



*Solar 3.0*


Residential  
and  
Commercial Solar PV

[www.Solar30.org](http://www.Solar30.org)




**Initiatives**  
Local best practices

National impact



**Partners**  
Collaborative Consortium

Solar 3.0 Team



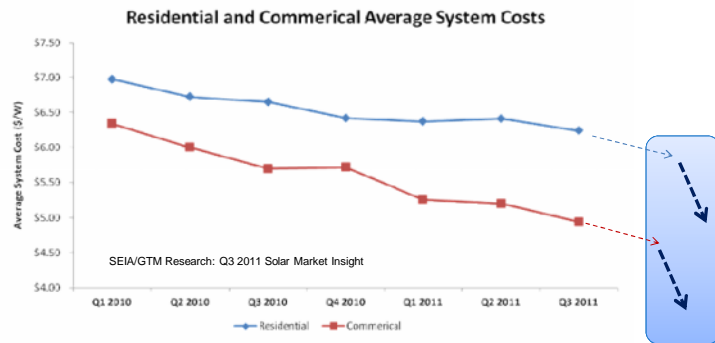
## Solar 3.0 Defined

- An industry initiative to rapidly expand the market
- Earlier efforts focused on pre-requisites
  - Solar 1.0
    - 2006 – 2008
    - Policy focus
  - Solar 2.0
    - 2009 – 2010
    - Technology focus
- Solar 3.0 Outreach and Promoting best Practices
  - Identify **inefficiencies** and promote consistencies

## Solar 3.0 Team



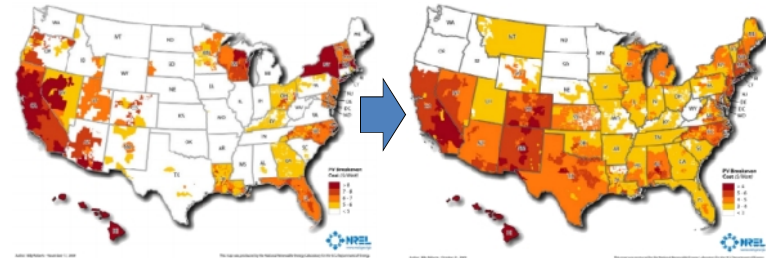
### Installed System Costs Continue to Decline



**Solar 3.0 = Better Tools | Efficient Markets | Lower Costs**

### Lower costs = Larger Market

- Residential PV break-even installed price in 2008 assuming full retail net metering, state incentives and 30% TC.
- Residential PV break-even installed price in 2015 assuming full retail net metering and 30% TC.



## Solar 3.0 2012 Goals

- Develop a comprehensive Solar 3.0 implementation plan
  - Motivate adoption of optimal permitting and inspection practices by code officials and related stakeholders
  - Increase awareness of tools, standards, and guidelines by 50%
  - Achieve 30% Solar 3.0 Tool Kit adoption by code officials in the targeted communities
- Select Top 100 communities for maximum adoption
  - Communities will receive in-person and online workshops at no cost to implement Solar 3.0 toolkits
  - Communities will be coached and evaluated for “Solar readiness”
- Establish [www.Solar30.org](http://www.Solar30.org) as a clearinghouse of expert information on solar PV system deployment best practices

## Top 100 Targets in 2012

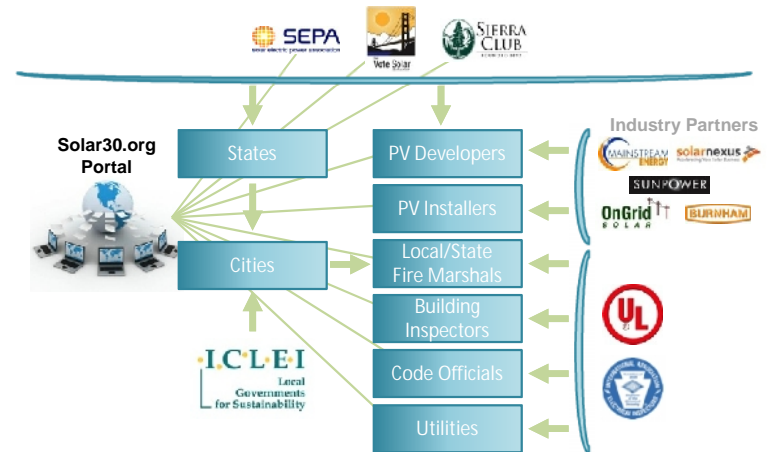


## Solar 3.0 Cost Reduction Tools

- Solar 3.0 Resource Toolkit
  - Industry best practices
  - Comprehensive curriculum
  - Metrics & dashboards
- National Outreach
  - State
  - Metro region
  - City
- Stakeholder Education
  - Cities
  - Utilities
  - PV industry



## Solar 3.0 Outreach & Channels



## Accomplishments To Date

- Solar30.org web site & tool kit
- Survey of installation practices
- **PV Online Training joint development**
- **Companion course development**
- California Guidebook contributions
- Baseline metrics analysis
- Events program started

## PV Online Training

### Objective –

To educate code officials in using proper methods for:

- Inspecting residential solar PV installations
  - Detecting common installation mistakes
  - Applying an expedited permit process
- Training uses DOE's NTER online training platform
  - Training to be available in May
  - An information button or "i-button" references the National Electrical Code.
  - Hands-on companion workshops are being planned by Regional Training Providers and SolarTech's 3.0 initiative

# PV Online Training for Code Officials

## Modules

1. Roof Mounted Arrays and Wire Management
2. Electrical: Roof and Ground Mounted
3. Ground Mounted Arrays
4. Appropriate Signs
5. Equipment Ratings
6. Expedited Permit Process

*This content will be presented via text, drill-down information, and a variety of media including still photos, videos, and selected 3D models.*

## Capstone

- How to Identify Solar Installation Problems

*This will be an immersive, highly interactive lesson using 3D models and game-based interaction techniques.*



### 4. Appropriate Signs

Topic 4: Recommended Signs and Labels

**Key Points:**

- Panels are with integrated DC Disconnects (i.e. Missing Information and/or Tool Labels on the front)
- Panels (Maximum Power Point Current)
- Panels (Maximum Power Point Voltage)
- Maximum System Voltage
- Short Circuit Current
- Maximum DC Voltage (at open circuit) at the array
- If an array was not created in a safety-oriented location, a disconnect will be installed at all service disconnects for all sources of electrical power
- All DC conductors and related wiring shall be covered with the appropriate safety marking throughout the system.
- All conductors, raceway and their associated hardware shall be marked with the appropriate safety marking throughout the system.
- Where the conductors or their associated hardware are not marked, the marking shall be provided.
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Photo voltaic Online Training

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### 5. Equipment Ratings

Topic 2: Junction Boxes




**Key Points:**

- Junction boxes should be installed in compliance with their listing and labeling.
- Junction boxes installed in exterior locations should be made of clear, air-proof or waterproof and all wire nuts and splices should be contained within a junction box.
- They must have a ground terminal available, that doesn't require the use of a cover.

**Common Installation Practices:**

- Grounding boxes or conductive bodies making them suitable for use as grounding electrodes.
- Using appropriate fittings for being constructed from weather resistant materials.
- Making sure the wire nuts are properly installed in the box.
- Using an over cover in suitable locations.
- Ensuring wiring is done according to the applicable code.

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Photovoltaic Online Training 





# Solar Photovoltaic Workshop

Presented in Partnership by:



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# Solar Photovoltaic Workshop

Developed in Partnership with:



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 **PV Installation Concerns** 

- Utility compatibility and interaction
- Environment  
(e.g. indoor, rainproof, corrosion resistant)
- Maximum number of modules
- Fire exposure ratings
- Location on roof
- Effect on roof covering
- Wind and snow loading

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 **Items needed to Inspect PV?** 

- Permits
- Plans
- Wiring
- Attachment
- Equipment

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## Plans - Electrical



- Electrical plan should be submitted that includes the following:
  - Locations of main service or utility disconnect
  - Total number of modules, number of modules per string and the total number of strings
  - One-line diagram of system
  - Specify grounding/bonding, conductor type and size, conduit type and size and number of conductors in each section of conduit

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## Plans - Electrical (cont.)



- Electrical plan should be submitted that includes the following:
  - Make and model of modules, inverter(s) and/or combiner box if used
  - If batteries are to be installed include them in the diagram and show their locations and venting
  - Equipment cut sheets including inverters, modules, AC and DC disconnects and combiners

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## Plans - Electrical (cont.)





- Electrical plan should be submitted that includes the following:
  - Labeling of equipment as required by Article 690 and Article 705
  - Site diagram showing the arrangement of panels on the roof or ground, north arrow, lot dimensions, and the distance from property lines to adjacent buildings/structures (existing and proposed)



## Plans - Structural





- Structural plan identifying support information for roof mounted systems including the following:
  - The type of roof covering and the number of roofing layers installed
  - Type of roof framing, size of members and spacing
  - Weight of panels, support locations and method of attachment

 **Plans - Structural (cont.)** 

- Structural plan identifying support information for roof mounted systems including the following:
  - Framing plan and details for any work necessary to strengthen the existing roof structure
  - Any relevant calculations (when required)
  - Location of PV equipment on the building

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 **Plans - Structural (cont.)** 

- Structural plan identifying support information for roof mounted systems including the following:
  - Where an approved racking system is used...
    - provide documentation showing the manufacturer of the rack system
    - maximum allowable weight the system can support
    - attachment method to the roof or ground
    - product evaluation information or structural design for the rack system

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## Plans - Code Requirements

- Site Plan –  
NEC 80.21 (Annex H), IBC 107.2.5, IRC R106.2
- One-Line Diagram –  
NEC 215.5
- Attachment Details –  
NEC 110.3(B), IBC 107.2.1, IRC R106.1.2
- Equipment Specifications –  
NEC 690.4(D), IRC R905.16.1, IRC R905.16.3,  
IRC M2302.3, IRC M2302.4, IBC 1505.8,  
IBC 1507.17.1, IBC 1507.17.3, IBC 1509.7.2,  
IBC 1509.7.4

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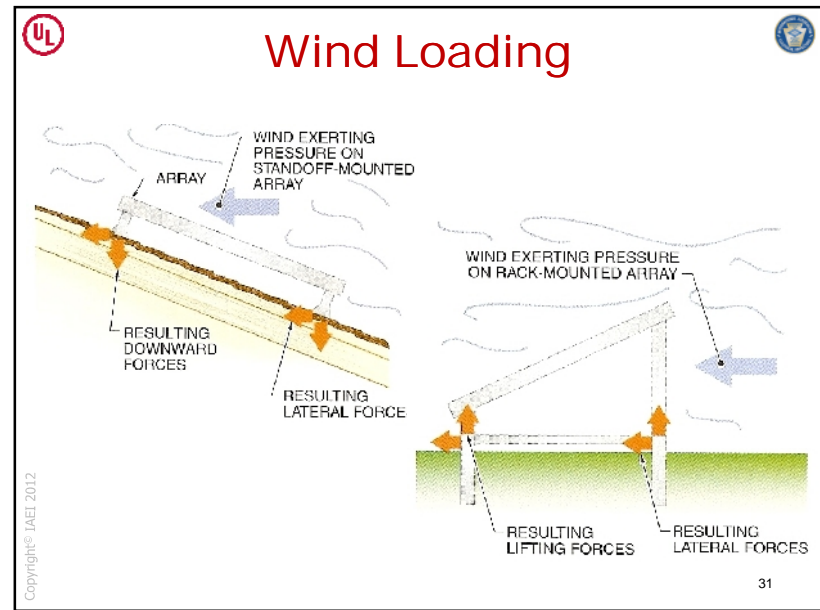
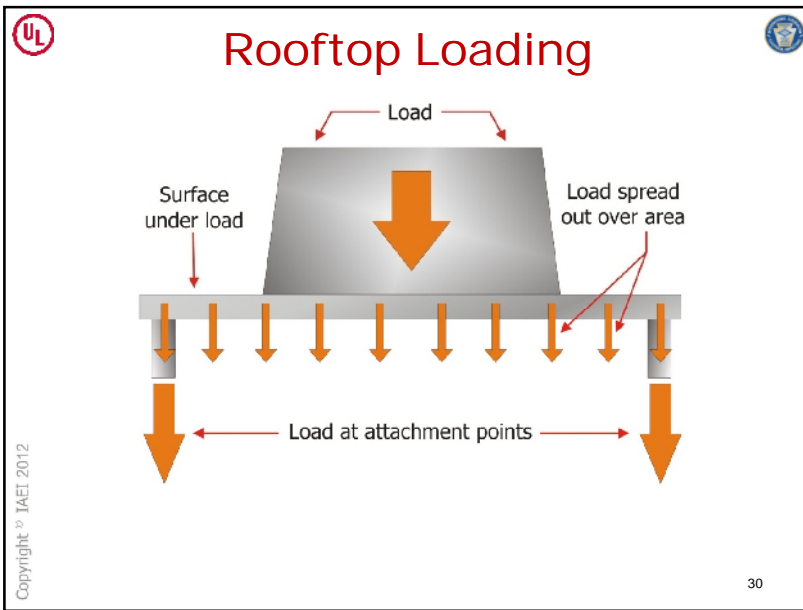


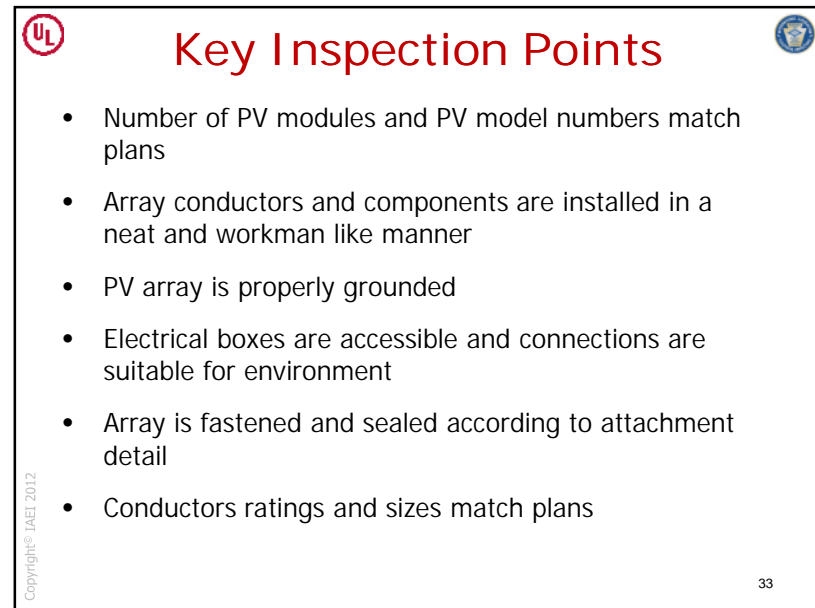
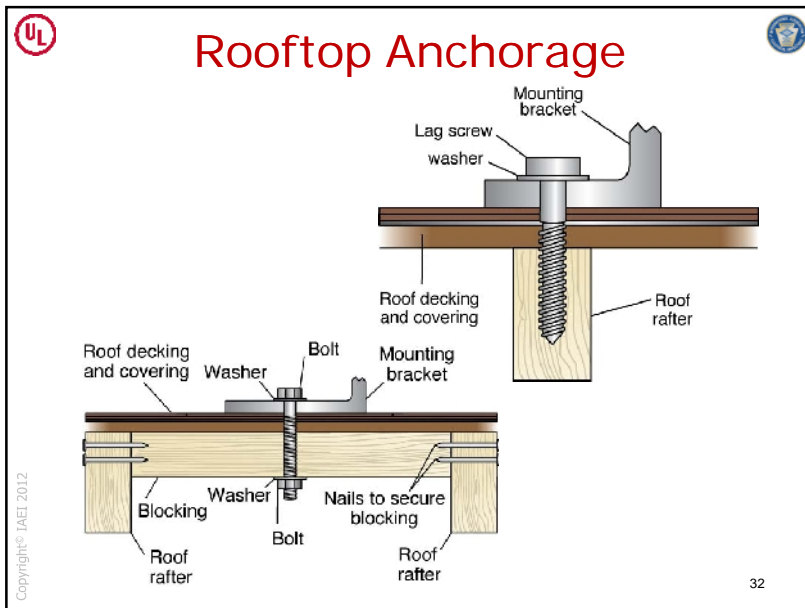
## Attachment

- The International Building Code (IBC) Section 106.3 Load Supports
- Dead loading and wind loading of roof are covered in IBC 1603.1.4, 1603.1.8, 1604.2, 1606.2

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## Key Inspection Points (cont.)

- Appropriate signs are properly constructed, installed and displayed, including:
  - Sign identifying PV power source system attributes at dc disconnect
  - Sign identifying ac point of connection
  - Sign identifying switch for alternative power system

## Key Inspection Points (cont.)

- Equipment ratings are consistent with application and installed signs on the installation, including:
  - Inverter has a rating as high as max voltage on PV Power Source sign
  - DC-side OCPD's are DC rated at least as high as max voltage on sign
  - Switches and OCPDs are installed according to manufacturers specifications

**UL Key Inspection Points (cont.)**

- Many 600 volt dc switches require passing through the switch poles twice in a specific way

THIS SWITCH IS SUITABLE FOR USE IN ACCORDANCE WITH NEC ARTICLE 690 PHOTOVOLTAIC INSTALLATIONS.


BASIC SWITCH	
NAMEPLATE RATING, 600VDC	ISC RATING, 600VDC
30A	5.2A
60A	36.4A
100A	64.0A
200A	128.0A
400A	256.0A
600A	384.0A

TYPICAL WIRING DIAGRAM

FUSED CONSTRUCTION

NON-FUSED CONSTRUCTION

PHOTO COURTESY OF JEFF FECTEAU



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**UL Key Inspection Points (cont.)**

- Equipment ratings are consistent with application and installed signs on the installation, including:
  - Inverter is rated for the site ac voltage supplied and shown on the ac point of connection sign
  - OCPD connected to the ac output of the inverter is rated at least 125% of maximum current on sign, and is no larger than the maximum OCPD on the inverter listing label
  - Sum of the main OCPD and the inverter OCPD is rated for not more than 120% of the busbar rating

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**UL** Key Inspection Points (cont.)

**EATON**

225 AMPS MAX. - SEE MAIN BREAKER RATING.  
225 AMPS MAX. BUS RATING

**EATON**

200 AMPS MAX. - SEE MAIN BREAKER RATING  
200 AMPS MAX. BUS RATING

<p><b>EATON</b></p> <p>225 AMPS MAX. - SEE MAIN BREAKER RATING. 225 AMPS MAX. BUS RATING</p> <p>SEE DATE SHEET FOR FURTHER INFORMATION.</p>	<p><b>EATON</b></p> <p>200 AMPS MAX. - SEE MAIN BREAKER RATING 200 AMPS MAX. BUS RATING</p> <p>SEE DATE SHEET FOR FURTHER INFORMATION.</p>
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**UL** Other Code Requirements for PV Systems

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## Solar 3.0 Event Schedule

- Workshops (with CEU's)
  - July 24 - Boston, MA
  - August 28 - Plano, TX
  - Sept 26 - Phoenix
  - Oct 11 - Madison, WI
  - Nov 16 - San Francisco, CA
  - Oct/Nov – NY/NJ
- Outreach
  - July 11 - San Francisco, CA
  - Oct XX - Washington, DC
  - Sept 10 - Orlando, FL

## Get Involved Solar 3.0

- Come to [www.solar30.org](http://www.solar30.org)
  - Sign up for news
  - Complete your community or utility profile
  - Explore best practices in Permitting
- Join Solar 3.0 on LinkedIn
- See how Solar 3.0 can benefit your community

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A National Platform for Process Innovation

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**Solar Tech**  
**SunShot**  
U.S. Department of Energy

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**Reducing Solar PV Soft Costs Nationwide**

Solar 3.0 is an outreach initiative to promote process innovation in American cities through the standardization of local best practices, zoning codes and codes, permitting processes and interconnector rules for distributed solar PV. Funded by the [U.S. Department of Energy](#), the main goal of Solar 3.0 is to increase the competitiveness of solar PV by ensuring cost hardware balance of system costs by 10% in identified U.S. target communities by 2014.

**News**  
Announcing Solar 3.0 Program Mobilization Event at Intersolar 2012  
We discuss solar PV getting to market in 2014.  
If you are an employee or contractor of an organization

**Events**  
Register Today for SVLG's 12th Annual Energy Summit  
SVLG is looking for 2012 to break down barriers.  
SVLG's 14th Annual Energy Summit, the 14th Annual

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- Email:

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**Target Communities**

A Solar 3.0 Target Community (TC) is a community in a State that has been:

- Identified by the Solar 3.0 Team [permanently](#) regulatory, utility, resource, solar market activity, regulatory enforcement, alternative credit, and other incentives as described in [Solar 3.0 Target Communities](#)
- Determined to have the qualities that ensure it to adopt solar best practices and standards more quickly than others
- Judged to have the potential to reduce non-hardware PV balance of system (BOS) cost made by 10% within three years

To view the communities on the Solar 3.0 list, visit the [Detailed Comparison](#) page. If you would like your community to be considered for inclusion, please complete the [Solar 3.0 Community Survey](#) or send us a message on the [Solar 3.0 Web](#).

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**Training**

**July 2012 Events**

[Leveraging Solar 3.0 To Reduce Soft Costs - July 11, 2012, San Francisco, CA](#)

If you work for a municipality, utility, Authority Having Jurisdiction, or a company involved in selling, installing, or financing solar PV systems, you are cordially invited to attend "Leveraging Solar 3.0 To Reduce Soft Costs," a seminar held in conjunction with Inverstrat 2012. Solar 3.0 is focused on reducing the costs associated with residential and commercial solar installations in the U.S. market. At this session, you will discover:

- How Solar 3.0 benefits your community
- Key findings of a survey of 500+ building inspectors regarding U.S. solar installation trends
- How online solar training courses covering inspection, installation, and permitting practices (with Q&A)
- Solar30 up, a clearinghouse for best practices and standards in solar PV
- How to engage with the Solar 3.0 team

**Registration Information**

Event	Date	Price
Leveraging Solar 3.0 General Admission for municipal, utility, and PV industry professionals	Jul 11, 2012	Free

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Register Today for SVLG's 12th Annual Energy Summit

SVLG's 12th Annual Energy Summit

The **12th Annual Energy Summit** presented by the Silicon Valley Leadership Group is a single day conference that offers and showcases case studies on the energy issues that matter most to your company. The event brings together hundreds of business leaders from facilities, energy management, sustainability, finance, and business development. Terry Farley, CEO of iStock Gas & Electric Corporation, will give the keynote address.

Name: 12th Annual Energy Summit

Presented by: Silicon Valley Leadership Group

Corporate Sponsors: Terry Farley, CEO, Pacific Gas & Electric Corporation

Date: June 8, 2012

Location: Computer History Museum, Mountain View, CA

Register [here](#).

0 Comments [Leave a comment](#)

**Recent Posts**

[Join Us At The Solar Inspection Forum In Phoenix on July 24](#)

[Solar 3.0 Business Now Available](#)

[Announcing Solar 3.0 Program](#)

[Publication Focus at Inverstrat 2012](#)

[Free SunShot Seminar: Leveraging Solar 3.0 To Reduce Soft Costs](#)

**Solar 3.0 Calendar**

July 2012						
S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

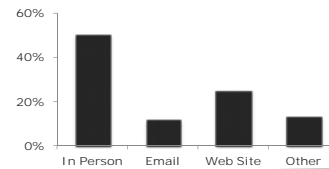
## Solar 3.0 – Key Metrics from Code Officials and Local Governments

Recent surveys conducted by the International Association of Electrical Inspectors (IAEI) and ICMA of code officials and local governments have highlighted a number of issues in the realms of permitting, inspection, and interconnection for the Solar 3.0 team to address. They include:

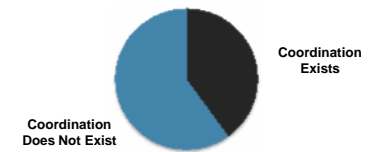
- In most jurisdictions, permits have to be obtained in person.
- Coordination between non-municipal utilities and authorities having jurisdiction is limited.
- Few local governments engage in solar education campaigns.
- A vast majority of local governments do not offer expedited or streamlined permitting processes for standard PV systems.
- Most jurisdictions do not make solar permitting information or fee schedules available online.
- A major lack of training amongst both code officials and solar installers exists.

## Solar 3.0 – Key Metrics from Code Officials

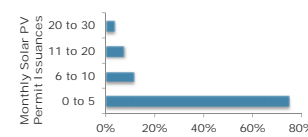
Only 25% of jurisdictions provide permits in an online location  
Options for Obtaining Permits



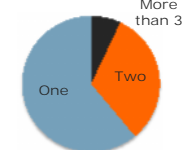
60% of AHJs do not coordinate with the local utility on PV solar processes



Number of Permits Issued on a Monthly Basis



Number of Departments Required to Review PV Systems



40% of jurisdictions require more than one department to review of PV system permits

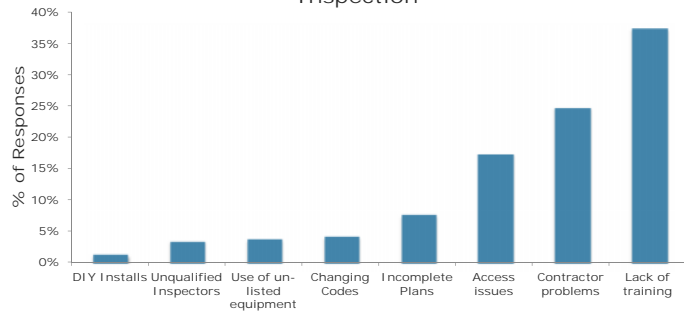
Source: International Association of Electrical Inspectors. Survey of Solar Installation Practices. www.Solar30.org. April 2012.



### Solar 3.0 – Key Metrics from Code Officials

A recent survey of the International Association of Electrical Inspectors determined that a lack of training amongst both inspectors and the solar industry is the single largest barrier to more efficiency in permitting, inspection, and interconnection of rooftop solar PV systems.

Major Obstacles to Successful and Efficient PV Inspection



Source: International Association of Electrical Inspectors. *Survey of Solar Installation Practices*. www.Solar30.org. April 2012.

### Solar 3.0 – Key Metrics from Local Governments

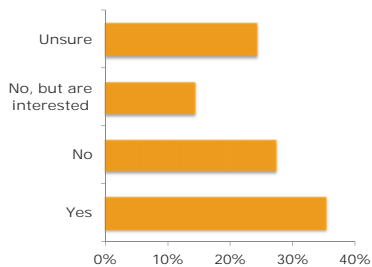
Financial and customer acquisition issues are a major component of non-hardware balance of system costs. Solar 3.0 will also track key metrics in these areas using iterative ICMA surveys as they become available.

Metric	2011 Survey Result
% of jurisdictions reporting existence of bulk purchasing/solarize and/or customer aggregation programs.	8%
% of jurisdictions reporting that third party financing is available.	35% yes, 23% no, 42% unsure
% of jurisdictions with an active community solar program.	2%, 5% in progress

Source: ICMA. *ICMA Solar Survey of Local Governments 2011*. ICMA. Available at: [http://icma.org/en/icma/knowledge\\_network/documents/kn/Document/303523/2011\\_ICMA\\_Solar\\_Survey\\_Summary\\_Results](http://icma.org/en/icma/knowledge_network/documents/kn/Document/303523/2011_ICMA_Solar_Survey_Summary_Results)

## Solar 3.0 – Key Metrics from Local Governments

Responses to the following Question: "Have your code officials gone through training on approving permits and inspecting solar PV installations?"



**Of 2,500 local governments surveyed, only 13% offer an expedited process for rooftop PV installations**

Source: ICMA. ICMA Solar Survey of Local Governments 2011. ICMA. Available at: [http://icma.org/en/icma/knowledge\\_network/documents/kn/Document/303523/2011\\_ICMA\\_Solar\\_Survey\\_Summary\\_Results](http://icma.org/en/icma/knowledge_network/documents/kn/Document/303523/2011_ICMA_Solar_Survey_Summary_Results)

## What Can You Do?

- Pull: the program and tools towards you
- Push: the tools out through your networks
- Tell: the story

**Solar3.0 = Better Tools | Better Markets | Better Business**

Questions?

Thank You