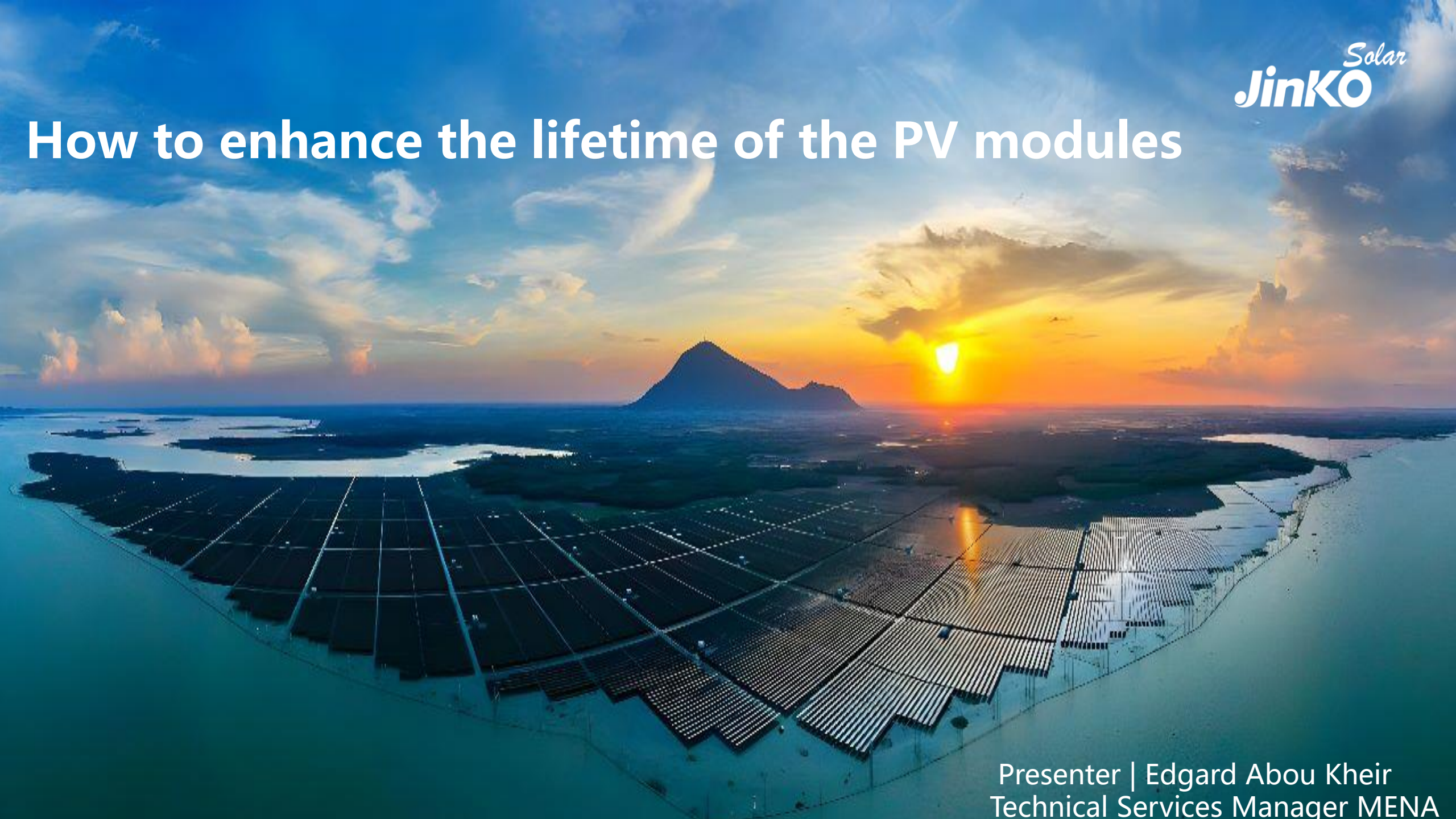
How to enhance the lifetime of the PV modules



Presenter | Edgard Abou Kheir
Technical Services Manager MENA

Content

Vertical Integration

JinKO Solar

Wafers

120GW

Cells

110GW

Modules

130GW

100GW
TOPCon Delivered*

15%
Market Share*

26
Efficiency World Records

100GW+
n-type module Capacity

Globalized Strategic Layout Strategy

Pioneering a vertical integration operational model, JinKo Solar leads the industry by seamlessly connecting silicon wafer, cell, and module production.

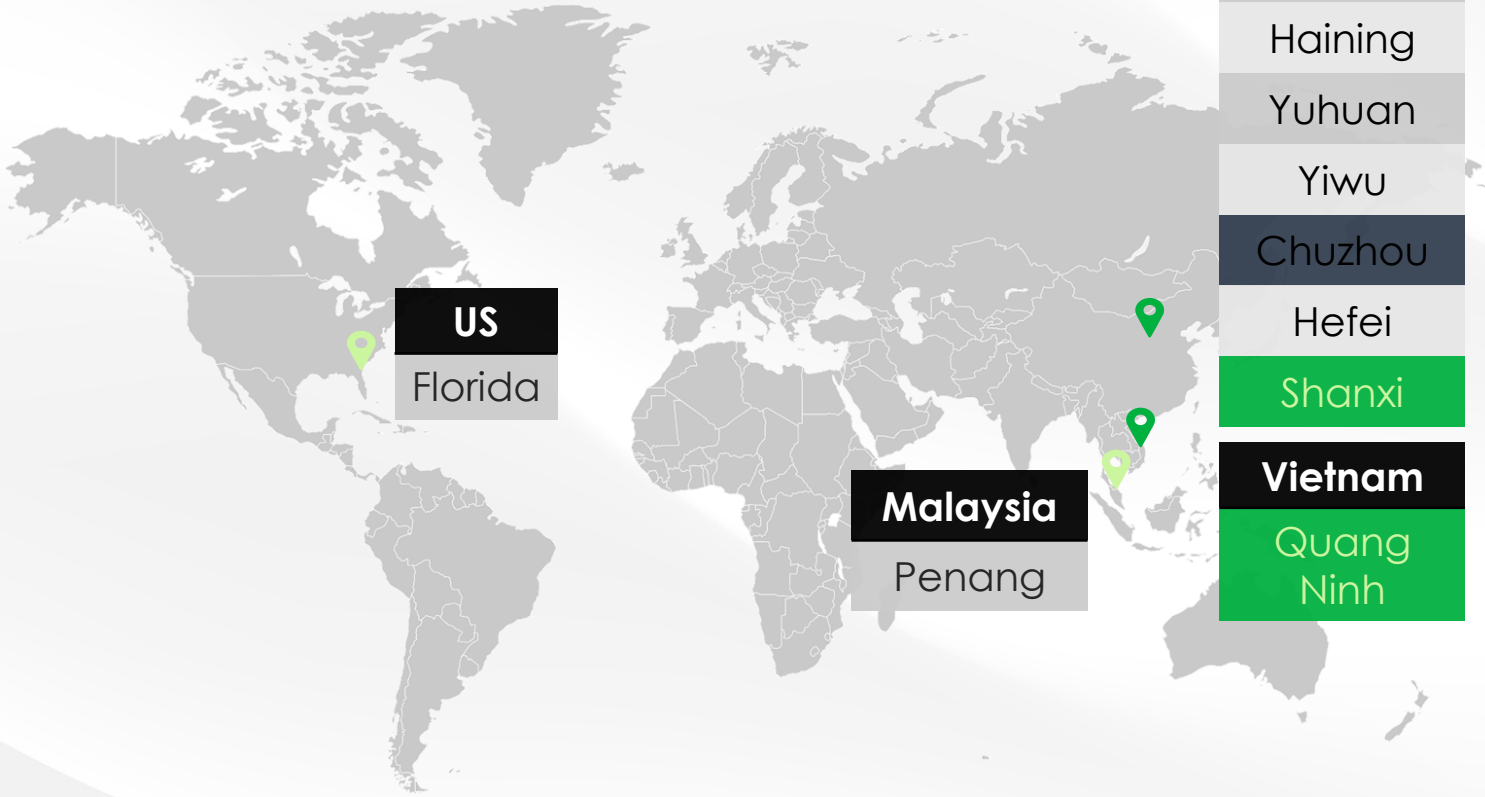
14
Production Facilities

35
Sales Offices

2
Vertical Integrated Super Factories – Quang Ninh & Shanxi

190+
Covered Countries

3000+
Strategic Customers



Leading Edge Technology

26 times break the world record. The 182 **n-type TOPCon cell** reaches **26.89%** maximum conversion efficiency, setting two new world records in **n-type TOPCon tandem with 32.33% and 33.24%.**

3500+
Granted Patents

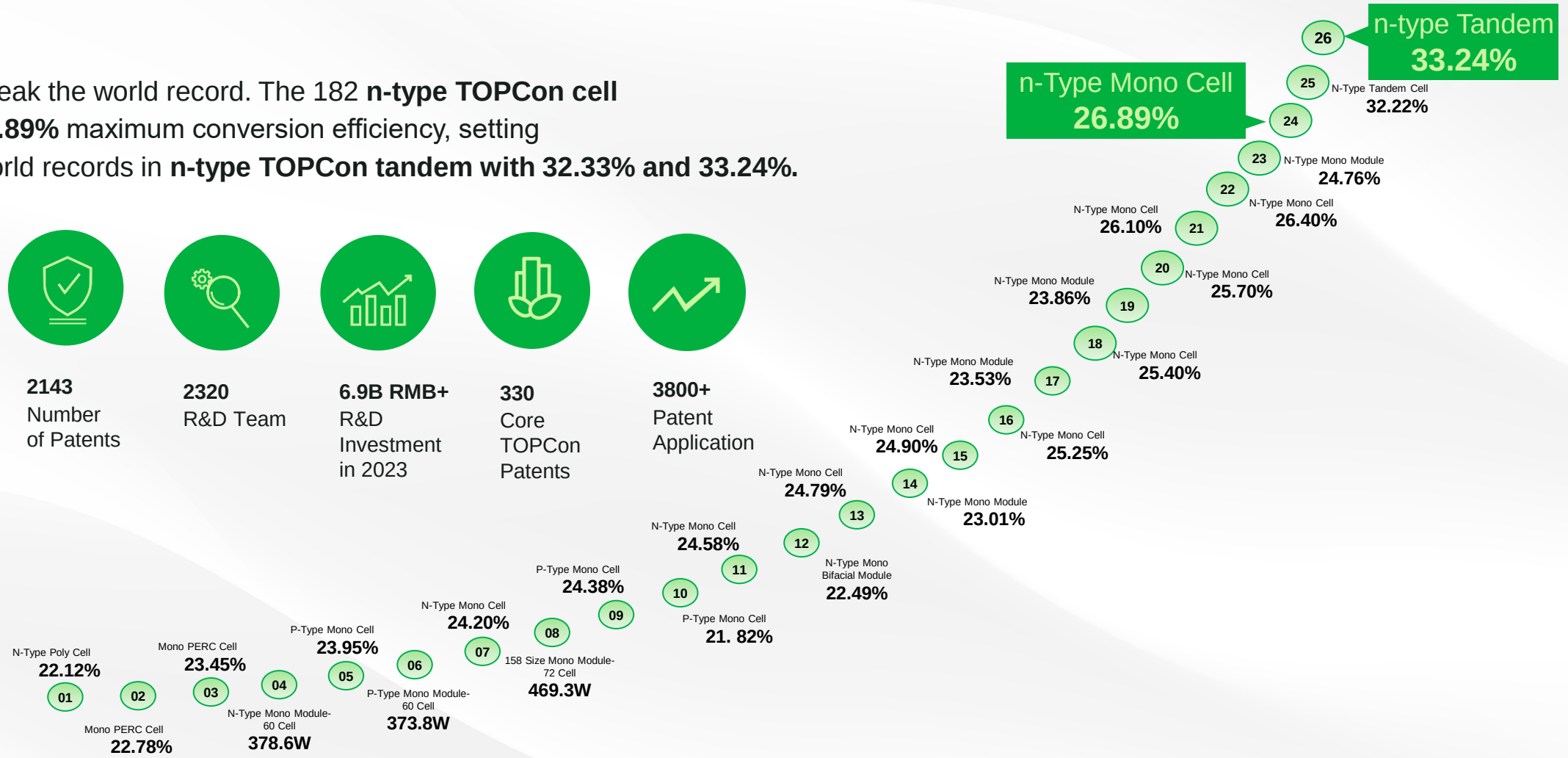
2143
Number of Patents

2320
R&D Team

6.9B RMB+
R&D Investment in 2023

330
Core TOPCon Patents

3800+
Patent Application



Jinko Solar Global Landmark

❖ Conversion Efficiency

- ✓ **14%** Conversion efficiency of the first module.
- ✓ **21%** Conversion efficiency after 100GW shipment.
- ✓ **22.5%** Conversion efficiency after 200GW shipment.

❖ Module Power

- ✓ **230Wp** The first module power.
- ✓ **545Wp** After 100GW shipment.
- ✓ **625Wp** After 200GW shipment.

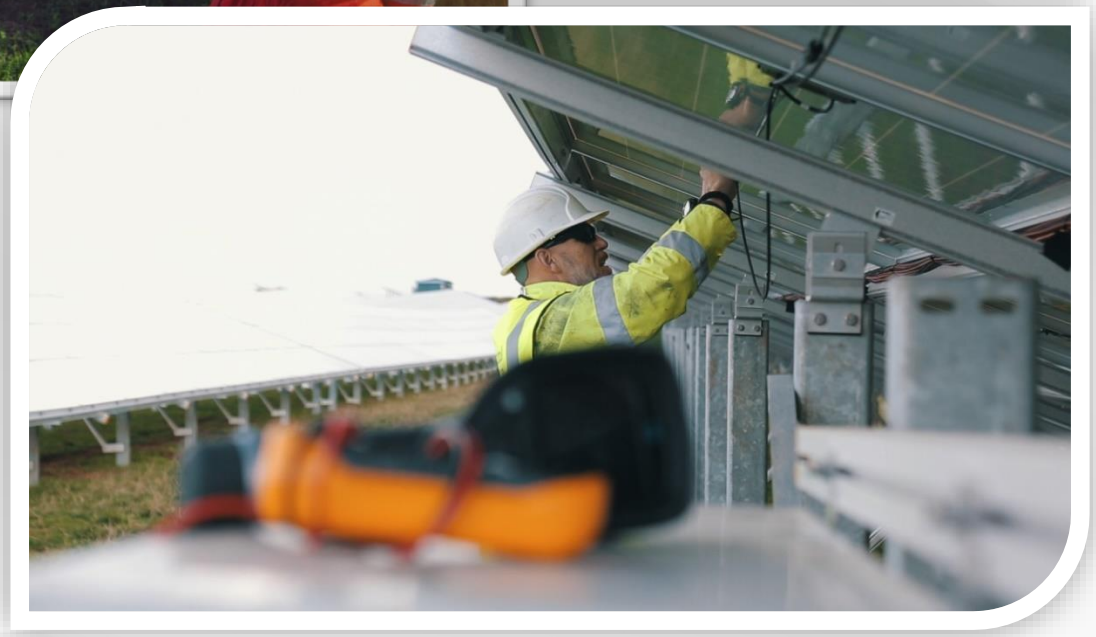
❖ Module Price

- ✓ **90 cent/Wp** the price of the first module.
- ✓ **22 cent/Wp** the price after 100GW shipment.
- ✓ **15 cent/Wp** the price after 200GW shipment.

Content

Why O&M?

- Monitoring & Reporting
  - Reliability
    - Better LCOE
      - Preventive maintenance
        - Corrective maintenance



Routine inspection and troubleshooting

Visual Inspection：

- **Module surface:** dirt, bird-dropping
- **PV connectors:** loosened and burned. Use thermal infrared imager to check the temperature of the connector
- **Junction box:** deformation or burn mark. Open the box and observe whether the potting material is yellowing or turning black
- **Mounting structure:** deflection and rusting, and use internal hexagonal wrench to fastening bolt
- **Glass:** Breakage
- **Backsheet:** scratch, burn mark, or yellowing

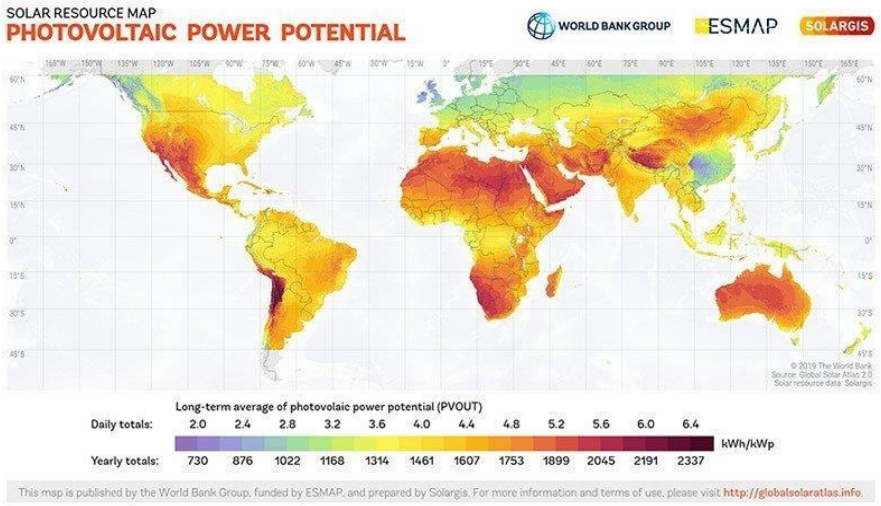
Scratched backsheet

Broken glass

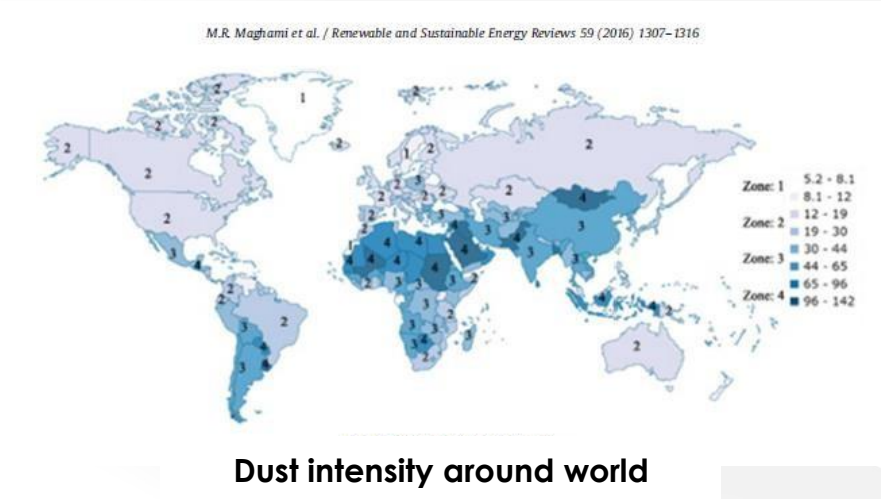
Dirty surface

Content

Soiling Situation of PV Module



Global solar resource distribution



Dust intensity around world

- High radiation and high soiling zones coincide with each other.
- Major markets for modules have relatively serious soiling problems.
- Modules are inevitably affected by droppings, snow, pollution, etc.

Dust

Ashes

Pollution

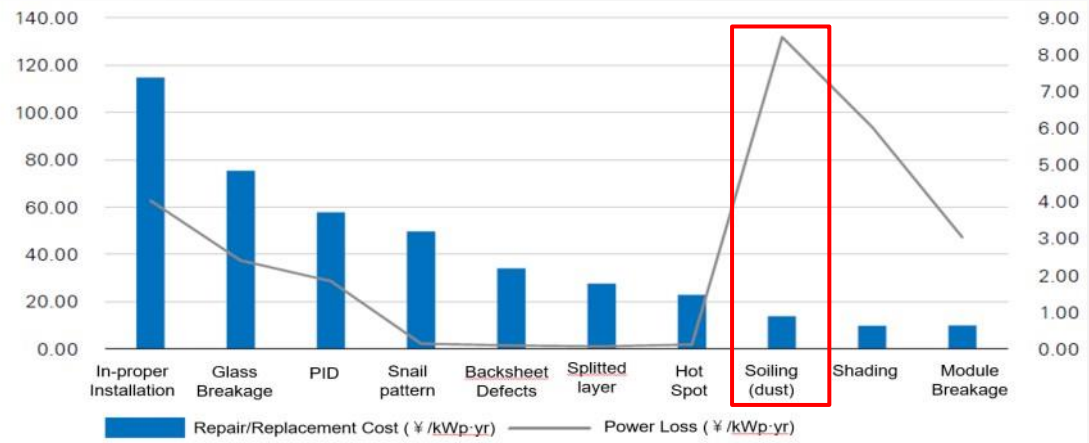
Dropping

Raining

Snowing

Potential Risk of Module Soiling

Irradiation Intensity	Dust reduces the radiation intensity received by the PV module, resulting in module power degradation.
Hot Spot Effect	Partial shading leads to localized heat generation and the formation of a hot spot effect, which can easily damage modules and increases safety risks.
Temperature Effect	Soiling affects the heat transfer of the module and increases the heat transfer resistance. When the temperature rises, the module output power decreases.
Chemical Corrosion	Some dust is corrosive and can cause chemical corrosion of the modules, which in turn reduces the life of the PV modules.



Reference: PV Investment Technical Risk Management, European Union's Horizon 2020 research and innovation programme

- The **module soiling** will generally causes a **5% ~ 10% reduction** in PV system power generation, and in extreme cases the loss of power generation can **exceed 30%.**
- Compared to other impacts, the economic loss from soiling is high, while the O&M and repair costs are relatively low.

Cleaning

Tools

- Clean water
- Wipers
- Soft Bruches

Optimized cleaning frequency

Time: Early in the morning or late in the afternoon

The water pressure shouldn't exceed 6 bar and the PH value is 5~8

Common Cleaning Methods

	Manual Cleaning	Vehicle Cleaning	Robot Cleaning
Restrictions	Road for people walking	High requirements for spacing and road conditions	Almost no restriction
Expense	Depends on local labor and water costs	Depends on local labor and water costs	Depends on PV plant layout
Frequency	2-6 months/once	2-6 months/once	Almost everyday
Cleaning Effect	Worst	Poor	Best
Investment	Continuous investment, accompanied by rising labor costs	Continuous investment, accompanied by rising labor costs	Large initial investment, low maintenance cost
Disadvantage	Low cleaning efficiency, labor cost large, personnel safety	Need professional team to operate, cost high, low cleaning efficiency	Need stability of equipment operation, professional maintenance

Cleaning

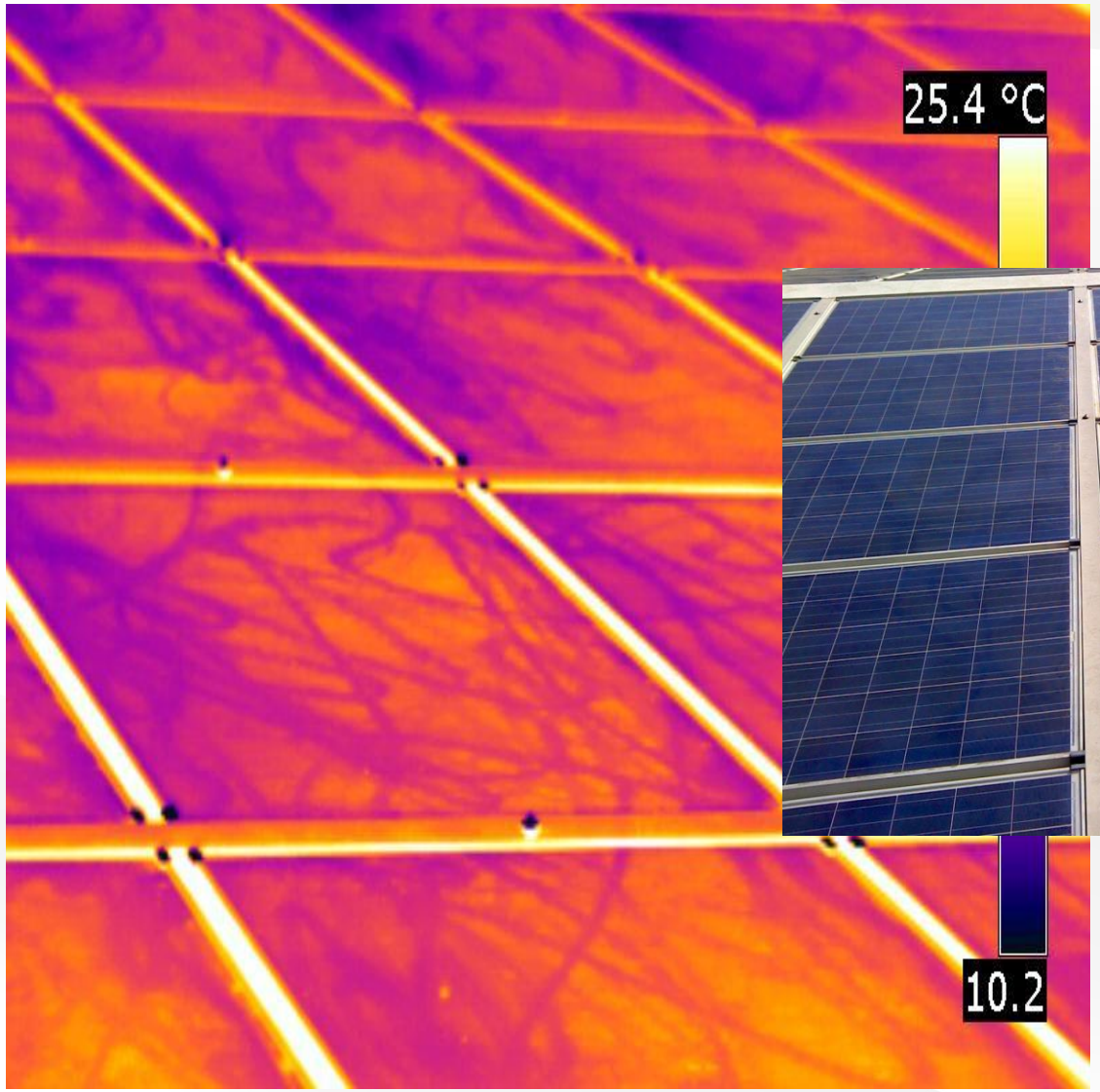
Pay attention to corners and birds dropping

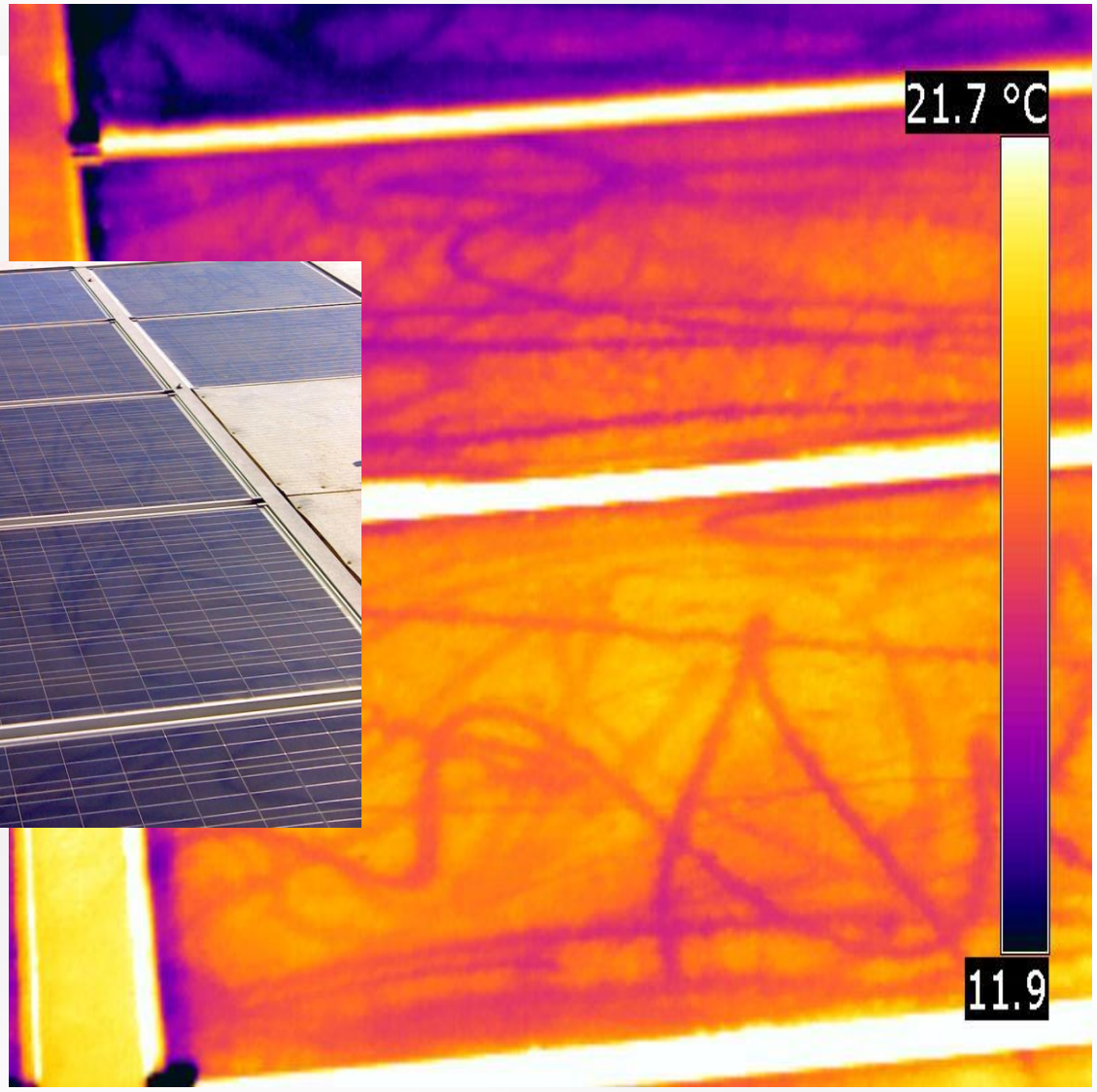
Make sure the module surface temperature is cool to touch

DON'T:

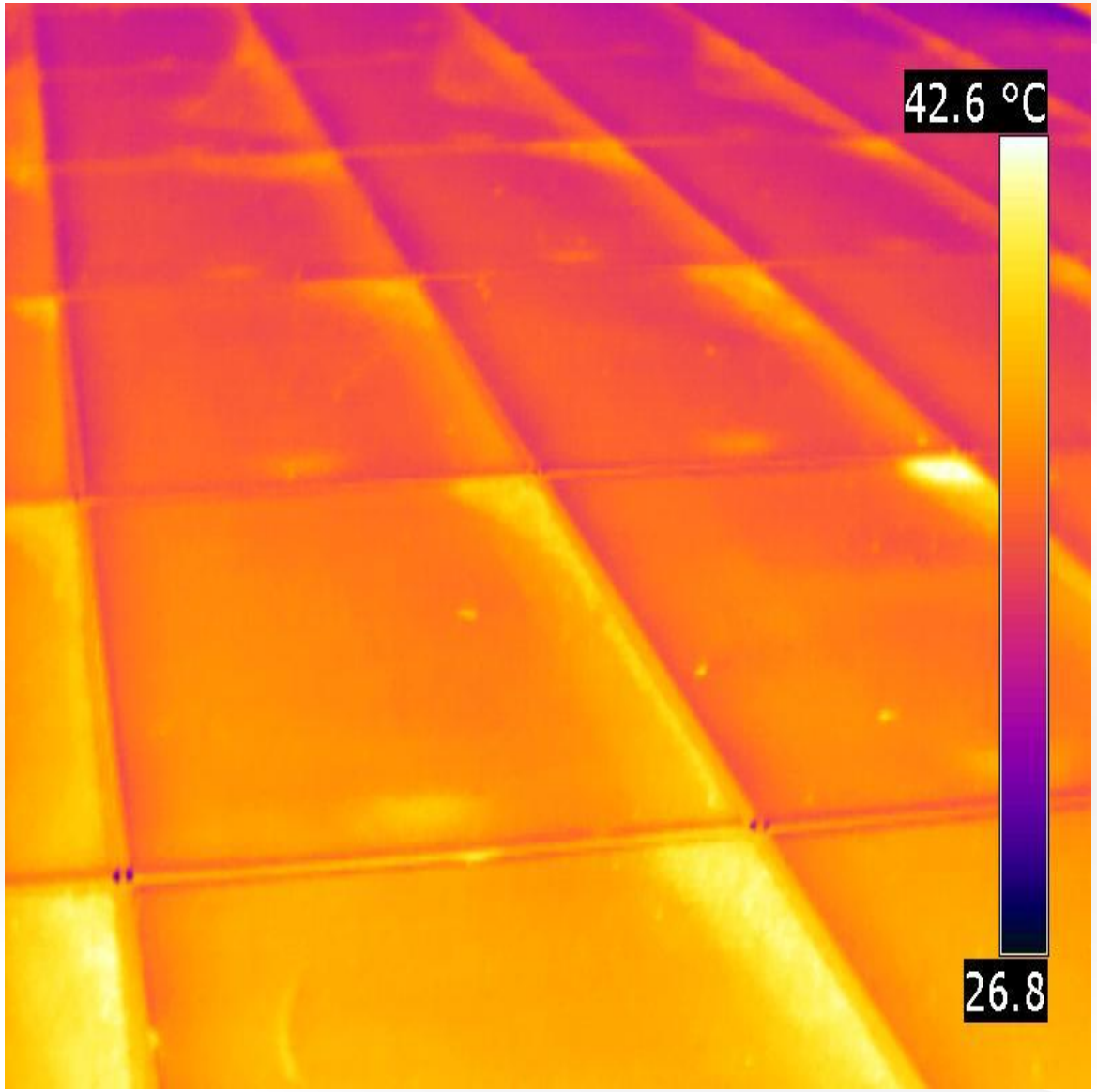
- Step on modules
- Use sharp tools to scrap the dirt
- Use hot water for cleaning
- Use chemicals without Jinko Solar's approval
- Clean a PV module with broken glass or other signs of exposed wiring

Cleaning Damage





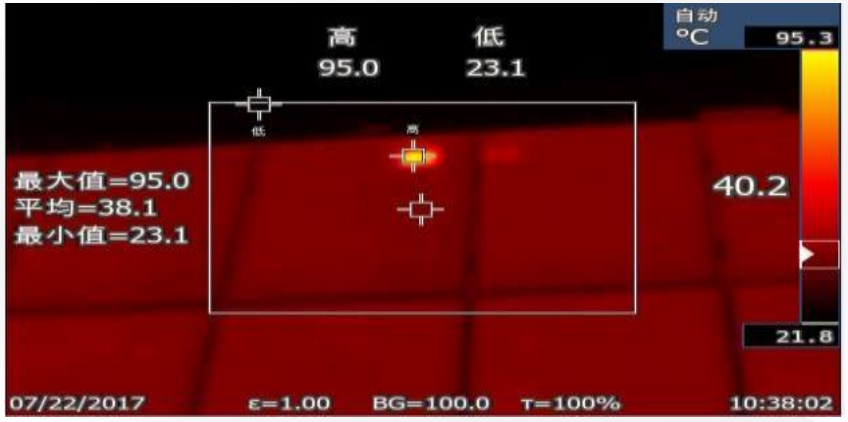
Hotspots due to soiling



Module shading

PROBLEM

Weeds, trees, dust, utility pole, landscape and other shading will cause the hot spot effect. It may cause a certain part of the module temperature to rise which in turn results in material degradation, solder joints meltdown, burn and other permanent damage, even fire.



SOLUTION

- **Avoid shading as much as possible**
- **Clean the PV modules often**

Shading effects

- Hotspots causing backsheet failure

Connectors

PROBLEM

- The connector is of bad quality
- The connector is loose and not properly fixed
- The connector is aging at an accelerating rate due to environmental factors

The above factors will cause the connector head to loosen and over-heat, affecting the overall output of the power station, and the connector head could burn, posing great safety risk.

SOLUTION

- **Check whether the connector is properly soldered**
- **Replace defective connectors**

Junction box

PROBLEM

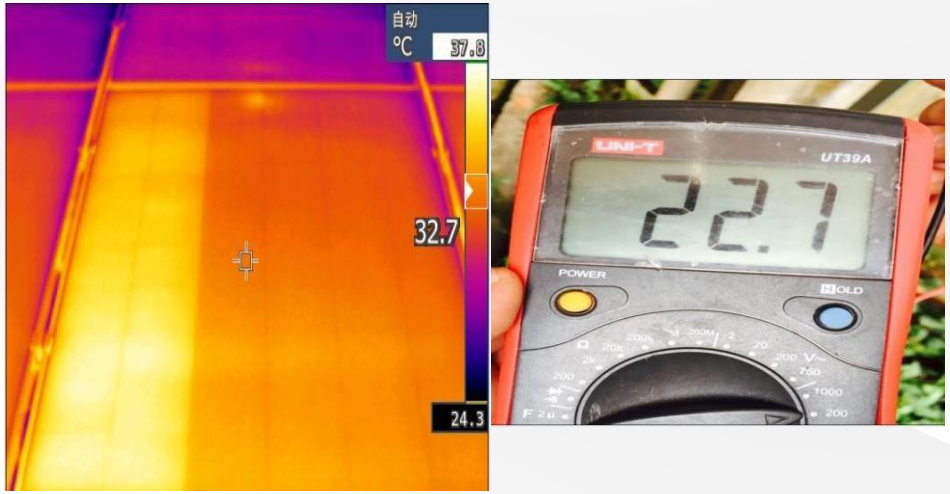
Test the module voltage using a multi-meter. If the voltage is about 1/3 and

2/3 of the normal value or no voltage at all

or if the thermal infrared test shows an

even number of string hotspot, then there

is an issue.



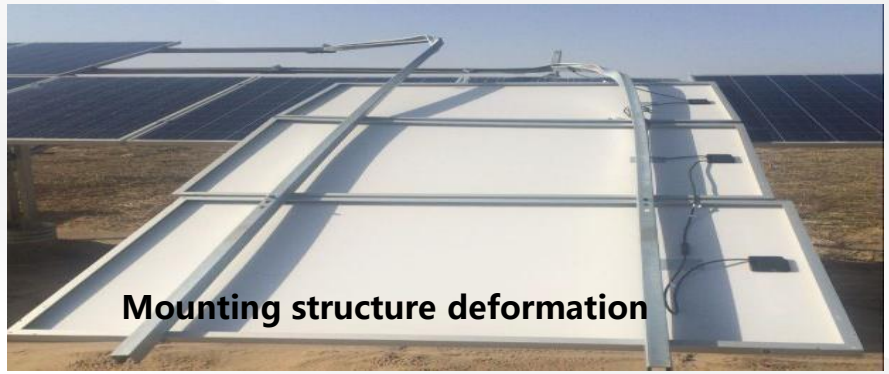
SOLUTION

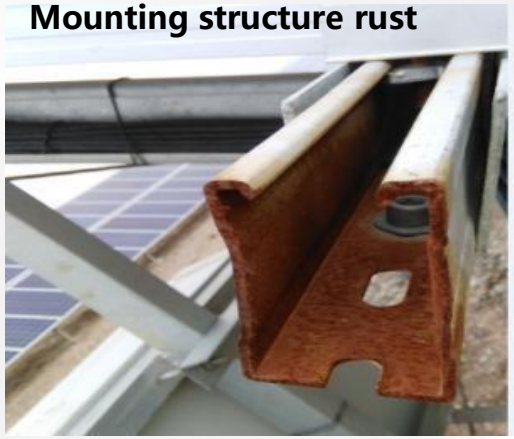
- **Routine inspection using thermal infrared imager**
- **Contact customer service for maintenance**
- **Replace the diode**
- **Conduct earthing resistance test**

Mounting structure, bolts,clamps

PROBLEM

- Mounting structure deformation or tilting due to wind; clamp bolts loosened
- Corrosion and rust due to environmental or quality problems
- Modules are cracked due to small vibration caused by strong wind.





SOLUTION

- **Replace or reinforce the deformed support immediately.**
- **Anti-corrosion treatment on support, bolt and earthing slab**

Violent operation

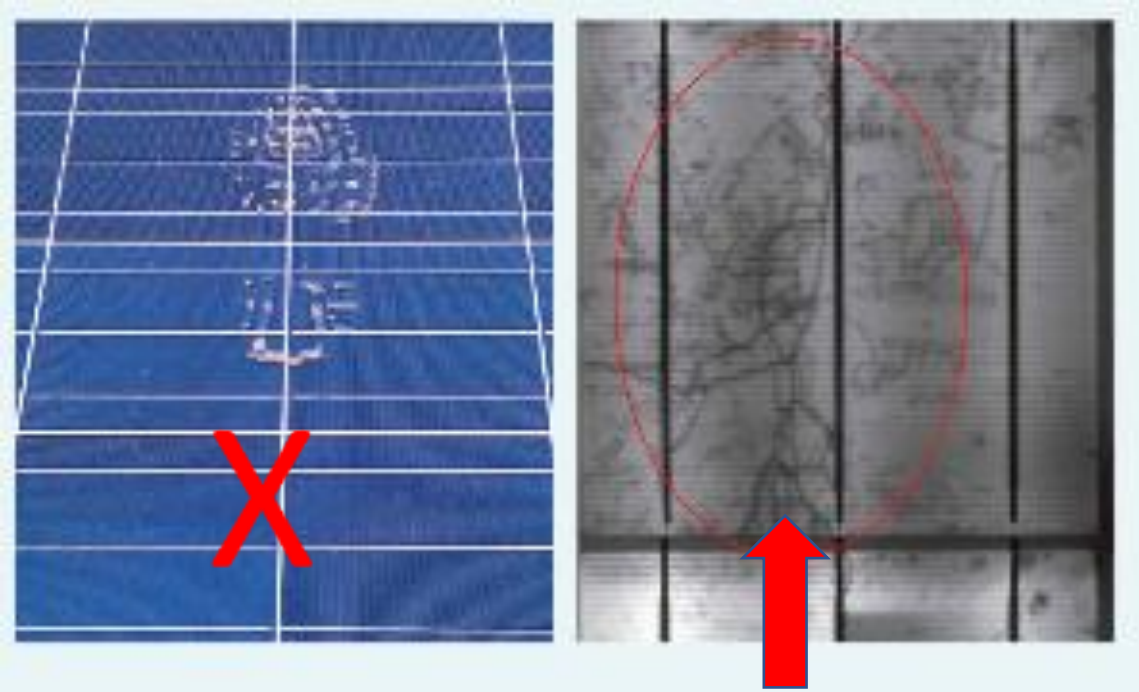
PROBLEM

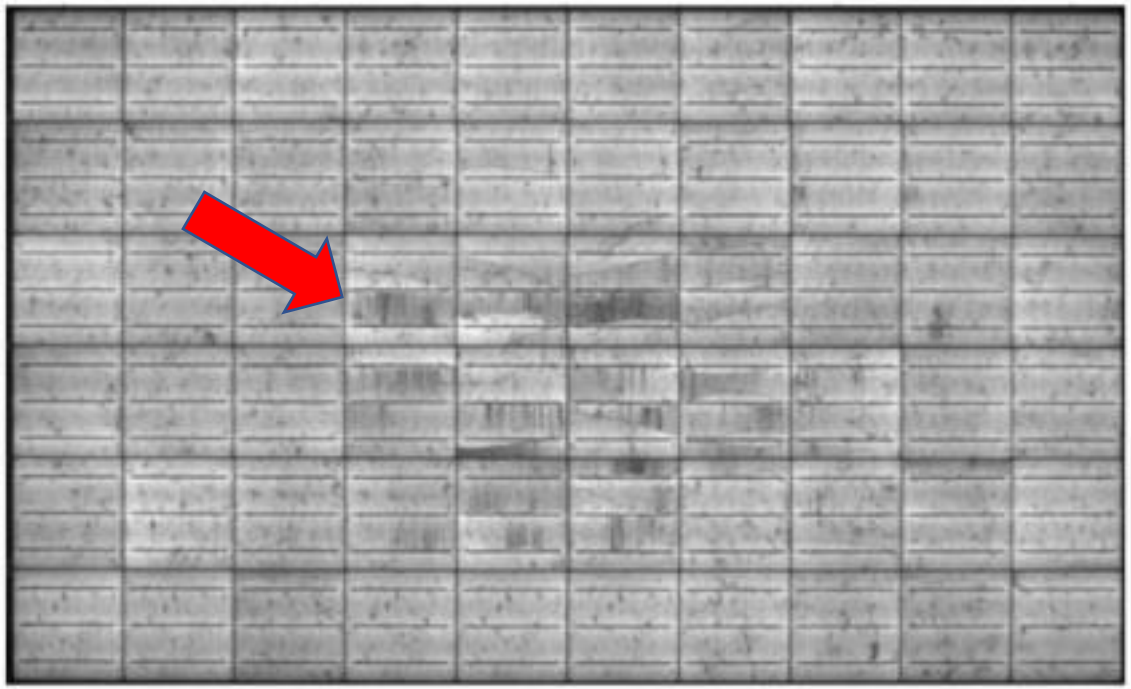
- Handling modules by one person, Standing on modules
- The transportation of spare parts
- Spare parts are randomly placed in the open air

SOLUTION

- Protective tools for transportation/placement
- Two people are required to handle 1 panel, avoid stepping on the panels
- Spare parts shall be well placed on a pallet on a flat floor and covered

Stepping damage to modules



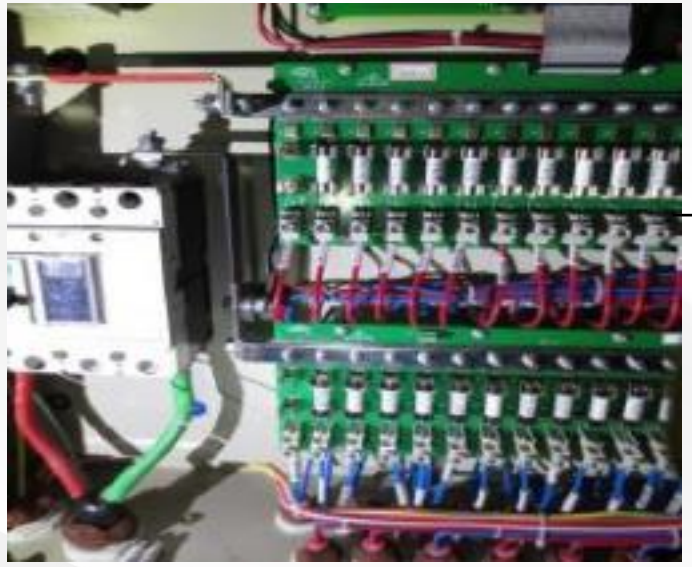


During the production process Jinko takes EL before and after lamination and stores the results (0 Micro crack Production)

Content

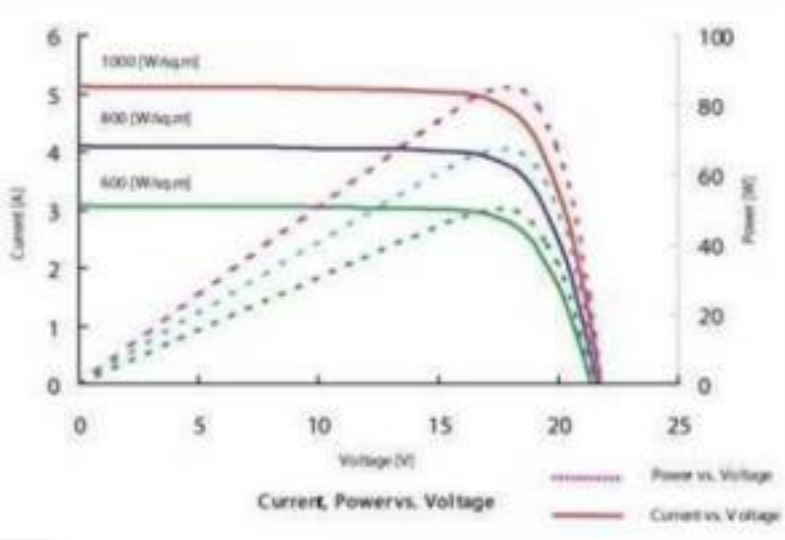
Testing devices

Diodes/module Voc check



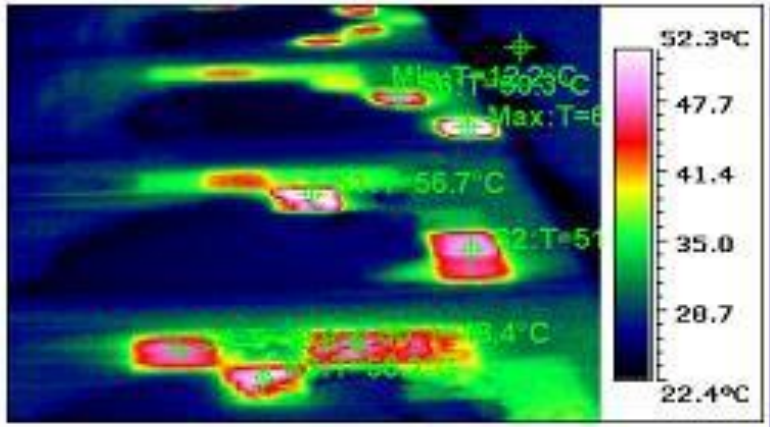
String Voc check

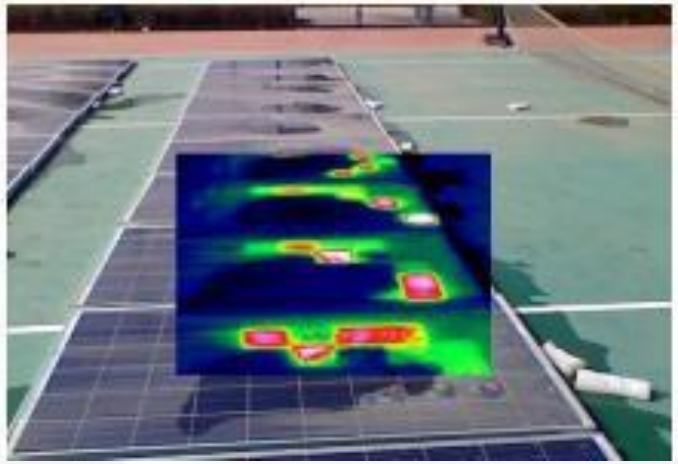
IV tester

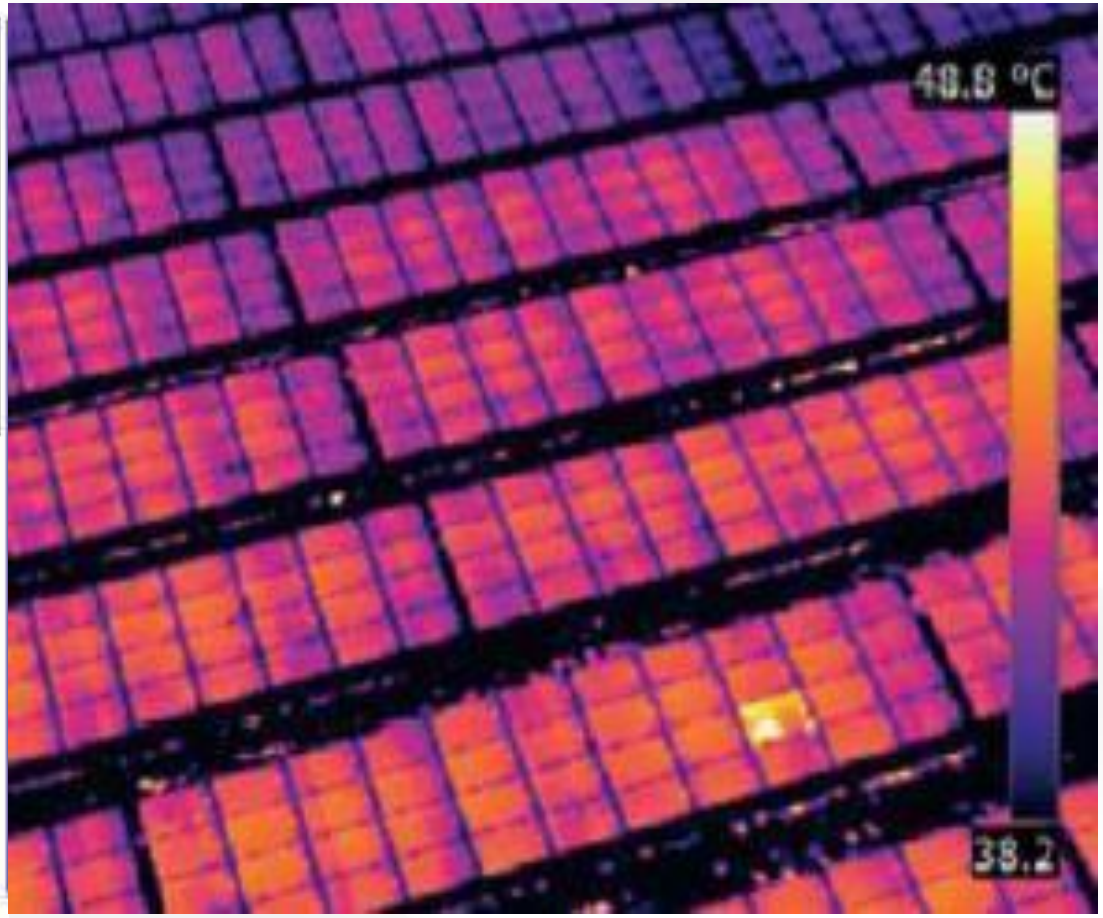


- Portable IV tester can be used for on-site power testing (power test uncertainty ±10% should be considered). Initial on-site checking can be used for reference before modules are sent to 3rd party lab for tests.

IR camera







- Infrared imager or thermal tester will be beneficial for operation. It will help to check the potential risks on hot-spot and avoid unnecessary performance loss of PV projects.

Warranty claims and after sales services

- Professional engineer service team to provide all kinds of product information and maintenance guidance for customers
- Site visit to provide technical support

- Make regular return visits to the customers , collect improvements of the problem, also about the satisfaction degree of customers.
- Record and analyze the abnormality, help the factory to improve the quality and process, and provide better products and service to customers

Thanks!