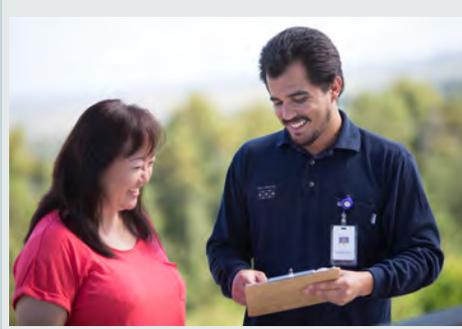


# Power Supply Improvement Plans Update Report

*Power Supply Improvement Plans:  
Supplemented, Amended, and Updated*

**1 April 2016**



**Hawaiian Electric  
Maui Electric  
Hawai'i Electric Light**

## **Preface**

The Hawaiian Electric Companies respectfully submit this supplemented, amended, and updated Power Supply Improvement Plan (PSIP) to comply with Order No. 33320 issued by the Hawai'i Public Utilities Commission on November 4, 2015 in Docket No. 2014-0183.



# Executive Summary

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## SHARED COMMITMENT TO A CLEAN ENERGY FUTURE

With an unprecedented 100% Renewable Portfolio Standard, Hawai'i's clean energy leadership is clear and indisputable. Achieving this critical goal will require a comprehensive transformation of our island power grids. A multidimensional planning process that requires near-term actions to set the foundation for the plan and a recognition that flexibility is critical as the specifics for the long-term continue to change as technology and costs continue to evolve. While there are many views on the best path to achieve our 100% RPS goal, there is notable unity in Hawai'i in recognizing the critical importance of addressing the negative economic, environmental and energy security impacts of our state's dependence on imported petroleum oil. Most of all, that shared mindset will be required for our entire community – government, business, developers, community and environmental groups, utilities, and customers – to come together to address the issues that must be resolved to achieve this goal for our island home.

### A Dynamic Energy Environment

Changes that took place in the 18 months since we filed our Power Supply Improvement Plans in 2014 demonstrate how dynamic our Hawai'i energy environment is. Consider just a few of the changes:

- Passage of Act 97, which extended a 40% RPS requirement in 2030 to a 100% RPS in 2045.
- Dramatic decline in the price of fuel oil by more than 75%, creating significant changes and uncertainty in forecasted costs, and much lower bills.
- Hawai'i Public Utilities Commission (Commission) Decision & Order No. 33258 ending the Net Energy Metering (NEM) program for new solar customers and

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Shared Commitment to a Clean Energy Future

concurrently creating two new replacement programs: Customer Grid-Supply and Customer Self-Supply.

- Valuable ongoing experience with increasing levels of distributed generation (DG), including the testing and installation of advanced inverters to allow greater amounts of DG and reduce the need for distribution upgrades.
- In addition, NextEra Energy and the Hawaiian Electric Companies have proposed a merger which is pending before the Commission.

Energy technology and policy is constantly evolving and customer needs and expectations are changing.

Therefore, our planning in this context of change must include:

**Actions to be taken in the immediate future** to take advantage of available resources and achieve near-term energy goals, satisfy customer preferences, and provide a hedge against uncertainty in future oil prices.

**Near-term steps** that help us further understand, explore, and develop longer-term resources.

**Long-term energy planning using the best information available today but recognizing the limitations on insights into the future.** The actions identified in the 2025–2045 time period are less certain, and are expected to be further optimized and adjusted based on changing circumstances in future planning updates to reach our 100% renewable energy goal in other ways.

**Preservation of a reliable and resilient power grid.** Hawai'i's small and islanded power grids make this especially challenging and even more critical to achieve. The resiliency of our grid and reliability of service is vital for our economy, for our military partners, and for critical infrastructure. Our customers expect and deserve it.

## Key Results—What Are the Takeaways?

There are several notable high level results from this Power Supply Improvement Plan Update:

- I. **Our companies' project we can exceed the RPS requirements** as defined under the current law and can also chart a path to achieve true 100 percent renewable energy for electricity by 2045. The *Additional Insights* section (below) highlights some considerations and challenges to meeting these bold goals.

2. Customer participation through the use of market-based distributed energy resources (DER) plays a critical role. We project that the capacity of installed **DER, largely private rooftop solar, can grow by about 370 percent** compared to our 2014 PSIPs.
3. We can essentially re-invent our power system – by modernizing generation to be more flexible and efficient, transforming our transmission and distribution system to be smarter and better integrate distributed private and larger scale renewables, and obtain the energy security and environmental benefits from a 100% renewable future – all while **keeping electric rates stable and relatively flat** on a real dollar basis.
4. **Liquefied Natural Gas (LNG) as a transitional fuel**, combined with more efficient and flexible modern generation, provides the best path with the lowest cost and lowest carbon footprint to reach Hawai'i's 100%renewable energy goal.

## Additional Insights

Despite future uncertainties, long-term planning should be viewed as providing useful directional insights. Some of these insights include:

- a. Our long term portfolios must include a diverse set of resources. With greater use of renewable energy, a diverse mix of renewable resources provides greater assurance of self-sufficiency and energy resiliency as weather patterns vary and other unforeseen events occur.
- b. Dispatchable, firm renewable energy (currently biomass and geothermal) on Maui and Hawai'i Island are key to achieving high levels of renewable energy at reasonable costs.

This suggests that policymakers, government agencies, and private organizations with interests in energy, agriculture, water use and land use, need to be involved in developing clear policies and rules that will determine the feasibility of these options for the future.

- c. With their more abundant open spaces, the neighbor islands will lead the way and in fact, Moloka'i and Lāna'i are projected to reach a 100% RPS by 2030, while Maui and Hawai'i Island could achieve a 100% RPS by 2040. This will help O'ahu, with its larger population and energy needs challenged with limited land and on-island renewable resources, meet the 2030 70% RPS goal.

To reach 100% RPS in 2045, O'ahu appears to need additional resources beyond those available on island (e.g., currently, offshore wind, biofuels, neighbor island renewables transmitted via interisland cable). These alternatives need to be studied

## Executive Summary

Key Results: The Path to 100% Renewable Energy

further to better understand their respective risks and relative costs. Such endeavors require the efforts and input of our entire state, not just the utility. Policies, environmental permits, community and cultural issues and concerns must be addressed. Changes in state policies, statutes, and regulations governing resource development may also be needed. And as circumstances change in the years ahead, the alternatives for O’ahu may be revised.

In the context of the potential need for resources to be shared amongst the islands to cost-effectively achieve 100% renewable energy, the concept of consolidated rates for the Hawaiian Electric Companies should be evaluated.

- d. Planning must be looked at as a continuous process – a process in which analysis is updated for changing circumstances, new technologies, changing economics, and new policies. Action plans and long-term directions should be reviewed continuously, especially given the rapid change in the clean energy sector.

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## KEY RESULTS: THE PATH TO 100% RENEWABLE ENERGY

Each Preferred Plan considered a number of factors.

**Electricity Rate and Bill Impacts.** Recognizing the importance of affordability to our customers, limiting overall costs and annual rate increases was a high priority.

**Customer Choice.** To meet the diverse needs of our customers, all plans must facilitate customer choice and aim to be fair to all customers.

**Future Fuel Prices.** Because of changing fuel markets, each plan must be evaluated for different oil, biofuel, and LNG price scenarios.

**Infrastructure Investments.** To ensure electric grid resiliency and meet our state’s clean energy goals, all approaches require investment in new infrastructure by customers, developers, and the utility.

**Service Reliability and Resiliency.** To meet the needs of our customers and our state’s economy, the modernized grid must be reliable and resilient to ensure all resources remain connected, even during severe or abnormal weather conditions.

**Flexibility.** Recognizing our dynamic energy environment and the benefits for our customers, plans must adapt to accommodate future technology and pricing breakthroughs.

**Minimizing Risks.** Our Preferred Plans minimize the risks – financial, implementation, and technology among them – inherent in any plan of this magnitude.

Under the current Preferred Plans, our tri-company consolidated renewable energy mix in 2045 could be the amounts listed in Table ES-1.

| Renewable Resource | MW    |
|--------------------|-------|
| Total DG-PV        | 1,220 |
| FIT*               | 40    |
| Utility-scale PV   | 870   |
| Onshore Wind       | 530   |
| Offshore Wind      | 800   |
| Hydro              | 20    |
| Geothermal         | 120   |
| Waste/Biomass      | 130   |

\* = all solar

Table ES-1. 2045 Renewable Energy Resources

Figure ES-1 shows the total capacity of renewable energy included in the Preferred Plans on a consolidated basis. By 2045, the total capacity of renewable energy on the systems is more than double the total of the system peaks to be served.

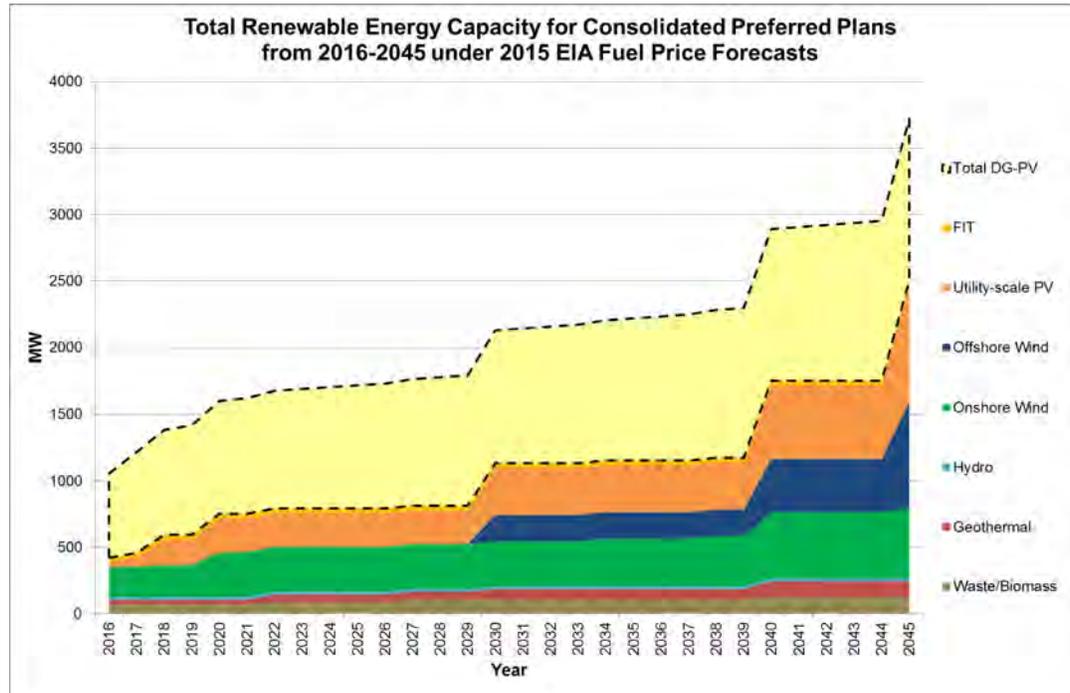


Figure ES-1. Total Renewable Energy Capacity for Consolidated Preferred Plans from 2016-2045 under 2015 EIA Fuel Price Forecasts

Again, while instructive for directional planning, this prediction of a renewable resource mix 30 years into the future is certain to evolve as we adapt to take advantage of rapidly evolving technology, policies, and energy options.

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Key Results: The Path to 100% Renewable Energy

### Achieving the RPS

Under the current Preferred Plans, RPS will exceed requirements as our companies move toward 100% renewable energy by 2045 (Figure ES-2).

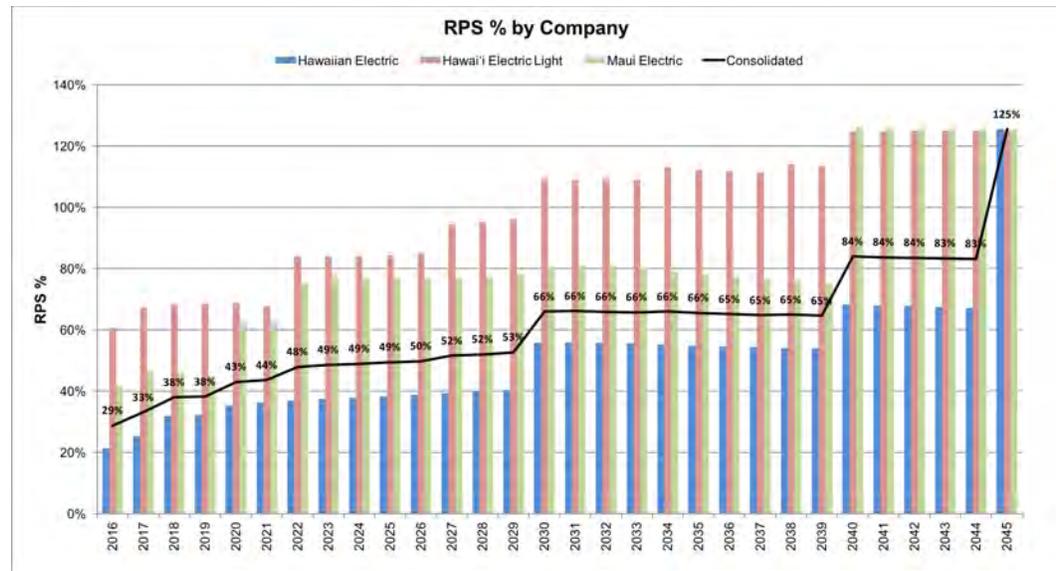


Figure ES-2. Renewable Portfolio Standards Compliance of Preferred Plans

The calculation of the RPS per the law does result in values over 100%. To emphasize that we are committed to achieving 100% renewable energy in 2045, Figure ES-3 shows the renewable energy as a percent of total energy including customer-sited generation.

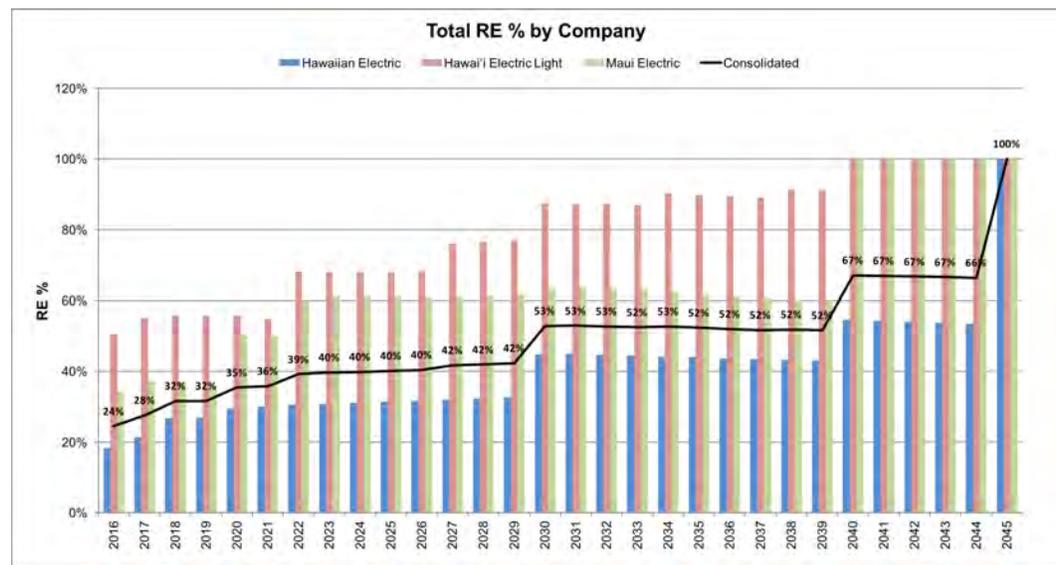


Figure ES-3. Total Renewable Energy Percent of Preferred Plans

Figure ES-4 provides a long-term view of a path towards 100% renewable in 2045. Under the current Preferred Plans, the possible path as our tri-companies move toward 100% renewable energy by 2045 is as follows:

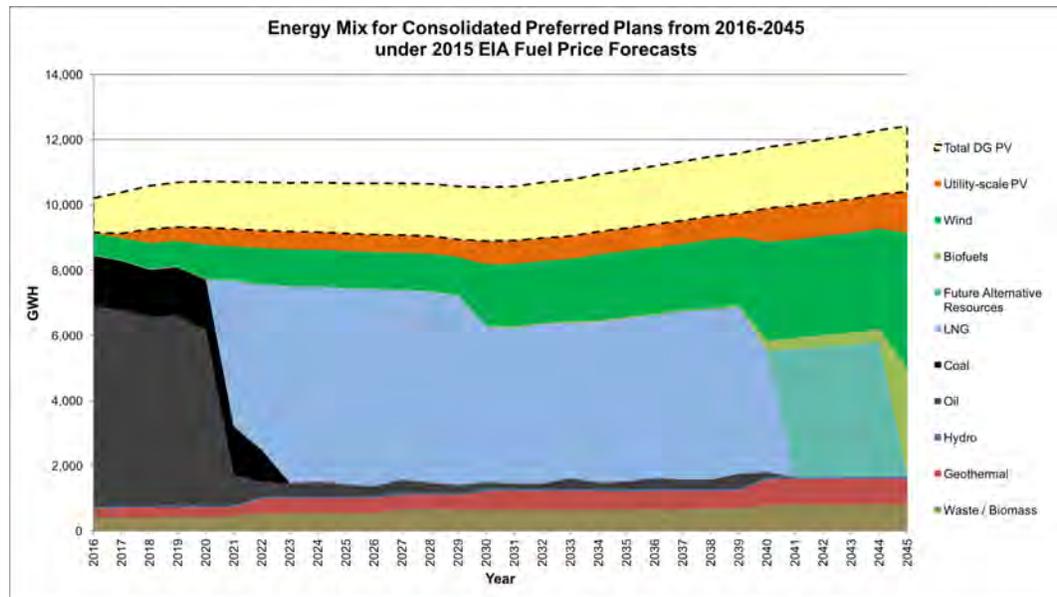


Figure ES-4. Energy Mix for Theme 2 on O’ahu from 2016-2045 under 2015 EIA Fuel Price Forecasts

Future Alternative Fuels: During the last intervening years in the transition to 100% renewable energy, potential fuels at this time could include biofuels, LNG, oil, other renewable options or a mix of options. Given rapidly evolving energy options and technology, the exact fuel mix is difficult to predict today.

### Multiple Benefits Provided from Demand Response Programs

Demand Response (DR) programs – market-based programs that incentivize customers for change in electricity usage patterns – play a key role in integrating variable renewables. In addition to providing capacity and load shifting, DR can also provide other ancillary services, such as regulating reserves. Load shifting DR programs to encourage more usage at times when solar generation is most abundant appears to provide the most value.

## Executive Summary

Key Results: The Path to 100% Renewable Energy

### Distributed Energy Resources Plays a Critical Role

Economic, market-based DER contributes a significant portion of the resource mix, resulting in a 250% increase over current levels and a 370% increase over the starting point level in our 2014 PSIP. The current PSIP Update assumes market-based levels of DER for O'ahu, Hawai'i Island and Maui and higher levels of DG-PV for Moloka'i and Lāna'i, as those smaller islands are leading the rest of the state in developing new solutions for DG integration challenges. However, because the market-based DER is expected to largely be variable solar PV, the energy contribution of market-based DER, while still significant, is smaller than the megawatt capacity suggests. This is the assumption for now, but as we continue to analyze the long-term options for addressing the challenge of closing the gap to 100% renewable energy on O'ahu and as technologies and their prices change, the option of pursuing a higher DG-PV strategy on O'ahu in later years should be kept open.

### Community-Based Renewable Energy (CBRE) Enables Broader Customer Benefits

Community-Based Renewable Energy (CBRE) could also provide a significant contribution to the attainment of 100% renewable energy, and allow many other customers to participate and benefit from renewable energy options like solar PV who otherwise cannot or would not.

### Liquefied Natural Gas (LNG) as a Bridge Fuel Provides the Most Affordable Pathway to 100% Renewables

There appears to be alignment among most stakeholders that Hawai'i must achieve the 100% RPS goal in a cost-effective manner. Our PSIP Update confirms that LNG and generation modernization (as described below) offer the best path forward in the transition to 100% RPS.

LNG is a prudent choice because it will displace 80 percent of our imported oil use between 2021-2040, keep electric rates lower than they were 18 months ago, lessen price volatility, and significantly reduce our carbon footprint. This is true across the range of fuel prices evaluated in this PSIP for O'ahu, Maui and Hawai'i Island combined.

The Governor has stated his concern that using LNG will divert focus away from a 100% renewable energy future. We understand our responsibility in working with others throughout the state not to let that happen. We believe we can move aggressively towards 100% renewables with LNG as a transitional bridge fuel through 2040, limiting permanent infrastructure while allowing for variable demand and lessening the cost burden on customers as we make the transition to renewables.

Although, as noted below, the current LNG option and the significant benefits it can provide customers is available only under the merged scenario, we would still be interested in pursuing LNG in an unmerged scenario if an option is developed and provides meaningful cost savings, reliability and environmental benefits for our customers. However, the merged scenario below provides a clearer and more immediate path for delivery and earlier benefits for customers.

Furthermore, the case utilizing LNG and the advanced combined cycle generator produces fewer carbon dioxide emissions than the accelerated renewable generation planning scenario by over 4 million tons during the 30-year planning period. These results demonstrate the value of efficient and flexible generation utilizing clean burning natural gas along with renewable generation additions while meeting the 100% RPS targets by 2045. Not only will customers realize the lowest overall cost, but they will also receive the long-term benefits of a cleaner environment.

## The Need for Flexible and Efficient Generation Is Needed

As the Commission has recognized in its Inclinations paper, “the Hawaiian Electric Companies should continue to evaluate opportunities to retire and replace older, high cost plants with new resources with valuable characteristics that provide required support services cost-effectively to maintain a reliable electricity grid with high levels of renewable resources.”<sup>1</sup> One example of a flexible and efficient generator is an advanced combined cycle unit planned for O’ahu. Such generators have many benefits -- fast starting, cycling, fast ramping, fuel efficiency, low emissions, and improved reliability -- all of which lower operating costs for customers. The flexibility of these units supports the variable nature of renewable generation and the transition to 100% RPS, as well as reduces the size of costly energy storage systems. When sited at existing generating stations, they can take advantage of existing infrastructure, minimizing the impact to the local community. On Maui and Hawai’i Island, existing dispatchable combined cycle generators already provide a considerable amount of flexible generation, allowing higher levels of renewable generation on those islands. Use of LNG in these generators can enhance their flexibility while lowering costs and reducing emissions. LNG was not found to be cost-effective for use on Moloka’i and Lāna’i.

The PSIP Update results indicate that for Oahu, the lowest overall cost and lowest emissions are achieved in the case that includes a large-scale advanced combined cycle facility to replace older steam generators at the Kahe power plant combined with the use of LNG. Updated generation facilities will also make our overall system more resilient as

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<sup>1</sup> Docket No. 2012-0036, Order No. 32052: Regarding Integrated Resource Planning, Exhibit A: Commission’s Inclinations on the Future of Hawai’i’s Electric Utilities, at 7.

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Key Results: The Path to 100% Renewable Energy

a result of siting the new facilities outside of recently revised tsunami inundation zones. More specifically, with input from NextEra Energy, we have identified a 383 MW 3x1 combined cycle facility to replace Kahe Units 1-4 which could use LNG as a substitute for oil. This scenario – only possible as a merged entity – results in lower costs to customers over the planning period of cases evaluated, supports an increasing amount of renewables, reduces environmental emissions, and improves grid reliability and security. Furthermore, this advanced 3x1 combined cycle option appears to be advantageous with or without LNG, but is clearly better when using LNG as a transitional fuel source to get to a 100% RPS. In fact, when utilizing both LNG and the advanced combined cycle option on O’ahu, carbon dioxide emissions would be reduced by over 4.1 million tons by 2023. This is the equivalent of removing over 110,000 passenger vehicles from the road each year.

Again, such a scenario combined with other projects and programs envisioned for this same timeframe (such as Smart Grid, Schofield Generating Station projects, and others) would require the financial backing and development capacity of the merged organization.

## Grid-Connected Microgrids on Military Installations Enhance Statewide Resiliency

In Hawai’i, there is a growing and important role for distributed generation at military sites to enhance energy resiliency and security.

Microgrids on military sites that operate in complementary fashion interconnected to the utility grid:

- Provide resiliency and energy security for all our customers by using diversified locations for firm generation.
- Provide enhanced energy resiliency and security on military bases that are key to national defense and emergency or disaster response. These bases house airfields, ports, logistics, manpower, and housing necessary for major humanitarian response missions.
- Help ensure our state is capable of supporting military core missions and therefore remains a key sector of our economy.

In addition to the Schofield Barracks Generating Station previously approved by the Commission and well into the development process, this PSIP Update also includes plans for similar distributed generation on Marine Corps Base Hawai’i and Joint Base Pearl Harbor-Hickam.

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## FIVE-YEAR ACTION PLANS: SETTING A COURSE FOR OUR RENEWABLE FUTURE

Hawai'i is well on its way to meeting its energy goals as the Hawaiian Electric Companies exceeded a 23% RPS in 2015, substantial progress from 9% achieved in 2008, the year Hawai'i broke new ground with bold new renewable energy goals under the Hawai'i Clean Energy Initiative. The five year Action Plans will keep up the momentum.

Again, given the uncertainty and the future changes inherent in planning for a 30-year horizon, it's most important to focus on five-year action plans that keep up our progress, support the integration of increasing amounts of variable energy and reduce risk. The Action Plans are designed not to foreclose any future resource option.

### Key Steps In Our Five-Year Action Plans

**Implementing a Smart Grid Foundation Project** to install the modern wireless network, smart meters and other enhanced technology to modernize and improve the efficiency of our existing power grids.

**Implementing a Demand Response Management System (DRMS)** to enable greater use of evolving DR programs.

**Pursuing Market-Based DER for O'ahu, Hawai'i Island and Maui and High DG-PV for Moloka'i and Lāna'i.** High DG-PV will be considered for O'ahu in later years as an option to help close the gap to get to 100% renewable energy. In the near-term Action Plan period, market-based and High DG-PV levels are similar. DER programs by their nature can be adjusted to meeting changes in market interest, technology, pricing, value, and system needs.

**Installing Circuit Level Improvements on All Islands.** Enabling monitoring and controls to DER systems, upgraded conductors, voltage regulators, transformer replacements, reconfiguring circuits, distributed energy storage while leveraging existing and future advanced inverter functionality.

#### **Pursuing Energy Storage Options:**

- Installing 90 MW of utility-scale battery storage on O'ahu to provide contingency reserve power to help maintain reliability in an emergency situation, ensure energy resiliency under low inertia operating conditions, and to help meet fluctuating energy needs due to variable wind and solar resources.
- Install energy storage on Maui and Hawai'i Island to provide contingency reserves.
- Participating in many energy storage pilot projects with technologies that may provide grid services. Some of these pilots include (not an exhaustive list)

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Five-Year Action Plans: Setting A Course For Our Renewable Future

partnerships with innovative start-ups, such as Stem<sup>2</sup> and Shifted Energy<sup>3</sup>. Based on what we learn, we can pursue “front-of-the-meter” storage options and demand response programs, both directly and indirectly.

- Implementing several Moloka‘i projects including:
  - A battery storage research project in partnership with Hawaii Natural Energy Institute to determine applications for batteries in high solar PV penetration scenarios.
  - A pilot program in partnership with E-Gear LLC, installing their specialized Energy Management Controller and storage technology to allow at least 10 rooftop PV systems in the queue to move forward. The program will test the equipment monitoring capability and controllability of such systems by Molokai system operators and the impact of such advanced PV systems on the grid.
- Evaluation of other storage options, including for load shifting, as technologies improve and costs reduce.

**Implementing Community-Based Renewable Energy** using a phased approach to help ensure a sustainable program, in line with the market demand, while respecting the technical limitations of the electric grid. Community-based renewable energy programs are intended to provide affordable renewable energy options for our many customers who are renters or live in multi-unit buildings. The first phase is envisioned to last two years, to commence upon Commission approval. Learnings from the first phase will inform the planning process for the second phase.

**Issuing Requests for Proposals to seek over 351 MW of additional renewable energy** by 2022 via a competitive processes.

- 225 MW of utility- scale wind and solar for O‘ahu. This includes 25MW under a proposed CBRE program.
- 20 MW of firm dispatchable renewable capacity for Hawai‘i Island in 2022.
- 60 MW of variable renewable and 38 MW of firm dispatchable renewable or renewable-capable generation capacity for Maui to address the anticipated retirement of the Kahului Power Plant in 2022, growth in customer demand, constrained South Maui transmission capability, and Hawaiian Commercial & Sugar (HC&S) ceasing operations.
- 5 MW of wind energy for Moloka‘i and 3 MW of wind energy for Lana‘i for 2020

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<sup>2</sup> Stem is an energy storage provider that has deployed a pilot project aimed at demonstrating how distributed storage can help the utility affordably integrate more renewable energy onto the system.

<sup>3</sup> Hawaiian Electric is working with a company called Shifted Energy to deploy 499 grid interactive water heaters at the Kapolei Lofts development project (housing in Kapolei developed by Forest City) for the demand response program. See <http://www.greentechmedia.com/articles/read/hawaii-to-test-smart-water-heaters-as-grid-resources>.

**Researching alternative curtailment policies** to help ensure cost-effectiveness and flexibility in contracting renewable resources and supporting the reliable operation of the grid.

**Deactivating generation not well suited to support the integration of renewables.**

For O‘ahu, under the plan using LNG, Kahe Units 1 to 3 and Waiau Units 3 and 4 will be deactivated. On Maui, Kahului Units 1 to 4; and on Hawai‘i Island, the plan assumes the Puna Steam Unit will be deactivated.

**Taking the next steps to pursue the benefits of LNG.** Given the environmental, cost saving, price stability and price hedging benefits of LNG, we plan to submit an application to the Commission for approval of an LNG fuel supply agreement and related regulatory applications for the modernization of generation at O‘ahu’s Kahe Generating Station described in the Need for Flexible and Efficient Generation section above.

**Improving flexibility of existing generation** to help facilitate the integration of variable renewable generation (lower operating levels, ramp improvements).

## Investments for Hawai‘i’s Renewable Future

Achieving 100 percent renewable energy takes substantial capital investment. All options, whether the Preferred Plans or other candidate plans, require substantial amounts of capital, compensated for by customer savings over time. The total capital investment over the next 30 years for Hawai‘i is estimated to be \$25.8 billion (in nominal dollars), of which the utility may invest 53%, or \$13.6 billion. The balance may be made by project developers, customers, and the State (via tax incentives).

However, with this investment, we are able to modernize generation to be more flexible and efficient, transform our transmission and distribution system to better integrate both distributed and larger utility-scale renewables, and obtain the energy security and environmental benefits by achieving a 100% renewable future, all while keeping electric rates stable and relatively flat on a real dollar basis. Figure ES-5 through Figure ES-8 depicts the average monthly residential bill for O‘ahu over the planning period.

**Executive Summary**

Five-Year Action Plans: Setting A Course For Our Renewable Future

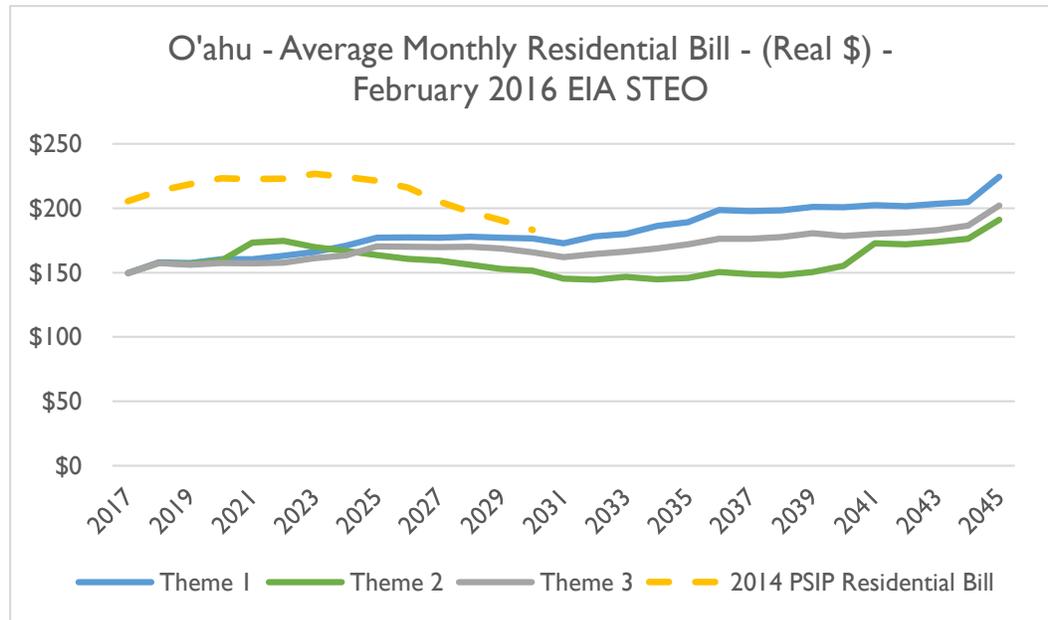


Figure ES-5. Residential Bill (Real 2016 \$): February 2016 EIA STEO

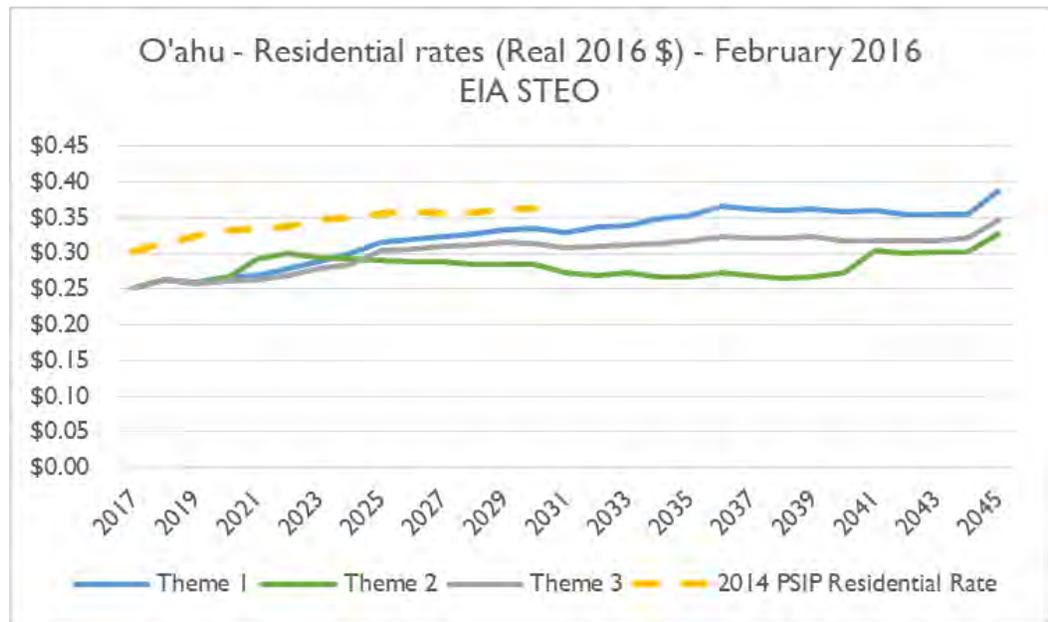


Figure ES-6. Residential Rates (Real 2016 \$): February 2016 EIA STEO

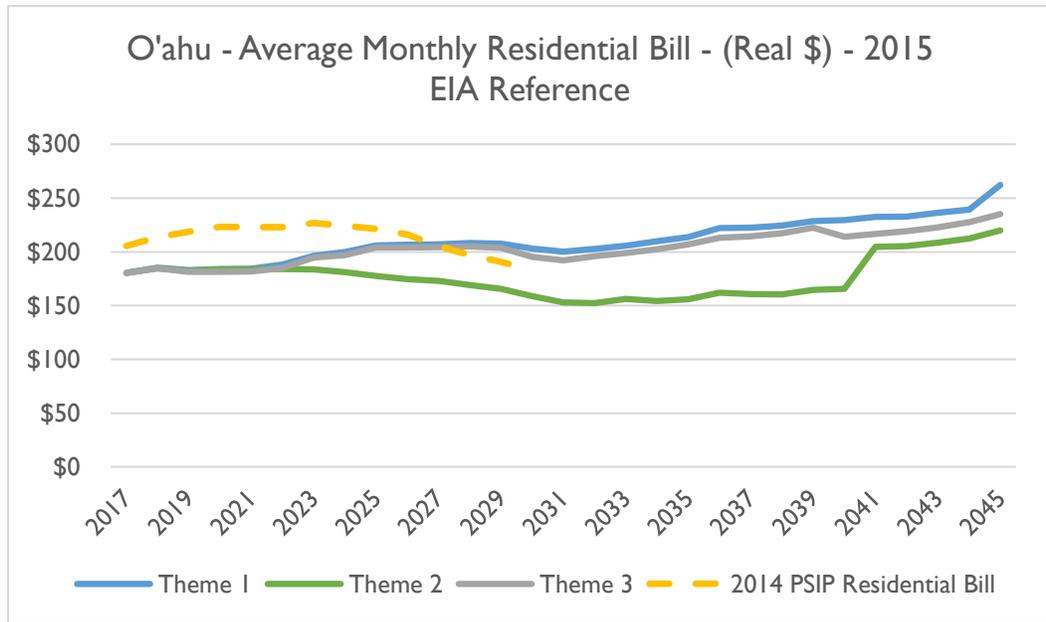


Figure ES-7. Residential Bill (Real 2016 \$): 2015 EIA Reference

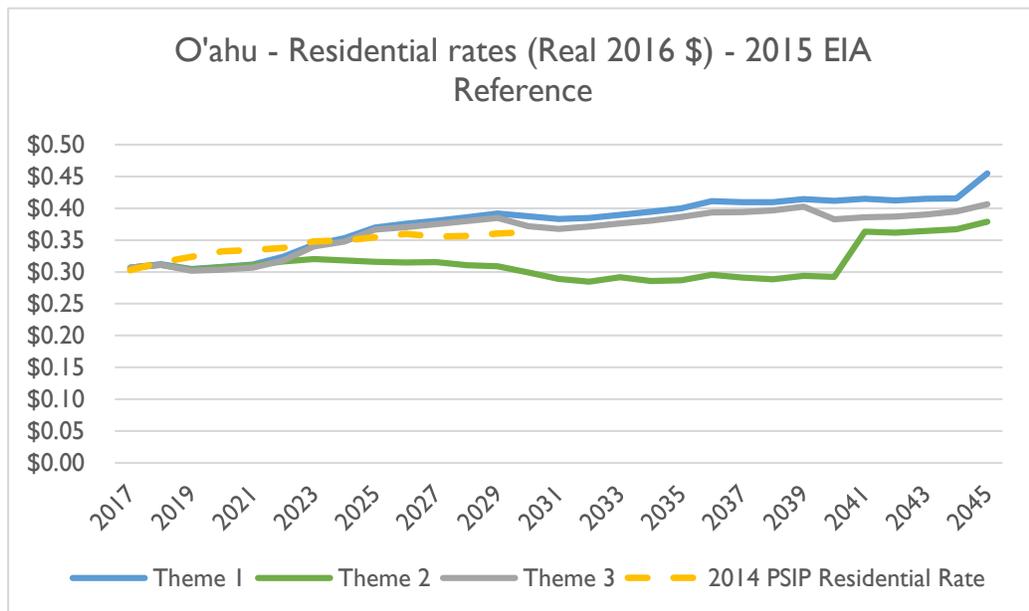


Figure ES-8. Residential Rates (Real 2016 \$): 2015 EIA Reference

### Stakeholder Input

Consistent with the Commission’s directive, on January 15, 2016, most of the Parties in this docket filed reports providing input into the process outlined in Order 33320. In addition, we held a stakeholder conference on December 17, 2015 and participated in an

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Five-Year Action Plans: Setting A Course For Our Renewable Future

Executive Summary Planning Status of Our PSIP Update Interim Status Report technical conference on January 7, 2016. The Commission also held another Technical Conference on March 8, 2016. We've also proposed another Technical Conference to be held on April 15, 2016.

We've considered the input received and have incorporated it, to the largest extent possible, into our analyses. Also, we've addressed several key points of feedback from the Parties. Examples include: sharing of resource cost assumptions with the Parties; establishment of an FTP site to facilitate sharing data and other information with the Parties and obtaining their feedback; use of a "decision framework" to establish a clear basis for how plan objectives will be prioritized; and introduction of a "PSIP Optimization process" consisting of iterative cycles for Distributed Energy, Demand Response and Utility-Scale Resources to capture analytical steps in achieving the 100% RPS goal.

We invited Parties in the docket to attend and participate in our working meetings where we reviewed analysis, made decisions on further refinements, and discussed the modeling analysis for completing the 2016 updated PSIPs. Representatives from DBEDT, the Consumer Advocate, and the County of Hawai'i participated in about 10 meetings.

As indicated in our Proposed PSIP Revision Plan, additional organizations provided independent technical analyses to help address issues of concern. These stakeholders include the Hawaii Natural Energy Institute, Electric Power Research Institute, U.S. Department of Energy, University of Hawai'i Economic Research Organization, National Renewable Energy Laboratory, and Hawai'i Energy.

## Unprecedented Process

The 2016 updated PSIP is a first of a kind planning analysis that aims to optimize resources across those owned by customers, other third parties, and utilities, to include behind-the-meter DER, distribution resources, transmission, and centralized power plants. Though this massive planning process we are completely transforming our power grids.

To create our 2016 updated PSIPs, we developed new tools, new processes, and new methods to plan for the utility of the future and used a team of industry-leading consultants. Because of schedule constraints, we have not been able to fully utilize some of these new tools, processes, and methods, nor fully realize their benefits. After the April 1 filing, we plan to continue using these newly developed methodologies as we continue our work in this docket and in other related (such as DER and DR) dockets.

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## NEXT STEPS

Given the scope of that directive and the timeframe in which to complete it, we have completed a thorough analysis to develop PSIP updates that include five-year action plans that can be implemented in the short-term. We will continue to evaluate the potential long-term renewable resource options especially for the period of time after 2030.

### Updated Fuel Price Forecasts

One of the foundations of our analysis is the fuel price forecasts for LNG and petroleum-based fuels. The U.S. Energy Information Administration issues updated fuel price forecasts generally mid-year. After we receive these forecasts, we can update our analysis based on these updated prices. We expect to file an addendum to our 2016 updated PSIPs within two months after these fuel price forecasts are published.

### Analyze Inter-Island Transmission

Given the findings of the PSIP Update that O'ahu will likely need a substantial amount of off-island renewable resources in order to meet a 100% renewable energy goal in 2045, we plan to reassess the scope and requirements for an interisland cable. As a follow-up action, we plan to (a) identify viable resource alternatives, such as wind and geothermal, and resource availability and location; (b) develop capital cost estimates for the alternatives, including cost to integrate the resources; and (c) complete the analyses comparing the alternatives and mixes of alternatives.

### Perform Further Research on Offshore Wind

Although our current plan projects the use of significant amounts of offshore wind energy, we plan to perform further evaluation of the viability of these resources. This would include assessing the resource potential, evaluating possible onshore interconnection configurations, identifying risks factors (for example, permitting, community acceptance, natural hazards and hazards from human activity), and refining resource development and installation costs. These evaluations will be performed in conjunction with our planned analysis of an interisland cable system.

### Perform Additional System Security Analysis for the Preferred Plans

While system security analyses were performed as part of the PSIP Update, additional analysis will be completed, including a protection coordination study, reactive power requirements and voltage stability analysis.

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Working Together for Hawai'i's Renewable Energy Future

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### WORKING TOGETHER FOR HAWAI'I'S RENEWABLE ENERGY FUTURE

Although our energy environment is changing more rapidly than ever, what is clear is that Hawai'i's 100% RPS goal is achievable, technology and pricing will continue to change to make this possible, and foundational investments in more flexible generation and use of cleaner fuels in the transition can be an important step as increasing amounts of variable renewable energy resources are added on our path to 100% renewable energy. Most importantly, achieving the groundbreaking 100 percent renewable energy goal for our state will take *our entire community working together* to make the difficult decisions needed to achieve this clean energy future for our state.

