



**Soltec**

# **Bifacial PV Tracking**

## **Designing Bifacial PV projects**



# Soltec bifacial: evolution

● 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.



● 2017

Soltec launches SF7 Bifacial Single-Axis Tracker.

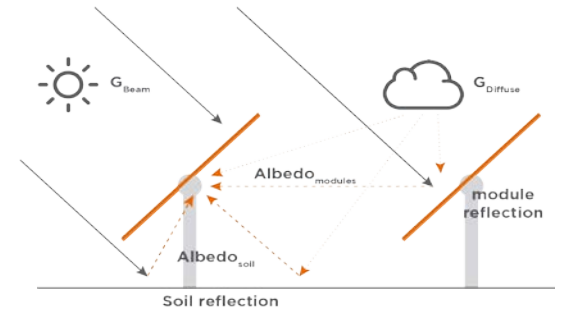
- Higher mounting height
- Shadow-free backside
- Wide-aisle reflecting surfaces

● 2018

Soltec Leads with the World's First Bifacial Tracking Evaluation Center → **BiTEC (Bifacial Tracker Evaluation Center)**

BiTEC measures bifacial performance and its effect on yield from different variables:

- Modules: performance comparison
- Tracking systems Vs. Fix-tilt systems
- Albedo from different soil types
- Influence of pitch (GCR): comparison
- Influence of tracker height: comparison
- Interferences losses: shading influence



● Soltec Supplies SF7 Bifacial Single-Axis Tracker to 17 MW PV Project in Israel

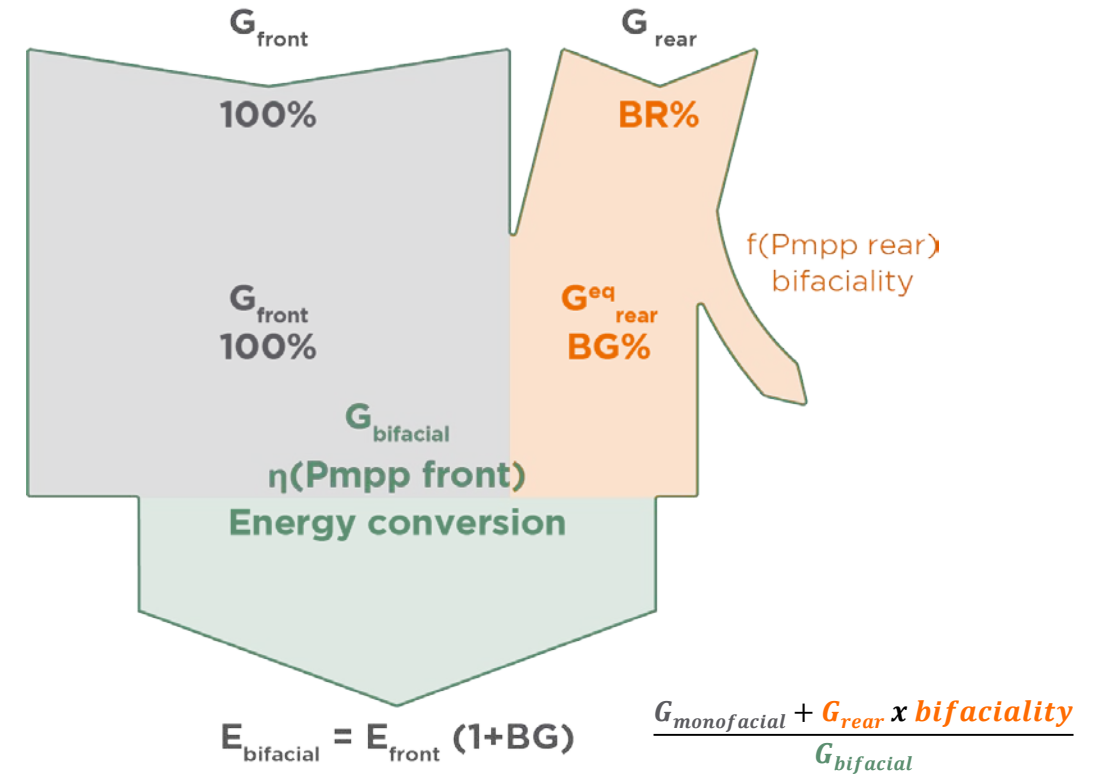
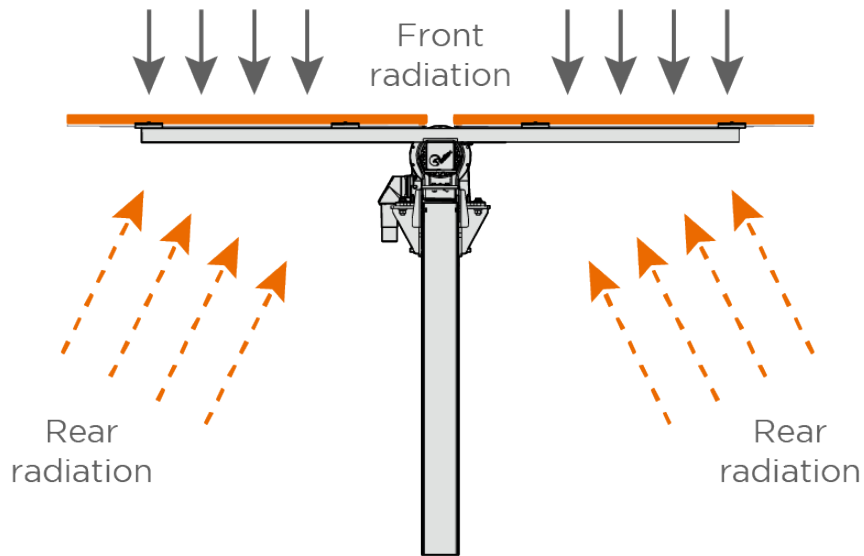
**1.1+ GW**

SF7 Bifacial contracted for 2019

# Energy gain: know it

$$E_{bifacial} = E_{monofacial} \times (1 + \text{Bifacial Gain})$$

$$E_{bifacial} = E_{monofacial} \times (1 + \text{Bifacial Ratio} \times \text{bifaciality})$$



$$\text{Module bifaciality} = \frac{P_{mpp rear}}{P_{mpp front}}$$

$$\text{Bifacial Ratio} = \frac{G_{rear}}{G_{front}}$$

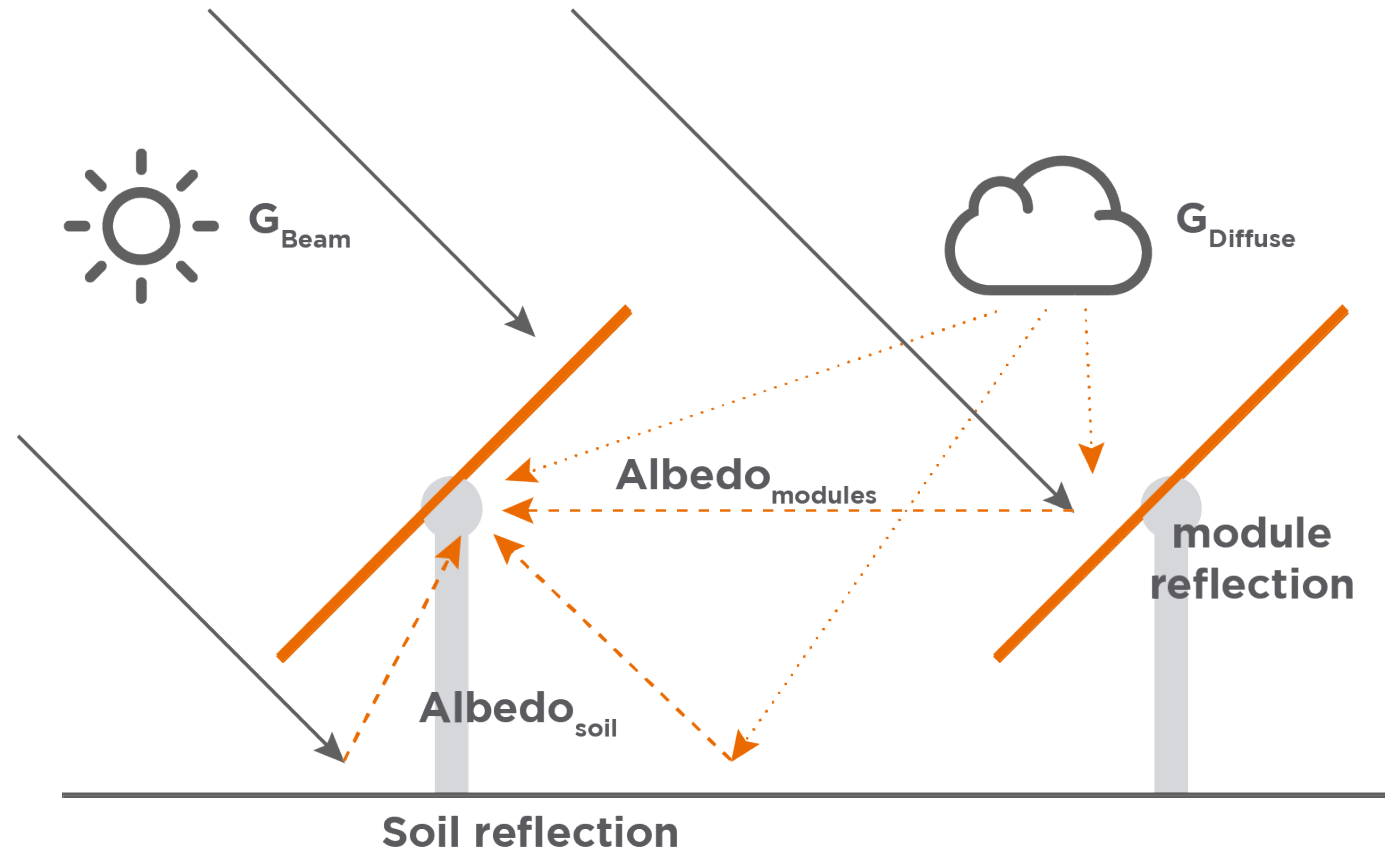
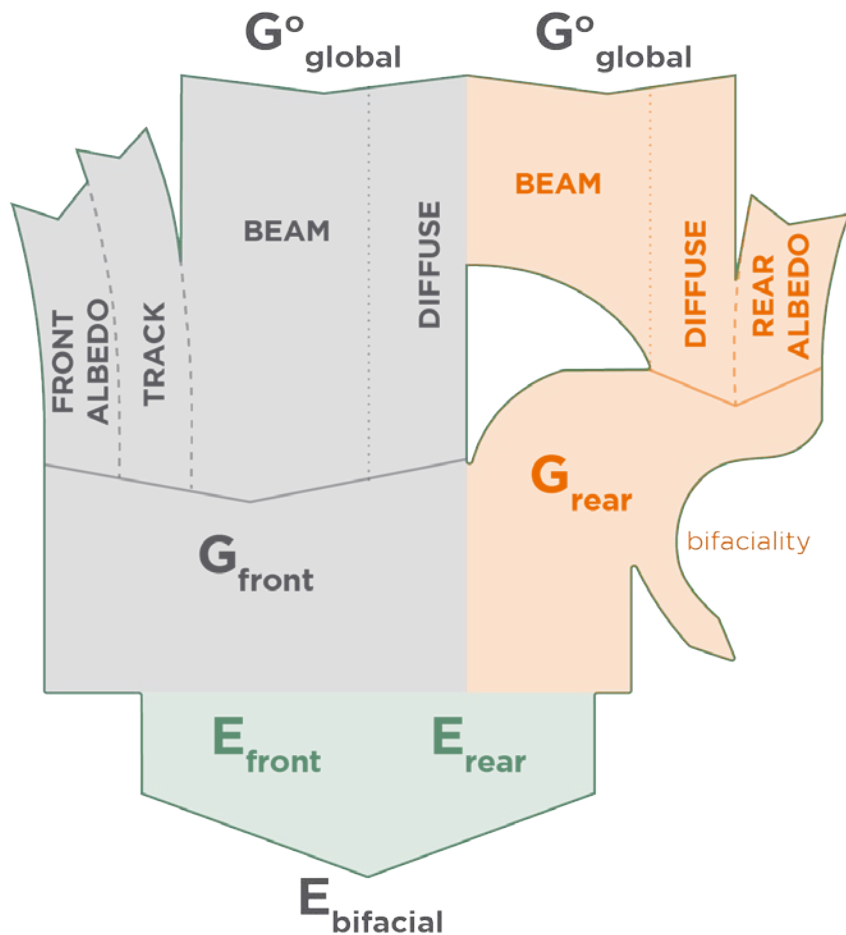
$$\text{Bifacial Gain} = \frac{E_{rear}}{E_{front}} = \frac{h \times G_{rear} \times \text{bifaciality}}{h \times G_{front}} = \text{Bifacial Ratio} \times \text{Bifaciality}$$

$$E_{bifacial} = E_{monofacial} \times (1 + \text{Bifacial Ratio} \times \text{bifaciality})$$

## Energy gain: know it

### Bifacial Ratio

$$G_{rear} = G_{diffuse} + G_{reflected}(albedo)$$





$$E_{bifacial} = E_{monofacial} \times (1 + \text{Bifacial Ratio} \times \text{bifaciality})$$

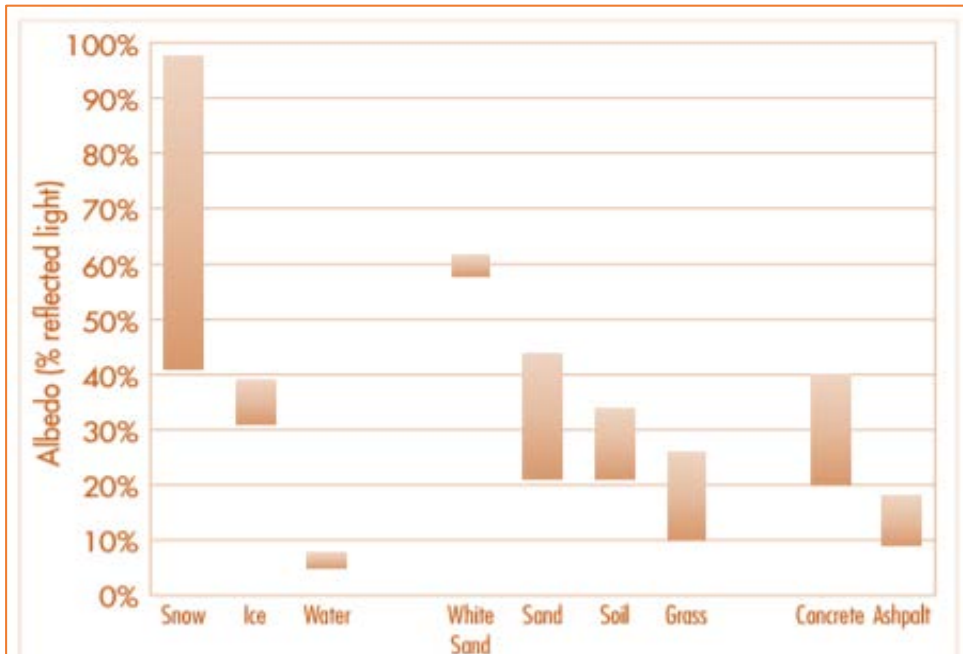
## Energy gain: maximize it

### Albedo

(Percentage of radiation reflected by a surface)

Soil surface: color and texture

↑ white and smooth → ↑ bifacial gain



Source: NREL

It can vary with seasons:



Best Case **Snow**

Good Case **White sand**

Medium Case **Ground-grass varieties**

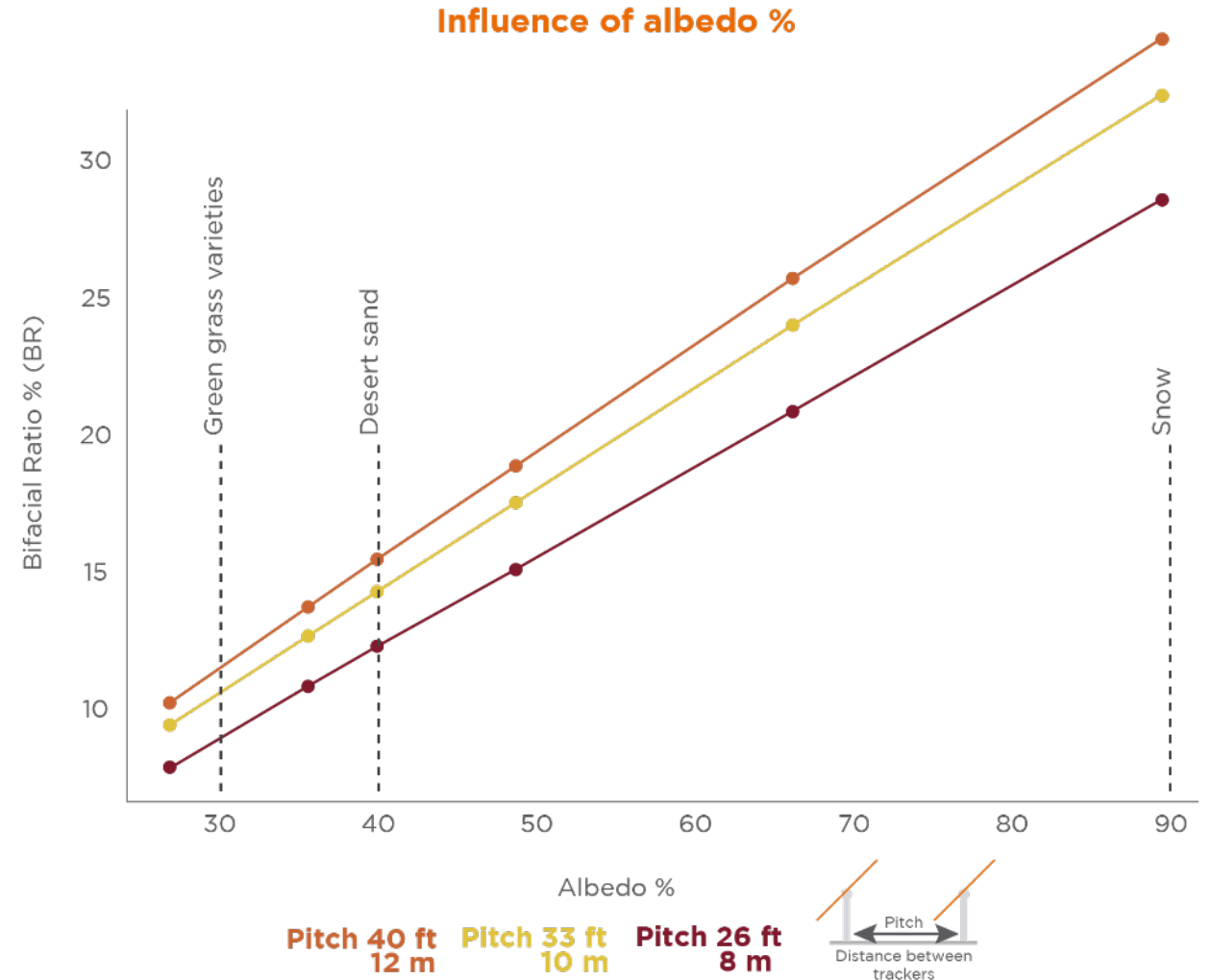
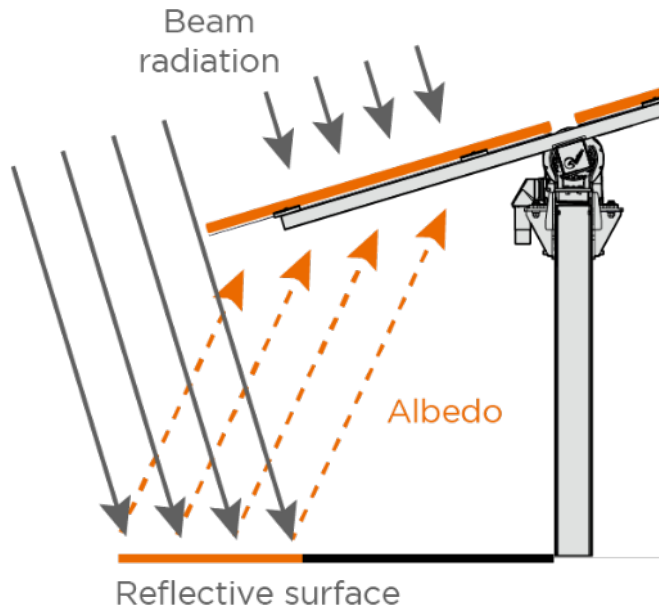
Worst Case **Volcanic Rock**

$$E_{bifacial} = E_{monofacial} \times (1 + \text{Bifacial Ratio} \times \text{bifaciality})$$

## Energy gain: maximize it

### Albedo: Soil surface (Bifacial Ratio)

- ✓ Surface's size between rows of trackers determinates the reflected surface.
- ✓ Approximately linear



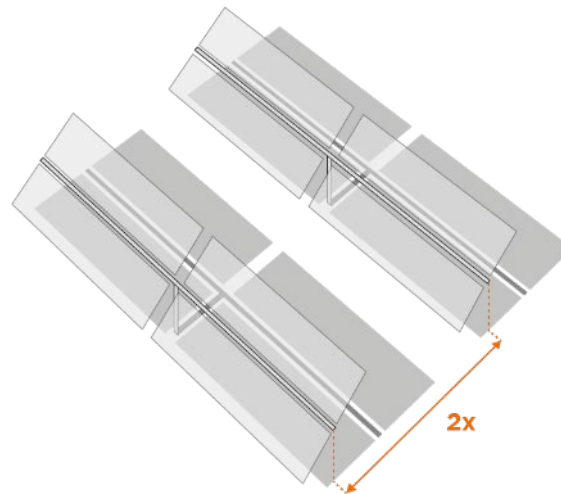
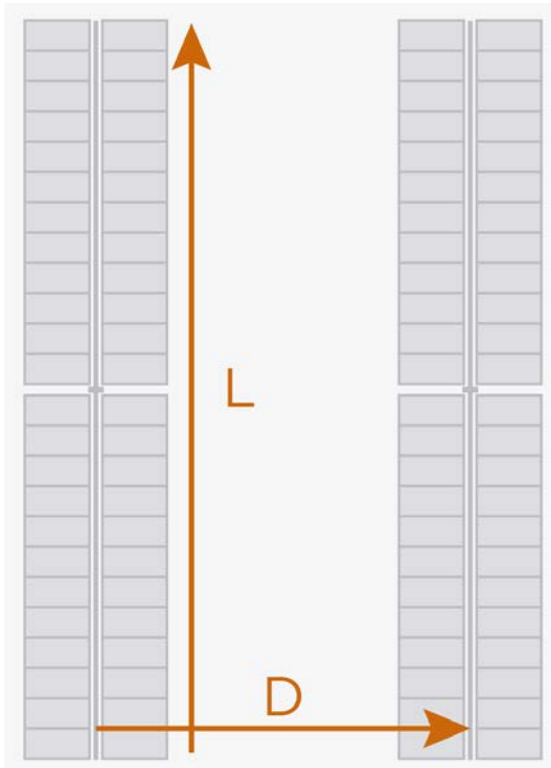
$$E_{bifacial} = E_{monofacial} \times (1 + \text{Bifacial Ratio} \times \text{bifaciality})$$

## Energy gain: maximize it

↑ Pitch => ↑ Reflected Area

↓ GCR => ↑ Bifacial Energy

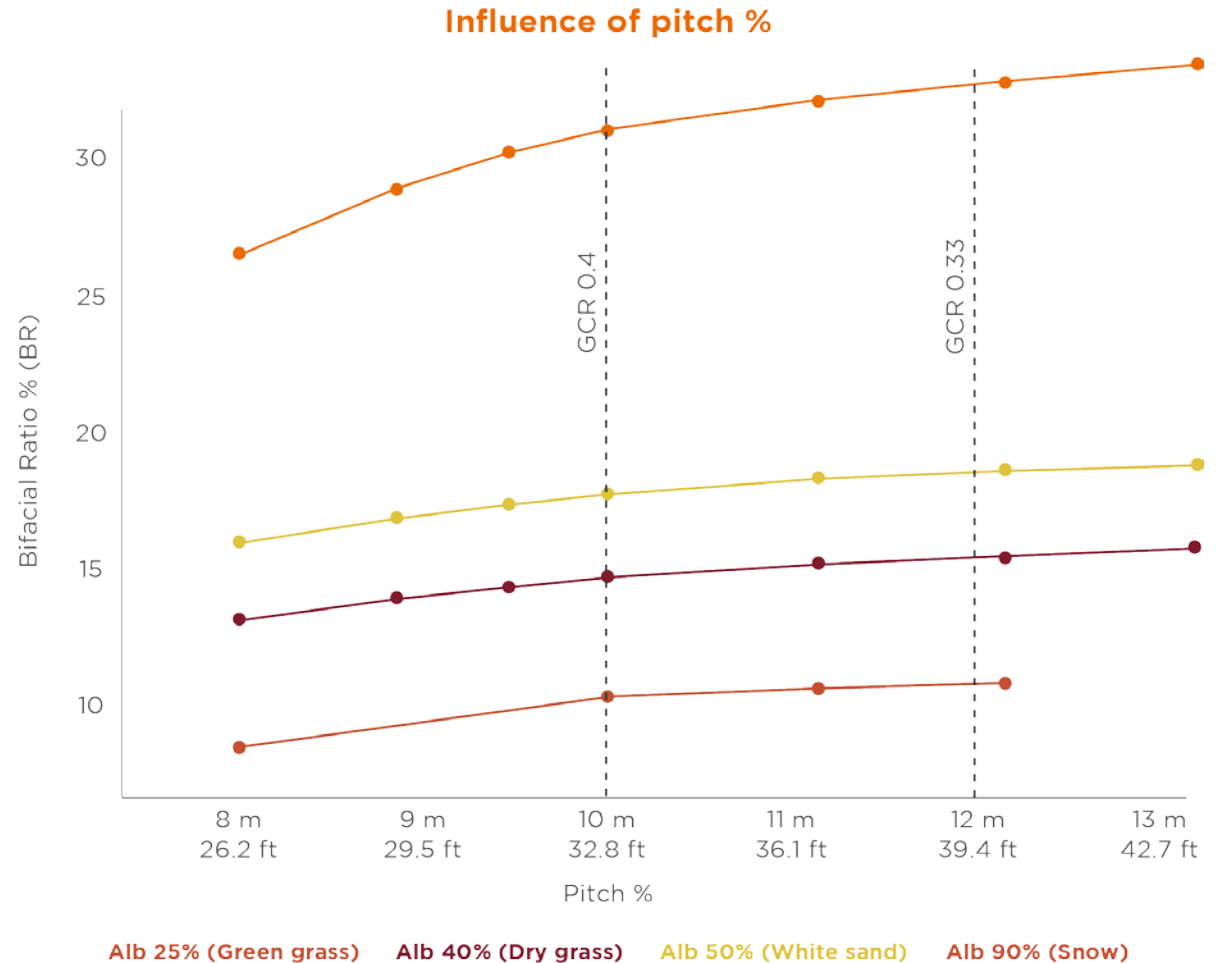
Pitch is relevant: ↑ surface = ↑ energy gain.



### X2 Wider Aisles

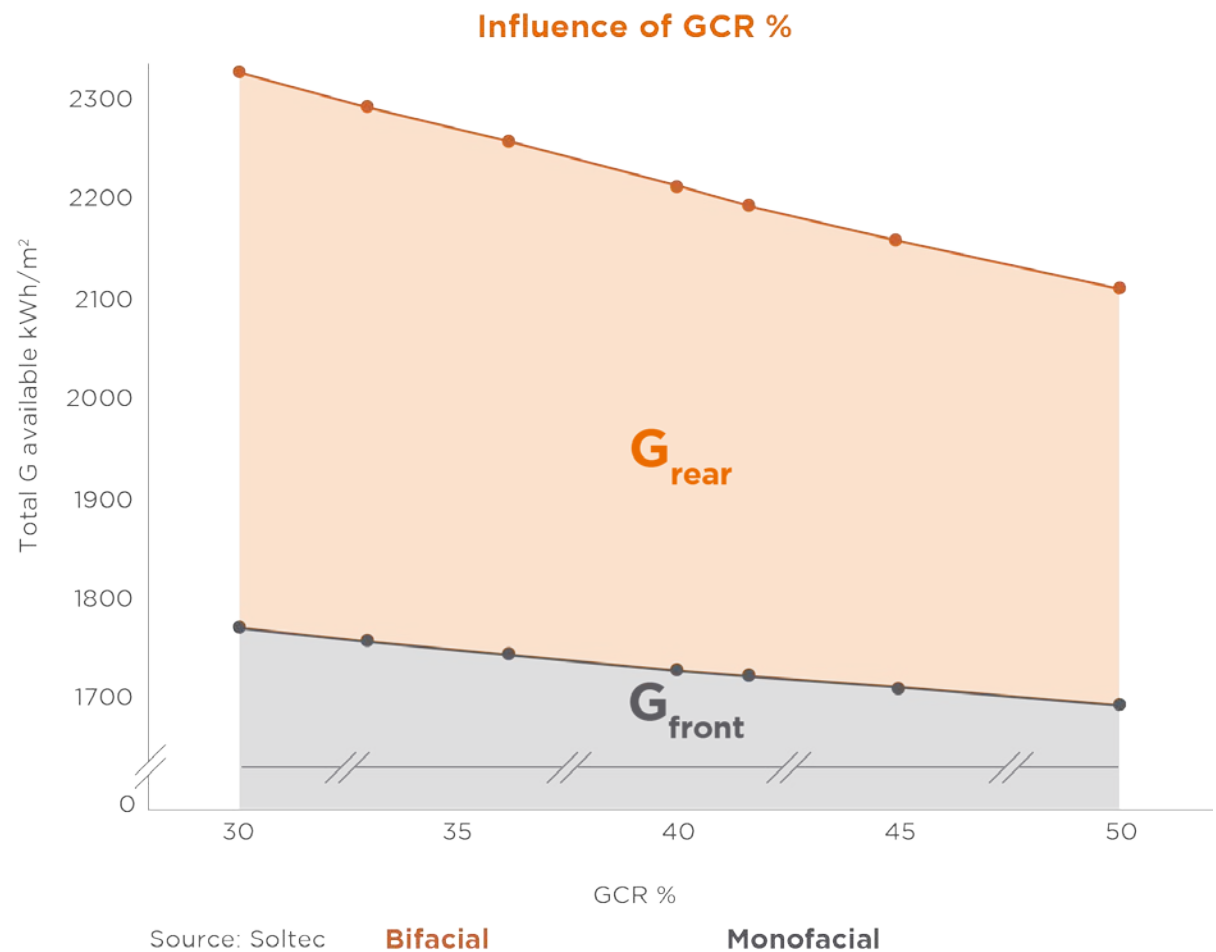
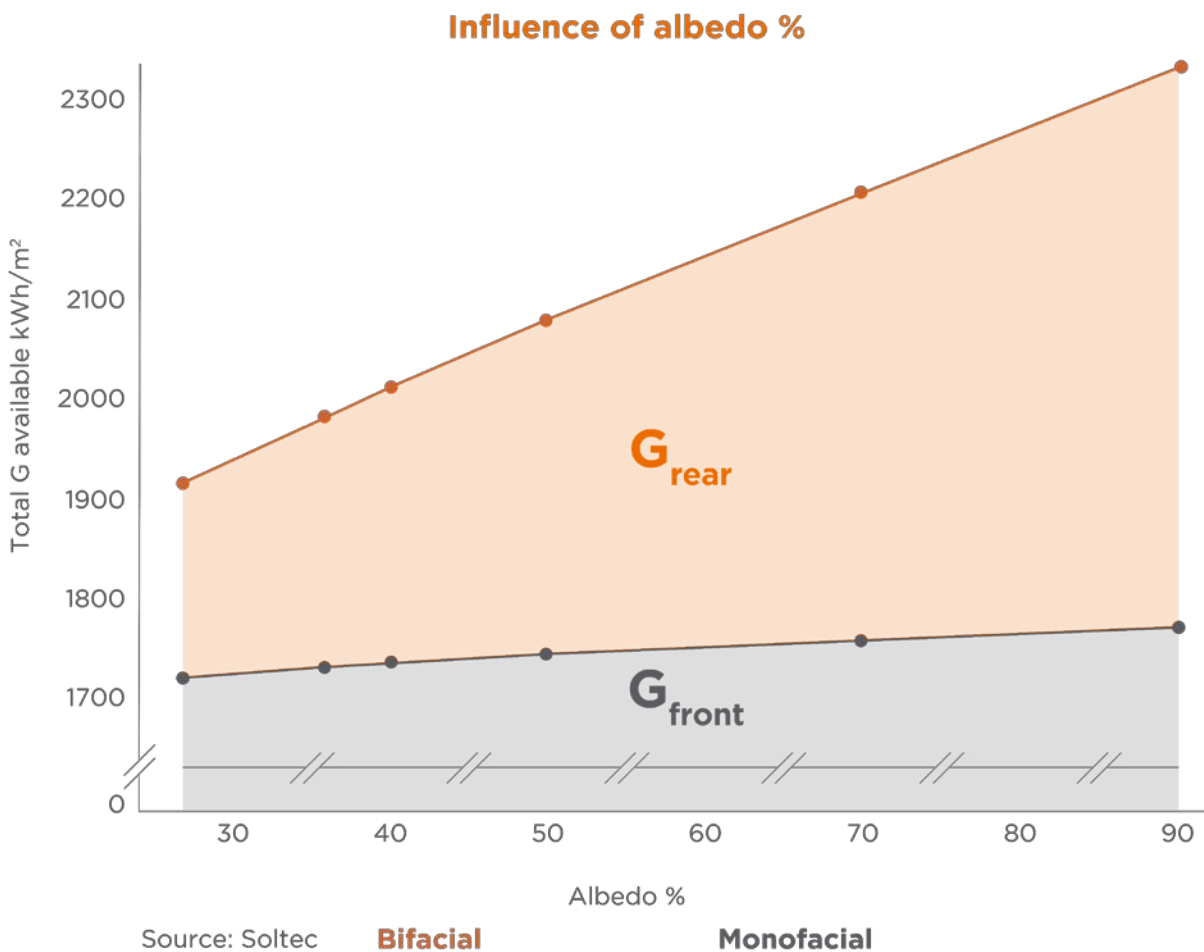
Maximize reflected solar energy (albedo) while improve O&M accessibility for modules washing and vegetation control.

GCR: Ground Coverage Ratio  
(tracker width/pitch)



# Energy gain: compare it

Available Energy Irradiation =  $G_{\text{front}} + G_{\text{rear}}$

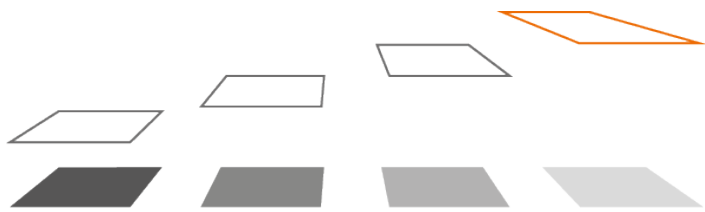




# Energy gain: compare it

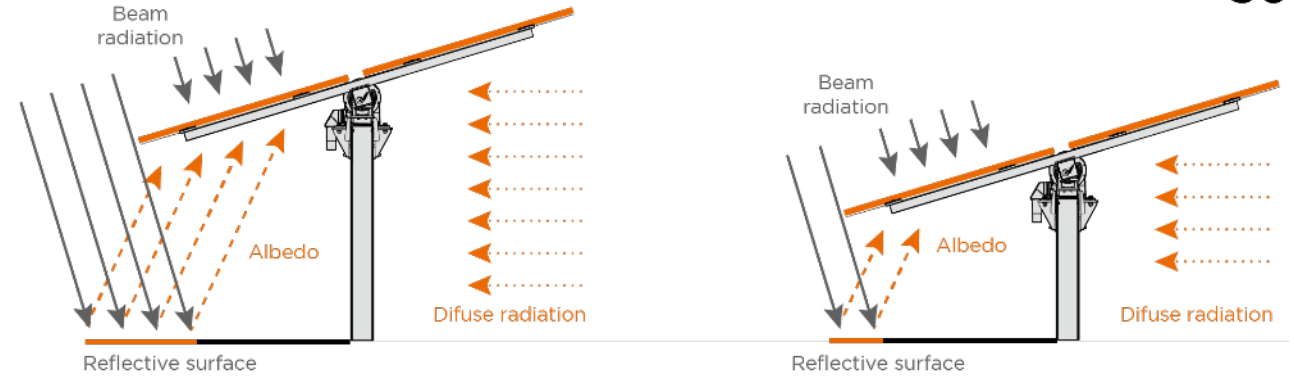
## View factor: Height of the tracker

- ✓ The height of the structure is directly correlated with:
  - ✓ The area that reflects
  - ✓ Diffuse input
- ✓ The higher, the more gain energy.

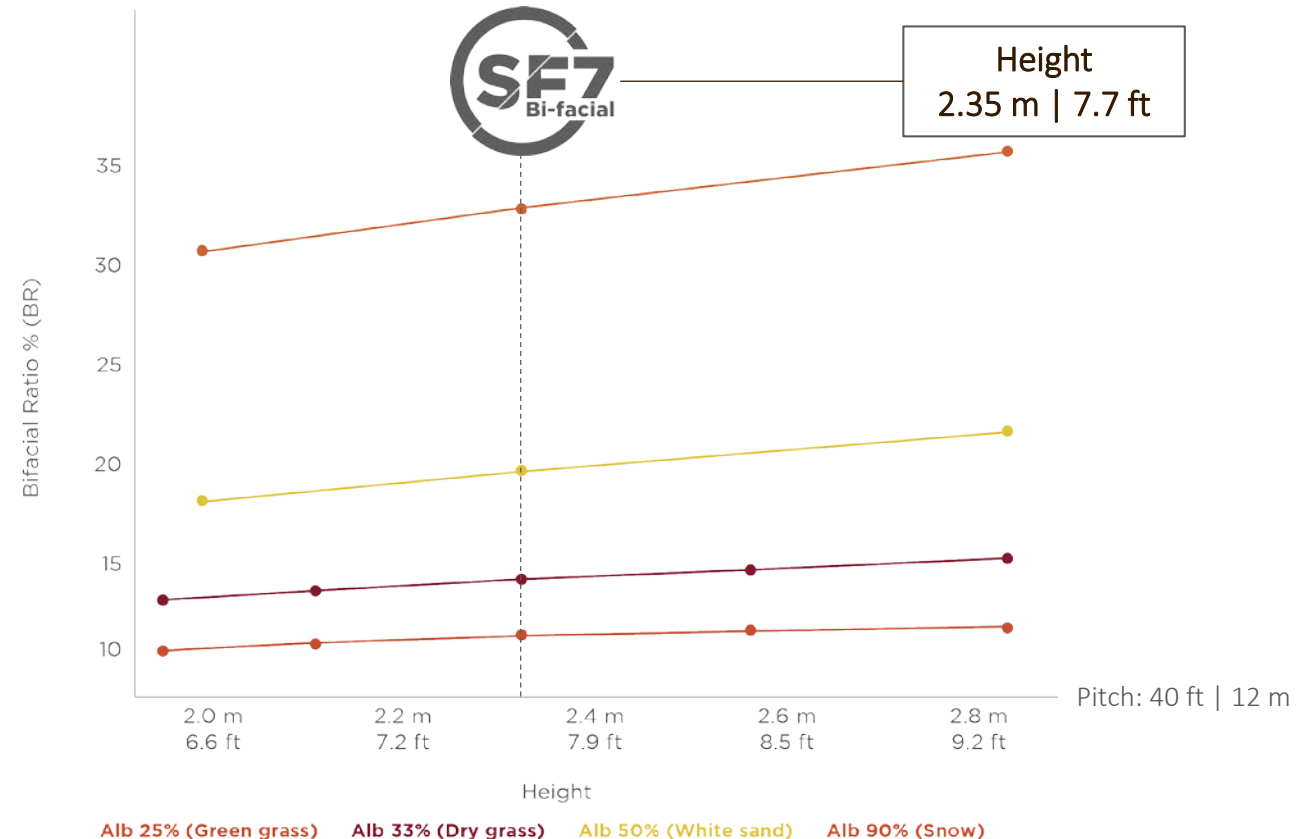


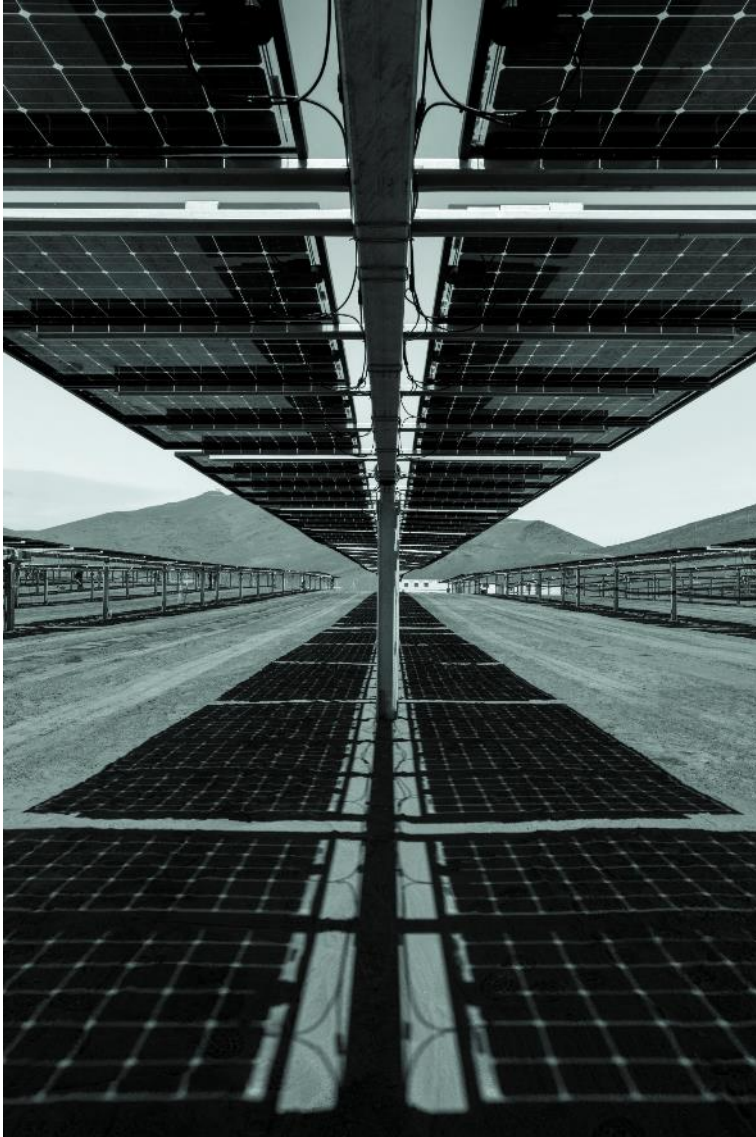
### Taller Tracker

Bifacial performance is increased by height of installation, reducing shadow intensity projection.



### Influence of height





## Shading = interference

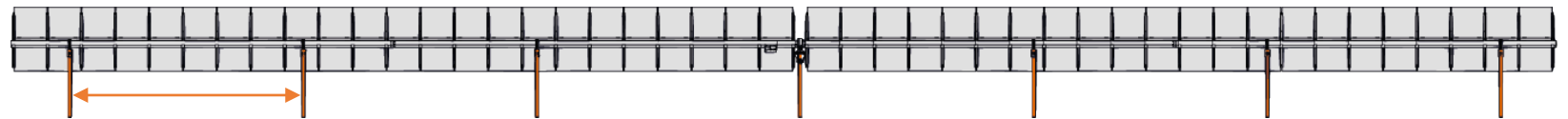
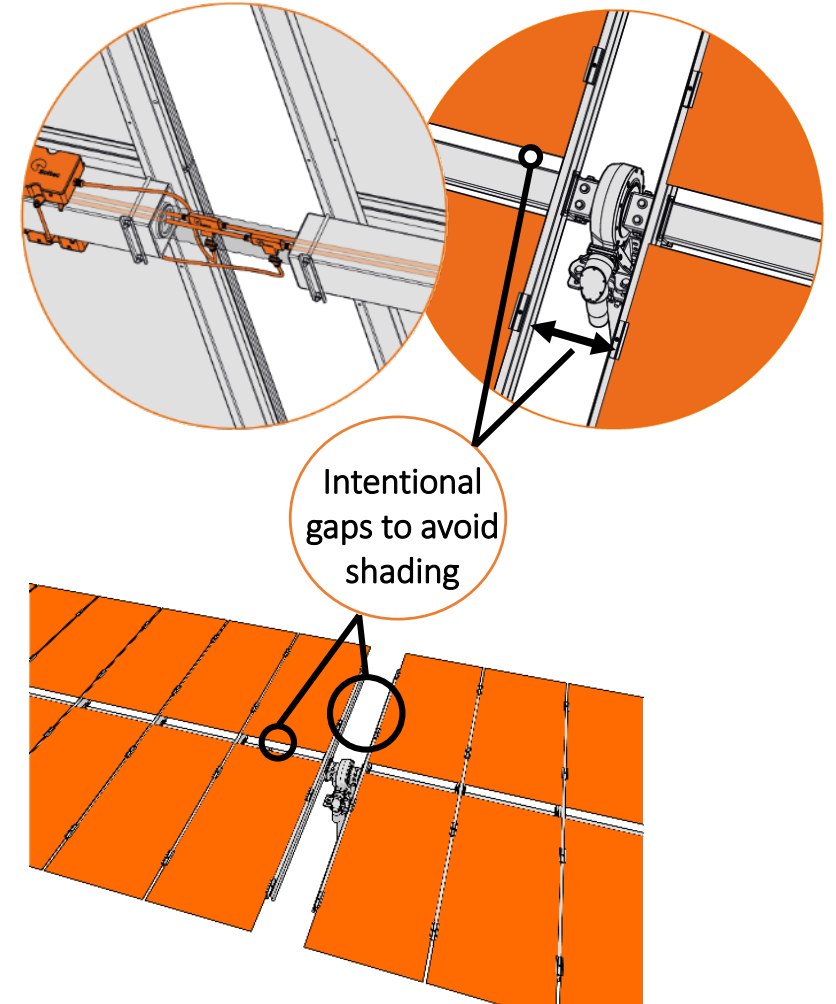
Bifacial = new concept

All objects cast a shadow.

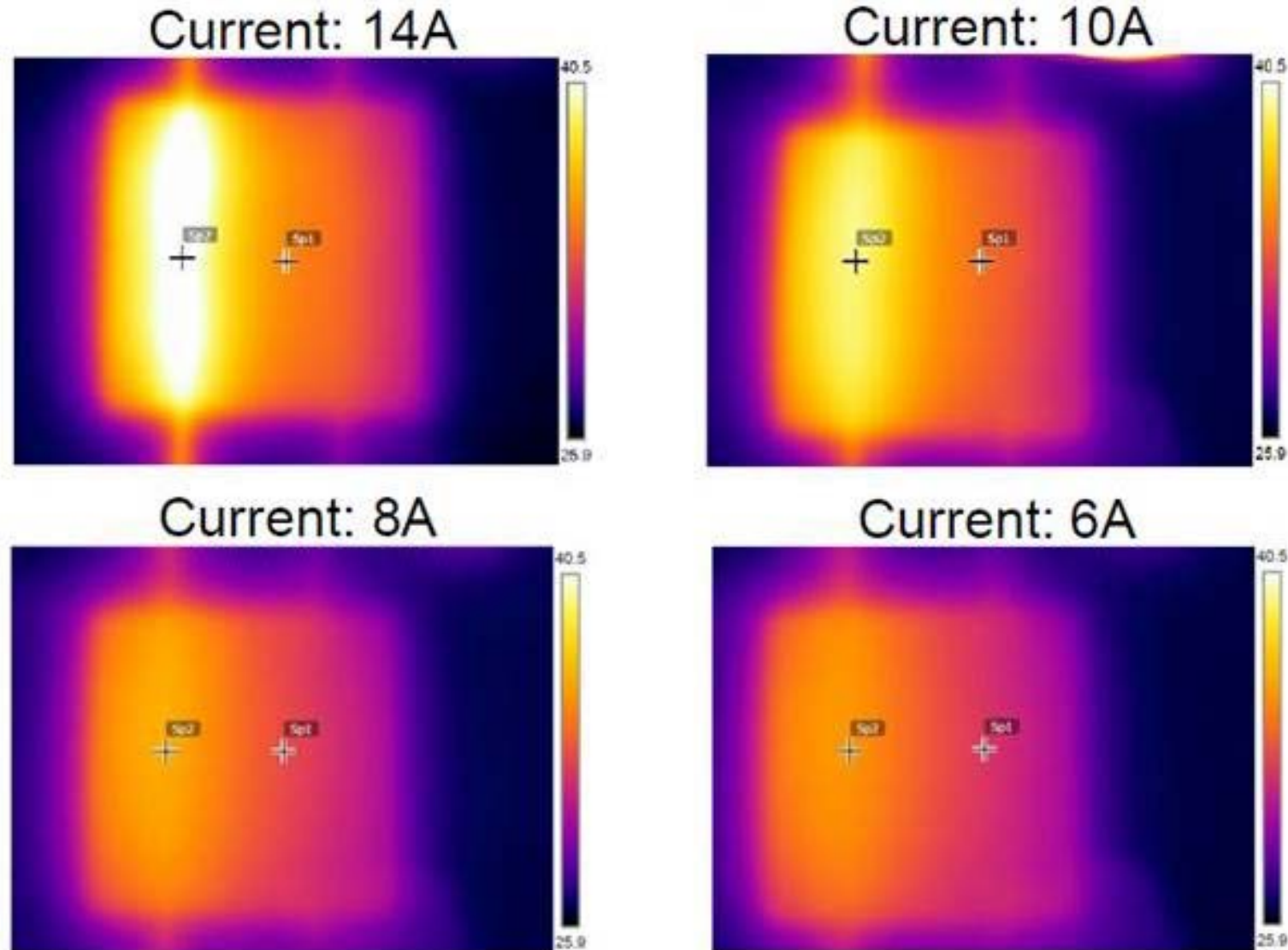
Shading = losses

Minimizing the number of objects shading:

- ✓ No rear shading from torque tube → **5% less interferences**
- ✓ 7 piles/90 modules → **46% fewer piles/MW**
- ✓ No hanging wires → **81% fewer wiring** → StringRunner
- ✓ No dampers

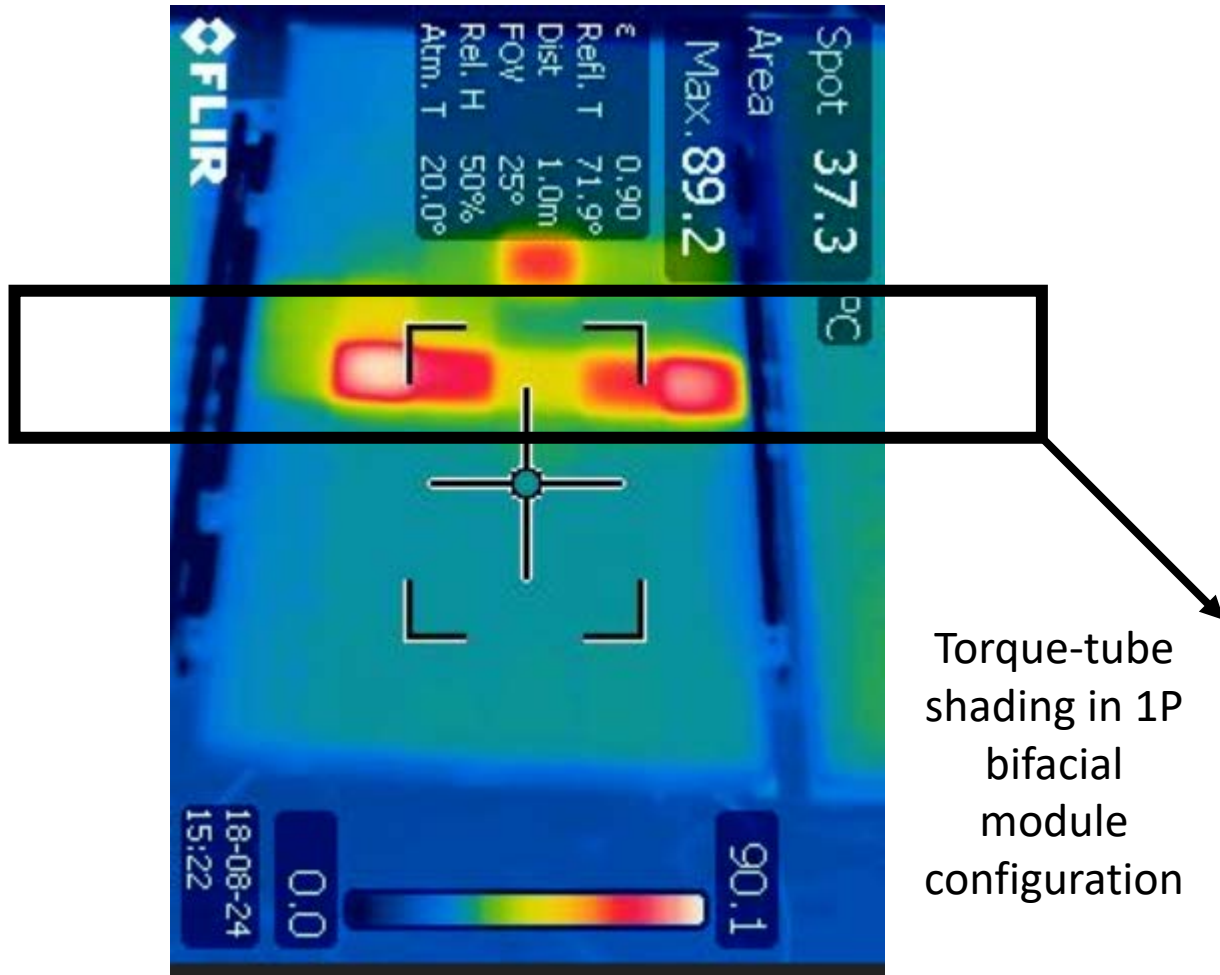


# Localized temperature Non-Uniformity Under current application





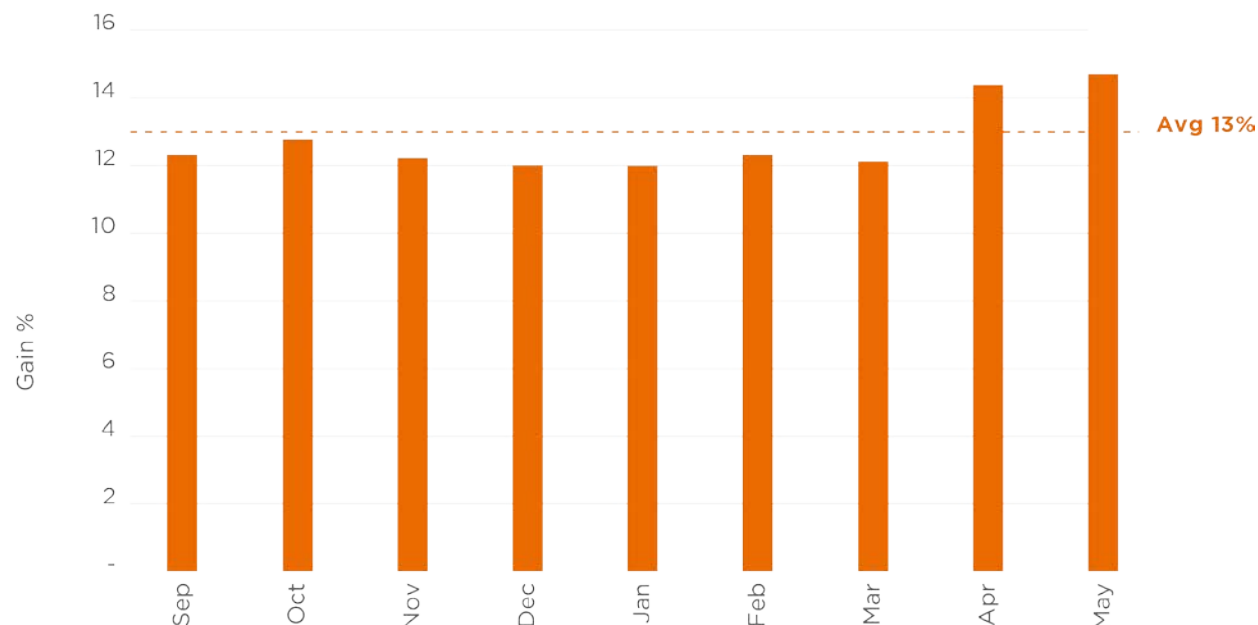
# Torque-tube shading interference





# Case Study: La Silla (Chile, 2015)

## Bifacial Gain



Energy Gain=13%

	Gain=12%	Gain=15%
$\Delta$ LCOE	-5.3%	-7.2%
$\Delta$ IRR	5.7%	9.1%




GCR=0.33, PV bifacial module

# Bi-facial: New vision for a PV plant design

Monofacial tracking PV plant Vs. Bifacial tracking PV plan

 Energy production kWh/kWp
 Vs.
  Smaller plant kWp for  kWh

	Same peak power	Same production
Peak power	50 MWp	43,85 MWp
Module units	=	↓ 12%
Module price	↑ 10%	↓ 4%
Tracker units and price	=	↓ 12%
DC-AC-MV	↑ 10%	=
Labour structure	=	↓ 12%
Civil Works	=	↓ 12%
Labour DC	=	↓ 12%
kWh/year	↑ 14%	=
Final price	↑ 6%	↓ 7%

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

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

## Summary



Up to 35% ↑ energy on snow

Up to 17% ↑ energy on white sand

PV BIFACIAL TRACKING → HIGHER YIELD

Specific tracker for bifacial PV modules

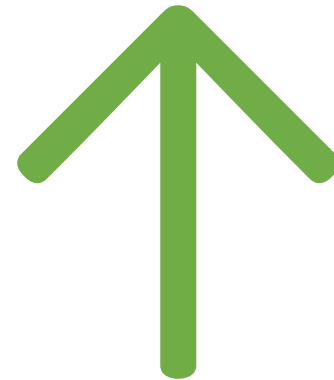
Soil:

↑ white and smooth

↑ Pitch

↑ Height

↓ Shading



Energy



# THANK YOU



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