Roof Coatings & Solar Roofs
New Opportunities
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- US Solar Market
- Solar Technologies
- New Building Codes & Standards
- Roof Replacement & Solar
- Elastomeric Roof Coatings & Solar
- Solving Technical Roof & Solar Performance Issues with Elastomeric Coatings
The US Solar Market
Solar Installation Growth 2005 - 2014

As Industry Scales, Prices Fall

Figure 1.1 Annual U.S. Solar PV Installations, 2000-2014
Solar Job Growth

1. California
2. New Jersey
3. New York
4. Massachusetts
5. North Carolina
6. Arizona
7. Nevada
8. Connecticut
9. Texas
10. Florida
Solar Technology
Types of Solar

- Polycrystalline – Monocrystalline cSi
  - 15% to 22% Efficiency
  - Weight 3 to 5 lbs. SF
  - Requires racks or rails to install
  - Hundreds of manufacturers

- Thin Film PV - CIGS Technology
  - 10 to 17% Efficiency 24% Possible
  - Weight less than 0.7 lbs. SF
  - Peel-n-Stick – No racking - No rails
  - Miasole
  - Global Solar
  - Solopower
Ballasted Racking - Crystalline

Pros

• No penetrations
• Lower labor cost than attached
• Faster installation than attached

Cons

• Dead load limitations
• Wind zone limitations
• Seismic limitations
• Slope limitations
• Solar angle limitations
Attached Racking - Crystalline

Pros

• Lower dead loading than ballast
• Better for high wind zones
• Higher solar angle settings
• Required for sloped roofs

Cons

• Many roof penetrations
• Highest labor cost
• Higher maintenance cost
• More parts and pieces
Building Integrated BIPV Modules

Pros

- Peel-n-Stick – No racks – No rails
- Best for high wind zones
- Best for seismic zones
- Lowest labor cost
- Lowest weight

Cons

- Lower power output
- Higher operating temperatures
- Permanent attachment
• Most roofs have an effective performance and service life of less than 25 years
• Most solar installations require a minimum of 25 years to make financial sense.
• While new roofs can be designed for 25 to 30 year systems – what about existing roofs already 5 years or even 10 years old?
Factors Affecting Roof Service Life Performance

- **Early Generation Membranes**: Some roof materials have not perform as expected, for example earlier generation TPO and some PVC roof systems.
- **Workmanship**: Contractor workmanship can be a contributing factor.
- **Bad Design**: Poor roof design or the wrong roof system choice for the location.
- **Limited Roof Budgets**: The roofing industry knows how to build a 30-year roof, if the owner is willing to pay for the additional cost.
- **Maintenance**: Lack of maintenance or neglect by building owners, who assume a new 25-year warranted roof will last that long without any effort, out of sight, out of mind.
- **Cheap Roofs**: Some inexpensive roof systems may simply have a shorter service life, for example, a 2-ply basic asphalt cap and base sheet or 45-mil TPO.
Rack Mounted Solar Impact on Roofing
Ballasted Rack Mounted Solar Impact on Roofing

- **Foot Traffic & Material Stockpiling**: Exposes the roof to heavy foot traffic as the roof becomes the work surface during the solar array construction.

- **Drainage**: Ballasted solar arrays with paver ballast can alter or block roof water drainage flow patterns to drains and scuppers.

- **Membrane Wear**: Increased membrane surface wear. The ballasted array PV systems can be abrasive to the membrane surface from shifting and movement caused by different forces such as wind and thermal cycling.

- **Point Loading**: Ballasted solar arrays heavier weight loading points can increase deck deflection between structural supports, creating new roof ponding areas or expand existing roof ponding areas and adding stress to the roof system.
Attached Rack Mounted Solar Impact on Roofing

- **Multiple Roof Penetrations:** Mechanically attached racks systems increase the number of roof top penetrations. On built up and modified bitumen roofs, more pitch pockets. On single-ply roofs, more boot flashings. Penetrations increases the possibility of future roof leaks if the penetrations are not properly installed and maintained.

- **UV Damage:** An array’s bright metal frame surfaces of aluminum and steel and the reflective glare from solar glass panels can concentrate, focus and increase UV and heat exposure to the roof membrane. Higher UV and heat exposure accelerates the membrane aging process, creating the need for more frequent repairs and premature roof replacement.

- **Surface Wear:** The solar array installation work and increased maintenance traffic can accelerate granule erosion on granule surface modified bitumen membranes and standard cap sheet system.
Impact of BIPV Solar on Roofs

Grand Valley State University displaying Uni-Solar Thin Film Solar Cells
Thin Film- Building Applied Photovoltaics Impact on Roofing

Newer flexible thin film solar modules pose a different set of roof top challenges compared to conventional rack mounted crystalline solar panels.

• **Heat:** Flexible thin film PV panels when bonded with an adhesive to the roof membrane surface can heat the roof surface to 160-degrees in the summer sun. Higher heat loading and wider thermal cycles on the roof can cause accelerated heat ageing to many roof membrane types, drastically reducing the roof service life.

• **Bonding:** Flexible PV thin film modules bond directly onto the roof membrane surface. The roof had better last as long as the projected 25-year PV panel service life. The bonded solar panels are nearly impossible to de-bond from the roof membrane surface without damaging the solar panels.
New Building Codes & Standards
New Codes and Standards

FM Global
Property Loss Prevention Data Sheets 1-15
July 2014
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ROOF MOUNTED SOLAR PHOTOVOLTAIC PANELS

Approval Standard for
Flexible Photovoltaic Modules
Class Number 4476

Approval Standard for
Rigid Photovoltaic Modules
Class Number 4478
New Codes and Standards

ACCEPTANCE CRITERIA FOR BUILDING-INTEGRATED PHOTOVOLTAIC (BIPV) ROOF COVERING SYSTEMS

AC365

Approved June 2015

Miami-Dade County
High Velocity Hurricane Zone (HVIHZ)
Solar Systems
Electronic Permit Application
Codes & Standards - California

STRUCTURAL SEISMIC REQUIREMENTS
AND COMMENTARY
FOR
ROOFTOP SOLAR
PHOTOVOLTAIC SYSTEMS

WIND LOADS ON LOW PROFILE SOLAR
PHOTOVOLTAIC SYSTEMS ON FLAT ROOFS
Code & Standards Impact on Solar Roofs

• **Fire Ratings:** New code requirements require modules and roof assembly to have same fire rating.

• **Wind Uplift:** New wind uplift requirements – additional ballast, roof type – mechanical or fastened fully adhered depending on installation type.

• **Seismic:** Rack attachment/ballast limitations depending on seismic zones

• **Hail:** Zone limitations on type of modules.

• **Weight Limitations:** Increase or decrease in dead loading.

• **Array Placement:** Fire codes require setbacks, open paths, smoke & heat venting and labels.

• **Roof assembly components:** New requirements for different application methods.
Roof Replacement for Roof Top Solar
Roof Replacement for Rack Mounted Solar

- Roof replacement cost on a solar array roof is significantly higher compared to a standard re-roof. During re-roofing solar power production is shut down resulting in revenue losses for PPA and lease financed projects and increased energy cost for the building owner.

- On rack-mounted solar, one must factor the cost to disassemble the solar array, create an inventory list with a re-assembly plan, remove the solar array components and solar panels from the roof, and stockpile in a secure area. Cost can be 2 or 3 times the original solar installation cost.
• BIPV Solar may require a secondary membrane panel to allow removal and re-installations

• Roof membrane manufacturer’s may require thicker membranes – more expensive roof assemblies – for example a layer of Densdeck or fully adhered roof systems or more slip sheets.
Elastomeric roof coatings are a simple and economic solution to increase an existing roof service life. Modern roof coatings create a new durable and weatherproof roof surface and provide an economical solution to the placing solar on existing roofs.

There are certain instants where applying an elastomeric coating can provide additional benefits to a new roof system.
Solar & Existing Roof Challenges

Installing a new solar array over any existing low slope roof system means in nearly every case, the current roof system will wear out long before the solar array stops producing energy.

- If the existing roof is less than 10-years old and good shape and not leaking. An owner may find it difficult to justify the high upfront cost of a new roof prior to installing the new solar array. One must factor in the higher future cost of a new roof and include this cost when calculating the CPW and ROI on the solar system. This additional cost may make the cost of solar unattractive to the owner or the solar financing source.

- If the roof is more than 10-years old and in fair shape. The cost of an installing complete new roof system, especially if a tear-off is involved, may make the cost of the solar array unattractive. Installing a solar array over an older roof makes it harder to finance the solar array or to maintain the existing roof warranty.
Matching Roof and Solar Service Life with Elastomeric Roof Coatings

• Prior to installing a new solar array on an existing roof. Applying a new high performance elastomeric roof coating system can extend the performance life of the existing roof for another 10-to–20 years depending on the coating type and application.
• In many cases, the roof coating system can be re-coated again once the first roof coating warranty period is up.
• The elastomeric roof coating synchronizes the roof service life with the solar power production life, without re-roofing.
• Roof coatings can be applied to existing roofs with an existing solar array.
Solving Technical Roof & Solar Performance Issues with Elastomeric Coatings

Elastomeric Coating Advantages

Applying an elastomeric or liquid applied roof coating systems on roofs prior to or even after the solar installation can solve a number of technical roof and solar array problems.

• Increased roof service life.
• New extended roof system warranty
• Recoating the first roof coat can extend the roof life and match the array service life.
• Improve and match roof and solar fire rating to meet new code requirements
• Increase membrane thickness to resist increased roof foot traffic.
• Additional coating solar reflectivity can help increase power output.
• Coatings can reduce seam repairs and lower maintenance cost.
• Coatings can reduce heat loading and other environmental stress.
Coatings and Rack Mounted Systems

- Coatings can reduce roof surface abrasion and wear on ballasted rack systems.
- Coatings can increase surface friction of ballasted rack systems in seismic regions.
- Coating can increase roof and solar fire ratings.
- On modified bitumen roofs – coatings can reduce or stop granule erosion.
- On modified bitumen roofs – three course seams with coating and fabric can reduce seam failure and allow placement of the array over seams.
- The increase indirect reflective light from the bright white coated roof surface, curbs and parapets can increase the electrically power production of the solar panels.
Coatings and Thin Film Flexible Modules (BIPV)

- Coatings reduce the heat aging impact of dark solar panels on the roof membrane by sealing the roof membrane from external environmental roof top conditions.
- On modified bitumen roof coating provides a smooth surface to bond the solar panels without risking granule bonding failure.
- On modified bitumen roofs, coating forms a protective barrier preventing volatile oils in the asphalt from causing adhesive failure and the solar panel de-bonding.
- On PVC roofs, coatings prevent plasticizer loss from module’s butyl based adhesives
- Coatings can increase the membrane thickness on shorter life cycle membranes such as 45-mil TPO or PVC
- Some coating can be an adhesive and sealant – bonding the module to the coating.
Financial Benefits – Elastomeric Coatings & Solar

• Elastomeric roof coatings provide an economical benefit by increasing the existing roof service life and synchronizing the roof asset life with the solar-array power production life.

• Roof coating systems are less expensive compared to replacing the roof with a new roof system.

• Applying a roof coating to an existing roof with an existing rack mounted solar array is less disruptive and may not require a system shut down to the power production of the solar array. Reducing revenue loss for a PPA or leased solar roof.

• White reflective roof coating cost and solar might qualify for the PTC 1603 tax credit. The PTC is a tax credit worth 30% of the cost of the roof coating and the solar cost.

• Some states and cities offer energy efficiency rebates in addition to solar array rebates.
The Roof Types – Solar + Coatings

• Most solar will be placed over existing roofs and could benefit from a roof coating.
• Modified Bitumen – New and Existing MB should require a coating for long term performance
• Thinner 45-mil and 60-mil TPO and EPDM should require a coating
• All PVC roofs and flexible thin film modules require a coating
• Concrete roofs should require a coating
• Cap sheet & smooth surface BUR should require a coating
• Exposed fastener corrugated metal roofs should require a coating
Questions:

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