

Webinar powered by Soltec

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5 PM - 6 PM | CEST, Berlin

8 AM - 9 AM | PDT, Los Angeles

10 AM - 11 AM | CDT, México City

11 AM - 12 PM | EDT, New York



Marian Willuhn

Editor | pv magazine



Albedo enhancing materials - Striving for highest cost-efficiency of bifacial tracker arrays



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**Making Tracks,
Building Trust**

Striving for highest cost-efficiency of bifacial tracker arrays

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Striving for highest cost-efficiency of bifacial tracker arrays

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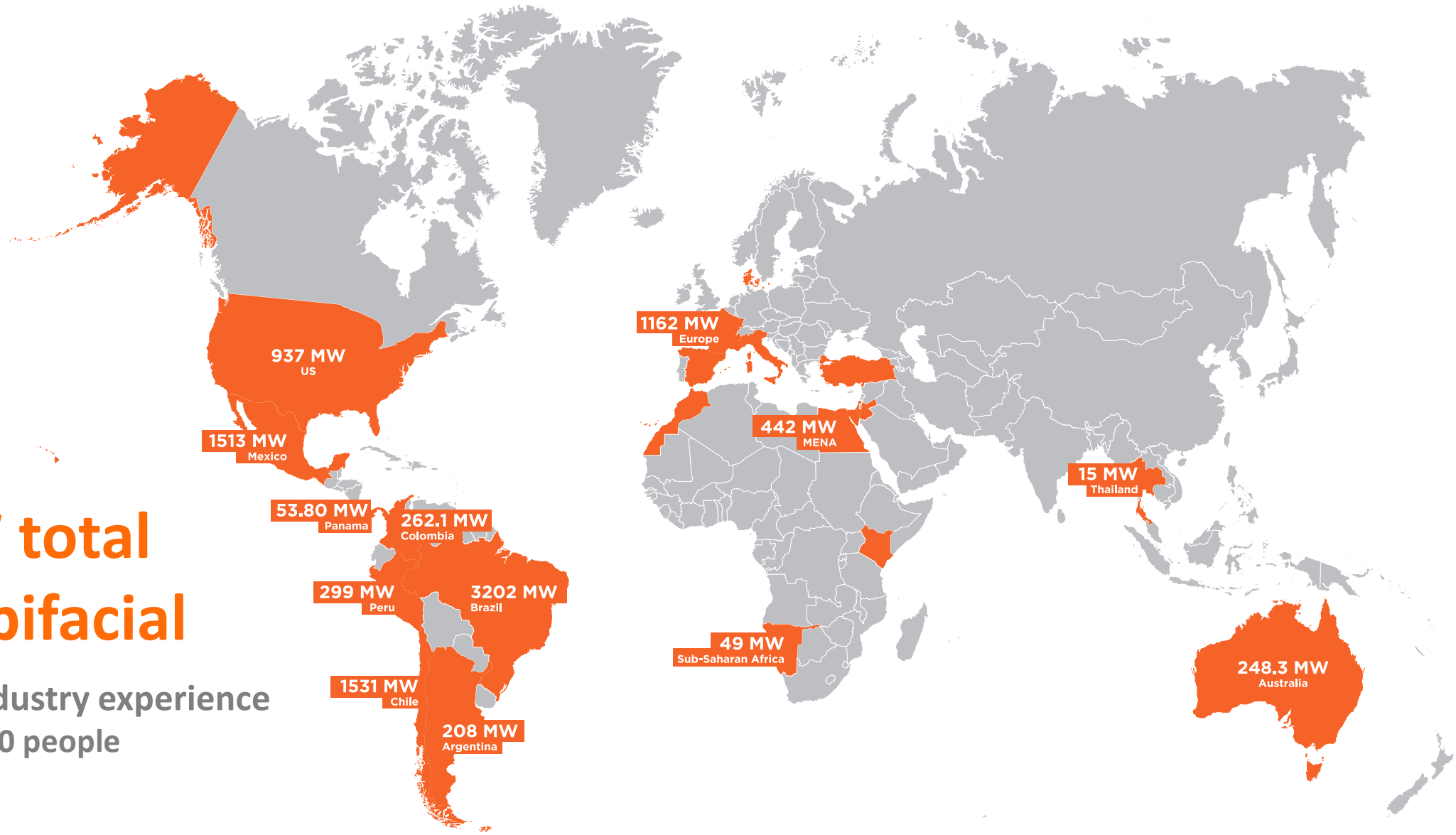
1. Introduction and Track Record
2. Bifacial Experience
3. Bifacial PV Plant Design Considerations
4. Conclusions



1. Introduction and Track Record

10+ GW total
3+ GW bifacial

16 years of industry experience
More than 1,600 people



2. Bifacial Experience

● 2015



'La Silla' solar plant (Chile), 2015. Soltec produced **the first solar tracker specifically designed for bifacial modules** installed in a utility scale solar plant. **Bifacial Gain = 13.3%**

● 2017



Soltec launches SF7 Bifacial Single-Axis Tracker.

- Higher mounting height
- Shadow-free backside
- Wide-aisle reflecting surfaces

● 2018

Soltec Leads with the World's First Bifacial Tracking Evaluation Center

BiTEC (Bifacial Tracker Evaluation Center) measures bifacial performance and its effect on yield.

Bifacial Gain = 7.3% to 15.7%

● 2019-2020

3+ GW SF7 Bifacial in projects worldwide

Sao Gonçalo I-Brazil (475 MW), Cluster MG-Brazil (118MW), Tlaxcala Mag II-Mexico (219,6 MW) among others.



3. Bifacial PV Plant Design Considerations

- a) Overview: Design Proposal
- b) Ground Coverage Ratio (GCR)
- c) Maximum Tracking Range
- d) Cooling: Tracker Topology
- e) TeamTrack
- f) DC-AC Ratio
- g) Albedo Enhancing Materials
- h) Module technology



3. a) Overview: Design Proposal

Bi-facial: New vision for a PV plant design

Monofacial tracking PV plant Vs. Bifacial tracking PV plant


	Same peak power	Same production
Peak power	50.00 MWp	43.86 MWp
Module units	=	↓ 12%
Module price	↑ 2,6%	↓ 10%
Tracker units and price	=	↓ 12%
DC-AC-MV	↑ 10%	=
Labour structure	=	↓ 12%
Civil Works	=	↓ 12%
Labour DC	=	↓ 12%
kWh/year	↑ 14%	=
Final price	↑ 3%	↓ 10%

Case: Albedo: 40%, GCR: 0.33 → Bifacial Gain: 14%

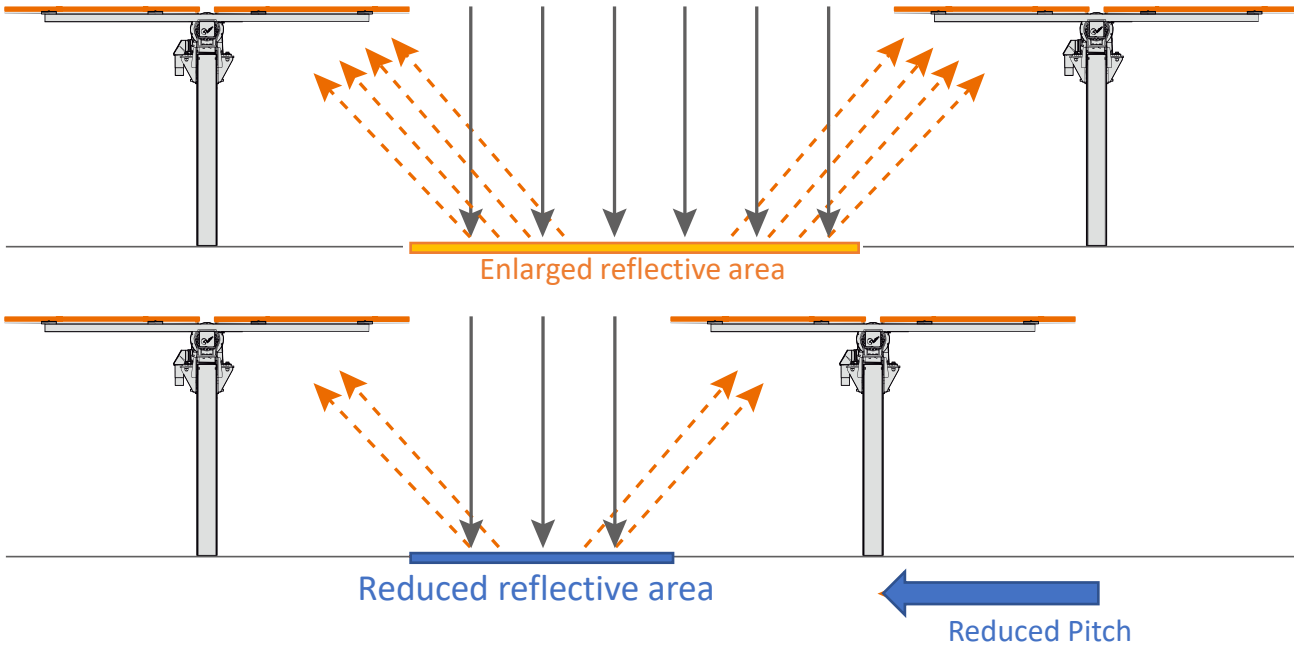
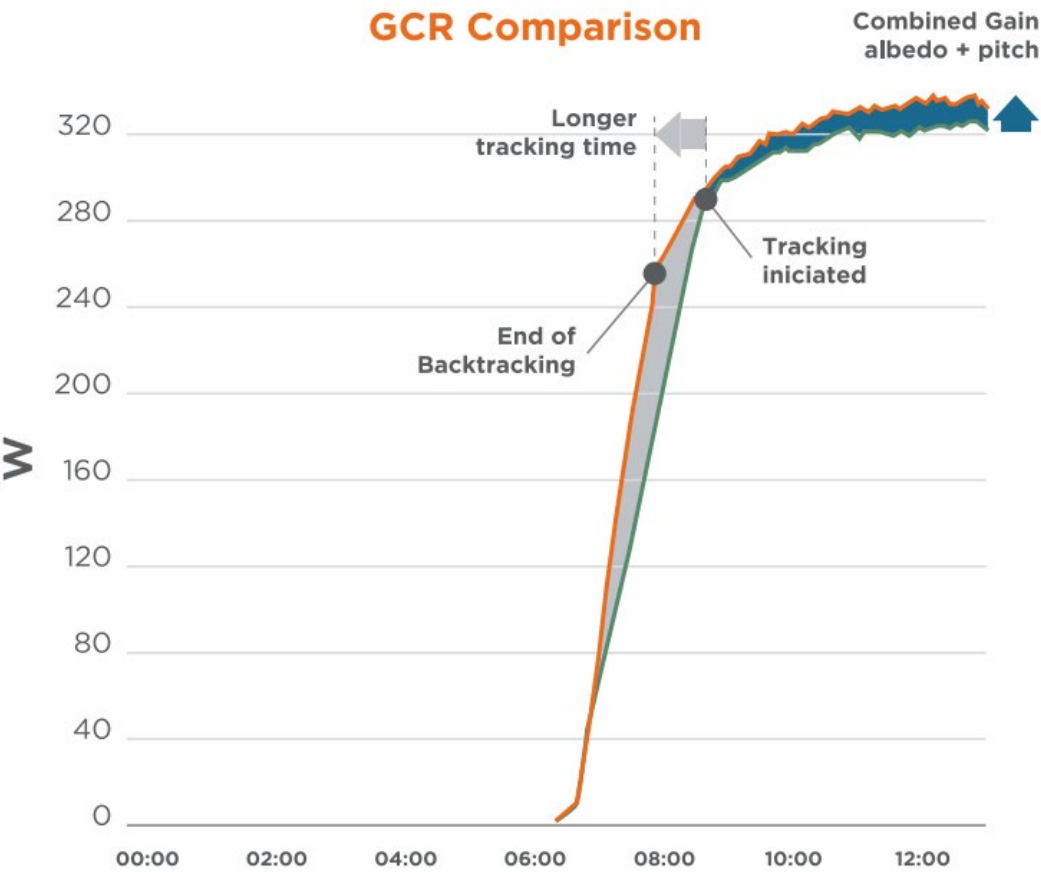
+
Energy production
kWh/kWp

Vs.

Smaller plant
— KWp for = kWh

- 
- Lower GCR
 - Less structure
 - Less cable
 - Better price for installation

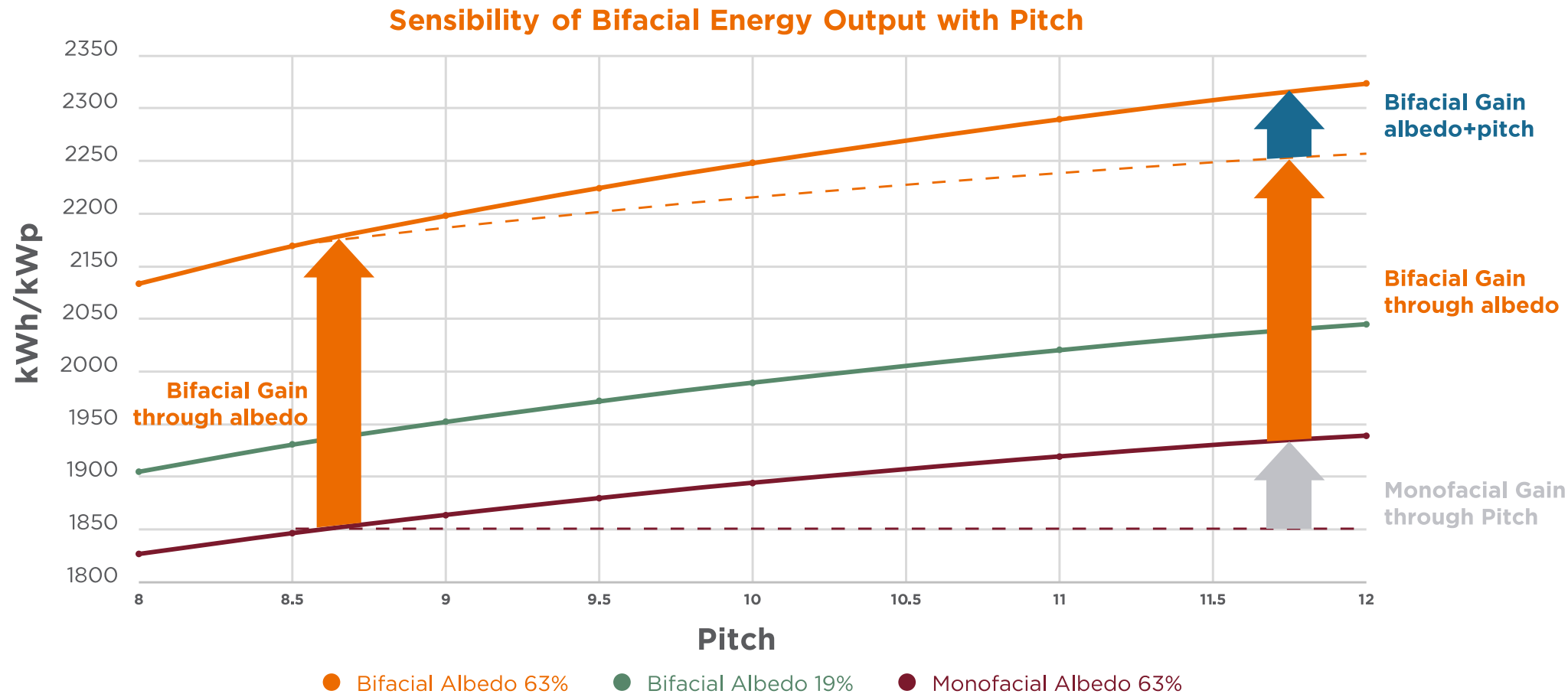
3. b) Ground coverage Ratio (GCR) - Pitch increases Bifacial Gain



Pitch	8.7 meters	10 meters	12 meters
Bifacial Gain	9.49%	12.11%	14.58%
Δ	-2.62%	Baseline	2.47%

Pitch increases daily tracking period and enlarges reflectance area

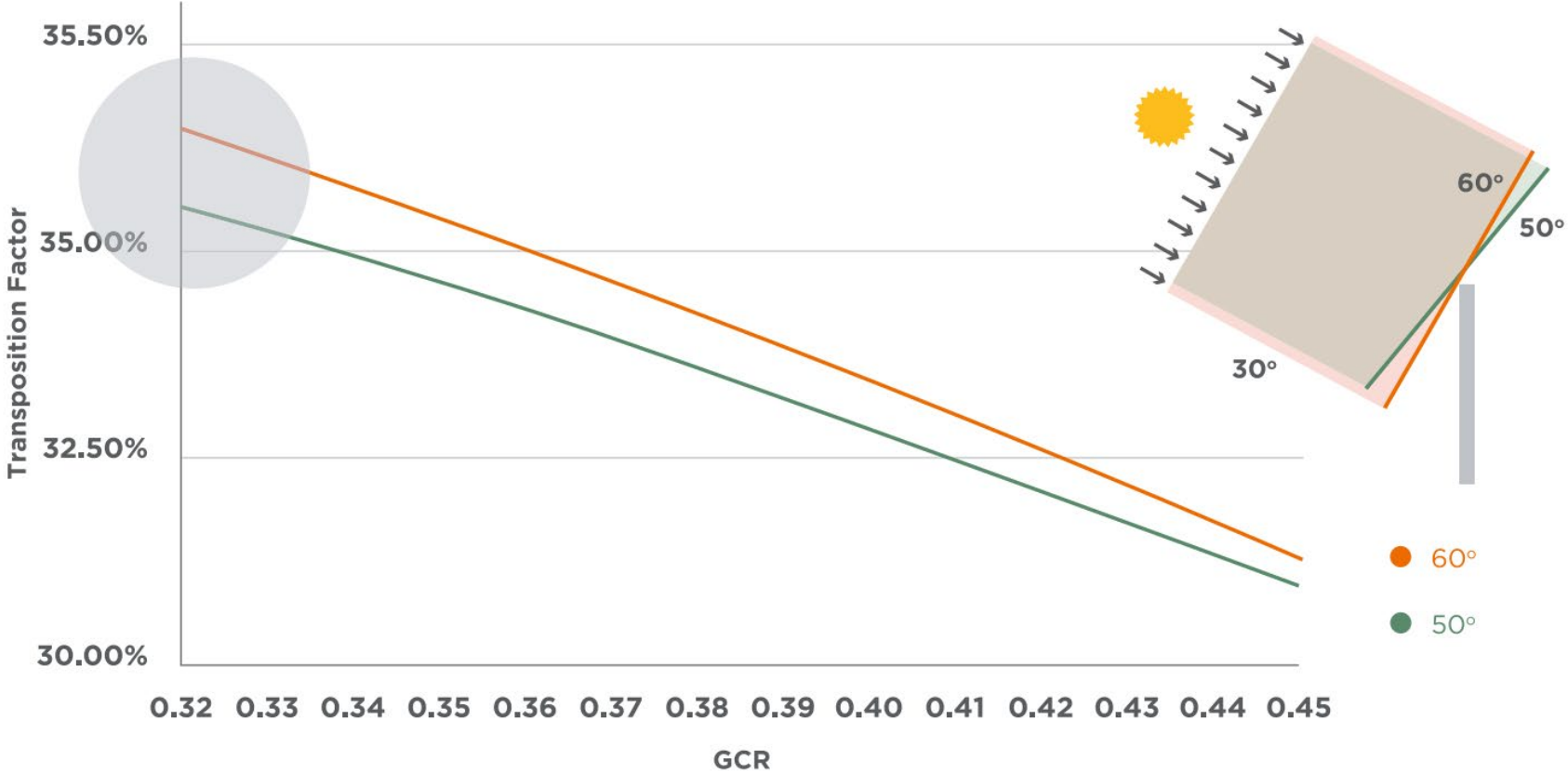
3. b) Ground coverage Ratio (GCR)



Monofacial with more pitch	= more tracking period	=	more energy Yield
Bifacial with more pitch	= more tracking period + more bifacial gain	= much	more energy Yield

Note: Higher power density promotes higher pitch lay out

3. c) Maximum Tracking Range



Pitch (m)	Tracking Angle (°)	kWh/kWp/ year	Diff
12	60	2046	+0.40%
12	50	2038	

Maximum tracking angle means:
Increase tracking time, reducing
non-oriented time (backtracking)

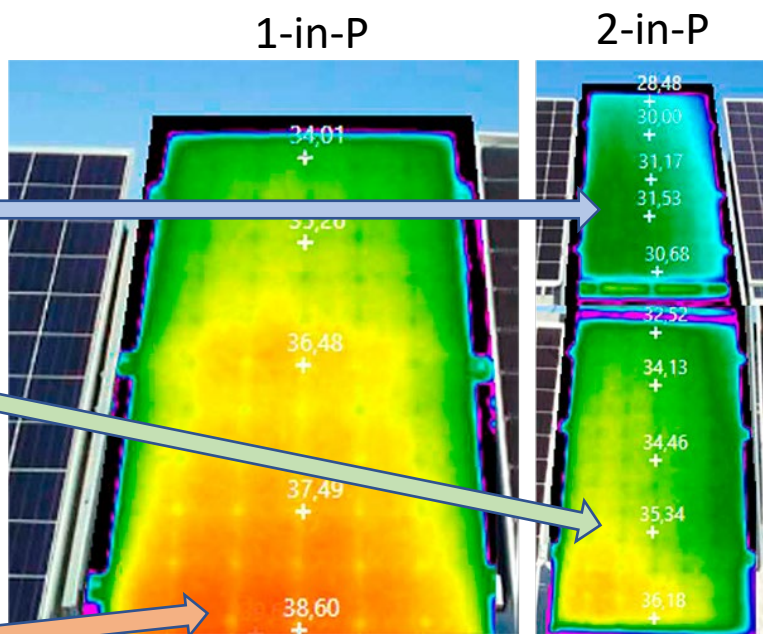
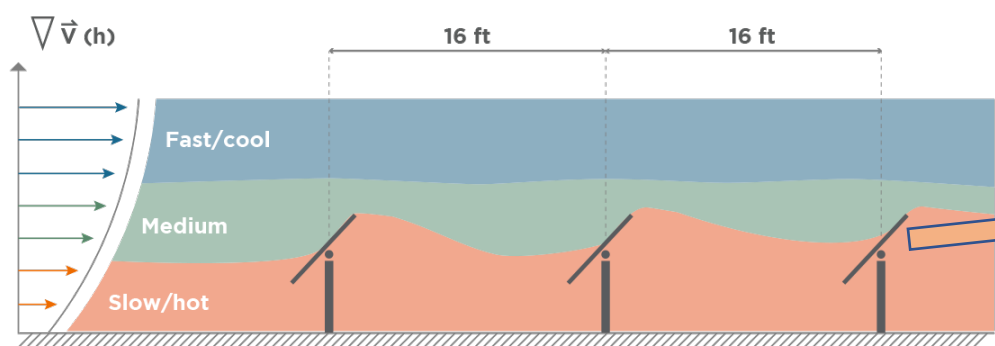
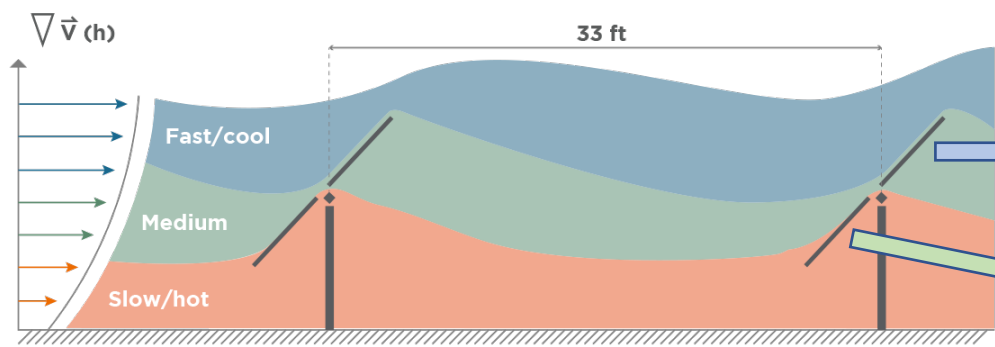
Synergy between tracking range
and pitch in bifacial:

The more pitch, more diffuse
radiation for back-side and
longer tracking time

The more tracking range, more
direct radiation for front-side

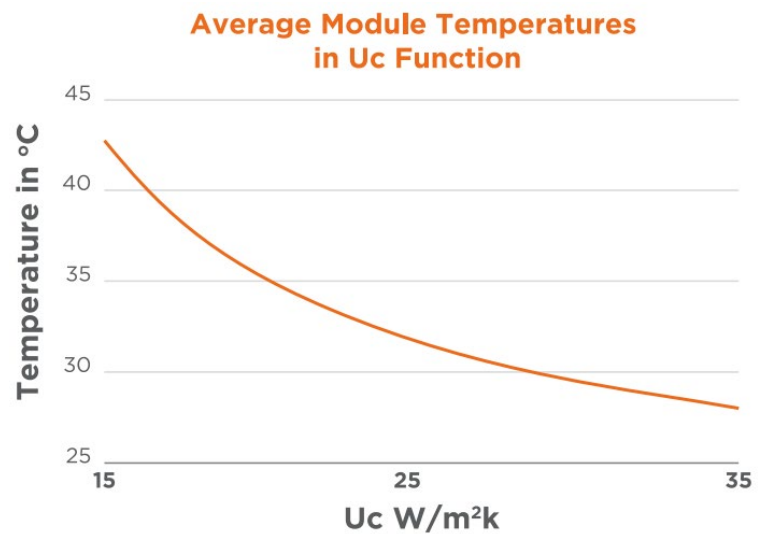
Note: Higher energy density of bifacial trackers allows higher pitch lay out.
Typically the bifacial plants are deployed with higher pitch.

3. d) Cooling: Tracker Topology



GCR 40%	Pitch	Average Temp.	ΔT	Δ Energy
1P Tracker	5 m	33.96°C	3.52°C	1.3%
2P Tracker	10 m	30.44°C		

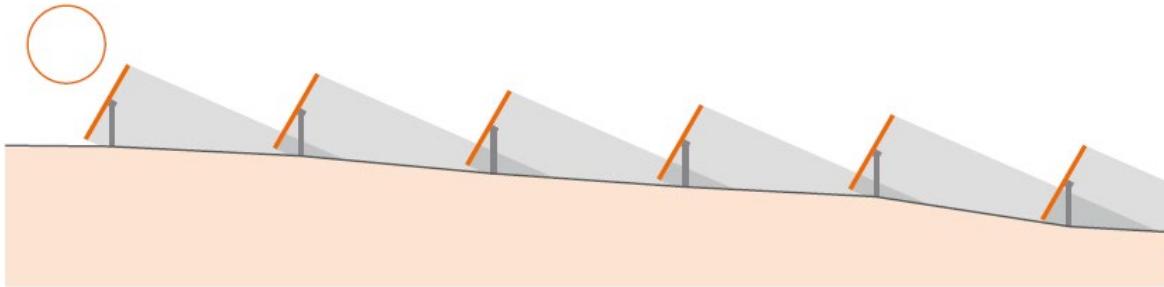
Higher module and pitch promotes better cooling.
Cooling reduces module temperature and increases energy yield.



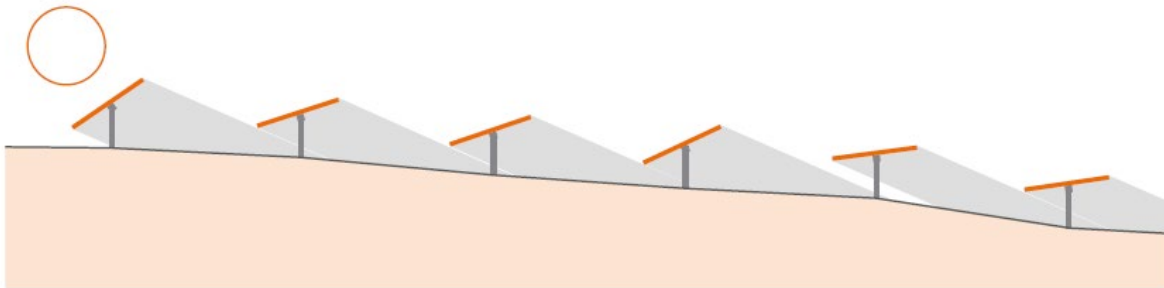
3. e) Team Track

TeamTrack is part of comprehensive SF7 tracker position control that avoids inter-row shading in the early and late-day hours due to uneven terrain influences

Standard tracking



Soltec TeamTrack



- + TMS monitoring of tracker position angles
- + Target Command issues tracker position angle updates
- + TeamTrack layout parameters are uploaded to the system during commissioning
- + Inter-row shading is avoided, and yield-gain achieved



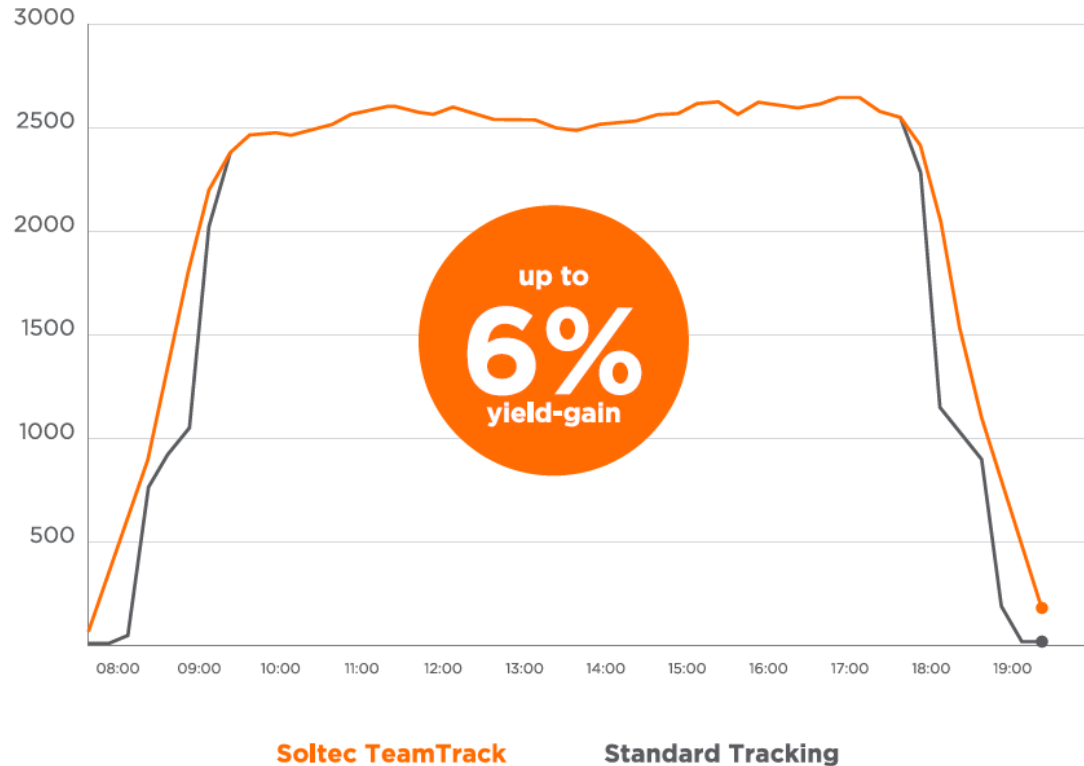
TeamTrack achieves up to 6% yield-gain over standard tracking.

- Tracker Control with no blind spots
- Yield-gain 3D modelling
- Project Cost Control
- SF7 Synergy

3. e) Team Track

Project Cost Control

TeamTrack stands out from existing solutions that add equipment and feedback response mechanisms, that add cost and vulnerability. TeamTrack enables cost reduction in earth-grading on contours and steps. TeamTrack is zero maintenance and provides for hardware independent software update.



- + 5% yield density over gap-trackers
- + 4% yield density over linked-trackers
- + Bifacial boost drop-in alternative
- + Up to 2% yield-gain on 120°+ tracking

SF7 Standard features also include:

- 46% less piles per MW
- 17% less parts count
- 58% less screw connections
- 30-second module fastening
- Superior self-powering with no auxiliary PV module
- Wireless, NFC, and TMS technology
- Double-wide access aisles

+5% MWh per hectare

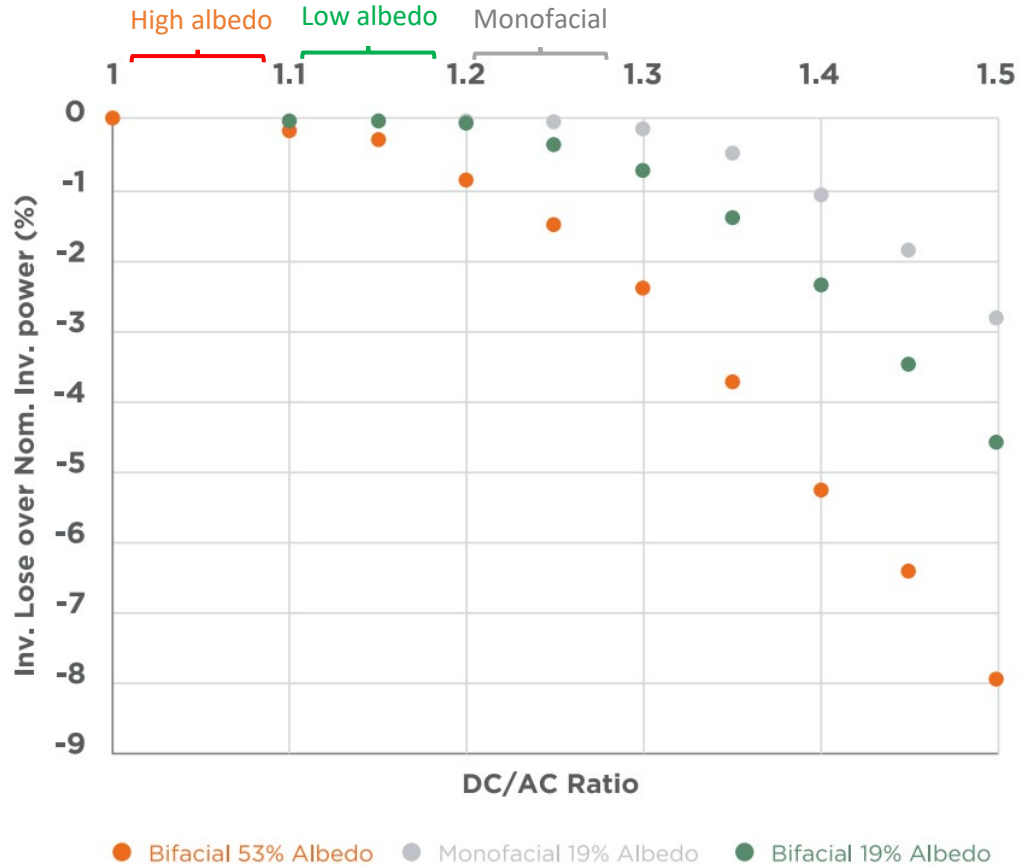


SF7 Synergy

TeamTrack takes its place in SF7 synergies with site-dependent yield-gain of up to 6% that combines with other standard yield-gain elements on SF7:

3. f) DC-AC Ratio

Bifacial modules required higher AC nominal power

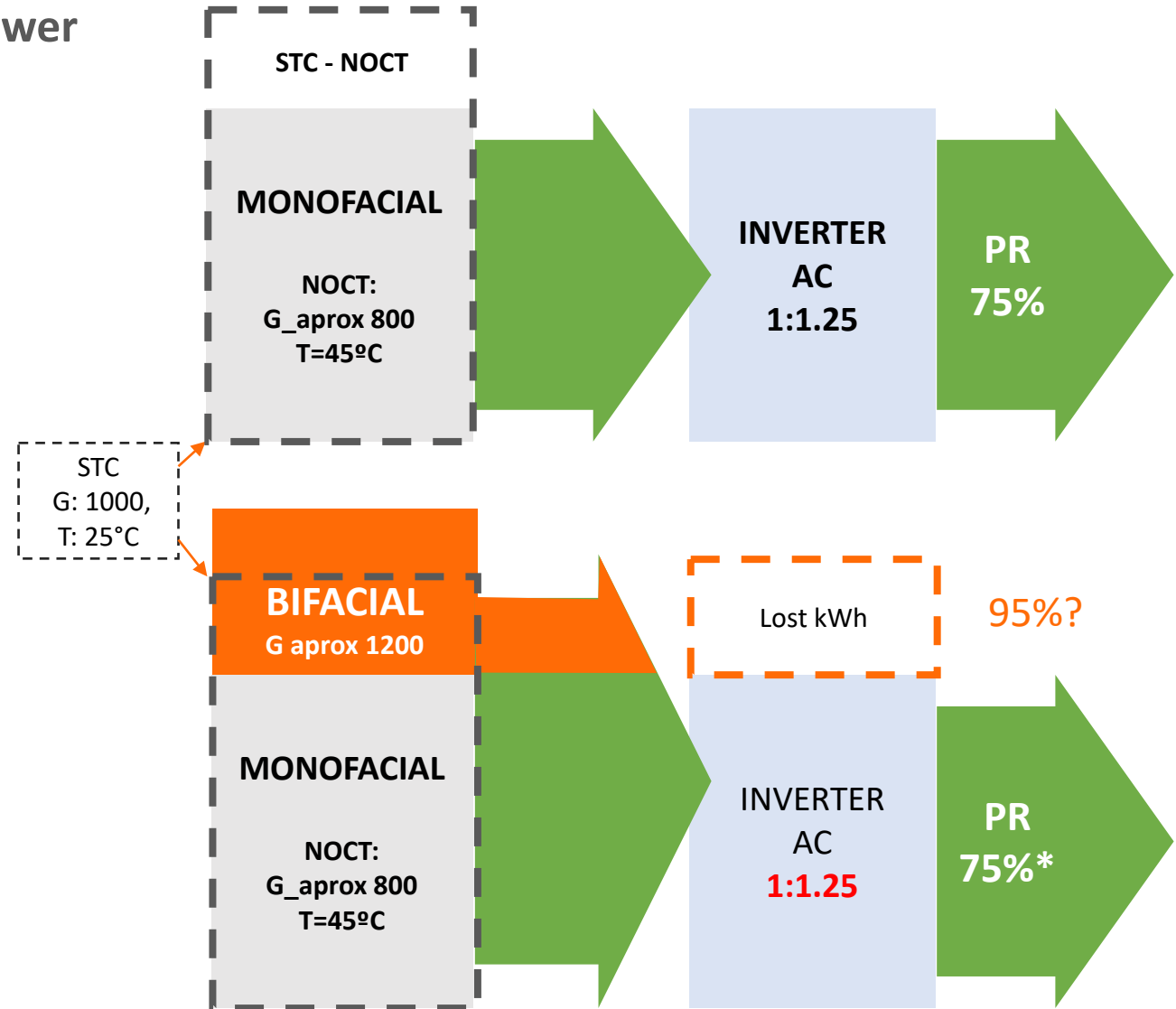


Bifacial power is not included in nominal power (Wp)
Bifacial extra-gain should not be capped in inverter
DC-AC ratio depends on albedo

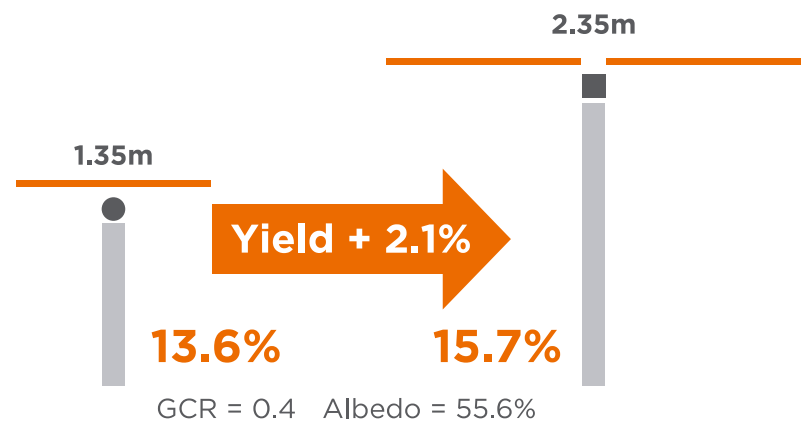
* Typical PR expected for optimal bifacial plants $\approx 95\%$

DC: Peak power

AC: operation power

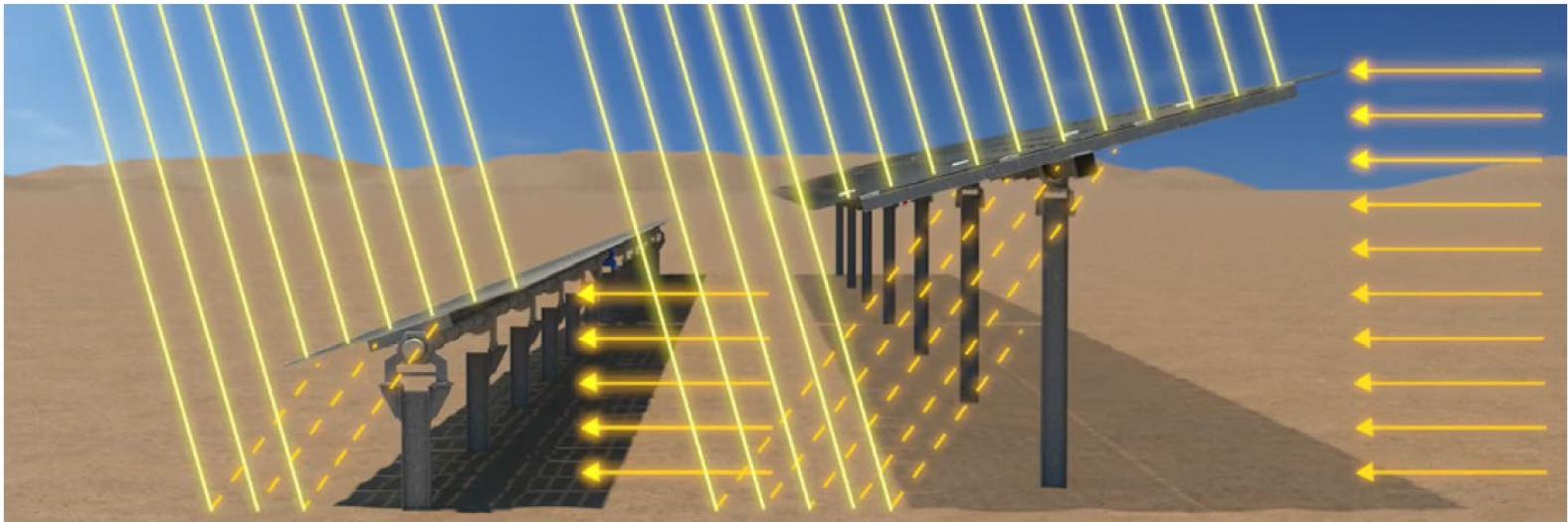


3. g) Albedo Enhancing Materials (AEM) - Tracker topology



1P Standard tracker	Measured Bifacial Gain	2P SF7 Bifacial
16.8%	Fall	19.2%
12.6%	Winter	14.3%
11.2%	Spring	13.1%
13.7%	Summer	15.8%
13.6%	Year	15.8%

BiTEC – Full Year of Field Data 1P vs 2P

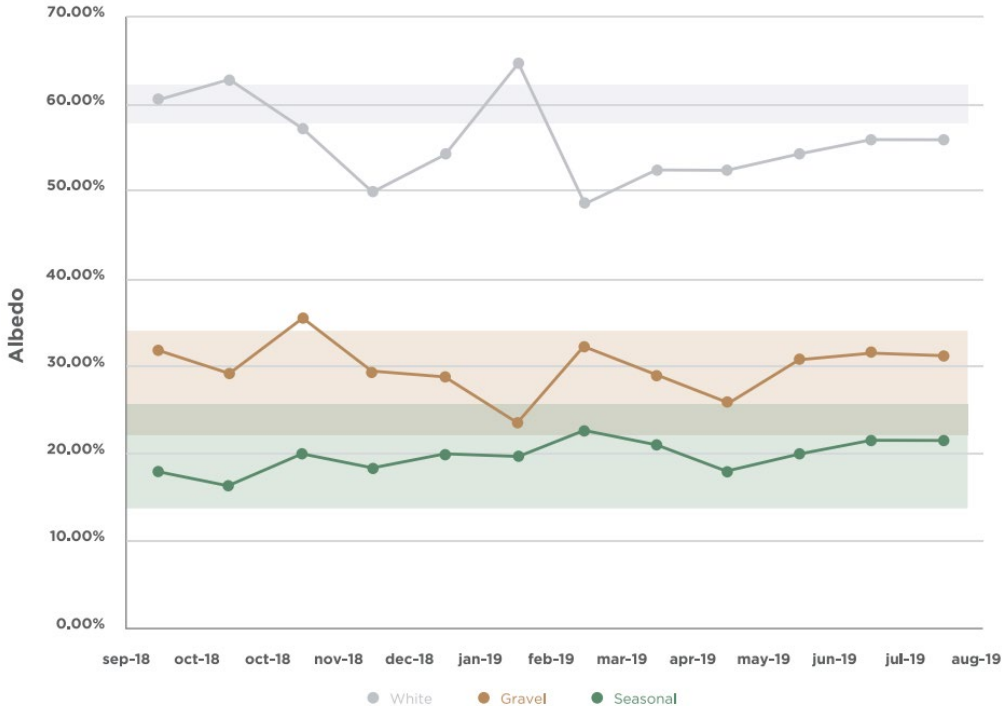


Test Considerations:

- Results based on energy performance at module level
- Only internal Trackers considered (avoid effect of higher diffuse on external Trackers)
- Only central modules considered (avoid effect of higher diffuse on edge modules)
- Results expected to be the average for large utility scale plants
- Geotextile AEM

3. g) Albedo Enhancing Materials (AEM)

- Soil Albedo: Seasonal



BiTEC – Full Year of Field Data

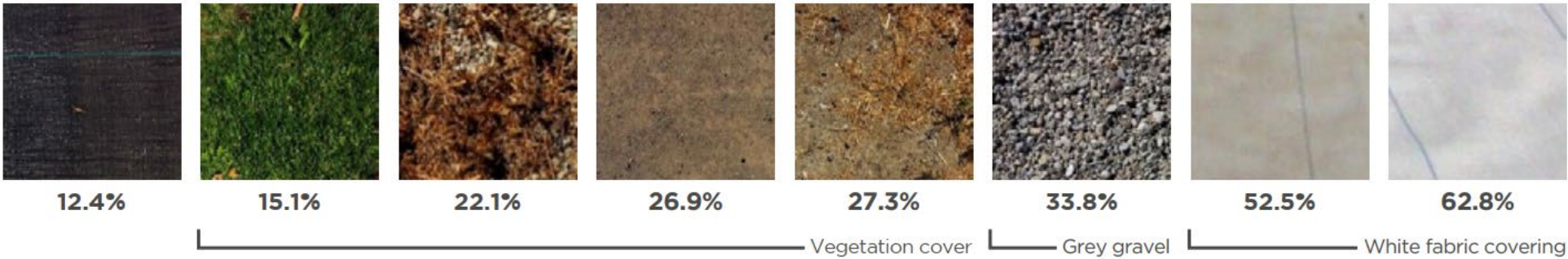
Fall	Winter	Spring	Summer
7.9%	6.5%	6.1%	7.2%

Energy Yield on Bifacial depends on albedo
Natural soil albedo varies with time

Natural soil seasonal Evolution



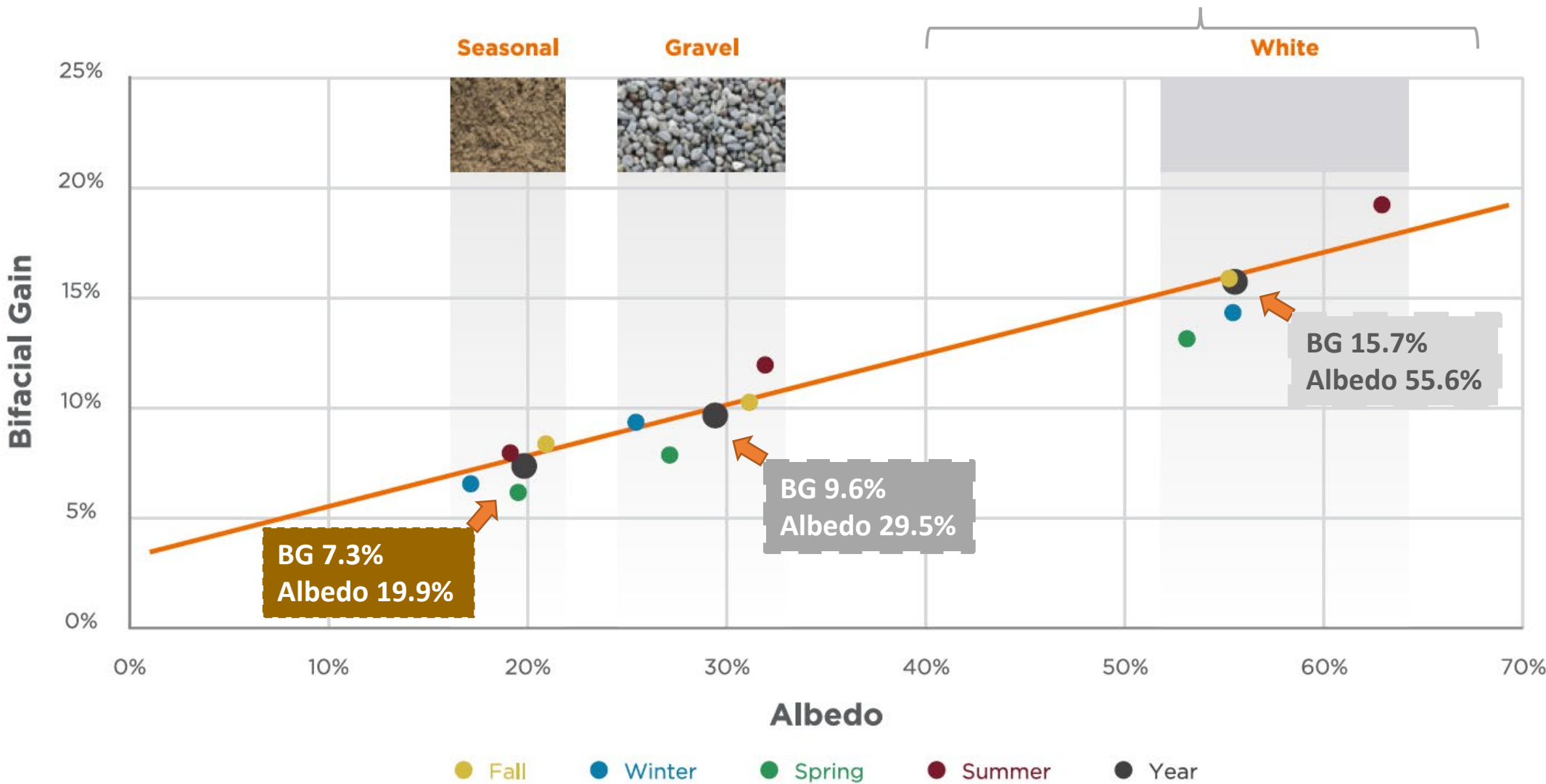
Albedo Enhancing Materials



3. g) Albedo Enhancing Materials (AEM)

- The Bifacial Year – Bifacial Gain Results

AEM -> BG
from 10% to 25%



3. h) Module technology

Important Parameters:

- Module **Bifaciality**: ranges from 60 to 90%
- Module **Transparency**: ranges from 3 to 5%
- **Cell Technology**: HJT vs PERC p-type
 - Temp coeff: $-0.12\%/^{\circ}\text{C}$
 - LeTID/LID. Different behaviour

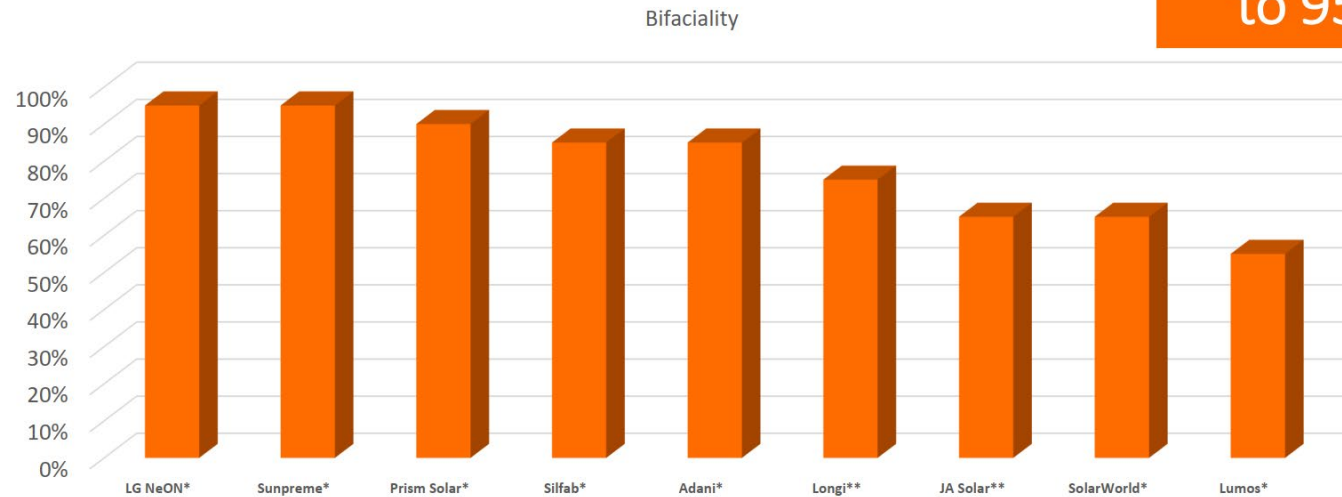
→ up to 6% more yield (high albedo)

→ up to 1.5% more yield

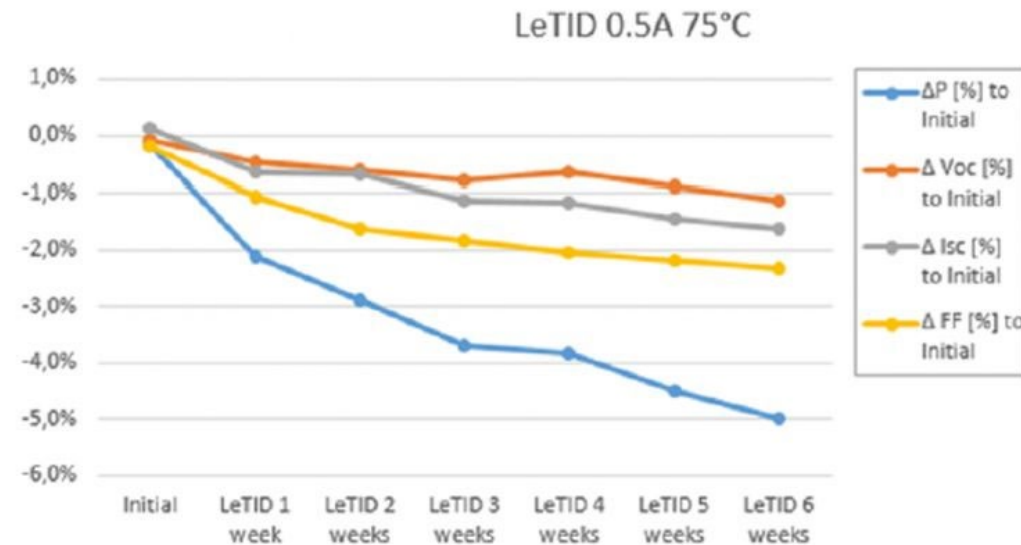
→ up to 2.4% more yield

→ up to 5% more yield

Bifaciality: Module selection

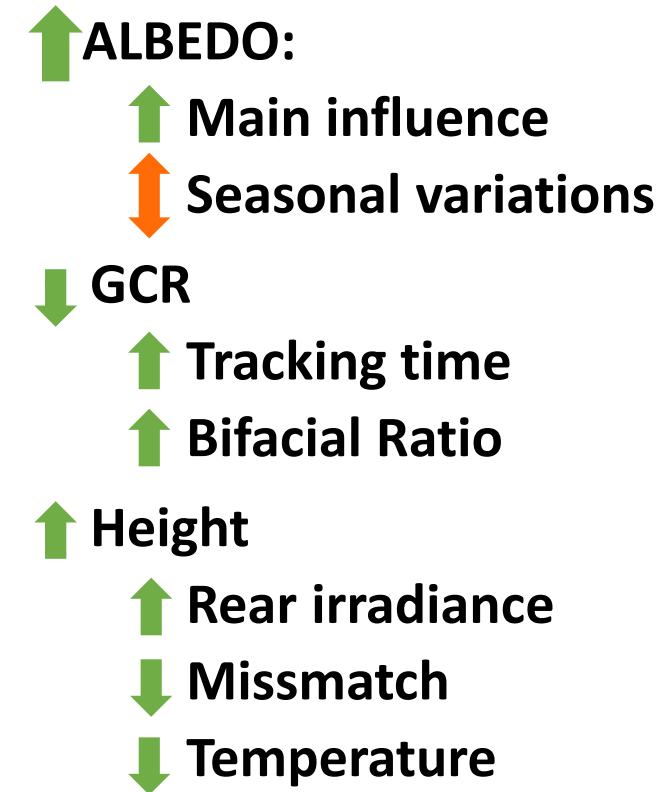


* Info from Bifacial PV Systems Solar Professional Magazine



8. Conclusions

- Experience:
 - 5 years since the first commercial Bifacial Tracker: La Silla Plant, BG = 13.3%
 - 1 FULL YEAR of BiTEC performance* data: September 2018 - August 2019
 - Bifacial Gain of 15.7% for SF7 bifacial with albedo 55% and 7.3% under seasonal albedo
 - Bifacial Gain for 2P SF7 Bifacial is 2.1% higher than 1P tracker
 - Biggest Bifacial Plants with Soltec Trackers: Magdalena II: 219.5MW & Sao Gonçalo: 608.67 MW
- Bifacial PV plant Design key factors:
 - Less Peak Power with same yield \leftrightarrow More yield with same peak power
 - GCR: Higher pitch \rightarrow More bifacial gain
 - Higher tracker means better cooling \rightarrow Increase yield
 - Higher Tracking Range \rightarrow more tracking time
 - DC-AC Ratio should be reduced with high albedo for bifacial plants
 - SF7 TeamTrack algorithms increase yield up to 6%
 - Soil Albedo & AEM increase sensibly energy yield \rightarrow from 7.3% to more than 15.7%
 - O&M is relevant for bifacial performance: Trackers' design can ease O&M tasks (2P vs 1P)



Thank you!
Any questions?

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Building Trust**