Are Incentives the Thing?

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Abstract

There is a prevailing theory in the solar industry and solar research fields that incentives drive implementation of renewable energy projects. To investigate the validity of this claim, we reviewed available literature and data from an upcoming analysis on time series market penetration of distributed generation and state, local, and utility incentive data. Our findings indicate that the value of incentives does not correlate directly with increased market penetration. The data we reviewed and more recent analytic findings indicate that decreases in the distributed generation price have an uneven impact on market penetration in different jurisdictions, regardless of the state and local incentive environment. These findings imply that state and local policymakers may better support their distributed generation goals through development of process standardization and market creation, rather than focusing on financial incentives.

What We Want to Know

Prices for distributed solar have been declining throughout the last decade (Feldman et al. 2013). During this same time period, the compound annual growth rate for distributed photovoltaic (PV) installed capacity has been 55% (Sherwood 2014). These relatively rapid changes in market development have reinvigorated discussion at the federal, state, and local levels about the need for and impacts of financial incentives to support solar markets.

In this paper, we take a meta-analysis approach, looking at historical incentive impact literature. We analyze current data to better understand how incentives influence distributed generation (DG) PV markets. In this way, we aim to inform jurisdictional decisions on whether or not (or where) to implement incentives. Our findings broadly indicate that incentives on their own cannot be quantitatively connected to wide-ranging market development, and thus, that state, local, or utility general incentives at the current levels are unlikely to reap the intended benefits of market development. However, there is empirical evidence that in certain, targeted, niche situations, policymakers have the opportunity to drive market development with incentives.

What the Literature Told Us

The question of whether incentives increase adoption of alternative energy technologies is not a new one. The literature analyzing financial incentives, such as tax credits, grants, and rebates, is limited or dated and studies specific to distributed solar are even more so. Early studies on financial incentives focused on the adoption of solar thermal (water and/or space heating) technologies. Feiveson and Rabl (1982) examined various subsidy strategies and recognized that they are necessary for solar thermal technologies to be competitive with fossil fuels, given the implicit subsidization of fossil fuels' negative externalities. While the authors posited that the magnitude of such a strategy would not be fiscally tolerable, they did not cite any empirical evidence that such strategies would result in increased adoption. Durham et al. (1988) examined solar water heating technology specifically, and found that the amount of the state tax credit did significantly impact adoption of the renewable technology. Hasset and Metcalf (1995) used panel data to examine, through regression analysis, how tax incentives impact what they called "energy conservation investment." They found that there is a statistically significant and positive relationship. However, the authors' definition of energy conservation investment included energy efficiency improvements and all types of renewable technologies.

More recent policy efforts have focused on other renewables, including distributed solar photovoltaics. The types of incentives or policies considered have varied widely. Feiock et al. (2010) and several other studies have examined the drivers behind the adoption of supportive policies, but studies on the effectiveness of such policies are more limited. The earliest studies, such as Gouchoe et al. (2002) and Bolinger et al. (2004) took a case study approach on financial incentives rather than an empirical analysis approach. While the authors noted that renewable adoption has occurred in the jurisdictions that contain incentive programs, they could not draw any conclusions about how effective the programs were at increasing adoption.

The first econometric analysis to study (non-solar-thermal) renewable energy technologies was that by Menz and Vachon (2006), although the focus was on wind power. The only financial incentive the authors examined was the presence of a public benefit fund, but they did not find it to be statistically significant. However, their model was likely misspecified because they did not include a state fixed-effects variable. Kneifel (2008) corrected for this exclusion and found that public benefit funds did indeed result in a statistically significant increase in renewable capacity. Kneifel limited his analysis to all non-hydro renewable technologies and used the EIA as his data source. However, EIA data are focused on large-scale projects, so we cannot make any conclusions about solar specifically, nor can we draw any conclusions about distributed technologies. Shrimali and Kneifel (2011) also limited their analysis to non-hydro renewables and used EIA data. These authors came to the same conclusion about non-hydro renewables as Kneifel, but they also isolated individual technologies. For solar, they found that clean energy funds were not a statistically significant variable affecting growth in renewable capacity. That being said, solar projects may not have qualified for the funds if other technologies were more economically viable. Moreover, the conclusion only related to large-scale solar installations, given the EIA data.

There are many other types of financial incentives in addition to public benefit funds. Sarzynski et al. (2012) examined the effectiveness of four types of financial incentives: income tax incentives, cash incentives, sales tax incentives, and property tax incentives. Per the author's analysis, states with cash incentives (rebates and grants) experience more extensive deployment of solar capacity, while tax incentives are not statistically significant variables. This may be attributable to many factors, including an absence of sufficient tax liability, which is required in order to take advantage of tax credits. The study does not distinguish between residential-, commercial-, and utility-scale projects. Shrimali and Jenner (2012) expanded on this study by distinguishing between residential- and commercial-scale capacity additions. The authors found that, while cash incentives and property taxes relief reduce the balance of system (BOS) costs, all financial incentives are insignificant variables in increasing deployment of residential capacity. Thus, there are likely other policy impacts at play, or consumers are not purchasing based on economic indicators alone. However, capacity is only one measure of adoption; the number of systems is also a robust measure that has not been used. Moreover, none of the preceding studies accounted specifically for local and utility financial incentives.

Kwan (2012) incorporated all state, local, and utility incentives available to residents into a dollar-per-kilowatt measure, and found that increases in the value of incentives led to a statistically significant increase in the number of residential solar installations. While this finding is contrary to that of Shrimali's and Jenner's (2012), the authors took different approaches. Kwan measured the magnitude of incentives while Shrimali and Jenner measured the presence of incentives. Accordingly, Shrimali and Jenner failed to distinguish between incentives for specific classes (residential vs. commercial vs. utility) and variations in the value of these incentives. Furthermore, the presence of local incentives may actually be a large factor influencing the differing conclusions. For example, according to Li and Yi (2014), the presence of a local incentive positively impacts installed solar capacity; however, Li's analysis does not isolate the incentive's impacts on residential installations specifically. Interestingly, Li did not find the number of state incentives to be statistically significant, but this may be due to the small sample size or the lack of a fixed effects variable to control for state differences. A state-specific study would eliminate the need to control for the differences between states. Sawhney et al. (2014) used Tennessee as a case study and found that the Tennessee Solar Institute grant program was the most influential variable in increasing total capacity (no distinction of class).

What the Data Tell Us

Much analysis remains to be done before we can draw strong conclusions on the effectiveness of state and local financial incentives in driving the adoption of distributed solar. Though Kwan (2012) comes closest to answering the question, we still don't know what the impacts of specific incentives types are or how incentives function in a rapidly changing price environment.

Doris et al. (2014, forthcoming) are attempting to expand on Shrimali and Jenner (2012) and Sarzynski (2012). The intent is to analyze the effectiveness of likely used incentives, and not just the presence of incentives. This work culminates in Figure 1, which illustrates a lack of connection between residential incentives and market penetration. One would expect to see some correlation between the two instead of a scatter plot as is shown. However, this work is limited because it represents current incentives and current installed capacity. Time series data of incentive levels and installed capacity would likely reveal more clear and decisive findings to inform policymaker decisions, but those datasets do not currently exist broadly at the national level.

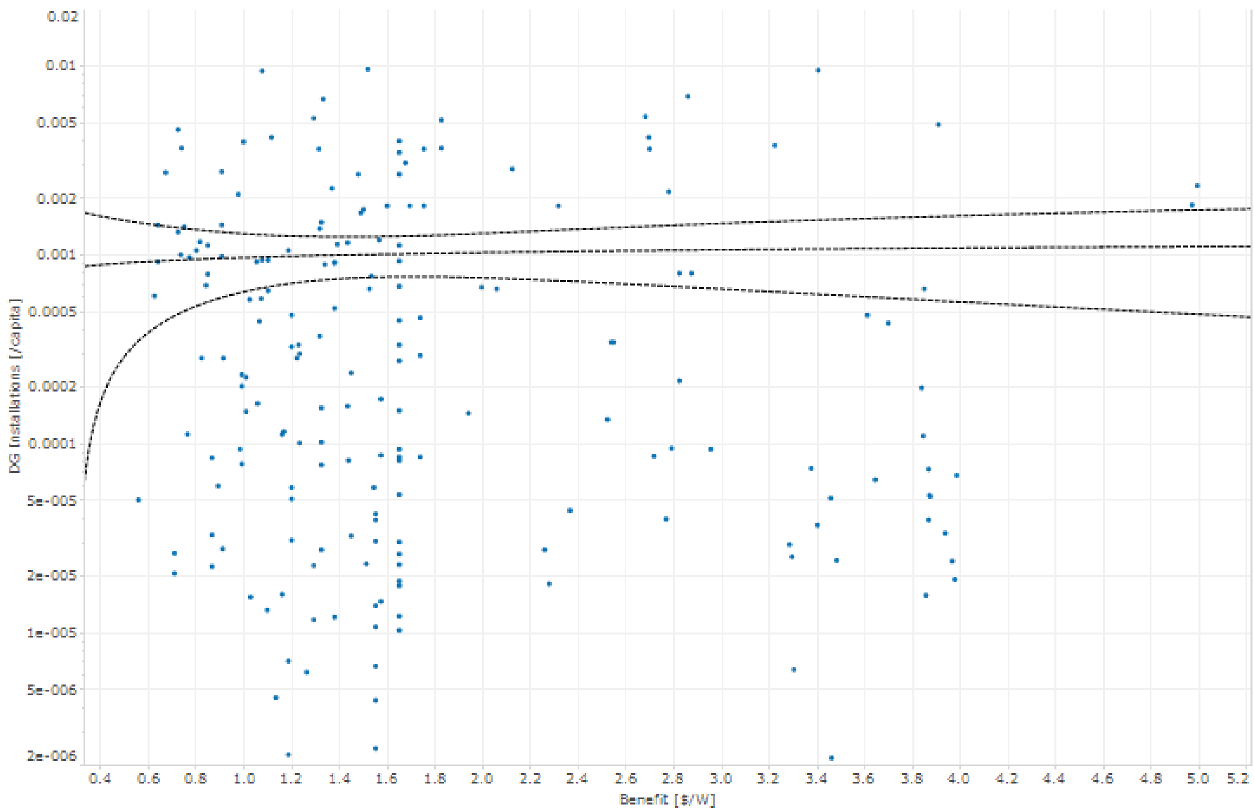

Figure 1: Likely residential incentive benefit and DG installations (Doris et al., forthcoming)

Given the complications and the lack of data for evaluating and understanding incentives in this highly price-changing market dynamic, and the lack of resources available for state and local jurisdictions to provide incentives, the importance of non-financial incentives and policies may be increasing. Krasko and Doris (2013) found that non-financial policies and population can explain 70% of market penetration of distributed photovoltaics. Steward et al. (2014) found that non-policy factors (e.g., extremely good or poor solar resource), can have as much, or more influence than non-financial and financial policy impacts all together.

What Literature, Data, and Analysis Can Tell Policymakers

Using historical data, we found that niche incentives, only when layered on top of high quality market access policies, can support distributed generation penetration in target markets within the affected jurisdictions. In areas with limited financial resources, policies that are low-cost to government have been illustrated to effectively support markets for distributed generation. There is, however, an argument to be made that historical data will not provide such useful information going forward given the rapid nature of market and policy changes for distributed generation. That is, as prices fall and market penetrations rapidly increase, particularly in areas with historically effective financial and non-financial incentive policies, there may be an increased need to evaluate up-to-date, non-traditional mechanisms for supporting distributed generation markets. This nascent discussion is occurring now; in Austin, Texas, and in parts of Minnesota, policymakers are exploring the value of solar rate tariffs, complex and increasingly transparent rate designs, and in other states, highly targeted and flexible financial incentives.

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