

BEFORE THE PUBLIC UTILITIES COMMISSION  
OF THE STATE OF HAWAII

----- In the Matter of ----- )  
 )  
The Application of Hawaiian Electric Co, Inc )  
for the Approval to Commit Funds )  
For the East O`ahu Transmission Project )  
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PUC Docket 03-0417

PUBLIC UTILITIES  
COMMISSION

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FILED

LIFE OF THE LAND'S  
STATEMENT OF POSITION  
&  
CERTIFICATE OF SERVICE

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Aloha Commissioners:

Along with a recently opened docket on Integrated Resource Planning, the Applicant emphasizes building the infrastructure necessary to continue their reliance on fossil-fuel powered central stations connected to load centers with high-voltage transmission lines, primarily using overhead technologies.

The Public Utilities Commission issued Order No. 20968 on May 10, 2004 specifying the matters that are relevant for docket no. 03-0417. This includes whether the proposal "is preferable to other feasible non-transmission options". Our analysis will show that it is not.

Our analysis will show that energy efficiency and renewable, distributed energy is better for the planet and better for our economy than the Applicant's proposal.

Our Statement of Position -- the Direct Testimony of Life of the Land's expert witness, Henry Q Curtis -- will be divided into 6 parts: (1) environmental impacts; (2) health impacts; (3) economic impacts; (4) Hawai'i State Constitution; (5) Options; and (6) A Sustainable Energy Self-Sufficiency Alternative.

In Part 1 we note that the fossil fuel industry is responsible for the plurality of the world's pollution. Ocean-based oil spills since 1970 are greater than 100 Exxon Valdez oil spills. This level of releases is dwarfed by land spills, which is itself dwarfed by air emissions. There have been significant ocean-based oil spills in the ocean waters in and around Hawai'i. GDS<sup>1</sup> analyzed the potential economic impacts of a major ocean-based oil spill to Hawai'i. There were 15 oil spills of 10,000 gallons or larger in Hawai'i from 1982-98, including the 1996 Wai'au Pipeline rupture<sup>2</sup>. Even more devastating, the fossil fuel industry is widely acknowledged as primarily responsible for the increase in global warming gases that is already being evidenced in the planet's climatic volatility. A study by the Department of Defense that grappled with the economics of global warming found that "because of the potentially dire consequences, the risk of abrupt climate change, although uncertain and quite possibly small, should be elevated beyond a scientific debate to a U.S. national security concern."<sup>3</sup> Continued reliance on fossil-fuel fired central generation stations connected to load centers with a lot of overhead high-voltage transmission lines will surely lead to global disaster.

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<sup>1</sup> During the 2000 Legislative Session, the Hawaii Legislature considered a Renewable Portfolio Standard (RPS) for the State of Hawaii (HB 1883). Following the session, the Department of Business, Economic Development & Tourism contracted with GDS Associates, Inc., to conduct an RPS analysis.

<sup>2</sup> "These include the two Chevron Pipeline Spills ('87 and '96), T/B Hana Spill ('87), Exxon Houston Grounding ('89), T/V Star Connecticut Grounding ('90), T/V Yupex, the AGI Pipeline Spill ('97), F/V VAN LOI grounding on Kauai (99). The general causes can be linked to mechanical failures (most human error or weather related) which resulted in the spill of a large quantity of refined product." U.S. Coast Guard: Marine Safety Office Honolulu Fact Book. Oil Spill Planning Fact Sheet. 6/18/99  
[www.uscg.mil/d14/units/msohono/factbook/spillplan.htm](http://www.uscg.mil/d14/units/msohono/factbook/spillplan.htm)

<sup>3</sup> <http://pubs.acs.org/cen/topstory/8209/pdf/climatechange.pdf>

In Part 3 we note that Macroeconomic Models and Input-Output Models are used throughout the industrial world to measure the total financial impacts from a given project. However, utilities tend to rely on primitive engineering cost models which highly distort optimization, and lead to false answers. We will review work by Dr. Shimon Awerbuch and Enterprise Honolulu, and then analyze five significant economic studies: the U.S. Department of Energy; Black & Veatch; the University of Nevada, Las Vegas (UNLV); Repowering the Midwest, and GDS. We will refer to an energy efficiency input-output model. We then evaluate portfolio theory.

In Part 4 we will examine the energy self-sufficiency clause in the state constitution.

In Part 5 we give an overview of renewable energy and energy efficiency options which could supply all of the electrical needs within the State.

In Part 6 we will illustrate a Sustainable, Energy Self-Sufficiency Alternative.

## **PART I: ENVIRONMENTAL IMPACTS**

### **Oil Spills**

Ocean-based oil spills since 1970 are greater than 100 Exxon Valdez oil spills; extensive land-based spills far exceeding ocean-based spills, and even greater air releases, including the majority of the global warming gases released by mankind.

GDS Associates analyzed the economic risk for a sea-based oil spill.<sup>4</sup>

"Transportation of oil and oil products poses the constant risk of a spill, with subsequent damage to the environment and the economy. In 1999, over 50 million barrels of crude oil and another 8.6 million barrels of refined oil imports were imported into Hawaii by sea. In addition, about 9 million barrels of refined product were shipped by barge from Oahu to neighbor islands.<sup>5</sup> On Oahu, large quantities of petroleum products are transported to power plants and other locations via pipelines, which have suffered accidental leaks in the past. Transportation of petroleum products on all islands by tanker truck poses the further risk of accidental spills.

Following the *Exxon Valdez* disaster in Alaska in 1989, the State of Hawaii Department of Health commissioned a study by the University of Hawaii Sea Grant College Program of the potential impacts of oil spills at sea on Hawaii. Dr. Rose Pfund led the study and edited the final report, *Oil Spills at Sea, Potential Impacts on Hawaii*<sup>6</sup>. This study evaluated a worst-case scenario, which would have been a major ecological disaster<sup>7</sup>.

The economic costs would have been huge for such a spill. Cleanup costs alone would have been \$210 to

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<sup>4</sup> Analysis of Renewable Portfolio Options for Hawaii (March 2001) Submitted to the State of Hawaii Department of Business, Economic Development & Tourism by GDS Associates.

<sup>5</sup> DBEDT ERTD Data

<sup>6</sup> Pfund, Dr. Rose T. *Oil Spills at Sea, Potential Impacts on Hawaii*. University of Hawaii Sea Grant Program, 1991.

<sup>7</sup> Pfund. p. 69

\$305 million<sup>8</sup>. It was estimated that oil washed up on the beaches of Oahu would result in a 32% reduction in tourism in the first year and a \$.06 billion loss in revenues to the tourist industry.<sup>9</sup> Oahu's beaches and coral reefs would have also suffered severe environmental damage, and wildlife would have been killed in large numbers.

As a result of the study, tanker operators agreed to use the wider Kauai Channel, to reduce the risk of collision and to provide more maneuvering space in event of mechanical malfunction. Soon after, in reaction to the *Exxon Valdez*, the Federal Oil Prevention Act of 1990 set up a planning and command structure emphasizing oil spill prevention and a response structure. Additional liability was placed on tanker operators as a strong incentive to increase safety. Hawaii spill-prevention efforts and preparedness to deal with the spills were enhanced<sup>10</sup>.

Hawaii remains vulnerable to oil spills. The offshore terminals are well managed, but human error or mechanical failure could lead to a major spill. For example, the *Exxon Houston* grounded near Barbers Point a few years ago. Through hard work and luck the ship was saved, and the loss of its 3.8 million gallons (90,000 barrels) of crude oil and its bunker fuel was prevented<sup>11,12</sup>.

"The model calculates (1) the fixed and variable operating costs of existing fossil fueled resources, (2) the fixed and variable operating costs and the cost of capital associated with new fossil-fueled resources, and (3) the fixed and variable operating costs and the cost of capital associated with new renewable resources. The model does not"<sup>13</sup>

### The Waiiau Oil Spill<sup>14</sup>

On May 14, 1996, at 1:30 a.m., a Chevron pipeline bust, discharging No. 6 bunker fuel oil adjacent to HECO's Waiiau Power Plant. Over 41,000 gallons of oil gushed into Waiawa Stream. Being slightly heavier than the fresh water, it slowly sank through the water table, contaminating life forms along its trip. Upon reaching Pearl Harbor, the oil slowly rose through the water column, being slightly heavier than salt water. The 10-acre Waiawa Wetland of the Pearl Harbor National Wildlife Refuge, a restricted wildlife area and home to the state's four endangered species of water birds (Hawaiian stilt, coot, duck, moor hen), was contaminated with pools of submerged oil. An oil sheen covered approximately 90,000,000 square feet of open water in Pearl Harbor during the first six days after the spill.

Areas impacted included freshwater and saltwater wetlands, shorelines and intertidal areas including mangroves, mudflats, rocky shorelines, sandy beaches, riprap, seawalls and piers. Regulators estimated that 77,965 linear feet of intertidal habitat was oiled.

The cleanup resulted in the repeated, episodic high-pressure washing of the Pearl Harbor shoreline, which destabilized and eroded shoreline soils. The shoreline continued to emit an oil sheen more than a month, which had a devastating impact on egg, larval, juvenile and adult stages of recreationally and commercially valuable finfish, invertebrates, green turtles and birds.

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<sup>8</sup> Pfund. p. 35

<sup>9</sup> Pfund. p. 57

<sup>10</sup> Rappa, Peter J, and Jacqueline N. Miller, *Hawaii's Readiness to Prevent and Respond to Oil Spills, Summary and Recommendation*. Honolulu University of Hawaii. 1996

<sup>11</sup> Rappa p. 24

<sup>12</sup> GDS page 16

<sup>13</sup> GDS page 21

<sup>14</sup> NOAA Damage Assessment and Restoration Program (DARP) [www.darp.noaa.gov/southwest/chevron](http://www.darp.noaa.gov/southwest/chevron)

Initially the federal and state regulators estimated that the habitat would take ten years to recover, this was later revised upwards to fifteen to twenty years.

"For nearly two weeks after the initial pipeline breach, spilled oil continued to be mobilized from Waiau Stream and released into Pearl Harbor. The U.S. Coast Guard (USCG) reported that pockets of residual oil up to 24-inches deep in Waiau Stream and the marsh were warmed by the hot afternoon sun, mobilized to neutral buoyancy in the fresh water and then floated downstream just below the water's surface in basketball-sized "globs." These floating oil globs did not resurface and become readily visible until reaching the denser salt water of Pearl Harbor some 200-feet to 400-feet from the mouth of Waiau Stream, depending on the strength of the ebb tide and the amount of freshwater flow from the stream (USCG 1996j).

An estimated total of 982 barrels (41,244 gallons) of No. 6 fuel oil were released into Waiau Stream, creating pools of submerged oil throughout the lower portion of the 10-acre marsh. The estimated volume of oil reported released was based on information provided by Chevron and calculated by Petrospect, a Chevron contractor (Chevron 1996). The spill created a sheen of floating oil throughout East Loch, covering approximately 2,290 acres of open water during the first six days of the spill event (Gundlach 1997).

This oil spill is referred to in this Final Restoration Plan and Environmental Assessment (Final RP/EA) document as the "Incident." Chevron is the Responsible Party for this Incident and has acknowledged its liability (Chevron 1996, Pai 1996).

As described in more detail in Section 2, immediate impacts of the discharged oil included:

- \* the closure of Pearl Harbor to navigation and vessel traffic,
- \* interruption of U.S. Department of the Navy (USN) construction projects around Pearl Harbor,
- \* suspension of ferry service to Ford Island,
- \* closure of the USS *Arizona* Memorial Visitor Center (Visitor Center) on the East Loch shore at Halawa Stream,
- \* suspension of boat trips to the USS *Arizona* Memorial which straddles the sunken hull of the USS *Arizona* in the near shore waters of East Loch off Ford Island,
- \* partial closure of the City and County of Honolulu bicycle/jogging path around the perimeter of East Loch, and
- \* closure of Pearl Harbor to commercial fishing and boating.

Oiling of shorelines and intertidal areas affected freshwater and saltwater wetlands, mangroves, mudflats, rocky shorelines, sandy beaches, riprap, seawalls and piers. These oiled habitats contribute to many recreationally and commercially valuable fish and wildlife species and the prey and forage items for these species. The contamination of the water column and sediments of Waiau Marsh and Pearl Harbor by this oil may have caused impacts to egg, larval, juvenile and adult stages of recreationally and commercially valuable finfish and invertebrates which utilize the Pearl Harbor estuary. ...

The repeated, episodic high-pressure washing of this shoreline, the continuous medium-pressure washing of this shoreline, and the abrasive action of the sorbent booms and pom-poms, all acted to destabilize and erode shoreline soils and material filling in the riprap. The protective *naupaka* shrub sheltering the shoreline was cut away by Chevron contractors because it was oiled. This action exposed the shoreline to the persistently erosive forces of wave action and boat wake wash. Because the Chevron cleanup crews needed unrestricted access to the shoreline, seven separate pathways, each a swath about three feet wide, were cut through the mature *naupaka* shrub barrier to the water's edge (Petrossian 1997).

The USCG did not view the emergency stabilization of the degraded and destabilized Visitor Center shoreline as an oil spill response measure (Whipple 1996). In November 1996, unusually heavy rains on leeward Oahu exacerbated the erosion of the Visitor Center shoreline. Shoreline soils eroded into Pearl Harbor by these rains created potentially unsafe conditions along the shoreline areas for visitors, employees and occasional after-hours fishermen. In November 1996, the National Park Service (NPS) undertook an

emergency shoreline stabilization project using sandbags to fill in the eroded areas (Petrossian 1997)."<sup>15</sup>

## **Global Warming**

Global Warming: Chemical and Engineering News (March 1, 2004)<sup>16</sup>: Climate Impacts: A Worst-Case View of Global Change.

"Defense Department report warns of 'abrupt' global warming impact ... A Pentagon report made public last week lays out the worst-case impact from an abrupt change in climate, driven by global warming. The report considers a scenario of a fast change in climate, rather than a more gradual one in which technological innovation could help stave off disaster."

Global Warming: Fortune Magazine (Feb 25, 2004)<sup>17</sup>: CLIMATE COLLAPSE.

"The Pentagon's Weather Nightmare: The climate could change radically, and fast. That would be the mother of all national security issues. By David Stipp. Global warming may be bad news for future generations, but let's face it, most of us spend as little time worrying about it as we did about al Qaeda before 9/11. Like the terrorists, though, the seemingly remote climate risk may hit home sooner and harder than we ever imagined. In fact, the prospect has become so real that the Pentagon's strategic planners are grappling with it. The threat that has riveted their attention is this: Global warming, rather than causing gradual, centuries-spanning change, may be pushing the climate to a tipping point. Growing evidence suggests the ocean-atmosphere system that controls the world's climate can lurch from one state to another in less than a decade -- like a canoe that's gradually tilted until suddenly it flips over. Scientists don't know how close the system is to a critical threshold. But abrupt climate change may well occur in the not-too-distant future. If it does, the need to rapidly adapt may overwhelm many societies -- thereby upsetting the geopolitical balance of power. Though triggered by warming, such change would probably cause cooling in the Northern Hemisphere, leading to longer, harsher winters in much of the U.S. and Europe. Worse, it would cause massive droughts, turning farmland to dust bowls and forests to ashes. Picture last fall's California wildfires as a regular thing. Or imagine similar disasters destabilizing nuclear powers such as Pakistan or Russia; it's easy to see why the Pentagon has become interested in abrupt climate change." (emphasis added)

Decreasing emissions of greenhouse gases is very serious. Two programs to address the issue are the Regional Greenhouse Gas Initiative (RGGI), and the Chicago Climate Exchange (CCX).

The Regional Greenhouse Gas Initiative (RGGI or "ReGGIe") is a cooperative effort by 9 Northeast and Mid-Atlantic states to discuss the design of a regional cap-and-trade program initially covering carbon dioxide emissions from power plants in the region. In the future, RGGI may be extended to include other sources of greenhouse gas emissions, and greenhouse gases other than CO<sub>2</sub>.

How Did RGGI Get Started? In April 2003, New York Governor George E. Pataki sent letters to the 11 governors from Maine to Maryland, inviting their states' participation in discussions to develop a regional cap-and-trade program covering carbon dioxide emissions from power plants within two years. By July 2003, the governor had received positive responses from eight of those governors, including those from Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, Rhode Island, and Vermont. The governors agreed to have their representatives participate actively in the discussions. After discussions got underway, representatives from the Eastern Canadian Provinces Secretariat and the Province of New Brunswick began observing the process. Maryland and Pennsylvania also send representatives to observe the process.

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<sup>15</sup> Final Restoration Plan and Environmental Assessment for the May 14, 1996 Chevron Pipeline Oil Spill into Waiuu Stream and Pearl Harbor, Oahu, Hawaii (November 1999): 1.2 Overview. [www.darp.noaa.gov/southwest/chevron/phfnlea1.html](http://www.darp.noaa.gov/southwest/chevron/phfnlea1.html)

<sup>16</sup> Volume 82, Number 9. <http://pubs.acs.org/cen/topstory/8209/8209notw9.html>

<sup>17</sup> [www.fortune.com/fortune/technology/articles/0,15114,582584,00.html](http://www.fortune.com/fortune/technology/articles/0,15114,582584,00.html)

The positive response from the Northeast and Mid-Atlantic governors should come as no surprise. All of the Northeast and Mid-Atlantic states are in various stages of studying or implementing programs to reduce greenhouse gas emissions. For example, in April 2000, New Jersey adopted a statewide goal of reducing greenhouse gas emissions to 3.5% below 1990 levels by 2005. Similarly, the New England governors and the Eastern Canadian premiers issued a Climate Change Action Plan in August 2001, which calls for the reduction of greenhouse gases to 10% below 1990 levels by 2020. New York's State Energy Plan calls for the reduction of the state's carbon emissions to 5% below 1990 levels by 2010 and to 10% below those levels by 2020. The regional cap-and-trade program will assist all participating states in reaching such state-specific goals. ...

The action plan sets out the following goal for RGGI: Develop a multi-state cap-and-trade program covering greenhouse gas (GHG) emissions. The program will initially be aimed at developing a program to reduce carbon dioxide emissions from power plants in the participating states, while maintaining energy affordability and reliability and accommodating, to the extent feasible, the diversity in policies and programs in individual states. The goal is to have an agreement on program design by April 2005 or sooner. After the cap-and-trade program for power plants is implemented, the states may consider expanding the program to other kinds of sources.

The action plan also establishes guiding principles for the program design, including: emphasizing uniformity across the participating states; building on existing successful cap-and-trade programs; ensuring that the program is expandable and flexible, allowing other states or jurisdictions to join in the initiative; starting the program simply by focusing on a core cap-and-trade program for power plants; and focusing on reliable offset protocols (i.e., credits for reductions outside of the power sector) in a subsequent design phase.<sup>18</sup>

The Chicago Climate Exchange (CCX) is a voluntary, legally binding multi-sector market for reducing and trading greenhouse gas emissions. CCX was designed to allow public and private sectors entities to use market based mechanisms to account for greenhouse gas emissions reductions. CCX will allow participants to receive credit for reductions and to buy and sell credits. Members include utilities and non-utility corporations, University of Chicago, Tufts University, University of Iowa, University of Minnesota, University of Oklahoma, and Jesuit Community of Santa Clara University.<sup>19</sup>

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<sup>18</sup> [www.rggi.org/about.htm](http://www.rggi.org/about.htm)

<sup>19</sup> [www.chicagoclimatex.com](http://www.chicagoclimatex.com)

## PART 2: HEALTH IMPACTS

Electric power plants emit more of the pollution that causes soot/smog than any other industry. Each year, smog and soot cause millions of asthma attacks, bronchitis, heart disease and thousands of premature deaths. Children, senior citizens and people with asthma are most at risk.

EPA's Toxics Release Inventory (TRI) program (also known as Community Right-to-Know) has released 2003 data on toxic emissions that are being released to the nation's air, water and land from major industry sectors throughout the United States.<sup>20</sup> The Top 10 Hawai'i emitters were:

1. Kahe Generation Station (HECO)
2. Schofield Barracks (US Army)
3. Pearl Harbor Naval Complex (US Navy)
4. Waiiau Generation Station (HECO)
5. Chevron Refinery
6. Hill Generation Station (HELCO)
7. Kahului Generation Station (MECO)
8. AES Hawaii
9. Tesoro Hawaii
10. Puna Generating Station (HELCO)

The electric power industry is responsible for 66% of the total sulfur dioxide (SO<sub>2</sub>), 35% of the total carbon dioxide (CO<sub>2</sub>) and 29% of the total Nitrogen Oxide (NO<sub>x</sub>) emissions nationwide. Every year many millions of tons of carbon dioxide, sulfur dioxide, nitrogen oxides and particulate matter are released into the air. Emissions from burning coal have devastating environmental and public health impacts. ...

Sulfur dioxide is one of the main contributing gases that make acid rain. While water vapor floats above the earth's surface it comes in contact with and absorbs sulfur dioxide making sulfuric acid. The more sulfur dioxide that exists in the atmosphere the higher the acidity of precipitation will be. Acid rain is responsible for increased animal mortality, animal birth defects and acidification of lakes and streams. ...

Nitrogen oxides also contribute to acid rain. In addition, nitrogen oxides contribute to the formation of ozone (O<sub>3</sub>), which is the primary ingredient in smog. Ozone is created when sunlight and heat react with the nitrogen oxides and volatile organic compounds (VOC's) from power plants and automobiles. Instead of acting as a protective layer from ultraviolet rays high in the atmosphere, when ozone is found close to the earth's surface it is considered a pollutant and causes health problems. Ground level ozone exacerbates respiratory illness such as asthma and emphysema, especially in children and older adults. More asthma related hospital visits, and other respiratory emergencies are reported on days when there are high levels of ozone.<sup>21</sup>

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<sup>20</sup> Hawaii Toxics Release Inventory Fact Sheet. Hawaii Report: 2003 TRI [www.epa.gov/region09/toxic/tri/report/03/hawaii.pdf](http://www.epa.gov/region09/toxic/tri/report/03/hawaii.pdf)  
TRI [www.epa.gov/region09/toxic/tri/report/index.html](http://www.epa.gov/region09/toxic/tri/report/index.html)

<sup>21</sup> [www.cleanair.org/Energy/energyImpacts.html](http://www.cleanair.org/Energy/energyImpacts.html)

### **PART 3: THE ECONOMIC IMPACTS**

We open with a discussion on engineering costs. Utilities rely on engineering costs to compare alternatives. We highlight Dr. Shimon Awerbuch's work. Since engineering cost analysis leaves out many financial inputs, it bears little resemblance to sound economic and financial analysis. We then outline the nature of economics, followed by a discussion of the multiplier effect. We then review macroeconomic analysis by Enterprise Honolulu (formerly known as the Oahu Economic Development Board). Then we move into microeconomic analysis from the U.S. Department of Energy with an article called Dollars from Sense.

Next we examine several advanced studies on the economic impacts of increasing the use of renewable energy: Black & Veatch (Pennsylvania); University of Nevada, Las Vegas (UNLV); University of Illinois (Repowering the Midwest) and GDS (Hawai'i). We provided a brief overview of an energy efficiency input-output study by Geller et al, which concluded that energy efficiency creates more jobs and economic growth than any form of energy supply.

We review other approaches to economic impacts including modern portfolio theory (MPT);

#### **Engineering Costs**

Central to our argument will be distinguishing Engineering Costs from Financial Costs. Engineering Costs tend to ignore market risk, balance of payment rates, and discount rates, among other things. There may not be much of a problem when similar technologies are being compared. However, when very technologies are compared, Engineering Costs Models can lead to wildly incorrect conclusions. By Dr. Shimon Awerbuch wrote a key paper: Know Thy Costs: To remain competitive, planners must adopt sophisticated finance valuation tools:

For nearly a century, utility planners have used engineering-economics based models to estimate the cost of electricity produced by different generating technologies. In 1978, EPRI formalized these models and they are widely known under the name of EPRI-TAG or Revenue Requirements Models (RRM). While these procedures are almost universally used to estimate the kWh cost of electricity for planned resource alternatives, it is not generally understood that, as commonly applied, these approaches are rule-of-thumb proxies which yield only rough approximations of true cost.

This may have been reasonably useful in a simpler time, when the capacity choice may have been limited to a coal versus an oil-fired steam plant, both of which had similar financial risk characteristics. Today's environment, however, is far more complex and includes a variety of resource options - from purchased power, to capital-intensive renewables - which differ considerably in terms of their financial risk, flexibility attributes and the strategic options they create for management. In order to remain competitive in this environment, firms will have to adopt more sophisticated finance-oriented valuation tools.

Surprisingly, IRP and similar processes have not engendered investigations and debates about appropriate procedures for valuing resource alternatives. While these processes raise all sorts of planning issues, everyone seems quite content to leave the "seemingly arcane procedures for estimating leveled electricity (busbar) costs to the green-visor types with little meaningful outside review.

This means that some of the firm's most important decisions are made on the basis of black-box output that

few truly understand.

Correct resource valuation (i.e., investment analysis) is important in a monopoly setting. Partially competitive environments make resource valuation even more crucial, yet it seems widely believed that the prospect of a restructured industry eliminates the need for discussion of how renewables and conventional technologies should be valued. The assumption is that the market will take care of it. But competition does not imply that we will get brilliant, or even just plain "correct", analyses of the cost of electricity from various renewable and conventional sources. ...

**Traditional Cost Models.** EPRI-TAG, the RRM and similar models which rely on busbar costs generally favor expense-intensive over capital-intensive technologies. This section presents a number of reasons why engineering cost approaches do not correctly reflect the relative value of resource alternatives.

*Engineering Approaches Ignore Financial Risk.* Engineering models do not account for financial risk. Loosely defined, financial risk is the variability of annual costs. Under an engineering approach, a *risky* annual cost stream has the same present value as an equivalent but *safe* cost stream. This violates fundamental finance theory. Dollar for dollar, a risky cost stream, such as future outlays for fuel, has a *higher* present value since it is less desirable than a safe cost stream. This intuition - that a risky cost stream is less desirable - seems to be widely understood. ...

*Engineering Approaches Compare Resource Alternatives Exclusively on the Basis of their Busbar Cost.* The busbar costs exclude overhead and indirect costs such as fuel purchasing, engineering staff time, or Clean Air Act compliance costs. Ignoring these costs in the resource evaluation probably worked reasonably well when technology alternatives were fairly homogeneous - i.e., when the alternatives consisted of technologically- equivalent fossil-fired options which required (or "consumed") more or less the same types and amount of over- head resources.

Today's technology choices, however, are considerably more heterogeneous, consisting of a variety of technological and institutional alternatives with vastly different cost characteristics. The overhead requirements for this diverse range of resource options vary considerably. For example: some passive, renewable alternatives, such as remote PV sites, operate reliably and require little support from the corporate infra-structure thus consuming very little over- head or indirect costs as compared to traditional central station technologies.

Busbar cost comparisons thus tend to overstate the cost of renewable options relative to traditional fossil alternatives. ...

*Engineering Cost Approaches Estimate "Stand-Alone" Costs for Resource Options When They Should Evaluate Their Impact on the Cost and Risk of the Generating Portfolio.* Financial portfolios are widely used by investors to manage risk and to maximize performance under a variety of unpredictable economic outcomes. Similarly, it is important to conceive of electricity generation not in terms of the cost of a particular technology today, but in terms of its *portfolio cost*. At any given time some alternatives in the portfolio may have high costs while others have lower costs, yet over time, the astute combination of alternatives serves to minimize overall generation cost relative to the risk. By contrast, traditional engineering cost approaches focuses on finding the *least cost* alternative -- a questionable procedure that is roughly analogous to trying to identify yesterday's best performing stock and investing in it exclusively.

Financial investors understand that the future is unpredictable; therefore, rather than emphasizing fortune telling, investors focus on building robust portfolios that are expected to maximize return for the given level of risk. Portfolio theory principles suggest that the important measure for valuing alternative resource options is *how a particular option affects the generating costs of the portfolio of resource options relative to how it affects the risk of that portfolio*. Finding the "least- cost" technology is probably no longer relevant, assuming it is even possible in this dynamic environment. Rather, it makes more sense to focus on developing efficient (i.e., optimal) generating portfolios which may consist of various technological as well as financial and contractual options. ...

Traditional, engineering-based energy valuation tools focus on direct cash flows and ignore financial risk, overhead costs, embedded options and quality issues surrounding the generation of power in a newly emerging competitive environment. These tools failed miserably when American manufacturers tried to use them in an effort to understand and become part of the "new manufacturing" twenty years ago. It is important for energy managers and public policy makers to understand the potentially misleading indications that such

tools can give and to pro actively support additional research which will lead to more robust valuation models.

## Economics

Economics is the study and analysis of production (supply), distribution, and consumption (demand) of goods and services, many of which are scarce. Economics is divided up into two major areas: microeconomics and macroeconomics.

Macroeconomics is a top-down approach which looks at the big picture: national or regional systems and their big picture characteristics: unemployment, inflation, economic growth, balance of payments, national and international economies. In graduate school, Macroeconomics is called National Income Theory.

On the other hand, Microeconomics is a bottom-up approach which examines the behavior of the individual components of the economy, such as consumers and firms. In graduate school, Microeconomics is called Price Theory. At its simplest level, microeconomics examines supply and demand curves for an individual good in a specific market to determine how a given change in price will affect demand, or how a given change in demand will affect price.

## Economic Multiplier

The economic multiplier effect means that one dollar invested in Hawai`i generates additional dollars to the state economy, and one dollar exported decreases the state GDP by more than one dollar. Institutions, such as DBEDT, use economic multipliers in their economic analysis. Each dollar that a tourist brings into Hawai`i ripples through the economy, each dollar exported for oil is a potential ripple that never materialized. The economic multiplier is calculated by analyzing money flows via an Input-Output Model. The analysis looks at both direct spending and indirect spending. Two related issues are foreign investment and leakage. Foreign investment refers to out-of-state money that is invested within the local economy. Leakage refers to all the ways money in the economy leaks out of the economy.

For Hawai`i, we could bring money into the economy by providing markets for local (Hawai`i) and foreign (non-Hawai`i) investors, encourage investments by wind companies; keep money in Hawai`i by using renewables such as solar water heaters and photovoltaic panels; or continuing to export money [\*\*\* how much] for oil and coal.

Money exported from the economy is lost. There is no gain in economic productivity. No new jobs are created. No new industries are created. Instead, a "hole" is carved out of the Hawaii economy, taking with it all of the economic "multiplier" benefits that would have accrued had that money remained in Hawaii. We are buying jobs for people in other regions of the world.

## Enterprise Honolulu

An example of a macroeconomic analysis of Hawai'i's energy picture comes from Enterprise Honolulu (formerly known as the Oahu Economic Development Board). Their Economic Development Series (EDS) analyzes Hawai'i's economy. From EDS Installment #10: Imports, Exports and Economic Development (August 28, 2003):

"A Key characteristic of a healthy economy is that it exports more than it imports. This is especially important for an island economy with no land-based contiguous markets. These goods arrive each day in containers at Sand Island and at the airport via cargo planes from global suppliers in other parts of the world.

We pay for all of these overseas shipments ... with the money available to us. Imagine if we had to pay for all these products with hard cash, and that no cash was coming into the state. How long would it take before we had no money left in the islands?

In order to pay for the things we import, we need a flow of exports to keep refilling our coffers. And the flow of payments for the goods and services we import should be at least balanced by the flow of goods and services we export. If payments for imports exceed payments for exports, we have a 'trade deficit'. Just like a negative balance in your checking account impacts your household, if a trade deficit continues too long, a region's quality of life begins a downward slide.

So how are we doing? According to the State's Department of Business, Economic Development and Tourism, not do well:

Imports (goods and services)	\$14.954 billion
<u>Exports (goods and services)</u>	<u>\$ 2.194 billion</u>
Deficit (goods and services)	-\$12.760 billion

This massive deficit could bankrupt us in no time. Fortunately, tourism overshadows Hawaii's export business and greatly reduces the trade deficit:

Deficit (goods and services)	-\$12.760 billion
Tourism (goods and services)	<u>\$10.033 billion</u>
Net Deficit (goods and services)	-\$2.727 billion

Federal expenditures of over \$9 billion per year also keeps us from hitting bottom. However, the fragility of the tourism industry combined with the dependence upon the federal government makes our whole economy fragile. To overcome these challenges, Hawaii must design new strategies which will result in sustainable prosperity for our state."<sup>22</sup>

EDS Installment #11: Export Enhancement and Import Substitution - Key Strategies for Hawai'i's Prosperity (September 4, 2003):

"Key strategies to overcome the deficit and protect us from volatility of the tourism industry and dependence on the federal government include economic diversification to achieve: ... Export Enhancement - Increasing the volume of goods and services we sell outside Hawaii. ... [and] Import Substitution - Replacing goods and services bought outside the region."<sup>23</sup>

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<sup>22</sup> [www.enterprisehonolulu.com/html/pdf/EHeseries10.pdf](http://www.enterprisehonolulu.com/html/pdf/EHeseries10.pdf)

<sup>23</sup> [www.enterprisehonolulu.com/html/pdf/EHeseries11.pdf](http://www.enterprisehonolulu.com/html/pdf/EHeseries11.pdf)

## United States Department of Energy

An example of a microeconomic analysis comes from the National Renewable Energy Labs (NREL) of the United States Department of Energy (1997) entitled: Dollars from Sense: The Economic Benefits of Renewable Energy<sup>24</sup>

"Every year, Americans spend about \$1900 per person on energy purchases, which is about 8% of the average person's total expenditures on goods and services in a given year. Of this amount, approximately 40% goes to pay for electricity. Energy purchases represent a significant cost to society -- nationally and locally -- and it is important to spend energy dollars in a way that strengthens the economy rather than depleting it.

IN many cases, energy dollars leave the community, going to regional utilities or suppliers of oil or natural gas. Once those dollars have been spent on importing energy into the community or state, they are not available to foster additional economic activity. Because every dollar spent on imports is a dollar lost from the local economy, these energy imports represent a substantial loss to local companies in terms of income and jobs. The challenge is to meet our insatiable appetite for energy while supporting local economic development.

*A growing number of state and local governments are investigating ways to keep their energy dollars at home -- for many, the answer lies in renewable energy resources.*

**How Renewable Energy Investments Help the Economy.** There are two main reasons why renewable energy technologies offer an economic advantage: (1) they are labor-intensive, so they generally create more jobs per dollar invested than conventional electricity generation technologies, and (2) they use primarily indigenous resources, so most of the energy dollars can be kept at home.

*According to the Wisconsin Energy Bureau, "Investment in locally available renewable energy generates more jobs, greater earnings, and higher output ... than a continued reliance on imported fossil fuels. Economic impacts are maximized when an indigenous resource or technology can replace an imported fuel at a reasonable price and when a large percentage of inputs can be purchased in the state." The Bureau estimates that, overall, renewables create three times as many jobs as the same level of spending on fossil fuels.*

For states and municipalities with insufficient conventional energy reserves, there is a simple trade-off: import fossil fuels from out-of-area suppliers, which means exporting energy dollars ... or develop indigenous renewable resources, which creates jobs for local workers in the construction, operation, and maintenance of nonfossil power plants and associated industries.

The advantages of renewable energy investments are becoming increasingly clear, even in areas that have traditionally favored fossil fuels. "Texas is now a net energy importer," said Texas Land Commissioner Garry Mauro, speaking at the dedication of the state's first commercial wind-power project in November 1995. "We can accept our status as a net energy importer ... or we can face the challenge head on and serve as a model to others by embracing new ideas such as wind power and solar energy - ideas that will make Texas the leader in renewable energy development, energy-efficient building techniques, job creation, and environmental health."

The renewable energy industry provides a wide range of employment opportunities, from high-tech manufacturing of photo voltaic components to maintenance jobs at wind power plants. Through the multiplier effect (see sidebar, left), the wages and salaries earned by industry employees generate additional income and jobs in the local economy.

*A state that imports most of its fossil fuel can receive a substantial employment and earnings benefit from developing indigenous renewable resources.*

**- Powering the Midwest: Renewable Electricity for the Economy and the Environment. a 1993 report by the Union of Concerned Scientists**

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<sup>24</sup> LOL-EX-3

The taxes paid by renewable energy companies also strengthen the area's economic base, ultimately reducing the burden on individual taxpayers in the community; in fact, generating power from renewable resources contributes more tax revenue than generating the same amount of power from conventional energy sources. As an example, the California Energy Commission has found that solar thermal power plants yield twice as much tax revenue as conventional, gas-fired plants.

In some cases, renewable energy investments can enable individuals, companies, or communities to reduce their utility bills. For example, schools can cut costs by using wind power (see page 10), and electric cooperatives can provide cheaper electricity to members with photovoltaics (see page 15).

Although the local economic benefits associated with renewable energy investments are evident, it is also important to note that, in the short term, increased reliance on in-state energy resources could reduce the income of energy-exporting states. In the long term, however, the advantages of developing renewable energy technologies go far beyond the local economy - they benefit the country as a whole.

#### The Multiplier Effect: A Little Goes a Long Way

The multiplier effect is sometimes called the ripple effect, because a single expenditure in an economy can have repercussions throughout the entire economy, much like ripples spreading across a pond. The multiplier is a measure of how much additional economic activity is generated from an initial expenditure.

In the town of Osage, Iowa, for example, \$1.00 spent on consumer goods in a local store generates \$1.90 of economic activity. This occurs as the dollar is respent; the store pays its employees, who purchase more goods, all with the same original dollar.

The multiplier effect causes different types of economic benefits as a result of investments in renewable energy technologies:

Direct effects -- These are on-site jobs and income created as the result of the initial investment; the people who assemble wind turbines at a manufacturing plant, for example.

Indirect effects -- These are additional jobs and economic activity involved in supplying goods and services related to the primary activity; people such as the banker who provides loans to the plant's owners, and the workers who supply parts and materials to the turbine assemblers.

Induced effects -- This is employment and other economic activity generated by the respending of wages earned by those directly and indirectly employed in the industry; jobs created by the manufacturing plant workers spending their wages at the local grocery store, for example."

### **Black & Veatch**

There are several microeconomic studies which have been conducted covering areas beyond Hawai'i. HECO consultant Black & Veatch wrote one titled Assessment of the Potential Impacts of a Renewable Portfolio Standard in Pennsylvania.<sup>25</sup>

Historically, utilities were charged with planning utility systems to obtain a safe, adequate, and reliable supply of electricity at the lowest reasonable cost and in an environmental acceptable manner. Practically, this objective has translated into selecting the expansion plan having the lowest cumulative present value cost, which consists of incremental system fuel and variable O&M costs of new unit additions. Even so, it has long been recognized that there can be significant socioeconomic impacts associated with new power plant investment that are not directly accounted for in an expansion planning study. It is also possible that two competing economic plans may generate very different socioeconomic benefits even if the direct costs are comparable. For this reason, it is important to consider the socioeconomic costs and benefits of

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<sup>25</sup> LOL-EX-5

## Impact of Nevada's Renewable Energy Resources included the following:

Given the Nevada RPS, it is helpful, from a policy perspective, to quantify the economic impact of increased dependence on renewable energy in Nevada. For simplicity, we focus on employment and GSP impacts at different levels of dependence on renewable energy generation. Employment impacts may arise from a variety of sources. There will be direct employment impacts from constructing and maintaining renewable generation facilities.

Second round, or indirect employment impacts, can follow as Nevada firms that supply labor and materials to generation facilities expand. Finally, new jobs can be created in the retail, services, and other sectors that support consumption activities. Similarly, direct GSP impacts will arise from the construction, maintenance, and operation of renewable generation facilities. Indirect and induced effects from increased demand for renewable energy generation products and increased household wealth, respectively, are also important sources of economic activity.

In the following section, we quantify the sum of direct and indirect economic impacts, in terms of employment and GSP, of developing Nevada's renewable resources. We focus on three scenarios: current-use, low-use, and a representative high-use scenario. The three scenarios deepen our insight of the economic impact we may expect from the implementation of the Nevada RPS. To estimate the economic impacts, we employ a structural demographic and economic model developed by Regional Economic Models, Inc (REMI) specifically for Nevada. In the following section, we discuss the REMI model and its assumptions. Next we outline each of the three scenarios and the resulting employment and GSP impacts. We conclude the section with a comparison of the different model results

### The REMI Model

The REMI model is a state-of-the-art econometric forecast model that accounts for dynamic feedbacks between econometric and demographic variables. The REMI model is national recognized by the business and academic community as the best regional forecast tool available. The REMI model forecasts county employment based on a model that includes over 100 stochastic and dynamic relationships and a number of identities. The national economy is taken as exogenous. The relationship spans 53 sectors of employment figures, detailed population and demographic forecasts that include economic and non-economic migration, capital formation, and county-level import export relationships. A complete explanation of all of the relationships contained in the model is given in Regional Economic Modeling: A Systemic Approach to Economic Forecasting and Policy Analysis by George I. Treyz.

The REMI model allows for an open economy, thus the model *explicitly* accounts for trade among the counties of Nevada and throughout the U.S.

## University of Illinois

Another major economic study came out of the Midwest in 2001. Job Jolt: The Economic Impact of Repowering the Midwest was conducted by the University of Illinois's Regional Economic Applications Laboratory (REAL) and was written by the Environmental Law & Policy Center:

Implementing the *Repowering the Midwest* Clean Energy Development Plan would create more than 200,000 new jobs across the 10-state Midwest region by 2020, up to \$5.5 billion in additional worker income, and up to \$20 billion in increased economic activity. ...

The Regional Economic Applications Laboratory (REAL), a nationally known research center of the University of Illinois, used its modeling techniques to determine the economic impacts of implementing the clean energy development plan proposed by the Environmental Law & Policy Center (ELPC) and its Midwest partners. ...

The economic impacts of implementing the Clean Energy Development Plan were estimated using regional econometric input-output models developed by REAL to forecast the local impacts of changing economic conditions and policies. Since 1989 REAL has developed, and continually refined, a portfolio of models covering metropolitan regions and states across the Midwest. Using primarily U.S. Census data, REAL's dynamic models track employment, income and output data across 53 industrial sectors, factoring in 13 demand variables (consumption, investment, government expenditures, etc.) and eight demographic variables (age, sex, migration, etc.) ...

*Energy Efficiency Impacts* for the Midwest measures the changes in employment, income and economic output that would result from investments in energy efficiency that save up to 17 percent of electricity use by 2010 (versus business-as-usual) and 28 percent by 2020.

*Renewable Energy Impacts* for the Midwest measures the changes in employment, income and economic output that would result from a program of clean energy development (wind, solar, biomass) in which 8 percent of the Midwest electricity would be generated from renewable energy by 2010 and 22 percent by 2020. And, with efficient gas uses, 18% by 2010 and 46% by 2020. ...

The results of REAL's study indicate that the energy efficiency measures outlined in Repowering the Midwest's Clean Energy Development Plan will generate as many as 84,000 jobs by 2010 (over and above a business-as-usual baseline) rising to 141,000 jobs by 2020. These jobs will generate local income -- direct and indirect -- of up to \$1.8 billion by 2010 rising to \$3.2 billion in the year 2020. The plan will increase Midwest economic output by as much as \$7.1 billion by 2010 rising to \$12.7 billion by 2020.

REAL's study shows that implementing the renewable energy component of the Clean Energy Development Plan in *Repowering the Midwest* will generate 25,000 - 41,000 jobs by 2020. These jobs will generate local income of \$700 million - \$1.3 billion in 2010, rising to \$1.7 billion - \$2.3 billion in 2020. Implementation also will increase annual Midwest economic output by \$2.3 billion to \$4.0 billion in 2010, and by \$5.5 billion to \$7.3 billion in 2020 ... Renewable energy will create new jobs -- both direct and indirect -- in all major economic sectors.

## GDS

GDS: Analysis of Renewable Portfolio Standard Options for Hawaii.<sup>26</sup> GDS developed a computer spreadsheet-based cost model. They assumed two oil price scenarios: \$22/barrel and \$25/barrel in 2003 (with yearly price increases) and two renewable energy penetration levels: 9.5% and 10.5% in 2010. Each of the four scenarios saved money as compared to the applicants published fossil fuel plans. GDS noted: "Additional savings would be realized if oil prices escalated above the levels modeled."

GDS subcontracted with Global Energy Concepts, Inc. (GEC) to update its earlier study, "Renewable Energy Resource Assessment and Development Program," completed as part of DBEDT's *Hawaii Energy Strategy* program in 1995. GEC reviewed the more than 200 potential renewable energy projects identified in that report. For this study, GEC selected those projects that offered the most

The dollar savings associated with implementing renewable energy projects represent a very small percentage of total utility costs. Nevertheless, the renewable portfolio standards do offer statewide financial savings with the additional

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<sup>26</sup> Submitted to the State of Hawaii Department of Business, Economic Development & Tourism by GDS (March 2001) [www.hawaii.gov/dbedt/ert/rps01/rps01.html](http://www.hawaii.gov/dbedt/ert/rps01/rps01.html)

benefits of renewable energy cited above. Should oil prices be higher, the savings would increase. Naturally, if oil prices are lower, the savings would not be as great.

The GDS Report assumed that most renewable energy projects would not be built on Oahu.

### **Energy Efficiency**

Energy Efficiency and Job Creation Report (1992). Howard Geller, John DeCicco and Skip Laitner.

Numerous studies have examined the energy, economic, and environmental impacts of a national energy strategy that emphasizes greater energy efficiency. America's Energy Choices, for example, showed that vigorous adoption of cost-effective energy efficiency and renewable energy measures could reduce national energy intensity in 2030 by nearly 50%, dramatically reduce our nation's petroleum dependence, save consumers more than \$2 trillion net over the next 40 years, and cut carbon dioxide emissions in 2030 by more than 70% relative to emissions in 1988.<sup>27</sup> However, America's Energy Choices and similar studies only consider direct economic impacts -- the cost of energy efficiency measures and the value of the energy savings.

The purpose of this study is to build on America's Energy Choices by analyzing the indirect economic benefits of a high efficiency energy strategy -- the impacts on employment and income that could result from shifting economic activity away from the energy supply sectors of our economy and from reducing the cost of energy services. ...

The analysis is conducted using an input-output economic model. ... The results of this study are consistent with other input-output studies that examine how energy efficiency improvements affect employment levels. These other studies, which consider more limited efficiency investments and/or geographic coverage, indicate that specific energy efficiency measures or programs create more jobs at the regional or state level as compared to energy supply projects.

In conclusion, this study adds a new dimension to the national debate over energy priorities. Energy efficiency improvements lead to more jobs and higher personal income at the national level, in addition to saving consumers money, reducing energy imports, and cutting pollutant emissions associated with energy supply. In terms of energy policy objectives, it is unnecessary to choose either economic benefits and jobs on the one hand or environmental protection on the other. We can create more jobs and better protect the environment by adopting policies that enhance energy efficiency. Given the economic, energy, and environmental challenges that our nation faces, can we afford not to act?

### **Portfolio Analysis**

Putting all of one's eggs in one basket is risky, for any type of investment portfolio. Relying on one fuel source is an enormous strategic risk for both present and future commerce and for economic security. Hawai'i places a greater concentration on one fuel source than any other state in the nation for any type of fuel. Excluding Kaua'i, most electricity in Hawai'i is generated from oil (78.6%) followed by coal (14.8%). No other state in the country relies on any one fuel

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<sup>27</sup> America's Energy Choices: Investing in a Strong Economy and a Clean Environment. ACEEE, Alliance to Save Energy, Natural Resources Defense Council, and Union of Concerned Scientists (1991)

source -- be it oil, coal, nuclear or hydroelectric -- for over 70% of its generation. When looking at creating a portfolio of alternatives, Hawai'i is at one extreme end, placing more of its eggs in one basket than any other state.

Modern portfolio theory states that rational investors will use diversification to optimize their portfolios. The theory states an asset should be priced given its risk relative to the market as a whole. Investors select portfolios based on their overall risk-reward characteristics instead of merely compiling portfolios from securities that each individually have attractive risk-reward characteristics. In a nutshell, inventors should select portfolios not individual securities. Efficiency refers to a balance of volatility (risk) and expected return (reward) for a given portfolio. Beta is the ratio of the relative risk of a commodity compared to the average market risk.

#### **PART 4: THE STATE CONSTITUTION**

The State Constitutional Convention (ConCon) of 1978 proposed amending the constitution to include the term energy-self-sufficiency: Article XI, Section 1.

“the State ... shall conserve and protect ... natural resources, including ... energy sources, and shall promote the development and utilization of these resources ... in furtherance of the self-sufficiency of the State.”

The Committee on Environment, Agriculture, Conservation and Land's Standing Committee Report ("SCR") No. 77 was the only committee report from the ConCon dealing with this amendment:

“Your Committee on Environment, Agriculture, Conservation and Land ... begs leave to report as follows ... The consensus of your Committee with regard to self-sufficiency was to constitutionally recognize the growing concern and awareness of Hawaii as being overly dependent on outside sources for, among other resources, food and energy. Your Committee spent much time considering the need for a separate section on an energy policy for the State. However, it was concluded that the promotion of energy conservation, the development of clean, renewable sources of energy, and the achievement of increased energy self-sufficiency would be adequately covered by the provisions of this section.”<sup>28</sup> (emphasis added)

The Constitutional Convention Submission & Information Committee wrote a 2-page summary of the proposed amendments which appeared in the joint Sunday Star-Bulletin & Advertiser (on Sunday the papers produced one uniform paper) had a bold headline spread across pages A26 & A27:

Amendment "23. Environment and Resource Protection. If approved, the State and the counties would be required to conserve and protect the natural beauty and resources of Hawaii and to promote the use and development of these resources in a manner consistent with conserving the resources while promoting self-sufficiency in Hawaii. Each person is affirmed to have the right to a clean and healthy environment with the State holding all public natural resources in trust for the benefit of the people. Each person would have the right to sue to enforce his right to a clean and healthy environment as defined by law."

Following passage of the amendment, the Legislative Reference Bureau informed the 1979 state Legislature:

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<sup>28</sup> Constitutional Convention of 1978: LRB Ref. KFH 401 1978 A225 v1 c1; See also: Constitutional Amendment Information Sheets. LRB

Energy "Committee Report ... The provision regarding 'self-sufficiency' was included to recognize the growing concern and awareness of Hawaii as being overly dependent on outside sources for, among other reasons, food and energy. ... Legislation. No legislation appears necessary at this time.<sup>29</sup>

The Hawaii Supreme Court has stated:

"the Hawai`i Constitution must be construed with due regard to the intent of the framers and the people adopting it, and the fundamental principle in interpreting a constitutional provision is to give effect to that intent." ... "This intent is to be found in the instrument itself." ... As we recently reiterated in ... "[t]he general rule is that, if the words used in a constitutional provision . . . are clear and unambiguous, they are to be construed as they are written."<sup>30</sup>

The constitutional mandate for energy self-sufficiency does not mention cost. Fake (engineering) costs favor fossil fuels. Sound financial economic analysis reveals that indigenous energy resources are better for the economy.

## **PART 5: RENEWABLE ENERGY OPTIONS**

Hawai`i is perfectly poised with almost constant sunshine, prevalent trade winds & surrounded by a deep, cold ocean, to become a model of energy self-sufficiency. Hawai`i has an abundant and varied portfolio of renewable energy resources. This includes solar, wind, hydroelectric, biomass, wave, deep cold sea water. Hawai`i also has great opportunities to decrease the need for air conditioning through the use of ocean temperature differentials. Finally, Hawai`i has an installed and developed capacity for cogeneration to be used during the transition to a sustainable energy self-sufficient future.

### **Solar Energy**

The sun showers the Earth with an amazingly large supply of energy. Each day more solar energy falls to the Earth than the total amount of energy the planet's 6.1 billion inhabitants would consume in 27 years. *National Renewable Energy Laboratories*. [www.nrel.gov/documents/solar\\_energy.html](http://www.nrel.gov/documents/solar_energy.html)

The total potential for solar panels in the Netherlands is large. In total, roofs and disused land offers room for the placement of panels ... would provide three-quarters of the electricity consumed in the Netherlands. If we only consider the roof potential on dwellings and non-residential buildings, then more than a quarter of the energy consumed in the Netherlands could be generated by solar panels.<sup>31</sup>

According to researchers at the National Renewable Energy Laboratory (NREL) in Golden, Colo., photovoltaic units -- or solar panels -- spanning only 10,000 square miles could provide all the electricity the United States needs based on the current solar energy technology of 10-percent system efficiency. With next-generation 15-percent efficiency models, that land space would be decreased by 30 percent. An area roughly equivalent to 1 percent of the continental United States could supply enough electricity to charge the world.<sup>32</sup>

Spire is the world's leading supplier of photovoltaic manufacturing equipment, turnkey production lines, and solar energy business. The City of Chicago and a local utility signed an agreement to purchase \$6M worth of photovoltaics in exchange for Spire's commitment to establish a Chicago-based photovoltaic manufacturing facility. By guaranteeing a

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<sup>29</sup> Constitutional Amendment Information Sheets (late 1978), page 110

<sup>30</sup> Hawaii State Court No. 20267 (1997) [www.hsba.org/HSBA/Legal\\_Research/Hawaii/sc/20267.cfm](http://www.hsba.org/HSBA/Legal_Research/Hawaii/sc/20267.cfm)

<sup>31</sup> KPMG Report, page 15. (KPMG is HEI's auditor)

<sup>32</sup> Global Energy Network Institute (GENI): Editorial: Solar eclipse. *January 12, 2001*  
[www.geni.org/energy/library/technical\\_articles/editorial\\_solar\\_eclipse.html](http://www.geni.org/energy/library/technical_articles/editorial_solar_eclipse.html)

market to Spire, the City of Chicago was able to keep a greater share of the renewable investments within Chicago, increasing employment and diversifying the local economy.<sup>33</sup>

## Wind

Economical wind farms could be built on O`ahu, including 50MW mauka of the Kahe Generation Station, and 80MW on mauka and makai lands of Kahuku.

The Pacific Northwest Laboratory (PNL) of the Department of Energy (DOE) has published estimates of the wind power resource available in the United States. PNNL estimates that 9% of the lower forty-eight states had "good" (class 4) or "excellent" (greater than class 4) wind resources. ... The total amount of US land with "excellent" wind characteristics, with moderate exclusions, is just over one percent of total land area. This would support approximately 3,500 gigawatts (GW) of wind capacity, with nearly eight megawatts (MW) of rated capacity per square kilometer. The rated (peak) wind capacity of 3,500 GW is about five times the 713 GW of 1999 installed conventional utility and non-utility generating capacity in the United States.<sup>34</sup>

The developable wind power resource of the US, that is, what could be developed without incurring undue impacts to birds, noise, or visibility, is estimated to be between 2 to 10 times the entire electricity consumption of the US.<sup>35</sup>

## Wave Power:

Tidal energy offers a great opportunity. Since water is 1000 times more dense than wind, the size of the blade can be much smaller. It makes sense to be open to wave power facilities. The pilot project in state waters off the coast of the Marine Corps Base Hawaii hold much promise.

Hawaii may be an ideal site for early commercial development of WECS owing to the following reasons ... Hawaii has one of the better and more consistent wave regimes.<sup>36</sup>

## Sea Water Air Conditioning (SWAC)

Market Street Energy Company, based in St. Paul, Minnesota, plans to build two Sea Water Air Conditioning (SWAC) systems (2007, 2009) in Honolulu. Each will displace approximately 17 MW of grid power. The company believes that five systems would be economical, offsetting a total of 68 MW of electricity. The fixed costs would account for 85 percent of the lifecycle costs. Perhaps half of the capital construction costs would be spent on outside equipment and half would be spent in the local market.

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<sup>33</sup> Collaborations Build Environmental "Brightfield" on Chicago's Industrial West Side [www.consciouschoice.com/2002/cc1504/greentechnologyctr1504.html](http://www.consciouschoice.com/2002/cc1504/greentechnologyctr1504.html); Chicago "Blight field" Converted to Brightfield: Spire Chicago Solar and Greencorps Chicago Replace a Brownfield Site [www.fkassociates.com/solarpower.html](http://www.fkassociates.com/solarpower.html); Chicago will be America's Greenest City [www.consciouschoice.com](http://www.consciouschoice.com).

<sup>34</sup> [www.thegreenpowergroup.org/wind.html](http://www.thegreenpowergroup.org/wind.html)

<sup>35</sup> [www.cfcae.org/Wind\\_Power/Wind\\_Facts.htm](http://www.cfcae.org/Wind_Power/Wind_Facts.htm)

<sup>36</sup> DBEDT's Feasibility of Developing Wave Power as a Renewable Energy Resource for Hawaii, page 1

Waikiki seawater air conditioning cold water circulation system could reduce Waikiki's entire energy economy by 40%<sup>37, 38</sup>.

### **Combined Heat and Power (Cogeneration):**

Urban Honolulu has a gas infrastructure and has sufficient additional capacity already installed to handle a great deal of new distributed generation. There is a gas grid in urban Honolulu. A Synthetic Natural Gas Pipeline exists from Waikiki to Hawaii Kai. The gas line has enough capacity for 150 MW of power in urban and east Honolulu. The plant producing Synthetic Natural Gas is at 57 percent capacity. Since cogeneration utilizes the heat produced by burning gas, facilities with cogeneration do not need to purchase electricity to generate heat. Thus One MW of cogeneration sheds two MW from the generation of electricity. There is no transmission losses with cogeneration.<sup>39</sup>

### **Demand Side Management**

DSM programs traditionally seek to decrease average demand, but more importantly, they need to decrease peak demand. The level of peak demand determines the need for new generation and transmission. Decreasing this peak demand, through efficiencies, peak shaving, load leveling, etc., is paramount.

Utilities are in the business of making energy and selling it to customers. Demand Side Management (DSM) or Energy Efficiency (EE) programs run counter to this. Utilities are rewarded for decreasing sales. The major problem is that over 50% of the program costs go to overhead. This is an inefficient efficiency program. Alternatives exist:

Efficiency Vermont is an independent entity whose sole mission is energy efficiency. It provides technical advice, financial assistance, and design guidance to help make Vermont homes and businesses more energy efficient. *They are* funded by an "energy efficiency charge" that appears on consumers' electric bills. Efficiency Vermont was a 2003 winner of Harvard University's Kennedy School of Government's Innovations in American Government Award.<sup>40</sup>

The Connecticut Light & Power Company (CL&P) has established a Request for Power (RFP) program that allows customers, on their own or in partnership with a third-party energy consultant, to bid for funds to design and implement energy efficiency projects custom-tailored to their specific needs. The objects of the program are to save energy, money, and the environment and encourage third-party energy providers to enter the conservation field. RFPs are issued at

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<sup>37</sup> Uncontested testimony by Life of the Land witness Dr. John Harrison during the Board of Land and Natural Resources (BLNR) contested case hearing re Conservation District Use Application (CDUA) OA-2801.

<sup>38</sup> Dr. John Harrison worked as a post-doctoral marine scientist for the University of California at Berkeley where he administered the U.S. Department of Energy funded ocean thermal energy conversion (OTEC) environmental research program in Hawaii. Dr. Harrison wrote the Ocean Thermal Energy Conversion (OTEC) handbook for the U.S. Department of Energy's solar energy research institute. Dr. Harrison was hired by the United States Department of Commerce, National Marine Fishery Services to write the environmental analysis section of the federal environmental impact statement for the 40-megawatt ocean thermal energy conversion (OTEC) pilot plant that was intended to be installed at Kahe Point adjacent to and in combination with the Hawaiian Electric Kahe Point generating facility.

<sup>39</sup> Uncontested testimony by Life of the Land witness Todd Scheibert during the Board of Land and Natural Resources (BLNR) contested case hearing re Conservation District Use Application (CDUA) OA-2801.

<sup>40</sup> [www.newrules.org/electricity/efficiencyvt.html](http://www.newrules.org/electricity/efficiencyvt.html) [www.encyvermont.com/Docs/Innovations%20Award.doc](http://www.encyvermont.com/Docs/Innovations%20Award.doc)

regular intervals (rounds) throughout the year. Each round is allocated a specific portion of the RFP program's annual budget. The proposals received during a specific round compete against one another.<sup>41</sup>

## Summary

In the early 1990s, the Commission adopted the Integrated Resource Planning (IRP) process, which placed emphasis on the lowest reasonable cost. At that time, the Hawai'i State Constitution's energy self-sufficiency clause was overlooked, the global warming evidence was not nearly as strong, the economic input-output analysis was not done, and the cost of renewable energy was higher.

Today, the Hawai'i State Constitution's energy self-sufficiency clause, the economic, environmental and health impacts, and renewable energy cost and options are all in alignment.

In the past five years, major economic studies have revealed the enormous benefits of investing in local resources.

In the last couple of years the analysis of greenhouse gases, and the evidence of global warming, has become overwhelming and terrifying.

Recently University of Hawaii scientists have been able to analyze material found in mauka areas and to determine that they came from dust storms in the Gobi. What goes up, comes down. Trade winds do not make it vanish. The Applicant's pollution lands on our 'aina, on the oceans, and on other countries. This pollution affects health, contaminates food supplies, and poisons the planet.

There are two competing paths for the future: (1) fossil fuel based central-station with transmission lines; and (2) renewable distributed generation. Which future infrastructure is "reasonable" and "in the public interest"?

Least cost planning must include economic, environmental and health impacts.

The role of government is to implement the Constitution -- In that context the decision is not "Is the Applicant's plan good?" -- rather it is what is our vision for Hawai'i's energy future and does this proposal get us there?, or move us in the right direction? Sadly, the answer is no.

## APPENDIX

Exhibits 1-6 were submitted to all parties in the Distributed Generation Docket ( 03-0371) as exhibits to Life of the Land's Replies to Direct Testimony Information Requests dated August 18, 2004

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<sup>41</sup> [www.aceee.org/utility/18bnurfpcr.pdf](http://www.aceee.org/utility/18bnurfpcr.pdf)

Exhibit 8 is in the public arena. HECO and others have filed comments on the document

Exhibit 10 was provided to HECO in BLNR OA-2801

Exhibits 15-18 have been submitted by other parties to all parties including the PUC.

**Exhibits: electronic and hard copies provided (LOL-Ex-)**

- 1     Job Jolt: The Economic Impact of Repowering the Midwest. The University of Illinois's Regional Economic Applications Laboratory (REAL) and was written by the Environmental Law & Policy Center. Submitted to all parties in PUC Docket No. 03-0371 re Life of the Land's Replies to Direct Testimony Information Requests ("DT-RIRs") dated August 18, 2004
  
- 2     Assessment of the Potential Impacts of a Renewable Portfolio Standard in Pennsylvania. consultant Black & Veatch
  
- 3     The Potential Economic Impact of Nevada's Renewable Energy Resources The University of Nevada Las Vegas (UNLV)
  
- 4     Imports, Exports and Economic Development Enterprise Honolulu (formerly known as the Oahu Economic Development Board). Their Economic Development Series (EDS) analyzes Hawai'i's economy. From EDS Installment #10: (August 28, 2003): [www.enterprisehonolulu.com/html/pdf/EHeseries10.pdf](http://www.enterprisehonolulu.com/html/pdf/EHeseries10.pdf)
  
- 5     Export Enhancement and Import Substitution - Key Strategies for Hawai'i's Prosperity Enterprise Honolulu (formerly known as the Oahu Economic Development Board). Their Economic Development Series (EDS) analyzes Hawai'i's economy. EDS Installment #11: (September 4, 2003): [www.enterprisehonolulu.com/html/pdf/EHeseries11.pdf](http://www.enterprisehonolulu.com/html/pdf/EHeseries11.pdf)
  
- 6     Importing Energy, Exporting Jobs, from Dollars from Sense: The Economic Benefits of Renewable Energy National Renewable Energy Labs (NREL) of the United States Department of Energy (1997)
  
- 7     Energy Efficiency and Job Creation Report (1992). Howard Geller, John DeCicco and Skip Laitner.
  
- 8     Analysis of Renewable Portfolio Options for Hawaii (March 2001) Submitted to the State of Hawaii Department of Business, Economic Development & Tourism by GDS Associates.
  
- 9     Department of Defense: Abrupt Climate Change

- 10 Know Thy Costs: To remain competitive, planners must adopt sophisticated finance valuation tools Dr. Shimon Awerbuch
- 11 Efficient Vermont: [www.encyvermont.com/Docs/Innovations%20Award.doc](http://www.encyvermont.com/Docs/Innovations%20Award.doc)
- 12 Conscious Choice: Collaborations Build Environmental "Brightfield" on Chicago's Industrial West Side  
[www.consciouschoice.com/2002/cc1504/greentechnologyctr1504.html](http://www.consciouschoice.com/2002/cc1504/greentechnologyctr1504.html); Chicago "Blight field" Converted to Brightfield: Spire Chicago Solar and Greencorps Chicago Replace a Brownfield  
[www.consciouschoice.com/2002/cc1504/aboltinterview1504.html](http://www.consciouschoice.com/2002/cc1504/aboltinterview1504.html)
- 13 Climate Collapse: The Pentagon's Weather Nightmare. Fortune Magazine (Feb 25, 2004).  
[www.fortune.com/fortune/technology/articles/0,15114,582584,00.html](http://www.fortune.com/fortune/technology/articles/0,15114,582584,00.html)
- 14 Climate Impacts: A Worst-Case View of Global Change Chemical and Engineering News (March 1, 2004).  
Volume 82, Number 9. <http://pubs.acs.org/cen/topstory/8209/8209notw9.html>
- 15 A Report on Public Input. 3Point. September 2003
- 16 Consumer Advocate letter dated Feb. 25, 2004
- 17 EOTP Final Environmental Assessment Volume 1
- 18 EOTP Final Environmental Assessment Volume 2
- 19 Henry Curtis Biography

**Documents provided only in electronic format (LOL-Ref-)**

- 1 Assessment of the Potential Impacts of a Renewable Portfolio Standard in Pennsylvania. B&V Presentation
- 2 Assessment of the Potential Impacts of a Renewable Portfolio Standard in Pennsylvania. B&V Summary
- 3 The 1978 Constitutional Convention's Committee on Environment, Agriculture, Conservation and Land's Standing Committee Report ("SCR") No. 77
- 4 Hawaii Energy Strategy 2000

- 5 Chicago Climate Exchange. [www.chicagoclimatex.com/about/pdf/CCX\\_Corp\\_Overview\\_2005.pdf](http://www.chicagoclimatex.com/about/pdf/CCX_Corp_Overview_2005.pdf)
- 6 Waiiau Spill. DBEDT's Feasibility of Developing Wave Power as a Renewable Energy Resource for Hawaii
- 7 NOAA Damage Assessment and Restoration Program (DARP) [www.darp.noaa.gov/southwest/chevron](http://www.darp.noaa.gov/southwest/chevron)
- 8 Efficiency Vermont. News Rules. [www.newrules.org/electricity/efficiencyvt.html](http://www.newrules.org/electricity/efficiencyvt.html)
- 9 National Renewable Energy Labs solar. [www.nrel.gov/documents/solar\\_energy.html](http://www.nrel.gov/documents/solar_energy.html)
- 10 Regional Greenhouse Gas Initiative. [www.rggi.org/about.htm](http://www.rggi.org/about.htm)
- 11 World Resource Institute: Wind
- 12 DSM. Connecticut Light & Power
- 13 Solar Energy: from perennial promise to competitive alternative. KPMG
- 14 Editorial: Solar eclipse. GENI re NREL. Global Energy Network Institute (GENI). *January 12, 2001*  
[www.geni.org/energy/library/technical\\_articles/editorial\\_solar\\_eclipse.html](http://www.geni.org/energy/library/technical_articles/editorial_solar_eclipse.html)
- 15 Hawaii Energy Strategy 2000, Chapter 3
- 16 Hawaii Energy Strategy 2000, Appendix C
- 17 The Economic Benefits of Renewable Energy. National Renewable Energy Labs (NREL) of the United States Department of Energy (1997) entitled: Dollars from Sense
- 18 BLNR CDUA-2801 Kamoku-Pukele re McConnell's Proposed Findings of Fact, Conclusions of Law & Decision and Order
- 19 BLNR CDUA-2801 Kamoku-Pukele re BLNR's Findings of Fact, Conclusions of Law & Decision and Order

Additional Document

Final Restoration Plan and Environmental Assessment for the May 14, 1996 Chevron Pipeline Oil Spill into Waiiau Stream and Pearl Harbor, Oahu, Hawaii (November 1999): 1.2 Overview.

[www.darp.noaa.gov/southwest/chevron/phfnlea1.html](http://www.darp.noaa.gov/southwest/chevron/phfnlea1.html)

Dated June 22, 2005

Henry Q Curtis

Henry Q Curtis  
VICE PRESIDENT FOR CONSUMER ISSUES  
LIFE OF THE LAND

Certificate of Service

I hereby certify that I have this date served a copy by hand delivery of the foregoing Motion To Intervene by Life of the Land, in PUC Docket Number 03-0417, upon the following parties. The original and 8 copies to the PUC, two copies to the Consumer Advocate, and one copy to HECO. We are mailing a copy of this Motion To Intervene to the Kauai Island Utility Cooperative, and enclosing in that mailing, a copy of our Motion to Intervene in HECO's CHP docket.

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