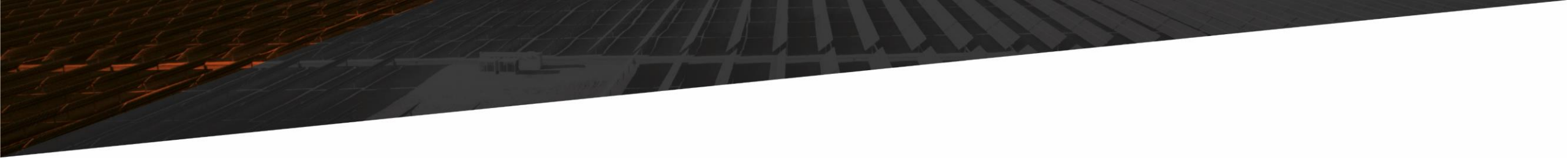
ATA - November 2020

The new era of tracker technology:

SF8 single-axis tracker

Soltec

Making Tracks,
Building Trust



Our Company

Soltec specializes in the manufacture and supply of single-axis solar trackers with global operations and a workforce of over 1600 people, blending experience with innovation.

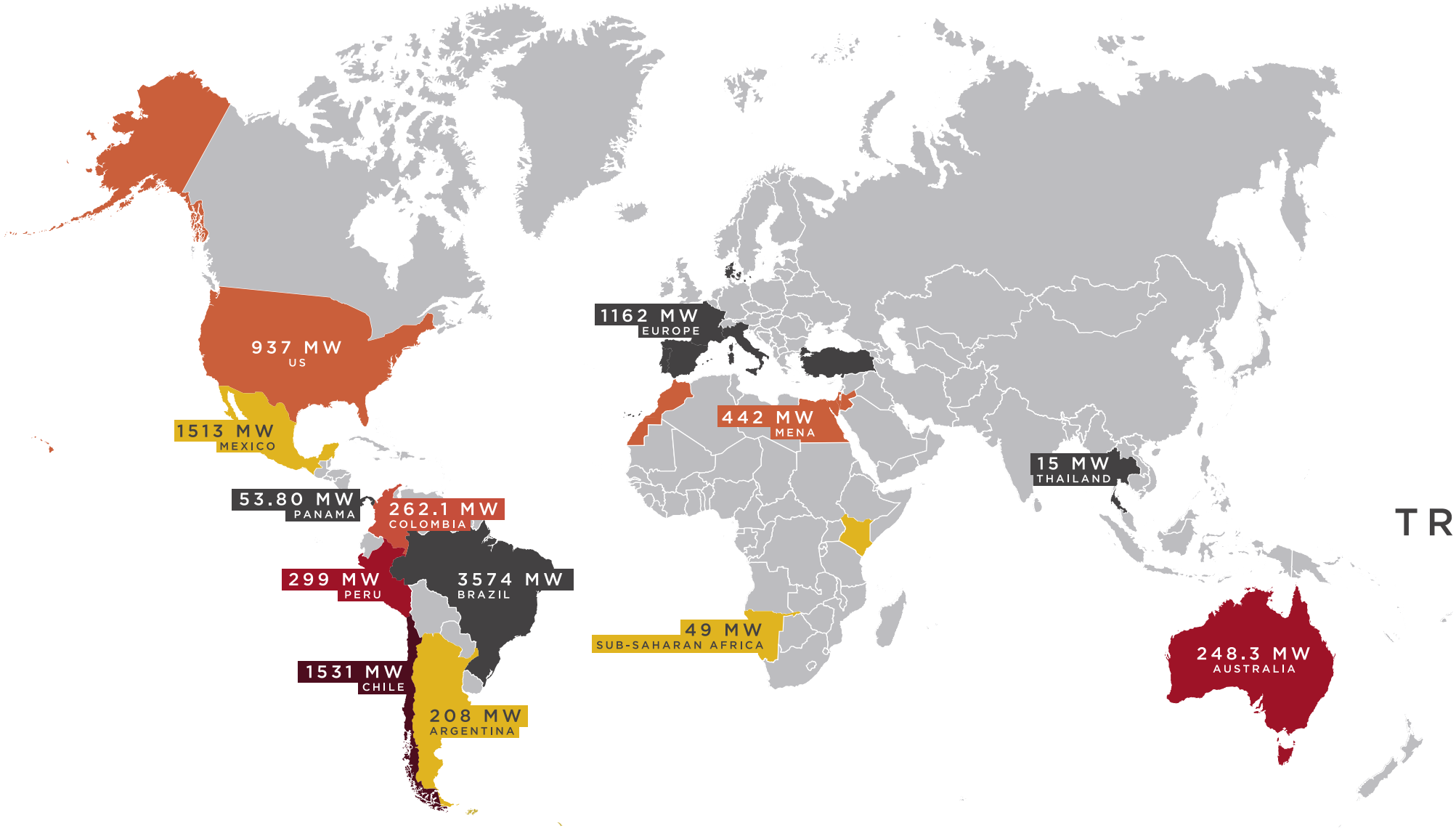
Our Situation

11 GW
Track Record
Worldwide

3.6 GW
Solar Trackers
Sold 2019

#3
Global Tracker
Manufacturer

#1 LATAM
30% Market Share
#2 Europe 18%



11 GW
SOLTEC'S TRACK RECORD

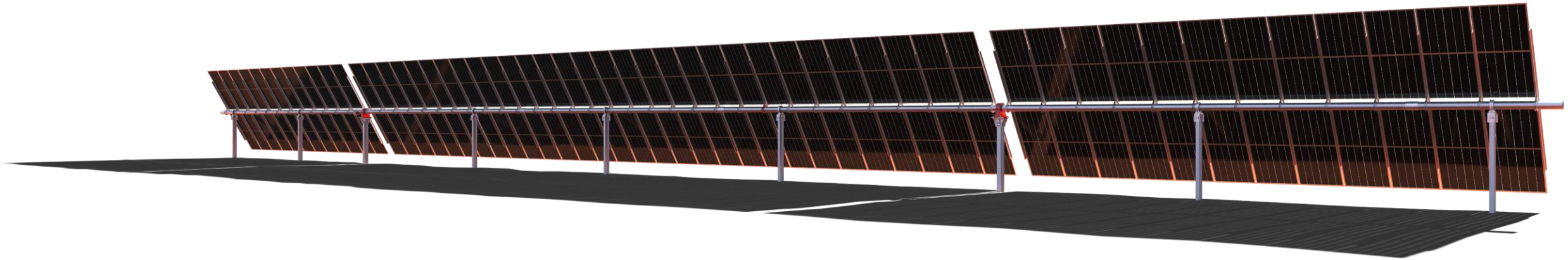
Focus in R&D

Investment
Pioneers in 2P configuration
SF7 adaptable to all terrains
First Bifacial Tracker in the world
More than 90 registered patents
Pioneers in wind design validated by RWDI


SF∞
SINGLE-AXIS
TRACKER
Otherworldly Tracker: Engineered for greatness

SF8

SINGLE-AXIS TRACKER



Otherworldly tracker: Engineered for greatness

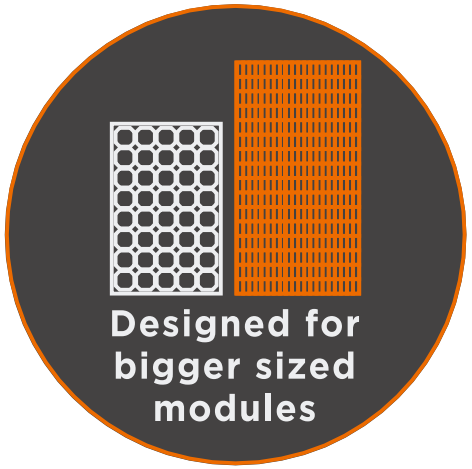
SF8 is the new generation of single-axis trackers, elegantly engineered for robustness and specially designed for larger modules. Its unique 4 to 6 strings 2x60 configuration with multidrive transmission system within the tracker structure and supersized torque-tube with improved geometry, offers the highest resilience to wind while keeping its elegant design, reducing the number of parts and easing the tracker installation.

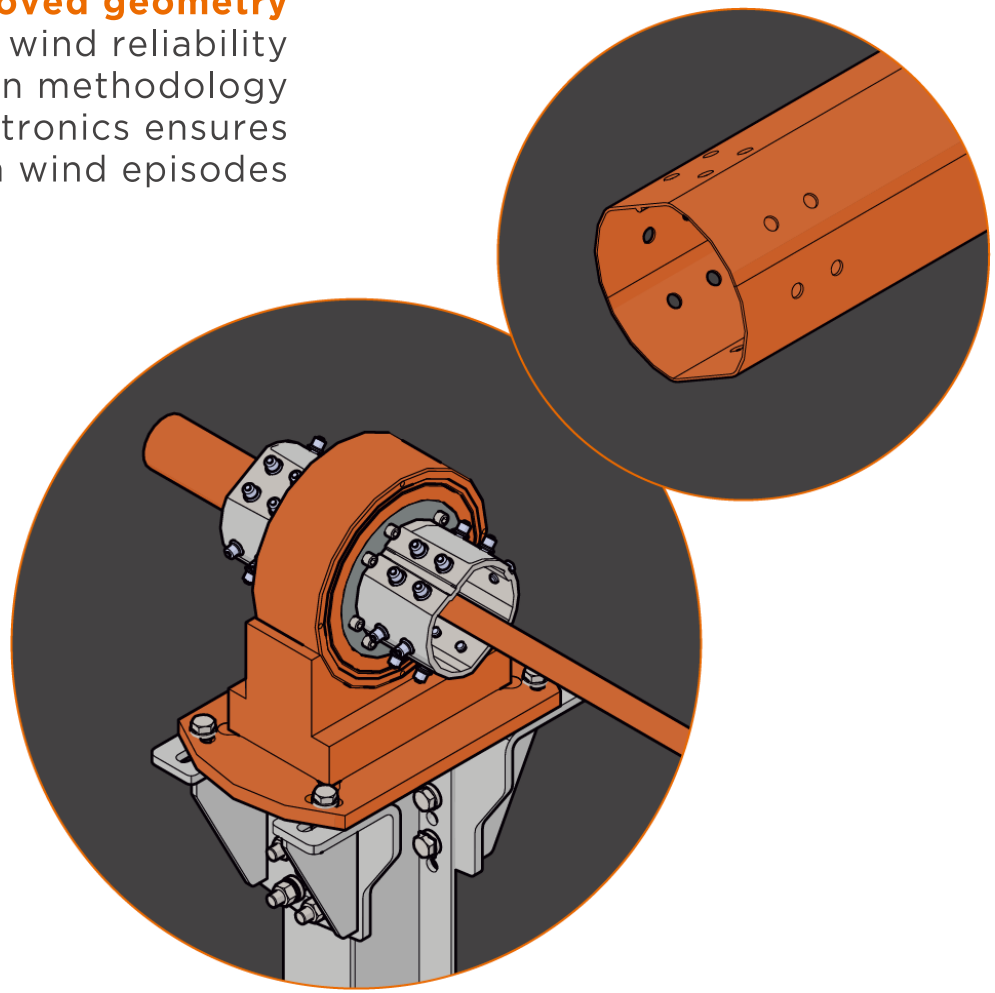
EXTREMELY ROBUST

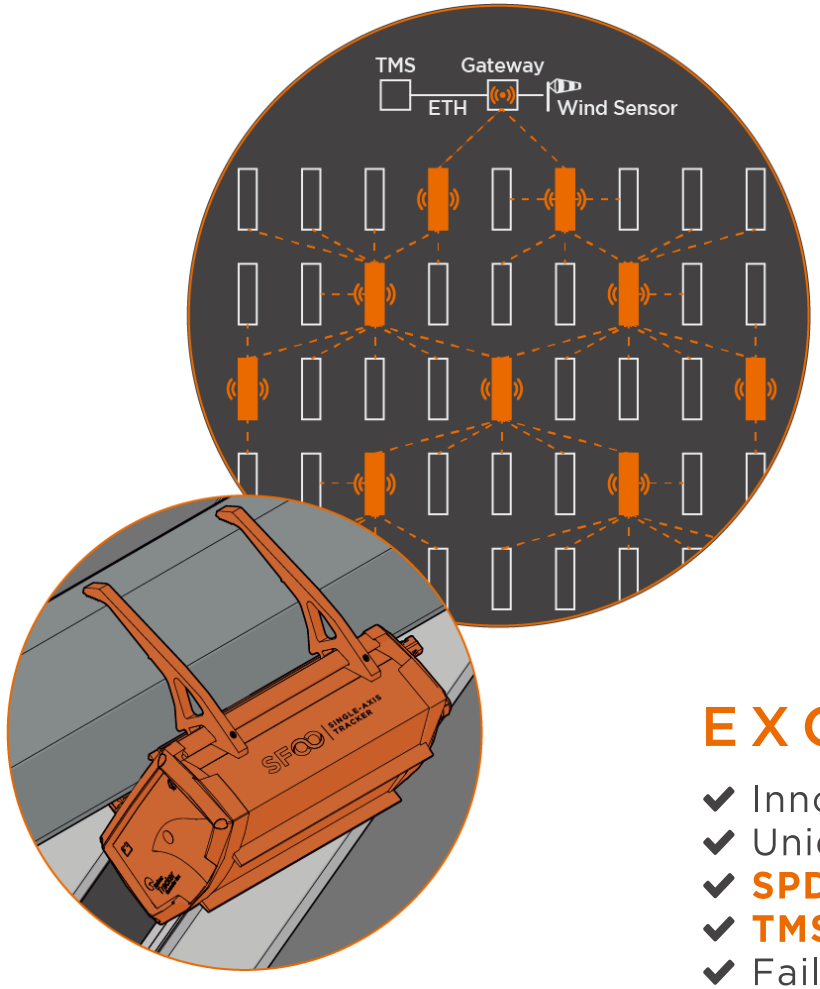
- ✔ Unique **multidrive** transmission system within the tracker structure
- ✔ Specially designed for larger **72** and **78** cell modules
- ✔ Supersized torque-tube for better wind resistance
- ✔ New torque-tube with **improved geometry**
- ✔ **2 or more drives** per tracker, better angle accuracy and wind reliability
- ✔ **Dy-Wind**: most advanced tracker wind design methodology
- ✔ **Self-stow**: Completely autonomous tracker electronics ensures the most secure position for given wind episodes

22%

More Rigid







up to **8.6%**

Greater Yield

6% TeamTrack + **0,5%** Bifacial TeamTrack
+ 2,1% Bifacial Gain 2P vs 1P

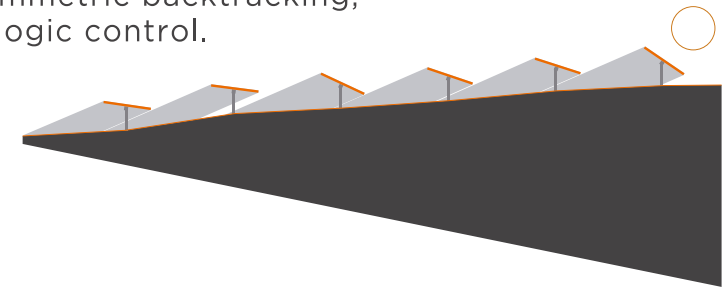
EXCEPTIONALLY SMART

- ✔ Innovative Open Thread mesh network, **Full Wireless** system
- ✔ Unique **Internet of Things** (IoT) technology enabled (no repeaters needed)
- ✔ **SPD**: Electric Surge Protection Device for overvoltage protection
- ✔ **TMS**: Tracker Monitoring System incorporated for full PV plant control
- ✔ Fail-safe **redundancy,** flexible gateway communication with **lowest latency** on the market

MIREC AWARDS
Innovative Technology

Bifacial TeamTrack™

Up to 1.2% energy gain, with comprehensive control system designed to maximize solar panel productivity, including asymmetric backtracking, diffuse-stow, and meteorologic control.



4 to 6 STRINGS
up to **100 KW**

ELEGANTLY SIMPLE

- ✔ **4 to 6 strings** ease module electrical connection, reducing costs
- ✔ **5.16% fewer parts** per module than the previous generation SF7
- ✔ **Easier and quicker installation:** fewer piles per MW and a reduced number of parts and screw connections than competitors
- ✔ **Lower installation** and **maintenance** costs allow for optimized BOP and more competitive LCOE
- ✔ Higher MW installation rate
- ✔ **PV Series Power Supply 2.0** feeds/powers the tracker straight from the string for lowest operational cost

Dy-WIND

Dynamic Wind Analysis in Tracker Array Design

SF∞ SINGLE-AXIS TRACKER

- The studies have shown that certain **wind-design code standards** applied to solar trackers **are insufficient.**
- They do not consider the **aeroelastic effects** (or second order effects) produced by the action of wind impact on the tracker.
- It is necessary to find **new analysis methodologies** that improve the design of reliable tracker structures.
- The wind consultant leader **RWDI** in collaboration with **Soltec** has developed a **new method** for comprehensive **dynamic analysis in tracker** wind-design = **Dy-WIND.**

DYNAMIC EFFECTS AND WIND TUNNELS

Dy-WIND
Dynamic Wind Analysis in Tracker Array Design

Wind tunnel (rigid models)

2013/2014

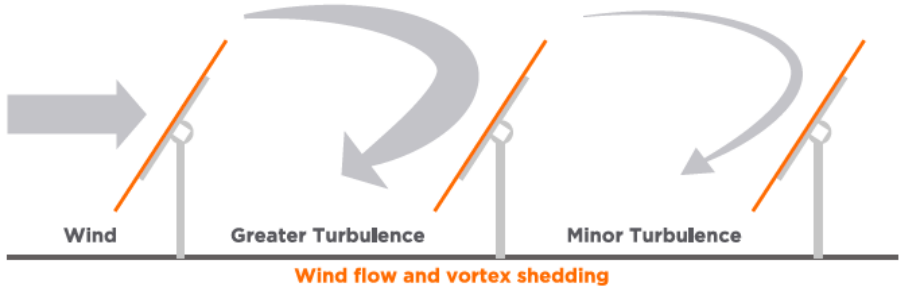
Wind tunnel (sectional models)

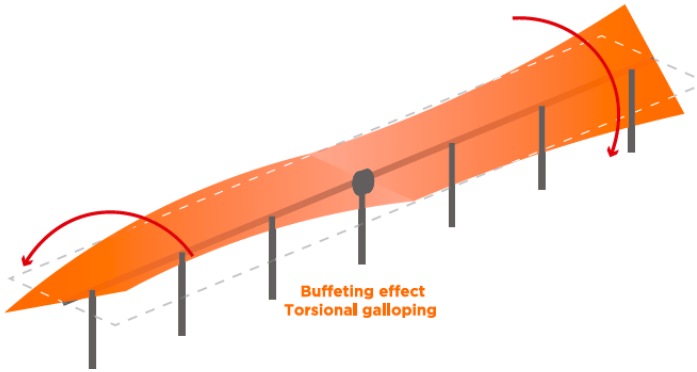
2017/2019

Aerolastic wind tunnel

2019/2020

Mechanism 1: Resonant Vibration





Mechanism 2: Torsional Flutter
Mechanism 3: Torsional Galloping

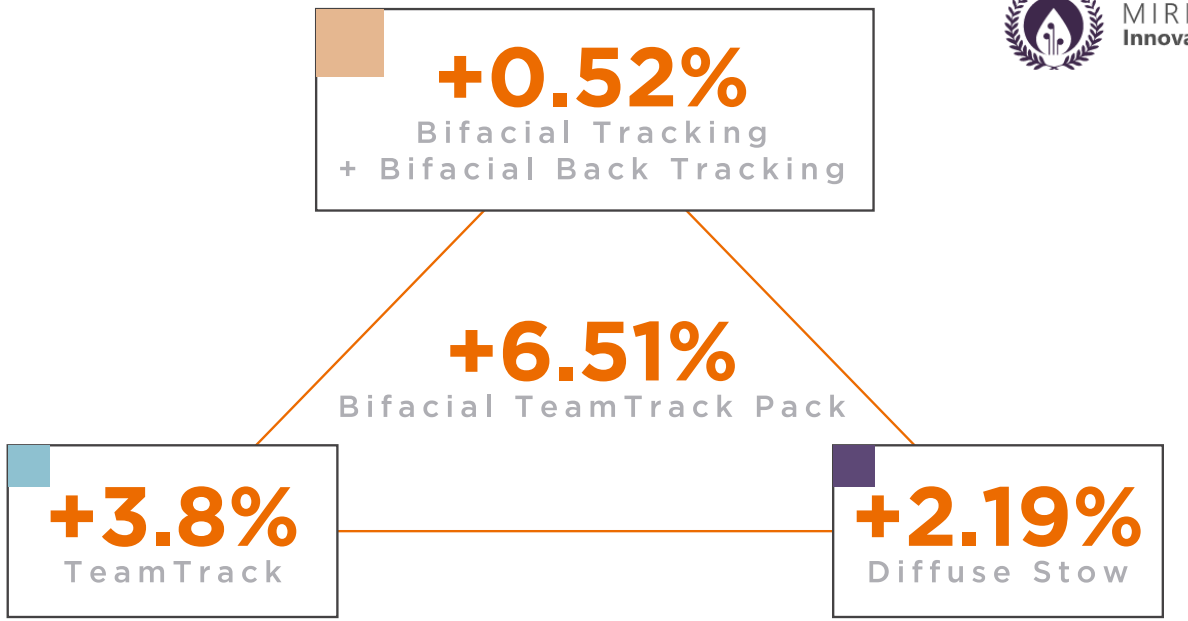
SF8 SINGLE-AXIS TRACKER

up to 8.6% Greater Yield

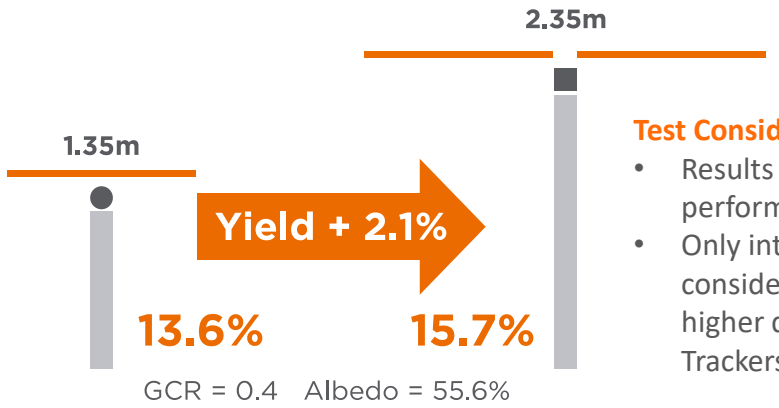
6% TeamTrack + **0,5%** Bifacial TeamTrack
+ 2,1% Bifacial Gain 2P vs 1P

MIREC AWARDS
Innovative Technology

1P Standard Tracker	Measured Bifacial Gain	2P SF7 Bifacial
16,8%	Fall 2018	19,2%
12,6%	Winter 2019	14,3%
10,4%	Spring 2019	12,1%
13,7%	Summer 2019	15,8%
16,6%	Fall 2019	19,5%
16,8%	Winter 2020	18,7%
12,5%	Spring 2020	14,5%



Algorithm	Gain
TeamTrack	3,80%
STOW-diffuse	2,19%
TeamTrack Bifacial (in case of bifacial modules)	0,5%
TOTAL	**6,51%**



Test Considerations:

- Results based on energy performance at module level
- Only internal Trackers considered (avoid effect of higher diffuse on external Trackers)

Test Considerations:

- 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

HOW TO SIMULATE BIFACIAL PROJECTS IN PVSYST®

Parameter	SF8 Bifacial	Conventional linked row 1P Tracker(2)	Conventional 1P Tracker(2) (piers, bearings under PV)	Conventional 1P Tracker(2) (no piers, bearings under PV)
Angle	-60° +60°	-52° +52°	-60° +60°	-60° +60°
Height	2.35 meters	1.35 - 1.50(3) meters	1.35 - 1.50(3) meters	1.35 - 1.50(3) meters
Shading loss factor	0.7 %	20 %	18.7 %	12.3 %
Shed transparent fraction	(MT(1) + 3.75) x 1.017 (%)	MT(1) + 1%	MT(1) + 1%	MT(1) + 2.1%
Thermal factor (Uc)	31.3 W/m² k	25 W/m² k	25 W/m² k	25 W/m² k
Thermal factor (Uv)	2.3 W/m² k/m/s	1.2 W/m² k/m/s	1.2 W/m² k/m/s	1.2 W/m² k/m/s
Mismatch loss factor	0.4 + 0.025 x Albedo(%)	8.8 %	7.8 %	3.5 %

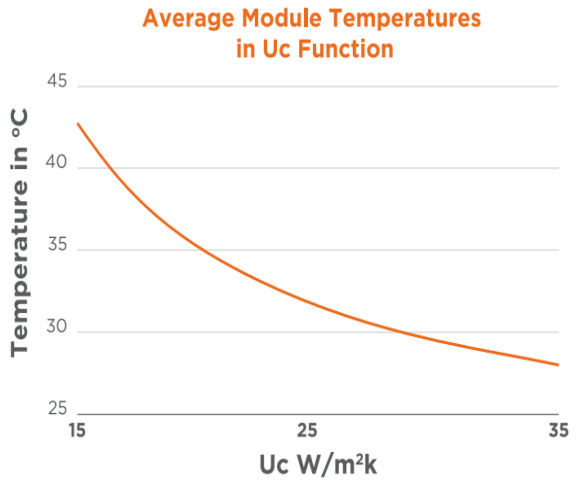
SF8 Bifacial Parameters | MT(1) = Module transparency | (2) Source: Bifi PV workshop July 2020 by Nextracker | (3) Specific value depends on module size and site conditions

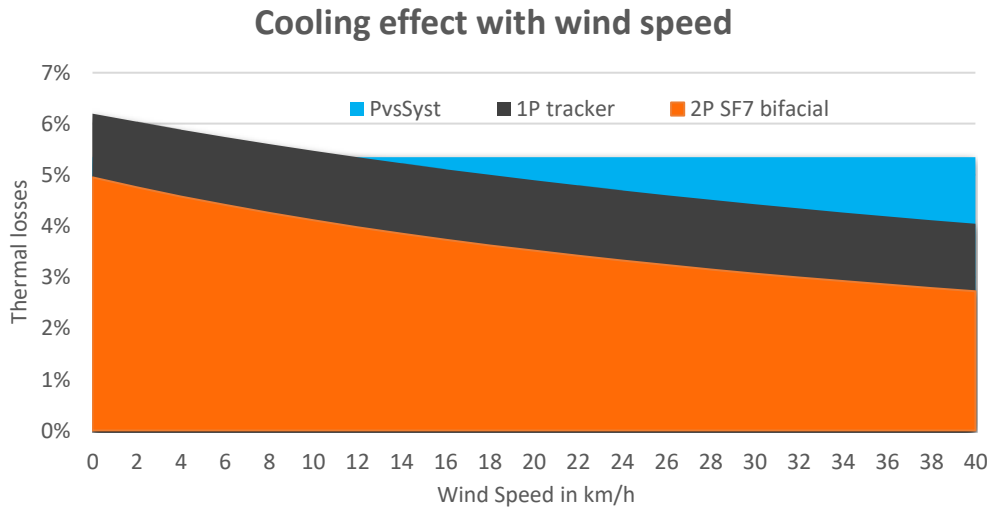
THERMAL FACTORS U_c - U_v

	Thermal factors		Wind in m/s			
	Uc	Uv	1	5	10	20
PVSyst default	29	0	29	29	29	29
1P tracker*	25	1,2	26.2	27.4	28.6	29.8
2P Soltec tracker	31,3	2,3	33.6	35.9	38.2	40.5

$$U = U_c + U_v \cdot w$$

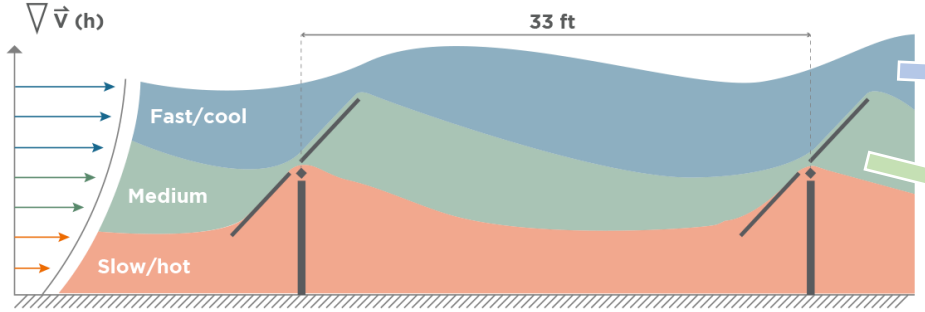
Thermal Factors calculated by CENER

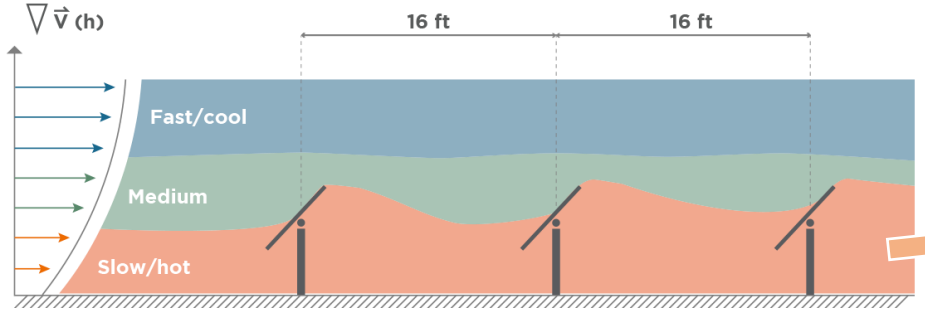


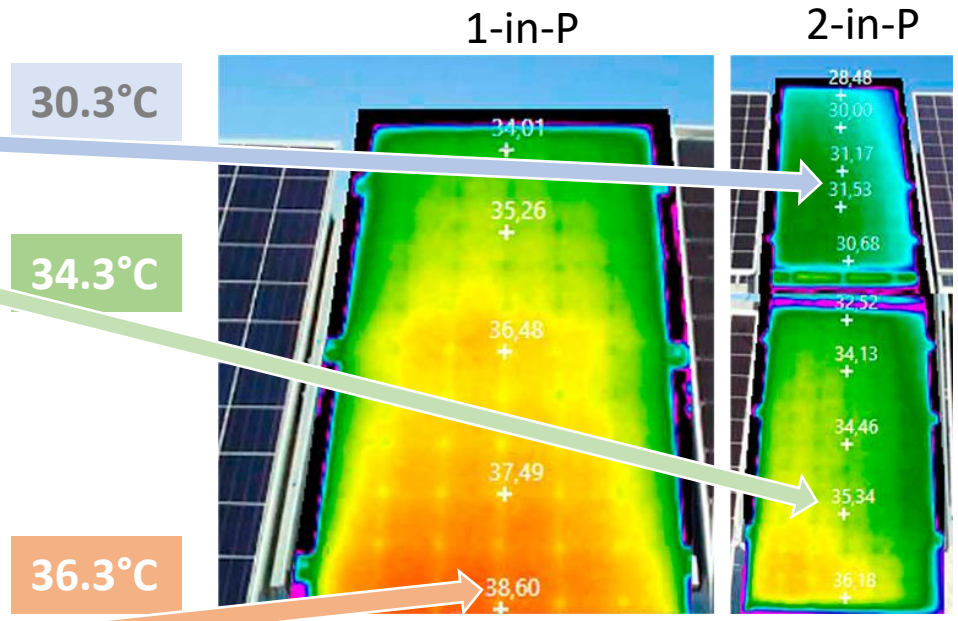


* **Greg Beardsworth** et al. QUANTIFYING YOURBIFACIAL GAINS https://info.nextracker.com/quantifying-your-bifacial-gains

COOLING: TRACKER TOPOLOGY



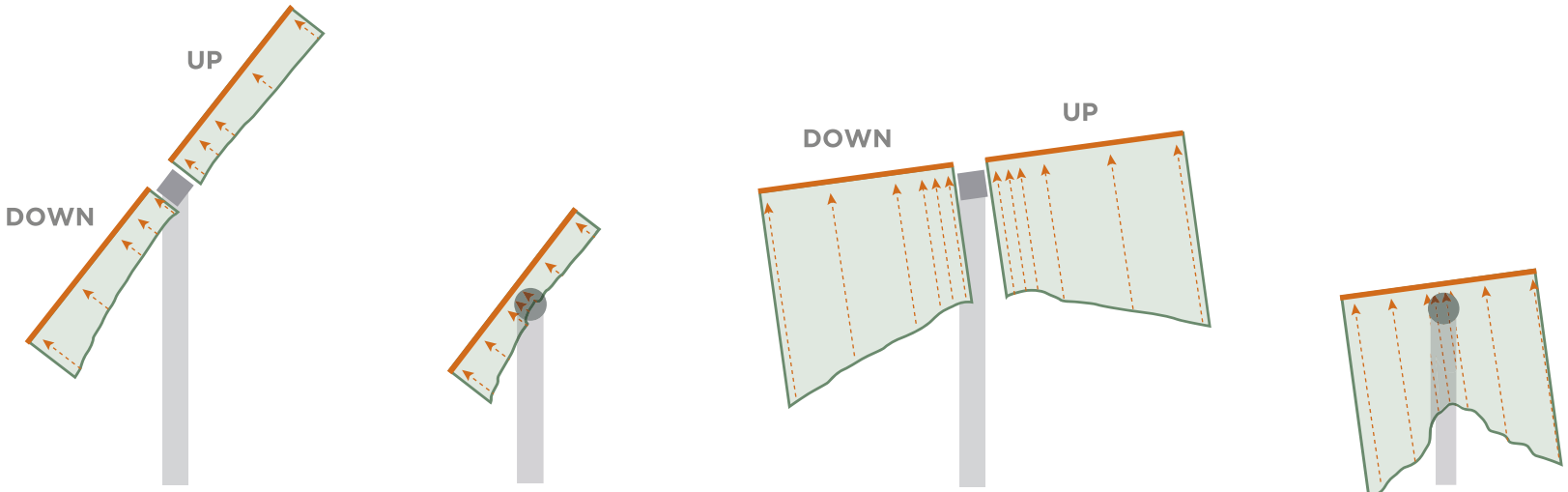




GCR 40%	Pitch	Average Temp.	ΔT	ΔEnergy
1P Tracker	5 m	33.96°C	3.52°C	1.3%
2P Tracker	10 m	30.44°C		

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

MISMATCH



2P tracker
52.5° angle
square torque-tube
2.35 m module height

1P tracker
52.5° angle
round torque-tube
1.35 m module height

2P tracker
7.5° angle
square torque-tube
2.35 m module height

1P tracker
7.5° angle
round torque-tube
1.35 m module height

Module rear side irradiation distribution with trackers in 2P Vs. 1P in different anglesand hights, with square and round torque tubes. Source: BiTEC

Accurate simulations carried out using NREL's Bifacial Radiance software

Mismatch Effect in Soltec SF7 Bifacial Arrays by SUNLAB (Ottawa's university)

	2P, 0.2 albedo	2P, 0.6 albedo	1P, 0.6 albedo
PVSyst Rear Mismatch Loss Factor	0.9%	1.9%	3.4%

PVSyst Rear Mismatch Loss Factor for Soltec Tracker:
0.4 + 0.025 x Albedo (%)

	High Albedo	Rear Mismatch Loss Factor
BITEC	2P Soltec Bifacial	1,90%
Ref 1*	2P Standard	2,50%
BiTEC	1P Standard	3,40%
Ref 1*	1P type 1	2,40%
Ref 2**	1P type 2	3,50%

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**Jim Crimmins et al. Field testing meets modeling: validated data on bifacial solar Performance https://arraytechinc.com/field-testing-meets-modeling/

INFLUENCE OF REAR SHADING

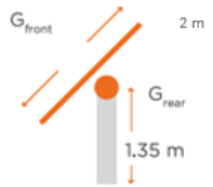
	Shading Factor
2P Soltec Bifacial	0,7%
2P standar**	6,5%
1P standard	5,6%
1P linked row**	7,8%
1P type 2*	12,3%
1P good DC Wiring*	20,0%
1P poor wiring*	24,3%

Comprehensive Modeling
bifacial radiance

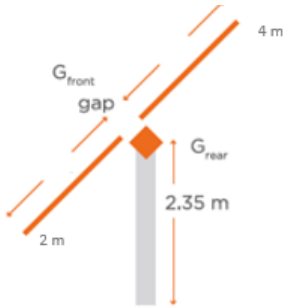
Real module location
torque tube shading

Racking shading could reach
↓6% rear irradiation loss

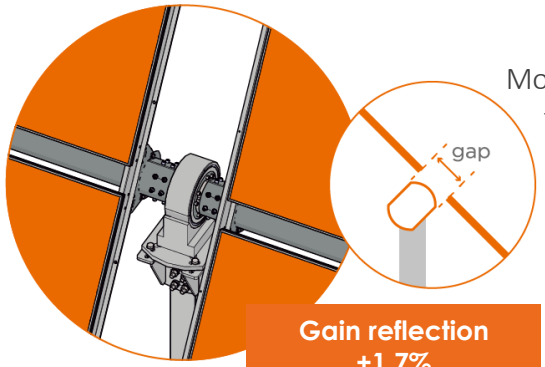
Shading factor: -5.6%
Module 1 = continuous plane
With torque tube



Shading factor: -0.7%
Module 1 + Gap
+ Module 2
With torque tube



Example of central row. Simulations count with my rows.



Modules gap over torque tube

No Shading
2P module mounting:
no backside shading from torque tube.

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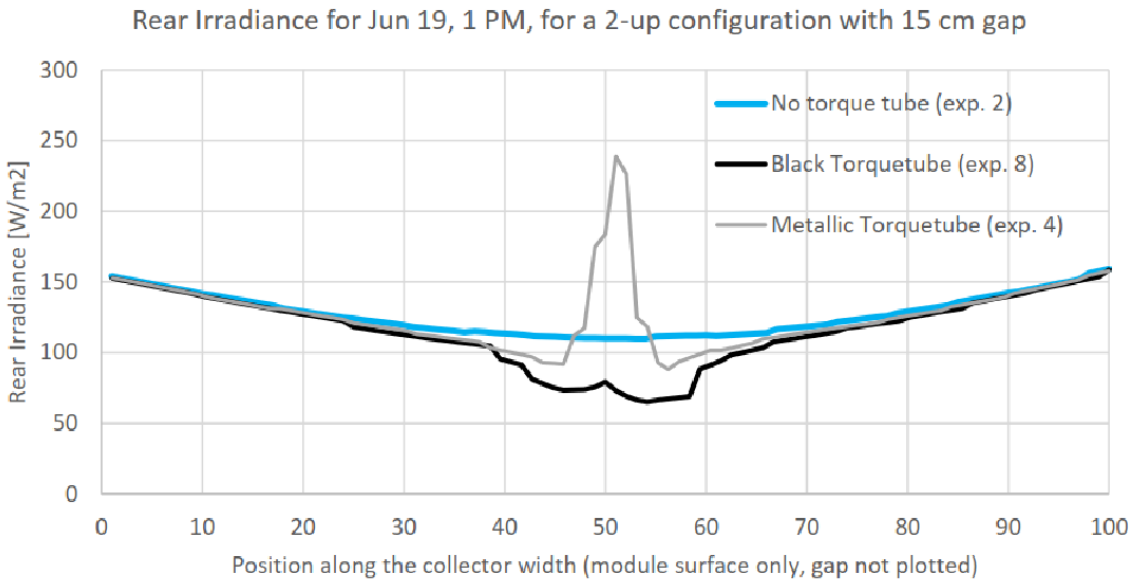
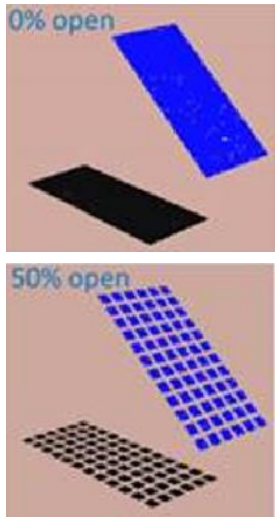
TRANSPARENCY



Module Transparency



$$MT = Module\ Transparency$$

$$MT \approx 1 - \frac{n_{cells} \cdot Cell\ surface}{Module\ surface}$$

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QUANTIFYING YOURBIFACIAL GAINS
https://info.nextracker.com/quantifying-your-bifacial-gains

	Transparent Fraction
2P Soltec Bifacial	**(MT + 3.75) x 1.017 (%)**
1P round tube*	MT+2.1 (%)

CONCLUSIONS

- New **SF8** can keep the greatest installation tolerances without compromising stability at high-wind speeds.
- New **SF8** solar tracker, with its reinforced structure is 22% more rigid than the previous generation, is able to withstand high winds even with large modules of 72-78 cells no matter the location.
- Soltec's **Dy-WIND** system reinforces Soltec trackers to face any meteorological adverse circumstance together with its full-wireless system developed with **Open Thread**.
- New **SF8** produces up to **8.6%** more power generation when mounted with bifacial modules.
- Bifacial Gain, albedo and new tracking algorithms have been carefully considered as part of the **SF8** superior design to **maximize performance**.
- The specific performance and advantages of bifacial modules can be simulated using available software, such as PVsyst®, if provided bifacial parameters are properly entered. To do that, it is necessary to adjust the values for **Structure Shading factor, Shed Transparent fraction, Field Thermal Loss factors and Mismatch Loss factor.**

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