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A policy analysis of Hawaii's solar tax credit

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ABSTRACT

The study assesses the impact of Hawaii's solar PV tax credit policy in terms of the investment benefits accruing to households, the income distribution of these benefits, and the cost to taxpayers. Hawaii is an interesting case because of its generous tax credits and fast growing PV installations. We find that rising electricity rates and declining PV installation costs have driven PV deployment through an increasing internal rate of return on PV investment since 2009. The state tax credit favors high-income households who have higher tax liabilities and are more likely to break the largest barrier to market entry, home ownership. The internal rate of return for the typical Hawaii household is 25% and 16% with and without the state tax credit. We estimate that single-family homeowners in Hawaii may ultimately demand as much as 1100 MW of PV, which would play an important role in meeting Hawaii's clean energy goal of achieving 100% renewable sources for electricity by the year 2045. It would also cost the taxpayer $1.4 billion. Moreover, PV tax credits serve to redistribute wealth from taxpayers to upper income groups, many of whom already have ample incentive to install PV.

1. Introduction

Concern over human-induced climate change and the volatility of fossil fuel prices have lead to large-scale development of renewable energy [1]. Policies supporting renewable energy adoption can indirectly reduce greenhouse gas emissions by generating technological change [2]. Solar photovoltaic (PV) could potentially contribute large quantities of renewable energy but it has been relatively costly. PV is attractive because of its long expected economic life, nearly negligible maintenance costs [3], its distributed nature (reducing transmission and distribution costs) and relative ease of siting (on otherwise unused rooftops). There is a wide array of policies used to encourage PV adoption and are credited for its early uptake [4,5]. The price of PV has declined rapidly in recent years [6].

The State of Hawaii (Hawaii) has aggressive renewable energy goals and relatively generous PV subsidies. This year Hawaii adopted a 100% renewable portfolio standard (RPS) target by the year 2045 [7]. RPSs mandate specified levels of electricity sales be met through renewable sources by target dates. The 100% mandate replaces an existing RPS that required 40% by 2030. Currently (2014), Hawaii meets 21% of its power generation from renewable energy, of which about a quarter is from rooftop PV [8].[1]

In 2003 Hawaii adopted an individual and corporate tax credit of 35% for the up-front cost of eligible renewable energy technology, including PV. This is in additional to the Federal Residential Renewable Energy Tax Credit covering 30% of the cost of PV systems. Hawaii's credit was capped at $5000 per system [9]. The law has been amended a number of times, for example, to allow rebates to households with income under $40,000 annually, and to allow excess credit to be carried forward to future tax years.

The Hawaii PV tax credit has been at the center of heated public debate. The controversy stems largely from unforeseen budgetary impacts. According to the State Department of Taxation, by fiscal year 2013 the state spent a total of $420 M for both residential and commercial PV tax credits [11–12]. Some of the early controversy surrounded the difference between legislative intent and implementation. Because the law did not clearly define what constitutes

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[1] Does not include KIUC (annual RPS status report for 2014 not yet available).

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a "system," or restrict the number of systems per roof, many households claimed tax credits for multiple systems on a single property – effectively eliminating the $5000 cap. To address this discrepancy, the State Tax Department released new administrative rules in 2012 defining a PV system as an installation with output capacity of at least 5 kW for a single-family residential property [13]. Hawaii has adopted other incentives for PV generation, including net energy metering (NEM) and feed-in-tariff (FIT).

We study the impact of PV subsidies on Hawaii's residential PV adopters and taxpayers. Hawaii is an interesting case because PV is relatively cost effective in Hawaii compared to other U.S. states due to electricity rates three to four times the U.S. average [14,15]. We estimate the incentive for households to install PV by calculating the 1) payback period and 2) internal rate of return (IRR) for PV installation, with and without the state tax credit. These estimates are done using census data for a range of income groups. While there are numerous analyses on the profitability of PV investment, this study further contributes to this literature by also assessing the distributional impacts of PV support policies. Focusing on IRR, we isolate the impact of Hawaii's PV tax credit by calculating the 3) historical 2005–2014 IRR for the median income 3-person household, with and without the state tax credit. This allows us to disentangle the impact of the state tax credit from relative prices. Lastly, we calculate the 4) maximum amount of PV capacity that might be installed on residences, also by income groups and, from this, 5) the potential total loss in tax revenues.

This paper is organized as follows. Section 2 discusses PV support policies, in Hawaii and elsewhere. Section 3 explains the estimation methodology, assumptions and data. Section 4 presents findings and Section 5 offers discussion and concluding remarks.

2. Background – PV support policies and trends

There is a strong argument for supporting infant technologies such as PV as a market-building strategy. Increasing deployment through subsidies allows the industry to take advantage of economies of scale, which in turn lowers cost and reduces the need for subsidy [16]. As worldwide installations grow, PV costs have fallen by more than 3% per year since 1998 [17]. There are a number of policies that encourage the deployment of renewable energy like PV. They range from tools that discourage greenhouse gas emissions, like a carbon tax, to direct support and subsidies. The most common are the RPS, feed-in-tariff (FIT), net energy metering (NEM), and subsidies for capital investment. An income tax credit falls into this latter category.

The RPS is a popular mechanism among U.S. states as well as countries across the globe. Twenty-eight states, Puerto Rico and the District of Columbia have RPSs [18]. Several states, such as New Jersey, mandate that PV meet a specific portion of the overall target. These "solar carve outs" aim to level-the-playing-field with other renewable technologies due to the historically high levelized cost of PV [19]. Shrimali and Kneifel [5] suggest that the RPS can encourage PV deployment and Sarzynski et al. [14] argue that a "solar carve-out" provision enhances the effectiveness of RPS for PV deployment. Krasko and Doris [20] find that new PV capacity on average increases by nearly 16% each year with such a provision.

There is no national level RPS in the U.S. A number of countries have adopted policies similar to the RPS that potentially include trading of credits. Australia, for example, adopted a Mandatory Renewable Energy Target (MRET) in 2001 that allows for trading of renewable energy certificates [21]. As of 2014, more than 14 countries have similar renewable energy target/credit policies [22]. Though the RPS serves as an overall mandate to increase renewable energy, it is often coupled with additional incentive mechanisms that aid the market. FIT and NEM, for example, subsidize PV generation.

The FIT is a guaranteed tariff rate that utilities pay independent power producers for the generation of qualifying renewable energy for a specified period of time. The rate represents a premium over market price, but excludes tax rebates or other production subsidies paid by the government [26]. The duration makes it easier for investors to plan and structure projects, even in the face of changing fossil fuel prices. Several studies show that the RPS combined with FIT is an extremely effective policy package to facilitate PV adoption [23–25]. As of 2014, Zhi et al. [22] counted 75 jurisdictions with FIT mechanisms. Germany, for example, has been pioneering in its deployment of FIT. Germany adopted a FIT for PV in 1991 that guaranteed a rate equivalent to 90% of the residential electricity price for a 20 year period [27]. With concern over artificially high costs, in 2000 the government launched a new FIT that included a 5% annual decrease for the reimbursement for new systems, with the intent of encouraging development of more cost-effective panels [28]. Leepa and Unfried [29] suggest it is appropriate to make adjustments to the FIT related to the decline in PV panel prices. Similarly, Spain was a leader in PV distribution but began to curb its' FIT prices during the 2008–09 recession [30]. Its FIT policy was organized such that above-market costs were not passed directly to consumers but rather carried as government-backed debt. Reuter et al. [31], however, argue that uncertainty in future FIT regimes requires higher price levels to encourage renewable energy investment.

Like the RPS, there is no national level FIT in the U.S. Individual states, like California and Hawaii, however, have adopted their own FIT mechanisms. Hawaii's FIT provides a 20-year contract for eligible systems up to 5 MW. The rate is tiered based on the size of the system. For systems up to 20 kW, which would be most relevant to households, it is set at $0.218/kWh. The rates were established under the assumption that PV providers will receive the 35% state renewable energy tax credit. Because Hawaii's electric rates are substantially higher than the FIT rates, the NEM provides a better return and is almost always chosen by households [32].

The NEM allows customers to receive credit for their excess PV generation. While programs vary, usually credits are granted at a retail rate (i.e. one-for-one credit), they can rollover month-to-month, and expire within the year. This is the case in Hawaii. Because the customer is receiving retail rates (rather than wholesale), as well as using the utility as a "bank," there is a subsidy to the consumer via the credit for ongoing PV generation. This policy has generally been used for early technology adopters. Nonetheless, governments have had difficulty rolling back the benefits of NEM as PV adoption increases. California provides a good example. California's NEM program was initially intended for total renewable generation capacity at 5% of a utility's aggregate customer peak demand [33]. In 2013, however, AB 327 was passed extending the NEM through July 2017 [34]. It also requires the California PUC to craft a new NEM tariff that more accurately reflects the costs and benefits of distributed renewable generation [35].

There are two electric utilities in Hawaii. The larger utility operates on Oahu, Maui County and Hawaii Island (Hawaiian Electric Companies), and another operates on Kauai (Kauai Island Utility Cooperative, KIUC). The NEM law applies to systems up to 100 kW for Hawaiian Electric Companies and 50 kW for KIUC. In its initial form in 2001, the NEM was supposed to be applied to 0.5% of peak demand (Act 272). In 2008, the capacity limit was increased to 15% of peak load per distribution circuit that, if exceeded, required the applicant to pay for an interconnection study. This limit was based on two arguments. The first is the intent to be an incentive for early adoption and the second was in caution of potential impacts to grid stability [36]. Many circuits quickly reached this limit