

The Roofing Industry Alliance for Progress





Roofing & Solar- The Future

Renewable Energy World magazine estimated commercial and residential roof top photovoltaic deployment after accounting for solar shading could total between 6 to 10 billion square meters in the United States.

Photovoltaics installed on this roof surface area could generate 25% to 40% of the current US power consumption.



Growth in U.S. Installations

- The U.S. added 342 megawatts (MW) of PV in 2008, including 292 MW of grid-tied capacity.
- For grid-tied PV, this represents an 81-percent growth rate over the 161 MW of grid-tied installations in 2007 and brings total installed grid-tied PV capacity in the U.S. to more than 1 gigawatt.
- This represented about 18,000 installations in 2008 vs 14,306 in 2007, both ground and roof mount systems.
- Installations grew especially fast in 6 states, including California, Hawaii, Maryland, North Carolina, Ohio, Oregon and Pennsylvania, where on-grid capacity additions more than doubled over 2007 figures.

Not All States Are Equal

Grid-Tied PV Capacity in the States (MW-dc)		
State	Installed in 2008	Cumulative
California*	178.6	530.1
New Jersey	22.5	70.2
Colorado	21.6	35.7
Nevada	14.9	34.2
Hawaii	11.3	15.8
New York	7.0	21.9
Arizona	6.4	25.3
Connecticut	5.3	8.8
Oregon	4.7	7.5
North Carolina	4.0	4.7
Others	15.3	36.4
TOTAL	292	791

Source: Larry Sherwood (IREC)

Solar markets remain fragmented, California represents 67% of the US market, followed by New Jersey.

Growth is driven by state and utility rebate programs + Federal Investment Tax Credit (ITC).

A total of 42 states and the District of Columbia now have net metering rules allowing owners of solar energy systems to sell excess electricity back to the grid.

Solar in states without good rebate or incentive programs will be slow to grow and may not make economic sense.



Codes – Solar – Roofing NEC

National Electrical Code (NEC) Article 690 “Solar Photovoltaic Systems”

Many of the PV systems in use and being installed today may not be in compliance with the *NEC* and other local codes.

contributing factors to this situation:

- The PV industry has a strong do-it-yourself and new contractor faction that is not fully aware of the dangers associated with low-voltage and high voltage, direct-current (dc) and alternating-current (ac) electrical power systems.
- Electricians and electrical inspectors have not had significant experience with direct-current portions of the Code or PV systems.
- The electrical equipment industries do not advertise or widely distribute equipment suitable for dc use that meets *NEC* “690”



Codes – Roofing - Solar



Codes – Solar – Roofing - UL

- UL 1703 is the benchmark standard for Photovoltaic modules
- UL 1741 is the standard for Inverters
- UL 4703 PV Cables Type PV: suitable for interconnection wiring of grounded and ungrounded photovoltaic power systems as described in section 690.31 (A) and other parts of the National Electrical Code (NEC), NFPA 70.
- For single conductor, double insulated wires installation without using a conduit is permitted according to section 690.35 (D) of the NEC.

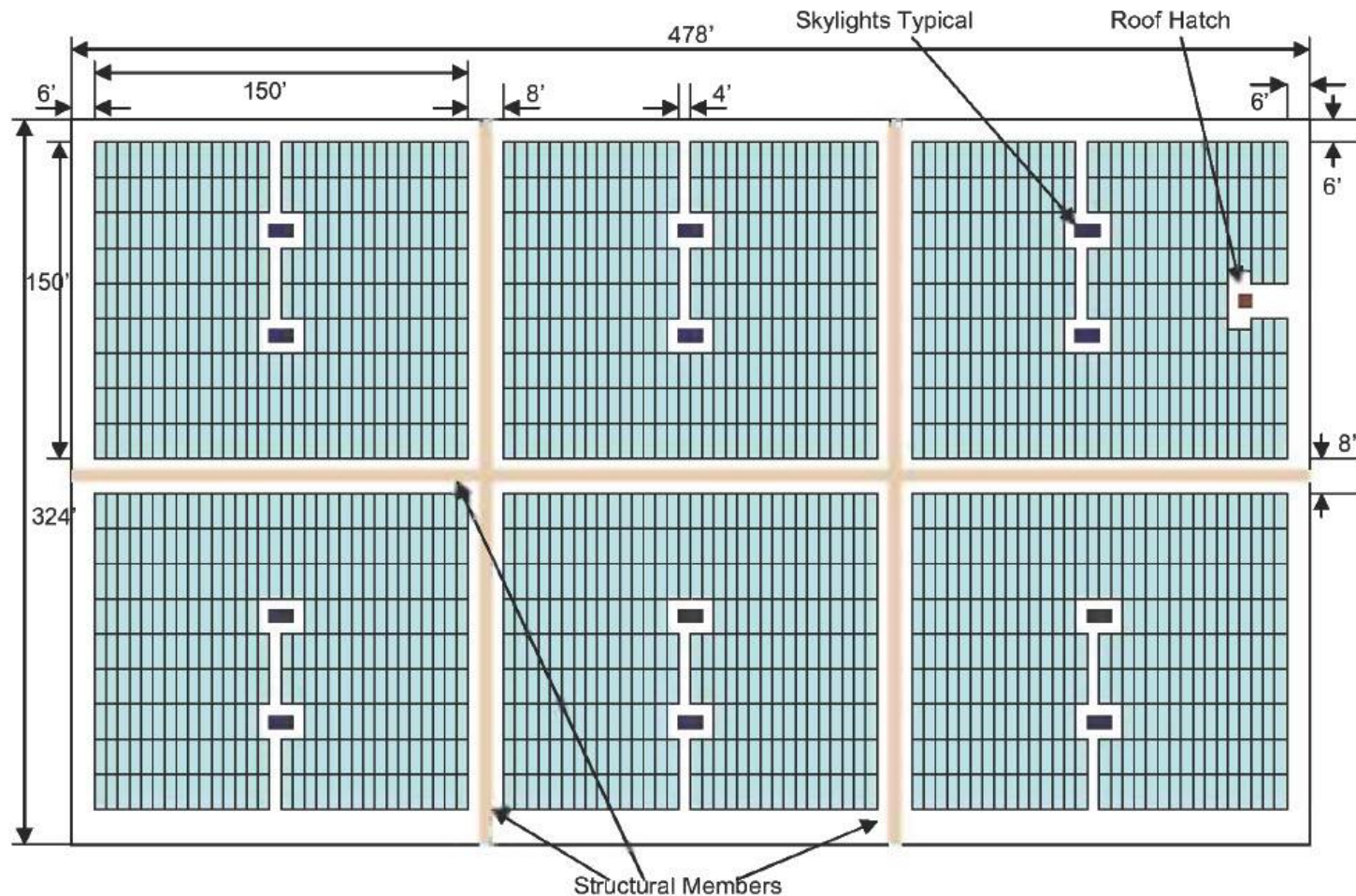


UL & Fire Codes

- As a result of catastrophic fires in California, State Fire Officials are preparing to implement a statewide requirement for Class A fire rating of all roofing products and have been considering requiring that all PV modules obtain Class A rating as well.
- To date, there are few Class A rated PV modules or BIPV products of all the several hundred listed modules. □
- At present, the effects of fire on UL 790 fire Class A rated roofing materials when Class B or Class C rated PV modules are present is not well understood.
- For instance will a Class B or C rated module reduce the fire resistance performance and/or fire rating of some Class A rated roof systems? If so, which roof systems are impacted and to what extent?

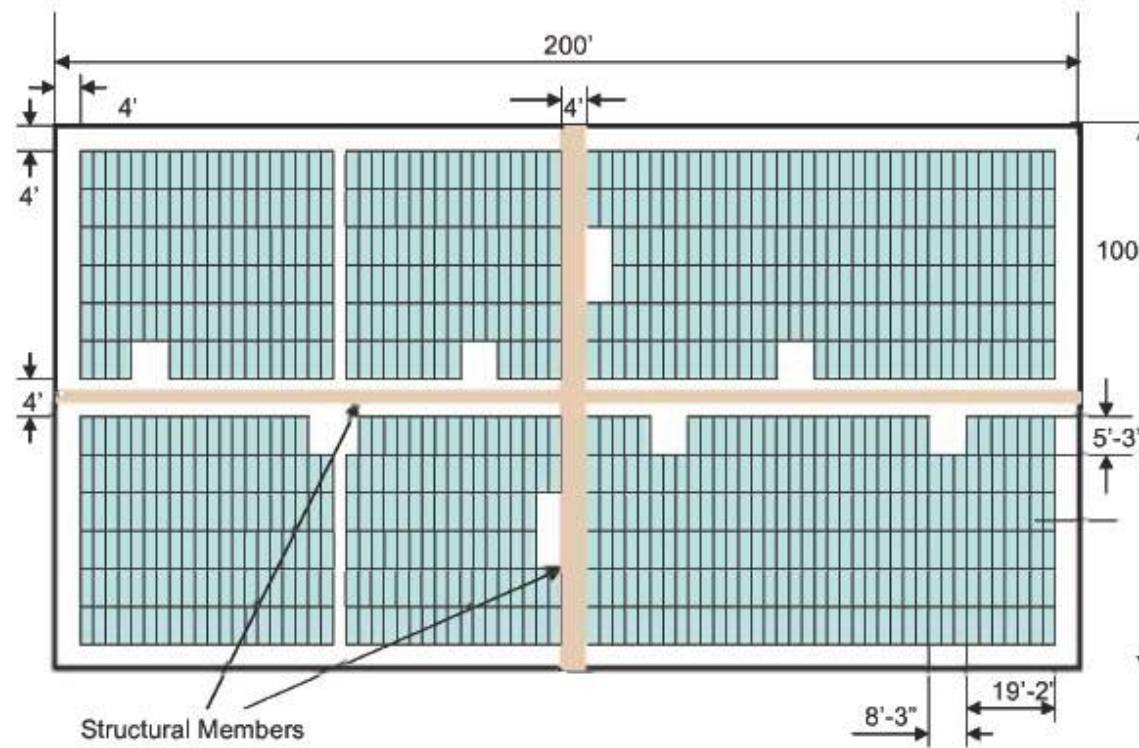
Roofs – Solar and Access

- Concerns about solar arrays on roofs and fireman access in California have reduced roof top solar installation area.

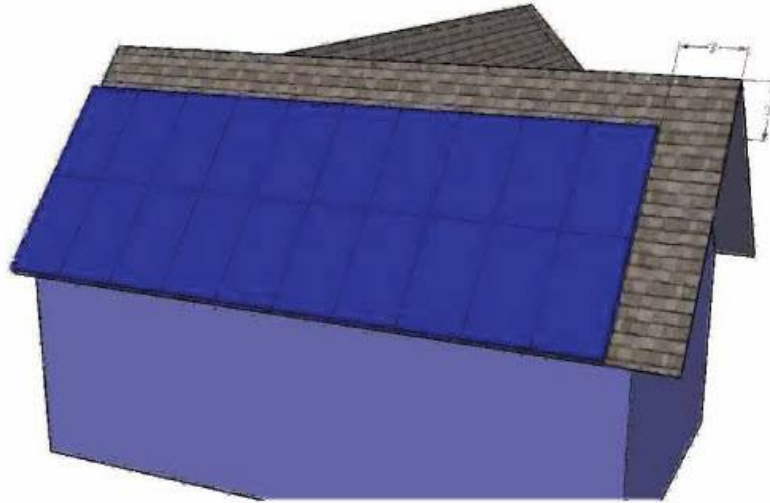


Roofs - Solar and Access

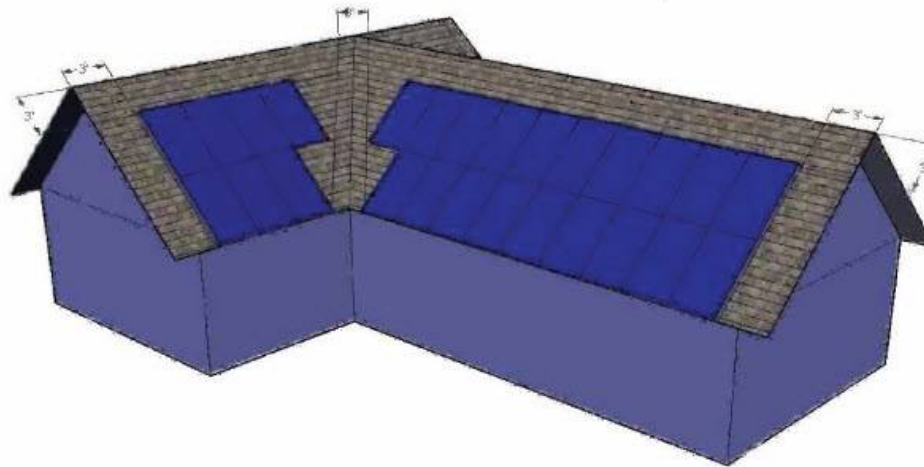
Example 8 Small Commercial (Axis < 250') – 4' Walkways
Venting Opportunities Every 20' Along Walkway



Solar Access – Residential



EXAMPLE 2 Cross Gable with Valley



http://www.ocfa.org/_uploads/pdf/PhotovoltaicGuideline.pdf



ASTM & Solar E-44

ASTM is starting to review and revise a wide range of Solar Standards.

- Two new Task Force for Standards
- [WK21327](#) the Installation of Roof Mounted Photovoltaic Arrays
- [WK22010](#) Solar Radiation Weathering of Photovoltaic Modules



Solar America Board of Codes and Standards (Solar ABCs)

- The Solar ABCs is created as a central body to address solar codes and standards issues. Its activities improve the responsiveness, effectiveness, and accessibility of solar codes and standards to U.S. PV stakeholders at all levels.
- The Solar ABCs identifies codes and standards related issues, present them to stakeholders, receives stakeholders' input and suggestions, encourages development of codes and standards, prepares and presents topical reports on these issues to DOE and other stakeholders.
- The Solar ABCs catalyzes appropriate activities to support the development of codes and standards that facilitate the installation of high quality, safe photovoltaic systems. In addition, it supports the new technologies, including those of the Solar America Initiative Technology Pathway Partnership (TTP) award winners.
- <http://www.solarabcs.org>



Solar Finance



Solar Finance: Types

- **Direct Purchase:** Owners purchase the photovoltaic system using internal cash flow and utilize the tax credits, state and local rebates, utility rebates and REC's or they can go to their existing lending/leasing institutions.
- **Finance lease:** This is like a bank loan, and the owner, the lessee is considered the owner of the equipment for both accounting and tax purposes.
- **Operating Lease:** The lessor is considered the owner for the tax credits, depreciations and rebates. The lessee is renting the roof / equipment and can write off the cost of the lease.
- **Tax-Exempt Lease:** These lease types can meet the needs of schools, universities, state and local governments. The public agency pays for the cost of the roof and photovoltaic from current utility cost. The lessor depending on the lease package structure takes the tax benefits and in some cases can have a tax-exempt package on the earned interest.
- **Power Purchase Agreement:** An outside investment group owns and operates the solar equipment and sometimes the roof. The building owner pays the solar array owner for the electricity produced by the solar array. The array owner in effect is a mini-utility company. The array owner may sell back surplus power by net metering to the local utility company



Solar Finance – Popular Methods

- Capital leases, power purchase agreements (PPA's) and bond options are very important for selling to state, local governments, school districts and other public agencies.
- With the commercial owner, it is important to explain the tax benefits, state, utility rebates, performance incentives and renewable energy credits to show the owner their real cost, plus monthly energy savings and payback period for their investment.
- Power purchase agreements are becoming very popular with large real estate and big box owners. In 2008 73% of all California non-residential installations were PPA's.
- Permanent PV systems or re-deployable PV systems?



Stimulus Package Cash Grant

- Grants will be available, instead of a tax credit, for offsetting 30 percent of the cost of installing a solar energy system at a business. Large-scale solar plants, often developed to sell power to utilities, also are eligible.
- This applies only to systems that are installed in 2009 and 2010. Projects that began before the end of 2010 and put in service by Jan. 1, 2017 also qualify.
- The U.S. Department of Treasury will still need to work out the details of the program.[The cash provision does not apply to home installations.]



RPS – Mandated Requirements

- Renewable Portfolio Standards (RPS), also referred to as Renewable Electricity Standards (RES), puts a requirement on retail electricity providers to supply a minimum percentage of their electricity from renewable sources, such as solar, wind and geothermal.
- Approximately half the states have mandatory RPS programs and of those states, approximately a dozen have solar-specific designs (either a solar carve out or a multiplier).
- National RPS is expected within the year.



- **Performance Based Design**



Performance Based Design

- Many State rebate and incentive programs are now performance based.
- Solar output must perform within 10% +/- of system design.
- Failure to perform can mean reduce rebate program payments or having to add additional modules at the contractors expense.
- Can be very costly.



Critical Design Elements

- The building's orientation, solar shadowing and solar insolation are important design elements used to determine what type of PV system can be used, how big of a photovoltaic system can be installed on the roof.
- Determining the location of shadows from roof top equipment, parapet walls, trees and building throughout the entire year and the day is one of the most important design consideration for locating the solar array.



String Array Design

- String arrays average 2-25 modules.
- String array power balanced to inverter power input and current requirements.
- String array design must meet NEC 690 code requirements for voltage, current wire size, grounding, surge protection, combiners and disconnects.
- Array cables must be UL rated for exterior exposure with locking connections.
- Modules must be UL 1703 certified.
- Use same module brand and STC ratings
- Mismatched modules (brand/STC) and shaded strings split into separate arrays and inverters.



Inverter Design Considerations

- Inverter must be UL 1741 certified.
- Inverter should be located as close as possible to array string to reduce main DC cable length (power loss).
- Small array < 30-KW or more inverter matched to string array power input.
- Array > 30-KW go to larger central inverter matched to string array power input.
- Calculate array power production for both high and “low” site temperatures. Low module temperature = higher power output. Do not exceed inverter’s manufacturer’s and NEC input requirements.
- Locate inverter in cool-shaded area.
- Inverters are heavy and make noise, choose placement wisely.

DC-to-AC Not The Same

Derate Factors for AC Power Rating at STC

Component Derate Factors	PWATTS Default	Range
PV module nameplate DC rating	0.95	0.80 - 1.05
Inverter and Transformer	0.92	0.88 - 0.96
Mismatch	0.98	0.97 - 0.995
Diodes and connections	0.995	0.99 - 0.997
DC wiring	0.98	0.97 - 0.99
AC wiring	0.99	0.98 - 0.993
Soiling	0.95	0.30 - 0.995
System availability	0.98	0.00 - 0.995
Shading	1.00	0.00 - 1.00
Sun-tracking	1.00	0.95 - 1.00
Age	1.00	0.70 - 1.00
Overall DC-to-AC derate factor	0.77	

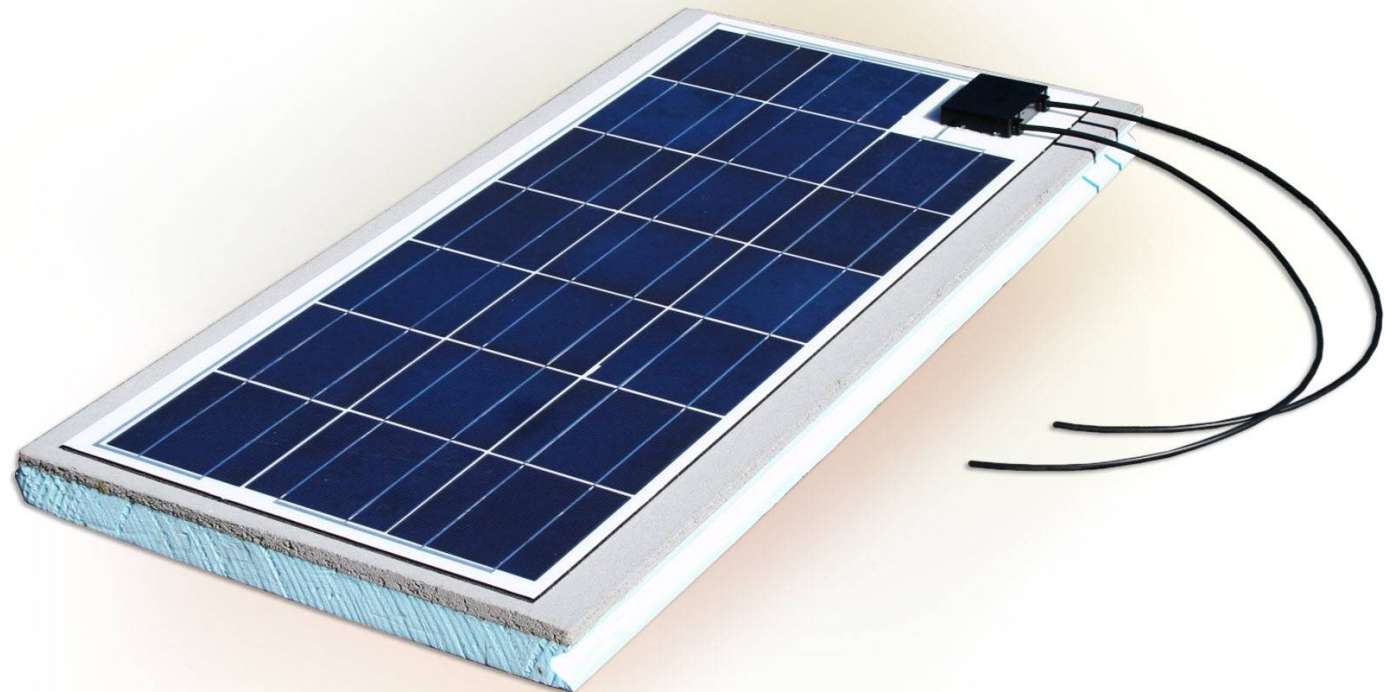


- **Other New Solar Products**

New Solar Products

T.Clear Solar LightGuard Panel
based on SolarSeal Technologies

Solar Protected Roof Membrane System



SolarSeal Fan-Fold



SolarSeal Off-Set Fan-Fold System patents pending

SolarSeal Fan-Fold





Thank you.

Michael Gumm, principal and founder at

Corporate Roof Consultants

www.corporateroof.com

SolarPower Restoration Systems, Inc.

www.solarpower-restoration.com

SunPods, Inc.

www.sunpods.com