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Increasing residential solar installations in California: Have local permitting processes historically driven differences between cities?

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ABSTRACT

Local governments are agile policy makers expected to make significant contributions to climate change mitigation through local legislation. One mitigation mechanism available to local governments is to make it easier for households to install solar photovoltaic (PV) panels that generate emission-free electricity. Streamlining PV permitting policies is currently being promoted in states such as California as a way to boost rates of residential solar installation. Fixed effects modelling is used to examine whether streamlining permitting for PV increased rates of PV installations in California prior to 2013. To fill a gap in longitudinal data on implementation dates of local policies to support PV, a combination of surveys, partial databases, and publicly available city-level information is utilized to build a complete picture of changes in relevant policies from 2005 to 2013. Modelling results are unable to reject the null hypothesis that the implementation of streamlined permitting has no effect on residential PV installation rates. This highlights the limitations of what can be assessed given the current sparsity of data on city-level policy changes even employing significant original data collection and compilation.

1. Introduction

Urban areas account for up to 76% of CO_2 emissions globally (Seto et al., 2014). This, combined with the comparatively fast pace at which city governments are able to enact policies (Feiock et al., 2013), positions cities as a potentially critical arena for measures to reduce greenhouse gas (GHG) emissions. Over the past several decades, city governments have become increasingly involved in efforts to reduce GHG emissions and mitigate climate change (Bulkeley, 2010), and have continued to gain prominence since international and national-level agreements and policies often stall during negotiations (Betsill and Rabe, 2009; Bulkeley and Betsill, 2013). Encouraging distributed renewable generation, particularly solar photovoltaic (PV) panels, is one of the ways that cities can reduce GHG emissions associated with their jurisdiction. Determining which city government policies have a measurable impact on residential solar PV installations could aid city governments in allocating resources for climate change mitigation, to the extent that local jurisdictions are able to set renewable energy goals independent of regional and national actors.

One mechanism by which local governments are expected to be able to increase PV installations is by removing relevant barriers, whether these are financial, regulatory, or time barriers. California is currently attempting to remove some of these barriers with AB 2188, a measure that mandates all local jurisdictions in California adopt an ordinance creating an expedited, streamlined permitting process for small rooftop solar PV systems by September 2015 (Kaatz and Anders, 2015). There is an expectation that reducing barriers to installing residential PV will increase installation rates; permitting application procedures, review times, and fees have been identified as significant barriers to installing residential solar (Pitt, 2008), and several recent papers indicate that local governments could reduce residential solar PV costs and installation times by streamlining permitting processes (Burkhardt et al., 2015; Dong and Wiser, 2013; Seel et al., 2014). However, there was no analysis prior to rolling out AB 2188 that confirmed whether streamlining solar permitting would effectively increase the rate of residential PV installation, despite several cities in California having chosen to streamline permitting processes in earlier years.

This paper examines whether California cities that streamlined permitting in years prior to the implementation of AB 2188 observed higher rates of PV installation, using data up to the year 2013 before AB 2188 was in effect.[1] Previous studies examining impacts of residential PV permitting on installation rates have examined data from only one

Abbreviations: CEC, California Energy Commission; CPUC, California Public Utilities Commission; ICLEI, "Local Governments for Sustainability" network; IREC, Interstate Renewable Energy Council; IOU, Investor Owned Utility; POU, Publicly Owned Utility; TPO, Third Party Ownership

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[1] 2013 also marks the year when record keeping of solar installation data transferred between different state agencies, and so there is discontinuous data between 2013 and 2014 that restricts the end-year usable for analysis (Lawrence Berkeley National Lab, 2016b).

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Table 1
Descriptive statistics for main sample (57 cities).

Variables	Units	Mean	SD	Min	Max
Watts of PV installed annually	Watts/capita (i.e., W/capita or kW/1000 people)	4.20	7.04	0.017	64.39
Number of PV systems installed annually	PV systems/1000 people	0.90	1.41	0.01	11.72
Streamlined permitting	1 if permitting was streamlined,0 otherwise	0.11	0.31	0	1
Permitting fees < $400[a]	1 if permitting fee under $400,0 otherwise	0.28	0.48	0	1
PACE[a]	1 if PACE program in place,0 otherwise	0.24	0.42	0	1
Electricity price[b]	$/kWh	0.15	0.02	0.08	0.18
Financial incentives[b]	$/kW installed	1.84	1.06	0.00	4.50
Median age[b]	Years	34.10	3.40	25.70	43.00
Share of registered democrats	Percent	43.21	8.12	28.00	58.00
Share of households with income > $100,000	Percent	26.76	10.19	5.30	54.10
Share of households with income $100,000 to $50,000	Percent	31.27	4.08	21.50	45.30
Share with bachelor's degree or higher	Percent	30.47	13.90	7.30	69.9

[a] Values for sub-sample (23 cities).
[b] prior to non-linear transformations.

or two years of city permitting practices (Hsu, 2018); the current paper contributes to the literature by using fixed effects analysis to examine, for a sample of California cities through the years 2005–2013, the impacts on existing trends in PV installation when cities increase the availability of online information for permitting and achieve average turnaround times for residential solar permit issuance of three days or less. No data set previously existed recording changes in cities' solar permitting practices over several years, and the current paper further contributes to the literature by developing this data set for cities in California over nine years.

2. Predictors of residential PV adoption

Permitting can add unnecessary complexity for both households and installers, and soft costs can make up 30–40% of the total cost for a PV system (Treadwell et al., 2012). High fees, long permitting times, and lack of widely accessible permitting information may all contribute small but potentially significant barriers to the already expensive and lengthy process of installing residential solar PV (IREC, 2013). Variations in permitting procedures between jurisdictions are associated with average installation cost differences of $0.18/W installed for residential PV systems across the US between the best and worst cities, and streamlining permitting processes could reduce PV costs in California specifically by $0.27-$0.77/W (Burkhardt et al., 2015; Dong and Wiser, 2013). The time that it takes to issue permits can vary from a few hours to over a month, and long wait times introduce additional costs and frustrations to bringing PV systems online (Dong and Wiser, 2013; IREC, 2013).

Several recent papers have examined individual level and zip-code level predictors of residential PV adoption (Davidson et al., 2014; Kwan, 2012; Robinson and Rai, 2015). One prior study that examined streamlined permitting impacts in the context of comparing city versus state policies found no impact of permitting policies (Li and Yi, 2014), but did not take into consideration factors such as how long streamlined permitting policies had been in place, and did not restrict the sample to residentially-sized PV systems. Another prior study found that the presence of streamlined permitting processes in a city correlates with greater installed PV capacity, but only used data on permitting processes for the years 2010 and 2011 and so was not able to confirm that streamlining permitting policies causes a change in rate of residential PV installations (Hsu, 2018).

PV adoption is predicted by demographics at the individual level and zip-code level, with higher income groups, older residents, and more educated residents being more likely to adopt PV (Davidson et al., 2014; Kwan, 2012). At the individual and zip-code level PV adoption is positively predicted by higher home values, higher cost of electricity, lower housing density, and presence of financial incentives (Davidson et al., 2014; Kwan, 2012). Availability of Property-Assessed Clean

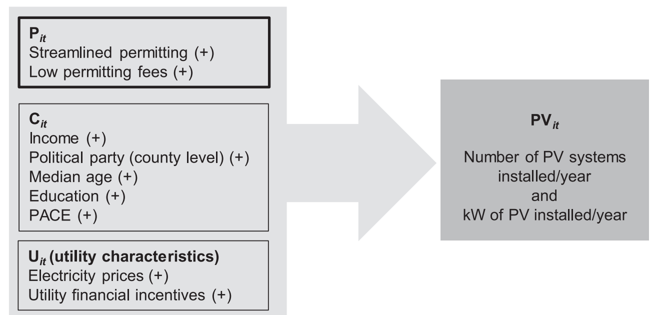

Fig. 1. Factors expected to drive city-level differences in residential PV installation rates. Signs indicate expected direction of effect on PV installation rates.

Energy (PACE) financing has also been found to increase installation rates of residential solar PV (Kirkpatrick and Bennear, 2014).

3. Method

This analysis focuses specifically on PV installations in cities within the state of California. Multi-year panel data on city policy status was not readily available, and was compiled from multiple sources as described in Section 3.2. Since US Census American Community Survey (ACS) 1-year data was used for consistency, only cities with populations over 65,000 in all years 2005–2013 had full demographic data available. The initial set of cities for which PV installation rates and policy data were sought contained 114 localities with populations over 65,000 for years 2005–2013, but only 98 of these had PV installation records for all years. Of these 98, only 57 had definitive permitting records and only 23 had definitive information regarding permitting fees specifically for residential solar PV for all years of interest (following procedures described in Section 3.2). Thus, fully balanced panel data including streamlined permitting indicators were available for 57 cities, and permitting fees and PACE indicators were examined using a fully-balanced sub-sample of 23 cities. Table 1 provides descriptive statistics for the main sample of 57 cities.

3.1. Empirical approach

Cities that chose to streamline residential solar permitting procedures may be inherently different from those that did not, and these differences may drive higher solar installation rates even prior to streamlining permitting. This poses a problem of selection bias, which can be partially addressed by using fixed effects analysis to control for time- and city-invariant differences (see Eq. (1)). Fixed effects modelling assumes that there are no time- and city-specific unobserved factors