【《UH・UR合同シンポジウム》報告】Renewable Energy Policy Development in Hawai'i

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Renewable Energy Policy Development in Hawai'i

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Abstract

This presentation reviews the development of recent renewable energy policy in Hawaii. It aims at identifying factors that influence the effectiveness of these policies in terms of energy availability and prices, energy security, and greenhouse gas reduction potential in the region.

The State of Hawaii has a unique energy situation relative to the mainland United States. In 2008, close to 70% of electricity in the United States came from the combustion of coal and natural gas. In contrast, the State of Hawaii supplies more than 90% of its electricity by combusting imported petroleum. Given the local policy makers' and the general public's concerns about such high oil import dependence, the State adopted Hawaii Clean Energy Initiative (HCEI, 2008). HCEI aims to achieve 70% clean energy by 2030 with 30% from efficiency measures and 40% coming from locally generated renewable sources. Subsequently, a few policies to enhance clean energy development have been implemented (feed-in tariff, revenue decoupling, net metering). However, few in-depth studies analyze the effectiveness of such policies. Drawing on the experience in other US states and countries, the presentation will intend to assess the effectiveness of these new policies.

Comparing the cases of Hawaii, Japan, and Okinawa in particular, could generate useful implications about the ongoing energy policy reforms in these regions. Given the rising oil prices and concerns about reliance on nuclear power after the Fukushima accident in 2011, Japan is increasing its reliance on oil- and natural gas fired power generation on one hand and has been accelerating its policies to encourage renewable energy adoption (including feed-in tariffs in 2012) on the other. Documenting the details of political economy behind policy changes in both places tell us what factors promoted renewable energy policy. By assessing the effectiveness of the newly adopted policies, we will have a better idea about how renewable energy policy could be improved to allow more efficient energy transition that strikes an optimal balance between energy security and effectiveness in addressing climate change concerns. Given the similarity

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and difference of energy situations in Okinawa and Hawaii, shared discussions on energy policy in the two island states will generate a useful learning and research opportunity.

1. Introduction

This presentation reviews the development of recent renewable energy policy in Hawaii. It aims at identifying factors that influence the effectiveness of these policies in terms of energy availability and prices, energy security, and greenhouse gas reduction potential in the region.

2. Current Energy Issues in Hawai'i: Uniqueness and Challenges

The State of Hawaii has a unique energy situation relative to the mainland United States. In 2008, close to 70% of electricity in the United States came from the combustion of coal and natural gas. In contrast, the State of Hawaii supplies more than 90% of its electricity by combusting imported petroleum. [1] Hawaii uses imported petroleum to derive multiple key end-products—jet fuel, gasoline, and diesel, with the residual fuel oil used for electricity generation.

The oil used in Hawaii is low-sulfur fuel oil—different from high-sulfur fuel oil that is widely used over the world including the mainland United States. Over the world, a few, isolated small markets for low-sulfur fuel oil exist. Hawaii purchases low-sulfur fuel oil mainly from the Asian market, where the price increase was observed, especially after the 2011 Tohoku Earthquake and Tsunami, as the demand for low-sulfur fuel oil increased in Japan.

Unlike many other mainland United States, where electricity can flow from one state to another with large interstate electricity markets, each island in Hawaii has an isolated electricity grid. The total sales of electricity on Oahu were 7.3GWh or less than 20% of the net electricity generation in Texas. The limited market size does not allow Hawaii to exploit economies of scale by utilizing large-scale electricity generation with cheap resources. The limited market size also implies limited rooms for competition on the supply side: the power sector in Hawaii is integrated, and has highly monopolistic industry structure at all stages of electricity generation, transmission and distribution.

Due to the above factors, Hawaii faces the highest electricity rate in the United States ($0.32/kWh compared to the US average of $0.10/kWh in 2011). The electricity price in Hawaii has been increasing over the last decades as the oil price increased. Concerns about volatility in electricity rates, due to volatility in oil prices, also exist.

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[1] Most of the state- and national-level energy data on this essay comes from US Energy Information Administration State Energy Data System (http://www.eia.gov/beta/state/seds).

3. Hawai'i's Clean Energy Targets and the Economics of Renewable Energy Policy

3.1 Hawai'i Clean Energy Initiative

Given the local policy makers' and the general public's concerns about such high oil import dependence, the State adopted Hawaii Clean Energy Initiative (HCEI, 2008). HCEI's goal consists of two targets: Renewable Portfolio Standard (RPS) and Energy Efficiency Portfolio Standards (EEPS). HCEI aims to achieve 70% clean energy by 2030 with 30% from efficiency measures and 40% coming from locally generated renewable sources. Note that the latter two numbers actually do not simply add up. Hawaii Legislature mandate in 2009 states that "by 2030, 40% of net electricity sales by electric utility companies in Hawaii shall be from renewable electrical energy, and energy efficiency measures shall cause the equivalent of a 30% reduction in energy use." So the denominators of these two numbers are different. In fact, EEPS target is in terms of quantity: it states that the electricity consumption should be lower than the business-as-usual level by 4300GWh, i.e. about 30% of expected demand.

RPS is an ambitious target in terms of scale. As of 2010, HECO had 1,140GWh of renewable generation (about 12% of the total, 9,527GWh).[2] HECO would need another 28% (or 2,667GWh) in order to meet RPS in 2030 assuming that the electricity generation volume stays the same. In other words, renewables generation must more than double for RPS to be met.

Hawaii Energy, an energy-efficiency arm of the State of Hawaii Department of Business, Economic Development and Tourism (DBEDT), uses demand-side management fees (collected from electricity users) in order to support energy-efficiency improvement in the State.[3] Hawaii Energy spent $19.5 in ratepayer funds for energy-efficiency improvement as incentives to ratepayers in the state. Ratepayers receiving the incentives invested $99.7M, with a life-time cost savings of $473.2M, "yielding a 474% return on investment" (Hawaii Energy Annual Report PY2010, p.6). Even if the ratepayers paid for Hawaii Energy's incentives on their own, the rate of return would still exceed 300%. Then the question is: why is it necessary to use ratepayer-funded fees for energy-efficiency improvement when the customers could yield such a high rate of return on energy-efficiency investment on their own?

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[2] Hawaiian Electric Company (2012) 2011 Renewable Portfolio Standard Status Report, http://www.heco.com/vcmcontent/StaticFiles/pdf/2012-05-04_RPS%20Report_2011.pdf, retrieved on November 13, 2012.

[3] What would count towards energy efficiency? Energy audits, appliance upgrades (to Energy Star products) and home/building improvements in the residential, commercial and the government sectors; driving less and driving alternative fuel vehicles (e.g. electric cars) in the transportation sector (HCEI, http://www.hawaiicleanenergyinitiative.org/energy_efficiency/). Beginning in 2015, electric energy savings brought about by the use of renewable displacement or off-set technologies, including solar water heating and sea-water air-conditioning district cooling systems, shall count toward this standard (PUC Annual Report, Fiscal Year 2010-11, p. 21).

Several previous studies have estimated the effectiveness of state energy efficiency programs in the United States in terms of program costs per kWh saved. The estimates range from 1 cent/kWh to more than 20 cents/kWh (Arimura et al. 2012). Energy efficiency program supports usually involve out-of-pocket expenses from participating customers as well. Including those costs, what would be the overall costs of these programs per kWh saved? Among many ways in which demand side management is implemented, which programs are most effective? Further studies would be needed to address these questions.

3.2 Brief Review of the Economics of Supporting Renewable Energy

In order to consider the efficacy of HCEI and related policies, it is useful to review what economic theory says about the efficiency of various policies:

- The principle of economics implies that the optimal policy to address an externality issue (a "market failure") is the one that addresses it directly. Economic theory suggests efficiency will be improved by matching the right policy instrument to (each) market failure.
- If the policy goal is to address the market failure associated with CO2 emissions (from fossil fuel use), then the best policy is to price CO2 emissions via emissions tax or cap-and-trade on CO2 emissions. Subsidizing renewable energy (via RPS or FIT) is a second-best policy. Overall, studies find that "policies that create incentives for fossil-fueled generators to reduce emissions intensity, and for consumers to conserve energy, perform better than those that rely on incentives for renewable energy producers alone" (Fischer and Newell 2008). Palmer and Burtraw (2005) estimate that RPS, if adopted nationally in the United States, will raise electricity prices. Price consequences of RPS are important in Hawaii given its high electricity price.
- What would justify subsidizing renewable energy? Market failure associated with renewable energy (e.g. technology spillovers that generate positive social benefits beyond the inventor of renewable energy technology) would justify a subsidy on R&D in renewable energy. However, a renewables production subsidy, to generate the same emissions reductions as an emissions tax, must be substantially larger than the size of a fossil output tax—because electricity consumption is not reduced under renewable production subsidy (Fischer and Newell 2008) .
- To the extent that a market failure associate with renewable energy is not unique to renewable energy (e.g. technology spillovers), a subsidy for addressing spillovers should be applied not only to those industrial sectors related to renewable energy but to other

sectors of the economy as well. Other concerns such as energy-import independence must be analyzed for its efficiency, and benefits of independence must be weighed against the costs.

4. Policies for Addressing Targets

How is Hawaii going to achieve HCEI goals? The State of Hawaii has adopted several new policy instruments to enhance clean energy development. I review three key elements: revenue decoupling, feed-in tariff, and net metering.

4.1 Revenue Decoupling

Under traditional regulation, electric utilities have an incentive to increase sales (i.e. sell as much electricity as possible) in order to increase profits. With increased interests in energy efficiency improvement, many US states have adopted regulatory reforms so that utilities do not have an incentive to increase sales. "Revenue decoupling" is one such reform adopted in several states. In 2010, Hawaii's Public Utilities Commission approved a decoupling mechanism, which entails: (1) a sales decoupling component, or Revenue Balancing Account, which is intended to break the link between the Hawaiian Electric Companies' sales and their total electric revenues; and (2) a Revenue Adjustment Mechanism, which is intended to compensate the Hawaiian Electric Companies for increases in utility costs and infrastructure investment. The rationale behind decoupling is that "utilities are no longer incentivized to maximize sales volume and those that reduce costs (fixed or variable) through efficiency measures will see an increase in short-term profits because the revenue stream is largely fixed" (Center for Climate and Energy Solutions, http://www.c2es.org/us-states-regions/policy-maps/decoupling/detail, retrieved November 13, 2012).

Revenue decoupling has many proponents—not surprisingly, utilities support it. However, economists are in general skeptical of the efficacy. Brennan (2011) summarizes the critical arguments:

- Decoupling does not include charging for distribution through fixed fees for customers even though fixed cost of distribution services should be best collected via fixed fees, not through rate increase.
- Under decoupling, if one customer reduces her use, the rates charged to all customers rise to keep distribution revenues intact.
- Making utilities' revenues and profits independent of use will discourage them from taking steps to increase their own operational efficiency and reduce their incentives to manage risks associated with variation in usage.

Few studies have analyzed the effectiveness of revenue decoupling. Using US utilities' data from 1981 to 1996, Knittel (2002) finds that revenue decoupling is not statistically associated with greater efficiency levels of power plants. Arimura et al. (2012) finds that decoupling is not statistically associated with smaller electricity demand by using data from US utilities in 1992-2006. Again, given Hawaii's already high electricity rates, the effects of revenue decoupling on the electricity prices should be investigated further.

4.2 Feed-in Tariff and Power-purchase Agreements

Feed-in tariff (FIT) guarantees a predetermined, above-market price for power over a period of years. It is the most popular device as a support for renewable energy outside the US-in particular in European countries. FIT provide strong incentives for minimizing costs and maximizing production for renewable energy producers. A drawback is that it does not provide stronger incentives for generating power when it's more valuable (scheduling maintenance etc). It also shifts all risk related to the supply/demand for electricity to other market participants.

There are mixed evidence on the effectiveness of FIT in Europe. In particular, sustainability of FIT is an issue in many countries where FIT has been in use. Spain's case is an example where a high level of FIT resulted in excessive introduction of renewable energy units (e.g. PV), resulting in a large public expenditure on FIT subsidies and on increased electricity prices. The same has happened in Germany, where initial success in expanding the renewable energy sector (largely due to favorable FIT) came with large expenditures to support the FIT system and higher electricity prices.

As of now, the level of FIT rates in Hawaii is lower than those in Spain and Germany. FIT in queue as of November 2011 totals 35.44MW, less than 1.5% of the state's total capacity (2,536MW as of 2010, PUC Annual Report p.16). The scale is still limited. As the scale becomes larger, however, given the high electricity prices, minimizing the effects of FIT on the prices is an important policy concern.

Just as in Germany and Spain, the State of Hawaii applies different rates for different renewable technology options (e.g. higher FIT rates for solar-based options relative to wind power). This practice is also questionable from an economics point of view. Texas, where RPS resulted in a large expansion its wind power sector, is considered to achieve RPS with relatively low costs because of its technology neutrality (at least in the beginning)—as the result, the most economical resource (wind energy) could be used most intensively.

The State's Public Utilities Commissions have also approve several "power purchase agreements" between HECO and independent renewable energy producers. One example is Kahuku Wind, a 30MW wind farm on the northern end of Oahu, which agreed to supply power to HECO at 20 cents/kWh (a rate comparable to the costs of electricity generation based on oil). Recent fire accidents on their battery system caused the plant to stop its operation. Though there was no explicit subsidy for the construction of the power plant, it received a $117 million federal loan guarantee—which does involve taxpayers' money when the loan is defaulted.

4.3 Net Metering

Net energy metering (NEM) intends to promote renewable electricity generation in a decentralized way, thereby reducing utilities' generation that is mostly based on conventional energy sources (fossil fuel, or nuclear in the case of the mainland US). Net metering allows customers to connect their renewable generator (e.g. PV solar panels on their rooftop) to the utility grid, allowing them to export surplus electricity into the grid, and to receive credits at full retail value, which can be used to offset electricity purchases over a 12-month period.

Installed net energy metered systems in Hawaii are still small in scale, but are increasing rapidly. The total installation in the state was 47.4MW as of 2011 while it grew to 92.4MW as of 2012 (or from less than 2% of the state's total capacity (2,536MW as of 2010) to 3.6% (PUC Annual Report p.16, HECO 2012 Hawaii Clean Energy Update September 2012). There is a limit of 15% on the extent of distributed generation in each circuit (e.g. at street levels). Many streets have reached the 15% threshold.

Some researchers are concerned about the potential impacts of net metering on electricity bills including for those who do not have NEM units (i.e. those without PV panels)[4]. As in many other states, the fixed-rate portion of electricity bills is not enough to cover the whole fixed costs of electricity services. Instead, the variable, volumetric charges cover not only the variable costs (e.g. fuel costs) but a portion of the fixed costs. As more customers adopt PV panels and utilize net metering, the utility's revenue will shrink. However, NEM customers would typically stay connected to the grid because solar power is intermittent and they receive electricity from the grid when their PV generation is lower than their consumption. In order to cover the costs of the whole electricity services, the utility would then need to increase the electricity rates. PV owners are able to generate their own power when there is enough sunlight hitting their panels. However, they still have to rely on HECO's grid when clouds roll in and at night. HECO is obligated to provide them with electrical service even when they aren't helping pay for the fixed costs HECO needs to collect to keep its system functioning.

This concern was raised in a local newspaper in Hawaii's context (Star Advertiser February 3, 2012). Homeowners and businesses that installed PV panels shaved millions of dollars off their electric bills. According to HECO, their savings translated into a loss

[4] The discussion here is based on Borenstein, S. "Solar Iinitiative has a dark side," www.mercurynews.com, posted on August 20, 2004, and "Hawaii leads the nation in electricity prices," "Loss of tax credits might dim solar industry," Star Advertiser, February 1 and 5, 2012.

of $7.4 million of revenue that HECO would have normally used to pay for fixed costs, such as meter reading and billing. HECO estimates that it would have to raise rates by 0.05 cent per kilowatt-hour on Oahu. Though the magnitude of the rate increase may be small yet, it might increase as PV is installed across residents in a larger scale.

5. Further research opportunities

The uniqueness of Hawaii's energy condition implies that a simple extrapolation of the findings on the US national level would not be applicable to Hawaii. The unique energy challenges faced in Hawaii, together with high electricity prices that may continue to increase in the near future, implies that Hawaii needs to adopt policies that improve its energy security in an efficient matter.

First, the uniqueness points to an urgent need for Hawaii to assess what approximately it would cost for them to adapt renewable energy in a large scale (e.g. at the scale indicated by HCEI). Further studies on the costs and benefits of HCEI targets are necessary for us to see if these targets are too ambitious. Secondly, research also needs to study the effectiveness of the policy changes that are recently introduced in the state—revenue decoupling, net metering, feed-in tariffs, in particular. As described above, previous studies do not find an impact of revenue decoupling on the efficiency of power generation or on the electricity demand. Because Hawaii adopted revenue decoupling in 2011, it is still too early to assess its impacts on the power sector's efficiency. While assessing the policy in the near future would be useful, research on alternative ways to make energy efficiency compatible with utilities' objectives is yet underdeveloped and needs to be explored. There is also an ample research opportunity to study optimal rate structures in the presence of decentralized generation (e.g. PV panels in the residential sector) that improves energy efficiency.

By assessing the effectiveness of the newly adopted policies, we will learn how renewable energy policy could be improved to allow more efficient energy transition that strikes an optimal balance between energy security and effectiveness in addressing climate change concerns.

Comparing the cases of Hawaii, Japan, and Okinawa in particular, could generate useful implications about the ongoing energy policy reforms in these regions. Given the rising oil prices and concerns about reliance on nuclear power after the Fukushima accident in 2011, Japan is increasing its reliance on oil- and natural gas fired power generation on one hand and has been accelerating its policies to encourage renewable energy adoption (including feed-in tariffs in 2012) on the other. Documenting the details of political economy behind policy changes in both places tell us what factors promoted renewable energy policy. By assessing the effectiveness of the newly adopted policies, we will have a better idea about how renewable energy policy could be improved to allow more efficient energy transition that strikes an optimal balance between energy security and effectiveness in addressing climate change concerns. Given the similarity and difference of energy situations in Okinawa and Hawaii, shared discussions on energy policy in the two island states will generate a useful learning and research opportunity.

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