



Web Summit 2021

LISBON, PORTUGAL NOVEMBER 1-4, 2021



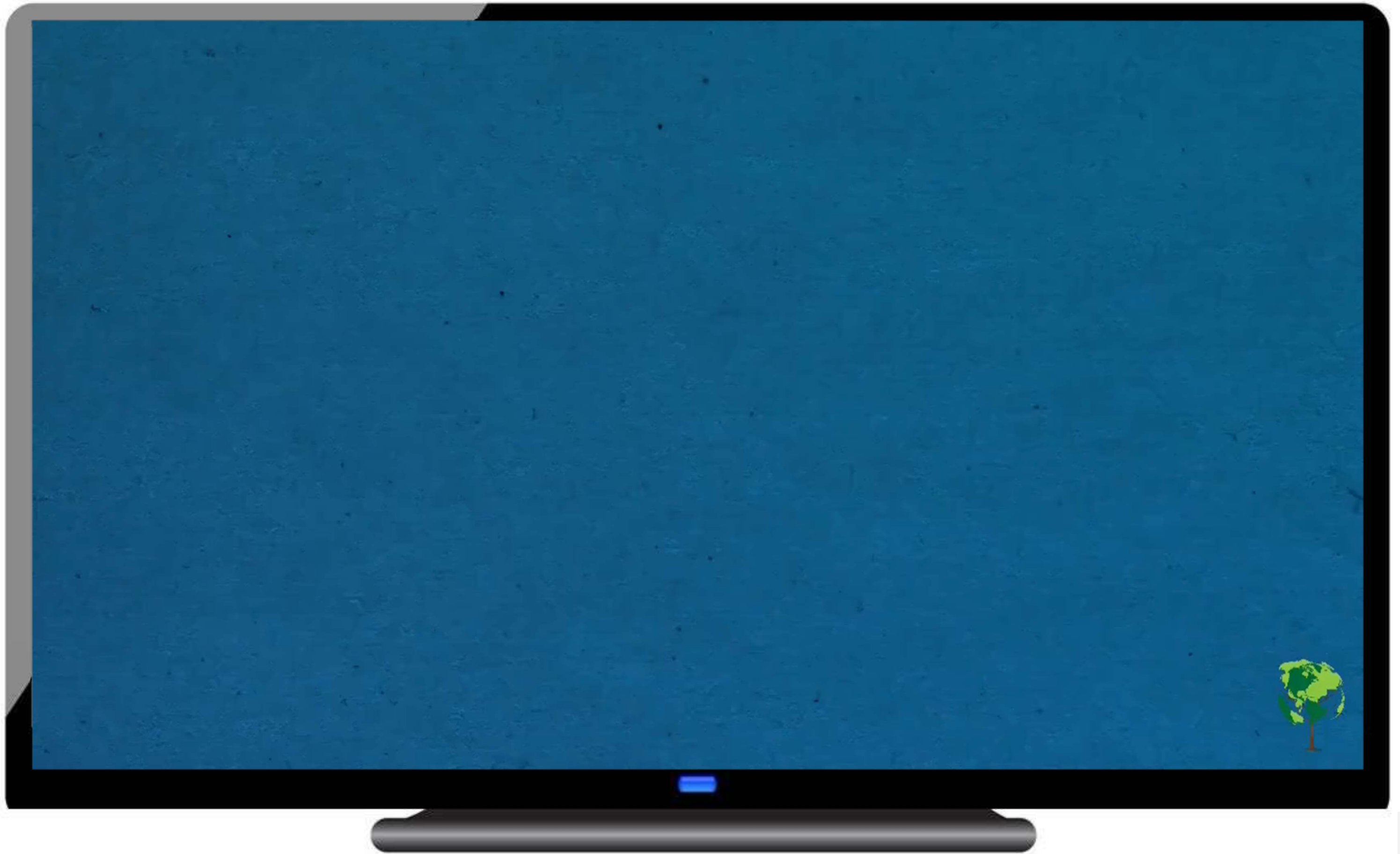
TERRA PAVE PRODUCTS for SOLAR & PAVEMENT/TRANSPORTATION INDUSTRIES

TERRA PAVE PRODUCTS are the ECO-FRIENDLY, COST EFFECTIVE SOLUTIONS to the CHALLENGES in these MARKETS

TERRA PAVE TEAM

Dr. Yetkin Yildirim for team at UTA-TPI
David Pham for team at EEI





TERRA PAVE products (SPRAY-ON PERMANENT GROUND COVERING, WATER-BASED POLYMERS)

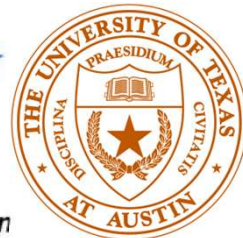
Proven Superior
TERRA PAVE products



Sandia National Laboratories



NREL National Renewable Energy Laboratory



& +30 countries



COST-EFFECTIVE



TERRA PAVE products (SPRAY-ON PERMANENT GROUND COVERING, WATER-BASED POLYMERS) will:

- ✓ **SOLVE** all **CHALLENGES** for the:
 - ✓ Adoption of **BI-FACIAL PV** @ solar farms,
- ✓ **LOWER COSTS**
 - ✓ of **O&M** for existing solar farms, and **much more** ...

Current Market & Bifacial PV Forecast Market

2021 for TERRA PAVE PRODUCTS Solar

Industry

Terra Pave O&M market



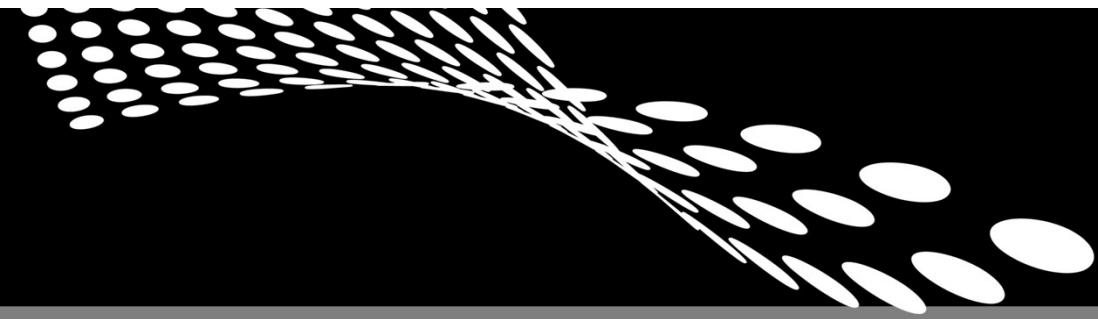
>\$8.75B

Terra Pave O&M, BI-FACIAL markets



>\$19B

Existing Ground Mount Solar Farms Energy Output, (O&M) Operation & Maintenance Costs



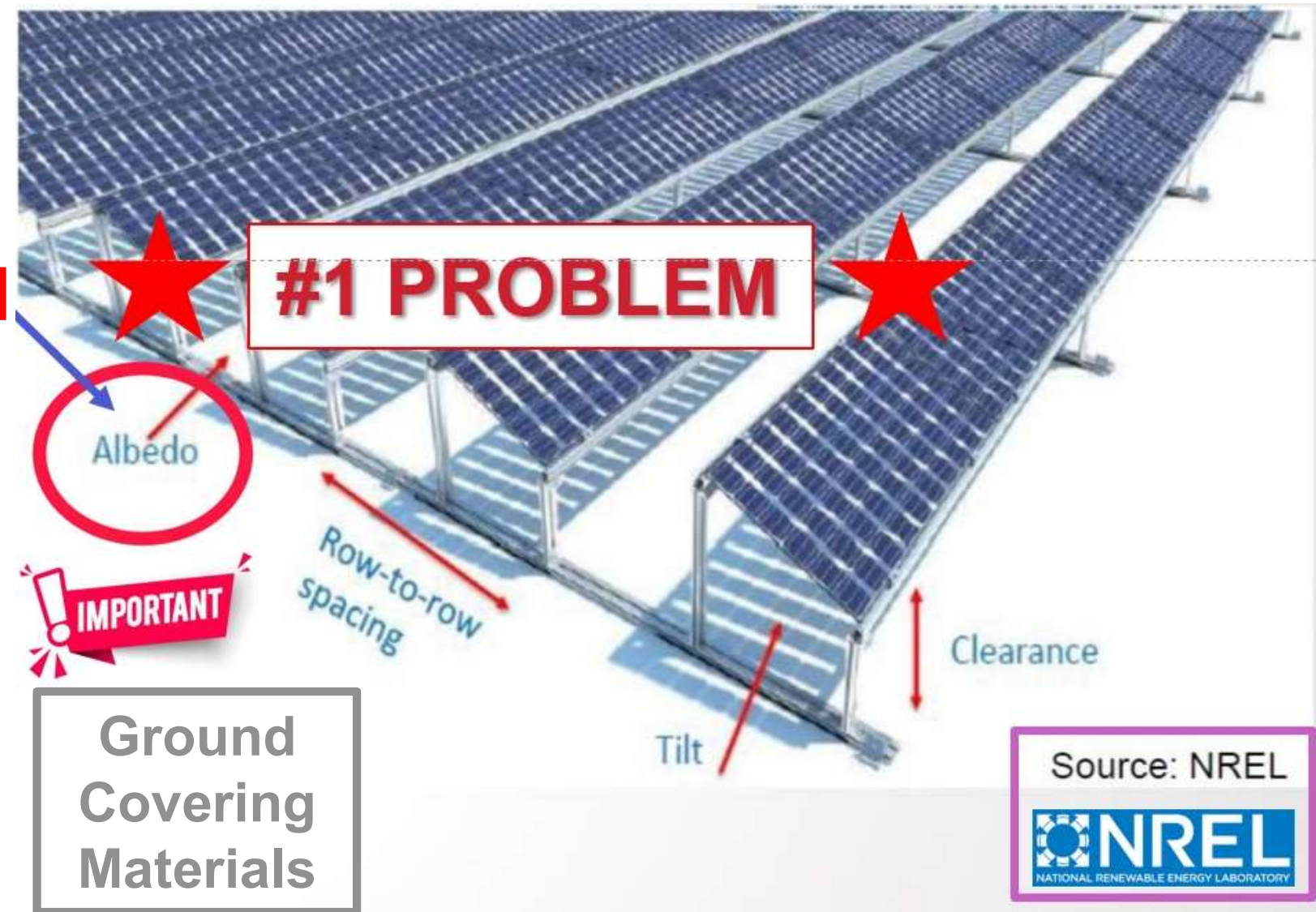
- ✓ **DIRT/DUST CONTROL**
- ✓ **SOLAR PANELS CLEANING REDUCTION**
- ✓ **VEGETATION GROWTH ELIMINATION**
- ✓ **LOWER O&M COSTS**
- ✓ **INCREASE OUTPUT REVENUE**
- ✓ **EROSION CONTROL**



Energy Production for Bi-facial PV

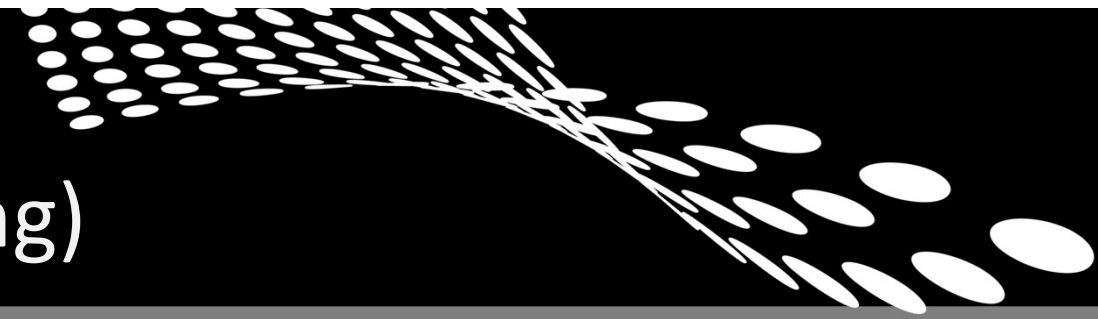
Variable, Changes {

ALBEDO



THE
FUTURE
MARKET

TERRA PAVE PRODUCTS – TSW/TSW Albedo (Spray-on Permanent Ground Covering)



TERRA SEAL WHITE (TSW) Albedo – Water based liquid polymer

- ✓ NON-HAZARDOUS
- ✓ NON-PETROLEUM BASED
- ✓ NON-TOXIC
- ✓ NON-CORROSIVE
- ✓ WATERPROOF
- ✓ EROSION RESISTANCE
- ✓ NO SPECIAL HANDLING or
- ✓ NO SPECIAL EQUIPMENT REQUIRED

TSW Albedo = SNOW
7/365 days

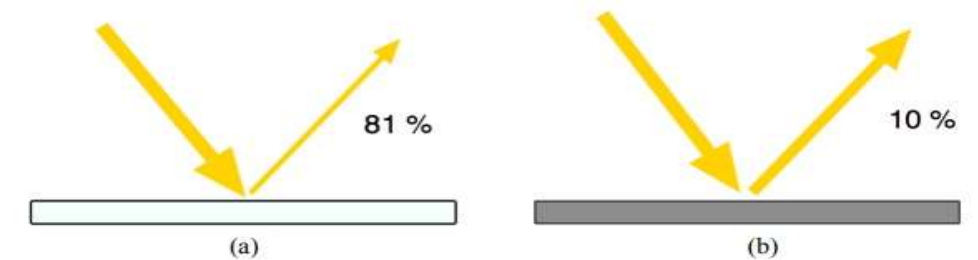


Figure 3. Light reflecting off a surface, where (a) has an albedo of 0.81 and (b) an albedo of 0.1.

Table 1. The albedo of different kinds of surfaces. [17]

Surface type	Albedo
Green grass	0.24
Red brick	0.24
White sand	0.67
Snow	0.85

Challenges for Bifacial Panels - ALBEDO

SOLVED to these Challenges with **TERRA PAVE** Products



A

Bifacial adoption is happening **much faster** than anticipated



B

Modeling energy production of bifacial systems is likely on the **conservative** side



C

Project economics are favorable, but **design** and **optimization** require **new ways of thinking**



D

Performance guarantees will be **challenging**



Terra Pave ALBEDO for Solar Farms



Tracking
Albedo = Snow



Fixed Tilt
Albedo = Snow



BATTLE TESTED at Army base in Texas for Terra Pave Products



M1-A2C Abrams Tanks (each weight in at 73.6 short tons with speed at 73 km/h on road) demonstrated that **TSW > 3X TENSILE STRENGTH** existing products.

Ground Mount Solar Farms & Pavements Industries

Eco-Friendly GREEN Solar Projects & Pavements



- ❖ Highways,
- ❖ Roads,
- ❖ Parking lots,
- ❖ Airfields/Runways, Levies, Haul Roads, Driveways, Cart Paths, Golf Courses, Landfill Capping, Slope Erosion Control, Water Retention Basins, Bunker Liners, Vehicles Lots, Helicopter Pads, Walking Trails/Paths, Pond Linings and **MANY MORE...**

TERRA PAVE PRODUCTS

Terra Pave White (TSW) & Terra Pave Black (TSB)

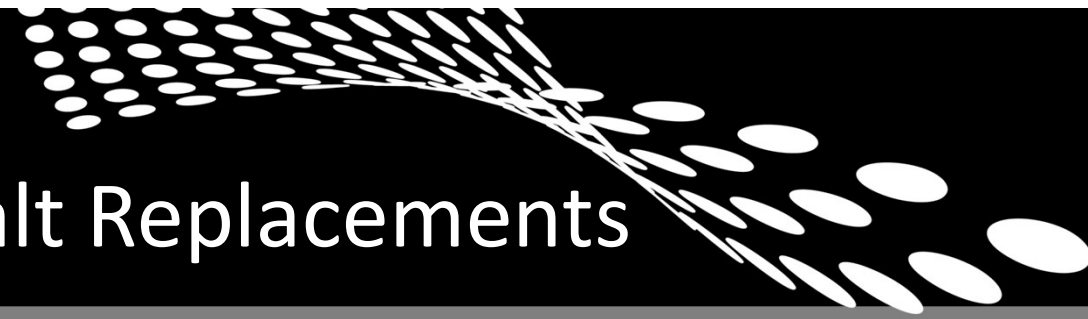


COST-EFFECTIVE



TERRA PAVE PRODUCTS – TPW & TPB

Climate Wrecking Concrete/Cement, Toxic Asphalt Replacements



BEFORE

Loose soil



Concrete/Cement replacement

AFTER

Terra Pave White (TPW)
TPW after 24 hours of curing



Asphalt replacement

AFTER

Terra Pave Black (TPB)
TPB after 48 hours



* Soil Grader



* Soil Compactor



* Water Sprayer

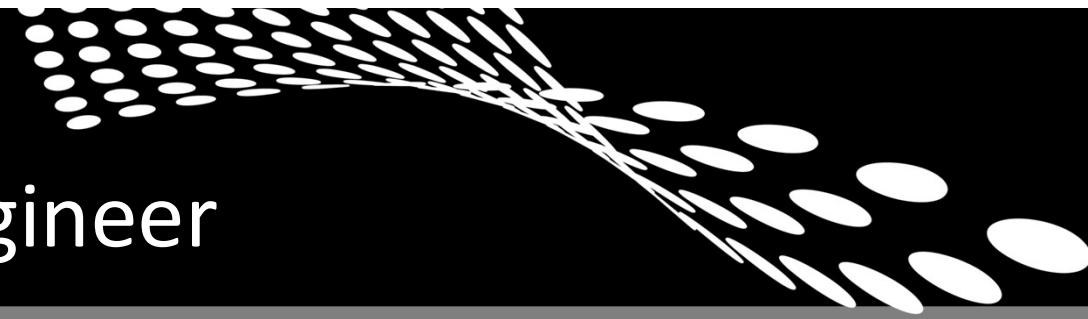
✓ NO SPECIAL HANDLING or EQUIPMENT

- ✓ NON-HAZARDOUS
- ✓ NON-PETROLEUM BASED
- ✓ NON-TOXIC
- ✓ NON-CORROSIVE
- ✓ WATERPROOF
- ✓ IMPROVE BRAKING DISTANCE
- ✓ EROSION RESISTANCE
- ✓ 3X TENSILE STRENGTH TO CEMENT



TERRA PAVE PRODUCTS - Recommendation

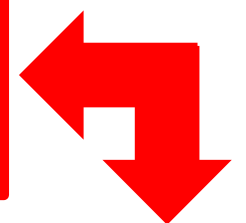
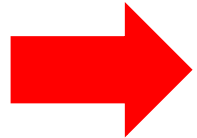
City of San Marcos, TX Environmental Engineer



Product testing, done by San Antonio Texting Labs shows that it has no detectable concentrations of volatile, semivolatile, heavy metals or petroleum hydrocarbons. The analysis of TerraPave and AEP, and clearly shows the advantage of this product for human health and the environment. Costs are equivalent to AEP when comparing amount of product applied per unit area (gallons/ft² or yd²).

The Streets Department estimates that between 4500 to 6000 gallons of AEP oil is used each year on the city's mill and overlay projects performed in-house. By changing to TerraPave, the city will reduce the application of 37,500 to 50,040 pounds of oil each year to the environment. This total includes a reduction of 5,200 to 6,900 pounds of chemicals that are covered under the TCEQ's Texas Risk Reduction Program for spills to the environment.

Furthermore, the Streets Manager is also considering requiring all of the city's asphalt contractors to use TerraPave instead of AEP for city roads. This proactive step will have a significant multiplying benefit for the environment in San Marcos, Texas.



(a) Prepared by Elizabeth (Lisa) Arceneaux, P.E. local environmental engineer.

Lisa Arceneaux, P.E., CISEC, CPESC
Environmental Engineer
City of San Marcos, Texas
Department of Transportation

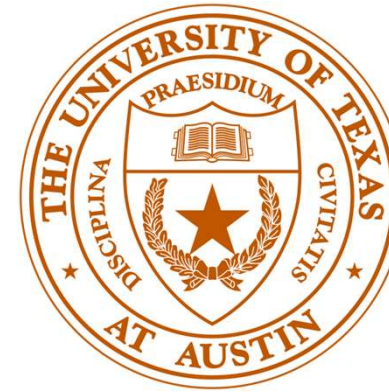
**Imagine this for all CITIES,
TOWNS on Planet EARTH!!!**



TERRA PAVE PRODUCTS – The TEAM



And the TEAM @



Dr. Yetkin Yildirim (President/CTO, P.E.) & **University of Texas Austin/Terra Pave International**,
+35 years Chemical/Civil Eng.



And the TEAM @



David Pham (President/CTO) & **Eco-Estates International** – Electrical & Computer Engineering
+30 years in Semiconductor/Solar/Green Building

TERRA PAVE PRODUCTS (SPRAY-ON PERMANENT GROUND COVERING, WATER-BASED POLYMERS)

TERRA PAVE PRODUCTS

- ❖ NON-HAZARDOUS
- ❖ NON-PETROLEUM BASED
- ❖ NON-TOXIC
- ❖ NON-CORROSIVE
- ❖ WATERPROOF
- ❖ EROSION RESISTANCE
- ❖ IMPROVE BRAKING DISTANCE
- ❖ NO SPECIAL EQUIPMENT &
- ❖ NO HANDLING PROCEDURE REQUIRED
- ❖ >3X TENSILE STRENGTH TO CEMENT

COST-EFFECTIVE



TERRA PAVE PRODUCTS WILL:

- ✓ SOLVE ALL ISSUES for the IMPLEMENTATION of BIFACIAL SOLAR FARMS,
- ✓ LOWER COSTS of O&M for EXISTING SOLAR FARMS,

FAST WORLD-WIDE COMMERCIALIZATION

and also WILL HAVE

A DIRECT POSITIVE ECO-IMPACT for the HEALTH of our PLANET, and for EVERY HUMAN and LIVING SPECIES on EARTH.



Thank You!



APPENDIX to follow

Energy Production for Bi-facial PV



Bifacial Technology is not only about Module

IMPORTANT

Ground Covering Materials

Variable, Changes

Main Parameters to consider:

Albedo IMPORTANT #1 PROBLEM	
Clearance/height	
Racking	No backside shading
Row spacing (GCR)	()
Inverter DC/AC ratio	

Racking/tracker



#1 PROBLEM

Albedo
IMPORTANT

Fixed

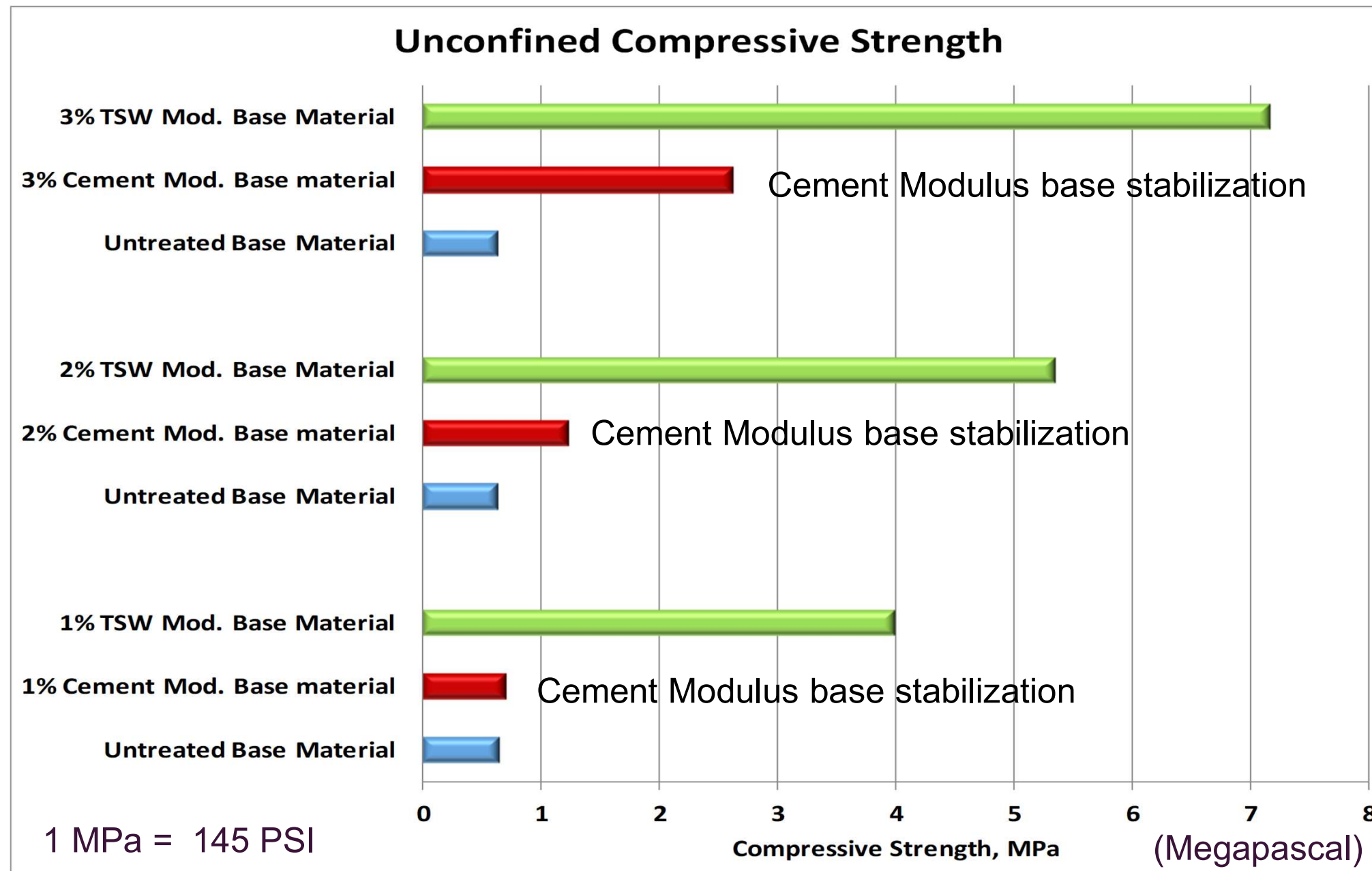
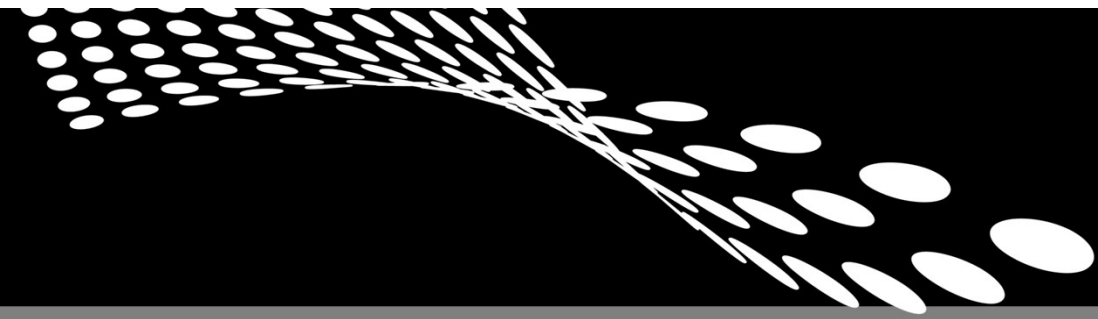
Storage

Inverter

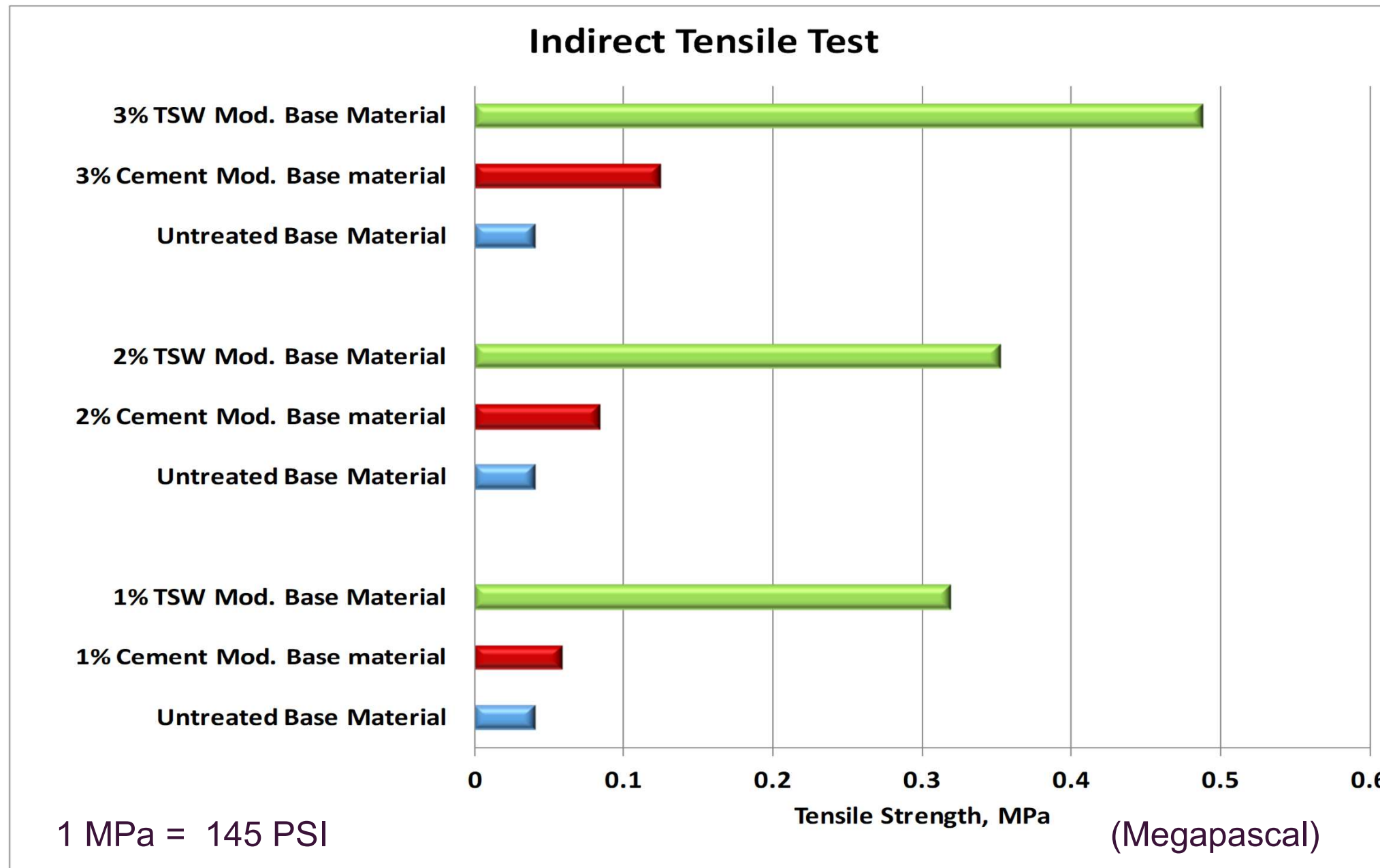
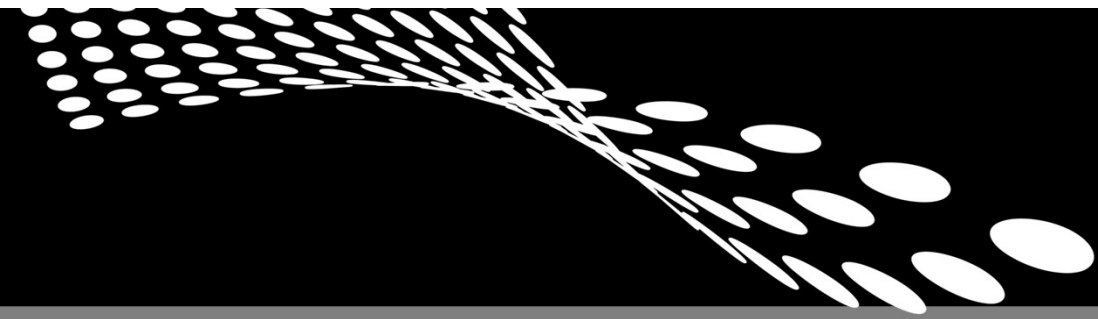


System integration plays a key role in improving bifacial gain

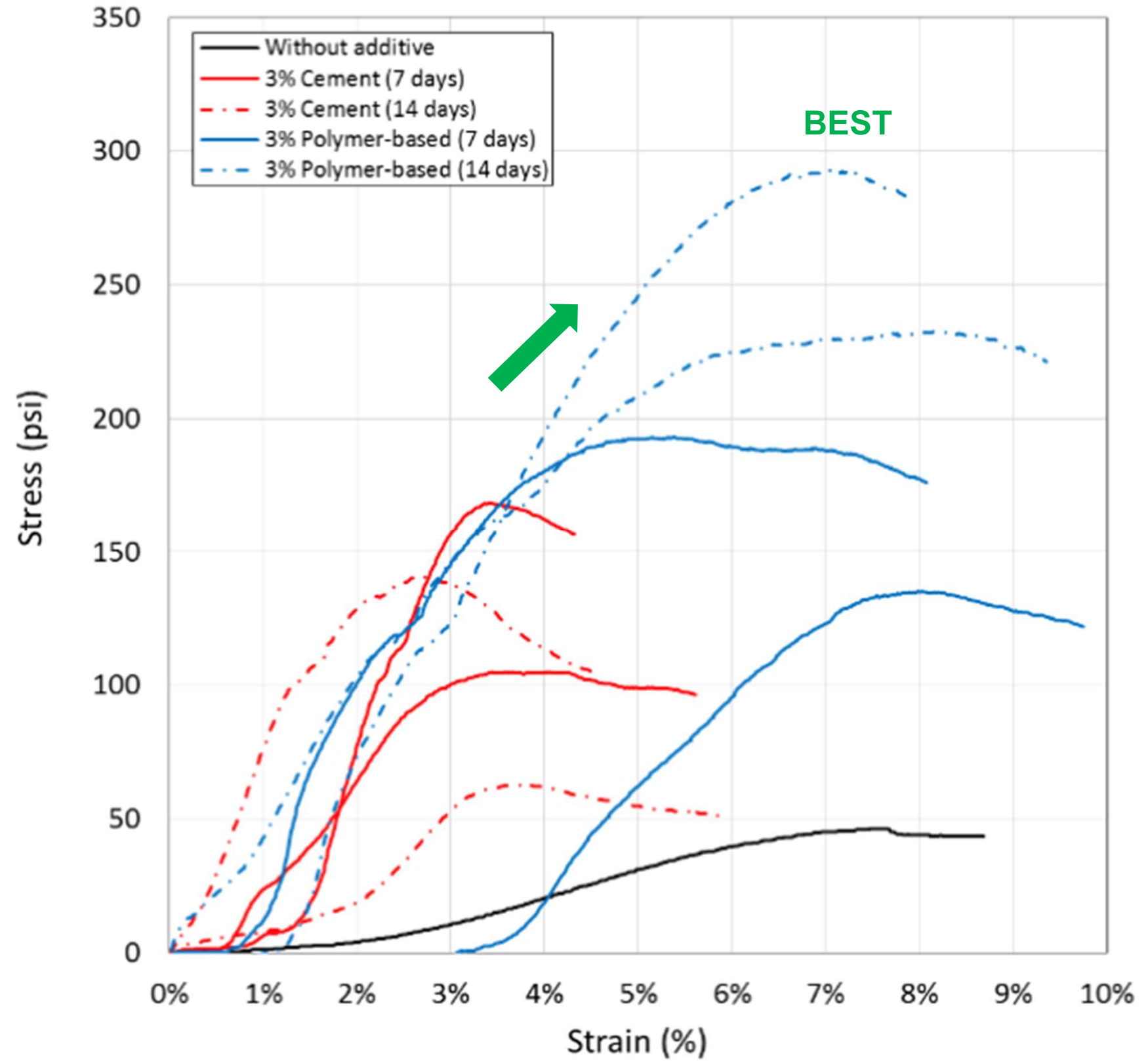
Terra Pave Test – Compressive Strength



Terra Pave Test – Tensile Strength



Terra Pave Test



Terra Pave Test – Permeability

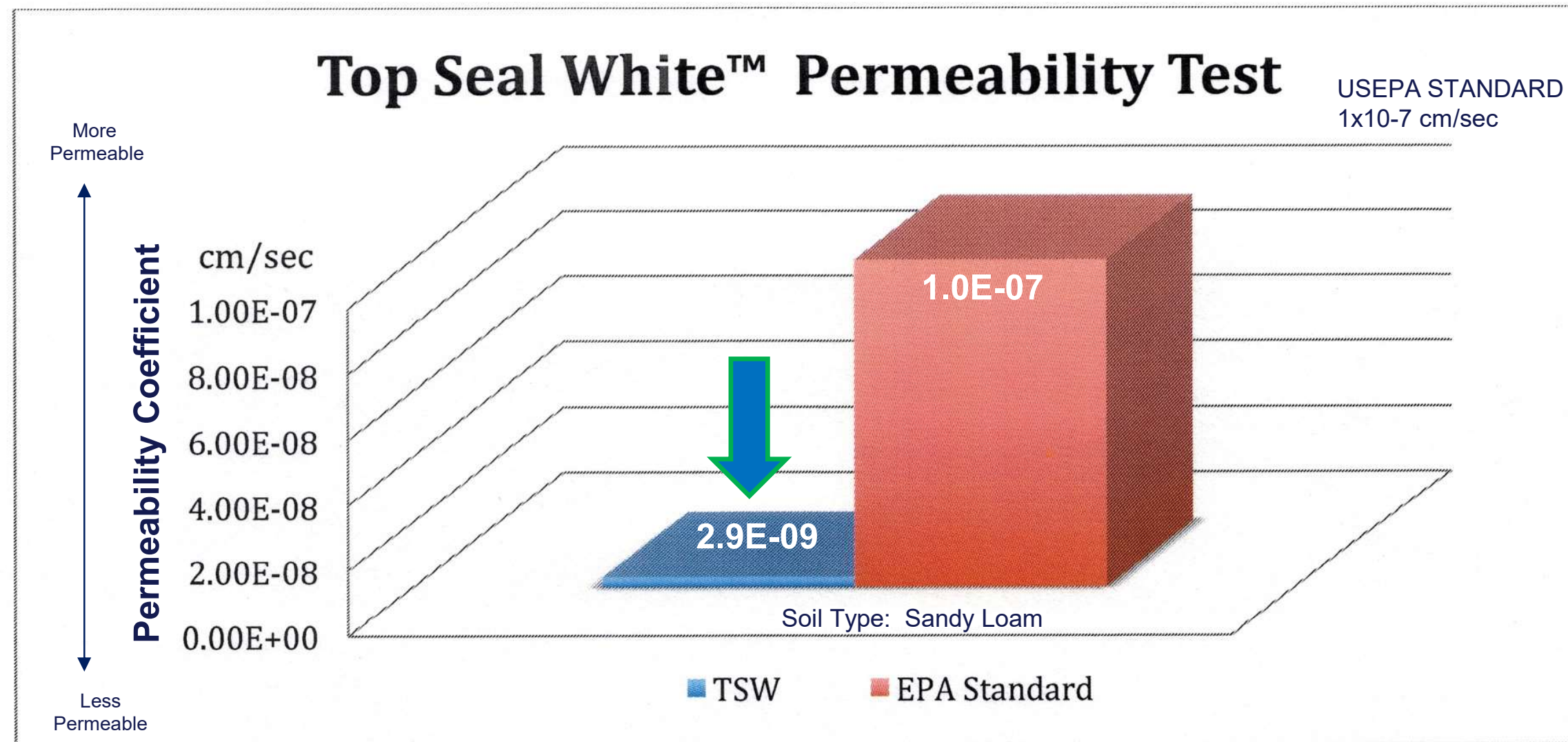
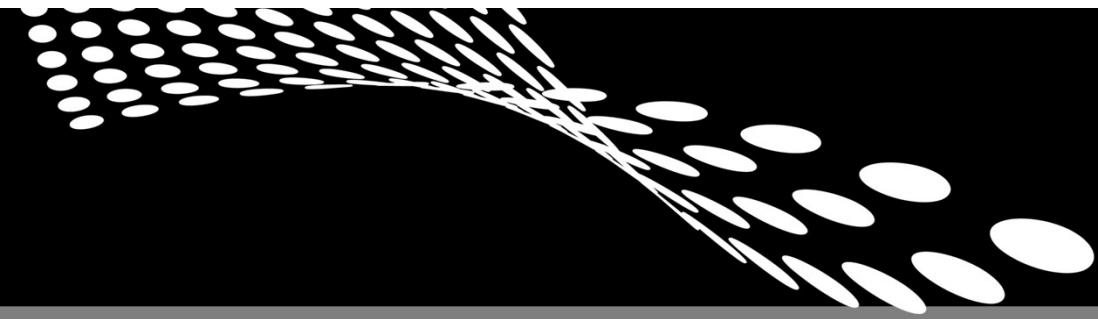
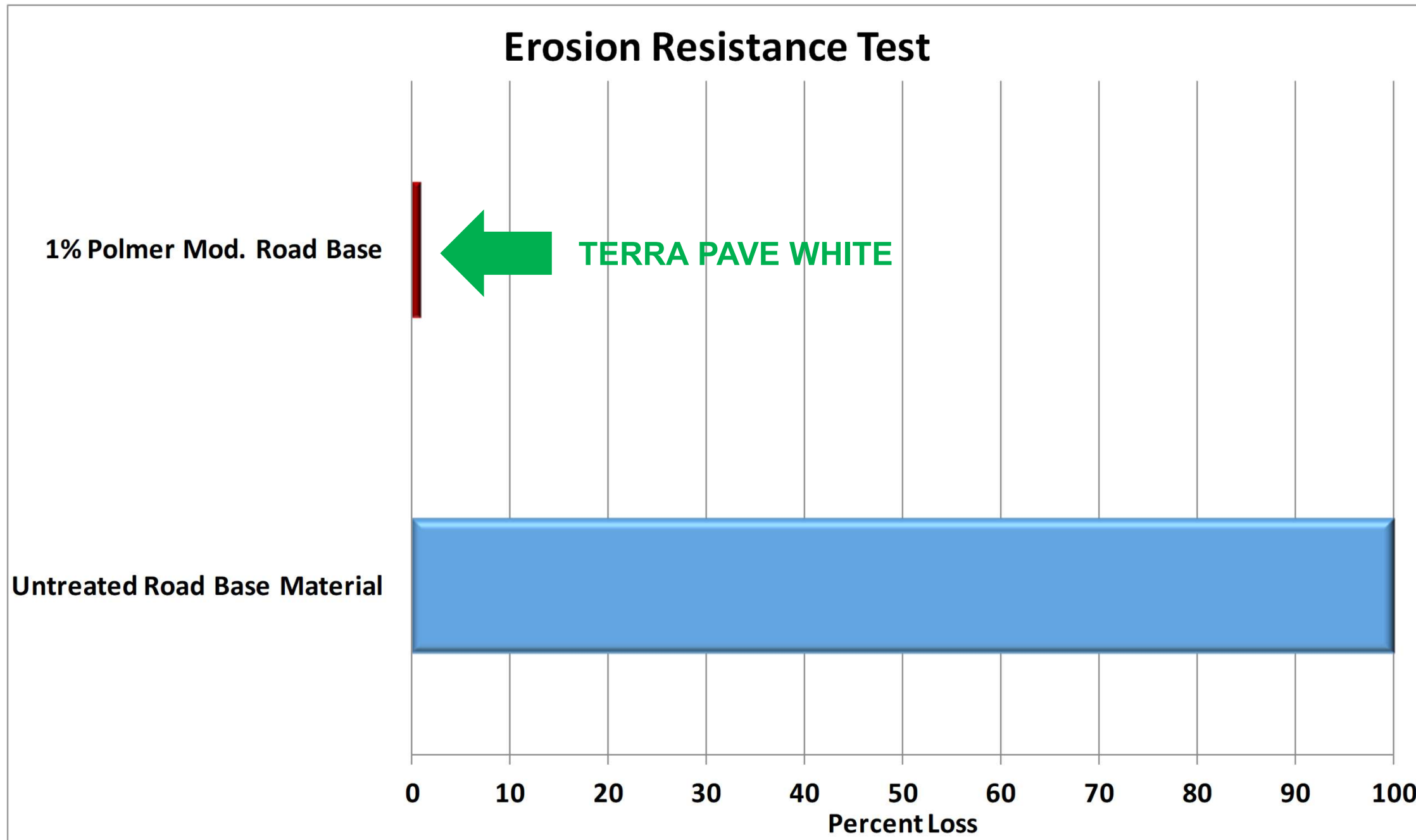
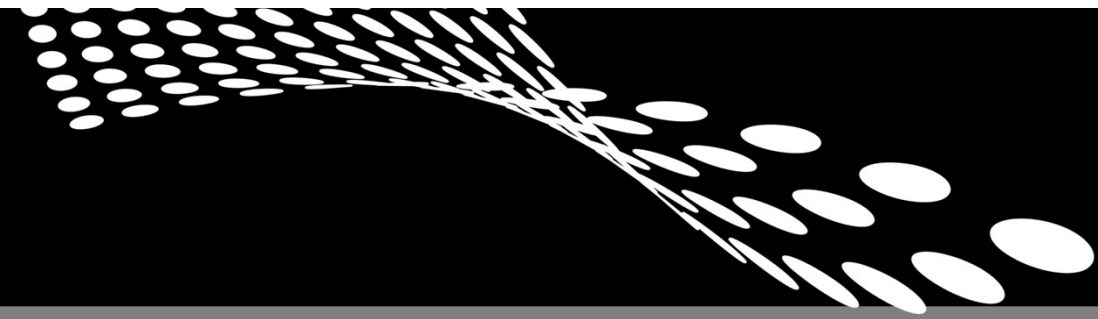


Figure 1: TSW vs. US EPA Standards

Top-Seal treated soil, at 2.9x10⁻⁹ cm/sec. the liquid would need **16.4 years** to go through 15 cm.

The USEPA standard of 1x10⁻⁷ cm/sec. it would take liquid **4.76 years** to traverse 15 cm.

Terra Pave Test – Erosion Resistance



TOP SEAL WHITE™ & TOP SEAL WHITE ALBEDO™



VEGETATION CONTROL & MOWING



DIRT SOILING & PV CLEANING



+2.4% higher output

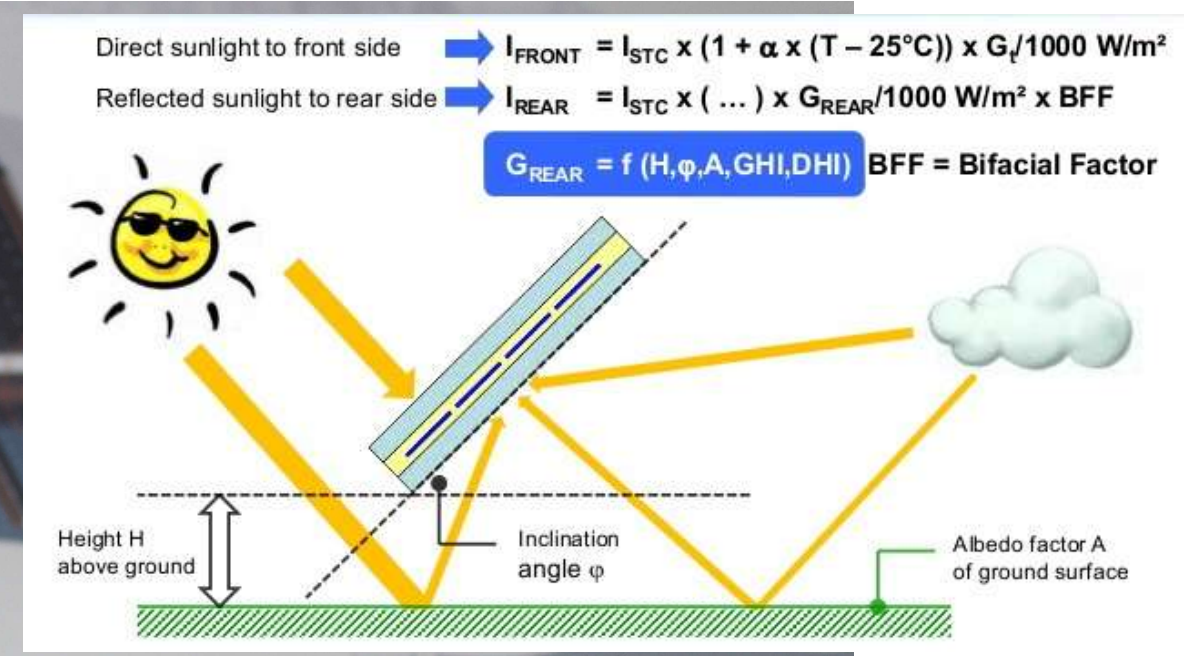


TOP SEAL WHITE



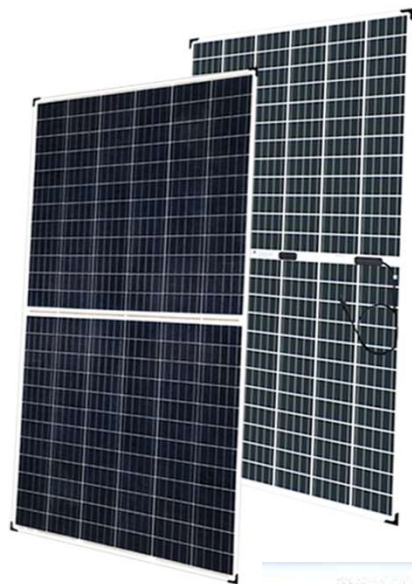
TOP SEAL WHITE ALBEDO

TOP SEAL WHITE



Energy Production for Bifacial Panels

THE SOLAR RESOURCE BIFACIAL PERFORMANCE MODELS AND PARAMETRIC SENSITIVITIES

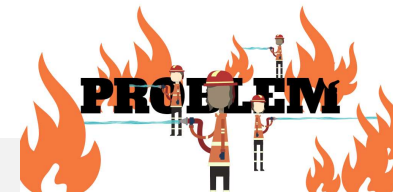
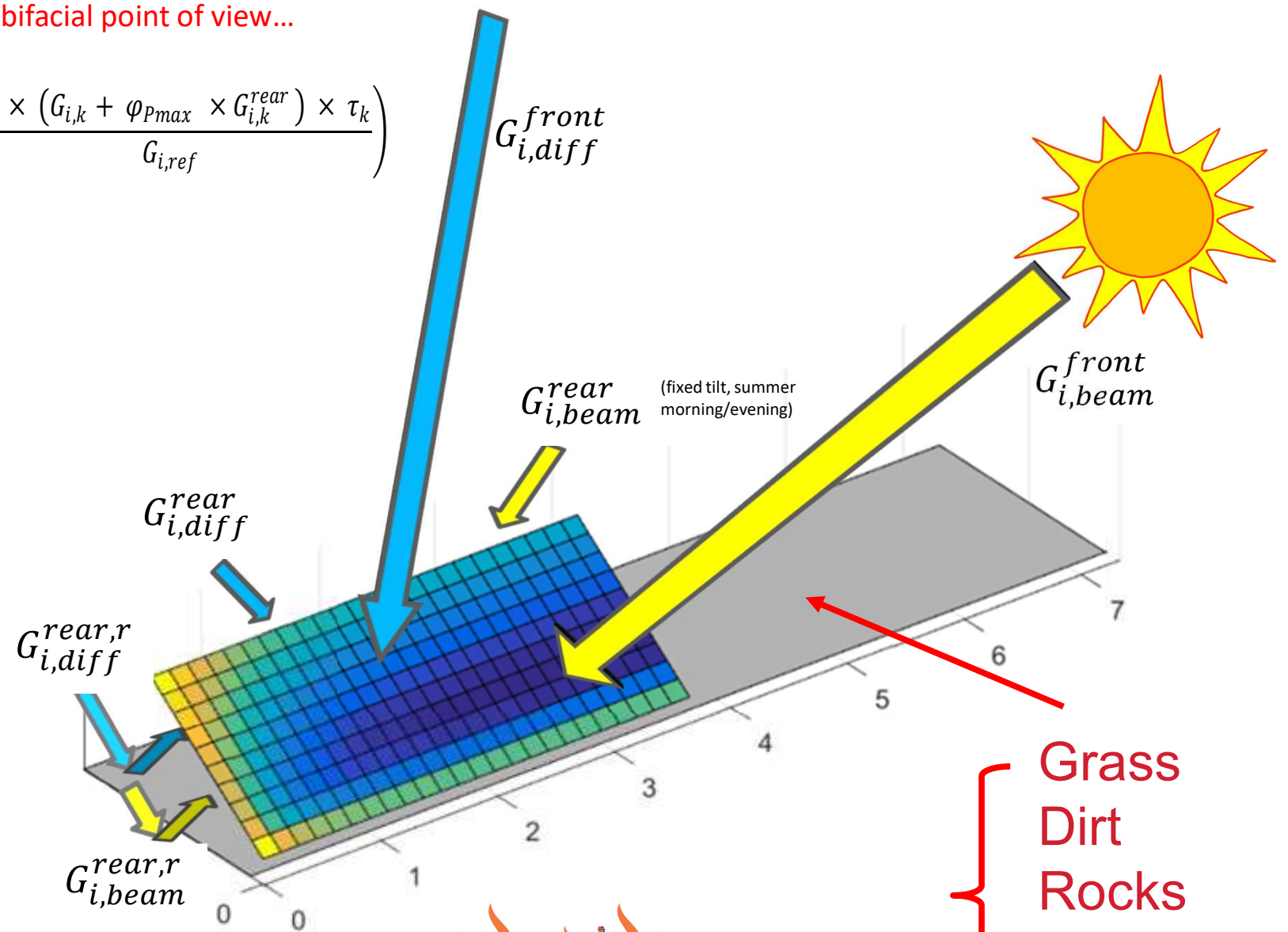
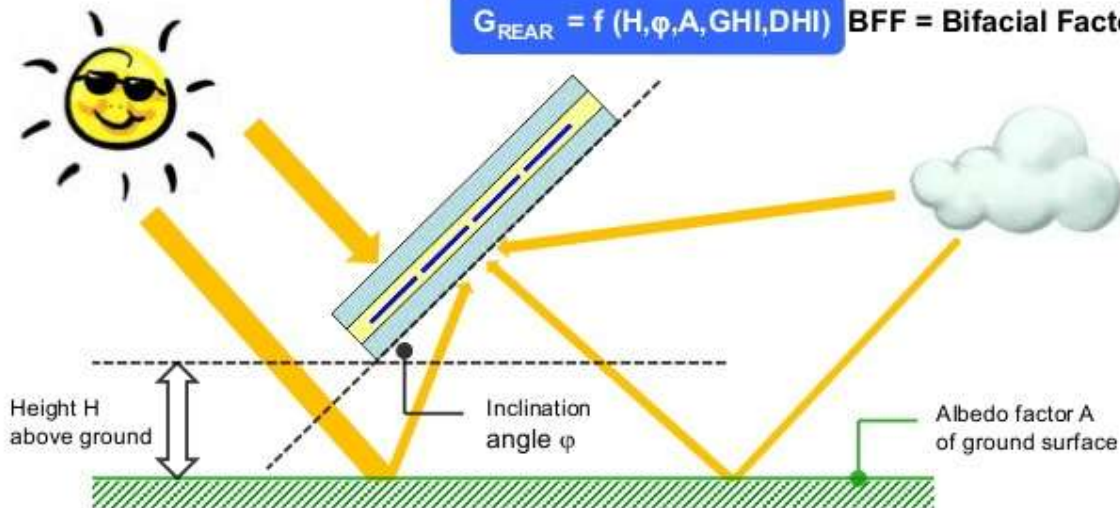


From a bifacial point of view...

$$PR_{bi} = \left(\sum_k P_{out,k} \times \tau_k \right) / \left(\sum_k \frac{P_0 \times (G_{i,k} + \varphi_{Pmax} \times G_{i,k}^{rear}) \times \tau_k}{G_{i,ref}} \right)$$

Direct sunlight to front side $\rightarrow I_{FRONT} = I_{STC} \times (1 + \alpha \times (T - 25^\circ C)) \times G_p / 1000 \text{ W/m}^2$
 Reflected sunlight to rear side $\rightarrow I_{REAR} = I_{STC} \times (\dots) \times G_{REAR} / 1000 \text{ W/m}^2 \times BFF$

$G_{REAR} = f(H, \varphi, A, GHI, DHI)$ BFF = Bifacial Factor



Variable, Changes

- Grass
- Dirt
- Rocks
- Gravels
- Snow

Voucher Testing Request 2

THE SOLAR RESOURCE BIFACIAL PERFORMANCE MODELS AND PARAMETRIC SENSITIVITIES

Albedo Testing comparison:

- Terra Pave White / White Albedo (**Eco-Friendly Cost-Effective**)
- Snow – Seasons variable
- White Rocks – Not Economical, Variable
- White Sands – Not Economical, Variable
- Dirt – Seasons variable
- Green Grass – Seasons variable

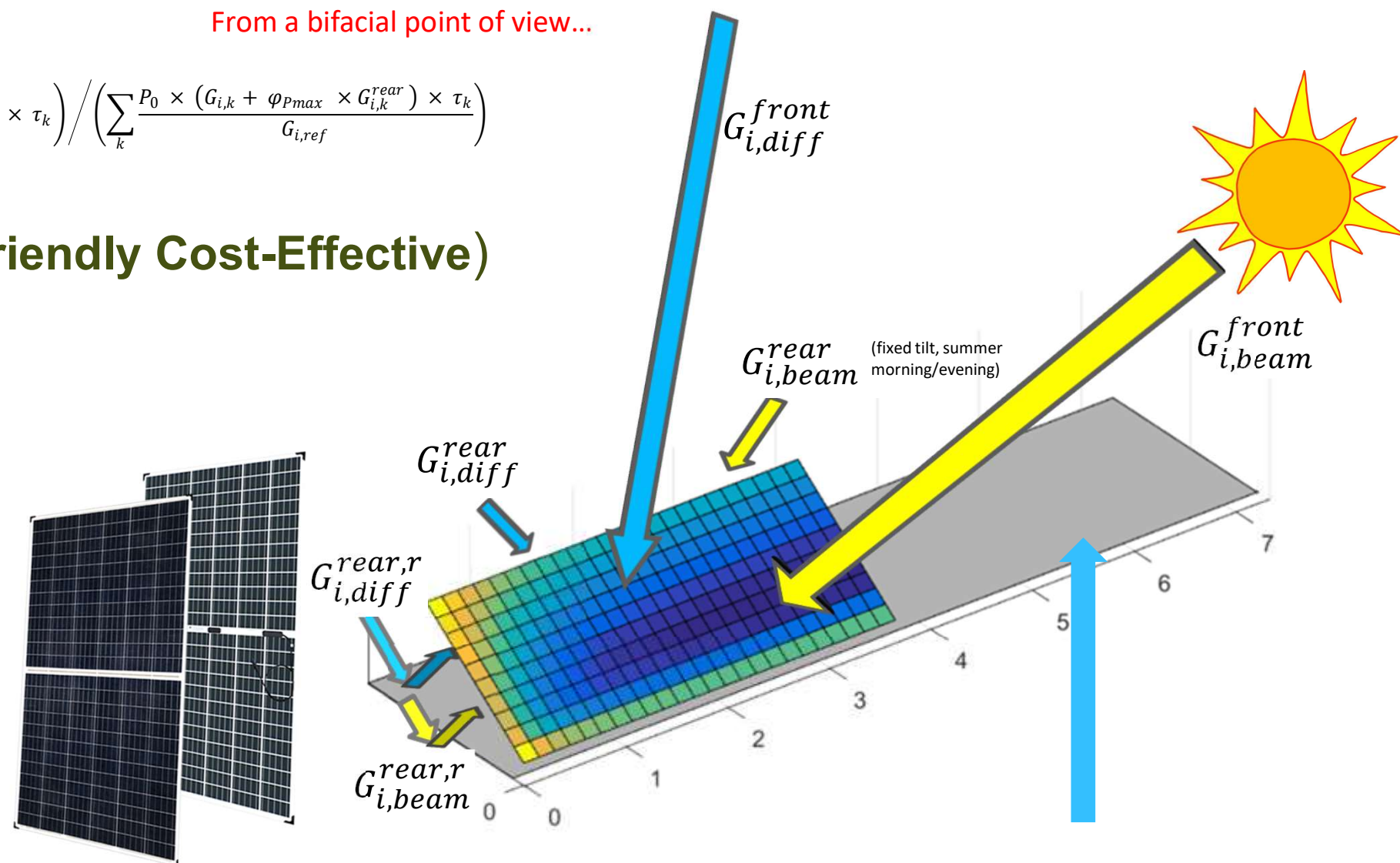
White painted concrete and concrete

* not eco-friendly and not economical



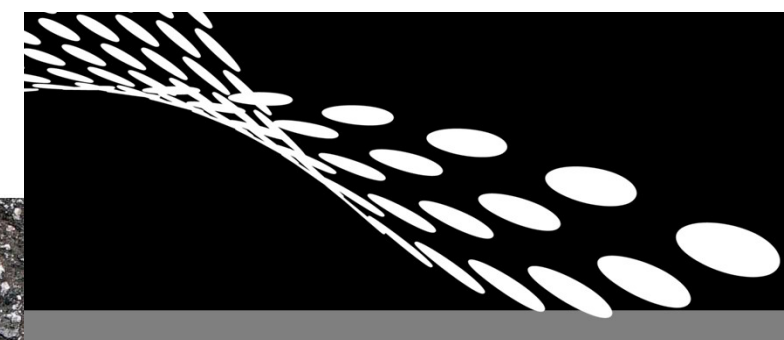
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TSW Terra Pave White & White with Improved Albedo

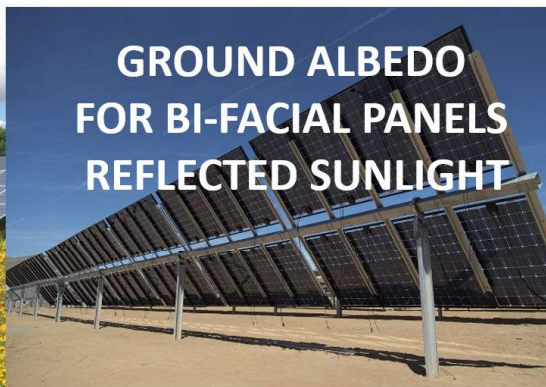
TERRA PAVE PRODUCTS ARE THE ECO-FRIENDLY COST-EFFECTIVE SOLUTIONS FOR THESE ISSUES FOR SOLAR FARMS



DIRT/DUST SOILING SOLAR PANELS



OVERGROWN WEEDS & VEGETATION



GROUND ALBEDO FOR BI-FACIAL PANELS REFLECTED SUNLIGHT



The **Eco-Friendly Cost-Effective** products (**Top-Seal White™**, **Top-Seal Black™**) were developed, manufactured in Austin, TX, tested on a small scale basis and then field applied and proven through testing with the Texas Department of Transportation (TXDOT), US Army, the City of Austin, TX and City of San Marcos, TX. The products have superior strength and binding properties, dries within an hour thus allowing work to be completed days and weeks ahead of schedule, have no odor or tracking issues and is much safer to workers and the environment. Product testing, done by San Antonio Testing Labs, a NELAP certified lab, following EPA approved test method shows that no detectable concentrations of volatile, semi-volatile, heavy metals or petroleum hydrocarbons.



TSWhite Albedo



Schematic of a system using bifacial modules

TERRA PAVE → ENVIRONMENTALLY SAFE

- ◆ NON-HAZARDOUS
- ◆ NON-CORROSIVE
- ◆ NON-PETROLEUM BASED
- ◆ NON-TOXIC

COST-EFFECTIVE

NO SPECIAL EQUIPMENT or HANDLING PROCEDURES REQUIRED

ECO FRIENDLY

ESTATES ECO International

made in USA

Top-Seal White™ & Top-Seal White™ Albedo: Durable Strong Low Maintenance, Eco-Friendly dirt/Dust/Vegetation Control, Bi-Facial panel reflection surface, strength is comparable to cement concrete, concrete pavement surfaces/road base replacement.

Top-Seal Black™: Durable/low maintenance, eco-friendly asphalt pavement surfaces replacement, excellent to prevent the penetration of water and air into the pavement surfaces, increase surface friction thereby shortening braking distance.