge to engage very high end owners who are in their holiday home for a short time each year. They see a better return on their dollar with other kinds of investment. But I see a lot of waste there, and I think that giving back a little help to the community and the world would be a nice kokua[13] on their part. I designed a system for a very wealthy home all panels on the roof, and we could've cut their bills in half. We are doing more business with folks that are actually asking an equity loan to install their PV.

EAC: If the public is told at the last minute, it might oppose also potentially beneficial projects. Many projects encountered resistance… geothermal power plant has run into problems in the past, land acquisition for biomass and biofuel projects were opposed too. The same happened with the microalgae project that wanted to come here at the Natural Energy Lab, it came too sudden. Opposition driven by the perception that government is "in bed" with investors and they are going to exploit the community. This happens if there is too much of an element of surprise... And if you try to force it they will sue you.

PUC (D.M.): There is a political risk because with elections some positions could change, including the chairman of the PUC; consequently the approach towards some issues at stake could be altered. I don't think a new Governor will change the whole system, but I know that some candidates suggested restructuring DBEDT or the Energy Office.

EC: This political instability does not reassure potential investors. Hawaii does not have a very good reputation with big investments. Even the interisland project is taking way longer than planned, and the superferry failure is another story that casts shades on project stability here.

HECO (R.A.): The zero sum thinking represents a major challenge. People are still spending lots of time fighting with each other. We have to get (statewide) to 40% renewable generation and 30% energy efficiency, so there is room for everybody. But people seem to be thinking that we are dealing with a finite pie, and if someone takes a slice it is going to be at the expense of somebody else. It may apply in other fields, but not in this case, with such aggressive renewable goals. We should stop fighting among ourselves. Offsetting oil we still have 6-8 billion dollars worth of work… there is room for everybody.

A2.1 Other Focus Areas

The interviews also addressed issues that are central to the development of a new energy scenario. In the logic of this study it is important to have an understanding of the structural elements and the dynamics in the system before any specific solution is suggested. At the same time I believe it is important to report the different point of views of crucial actors about currently debated issues. Finally, I hope that these interviews can clarify some issues to the Hawaiian public: during my stay on the island I perceived a widespread lack of clarity in the understanding of the regulatory environment and the mechanisms that characterise the system

[13] In Hawaiian language "kokua" means helping out, supporting others

A2.2.1 PPAs

Can new PPAs between IPPs and the utility be based on avoided costs?

PGV: There is no more "avoided costs". There are contracts out there linked to oil prices but the new ones can't...

PUC (C.C.): Should be from now that PPAs are decoupled from oil prices. The price of generation is transferred to the users no matter what… There is no profit margin that can be made on the PPAs. So ratepayers would benefit from integration of more and cheaper renewables over the long term.

What are the chances of reviewing the existing contracts based on avoided costs?

PUC (C.C.): Imagine being an equity owners or somebody who invested in a power plant… Lenders and financers agreed to fund a project under certain conditions, how would they feel about seeing them changed after they made their investment? Or even, would someone be ready to invest here if they know that the PUC can change these contracts along the way after they made their investment? People have been asking this, but it may not be allowed under constitution as well.

DBEDT: It's not going to happen that we can intervene, but it would be totally beneficial for the customers, for sure. Currently it is the IPPs that reap the benefit between the actual generation cost and the avoided cost level. Of course they could reconsider voluntarily their existing contracts…

PUC (C.C.): Of course if parties agree to review the PPAs, they can do any change, we can be happy to see some changes, but we can't require it. In fact they might renegotiate part of the geothermal PPA. If you had subscribed a contract at avoided cost, why would you give it up?

PGV: That's true. We have investors so it would require a major effort to convince them to renegotiate the first 25 MW (out of 30 MW) that are based on avoided cost. Our contract is running until 2027.

How will it work with new PPAs?

PUC (C.C.): They have to submit the PPA to the PUC for approval, in order to check how it is going to affect rates, how compatible it is with the policy that we need to achieve that it is consistent with goals. Even with the new planning process (CESP) once it will be up and running again. You're always trying to get them to promote and develop PPAs that integrate renewable energy. And if the project is large enough the utility has to present a competitive bid, so there is an effort to keep costs low.

PUC (D.M.): PPAs include confidential information that the PUC can review but that are not open to the general public.

PUC (C.C.): HELCO does not share with others the negotiations with an IPP. They will tell you they are in contact with many IPPs classified as renewable. These potential IPPs will include biomass (eucalyptus trees on Hamakua coast for example), wind, solar, and other renewable energy resources.

A2.2.2 A New Utility Model

Federal regulation has been encouraging a liberalization of energy markets to reduce the monopolistic and vertically integrated power of privately owned utilities. How does that apply to Hawaii?

PUC (C.C.): Generally, Federal Energy Regulatory Commission directives do not apply in Hawaii. The situation here is very different with isolated grids on each island, and we are not connected to the large interconnected grid that is on the mainland. So it would be a technical and policy decision to require such a restructuring of the local electricity market, given consideration to the characteristics and the small sizes of our grids.

DBEDT: There have been some currents pushing for a municipally owned utility. From the statues they are in charge of the distribution but there is nothing against them also doing generation or buying it from IPPs. It's a transition period, HELCO has stated they will not invest in new fossil fuel plants but still have some capital invested in existing plants. If you told the utility could not generate anymore from something they invested in, you would have to give them compensation. Nevertheless, they do have some very old power plants on the island which they have been talking about retiring for a very long time and have not done it yet.

PUC (C.C.): We are moving towards a more liberalized scenario also with the help of competitive bidding, the net metering, and now the FIT; a lot of generation coming from non-utility sources. If we should move towards a 100% generation not coming from the utility that is a bigger decision. Furthermore if they are willing to do that they would have to come to us for approval. The utilities are moving towards less and less generation though, even if they always told us that they need to control a certain amount of baseload because they have obligation to serve and nobody else has it.

HECO (R.A.): Some of our plants are fully depreciated and we don't make any money off fuel as it is a cost we pass through to customers. On the Big Island, the only plant that is significantly new is Keahole, and that plant can be biofueled. The older plants on the Hilo side have basically been paid for, so we don't have as much to lose. All the costs of fuel we get to recover 1:1 because it's passed on, like labour, maintenance and operating costs. The only variable in our financial equation is capital investment, as we have a rate of return on it. What we make money from is that capital investment. And as we switch to more renewable energy and energy efficiency there are huge investment opportunities for investment. It will give us as much revenue as a new plant, plus we don't have to fight for it because people want us to install smart meters, smart girds, allow higher integration of renewable. So there is, for us, hundreds of millions of dollars of capital work lie ahead on things that facilitate renewable energy; and at the same time, we would keep the power supply we need to back up these renewable activities. A lot of our money in the future is going to be on the transmission delivery, control rooms and meter side of the equation. So if we put our plants in storage instead of actually using them full time the company wouldn't be running a big risk, or at least a small enough risk to ask the PUC to amortize the remaining costs over a couple of years, so we will put the black units away. Retiring our units shouldn't be a major loss in those circumstances.

Could the PUC raise funds through the PBF to compensate HELCO for shutting down some plants?

PUC (C.C.): PBF is used just for energy efficiency programs, and is not enough to cover major generation investments; it's not intended for that.

We could say that HECO might see an opportunity in refocusing the strategy more on a transmission/distribution/retail model rather than generation?

HECO (R.A.): Right, and then generation as backup because a lot of the renewable stuff especially wind and sun and even geothermal has challenges. So if we used to dispatch, let's say, 100% every day from our steam units we may go to 20% on a daily basis, but they will be there if needed (e.g. no wind or sun, technical problems...). So the money we are saving on oil is being spent on wind and sun and geothermal instead of being sent out of state. The state wins, we're ok because we're compensated for our expenses, and we are also making money on all the investments we need to accommodate renewable. We will use our borrowing capacity doing the transmission, distribution, smart grid and some backup energy. That's the reason why we haven't gone into the wind farm business, or the solar business, or the geothermal; we just don't have the borrowing capacity for it. We will be focusing on the things that are really in our core business, by common agreement, and then use our generation to back up the system, while generation will be increasingly done by third parties.

HELCO (J.D.): We already are distributors, we are providers. This is our role, we take the energy from all sources and we distributed on the grid, but of course when the wind starts blowing we have to be able to back it up.

But you can't really say you are backing up renewable energy, because you start your plants first and then take IPPs on-board as the load increases. So it is renewable energy that backs you up…

HELCO (J.D.): The fact is that you can't start running the steam units on a moment's notice. Things can get very technical, and we're trying to say some things that not always are grasped, and as an isolated grid we are facing things that in interconnected grids they can not see… We can't risk breakdowns, because if problems happen we end up losing a lot of customers.

TG: The major point that I am trying to make people understand is that each island utility's current power dispatch to the energy distribution grid is governed by a reliability first priority that includes a purchased power "pecking order". The determination of the "pecking order" was refined at the time each successive agreement, PPA, came in place. These existing contracts vary in price, availability, performance, curtailment, and expiration date and, as long as they are in place, they will affect future PPAs that may not tied to the price of fuel oil.

A2.2.3 Institutional Capacity

Who can be driving the process towards a clean energy system?

DBEDT: It is central that state administration, legislative and regulatory bodies, and the utility have an agreement on the goals. This is what we are achieving with the HCEI. But you can't do anything unless the utility agrees with it. PUC is given the authority to take action against the utility, if they don't meet the RPS goals. In 2008 the 70% goal was announced publicly after a lot of discussion and groundwork in the previous years. With a lot of nudges from the Governor who is very much on the frontline.

DBEDT: The HCEI is not a legislative or executive body, HCEI identifies if more legislation is needed or if changes in how the PUC operates are wanted. A number of the regulatory changes the PUC is now working with, like FIT, came through the HCEI process.

PUC (D.M.): The initiative is a white paper, a non binding straw-man, a collaboration to build up ideas and develop a broad framework for change.

PUC (C.C.): As a State we have some policy goals to achieve, and because the utility wouldn't achieve them automatically, we, as the PUC, are tasked with their implementation. While we are tasking the utility to come up with more renewable, we also have to try to keep as reasonable as possible the rates and at the same time make sure that a service is provided. And we have to make sure that the utility is financially healthy. At the end of the day it is almost conflicting goals. We can't say take this renewable and don't care about reliability or rates, for example. The utility has to find a way to take on-board more renewable energy.

PUC (D.M.): What is interesting is that in the last couple years the legislator has given more power to the PUC, which now also has a more active role in guiding the process, as it can come up with regulatory instruments. This is still under the HCEI influence.

TG: The Governor's oversight does have an influence on strategic decisions in Hawaii, but of course this also translates in a potential lack of continuity during times of political and economic instability.

Does the PUC have an adequate staff to take care of all these tasks?

PUC (C.C.): The legislator has recognized that issue. I presented a restructuring report that was approved, but when the economy went bad it was temporarily suspended. Now in 2010 they got back to us so we are working on getting our resources up to speed and implement the restructuring plan.

What is your typical role?

PUC (C.C.): If the utility comes up with a proposal, evaluate it on the record, see what they are proposing, open a docket and involve interested actors: consumer advocate, environmental groups, solar or wind industry non profit groups you might let in…

PUC (D.M.): On the other hand the decoupling proceedings were initiated by the commission, which is kind of unusual.

Can you push the utility to accept power from a provider they are not considering? Do you have that capacity?

PUC (C.C.): No. We are regulators; we are not managing the utility. We might indirectly say why aren't you doing this, and they would be expected to reply, but we are not their managers…

Can you ask them to shut down some plants to include more renewable?

PUC (C.C.): That would be something to be decided through the RPS, the Commission will not come up with "shut down this or shut down that", but if they have to come up with more renewable energy, and there is no demand growth (actually with energy efficiency we are trying to shrink the pie), at some point you have to start shutting things down in order to get that percentage. So we wouldn't drive it directly, but indirectly the process is driven by the fact that they have to meet the goals, and how to do it is pretty much up to them. Again we regulate them, not own them.

Is there a planning body at the state level... managing the energy plan, or is it all in the hands of the utility?

PUC (C.C.): The PUC established a process in the early 1990s called Integrated Resources Planning; recently we have an open case to evaluate when we should revise that program. It would be to incorporate concepts like scenario planning, actually it is going to be called (if approved) Clean Energy Scenario Planning. And that process does fall under the commission.

What about at a County level?

EAC: The previous County administration had put together the energy commission to develop recommendations for local policy. Interestingly it is quite common that the legislative branch accuses the administration of moving too slow. I think that this push is a positive element. It is important that we set goals at a County level, in order to focus efforts. I was glad to hear the Major setting a "50% renewables" goal for our island.

How much can be decided at a County level? Do you have to rely on State-wide decisions?

EAC: The State is very much concentrated on Oahu, since it drives our economy. I think the other counties should take care of themselves as much as possible. And counties can work directly with the Federal government, even better. We are hosting on the island the Pacific Command of the Department of Defense. Therefore when we talk about energy and food security here we are talking about national issues, I think we can count on support to achieve our goals.

A2.2.4 The Evolution of The Energy Scenario

Is there enough power generation on the island?

HELCO (J.D.): We have 46% reserve margin.

Then, in order to actually use more renewable energy, some baseload replacement shall take place…

DBEDT: Replacing baseload is an issue. Technology as geothermal can work as a baseload replacement, as the new 8 MW expansion should prove, but also biofuels are an option.

HECO (R.A.): In time we will shut down some of our plants and we'll put them in storage, keeping the air permits, in order to back up eventual problems with integrated renewable sources. I don't know how many power plants we will actually dismantle until the system reaches a certain reliability. Shipman (the oldest plant in the systems, that we should really take down) actually was a crucial backup the last time geothermal ran into some problems. One of the challenges even with geothermal is that the plant can go from a 30MW output down to 10 MW in a day, because of steam source getting plugged.

HELCO (J.D.): The PUC appreciates that we have the obligation to serve, we are required to serve users whether we loose money or not, and anyways we can recover costs through PUC approval. If IPPs for any reasons start loosing money they can just shut down. So the PUC always wants to have a quote of generation under obligation to serve. This is also why they want us to participate in bids for new firm generation.

EAC: We all understand the issues of reliability, but we have to find some alternatives.

PGV: In our case we went to HELCO saying we had the capacity for supplying more power. They first said that they had more than enough power, but that given the plus that we are a renewable source, HELCO was willing to discuss under a pre-requirement. The requirement was that the power supplied should have had the same characteristics of the utility's power generators, basically dispatchability, grid support and ancillary services. So we took a look at that, and our engineers made it possible, and the new 8 MW expansion could take place. That is the key for the expansion of renewable energy penetration. HELCO wants something that can take the place of what their oil power plants do today, the "as-available" characteristics of the wind have been a major challenge for the system operators.

DBEDT: But we do know that geothermal generating costs are far below the avoided costs, and as consumers we would be paying much less if these saving were passed on to us. Geothermal could double its output according to permits but there is no market for that power…

PGV: We have a permit for 60 MWs but we don't have a contract for it. The fact is that on a grid you should try to generate power close to where the demand is, our company should push more on that. We have facilities in an area where there is not a lot of demand, so there is kind of a grid lock-in. If something could be worked out on the West side of the island, and if oil prices happen to go up again so that our prices are really competitive with their generating costs, HELCO would probably consider some replacement of their plants.

Is there the possibility to review the existing PPA and renegotiate it for 60 MW, so doubling the current output? It could be appealing for all sides…

DBEDT: Nobody has ever addressed the issue on these lines; we've been concentrating more on shifting load to hours where there is renewable curtailment.

PGV: We would be interested in finding some other market for our curtailment. We are talking with some people for ammonia or hydrogen generation. We typically curtail 10 hours a day 3 MW.

What could be an incentive to make the utility integrate more renewable energy?

EC: Something would be needed, because as things are, HELCO has no incentives to do so. They would just lose some control on the system

PGV: I guess that if there was a mechanism with which the utility could make some kind of profit on purchasing renewable power that would give a significant incentive… But as I said, once we will prove for the new 8 MW that our dispatchability is reliable, it will encourage HELCO to consider more geothermal integration.

HECO (R.A.): Beyond the new 8 MW contract, on the Big Island there is a potential for hundreds of MWs of geothermal, which could one day be exported to the whole island chain. Now we should probably build another 20-30 MW on the West side. We have to work with the native Hawaiians which have some concerns, but if we can do that I'd rather have geothermal as an integrated renewable. On the other hand there is also a biomass plant that has been looked at on the Hamakua coast, and we know there is some movement to buy land for biomass, there is some good forest land there. First we should biofuel Keahole (it's the newest plant we have; it's in the best conditions and on the West side). We think it will be needed for at least the next 10-15 years, so we'll get paid for the investment and, in the

meantime, we will develop more geothermal (or some other renewable) then we will consider slowing it down.

How much would it cost to biofuel a plant?

HECO (R.A.): On Oahu we did a study for Kahe power plant, which has 6 units for a total of 700 MW. The estimation was of 4 million per unit to convert it, so a very low capital cost. If the interisland cable will take wind energy from neighbour islands we could still ramp it down, but we will still need to keep it running.

What about geothermal costs?

PGV: When people say geothermal is cheaper they should watch out. Today a new oil fired turbine unit would cost something like $2 000 per kW, while a geothermal project would cost $5 000 - $ 6 000 per kW. The infrastructural investment is much higher. But then we have to see the fuel prices for combustion power plants, and that will determine the payback time.

Back to Biofuels...

HELCO (J.D.): We haven't negotiated a purchase power contract yet but we did develop a term sheet with one company. But we have already so much renewable energy on the system that when it's time to dispatch this biomass unit we will have to back them down to their minimum load level. They would like to run at a higher capacity level, they have 25 MW that are dispatchable, and they would like to dispatch at an average 20 MW. There's so much renewable energy on the system that they're going to be able to dispatch only 16 MWs, so they're going to say I can't make my project work unless we raise the energy price.

DBEDT: I am not sure about how many can be converted to biofuels, but we hope it's going to be a big part of the solution.

The Revised Statutes talk about relying on sustainable energy sources that foster Hawaii's independency...

DBEDT: We can locally grow or own fuels instead of importing them and that's a plus. Biomass and biofuels are the only resources we have that can be used to give us liqueous and gaseous fuels, the other sources can give us electricity or heat. But we know how to burn stuff for electricity, that's for sure. And they are also going to be hugely important for the transportation sector. Biofuels and biomass are players we've got. The question is what kind of crops shall we use, what yield per year is achievable...

People could be concerned shifting agricultural land use from food to biomass/biofuel production.

DBEDT: The Department of Agriculture is looking at this. But we have a lot of agricultural land that is not being used at the moment. What I am seeing is that all our farming land is being converted to housing, or gardens with a couple of horses running there: that land is not producing food either. If we can give incentive to preserve agricultural land we should. It is hard to understand what the scenario is going to look like when farmers will have to decide which kind of crop is a better investment. We are very far from an understanding of how many acres we would need to produce a certain amount. But what are we doing now with biofuels? We got biodiesel from waste oil, some dedicated crops, we have potential for ethanol, and experiments with algae are coming along. We can grow trees very well and sugar cane too with high yield. But we can't grow anything for sure if we change the use of ag-land.

HECO (R.A.): We are experiencing an under-exploitation of ag-land, the topsoil is running off because there are no cultivations. Maybe one day we'll reach a point where food and fuel compete, but now we have vacant ag-lands. It is not our goal to replace all our liquid fuel we use today with biofuel because as we integrate more renewables, the liquid fuel use should be less than it is today. We just issued a Request for Proposals for Biofuels and we have enough bids to have it significantly produced locally if those biofarms work. At that point nobody will want us to take that plant off line because everything it produces is green electrons.

TG: I seriously doubt that we can produce all the needed biofuels locally to reach some of the stated energy independence goals. Hawaii does not have the topography that allows for large-scale intensive industrial agriculture. And then there are the availability problems of non-potable water, work force and chemical fertilizers. Furthermore, I have seen double counting proposals that use the same land... to argue that Hawaii could meet its energy and food demands.

EAC: I think we have to define what is renewable. To consider biofuels as renewable they must be locally produced and sustainably. So biofuels and biomass coming from Hawaii but not ones that are imported. HECO is signing contracts to import biofuels; it is not different from importing oil or natural gas. I would like to get the Major to specify that if it is not locally made it can't qualify as renewable. That would help to define our planning. So that simply replacing the fuel in existing power plants does not do the trick.

PUC (C.C.): We can have an indirect influence I guess, but it's not up to us to evaluate what the mix should look like or what specific technology represents the best solution. The overall driver is the RPS, the big instrument to drive the utility. They have to decide which is the best way to achieve the targets, and then they also have to convince us it's a good way. So we're not directly telling them to shift to biofuels, but they are moving towards that. When they will come with a proposal, at the end of a bidding process, they will have to seek approval, and the commission will decide if we want to push them in this direction or not.

WK: Communities are afraid it's going that there is going to be a competition between biofuel land and ag-land. Already 90% of goods are important to the island, and most of the food is imported, even if in the State we are the largest food producers. We would like to be reassured about more food security, independency and self sustainability.

But communities have also been opposing geothermal energy in the past...

WK: We do feel we have to outweigh a trade off between geothermal and biofuel, somehow. Our leaders should plan it carefully. In the 80s there was this big issue of exploiting geothermal energy to export it to Oahu, and that encountered a very strong resistance. The communities feel that the resources of their island should be first of all be used by the locals. The native Hawaiians have softened their positions about geothermal, but there still are some pockets of resistance. People can feel the manifestations of Pele[14] every day; She is a Goddess that in the community is felt every day from the flumes, the lava, the rumbles... On the other hand there are people that are concerned about the possibility of having a good renewable source. But there are people that strongly believe in Her, we have to develop this discussion in a delicate way and with awareness of the communities' feelings. In order to become self-sustainable people are going off-grid, but there is a risk that this will increase the costs for the

[14] Pele, in Hawaiian traditional religion, is the Goddess of the volcanoes

other consumers that are still stuck to the grid. I was talking to Jose Dizon and he told me that more users there are, the cheaper the bills would get, so more development would drive costs down.

What is the approach, on a State level, towards emerging technologies?

DBEDT: We saw many mature technologies taking off, and have expectations on other ones that we are trying to help. We have not done what happened in other countries where they gave strong incentives for a specific technology. We don't have huge funds like in the European Union, and we chose to invest on different technologies, going for a mixed portfolio.

What about distributed generation, what are the trends in the system?

PGV: I know that they don't have a precise grasp of what is out there. I heard an estimate of about 9 MWs, which is huge.

DG: As I said everybody wants to sell solar installations now. Seems like the utility should upgrade its infrastructure to accommodate more PV, so now the market is very active on solar heaters. At some point we might start pushing for off-gird solutions if the utility doesn't allow further expansion, but that would hurt them. People are finding many different solutions with storage, from golf carts' batteries to home made ones. And of course they have to change their life-styles too and plan their energy use.

PUC (C.C.): We are still finalizing the Feed-In-Tariffs process, and have to decide what the exact tariffs will be in place and what percentage can be covered with DG. Of course the utility still can refuse interconnections if they would cause substantial harm to the grid.

So the utility would have to prove it? Now it is the user that has to supply the study... Is there going to be a reversed burden of proof?

PUC (C.C.): That is yet to be issued in our final order.

DG: What we have in place now is a net metering agreement. With a grid tied battery back up system the users get from the grid the power they can't generate themselves. If a tiered system comes in people would be only using electricity from the grid and then have a capped output that pays them back. The result is that people will have to put in larger systems to compensate for the amount they will have to pay for. And there is not much room for more systems.

But doesn't the DG, under the current configuration, replace power coming from other renewable sources? I mean they are not eroding the fossil-fuel baseload and they probably are harder to integrate…

HELCO (J.D.): Absolutely, that is what we're saying. We are increasing the cost of energy on the island because we have to prioritize the intermittent stuff, which is expensive. Because the renewable energy standards are based on energy, not capacity, the green intermittent energy is replacing the green firm energy. You do not increase your renewable energy balance. The mindset is maximise wind, maximise solar, maximise all renewable energy… While from a policy standpoint we should be understanding what is the right amount of solar, what is the right amount of wind ,the right amount of geothermal… you know we don't preclude any, we are not in this market.

How does the utility envision the future of the energy system?

HELCO (J.D.): I think the commission will always match us a certain amount of generation by third party. And if we're going to decrease the amount of energy we consume through energy efficiency programs, people shouldn't be building many more power plants here... If anything shall be build in the future it shall be small distributed plants, spread out across the community. I don't think there should be other central plants build, with the possible exception of geothermal. And we will try to convert all our plants on all islands to biofuels and keep them alive as long as possible because it's already sunk investment the users paid for.

HECO (R.A.): Even if 40% renewable by 2030 is the legal requirement, our goal should be 100% locally produced renewable energy. We need all the technologies: geothermal, biomass, biofuels, wind, solar, ocean energy… our current plants will continue to exist if only as a back-up.

A2.2.5 Strengthening the grid

It seems like the grid and the distribution infrastructure needs upgrades to accommodate more renewable energy. What is the current scenario?

EC: People at HELCO are right when they say that in an isolated grid there are some challenges, but the utility could and should do much more to improve the transmission infrastructure. There are technologies out there that could really help. I've seen them applied in Texas, and here, as far as I know, they didn't even take a look at such options.

DBEDT: Each island either has completed, is in the process, or will have a grid study to address this issue. HECO has received some funding from DoE to do some testing with smart grids. There is a lot of interesting potential but it will also depend in which direction the grid is developed, I think. The grid restructuring can have different priorities: renewable energy, reliability, communication with users…

HECO (R.A.): We need to strengthen the grid as part of this work. One problem outside of Oahu is that we have on a small rate base and already very high rates. We have to balance between investing and having the grid people would like and the fact that there aren't many rate payers to pick up the cost of it. And if electricity prices get even higher nobody can do business. We have debated and will continue to debate the idea of State-wide rates, because having everything in the same pocket would allow wider investments, especially in neighbour islands.

PUC (C.C.): Also in the case of smart meters and smart grids the utility will have to supply us information and explain the benefits and costs for users, in order to seek approval and get cost recovery for the investment.

DG: The utility has to upgrade its infrastructure to accommodate all these PV systems (also in consideration of the oversized systems that will be out there to compensate the feed-in-tariff) When we started we could install systems wherever and whenever we wanted.

EAC: There hasn't been any discussion in the EAC about Smart Grids, although it is a subject that I intend to bring forth more in the education, the utility and the planning committees. People have to understand that smart grids are important and start pushing for

policy. With a bottom up approach. Education and planning committees can play an important role in this, with the help of the County. At that point we could open up the doors to a PBF surcharge for a smart grid.

EC: It would be a capital intensive practice, but I don't understand why HELCO is not grasping some opportunities. Quite recently there were funds available from DoE to match investments in smart grids. Some utilities asked for fifty million dollars (so a one hundred million investment…). HECO, asked for five million dollars, in total, for all the islands… Just to do very little incremental improvements.

What could be done on the existing grid in terms of DSM and DR?

HELCO (J.D.): On the current grid it's possible to have time-of-use tariffs, and we have in our current rate case a pilot that we would like the PUC to approve. The Big Island has twice the line mass of all other islands combined and we have the lowest population, that's a challenge for upgrades. We serve about 20 customers per square mile, while in Oahu there are 500 customers per square mile. We have a plan for smart meters and we are pushing for it.

Did you ever consider clustering some microgrids for the remote areas of the island, so you reduce your line mass?

HELCO (J.D.): We looked at that, and have some studies. Kohala, for example, is served by a radio line, but they don't like when they are cut off if a line goes down. On the other hand we have to handle the costs, and doing a microgrid will cost as much as putting a second line there...

What about the interisland cable?

EAC: From HECO's point of view, that's the only way they can take power to Oahu from the neighbor islands. But I don't think that this affects Hawaii Island so much because Hawaii Island should go at 100% renewable before we can even consider a cable connecting us to other islands. I don't think it's going to happen to connect Hawaii with Oahu. We have 7000ft deep and strongest currents in the world, so there are also logistic major challenges. The only people talking about interisland cable are on Oahu.

HECO (R.A.): We support it as the neighbor islands have the renewable resources while Oahu has the load. If the power flows here to Oahu, then clearly Oahu has to do something for the smaller islands back... for example starting to pay some of their rates. That's why I think we should have centralized rates based on Oahu, to make it fair.

WK: Communities are very concerned that what comes from the island stays on the island. Or at least serves the island first. Sending resources to Oahu would meet very strong opposition I think.

A2.2.6 Information Flows

Are you satisfied with the information flows in the system?

DBEDT: There is definitely the need for better information. Colleagues in the regulatory and policy areas often complain that they don't know what the actual operating costs in Hawaii

are. There are problems in accessing key data on flows. The utility also wants to protect its customers and this makes it hard to access net metering flows. We have a big need of data to calculate FIT costs, and colleagues were scratching their heads. We couldn't even get the data on how much is being curtailed in the system.

PUC (C.C.): It depends from the situations. When projects are competitively bid, less information are needed. That's the intent, driving the price down and getting the best offer for the generation. If there is no competitive bidding than we have to take a closer look, on what costs are, what is the investment, the tax credits and thus understand if they are charging a reasonable amount or not. You could always use more information, and it's hard to understand how much more you can ask time by time…

DG: I found out about Hawaiian Home Lands grants almost by accident, and there are unique opportunities coming up. I would've liked to know this a little bit sooner. I got late on that because I was not aware of the program and people who were aware wouldn't share. So I think there should be a fare communication effort towards all contractors involved. There are several options that people should be allowed to select from. SAIC, who has a list of qualified contractors, could do email blasts. The same could be done when an agency starts a grant program. County officials of the planning department should also start fair and open selection processes for large projects. The information flows with HELCO, are good. I have some contacts that are really wonderful to work with. If I know I am going to propose a system I email them and they let me know if a study is required for a certain size, and how expensive the study might be… Users don't do this, it's the provider that should take care of it. [15]

PGV: We have very open lines of communication with HELCO, they are very helpful and we try to be as helpful as possible. There is also some contractual information, but it's all working.

HECO (R.A.): With a big independent power producer we have pretty good communication, though it also depends from case to case; the relations with some companies are better than with others. The greater struggle is to gather information about small distributed installations such as residential PV; we have reached very high penetration levels, and we don't have enough information from them and they feel frustrated with us. We probably both need to do better on that. We will do some studies with Federal (DOE) funds and our money. Hopefully we will disclose more, and the industry more too. It is important to allow more distributed generation.

EAC: Navigating through the PUC dockets is really too complicated and time consuming. In the end it is so overly complex that you are not actually sharing information in an effective way. If you own a PV system is really hard to understand what the exact regulation is and which the upcoming changes are. With Energy Future Hawaii we want to get information from all the stakeholders, to create a clearing house for information. It looks tricky to get information from HELCO because they need to get corporate approval every time. Our commission has been discussing about having more inputs from the public in the meetings. We are going to advertise the meetings, so that we can be trusted by being open and transparent, that's what people want.

[15] Interestingly you have to "committ" yourself with a provider to know if you can install a PV system

Practically all the actors also reported the importance of education and community engagement, as it emerged in the SWOT section.

A2.2.7 Energy Efficiency Programs

How is the collaboration with SAIC, the company that is running the Hawaii Energy efficiency program?

DG: We are very much in touch with them and they are great to work with. They come to do the inspection in the homes where we want to install the solar water heaters, in order to grant the rebate. They are wonderful to work with. They are very polite and the home owners appreciate it. HELCO was doing alright too when they were in charge of the programs.

WK: We don't perceive them as too proactive, you have to call them and then they will try to help out... If you call them they are there. I guess they could be handing out more information.

DWS: The first contact with Hawaii Energy works like this: you give them your account number and they give an overlook and try to understand what the potential benefits are. They are available for free audits too. In my experience they are more helpful than HELCO, a bit more proactive. As far as I know the money collected through the PBF on the Big Island stays on the Big Island. The demand response and time-of-use agreements are with HELCO. Since we are such a large user we have a dedicated HELCO guy who monitors and knows very well our loads. From 5:30pm to 7:30pm (peak-hours) they shut down our wells and give us a discount based on the load they are facing. There is no real time pricing, it is the utility that knows what is the load and the curtailment is paid proportionally how much stress we take off, it could be that we are saving $10 like $1000 depending on the day…

You are not making an informed decision, then… Wouldn't it be better if they let you now what is the discount and then you decide if you want to keep pumping or not?

DWS: Well, if we knew it would be better. But energy bills for pumping the water are direct costs of the DWS, and as such are passed on to the consumers as a cost. Of course we want to do it for the greater good, but there is no real economic driver...

What are the utility's programs? Would you be interested in getting the energy efficiency programs back?

HELCO (J.D.): We want to extend our demand response program, which will allow us to control the load more actively. As I said, with smart meters we are going to be working with time-of-use tariffs. As far as it concerns energy efficiency programs, we were handling them for ten years and we had some of the best programs of the nation. But then they moved it under a third party administration.

HECO (R.A.): That was a political decision that we argued against but the decision was made, so we'll go on with that. We're trying to help them be successful because customers do need energy efficiency. If given an opportunity we would love to have them back.

What can be your incentive in effectively promoting something that actually reduces your sales?

HECO (R.A.): The new regulatory environment includes decoupling, which means that energy efficiency does not hurt us anymore as our compensation is not tied to sales anymore. We're paid on a different basis. So the main reason for which people used to say outsource

the efficiency program is no longer there. We will get the money we need to cover our costs and get a rate of return, and customers that are efficient will pay less, while the other ones will pay more. Energy efficiency just changes who pays. Now we need to do a good job with the integration of renewable energy, we need to show our commitment to the plan and we make a better case for ourselves as leaders in reducing the use of oil in our system.

Is there a possibility to give the energy efficiency programs (and the PBF management) back to the utilities?

PUC (C.C.): The law currently says no, that these programs must be administered by a third party. We could change the law I guess but at the moment this is the situation.

Appendix 3 – Bioenergy in Hawaii

A short facts and statements list that gives an idea of the bioenergy proceedings in Hawaii:

- In June 2010, the PUC approved "two-year contract for a subsidiary of Iowa-based Renewable Energy Group® to supply three to seven million gallons of renewable biodiesel annually to fuel Hawaiian Electric Company's new 110-megawatt combustion turbine generator unit at Campbell Industrial Park Generating Station" (HECO, 2010d). The plant is located on Maui.

- In the same month "the Hawaii Public Utilities Commission (PUC) has approved Hawaiian Electric Company's plan to test biofuel blends in a 90-megawatt steam turbine generating unit at Kahe Power Plant that presently runs on low sulfur fuel oil (LSFO)". The Vice-president of HECO in that occasion declared "fuel switching in our existing generating units rather than building new facilities will save our customers billions of dollars" (HECO, 2010d)

- "Hawaiian Electric Company worked with the Natural Resources Defense Council to create a procurement policy to make sure that only sustainable biofuel feedstock is used in Hawaii and that a preference is given to local biofuels as soon as possible" (HECO, 2010d)

- "On March 31, 2010, Hawaiian Electric issued requests for proposals (RFP) to supply renewable biofuel sustainably produced from local Hawaii feedstock to potentially procure future supplies for existing generating units in the HECO, HELCO, and/or MECO systems" (HECO, 2010)

- In the request for proposals it is specified that for suppliers of biofuel "as a guideline, a contract duration of 10 years with multiple five-year renewal periods is potentially acceptable" (HECO, 2010d)

- Extract from the RFP: "HECO will consider and evaluate flexible pricing structures designed to facilitate the success of the agricultural and technology developers while maintaining HECO's responsibility to its shareholders and customers to ensure competitive pricing" (HECO, 2010d)

- During the interviews (see Appendix 2) Jose Dizon, talking about biofuels on Hawaii Island, stated: "we haven't negotiated a purchase power contract yet but we did develop a term sheet with one company […], they have 25 MW that are dispatchable" (Dizon, 2010)

- Act 253 in the Session Laws of Hawaii (2007) the *Hawaii Bioenergy Master Plan Project* was established "The Act called for the preparation of a bioenergy master plan to 'set the course for the coordination and implementation of policies and procedures to develop a bioenergy industry in Hawaii' " (Hawaii Natural Energy Institute, 2010)

- The *Hawaii Bioenergy Master Plan Project* was published in 2009. It recommends to "develop clear and consistent policy for use of State lands" by December 2011, but also to "establish a bioenergy program" and to "require Life Cycle Analysis for use of State lands or funding support" (Hawaii Natural Energy Institute, 2010).

- Diane Ley (State Executive Director for USDA Farm Service Agency) stated that in Hawaii there is the potential to establish and meet new market demands for up to 80 million gallons of biofuel per year from the Department of Defense and another 200 million gallons per year from the utility (Ley, 2010).

- The Hawaii Agriculture Research Center in 2006 prepared for the State of Hawaii Department of Agriculture a study called *Biodiesel Crop Implementation in Hawaii.* The study concludes that "it should be quite achievable for biofuels produced from in-state resources to displace 20 percent of the gasoline and diesel fuel needed for vehicle transportation in Hawai'i. This could be accomplished using about 10 percent of available agricultural land for energy crop production to supply the required biomass feedstock". These calculations are based on "the maximum theoretical case" in which they "assume utilization of all identified agricultural land and unused biomass wastes/residues" (Hawaii Agriculture Research Center, 2006). So using 10% of the whole agricultural land in Hawaii should make it "quite achievable" to satisfy 20% of the fuel needed just for transportation.

- The next figure reports the biofuel potential demand for HECO's plants (including subsidiaries)

COMPANY	Plant "generating unit(s)"	Location	Crude Biofuel barrels	Biodiesel barrels	TOTAL gallons (millions)
Helco	Keahole	Keahole, Hawaii		458,000	19.2
	Puna	Keau, Hawaii		38,000	1.6
	Hill	Hilo, Hawaii		6,600	0.3
	Waimea	Waimea, Hawaii		2,200	0.1
					21.2
	*Hill	Hilo, Hawaii	398,000		16.7
	*Shipman	Hilo, Hawaii	16,000		0.7
	Puna	Keau, Hawaii	169,000		7.1
					24.5
Meco	Maalaea	Kihei, Maui		1,091,000	45.8
	Miki Basin	Lanai		35,000	1.5
	Manele CHP	Lanai		10,000	0.4
	Molokai	Molokai		58,000	2.4
Heco	*Kahe @ 50% *assumes a 50/50 blend*	Nanakuli, Oahu	2,700,000		113.4
	Campbell Industrial Park	Kapolei, Oahu		150,000	6.3
TOTAL			3,283,000	1,848,800	
	millions of gallons:		**137.9**	**77.6**	**215.5**

* These sites currently receive fuel via pipeline.

A3-1 Total estimated annual fuel consumption by fuel and type contained in HECO's request for proposal for biofuels supply (HECO, 2010d)

- The following figure taken from the *Hawaii Bioenergy Master Plan Project,* gives an idea of the surface of agricultural land across the islands. It is quite clear that Hawaii would be producing biofuels for the other islands as well.

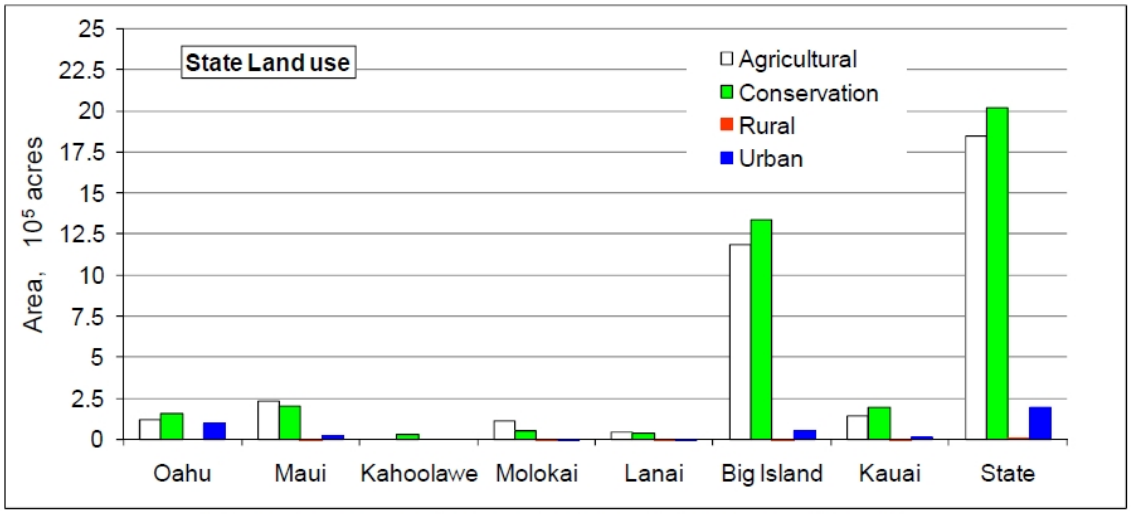

Fig. 1 Acreages of different land uses in the State of Hawaii.

A3-2 Land use in Hawaii State (HNEI, 2009)