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# **Proposals and Process 2017 National Electrical Code**

**for**

**Solar America Board for Codes and Standards**

**Stakeholder Meeting; October 23, 2014**

**Ward Bower**

**Ward Bower Innovations LLC**



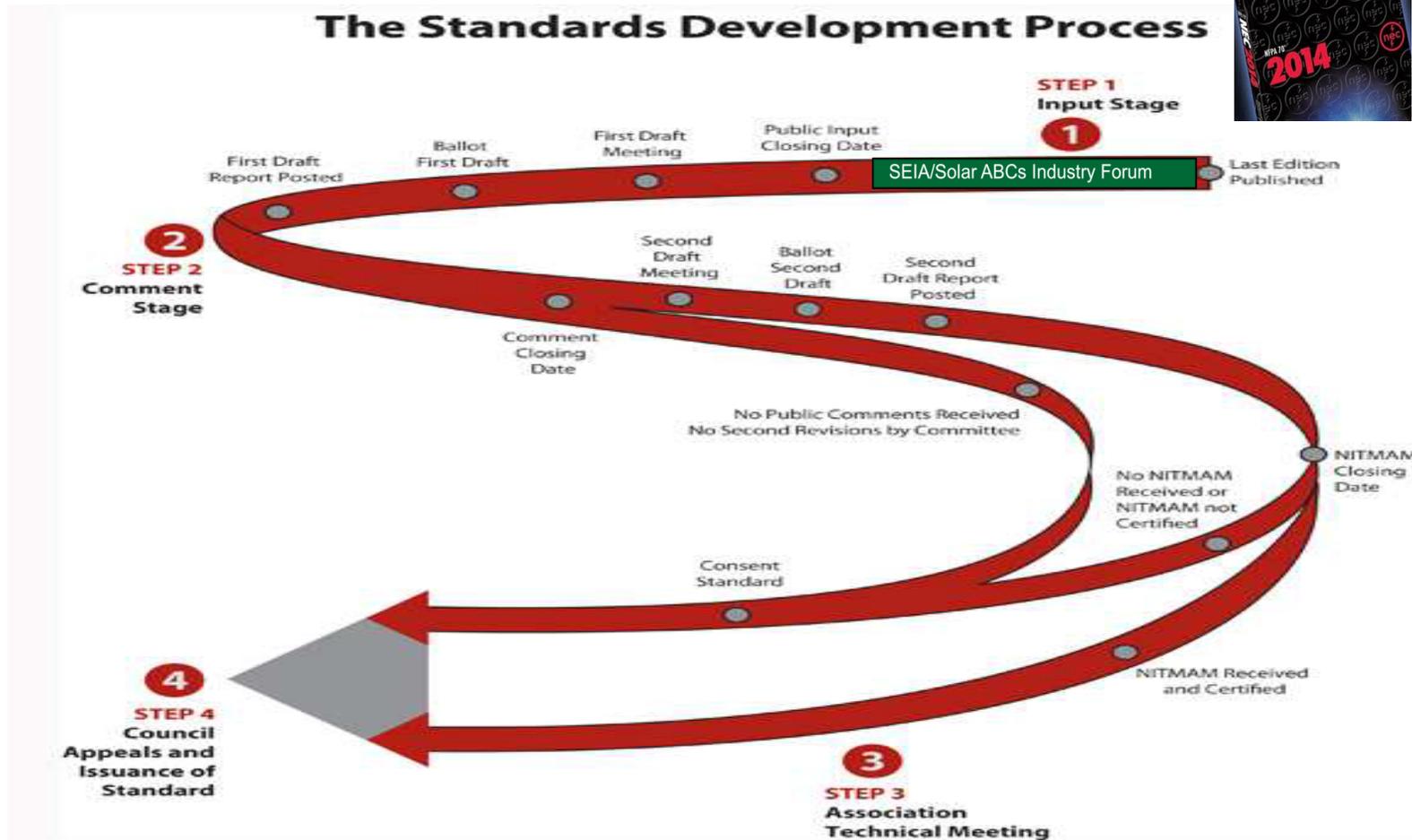
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# Introduction

- **The New NFPA Input Process for the NEC<sup>®</sup>**
- **Sneak Preview-The most significant PV-related changes proposed for 2017NEC<sup>®</sup>**
- **The SEIA/Solar ABCs Proposed 2017 PV Changes**
- **Impacts of major changes (safety, economics, reliability, hardware)**



# New NFPA Input/Comment Process



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# New NFPA Input/Comment Process – Important Dates

<b>Public Input Closing Date for Paper Submittal</b>	<b>10/3/2014</b>
<b>Public Input Closing Date for Online Submittal (e-PI)</b>	<b>11/7/2014</b>
<b>Final date for First Draft Meeting</b>	<b>1/12-24/2015</b>
<b>Posting of First Draft and Panel Ballot</b>	<b>3/13/2015</b>
<b>Final date for Receipt of CC First Draft ballot</b>	<b>7/3/2015</b>
<b>Final date for Receipt of CC First Draft ballot - recirc</b>	<b>7/10/2015</b>
<b>Post Final First Draft for Public Comment</b>	<b>7/17/2015</b>
<b>Public Comment Closing Date for Paper Submittal</b>	<b>8/21/2015</b>
<b>Public Comment Closing Date for Online Submittal</b>	<b>9/25/2015</b>
<b>Final date for Second Draft Meeting</b>	<b>11/2-14/2015</b>
<b>Post Final Second Draft</b>	<b>4/8/2016</b>



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# Quick Overview of ePI

<http://www.nfpa.org>

**Click on Codes and Standards**

**Proceed to Standards Development Process**

**Then proceed to Submitting Public Input  
(and Comments in Comment Stage)**

**Select Choose a Document (NFPA70)**

**Choose Next Edition and Sign In**

**Follow Step-by-Step instructions**

**You will have to establish and account!**



# Article 690 Definitions

Green: Underline is New or Change,  
Red ~~Cross-out~~ is Deleted

## Proposed for 2017

<u>Inverter Input Circuit</u>	<u>Inverter Output Circuit</u>
<del>Building Integrated PV</del>	<u>Engineering Supervision</u>
<u>DC-DC Converter Source Circuit</u>	<u>Generating Capacity</u>
<u>DC-DC Converter Output Circuit</u>	<u>Generating Station</u>
<u>Photovoltaic Circuit</u>	<u>Stand-alone System</u>
<u>Photovoltaic Modules/Shingles</u>	<u>Utility Distribution System</u>
<u>Reference Grounded PV System</u>	<u>Utility Transmission System</u>

NEW DRAWINGS and NOTES Fig 1(a) and (b)



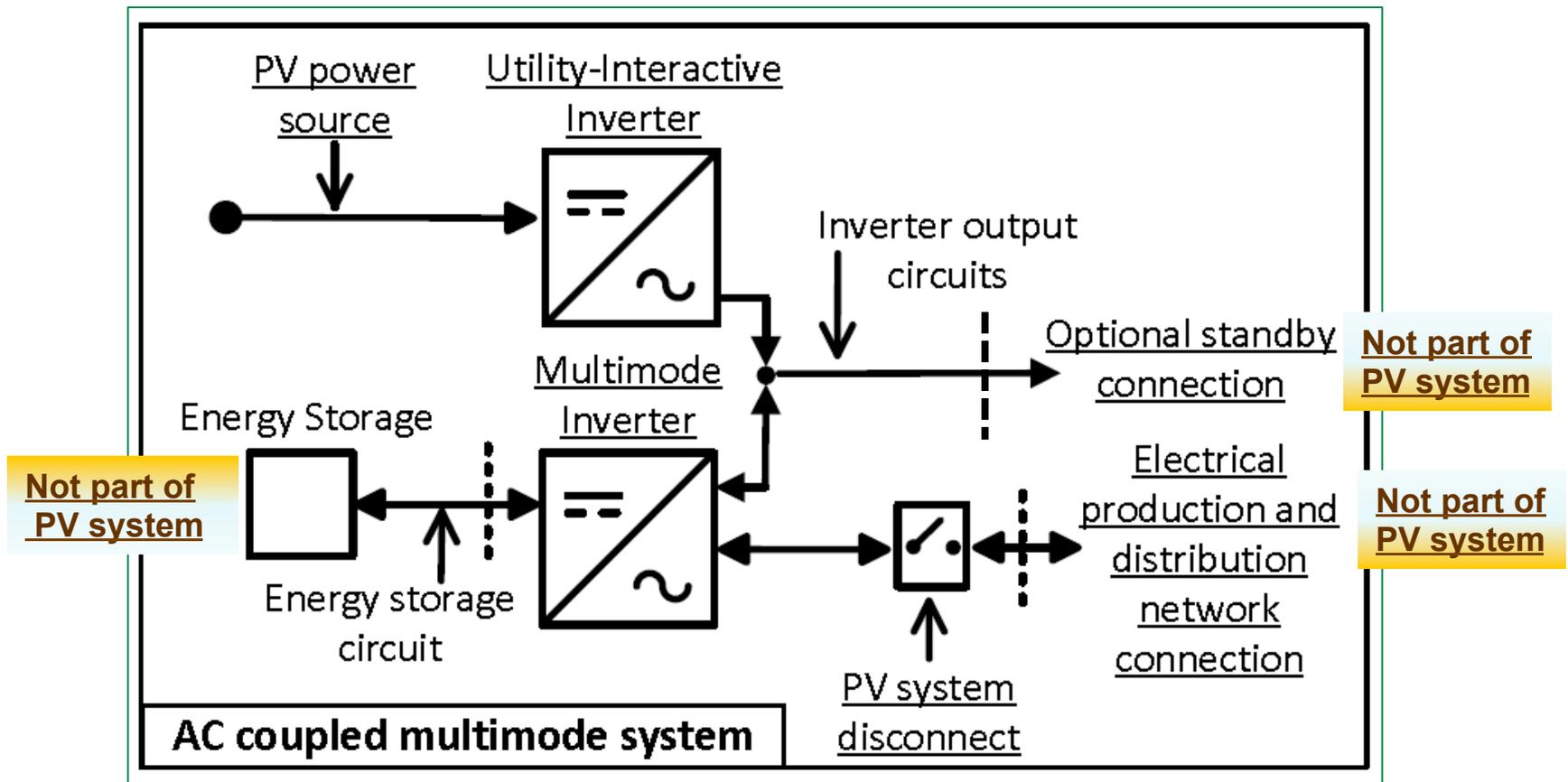
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## 690.4 ~~Installation~~ General Requirements

- 690.4(D) Multiple ~~Inverters~~ PV Systems. Multiple PV Systems shall be permitted to be installed in or on a single building or structure.  
(Requirements for directories deleted)



# THE PV SYSTEM BOUNDARIES



# ~~690.5(A) Ground-Fault Detection and Interruption~~

Proposed for 2017

## Referenced Grounded

“NOT HARD GROUNDED”

Fuse or Resistor  
Circuit Breaker  
Listed Electronic GFP  
Non-isolated  
Grounded Ckt

“NOT UNGROUNDED”

- 690.5 MOVED TO 690.41(B)



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## 690.11. Arc-Fault Circuit Protection

For 2017 the requirements {PV Systems with >80V must be protected with AFP – Includes ground mount systems}

(1) The system shall detect and interrupt arcing faults resulting from a failure in the intended continuity of a conductor, connection, module, or other system components in the dc PV source & dc PV output circuits.

~~(2) The disabled or disconnected equipment must be manually restarted.~~

~~(3) There is an annunciator that provides a visual indication that the circuit interrupter has operated. Indication shall not reset automatically.~~

Exception: DC output circuits installed in listed raceway or enclosed cable tray, or cables listed for direct buried, are permitted to be omitted from arc fault circuit protection.



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# 690.12 Rapid Shutdown of PV Systems on Buildings

PV system circuits installed on or in buildings shall include a rapid shutdown function that controls specific conductors of a PV system.

## A) Controlled Conductors:

1) PV & dc-to-dc converter output ckts

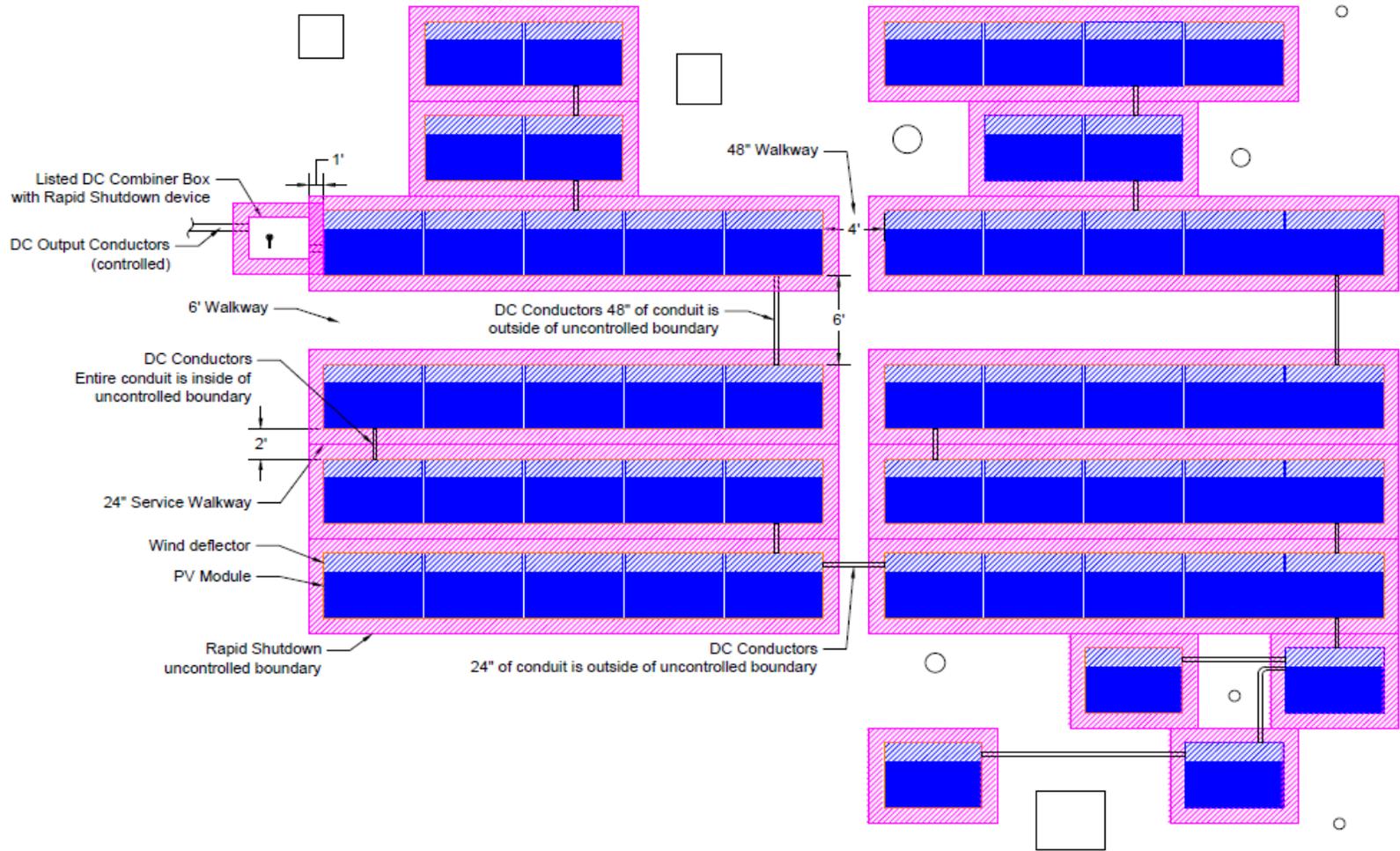
2) PV & dc-to-dc converter source circuit conductors more than 30 cm (1 ft) from the array in all directions, and more than 1 m (3 ft) from the point of entry inside a building.

Exception: PV and dc-to-dc converter source circuit conductors within 30 cm (1 ft) of a rapid shutdown device enclosure where a portion of the enclosure is located within 30 cm (1 ft) of the array.

(3) PV inverter output circuits



# Rapid Shutdown Boundaries



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# 690.12 Rapid Shutdown of PV Systems on Buildings

**Controlled Limits: <30V within 10s of initiation**

**Initiation:**

**1) Loss of Util Voltage- bldg disconnect initiates**

**2) Loss of Util Voltage- PV disconnect initiates**

**3) Readily accessible with indication (S-A)**

**Sign at Initiator for Rapid Shutdown Required**

**Equipment: RSD listed, Initiator not listed**

**Guarding: On or in building (not controlled) must be guarded.**

**Less than 2 ft above roof and behind modules is guarded.**

**Exception: Module interconnection conductors <5ft and limited to Single Module by RSD.**



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## 690.13 PV System Disconnecting Means

**Disconnect PV system from ALL other systems**

**Location: Readily Accessible but Permitted to be Remote from Point of Entry into Buildings (690.12)**

**Marking: Marked to ID it is Disconnect. Indicate OPEN OR CLOSED. Marked with warning if energized from both sides.**

**Suitable for Use: Not required as service equipment**

**Max Disconnects: Single PV disconnect for combined output of inverters or AC Modules**

**Interrupting Rating: Sufficient for maximums at terminals of the PV System disconnect**

**Grouping: Deleted but covered in main paragraph above**

**Type: Simultaneous disconnect from all conductors of other circuits and suitable for backfeed.**



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# 690.15 Disconnection of PV Equipment

The section has been rewritten to include:

Isolating Devices or Disconnecting Means as installed for

1. Location- Isolating devices required for all equipment from conductors not solidly grounded
2. Interrupt Rating- Isolating devices(not required) Disconnecting Means (required)
3. Isolating Device not required to simultaneously disconnect all current carrying conductors
4. Equipment Disconnecting Means disconnects all conductors not solidly grounded. Externally operable -no personnel expose

~~690.16 and 690.17 Deleted Fuse Servicing and list of disconnect types~~



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## 690.41(A) System Grounding

### (A) PV System Grounding Configurations.

#### One or more of the following employed:

- (1) Reference grounded 2-wire PV systems with one conductor referenced to ground.
- (2) Reference grounded bipolar PV systems with the reference (center tap) conductor referenced to ground
- (3) PV systems not isolated from the inverter output circuit.
- (4) Ungrounded PV systems
- (5) Solidly grounded PV systems as permitted in 690.41(B) Exception.
- (6) PV systems that use other methods that accomplish equivalent system protection in accordance with 250.4(A) with equipment listed and identified for the use.



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## 690.41(B) Ground-Fault Protection

DC PV arrays shall be provided with dc ground-fault protection:

*Exception: Ground-mounted or pole-mounted PV arrays with not more than two paralleled source circuits and isolated from buildings shall be permitted without GFP PV systems w/no GFP shall be solidly grounded.*

1)GFP Shall detect in current carrying conductors, interrupt in Ref Grd systems, isolate GF, indicate, be listed for PV GFP.

2)Isolate by disconnecting current-carrying wires or automatically disconnecting inverters / charge controllers



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## 690.47 Grounding Electrode System

A building or structure supporting a PV system shall have a grounding electrode system installed in accordance with Part III of Article 250.

The PV system equipment grounding conductor be connected to the grounding electrode conductor of the grounding electrode system for the building or structure supporting the PV system in addition to any other EGC requirements in 690.43(F).

For solidly grounded PV systems the grounded conductor shall be connected to a GES with a GEC sized in accordance with 250.166.



# 690.71, 690.72, 690.74(B)(3)



- Modernized the NEC to specify 50V nominal and removed the references of 2V cells at 48V nominal.
- Battery Systems > 50V required to have provisions to segment to 50V or less
- >50 V Battery Systems now requires to include ground fault detection and indication
- Remove the “~~Hard Service~~” listing requirement



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# 690.100 Large Scale PV Electric Supply Stations

- Accessible only to qualified personnel for maintenance/ops
- Access restricted (fencing or structure compliant with NEC)
- Dedicated connection to the Utility.
- Electrical loads limited to auxiliary equipment for the generation of the PV power.
- Large-scale PV electric supply stations not installed on buildings.
- Systems < 5MW ac are not Large-Scale
- Engineering Supervision. Designed and approved by a professional engineer competent in the specific area under supervision



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# Impacts for “Proposed” Changes for the 2017 NEC\*

- **More clarity for AHJs, Designers and Installers**
- **Better Organization for Requirements**
- **Improved Safety - First Responders - Rapid Shutdown**
- **Defined Requirements for How PV Systems were Really Grounded- (Reference Grounding)**
- **Improved Arc-fault & Ground-fault requirements**
- **Referred GES to the common locations in NEC**
- **Defined and allowed Engineering Supervision Design for Large Scale PV**





**Thank You!**  
**Solar ABCs – SEIA**  
**Photovoltaic Industry Members**

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