BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF HAWAII

In the Matter of the Application of HAWAIIAN ELECTRIC COMPANY, INC., HAWAII ELECTRIC LIGHT COMPANY, INC., and MAUI ELECTRIC COMPANY, LIMITED For Approval to Commit Funds in Excess of $2,500,000 for the Smart Grid Foundation Project, to Defer Certain Computer Software Development Costs, to Recover Capital and Deferred Costs through the Renewable Energy Infrastructure Surcharge, and Related Requests.	DOCKET NO. 2016-0087

ORDER NO. 34281

DISMISSING APPLICATION WITHOUT PREJUDICE AND PROVIDING GUIDANCE FOR DEVELOPING A GRID MODERNIZATION STRATEGY

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DISMISSING APPLICATION WITHOUT PREJUDICE AND PROVIDING GUIDANCE FOR DEVELOPING A GRID MODERNIZATION STRATEGY

I.

INTRODUCTION

Hawaii's electric grids are transforming at a tremendous rate. Driven by changes in customer behavior and preferences, rapid technological innovation, and energy and environmental public policies, the State is a global leader when it comes to the penetration of distributed energy resources ("DER"). Currently, more than 17 percent of the HECO Companies' customers have deployed DER, and the forces underpinning this adoption will likely only

grow over time. In addition, pursuant to House Bill 623,[1] the State's electric utilities must meet the goal of a 100 percent renewable portfolio standard ("RPS") by the year 2045. Consequently, the integration of renewables and DER remains one of the primary challenges and opportunities for electric utilities in Hawaii. It is within this larger context that the commission has considered the HECO Companies' Application to implement a Smart Grid Foundation Project ("SGF Project").[2]

In the commission's view, a modernized grid is the "backbone" necessary to advance the State's RPS goals, support integration of additional levels of renewables, encourage competition, empower consumers to make their own choices concerning the level and types of electric service they desire, and leverage customer-sited resources to assist in grid operation. Likewise, implementation of a grid modernization program should assist in both improving and ensuring system reliability and flexibility.

Several questions and concerns have emerged in the commission's review of the Application. As discussed in greater detail below, the Companies' own analysis demonstrates that the

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[1]Codified at Hawaii Revised Statutes ("HRS") § 269-92.

[2]"Application of Hawaiian Electric Company, Inc., Hawaii Electric Light Company Inc., and Maui Electric Company, Limited, Exhibits A-I; Verification; and Certificate of Service," filed on March 31, 2016 ("Application").

Project may not be cost-effective as proposed. The commission further questions the justification for such a large investment whereethe project asserts only an indirect link to address the primary issue currently facing Hawaii's distribution grids, i.e., DER and renewable energy integration, more broadly. The application does not specifically address how the Companies intend to integrate customer-sited assets in the near term and long term.

The Application does not address the risks of redundancy due to DER growth or obsolescence due to technological advancement. It does not articulate an approach for leveraging the growing amounts of DER connected to the State's electric grids. Moreover, the commission has questions related to the priority, sequencing, and pace of grid modernization investments proposed, given Hawaii's unique challenges and opportunities.

The commission recognizes the urgency with which the Companies must move to modernize the islands' electric grids in order to expeditiously meet the State's energy goals. That said, given the concerns articulated above, and that grid modernization represents a set of critical strategic investments for the Companies to position the utilities for future opportunities and to address grid challenges, the commission is concerned that the Companies' Smart Grid Strategy and Roadmap, submitted as Exhibit B to the Application, does not provide the level of specificity and

detail necessary to fully evaluate the merit and value of the overall approach.

Because many of the questions and concerns raised herein pertain to grid modernization more broadly, it is difficult to properly explore these interrelated areas of inquiry within the confines of a discrete G.O. 7[3] application. Indeed, many of the topics that require thoughtful consideration could arguably be characterized as beyond the scope of the instant proceeding.

Rather than waste commission and stakeholder resources evaluating the instant Application without the benefit of a rigorous and stakeholder-informed Grid Modernization Strategy, the commission prefers to create the space and time necessary to explore the full spectrum of innovative approaches to grid modernization as it relates to Hawaii's unique characteristics. The commission therefore dismisses the Application without prejudice and, as explained in greater detail below, concludes there is a need for the development of a well-vetted, overarching strategy for grid modernization that is informed by stakeholder input.

The commission hopes that this process will provide a forum to convene industry experts and representatives to deliver

[3]General Order No. 7, Standards for Electric Utility Service in the State of Hawaii ("G.O. 7").

presentations and facilitate dialogue on a variety of grid modernization topics that would appear to be most critical in Hawaii. The commission intends for the dialogue generated by this process to help inform the Companies as they develop detailed, grid modernization strategies for each island system.

The overall goal is to deploy modern grid investments pursuant to an appropriate priority and sequence, and at an optimal pace to ensure that these critical strategic investments:

- cost-effectively maximize flexibility;
- minimize the risk of redundancy and obsolescence;
- deliver customer benefits; and
- enable greater DER and renewable energy integration.

Executed effectively, grid modernization will contribute to the HECO Companies' transformation to meet changing customer preferences and serve an evolving energy market as well as enable the achievement of other energy policy goals. The commission is providing the guidance herein to assist the HECO Companies in defining a Grid Modernization Strategy that achieves these objectives.

The Companies, informed by stakeholder input, must consider and address the following:

1. Definition and guiding principles. The Companies must consider and provide a specific preliminary definition and guiding principles to inform grid modernization in Hawaii.

2. Current status of the electric grids. The Companies and stakeholders need to assess and better understand the present status of each island's electric grid to better inform which steps must be taken to achieve the State's energy goals.

3. Grid architecture and interoperability. There is a need to assess a Hawaii-specific grid architecture that can actively shape the evolution of the islands' electric grids rather than to passively allow grid evolution in a bottom-up manner. In addition, open standards and interoperability must be viewed as foundational components of the integrated grid.

4. Grid-facing technologies. The Companies must solicit and facilitate discussion regarding the capabilities of a modern distribution network, the status of technologies required to enable these capabilities, the regulatory changes that may be necessary to facilitate the development of a modern distribution network, and the steps that the Companies should take to integrate relevant technologies in a cost-effective manner.

5. Customer-facing technologies. The Companies, in conjunction with stakeholders, must assess how customer-facing technologies, practices, and strategies can be used to (a) enable customers to manage their electric usage more efficiently and enable maximum customer cost savings; (b) enable customers to harness their electric loads as a responsive resource to meet grid service needs; and (c) further integrate resources such as DER, including energy storage devices and electric vehicles.

6. Pace of implementation. The Companies must address the sequence and pace of grid modernization infrastructure investments, including both grid-facing and customer-facing technologies.

7. Costs and benefits. The Companies and stakeholders should examine what might constitute an appropriate framework to evaluate the cost-effectiveness of grid modernization technologies and practices, including an evaluation of hard-to-quantify impacts such as improved reliability, increased customer choice, and reduced environmental impacts.

8. Flexibility and resilience. The Companies should consider how grid modernization investments can be designed and implemented to cost-effectively meet the dual goals of enhancing grid flexibility and resilience.

9. Health, cybersecurity, data access and privacy. The Companies must proactively address the myriad issues related to health, cybersecurity, data access and privacy.

By our action today, requiring the HECO Companies to submit a detailed, scenario-based Grid Modernization Strategy, the commission reaffirms its commitment to grid modernization and to the resolution of this important component of the State's energy future in a timely fashion.

II.

BACKGROUND AND CONTEXT

The electric power system is transforming from one composed predominately of large, central power plants feeding power to customers, to a dynamic system composed of variable energy resources and, increasingly, two-way power flows. To date, this transformation has been driven by forces such as rapid technological innovation, expanding customer interests and demands, and energy and environmental public policies.

Technology-driven changes will continue to impact the electric industry in Hawaii. Accordingly, the commission believes it is imperative to proactively engage and address these challenges, in conjunction with stakeholders and the electric utilities, to help shape the transformation to ensure that benefits are maximized, risks minimized, and the State's energy goals are

achieved in a cost-effective manner - all while upholding the commission's core tenets of ensuring all regulated entities operate at a high level of performance so as to serve the public fairly, efficiently, safely, and reliably.

As described in this Order, the electric grid must become the enabling platform for Hawaii's energy future. The grid must ensure resilience, mitigate vulnerabilities, incorporate innovation, and continue to provide affordable, safe, and reliable power to meet the needs of customers. To reach these objectives will require more than just sound technical solutions. It will require new business models, new regulatory approaches, new responsibilities and obligations for grid operators, more fully engaged customers, and the emergence of new providers that will facilitate increasingly innovative solutions.

To determine the vision of the future grid, the physical infrastructure for electricity delivery, it is necessary to look at the grid in the context of the entire value chain of the electric system, which includes the traditional grid infrastructure at the transmission and distribution-level, as well as generation, storage, and end uses (loads). Looking at the grid in the context of the entire value chain allows an understanding of the evolving role of the grid as an enabling platform, as well as the evolving role of grid operators. As the enabling platform, the grid must be able to reliably integrate all generation sources and

effectively interface with third-party entities that will provide services to the larger electric system. Looking through this lens helps to illuminate necessary changes in the utility business models and the evolving regulatory framework.

Determining the optimal architecture and vision for Hawaii's future electric grid is not a static exercise. It will require the engagement and collaboration of stakeholders, the HECO Companies, and the commission. The commission initiated this conversation through its Inclinations on the Future of Hawaii's Electric Utilities (the commission's "Inclinations"), issued on April 28, 2014,[4] wherein it articulated the commission's perspectives on the vision, business strategies and regulatory policy changes required to align the electric utility's business model with customers' interests and the State's public policy goals. By this Order, the commission encourages the HECO Companies to continue this dialogue with the stakeholders to advance the development of Hawaii's integrated grid of the future, particularly as it pertains to grid modernization and the deployment of so called "smart grid" technologies.

In order to adequately frame the discussion in this Order and to provide context for the guidance contained herein, it is

[4]In re Public Util. Comm'n, Docket No. 2012-0036, Decision and Order No. 32052, filed April 28, 2014, Exhibit A, at 1.

prudent to: (a) examine prior commission guidance pertaining to the proper alignment of the utility business model with customer interests and public policy goals; and, (b) review, at a high-level, the current state of Hawaii's electric grids, as well as to acknowledge open dockets that are addressing various interrelated challenges and opportunities currently facing the power systems in Hawaii.

A.

Commission's Inclinations on the Future of Hawaii's Electric Utilities

Given the rapidly evolving nature of the electric utility business, the commission has previously expressed concern that the HECO Companies have yet to articulate a sustainable business model that is aligned with customers' interests and the State's public policy goals.[5] Accordingly, in the exercise of its duty to act in the public interest, through the Inclinations the commission felt compelled to offer perspectives on the requisite strategic vision, business strategies, and regulatory policy changes to define and develop the "electric utility of the future" in Hawaii.[6]

[5]See, e.g., In re Maui Elec. Co., Ltd., Docket No. 2011-0092, Order No. 31288, filed May 31, 2013, Exhibit C, at 3; Commission's Inclinations at 1.

[6]Commission's Inclinations at 1.

The commission stated its view that the objectives of lower, more stable electric bills and expanding energy options, while maintaining reliable energy service in a rapidly changing system operating environment, are essential principles that form the foundation for the future strategic business direction of the HECO Companies.[7] To that end, the commission provided guidance for future business strategy, energy resource planning and project review across three areas: (1) creating a 21st century generation system; (2) creating modern transmission and distribution grids; and (3) addressing the policy and regulatory reforms to achieve Hawaii's clean energy future.[8]

1.

Creating a 21st Century Generation System

The commission noted that, in order to further stabilize and lower the costs of generation, the HECO Companies should expeditiously:

- Seek high penetrations of lower-cost, new utility-scale renewable resources;
- Modernize the generation system to achieve a future with high penetrations of renewable resources; and

[7]Commission's Inclinations at 3.

[8]Commission's Inclinations at 3.

- Exhaust all opportunities to lower fuel costs in existing power plants.[9]

Of particular relevance to the instant proceeding, the commission specified guidelines to govern necessary investments in grid flexibility. With the growth of distributed and utility-scale renewable resources, the commission noted that integration studies and planning efforts demonstrated that integrating high levels of renewable resources will require grids that can accommodate the new demand patterns and the variability of renewable resources.[10] These studies also indicate that Hawaii's grids will require new tools to achieve higher penetrations of renewable resources and to maintain grid stability. For these reasons, the commission expressed its support for cost-effective investments to upgrade the generation system to enable integration of renewables, "so long as such efforts utilize new tools, such as energy storage, demand response, and other load management techniques, on an equivalent basis to traditional generation assets, which is consistent with a vision of an 'Integrated Grid' of the future articulated by some industry analysts."[11] Consistent with this guideline, the commission

[9]Commission's Inclinations at 4.

[10]Commission's Inclinations at 6.

[11]Commission's Inclinations at 6 (emphasis added).

required each of the HECO Companies to file "Power Supply Improvement Plans" ("PSIPs") to identify strategies, action plans, and schedules to expeditiously achieve the guidance outlined in Section 1 of the Commission's Inclinations.[12]

2.

Creating Modern Transmission & Distribution Grids

Although all three sections of the commission's Inclinations are interrelated and must be viewed in concert, "Section 2: Creating Modern Transmission & Distribution Grids," contains guidance that most squarely addresses issues related to grid modernization.

Noting the influx of DER on the network, the commission expressed its belief that "Hawaii should be poised to lead the world in the development of advanced grids that can interlink a bulk power system that has a high level of renewable generation with the profusion of DER."[13] To that end, the HECO Companies should pursue appropriate and mutually beneficial investments in the transmission-and-distribution grids to anticipate and enable the energy choices that customers will demand and integrate

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[12]See In re Public Util. Comm'n, Docket No. 2014-0192, Order No. 32257, filed August 7, 2014.

[13]See Commission's Inclinations at 11.

customer-sited resources into the broader electric system in an effort to provide benefits to all system users."[14]

The commission has also recognized a growing role for non-utility energy service providers that can inter-mediate the relationship between the utility and customer by aggregating distributed, customer-sited assets into controllable energy resources with technical characteristics that are similar to conventional generation resources, an arrangement sometimes described as "virtual power plants." Hawaii's utilities should be actively pursuing the incorporation of virtual power plants and integrated energy districts (i.e., microgrids) into power system design and operation.

The commission outlined several principles to guide the creation of a modern, integrated transmission system in Hawaii, including:

- New transmission projects must consider non-transmission alternatives;
- New utility-scale combustion-technology generation projects should be located at existing utility or IPP generating plant sites;
- Location of large-scale renewable energy projects must be balanced against the cost of necessary transmission system upgrades to deliver remote power supplies to major load centers;
- Development of integrated energy districts, or microgrids, should be evaluated as potential

[14] See Commission's Inclinations at 11.

non-transmission alternatives to expansion of the transmission system.

With respect to the development of a state-of-the-art distribution system to enable utilization of clean energy, the commission stated its belief that the HECO Companies will need to move promptly with plans to upgrade the utilities' distribution systems to enable new clean energy technologies and improve customer service. New demands on the distribution system require investments in advanced distribution system technologies, which is currently an area of significant innovation within the electric utility industry.

The commission provided the following broad guidance to govern the future development of the Companies' distribution plans: (a) adopt advanced distribution system technologies and develop a plan to cost-effectively integrate renewables and improve customer service; (b) develop a customer-focused advanced metering infrastructure program ("AMI"); (c) harness DER to benefit the system and customers; and (d) develop and maintain cybersecurity requirements for new distribution system technologies.

a.

Advanced Distribution System Technologies and Planning

An advanced distribution system is necessary to enable the continued integration of DER, including support for other new customer energy options such as electric vehicles ("EV"), and to improve customer service through enhanced energy outage detection and timely restoration. These investments should allow a transition from the prior design of a uni-directional distribution network into one where distribution circuits and substations are capable of bi-directional power flows. The commission has stated that the future distribution system must have the capability to act both as a delivery service and an aggregator of customer-sited DER to benefit both the customer and the grid.

b.

Customer-Focused Advanced Metering Infrastructure Program

The commission has indicated that advanced metering technologies may well serve as a valuable component of an advanced distribution system; however, the HECO Companies must provide strong supporting evidence and justification that this major investment will improve customer service and system efficiencies from the outset and complement broader efforts to upgrade the distribution systems. To that end, the commission offered the

following to guide the development and implementation of smart grid and advanced metering infrastructure programs:

- Focus on delivering immediate value and benefits to customers with installation of smart grid infrastructure. Examples would include offering web portals for customers to access and view energy consumption data; improving outage response and power quality; and supporting rapid adoption of innovative rate structures.

- Enable customer-sited DER, including broader use of demand response technologies, electric vehicle charging networks, distributed generation, and energy storage systems.

- Work with third-party service providers, such as Hawaii Energy, to maximize benefits to customers as the Companies expand smart grid programs in all service territories.

- Develop data privacy policies prior to widespread rollout of smart grid infrastructure and ensure continual reassessment and updating of such policies.

c.

Harness DER to Benefit System and Customers

As a result of the exponential growth Hawaii has experienced in rooftop photovoltaic ("PV") systems, coupled with continued innovation in other DER, such as EVs and distributed energy storage, the HECO Companies will need to proactively plan for future additions of DER. The rapid adoption of these technologies will require the utilities to design programs and develop distribution system infrastructure to optimize the system and maximize customer benefits. Accordingly, the commission

issued guidance directing the HECO Companies to address the following:

- The utilization of grid support functionality embedded in advanced inverters, customer-sited energy storage, and energy management systems to provide ancillary services;

- Enabling two-way communications with customer-sited DER to enable real-time monitoring and active utility management;

- The utilization of technical capabilities of advanced inverters, energy management control systems, and customer energy storage systems to develop a non-export option for distribution generators, and the development of appropriate tariff provisions to accommodate this choice; and

- The utilization of distributed energy storage sited on utility distribution infrastructure or behind the meter to mitigate the impacts of high penetration solar PV systems.

d.

Cybersecurity Requirements for New Distribution System Technologies

With the addition of new information technology and two-way communications systems into utility distribution networks and operations, the commission noted that the HECO Companies will need to develop and maintain cybersecurity requirements that protect customer's privacy and the electric system's security. These requirements are not static, and will need to evolve with ongoing changes in technology and customer needs and will be

reviewed by the commission to meet acceptable standards and practices.

3.

Policy and Regulatory Reforms to Achieve Hawaii's Clean Energy Future

The utility's traditional role in power supply is changing with high penetrations of renewable energy resources, the retirement of existing fossil generators and the need to incorporate new, smaller, more flexible, and efficient generators. The utility's role in energy delivery is also evolving to effectively become that of a network systems integrator and operator. With more DER options, as discussed above, a customer's role has the potential to evolve to effectively become a "prosumer" of energy and grid services, that is one who both consumes and provides power supply and grid support services.

As a consequence of these changes, the commission noted that Hawaii's electric utilities will increasingly be required to:

- Integrate large quantities of utility-scale, primarily variable, renewable energy resources onto the transmission system;

- Add increasing amounts of customer-sited distributed generation onto the distribution system;

- Systematically retire old, inefficient fossil generators, acquire new flexible generation resources and utilize technologies such as energy

storage and demand response to reduce costly must-run generation;

- Incorporate and dispatch an expanding portfolio of utility-scale and distributed renewable resources in conjunction with a declining fossil power supply portfolio to maximize renewable energy and minimize energy and ancillary service costs;

- Procure and manage a diverse commercial portfolio of fossil fuel supply contracts and renewable energy power purchase agreements to increase cost-effective renewable energy utilization, lower total energy costs and minimize and mitigate energy commodity price volatility;

- Integrate demand response ("DR") technologies and dynamic pricing rate structures to manage and shift customer loads on a real-time basis to better accommodate as-available renewable energy supplies;

- Utilize smart meter, communication network and data management technologies to empower customers to better manage their energy usage and access other energy management options; and

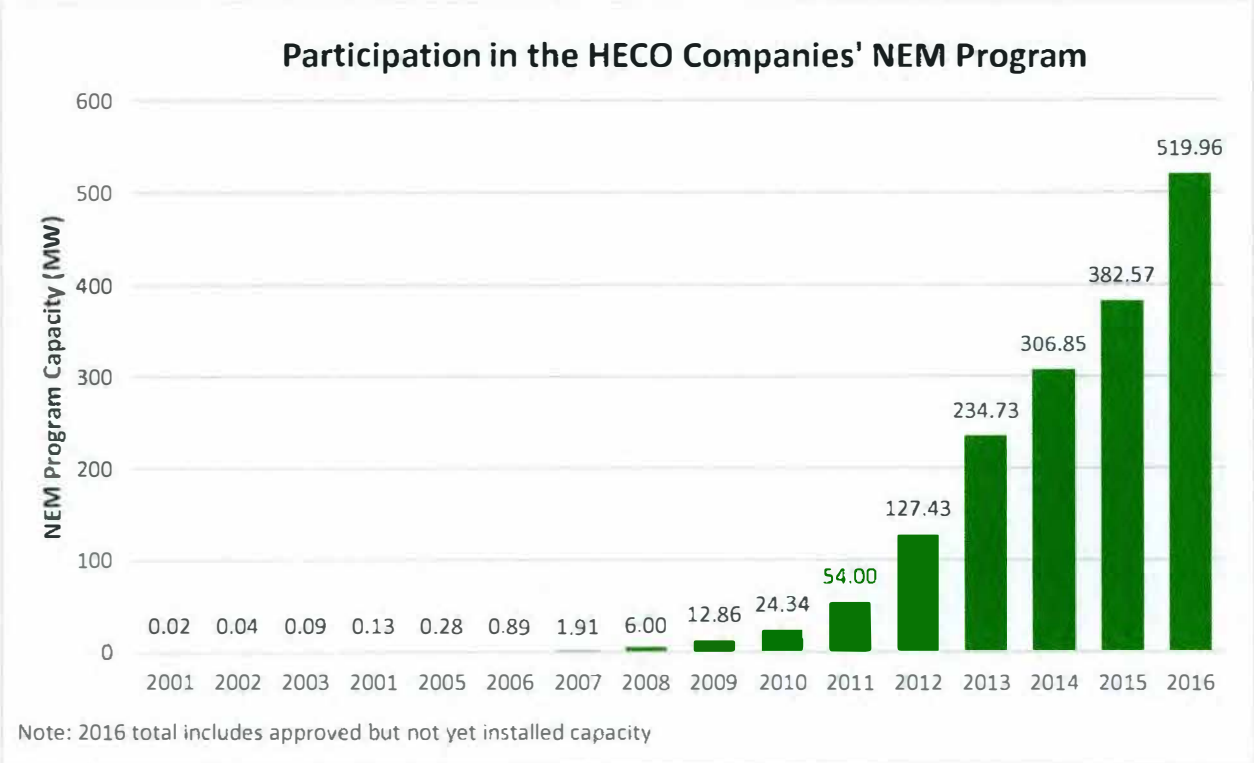
- Employ diverse smart grid technologies including energy storage, smart inverters, electric vehicles and smart grid control devices into a seamless, integrated operating system.

The aforementioned strategic initiatives must be assimilated in a cohesive, integrated manner to address rapidly changing customer, technical, and economic requirements. As a result, the commission stated that Hawaii's electric utilities will need to transform their business models accordingly, particularly in the power generation and energy delivery functions.

B.

Examining the Current State of the Grid

The factors driving the transformation of Hawaii's electric power system have only amplified in the years since the commission provided its Inclinations. Due to Hawaii's high electric rates, declining technology costs, innovative financing products, and State tax policy, distributed solar PV systems have grown substantially in the HECO Companies' service territories. The figure below demonstrates the exponential growth in distributed PV solar installations.



Source: HECO Net Energy Metering Reports 2001-2015, HECO Weekly Queue Report as of December 13, 2016

This growth has placed Hawaii in a position of national prominence with respect to the amount of installed solar PV per capita. Over 77,000 of the Companies' customers, roughly 17 percent, have rooftop solar PV systems installed or approved. By necessity, Hawaii is at the forefront of integration challenges associated with these high penetration levels.

In response to this rapid transformation already under way, the commission has initiated various investigatory proceedings to address many of these issues, as well as their interrelationships with one another.

On April 28, 2014, the commission issued four Orders[15] that collectively provided broad guidance with respect to electric utility planning and operations, including instructions to the HECO Companies to develop and file PSIPs. In Docket No. 2014-0183, the commission initiated a proceeding to consolidate review of the

[15]See In re Public Util. Comm'n, Docket No. 2012-0036, Decision and Order No. 32052, filed April 28, 2014 ("Order No. 32052"); In re Public Util. Comm'n, Docket No. 2011-0206, Decision and Order No. 32053, filed on April 28, 2014 ("Order No. 32053"); In re Public Util. Comm'n, Docket No. 2007-0341, Order No. 32054, "Policy Statement and Order Regarding Demand Response Programs," filed on April 28, 2014 ("Order No. 32054"); and In re Public Util. Comm'n, Docket No. 2011-0092, Decision and Order No. 32055, filed on April 28, 2014 ("Order No. 32055").

PSIPs filed for each of the HECO Companies."[16] As the commission stated in Order No. 33320:

> The ultimate purpose of this proceeding is to determine a reasonable power supply plan for each of the HECO Companies that can serve as a strategic basis and provide context to inform important pending and future resource acquisition and system operation decisions."[17]

The commission further stated that the development of acceptable PSIPs is "essential to the HECO Companies fulfilling their role to provide a platform to meet the diverse service requirements of their customers by integrating a variety of generation sources and customer-sited resources in an economically and operationally efficient manner."[18] The commission reiterates that the purpose of the PSIPs is to provide context and analytical support for major pending and future resource acquisition and system operation decisions. The PSIPs should contain well-vetted, comprehensive system analysis that provides the necessary context for decision-making."[19]

In Docket No. 2014-0192, the commission initiated an investigation to examine the technical, economic, and policy

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[16]Order No. 32257 at 1.

[17]Order No. 33320 at 2.

[18]Order No. 33320 at 137.

[19]See Order No. 33320 at 40-41.

issues associated with DER as they pertain to the electric operations of the HECO Companies and KIUC.[20] Phase 1 of this proceeding led to the development of interim options for customers to invest in new forms of DER, including the grid-supply, self-supply, and time-of-use options, after the closure of the Net Energy Metering ("NEM") Program. Phase 2 of this proceeding will continue a stakeholder process to develop a longer-term, competitive market structure for maximizing the benefits of DER in Hawaii.[21]

Pursuant to Act 100, codified as HRS § 269-27.4, the Legislature concluded that all Hawaii residents should be able to participate in and enjoy the economic, environmental, and societal benefits of renewable energy. Accordingly, the Legislature enacted a community-based renewable energy ("CBRE") statute to make renewables and DER more accessible to a greater number of customers.[22] In Docket No. 2015-0389, the commission, in conjunction with the Companies and stakeholders, continues to expeditiously develop a CBRE program

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[20]In re Pub. Util. Comm'n, Docket No. 2014-0192, "Instituting a Proceeding to Investigate Distributed Energy Resource Policies," Order No. 32269, filed August 21, 2014.

[21]See In re Pub. Util. Comm'n, Docket No. 2014-0192, Order No. 34206, filed December 9, 2016.

[22]See HRSe§ 269-27.4.

framework that ensures flexibility and allows for market innovation, while also maintaining critical consumer protections.

In its DR Policy Statement, Order No. 32054, the commission addressed the HECO Companies' DR programs and set forth "policy guidelines for the continued operation and expansion of demand response programs, and order[ed] the HECO Companies to respond to a number of commission directives in furtherance of these guidelines."[23] Among other things, in the DR Policy Statement, the commission directed the HECO Companies to "undertake, immediately and expeditiously, an overhaul of their existing DR programs by (1) consolidating those programs into a single integrated DR portfolio; (2) establishing appropriate overall objectives and goals for the integrated portfolio, as well as each individual program within the portfolio; and (3) developing and utilizing appropriate standards to measure the performance of, and the overall benefits achieved by, the integrated portfolio and each individual program within the portfolio."[24]

In Docket No. 2015-0412, the HECO Companies filed their Application for approval of the DR program portfolio tariff

[23]Order No. 32054 at 1.

[24]Order No. 32054 at 84.

structure, reporting schedule, and program cost recovery through the demand-side management surcharge."[25] With respect to the DR program structure, the Companies have proposed to acquire several distinct grid services,[26] including capacity, fast frequency response, regulating reserve, and replacement reserve through various Grid Service Tariffs, riders, and contracts with third-party aggregators.[27] The Companies are currently in the process of revising this Application and expect to begin enrolling customers in DR programs in mid-2017.

The functional interrelationship of all of these various programs and elements is only possible with a modern, responsive, and plug-and-play grid.

C.

The Integrated, Plug-and-Play Grid

As previously mentioned, the proliferation of DER has already had a significant impact on the operation of the electric power grid and, through a combination of technological improvements, policy incentives, and consumer choices in

[25] See Application at 1-2.

[26] See In re Public Utilities Commission, Docket No. 2007-0341, "IDRPP Supplement: System Response Requirements," filed November 6, 2015.

[27] See Application at 41.

technology and service, the role of DER on the electric grid is likely to continue to grow. The successful integration of increasing amounts of DER depends on modernizing the existing electric power grid. That grid, especially its distribution systems, was not designed to accommodate high penetration of DER while sustaining high levels of electric service quality and reliability. The technical characteristics of certain types of DER, such as variability and intermittency, and the flexibility to act as both generation and load, are quite different from central power stations. In order to realize the full value of DER and to serve all customers safely, reliably, and at just and reasonable rates, the need has arisen to integrate DER in the planning and operation of the grid and to expand its scope to include DER operation, an approach many refer to as the "integrated grid."

To facilitate this transformation, the power grid must become a "plug-and-play" platform that integrates an ever-growing set of DER technologies.[28] By connecting to this platform, DER owners will have access to a grid that supports their needs as customers and, through the integrated grid, provides access to DER markets that increase the value of their investment.

[28]Tony Brunelo et al., "Building the Plug & Play Grid," More Than Smart, March 2016, available at http://morethansmart.org/wp-content/uploads/2016/03/BrunelloDeMartini_Building-the-PlugPlay-Grid_March-2016.pdf

Achieving this potential for all customers requires a thoughtful approach that:

- Modernizes and reinforces the grid and its operations to improve reliability and integrate DER and renewables;
- Connects DERs to markets that provide new value opportunities; and
- Transitions to customer rate designs and DER programs that better reflect the benefits and costs of distributed resources.

Modernizing and reinforcing the grid will be critical for customers seeking to adopt DER and connect to the grid quickly, and with minimal hassle. Utilities must anticipate future DER growth and reinforce local grids to accommodate these new resources. As already experienced in Hawaii, once connected, concentrations of distributed resources can quickly complicate grid operations. Grid operators need advanced sensors, communications, and automation so they can see what is happening in real time, safely and efficiently meet customer needs, minimize disruptions, and maintain reliability. To meet these challengese utilities will need to expand their capabilities to plan and manage a modernized plug-and-play grid, ensuring that all customers receive safe and reliable energy, while seamlessly integrating rapid growth in distributed resources.

Connecting DER to markets and opportunities to create additional value can encourage innovation and creative solutions that expand customer choice and benefit the grid. Efforts are

already underway in Docket No. 2015-0412 to value and unbundle requisite ancillary services with the intent to allow customer-sited resources to meet these grid service needs."[29] This unbundling of essential grid services will provide new value creation opportunities for DER and help leverage these customer sited resources to cost-effectively enhance grid reliability and resiliency.

Finally, to maintain affordability, and in some instances reduce the cost of energy services for all customers, rate designs and programs must evolve along with this overall grid transformation. The transition in program and rate design for customers who deploy DER has already begun in Docket No. 2014-0192, and will continue during Phase 2 of that proceeding.

These substantial changes to modernize the grid and create new markets will certainly take time. But approached with the requisite sense of urgency, thoughtfulness, and diligence, the foundation developing now will be established by the turn of the decade: with functioning markets for DER, a modernized grid, increasingly informed and engaged customers, and significant

[29] See In re Hawaiian Elec. Co., Inc., Hawaii Elec. Light Co., Inc., Maui Elec. Co., Ltd., Docket No. 2015-0412, "Application of Hawaiian Electric Company, Inc., Hawaii Electric Light Company, Inc. and Maui Electric Company, Limited; Verification; Exhibits 'A'-'I'; and Certificate of Service," filed December 30, 2015, at 37-44.

progress on the State'œs path to achieving a 100 percent RPS. Underpinning this, utilities will evolve to become facilitators of customer choice and the clean energy economy by unlocking the benefits of DER while enhancing the reliability critical for everyone.

With this vision of the integrated grid of the future as a backdrop, the commission has examined the HECO Companies' Application for their SGF Project.

III.

SMART GRID FOUNDATION PROJECT APPLICATION

In their Application, the Companies seek commission approval to commit an estimated $340 million for their SGF Project.[30] According to the Companies, the Project would transform their electric power system by establishing "a more dynamic and secure power grid that gives customers more control, greater flexibility and more choices, responds to outages more quickly, seamlessly connects with cleaner energy resources, and better secures the grid from attacks . . . ."[31] The Project consists of the following eight (8) subprojects:

[30]Application at 12.

[31]Application at 1-2.

- Installation of AMI to provide two-way communications and control between the Companies and the installed smart meters;

- Creation of a Customer Facing Solution ("CFS") that uses information from smart meters, provided through online and mobile pathways, to give customers more information and control over how they use their energy;

- Implementation of Conservation Voltage Reduction ("CVR") technologies to improve voltage efficiencies and burn less fuel to generate energy to meet demand;

- A Direct Load Control ("DLC") subproject to upgrade existing DLC switches on Oahu to improve monitoring and control of participating customers' water heater operations and stabilize the power grid during peak demand;

- Development of an Enterprise Data Warehouse ("EDW") to serve as the central repository of the large amounts of data gathered over the AMI network and other Company data;

- Enhancement of the Companies' existing Enterprise Service Bus ("ESB") to enable seamless flow of data through the Companies' various computer systems;

- Implementation of a Meter Data Management System ("MDMS") to capture and manage the customer interval energy usage data obtained from the smart meters to enable automated billing and operational efficiencies; and

- Expansion of HECO's Outage Management System ("OMS") on Oahu to MECO and HELCO in order to improve outage communications, and increase the speed and efficiency of power restoration.[32]

[32]Application at 4-5.

The Companies introduced two additional proposals that relate to each of the aforementioned eight SGF subprojects: one for Customer Engagement ("CE") activities to help customers maximize the benefits of the new smart grid technologies and support the eight subprojects listed above, and a second for a Project Management Office ("PMO") that will support the eight SGF subprojects, as well as the CE activities, in order to ensure smooth, cost-effective and coordinated project execution."[33]

A.

Issues and Concerns

1.

Cost Justification

At the outset, the commission underscores the fact that the SGF Project's cost is substantial. The SGF Project is scheduled to be implemented over a five-year period at an initial cost of $340 million. Once placed in service, the Companies estimate that an additional $345 million of ongoing costs would need to be incurred over the anticipated twenty-year asset life to support and maintain the investment. Another $51 million of post-in-service costs will be incurred in connection with the accelerated depreciation of the Companies' existing non-smart

[33]Application at 5.

meters. Accordingly, the Companies' economic analysis assumes a twenty-year economic cost of $736 million in nominal dollars."[34]

In addition, the commission notes that since the Companies last proposed to install AMI in Docket No. 2008-0303,"[35] the projected costs have increased substantially from $110 million to $340 million. This is particularly troubling where, as here, the HECO Companies' own analysis, which yields a benefit-cost ratio of 0.84, does not appear to justify the extraordinary costs in terms of benefits that customers will see over a twenty-year time horizon.

By the Companies' own calculations, the SGF Project is not cost-effective, but may be justified by future applications that will not be in place for some time. Accordingly, if the selected system does not scale and adapt well to future requirements, the anticipated benefits may not be realized without additional, possibly significant, future investments. This concern is only amplified given the issues of technology risk and DER integration, further described below.

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[34]See Application at 43.

[35]In this proceeding, the estimated cost of the project at the time of the application was approximately $110 million. Subsequently, the cost was later revised in the proceeding to $115 million. See, e.g., Response to CA-IR-35 in Docket No. 2008-0303.

The commission has additional concerns with respect to the Companies' procurement approach for a capital expenditure of this magnitude. As indicated in Exhibit E of the Application, the Companies propose to sole-source the AMI and communication infrastructure (the fundamental component of the SGF Project, which is also the largest portion of the overall cost), based in part on the Companies' selection of technology provided by a "leading implementer of [AMI]."[36] Notwithstanding the Companies' assertion, this approach provides limited bases on which to evaluate the SGF Project's cost and challenges the Companies' efforts to demonstrate that the overall grid modernization investment is reasonable, prudent, and in the public interest.

Finally, in reviewing the overall costs and rate impact of the SGF Project, the commission is concerned that the Companies' proposal appears to incur extensive, near-term capital spending with only limited projected customer bill savings that would occur later in the planning period and would be subject to several uncertainties. The commission observes that front loaded capital expenditures may present inherent risks for a utility with structurally declining sales and customer rates high enough to potentially drive significant load defection. From the commission's preliminary review, it would be prudent to examine

[36]Application, Exhibit E, at 4.

alternative strategies that can deliver more certain and timely benefits to customers.

2.

DER Integration

Despite the primacy of the DER issue, the SGF Project does not appear to directly address DER integration. The proposed SGF Project scope largely points to speculative indirect future benefits resulting from increased data visibility to improve hosting capacity models for DER.[37]

It is difficult to evaluate such a major grid modernization investment when, as here, the project asserts only an indirect link to addressing the primary issue currently facing the distribution grids. The Application does not appear to justify whether the scope and design of the SGF Project is appropriate for addressing the urgent distribution system needs facing the HECO Companies. It is not clear how the Companies have prioritized various components of the SGF Project, given their disparate impact or contribution in terms of enabling additional DER to be integrated into each island system.

[37]Application at 8.

3.

Technology Risk

The commission's concerns pertaining to the Companies' procurement approach and the SGF Project's substantial cost are only compounded by the risk that the proposed technology could become obsolete over the life of the SGF Project.

The SGF Project's approach is to essentially implement an AMI system with several additional technology applications layered on top of this architecture. Such an approach is largely similar to AMI or so called "smart grid" programs at numerous mainland utilities, as well as a project recently completed by Kauai Island Utility Cooperative ("KIUC").[38] That said, many years have passed since the first wave of AMI deployment occurred on the mainland and since KIUC began its AMI deployment in 2011. In the interim, DER on the HECO Companies' distribution systems has grown substantially, such that now some 17 percent of the Companies' customers have installed DER. This exponential growth has created unique challenges and opportunities for the HECO Companies.

As a result of these developments, there would appear to be a substantial opportunity for the Companies to leverage customer-sited resources and potentially "leapfrog" certain grid

[38]See In re Kauai Island Utility Coop., Docket No. 2010-0299, Decision and Order, filed September 29, 2011.

modernization investments deployed by electric utilities in jurisdictions with low DER penetration. Third-party providers could be utilized to perform many grid modernization functions; indeed, these entities are already measuring energy use, generation, and power quality for large numbers of the HECO Companies' customers. Leveraging this existing, third-party infrastructure may well provide a lower cost and lower risk alternative for some components of grid modernization, particularly in the early years of the overall grid modernization initiative.

It has been observed that some of the forces driving the transformation of Hawaii's electric grids include: (1) an evolution in customer behavior and expectations; (2) increasing reliance on renewable, intermittent resources and a shift to more decentralized energy resources; and (3) technological advancement leading to alternative methods and designs for providing and integrating services to the grid that are provided by customers' responsive resources, including demand management, onsite generation and energy storage."[39] These forces will likely only be amplified over the twenty-year time horizon of

[39]See "DR 2.0, A Future of Customer Response," Paul De Martini, Newport Consulting, prepared for the Association for Demand Response and Smart Grid, July 2013, at 7.

the proposed SGF Project and customer adoption of DER will continue to proliferate.

Accordingly, the Companies should be exploring ways to leverage existing infrastructure and strategically and holistically integrate this growing portfolio of DER in order to lower risk to customers while increasing flexibility in grid modernization investment and deployment. The instant Application does not make it clear how the Companies intend to integrate and leverage customer-sited assets over the short, medium, and long term.

The commission observes that other jurisdictions have begun to examine AMI proposals and are considering the appropriate roll out strategy, and whether third-party meters or advanced inverters with metering systems could provide appropriate functionalities.[40] Indeed, details have been sought on functionality, benefits provided, required deployment levels, and whether the data and related benefits expected from advanced meters could be (or should be) provided by third-parties' technologies.

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[40]See, e.g., NYPSC, Staff Proposal, Distributed System Implementation Plan Guidance, at 23.

In this regard, the commission applauds the HECO Companies' work related to the SEAMS for SHINES project[41] and questions whether such an innovative, holistic approach to DER integration can become a central part of the Companies' Grid Modernization Strategy moving forward.

Interrelated to the issue pertaining to technology risk noted above, the commission is concerned about the technology roll out of the SGF Project and believes there is a need to meaningfully explore alternative approaches that could simplify implementation and permit more flexibility. For instance, metering replacement could be driven more by demand to participate in certain customer programs rather than by a mandatory roll out to all customers on an opt-out basis.

[41]In collaboration with the U.S. Department of Energy ("DOE"), this project is exploring a new solution called SEAMS (System to Edge-of-Network Architecture and Management for SHINES, i.e. PV and energy storage) to better integrate and manage the impact PV and storage systems will have on the grid. Using the SEAMS approach, an interdisciplinary team is designing and demonstrating new energy management system logics to "see and interface" with distribution-system level, customer-hosted electricity resources. The team is developing and deploying integrated technologies with edge-of-network data, communication, and forecasting support to demonstrate SEAMS intelligence to "practically" manage distribution level issues introduced by high penetration PV and solar variability. The team is also evaluating the cost effectiveness of distributed assets and integrated SEAMS capabilities to support reliable grid transformation needs.

In sum, the commission has serious concerns that the Application does not adequately address the risks of redundancy due to DER growth or obsolescence as a result of technological advancement. The commission is also concerned about the timing and sequencing of the substantial investments proposed in the Application, and whether or when corresponding benefits to customers will be realized. These concerns are only heightened given that the majority of customer benefits are only projected to manifest in the latter half of the twenty-year time horizon.[42]

B.

Conclusion

The commission continues to emphasize the importance of grid modernization to enable greater penetration of renewables and customer-sited DER, expand energy options for customers to manage their energy usage, and automate system control and operation. Grid modernization represents a set of critical strategic investments for the Companies to position themselves for future opportunities and to address grid challenges. As such, investments in modernizing Hawaii's electric grids will require thoughtful and deliberate deployments of capital over the next

[42]See Application at 44 (monthly economic impact on a typical residential customer not projected to transition into net savings until 2029).

decade or more. Such investments must be strategically calibrated and prioritized to meet clearly defined goals in order to achieve the vision for Hawaii's integrated grid of the future. Each project or series of projects must methodically and cost-effectively advance this ultimate objective. Strategic missteps today could have substantial ramifications for decades in lost opportunities, technological lock-in, or result in significant stranded assets.

The commission is concerned that the Companies' strategic vision outlined in its Smart Grid Strategy and Roadmap lacks the level of detail necessary for the commission to effectively evaluate the SGF Project. This is particularly troubling where, as here, the SGF Project is intended "to implement the initial Smart Grid capabilities that will serve as the platform to support not only immediate customer benefits, but also as the cornerstone for additional projects."[43] Given the magnitude of the investment, and what is at stake, the commission believes it is essential for the Companies to articulate and submit a well-vetted and detailed strategy that addresses grid modernization in a comprehensive and holistic manner. The Companies' Grid Modernization Strategy must be informed by input from the community

[43]Application at 2.

and stakeholders who are to utilize, and be served by, the platform that is a modern grid.

The commission recognizes the urgency with which the Companies must move to modernize the islands' electric grids in order to expeditiously meet the State's energy goals. That said, given the concerns articulated above, as well as the lack of stakeholder input and the lack of a well-vetted, overarching strategy for grid modernization, the commission concludes that there is a strong likelihood that expending commission and party resources toward the evaluation of the instant Application would prove injudicious. The commission therefore dismisses the Application without prejudice.

As explained in greater detail in the section that follows, the commission directs the Companies to submit a comprehensive Grid Modernization Strategy for each of the electric utilities. The expectation is that a rigorous and detailed Grid Modernization Strategy will provide the comprehensive and holistic approach and context to inform the commission's review of discrete grid modernization project application(s) submitted by the Companies to effectuate the overarching strategy.

IV.

GRID MODERNIZATION STRATEGY

A.

Overview and Approach

Modernization of Hawaii's electric power systems, which will include the deployment of technologies such as distribution management systems, communication, sensors, and energy storage, is fundamental to moving toward the integrated, plug-and-play grid of the future. In the longer term, a comprehensive Grid Modernization Strategy must incrementally progress from adequately equipping the distribution system with monitoring and communication infrastructure to: (1) enabling intelligent, rapid, and precise control; (2) deploying automated solutions across the system; and (3) facilitating market-based transactions for grid services.

In order to reach this future state, the HECO Companies will need to develop a comprehensive Grid Modernization Strategy for each of the electric utilities that recognizes, among other things, the need for investment to integrate cost-effective DER and for actively identifying barriers to the deployment of DER, such as safety standards related to technology or operation of the distribution circuit. The expectation is that a detailed Grid Modernization Strategy will provide the necessary context to

inform the commission's review of discrete grid modernization project application(s) subsequently submitted by the Companies.

The commission further directs the Companies to identify and address both grid-facing and customer-facing issues related to grid modernization. The commission expects the Companies to consider several important factors that may affect the opportunities available for grid modernization in Hawaii, including, but not limited to, the following:

1. Cost-effectiveness. The Companies must ensure the cost-effectiveness of grid modernization investments.

2. Customer protection. The Companies must develop policies that will ensure that all electricity customers, and especially low-income customers, renters, and small business customers, are able to benefit from grid modernization developments to the greatest extent possible.

3. Customer engagement. The commission expects that achieving the opportunities afforded by grid modernization will require customer engagement, and that the commission, the HECO Companies, and other stakeholders will need to take steps to effectively promote customer engagement.

4. Timing. The Companies must consider questions regarding the appropriate time to implement particular grid modernization technologies and practices, especially given the rapid pace at which technologies evolve.

Additionally, because they provide a platform for future investments in energy delivery infrastructure, primarily, but not limited to, the electric distribution networks owned and operated by the HECO Companies, the Companies' Grid Modernization Strategy should also reflect the following parallel goals:

1. Modernize the electric distribution system to accommodate two-way flows of energy and energy services through the Companies' networks;

2. Enable customer choice of new technologies and services that reduce emissions and improve reliability in a cost efficient manner; and

3. Provide opportunities for DER to create value through the provision of grid services.

B.

Format and Process

Ultimately, the aim of this process is for the HECO Companies to file a detailed, holistic, and scenario-based Grid Modernization Strategy for each of the utilities no later than June 30, 2017.

The Companies are encouraged to ensure that their Grid Modernization Strategy as filed is well-vetted and adequately informed by stakeholders. This can be accomplished through stakeholder workshops, conferences, or other means, prior to submission of the Grid Modernization Strategy. The Companies are

encouraged to work with all stakeholders to comprehensively, holistically, and innovatively address an appropriate Grid Modernization Strategy in Hawaii, given the island grids' unique needs and characteristics.

An initial draft of the Companies' Grid Modernization Strategy shall be available for stakeholder review and comment no later than one hundred and twenty (120) days from the date of this Order. This draft shall be available to any stakeholder upon request.

Upon submission of the Companies' final, proposed Grid Modernization Strategy to the commission, stakeholders will be provided, at a minimum, with an opportunity to file written comments on the strategy. Depending on the contents of the HECO Companies' filing, the commission may institute further proceedings to investigate the filing, such as commission sponsored technical conferences.

By dismissing the Application and instituting the process outlined herein, the commission does not suggest that investments in Hawaii's electric grid infrastructure proposed in the SGF Application are not needed or useful. Rather, given the questions the commission has with the current Application, and given the leadership role Hawaii maintains regarding DER penetration, the commission wishes to leverage the insights and expertise of industry and the stakeholder community to assist the

Companies' development of a detailed, comprehensive, and holistic Grid Modernization Strategy that will guide the HECO Companies' approach to grid modernization investment over the short, medium, and long term.

In the sections that follow, the commission provides initial guidance concerning grid modernization in Hawaii, including the identification of initial subject areas the Companies must consider as they develop their Grid Modernization Strategy.

C.

Definition

Definitions of grid modernization abound, and the commission acknowledges that there is no single, universally-recognized definition. The Energy Independence and Security Act of 2007 described grid modernization as "the modernization of the Nation's electricity transmission and distribution system to maintain a reliable and secure electricity infrastructure that can meet future demand growth" and to meet ten (10) characteristics or functions.[44] A modernized electric grid requires several technology types to work in concert.

[44]See 42 U.S.C. § 17381 (2016).

The U.S. DOE's five (5) main smart grid technology areas are:

1. Integrated communications allowing for real-time information and control;
2. Sensing and measuring technology supporting rapid and accurate system and human responses;
3. Advanced components such as storage and superconductivity;
4. Advanced control methods, such as voltage optimization; and
5. Improved interfaces and decision support for distribution system managers.

Some examples of these technologies that are actively being deployed include, AMI outage management with field devices, two-way communication networks, automated controls, and voltage regulation.

Although the commission observes that there are a variety of perspectives regarding what "grid modernization" entails, the commission believes that adopting a definition that reflects the goals and objectives of Hawaii will ensure that the commission, Companies, and stakeholders have a common understanding of how the Companies will approach grid modernization. Therefore, the commission suggests the following preliminary definition to guide further discussion on grid modernization in Hawaii:

> A modernized grid assures continued safe, reliable, and resilient utility network operations, and enables Hawaii to meet its energy policy goals, including integration of renewable electricity sources and distributed energy resources. An integrated, modern grid provides for greater system efficiency and greater utilization of grid assets, enables the development of new products and services, provides customers with necessary information and tools to enable their energy choices, and supports a secure, open standards-based and interoperable utility network.

D.

Guiding Principles

In order to assist the Companies as they develop the Grid Modernization Strategy, the commission observes that it may be helpful to suggest foundational principles to shape the framework by which a comprehensive strategy should be designed and evaluated.

To that end, the Legislature has stated:

> In advancing the public interest, the commission shall balance technical, economic, environmental, and cultural considerations associated with modernization of the electric grid, based on principles that include but are not limited to:
>
> 1. Enabling a diverse portfolio of renewable energy resources;
>
> 2. Expanding options for customers to manage their energy use;

3. Maximizing interconnection of distributed generation to the State's electric grids on a cost-effective basis at non-discriminatory terms and at just and reasonable rates, while maintaining the reliability of the State's electric grids, and allowing such access and rates through applicable rules, orders, and tariffs as reviewed and approved by the commission;

4. Determining fair compensation for electric grid services and other benefits provided to customers and for electric grid services and other benefits provided by distributed generation customers and other non-utility service providers; and

5. Maintaining or enhancing grid reliability and safety through modernization of the State's electric grids.[45]

In addition, to those listed above, the commission identifies the following principles for grid modernization in Hawaii:

- Move toward the creation of efficient, cost-effective, accessible grid platforms for new products, new services, and opportunities for adoption of new distributed technologies;

- Ensure optimized utilization of electricity grid assets and resources to minimize total system costs;

- Enable greater customer engagement, empowerment, and options for consuming and providing energy services;

[45]HRS § 269-145.5(b).

- Maintain and enhance the safety, security, reliability, and resilience of the electricity grid, at fair and reasonable costs, consistent with the State's energy policy goals;

- Facilitate comprehensive, coordinated, transparent, and integrated distribution system planning.

The principles outlined above are not to be construed as a framework for regulatory decision-making, but rather should be viewed as initial guidance for the Companies and stakeholders to inform the continued program design, evaluation, and deployment of grid modernization investments.

E.

Areas of Interest

In order to provide some threshold guidance as to elements that, at a minimum, should be addressed in the Companies' development of a Grid Modernization Strategy, the commission highlights the following areas of interest. These illustrative examples are not an exhaustive list of components, but rather are offered to inform the Companies' approach.

1.

Current Status of Electric Grid Infrastructure Pertaining to Grid Modernization

The commission's stated vision of an integrated grid has included goals of more efficient use of energy, deeper penetration of DER, establishment of vibrant markets to transact electric grid services, and adoption of innovative and sustainable energy technologies. These goals are substantial and require a long-term approach comprising incremental steps, each one meant to bring the State toward a cleaner, more resilient and more affordable energy system through the development of dynamic, self-sustaining markets. As a first step, the Companies and stakeholders need to assess and better understand the present status of each island's electric grid.

During the course of this process, the commission anticipates electric industry experts and stakeholders will address many interrelated questions regarding grid modernization. For this area of interest, the commission suggests the Companies and stakeholders consider the following initial questions:

- What grid modernization technologies and practices have the HECO Companies' already explored or implemented, and what plans does each Company have for introducing additional technologies and practices?

- To what extent does each of the HECO Companies' recent investments in grid modernization affect decisions about future investment in grid modernization?

- What role do existing commission regulations, policies, and practices play in encouraging or discouraging future investments in grid modernization infrastructure?

2.

Grid Architecture and Interoperability

Grid architecture is the specialization of system architecture[46] for electric power grids. As such, it includes not just information systems, but also industry, regulatory, and market structure; electric system structure and grid control framework; communications networks; data management structure; and many elements that exist outside the utility but that interact with the grid, such as buildings, DER, and microgrids.

The commission acknowledges that the notion of grid architecture involves certain abstractions; however, it can serve as a practical tool for obtaining insights at the system level across multiple relevant domains. The electric power industry has recognized that the complexity of the power grid has passed the point where intuitive or siloed approaches to changes are

[46]System architecture is a discipline for describing, analyzing, and communicating structural representations of complex systems. Stated simply, a system architecture is a model of a (complex) system, the purpose of which is to help think about the overall shape of the system, its attributes, and how the parts interact. See JD Taft, A Becker-Dippmann, "Grid Architecture," PNNL, January 2015, at 3.1 ("Grid Architecture").

workable.[47] Architecture provides the disciplines and methods to view the grid from a system standpoint, and to share those views with stakeholders. It organizes information in ways that provide significant insights not available through other means.

The power of grid architecture would appear to be in its ability to aid in managing complexity, the use of which could well be the difference between being able to actively shape the evolution of the grid based on sound representation of a multiplicity of structures and the interactions involved, versus passively allowing the grid to evolve in a bottom-up manner and waiting to see what emerges.[48] Indeed, the sensing network and related communications infrastructure, in particular, are core investments that must be designed and implemented to support multiple existing and future operational applications over their asset lives.[49]

Interoperability is another critical, foundational component of the integrated grid. Within the electricity system,

[47]Proceedings of the Future of the Grid - Evolving to Meet America's Needs National Summit (June 26, 2014; DOE-OE/GridWise Alliance); https://www.smartgrid.gov/sites/default/files/Preread_materials_National_Summit.pdf

[48]Grid Architecture at 3.4.

[49]Jeffrey Taft and Paul De Martini, "Sensing and Measurement Architecture for Grid Modernization," PNNL, February 2016, at 11 ("Sensing and Measurement Architecture").

interoperability means the seamless, end-to-end connectivity of hardware and software from the customers' appliances all the way through the transmission and distribution system to the power source, enhancing coordination of energy flows with real-time flows of information and analysis."[50] As capital investments or new information technology opportunities related to grid modernization come before the commission for approval, the commission must evaluate each to determine whether they have characteristics and attributes that contribute to interoperability, i.e., facilitate and enhance the transactions and flows of energy and information across the electric grid, from electricity use through delivery and production.

The commission encourages stakeholders to provide their views on grid architecture and interoperability and how these concepts may be integrated into the Companies' grid modernization efforts.

For this area of interest, the commission suggests the Companies and stakeholders consider the following initial questions:

- How might the Companies' grid architecture be developed to leverage smart technologies

[50] GridWise Architectural Council Policy Team, "Introduction to Interoperability and Decision-Maker's Interoperability Checklist Version 1.0," at 1, available at http://www.gridwiseac.org/pdfs/gwac_decisionmakerchecklist.pdf ("Interoperability Checklist").

and intelligence in order to enhance edge-of-network capabilities?

- How should the Companies' grid architecture be designed and optimized to address the elements of interoperability, cybersecurity, flexibility, and adaptability? More specifically, what are the advantages and disadvantages of a grid system design where the sensing network and related communications infrastructure are viewed as core investments decoupled from specific applications, e.g., AMI?[51]

- How might the Companies' grid architecture be considered as a foundational requirement for grid modernization?

- What steps should be taken to promote open, interoperable grid modernization technologies?

- What steps might be taken to develop a framework for assessing a project's contribution to the interoperability of the grid?[52]

3.

Grid-Facing Technologies

Grid-facing technologies are those that automate grid operations and allow utilities to monitor and control grid conditions in near real time. These include advanced distribution technologies that will automatically notify utilities of outages, allow them to reroute power where possible, and enable more efficient dispatch of repair crews. Grid-facing technologies also

[51]See Sensing and Measurement Architecture at 11.

[52]See, e.g., Interoperability Checklist.

allow operators to automate system diagnostics and remotely monitor the system for disturbances, thereby enabling the system to "self-heal," reducing the frequency and duration of customer outages. In addition, the modern grid will facilitate the use of technologies to maximize its efficient operation and should be capable of fully integrating new DER, such as renewable systems, energy storage technologies, and plug-in EVs.

The commission expects stakeholder workshops to facilitate discussion regarding the capabilities reasonably expected of a modern distribution network, the status of technologies required to enable these capabilities, the regulatory changes that may be necessary to facilitate the development of a modern distribution network, and the steps that the Companies should take to integrate relevant technologies in a strategic and cost-effective manner.

For this area of interest, the commission suggests the Companies and stakeholders consider the following initial questions:

- What are the key grid-facing technologies and practices that the Companies should be implementing to maximize the reliability and efficiency of the grid, while materially enhancing the ability to further integrate DERs?

- How do grid-facing technologies and practices overlap with customer-facing technologies and practices, such as advanced meters, and to what extent do they need to be coordinated?

4.

Customer-Facing Technologies

Customer-facing technologies include, for example, advanced meters, two-way communication systems, web-based information portals, in-home energy information devices, programmable communicating thermostats, and smart appliances/electronics.[53] Customer-facing technologies can help customers save money when used in combination with dynamic pricing rate designs, enabling customers to respond to price signals that indicate how the cost of electricity fluctuates through the day, week, and year. Customer-facing technologies can also enable customers to manage their electricity use more efficiently and to participate in DR programs that may provide valuable ancillary services to the grid.

For this area of interest, the commission suggests the Companies and stakeholders consider the following initial questions:

[53]Smart appliances/electronics are devices that are controllable and programmable, e.g., dishwashers that can be programmed to run at a specific time of day when electricity prices are lower.

- How can customer-facing technologies, practices, and strategies be used to (1) enable customers to manage their electric usage more efficiently and enable maximum customer cost savings; (2) enable customers to harness their electric loads as a responsive resource to meet grid service needs; and (3) further integrate resources such as distributed generation, energy storage devices, and electric vehicles?

- What are the appropriate roles for the HECO Companies and stakeholders in identifying and deploying customer-facing technologies to achieve these goals?

- How should the commission and other stakeholders ensure an open and robust market for third-party, customer-facing technology providers and ensure adequate consumer protection?

5.

Pace of Grid Modernization Implementation

The commission recognizes that grid modernization will be an evolving process. While the development of a Grid Modernization Strategy is critical at this juncture, the optimal pace for the implementation of new technologies and practices is less clear. To some extent, the pace of grid modernization will depend on the Companies' investments in grid modernization technologies to date, the lifespan of assets already deployed, and on current capital spending plans. Furthermore, the pace of grid modernization will depend upon the answers to many of the questions raised above, including questions regarding

the cost-effectiveness of specific grid modernization technologies and practices.

The commission is seeking input on the sequence and pace of grid modernization infrastructure investments, including both grid-facing and customer-facing technologies. The Companies' strategy should identify grid modernization technologies as discrete components under the overall strategy and specify the anticipated implementation timing for each component, as well as how each component relates to the other(s). For this area of interest, the commission suggests the Companies and stakeholders consider the following initial question:

- How should the Companies determine the appropriate sequencing and timing for implementing various grid modernization technologies and practices?

6.

Costs and Benefits of Grid Modernization

A key component of a well-developed Grid Modernization Strategy will be to enhance understanding of the range of costs and benefits associated with grid modernization technologies and practices. As discussed, grid modernization offers the potential to bring many benefits to customers, including enhanced reliability, and increased customer opportunities to manage usage, adopt new technologies, and reduce costs. Achieving many of these

benefits, however, will require investments by the HECO Companies, that may be passed on to ratepayers. One of the key objectives of this inquiry will be to enable the Companies and other stakeholders to identify those grid modernization opportunities that are cost-effective and offer the greatest benefits to customers.

The commission recognizes that this important issue has been explored in other jurisdictions, and expects to benefit from experience gained elsewhere. For example, DOE has conducted significant analysis of smart grid costs and benefits. The commission observes that the use of DOE'ęs information may be an appropriate starting point.[54] To the extent possible and practical, it may make sense to leverage the experience of jurisdictions that have already articulated frameworks for evaluating the costs and benefits associated with grid modernization, such as Massachusetts, California, New York, Maryland, and Illinois.

Stakeholders should be prepared to share any relevant experience and information they have regarding a grid modernization cost-effectiveness assessment. For this area of interest, the commission suggests that the Companies and

[54]The DOE'ęs dedicated website for Smart Grid issues is available at http://energy.gov/oe/technology-development/smarte_grid; see also, http://www.ęsmartgrid.gov/recovery_act/program_impacts

stakeholders consider the following initial questions, among others:

- What is the appropriate framework to evaluate the cost-effectiveness of grid modernization technologies and practices, including grid-facing and customer-facing technologies?

- How should the commission evaluate hard-to-quantify impacts such as improved reliability, increased customer choice, and reduced environmental impacts?

7.

Flexibility and Resilience

As DER plays a more prominent role on the grid, operations to reconfigure or isolate portions of distribution circuits may become more challenging. Human operators may struggle to keep up with the increasing speed and complexity of information flow, analysis, and decision-making. Instead of managing one-way power flows from a few large generators connected at transmission voltage, operators currently see two-way variable flows created by many smaller DERs connected to the distribution system or behind the customer meter. Safety and reliability issues may increase in both frequency and magnitude unless system operators have the enhanced capabilities of a modern grid.

The integrated grid of the future will allow the Companies to take a proactive approach to identifying and resolving operational issues as they arise. There will be more

communications and automated equipment along the network that would allow the system to recognize a fault and reroute energy to another circuit, while accounting for the impacts of and on the DER connected to the circuit.[55] Furthermore, a modernized, distributed grid should prove more resilient in the face of potential catastrophic events, including natural disasters.

Developing these operational capabilities may require expansion of fiber optic and/or field area networks for real-time data collection; automated sensors and devices to capture data and to control grid devices in response to real-time disturbances; and management systems to operate the distributed grid.[56]

Grid modernization and reinforcement, along with a capable system operator, are essential to enabling much greater DER adoption and unlocking value, while enhancing reliability and resiliency for all customers.

[55] "Smart Grid for Distribution Systemse The Benefits and Challenges of Distribution Automation (DA)," IEEE, available at http://grouper.ieee.org/groups/td/dist/da/doc/IEEE%20Distribution%20Automation%20Working%20Group%20White%20Paper%20v3.pdf.

[56] See, e.g., "Grid Modernization Distribution System Concept of Operations," Southern California Edison, January 17, 2016, available at https://www.edison.com/content/dam/eix/documents/innovation/SCE%20Grid%20Modernization%20Concept%20of%20Operations%201.17.16b.pdf

For this area of interest, the commission suggests that the Companies and stakeholders consider the following initial question, among otherse

- How might grid modernization investments be designed and implemented to cost-effectively meet the dual goals of enhancing grid flexibility and resilience?

8.

Health, Cybersecurity, Data Access and Privacy

The commission recognizes that there are additional potential concerns related to grid modernization, such as the perceived health effects of customer-facing technologies, cybersecurity, and data access and privacy. The commission recognizes that some of these are significant issues, and that many of them are being addressed in other jurisdictions and through federal activities. The commission encourages stakeholders to provide their views on how the Companies should address these issues.

For this area of interest, the commission suggests that the Companies and stakeholders consider the following initial questions, among others:

- What steps should be taken to address the expressed health concerns associated with grid modernization that have been raised by the public in this docket and in a few other areas of the country?

- What steps should be taken to address cybersecurity and data privacy and access concerns associated with grid modernization?

F.

Conclusion

The commission expects that a detailed Grid Modernization Strategy will provide the comprehensive and holistic vision and context to inform subsequent review of discrete grid modernization project applications submitted by the Companies. Although the commission recognizes that the process articulated herein will take several months, it is expected that the development of a detailed, overarching strategy in advance of reviewing a specific G.O. 7 Application will result in an expedited deployment of grid modernization investments in the long-run.

The commission expects that the strategy will be flexible and able to accommodate changes over time, as the underlying elements, such as technology, customer expectations, and value proposition, continue to evolve. As the Companies address each of the commission's suggested areas of interest articulated above, the Grid Modernization Strategy should offer a detailed look into the analysis conducted, conclusions reached, and any stakeholder input offered thereon. Further, the Companies should present an overall strategy and grid modernization investment budget that reflects a modular, flexible approach,

consistent with the latest industry best practices. To that end, the Strategy should identify the discrete grid modernization components that make up the larger strategy and articulate the proposed priority, implementation timing, and expected costs and benefits of each.

VI.

ORDERS

THE COMMISSION ORDERS:

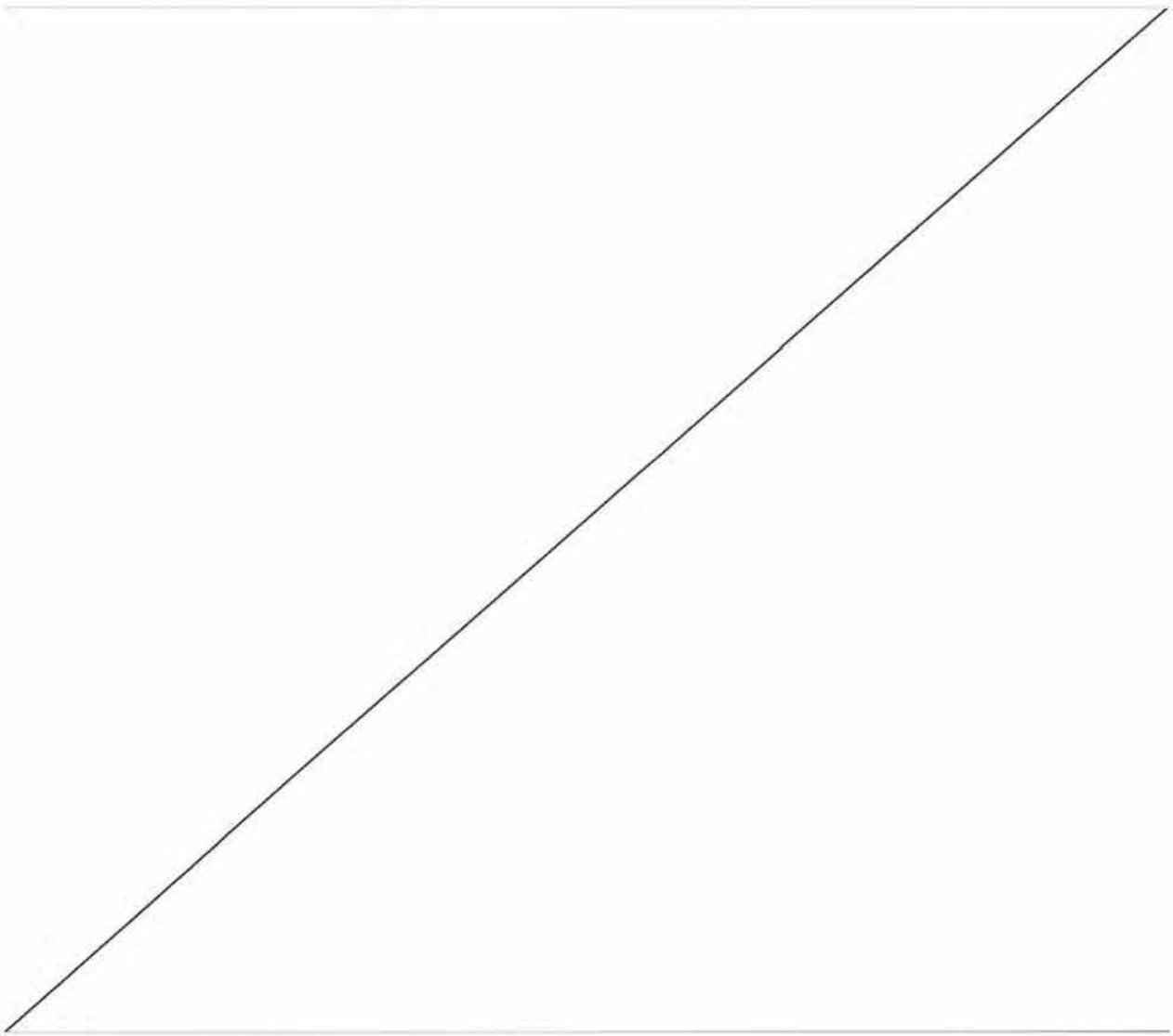
1. The commission dismisses the Application without prejudice.

2. The commission denies as moot the motion to intervene of each of the following movants: The Department of Business, Economic Development, and Tourism; Renewable Energy Action Coalition of Hawaii, Inc.; Life of the Land; Puna Pono Alliance; Richard H. Conrad; Sally K. Kaye; SunPower Corporation; The Alliance for Solar Choice; Hawaii Solar Energy Association; and Energy Freedom Coalition of America, LLC.

3. The commission directs the HECO Companies to submit a detailed, scenario-based Grid Modernization Strategy for each utility no later than June 30, 2017. An initial draft shall be made available to stakeholders no later than one hundred and twenty (120) days from the date of this Order.

4. The Final Grid Modernization Strategy documents shall be filed in the new docket that will be initiated when the Final Grid Modernization Strategy is filed. Upon submission of the Companies' Final Grid Modernization Strategy, the commission intends to institute a separate docketed proceeding.

5. The commission further directs the HECO Companies to brief the commission in April 2017 on the approach and content of the Draft Grid Modernization Strategy.



6. This docket is closed, unless ordered otherwise by the commission.

DONE at Honolulu, Hawaii JAN - 4 2017.

PUBLIC UTILITIES COMMISSION
OF THE STATE OF HAWAII

By _____
Randall Y. Iwase, Chair

By _____
Lorraine H. Akiba, Commissioner

By _____
Thomas C. Gorak, Commissioner

APPROVED AS TO FORMe

_____
Matthew T. McDonnell
Commission Counsel

2016-0087.ljk

CERTIFICATE OF SERVICE

The foregoing order was served on the date of filing by mail, postage prepaid, and properly addressed to the following partiese

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