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The impact of city-level permitting processes on residential photovoltaic installation prices and development times: An empirical analysis of solar systems in California cities

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HIGHLIGHTS

- The study uses a unique dataset from the U.S. DOE's Rooftop Solar Challenge Program.
- We quantify the price and development-time effects of city-level permitting processes.
- Most favorable permitting practices can reduce average residential PV prices by \$0.27–\$0.77/W.

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ABSTRACT

With “soft” costs accounting for well over 50% of the installed price of residential photovoltaic (PV) systems in the United States, this study evaluates the effect of city-level permitting processes on the installed price of residential PV systems and on the time required to develop those systems. The study uses a unique dataset from the U.S. Department of Energy's Rooftop Solar Challenge Program, which includes city-level permitting process “scores,” plus data from the California Solar Initiative and the U.S. Census. Econometric methods are used to quantify the price and development-time effects of city-level permitting processes on more than 3000 PV installations across 44 California cities in 2011. Results suggest that cities with the most favorable permitting practices can reduce average residential PV prices by \$0.27–\$0.77/W (4–12% of median PV prices in California) compared with cities with the most onerous permitting practices, depending on the regression model used. Though the empirical models for development times are less robust, results suggest that the most streamlined permitting practices may shorten development times by around 24 days on average (25% of the median development time). These findings illustrate the potential price and development-time benefits of streamlining local permitting procedures for PV systems.

1. Introduction

The cost of photovoltaic (PV) systems has declined dramatically (Barbose et al., 2012), opening new and growing markets for solar energy (Bazilian et al., 2013). Recent literature has sought to understand these cost trends (Wiser et al., 2007; Branker et al., 2011; Peters et al., 2011; Hernández-Moro and Martínez-Duart, 2013) and the variation in costs caused by altered assumptions and market contexts (Zweibel, 2010; Darling et al., 2011; Reichelstein and Yorston, 2013; Seel et al., 2013). Additionally, a substantial literature on learning and experience has been applied to solar energy (e.g., Schaeffer et al., 2004; Soderholm and Sundqvist, 2007; Neij, 2008; van Benthem et al., 2008; Kahouli-Brahmi, 2009; Nemet, 2009; Junginger et al., 2010; Green, 2011). Despite this body of work, further research is required to better understand the geographic scope of learning (that is, the degree to which learning-based cost reductions are occurring at the local, national, and/or international level; see Shum and Watanabe, 2008; Martinsen, 2011), to isolate learning-induced cost reductions from the variety of other factors that impact cost trends (e.g., Nemet, 2006; Mukora et al., 2009; Yu et al., 2011), and to explore learning and cost-reduction possibilities for non-hardware balance-of-system costs (Schaeffer et al., 2004; Hoff et al., 2010).

This study builds on this literature by focusing squarely on understanding one component of non-hardware PV costs: the effect of U.S. city-level permitting processes on the installed price of residential PV systems and on the time required to develop and install those systems. Even as early as 1978, there was recognition

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that non-hardware costs were important, with NASA estimating very substantial balance-of-system costs (Rosenblum, 1978). Moreover, with recent declines in PV system prices been driven primarily by declining PV module prices (Barbose et al., 2012; Bazilian et al., 2013), non-hardware business process (or “soft”) costs merit more attention than ever before. Ardani et al. (2012) and Goodrich et al. (2012) report non-hardware costs at roughly 50% of the total price of a typical residential PV system in the United States in 2010. With current PV module prices well below what was observed in 2010, however, non-hardware costs now constitute more than 60% of a typical installation price in the United States. Therefore, understanding non-hardware, business process costs is crucial for identifying further PV cost-reduction opportunities.

City-level permitting processes are one core element of these business process costs, and potentially add both considerable costs and development time to PV installations. Costs could include both direct costs, in the form of administrative labor and fees imposed on PV installers, as well as indirect costs, in the form of economic rents that accrue to installers as a result of barriers to entry into local markets created by onerous permitting processes. As a result of these potential impacts, the U.S. Department of Energy (DOE) identified permitting procedures as a barrier to widespread PV deployment and launched the SunShot Rooftop Solar Challenge Program[1] to address this barrier.

To provide some context, a typical PV permitting process in the United States may involve many local government departmental reviews—such as building, electrical, mechanical, plumbing, fire, structural, zoning, and esthetic reviews—as well as a permitting fee. Taking California as an example (other states are similar), state laws and regulations provide some direction to local permitting procedures, for example, by establishing building, zoning, structural, electrical, and fire requirements, as well as by limiting discretion in the establishment of permitting fees. In enforcing these regulations, however, local governments can either follow the regulations directly or modify the standards under limited circumstances: the result is a wide mix of requirements and procedures that vary by city (OPR, 2012). Moreover, after a PV system is installed, site inspections and final approvals are required for permitting (by local agencies) and interconnection (by local utilities) purposes, which can also vary by jurisdiction.

On the one hand, these permitting processes could add long-term value to the PV industry by protecting consumers, promoting public safety, and rewarding the most diligent installers. However, the quantity and diversity of PV permitting documentation requirements, application procedures, inspection processes, and fees used by local jurisdictions complicates the business of PV installers: there are more than 18,000 local jurisdictions in the United States, each with unique and sometimes time-consuming and costly permitting requirements. Clean Power Finance surveyed 273 installers across 12 states and found that more than one third of installers avoid jurisdictions with particularly challenging permitting processes (Tong, 2012). As a result, though permitting procedures do serve important public purposes, onerous procedures may impose unnecessary direct costs (administrative labor and permitting fees) and time on the PV development process and may also raise PV prices by creating entry barriers and thereby restraining competition among PV installers.

Many efforts are underway in the United States to streamline and bring down the cost of local permitting processes. DOE's Rooftop Solar Challenge is engaging diverse teams of local and state governments along with utilities, installers, non-governmental organizations, and others to make solar energy more accessible and affordable, including by working to reduce administrative barriers to residential and small commercial PV installations. SolarTech, a non-profit industry consortium, developed Solar3.0—A National Platform for Process Innovation to Deliver PV “to increase the competitiveness of solar PV by reducing non-hardware balance-of-system costs by 50% in identified U.S. solar communities by 2014.”[2] SolarFreedomNow, a grassroots initiative, advocates a single national policy to cut paperwork and red tape.[3] The DOE-funded Solar America Board for Codes and Standards (Solar ABCs) has developed an expedited permit process for PV systems (Brooks, 2012). Also funded by DOE, Clean Power Finance created a National Solar Permitting Database, an online tool that compiles solar permitting requirements from around the nation.[4] In addition states such as California and organizations such as the Interstate Renewable Energy Council (IREC) have initiated efforts to expedite permitting and field inspections (OPR, 2012; IREC, 2010). California, Colorado, and a limited number of other states have created caps on the permit fees that can be automatically charged for PV installations, while Vermont uses a streamlined state-wide registration process for PV and eliminates local permitting requirements. Stanfield et al. (2012) describe the diversity of approaches that can and have been used to streamline and lower the cost of local permitting requirements.

Several approaches have been used to compile and analyze the cost impacts of local permitting processes for PV installations. The Sierra Club's California Solar Permit Fee Campaign collected data to compare permit fees and time requirements across northern and southern California cities (Mills et al., 2009; Mills and Newick, 2011). Building on the Sierra Club effort, Vote Solar created a Solar Permit Map, with additional city-level permitting data contributed by users (Vote Solar, 2013).[5] A National Renewable Energy Laboratory survey of U.S. PV installers reported that residential PV permitting, inspection, and interconnection (PII) labor costs averaged \$0.13/W; with an assumed average permitting fee of \$0.09/W, total PII costs averaged \$0.22/W (Ardani et al., 2012). This compares with a median total installed price of \$6.10/W for PV systems less than 10 kW in size and installed in 2011 (Barbose et al., 2012). Lawrence Berkeley National Laboratory (LBNL) showed that PII costs in Germany averaged only about \$0.03/W, almost \$0.20/W lower than U.S. costs, owing to Germany's uniform and simplified regulatory structure (Seel et al., 2013; see also the PVGrid project[6]).[7] Earlier, Sunrun (2011) estimated that local permitting and inspection could cost \$0.50/W in total for a typical residential installation in the United States, or \$0.28/W if excluding the impact of permitting on sales and marketing costs as well as variations in building requirements. Only considering the labor costs of permitting (and excluding the permit fee), Clean Power Finance's recent survey of PV installers yields an average estimate of roughly \$0.11/W (Tong, 2012). As for impacts on development times, Clean Power Finance estimates that the average permitting process requires 8 weeks (Tong, 2012). Earlier, Sunrun (2011) reported that PV installation delays as a result of permitting procedures averaged 3.5 weeks.

This study addresses two specific research questions. First, how does the permitting process at the city level affect residential PV installation prices, considering not only the permitting fee but also any labor or entry costs borne by PV installers? Second, how does the permitting process determine the time needed to develop a

[1] For program information see http://www.eere.energy.gov/solarchallenge/.

[2] For information see http://solar30.org/.

[3] For information see http://solarfreedomnow.org/.

[4] For information see http://www.solarpermit.org/.

[5] For information see http://votesolar.org/solar-map/.

[6] For information see http://www.pvgrid.eu/.

[7] Langen (2010), meanwhile, estimated PII costs of \$0.8/W for the United States and \$0.4/W for Germany.

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