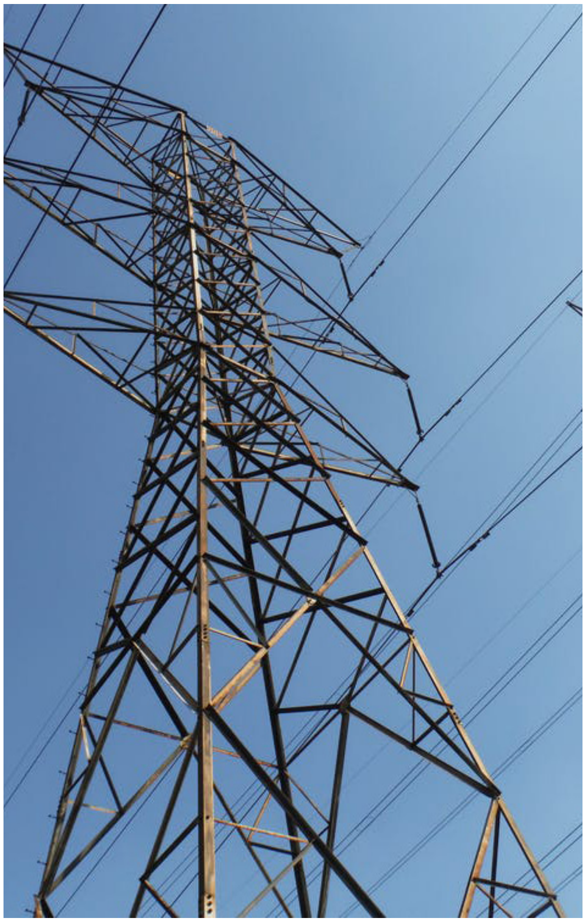


UNIVERSITY OF HAWAII ECONOMIC RESEARCH ORGANIZATION

THE UNIVERSITY OF HAWAII SEA GRANT COLLEGE PROGRAM

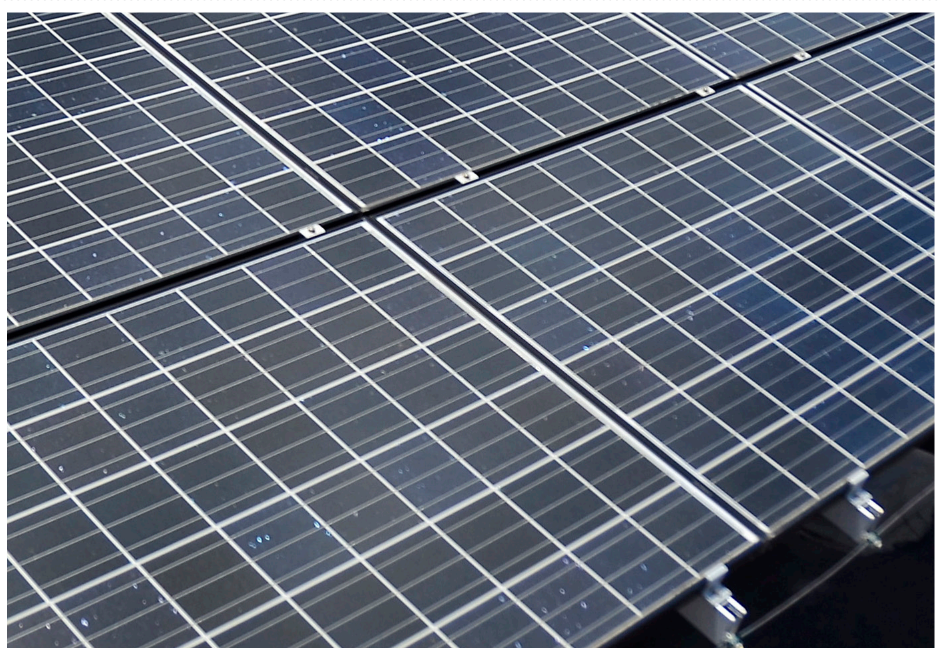
Governing Green Power Realigning Institutions To Fit New Technologies

NOVEMBER 14, 2017

UHERO

THE ECONOMIC RESEARCH ORGANIZATION AT THE UNIVERSITY OF HAWAIʻI

Sea Grant University of Hawaiʻi



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Governing Green Power
Realigning Institutions To Fit New Technologies

A summary and elaboration of issues and ideas from a conference held in Honolulu, Hawai`i, March 28-30, 2017.

By Michael J. Roberts, Richard Pratt, Makena Coffman and Matthias Fripp

About the Conference and this Report

The "Governing Green Power" conference was held in Honolulu at the University of Hawai`i at Mānoa, March 28-30, 2017. The motivation for the conference was the recognition that energy technologies are changing faster than energy-related institutions — the organizational structures, market mechanisms, and regulatory incentives that govern power generation, transmission, distribution and storage. The complex system of the future that many of us envision — what some call Utility 2.0 — will require a carefully balanced infrastructure, dynamic price setting, and sophisticated automated control systems. How can this vision be achieved? How do the institutions that govern the electricity sector need to change to ensure that Utility 2.0 will be managed as fairly and efficiently as possible?

These were the broad questions that led to this conference. Hawai`i is a good place to discuss such cutting-edge issues because, with broad public and political support and the nation's most ambitious renewable energy portfolio standard, the state is on the leading edge of renewable energy. Moreover, the Islands' high cost of oil-based conventional generation likely make a substantial transition toward renewables economically feasible even in the absence of pollution externalities. The state is thus an important test bed for technologies and institutions needed to make renewable energy viable, fair and efficient. At the same time, for Hawai``i's transition to be successful its work must be informed by developments in other places that are setting their own goals and wrestling with similar issues.

For this reason the conference included scholars, industry experts and stakeholders from Hawai`i, the U.S. mainland and abroad, bringing their diverse expertise, experience and perspective to the discussion. The conference agenda and attendees are listed in an appendix and can be found with a copy of this report at the conference website.

The conference was sponsored by a diverse collection of parties who shared its goals. These are, alphabetically:, Blue Planet Foundation, Carlsmith Ball, Collaborative Leaders Network, UH Mānoa College of Engineering, UH Mānoa College of Social Sciences, UH Mānoa Department of Economics, Hawaiian Electric Company, UH Mānoa Hawaii Energy Policy Forum, UH Mānoa Hawaii Natural Energy Institute, UH Sea Grant, the Sierra Club, UH Office of Sustainability, UH Economic Research

Organization, and Ulupono Initiative. Of course, the views recounted here are those of the authors and individual attendees, not the sponsors.

After brief introductions and motivating opening comments by Governor David Ige, the conference was structured around a series of pre-defined topics. We did not ask participants to present formal papers, but rather to make a brief panel presentation about what issues they saw as most critical relating to the integration of renewable energy. Conference calls and email correspondence before the conference allowed the panelists to coordinate their discussion. Each panel's presentations took about half the time allotted to frame and discuss the issue. The remaining time was dedicated to facilitated discussion among all participants. Attendees also shared several meals, all of which provided opportunities for intensive, substantive discussion around conference topics.

As expected, discussion in one session often overlapped with content in other sessions; it was difficult and unrealistic to make sharp demarcation. We aimed for an open and vibrant sharing of ideas, and it appeared that we were successful in that regard. (Results and comments of participants from an exit survey are provided in Appendix C of this report.)

The underlying issues can be complex, involving technical aspects of engineering, economics, law and the policy process. Some issues seemed well understood by most, while in some cases experts in different disciplines may have been talking past each other. On some points there seemed to be consensus, while others remain far from settled. A large presence of energy economists and engineers may have resulted in a little too much jargon unfamiliar to a wider audience. All attendees were leading experts in their respective areas, and at the same time, nearly all claimed to have learned a lot from the exchange, which is a gratifying start.

With the goal of continuing the conversations that are needed to improve the transition to renewables, this report summarizes and elaborates on a number of major issues that arose during the conference. It is *not* point by point reporting of the proceedings. Instead, we have attempted to provide context about the exchanges that took place and then to focus on distilling the major recurring themes of interest to many of the participants. We also offer some conclusions and recommendations which. while reflecting views of some participants, are ultimately the authors' and not a collective consensus position.

The themes we identify are: *Getting Prices Right*, *Inefficient Rate Designs*, *Grid Defection*, the *Importance of Aligning Incentives*, and *Managing the Transition to Utility 2.0*. Although these themes and the overall report reflect our views and opinions, we have attempted to incorporate alternative views to capture the range of discussion that took place at the meeting. In a number cases this goes beyond what was discussed directly during the conference in order to provide context for a broader audience and articulate the policy relevance of the discussions, for Hawai`i and other places. In some cases, differences in point of view are highlighted so that a wider audience can understand and appreciate them. We do not attribute names to specific views. Participants were promised we would not so they could feel comfortable speaking freely. The report is filled with links to other sources of information that readers are encouraged to follow for more background detail. The links are in lieu of references.

Contents

Executive Summary

Renewable energy technologies are changing fast. Today, despite remarkably low prices of oil, natural gas and coal, solar is now the most affordable source of electricity on a levelized-cost basis. And while affordable renewable energy has difficult challenges with variability and intermittency, rapidly falling battery costs and smart-grid systems can provide solutions to those challenges. The largest obstacles facing transitions to a clean, renewable energy future more likely pertain to the need to change institutions—the organizational structures, market mechanisms, and regulatory incentives that govern power generation, transmission, distribution and storage.

The conference themes, along with questions and points relating to them, are:

Getting Prices Right

Time-varying pricing and storage will become increasingly important as more intermittent renewable energy is integrated into the grid. Some questions this raises include: What would truly efficient pricing look like? How could it be achieved? What kinds of issues arise as prices become more variable? What kinds of pricing and contracting arrangements can be made with customers willing to embrace variable instead of fixed-rate pricing? How much does efficient variable pricing save relative to flat rates in a system with a lot of renewable energy?

Major Points

- *Efficient prices equal the marginal (or incremental) cost of electricity at each moment, at least for customers who are willing and able to have time-varying prices.*
- *Variable, marginal cost pricing would enable more flexible demand response technologies that would allow electricity loads to adjust with intermittent supply.*
- *Demand-side adjustments can also help in contingency events when a power plant falls offline, for regulating small variations from variable wind or clouds, or other disruptions.*
- *Some worried about the distributional consequences of variable marginal-cost pricing, while others emphasized the role of large-scale commercial customers that will likely see the value in potential cost savings.*
- *Marginal cost pricing will likely recover less revenue than needed to operate an efficient electricity system, or possibly enough for certain traditional base-load generators to remain in operation.*
- *While fixed charges at the retail level and capacity markets at the wholesale level can help to reconcile revenue shortfalls, there are many unresolved questions about how to allocate fixed charges and how to clear capacity markets in a manner that treats all customers and supply sources fairly.*

- *A new, multi-resource capacity auction mechanism was suggested that would collect bids from generation, transmission and demand-response providers to clear a least-cost planning model encompassing timescales from minutes to decades.*
- *In a high-penetration renewable system, the value of flexible pricing arrangements could be worth at least three to four times as much as a fossil system, and even could make a 100% renewable system more cost effective than a fossil system by 2045.*

Inefficient Rate Designs

Current rate structures can cause unintended consequences that may work against efficient integration of renewable energy. What are some of the most problematic rate structures? How do these influence efficiency as well as fairness? How could goals of these problematic rate designs be achieved in more effective manner?

Major Points

- *Commercial and industrial customers often pay a demand charge that scales with their peak load. Since peak loads differ across customers, and peaks may become less costly if aligned with times of plentiful renewable energy, these charges will become increasingly misaligned with system costs.*
- *Net-metering agreements, which typically allow customers with solar PV to buy and sell from the utility at the same price, do not account for the time-varying value of electricity. And because fixed costs tend to be folded into volumetric rates, net metering implicitly redirects some costs to other customers.*
- *Feed-in tariffs typically pay fixed, above-market prices to early renewable energy producers, prices that exceed the incremental cost of power in the system, and far exceed the incremental cost of renewables, which is essentially zero.*
- *Block pricing, which charges customers a higher volumetric price depending on the amount of electricity used each month, can distort incentives for distributed generation. Equity motives for block pricing might be achieved more effectively and efficiently through other means, like means-tested energy assistance.*

Grid Defection

As solar photovoltaic, batteries, and small-scale generators become increasingly cost effective, and grid management costs rise, some electricity customers may find it economical to produce more energy themselves or disconnect from the grid altogether. As demand for electricity from the central utility falls, grid infrastructure and management costs must be spread over a shrinking load, raising average prices, potentially causing more grid defection. Under what circumstances would grid defection actually make economic sense? How might pricing policies cause more grid defection than socially desirable? What kinds of pricing policies would deter inefficient grid defection? Is mass grid defection plausible?

Major Points

- *While many remain skeptical that large-scale exit from the traditional grid will be desirable for most customers, the pace of cost declines for solar PV and batteries has far exceeded expectations, and these declines are likely to continue as volume grows. Grid defection could be more likely that some believe*
- *A key concern is "inefficient bypass," which refers to customers who bypass the grid even when the incremental cost of keeping them connected is less than the price such customers would be willing to pay.*
- *If some customers leave the grid, efficiently or not, fixed costs of the grid infrastructure would need to be covered by fewer and fewer customers, possibly leading to more defection.*
- *Efficient marginal-cost pricing combined with fixed charges and exit fees to cover sunk grid costs could resolve inefficient grid defection, but may be politically untenable.*

Aligning Incentives

Currently, regulated utilities are allowed to set prices in order to collect revenue to cover approved operating expenses and a "fair rate of return" on capital investments. In many cases, regulated utilities have little incentive to control costs. The more distributed nature of the future utility is putting greater stress on the traditional regulatory model. How should incentive structures change so that the utility of the future will be motivated to manage the grid in cost effective way?

Major Points

- *Utility regulation has always struggled with an inherent tension between keeping prices low while providing utilities an incentive to control costs appropriately.*
- *Cost-of-service regulation may work adequately when the utility has little private information about its cost of operations and the scope for innovation is limited.*
- *Given uncertainty about continuing, rapid technological advance, it is objectively unclear what kind of grid enhancements are needed, and we should expect the regulated utilities to come down on the side that maximizes their own investment while minimizing that of competing interests and resources.*
- *Many suggested a turn toward holistic, customer-oriented, performance-based incentives, while others expressed concern that poorly designed incentive structures could lead to windfall gains to the utility that could be difficult to reverse.*

Managing the Transition to Utility 2.0

Who gains and who loses from the transition toward renewable energy and a modernized grid that can manage it effectively? What are the political and economic *obstacles to this transition? What kind of process can best manage and resolve tensions between the various interests and stakeholders?*

Major Points

- *The transitions from fossil fuels toward renewable energy are both technically and institutionally complex. Such transitions require wrestling with difficult choices in a way that employs solid analytics in a transparent and public regarding way.*
- *Complex transitions can be managed with a range of policy mechanisms, ranging from "top down" approaches such as mandates to "bottom up" approaches that may emphasize performance-based incentives.*
- *While much of the policy emphasis has focused on renewable energy goals, more attention needs to be directed toward implementation of those goals.*
- *There are roles for both experimentalism (trying out new policy tools to see how well they work) and incrementalism, no-regret steps that move things forward.*
- *Successful transition requires adaptive institutional with strong leadership that is willing to be pro-active instead of reactive.*
- *Successful transitions require constructive stakeholder and community engagement that clearly defines the issues, develops the right forums for discussion at the right time, and skillfully facilitates productive interaction.*