

Capturing the Thin-film Advantage

Presented by Steve Heckeroth,
BIPV Consultant

Solar Forum

November 20, 2003

Advantages of Roll to Roll Vapor Deposition on Flexible Substrate

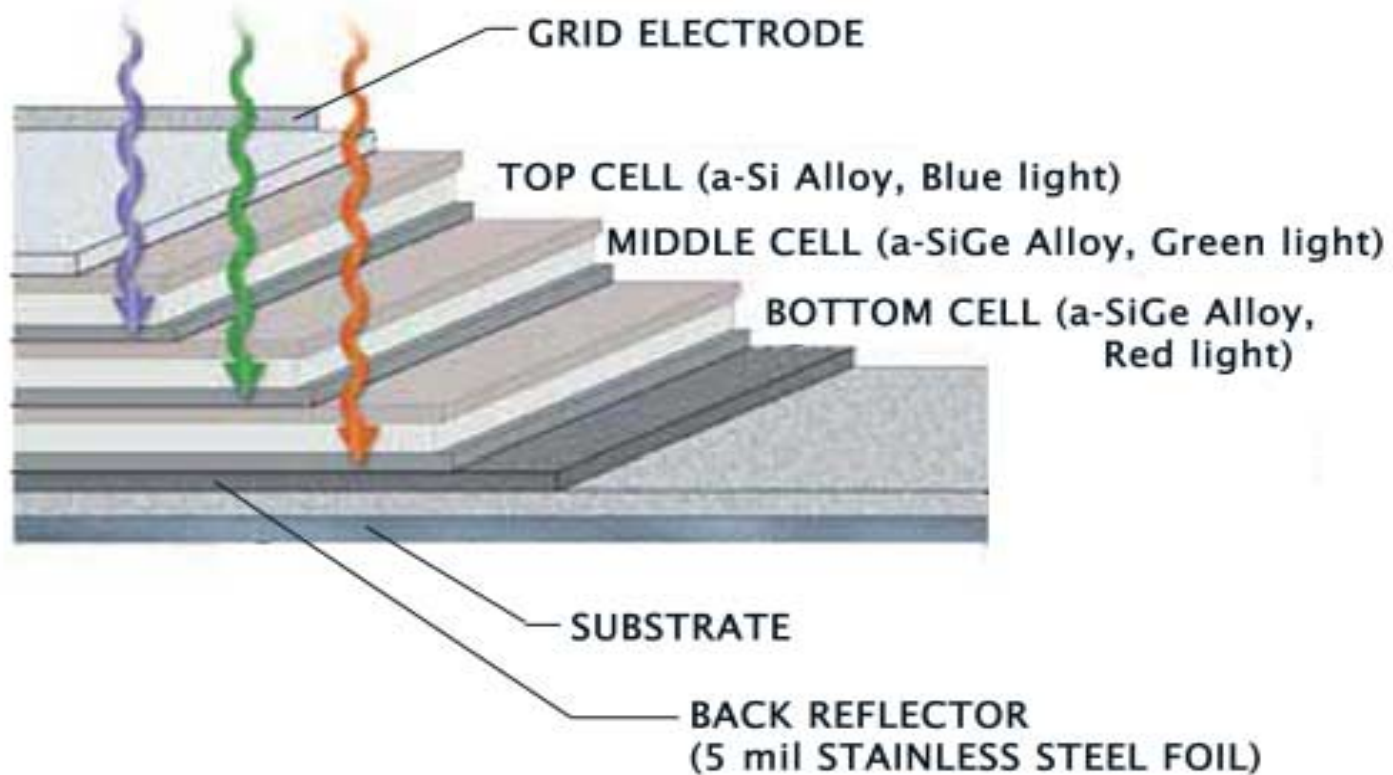
- Potential cost reduction with high-volume manufacturing process.
- Durable, shatterproof, lightweight and flexible.
- Easily integrated with roofing material.
- Superior full spectrum performance in high heat and low light conditions.
- Low embodied energy

Triple Junction Full Spectrum Performance

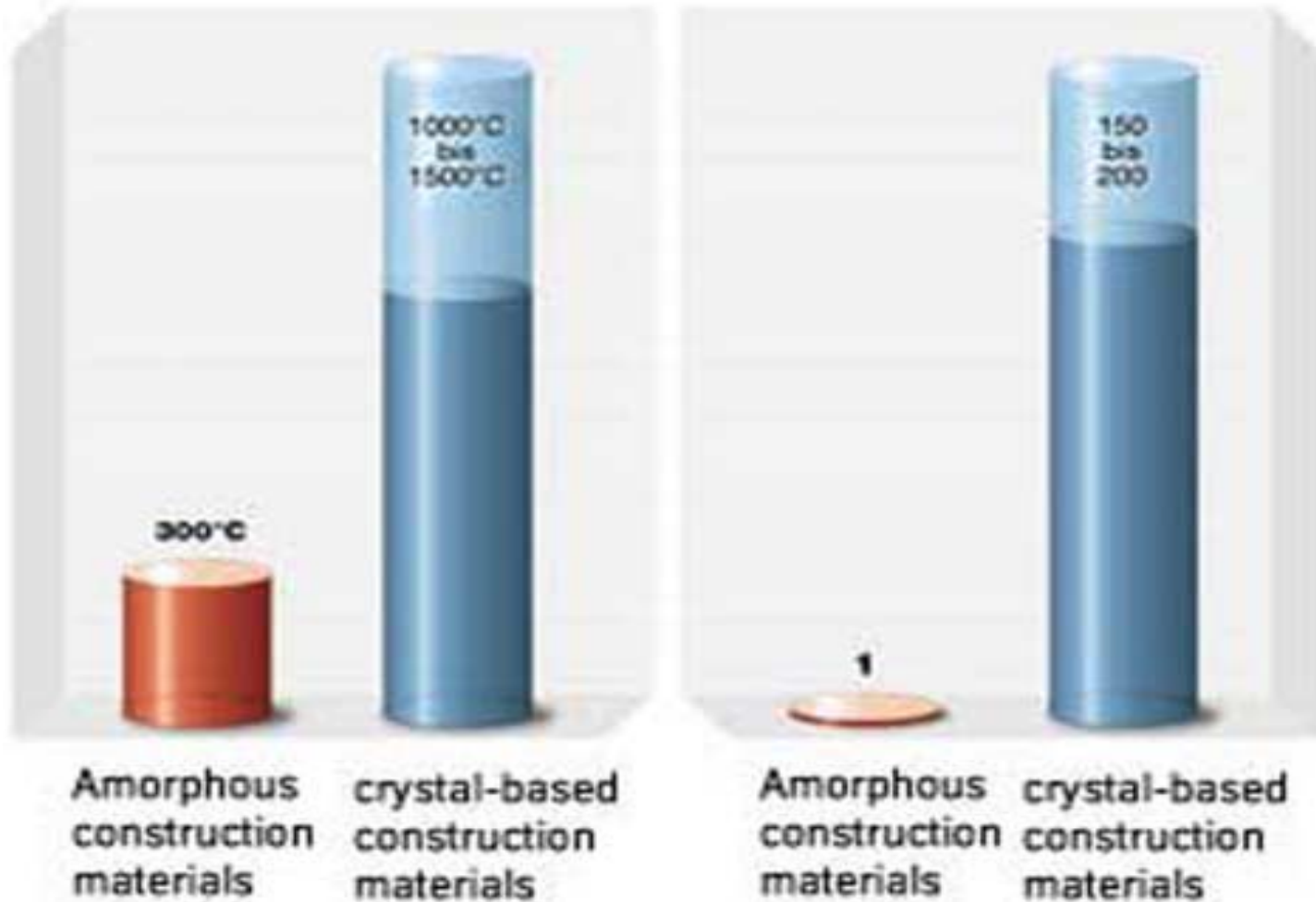
LIGHT WAVELENGTH

SHORT

LONG



Low Embodied Energy



Building Applied Photovoltaic Modules

- Glass modules can break
- High cost per sq. ft.
- Racks are expensive
- Electrical cables & conduit are exposed
- Modules detract from building's appearance
- Modules add excess weight to roof
- Roof penetrations required



2kW Crystalline

Building Integrated Photovoltaic Roofing

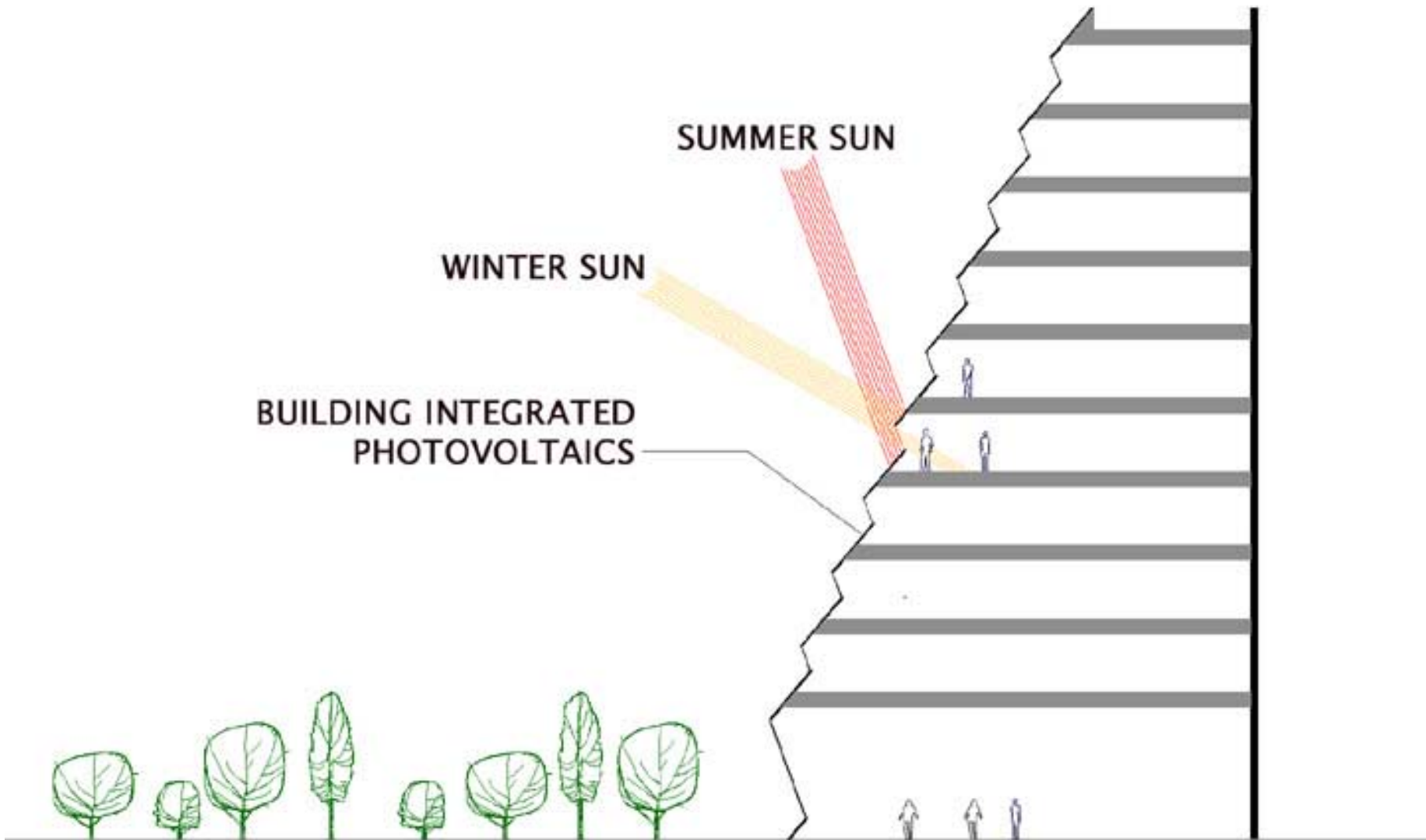
- Laminates are unbreakable and vandal resistant
- Lower cost per square foot
- Avoids the expense of racks
- Easy to install
- No roof penetrations
- Lightweight
- Laminates are aesthetically superior
- Quick connects protected by head flashing or ridge cap



2 kW UNI-SOLAR PVR

Architecturally Integrated Photovoltaics

Modifying a building's skin to increase performance



Architecturally Integrated Photovoltaics

Proposal for 130 kW Shade Structure



Architecturally Integrated Photovoltaics



Existing handrail



Rendering for
Moscone RFP
Mimicking
architectural
motifs with
flexible thin-
film on barrel
vaulted roofs 9

Enhanced Aesthetics with Uni-Solar Thin-Film

Exposed air handlers on
roof of Moscone Center



Rendering for
Moscone RFP
showing thin-film
laminates on
barrel vaulted
roof

2 kW Factory Bonded on Standing Seam Metal Roofing 1994



2 kW Factory Bonded on Standing Seam Metal Roofing 1996



3 kW Factory Bonded Standing Seam Metal Roof 1999



30 kW Parking Shade Structure 1999

Application for factory bonded laminates



Mid-Roof Termination Strategy

10 kW Installation 2000



Field Bonding to Standing Seam Metal Roofing



5.6 kW of Field Bonded Laminates 2001



3.8 kW Field Bonded Laminates 2002



Using Laminates as a Roofing Material

Developed through PIER program



Overlapping Clamping Batten System



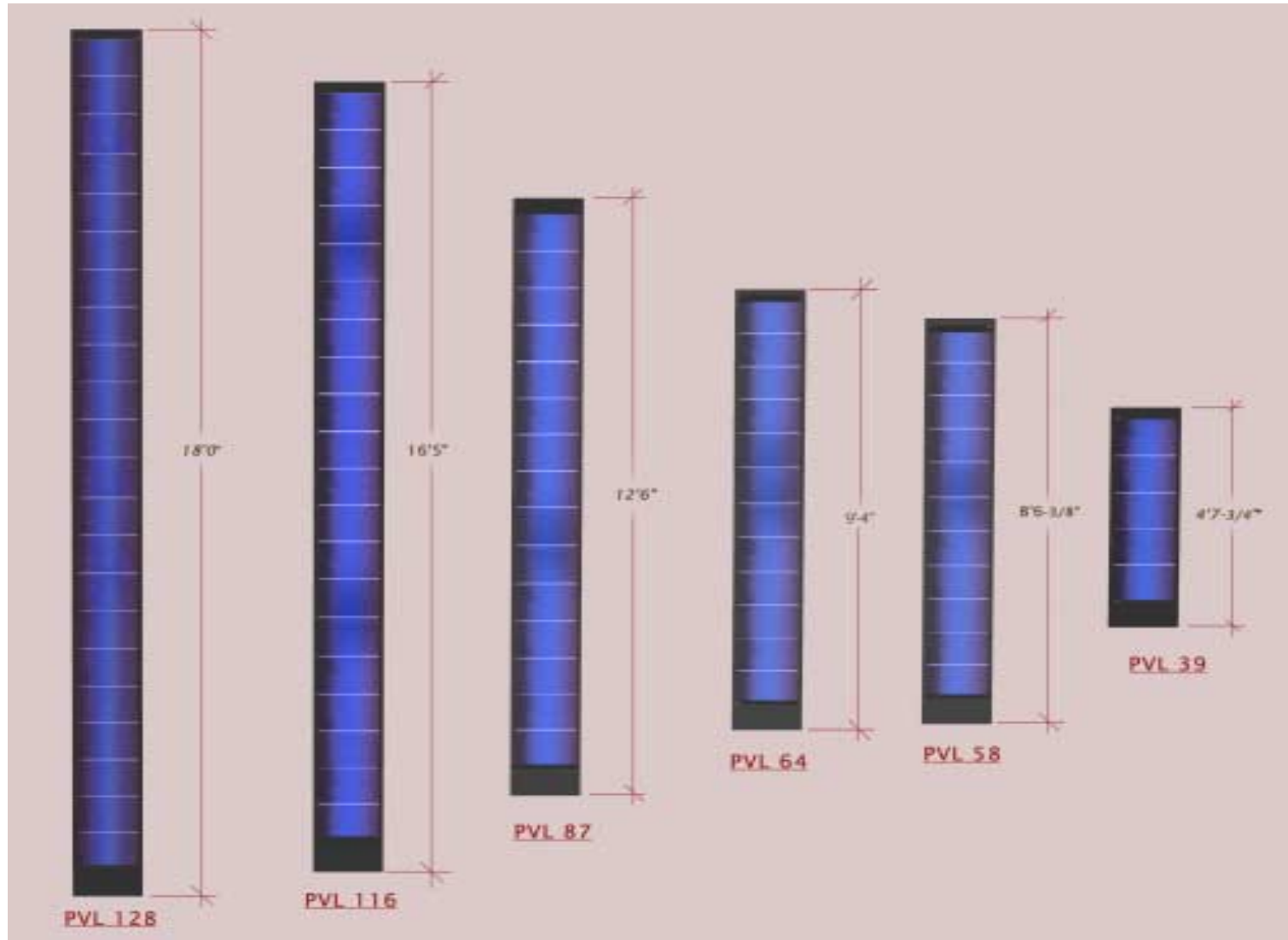
Clamping Batten Installation on Roof Deck 2003



2 kW Full Roof Clamping Batten Solution



New Laminate Lengths



Solar Integrated Technologies (SIT)

Uni-Solar flexible thin-film integrated with single-ply membrane



Low-Cost Transport

up to 100 kW on one truck



Low-Cost Installation

Installs just like single-ply membrane



Lowest Cost per Watt & sq.ft.

synergy with dual function



Contact Information:

Steve Heckeroth

BIPV Consultant

Tel: 707 937-4536

Fax: 707 937-0338

Cell: 916 549-2233

Steve@renewables.com