POWERING PARADISE

How Hawaii Is Leaving Fossil Fuels and Forging a Path to a 100% Clean Energy Economy

By Dan Cross-Call, Jason Prince, and Peter Bronski

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Suggested Citation
Dan Cross-Call, Jason Prince, and Peter Bronski, *Powering Paradise: How Hawaii Is Leaving Fossil Fuels and Forging a Path to a 100% Clean Energy Economy*, Rocky Mountain Institute, 2020, **www.rmi.org/insight/powering-paradise.**

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Acknowledgments
The authors thank the following individuals for graciously offering their insights on this work. Their perspectives have been anonymized and aggregated, and are infused throughout this report's narrative.

- Jim Alberts, SVP Business Development & Strategy, the HECO Companies
- Colton Ching, SVP Planning & Technology, the HECO Companies
- Leslie Cole-Brooks, former Executive Director, Hawaii Solar Energy Association; former Executive Director, Distributed Energy Resources Council of Hawaii
- Kyle Datta, former General Partner, Ulupono Initiative
- Jay Griffin, Chair, Hawaii Public Utilities Commission
- Robert Harris, Director of Public Policy, Sunrun (prev. Sierra Club)
- Rep. Chris Lee, Hawaii House of Representatives
- Dawn Lippert, CEO, Elemental Excelerator
- Melissa Miyashiro, Managing Director, Blue Planet Foundation
- Hermina Morita, Former Chair, Hawaii Public Utilities Commission
- Dean Nishina, Executive Director, State of Hawaii Division of Consumer Advocacy
- Jeff Ono, Partner, Watanabe Ing (prev. State of Hawaii Division of Consumer Advocacy)
- David Parsons, Chief of Policy & Research, Hawaii Public Utilities Commission
- Brad Rockwell, Power Supply Manager, Kaua'i Island Utility Cooperative (KIUC)
- Steven Rymsha, Director of Grid Solutions, Sunrun (prev. MECO, KIUC)

ABOUT ROCKY MOUNTAIN INSTITUTE

Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. RMI has offices in Basalt and Boulder, Colorado; New York City; the San Francisco Bay Area; Washington, D.C.; and Beijing.

Support for this work was generously provided by the Robertson Foundation.

This paper is the work of RMI alone and does not necessarily reflect the opinions or views of the Hawaii PUC nor any other persons or organizations in Hawaii.

Hawaii is "building more than an innovative and clean economy—we're building hope."

—Rep. Chris Lee and Melissa Miyashiro (*Seattle Times*, 2019)

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List of Acronyms

AMI	Advanced metering infrastructure
ARA	Annual revenue adjustment
CBRE	Community-Based Renewable Energy
CGS	Customer Grid-Supply
CSS	Customer Self-Supply
DBEDT	The Department of Business, Economic Development, & Tourism
DER	Distributed Energy Resource
DR	Demand response
ESM	Earnings sharing mechanism
GMS	Grid modernization strategy
GSPA	Grid services purchase agreement
HCEI	Hawaii Clean Energy Initiative
HECO	Hawaiian Electric Company Inc.
HELCO	Hawaii Electric Light Company Inc.
HSEO	Hawaii State Energy Office
IGP	Integrated grid planning
IRP	Integrated resource plan
KIUC	Kaua'i Island Utility Cooperative
LVM	Locational value map
MECO	Maui Electric Company Limited
MPIR	Major projects interim recovery
MRP	Multiyear rate plan
NARUC	National Association of Regulatory Utility Commissioners
NASEO	National Association of State Energy Officials
NEM	Net-energy metering
PBR	Performance-based regulation
PIM	Performance incentive mechanism
PPA	Power purchase agreement
PSIP	Power Supply Improvement Plan
PUC	Public Utilities Commission
PV	Photovoltaics
RFI	Request for information
RPS	Renewable portfolio standard
SCADA	Supervisory control and data acquisition
SGF	Smart Grid Foundation

Executive Summary

Surrounded by thousands of miles of blue ocean, a string of sparkling islands carves a slice of paradise in the middle of the Pacific Ocean. Famous for its stunning beaches, lush forests, and active volcanoes, Hawaii has been showcased in iconic movies from Jurassic Park to Pearl Harbor.

Beyond its natural beauty, Hawaii has also become recognized for its leadership in paving a path to an economy powered by renewable energy.

The implications of Hawaii's embrace of clean energy extend far beyond the island chain. In 2015, Hawaii was the first US state to proclaim a 100% renewable energy target for each of its six separate island electric systems. Since then, 14 other states, over 110 cities, and 20 utilities have followed suit to commit themselves to 100% clean or renewable energy goals. A consummate role model, Hawaii continues to pioneer approaches to make ambitious clean energy targets a reality, from how energy resources are procured and managed, to how the electricity system is planned, to re-envisioning the role and business model of the utility.

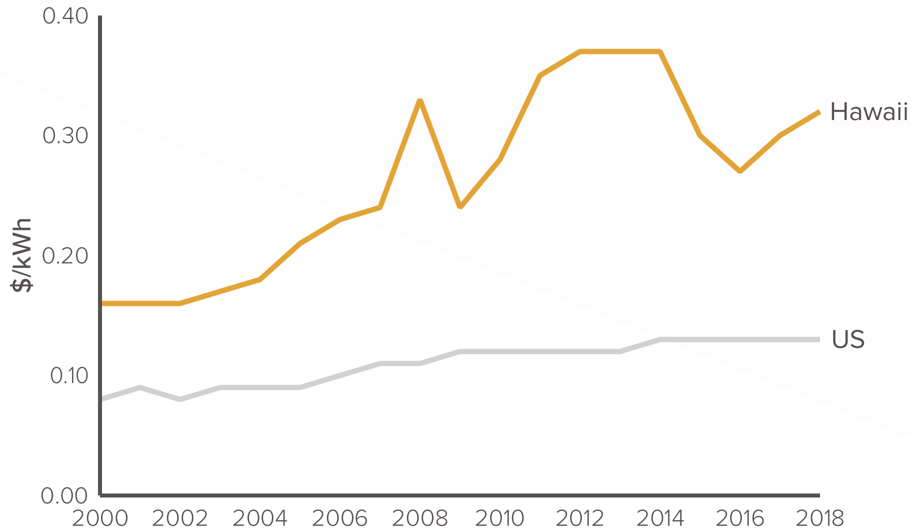
So how do a set of islands so far removed from the US mainland become the paragon of the clean energy transition?

EXHIBIT 1
Overview of Hawaii's Electricity Sector

3X

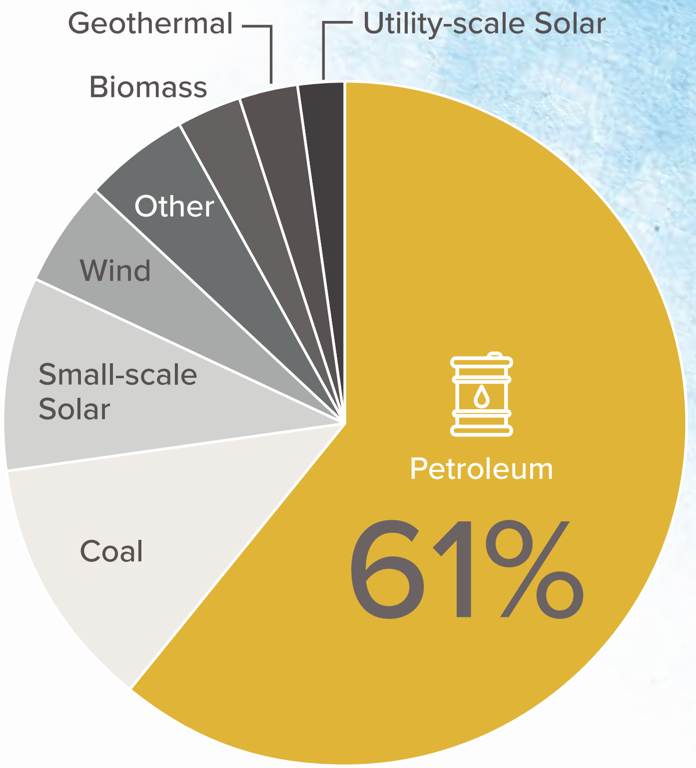
Hawaii's retail electricity rates are the **highest** in the United States and roughly **triple** the US **average**.

Average Annual Residential Electricity Rates



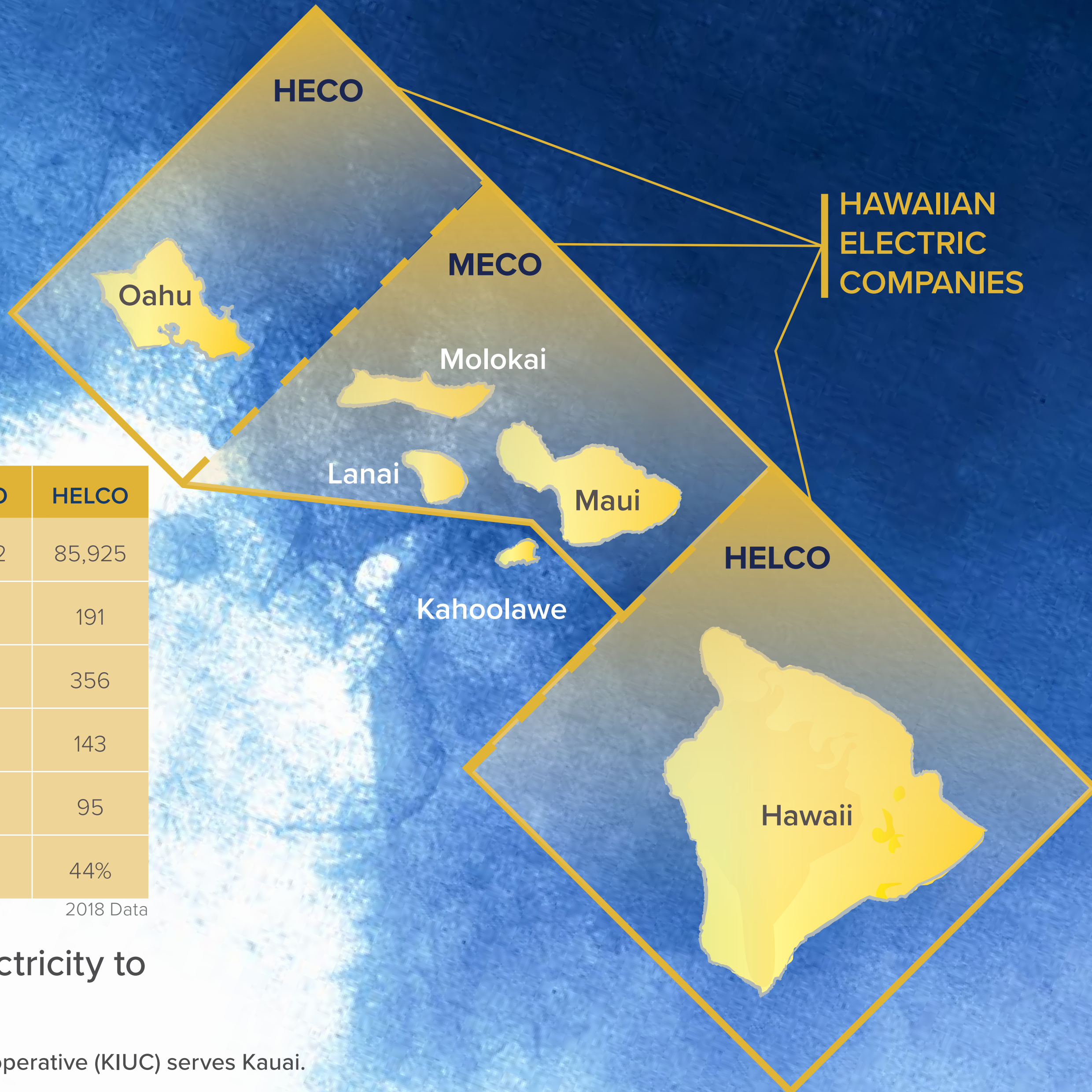
Source: The Energy Information Agency and the Hawaii State Energy Office

Hawaii Electricity Production by Source (2018)



A major driver of Hawaii's expensive electricity is the state's **dependence** on **imported petroleum** for electricity generation.

KAUAI ISLAND UTILITY COOPERATIVE



	KIUC	HECO	MECO	HELCO
Customers (#)	37,705	304,948	71,352	85,925
Peak demand (MW)	77	1,190	218	191
Total generation capacity (MW)	210	2,626	466	356
Renewable generation capacity (MW)	93	908	192	143
Customer-sited solar (MW)	31	524	112	95
Renewable energy (% of sales)	44%	22%	37%	44%

2018 Data

Two electric utilities provide electricity to Hawaii's 1.42 million residents:

1. The nonprofit member-owned Kauai Island Utility Cooperative (KIUC) serves Kauai.

2. The investor-owned Hawaiian Electric Companies (the HECO Companies) serves 95% of the state's residents and is comprised of Hawaiian Electric Company Inc. (HECO) serving Oahu; Maui Electric Company Limited (MECO) serving Maui, Molokai, and Lanai; and Hawaii Electric Light Company Inc. (HELCO) serving Hawaii Island.

Source: The HECO Companies and Kauai Island Utility Cooperative

In part, Hawaii's leadership is circumstantial. Hawaii's power plants rely heavily on imported fossil fuels (mainly oil), which are expensive to ship to the islands and susceptible to global commodity price volatility and supply disruptions. High fuel costs translate to the most expensive retail electricity rates in the nation—up to roughly three times higher in Hawaii than the US mainland average. This creates a greater financial incentive for Hawaii's utilities to pursue grid-scale renewables and for Hawaii's residents to adopt self-generation technologies like solar photovoltaics (PV) and other distributed energy resources (DERs) including technologies that enable the production and flexible consumption of energy.

As of 2019, Hawaii has over 80,000 rooftop PV systems[1] and distributed solar is the number one source of clean electricity in the state.[2] The degree of solar saturation is unprecedented in the United States. Compared to the 2% national average,[3] 19% of the HECO Companies' residential customers have rooftop solar, and on Oahu, solar is on one out of every three single-family homes.[4] All this solar has forced changes to the electricity system to accommodate customer choice and leverage the full spectrum of services that customer-sited technologies can provide to the grid.

In addition to these market dynamics pulling Hawaii through the energy transition, deliberate leadership from legislative, utility, regulatory, and grassroots levels is also critical to moving the state forward.

A series of legislative precursors pushed by brave politicians created the momentum to pass the 100% renewable law in 2015. Similarly, Hawaii's utilities are leading on the implementation of innovative electric planning and procurement processes, customer solar and demand management programs, and advanced rate designs that will allow the state to achieve that 100% target. The operationalization of these strategies has been directed by consistent regulatory guidance that has set the course for utility evolution and ensures alignment of utility incentives with customer needs and state policy goals.

And underlying all the state's progress is a dedicated community of stakeholders including city, county, and state representatives; energy advocates; renewables developers; environmental organizations; and other nonprofits that have built public support for the state's ambitions and fostered the cohesion required to make change.

The culture of relentless innovation that permeates Hawaii continues to be cultivated by this community. Together, these organizations and individuals constitute a broad ecosystem of bold, committed change agents that are demonstrating that a decarbonized energy system is not only possible but also practical and necessary.

From the efforts of the Hawaii energy community, three important lessons emerge:

1. **A willingness to try** – Hawaii is constantly pushing boundaries, without always having a clear script for where it will go. Others can learn from Hawaii's missteps, but should also be emboldened to take their own risks, assured that rapid feedback loops will accelerate rather than impede progress toward solutions.

2. **Clear guidance from leadership** – From the justification for the 100% renewable energy goal, to the framing for the utility of the future and expectations for stakeholder engagement in regulatory proceedings, Hawaii demonstrates the importance of establishing reasoned, clear, and compelling intentions for the energy transition.

3. **Stakeholder engagement** – As it stepped into the unknown across so many fronts, Hawaii has consistently crowdsourced invaluable wisdom from local stakeholders, as well as drawn upon national and international experience. Ensuring broad support for its actions has been critical for maintaining momentum and making progress toward goals that benefit everyone.

What follows is a description of Hawaii's journey through the energy transition of the last decade, as it discovers and embodies these lessons. It is based on insights from interviews with a set of key stakeholders, combined with Rocky Mountain Institute's (RMI's) own research and firsthand experience working in Hawaii, including with the Public Utilities Commission (PUC).

Our goals with this report are twofold:

1. To shine a deserving light on Hawaii's visionary clean energy leadership, and

2. To offer insights, perspectives, and learnings that can help others around the world follow in Hawaii's footsteps while navigating their own clean energy transitions.

By necessity, this report is an incomplete telling of the Hawaii energy story—too many events and untold numbers of individuals and organizations have been instrumental to the unfolding narrative. However, in order to share a meaningful review of what is taking place in Hawaii, beyond the glimpses that trickle out with piecemeal news events and reporting in industry media, we have attempted to distill the story to a digestible and insight-oriented length. In that manner, we hope that we have filled in some details of what many across the US and global energy system have been hearing out of Hawaii, as well as paint a picture of how the clean energy transition can be managed everywhere.

Of course, Hawaii's story cannot be told through simple cause-and-effect relationships. Rather, it must be compiled by weaving together temporally and topically interrelated threads. For this reason, report chapters are organized thematically—leadership, market transformation, grid evolution, and utility business model innovation—and events between each chapter often overlap (see Exhibit 2).

EXHIBIT 2

Timeline of Events

Note: HECO refers to the HECO Companies

1993

Utility-Scale Renewables

Puna Geothermal Venture “PGV” (25 MW geothermal)

2001

Leadership

Act 272: 9% Renewable Portfolio Standard established

Rooftop Solar

Net energy metering (NEM) enacted

2002

Utility Business Model

KIUC formed

2006

Utility-Scale Renewables

Kaheawa Wind Power “KWP” (30 MW wind)

2008

Leadership

Hawaii Clean Energy Initiative established

Utility-Scale Renewables

Contracting price-tie between oil and renewables severed

2009

Leadership

Act 155: 40% Renewable Portfolio Standard

2010

Rooftop Solar

Sunrun arrival

Utility Business Model

PUC approves decoupling mechanism

2011

Rooftop Solar

Fukushima disaster sends Hawaii electricity prices higher

SolarCity arrival

Utility-Scale Renewables

PGV expanded (13 MW geothermal)

KIUC Biomass-to-Energy (7 MW biomass)

Grid Planning

PUC issues revised Integrated Resource Plan (IRP) Framework

2012

Rooftop Solar
Vivint arrival

Utility-Scale Renewables
KWP II (21 MW wind / 10 MW storage)

Auwahi Wind (21 MW wind / 11 MW storage)

Grid Planning
PUC provides 'Principle Issues' to be addressed in IRP

2013

Rooftop Solar
HECO announces solar interconnection process changes

Grid Planning
HECO files IRP Report

2014

Grid Planning
PUC rejects the IRP Report and issues *Inclinations*

HECO files Power Supply Improvement Plans (PSIPs)

HECO files Smart Grid Roadmap

2015

Leadership
Act 97: 100% Renewable Portfolio Standard

Rooftop Solar
NEM repealed

Customer Self-Supply (CSS) and Customer Grid-Supply (CGS) tariffs become effective

Grid Planning
PUC rejects PSIPs

Utility Business Model
Maui County issues RFP for utility ownership options analysis

2016

Grid Planning
HECO files Smart Grid Foundation Project (SGF) and PSIP Update

Utility Business Model
PUC rejects NextEra merger

2017

Rooftop Solar
PUC approves Customer Grid-Supply Plus (CGS+) and Smart Export tariffs

Utility-Scale Renewables
KIUC SolarCity/Tesla Project (13 MW solar / 13 MW storage)

Grid Planning
PUC rejects SGF, orders HECO to submit Grid Modernization Strategy (GMS)

HECO files GMS

PUC approves PSIPs

Utility Business Model
PUC approved demand response performance incentive and establishes shared-savings incentive

2018

Rooftop Solar
CGS+, Smart Export, and Net Energy Metering Plus (NEM Plus) tariffs become effective

Grid Planning
HECO files IGP Report and Workplan

Utility Business Model
PUC opens performance-based regulation (PBR) docket and conducts Phase 1, issuing 3 Staff Concept Papers

2019

Utility-Scale Renewables
KIUC AES Lawai (20 MW solar / 20 MW storage)

PUC approves 7 HECO projects (260 MW solar / 1 GWh storage)

HECO issues Stage 2 RFP for 900 MW

Grid Planning
PUC accepts IGP Workplan and GMS

HECO files IGP review point proposal. PUC responds citing concerns

HECO executes first Grid Services Purchase Agreement

Utility Business Model
State Energy Office publishes utility ownership study

PUC issues the PBR Phase 1 Decision and Order and Phase 2 Convening Order

Each chapter focuses on one important facet of Hawaii's experience and highlights takeaways that characterize the state's energy transition. Takeaways provide insights for the many different aspects of energy system innovation that Hawaii embodies. They are described throughout the report and summarized here for ease of reference.

Prologue: Committing to a 100% Renewable Energy "Moonshot"

Transforming the electricity system is a complex problem with diverse stakeholders, far-reaching implications, and no ready blueprint. Solving such a complex problem requires systems thinking, collaboration, and experimentation. It also benefits from a clear organizing principle—In Hawaii's case, the 100% renewable portfolio standard (RPS).

1

Leadership Defines the North Star

There is never a perfect time to commit to ambitious energy sector goals, so leaders from government to grassroots must work together and be willing to take chances to advance policies that support systemic change. In Hawaii, leaders have consistently articulated and justified a vision for the energy transition that galvanized support for a progressive portfolio of legislation and aligned stakeholder efforts toward renewable energy goals.

2

The Rooftop Solar Revolution

As the economic case for DERs propels adoption, utility programs and policies must adapt to ensure that the full spectrum of DER capabilities are harnessed to support grid operations. By refining solar compensation amounts and increasing transparency of the distribution system, utilities can work with customers and third parties to optimally site DERs and more efficiently solve grid issues. In Hawaii, record levels of rooftop solar necessitated technical and operational advancements as well as new approaches to customer programs that continue to evolve and improve the beneficial integration of customer-sited technologies.

3

Going Big with Renewables

Utility-scale renewable generation represents a low-cost opportunity for cleaner electricity supply. But all development is local, and community engagement is critical to ensure support for renewable projects. Without addressing the human element of renewables, projects do not get built. In Hawaii, land scarcity and inter-island dynamics underline this point and emphasize the need to ensure that benefits from renewable energy are equitably shared and well understood.

4

Reinventing the Grid

Utility planning, traditionally the exclusive domain of utility engineers and energy insiders, must be reformed to address a changing electricity ecosystem. The locational nature of DERs requires more focus on distribution planning, whereas the range of grid services that DERs can provide necessitates a systems approach to planning that accounts for the generation, distribution, and transmission systems in an integrated manner. Hawaii's utilities are pioneering modern practices for their island grids that address these changes by reconsidering the roles of customers, service providers, and the utility in planning and procurement.

5

The Utility Business Model Reimagined

Whatever their ownership structure, utilities are fundamentally businesses that provide electricity and behave according to a relevant set of incentives for doing so. Attention to those incentives is critical to ensure they are aligned with policy objectives for achieving renewable energy goals. For this reason, Hawaii is updating utility regulations in a manner that encourages a modern, viable utility business that fulfills customer and societal needs. The state is investigating performance-based regulation (PBR) to create an appropriate and effective regulatory framework that fulfills the ambitions of the state's energy transition.

Epilogue: The Canary on The Mountaintop

The Hawaii energy transition is not an abstract story removed from mainland concerns. Hawaii is on the front lines of the global climate challenge, including very directly for scientific measurement and now, increasingly as a barometer for coming challenges as well as solutions. Hawaii's energy future may be our shared future, and we would all do well to make it a successful one.

Rocky Mountain Institute's Roles in Hawaii

RMI has been fortunate to work with Hawaii stakeholders in support of the state's energy transition in a variety of capacities over the years. This has spanned energy system planning work performed for the Department of Business, Economic Development, & Tourism (DBEDT) and the HECO Companies in the 2004–2007 timeframe, to our current work for the Hawaii PUC.

In 2014, a Hawaii project team attended RMI's inaugural e-Lab Accelerator workshop. That team, composed of representatives from the HECO Companies, the PUC, environmental groups, and DER companies, came together to review system needs and map a path forward for DER integration and utility reform. A second Hawaii team attended the 2016 e-Lab Accelerator for a strategic planning discussion of transportation electrification issues in the state, leading to the creation of Drive Electric Hawaii.[5] In 2019, another group of transportation stakeholders, including the State and County governments and the Ulupono Initiative, attended RMI's Mobility Innovation Lab meeting to advance transportation electrification in the state, tackling challenges in procurement of electric vehicles for government fleets.

Since 2017, RMI has served as an advisor to the Hawaii PUC. In this capacity, we support the Commission's review of new tariff designs and customer programs for solar and DER expansion, as well as advise the Commission on process design and management of regulatory dockets including the Integrated Grid Planning (IGP) and Performance-Based Regulation (PBR) proceedings. In the PBR investigation, RMI also serves as facilitator of the stakeholder process to develop new PBR regulations for the HECO Companies.

Our firsthand experience in Hawaii, including personal appreciation and admiration for the work unfolding there, inspired us to write this paper and informs the story we have sought to tell.

Prologue
Committing to a 100% Renewable Energy “Moonshot”

In June 2015, Hawaii Governor David Ige signed into law the landmark Act 97 legislation that established a 100% renewable energy target for the state’s electricity sector (see Exhibit 3). With Ige’s signature, Hawaii became the first state in the nation to commit to such an ambitious energy path.[6]

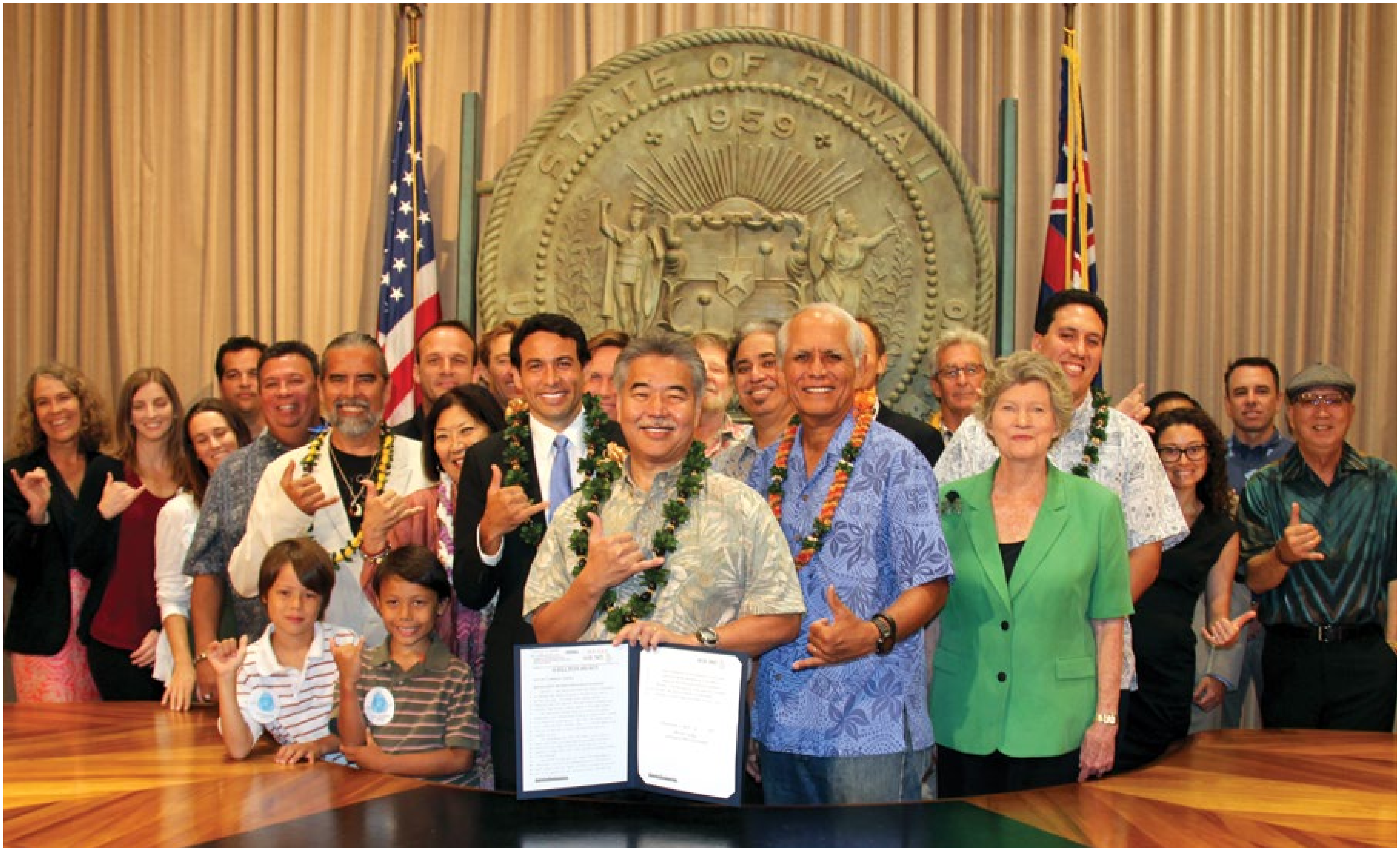
Some considered the 100% target technically unattainable, unfeasibly expensive, and politically untenable. But Act 97 did not occur in a vacuum. Its passage was part of a sustained effort in the Aloha State that spanned more than a decade and included a progression of clean energy milestones. Act 97 built on this momentum and galvanized the state’s stakeholders around a shared vision that fundamentally changed the energy transition dialogue. The conversation was no longer *if* Hawaii could achieve a 100% renewable energy future, but *how* Hawaii would achieve that future. In short, many called Act 97 a “gamechanger.” And it was.

With Act 97, even Hawaii’s most resistant or skeptical stakeholders became friendly allies, at least when it came to the grand vision. Far from impossible, stakeholders have found that 100% could be achieved *ahead* of the law’s 2045 mandate and at a net *savings*, rather than cost, to the state and its citizens.[7] Differences—sometimes significant—remain regarding the practical matters of how to get there, but everyone is now in one canoe, paddling toward a common destination. Going forward, the effort is to make the paddling ever more coordinated and efficient.

This story is still being written, with important chapters just ahead. But already, one thing is clear: Hawaii has brought the 100% renewable energy moonshot resolutely down to Earth.

EXHIBIT 3

Governor Ige Presenting the Signed Act 97 Legislation



Source: Governor David Y. Ige, https://www.flickr.com/photos/govhawaii/sets/72157654251533972/

Hawaii's Innovation Lab Approach to Energy Transformation

Transforming Hawaii's energy system is a complex problem: the forces of change are varied, engaging the diverse cast of stakeholders is imperative, and innovative solutions must be developed. Tackling such a complex problem requires an "innovation lab" approach.

Innovation labs approach problem-solving by holistically addressing three types of complexity that frequently define intractable challenges: dynamic, social, and generative (see Exhibit 4). Confronting these elements in combination requires an innovation mindset that is unlike conventional policymaking or technical problem-solving.

Dynamic complexity refers to problems in which cause and effect are far apart (e.g., in time or in space) yet interdependent. For example, climate change effects being felt today in one geography may be caused by actions that took place years ago in a different geography. Similarly, resource planning or regulatory changes made today will impact investment decisions for years to come. Dynamic complexity requires a ***systems-based approach***. Thinking systemically allows stakeholders to broaden and deepen their understanding of interactive effects, to better see the whole picture of what is happening and what could happen.

Social complexity refers to situations where actors have different perspectives and interests. Energy issues inherently involve many stakeholders and institutional interests, including utilities, service providers, customer advocates, and environmental advocates. Each has important and differing points of view, needs, and requirements. Social complexity requires a ***collaborative approach***, in which "stakeholders shift from being unwilling or unable to work together, to building their capacity to work together across differences."[8]

Generative complexity refers to challenges that have never been confronted before, in which the future is uncertain. Solutions that have worked in the past for other challenges cannot be "copied and pasted;" there are no best practices to repeat. Generative complexity requires a ***creative and experimental approach***, in which stakeholders are willing to test new ideas, knowing that they must act now, learn from potential failures, and iterate as they move forward into uncharted territory.

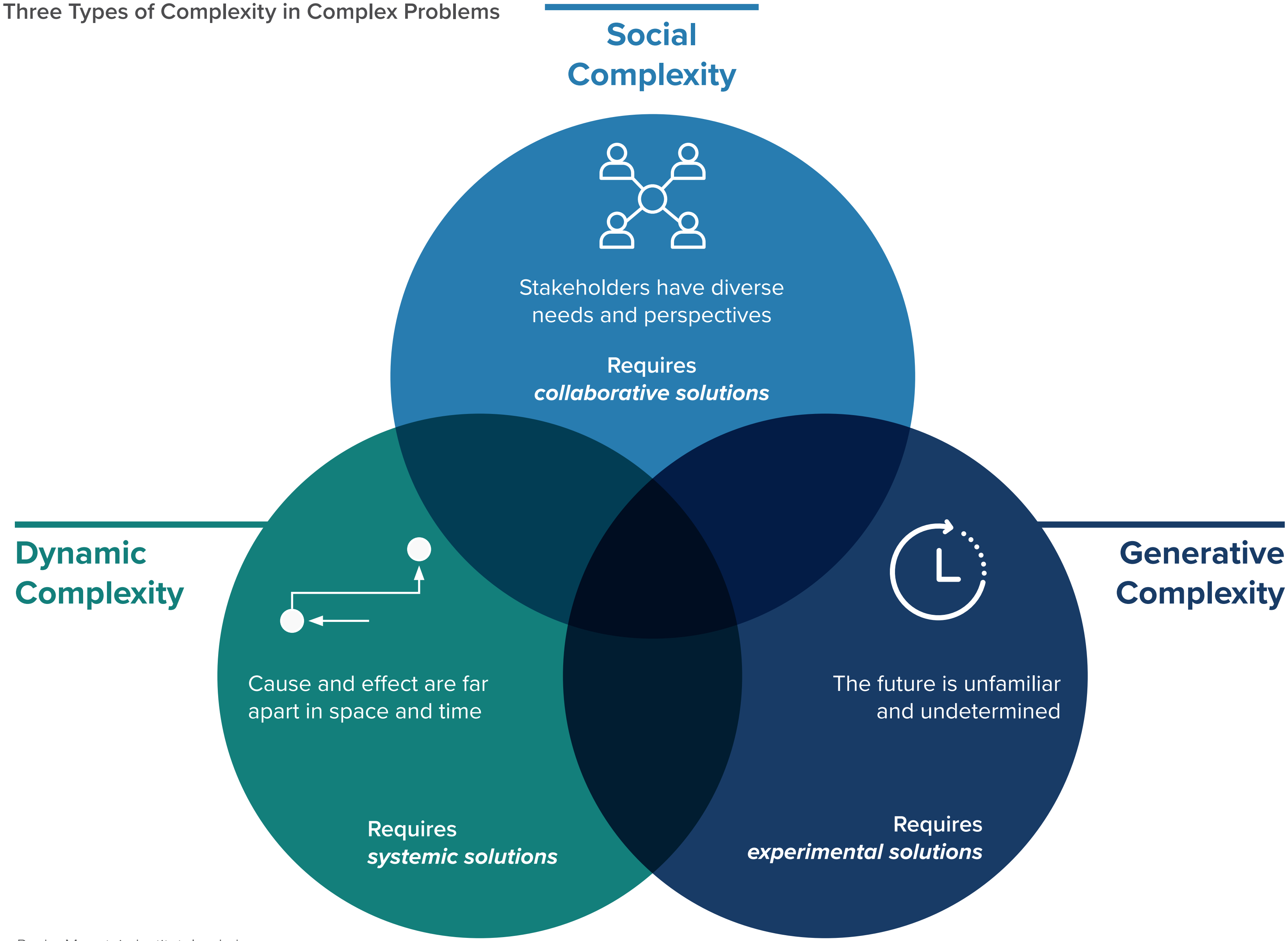
Problem-solving approaches that recognize and address these three types of complexity head-on are more likely to succeed, avoiding the pitfalls of more traditional or linear problem-solving. Solutions that consider all aspects of the system, explicitly include a variety of perspectives and are designed to be flexible and iterative can create pathways to transformative new solutions, rather than tweaks around the edges.

Innovation labs can be formal entities, such as RMI's Electricity Innovation Lab (e^-Lab). For the past seven years, e^-Lab has convened stakeholders from across the North American electricity system to work collaboratively and advance clean energy solutions. Now, RMI's e^-Lab approach is being adapted and applied elsewhere around the world, such as in Australia's A-Lab[9] and Chile's own e^-Lab.[10]

In other cases, innovation labs develop organically. Although no official "Hawaii energy innovation lab" exists for the state's collective efforts, stakeholders have been operating as a de facto innovation lab to bring systemic, collaborative, and creative approaches to tackle the state's complex challenge of transitioning to a 100% renewable energy economy. That's why Hawaii is often described as an "innovation ecosystem," where leaders from the utilities, state and federal government institutions, and environmental groups, as well as organizations like Elemental Excelerator—which funds startups with place-based, community-oriented approaches—play pivotal roles to foster new technology, policies, business models, and more.

EXHIBIT 4

The Three Types of Complexity in Complex Problems



Source: Rocky Mountain Institute's e Lab

Leadership Defines the North Star

1

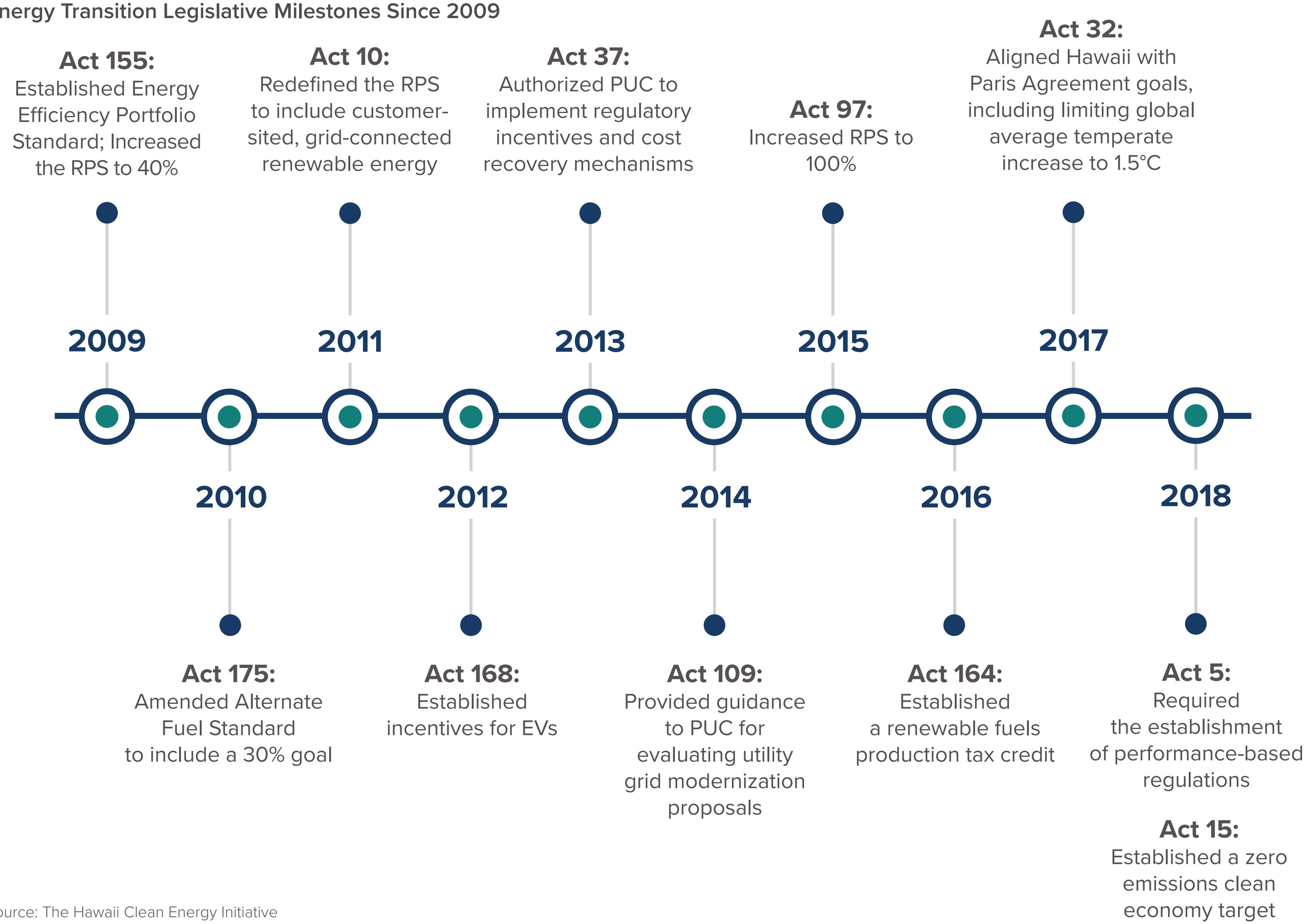
Introduction: A Legislative Portfolio for the Energy Transition

Act 97 is arguably Hawaii's most important clean energy milestone to date, but the state's renewable energy story has had more than one climax. The first watershed moment came with the launch of the Hawaii Clean Energy Initiative (HCEI) in 2008. A partnership between the state of Hawaii and the US Department of Energy, HCEI supports stakeholder collaboration to make Hawaii an innovation test bed for the transformation of the energy sector into one based on renewable energy and energy efficiency. HCEI thus describes itself as the "impetus that started Hawaii's journey from the most fossil fuel-dependent state in the country to a world leader in clean energy."[11]

With oil prices and Hawaii's retail electricity rates spiking in 2008, the state's leadership was sharply reminded that heavy reliance on imported oil left the islands exposed to volatile and high prices. It was clear that something needed to be done. Yet forming HCEI took a dedicated "coalition of the willing" that worked across party lines in the service of a common good for Hawaii's residents.

EXHIBIT 5

Energy Transition Legislative Milestones Since 2009



Source: The Hawaii Clean Energy Initiative

“If HCEI was the spark that ignited Hawaii’s clean energy transition, the ensuing flame has been the result of sustained efforts by the state’s legislature, governor’s office, energy office, grassroots advocates, and PUC.

Hawaii was under the governorship of Linda Lingle at the time, the only Republican governor in a 40-year stretch of Democratic governors[12] and a continuously Democratic state legislature.[13] Lingle formed a coalition with Democratic Hawaii House of Representatives member Hermina “Mina” Morita (who later served as chair of the Hawaii PUC), Democratic State Senator J. Kalani English, and long-time administrator of Hawaii’s State Energy Office Maurice Kaya.

HCEI might never have happened if it were not for everyone in this group rising above partisanship and concerns over who would get to claim credit for the win. As it happened, there was enough credit for all parties and individuals to share in the ensuing success.

In the years since HCEI was established, Hawaii’s legislature passed a steady stream of legislative milestones year after year (see Exhibit 5).[14] From Act 155 in 2009, which expanded Hawaii’s renewable portfolio standard (RPS) to 40% by 2030,[15] to Act 97 in 2015, which raised the target to 100% by 2045, legislation created and illuminated a North Star for the state to follow.[16]

If HCEI was the spark that ignited Hawaii’s clean energy transition, the ensuing flame has been the result of sustained efforts by the state’s legislature, governor’s office, energy office, grassroots advocates, and PUC.

Thanks to the collective action of these stakeholders, the portfolio of bills ratified—some incremental advancements, others monumental milestones—provided the momentum to enable the energy transition to survive election cycles and administrations. They also created a culture of ambition and change.

Regulatory Leadership by the PUC

Legislation may have defined Hawaii’s North Star, but it has been the PUC’s responsibility to steer the state’s electricity providers in the direction of that 100% renewable energy goal.

Like other state commissions around the country, Hawaii’s PUC was established for the traditional role of reviewing and approving utility business investments to ensure “just and reasonable” rates to customers. In response to the changing energy landscape, however, the PUC is transforming itself into a more modern agency that anticipates and proactively addresses the evolving needs of the grid. Often serving as the leader of electricity reforms, the Hawaii PUC has stewarded the state’s energy transition by managing policy investigations and reviewing new utility programs and planning processes, while simultaneously tending to its core responsibilities for utility rate cases and oversight of other industries.

Many commissioners and regulatory staff have put their stamp on this effort. Important early leadership was provided by Mina Morita. She became chair of the PUC at a pivotal time—in 2011—after a decade-and-a-half serving in Hawaii's House of Representatives where she helped advance legislation such as net metering and the state's original RPS. Then as PUC chair, Morita shepherded efforts around transformation of the utility and cross-department collaborations that spanned the PUC, the governor's office, and the legislature.

During the same period, Michael Champley was instrumental in using his prior experience as a mainland utility executive to understand the issues Hawaii's utilities faced and where they might go. Champley helped the Commission craft its famous *Inclinations* vision statement (described in Chapter 4), which guided the Hawaii energy community's thinking about utility system transformation and proved to be critical in informing subsequent reform activities and decisions. Commissioners Lorraine Akiba and Tom Gorak similarly contributed their legal and policy expertise to advance the state's regulatory leadership by establishing new market opportunities for demand response and other customer-based resources, as well as improving utility solicitations for grid-scale renewables and energy storage.

Chair Randy Iwase, retired at end of 2018, continued to lead the PUC to ground the complex issues before the Commission in the real effects they have on citizens, frequently reminding his staff as well as stakeholders to proceedings that all decisions need to be coherent to "the person at the bus stop." And today, current Chair James "Jay" Griffin is applying his experience from previous roles at the University of Hawaii and as Chief of Policy for Commission staff. Under Griffin, the Commission has redoubled its efforts to lead by maintaining clear guidance to parties in a manner that supports progress toward the objectives set by the state's legislature.

Joined by Commissioners Jennifer Potter and Leo Asuncion, the PUC is now led by three career energy professionals who bring decades of combined utility industry experience—demonstrating the importance and value of placing qualified people to oversee the energy transition.

There is undoubtedly a lot of retrospective analysis that can and will be applied to PUC actions, but early indications are that the Commission, Hawaii's utilities, and the state's energy system are moving in the right direction. Historic renewable energy with storage contracts are being approved (see Chapter 3), while nation-leading proceedings are advancing on integrated grid planning (Chapter 4) and performance-based regulation (Chapter 5). In addition, by one important metric, the credit rating agency Moody's issued a statement in October 2019 upgrading the HECO Companies' outlook from "stable" to "positive," noting positive developments in the PBR proceeding that are expected to provide clear, fair regulations for the HECO Companies to operate under.[17]

Credit for the 100% RPS is frequently bestowed upon Chris Lee, a member of Hawaii's House of Representatives since 2008 and author of the bill.[18] "Getting policy changes done is hard. Getting them done *right* is even harder," said one stakeholder interviewed for this report. "I don't think we'd be where we are today without [him] and his willingness to take some risks, his audacity to take some bold steps."

For a politician such as Lee, taking bold steps came partly down to legacy. What could he do while in office that would make his time there worthwhile? For Lee, it was planning for Hawaii's future. His focus was admirable, but also challenging since in politics, decision-making and political will are typically focused on issues immediately linked to election cycles.

To cultivate the longer-term vision, Lee did not rely on emotional appeals to climate action alone. To build the "burning platform" to overcome the inertia of status quo, Lee and other Hawaii legislative leaders focused on the economic rationale for the energy transition. He quantified the fast-evolving economic opportunity of renewable and distributed technologies and compared it with the risks of inaction. That tactic proved a crucial leverage point that helped overcome sources of potential political division.

Image courtesy Wikimedia/ LeeHIHOR CC 4.0

It is a strategic approach that states across the country can use to frame their own energy transitions. Analyzing the economic competitiveness of renewable energy in comparison to conventional solutions draws attention to the tangible benefits of cleaner grids. RMI's clean energy portfolios analysis supports this justification, demonstrating that renewable energy technologies represent cost-effective alternatives to proposed new natural gas-fired generation across a range of US geographies.[19]

Legislatures nationwide can require similar economic analyses to substantiate renewable goals for their own jurisdictions. Doing so empowers regulators to exercise their own responsibility to ensure that utility plans appropriately consider the economic benefits of cleaner grids. Such analysis can also help characterize energy reform according to the benefits that flow back to customers and society.

Cogent and deliberate policy framing by state elected officials has been paramount to advancing Hawaii's climate agenda. Although individual names undoubtedly emerge as champions of Hawaii's clean energy transition—from Governor Lingle in the late 2000s to Representative Lee and Governor Ige today—in truth, no single person is solely responsible for Hawaii's accomplishments.

> “If you wait for that perfect moment, you might not know what it will be until it has already passed. We don’t have a conversation of ‘This is the year.’ Every year builds off what we’ve done the previous years.

“States shouldn’t wait to have the perfect champion or climate leader. If you wait for that perfect moment, you might not know what it will be until it has already passed,” reflected one interviewee. “We don’t have a conversation of ‘This is the year.’ Every year builds off what we’ve done the previous years. It’s a building of momentum; it’s rare that bold legislation will pass in its first year of trying.”

In Hawaii, leaders like Lee succeeded in crafting an effective narrative that established the rationale for the energy transition. However, to build the momentum that provided the context for Act 97’s passage, the state also depended on critical grassroots advocacy efforts to communicate that narrative and gain broader support of ambitious energy goals.

Image courtesy United States Department of Defense via Flickr.

We’re All in One Canoe: The Role of Grasstops and Grassroots Advocacy Campaigns

In Hawaii, as elsewhere, political and regulatory leadership alone do not drive systemic change or create impact. Advocacy at both the grasstops and grassroots levels is also a necessary force. It was advocates engendering strong community support over the years that helped prompt Hawaii’s legislative change and continue to provide beneficial tailwinds for elected leaders willing to step out in front.

Consider the nonprofit Blue Planet Foundation’s ongoing “We Are 100” campaign, for example.[20] The initiative showcased 100 diverse Hawaii individuals, companies, and community organizations all helping the state build a 100% clean energy future. As Blue Planet Foundation aptly noted, “These are stories of people who don’t just have skin in the game [economically], they have soul in the game.”

Karen Young, an Oahu resident, was one of the first to be profiled by We Are 100.[21] Young lived in the shadow of the island’s coal-fired power plant, which is one of the most significant contributors to local air pollution. That fact motivated Young to become an early adopter of clean energy. Wanting to be an active part of Hawaii’s energy transition, she invested in rooftop solar and storage, and aspires to drive an electric vehicle.

Lessons for the Energy Transition:
How the Government of Hawaii Leads by Example

Issues of reputation, optics, and leadership come full circle when it comes to how the state demonstrated its own commitment to a 100% clean energy future. This was not to be a mandate bestowed upon the state's private sector from on high by the legislature. Rather, the state would require the public sector—that is, itself—to walk the talk and lead by example.

Thus, in 2015 and 2016, Hawaii passed a pair of bills that require the state government's two largest power users—the public schools[22] and the university system[23]—to achieve net-zero energy facilities by 2035. They were to be lighthouses to show that the aspiration was possible and that all stakeholders were equally responsible and were in this together.

Within two years, the state unveiled its first two net-zero energy buildings at the University of Hawaiʻi Mānoa.[24] Meanwhile, the University of Hawaiʻi Maui College has become the first campus to achieve net-zero energy and 100% renewable power with its portfolio of on-site solar and storage facilities.[25]

These examples are important, not just for managing optics, but for their value as real-world demonstrations that prove that ambitious energy goals are achievable.

Young is a personified embodiment of Hawaii's "we're all in one canoe" mantra, in which each person does their part to contribute to the advancement of the whole.

We Are 100 is also an important reminder of the social dynamics at play in the energy transition. For all the technical talk about the mechanics and technologies required to achieve a 100% renewable electricity system, Hawaii residents themselves, their values, and their attitudes also need to be considered. A so-called "perfect" 100% renewable power grid would mean relatively little without the embrace of the citizens who use it.

Public alignment on the 100% goal and engagement in the process of getting there is thus paramount to making progress. Given the relatively small island populations and tight-knit communities, issues of reputations and optics are crucial. *Who* delivers a message is arguably as important as *what* the message is. Blue Planet, for its part, has positioned itself as a trusted voice—one that presents an honest, accurate, and well-researched viewpoint. Leveraging that credibility, it has been willing to lead as the advocate pushing climate agendas before they become popular and before there is a groundswell of social consensus.

In fact, by the time Act 97 passed in 2015, Blue Planet had been pushing for Hawaii to adopt 100% renewable electricity legislation for years. It didn't succeed in 2013; in 2014, Blue Planet got closer, but the legislation still did not pass. Then in 2015, Hawaii made history. The North Star was fixed and shining brighter than ever, thanks in part to the advocacy and community engagement of Blue Planet, the Ulupono Initiative, and others—beating a steady drum to bring Hawaii's citizens into the state's journey.

The Rooftop Solar Revolution

2

Introduction: The Buildup to Broad Solar Adoption

Convincing the public that renewable energy is good for them does not always require grassroots advocacy; sometimes, the argument makes itself.

In March 2011, a massive 9.0 earthquake off the coast of Japan precipitated a cascading series of events that ultimately sparked Hawaii's rooftop solar boom more than 4,000 miles away.

Damage from the initial earthquake, its aftershocks, and the resulting tsunami that caused the infamous Fukushima Daiichi nuclear disaster prompted the Japanese government to shutter the country's entire nuclear fleet.[26] To make up for the shortfall in generation, Japan ramped up production from its oil-fired power plants, boosting petroleum demand by upward of 300,000 barrels per day—representing a near-40% increase in Japanese demand for fuel oil and 43% for crude oil.[27]

After decades of consistently inexpensive oil (<$50/barrel), prices on the Brent global oil benchmark surged to near-record levels (>$100/barrel) and stayed there for three straight years.[28] And as high as Brent prices went, they went even higher for Hawaii. The Aloha State's cost of fuel oil rarely dipped below $130/barrel between 2011 and 2014.[29]

Since petroleum fueled 80% of Hawaii's electricity generation in 2011, as oil prices rose, so did retail electricity rates.[30] Through 2012, residential retail electricity prices rose to a statewide average of $0.37 per kilowatt-hour (kWh) (ranging from a low of $0.35 on Oahu to a high of $0.47 on Lanai)—more than three times the US national average.[31]

Against this backdrop of financial pain that customers were feeling from their monthly utility bills, the costs for energy alternatives—specifically solar PV—were rapidly declining. Between 2010 and 2014, the per-watt installed cost of residential solar PV systems in the United States dropped an incredible 52%, and solar costs have continued creeping downward since.[32]

Nowhere was solar more "in the money" than in Hawaii: electricity was exceedingly expensive, sunshine was abundant, and favorable policies made solar especially economic. Hawaii solar projects benefitted from not only the 30% federal investment tax credit, but also a 35% state-specific renewable energy tax credit.

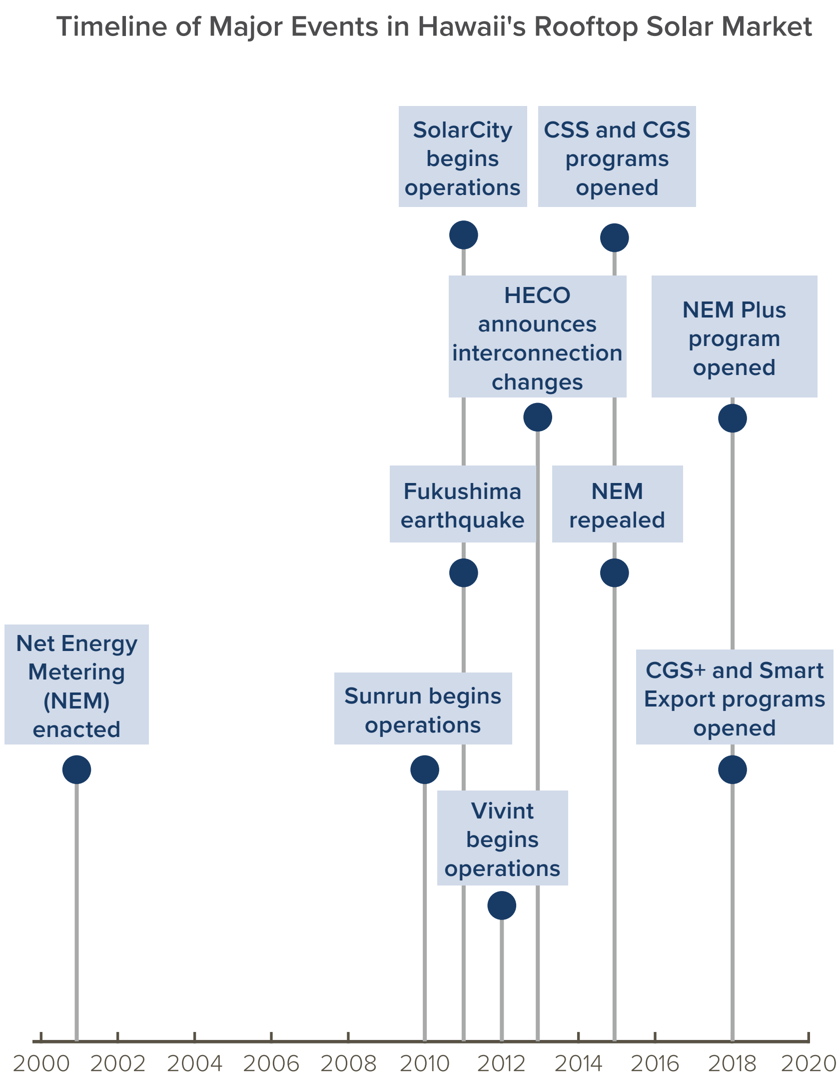
Around this time, perhaps not coincidentally, leading solar installers from the mainland began flocking to the islands. Between 2010 and 2012, Sunrun,[33] SolarCity,[34] and Vivint[35] all opened shop in the state.

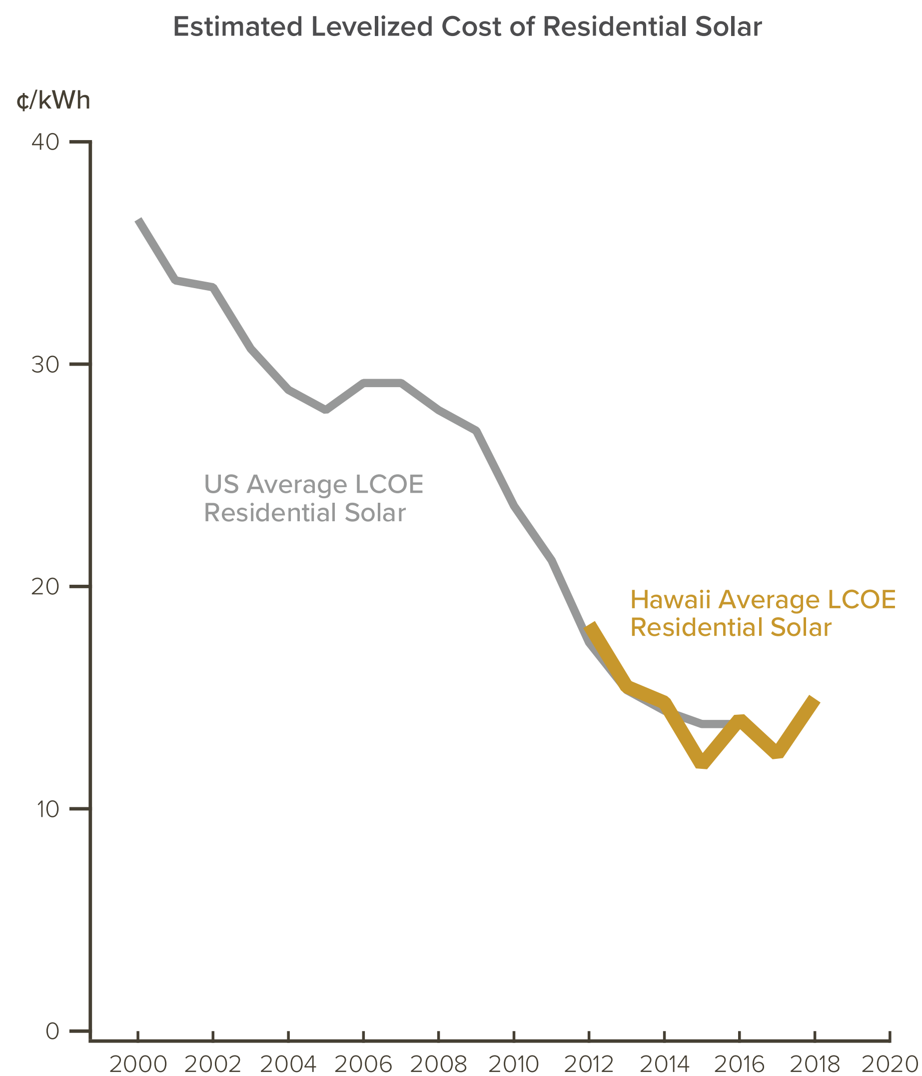
With the national players came expanded customer options such as third-party financing and solar leasing that made rooftop solar accessible to more homeowners than ever. Rather than face steep purchase costs for a new rooftop system, customers were offered the chance to "go solar" for $0 upfront. The installers covered the cost of the solar system and allowed customers to repay them via monthly payments. This financing arrangement allowed customers to realize immediate savings on their electric bills. As a result, droves of homeowners across the state installed solar on their roofs.

Hawaii's solar market was now open for business. Though some residences were adopting solar in the late 2000s, a massive rush to rooftop solar began in the early 2010s thanks to the collision of steeply falling PV prices, fast-rising retail electricity prices after Fukushima, and the introduction of solar financing options (see Exhibit 6).

EXHIBIT 6

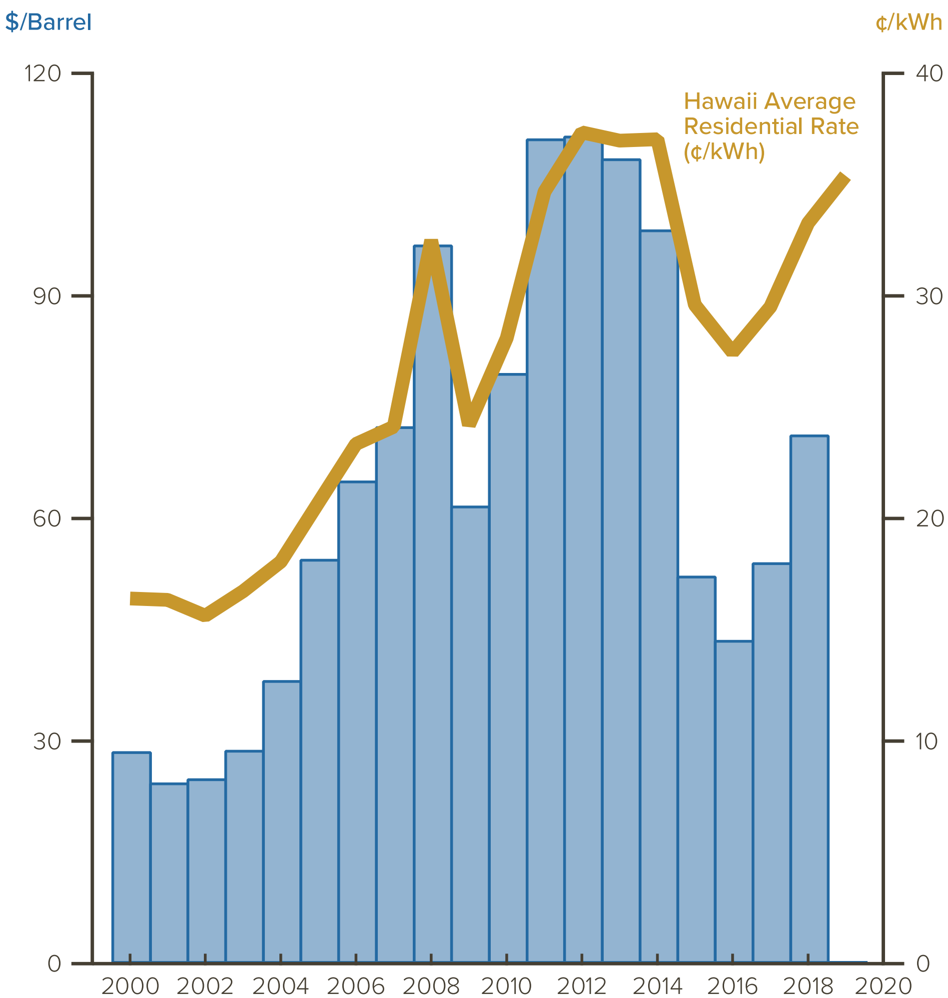
Net Metering, Declining Solar Costs, and Third-Party Finance Propel Hawaii's Solar Rooftop Revolution





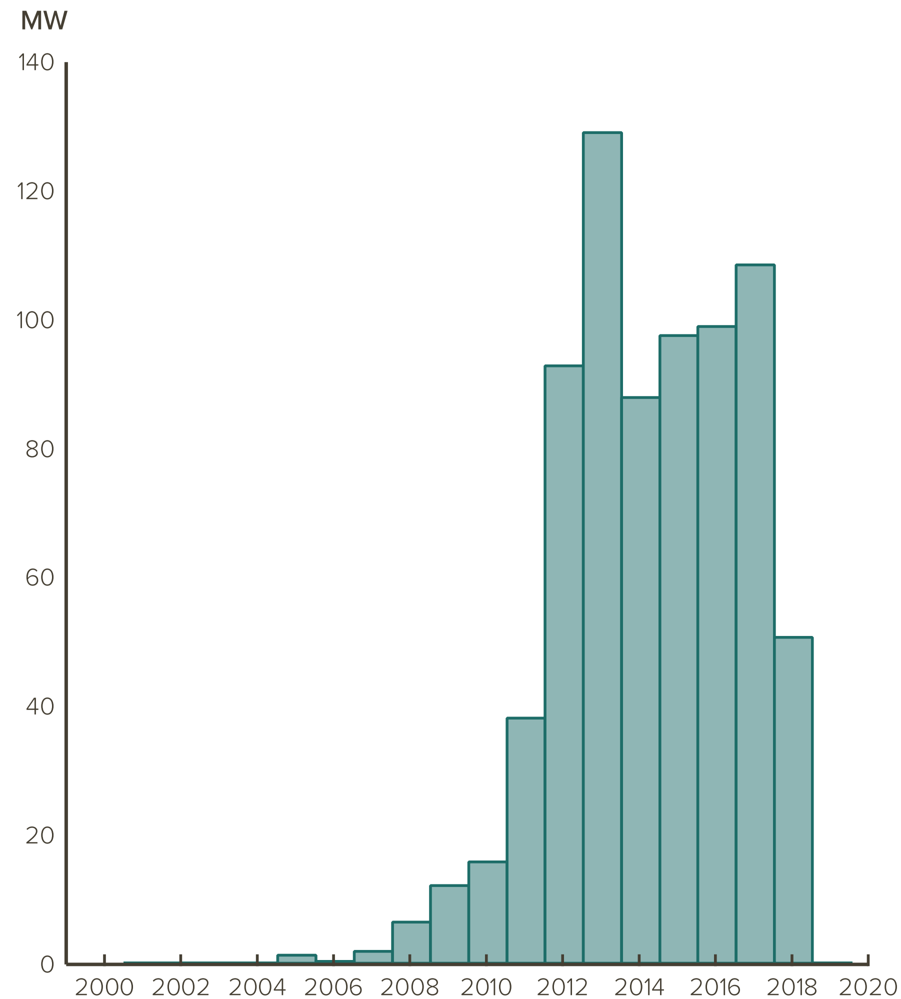
Source: Hawaii Solar Energy Association and Lawrence Berkeley National Laboratory

Oil Prices and Average Hawaii Residential Electricity Prices



Source: US Energy Information Agency and Hawaii State Energy Office

Annual Distributed Solar Additions for the HECO Companies



Source: The HECO Companies

Net Metering Growing Pains

A confluence of economic factors vaulted Hawaii into the echelon of leading states for installed solar capacity per capita.[36] But growth was at unprecedented speed and magnitude, setting Hawaii's solar market on a trajectory for new friction points and the necessary evolution of customer-sited solar programs.

In addition to the comparative costs of electricity and solar, another key variable that made residential solar "in the money" in Hawaii in the early 2010s was the state's net energy metering (NEM) policy. NEM compensated customers at the full retail electricity rate for excess solar generation that was exported to the grid.

Although Hawaii first enacted NEM in 2001 as a market catalyst, the residential solar market was slow to take off through most of that decade. Less than 1,000 distributed generation solar systems were added to the islands' grids by 2011. Then, annual installed capacity more than doubled between 2011 and 2012, driven almost entirely by the residential and commercial rooftop market segments. Rooftop solar growth in 2013 was even stronger.[37]

By late 2013, rooftop solar penetration reached record levels and the HECO Companies started pumping the brakes on interconnections due to concerns that the state's island grids would experience operational challenges. Distributed solar was generating more than 120% of daytime minimum load and more than 75% of daily peak load on some Oahu circuits.[38] With customer applications for more solar piling up, the HECO Companies needed to better understand the yet unknown grid impacts of high solar saturation. Through empirical analysis of circuit-level operations data, the Companies eventually realized that it could evolve its interconnection requirements to ensure that the full spectrum of DER capabilities—including storage and inverter power electronics functionality—were utilized to minimize any potential negative impacts and maximize DER's provision of services to support a safe and reliable grid.

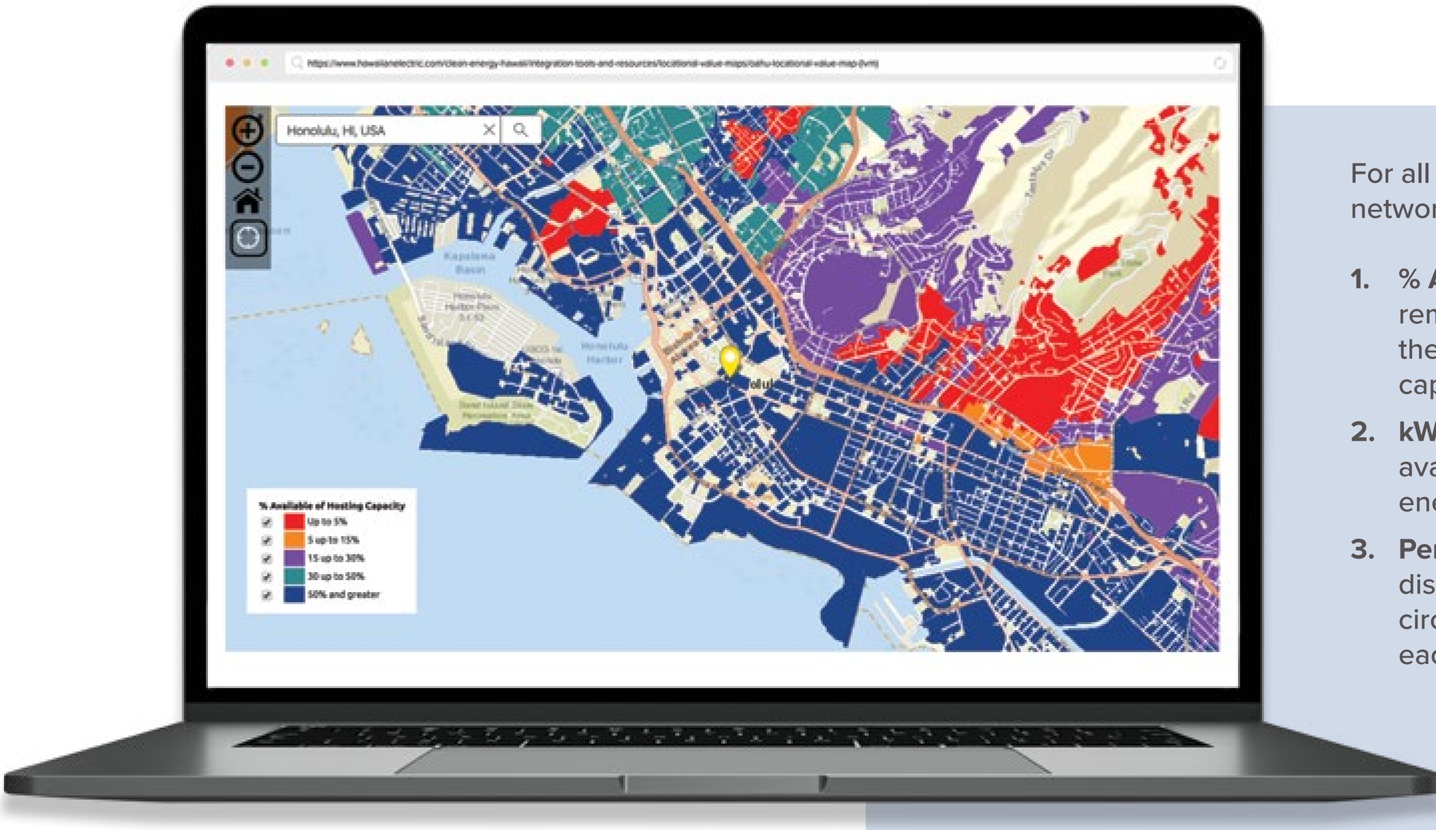
An additional solution the Companies developed related to how the utility visualized distributed solar on the grid. Visualizations served two important roles: they were an internal tool for utility planning and an external tool to steer the market to areas of Hawaii's grids that could accommodate more solar without requiring major upgrades.

In the early years of the decade, the HECO Companies produced locational value maps (LVMs) that showed percent daytime minimum load and percent daily peak load for the islands' major distribution circuits. The US Department of Energy and the state of California had already begun adopting similar methods, and it initially worked well for Hawaii too. As Hawaii's solar saturation surpassed other leading solar states, however, it became infeasible to use the same tools. The Companies had to start thinking—and visualizing—differently.

"A confluence of economic factors vaulted Hawaii into the echelon of leading states for installed solar capacity per capita. But growth was at unprecedented speed and magnitude, setting Hawaii's solar market on a trajectory for new friction points and the necessary evolution of customer-sited solar programs.

EXHIBIT 7

Map of Honolulu's Hosting Capacity[39]



For all circuits on the primary distribution network, Locational Value Maps provide:

1. **% Available:** The percentage of remaining space available for solar on the primary circuit based on hosting capacity
2. **kW Available:** The total capacity output available for customers to connect solar energy systems to the grid
3. **Penetration Range by Circuit Peak:** The distributed generation currently on each circuit compared to peak demand on each circuit

Source: The HECO Companies Locational Value Map, accessed December 17, 2019

Starting in 2013, the utilities worked with residential solar installers to adjust their LVMs to focus on hosting capacity (see Exhibit 7).[40] The HECO Companies became one of the first utilities in the country to adopt the method, and the first to do so for every distribution feeder circuit on its system.

The idea was simple, yet powerful and effective: make it easier for the utility and solar developers alike to see where solar could be connected to the grid without requiring expensive upgrades to the distribution system.[41] A win-win, hosting capacity maps helped align customer DER adoption with locational grid needs and constraints.

The evolving utility responsibility for DER integration would become increasingly important in Hawaii's energy transition, but by 2013 one thing was already abundantly clear: distributed generation was not merely a novelty on Hawaii's grid. It had reached such high penetration that the utility, solar developers, and customers needed to be more intentional about when, where, and what was deployed.

Lessons for the Energy Transition: **Increasing Transparency to Support Optimal DER Deployment**

> "Hosting capacity maps can help guide the siting of DERs to locations where they provide the most value.

In the wake of Hawaii and California adopting the hosting capacity approach to distribution system mapping, other states have followed suit. In Rhode Island, National Grid provides both heat maps (showing the forecasted percent loading of distribution circuits) and hosting capacity maps (showing kW of remaining available capacity on distribution circuits).[42]

In New York State, utilities including Central Hudson,[43] Con Edison,[44] and a joint effort of New York State Electric & Gas and Rochester Gas & Electric[45] have also rolled out hosting capacity maps. The same is true of utilities in Minnesota, Illinois, Washington, D.C., and parts of Maryland. Calls for hosting capacity analysis are also being heard now in places like Georgia.[46]

As an important component of modern, transparent distribution planning, hosting capacity maps can help guide the siting of DERs to locations where they provide the most value and cause the least operational problems. They can also help identify grid constraints and enable third-party developers to propose solutions so that potential issues can be addressed before they arise.

Solar After Net Metering

In September 2013, to allow for sustainable solar growth that harnessed a fuller spectrum of DER capabilities, the HECO Companies emailed contractors announcing changes to the solar interconnection process.[47]

The solar industry was incensed.[48] Though a necessary step in the right direction, the new process was not without its obstacles. A new requirement for interconnection application approvals prior to system installation added lengthy, unpredictable reviews and the risk of costly system upgrade fees. Interconnection applications accumulated as the rate of installations declined dramatically.

There was no simple solution. The PUC recognized that the state was surpassing customer-sited solar precedents on the mainland and "by necessity [had to] become a leader in solving the challenges associated with high penetration of distributed generation."[49] In 2014, the Commission ordered the HECO Companies to make the interconnection queue more transparent and to implement a distribution circuit monitoring program to empirically demonstrate if solar caused operational issues as the utility claimed.[50]

The monitoring plan provided visibility into the grid and helped demonstrate that overvoltage concerns were not always justified. The plan also complemented the LVM process by allowing the HECO Companies to calibrate its hosting capacity models with better data, thereby allowing more solar to interconnect.

After extensive stakeholder debate, in October 2015 the PUC decided that it was time to transition away from the unsustainable growth of solar under NEM. The PUC closed the program to new customers as "the first step in an evolution of distributed energy resource policies."[51] NEM simply did not "provide the correct market signals to customers and market actors to address periods with an excess supply of energy to the grid." In an attempt to rectify these market signals and incentivize DER providers to include storage and help align solar output with grid needs, the PUC approved two new programs to replace NEM: Customer Self-Supply (CSS) and Customer Grid-Supply (CGS) (see Exhibit 8).

The decision to close NEM reverberated through the state's solar market. Capacity caps were placed on the two new programs, so it was uncertain how long they would last. The added complexity of CSS and CGS also made it difficult for installers to communicate estimates of how much solar would save customers. The sales cycle slowed. Many smaller companies folded. Some that survived laid off part of their workforce. Customers were caught in the middle, and many felt like they had missed the NEM boat and now could only get a second-rate solar deal.

But as the PUC intended, by closing NEM and introducing the new tariffs, solar installers were forced to adapt their business models and focus on advanced inverters, demand flexibility, and battery storage, which better supported the grid and helped make the economics for solar customers work under the new programs. Thus, whereas Honolulu saw only 5 solar-plus-storage permits in 2015, that number shot up to 40 in 2016 and 731 in 2017[52] and now nearly all new solar systems are being paired with storage.

Customer Self-Supply (CSS):[53] Self-generated electricity must either be consumed as it is produced or stored for later use by the customer. Since these systems do not send energy to the grid, they are eligible for expedited interconnection review.

Customer Grid-Supply (CGS):[54] Customers can export excess generation to the grid but are compensated for it at a rate akin to avoided cost rather than the retail rate as under NEM.

Did the Loss of NEM Stall Hawaii's Residential Solar Market?

The October 2015 sunset of net metering is often singularly blamed for the ensuing downturn in Hawaii's residential solar market.[55] It was undoubtedly a major influence, but it was not the only one.

Between 2014 and 2016—spanning Hawaii's repeal of NEM—oil prices declined and the average retail statewide electricity rate dropped by a full 10 cents per kWh.[56] Thus, although compensation for solar exports at roughly 15 cents per kWh under the new programs was still relatively generous compared to the mainland, the financial incentive to adopt solar to avoid grid purchases was reduced around the same time that CSS and CGS were introduced.

Encouragingly, in the years since NEM's repeal, despite a slowdown in the DER market, customer-sited resources have made the largest contribution of any source toward the HECO Companies' RPS progress[57] and solar-plus-storage installations have reached record levels. Furthermore, Hawaii's residential solar market in the post-NEM era has paralleled broader trends in the national solar market and at times outperformed national averages. For example, the US residential solar market contracted by 15% in 2017, then rebounded by 7% in 2018;[58] meanwhile the Hawaii market grew by 19%[59] in 2017 and another 5% in 2018.[60] And although Hawaii saw net job loss among its solar industry in 2017[61] and 2018,[62] it was only one of 20 states where solar jobs fell, as the national solar industry had two consecutive years of net solar job loss.[63]

The influence of NEM's repeal in Hawaii must be considered in this context—some causation, but also correlation with other forces that were impacting the US solar industry writ large.

The rate of new solar installations slowed in Hawaii post-NEM, but solar (and storage) were still growing. Hawaii customers exhausted the available capacity designated for CGS by September 2016.[64] The HECO Companies added more capacity to the program, but that too was fully subscribed in just over a year.[65]

To accommodate unwavering customer demand for rooftop solar and ensure that the HECO Companies could harness customer-sited generation to achieve the 100% RPS, the state needed new programs. In October 2017, the PUC approved two new tariffs—Customer Grid-Supply Plus (CGS+) and Smart Export[66]—which became effective in 2018 and further evolved the way customer-sited solar interacts with Hawaii's grid (see Exhibit 8). The new programs incorporate utility controls and send price signals that encourage solar export during certain hours to ensure that variable rooftop solar generation supports the grid.

Eight months after CGS+ and Smart Export enrollments began,[67] the HECO Companies added another DER-focused customer tariff to the menu: NEM Plus.[68] For customers with pre-existing solar systems grandfathered under Hawaii's original NEM program, NEM Plus opened a new set of options. Without affecting their original NEM agreement, customers could now add a battery system and/or additional solar panels. This was especially attractive for customers considering home renovations, purchasing an electric vehicle, or making other choices that would impact their total electricity consumption. However, system expansions under NEM Plus would not be allowed to export to the grid; this would ensure streamlined approval and interconnection, since they would not result in net impacts to the distribution grid.

Customer Grid Supply+ (CGS+):[69]
Similar to CGS but the utility can curtail the system's output for grid stability, if necessary.

Smart Export:[70]
Designed for solar-plus-storage systems, customers can export to the grid but receive no compensation for exports from 9:00 a.m. to 4:00 p.m. and are compensated at rates akin to avoided costs from 4:00 p.m. to 9:00 a.m.

EXHIBIT 8

The HECO Companies Rooftop Solar Program Characteristics

	NEM	NEM Plus	CSS	CGS	CGS+	SMART EXPORT
Overview	Compensates solar export at the retail rate	Allows NEM customers to add to existing systems	Solar export is prohibited	Compensates solar export at roughly half the retail rate	Compensates solar export at reduced rate, and HECO can curtail systems	Applicable to solar-plus-storage systems, compensates solar export during certain hours
Year Program Became Available	2001	2018	2015	2015	2018	2018
Program Status (As of 2019)	Closed	Open	Open	Closed	Open	Open
Solar Export to Grid Allowed?	Yes	–––	No	Yes	Yes	Yes
Grid Export Restrictions?	No	–––	Yes	No	Utility or aggregator can curtail system	Economic (no credit for export from 9 a.m.–4 p.m.)
Export Credit Rate (¢/kWh)	Retail*	–––	–––	15	10	15
Program Cap (MW-ac)	–––	–––	–––	75	49	35
Battery Storage?	–––	Typical	Typical	–––	–––	Required
Advanced Inverter Functionality Required?	No	Yes	Yes	Yes	Yes	Yes

*Average residential electricity rates in Hawaii in 2018 were $0.32 per kWh

Source: The HECO Companies

Making the Benefits of Solar Available to All

In 2018, concurrent with developments to its homeowner-focused rate structures, the HECO Companies rounded out its solar offerings with the Community-Based Renewable Energy (CBRE) program,[71] colloquially known as "solar without a roof." CBRE was aimed at bringing the distributed solar revolution to those customers beyond the reach of traditional rooftop PV, such as apartment dwellers and townhome or condo owners who lack their own roof.

Like virtual or remote metering in other states, CBRE credits subscribers' bills based on the output of off-site community solar arrays. HECO announced approval of its first such community solar project in September 2019: a 270-kW facility that was already fully subscribed at the time of the announcement.[72]

Usually the tip of the spear, the HECO Companies was late to join the community solar trend. CBRE came years after Colorado passed the nation's first community solar garden legislation in 2010[73] and Minnesota passed its lauded community solar program in 2013.[74]

However, with Hawaii ranked 49th for per capita energy consumption yet 17th for per-capita energy expenditures,[75] further CBRE development is required to ensure that all Hawaii residents, not just homeowners with rooftops, can financially benefit from solar. The need for such options is even more pronounced on Oahu, which has a high concentration of Hawaii's population, energy consumption, and high-rise apartments.

Kauai's Approach to Distributed Generation

Kaua'i Island Utility Cooperative (KIUC) is known for its high-profile investments in utility-scale solar-plus-storage projects, including a 2015 contract with SolarCity/Tesla for a project that came online in 2017 and represented the first "fully-dispatchable" utility-scale solar system in the United States.[76] Investments such as these have helped KIUC make the fastest gains toward 100% renewable energy relative to HECO, MECO, HELCO, and the statewide average.[77] Yet there is a story to be told about KIUC's admittedly small rooftop solar market as well.

In 2011, KIUC closed its NEM program[78] and replaced it with an avoided cost-based Schedule Q rate option.[79] Similar to what the HECO Companies later offered through its post-NEM programs, KIUC's Schedule Q offered two options: no grid export or grid export compensated at an avoided cost price.

Mirroring customer responses to the HECO Companies' programs, those KIUC customers that participated in the no grid export option typically installed batteries to prevent excess generation from going to the grid. Others that participated in the grid export option often oversized their solar installations relative to household demand so that enough solar would be exported during the day and compensated at lower avoided cost rates to offset the cost of more expensive electricity purchased from KIUC at night.

This oversizing behavior exacerbated daytime solar exports, and threatened to cause operational issues on the grid. To address it, KIUC unveiled its Right-Sizing Program.[80] Based on a home's average monthly kWh consumption, KIUC specifies the "maximum" size PV system a customer can install. In truth, customers still have the right to install larger systems, but if they do, that portion of the system above the maximum limit may get separately metered and KIUC may curtail if needed.

Unlike the HECO Companies more turbulent rooftop market experience and reactionary approach to evolving customer solar programs, KIUC has gradually and proactively adapted its rooftop solar offerings to ensure sustainable growth. Still, with 4,800 rooftop systems across the 37,000 meters served in 2018,[81] KIUC will also need to further refine its program to catch up to the HECO Companies' solar penetration levels, enable customers to utilize the full spectrum of DER capabilities, and help Kauai meet its renewable energy goals.

Going Big with Renewables

3

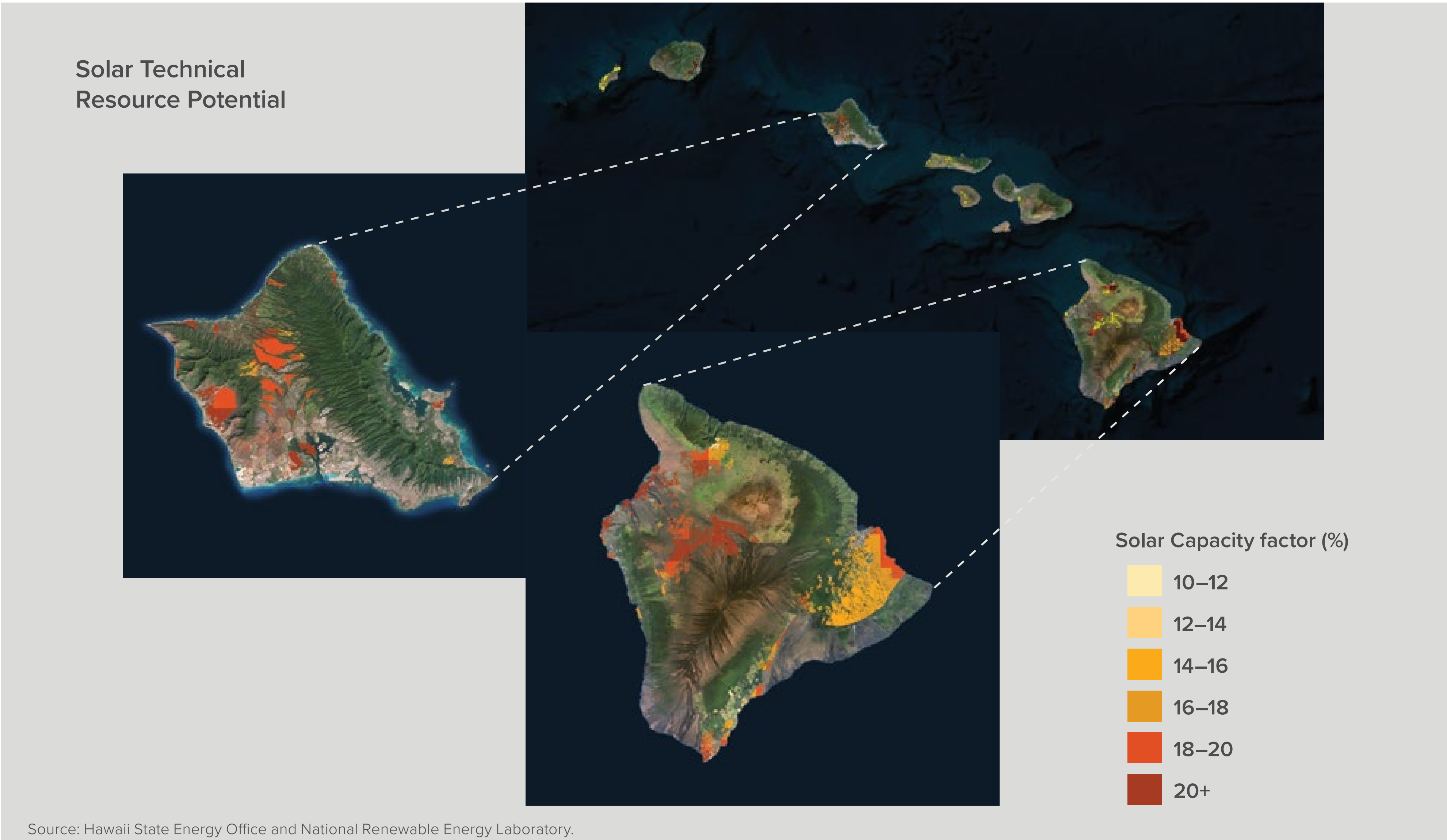
Introduction: Tapping a Locally Appropriate Resource Mix

High on a south-facing ridge in the West Maui mountains, a string of 34 gleaming white wind turbines mark the skyline. Situated 3,000 feet above the Pacific Ocean, their blades are often seen spinning in the reliable trade winds that blow across Maui's slopes.

The idea of matching a portfolio of utility-scale renewable generation to a region's best local resources is no secret. But across each of Hawaii's six independent island grids, the "best-fit" renewables mix has been surprisingly varied given differences in resource potential (see Exhibit 9).

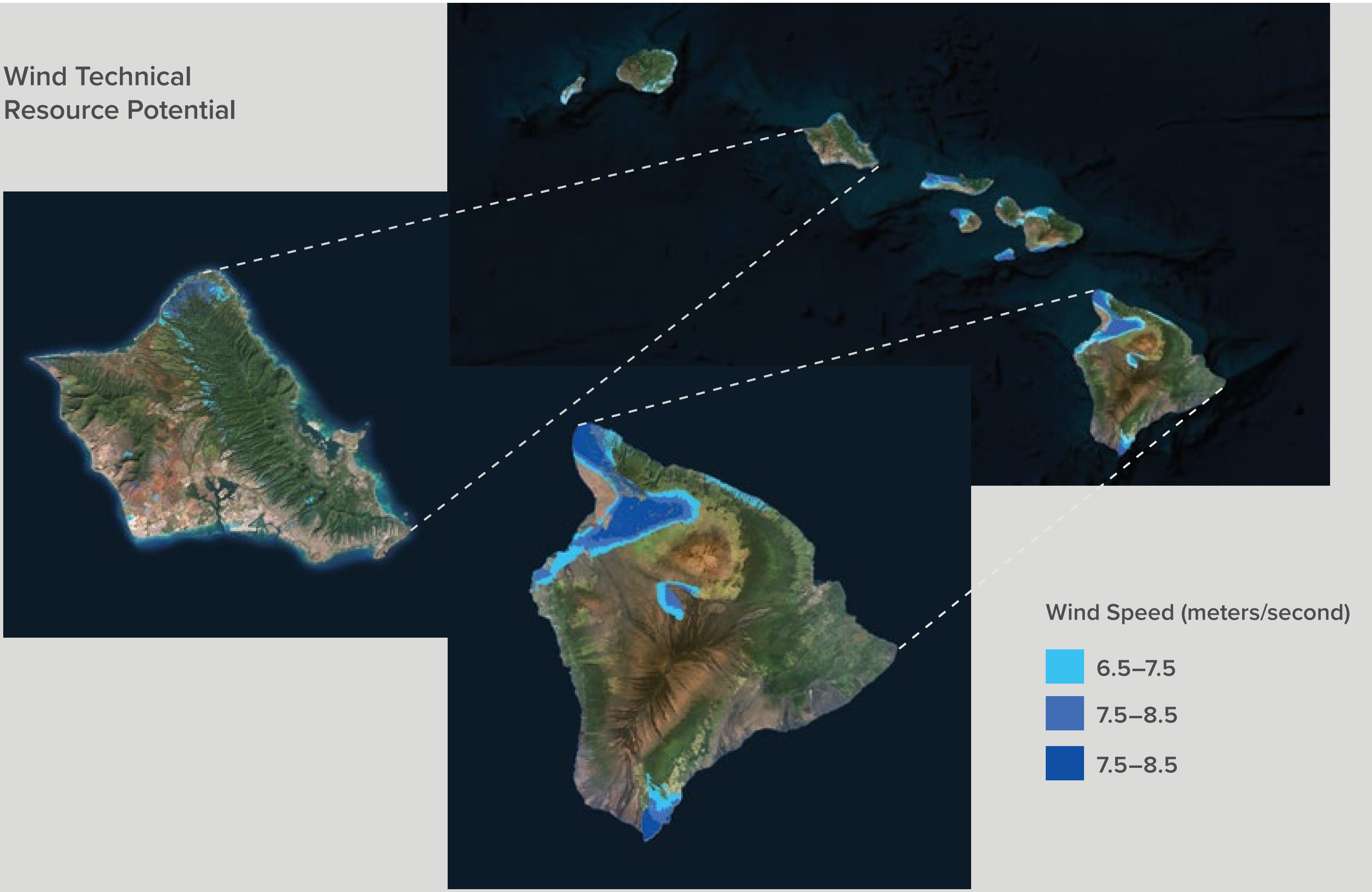
EXHIBIT 9

Hawaii's Technical Potential for Solar and Wind by Island



Source: Hawaii State Energy Office and National Renewable Energy Laboratory.

Wind Technical Resource Potential



The first major wave of large-scale renewable energy growth in Hawaii came from wind, with a boom that just preceded that of rooftop solar.[82] A second major wave has occurred more recently with utility-scale solar and solar plus storage.[83] Biomass, hydro, waste-to-energy, and geothermal projects further round out the renewables picture.[84]

Maui is the most wind-powered of the Hawaii islands,[85] with one wind and two wind-plus-storage projects providing over 20% of island electricity needs. Thanks to steady winds, these projects have consistently achieved capacity factors approaching 45% in years when US onshore wind has average capacity factors in the mid to high thirties.[86]

Since the highest wind production on Maui is coincident with daytime demand, the storage systems are used to balance the wind output and provide ancillary services such as frequency regulation. To fully capture the value of the island's wind resources, MECO was one of the first utilities in Hawaii to require developers to provide asset optimization through the incorporation of storage and controls to ensure utilization of renewable generation's technical capabilities to best support grid needs.

On Kauai at the western end of the archipelago, co-op KIUC went a different route. Apart from some hydro power[87] and a small 7 MW biomass plant[88] that supplies 10% of the island's electricity by burning invasive plants and locally grown eucalyptus, the primary renewable generation resources on the island are utility-scale solar and solar-plus-storage. A SolarCity/Tesla 13 MW solar and 52 MWh storage system captured attention when it was installed in 2017 and provided power for 13.9 cents per kWh.[89] An even larger 20 MW solar and 100 MWh storage system developed by AES Distributed Energy, costing only 11 cents per kWh, came online in 2019.[90] Now, a new wave of Kauai projects is dominating headlines, including the 14 MW solar array and 70 MWh battery located at the US Navy's Pacific Missile Range Facility at Barking Sands.[91] It will also sell power to KIUC for 11 cents per kWh; but in the event of a short or extended grid outage, the system can "island" itself as a microgrid and keep the Navy facility up and running. It is expected to come online in early 2020.

Meanwhile, the volcanically active Big Island, book-ending Kauai at the eastern end of the Hawaiian archipelago, is a natural fit for tapping Hawaii's geothermal resources. It hosts Hawaii's only major geothermal power plant: the 38 MW Puna Geothermal Venture power plant.[92] In 2017, Puna supplied an impressive 30% of the island's power and helped HELCO achieve 57% of its total electricity sales from renewables. However, in 2018 the geothermal plant was forced to close when lava flows from an eruption of the Kilauea volcano damaged the plant and its substation.[93] Due to the loss of PGV, HELCO's 2018 percent of sales from renewables dropped to 44%, and the facility is only tentatively scheduled to reopen in 2020.[94] Given the relative abundance of land on the Big Island, it is no surprise that additional utility-scale projects are being sited there. Two of the seven solar-plus-storage contracts that the HECO Companies sent to the PUC for approval in January 2019 were for Big Island projects.[95] Each represented 30 MW of solar and 120 MWh of battery energy storage, and they were priced at 8 and 9 cents per kWh.

The PUC approved six of the Companies' seven proposed projects in March 2019.[96] In addition to the two Big Island projects, the PUC approved three solar-plus-storage projects representing 127 MW of solar and 508 MWh of storage on Oahu, and one 60 MW solar and 240 MWh storage project on Maui. Prices for the projects were approximately 10 cents per kWh or lower.

Incredibly, these procurements were followed in August 2019 by an announcement that the Companies were seeking bids for 900 MW of additional renewable energy, storage, and grid services.[97] It is one of the largest single renewable energy procurements pursued by a US utility to date and clearly reflects the ambition of the state's 100% renewable energy goals.[98]

Building Support for Utility-Scale Renewable Projects

To achieve the state's 100% RPS, larger-scale renewable generation must accompany rooftop solar deployment. The HECO Companies' recent solicitations have demonstrated the cost-effectiveness of utility-scale renewables and made it clear that pursuing an "all-of-the-above" renewables strategy is prudent. Notwithstanding, land scarcity on the islands magnifies the issue that one interviewee for this report highlighted: "All deployment is local."

Although residents don't like high electricity prices and are concerned by the human health and environmental justice impacts on those living downwind from fossil-fueled power plants, renewable energy projects are not immune to community opposition.

Use of scarce land to generate electricity highlights opportunity costs. An acre used for a solar farm can no longer be used to develop much-needed affordable housing.[99] Neither can that acre grow crops to make Hawaii less dependent on imported food; today Hawaii farms supply less than 20% of the islands' food, making Hawaii as dependent on imported food as it has been on oil.[100]

Moreover, some residents do not like the idea of their views being affected by power plants—even renewable ones. Similar concerns exist regarding how large renewable projects will impact tourism rooted in Hawaii's natural aesthetic. How might fragmenting views of lush forested hillsides or plunging waterfalls by building wind and solar farms harm the state's scenic flightseeing tours?

To overcome these concerns, it is important yet challenging to convey to residents the "hidden" savings realized by past renewables projects. Retail electricity rates have risen since 2016 despite more low-cost renewable generation coming online. This disconnect is at the forefront of the PUC's current performance-based regulation proceeding (see Chapter 5). Having identified utility capital and operational expenditures as driving retail rates up, the Commission is working with stakeholders to develop targeted new measures to incentivize cost control in those areas.[101]

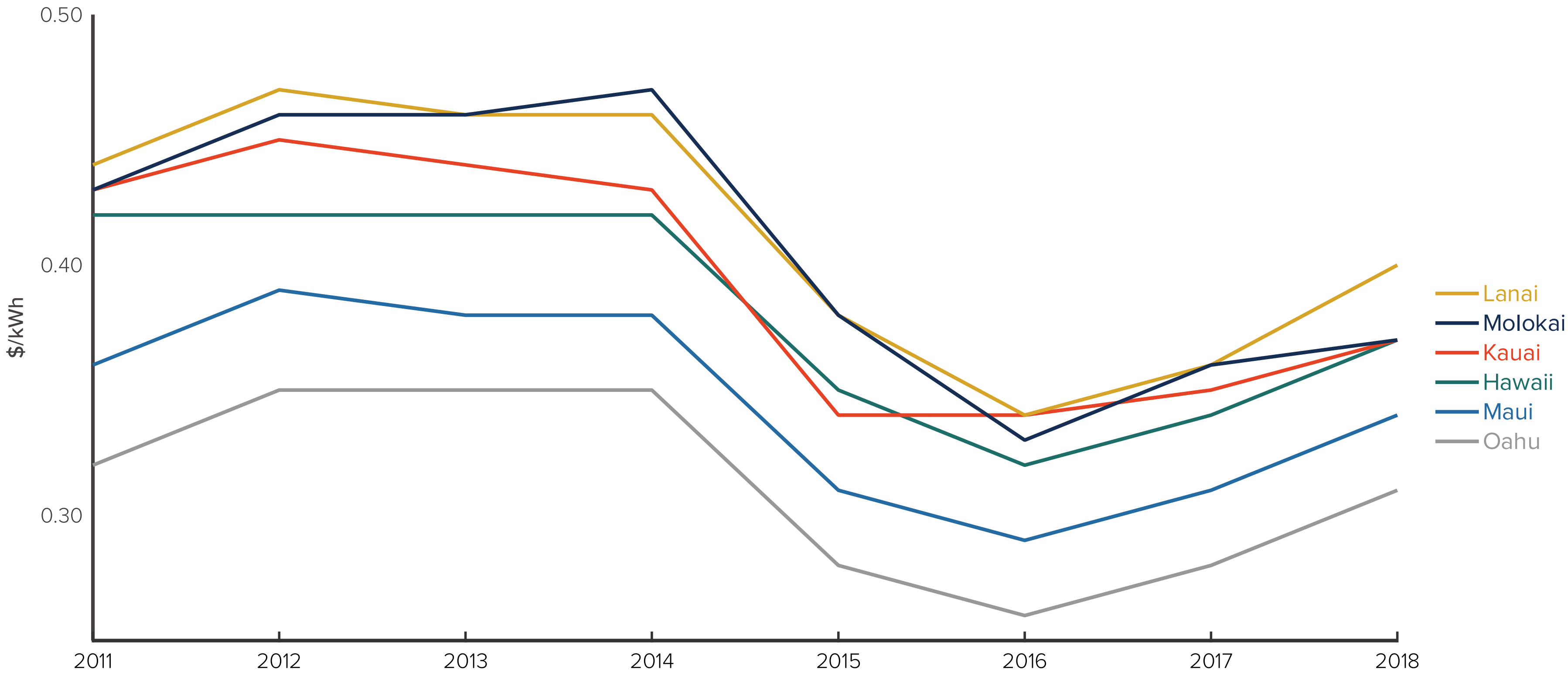
In the meantime, however, customers receive a monthly utility bill, and they want that bill to go down. That renewables already have to a degree prevented their bill from being even higher by acting as a hedge against high and volatile oil prices is not always obvious.

Nowhere has that effect been stronger than on Kauai, historically home to some of Hawaii's highest per-kWh electricity prices.[102] In 2012, residential electricity prices on the island averaged $0.45 per kWh, 22% higher than the statewide average ($0.37) and 29% higher than on Oahu ($0.35). By 2018, Kauai had closed the gap through its aggressive pursuit of renewable energy, moving to within 12% of the statewide average and within 19% of Oahu (see Exhibit 10). Helping residents recognize these benefits has been key to building stronger support for the energy transition.

"Although residents don't like high electricity prices and are concerned by the human health and environmental justice impacts on those living downwind from fossil-fueled power plants, renewable energy projects are not immune to community opposition.

EXHIBIT 10

Average Annual Residential Electricity Rates by Hawaii Island[103]



Source: Hawaii State Energy Office

In addition to building community support for utility-scale generation, Hawaii's clean energy advocates have needed to overcome differences in opinion within the state's clean energy sector itself. Although there is generally widespread agreement on the 100% renewable energy target, the best way to get there is not unanimous. "No market segment wants to risk ceding a piece of the pie," said one stakeholder. This zero-sum logic has especially pitted distributed solar installers against utility-scale developers. But with the state average RPS achievement still under 28% in 2018,[104] everyone interested should still be able to get a slice of the 100% pie.

The difficulty in cultivating enough support to develop utility-scale renewables, even when they offer record-breaking prices, is an important reminder that diverse interests and perspectives exist under the surface of broad, high-level enthusiasm for Hawaii's clean energy ambition.

Lessons for the Energy Transition:
Connecting Renewables Amid Regional Power Dynamics

> “Interconnecting utility-scale renewables with demand centers takes more than technical or economic solutions. It requires systems thinking. And human systems, such as community dynamics, often prove the most important.

Community opposition to large-scale renewable development exists in many places, such as the debate about transmission lines to connect Great Plains wind farms to East Coast load centers; the idea of a broader Western electricity market to enable California and others to balance load through exports and imports; cultural tensions between less-affluent regions such as Upstate New York sending renewable power to affluent downstate load pockets around New York City; and the resistance to impacts on coastal views by locals that prevented Cape Wind from becoming the first US offshore wind project near Cape Cod, Massachusetts.[105]

In Hawaii, experience with such opposition has underlined the need for community engagement and grassroots support for renewable projects. Stakeholders learned an important lesson with Oahu, the island expected to have the most difficult time reaching 100% given that as of 2012 it accounted for 75% of the state’s electricity consumption despite having less than 20% of Hawaii’s renewable energy potential.[106] One idea was to transmit renewable energy from Maui to Oahu via an undersea electric cable.[107] More challenging than the expensive price tag, the project was fraught with cultural and political tension. To many residents of the outlying islands, Oahu represented power, money, consumption, big-screen TVs, and air conditioning. They were not going to see their beloved green landscapes developed with utility-scale renewables for the sake of Oahu’s energy needs. Thus, the Maui-Oahu undersea transmission cable project was killed.

In its pursuit of 100% renewables, Oahu will likely need to rely on its own island’s more limited solar and wind renewable resource potential. Given that it is home to two-thirds of the state’s population, the utility and developers will need to work with residents to maintain support for the state’s renewable energy goals and ensure that essential renewable energy projects are developed in consultation with local communities.

The takeaway? Interconnecting utility-scale renewables with demand centers takes more than technical or economic solutions. It requires systems thinking. And human systems, such as community dynamics, often prove the most important.

Ascending the Power Purchase Agreement Learning Curve

Utility-scale renewables are particularly attractive in Hawaii given a recent trend of "mind-blowing" renewable pricing. But competitive pricing was not always the norm for the state. Given that Hawaii is surrounded by thousands of miles of Pacific Ocean, there are legitimate reasons for the "island premium" such as the need to import materials, which means costs are often higher in Hawaii than on the mainland.

As the island transitioned from fossil fuels to renewables, the HECO Companies and the PUC have ascended a steep learning curve in negotiating power purchase agreement (PPA) terms from independent power producers. Along the way, they have learned four important lessons.

First, they've improved their competitive procurement processes. For years, oil prices set the benchmark for avoided cost calculations that were the barometer for Hawaii renewable energy PPAs to be considered "in the money." As a result, PPAs executed in the 2000s contained a twisted irony: they were tied to avoided costs, which in turn were tied to oil prices. Thus, fixed-cost assets such as wind and solar farms had a floating price that was pegged to highly variable oil prices. Instead of renewables hedging oil price volatility and protecting Hawaii's customers from price spikes, prices from renewable energy PPAs followed oil prices. Customers quite reasonably questioned, "I see that wind farm spinning. So why is my utility bill going up?"

This counter-productive benchmarking experience provided an important lesson for Hawaii regulators and utilities when it came to wind and solar PPA pricing: renewables should not be tied to oil. In 2008, the price-tie was officially severed in an agreement cosigned by the state of Hawaii, its Division of Consumer Advocacy, and the HECO Companies that decreed, "All new renewable energy contracts are to be delinked from fossil fuel oil costs."[108]

Hawaii's procurement practices are constantly improving and have evolved in recent years to introduce more competition between developers and make them submit their most competitive offers with only thin margins added on top.

The results have been profound (see Exhibit 11). Although some mainland jurisdictions have captured more competitive prices, mainland solar projects are often much larger than Hawaii's given the relatively smaller size of the islands' grids, and Hawaii has nonetheless seen dramatic price reductions in its own procurements. Notably, solar-plus-storage pricing is now competitive with solar-only pricing from a few years ago, and costs continue to decline. The 90 MW of solar and 360 MWh of storage approved in March 2019 at $0.08 per kWh represented a 42% decrease in Hawaii solar-plus-storage PPA prices compared to a 2016 HECO Companies procurement.[109]

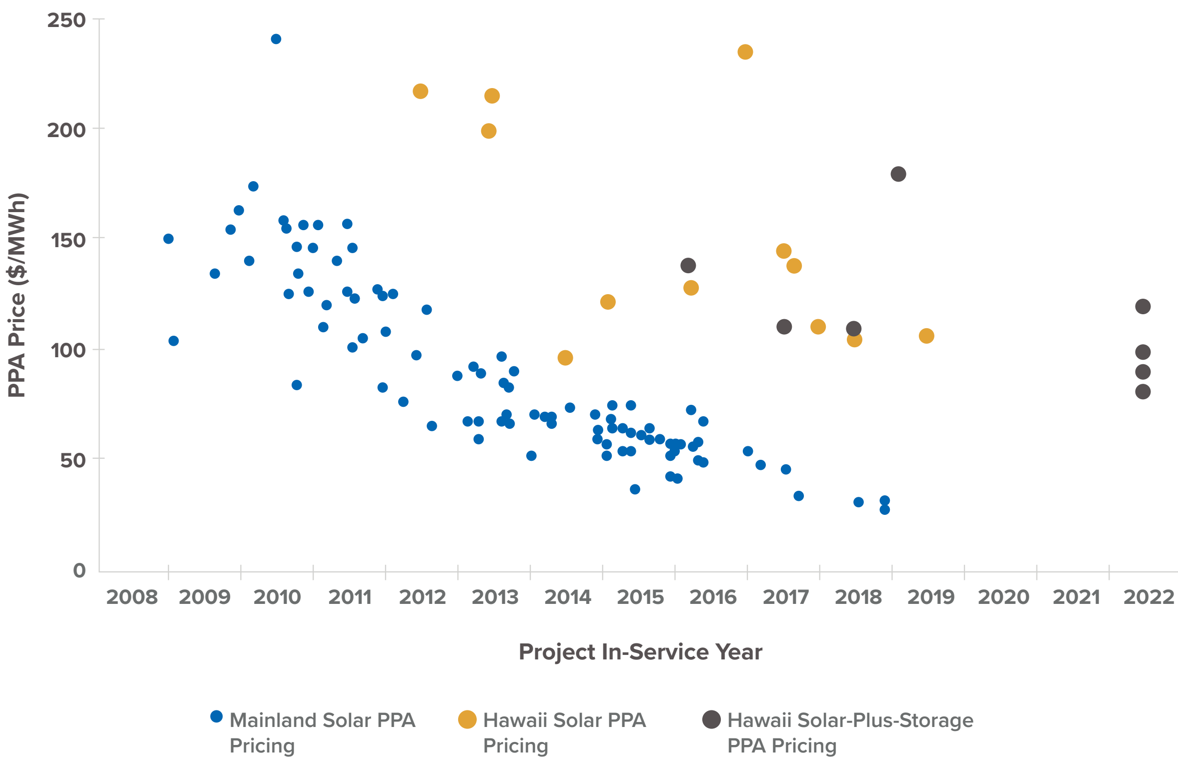
Second, Hawaii's utilities—both the HECO Companies and KIUC—have evolved their role in procurement related to land acquisition for large renewables projects.

KIUC took an innovative approach that stretched it beyond the traditional core utility business. It evaluated land and soil classifications, identified prime parcels and interconnection positions, and secured the development rights from landowners. Its RFPs could then focus on finding the best developers to build a project on a given site, rather than getting caught in a predicament where one firm might be better suited to build the project, but another might hold the interconnection position.

The HECO Companies have taken a more conservative approach. The Companies issued requests for information (RFIs) to landowners throughout their service territories, and in turn made that information available to developers.[110] Those developers still must do additional work to secure development rights, but it brings a measure of structure to what could otherwise be a Wild West of land speculation.

EXHIBIT 11

Hawaii Versus Mainland Utility-Scale Solar and Solar-Plus-Storage Pricing by In-Service Year



Source: Hawaii State Energy Office, Bloomberg New Energy Finance

Third, beyond the issue of PPA pricing, there is also the delicate balance of negotiating other contract terms—notably, the length of a PPA term. Not surprisingly, developers have favored the revenue certainty of longer 20-plus-year contracts. Hawaii's Division of Consumer Advocacy preferred to see shorter-term contracts, particularly with renewables pricing declining rapidly. Instead, the Consumer Advocate settled for a steady stream of investment, with waves of procurement that could incrementally accommodate more and more utility-scale renewable capacity at ever-better prices.

Fourth, to encourage competitive pricing, the PUC has sent appropriate signals to the state's utilities and renewable energy community that developers would be rewarded for bringing forward their best projects. Historically, the PUC took up to six months *per project* for review of utility-scale renewables proposals. For this procurement, when the HECO Companies submitted seven solar-plus-storage projects at record-setting rates in January 2019, the PUC prioritized its review and approved six of them as a batch after three months of review. The market took notice.[111]

In addition to reviewing projects on an expedited timeline, the PUC and Hawaii's utilities also learned that there was value in telling developers "no" the right way—that is, quickly and with clear reasons. For example, in 2014 KIUC issued a solicitation for large-scale energy storage projects. The utility did not select any, but it sat down with all the bidders in a webinar to explain why none had been chosen and what developers needed to do in order to get a "yes." It was an important lesson for all. One year later, in 2015, KIUC signed its now-famous project with SolarCity/Tesla for a utility-scale solar-plus-storage project at 13.9 cents per kWh.[112]

To support these improvements in the state's procurement efforts, Hawaii's State Energy Office (HSEO) has also played an important role by offering a variety of land resource planning tools[113] ranging from the Renewable EnerGIS mapping software[114] to a pair of visualization tools developed in partnership with the US Department of Energy, the University of Hawaii's Laboratory for Advanced Visualization and Applications, the HECO Companies, and the National Renewable Energy Laboratory.[115] These tools analyze complex planning data sets and communicate potential land impacts of different resource options in an accessible way to support policymakers and inform Hawaii's stakeholders. The HSEO, alongside the PUC, is also participating in an ongoing Task Force on Comprehensive Electricity Planning[116] focused on emerging issues in electric system planning that is co-hosted by the National Association of Regulatory Utility Commissioners (NARUC) and the National Association of State Energy Officials (NASEO).

The results from all these efforts are clear: Hawaii is capturing worldwide attention for record-setting prices for utility-scale renewables paired with storage, and for solicitations of a magnitude not seen anywhere before.[117]

Reinventing the Grid

4

Introduction: Hawaii Regulators Deliver a Vision for the Grid of the Future

A defining moment in Hawaii's energy journey came in April 2014, in the form of *Exhibit A* to the PUC's rejection of the HECO Companies' proposed integrated resource plan (IRP). Attached to that decision, but destined to live long beyond a single docket, the PUC published its *Commission's Inclinations on the Future of Hawaii's Electric Utilities: Aligning the Utility Business Model with Customer Interests and Public Policy Goals*.[118] Colloquially known by the shorthand Inclinations, many read it as a sharp rebuke of the HECO Companies' traditional *modus operandi.*

In *Inclinations*, the Commission reflected that the Companies "appear to lack movement to a sustainable business model to address technological advancements and increasing customer expectations... Without such a long-term customer-focused business strategy, it is difficult to ascertain whether HECO Companies' increasing capital investments are strategic investments or simply a series of unrelated capital projects to expand utility rate base and increase profits appearing to provide little or limited long-term customer value."[119]

> “*Inclinations* provided a holistic vision of the desired future and outlined a path that would enable the HECO Companies to take a leadership role in advancing through a new paradigm of grid planning that aligns utility and customer interests.

The *Inclinations* report represented a turning point, not just for how the PUC expected the Companies to operate, but for how the state expected the electricity system to evolve writ large. *Inclinations* provided a holistic vision of the desired future and outlined a path that would enable the HECO Companies to take a leadership role in advancing through a new paradigm of grid planning that aligns utility and customer interests.

Since the 2014 *Inclinations* report and associated IRP rejection, planning has advanced along at least three tracks:

1. Improvements to grid planning
2. Grid modernization to support the future system
3. Demand flexibility to support variable resource integration

In each case, the playbook and processes for grid services, planning, and investments are being rewritten.

When Integrated Resource Planning Is Not Enough

IRPs have been the bread and butter of utility and electricity grid planning for decades. The Hawaii PUC established an IRP framework as early as 1992, prescribing the components of resource plans that the HECO Companies had to regularly file. As the electric industry changed over the turn of the century, the PUC issued an order in 2011 that outlined a revised IRP framework.[120] The impetus was “to allow for a more effective, inclusive, and comprehensive planning process that acknowledges the dynamic and constantly changing utility environment that exists today.”

The revised IRP framework included several new design features to improve resource planning and streamline PUC evaluation of utility proposals to add generation capacity. These included the use of scenarios to address uncertainty, an independent entity to verify adherence of the planning process to the IRP framework, and the robust engagement of stakeholders to ensure community support for resource plans.

Building on the revised framework, the Commission provided further guidance in 2012 by specifying “principal issues” and objectives to be addressed in the IRP cycle.[121] The PUC clarified that it would review the IRP process and deliverables to evaluate consistency with the revised framework and principal issues.[122] The message was clear: the grid was changing and the PUC needed the utilities to change with it.

EXHIBIT 12

Drivers for Improved Planning Practices

The Hawaii PUC's imperative to evolve grid planning is symptomatic of macro conditions affecting the electricity ecosystem in Hawaii and beyond. These conditions encompass sweeping changes and constraints spanning policy, technology, customer preferences, and land use.

Renewable Energy Policy	Technology Advancement	Customer Preferences	Land Constraints
Achieving renewable energy goals like Hawaii's 100% RPS requires significant development of renewables and operational improvements to integrate those renewables Federal tax incentive structures encouraging third-party PPAs necessitate improved procurement practices to ensure competitive pricing can be achieved	Demand-side technologies expand the solution set for addressing grid needs Management of a distributed grid demands modern grid infrastructure and communications capabilities to enable DERs to support operations	Customer adoption of new technologies must be accommodated by utilities to ensure that customer-sited assets are optimized and support grid operations Smart rate designs must encourage technology adoption and enable customer choice	Land constraints and local opposition to some utility-scale projects creates a need to leverage customer-sited DERs to provide grid services and achieve ambitious renewable energy targets

The Companies filed a consolidated IRP in 2013 detailing action plans for each island within its service territories.[123] The PUC was not satisfied. Citing noncompliance with the revised framework and principal issues, the Commission rejected the IRP the following year,[124] prompting the *Inclinations* report. Although the HECO Companies had made improvements to its planning process, the IRP did not demonstrate to the PUC that planning practices were sufficiently evolving.

As part of the Commission's rejection, the PUC issued four orders encompassing grid operations and resource planning.[125] In aggregate, those orders required that the Companies aggressively pursue energy cost reductions, address challenges with renewable energy integration and customer-sited interconnection, and embrace demand response.

Improving the Improvement Plans: Three Rounds of PSIP

With its IRP rejected, the HECO Companies were left to consider where it went wrong. Commission feedback on the IRP reflected that incremental changes would not suffice for the utilities' next iteration of planning. The utility would have to re-envision and overhaul the planning process from the ground up. Thus began the Power Supply Improvement Plan (PSIP) process.

The Commission gave the HECO Companies a broad charge: the PSIPs should include "actionable strategies and implementation plans to expeditiously retire older, less-efficient fossil generation, reduce must-run generation, increase generation flexibility, and adopt new technologies such as demand response and energy storage for ancillary services, and institute operational practice changes, as appropriate, to enable integration of a diverse portfolio of additional low cost renewable energy resources, reduction of energy costs and improvements in generation operational efficiencies."[126] This would be no small task and proved difficult for the HECO Companies to deliver on.

The Companies filed its PSIPs before the end of the year, and the PUC acknowledged that they represented meaningful improvements over the prior IRP Report plans. Nonetheless, the Commission rejected the PSIPs in 2015 due to concerns across eight specified subjects, including lack of analysis on DERs and renewables, and unjustified costs for system security measures and fossil-fueled power plants.[127]

In response to extensive stakeholder interest and feedback on the PSIP process—21 motions to intervene were filed in the docket—the Commission adapted its approach to intervenors. It granted participant status to 18 organizations, allowing each of them to present analysis, testimony, and statements of position as permitted by further docket orders. The PUC also granted intervenor status to three government entities on the basis that each was "statutorily mandated to act in energy-policy areas and officially represent the interests within the scope of their respective mandates."[128] The three government intervenors—County of Maui, County of Hawaii, and the State Energy Office via DBEDT—were expected to assist the Commission in its PSIP investigation by providing their relevant perspectives and expertise.

In 2016, the HECO Companies filed updated PSIPs to address the PUC's noted areas of concern.[129] Yet, since the plans were closely tied to a possible HECO Companies' merger with NextEra Energy (see Chapter 5), they were rendered moot when the merger was rejected in 2016, necessitating the utility to take one more turn of the crank.[130] The third version of the Companies' PSIPs was then filed at the end of 2016 and finally accepted by the PUC in 2017.

The Commission endorsed the PSIPs overall vision but the HECO Companies would have to still seek PUC approval for specific actions pursuant to the plans like the issuing of RFPs. In accepting the PSIPs, the PUC recognized significant improvements in its transparency. incorporation of stakeholder input, and use of advanced analytic tools.[131] Despite improvements, the Commission also flagged concerns including anticipated increases in customer rates from anticipated investments, and lack of analysis underlying proposed generation, storage, and transmission projects. Given the difficulties getting to this point and persistent concerns, the Commission ordered the Companies to file a report that detailed how the utility would further evolve and improve its approach for the next round of planning.

Lessons for the Energy Transition:
It Takes Grit to Reform Planning Practices

“Hawaii has taken a trial-and-error, iterative approach to comprehensive planning reform, informed by the PUC’s consistent vision for integrated planning and enabled by the corresponding regulatory adjustments to align new planning processes with the evolving utility business model.

Hawaii’s experience updating planning approaches is informative to other jurisdictions starting down a similar path. As of 2019, at least 25 states and Washington, D.C. are making efforts to adapt their planning approaches to address grid modernization and higher levels of renewable energy.[132] In the context of entrenched and often opaque planning traditions, substantive revisions to planning practices are not easy.

Rising to the challenge, Hawaii has taken a trial-and-error, iterative approach to comprehensive planning reform, informed by the PUC’s consistent vision for integrated planning and enabled by the corresponding regulatory adjustments to align new planning processes with the evolving utility business model. This regulatory leadership was critical in supporting the HECO Companies pursuit of holistic transformation.

In addition to the PUC, a committed group of stakeholders has been critical to advancing Hawaii’s planning processes. Providing their expertise and perspectives, these stakeholders have committed to the years-long process of adapting planning every step of the way, through every working group, docket, and filed comment.

A Renewable Energy Grid Must Be a Modern Grid

Modern planning and a modern grid go hand in hand. For the HECO Companies to make the revisions to planning procedures that the Commission was requesting and address all the factors changing the electricity ecosystem, the utility would need to make significant upgrades to its grid infrastructure.

These upgrades would require investments in advanced metering infrastructure (AMI), supervisory control and data acquisition (SCADA), and communications capabilities. But for Hawaii, grid modernization is about more than digital meters taking granular readings of a home's electricity use. The modern grid needs to address the operations of the transmission and distribution system to provide better visibility into voltage, frequency, and other state-of-system variables as more DERs are connected. Similarly, the modern grid needs new control systems to optimally manage DERs and ensure that, as customer-sited assets proliferate, the full spectrum of their technical capabilities are utilized.

In 2014, the Companies filed a "Smart Grid Roadmap and Business Case" for grid modernization.[133] As part of its roadmap, HECO initiated a smart grid pilot on Oahu including roughly 5,000 customers to provide empirical information to help with program design efforts for full-scale smart grid implementation.

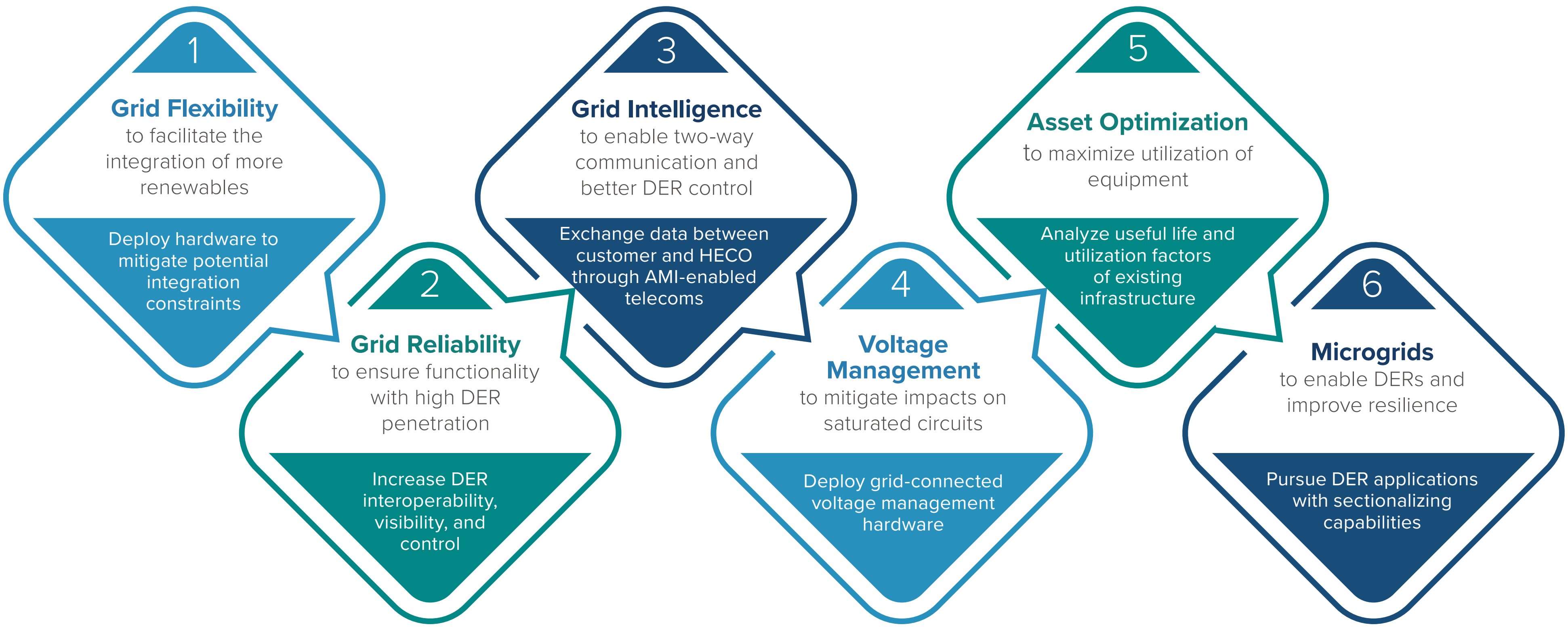
Following the smart grid pilot, the Companies applied for funds for a full-scale grid modernization program in 2016 called the Smart Grid Foundation (SGF) Project.[134] Grid modernization would not be accomplished by a single project but would evolve over time by layering operational capabilities and expanding customer options.

Rejecting the SGF in 2017, the Commission ordered the Companies to submit a revised and detailed scenario-based grid modernization strategy (GMS), which would "provide the comprehensive and holistic vision and context to inform subsequent review of discrete grid modernization project applications." The HECO Companies filed the GMS at the end of 2017, identifying six priorities to enable grid-of-the-future services like deploying DERs and operationalizing demand response at scale, all while maintaining reliability (see Exhibit 13).

The Commission approved the GMS in February 2018.[135] In its order, the PUC recognized that "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."[136] In 2019, the Commission approved the implementation of Phase 1 of the GMS, authorizing rate recovery for the deployment of advanced meters, a meter data management system, and improved telecommunications networks.[137]

EXHIBIT 13

Six Priority Objectives of the HECO Companies' Grid Modernization Strategy



Source: Adapted from the HECO Companies Grid Modernization Strategy

Harnessing Demand Flexibility for Grid Optimization

In exchange for approved investments in grid modernization infrastructure, utilities are expected to leverage technologies to enable customer choice and the provision of grid services by DERs.

In Hawaii, much of the action on this front has been related to the state's demand response (DR) proceeding.[138] After years of program development and stakeholder engagement, in 2018 the PUC approved a portfolio of four new DR programs that the HECO Companies' customers could participate in to support the management of the grid.[139] The new programs for *capacity grid services, fast frequency response, regulating reserves*, and *replacement reserves* allow the utility and its DR aggregator partners to control customers' DER equipment to provide load flexibility and support reliable, cost-effective operation of the grid.

The Companies' 2019 Advanced Rate Design Strategy[140] likewise proposes to leverage AMI to offer customers dynamic rates including time-varying, critical peak, and real-time pricing options. These advanced rates will support energy goals by financially incentivizing customers to use their DERs to align electricity consumption with low-cost and low-carbon electricity supply.

As Integrated Grid Planning (IGP) promises to pursue customer programs and pricing as primary sourcing mechanisms to procure solutions to its grid needs, new DER contracts like the landmark 2019 grid services purchase agreement (GSPA)[141] further illustrate the evolution of utility interactions with DERs. Developed in coordination with an IGP working group, the contract allows DERs—including 1,000 of Sunrun's Brightbox solar-plus-storage customer-sited systems—to deliver a package of services: load-shedding demand response and capacity resources, and real-time grid services such as frequency regulation and spinning reserves. The GSPA thereby ensures that DERs like solar-plus-storage serve as a grid solution.

These types of market signals and contract structures allow customers to make choices to adopt DERs and become partners with the utility in grid management. They are expected to be a critical component of Hawaii's 100% renewable energy future, enabling customers to be part of the two-sided optimization that matches cleaner supply with smarter demand in a dynamic balancing act that replaces the need for fossil fuel dispatch.

Moving to Integrated Grid Planning

The GMS included a complete picture for how grid modernization investments would lead to the grid of the future. But there remained a gap for how resource planning and aggregation of new service capabilities would be considered—that is, where previous IRPs and PSIPs came up short. Building upon the vision outlined in the GMS, the HECO Companies undertook a paradigm shift in planning with its ground-breaking proposal for integrated grid planning.[142]

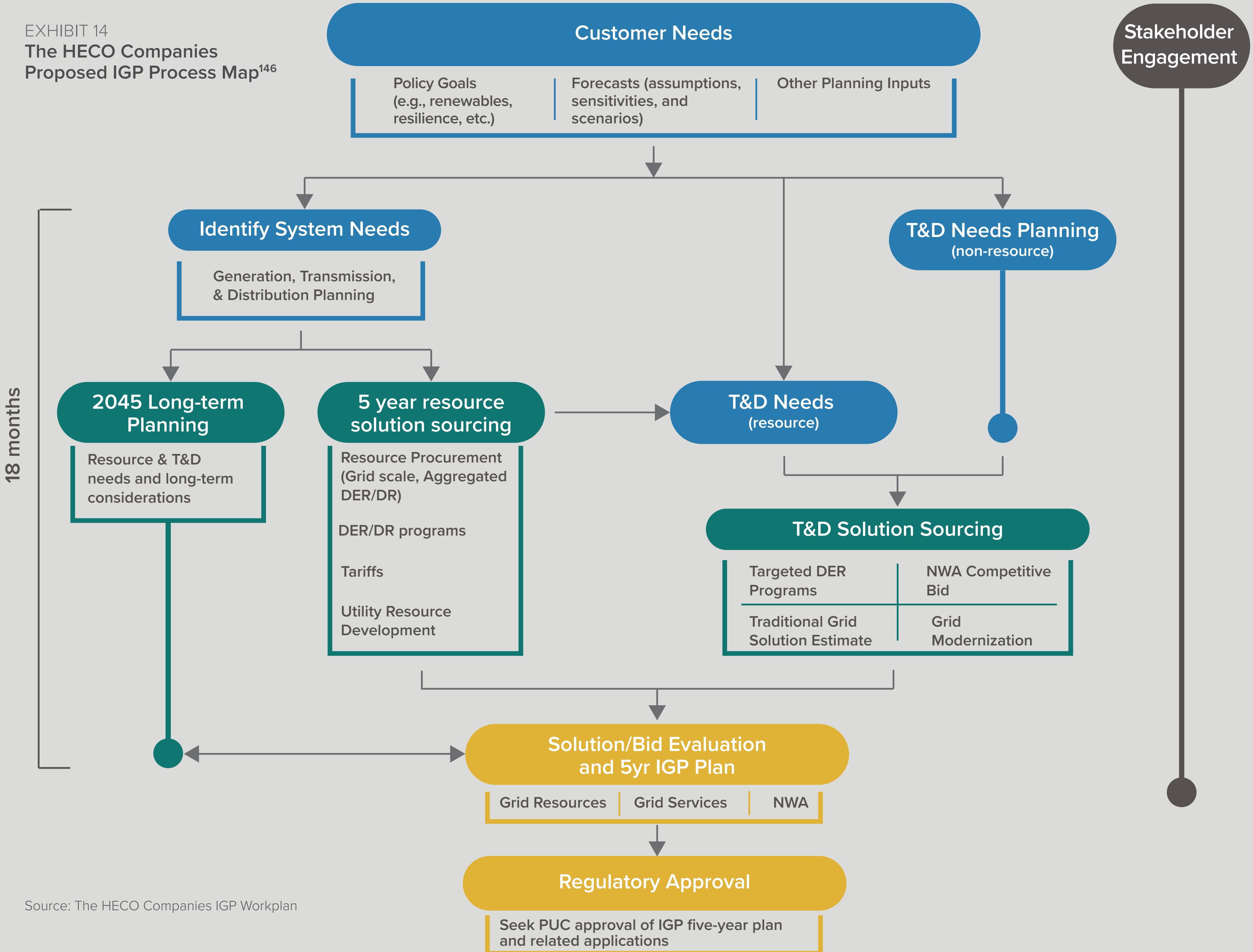
In its IGP Report and subsequent Workplan, both released in 2018, the Companies outlined a systems approach that harmonized the planning and procurement processes for generation, distribution, and transmission needs.[143]

The goal of IGP is to integrate and streamline the historically siloed planning and procurement processes for generation, distribution, and transmission.[144] Instead of identifying needs and sourcing solutions for each electric system component serially and in isolation, IGP considers all of them in parallel. For example, when evaluating solutions to grid needs, IGP considers the results of sourcing processes for generation resources as well as transmission and distribution resources to find the optimal solution set (see Exhibit 14). As proposed by the HECO Companies, the full IGP process, from needs identification through solicitation and evaluation, was to take 18 months.

With IGP, the HECO Companies responded to the PUC's requests for continued improvement by designing a revitalized planning process. In March 2019, the PUC issued an order to accept the IGP Workplan.[145] Commending the Companies' rigorous stakeholder engagement model and the Workplan's general responsiveness to prior Commission guidance, the PUC endorsed utility leadership of the proposed IGP process. Going forward, the Commission's role in IGP would be to provide guidance where necessary to ensure a timely, transparent, and collaborative process.

EXHIBIT 14

The HECO Companies Proposed IGP Process Map[146]



Source: The HECO Companies IGP Workplan

Bringing IGP Into Practice

For all the progress being made, the process of breaking new ground in grid planning has not been without challenge nor critics. But that is probably to be expected, as there is no precedent for what IGP is trying to accomplish.

Across seven subject matter working groups, the HECO Companies and stakeholders have grappled with identifying practical steps for implementation of the many aspects of a revised planning and procurement process. Overlap between groups has required revisions to initial working group scopes and necessitated close coordination between the Companies, stakeholders, and process facilitators.

Some have claimed the process is not doing enough. Rather than starting with the current, system-level planning construct and making incremental adjustments, they suggest that the whole planning framework should be re-envisioned to optimize for a DER-centric grid. This tension is reflected by one interviewee's sentiment that "we're a DG system run by a utility."

After more than 12 months spent reviewing existing practices and framing issues—including substantial timeline delay as the utility has developed preliminary proposals—more concrete IGP processes and technical content are beginning to emerge. Notably, an integrated procurement approach and a method for identifying grid needs are coming together to add critical detail to the IGP process. Similarly, an RFP for a non-wires solution pilot was released to the market in November 2019, which seeks to allow any capable technology to provide grid reliability services.

The Hawaii PUC has also leaned into the IGP process to help guide progress, maintain forward momentum, and ensure transparency. Through participation in working groups and formal guidance, the Commission and PUC staff have advanced the integrated agenda, continuing to highlight the goals outlined in *Inclinations* and emphasized throughout the state's planning evolution. For example, the PUC issued a filing in August 2019 to encourage inclusive consideration of non-wires opportunities in the HECO Companies pilot solicitation,[147] and offered further guidance in a November 2019 Order to give input on the Commission's role in IGP, improve stakeholder engagement, and maintain forward progress.[148] Stakeholders have also remained committed to the IGP process, battling working group fatigue from numerous monthly meetings to provide insight and inform the HECO Companies' deliverables.

Going forward, IGP will need to continue balancing the objective of expanding stakeholder engagement—including a diverse set of parties with differing levels of planning expertise and different business objectives—with the need to address technical details of planning that were previously considered the utility's exclusive domain. A robust record of Commission guidance and stakeholder feedback will support this, but the HECO Companies must continue to lead the process and pioneer a new path for integrated planning, as utilities nationwide eagerly watch and learn from the Companies' work.

The Utility Business Model Reimagined

5

Introduction: Recommitting to Hawaii's Electric Utilities

The year 2015 was seminal for Hawaii: the PUC closed net metering for rooftop solar, the HECO Companies saw its latest round of PSIPs rejected en route to IGP, and the legislature passed the state's 100% RPS. Meanwhile, a controversy was brewing that threatened to stall, if not outright derail, Hawaii's progress. One year earlier, in 2014, NextEra proposed a $4.3 billion takeover of the investor-owned HECO Companies in what was known simply as "the NextEra merger."

"For two years, it sucked the air out of the room," recalled one stakeholder. "In hindsight, because it was so high-profile and controversial at the time, it commanded too many resources and forced other issues to get back-burnered."

The idea of NextEra acquiring the HECO Companies had some merit. NextEra would be a source of capital to invest in infrastructure for Hawaii's grids. In addition, one of NextEra's mainland subsidiaries was a noted developer of utility-scale renewable energy projects. Beyond these benefits though, optimism was scarce and concerns abounded.

Would a NextEra-owned utility help the state meet its energy goals? Some said NextEra was not a fan of distributed generation and that DER companies would be "squashed under their heels like a little bug." Others saw Hawaii becoming more, not less, dependent on fossil fuels with NextEra keen to import liquified natural gas to the state. Moreover, some critics saw the proposed merger as "a doubling down on the 20th century centralized model where the utility controls everything, and where innovative third-party technologies and different rate designs for customers simply could not exist."

With such broad opposition to the merger, the PUC officially rejected NextEra's proposal in July 2016.[149]

But Hawaii was not settling for the status quo. After the PUC's 2014 *Inclinations* report, the installation of Alan Oshima as the Companies' new CEO, the push toward IGP, and the still-open question of evolving utility business models, the Companies were amid a transition—one in which regulation and incentives inform its willingness, ability, and motivation to adapt to a new energy future.

When the PUC denied the NextEra merger, the state embraced head on the challenge to find its own path to 100% renewable energy. The move to IGP was one piece of the puzzle. But looming over everything remained deep-rooted questions of the role and incentives—not to mention fundamental identity—of the utilities in the state's clean energy future.

If a utility is regulated according to a traditional cost-of-service model, with embedded structural biases to build, own, and rate base large capital infrastructure, clean energy will at best be a sideshow to its core business or, worse, a threat to undo the financial health and capabilities of the whole company. A more complete reconsideration of utility incentives was due.

In April 2018, the PUC opened its *Proceeding to Investigate Performance-Based Regulation* to undertake a fuller examination of the HECO Companies' regulatory incentives.[150] Hawaii is now pursuing what may be the most comprehensive examination in any US state of how performance-based regulation (PBR) can help achieve state policy goals and electricity system objectives.

Foundations of Performance-Based Regulation in Hawaii

Performance-based regulation does not happen in one fell swoop. Elements of PBR were introduced in Hawaii dating back to at least the 1990s. At that time, some of the same reforms discussed today were on the table.[151] These included increasing the number of years between the Companies' rate cases (multiyear rate plans) and introducing performance incentive mechanisms (PIMs) focused on service quality. Ultimately, the PUC decided not to adopt these proposals at the time.

More than a decade later, in 2010, the PUC approved Hawaii's first decoupling mechanisms, to undo the tie between the amount of energy sales and utility revenue and to better support energy efficiency and renewable integration.[152] A few years later, the Commission initiated a new decoupling proceeding, and established a set of performance metrics for the utility to track, a cap on how high utility revenues could grow between rate cases, and PIMs for reliability measures.[153]

In the ensuing years, the Commission introduced additional elements of PBR to the regulatory framework. In late 2017, the PUC allowed an initial, one-time performance incentive related to the HECO Companies' timely acquisition of cost-effective demand response from third-party aggregators.[154] Also in 2017, the Commission established a short-term shared-savings mechanism for the Companies' procurement of third-party renewable generation.[155] The incentive was based on an 80%/20% split between customers and the utility for the estimated first-year savings from each PPA entered into by the Companies, as compared to benchmarks set by renewable energy projects.

Despite having PBR components in place, concerns remained for the Companies' ability to meet the state's renewable energy goals, especially given forecasted increases in customer rates due to proposed grid modernization investments. Although the 2014 Inclinations report identified these issues and called for system transformation, fulfillment of that vision was lagging.[156]

Lessons for the Energy Transition:
Utility Ownership and Regulatory Models

> “Alternative regulatory models—for example Hawaii’s ongoing work with performance-based regulation (PBR)—may be more important for achieving clean energy aspirations than upending utility ownership models.

NextEra’s proposed takeover of the HECO Companies is not the only instance when the utility ownership question has surfaced in Hawaii. In May 2015, Maui County issued an RFP for an analysis of options, costs, and benefits associated with alternative forms of ownership for the island's electric utility.[157] It was the opposite of the NextEra approach—putting power into the hands of residents and customers, rather than the arms of a corporation. Kauai pursued this path when a group of local businesspeople purchased the island’s incumbent utility in 2002 and formed its own member-owned nonprofit cooperative.[158]

What is the best ownership structure for Hawaii’s utilities? By House Bill 1700 (Act 124), the state legislature tasked Hawaii’s DBEDT with exploring the possibilities.[159] The ensuing two-and-a-half-year process involved numerous community meetings, deep economic analysis, and thoughtful consideration of interactions among different parts of the system (e.g., ownership models and regulations).

The DBEDT study looked at eight different ownership structures, ranging from the familiar investor-owned and wires-only utility models, to muni and co-op possibilities, to a single-buyer model, with decentralized options and hybrids in between. Each structure was evaluated on a range of criteria, including its ability to meet state energy goals, maximize consumer cost savings, enable a competitive distribution system, align stakeholder interests, address conflicts of interest, and minimize transition costs.

The State Energy Office released the final report in June 2019.[160] One of its key takeaways, applicable to Hawaii as well as other states pursuing energy transitions: alternative regulatory models—for example Hawaii’s ongoing work with performance-based regulation (PBR)—may be more important for achieving clean energy aspirations than upending utility ownership models. Rather than reconstitute the utility entirely, there are likely to be lower transition costs by maintaining current structures while improving incentives—that is, a co-op for Kauai and an investor-owned utility for the other islands.

PBR with Aloha: Hawaii's Pursuit of Comprehensive Reform

To guide the current PBR investigation, the Commission adopted a two-phase approach. Phase 1, completed in May 2019, examined the state's current regulatory framework to identify specific areas of focus for further PBR development. Phase 2 is focused on refinements to regulations in those areas identified in Phase 1.

The PUC has employed a highly collaborative approach to the PBR proceeding, enabling a wide variety of stakeholders to engage in the process. This began in Phase 1, which consisted of three steps:

1. Identification of regulatory goals and outcomes to serve as guiding principles and to ground an assessment of the regulatory framework
2. Assessment of which outcomes are currently well-served by the regulatory framework and which require greater focus and examination
3. Determination of which regulatory mechanisms are best-suited to achieve each prioritized regulatory outcome and identification of attendant metrics, where appropriate, to measure the utility's performance in achieving that outcome

For each step of Phase 1, PUC staff hosted a workshop with stakeholders, for which RMI served as facilitator and designed the workshops to allow necessary foundation-setting and seek alignment among parties. The workshops reimagined norms of regulatory meetings and functioned more like design charrettes than adversarial hearings, including breakout activities, panels of outside experts, and presentations from parties themselves. Stakeholders reflected an appreciation for the workshop approach and opportunity to "think out loud"[161] about the complex set of issues raised by PBR.[162]

To encourage refinement of the PBR solution set, each workshop was preceded by a staff concept paper and followed by an invitation for parties to file written comments. The concept papers provided clear framing, teed up discussion topics, and offered background and frameworks for participants to respond to at workshops. The papers also allowed PUC staff to reflect on proceeding developments as they unfolded, clarify options being offered, respond to parties' discussions, and provide feedback on ideas that emerged. Parties' written comments allowed each organization to state its position more formally than was possible at workshops and to address the staff concept papers as well as positions emerging from other parties.

> "The workshops reimagined norms of regulatory meetings and functioned more like design charrettes than adversarial hearings, including breakout activities, panels of outside experts, and presentations from parties themselves.

EXHIBIT 15

Hawaii Goals and Outcomes for PBR[163]

Goal	Regulatory Outcome	
Enhance Customer Experience	Traditional	Affordability
		Reliability
	Emergent	Interconnection Experience
		Customer Engagement
Improve Utility Performance	Traditional	Cost Control
	Emergent	DER Asset Effectiveness
		Grid Investment Efficiency
Advance Societal Outcomes	Traditional	Capital Formation
		Customer Equity
	Emergent	GHG Reduction
		Electrification of Transportation
		Resilience

Source: Hawaii Public Utilities Commission. Order No. 36326, Docket No. 2018-0088

Phase 1 of the proceeding culminated with a *Staff Proposal for Updated Performance-Based Regulations* and further party comments, then the Commission's Phase 1 decision in May 2019. The Phase 1 decision adopted three goals and 12 outcomes to serve as the focus for PBR reforms (see Exhibit 15), as well as three guiding principles to inform further PBR development. The guiding principles established a clear set of design objectives for what new regulations should achieve:

1. **A customer-centric approach**, including achievement of ratepayer savings

2. **Administrative efficiency** to reduce cumbersome regulatory burdens

3. **Utility financial integrity** to maintain the utility's financial health and access to low-cost capital

The decision also laid out a portfolio of specific PBR mechanisms for further examination and development in the proceeding (see Exhibit 16).[164]

In sum, the Phase 1 PBR decision outlined a framework to establish a new regulatory paradigm for the HECO Companies. Utility revenues will be earned according to a combination of baseline target revenues designed to encourage cost control, plus *performance revenues* to encourage exemplary service.

EXHIBIT 16

PBR Mechanisms Adopted in Phase 1 Decision and Order[165]

Revenue Adjustment Mechanisms	
MRP with Indexed Revenue Adjustment	**Five-year Control Period** with **Externally-indexed Revenue Adjustment** allowing interim revenue changes pursuant to an indexed formula: **Annual Revenue Adjustment** = **(Inflation) - (X-Factor)** + **(Z-Factor) - Customer Dividend**
Earnings Sharing Mechanism (ESM)	Apply an **ESM** that provides both "upside" and "downside" sharing of earnings between the utility and customers when earnings fall outside a Commission approved range
Major Projects Interim Recovery (MPIR)	Examine the **MPIR adjustment mechanism** to determine how it can continue to provide relief for appropriate projects during the MRP consistent with other approved PBR objectives and mechanisms
Revenue Decoupling and Existing Cost Trackers	Continue to utilize **revenue decoupling** (i.e., the Revenue Balancing Account), to true up revenues to an annual revenue target and existing **cost tracking mechanisms** (e.g., PPAC, ECRC, etc.) to track and recover certain approved costs
Off-Ramps	Develop **off-ramp** mechanisms to provide for review of approved PBR mechanisms, pursuant to specified circumstances or conditions
Performance Mechanisms	
Performance Incentive Mechanisms (PIMs)	Implement a set of **PIMs** designed to help drive achievement of the following priority outcomes: *Interconnection Experience; Customer Engagement; and DER Asset Effectiveness*
Shared Savings Mechanisms	Develop **shared savings mechanisms** to address priority outcomes including *Grid Investment Efficiency* and *Cost Control*, mitigate capex bias, and reward pursuit of cost effective solutions to meet customer needs
Scorecards and Reported Metrics	Publish **Scorecards** with targeted performance levels to track progress against the priority outcomes of *Interconnection Experience, Customer Engagement, Cost Control*, and *GHG Reduction* and utilize **Reported Metrics** to highlight performance on the priority outcomes of *Affordability, Customer Equity, Electrification of Transportation, Capital Formation*, and *Resilience*

Source: Hawaii Public Utilities Commission. Order No. 36326, Docket No. 2018-0088

Target revenues will be adjusted according to an annual revenue adjustment (ARA), to be set by a formula that accounts for inflation, utility productivity, and customer benefits. An earnings sharing mechanism (ESM) will provide both "upside" and "downside" sharing of profits (and risk) between the utility and customers around a target earnings level. This sharing of over- and under-earnings should maintain the financial health of the utilities while protecting ratepayers from disproportionate utility profits. Lastly, performance mechanisms will financially incent utilities to address a set of prioritized outcomes and provide transparency on progress made to advance others.

In the backdrop of the PBR investigation, one of Hawaii's latest legislative dictates has also loomed. Days after the PUC opened the proceeding, the state legislature passed Act 5, which requires the establishment of "performance incentives and penalty mechanisms that directly tie an electric [utility's] revenues to that utility's achievement on performance metrics and break the direct link between allowed revenues and investment levels" by January 1, 2020.[166]

Whereas Act 5 did not mention the PBR proceeding, many interpreted the 2020 date as a deadline for its completion—a daunting timeline for an already ambitious undertaking. In a separate decision in 2019, however, the Commission determined that PBR components already in place and in development meet the objectives of the legislation.[167] Although very much in pursuit of Act 5's intent, the Commission has recognized that the current PBR docket requires more time to methodically reconsider the Companies' regulations and to enact reforms.

From Frameworks to the Details of PBR

Phase 2 of the PBR proceeding continues the collaborative approach established in Phase 1, with a notable change for who is responsible to develop PBR proposals. The Commission has directed parties to each file "initial comprehensive PBR proposals" aligned with the Phase 1 framework.[168] Parties are now iterating on their ideas throughout Phase 2 and will file final proposals as *statements of position* in Spring 2020. Following which, the Commission expects to hold a more formal evidentiary process with hearings before issuing a decision to adopt new PBR regulations.

Phase 2 expands on the workshop structure of Phase 1 by incorporating monthly working group meetings at which parties present, evaluate, and develop their PBR proposals. Two working groups are running in parallel, facilitated by RMI: a Revenue Adjustments Working Group to discuss core ratemaking components such as the ARA formula and earnings sharing mechanism design, and a Performance Mechanisms Working Group to develop metrics, performance targets for select metrics, and scorecards and PIMs for a subset of the Commission's 12 priority outcomes. Through the working group meetings, parties are grappling with questions over individual mechanism design and cross-mechanism interdependencies. Prominent issues for attention include:

- How to ensure the future PBR framework provides appropriate regulatory certainty for utilities to attract low-cost capital, while also integrating flexibility and opportunities for adjustment to mitigate risk to customers and the utility
- How to design annual revenue adjustments, including productivity factors (X-factor) and stretch factors (customer dividend), that consider both the need for customer savings and adequate recovery of utility costs
- How to reduce the inherent utility bias toward capital expenditures, while maintaining appropriate cost recovery for necessary grid infrastructure investments
- How to design and size performance incentives such that the utility is motivated to improve operations and customer services, while avoiding disproportionate rate impacts to customers

- How to design the best metrics and targets for performance mechanisms that motivate utility improvements and innovation, including whether to focus on sweeping outcome-oriented targets like accelerated RPS achievement—then allowing utility discretion for how to achieve— versus more narrowly constructed activity-based measures like interconnection management

- How to best evaluate PBR proposals, including financial modeling of interactive mechanism effects, in a manner that is sufficiently accurate and insightful on a forward-looking basis while recognizing uncertainty for the future

- How to maintain ambition and focus on the Commission's adopted outcomes and guiding principles—including cost savings for customers—without falling victim to the gravitational pull of making only piecemeal adjustments around the edges of existing regulations

On these issues, the interactive nature of regulatory incentives with utility investment plans and service definitions—being written in parallel in the IGP process—also comes up. How should parties evaluate PBR reforms, for example, when the schedule of utility investments and asset retirements that are in development in IGP may affect and be affected by the success of those reforms? On the other hand, how does the utility best conduct its planning and procurement processes housed in IGP, while the final incentives that will be adopted in the PBR proceeding and future rate cases remain unknown?

These and other chicken-or-egg type questions persist as PBR and other proceedings advance. To address those concerns, the Commission has sought to be clear and consistent in its expectations for PBR and other activities, while allowing ample space for the utility and parties to work with each other and bring ideas forward.

As the PBR investigation moves into advanced stages in 2020, many are watching to learn how Hawaii's pioneering work on comprehensive utility reform will come together. Or, as is the privileged case for RMI, serving as partners alongside Hawaii's community of electricity stakeholders who are working diligently to design that future.

Lessons for the Energy Transition: Leadership, Commitment, and Collaboration

Hawaii might have the most advanced investigation of performance-based regulation in the country, but it is hardly alone in this pursuit. As increasing numbers of states adopt 100% renewable or clean energy targets, there has been a wave of recognition that utility regulations need to be updated. Since Hawaii adopted its 100% RPS in 2015, utilities and PUCs across 19 states plus Washington, D.C.,[169] have explored elements of PBR, ranging from Colorado's[170] and Nevada's[171] legislated PBR investigations, to other select reforms in states like Minnesota[172] and Oregon.[173]

Hawaii's PBR investigation offers many lessons and approaches for consideration, from the design of performance-based mechanisms, to the persistently complex nature of trying to unravel capital bias in the utility business. But the lessons most notable from Hawaii's unfolding regulatory reform derive less from substance—though there has been no shortage of that—and rather relate to leadership, commitment, and collaboration. In short, Hawaii's PBR proceeding makes clear that the electricity sector transition cannot be put on autopilot; to get the details even approximately correct requires a substantial investment by all stakeholders, including deliberate space for codevelopment, in a manner that the sector is not necessarily accustomed to.

In Hawaii, the tone was set by Commissioners and PUC staff, who repeatedly and publicly state their commitment to the proceeding and their unwavering expectation that the outcomes should be meaningful. The Commission has given this more than lip service, investing substantial time and attention to manage the proceeding. It is not simply issuing information requests as in traditional regulatory processes and letting the utility and parties compete for the winning argument. Instead, PUC staff have taken painstaking measures to develop guidance documents and provide framing to give parties a common fact base and align stakeholders on a shared purpose.

The HECO Companies get credit as well. It has risen to the call of the Commission, sticking with a proceeding that is approaching the two-year mark, the intensity and focus of which continues to increase. The utility has devoted not only substantial time of its senior leadership, but also sincere commitment to listen to parties to understand and incorporate ideas into its own PBR proposals. The HECO Companies is also responding to information and data requests to help parties understand its core business, past performance, and future plans.

Likewise, other intervenors have stepped up in remarkable ways, giving countless hours of their time and shouldering the expense for additional expert consultants. Standing out among party commitments, the Ulupono Initiative went so far as to fund the creation of a financial model that can evaluate the effects of different PBR mechanism designs on the Companies' total revenue requirements and earnings. Ulupono then went further to share this tool with all parties in the proceeding, creating what is, in effect, an open-source model to allow any party to evaluate reform options and compare those with a common tool.

> "Hawaii's PBR proceeding makes clear that the electricity sector transition cannot be put on autopilot; to get the details even approximately correct requires a substantial investment by all stakeholders.

As in so many areas of the energy transition, Hawaii's lesson for the mainland is simple but important: collaborate with focused resolve. Hawaii has been fortunate to have a steady, focused regulator to lead its process, as well as a willing community of partners to bring their ideas into the work. The recognition that reform was needed turned out to be the easy part. Whereas the obvious next step, developing real, detailed reform options, has required a leap of faith that regulatory proceedings could go differently from the usual quasi-judicial, adversarial process.

Hawaii's approach to performance-based regulation in service of aggressive clean energy goals is a demonstration of the belief that breaking ground requires new approaches to policy design and collaboration, as well as a degree of systems thinking commonly lost amid more incremental modes of change. This approach also demonstrates that change, on the scale needed for the energy transition, is possible.

Epilogue: The Canary on the Mountaintop

At 13,768 feet (4,170 meters), Mauna Loa stands as the second-tallest mountain of Hawaii's islands. High on its northern slopes, perched amid the rarified air just over 11,000 feet above sea level, lies the world-famous Mauna Loa Observatory. Run by the US National Oceanic and Atmospheric Administration, it has continuously recorded the earth's definitive measure of atmospheric carbon dioxide (CO_2) concentrations since 1958.

The time-series plot of those concentrations—known as the Keeling Curve[174]—exhibits a predictable cycle over the course of a day and night, as well as seasonal variation over the course of a year, painting a smooth sine wave of CO_2 concentration, as if measuring the rise and fall of a person's breathing or the rhythm of a heartbeat. The Keeling Curve is Earth's climate cardiogram.

In the 62 years since measurements first began, one trend above all has been unmistakable: the steady rise in atmospheric CO_2 concentrations as human activity—especially the burning of fossil fuels—has caused the number to climb.

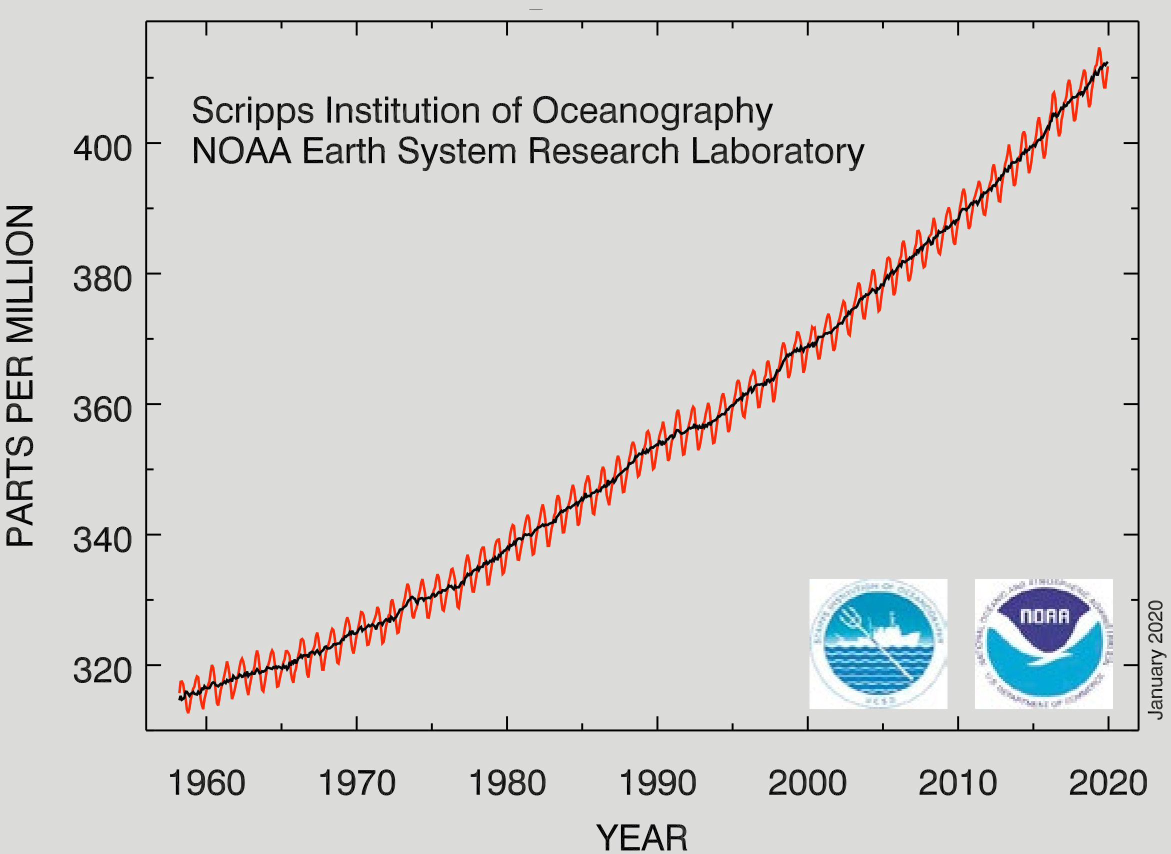
In May 2013, concentrations briefly crested the landmark 400 parts per million (ppm) threshold for the first time in human history.[175] In 2014, the number remained above 400 ppm for the entire month of April. In 2015, the global annual average came in above 400 ppm.[176] And then in September 2016—usually the annual low in seasonal atmospheric CO_2 variation—concentrations never dipped below 400 ppm.[177] Since then, the atmospheric CO_2 levels never dropped below 400 ppm at any time (see Exhibit 17).

The Keeling Curve has continued climbing higher and climbing faster.[178] In May 2019, the monthly average reached yet another record, this time nearly 415 ppm.[179] Hawaii's atmosphere has thus become the canary in the coal mine for the global climate crisis.

The Aloha State is on the front lines of global warming in other ways too. For about 20 fleeting but precious days each year, the state's three highest mountains—Mauna Kea and Mauna Loa on the Big Island and less-often Haleakalā on Maui—are blanketed in a pristine layer of blindingly white snow. But those days are numbered and will soon be gone. A group of climate modelers and other researchers from the International Pacific Research Center at the University of Hawaii predict that Hawaii's snows will nearly disappear by the end of the century.[180] Warmer air temperatures, especially at higher altitudes, and fewer winter storms tracking over the islands are to blame.

EXHIBIT 17

Atmospheric CO_2 Concentrations at Mauna Loa Observatory[181]



Source: National Oceanic and Atmospheric Administration

Meanwhile, warming ocean waters and shifting winds are bringing the effects of climate change to Hawaii via more-frequent direct hits from Pacific hurricanes, once considered a rarity for Hawaii.[182] A close call from Hurricane Lane in 2018 acted like a warning shot across Hawaii's bow.[183] If global fossil-fuel emissions continue unchecked, tropical storm formation near Hawaii is expected to increase in frequency 15% per decade in the years ahead.[184]

And of course, there are ever-present threats from sea-level rise, coastal erosion, wildfires, and economic and other human losses as a result. According to a 2018 federal report, Hawaii has even less time to prepare for these and other impacts than previously thought.[185] In recent years, Hawaii's King Tides—the highest tides of the year, usually in summer and winter when the earth, moon, and sun are in alignment—have approached record-setting levels[186] and sounded the alarm for what a "new normal" could look like for costly coastal erosion as sea levels rise.[187]

All of which is why Hawaii's clean energy leadership is more important than ever—not only for its own sake, but for all those states and countries that are watching Hawaii, ready to learn from it, imitate it, and join alongside it.

Where Does the Energy Transition Go from Here?

So, what happens next in Hawaii's clean energy transition? The next chapters are not yet written, but at least three themes are apparent.

First, there's the practical matter of taking further steps toward the state's 100% renewable energy target by modernizing the grid, advancing IGP, and completing the second phase of the PBR proceeding.

Second, the 100% RPS now sits within the broader context of Hawaii's zero emissions clean economy target, established to sequester more greenhouse gases than emitted within the state by no later than 2045.[188] A more complete vision is unfolding that goes beyond Hawaii's groundbreaking work in the electricity sector, as other major components of its economy gain momentum under the broad umbrella of the HCEI. These additional targets and expectations for building and transportation electrification only add to the need for a highly evolved, functional, and adaptive clean electricity sector.

Third is the embrace of uncertainty, with all the challenges and opportunities that go with it. The situation is akin to the early days of cellular telecommunications: originally envisioned for making phone calls and sending simple text messages and now the backbone of an entire mobile economy with applications that were previously unimaginable. So, too, might Hawaii's unfolding reforms with PBR, IGP, and manifold customer programs unlock new possibilities, not just for customers but also for the utilities and other players that each play a role for the electricity system to function as an integrated whole.

No one has a crystal ball for how this will play out, of course. But given progress over the last decade and the state's current momentum, we expect Hawaii to continue pushing the boundaries of what is possible, to nimbly adapt its strategies along the way—not without making any mistakes, but rather learning quickly from them—and to continue a path toward a 100% renewable electricity system that is affordable and resilient and encompasses all citizens.

As one stakeholder noted, "The middle way isn't always the right way." Perhaps ironically, the seeming extremes of Hawaii's approach may produce the best outcome thanks to the state's broad willingness to embrace a bold vision and collaboratively chart a course to get there.

The 100% renewable destination serves as an alluring beacon. For Hawaii residents, it represents the process of transforming the state's energy system into one that enables Hawaii to be a place where they can continue to live and raise families. For the world, it shows that 100% renewable is possible—not merely for hours or even days at a time, but as the new normal.

And as state representative Chris Lee and Blue Planet Foundation's Melissa Miyashiro wrote in a March 2019 *Seattle Times* op-ed encouraging Washington state's residents to support their own 100% renewable electricity target, it is "building more than an innovative and clean economy—we're building hope." That may be Hawaii's greatest lesson of all.

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