The Impact of Local Permitting on the Cost of Solar Power

How a federal effort to simplify processes can make solar affordable for 50% of American homes

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Endorsed by:

Alteris Renewables
American Solar Electric
Acro Energy
Corbin Solar
Greenspring Energy
groSolar
HelioPower
Mainstream Energy
Mercury Solar Systems
Namaste Solar
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The full report is available as a free download at www.sunrunhome.com/permitting.

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Executive Summary

The policy goal of supporting solar is to create the scale necessary to achieve **grid parity**, the point where solar stands on its own as an economic choice for millions of homeowners, without the need for subsidies. While solar equipment prices are falling, the total installed cost of residential solar is falling more slowly because of inefficient **local permitting and inspection processes**. It is appropriate and necessary for the Department of Energy (DOE) to address this problem because DOE has **already built the tools** to quickly streamline local permitting and inspection processes without sacrificing safety.

Local permitting and inspection add **$0.50 per watt**, or $2,516 per residential install, as described in detail in this report, due to:

- Wide variations in processes, most of which **do not improve safety**
- Excessive fees
- Slow, manual submittal and inspection processes

Permitting costs are equivalent to a **$1 billion tax on solar** over the next five years, and make it hard for installers to achieve any economies of scale. Countries like Germany and Japan have eliminated permitting for residential solar, handicapping the U.S. despite our superior solar resources.

A streamlined, consistent process for basic installations, like the "Common Application" for colleges, will eliminate waste and variability across jurisdictions, while meeting code and ensuring safety.

DOE already **funded and developed the resources** to quickly and efficiently implement a better process:

- Streamlined process—"Expedited Permit Process" by Solar America Board for Codes & Standards
- Local partnerships—25 cities in DOE's Solar America Communities program
- Local outreach channels—DOE's Solar America Communities Outreach Partnership

Leveraging these resources, DOE should launch a **Residential Solar Permitting Initiative**:

- Create a contest that rewards jurisdictions for improving permitting in key solar states
- Fund outreach organizations like DOE's Solar America Communities Outreach Partnership
- Target DOE's 25 Solar America Cities and 200 other high-volume cities
- Build an online "Common Application" tool and grade jurisdictions' progress

Standardizing local permitting will transform residential solar:

- Bring the cost of solar to grid parity for **50% of American homes** by 2013
- Close Germany's **40% cost advantage**
- Deliver the equivalent of a new **$1 billion solar subsidy** over five years

Note from SunRun

Local permitting is the most stubborn cost that residential solar faces, according to SunRun's nationwide network of installation partners. When DOE and other industry leaders requested granular data on these costs to support federal initiatives to streamline local permitting processes, SunRun set to work on an official report. This report includes a detailed breakdown of the permitting and inspection costs and a series of practical recommendations the federal government should champion to improve this patchwork of onerous requirements and processes.

We conducted extensive interviews with operations teams at fifteen installers in our network to gather cost data. Each of these installers, plus additional installers and organizations, has subsequently provided editorial comments and endorsed this paper. Our network spans seven states and represents over 20% of national residential solar market share. We believe this report provides the most comprehensive data currently available.

As the leading provider of solar power service, SunRun prioritizes safety and quality because we own, insure, monitor, and maintain our systems for 20 years. With more than 8,000 customers across seven states, 24 utilities, and more than 1,000 cities, we have deep knowledge of the residential solar market.

SunRun applauds the many organizations working to address this challenge, including DOE, Sierra Club, Solar America Board for Codes and Standards, SolarTech, and Vote Solar. We give special thanks to our partners who agreed to participate in lengthy interviews. Their commitment to solving this issue demonstrates their passion for improving the industry and underscores the need for federal leadership in reducing the costs of local permitting.

The full report is available as a free download at www.sunrunhome.com/permitting.

Please refer questions, comments, and collaboration requests to:

Ethan Sprague, Director, Government Affairs, ethans@sunrunhome.com
Rob Cahill, Manager, Business Development, robc@sunrunhome.com

The Impact of Local Permitting on the Cost of Solar Power

How simplifying processes can make solar affordable for 50% of American homes

"I've been trying to put solar panels on my house for the last five months. And the regulatory process – you can't get through it. What's going on here? Why is there regulatory opposition to solar energy?"
– George Schultz, former Secretary of State, Sep 5, 2007.

Schultz's observations become more relevant every year as equipment costs fall and jurisdictions add rules. In 2007, local permitting and inspection added 13% to what a homeowner would spend on panels. Today, they add 33%, and within a few years they will add 50%.[1] Consider thousands of local processes, fees, and timelines, and it's not surprising that a significant amount of the cost of a solar system is embedded in a local regulatory morass. These costs prevent **millions of Americans** from enjoying solar as an economic choice without rebates or other subsidies and prevent installers from achieving any economies of scale.

This report reveals that local permitting and inspection processes add an average of **$2,516 per installation, or $0.50 per watt,** based on in-depth interviews of the nation's leading installers.[2] The report also explains that the Department of Energy (DOE) **already has developed the tools** to begin solving this problem and that DOE leadership is **appropriate and necessary.**

By comparison, other countries have much simpler, less expensive processes that do not sacrifice safety. Germany, France, and Japan have eliminated permitting for basic residential installations.[3] Not surprisingly, Germany has the lowest installed cost in the world, 40% lower than the U.S., even though total incentives are expected to be lower in Germany in 2011.[4]

The bulk of the problem is **local process and variation**, not electrical code itself. Inefficient local process wastes time and money, and local variation forces installers to spend time and money customizing plans for each jurisdiction. Standardizing this process makes sense because **most installations are relatively similar** and "share many similarities of design… that allow for a nationally standardized expedited permit process," according to Solar America Board for Codes and Standards

[1] Assumes panel costs of $4 per watt in 2007, $1.50 per watt in 2011, and $1 per watt within a few years. "Solar Energy Handbook", Barclays Capital, September 23, 2010.
[2] Assumes five kilowatt average installation size.
[3] Interview with German Embassy; Norton Rose Group, http://www.nortonrose.com/knowledge/publications/pdf/file23839.pdf?lang=en-gb.
[4] "Solar Energy Handbook," Barclays Capital, September 23, 2010.

(Solar ABCs), an organization funded by DOE.[5] However, jurisdictions often design cumbersome processes to account for the **minority of complicated installations** that require more in-depth review.

A streamlined, consistent process for basic installations, like the "Common Application" for colleges, will eliminate waste and variability across jurisdictions. DOE has already funded development of these standards through **Solar ABCs[6]** to allow jurisdictions to streamline permitting for most installations while **following code and maintaining safety**. Jurisdictions can use this process to "simplify the structural and electrical review of a small PV system project and minimize the need for detailed engineering studies and unnecessary delays." In addition, jurisdictions make process improvements, like fair fees, email submission, fast turnaround, and less time waiting on site for inspections, to reduce unnecessary cost and delay. Cities like San Jose and Philadelphia have adopted similar measures and maintained safety. San Jose is now **one of the lowest cost cities for solar** in California.[7]

With the standardized process already developed, a **sponsored outreach initiative with incentives** is necessary to influence understaffed and diffuse building departments. This initiative should encourage jurisdictions to adopt the streamlined process for these installations. Outreach has already happened on a small scale, with organizations like Sierra Club and Vote Solar proving that advocacy is effective at influencing local permit processes. To scale these efforts to multiple jurisdictions, we need federal leadership, similar to the federal leadership that in 2005 directed states to review solar interconnection policies and offered best practices.[8]

It is **appropriate and logical for DOE to lead this initiative** since DOE already engages in local solar advocacy and market development. In 2007 and 2008, DOE launched the Solar America Cities program that designated 25 major cities "to identify barriers to solar energy use… and to collaboratively develop solutions to those barriers."[9] Certainly, one of these barriers is local permitting and inspection. Additionally, DOE funded the Solar America Communities Outreach Partnership, which educates and influences local jurisdictions to adopt solar best practices.[10]

DOE can leverage existing programs and quickly launch a new **Residential Solar Permitting Initiative**:

- Create a contest that rewards jurisdictions for improving permitting in key solar states
- Fund local advocates, e.g. DOE's Solar America Communities Outreach Partnership

[5] http://www.solarabcs.org/permitting.

[6] Solar America Board for Codes and Standards (Solar ABCs) developed the Expedited Permit Process in conjunction with Brooks Engineering.

[7] California Solar Initiative program data. https://csi.powerclerk.com/CSIProgramData.aspx.

[8] Energy Policy Act (2005) established a national standard for solar interconnection: www.todaysengineer.org/2005/Aug/interconnection.asp.

[9] http://solaramericacommunities.energy.gov/cities.

[10] DOE provided a $10 million grant to Solar America Communities Outreach Partnership for, "disseminating information through national newsletters and local government membership organizations, peer-to-peer information sharing at regional workshops, and tailored one-on-one workshops for local governments." http://solaramericacommunities.energy.gov/about/outreach_partnership.

- Focus initially on DOE's 25 Solar America Cities and 200 other cities with high solar volume
- Build online "Common Application" tool and database that grades jurisdictions' progress

By leveraging existing programs and focusing on 200 cities with significant solar volume—instead of all 18,000 jurisdictions—this initiative can impact more than 50% of the solar market rapidly and at a limited cost to DOE.

DOE can model its efforts after **Department of Education's "Race to the Top,"** which is a powerful example of federal government driving reform and standardization in traditionally slow-to-change organizations. "Race to the Top" was designed "to spur systemic reform," by issuing guidelines for reforms and rewarding states that made the most progress.[11] States responded to this contest with once-in-a-generation educational reform, in hopes of winning grants, before Department of Education awarded a single dollar of grant money. Similarly, DOE should fund a **permitting contest to incentivize jurisdictions to streamline permitting.** This solar permitting contest should focus on the four to eight states that have successfully emerging solar markets and where installers are facing roadblocks.

There is **recent precedent** for federal government to lead reform of **local renewable energy permitting**. In November, 2010, Department of Interior launched the "Smart from the Start" initiative to streamline offshore wind permitting by coordinating with "local, state, and federal partners."[12] Federal involvement will strengthen industry efforts to address permitting, such as SolarTech's 2009 permitting challenge and countless other local efforts.[13]

Success will provide a positive feedback loop for the solar industry that will create even more value than today's cost of permitting and inspection. German residential solar costs $3.50 per watt because the residential market has scaled and simplified the design and installation process, leading to lower costs. Similarly, with limited local variation in the United States, installers can benefit from scale and the solar industry can drive down costs to reach grid parity sooner.

Standardizing local permitting will transform residential solar:

- Bring the cost of solar to grid parity by 2013 for **50% of American homes**[14]
- Close Germany's **40% cost advantage**
- Deliver the equivalent of a new **$1 billion solar subsidy** over five years[15]

[11] http://www.whitehouse.gov/the-press-office/fact-sheet-race-top.
[12] http://www.doi.gov/news/pressreleases/Salazar-Launches-Smart-from-the-Start-Initiative-to-Speed-Offshore-Wind-Energy-Development-off-the-Atlantic-Coast.cfm.
[13] http://www.solartech.org/index.php?option=com_st_document&view=documentdetail&id=15&Itemid=58.
[14] Includes the federal Investment Tax Credit, which expires in 2016.
[15] Assumes 500,000 new solar installations over the next five years, equivalent to 0.4% of all housing units.

This effort, as much as any subsidy, will translate into increasing solar investment by the solar industry, in addition to increased local economic activity.

Local permitting costs $2,516 per installation

This report provides the most accurate estimates of permitting and inspection costs available. The cost averages $2,516 for each residential installation, or $0.50 per watt.[16] Local permitting and inspection processes are the "bane" of the solar industry, and costs are falling at a "glacial" pace.[17] Certain installers experience this cost rising, and some even refuse to sell in certain jurisdictions that have especially cumbersome processes. These costs are unnecessary and counterproductive, and streamlining will support safety through efficiency and repetition. The primary costs in the permitting process are listed below (see Appendix B for detailed discussion):

Complete permit application: $505. Since each jurisdiction has different requirements, installers may have to research code, customize drawings, and apply for zoning approval every time they do an install. Many jurisdictions require review by an expensive professional engineer even if similar plans have been approved before.

- ✓ Solution: adopt Solar ABCs standards across jurisdictions (longer term: provide national online application tool).

Submit permit application in person: $149. Jurisdictions usually require installers to drop off the application. This wastes time and gasoline—one installer reported driving three hours to drop off a permit, only to have the jurisdiction, short on staff, outsource to an office just three blocks from the installer's office.

- ✓ Solution: allow email submission of permit application (longer term: provide national online application tool).

Pay permit fee: $431. Jurisdictions charge fees that vary widely, some higher than $1,000. Many jurisdictions use solar permit fees to plug other holes in the budget. By comparison, the cost of issuing a permit for a local jurisdiction should be $250 or less, as estimated by organizations like Vote Solar.[18]

- ✓ Solution: reduce permit fees to $250 or cost of issuance.

[16] Assume five kilowatt system. Previous studies underestimate this cost by not accounting for the full time, effort, and materials required in the process. For example, a 2010 Department of Energy study estimates $0.25 per watt for local permit and field inspection. "Distributed PV Permitting and Inspection Processes: Case Studies from: Austin, Portland, Salt Lake City," Department of Energy, August 2010.

[17] Interviews with SunRun installation partners.

[18] http://votesolar.org/permitting-toolkit.

Variation in building requirements: $726. Jurisdictions often have requirements beyond what state or national code requires, such as larger fire barriers, extra disconnects to turn off the system, expensive labeling, and excessive roof penetrations. These add significant cost to a system. Solar ABCs standards allow jurisdictions to follow code with a simple form, helping jurisdictions feel comfortable that they are ensuring safety.

- ✓ Solution: adopt Solar ABCs standards across jurisdictions.

Field inspection: $236. Typically inspectors provide a 4-8 hour arrival window, forcing a costly employee to wait on site for the inspector to arrive, even though inspections are often only 15 minutes. In addition, some jurisdictions require "in process" inspections during an installation, going beyond what is necessary to ensure code compliance, wasting the time of construction crews and extending installation time.

- ✓ Solution: reduce inspection appointment arrival windows to two hours or less; eliminate "in-process" inspections.

Delay: 3.5 weeks. Installers report that local permitting causes an average delay of 3.5 weeks to build. The most significant delay is permit review, which ranges from 0-6 weeks. This delay frustrates customers, reducing satisfaction and referrals to friends and family, driving up cost.

- ✓ Solution: adopt Solar ABCs standards across jurisdictions; provide decision on each permit application within three business days.

Sales and marketing cost: $845. The cost, delay, and increased cancellation rate lower close rates, increasing acquisition cost. Customers usually assume the installer is at fault for delays, harming satisfaction. One east coast installer said: "this problem ripples through the entire customer process."

- ✓ Solution: all of the above.

This report likely underestimates the true cost of solar permitting because it focuses on directly quantifiable data only. Additional hidden costs include management opportunity cost, poor customer experience from delays, constraints to planning and pursuing innovative cost reduction measures, and the inability for installers to realize economies of scale across jurisdictions. This is clear from our interviews. Often CEOs and COOs spend time dealing with processes to handle permitting, and operations managers struggle to plan installations when permits may or may not arrive when expected.

Streamlined permitting will benefit jurisdictions

Standardization will save jurisdictions time and increase installation quality. Local officials reinvent the wheel by creating their own codes and requirements. They are short on budget, under-staffed, and over-extended, and solar is only one of many issues they face. A DOE release confirms: "Staff in local

permitting offices is grappling with not only resource issues, but cumbersome, often antiquated permitting procedures."[19]

Jurisdictions all intend to follow state or national electrical code, yet each jurisdiction interprets code in its own way and may add additional requirements without a clear safety benefit. Solar ABCs states on its website, "While jurisdictions everywhere share most of the same challenges in ensuring the safety of new PV systems, **inexperience with PV has led many to implement unnecessarily complex and inconsistent permitting procedures**. In these cases, barriers of time and expense brought about by requiring multiple departments to review the same application severely inhibit the timely and efficient construction of new PV systems."[20]

Adopting Solar ABCs standards will improve the quality of permit applications, reducing re-submission and failed inspection. One jurisdiction explained that about 90% of all plans submitted for permitting are essentially the same; however, solar installers still have to customize permit packets for each jurisdiction, leading to error. A 2010 SolarTech survey of building departments confirms that "incomplete applications" caused nearly 40% of permitting delays.[21] Furthermore, the cost is greater for low-income families, since permitting costs are mostly fixed regardless of system size, penalizing smaller homes. Ultimately, the current requirements and processes harm local communities by making solar power less affordable and slowing adoption.

Several innovative permit offices, mostly in larger cities such as San Jose, Portland, and Philadelphia, are already streamlining their processes. For example, San Jose does not require plan review for systems that meet basic criteria, has simple guidelines, and generally has a fast process.[22] As a result, San Jose's cost of installation is significantly below other large cities in California, with several leading installers consistently able to price below $6 per watt.[23] As another example, Philadelphia uses worksheets from the Solar ABCs standards to provide a combination electrical and building permit for smaller projects that meet certain criteria. Philadelphia has also made policy changes that have resulted in reduced permitting fees for smaller projects and has a fee cap for larger projects. This past summer, the city held a training session for electrical inspectors and is ensuring solar friendly language in its zoning restructuring initiative.[24] We commend these cities that are working to make solar more affordable for residents. However, to deliver on the promise of solar, we need thousands of cities to follow efficient standards and processes.

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[19] http://solaramericacommunities.energy.gov/pdfs/Success_Snapshots_SanJose.pdf.
[20] http://www.solarabcs.org/permitting.
[21] "Solar PV Permitting Study: Study and recommendations for residential permitting," SolarTech, June 2010.
[22] http://www.sanjoseca.gov/building/PDFHandouts/1-10Solar.pdf.
[23] Data from California Solar Initiative.
[24] See Philadelphia's Solar Guidebook for permitting practices: http://www.phila.gov/green/solarGuidebook.html.

Launching the Residential Solar Permitting Initiative

DOE can bridge installers and jurisdictions by launching a standardization initiative including outreach and a contest to incentivize jurisdictions in key solar states to take action. DOE should influence jurisdictions to adopt the Solar ABCs standards and other key improvements to transform the industry from thousands of mini-markets to a scalable national market. These actions can reduce about 75% of local permitting costs, or $1,900 per installation.

Immediate process improvements:

A. Adopt Solar ABCs standards
B. Reduce permit fees to $250 or cost of issuance
C. Provide a decision on each permit application within three business days
D. Allow email submission of permit applications
E. Eliminate multiple inspections (e.g. "in-process" inspections)
F. Reduce inspection appointment windows to two hours or less[25]

Our interviews confirm that Solar ABCs standards will increase efficiency, quality, and safety to improve the overall process. For example, higher-quality plans will reduce inspection times and may eliminate the need for installers to staff inspections, since approval will be more likely. These recommendations align with recommendations by organizations like Vote Solar and SolarTech.[26] This paper recommends email submission and a decision within three days instead of "over the counter" permitting because email eliminates the cost of driving to and waiting at the building department.

Furthermore, longer-term innovations such as online submission will benefit the entire process.

DOE's New Residential Solar Permitting Initiative

We recommend DOE launch a permitting initiative to streamline the process. These actions include:

A. Create a contest that rewards jurisdictions for improving permitting in key solar states
B. Fund national, state, and local advocates to encourage adoption
C. Focus advocacy on DOE's 25 Solar America Cities and 200 other cities with high solar volume
D. Build online "Common Application" tool and develop city-by-city compliance database

[25] Allowing third party inspections is an alternative process to ensure rapid approval for resource-limited cities.
[26] See Vote Solar's permitting best practices: http://votesolar.org/linked-docs/Best%20Practices.pdf.

A. Create a contest: DOE can learn from Department of Education's effective "Race to the Top" initiative and Challenge.gov models, and provide funding to states for local permitting contests.[27] Jurisdictions that exhibit the most improvement would be eligible to win grant money, thus providing a strong incentive to improve permitting processes. In the case of "Race to the Top," states responded with once-in-a-generation reform of local school districts before awarding even one dollar of grant money. This solar permitting contest should focus on four to eight states that have successful emerging solar markets, which is where installers face roadblocks. The White House can amplify this message, and showcase streamlined permitting in Washington D.C. with the upcoming White House solar installation.

B. Fund outreach to local communities: DOE should fund the appropriate mix of national, state, regional, and local organizations to educate jurisdictions and drive adoption of improved processes. DOE has previously funded these types of organizations for solar power. For example, DOE funded the Solar Instructor Training Network in 2009 to train local solar installers and the Solar America Communities Outreach Partnership in 2010 to educate jurisdictions. Local advocacy has also proven its effectiveness. For example, through advocacy, Vote Solar and local installers influenced Phoenix to reduce the residential solar permit fee from $1,000 to $225. Sierra Club has influenced high-cost jurisdictions to reduce permit fees to fair levels by publicly issuing fee reports across California counties. DOE should support similar efforts and leverage its Solar America Communities Outreach Partnership to educate, advocate, and influence jurisdictions.

C. Focus advocacy on key solar jurisdictions: DOE should leverage the existing 25 Solar America Cities to begin adoption and focus on the leading 200 cities across the country to target the majority of volume while controlling scope of the initiative. For example, in California, the leading 100 cities comprised 60% of installation volume in 2010 through November.[28] This approach reflects recommendations by other industry advocates, such as SolarTech's permitting roadmap.

D. Online application tool and city-by-city compliance database: While there are immediate process improvements that DOE can encourage immediately, an online application can transform permitting over time into a single standard, like the "Common Application" for colleges. The online tool, recommended by organizations such as SolarTech, can guide installers through the process, step by step, catching errors and making sure plans follow code. The tool will help installers design simple systems that require less plan review.[29] Jurisdictions will save up to 40% of their time, since they will not have to confront incomplete or error-filled applications. NREL's PV Watts is an example of a DOE-

[27] DOE endorsement will bolster state efforts. For example, jurisdictions in Colorado are circumventing a 2008 law, SB 117 that limits residential permit fees to $500 by charging separate "plan review fees." The average suite of fees charged Colorado in 2010 was $604, with five jurisdictions charging more than $1,000. New legislation set for 2011 attempts to end these loopholes.

[28] California Solar Initiative program data, https://csi.powerclerk.com/CSIProgramData.aspx.

[29] This feedback will encourage installers to design simpler, standardized, safe systems, creating a positive feedback loop.

designed tool that standardizes a key aspect of the solar industry—the calculation of solar production for any given site—removing the need for installers to develop their own production estimators. Similarly, an online permitting tool can streamline permitting dramatically with one simple application that benefits installers, jurisdictions, and consumers. Additionally, It is important to measure progress with transparent, online data. The data provide accountability as to whether jurisdictions have adopted the key process improvements and offer a grade to the jurisdiction. This data will allow industry advocates, such as Sierra Club and Vote Solar, to focus their local advocacy work on cities most in need of improvement, in coordination with broader national and state roadmaps from DOE, state government, SolarABCs, SolarTech, or others.

The prize: grid parity for more than half of American homes

For solar to be mainstream, it has to be at "grid parity," meaning that the cost of solar electricity is equal to or less than the cost of utility electricity. Residential solar will reach grid parity for mainstream Americans—more than 50% of all homes without any local or state subsidies—if the cost of turnkey residential solar falls to $3.50 per watt.[30]

Germany has already reached $3.50 per watt, not including any subsidies, by streamlining permitting to drive scale. Costs in the United States are falling too. Today, many leading installers can install at a turnkey cost of less than $6 per watt. However, equipment costs are expected to fall less than $1 per watt over the next five years. Without streamlined permitting and inspection, the U.S. will struggle to reach $3.50 per watt and the longer term DOE goal of $1 per watt.[31]

DOE has already identified the issue: "Permitting has become one of our top priorities here. It is one of the biggest barriers in the solar market right now," said Hannah Muller with DOE's Solar America Cities initiative.[32] We ask the Department to address the issue with urgency by adopting our recommendations as an initial course of action.

[30] At $3.50 per watt, solar electricity costs 13.8 cents per kilowatt-hour. Assumes: 25 year panel lifetime; $1,000 inverter replacement after ten years at 10% discount rate; 30% federal Investment Tax Credit; no local or state subsidies; 6% loan rate. At 13.8 cents per kilowatt-hour, 66 million housing units are at grid parity in 2013. Assumes: PV-Watts production by state; no shading or roof issues; state electricity prices from Department of Energy's "Electricity Power Monthly" for October, 2010; 5% annual electricity price increase; U.S. Census. States at grid parity include: HI, NY, CT, CA, NJ, NH, MD, AZ, ME, VT, RI, NV, NM, DC, MA, DE, TX, CO, PA, FL.

[31] Interconnection and rebate administration are two important sources of delay and cost.

[32] "Is Bureaucracy Killing Solar?" March 26, 2010. Greentech Media, http://www.greentechmedia.com/articles/read/is-bureaucracy-killing-solar.

Appendix

Appendix A: Methodology

This report provides new, actionable data on the cost of residential solar permitting and inspection and offers practical recommendations that the Department of Energy (DOE) can implement quickly.

SunRun interviewed operations professionals across its network of residential installers, which spans seven states and accounts for more than 20% of national residential solar market share. In the interviews, SunRun addressed the granular details of local permitting and inspection to target all the resources installers require during the process. These costs are challenging to quantify, even for installers living the realities every day, because they differ for every job, every region, and every home—a testament to the very inconsistencies we set out to quantify. The best way to uncover this data is through unique conversations, such as those SunRun conducted, that capture costs and time spent on permitting across a wide spectrum of installers.

To develop practical recommendations, SunRun consulted the key stakeholders in residential solar, including solar installers, solar industry organizations, local jurisdictions, and federal officials. These meetings revealed strong support across stakeholders for the Solar ABCs standards and the need to provide incentives for jurisdictions to adopt improved processes.

To ensure accuracy and broad support, SunRun shared cost data and recommendations with its entire installation network and the other key stakeholders. Every single installer endorsed the report, along with top industry organizations Sierra Club, SolarTech, and Vote Solar. This report incorporates feedback from every endorsing company and organization, as well as initial feedback from the Department of Energy and the White House. The report fairly estimates the average permitting costs across seven of the highest-volume solar states and represents the consensus solutions to improve residential solar permitting and inspection.

Appendix B: Data

Costs for each category are calculated from the bottom up, including fully-loaded labor costs, material costs, permitting fees, engineering fees, and other costs. The cost and delays hold back installation companies that want to provide solar to more and more customers.

Table 1 summarizes the cost of red tape: approximately $2,516 per installation and $0.50 per watt.

Table 1. Cost data

Process for local permitting and inspection	SUMMARY Average cost per install	DATA FROM INTERVIEWS Percent of jurisdictions requiring	Average cost per occurrence
Complete permit application	**$505**	**n/a**	**n/a**
Draw system plans	$250	100%	$250
Structural calculations	$176	43%	$413
Zoning application	$46	11%	$436
Determine requirements	$27	13%	$213
Print out permit packet	$6	100%	$6
Submit permit application in person	**$149**	**68%**	**$220**
Pay permit fee	**$431**	**95%**	**$454**
Variation in building requirements	**$581**	**n/a**	**n/a**
Smaller system due to fire setbacks	$202	18%	$1,116
Unable to install supply side tap	$167	4%	$3,753
Add extra disconnect	$116	60%	$193
Labeling	$38	100%	$38
Double flashing	$32	3%	$1,200
Extra attachments	$26	10%	$274
Field inspection	**$329**	**n/a**	**n/a**
Wait for inspector	$121	100%	$121
Travel to and from customer's home	$96	80%	$120
In-process inspection	$60	16%	$383
Rework and re-inspection	$40	6%	$667
Inspector conducts inspection	$13	48%	$28
Sales and marketing costs	**$520**	**n/a**	**n/a**
Lower close rates from higher cost	$400	100%	$400
Cancellations due to delay	$70	1.4%	$5,000
Reduced customer referrals	$50	2%	$2,500
TOTAL COST	**$2,516**	**n/a**	**n/a**

The following sections explain the details of how each category increases cost to installers.

Draw system plans: $250, up to one-week delay. Installers prepare system plans for submission, which includes at a base level the system layout, electrical diagrams, and equipment specification sheets.

Installers spend about six hours on average preparing these plans, including a 1-2 hour site visit, 1-2 hours driving to the site, 2-3 hours drawing plans, and 1-2 hour design review. Larger installers have templates that reduce drawing time. Smaller installers without appropriate software or resources sometimes pay outside firms to do the drawings, which typically charge $400 per drawing. Drawing plans is necessary for a safe system; however, variability between jurisdictions adds 30-50% additional manual work to properly present and customize plans.

- ✓ Solution: adopt Solar ABCs standards across jurisdictions (longer term: provide national online application tool).

Structural calculations: $176, up to one-week delay. About one in four jurisdictions require that every permit packet have structural calculations prepared by a professional engineer, often including a wet stamp, even if similar designs have been approved before. This is not required by state or national code. Most installation companies pay an average of $500 per install to an outside firm or individual to complete these calculations. This is a growing requirement, especially in Arizona and Southern California. Solar PV typically adds about 3.5 pounds per square foot, which is negligible for the structural integrity of the roof. Solar ABCs standards set clear guidelines for the few plans that should require structural calculations, such as installations on older roofs.

- ✓ Solution: adopt Solar ABCs standards across jurisdictions (longer term: provide national online application tool).

Zoning application: $46, up to three-week delay. Installers report that about 11% of jurisdictions require a zoning application, which includes scale plans and elevations for aesthetic and zoning approval. An east coast installer told SunRun that about 10% of all jurisdictions require presenting to a local board, which equates to more than ten hours of preparation, time driving to the local office, and spending $200 for a poster-board presentation. On average, installers will spend about six hours to complete these. Smaller installers may need to hire outside firms for as much as $1,200 to complete the more complicated requests that require expensive software tools. We suggest that installations meeting Solar ABCs standards should not require zoning, which will save time for jurisdictions as well.

- ✓ Solution: adopt Solar ABCs standards across jurisdictions.

Determine requirements: $27, up to four-week delay. As every jurisdiction has different requirements, designers must learn and update their knowledge of those requirements. The majority of jurisdictions do not have clear, transparent codes available online for how to build. Installers report on the challenges of even getting local building departments to answer the phone or return a call. Installers often feel it is necessary to visit the building department in person to discuss the issues. This cost is more relevant in jurisdictions where an installer has less experience, which applies to fringe jurisdictions, new installers, and lower volume installers. This is a key barrier to entry for new solar

installation companies. One solar installer went through a 30-day process of redlines and corrections that took 40 hours and $1,200 of labor simply to install a system in a new jurisdiction. Solar ABCs standards streamline requirements across jurisdictions, and eliminate time to determine requirements.

- ✓ Solution: adopt Solar ABCs standards across jurisdictions.

Print out permit packet: $6. Since the vast majority of jurisdictions do not allow email or online submission of permit packets, installers need to print out packets. Installers across the country report jurisdictions that require as many as seven copies, hundreds of pages of equipment manuals, and larger paper. One installer reports a jurisdiction that requires a 36' x 24' "scroll" for every installation, which costs more than $100 for printing and time wasted driving to a printing shop.

- ✓ Solution: email submission of permit application.

Submit permit application in person: $149. Once the permit packet is complete, the installer must submit the plans for review at the building department—a long, frustrating process that requires hours of wasted time for skilled workers. Typically, the installer drives the packet to the building department, which takes about two hours round-trip on average. Some installers will choose to mail the packet where it is allowed. Average wait time is 30 minutes, though installers speak of departments where wait times can be a half day or more. About 10% of jurisdictions offer over-the-counter permitting. Almost no jurisdictions allow online or email submittal, even though jurisdictions usually have internet access. Every installer interviewed was supportive of moving the process online or through email, which would eliminate the pick-up and drop-off cost. Processing takes as long as six weeks. As an example, one installer has hired two full-time permit runners to support about 1,000 installations per year. Another installer pays a firm $300 per permit to drop off and pick up individual permits.

- ✓ Solution: email submission of permit application.

Pay permit fee: $431: Jurisdictions charge a permit fee averaging $431, with wide variation, even above $1,000. By comparison, the cost to a local permit office is $250 or less to issue a permit, causing an unfair tax on solar. In a 2009 study of 250 municipalities in Southern California, Sierra Club found the average residential solar permit fee to be $494, with 70 municipalities charging more than $700. A 2009 study by Vote Solar found the average permit fee in Arizona to be $358. Additional fees can creep onto the permit fee. Certain fire departments now charge separate fees and one county in California charges a $350 incremental roadway fee for every installation. Many jurisdictions in Colorado charge plan fees to get around a 2008 law capping permit fees at $500 for residential installations, driving up the average fee above $600 with the worst 20% at $1,000. Too often, local jurisdictions will charge a high permit fee to plug other budget holes.

- ✓ Solution: reduce permit fees to $250 or cost of issuance.

Smaller system due to fire setbacks: $202. Installers report about 18% of jurisdictions have limited system size by requiring fire setbacks beyond current code, primarily in California. On average, this reduces the system size by one kilowatt, or five 200-watt panels. This hurts economies of scale for the installation, subtracting about $1,400 in gross margin per installation. In other words, the fixed cost of installation is spread across fewer panels, increasing the cost per watt. Jurisdictions vary significantly in their requirements, from requiring three feet of fire access on the roof on all sides to just one side. In 2012, International Fire Code is expected to set stricter standards resembling the existing California Fire Marshall's recommendation. Some jurisdictions will automatically adopt, and some, especially outside of California, will go through a longer public hearing process, which can take several months to many years. If passed, the stricter code will certainly add cost. To minimize this cost, installers and industry advocates need to participate in the public hearing process.

- ✓ Solution: adopt Solar ABCs standards to standardize across jurisdictions; influence public hearing process for 2012 International Fire Code.

Unable to install supply side tap: $167 per install. About 4% of interviewees, mainly in California, report pushback from the jurisdiction or utility on completing a supply side tap in appropriate situations. Instead, installers must replace the main service panel, which adds $5,000 to each installation and can run as high as $10,000 in certain situations. Many installers complete this safely in other jurisdictions and Article 690.64(A) of National Electrical Code (NEC) allows for a "supply side connection in which a PV system is connected to busbars, conductors or lugs that are located between the utility meter and the service disconnect."

- ✓ Solution: adopt Solar ABCs standards across jurisdictions.

Add extra disconnect: $116. Installers reported jurisdictions requiring an unnecessary AC or DC disconnect about 60% of the time, adding $193 in material and labor cost for each instance. Every installation already has a working disconnect at the inverter; however, jurisdictions (or utilities) may require an additional roof DC disconnect or an AC disconnect within eight feet of the service panel. However, installers point out that there is already one disconnect at or next to the inverter, not to mention the breaker panel, making a second disconnect duplicative.

- ✓ Solution: adopt Solar ABCs standards across jurisdictions.

Labeling: $38. Installers report variable requirements for the number and quality of electrical labels. The typical installation requires 5-10 labels and the installer on average will spend $38 per installation. However, certain jurisdictions include engraved labeling that can cost as much as $25 per label, further increasing the cost. Certain installers have decided to only use the highest cost labels in all jurisdictions in order to standardize, even though most jurisdictions do not require those labels.

- ✓ Solution: standardize permitting requirements.

Double flashing: $32. Installers report 2.7% of jurisdictions require double flashing on roof penetration, meaning two layers of flashing product per penetration, that installers estimate adds $1,200 in labor and material cost across the many penetrations on an average install. State or national code does not ask for this requirement. One layer of flashing that is properly installed seals the roof, and a second layer of flashing is unnecessary for all systems.

- ✓ Solution: adopt Solar ABCs standards across jurisdictions.

Extra attachments: $26. Nearly 10% of jurisdictions require unnecessarily strict maximum spans between penetrations. For example, certain jurisdictions require four feet of maximum span, despite structural engineers certifying that six feet is acceptable. This adds $274 in average extra build cost due to additional materials and labor of more penetrations. A standard system on a standard roof can have a standardized span across jurisdictions under the Solar ABCs, removing the need for jurisdictions to require excessive spans.

- ✓ Solution: adopt Solar ABCs standards across jurisdictions.

Wait for inspector: $121. Inspectors typically provide a four to eight hour window for when they will arrive on site. Sometimes they don't even show up, report installers. Furthermore, homeowners are often required to attend, forcing them to leave work, which hurts the customer experience of solar.

- ✓ Solution: Reduce inspection appointment windows to two hours or less.

Travel to and from customer's home for inspection: $96. The installer needs to drive to and from the customer's home for inspection. If inspectors could target specific time windows, they would be able to arrive at the end of an installation and inspect the system while the crew is still there, eliminating this carbon-unfriendly requirement for installers to drive back to the home for an inspection.

- ✓ Solution: adopt Solar ABCs standards, which will improve quality and make inspectors feel more comfortable so installers would not always have to send staff to oversee the inspection.

In-process inspection: $60. A concerning trend is that more and more jurisdictions require in-process inspections to examine the roof penetrations before the modules are installed. This "double inspection" is not necessary because jurisdictions can address key safety requirements in the permit packet and final inspection. Furthermore, "double inspections" add cost to jurisdictions, making it harder for them to provide reasonable permit fees. Installers reported that 16% of jurisdictions require these, and expressed concern that this percentage is rising. Typically, a double inspection requires a three-person installation crew costing about $100 per hour to waste several hours after completing penetrations waiting for the inspector to arrive.

- ✓ Solution: eliminate "in-process" inspections.

Rework and re-inspection: $40 per install. Installers report inspection failures about 6% of the time. This adds about $200 per occurrence in re-inspection fees, extended discussions with inspectors, rolling a truck back to the installation site, and additional materials. Often these are legitimate concerns by inspectors. Some installers report inconsistency with certain inspectors requiring different items than plan reviewers in the building department, where they fail inspection despite building to plan. Regardless, most installers believe that inspection failures would decrease significantly if requirements were consistent and standardized from jurisdiction to jurisdiction.

- ✓ Solution: adopt Solar ABCs standards across jurisdictions.

Inspector conducts inspection: $13 per install. Most inspections take only fifteen minutes, which emphasizes the absurdity of an eight-hour window provided by the inspector.

- ✓ Solution: adopt Solar ABCs standards across jurisdictions, which will improve quality, making inspectors feel more comfortable, and reduce the frequency with which installers send staff.

Lower close rates from higher cost: $400. Residential solar customers are highly price sensitive and the extra cost from permitting and inspection seriously harms customer adoption. The Solar Energy Industries Associations (SEIA) estimated price elasticity of demand at ~200% in a 2009 study for distributed solar. This means that eliminating permitting and inspection costs, which are about 8% of total turnkey costs, would stimulate 16% in new demand. A typical installer spends about $2,500 in marketing per sale, 16% of which would be saved with increased demand. SunRun frequently realizes even higher price sensitivity than the SEIA study, especially in markets where residential solar hovers almost at grid parity. For example, SunRun data shows close rates can double from as little as 3% in cost reduction.

- ✓ Solution: all of the above.

Cancellation cost due to delay: $70. Cancellation becomes more likely installation delay grows. Installers will often sink $5,000 in sales, marketing, and planning costs into the system before the homeowner cancels. Installers estimate more than 1% of customers cancel due to permitting delays.

- ✓ Solution: all of the above.

Reduced customer referrals: $50. As discussed throughout this report, the process of permitting and inspection taints the customer experience. The long delay causes a homeowner's excitement to wane, making them less likely to refer friends. Every referral helps avoid up to $2,500 in marketing costs. Installers estimate that permitting and inspection reduces referrals by 2%. This may underestimate the true cost since salespeople are accustomed to the current painful process.

- ✓ Solution: all of the above.

Additional balance-of-system costs not captured in estimates: $1000s. There are multiple additional unnecessary costs for solar energy not included in this report's estimates either because quantification is not cut and dry or these costs are not related to local permitting. These costs can add thousands of dollars to an install, and include, in order of importance:

Related to permitting

- Management opportunity cost: Executives at installation companies spend far too much time and energy focused on permitting issues.
- Planning and uncertainty: Installers are challenged to plan installation far in advance since building departments often lack transparency and reliability.
- Reduced competition among installers: Red tape makes it harder for startup installers to operate profitably and increases the minimum efficient scale required. One installer lost money on its first four installations in a jurisdiction due to complicated and unclear requirements. This barrier to entry reduces competition and slows movement down the cost curve.
- Grounding codes: installers have alleged that more complicated grounding code versus Germany adds cost to inverter design and manufacturing in the United States.
- Increased cost of salespeople: Installers report that salespeople have to be detail-oriented and reasonably well-versed in local code in order to provide accurate bids. This means salespeople need to have a greater skill set in addition to salesmanship, requiring higher-paid employees and forcing distraction from acquiring customers. Installers found this cost hard to quantify, though it is certainly a factor.

Not related to local permitting

- Interconnection delay: SunRun experiences an average interconnection delay of three weeks across the country, with certain utilities taking as long as ten weeks. This is a utility issue.
- Local taxes: In some states, state and local sales taxes on solar equipment and solar electricity add complexity and cost on top of permit fees. Like permit fees, the tax rules, rates, and registration processes vary by jurisdiction. For example, Colorado tax rules and rates are different in each town and are as high as 4% ($1,000 per install, $0.20 per watt).
- Rebate application cost: California installers estimate the cost of applying for rebates as high as $0.15 per watt, or $750 per install. Furthermore, the uncertainty of rebate programs adds significant cost for regulatory teams and increases financing costs. This is a utility/state issue.

Appendix C: Potential savings

The streamlined process recommended in this paper will reduce most of the costs, though certain costs will still remain as long as a permitting process remains. Table 2 summarizes potential cost savings from actions that can be taken immediately: $1,900 per install and $0.38 per watt. Additional improvements and innovations over time, such as online submission, will improve the entire process of permitting and inspection.

Table 2. Savings from implementing recommended solutions

Process for local permitting and inspection	Average cost per install	Immediate solution	Savings estimate, %	Avg. savings, $ per install
Complete permit application	**$505**	**Solar ABCs standards**	**90%**	**$455**
Draw system plans	$250	Solar ABCs standards	80%	$200
Structural calculations	$176	Solar ABCs standards	100%	$176
Zoning application	$46	Solar ABCs standards	100%	$46
Determine requirements	$27	Solar ABCs standards	100%	$27
Print out permit packet	$6	Email submission	100%	$6
Delay	*4 weeks*	Standards, rapid response	95%	*4 weeks*
Submit permit application in person	**$149**	**Email submission**	**100%**	**$149**
Pay permit fee	**$431**	**Cap fees**	**50%**	**$216**
Variation in build requirements	**$581**	**Solar ABCs standards**	**69%**	**$403**
Smaller system due to fire setbacks	$202	Solar ABCs standards	50%	$101
Unable to install supply side tap	$167	Solar ABCs standards	100%	$167
Add extra disconnect	$116	Standardize disconnects	50%	$58
Labeling	$38	Standardize (still need labels)	50%	$19
Double flashing	$32	Solar ABCs standards	100%	$32
Extra attachments	$26	Solar ABCs standards	100%	$26
Field inspection	**$329**	**Reduce inspection windows**	**100%**	**$243**
Wait for inspector	$121	Reduce inspection windows	80%	$96
Travel to and from customer's home	$96	Standards (less installer staffing)	50%	$48
In-process inspection	$60	Eliminate multiple inspections	100%	$60
Rework and re-inspection	$40	Standards (reduced rework)	80%	$32
Inspector conducts inspection	$13	Standards (faster inspection)	50%	$7
Sales and marketing costs	**$520**	**All solutions**	**85%**	**$440**
Lower close rates from higher cost	$400	All solutions	80%	$320
Cancellations due to delay	$70	Rapid response, standardize	100%	$70
Reduced customer referrals	$50	All solutions	100%	$50
TOTAL COST	**$2,516**	**All of the above**	**76%**	**$1,906**