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For Life and the Earth

SANYO

HIT® Double Photovoltaic Panels

Solar Power 2007

SANYO Energy (USA) Corporation
Solar Division

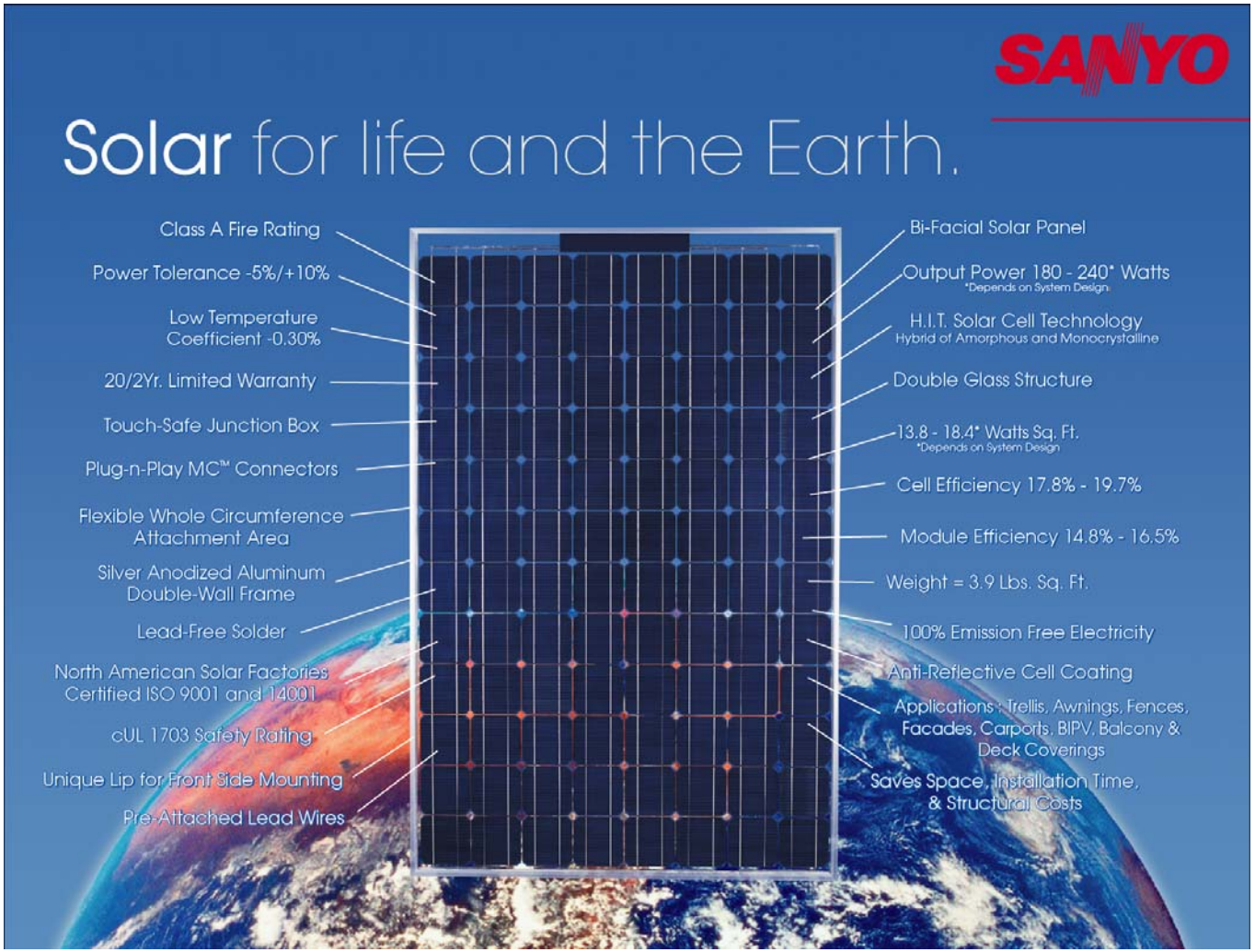
CRM Team

September, 2007

HIT® Double Bifacial Solar Panels

In addition to HIT solar panels, SANYO offers *HIT Double* solar panels.

HIT Double panels include all the HIT features + MORE…



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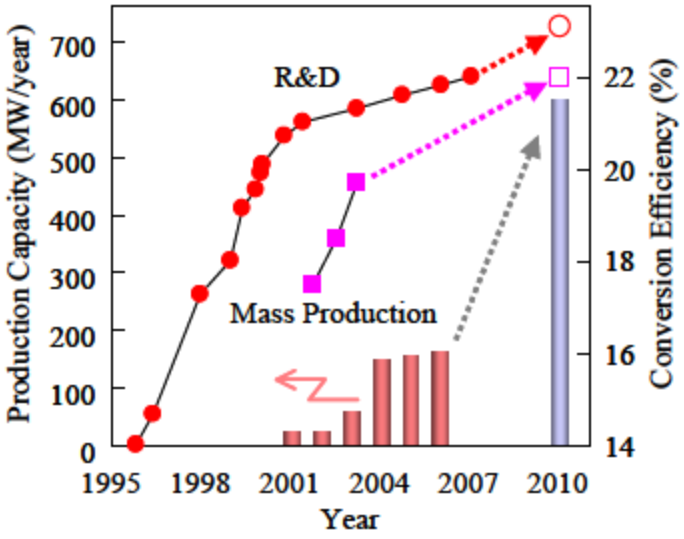
HIT® Bifacial Solar Cells

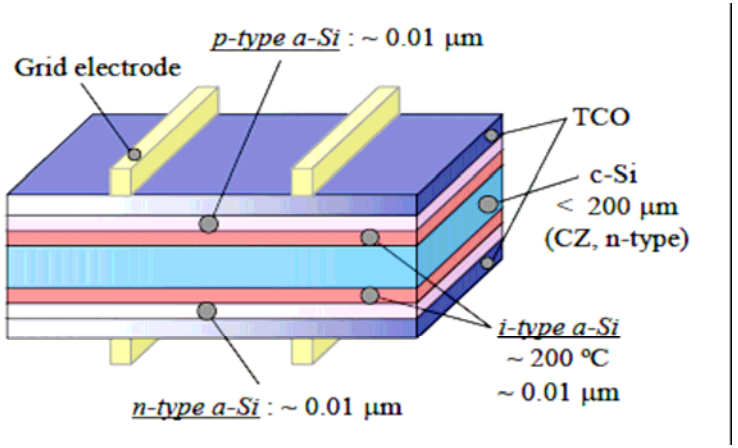
HIT® bifacial solar cells have an amorphous silicon layer on top and bottom of the cell with a single crystalline layer in the middle.

The multi-layered cells convert sunlight to electricity from both sides… simultaneously.

Progress of HIT Solar Cells toward 23% Cell Efficiency



Cross Section of HIT® Bifacial Solar Cell



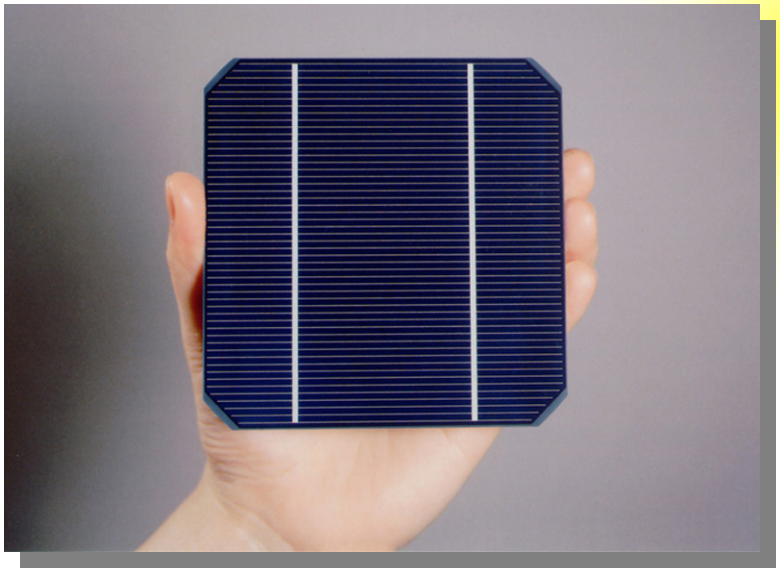
HIT® Double = Higher Efficiency

SANYO HIT vs. HIT Double

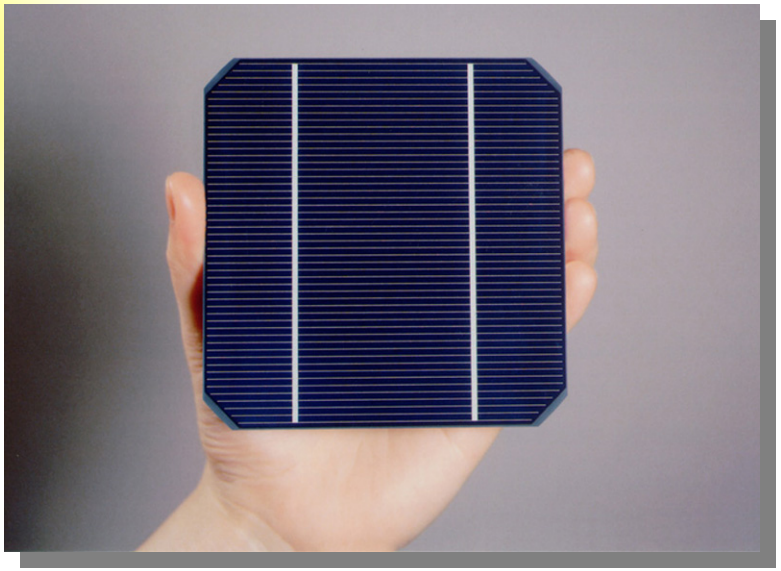
SANYO HIT® solar cells achieve up to *20.2%* cell efficiency in mass production.

SANYO HIT® Double solar cells achieve up to *24.2%* cell efficiency in mass production, *when* backside effect is 20%.

HIT



HIT Double



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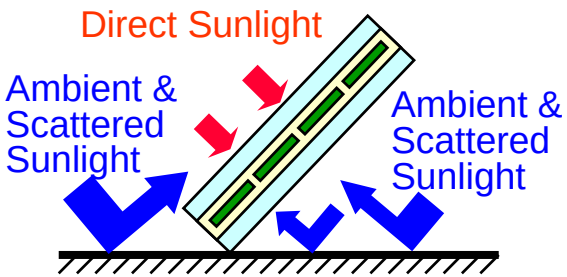
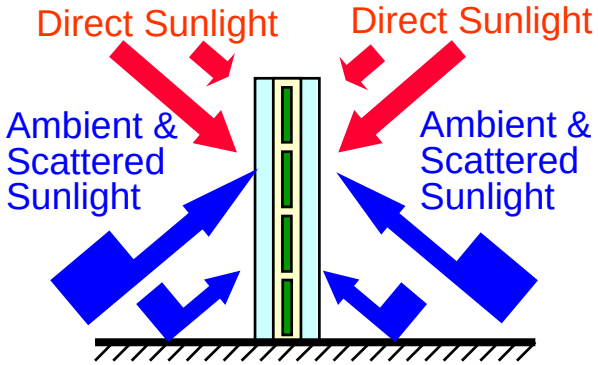
HIT® Double = Power from Two Sides

HIT® bifacial solar panels capture additional ambient or scattered sunlight to produce more power at any angle and any direction.

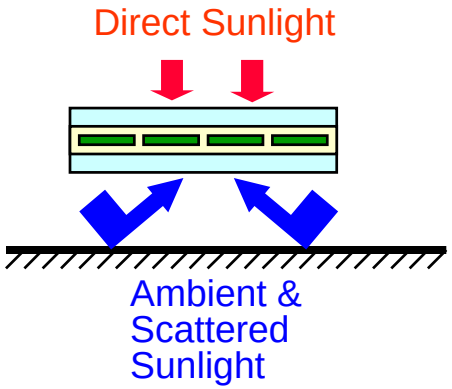
Slanted



Vertical



Horizontal



A key feature of HIT Double panels is their ability to open up new solar system design applications, possibilities, and styles including…

HIT® Double Application Possibilities

Residential Applications that Maximize Power

Residential

- Carports
- Trellises
- Fences
- Porch & Deck Coverings
- Awnings

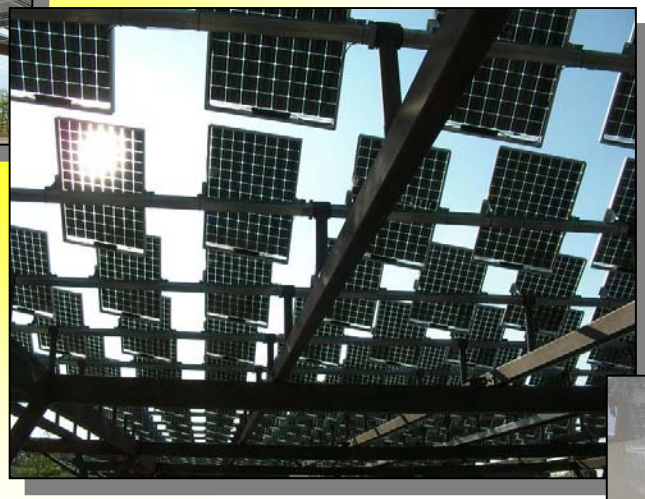
HIT® Double Application Possibilities

New Commercial Applications

Photo Rendering

Commercial
- Facades
- Siding
- Carports
- Awnings
- BIPV
- Fences

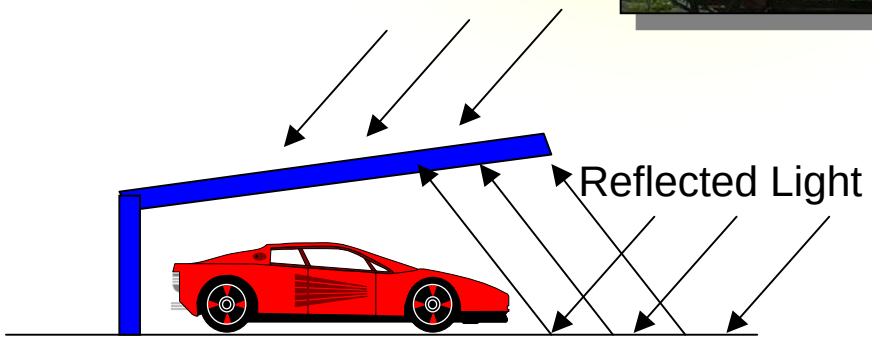
HIT® Double Application Possibilities



Carports

(Effective Use of Reflected Sunlight)

Site: Las Vegas Springs Preserve
Photo Courtesy of SunPower Corp.



Shade for parked cars & more power

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HIT® Double Application Possibilities

Photo Courtesy of Namaste Solar Electric

Coverings for

Decks

Porches

Balconies

Walkways

Photo Courtesy of 4th Day Energy

Photo Courtesy of Namaste Solar Electric

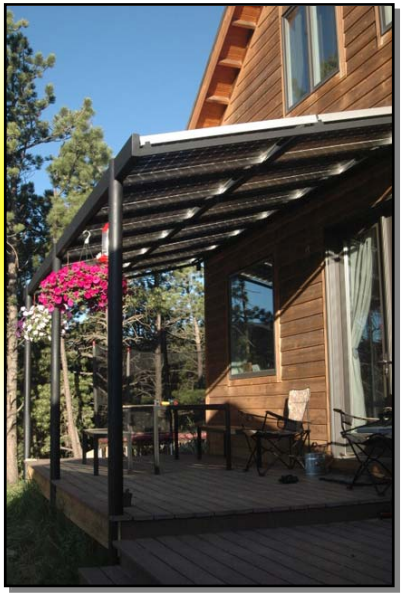

Photo Courtesy of Topher Donahu & Lighthouse Solar

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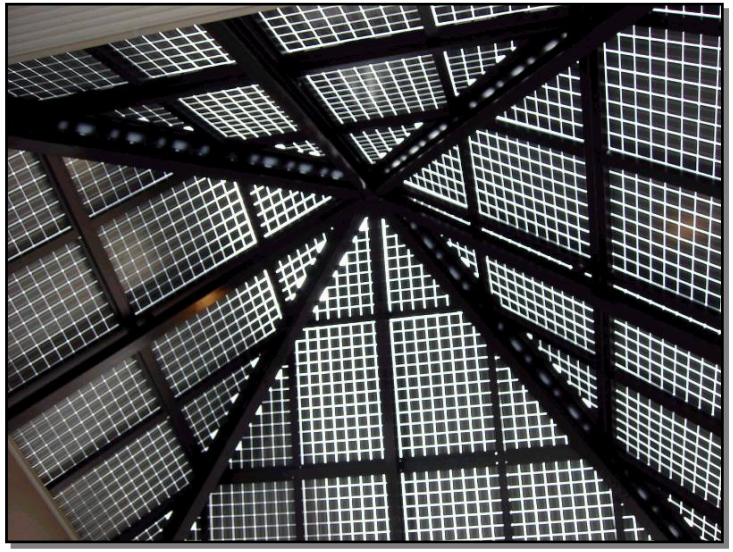
HIT® Double Application Possibilities

HIT Double for…

Bus & Train Shelters

Photos Courtesy of SANYO Electric Co., Ltd.



Architectural Applications & BIPV

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HIT® Double Application Possibilities

Solar Awnings

Example Only–Not actual HIT Double. Photo Courtesy of Toronto Hydro Corporation

Ground Mount Systems

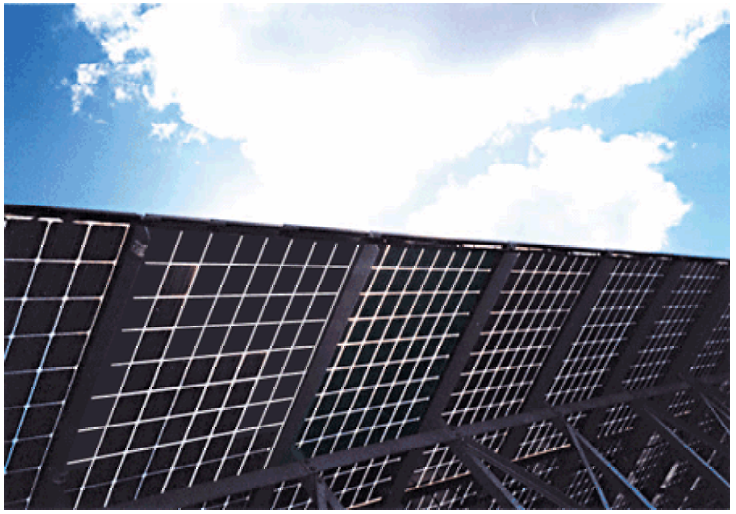

Photo Courtesy of SANYO Electric Co., Ltd.

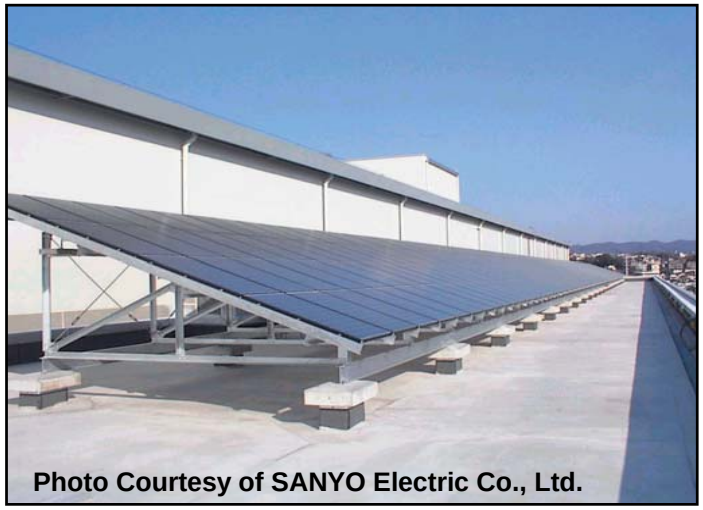

Photo Courtesy of SANYO Electric Co., Ltd.

Photo Courtesy of SANYO Electric Co., Ltd.

Roof Systems with White "Cool Roofs"

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HIT® Double Application Possibilities

Photo Courtesy of SANYO Component Europe Gmbh.

Single & Dual Axis Tracking Systems

Trellises, Canopies, Walkways & Outdoor Areas

Example Only - Not An Actual HIT Double Installation

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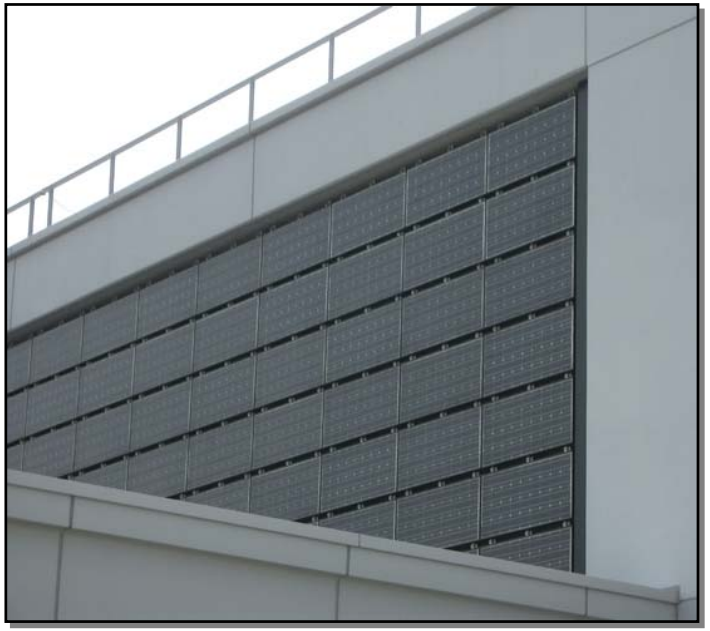
HIT® Double Application Possibilities

Commercial & Architectural
Facades
Siding
Vertical Installations
BIPV



Photos Courtesy of SANYO Electric Co., Ltd.

Examples Only—Not Actual HIT Double

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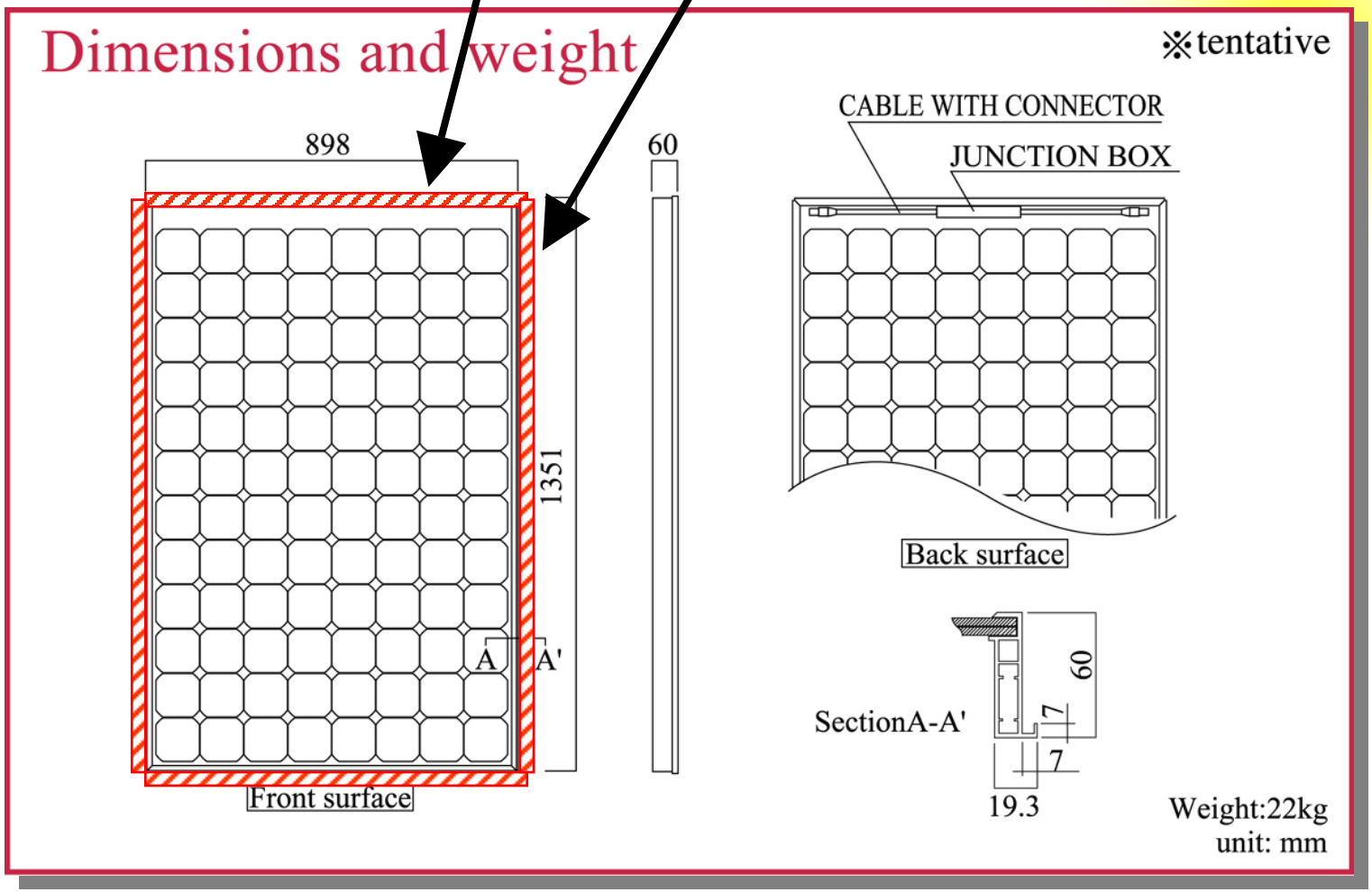
HIT® Double = More Attachment Area

Entire Frame Circumference for Attachments to Structures.



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HIT® Double = Maximum Power

To Maximize Power

1) Elevate panels above a surface as much as possible to allow reflected and ambient light beneath the panels.

2) Place panels over light-colored surfaces.

3) Do not allow support rails to directly cross or cover (shade) the panel's back face.

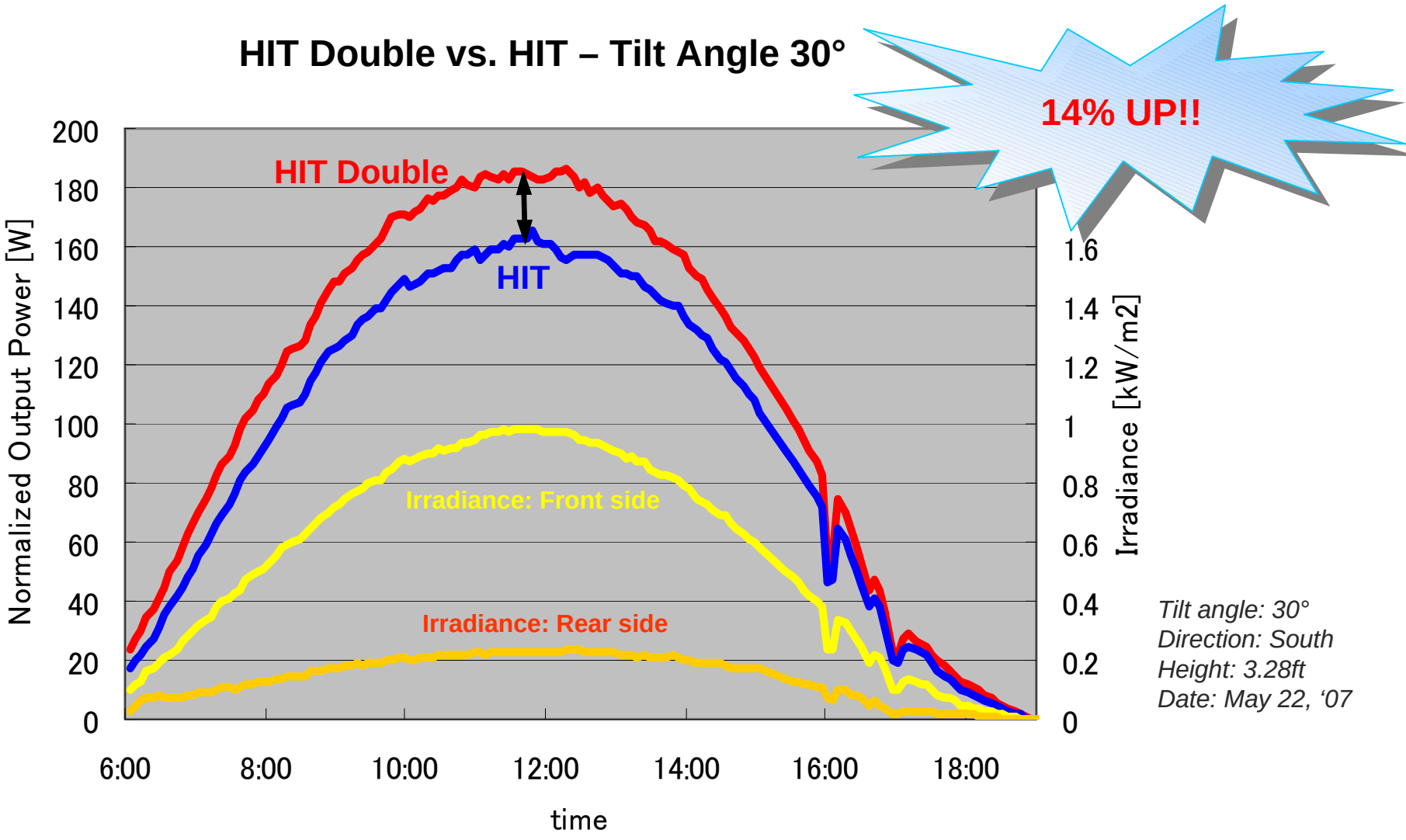
IMPORTANT

Bifacial panel's *Rated Power (P_{max})* is measured at Standard Test Conditions (STC). STC does not include power produced from the backside bifacial effect of the panels. Bifacial panels may produce up to 130% of their STC rating, depending on system design and site albedo—reflectance rate.***Use caution when selecting, calculating and sizing system components, to account for the increase in power.***

Results May Vary

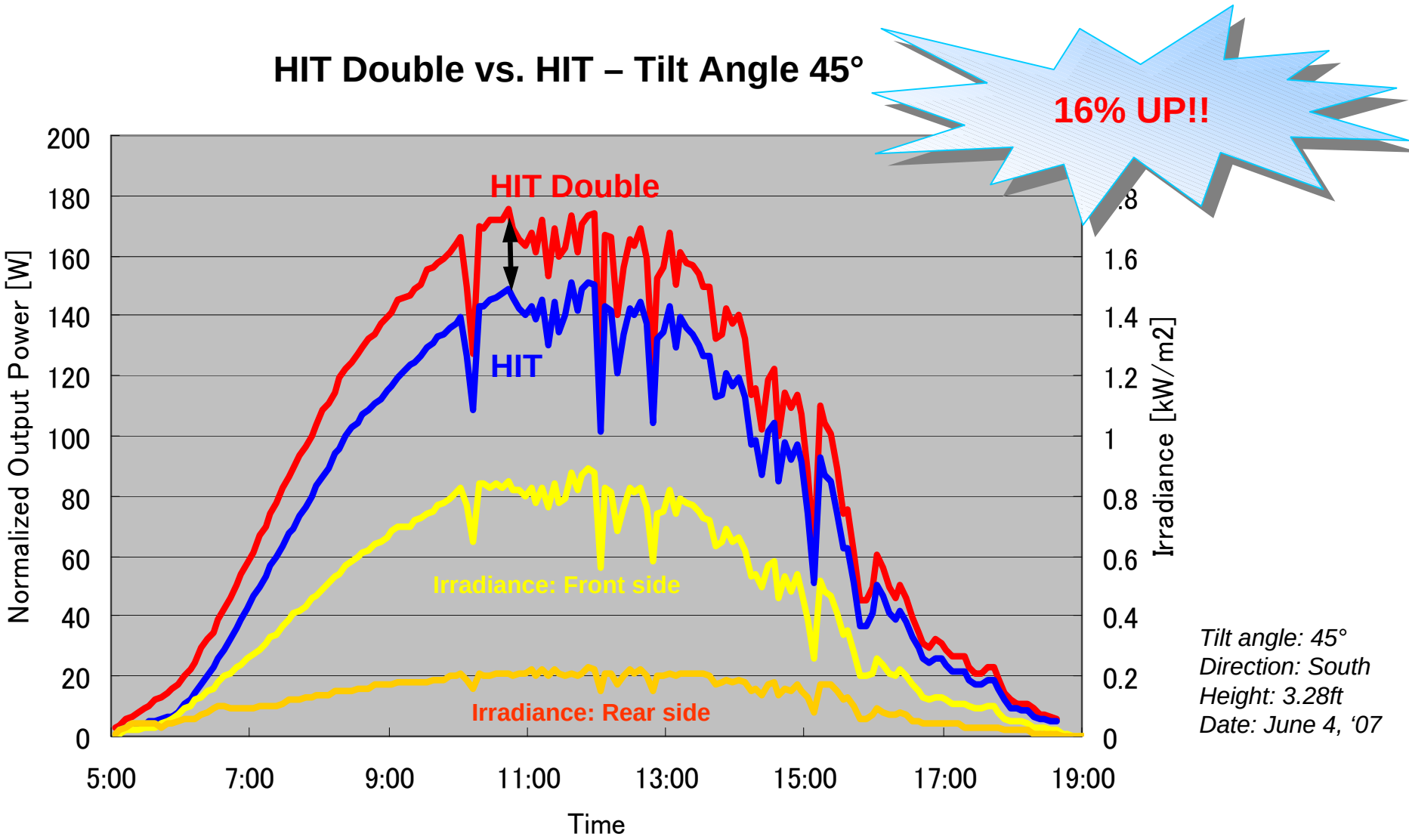
Actual power output will vary very much depending on tilt angle, direction, height, shadows of support structures or racking underneath the back face, albedo of the ground, and general conditions of the installation site like surrounding buildings and sunlight exposure.

HIT® Double Power Comparison



Tilt angle: 30°
Direction: South
Height: 3.28ft
Date: May 22, '07

HIT® Double Power Comparison



Tilt angle: 45°
Direction: South
Height: 3.28ft
Date: June 4, '07

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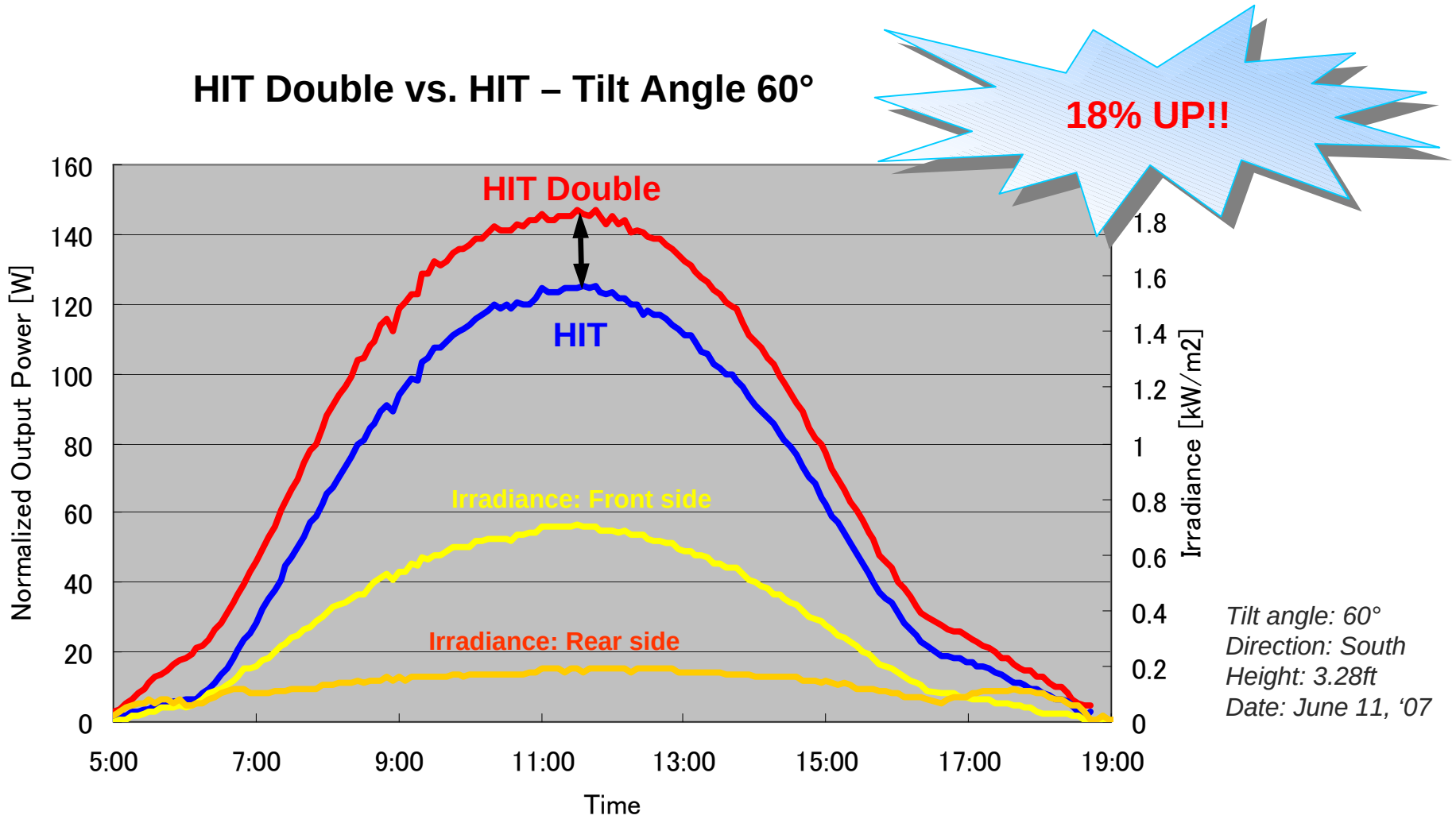
HIT® Double Power Comparison



Tilt angle: 60°
Direction: South
Height: 3.28ft
Date: June 11, '07

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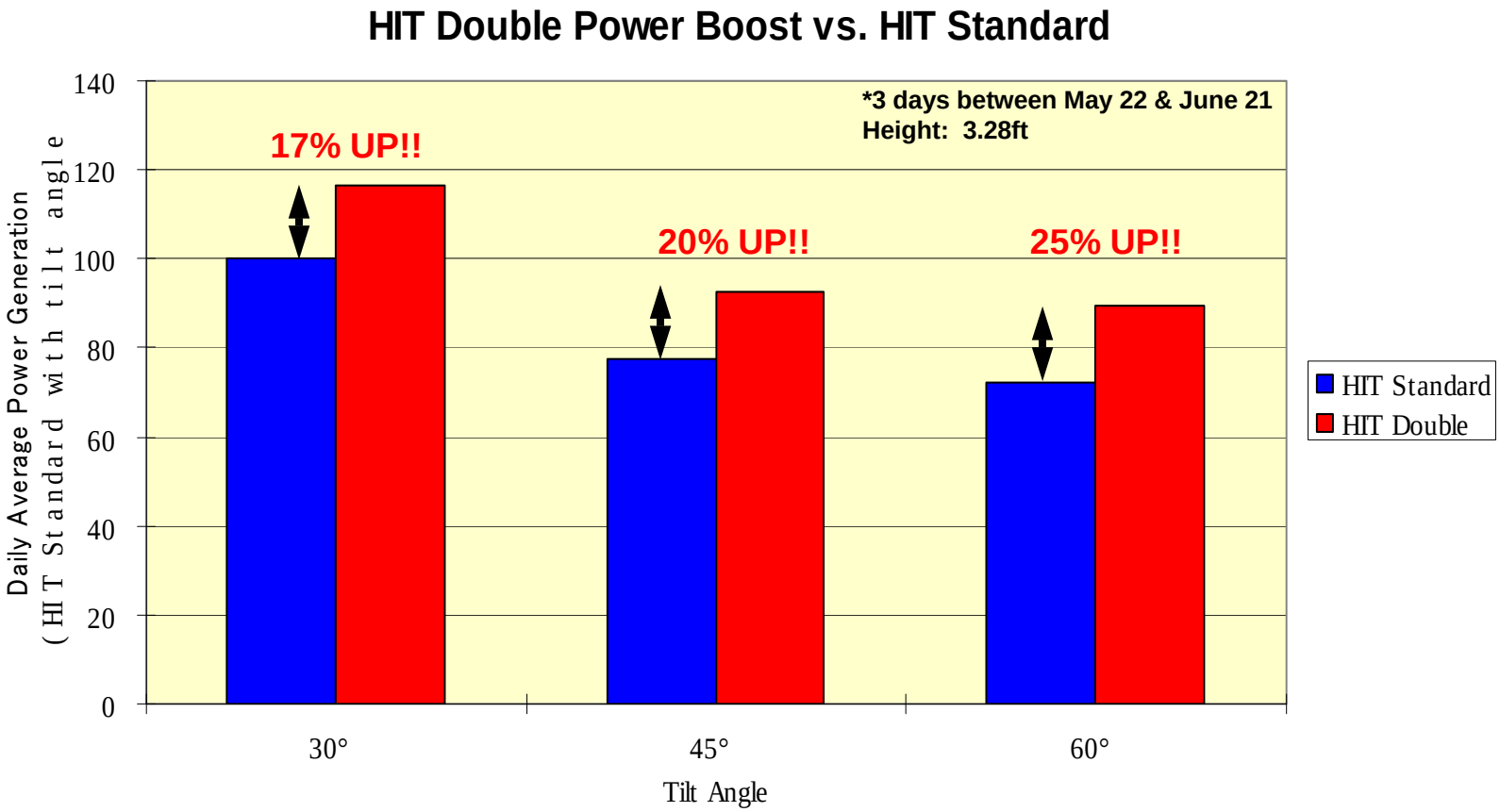
HIT® Double 3-Day* Accumulation Comparison

HIT Double generated 17% to 25% more power depending on tilt angle.



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HIT® Double = Higher Rebates

Higher performance is rewarded with higher rebates.

Use HIT® Double in areas with REC's or Performance Based Incentives and get higher rebates.

Enjoy more free money…courtesy of HIT Double.

PBI vs. EPBB

- EPBB = Expected Performance Based Buydown (upfront rebate)
- PBI = Performance Based Incentive (per kWh rebate)
- A $2.50 per Watt EPBB upfront rebate is equivalent* to a $0.39 cent per kWh PBI rebate paid over 5 years.
- With upfront rebates, if your system performs better than expected, you get nothing.
- With PBI rebates, when your system performs better than expected, you get more money!
- ***HIT panels outperform expectations. Opt into PBI using HIT Double panels and get more money!***

Depending on how much better your system performs compared to an EPBB calculation, your performance-based rebate is equivalent* to an upfront rebate of:

5% Better = $2.75/W

10% Better = $2.88/W

15% Better = $3.00/W

20% Better = $3.13/W

* Includes 5% EPBB adjustment and 8% discount rate as of Aug 07.

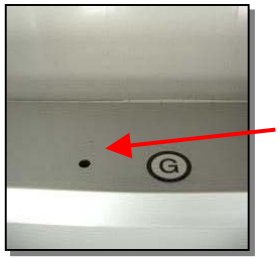
HIT® Double = Other Valuable Features

Pre-attached Lead Wires

Touch-Safe Junction Box

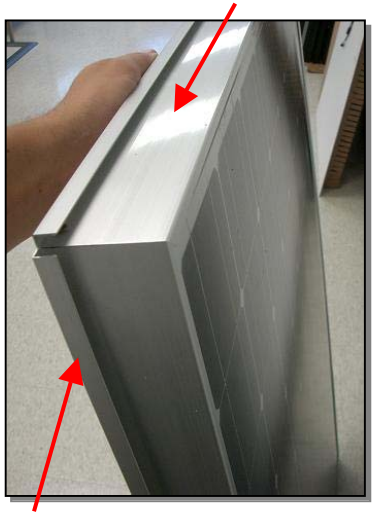
Stainless Steel Top-Down Clips

Plug-N-Play Connectors



Pre-Drilled Ground Hole

More Robust Frame Strength



Unique Attachment Rail

Panel Barcodes Inside & Outside

(for easy inventory tracking)

Class A

Highest Possible Fire Rating

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HIT® Double Empirical Relationship

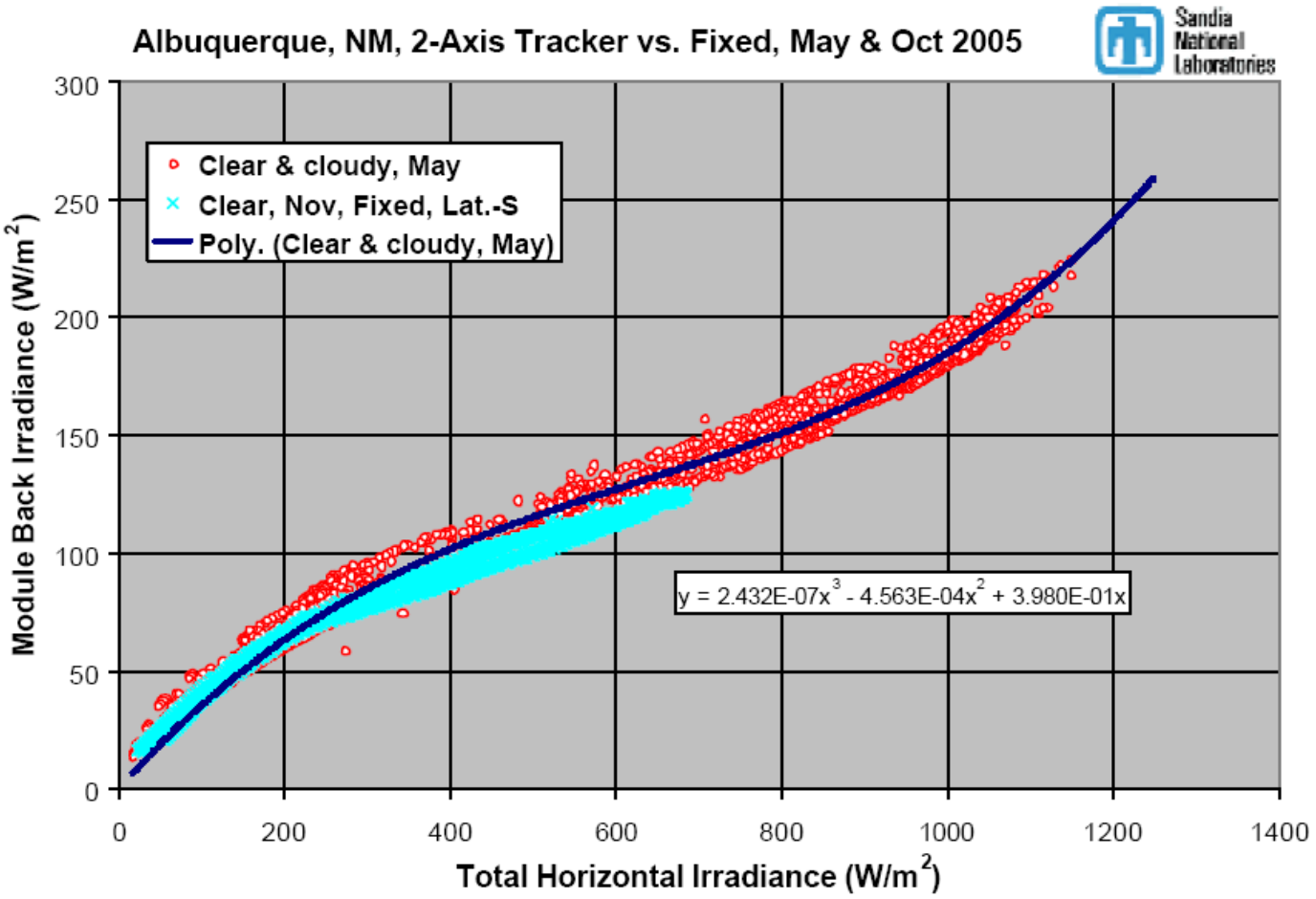
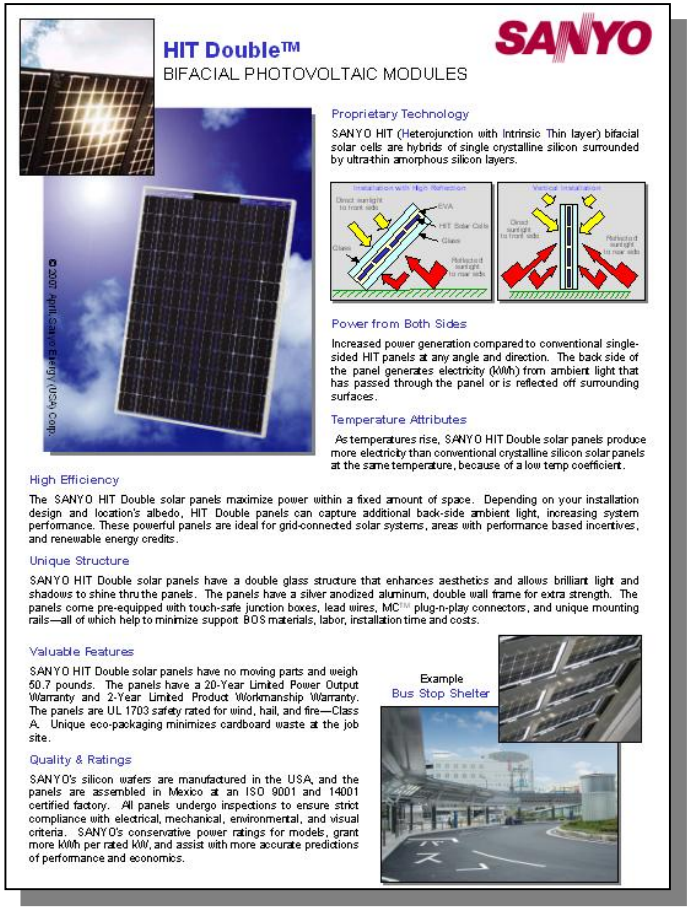


Fig. 11 Empirical relationship for module back surface irradiance as a function of total horizontal irradiance (THI), obtained in November 2005 with module in fixed position (latitude-tilt facing south) at Sandia. Results from four days with clear sky conditions are shown. The ground albedo was estimated to be about 0.30.

HIT® Double Specifications

Download a specification sheet for more detailed information about individual HIT Double models.



HIT Double™
BIFACIAL PHOTOVOLTAIC MODULES

SANYO

Proprietary Technology

SANYO HIT (Heterojunction with Intrinsic Thin layer) bifacial solar cells are hybrids of single crystalline silicon surrounded by ultrathin amorphous silicon layers.

Power from Both Sides

Increased power generation compared to conventional single-sided HIT panels at any angle and direction. The back side of the panel generates electricity (kWh) from ambient light that has passed through the panel or is reflected off surrounding surfaces.

Temperature Attributes

As temperatures rise, SANYO HIT Double solar panels produce more electricity than conventional crystalline silicon solar panels at the same temperature, because of a low temp coefficient.

High Efficiency

The SANYO HIT Double solar panels maximize power within a fixed amount of space. Depending on your installation design and location's albedo, HIT Double panels can capture additional back-side ambient light, increasing system performance. These powerful panels are ideal for grid-connected solar systems, areas with performance based incentives, and renewable energy credits.

Unique Structure

SANYO HIT Double solar panels have a double glass structure that enhances aesthetics and allows brilliant light and shadows to shine thru the panels. The panels have a silver anodized aluminum, double wall frame for extra strength. The panels come pre-equipped with touch-safe junction boxes, lead wires, MC™ plug-n-play connectors, and unique mounting rails—all of which help to minimize support BOS materials, labor, installation time and costs.

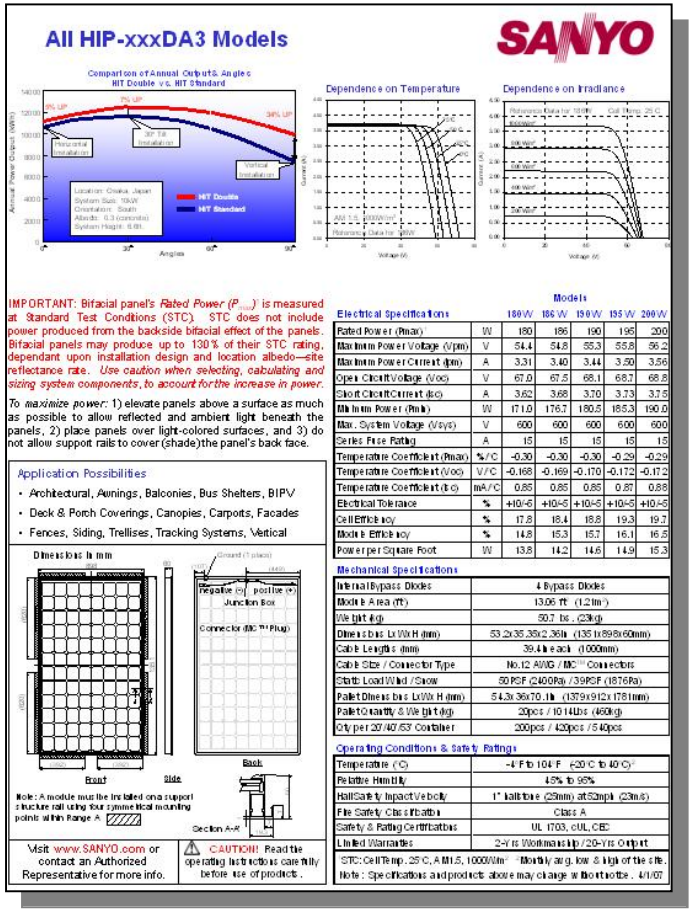
Valuable Features

SANYO HIT Double solar panels have no moving parts and weigh 50.7 pounds. The panels have a 20-Year Limited Power Output Warranty and 2-Year Limited Product Workmanship Warranty. The panels are UL 1703 safety rated for wind, hail, and fire—Class A. Unique eco-packaging minimizes cardboard waste at the job site.

Quality & Ratings

SANYO's silicon wafers are manufactured in the USA, and the panels are assembled in Mexico at an ISO 9001 and 14001 certified factory. All panels undergo inspections to ensure strict compliance with electrical, mechanical, environmental, and visual criteria. SANYO's conservative power ratings for models, grant more kWh per rated kW, and assist with more accurate predictions of performance and economics.

Example
Bus Stop Shelter



All HIP-xxxDA3 Models

SANYO

Comparison of Annual Output & Angles
HIT Double vs. HIT Standard

Dependence on Temperature

Dependence on Irradiance

IMPORTANT: Bifacial panel's *Rated Power (P_{max})* is measured at Standard Test Conditions (STC). STC does not include power produced from the backside bifacial effect of the panels. Bifacial panels may produce up to 130% of their STC rating, dependant upon installation design and location albedo—site reflectance rate. *Use caution when selecting, calculating and sizing system components, to account for the increase in power.*

To maximize power: 1) elevate panels above a surface as much as possible to allow reflected and ambient light beneath the panels, 2) place panels over light-colored surfaces, and 3) do not allow support rails to cover (shade) the panel's back face.

Application Possibilities

- Architectural, Awnings, Balconies, Bus Shelters, BIPV
- Deck & Porch Coverings, Canopies, Carports, Facades
- Fences, Siding, Trellises, Tracking Systems, Vertical

Dimensions in mm

Front Side Back

Note: A module must be installed on a support structure rail using four symmetrical mounting points within Range A.

Section A-A

Visit www.SANYO.com or contact an Authorized Representative for more info.

CAUTION! Read the operating instructions carefully before use of product.

Electrical Specifications		Models 180W	186W	190W	195W	200W
Rated Power (Pmax)	W	180	186	190	195	200
Maximum Power Voltage (Vpm)	V	54.4	54.8	55.3	55.8	56.2
Maximum Power Current (Ipm)	A	3.31	3.40	3.44	3.50	3.56
Open Circuit Voltage (Voc)	V	67.0	67.5	68.1	68.7	68.8
Short Circuit Current (Isc)	A	3.62	3.68	3.70	3.73	3.75
Minimum Power (Pmin)	W	171.0	176.7	180.5	185.3	190.0
Max. System Voltage (Vsys)	V	600	600	600	600	600
Series Fuse Rating	A	15	15	15	15	15
Temperature Coefficient (Pmax)	%/C	-0.30	-0.30	-0.30	-0.29	-0.29
Temperature Coefficient (Voc)	V/C	-0.168	-0.169	-0.170	-0.172	-0.172
Temperature Coefficient (Isc)	mA/C	0.85	0.85	0.85	0.87	0.88
Electrical Tolerance	%	+10/-5	+10/-5	+10/-5	+10/-5	+10/-5
Cell Efficiency	%	17.8	18.4	18.8	19.3	19.7
Module Efficiency	%	14.8	15.3	15.7	16.1	16.5
Power per Square Foot	W	13.8	14.2	14.6	14.9	15.3

Mechanical Specifications	
Internal Bypass Diodes	4 Bypass Diodes
Module Area (ft²)	13.06 ft² (1.2m²)
Weight (kg)	50.7 lbs. (23kg)
Dimensions (L x W x H mm)	53.2x35.35x2.36in (135.1x898x60mm)
Cable Length (mm)	39.4in each (1000mm)
Cable Size / Connector Type	No.12 AWG / MC™ Connectors
Static Load Wind / Snow	50 PSF (2400Pa) / 39 PSF (1876Pa)
Pallet Dimensions (L x W x H mm)	54.3x36x70.1in (1379x912x1781mm)
Pallet Quantity & Weight (kg)	20pcs / 1014lbs (460kg)
Qty per 20'/40'/53' Container	200pcs / 420pcs / 540pcs

Operating Conditions & Safety Ratings	
Temperature (°C)	-4°F to 104°F (-20°C to 40°C)*
Relative Humidity	45% to 95%
Hail Safety Impact Velocity	1" hail stone (25mm) at 52mph (23m/s)
Fire Safety Classification	Class A
Safety & Rating Certification	UL 1703, cUL, CEC
Limited Warranties	2-Yrs Workmanship / 20-Yrs Output

*STC: Cell Temp. 25°C, AM1.5, 1000W/m² **Monthly avg. low & high of the site.
Note: Specifications and products above may change without notice. 4/1/07

http://us.sanyo.com/industrial/solar/downloads.cfm

The World's Largest PV Monument

Maximum Power: 630kW
Solar Panels: 5,046
$C0_2$ Reduction: 95 Tons per Year
Weight: 3,000 Metric Tons
Dimensions: 315m x 9m x 37m
Location: Gifu, Japan
Completion: December 2001

SOLAR ARK

A Symbol of Coexistence with Our Environment