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THE ECONOMIC RESEARCH ORGANIZATION AT THE UNIVERSITY OF HAWAI'I

ENERGY & GREENHOUSE GAS SOLUTIONS RESEARCH PROGRAM

An Assessment of Greenhouse Gas Emissions-Weighted Clean Energy Standards

An Application of the Hawai'i Electricity Model

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The Clean Energy Standard (CES) is an emerging concept in U.S. energy policy. A CES is similar to the often-utilized Renewable Portfolio Standard (RPS), which requires a specified percentage of electricity be generated from sources deemed "renewable." The CES expands the variety of electricity sources to include relatively "clean" technologies, such as natural gas. In its most basic form, a CES would give full credit too all technologies deemed "clean" and no credit otherwise. This analysis proposes that technologies receive partial credit, based on their relative lifecycle (versus out-of stack) greenhouse gas (GHG) emissions where the worst-offender receives zero credit.

Using a model of Hawai'i's electricity sector projected to the year 2030, we show that the GHG emissions-weighted CES reduces the costs of GHG emissions abatement by up to 90% compared to Hawai'i's current RPS law. A GHG emissions-weighted CES provides incentive to not only pursue renewable sources of electricity but also promotes fuel-switching among fossil fuels and improved generation efficiencies at fossil-fired units. Moreover, the CES is particularly cost-effective when projected fossil fuel prices are relatively low (based on the EIA's Annual Energy Outlook).

Key Findings

Scenarios include: varying a) fossil fuel prices, b) biofuel emissions factors and c) large generation unit capital cost.

1) The GHG emissions-weighted CES provides a more cost-effective means of reducing GHGs than the RPS (up to a 90% cost reduction in the low fossil fuel price case). The CES is either equally or more cost-effective in GHG abatement within all scenarios.
2) The GHG emissions-weighted CES accounts for the GHG impacts of both fossil and renewable energy types (unlike the RPS that focuses solely on renewable sources of electricity) and thus better deters the introduction of coal.
3) The RPS is predominantly met by a switch from oil to bio-oil. The CES, on the other hand, promotes emissions reductions from improved heat rates as well as fuel- switching – allowing for greater flexibility in compliance.
4) Under the CES, the promotion of biofuel is sensitive to the assumption about lifecycle GHG emissions – which vary widely based on land-use practices.

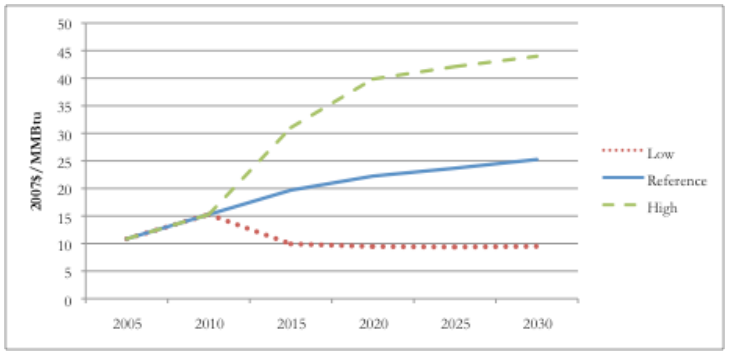
Though estimating the optimal amount is outside the scope of this analysis, President Obama did call in his 2011 State of the Union for 80% clean energy by the year 2035. Further inquiry should be made as to the best target for Hawai'i.

Implications For Hawai'i

Hawai'i's current RPS law does not distinguish GHG emissions (or lifecycle net energy) impacts of fuel and technology types. Moving toward a GHG emissions-weighted clean energy standard would better serve this distinction by allowing greater flexibility, and by: 1) promoting cleaner sources of electricity in a more cost-effective manner, 2) promoting generation efficiencies, and 3) making the law more technology-neutral from a GHG emissions standpoint.

With growing local interest in natural gas, of the CES framework could serve to level the playing field among technologies; where all generation technologies are assessed on their actual lifecycle emissions and hence their actual contribution toward climate change.

Oil Price Forecast



Source: EIA, Annual Energy Outlook (EIA, 2006; EIA, 2008; EIA,

Hawai'i's RPS Law

Hawai'i's electricity rates are nearly twice the national average. Hawai'i meets nearly 80% of its electricity demand through petroleum-burning, meaning that rapidly changing oil prices greatly affect electricity prices.

Hawai'i's RPS is among the most ambitious in the country – requiring that 40% of electricity be met with renewable sources by the year 2030. It specifies the following intermediate targets:

1) 10% of net electricity sales be based on renewable energy sources by the end of 2010,
2) 15% by 2015,
3) 25% percent by 2020, and
4) 40% by 2030.

CES and RPS Credits

This analysis proposes an alternative energy standard mechanism that better distinguishes technologies based on GHG emissions, both in terms of fuel and generation. The table below illustrates the differences between the RPS and CES policies. Notice oil receives no credit under the RPS scenario, but receives some credit under the CES scenario. Although this seems contradictory to the goal of greenhouse gas emission reduction, this is an important change to the RPS because it promotes generation efficiencies. It is possible to similarly craft a policy where neither coal nor oil get credit toward the standard. Generation efficiencies, however, will not be promoted. Note also that other renewable electricity sources receive equivalent credit under the RPS scenario, whereas under the CES scenario, credit varies based on lifecycle GHG emissions.

Table 1. CES and RPS Credits

	Illustrative Emissions-Weighted CES Credit	*RPS Credit*
Oil	0.16	0
Coal	0.00	0
Bio-oil/diesel	0.79	1
Geothermal	0.99	1
Wind	0.99	1
Solar Photovoltaic	0.93	1

Source: Estimates from GREET model 1.8d.1 (Argonne National Laboratory, 2010)

Cost-Effectiveness and Sensitivity Analysis

GHG emissions-weighted CES are found to be always at-least-as-good or an improvement over the RPS in terms of cost per ton of GHG emissions abated (See Table 2). Both policies are most meaningful when fuel prices are below those in the high case (See Figure 2). When fuel prices are at the low or reference level, the RPS and GHG emission-weighted CES promote a result that would otherwise not occur in the absence of these policies. The high fuel price case is not included in Table 2 because, unlike the Low and Reference fuel price cases, there are no cost savings for switching from using biofuel to using oil. Therefore, when fuel prices are High, there is no distinction between the No Policy, RPS, and CES outcomes.

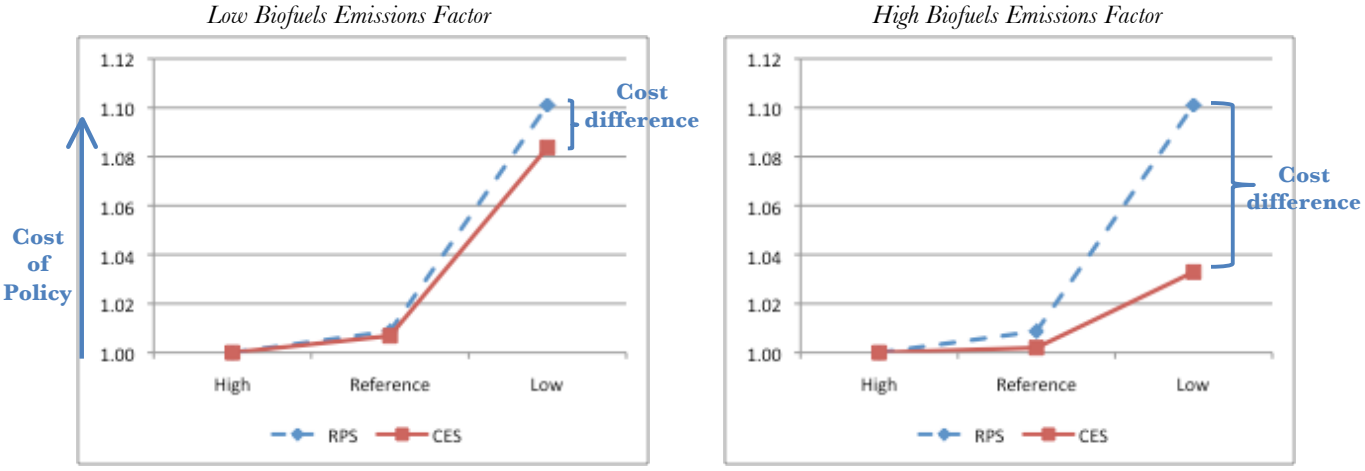
Table 2. Abatement Costs

	Low Fossil Fuel Price		*Reference Fossil Fuel Price*
	RPS	***CES***	***RPS & CES***
Cost per MTCO2 Abated	$138	$82	$24

Biofuel GHG Emissions

Biofuels are a potentially promising renewable energy source for electricity in Hawai'i. Because their lifecycle emissions can vary widely (where land use practices are a significant factor affecting net emissions), we test the effects of the RPS and CES using biofuel emission factors of 75% and 25% improvement over oil (i.e., biofuel emission factors are 75%, and 25%, lower than the emission factor for conventional oil). Varying biofuel emission factors demonstrates the importance of lifecycle emissions calculation as well as the relative lifecycle GHG emissions-weighting process. The figure below shows the change in total cumulative cost of the RPS and CES relative to No Policy under the assumption of high capital costs.

Figure 2. Change in Total Cumulative Cost of RPS and CES relative to No Policy under High Capital Cost



In Summary

Compared to an RPS, the CES is more cost-effective because it prioritizes investments into relatively "clean" technologies (both fossil and renewable fuels) and accounts for the efficiency of oil- and bio-fuel units. Therefore, a less costly oil-fired unit with higher efficiency (lower heat rate, measured in MMBtu/MWh) is preferred under the CES policy; while power suppliers under the RPS policy receive no credit as RPS accounting occurs on a MWh basis, only giving credit to renewable sources. Under the RPS policy, more existing oil-fired units are run with bio-oil. This is in contrast to the CES where technologies such as wind and solar are given relative favor as well as more efficient fossil-fired units.

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Authors: Makena Coffman, Department of Urban and Regional Planning, University of Hawai'i Economic Research Organization; James Griffin, Hawai'i Natural Energy Institute School of Ocean and Earth Science and Technology; Paul Bernstein, Operations Research