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PUBLIC UTILITIES
COMMISSION

BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF HAWAII

In the Matter of the Application of	)	
	)	
PUBLIC UTILITIES COMMISSION	)	DOCKET NO. 03-0371
	)	
Instituting a Proceeding to Investigate	)	
Distributed Generation in Hawaii	)	

DIVISION OF CONSUMER ADVOCACY'S
DIRECT TESTIMONY AND EXHIBITS

Pursuant to the agreed upon schedule set forth in Prehearing Order No. 20922, the Division of Consumer Advocacy submits its **DIRECT TESTIMONY AND EXHIBITS** in the above docketed matter.

DATED: Honolulu, Hawaii, July 14, 2004.

Respectfully submitted,

By [signature]
JOHN E. COLE
Executive Director

DIVISION OF CONSUMER ADVOCACY

CERTIFICATE OF SERVICE

I hereby certify that a copy of the foregoing **DIVISION OF CONSUMER ADVOCACY'S DIRECT TESTIMONY AND EXHIBITS** was duly served upon the following parties, by personal service, hand delivery, and/or U.S. mail, postage prepaid, and properly addressed pursuant to HAR § 6-61-21(d).

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CA-T-1
DOCKET NO. 03-0371

DIRECT TESTIMONY AND EXHIBITS

OF

JOSEPH A. HERZ, P.E.

THE DIVISION OF CONSUMER ADVOCACY

SUBJECT: ANALYSIS OF, AND RECOMMENDATIONS ON THE COST-EFFECTIVE DEPLOYMENT OF DISTRIBUTED GENERATION IN THE STATE OF HAWAII

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DIRECT TESTIMONY OF JOSEPH A. HERZ, P.E.

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME, POSITION AND PLACE OF EMPLOYMENT.

A. My name is Joseph A. Herz. I am employed by Sawvel and Associates, Inc. (Sawvel). I am the owner and president of Sawvel, which is an independent consulting firm. Sawvel is located at 100 East Main Cross Street, Suite 300, Findlay, Ohio 45840.

Q. PLEASE STATE YOUR PROFESSIONAL EXPERIENCE AND EDUCATIONAL BACKGROUND.

A. Exhibit CA-100 summaries by professional experience and educational.

Q. WHAT IS YOUR UNDERSTANDING OF THE PURPOSE OF THIS PROCEEDING?

A. I understand the Public Utilities Commission of the State of Hawaii ("Hawaii Commission") instituted this generic proceeding to examine the potential benefits and impacts of Distributed Generation ("DG") on Hawaii's electric distribution systems and market.[1] In its Order, the Hawaii Commission indicated that the objective of the instant proceeding is to develop policies and a framework for DG projects deployed in Hawaii. The policies and framework

[1] See Order No. 20582, dated October 21, 2003, filed in the instant proceeding.

will form the basis for the rules and regulations that are deemed necessary to govern participation in Hawaii's DG market.

In a related matter, the Hawaii Commission also instituted a generic proceeding to investigate the feasibility of implementing a competitive bidding process for the procurement of new generation capacity in Hawaii (i.e., Docket No. 03-0372). To be beneficial to Hawaii's electric industry and electric utility ratepayers, any supply-side resource addition should meet the technical and economic system needs of Hawaii's electric utility companies in a manner that is consistent with public policies and initiatives. Therefore, implementation of DG and competitive bidding for generating resources are interrelated and directly impact the lowest reasonable cost integrated resource planning ("IRP") activities of each of the electric utility companies.

Q. ON WHOSE BEHALF ARE YOU APPEARING IN THIS PROCEEDING?

A. I am appearing on behalf of the Division of Consumer Advocacy ("Consumer Advocate"), who is a participant to this proceeding to represent, advance and protect the interests of Hawaii's electric utility ratepayers. As such, it is my understanding that the Consumer Advocate's objectives are to ensure that the policies and framework established in the instant proceeding promote the deployment of DG projects representing the lowest reasonable cost alternative to meeting Hawaii's energy needs, while also ensuring the provision of reliable service to the State's electric utility customers.

In determining the lowest reasonable cost, I understand that the Consumer Advocate is required to consider the long-term benefits of renewable resources.[2] In addition, I understand that the Consumer Advocate must strive to meet the State's energy policy of reducing its dependence on fossil fuel by encouraging the use of renewable energy.[3] Therefore, the rules and regulations governing the deployment of DG projects must properly recognize the benefits, impacts and costs of DG in a manner that is consistent with State energy and environmental policies, while minimizing uncertainty and risks between the electric utility companies, their ratepayers and DG suppliers and their customers.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to present the Consumer Advocate's recommendations on each of the issues set forth in the Hawaii Commission's Prehearing Order No. 20922, filed on April 23, 2003, in the instant proceeding. These recommendations will serve as the basis for the policies and framework deemed necessary to ensure the cost-effective deployment of DG in Hawaii.

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2 See Hawaii Revised Statutes §269-54(c).

3 See Hawaii Revised Statutes §226-18.

Q. HOW IS YOUR TESTIMONY ORGANIZED?

A. I first present a summary of my conclusions and recommendations in Section II. I will provide my understanding of DG technology and its use on the mainland United States in Section III. In Section IV, I set forth the factors that must be considered in determining the deployment of DG in Hawaii's energy market, and explain why these factors are important to ensuring the reliable provision of electrical energy in the State. I will also discuss the impact of DG in Hawaii's energy market in this Section. In Section V, I will discuss what must be done to effectively deploy DG in Hawaii. Then, in Section VI, I will address general issues such as who should own and operate DG facilities and the role of the regulator and the electric utility in the deployment of DG in the State. Finally, in Section VII, I conclude my testimony by presenting my recommendations for the Hawaii Commission's consideration.

Q. ARE YOU SPONSORING ANY EXHIBITS IN THIS PROCEEDING?

A. Yes, I am sponsoring Exhibits CA-100 through CA-106. Exhibit CA-100 provides my educational background and summaries my work experience. Exhibit CA-101 summarizes the DG technologies that are both commercially available and emerging and the typical uses of each technology. Exhibit CA 102 summarizes how energy from DG resources is utilized to serve customers. Exhibit CA-103 provides population and land area information for each of the six islands served by the electric utility companies. Exhibit CA-104 summarizes the electric system peak demand and energy requirements together with the electrical use per capita for each of the six islands. Exhibit CA-105 provides the balance of peak demand and firm resources for each of the six islands. Exhibit CA-106 summarizes the utility system losses on each of the six islands. Exhibit CA-107 describes the ancillary functions of mainland utilities that are regulated by the Federal Energy Regulatory Commission ("FERC").

Q. WERE THE TESTIMONY AND EXHIBITS PREPARED BY YOU OR UNDER YOUR DIRECT SUPERVISION?

A. Yes, they were.

II. <u>SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS FOR THE HAWAII COMMISSION'S CONSIDERATION</u>

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS ON WHETHER THE INSTALLATION OF DG SHOULD BE ENCOURAGED ON THE BASIS THAT DG CAN BE BENEFICIAL TO HAWAII'S ELECTRIC CONSUMERS.

A. As described in my testimony, DG can promote the provision of reliable service at the lowest reasonable cost to Hawaii's electric consumers, if effectively deployed. In determining how to effectively deploy DG, the following must be considered.

For DG Projects Whose Output Is Utilized by the Customer:

1. Customers connected to the utility system and whose load, all or part of, is served by a DG installation may still require and utilize services from the electric utility.
2. The current "bundled" rate structures of the electric utility companies are not designed to separately identify the costs of providing these services. As a result, customers served by DG facilities may not pay an appropriate rate for the services that continue to be provided by the electric utility.
3. If customers served by DG facilities do not pay a rate that compensates the utility for the costs of providing utility services, the costs of providing these services will not be recovered from the cost causer (i.e., the customer served by the DG facility). This situation may eventually result in an increase in the rates charged other customers in order for the electric utility to recover the costs that are not recovered from the customer served by the DG facility.

For Situations Where the DG Output Is Utilized by the Utility:

1. The capability of DG to perform various utility supply-side resource functions differs by DG technology. For example, as-available renewable energy projects may only be able to provide energy and not capacity since the resource is dependent on the availability of the energy resource (e.g., wind or run-of-the mill hydro). Fossil fuel and

certain renewable resources such as biomass can, however, provide both energy and capacity, and can be dispatched to follow the load to be served.

2. Strategically located DG can improve transmission/distribution delivery system reliability and possibly defer capital improvements.

3. The electric utility's need for supply-side resources, and reliability concerns associated with each type of resource differs significantly between electric utilities. For example, some electric utilities may have adequate supply-side resource capacity while others may need to add additional capacity. Other utilities may have transmission/distribution system reliability and improvement concerns. Thus, the general deployment of DG must be determined on a case-by-case basis to ensure that the installation is cost-effective to the utility and its customers.

4. Interconnection issues need to be addressed, either in the terms and conditions set forth in a standard interconnection agreement, or in a separate agreement that is negotiated between the utility and the owner of the DG facility.

Q. BASED ON THESE CONCLUSIONS, WHAT ARE YOUR RECOMMENDATIONS?

A. To effectively deploy DG, the following items need to be done:

1. The current rate structure of each of the electric utility companies will need to be unbundled and rate tariffs modified so that customers connected to the utility grid are able to pay for generation, transmission and distribution services provided by the electric utility company, and back-up services, if required.
2. Interconnection standards and agreements should be developed to ensure that interconnection of a third-party owned DG facility does not negatively affect the electric utility's ability to provide reliable service.
3. The determination of whether a DG project's output represents the lowest reasonable cost option to meeting the electric system needs should be made when determining the electric utility's Integrated Resource Plan ("IRP").
4. A competitive bid process should be established for new generation, including DG resources.

III. GENERAL UNDERSTANDING OF DG TECHNOLOGY AND ITS USE ON THE MAINLAND UNITED STATES

A. GENERAL DEFINITIONS OF TERMS USED IN MY TESTIMONY

Q. IS IT IMPORTANT TO DEFINE THE TERMS USED IN YOUR TESTIMONY?

A. Yes, because people may use similar terms in different contexts when discussing DG. Thus, it would be helpful to set forth the definitions of the terms used throughout my testimony in order to avoid any misunderstanding as to the context in which the discussion is offered.

Q. WHAT IS DG?

A. DG involves the use of small-scale electric generation units located at or near the electric load. In a broader sense, DG sometimes consists of a portfolio of technologies, tools and techniques to supply energy services to customers at or near the point of use, including demand side management options. The Commission, however, focused this generic DG proceeding on supply side resources that generate and deliver electricity.[4]

For purposes of this proceeding, if a customer is served by a generating unit and is not connected to the utility grid, the electric utility will not provide energy to, or receive energy from, the customer.[5] Thus, only DG that directly or indirectly connected to the electric utility system is addressed in my testimony since this situation may have a significant impact on the electric utility's operations, the costs of providing service, and the resulting rates charged for the service rendered to its customers.

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4 See Order No. 20582, dated October 21, 2003, Section I, page 1.

5 See Exhibit CA-102, page 2 of 4.

Q. WHAT IS MEANT BY "SMALL-SCALE" ELECTRIC GENERATION?

A. The answer differs from utility to utility because the definition depends on the relationship of the DG unit size to the load served by the electric utility. For example, a 25 MW unit may be considered "small" for the island of Oahu, but would not be "small" for the island of Lanai simply because the electric load on Oahu is significantly larger than the load on the island of Lanai. A 100 MW unit may be considered "small" for a utility in California, but not be "small" for the electric utility systems operating in the state of Hawaii. A generation of this size exceeds the capacity of the largest generator on the electric utility systems, and represents a significant portion of the total load on each island.

Q. WHAT IS "EMERGENCY/STANDBY GENERATION" AND SHOULD IT BE CONSIDERED DG FOR PURPOSES OF THIS PROCEEDING?

A. An emergency/standby generator by my definition is generation that is only used during the period when the electric utility service to the customer is temporarily interrupted. Due to permit restrictions, emergency or standby generation is not allowed to operate and produce energy to serve the customer's load, or transmit power to the utility system for extended periods of time. Thus, the generator will not be considered a DG unit for purposes of this proceeding.

Q. WHAT IS "IRP?"

A. IRP is an approach that allows interested stakeholders to comment on how the electric utility plans to meet its future energy requirements. In Hawaii, the plan covers a 20-year period with a 5-year action plan that is revised every 3 years.[6] The Hawaii Commission has appropriately stated that the goal of an IRP is the identification of 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.[7]

An IRP therefore analyzes the costs of various supply and demand-side options and the effectiveness of each option in meeting specific goals and objectives identified by each utility in order to identify the options that will meet Hawaii's electric energy needs at the lowest reasonable cost. In developing an IRP the regulator also considers the utility company's financial integrity, size and physical capability, as well as the impacts on the utility's consumers, the environment, culture, community lifestyles, the state's economy, and society.

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6 See IRP Framework (Revised), Section III, Decision and Order No. 11630, filed on May 22, 1992 in Docket No. 6617.

7 See IRP Framework (Revised), page 3, Decision and Order No. 11630, filed on May 22, 1992 in Docket No. 6617.

Q. WHAT IS MEANT BY "LOWEST REASONABLE COST?"

A. "Lowest reasonable cost" is a term used in the IRP process to compare the cost of a resource option to the cost of other alternatives. The term "lowest reasonable cost" planning is more commonly used to identify that option which has the lower cost to the utility and ultimately the utility's customer. "Reasonable" is used, however, to recognize the fact that other non-monetary external costs or benefits associated with a specific alternative might ultimately lower the real or true cost of an option. Thus, the utility is required to consider both the monetary and non-monetary (i.e., external) costs of each option in determining what is reasonable.

Q. WHAT IS MEANT BY "CONNECTED TO THE GRID?"

A. Connected to the grid simply means that the customer has a physical connection to the electric utility's transmission and distribution system and can receive some or all of its energy needs from the electric utility.

Q. HOW ARE GENERATORS CONNECTED DIRECTLY AND INDIRECTLY TO THE ELECTRIC UTILITY GRID?

A. A DG is directly connected to the grid if it is connected to electric utility owned transmission and distribution facilities.[8] An indirectly connected DG is

[8] See Exhibit CA-102, page 3 of 4.

connected to the customer electric system and thus can decrease the amount of energy purchased from the electric utility, but is not directly connected to utility owned transmission and distribution facilities. The DG in this situation is usually referred to as "behind the meter" generation.[9]

Q. WHY IS THE DG PROJECT CONSIDERED "BEHIND THE METER?"

A. The generating source is located electrically on the customer side of the meter such that the output of the generator is not recognized as energy sales by the electric utility (i.e., "behind the meter"). An independent meter could, however, be installed on the generator to measure the output of the generator. This allows the customer to determine the customer's total energy usage by summing the energy use recorded on the utility's meter and the energy recorded on the generator meter.

Q. WHAT IS A "LOAD POCKET" AND WHY IS THE IDENTIFICATION OF LOAD POCKETS SIGNIFICANT FOR THE INSTANT PROCEEDING?

A. Load pockets are areas on the electric utility's system where the load exceeds the generation capabilities, and delivery system constraints prevent the wide-scale import of power from other parts of the delivery system or from other regions, as the case may be on the mainland United States where utility

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9 See Exhibit CA0102, page 4 of 4.

transmission systems are interconnected. DG may be of greatest value to the utility system in areas of concentrated loads, or where congested "load pockets" exist on the delivery system.

Q. WHAT IS MEANT BY THE TERMS "BUNDLED AND UNBUNDLED RATES?"

A. Bundled rates refers to the existing rate structure in Hawaii where the electric utility charges its classes of customers for all services (e.g., generation, transmission and distribution, ancillary customer billing and collection, etc.) under one rate. Unbundled rates simply identifies the rates that are applicable to the specific electric service provided by the utility to its customers (e.g., generation, transmission and distribution, ancillary services etc.).

Q. WHAT IS "STRANDED COSTS" AND WHY IS THIS COST IMPORTANT WHEN CONSIDERING THE COST EFFECTIVE DEPLOYMENT OF DG IN HAWAII'S ENERGY MARKET?

A. Electric utilities in Hawaii continue to operate as monopolies subject to Hawaii Commission regulatory oversight. As a result, the utilities have an obligation to serve its customers. In meeting the obligation, the utilities may be required to construct plant facilities (i.e., generation) that ensure the utility's ability to produce and deliver energy necessary to meet customer loads without service interruption.

As will be discussed in Section IV.B.4.b.(2) below, a customer's decision to install a DG unit to serve the customer's energy needs, may result in a reduction of the customer's electricity costs. If the loss of load for the electric utility is significant, however, the utility will realize less electric sales revenue and may not be able to receive compensation on and of the plant facilities that were initially constructed to serve that DG customer. This plant investment is thus, deemed to be "stranded" because the customer elected to have a DG unit produce the customer's energy needs in lieu of receiving such energy from the electric utility. Some utilities have sought to recover the costs of the stranded investment from the remaining customer base, resulting in higher rates.

Q. WHAT IS MEANT BY "FIRM" VERSUS "AS-AVAILABLE" ENERGY?

A. Firm energy refers to generation that has a known, quantifiable fuel source such that the energy produced by the generator can be provided when needed to meet customer loads (i.e., the energy can be dispatched to match loads). As-available energy refers to generation that relies on fuel sources that are subject to availability (e.g., sun, wind, run-of-the mill- hydro). Thus, one cannot rely on the energy produced by as-available generators to be available when needed to meet customer loads at any given point in time.

Q. WHAT ARE "EXTERNALITIES?"

A. Externalities refers to factors that are not readily quantifiable in monetary terms. Examples are public sentiment, preserving air quality, etc.

B. DG TECHNOLOGIES AVAILABLE AND UNDER CONSIDERATION ON THE MAINLAND UNITED STATES

Q. WHAT ARE SOME OF THE DG TECHNOLOGIES AVAILABLE AND UNDER CONSIDERATION IN THE MAINLAND?

A. Exhibit CA-101 summarizes the DG technologies that are commercially available and being implemented in 21 or more states, as well as those that are presently in the research and development stage. As noted below, the technologies use fossil fuels (e.g., oil, propane, synthetic natural gas, etc.) and renewable energy such as biomass, solar and wind.

The predominant projects that have been implemented to-date are diesel engines (including landfill gas), gas turbines, micro turbines, wind turbines, and small hydro (including matrix hydro). It should be noted, however, that renewable energy technology is very site specific as the fuel source is not transferable to other location, unlike fossil fuels. For example, landfill gas technology requires an adequate quantity of methane gas at a landfill. The diesel generator or reciprocating engine used in this application, however, can generally be moved to other locations if the volume of gas needed to run the engine is no longer available at the site.

Co-generation technologies, such as combined heat and power ("CHP") use fossil fuel, but offer greater efficiencies by providing both electricity and thermal energy from a single source.

Small hydro facilities were popular 20 to 30 years ago when many "mom and pop" installations were refurbished after they were abandoned by investor-owned utilities. These installations are typically in the 1,000 to 5,000 kW range. In recent years, however, many new small hydro installations have not been pursued, in part, because the FERC approval process has negatively affected the development of new facilities. This process is expensive and time-consuming for large hydro facilities (i.e., those greater than 5MW in capacity) and is cost prohibitive for a small hydro application on a per MW of capacity basis.

Wind turbines have become more prevalent in the past 5 years and have been installed in many different states on the mainland. Wind facilities require a large footprint of vacant land located away from the general population for safety and noise concerns.

Solar energy (photovoltaics) has been developed in the southwestern mainland where sunlight is prevalent during most of the year. This technology, however, has not been developed in very many other parts of the mainland. Small photovoltaic applications are used for isolated (not connected to the utility's transmission and distribution grid) applications, typically to charge a battery that powers a remote device such as a weather station, highway sign, etc.

Biomass generating projects have been developed in several states and are usually associated with water treatment facilities or other industries that produce the fuel source for the facilities such as wood waste or other biological waste that can be processed. This technology would be considered an existing and emerging technology for electric generating purposes because the project is considered a firm resource.

Compressed-air energy storage plants have been constructed, but primarily as a research and development project. Compressed-air energy storage requires unique geological traits that do not exist in many geographic areas. As with most renewable technologies, this technology is very site specific.

Geothermal is also similar to compressed air in that it requires unique geological properties and is very site specific. These types of plants have been constructed, but have not proven to be very reliable, as Hawaii has experienced with the Puna Geothermal project located on the island of Hawaii.

An emerging technology referred to as matrix hydro is also under development. This technology is a matrix of smaller generators mounted on a panel that is lowered in the water, often in the stop log of the dam. The individual generators in the matrix are approximately 450 kW, but can be aggregated to a much larger capacity installation because of its modular design concept.

Q. SHOULD ALL OF THE ABOVE DG TECHNOLOGIES DEEMED VIABLE FOR THE MAINLAND BE CONSIDERED APPROPRIATE FOR HAWAII'S ELECTRIC MARKET AND ITS CUSTOMERS?

A. No, either because the fuel source is not available (e.g., sufficient volumes of methane gas for landfill applications) or because of land space limitations (e.g., wind farms require large footprints of uninhabited land for public health and safety concerns). In addition, as will be discussed in greater detail in Section IV.B.4.a. of my testimony, Hawaii's electric systems are island systems and thus not able to depend on each other for generation support if the DG facility is not able to produce energy when needed to meet customer loads. This situation affects the electric utility's ability to provide reliable service, the cost of operation, and the rates charged for the service provided.

C. UTILIZATION OF DG OUTPUT BY UTILITY COMPANIES TO MEET CUSTOMER LOADS

Q. HOW IS THE OUTPUT OF DG UTILIZED?

A. Exhibit CA-102 summarizes how DG units are utilized to serve customers. As shown on this Exhibit, DG are supply-side resources that are connected to the electric utility's delivery system and can provide power to the electric utility's customers through one of two means, i.e., sale to the utility or use in whole, or in part by a customer.[10]

Q. PLEASE DESCRIBE THE FIRST SITUATION--SALE OF DG OUTPUT TO THE UTILITY.

A. The first situation occurs pursuant to the terms of a purchased power agreement (PPA) where the entire energy produced by the DG facility is sold to the utility for resale to the utility's customers. In this situation the energy is transmitted to the utility's transmission and distribution for dispatch to meet the utility's customers' load.[11] In this situation, the DG facility does not serve specific customer loads. It is my understanding that in the "regulated" Hawaii environment, DG participants can not presently sell electricity services directly to other customers by having DG output delivered, or "wheeled" over the utility's delivery system from the DG site location to other utility customers.

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10 Stand-alone generating units serve customers that are not connected to the electric utility's transmission and distribution system. In this situation, the customer's service is solely dependent on the performance of the stand-alone generating unit. If the generator is able to supply energy on-demand, all of the customer's energy needs will be served. If the generator provides intermittent energy, all of the customer's energy needs may not be served. As previously stated, stand-alone or "isolated" generating units are not considered as DG for purposes of this proceeding.

11 See CA-102, page 3 of 4.

Q. PLEASE DESCRIBE THE SECOND SITUATION WHERE THE DG OUTPUT SERVES A SPECIFIC CUSTOMER.

A. In the second situation, the DG facility is intended to serve part, or all of the specific needs of the customer. The electric utility is also expected to serve as a resource if the DG facility is unable to provide sufficient energy to meet the customer's load requirements. This situation could also involve delivering to the utility company excess energy produced by the DG facility not used by the customer under a net-metering arrangement.

Q. HOW DOES DG BENEFIT ELECTRIC UTILITY SYSTEMS AND THE CUSTOMERS THEY SERVE?

A. DG projects could alleviate a utility's need for additional generating capacity if the resource is considered firm. In addition, strategically located DG projects capable of performing functions more than just "as available" energy producers, can beneficially impact the electric utility's electric transmission and distribution systems and customers at a reduced cost and improved system reliability. A DG project may also allow a customer to reduce the customer's energy cost.

Q. ARE THERE OFFSETTING BENEFITS THAT MAY NEGATIVELY AFFECT THE UTILITY AND ITS REMAINING CUSTOMERS?

A. Yes, strategically located DG projects could have a varying impact on transmission and distribution systems, depending on the type of DG project that is implemented. For instance, a wind generation project may provide energy at a lesser cost than some existing generating resources (e.g., fossil fuel generation). Wind generation, however, typically does not provide capacity on-demand because the resource is subject to nature and is often remotely located on the electric utility companies' system from the areas of customer concentration due to the land area required to ensure the safe operation of a wind facility. So, wind might have a benefit to meeting a specific customer's energy needs, but have little benefit to the electric utility companies' delivery systems. Furthermore, a wind project may increase the cost of operation for an electric utility if the utility is required to install additional facilities to address varying levels of wind power entering the utility system which could impact the utility's power quality and system reliability.

On the other hand, a fossil-fueled generator can be started on-demand and has high availability and can thus be relied on to provide reliable service. The fossil-fueled generation, however, may also have a higher incremental energy cost. This type of DG project could better be relied on in the future to offset or avoid transmission and distribution investments that would affect the non-energy related components of electric rates.

Customers electing to install on-site generation may leave the utility with stranded costs that may be paid for by the remaining customer base, ultimately resulting in higher electric rates.

IV. FACTORS THAT MUST BE CONSIDERED IN DETERMINING THE DEPLOYMENT OF DG IN HAWAII'S ENERGY MARKET

Q. WHAT MUST BE CONSIDERED WHEN DETERMINING THE COST EFFECTIVE DEPLOYMENT OF DG IN HAWAII'S ENERGY MARKET?

A. First, one must consider the impact of the various types of technologies on the electric utility systems in Hawaii and thus the electric utility's ability to provide reliable service.

Second, consideration must be given to the costs of installing the DG unit on Hawaii's electric utility's customers. In other words, DG added to serve electric system needs should represent the lowest reasonable cost option determined in conjunction with the electric utility's IRP. In the case of DG installed to serve customer load, the utility's rates need to be unbundled so that the utility's cost of services to such customer are recovered from that customer; and not shifted to, and recovered from, other utility ratepayers. These matters are discussed in greater detail later in my testimony.

A. IMPACT OF VARIOUS DG TECHNOLOGIES ON THE ELECTRIC UTILITY'S SYSTEMS IN HAWAII AND THE UTILITY'S ABILITY TO PROVIDE RELIABLE SERVICE.

Q. PLEASE DESCRIBE HOW YOU ASSESSED THE IMPACT OF DG TECHNOLOGIES ON HAWAII'S ELECTRIC MARKET.

A. I first assessed the load served by each of the island utility systems in Hawaii. Next, I identified the size of the generating units available to serve each load. Then I determined how the output of DG could be utilized to meet the load in a cost-effective manner, without compromising the utility's ability to provide reliable service.

1. Identification of the electric system on each island and the load served by each system

Q. WHAT ISLAND SYSTEMS DID YOU CONSIDER?

A. I considered the following:

- Hawaiian Electric Company, Inc.'s ("HECO") system serving the island of Oahu,
- Maui Electric Light Company, Ltd.'s ("MECO") system serving the islands of Maui, Molokai and Lanai,
- Hawaii Electric Light Company, Inc.'s ("HELCO") system serving the island of Hawaii (HECO, MECO and HELCO are hereinafter collectively referred to as the "HEI Companies"), and

- Kauai Island Utility Cooperative's ("KIUC") system serving the island of Kauai.

The HEI Companies are what is commonly referred to as an investor-owned utility whose profits are generated from ratepayer revenues to pay dividends to shareholders. KIUC, on the other hand, is a member-owned cooperative whose ratepayers are also the owners of the utility system.

Q. HOW DOES THE DIFFERENCE IN OWNERSHIP BETWEEN THE HEI COMPANIES AND KIUC IMPACT THE COMMISSION'S DG CONSIDERATIONS?

A. Essentially, it does not. In order for DG to be effectively deployed, the electric utility company must be in a position to be able to reasonably recover its cost of providing services to its customers, and ratepayers must be reasonably assured that DG utilized by the utility represents the lowest reasonable costs for serving customer needs. As will be described in Sections IV.B.4.b.(2) and V.A. of my testimony, to do this, the rates of the electric utility companies will need to be unbundled and DG will need to be incorporated in each electric utility company's IRP process and implementation plan.

If a utility does not recover its cost of service for the customer(s) whose load is served in part by the DG, then the owners (i.e., either shareholders or cooperative members) may be required to bear the initial cost impact (i.e., reduced dividends or reduced patronage capital, respectively) until the utility is able to increase its rates to pickup such revenue shortfall from its other customers. In other words, the issue of avoiding subsidies between customers served by DG and those customers that are not served by DG is not impacted by utility ownership. The economics of installing a customer DG facility, however, are impacted by the form of utility ownership in Hawaii as will be discussed in Section VI.A. below.

Q. PLEASE DESCRIBE THE ISLANDS AND THE LOAD SERVED BY EACH ELECTRIC UTILITY.

A. Exhibit CA-103 provides population and land area information for each of the six islands served by the four electric utilities. As shown by Exhibit CA-103, the population and land area varies significantly between these islands. Oahu is the most populated island with a large metropolitan area (Honolulu). Although Maui and Hawaii have a similar level of population residing on each island, Hawaii has a significantly larger land area over which the population and load resides. As a result, Hawaii has a lower population density (i.e., one similar to Molokai and Lanai, which have a small level of population). Although closer in land area to Oahu and Maui than any of the other islands, Kauai has a much smaller level of population residing on the island when compared to the population on the islands of Oahu and Maui.

As one would expect, the electrical demand and electricity usage of the residential, commercial and industrial customers served by the electric system on each island (referred to as electric system peak demand and energy requirements) varies significantly between the islands and corresponds with the larger population centers on each of the islands.

Q. WHAT ARE THE ELECTRIC SYSTEM PEAK DEMAND AND ENERGY REQUIREMENTS OF EACH OF THE ISLANDS?

A. The electric system loads and energy requirements of each of the islands is provided in Exhibit CA-104. As shown on this exhibit, the electric system loads vary greatly between islands, with the largest load on Oahu served by HECO being approximately 250 times greater than the load served by MECO for the island of Lanai, which is the smallest load of all the islands.

As one would expect, the electric system loads varies in proportion to island population. For example, Oahu's population base represents 72% of the total resident population of the six islands, and represents 74% of the electric system load for all six islands. Accordingly, one would expect the electric system serving each of these islands to also vary significantly between the islands as a result of the difference in population, population density, electric system loads and geographic size and features of the islands.

It should also be noted that the island system loads are much smaller than the loads served by mainland investor owned utilities. The loads are more representative of mainland loads of large (Oahu), medium (Maui, Hawaii, and Kauai) and small (Lanai and Molokai) communities and rural areas on the mainland.

2. Description of the electric system serving each island

Q. PLEASE DESCRIBE THE ELECTRIC SYSTEMS SERVING EACH OF THE SIX ISLANDS.

A. The electric system serving each of the islands consists of power supply resources, comprised of utility owned generation and third-party (i.e., independent power producer ("IPP")) owned generation. The power supplied by an IPP is provided pursuant to the terms of a purchase power agreement executed by the utility and the third-party owner of the DG facility. Together facilities represent the total generation is required to produce the amount of electricity needed to serve by the customers connected to each utility system.

In addition, each utility has a delivery system consisting of transmission and distribution facilities to deliver the electricity produced from the power supply resources to the customers' point of connection to the electric system.

a. Available generating resources on each island

Q. PLEASE DESCRIBE THE GENERATING RESOURCES ON EACH OF THE SIX ISLANDS.

A. Exhibit CA-105 summarizes the firm resource capability used by the electric utility company to meet the peak demand of the customers served by the electric system on each of the islands. Exhibit CA-105 also compares the firm resource capability of generation on each island with the peak demand on each island. As shown by Exhibit CA-105, the firm resource capability exceeds the peak demand of the customers served from the electric system. This excess amount, referred to as reserves or reserve margins, is necessary for the utility to reliably serve the customers connected to the electric system.

Q. WHY ARE THESE RESERVE MARGINS NECESSARY FOR THE ELECTRIC UTILITY COMPANY TO PROVIDE RELIABLE SERVICE?

A. Reserve margins ensure the utility's ability to provide uninterrupted service during periods when a generating unit is not available due to equipment failure or scheduled maintenance. The amount of available firm generation that is not serving load (i.e., unloaded or "spinning" capacity) is recognized in determining the reserve margin. The reason is because firm resources can be called upon to serve load, if needed, when other units are taken out of service.

Q. WHY ARE AS-AVAILABLE GENERATING RESOURCES NOT CONSIDERED BY THE UTILITY IN DETERMINING THE UTILITY'S RESERVE MARGINS?

A. As available generation, including DG, in the form of wind turbines, photovoltaics or as-available hydro units, cannot be counted upon to provide capacity and energy on demand when needed by the utility. The reason is because the fuel source is dependent on nature, which cannot be controlled with any degree of certainty.

Q. HOW DO THE HAWAII ELECTRIC UTILITIES DETERMINE THE AMOUNT OF RESERVE MARGIN NEEDED TO RELIABLY SERVE THE ELECTRIC SYSTEM LOAD ON EACH OF THE ISLANDS?

A. Each of Hawaii's electric utilities establishes the operating reserve levels at an amount that is equal to the size of the largest generating unit, taking into account the size of other units that are not available for service due to scheduled maintenance or other reasons. These reserves are also used to pick up instantaneous increases in system load resulting from sudden changes in customer loads.[12]

b. Description of the transmission and distribution system serving load on each of the six islands

Q. PLEASE DESCRIBE THE DELIVERY SYSTEM ON EACH OF THE ELECTRIC SYSTEMS SERVING THE SIX ISLANDS.

A. As previously indicated, the delivery system consists of transmission and distribution facilities to deliver the output from the utilities' power supply resources to the electric utility's customers. The electric system on each of the six islands has its own set of unique delivery system constraints affecting the quality and reliability of service provided by the utility to its customers.

KIUC was reluctant to identify constrained points on its delivery system serving the island of Kauai due to heightened homeland security concerns. KIUC, however, identified capital improvement projects deemed necessary to meet anticipated load growth.[13]

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12 An example might be the need to have reserves in place to meet a sudden increase in load resulting from a customer DG unit not operating as expected. In other words, customers that receive all, or a portion of, their electricity from a DG unit, and who rely on the electric utility to supply the balance of the energy needs not provided by the DG unit, require the utility to maintain and hold in reserve a certain amount of the utility's generation in order to provide reliable service to its customers, including the customer served by the DG unit. By the same token, the utility must hold in reserve a certain amount of generating resources to meet the customers' energy demands whether or not DG facilities such as wind turbines, photovoltaics or as-available hydro units are operating or not.

13 See KIUC response to CA-SOP-IR-35.

The HEI companies provided a general description of delivery system constraints on the other five islands and provided a list of studies that provided additional information on each delivery system. The HEI companies indicated that the maps filed with the Commission may not be the most current maps for each of the transmission systems, but that a copy of the current transmission system maps would be available for review under a protective order.[14]

Q. HOW DOES THE EXISTING SYSTEM ON EACH ISLAND AFFECT THE UTILITY'S ABILITY TO COST-EFFECTIVELY PRODUCE SUFFICIENT ENERGY TO MEET THE UTILITY CUSTOMERS' ENERGY NEEDS?

A. The utility's larger central station generation output may need to be transmitted through the entire delivery system before the energy reaches the customer's point of utilization. Losses are incurred on the electric system as the output from the utility's generating resources is delivered to the customers' point of connection.

Q. WHAT IS THE MAGNITUDE OF THESE LOSSES?

A. Exhibit CA-106 summarizes the losses incurred on the electric system for the delivery of the power from the point of production to the customers' point of use. The losses on the transmission facilities are generally relatively small as

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14 See HECO, et. al. response to CA-SOP-IR-19.

shown by Exhibit CA-106. When all losses from the utility's point of generation to the customers' point of delivery are taken into account, however, the losses are much more significant. Exhibit CA-106 also shows that the transmission line losses on the HELCO's electric utility system are significantly greater than that of the other utility companies in the islands. This is due primarily to the large land area serviced by HELCO on the island of Hawaii and the distances between HELCO's power resources and the load centers on its electric system.

B. HOW DG CAN MEET LOAD IN A COST EFFECTIVE MANNER

1. Impact of DG on the Transmission and Distribution systems of Hawaii's electric utilities

Q. WHAT IMPACTS CAN DG HAVE ON HAWAII'S ELECTRIC TRANSMISSION AND DISTRIBUTION SYSTEMS?

A. If installed correctly, DG can have a positive impact on Hawaii's electric transmission and distribution systems by reducing the line losses that are presently occurring on each island system and addressing transmission constraints that exist in serving load pockets. On the other hand, if not installed correctly, DG unit will have a negative impact Hawaii's electric transmission and distribution system, resulting in increased costs to the electric utility that may ultimately be passed on to Hawaii's electric ratepayers in the form of higher rates. Each of these points will be discussed in the following sections of my testimony.

a. Ability of DG to reduce line losses currently existing on the transmission and distribution systems serving the load on each island

Q. HOW CAN DG AFFECT THE UTILITY TRANSMISSION AND DISTRIBUTION SYSTEM TO REDUCE THE LOSSES OCCURRING ON TRANSMISSION AND DISTRIBUTION SYSTEMS ON EACH ISLAND SYSTEM?

A. Generally, these losses can be avoided by installing DG facilities that are located at, or near the customer load because the output from such DG facilities is utilized near the DG unit. When DG is installed at the customer's location, the unit can decrease the flow of energy on the wires of the distribution feeder when the DG unit is in operation. If the DG unit is consistently and continuously operated such that the output of the unit matches the customer's load, or the unit is able to provide a steady stream of energy with the excess flowing back to the utility, the unit can help to improve the reliability of the specific feeder from which the customer is served.

b. Ability of DG to address existing transmission constraints in serving load pockets on each island

Q. HAVE YOU IDENTIFIED ANY TRANSMISSION CONSTRAINTS AND LOAD POCKETS THAT MAY PRESENTLY EXIST ON ANY OF THE ISLAND SYSTEMS THAT COULD BENEFIT FROM THE INSTALLATION OF DG?

A. Yes. Starting first with the island of Oahu served by HECO, the Honolulu metropolitan area is a good example of a load pocket that can be addressed with the installation of DG. With the exception of HECO's downtown Honolulu plant, HECO's supply resources are located to the west of Honolulu. The ability of the HECO delivery system to import power into Honolulu is constrained, and such constraints would increase if the Honolulu plant is taken out of service and not replaced with comparable sized generation in close proximity to the existing power plant site.

Thus, installation of DG inside the Honolulu load pocket would be of greatest value for the HECO electric system and HECO's customers. If significant quantities of DG were installed inside the Honolulu load pocket, particularly firm dispatchable DG, such DG installations may alleviate some of the delivery system constraints into the Honolulu system load pocket and possibly delay the need date for additional firm resources, as well as the planned transmission system upgrades.

As an aside, I note that HECO has an application before the Commission for approval to commit funds for transmission improvements referred to as the East Oahu Transmission Project. The East Oahu Transmission Project is intended to address several transmission problems concerning Oahu's 138 kV transmission system in the eastern half of the island. Specifically, the East Oahu Transmission Project that is deemed by HECO to be necessary to alleviate HECO's projection of potential overload situations and the potential loss of load reliability concerns for the Honolulu area.[15]

Although much smaller in magnitude, there may be similar load pocket situations on the islands of Hawaii, Maui and Kauai where the installation of DG would be of greatest value. Delivery system constraints, however, also exist on the islands of Hawaii, Maui and Kauai served by HELCO, MECO and KIUC, respectively.

With respect to the systems on the islands of Molokai and Lanai that are considered part of MECO's system, it is not clear what, if any, delivery system constraints exist on those islands at this time. Thus, it is not readily apparent at this time if DG can provide delivery system reliability improvements, or defer the need for delivery system capital improvements as has been identified for the other islands.

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15 See HECO's application for approval to commit funds for East Oahu Transmission Project, Docket No. 03-0417.

Q. HOW WILL "LOAD POCKETS" AND TRANSMISSION SYSTEM CONSTRAINTS BE IDENTIFIED IN ORDER TO DETERMINE WHERE INSTALLATION OF DG WOULD BE BENEFICIAL?

A. The utilities' IRP needs to identify the geographic locations, feeder locations and range of capacity that could be implemented by DG facilities.

2. Ability of DG to serve load on each island

Q. YOU PREVIOUSLY DESCRIBED HOW DG CAN SERVE THE LOAD EXISTING IN "POCKETS" ON EACH ISLAND. IS THERE ANY OTHER BENEFIT TO INSTALLING DG FOR PURPOSES OF MEETING THE LOAD ON EACH ISLAND?

A. Yes, in addition to serving load that is concentrated in a "pocket," DG can be recognized as an available resource for purposes serving increased loads and to determine the reserve margin required by each electric system, if the DG unit can be dispatched by the utility to match the system load. In addition, DG can be used to potentially defer or avoid the need to install new generation to meet customer loads.

Q. PLEASE PROVIDE AN EXAMPLE OF HOW ENOUGH DG PROJECTS COULD BE INSTALLED TO AVOID INSTALLING NEW UTILITY GENERATING UNITS ON THE ISLAND OF OAHU.

A. The HECO electric system is experiencing moderate to high load growth which will require the installation of new generating facilities to serve this load. I note that HECO's latest load forecast projects a 442 MW increase in electric system peak demand by 2025.[16] HECO will need additional firm resources to meet this significant increase in system peak demand, if realized.

Because DG projects are relatively small in capacity in relation to the capacity of a utility central station generator, it may not be possible to avoid the ultimate installation of the central station generator. It may be possible, however, to delay the installation of the generator by one or two years to improve service reliability in some areas until the generation is installed. The extent to which electric utility planned generating facilities can be delayed or avoided will be highly dependent on the number and size of DG projects that can be implemented prior to the beginning of approval and construction of a new generating project.

DG may also be valuable in meeting the generation reserve margins requirements for the islands of Oahu, Hawaii, Maui and Kauai. In this regard,

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16 See HECO et. al. response to CA-SOP-IR-22.

properly installed DG can improve system reliability and possibly defer capital improvement projects.

3. Positive cost implications of properly installed DG units

Q. HOW WOULD A CUSTOMER-OWNED DG PROJECT AFFECT ELECTRIC UTILITY COSTS?

A. If properly installed and operated, DG could decrease the utility's cost of generating energy. Presumably the customer-owned DG supplies energy at less than the cost of energy supplied by the electric utility. Thus, the cost of energy per kWh should decrease because the electric utility would decrease the energy generated from its highest cost generating unit to absorb energy supplied by the customer. It would also help to defer or avoid installing new utility generating units, and possibly defer transmission and distribution system improvements in areas where such improvements are needed.

A DG unit that is not properly installed, however, could result in a higher cost, and/or less reliable service to other ratepayers. This is addressed later in my testimony with regard to the need for standardized agreements and interconnection requirements.

4. Potential negative impacts of DG on the electric system on each island and the electric utility's ability to provide reliable service

Q. IS IT POSSIBLE FOR A DG INSTALLATION TO HAVE A NEGATIVE IMPACT ON A UTILITY'S SYSTEM AND ITS ABILITY TO PROVIDE RELIABLE SERVICE?

A. Yes, DG installations whose output is utilized to serve all, or part of a customer's load could potentially adversely impact the electric utility company ability to provide reliable service, depending on the type of facility installed. From a ratemaking standpoint, the installation of a DG project could also affect the electric utility costs and, thus, impact other customers that do not install their own DG unit. Under the existing bundled rate structures for each of the islands, the DG installation could increase the rate charged non-DG customers.

a. Why DG can negatively impact the electric utility's ability to provide reliable service

Q. PLEASE EXPLAIN WHY SERVICE RELIABILITY ISSUES ASSOCIATED WITH THE AVAILABILITY OF OUTPUT FROM GENERATING UNITS ARE MORE CRITICAL IN HAWAII THAN ON THE MAINLAND UNITED STATES.

A. Hawaii's electric utility companies are self-dependent since the utility system on each island is isolated from the other island systems. Thus each individual system cannot receive or provide surplus capacity to another utility serving another service territory for reliability purposes. Therefore, each individual electric utility must maintain sufficient generating capacity to serve the utility's customer loads. The generating capacity includes the reserve margins identified in Section IV.A.2.a. above.

Mainland electric utility systems, on the other hand, have been designed to rely on interconnections with other neighboring electric utilities and the agreements among the utilities to maintain and share their generation resources. This arrangement makes it possible for individual utilities to perform maintenance outages on generating units and at the same time rely on other utilities for generation if another of the utility's generating units is unexpectedly forced (i.e., tripped) out of service. This also allows the mainland utilities to support one another for reliability purposes and provides an opportunity to share or "market" surplus capacity among mainland utility service areas.

The result is that Hawaii's electric utilities must maintain a higher reserve margin than that required of utilities on the mainland in order to ensure the provision of reliable service. This important distinction significantly affects the assessment of the impacts of DG on the electric utility systems in Hawaii's market.

A reserve margin in the area of 12% is currently viewed as being reasonable for the mainland utilities. On the other hand, as shown by Exhibit CA-105, the reserve margins on each of the island systems serving the six islands is currently at much higher levels with the exception of MECO servicing the island of Maui. The reserve margins on each island, with the exception of Maui, range from 46% for HELCO to 126% for Molokai

b. Potential Rate Impacts of Installing DG on the Hawaii Utility Customers

(1) Potential to increase the electric utility's operating costs

Q. WHY DOES THE RELIABILITY OF DG FACILITIES NEGATIVELY AFFECT A UTILITY COMPANY'S OPERATING COSTS?

A. Simply stated, if the DG facility is not deemed to be a reliable capacity resource, then the electric utility will have to add generation to its system to maintain adequate generating capacity. If not operated continuously, the DG facility may not increase reliability and thus would primarily decrease the amount of energy flowing on the feeder at times when the DG is in operation. In addition, there is the potential that the distribution facilities may need to be oversized (inefficient from a cost standpoint) or contribute to a potential decrease in reliability, where distribution may be "undersized" or utility generation facilities are forced to be held in reserve for the irregular DG production. Furthermore, from an energy delivery standpoint, if the DG project is not properly connected to the customer's electric facilities, the electric utility feeder could subsequently cause voltage fluctuations or voltage flicker which could then cause a feeder outage if proper interconnection fuses and breakers do not operate to protect the electric utility system.

Q. HOW DOES ONE ASSESS THE COST/BENEFIT IMPACT OF DG ON EACH OF THE ISLAND UTILITY SYSTEMS AND ITS RATEPAYERS?

A. For DG installations whose output is utilized by the electric utility company for meeting electric system service needs, the assessment is done through the electric utility companies' IRP plan. This is the same as the method currently being utilized to assess the benefits of independent power purchase arrangements and their avoided costs and is presently in place.

With respect to DG installation whose output is utilized directly by the customer, the customer would assess the costs of the electricity services provided by the DG facility versus the avoided unbundled rate component of the utilities unbundled rate structure.

(2) Potential to increase rates in order to recover costs that are "stranded" due to a customer reducing the existing energy consumption through the installation of a DG facility on the customer's premises

Q. WHAT ARE THE POTENTIAL RATE IMPACTS OF CUSTOMERS INSTALLING DG FACILITIES?

A. If a large customer installs DG facilities but plans to remain connected to the electric system for servicing its electric needs not provided by the DG, the current rate structure would result in a loss of sales and the utility would not receiving the revenue for all of the services provided by the electric system. Depending on the magnitude of the revenue loss, the utility may eventually, require the customers remaining on utility system to make up the revenues lost by the utility company. Such a situation existed on the island of Lanai where a major utility customer contemplated the installation of a DG facility to serve the customer's existing load, which would have resulted in significant revenue loss to MECO.

Currently, the bundled rate to the customer is discounted as an incentive for the customer to not install DG and avoid the loss of revenue impacts on MECO and eventually the other ratepayers on the island. Unbundling the current rate structure is a better mechanism for dealing with situations such as this and should avoid the need to offer rate discounts.

Q. WHY WOULD AN UNBUNDLED RATE STRUCTURE AVOID THE NEED TO OFFER RATE DISCOUNTS TO AVOID THE LOSS OF REVENUE IMPACTS ON THE UTILITY AND THE OTHER RATEPAYERS?

A. An unbundled rate structure will allow the customer served by a DG facility to pay for the backup and other services provided by the utility. For example, the customer will still utilize the utility's transmission and distribution system and generating services when the customer's DG is not operating, or not serving all of the customer's load. The utility's transmission and distribution facilities must be sized and operated to meet the customer's peak demand, even if most of the time the customer doesn't receive power from the utility because the customer's DG is operating.

Also, some of the utility's generating reserve margin will likely be utilized to pick up, or absorb, moment-to-moment fluctuations in the customer's load and to maintain a proper voltage level at the customer's point of connection to the utility grid. The utility's reserve margins will also be utilized to pick up the customer's load when the customer's DG supply is interrupted either on schedule or unexpectedly. Unbundling the rates will allow the utility to continue to receive revenues for the services provided to the customer.

Q. WHY WOULD A CUSTOMER'S DECISION TO INSTALL DG AFFECT THE ELECTRIC RATES CHARGED THE UTIILTY'S NON-DG CUSTOMERS?

A. Currently, the electric utility companies' electric rates are based on the utility metering all of the customers' energy usage. The rates were not designed to recover revenues for fixed costs currently incurred if energy sales are decreased by customer-owned generating units whose energy is not metered.

Q. WHAT WOULD HAPPEN IF EXISTING RATES WERE TO CONTINUE TO BE USED AND DG IS INSTALLED BY CUSTOMERS?

A. If DG is installed "behind the meter" and, thus, decrease the metered energy (kWh), the utility's revenues would be less than it planned to receive when it designed its rates.

Q. IS THIS DECREASED REVENUE A PROBLEM?

A. Yes it could be, depending on the magnitude of revenues lost from the installation of the DG facility in relation to the level of fixed costs intended to be recovered from the lost revenue. The decreased revenue may eventually cause the electric utility to increase its rates to replace the revenue shortfall, to the extent the revenue shortfall exceeds the decrease in expenses caused by DG if the utility is unable to replace the loss load with load from new or existing non-DG customers.

Q. WHAT MUST BE DONE TO ADDRESS THE NEGATIVE CONSEQUENCES OF THIS SITUATION?

A. As will be discussed in Sections IV.B.4.b.(2) and V.A. of my testimony, the existing bundled rates must be unbundled.

C. OPERATIONAL ISSUES THAT MUST BE CONSIDERED WHEN DETERMINING THE APPROPRIATE SIZE OF DG UNITS DEEMED APPROPRIATE FOR HAWAII'S ENERGY MARKET

Q. WHAT UTILITY OPERATIONAL ISSUES NEED TO BE CONSIDERED TO IMPLEMENT DG?

A. The capacity and reliability of the DG technology and its impact on the operations of the electric utility is an important operational consideration. For instance, a 5,000 kW diesel generator installed on a 10,000,000 kW electric system on the mainland is a mere 5/100ths of 1% (0.05%) of the generating capacity of the electric system. A 5,000 kW, however, is 0.5% of a 1,000,000 kW peak demand electric system and 2.5% of a 200,000 kW peak demand electric system. During low energy use periods, these percentages are greater.

Thus, if the capacity of DG facilities is large compared to the utility energy needs, the energy produced by the DG facility and sold to the utility can potentially cause the utilities' generators to be turned off or operated at outputs that are inefficient for the utility. As a result, the utility will incur higher operating costs that must be recovered through the rates charged to the utility's other customers. If the DG facility is not a readily dispatchable resource, the electric utility will need to keep generating units on-line to replace the DG output if, for instance, the wind stops blowing (wind turbine) or the DG trips off because it is poorly maintained and thus intermittent.

D. POSSIBLE DG TECHNOLOGIES DEEMED APPROPRIATE FOR HAWAII

Q. BASED ON THE ABOVE, WHAT TECHNOLOGIES ARE IN OPERATION OR UNDER DEVELOPMENT THAT ARE PROMISING TO SERVE LOAD IN HAWAII?

A. DG technologies that are commercially available, and believed to be feasible and viable for Hawaii, are set forth in Exhibit CA-101. Most fossil fueled DG such as diesel, microturbines and biomass can serve as baseload and peaking resources because the technologies are considered firm resources because they can be dispatched to follow the load and for the most part have proven, dependable performance. Biomass could be considered less firm than diesel and microturbines depending on the source or availability of the fuel source. As previously discussed, CHP uses the waste hear from microturbines, internal combustion engines, or reciprocating engines to supply thermal loads thereby achieving high level of efficiency.

Solar photovoltaic and wind generation is both dependent on intermittent "fuels" (i.e., sun and wind). Thus, solar photovoltaics and wind cannot be considered to be firm capacity and energy resources that can be relied on as resources to meet the utility's peak, baseload or backup needs. When available, however, their energy generally can be absorbed by the electric utility system if the amount of generation is a small percentage of the electric utility generating resources. If the energy output cannot be absorbed, then the output of such resources must be curtailed. It may be possible to have certain intermittently fueled DG technology provide more reliable energy, but that it would require additional measures such as pumped storage hydro or battery systems, both of which are still comparatively costly.

The policies or rules governing the participation in Hawaii's electricity market through DG should not be limited to these technologies or types of DG, however, as new technologies may become commercially available and economically viable in the future. The viability and feasibility of available or planned DG technologies is site specific and should be analyzed in each of the electric utility companies' IRP process to identify the lowest reasonable cost options for customers.

Q. HAVE YOU EVALUATED THE AVAILABLE DG TECHNOLOGIES DEEMED APPROPRIATE FOR HAWAII IN ORDER TO DETERMINE WHICH SPECIFIC TECHNOLOGY, AND THE APPROPRIATE SIZE OF UNIT IS COST-EFFECTIVE AND THEREFORE SHOULD BE INSTALLED ON EACH ELECTRIC UTILITY SYSTEM?

A. No. The types of DG discussed in my testimony are listed for educational purposes and are taken from industry literature that is publicly available. Specific DG projects that should be implemented on each island electric utility system will need to be determined in the IRP process for each utility. In making this determination, each DG technology under consideration will have to meet financial viability scrutiny on a case-by-case basis.

E. DESCRIPTION OF THE COSTS/BENEFIT ASSESSMENT TO IDENTIFY COST-EFFECTIVE DG TECHNOLOGIES THAT SHOULD BE INSTALLED IN HAWAII

Q. HOW WILL COST EFFECTIVE DG PROJECTS AFFECTING THE OPERATIONS ON EACH ISLAND UTILITY SYSTEM BE IDENTIFIED?

A. The effect of DG on each utility system will need to be considered and evaluated for each island on a case-by-case basis in developing each utility's IRP. The reason is because the IRP requires the quantification of benefits and avoided costs for those DG installations whose output is dedicated to and utilized by the utility.

Q. HOW SHOULD DG BE EVALUATED IN THE IRP PROCESS?

A. The benefit or impact of DG should be evaluated against the lowest, reasonable cost option of serving utility customer needs consistent with the electric utility companies' IRP plans. The IRP goal is to identify "meeting near and long term consumer energy needs in an efficient and reliable manner at the lowest reasonable cost."[17] The "Governing Principles (Statement of Policy)" states that the IRP "shall be developed upon consideration and

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analyses of the costs, effectiveness, and benefits of all appropriate, available, and feasible supply-side and demand-side options"; and further provides that the IRP plans "shall give consideration to the plans' impacts upon the utility's consumers, the environment, culture, community lifestyles, the State's economy, and society."[18]

In doing so, the IRP plans will need to consider the impact DG projects have, not only on providing capacity and energy, but also the ancillary functions (described in Section V.A. of my testimony) required to operate the electric utility companies' systems. In addition, the IRP plan will need to identify congested load pockets on the electric utility companies' delivery system to properly recognize the potential technical and economic impacts of DG projects. The IRP should identify specific amounts of different types of DG that could provide the lowest reasonable cost alternative to serving the utility's customers' energy needs. This would allow customers and third-party suppliers to bid on these types of projects through a competitive bidding process.

The above discussion primarily relates to utility or third-party owned DG where the DG output is utilized by the utility to meet electric system needs. To the extent that a customer installed its own DG to serve that customer's energy needs, it is my understanding that the evaluation of costs and benefits,

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[18] See "A Framework For Integrated Resource Planning", revised May 22, 1992, II.A. and II.B.

both direct and external, would be outside the of Hawaii Commission's regulatory oversight.

1. Importance of considering externalities in the assessment of DG for Hawaii

Q. WHAT ARE THE EXTERNALITIES COST AND BENEFITS OF DG?

A. A comprehensive list of all externalities and the resulting costs/benefits would be difficult since externalities might include a broad range of variables, some of which are subjective and fairly tangential. For purpose of this generic proceeding, the focus will be on matters that possess, more or less, a direct relationship to the delivery of energy from the utility to its customers. Externality benefits that can result from DG include, but are not necessarily limited to:

1. the ability to match some of the electric systems load growth with smaller DG supply-side resources that are deemed to be better for the environment, rather than installing large increments of generating units in a central location;
2. the ability to defer the addition of large generating units, and delivery system (transmission and distribution) improvements with strategically located DG technologies;
3. the ability to improve reliability and the quality of electrical service with DG units located in close proximity to customer loads;

4. the ability of the utility to reduce fossil fuel usage by:
   - avoiding delivery system losses that are incurred by large central generating units by locating DG near the customer load;
   - installing DG technologies, such as CHP, near thermal loads to achieve higher thermal efficiencies;
   - installing DG technologies that use renewable energy; and
   - installing new technologies as such became commercially available at lower incremental costs than with large central generating units.

Externalities costs that can result from DG include, but are not necessarily limited to:

1. the loss of economy of scale benefits and the higher operating efficiencies of large central generating units compared to some types of DG technologies; and
2. the risks of performance of DG projects not directly under the ownership, operation and control of the electric utility.

In general, DG offers flexibility and more variety of technologies and applications than large central generating units, but has other costs and risks as previously described in Sections IV.B.3-4, IV.C. and VI.A of my testimony. Therefore, DG externalities benefits and risks should be considered as an integral part of the analysis conducted of all supply-side resources.

Q. HOW SHOULD DG EXTERNALITIES COSTS AND BENEFITS BE CONSIDERED WHEN ASSESSING THE COST EFFECTIVENESS OF DG VERSUS OTHER SUPPLY-SIDE RESOURCES?

A. A DG project should be subject to the same scrutiny, analysis and quantification of external costs and benefits, as would any other resource or DSM measure considered in developing an IRP. Therefore, the DG project should be evaluated in the IRP in the same manner as other supply-side resource alternatives. This is necessary in order to develop the lowest, reasonable cost plan for meeting the electric service needs of the electric utility's customers. On a practical level, the evaluation of supply and demand resources may not, on a meaningful level, incorporate a comparative analysis of the externalities in conjunction with the direct variables. It is my understanding that prior efforts to reach consensus on externalities and how to include externalities in the IRP process were not successful.

2. Potential for DG to promote achievement of the State's energy policy of reducing our dependence on imported fossil fuel

Q. WHAT IS THE POTENTIAL FOR DG TO REDUCE THE USE OF FOSSIL FUELS IN THE STATE OF HAWAII CONSISTENT WITH THE OBJECTIVES OF THE STATE'S ENERGY POLICY?

A. Depending on the type of DG technology and site-specific factors, DG can reduce the use of fossil fuels in a number of ways. First, certain types of DG technology rely on renewable resources to generate energy (e.g., solar energy (photovoltaics), wind turbines and hydro). Second, DG in most cases will reduce delivery system losses. Third, DG that also serves thermal load, such as CHP facilities, can do so at a higher efficiency resulting in a reduction of fossil fuel use.

As an aside, it is my understanding that the State has established "net metering" for eligible residential and commercial customers that own and operate DG facilities, intended to serve part or all of the customer's electricity requirement, on a first-come-first served basis until the total rated generating capacity of such net metered DG facilities equals 0.5% of the electric utility's system peak demand.[19] It should be pointed out that the renewable portfolio standard is determined using net electric utility sales. Thus, only the excess energy generated and delivered to the utility under a net metering arrangement can count toward meeting the renewable portfolio standard law since it is this excess energy that may result in utility sales.

V. WHAT MUST BE DONE TO EFFECTIVELY DEPLOY DG IN HAWAII'S ENERGY MARKET

Q. WHAT UTILITY ISSUES ARE AFFECTED BY DG?

A. DG affects nearly all issues that are normally the responsibility of the electric utility subject to the approval of the Commission. These issues include the

[19] See Hawaii Revised Statutes, §§269-101 and 269-102.

electric utility's generation, transmission and distribution system operations and costs, customer electric rates, service reliability and the IRP used to plan the utility system. The critical DG issues that have a direct impact on electric utility customers are electric rates and service reliability. Electric rates can be affected by DG because DG can impact the electric utility's costs and the amount of revenue collected by the utility from its customers.

If DG is successfully implemented, electric costs should be lower, but in no event any greater, than otherwise would have occurred absent DG. Likewise, reliability should be improved, and not degraded, because of DG implementation.

Q. WHY SHOULD COSTS NOT BE ANY GREATER THAN WOULD OTHERWISE HAVE OCCURRED ABSENT DG?

A. If DG is viewed as another electric energy resource, DG projects that are implemented by the electric utility are simply another alternative that is incorporated in the utility IRP that would contribute to the lowest reasonable cost plan. In other words, whether the generator is a 20 MW diesel generator or a 250 kW distributed wind generator, the utility IRP would evaluate these two resources by modeling their costs and availability on a total system basis to result in a lowest reasonable cost plan.

Q. WHAT IF A DG INSTALLED BY A CUSTOMER THAT IS CONNECTED TO THE UTILITY GRID WAS NOT CONSIDERED BY THE ELECTRIC UTILITY IN DEVELOPING THE UTILITY'S IRP?

A. This is an important question because a generator that is installed and operated by a customer affects the utility distribution system facilities, reliability of service to it and other customers, utility costs and potentially, utility rates. However, minimum interconnection standards should require a customer to notify the utility that it is installing DG to ensure that it is correctly electrically connected and safe. As previously discussed, this is already in place for the HEI companies.

Q. WHAT MUST BE DONE TO IMPLEMENT DG IN AN ORDERLY MANNER?

A. To effectively deploy DG on each of the islands, the current bundled rate structure of each of the electric utility companies will need to be unbundled and DG will need to be incorporated in the development of the IRP plan for each of the electric systems serving each of the islands. In addition, interconnection rules and agreements must be developed to ensure the timely and safe connection of DG facilities to the electric utility grid in a manner that does not compromise the utility's ability to provide reliable service. Next the cost effectiveness of DG technologies for Hawaii's energy market must be analyzed in the context of each electric utility's IRP. Finally, a competitive bid process should be developed for the procurement of additional resources.

Each of these points will be discussed in greater detail in the following sections of my testimony.

A. IMPORTANCE OF UNBUNDLING THE EXISTING UTILITY RATES

Q. WHY SHOULD ELECTRIC UTILITY RATES IN HAWAII BE UNBUNDLED TO IMPLEMENT DG?

A. There are several reasons why electric rates should be unbundled to implement DG. These reasons include the following:

1. Provides more accurate indication of the electric costs that would be avoided when a DG project is implemented.
2. Specifies costs that would not be avoided by DG.
3. Provides a means of comparing DG costs to the electric utility's generating costs.
4. Enables DG projects to be compared to the electric utility's generating costs included I the utility's rates, regardless of the owner of the DG project.

Q. WHAT ARE GENERATION ANCILLIARY SERVICE FUNCTIONS?

A. The generation ancillary service functions are utility system operating requirements that are needed for the delivery of electric power and energy resources to loads (including customer loads served by DG), while maintaining reliable operation of the utility power supply and delivery system. A general description of the ancillary functions for mainland utilities regulated by the FERC is provided as Exhibit CA-107. The Hawaii electric utilities provide similar ancillary services. There are differences, however, due to the mainland utility interconnected operations versus the isolated island system operations previously described in my testimony. The discussion earlier in my testimony regarding reserves and reserve margins is an example of some of the ancillary services that are needed for serving customers of the electric utility companies on each of the islands.

Under current FERC rules, entities that are interconnected to the mainland utility's transmission and distribution system and do not perform the ancillary services must pay others to supply these ancillary functions. Also, as noted in Exhibit CA-107, the ancillary service rates are based on the mainland utility's generation embedded costs to provide the specific ancillary service. Also the ancillary service rates are included and part of each mainland utility's transmission rates. In other words, entities that are connected to and utilize the mainland utility's transmission system are charged a "transmission rate" that consists of transmission and ancillary service charges.

Q. WHAT CHANGES ARE NEEDED TO EXISTING ELECTRIC UTILITY RATES TO AVOID A SHORTFALL OF REVENUE AND POTENTIAL FUTURE RATE INCREASES CAUSED BY DG?

A. Existing electric utility rates are "bundled," which means functions such as generation, transmission and distribution, and ancillary services are combined into specific customer rate schedules and billed to each customer accordingly. Unbundled rates separate the existing bundled rates into these functions. So, if generation costs are identified, and/or transmission, distribution and ancillary costs are identified, they can be subtracted from the bundled rate to provide proper recognition to a DG's capacity and energy output, the ancillary functions provided by the DG project and the locational benefit on the delivery system of the DG project.

Q. HOW SHOULD ELECTRIC RATES BE UNBUNDLED IN HAWAII?

A. Rate changes and unbundling should ideally be accomplished in a specific proceeding for that purpose. This should be done, however, in a manner that does not disrupt bundled rates used by the electric utility companies, and the Commission's gradual approach in addressing inter- and intra-rate class subsidies. The process for unbundling rates can be accomplished as follows.

Starting with the utility's revenue requirements in the last rate proceeding used to establish the existing rates, the utility's cost associated with transmission, distribution and ancillary service functions would be quantified.[20] These transmission, distribution and ancillary service costs would then be divided by total system requirements (i.e., system peak demand for demand metered customers; energy sales for non-demand metered or non-demand billed customers). The result of this calculation produces the transmission, distribution and ancillary service rates. These transmission, distribution and ancillary service rates would then be subtracted from the existing bundled rates for each rate class. The transmission, distribution and ancillary service rates would then be applied to each customer by one of the two methods previously described (contract reservation or customer's total load). The rate calculated as the difference of the existing bundled rate for each rate class and the transmission, distribution and ancillary service rate would then be applied to the customer's demand and energy billing units under the existing rate structures for demand and energy supplied by utility to customer with DG. This latter rate would be adjusted, if necessary, so that the combined unbundled rate revenue from this rate and the revenue from the transmission, distribution and ancillary service charges will be the same as the bundled rate revenues generated from each rate class under existing rates. This method would provide for the revenue neutral, unbundling of each utility's existing rate structures.

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20 The transmission and distribution service cost, to the extent practical, should be separated by service voltage levels in order to recognize the differences in transmission and distribution service cost for serving customers at different voltage service levels.

Q. HOW WOULD THE UNBUNDLED RATES BE APPLIED TO DETERMINE THE PRICE TO BE PAID FOR THE VARIOUS SERVICES PROVIDED BY THE UTILITY?

A. For starters, unbundled rates for transmission, distribution and ancillary service functions could follow the current approach utilized by the FERC for mainland utilities. Essentially, the FERC has two different methods for applying transmission and ancillary service charges. One method is to apply a transmission, distribution and ancillary service rate to a customer's contract capacity reservation. In the case of Hawaii's electric utility companies, the customer whose load is served in whole or part by DG, the contract capacity reservation could be an amount equal to the generating capability of the DG facility serving the customer's load. Under this method, the customer pays monthly a transmission, distribution and ancillary service charge to the utility for the amount of capacity "reserved" on the utility's system to backup the DG generator.

The other method is to apply the transmission, distribution and ancillary service charges to the customer's total load, regardless of whether the customer's load is served in whole, part or none at all by DG. Both methods are currently utilized on the mainland and could be applied to the electric utilities in Hawaii and the customers they serve with DG facilities. Both methods result in the electric utility company receiving revenues for the transmission, distribution and ancillary service functions provided by the electric utility to the customer with DG.

Q. WILL ONE NEED TO PREPARE AN "UNBUNDLED COST OF SERVICE" TO PERFORM THE ANALYSIS REQUIRED TO DETERMINE THE UNBUNDLED RATES?

A. No. Unbundling does not require a cost of service study. Although, a cost of service study should be prepared and filed with each electric utility company's rate filing, to identify class cost of service information, as well as unbundled costs as well. It is not necessary, however, to wait until the next rate filing, nor is it necessary to do a complete cost of service study to unbundle existing rates.

Q. WILL THIS UNBUNDLING PROCESS REQUIRE THAT A COST OF SERVICE STUDY BE PREPARED?

A. No. Existing rates do not need to be modified based on a cost of service study because rate structures would not be changed other than to break out the generation and transmission components of the electric rates.

Q. DO YOU THINK THAT THE UTILITIES WILL NEED TO MODIFY THEIR BILLING SYSTEMS TO INCORPORATE UNBUNDLED RATES?

A. Yes. I would expect some modifications will be required.

Q. WILL THERE BE A COST TO THE ELECTRIC UTILITIES TO MODIFY CUSTOMER BILLING SOFTWARE TO IMPLEMENT UNBUNDLED RATES?

A. Yes. There will be a cost to modify billing software to implement unbundled rates. Many electric utilities on the mainland implemented unbundled rates, so the process of unbundling has already been accomplished by other electric utilities. I personally have not directly participated in these activities, so I do not have first hand knowledge of the level of expenses required to obtain new software or to modify existing software to implement unbundled rates.

B. INTERCONNECTION MATTERS THAT MUST BE CONSIDERED TO ENSURE THE ELECTRIC UTILITY'S ABILITY TO PROVIDE RELIABLE SERVICE

Q. WHAT MUST BE CONSIDERED TO ALLOW A DG FACILITY TO INTERCONNECT WITH THE ELECTRIC UTILITY GRID?

A. The following requirements must be considered to allow a facility to interconnect with the electric utility grid.

1. Maintain safety, reliability, power quality and safe restoration of service;
2. Protect the utility's equipment and the customer's equipment and facilities; and,
3. Avoid adversely impacting operating efficiencies of the utility's system.

In general, the physical interconnection takes into account design, operating and technology specific requirements involving protection, synchronizing and control equipment. All DG facilities need to meet these requirements and should be subject to the same technical review and conform to the utility's interconnection agreements and requirements.

Q. WILL INTERCONNECTION REQUIREMENTS AND AGREEMENTS NEED TO BE DEVELOPED TO IMPLEMENT DG?

A. No, since the HEI Companies currently have a Commission approved standardized physical interconnection requirements, and a standardized interconnection agreement for DG.[21] These standards allow the interconnection of small sized DG technologies (i.e., less than 50 kw) with the electric grid while not impacting safety and reliability of the utility system. Having such standards in place provides for a streamlined, and perhaps less stringent, process for connecting alternative DG sources of electric power to the electric utility infrastructure. Such standards should be put in place for all DG projects for all Hawaii electric utilities. The standards may need to be revised to accommodate larger sized DG units. In addition, it was not evident to me that KIUC has similar interconnection requirements and agreement. If not, then KIUC should be required to consider the benefits of developing interconnection standards and agreements, although the cooperative may not be faced with the same risk of its customers electing to install DG units to serve the individual customer's energy needs.

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21 See Commission Order No. 19773 dated November 15, 2002 and Order No. 20056 dated March 6, 2003 in Docket No. 02-0051, consolidated.

It should be noted that the standardized interconnection agreement does not apply to a customer that enters into a power purchase agreement for sale to the utility of energy generated by the distributed generating facility. In this case, the DG participant and the utility should enter into an agreement that gives recognition to the impact the DG has on system operations. As previously indicated in my testimony, this assessment is currently done through the electric utility's IRP process that is presently in place.

Q. WILL ALL TYPES OF DG BENEFIT THE ELECTRIC UTILITY SYSTEM?

A No. As previously stated in Section IV.B.4.a. above, the reliability of the electric utility may be impacted if the DG facility is an as-available renewable energy project because Hawaii's utilities are not interconnected. Strategically located DG projects, however, could have a varying impact on transmission and distribution systems depending on the type of DG project that is implemented. For instance, a wind generation project may provide energy at a lesser cost than some existing generating resources. Wind generation, however, typically does not provide capacity on-demand because the resource is subject to nature and is often remotely located on the electric utility companies' system from the areas of customer concentration. So, wind might have a benefit to meeting customer energy needs, but limited benefits to the electric utility companies' delivery systems.

A fossil-fueled generator can be started on-demand and has high availability and can thus be relied on to provide reliable service. The fossil-fueled generation, however, may also have a higher incremental energy cost. This type of DG project could better be relied on in the future to offset or avoid transmission and distribution investments that would affect the non-energy related components of electric rates.

C. CHANGES DEEMED NECESSARY TO IDENTIFY COST-EFFECTIVE DG PROJECTS FOR HAWAII

Q. WHAT CHANGES TO THE IRP PROCESS ARE NEEDED?

A. As previously discussed in Section IV.E. above, the benefit or impact of DG should be evaluated against the lowest reasonable cost option of serving such needs in the development of the utility's.

In doing so, the IRP plans will need to consider the impact that DG projects have, not only on providing capacity and energy, but also the ancillary functions required to operate the electric utility companies system. In addition, the IRP plan will need to identify congested load pockets on the electric utility companies delivery system to properly recognize the potential technical and economic impacts of DG projects. The IRP should identify specific amounts of different types of DG that could be a least cost alternative for the utility's system.

In summary, a DG project should be subject to the same scrutiny, analysis and quantification of externality costs and benefits as would any other resource or DSM measure considered in developing an IRP. Therefore, the DG project should be evaluated in the IRP similarly to other resource alternatives.

D. NEED TO IMPLEMENT A COMPETITIVE BIDDING PROCESS FOR THE PROCUREMENT OF GENERATING RESOURCES IN HAWAII

Q. IS A COMPETITIVE BIDDING PROCESS NEEDED TO IMPLEMENT DG?

A. Yes. The appropriateness of implementing a competitive bid process for new generation is to be addressed in another Commission docket (i.e., Docket No. 03-0372). If DG is developed by the electric utility company or by a third-party (not the customer site) and the generating output is intended to be sold to the electric utility for resale to retail customers, DG projects should be measured or compared to other generating projects through a competitive bidding process. If a customer installs DG for its use first, then the customer makes its own economic decision by comparing the cost of the DG facility to the unbundled rates that would be implemented in conjunction with DG. Thus, the competitive bidding investigation initiated by the Commission, will be extremely important in assuring that all generation, including DG, is implemented within the framework of a least cost IRP.

VI. GENERAL MATTERS

A. WHO SHOULD OWN AND OPERATE DG PROJECTS IN HAWAII

Q. WHO SHOULD OWN AND OPERATE DG PROJECTS IN HAWAII'S ENERGY MARKET?

A. There should not be a restriction on who may own and operate DG projects. DG projects can be owned by a customer, the utility company or a third-party entity. As discussed, however, certain interconnection requirements and standards and unbundled rates should be put in place so as to avoid adverse safety, reliability and efficiency impacts of customer and third-party owned and/or operated DG projects. In addition, it is important to recognize the differences in risk and/or benefits that relate to the ownership structure and the operational capabilities and features of the DG projects and the owner and operator of such projects.

Q. WHAT ARE THOSE RISKS?

A. The risk associated with ownership and operation of generating facilities is related to the vested interest of the owner and/or operator of the generating facility. For instance, the purpose of the electric utility owner/operator is to generate energy for sale to its retail customers. Furthermore, electric utilities in Hawaii are granted a franchise authorizing the companies to provide service to customers in a given service area in exchange for the obligation to serve <u>all</u> customers. In meeting this obligation the utility is required to provide reliable service to these customers. Since the Hawaii utilities continue to be considered monopolies, they are subject to the Hawaii Commission's regulatory oversight.

On the other hand, a DG that is installed for the primary purpose of serving a customer's energy needs first, and then selling the remainder (or excess) of the energy to the electric utility cannot be considered a reliable energy source for the electric utility, although the facility may serve as a reliable energy source for the customer. The reason being that the DG unit was not installed to provide energy to the utility for purposes of meeting the utility customers' needs.[22] Furthermore, a third-party DG operator cannot be relied on to be a firm resource of energy for the utility unless the operator is bound by performance incentives/disincentives intended to ensure the reliable performance of the operator's DG unit. Even with such contractual incentives, the electric utility will be the only entity with the regulatory obligation (i.e., "on the hook" with the Commission) to provide reliable capacity and energy to its customers.

Likewise, the economic benefit of a DG facility to the electric utility is maximized when the third-party DG is operated as a firm resource (reliable). If the third party cannot, or will not operate in this manner, the electric utility will

22 While the "excess" energy described may not be considered a reliable energy source for the utility, the DG can benefit the utility by serving customer load, particularly load located inside a congested load pocket. As described elsewhere in my testimony, DG that reliability serves customer load can improve system reliability and possibly defer capital improvement projects.

need to install its own generation that is operated and maintained by the utility to be reliable in order to meet its regulatory obligation.

Q. PREVIOUSLY, YOU STATE THAT KIUC IS A COOPERATIVE AS OPPOSED TO AN INVESTOR OWNED UTILITY. DOES THIS FORM OF OWNERSHIP HAVE AN IMPACT THE CUSTOMER'S DECISION TO INSTALL A DG FACILITY?

A. Although it could, I do not believe the cooperative form of ownership will have an impact on a customer's decision to install a DG facility for the following reason. The cooperative's customer considering the installation of a DG facility is also an owner of the cooperative utility. To the extend that the cooperative electric utility's rates are not unbundled, or if the output of the DG facility installed by the customer is sold to the utility at rates, terms and conditions that are not the lowest reasonable cost for the cooperative utility, then it is likely that the cooperative utility's "margins" are likely to suffer (i.e., decline) and there will be less patronage capital to be returned to the utility's owners (i.e., the cooperative's customers) including the customer installing a DG facility.

Since KIUC is a newly formed cooperative, the organization needs to build patronage capital consistent. As previously stated, customers leaving the system to install their own DG facilities may impair the cooperative's ability to timely build patronage capita. In addition, the cooperation must maintain certain relationship of sales to members versus non-members in order to retain the tax exemption status currently granted. It would not be unreasonable for the larger customers to consider on-site DG installation, which ultimately may result in a significant loss of load. This situation could jeopardize the cooperative's ability to continue receiving tax exempt status, which ultimately would negatively impact KIUC's owner/customers.

Q. DO YOU BELIEVE THAT ELECTRIC UTILITIES WILL HAVE AN UNFAIR COMPETITIVE ADVANTAGE COMPARED TO THIRD-PARTY DG PROVIDERS IN PROVIDING DG SERVICES TO CUSTOMERS?

A. To answer this question, I have to assume that the electric utilities are interested in providing DG services to individual customers. It is possible that the utilities may somehow provide discounts or rebates to customers to encourage them to purchase DG services from the utility. If rates are not properly set up now, it is possible that the utilities could have a competitive advantage.

In addition, one would expect the electric utility to have a greater knowledge of the potential for DG at specific customer locations. Thus, in marketing DG, the utility could have a competitive advantage compared to others who do not have access to customer related information.

Regarding ownership and operating costs, I would expect the electric utilities to have access to the same vendors as would third parties and customers, and thus, would not have a technology or cost advantage.

Q. CAN DG BE FAIRLY AND COMPETITIVELY IMPLEMENTED IN HAWAII BY ELECTRIC UTILITIES, VENDORS (THIRD PARTIES) AND CUSTOMERS ALIKE?

A. Yes, I believe that DG implementations can be fairly and competitively implemented if unbundled rates are implemented and sufficient rules are developed to mitigate the possibility of anti-competitive or unfair practices. In addition, the electric utility will need to provide information that is known only by it to other parties. For instance, the electric utility IRP plan should identify electric feeders that would benefit from DG and the amount of annual benefit that would be paid to the DG owner for the savings in costs to the electric utility. Customer electric usage should also be made available to third parties at the authorization of the customer.

Q. WHAT RULES SHOULD BE IMPLEMENTED TO PREVENT AN UNFAIR ADVANTAGE FROM OCCURRING?

A. If the utilities intend to provide services to customers, the costs and revenues of providing these services should be segregated in a separate cost category that is not subsidized by revenues or discounts from the electric utility operation company. In this situation, the utility's installation of the DG project and the costs associated with such installation should be subject to the approval of the Commission to ensure that revenue from electric customers does not subsidize DG.

Q. SHOULD HAWAII'S ELECTRIC UTILITY COMPANIES BE ALLOWED TO INSTALL DG PROJECTS AT CUSTOMER LOCATIONS AND THEN BE ABLE TO INCLUDE THE COSTS OF SUCH PROJECTS IN THE UTILITY'S RATE BASE, THUS, CHARGING ALL CUSTOMERS FOR THE PROJECT THAT WAS INSTALLED FOR THE CUSTOMER WHERE THE DG WAS LOCATED?

A. My response would be a qualified "yes". The electric utilities should be allowed to include the cost of DG projects in the rate base, if the DG electrical output is used for all customers just like any other electric utility generating unit. If, however, the project primarily benefits a specific customer or group of customers, the reasonableness of including the costs of that project in rate base, without some offset in the form of contributions in aid of construction or other compensation, may be questionable.

Q. WHY SHOULD OTHER CUSTOMERS EVER BE REQUIRED TO PAY FOR DG LOCATED AT A CUSTOMER LOCATION?

A. If the customer at the DG location continues to pay for the electricity that it consumes just as any other customer would by paying through unbundled rates, then all customers are treated fair and equitably.

Q. WHAT IF THE DG PROJECT IS A CHP PROJECT THAT DECREASES THE CUSTOMER'S ELECTRIC USAGE BUT ALLOWS THE CUSTOMER TO USE HEATING ENERGY? THEN, SHOULD OTHER CUSTOMERS BE REQUIRED TO PAY FOR THE PROJECT COSTS?

A. Yes. The electric portion of the project costs should be allocated to the electric utility system while the cost of heating should be charged to the specific customer that uses the heat from the CHP project.

Q. WHO DETERMINES THE COST OF ELECTRIC ENERGY SUPPLIED BY CHP AND THE CHARGES FOR HEAT TO THE CUSTOMER?

A. These rates and cost allocation determinations should be approved by the Commission.

Q. WOULD SUCH A CHP PROJECT RECEIVE EQUAL TREATMENT IF IMPLEMENTED BY A CUSTOMER OR THIRD-PARTY VENDOR.

A. If the customer or third-party installed the same project, the customer and/or vendor would bear the costs of installing the project. The electrical energy output of the project would presumably be located "behind the meter" and would decrease the services that the customer would obtain from the electric utility based on its unbundled rates.

Q. WOULD THE CUSTOMER RECEIVE THE SAME ECONOMIC BENEFITS FROM EACH OF THESE PROJECTS, ONE UTILITY OWNED AND THE OTHER OWNED BY THE CUSTOMER OR THE VENDOR?

A. Yes. If the customer and the electric utility must pay the same amount to purchase and install the CHP, the cost of the project would be equal. In the case of the electric utility owned CHP, the customer continues to pay for electric energy at the utility's tariff rate and pays for heating services. In the case of the customer/vendor-owned project, the customer's electric bill will decrease because it is supplying much of its own electric energy needs and thus avoids the unbundled cost components that are supplied by the CHP project. Presumably, the reason that the customers installed the CHP project was that the total cost of owning and operating the CHP project, including avoided electricity costs, is less costly than without the CHP project. These customer/vendor ownership and operating costs would, however, be comparable to those of the electric utility.

Q. ARE YOU AWARE THAT ELECTRIC UTILITIES SUCH AS MECO OFFERED A DISCOUNT TO AN ELECTRIC CUSTOMER ON THE ISLAND OF LANAI TO DISCOURAGE THE CUSTOMER FROM IMPLEMENTING DG PROJECTS?

A. I am aware of the situation on Lanai that caused MECO to negotiate an arrangement that would not negatively impact the remaining customers on Lanai.

Q. DO YOU THINK THIS IS AN APPROPRIATE WAY TO IMPLEMENT DG?

A. No. The problem in this situation was that the customer intended to install electric generation to avoid electric utility costs. The costs that would be avoided would be all of the bundled costs of generation, transmission and distribution. If the customer disconnects from the electric grid entirely and no longer uses electric utility services then, in fact, electric utility services would no longer be used by the customer. If the customer continued to be connected to the electric utility grid, however, the customer would continue to use some level of electric utility services. In the Lanai situation, the customer would avoid the cost of these services because the existing "bundled" rates do not properly recover revenues for services that the customer would continue to receive. Unbundling rates would thus solve this inequity and would not require that the price of services be "negotiated" because the customer would continue to pay for transmission and distribution services and some generating services that it continues to use.

It should be noted that a customer disconnecting from the electric utility system is always a possibility with or without unbundled rates. Thus, the situation of a customer disconnecting from the grid is not considered in my testimony as a DG issue.

Q. SHOULD AN EXIT FEE BE APPLIED TO CUSTOMERS WHO DISCONNECT FROM THE UTILITY SYSTEM AND NO LONGER REQUIRE SERVICES FROM THE UTILITY?

A. A customer that exits the electric utility system by disconnecting from the electric grid can cause costs to be "stranded" and eventually could cause remaining customers to pay higher rates. This is not a DG issue for purposes of this proceeding, however, because a DG in this proceeding is a generator that is connected directly or indirectly to the electric utility system.

B. WHAT IS THE ROLE OF THE COMMISSION IN THE DEPLOYMENT OF DG IN HAWAII'S ENERGY MARKET

Q. WHAT IS THE ROLE OF THE COMMISSION IN THE DEPLOYMENT OF DG IN HAWAII?

A. For DG to be effectively deployed, the Commission must require each utility to prepare and provide to the Commission for its consideration and approval, unbundled rate structures. In addition, the Commission must require the incorporation of DG in the utility's IRP cycle and implementation plans.

Q. WHAT IS MEANT BY THE IRP CYCLE AND IMPLEMENTATION PLANS?

A. The IRP framework specifies that each utility shall conduct a major review and update of its IRP every three years (See Framework, paragraph III.B.2.). In reviewing and updating of the IRP, all supply-side options that may be supplied by the utility or others should be considered. After identifying and reviewing supply-side options, the utility may screen out those options that are deemed "clearly infeasible" (See Framework, paragraph IV.D.).

The utility's IRP plan "shall govern all utility expenditures for capital projects, purchased power and demand-side management programs" (See Framework, paragraph III.D.5.). Accordingly, once approved by the Commission, the IRP action plan for the upcoming five-year period is to influence and control all supply-side (and demand-side) resource decisions and acquisitions. Even power that a utility may be required to purchase under PURPA is to be reviewed in light of the utility's approved IRP action plan. Any such power purchased must eventually be incorporated into the utility's succeeding IRP plans.

Q. WHAT DOES THAT MEAN FOR THE UTILITY AND THE COMMISSION WITH REGARDS TO THE DEPLOYMENT OF DG?

A. The planning for DG should be incorporated into the development of each Hawaii electric company's IRP. The types of DG that should be included in the five-year action plan should be those that are commercially viable at the time that the plan is developed, and considered to be suitable for use in Hawaii. New technologies can be incorporated in the development of the next IRP so as not to interrupt the implementation of the five-year action plan in the Commission approved IRP.

It is important to note that the IRP process must be on-going to be utilized as an effective planning tool. In this regard, the Commission approved five-year action plan should not be modified. The timing of events set forth in the plan, however, may be subject to change depending on how well the sales and load forecasts match the forecasted levels upon which the plan was developed. At the same time, the process should continue to provide all the participants an opportunity to consider emerging technology that may become commercially viable subsequent to the submission of the current approved plan in developing the next IRP. Finally, the IRP plan must set forth the goals and objectives that are intended to be achieved with the action plan, the measures by which one will be able to assess the achievement of each goal and objective and the time line for achieving these goals and objectives. This must be done at the inception of the planning process to allow for an effective assessment of the alternatives under consideration in developing the five-year action plan.

VII. CONCLUSION.

Q. PLEASE SUMMARIZE YOUR RECOMMENDATIONS?

A. To effectively deploy DG, the following items need to be done:

1. The current rate structure of each of the electric utility companies will need to be unbundled and rate tariffs modified so that customers connected to the utility grid are able to pay for generation, transmission and distribution services provided by the electric utility company, and back-up services, if required.
2. Interconnection standards and agreements should be developed to ensure that interconnection of a third-party owned DG facility does not negatively affect the electric utility's ability to provide reliable service.
3. The determination of whether a DG project's output represents the lowest reasonable cost option to meeting the electric system needs should be made when determining the electric utility's Integrated Resource Plan ("IRP").

4. A competitive bid process should be established for new generation, including DG resources.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes. It does.

JOSEPH A. HERZ

Mr. Herz is President of Sawvel and Associates, a professional consulting firm founded in 1951. The firm has an outstanding reputation for rendering professional consulting service in the areas of public utility planning, financing, operations and management—particularly for electric and natural gas utilities—and is proud that it has served many clients on a continuing basis for more than forty years.

A graduate of the University of Nebraska, Mr. Herz is registered as a Professional Engineer. His professional experience consists primarily of planning analytical studies related to electric power supply, transmission arrangements, feasibility studies, economic analyses and rate studies and contract negotiations. He has conducted detailed cost-of-service, rate, financial and power supply and transmission studies involving various investor, municipal and cooperative-owned systems. He has testified on numerous occasions as an expert witness concerning regulatory rate matters before federal and state regulatory agencies.

Mr. Herz is experienced in long-range planning for expansion of utility systems, engineering, financial and economic feasibility investigations and analyses. Power supply experience includes evaluating the technical and financial feasibility of transmission and power supply resources and related arrangements; power pooling, including integration of transmission and generating facilities; and, preparation and negotiation of related power supply and transmission contracts and has served as an independent arbitrator on power supply disputes.

Under the direction of Mr. Herz, Sawvel and Associates has expanded its operations from a single-person consulting practice serving a localized region to a multi-disciplined engineering and consulting firm with three regional offices serving clients throughout the United States and its territories. Separate and apart from his activities with Sawvel and Associates, Mr. Herz is a principal in a newly formed natural gas utility in northwestern Ohio.

Education

University of Nebraska
B.S., Electrical Engineering, 1971

Registration

Professional Engineer — Indiana and Ohio

Professional Organizations

American Gas Association
American Public Power Association
American Standardization Society for Testing and Materials
American Water Works Association
The Institute of Electrical and Electronics Engineers, Inc.
National Society of Professional Engineers
Ohio Society of Professional Engineers

PROJECTS INVOLVING REGULATORY FILINGS

Joseph A. Herz, P.E.

Utility	Docket No.	Issues and/or Scope	Client	Year
Federal Energy Regulatory Commission: PacifiCorp	ER96-8-000	Transmission, cost of service and rate design	Utah Municipal Power Agency Deseret Generation and Transmission Cooperative, Inc.	1995
PacifiCorp Electric Operations	ER93-675-0000	Transmission issues, cost of service and rate design	Utah Municipal Power Agency	1993
PacifiCorp Electric Operations	ER91-494-0000	Transmission issues, cost of service and rate design	Utah Municipal Power Agency	1991
PacifiCorp Electric Operations	ER91-471-0000	Transmission issues, cost of service and rate design	Utah Municipal Power Agency	1991
Arizona Public Service Company	ER89-265-000	Transmission issues, cost of service and rate design	Plains Electric Generation and Transmission Cooperative	
1989Cincinnati Gas & Electric Company	ER89-17-000 and ER89-19-000	Transmission service, schedule restrictions and billing for transmission service	City of Hamilton, Ohio	1989
Utah Power and Light Company	EL85-12	PURPA wheeling under Sections 210, 211 and 212 of the Federal Power Act	Utah Municipal Power Agency and City of Manti, Utah	1985
Utah Power and Light Company	ER84-571/572	Transmission issues, cost of service and rate design	Utah Municipal Power Agency and the Cities of Manti and Provo, Utah	1985
Utah Power and Light Company	ER83-427-000	Transmission issues, revenue requirement, cost of service and rate design	Manti, Utah	1983
Arizona Public Service Company	ER82-481-000	Transmission issues, cost of service and rate design	Plains Electric Generation and Transmission Cooperative	1982
Arizona Public Service Company	ER81-179-000	Wholesale and transmission issues, cost of service and rate design	Plains Electric Generation and Transmission Cooperative	1981

PROJECTS INVOLVING REGULATORY FILINGS

Joseph A. Herz, P.E.

Utility	Docket No.	Issues and/or Scope	Client	Year
Colorado Public Utilities Commission: Public Service Company of Colorado	1425 Phase II	Engineering issues, cost of service and rate design	The Executive Agencies of the United States	1981
Florida Public Service Commission: Florida Power Corporation	80119-EU	Engineering issues, cost of service and rate design	The Executive Agencies of the United States	1980
Tyndall Air Force Base	010949-EI	Engineering and cost of service issues that have an actual or potential impact on the FEA	The Executive Agencies of the United States	2001
Hawaii Public Utilities Commission: Hawaii Electric Light Company, Inc.	99-0355	Transmission system improvements with IPP purchase power addition	Division of Consumer Advocacy, State of Hawaii	2000
Hawaii Electric Light Company, Inc.	99-0207	Generation and purchase power, operation and maintenance expenses, system losses and engineering issues	Division of Consumer Advocacy, State of Hawaii	
2000Hawaii Electric Light Company, Inc.	99-0346	Need for capacity additions/review of IPP Purchase Power Agreement	Division of Consumer Advocacy, State of Hawaii	1999
Hawaii Electric Light Company, Inc.	98-0013	Need for capacity resource additions, IPP purchase power agreement	Division of Consumer Advocacy, State of Hawaii	1999
Hawaii Electric Light Company, Inc	97-0420	Generation and purchase power, operation and maintenance expenses, system losses and engineering issues	Division of Consumer Advocacy, State of Hawaii	1999
Hawaii Electric Light Company, Inc	97-0349	Integrated resource planning	Division of Consumer Advocacy, State of Hawaii	1999
Kauai Electric Division	KE94-0097	Engineering issues, generation and purchase power, operation and maintenance expenses, system losses and cost of service and rate design	Division of Consumer Advocacy, State of Hawaii	1994

PROJECTS INVOLVING REGULATORY FILINGS

Joseph A. Herz, P.E.

Utility	Docket No.	Issues and/or Scope	Client	Year
Hawaiian Electric Company, Inc.	7766	Engineering issues, generation and purchase power, operation and maintenance expenses, system losses and cost of service and rate design	Division of Consumer Advocacy, State of Hawaii	1994
Hawaii Electric Light Company, Inc.	7623	Need for capacity resource additions and purchase power contracts	Division of Consumer Advocacy, State of Hawaii	1994
Hawaii Electric Light Company, Inc.	7764	Engineering issues, generation and purchase power, operation and maintenance expenses and system losses	Division of Consumer Advocacy, State of Hawaii	1994
Kansas Corporation Commission: Western Resources and Kansas City Power & Light	97-WSRE-676-MER	Western Resources Merger Intervention and other related relief	Kansas City, Kansas Board of Public Utilities	1999
Michigan Public Service Commission: Detroit Edison Company	Case No. U-7232	Interconnection agreements and power sales contract	Michigan Attorney General	1983
Missouri Public Service Commission: Kansas City Power and Light Company	Case No. ER83-49	Engineering issues, cost of service and rate design	The Executive Agencies of the United States	1983
Kansas City Power and Light Company	Case No. EO-78-161	Engineering issues, cost of service and rate design	The Executive Agencies of the United States	1980
Montana Public Service Commission: Malmstrom Air Force Base	D2001.10.144	Analyze proposed rate design for customers receiving default power supply and transmission services and limitations on the ability of qualified customers to return to the default supply services	The Executive Agencies of the United States	2001

PROJECTS INVOLVING REGULATORY FILINGS

Joseph A. Herz, P.E.

Utility	Docket No.	Issues and/or Scope	Client	Year
New Mexico Service Commission: Otero Electric Cooperative	Case No. 204B	Demand metering and rate design	Otero Electric Cooperative	1987
Gas Company of New Mexico	Case No. 1875	Engineering issues, cost of service and rate design	The Executive Agencies of the United States	1984
Gas Company of New Mexico	Case No. 1787	Engineering issues, cost of service and rate design	The Executive Agencies of the United States	1983
Gas Company of New Mexico	Case No. 1710	Engineering issues, cost of service and rate design	The Executive Agencies of the United States	
1982Gas Company of New Mexico	Case No. 1568	Engineering issues, cost of service and rate design	The Executive Agencies of the United States	1982
Ohio Public Utilities Commission: FirstEnergy Operating Companies	Case No. 98-1636-EL-UNC	Transmission system reliability - sale and transfer of generating assets	Industrial Energy Users of Ohio	1999
Utah Public Service Commission: Hill Air Force Base	01-035-01	Revenue requirements, cost of service, rate design	The Executive Agencies of the United States	2001
Hill Air Force Base	01-035-23	Revenue requirements, cost of service, rate design	The Executive Agencies of the United States	2001
Hill Air Force Base	01-035-35	Revenue requirements, cost of service, rate design	The Executive Agencies of the United States	2001
Hill Air Force Base	01-035-36	Evaluate power cost adjustment mechanism to determine if it is non-discriminatory, accurately reflects the actual cost of providing the service, and is necessary under the circumstances Utah Power & Light intervention	The Executive Agencies of the United States	2001
Hill Air Force Base	00-035-15	Revenue requirements, cost of service, rate design	The Executive Agencies of the United States	2001
Wyoming Public Service Commission: PacifiCorp	20000-ER-95-99	Revenue requirements, cost of service, rate design and jurisdictional allocations	Marathon Oil Company	1996

Distributed Generation Technologies

Energy Source	Description	Typical Size (kW)	Dispatchable?	Typical Uses	Commercially Available	Emerging Technology
Solar Energy (Photovoltaics)	A cell which converts the solar energy of the sun directly into electricity.	1-100	No	Baseload power off grid homes, remote industrial and small power applications (e.g. telecommunication, road signage, etc.).	√	
Microturbines	A relatively new technology, which is just making the transition to commercial markets. Microturbines can run on a variety of fuels, including natural gas, propane, and fuel oil. They consist of a compressor, combustor, turbine and generator. These small turbines contain essentially one moving part and use either air or oil for lubrication. Microturbines require little maintenance, but need a major (i.e., expensive) overhaul every four years.	30-300	Yes	Can be used in baseload, peaking or co-generation applications.	√	√
Fuel cells	In fuel cells, hydrogen and oxygen are separated by an electrolyte - inducing an electrochemical potential. This potential is converted into direct current electricity by protons moving through the electrolyte (combining with oxygen to form water) and electrons flowing through a separate electrical circuit.	1-200	Yes	Rural (off-grid) power. Transportation. Appropriate for baseload applications.	√	√

Distributed Generation Technologies

Energy Source	Description	Typical Size (kW)	Dispatchable?	Typical Uses	Commercially Available	Emerging Technology
	Fuel cell types include phosphoric aid, molten carbonate, solid oxide and proton exchange membrane. Only phosphoric acid fuels cells are available commercially. Fuels cells can be fueled by natural gas, hydrogen, biogas or propane. Hydrogen is the most used fuel source. Companies developing products for utilities and electric customers are concentrating on fuel cells that run on natural gas, but the automobile industry is investigating models that would run on gasoline or methanol.					
Wind Turbines	Wind turbines are packaged systems that include the rotor, generator, turbine blades, and drive or coupling device. The wind turns the blades of a windmill-like machine. The rotating blades turn the shaft to which they are attached. The turning shaft typically either powers a pump or turns a generator which produces electricity.	10 - 2,000	No	Homes and farms, process industries and remote communities. Could be considered baseload if not for dependency on wind.	√	

Distributed Generation Technologies

Energy Source	Description	Typical Size (kW)	Dispatchable?	Typical Uses	Commercially Available	Emerging Technology
	Selection of a suitable site is key to the economics of wind energy. In general, winds exceeding 5 m/s (11 mph) are required for cost-effective application of small grid-connected wind machines, while wind farms generally require wind speeds of 6 m/s (13 mph).					
Internal Combustion Engines	Includes diesel engines, natural gas engines.	50 - 5,000	Yes	Well-established, long history as back up or peaking applications.	√	
Reciprocating Engines	Natural gas, diesel, gasoline, landfill gas, digester gas.	5 - 7,000	Yes	High-speed units are derived from automotive or truck engines and operate at 1200-3600 rpm. Medium-speed engines are derived from locomotive and small marine engines, and operate at 275-1000 rpm. Most low-speed units are derived from large ship propulsion engines and operate at 58-275 rpm. Low-speed engines are designed to burn low-quality residual fuels.	√	
Stirling Engines	Natural gas primarily but broad fuel flexibility is possible.	<1 - 5	Yes	Space and marine industries, baseload and peaking.		√

Distributed Generation Technologies

Energy Source	Description	Typical Size (kW)	Dispatchable?	Typical Uses	Commercially Available	Emerging Technology
Energy Storage/ UPS Systems	Batteries, Flywheels, Superconducting Magnetic Energy Storage (SMES), Supercapacitors, Compressed Air Storage Systems (CAES).	5 - 150,000	Yes	Used to correct voltage sags, flicker, and surges, that occur when utilities or customers switch sources of power supply or loads. May also be used as an uninterruptible power supply (UPS).	√	√
Hybrid Systems	Solid oxide fuel cell combined with a gas turbine or microturbine. Stirling engine combined with a solar dish. Wind turbines with battery storage and diesel backup generators. Engines (and other prime movers) combined with energy storage devices such as flywheels.	5 - 25	Yes	Baseload and peaking.		√
Mini Hydro		100 - 1,000	No	Baseload energy. Serve isolated customer, small factory or connect to grid.	√	√
Biomass	Biomass is organic matter, such as agricultural wastes and wood chips and bark left over when lumber is produced. Biomass can be burned in an incinerator to heat water to make steam, which turns a turbine to make electricity. It can also be converted into gas, which can be burned to do the same thing.	1,000 - 50,000	Yes	Baseload combined steam and electric power.	√	

Distributed Generation Technologies

Energy Source	Description	Typical Size (kW)	Dispatchable?	Typical Uses	Commercially Available	Emerging Technology
Geothermal	A geothermal power plant is a steam power plant. Wells are to tap into an underground thermal heat source for hot water or steam. The hot water or steam goes through a heat exchanger, and spins a turbine generator.	1,000 - 30,000	Yes	Baseload.	√	

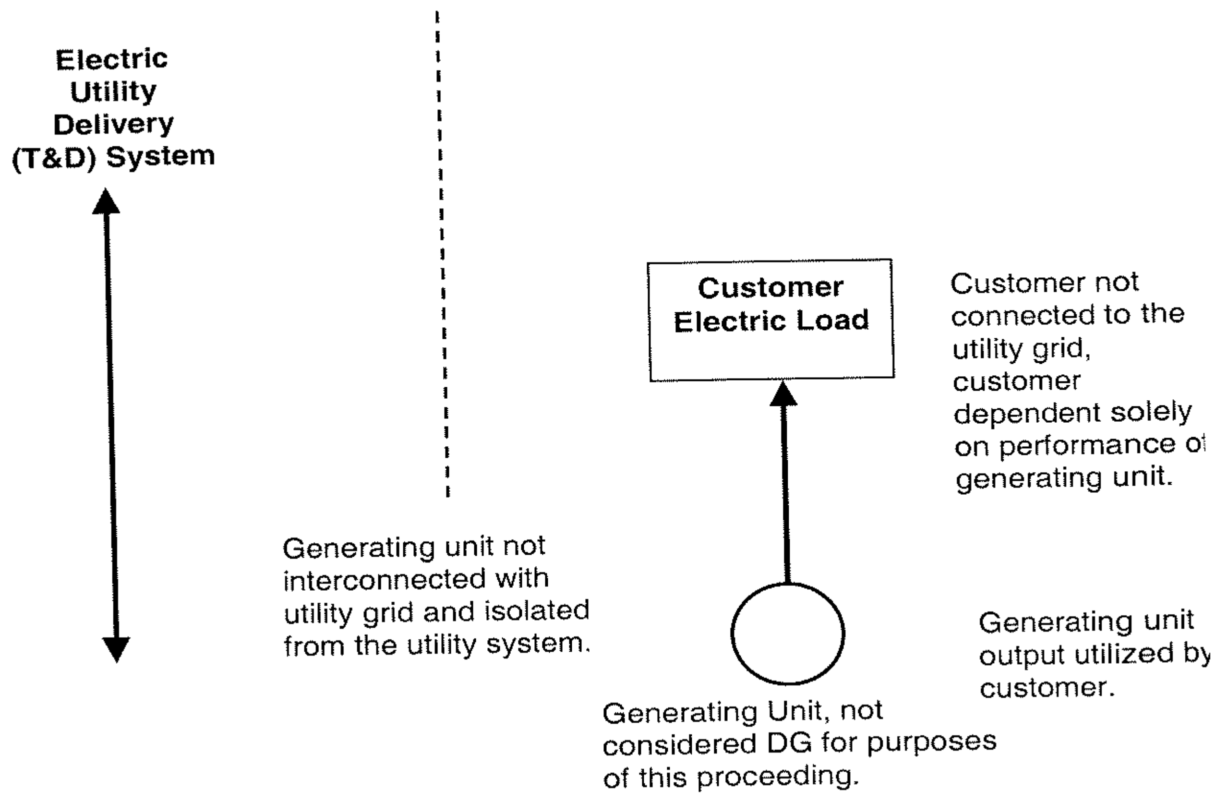
Delivery of Non-Utility-Owned Generating Resources to End Users

Generating Resource	Utilization of Output	Interconnection Requirements
I. Stand Alone, "Isolated" from Utility		
A. Not Connected to Utility Grid	Output utilized by customer, customer dependent solely on the performance of its generating unit.	Not applicable; generating unit not interconnected with utility grid and isolated from the utility system.
II. Interconnected to Utility Grid		
A. Direct Connection to Utility	Output sold to utility and utilized with other utility resources to serve utility system customer needs.[1]	Established by agreement with utility based on system impact analysis.
B. Connect to Customer	Output utilized by customer, with utility "backup" to provide balance of customer's needs; any excess delivered to utility is utilized by other customers.[2]	Standardized requirements and agreement unless relative size of the generating unit to the load or delivery system capabilities result in additional requirements determined from a system impact analysis.

(1) In the "regulated" Hawaii environment, DG participants can not presently sell electricity services directly to other customers or have DG output delivered, or "wheeled" over the utility's delivery system to other utility customers.

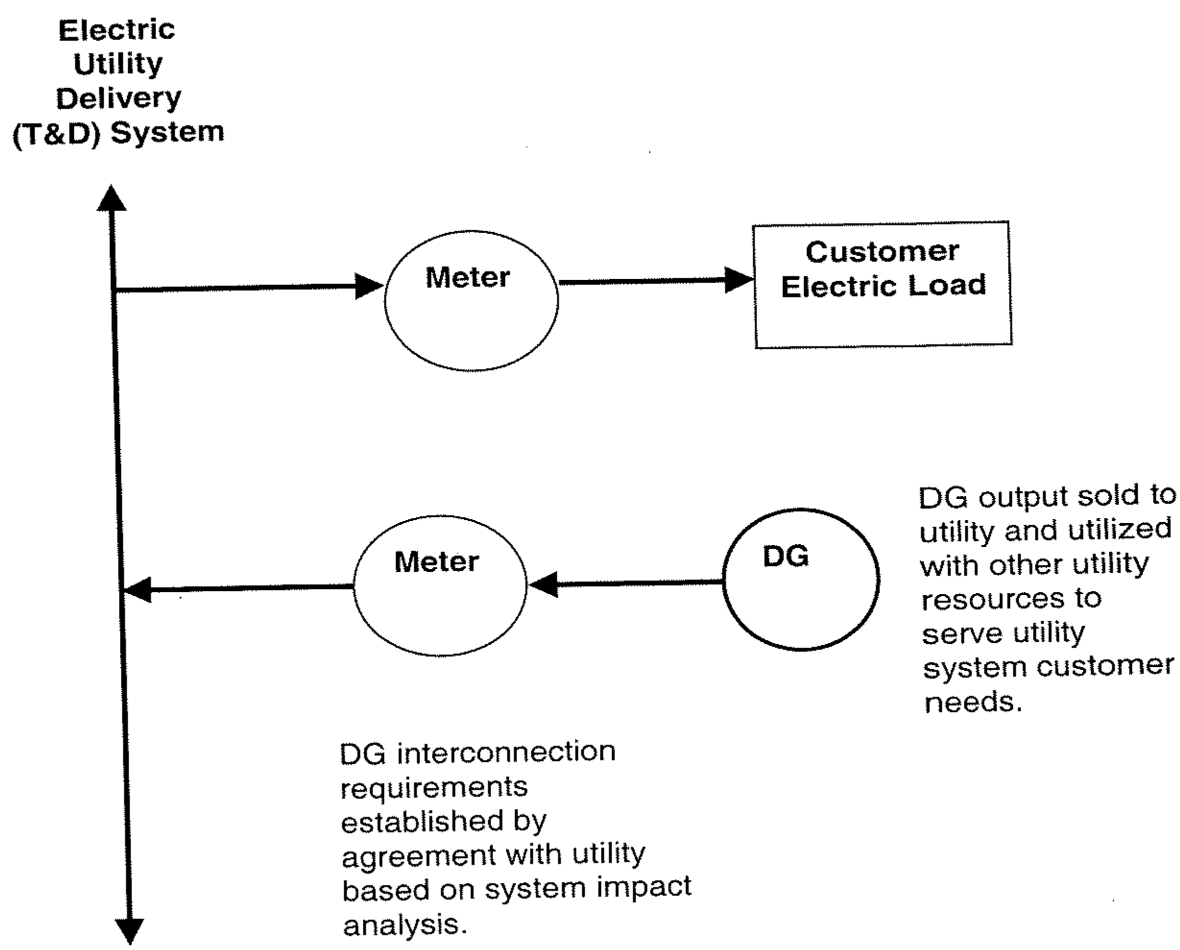
(2) The State has established "net metering" for eligible residential and commercial customers that own and operate DG facilities, intended to serve part or all of the customer's electricity requirement, on a first-come-first-served basis until the total rated generating capacity of such net metered DG facilities equals 0.5% of the UDC's system peak demand (see Hawaii revised statutes, section 269-101 and 269-102). It should be pointed out the renewable portfolio standard is determined using net electric utility sales, which only includes the excess energy generated and delivered to the utility under a net metering arrangement to count toward meeting the RPS.

I. Stand Alone, "Isolated" From Utility



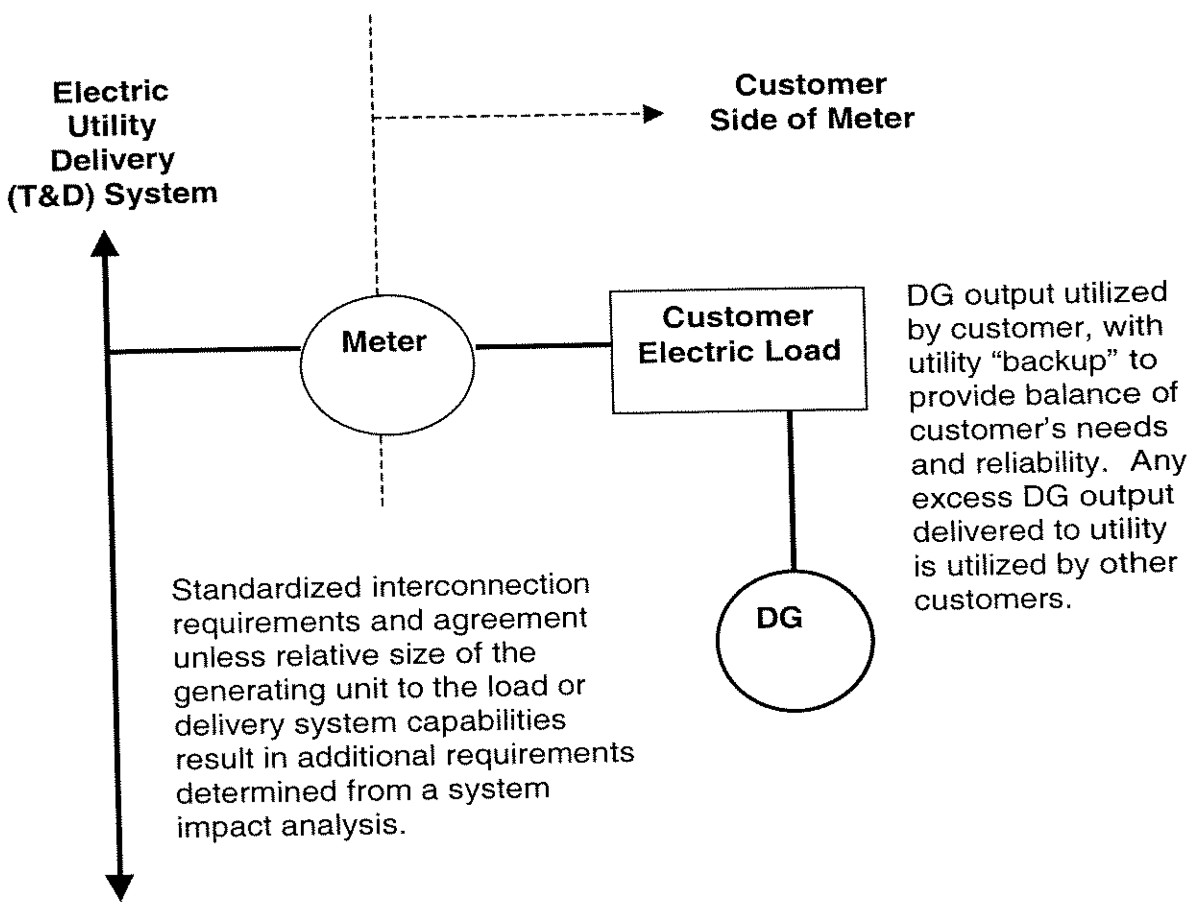
II. Interconnected to Utility Grid

A. Direct Connection to the Utility



II. Interconnected to Utility Grid

B. Indirect Connection Through Customer



Population (1990 and 2000 Census) and Land Area by Island

Line No.	Island	Resident Population[2]			De Facto Population[3]			Land Area (sq. mi.)	Population (2000)/ Sq. Mi. Density	
		April 1, 1990	April 1, 2000	Change ((c-b)/b)	April 1, 1990	April 1, 2000	Change ((f-e)/e)		Resident (c/h)	De Facto (f/h)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
1	Oahu [1]	836,231	876,156	4.8%	908,019	927,173	2.1%	608	1,441	1,525
2	Maui	91,361	117,644	28.8%	126,992	156,170	23.0%	727	162	215
3	Molokai	6,717	7,404	10.2%	7,677	8,131	5.9%	261	28	31
4	Lanai	2,426	3,193	31.6%	2,629	4,243	61.4%	140	23	30
5	Hawaii	120,317	148,677	23.6%	135,080	167,073	23.7%	4,038	37	41
6	Kauai	50,947	58,303	14.4%	67,737	75,040	10.8%	553	105	136
7	Subtotal	1,107,999	1,211,377	9.3%	1,248,134	1,337,830	7.2%	6,327	191	211
8	State [4]	1,108,229	1,211,537	9.3%	1,248,360	1,337,991	7.2%	6,423	189	208

(1) Population includes the Northwestern Hawaiian Islands, from Nihoa to Kure Atoll, except Midway (24 residents in 1990).
(2) Based on place of usual residence. Includes armed forces stationed or homeported in Hawaii and residents temporarily absent; excludes visitors present.
(3) Includes all persons physically present in area, regardless of military status or usual place of residence. Includes visitors present but excludes residents temporarily absent, both calculated as an average daily census.

(4) Includes the island of Niihau.

Source: Population from U.S. Bureau of the Census, 1990 Public Law 94-171 counts; U.S. Census Bureau, Census 2000 Redistricting Data (P.L. 94-171) Summary File (March 19, 2001); Hawaii State Department of Business, Economic Development & Tourism, Tourism Research Branch, records, Website: http://www.hawaii.gov/dbedt. Area from http://www.nationmaster.com/encyclopedia.

CA-103
Docket No. 03-0371

Electric System Peak Demand and Energy Requirements
(Net of DSM Impact)
2003 and 2008

Line No.	Island	Electric Utility Company	Peak Demand (MW)			Energy Requirements (MWh)		
			2003	2008	Change ((d-c)/c)	2003	2008	Change ((g-f)/f)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
1	Oahu	HECO	1,242.0	1,401.0	12.80%	7,522,200	8,366,100	11.22%
2	Maui	MECO	200.2	223.9	11.84%	1,130,400	1,280,100	13.24%
3	Molokai	MECO	6.8	7.1	3.68%	35,904	37,715	5.04%
4	Lanai	MECO	5.0	5.3	5.92%	27,859	29,290	5.14%
5	Hawaii	HELCO	184.0	210.0	14.13%	1,022,200	1,163,300	13.80%
6	Kauai	KIUC	73.5	77.8	5.91%	431,300	455,118	5.52%
7	Total		1,711.5	1,925.0	12.48%	10,169,863	11,331,623	11.42%

Source: HECO, MECO and HELCO; see HECO response to CA-SOP-IR-22.
KIUC; see Kauai Electric IRP, Docket No. 96-0266, Appendix A, Low Scenario.

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Docket No. 03-0371
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Electricity Use Per Capita

Line No.	Island	Electric Utility Company	2003 Energy Requirements (MWh)	2000 Population		Electricity Use Per Capita	
				Resident	De Facto	Resident (c/d)	De Facto (c/e)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
1	Oahu	HECO	7,522,200	876,156	927,173	8.59	8.11
2	Maui	MECO	1,130,400	117,644	156,170	9.61	7.24
3	Molokai	MECO	35,904	7,404	8,131	4.85	4.42
4	Lanai	MECO	27,859	3,193	4,243	8.73	6.57
5	Hawaii	HELCO	1,022,200	148,677	167,073	6.88	6.12
6	Kauai	KIUC	431,300	58,303	75,040	7.40	5.75
7	Total		10,169,863	1,211,377	1,337,830	8.40	7.60

Source: Energy Requirements - HECO, MECO and HELCO; see HECO response to CA-SOP-IR-22. KIUC; see Kauai Electric IRP, Docket No. 96-0266, Appendix A, Low Scenario.

Population from U.S. Bureau of the Census, 1990 Public Law 94-171 counts; U.S. Census Bureau, Census 2000 Redistricting Data (P.L. 94-171) Summary File (March 19, 2001); Hawaii State Department of Business, Economic Development & Tourism, Tourism Research Branch, records, Website: http://www.hawaii.gov/dbedt. Area from http://www.nationmaster.com/encyclopedia.

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Docket No. 03-0371
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Balance of Peak Demand and Firm Resources
(2003 - MW)

Line No.	Island	Electric Utility Company	Peak Demand (Net of DSM)	Firm Resource Capability			Reserve Capability	
				Generation	Firm Purchases	Total (d+e)	Amount (f-c)	Percent (g/c)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
1	Oahu	HECO	1,242	1,209	406	1,615	373	30.00%
2	Maui	MECO	200	226	4	230	29	14.64%
3	Molokai	MECO	7	15	0	15	9	126.47%
4	Lanai	MECO	5	10	0	10	5	108.04%
5	Hawaii	HELCO	184	160	109	269	85	46.41%
6	Kauai	KIUC	73	124	0	124	51	68.80%
7	Total		1,711	1,744	519	2,263	552	32.24%

Source: Peak Demand for HECO, MECO and HELCO; see HECO response to CA-SOP-IR-22.
Peak Demand for KIUC; see Annual Report.
Firm Generation for HECO, MECO and HELCO; see HECO response to CA-SOP-IR-24; KIUC Annual Report.
Firm Purchases from Adequacy of Supply Reports.

CA-105
Docket No. 03-0371

Utility System Losses

Line No.	Island	Electric Utility Company	Transmission Line Losses	Total System Losses
1	Oahu	HECO	1.36	5.14
2	Maui	MECO	1.23	7.15
3	Molokai(1)	MECO	n/a	9.14
4	Lanai(1)	MECO	n/a	4.95
5	Hawaii	HELCO	3.77	8.57
6	Kauai	KIUC	1.50	4.96

(1) System losses from financial reports.

Source: HECO, MECO and HELCO; see HECO response to CA-SOP-IR-19.
KIUC; see KIUC response to CA-SOP-IR-35.

ANCILLARY FUNCTIONS OF MAINLAND UTILITIES REGULATED BY THE FERC

The generation ancillary functions are utility system operating requirements that are needed for the delivery of electric power and energy from resources to loads while maintaining reliable operation of the utility power supply and delivery system. These ancillary functions are identified and described below:

1. Scheduling, System Control and Dispatch--Required to schedule and dispatch the movement of power within an electric utility system from multiple resources to serve customer needs reliably and economically.
2. Reactive Supply[1] and Voltage Control from Generation Sources—Maintain voltage levels on the delivery system within acceptable limits. In order to do so, generation facilities are operated to produce (or absorb) reactive power.
3. Regulation and Frequency Response—Provide for continuous balancing of resources (generation) with the customer energy consumption and maintaining frequency at sixty cycles per second (60 Hz).[2] It is

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[1] Power provided and maintained for the explicit purpose of insuring continuous, steady voltage on transmission networks. Reactive power is energy that must be produced for maintenance of the system and is not produced for end-use consumption. Electric motors, electromagnetic generators and alternators used for creating alternating current are all components of the energy delivery chain which require reactive power.

[2] This is a standard requirement to operate an alternating current (AC) electric system at 60 cycles per second.

accomplished by having on-line generation follow moment-to-moment changes in customer energy consumption.

4. Energy Imbalance—Provided when energy scheduled from generating resources not under the utility's control and actual delivery of energy from such resources differs over a single hour.

5. Operating Reserve-Spinning Reserve—Generating capacity is reserved (not loaded) to enable it to ramp up to serve customer energy needs immediately in the event of a system contingency (outage) and is provided by generating units that are on-line and loaded at less than maximum output.

6. Operating Reserve-Supplemental Reserve—Generating capacity is reserved (operating or not operating) to serve system energy needs in the event of a system contingency (outage). Supplemental reserves are not available immediately to serve system energy needs but rather within a short period of time (such as 10 minutes). It may be provided by generating units that are on-line but unloaded, by quick start generation (diesel and combustion turbine), or by interruptible load.

7. Generation Imbalance—A generator or system of generators must be able to automatically change their output when there is a difference between system energy needs and actual energy delivered from generation resources in the electric system during an hour.

Under current FERC rules, entities that use the utility's transmission and distribution system and do not perform the above ancillary functions must pay others to supply these ancillary functions. The ancillary function rates are based on the generating system embedded costs to provide the specific function. For instance, operating reserves are typically required to be a percentage (ex., 3%) of the MW output of the generator. Therefore, if 3% of the generator must be set aside to provide this function, 3% of the carrying costs and operating and maintenance costs of the specific generators providing the functions are divided by the MW capacity supplied by the generator to result in a rate per kW-month for the specific function.

These rates are filed and approved at FERC for utilities on the mainland. These rates are then used to charge wholesale and retail customers for the specific ancillary functions provided. Likewise, the generator owner is paid for the ancillary service functions provided by the generator.