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The power behind Pakistan's "under the radar" gigawatt-scale market

30 March 2023

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7:00 pm – 8:00 pm | AEDT, Sydney

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Welcome!

pv magazine webinars

Do you have any questions? ? 

Send them in via the Q&A tab.  We aim to answer as many as we can today!

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The power behind Pakistan's "under the radar" gigawatt-scale market

YINGLI ENERGY DEVELOPMENT CO., LTD.

Pakistan Solar Energy Market Trend

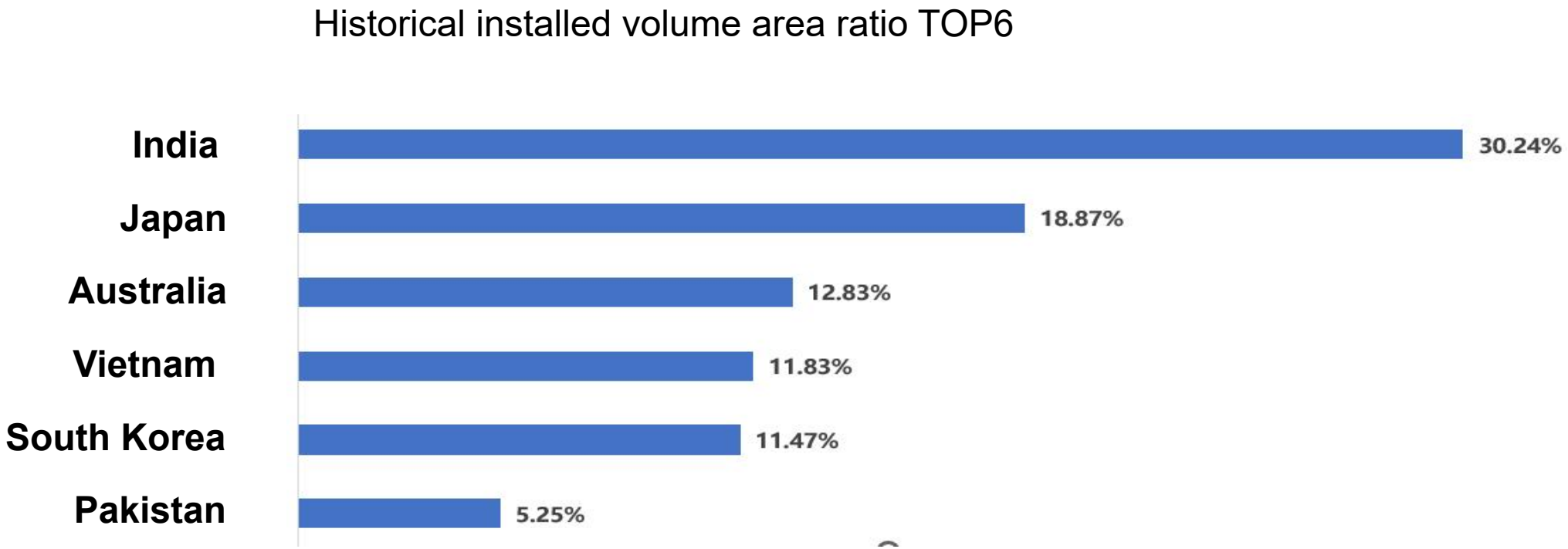
- Based on AEDB, Pakistani government has set an objective to realize at least 20% of its electricity generation as an alternative renewable source by 2025 and 30% by 2030, total Solar installation capacity will reach 12.8GW.

- With the rising costs of electricity in Pakistan and an unreliable grid supply, more industries and commercial organizations are turning to captive solar solutions. There has been a strong surge in domestic installation of rooftop photovoltaic panels in larger cities.

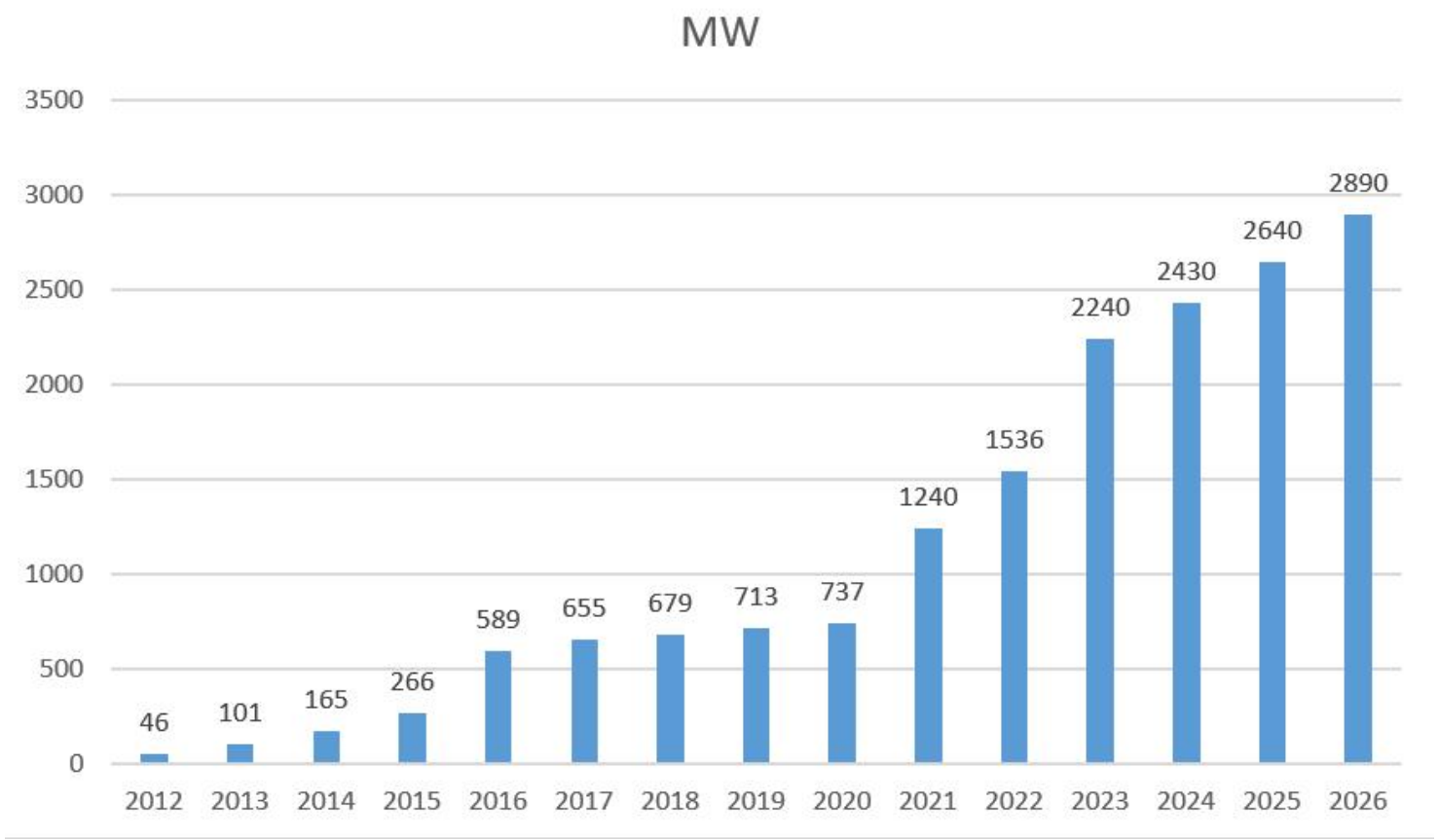
- To expand renewable energy in Pakistan’s energy mix, the World Bank has provided $100 million of financing to Sind Solar Energy Project to support independent power producers develop 400 MW of new solar power projects and provide partial grants to private sector firms for the commercial provision of Solar Home Systems to 200,000 households

Steady Growth of Demand in Pakistan

Although Pakistan has been restricted by foreign exchange control and other factors for a while, the market has been in a steady upward state since 2019.



Yearly Data for Pakistan Solar Market



Market Scope

1. Ground mounted Solar Power Plant

- According to the Pakistan Economic Survey, 6400MW solar power plant already connect to national graid.
- Utility sector is expected to dominate the Pakistani solar energy market during the forecast period due to the lowering cost of solar modules and numerous upcoming projects.
- Till February 2023, 58 IPPs were granted by Pakistan government, totally around 600 MWs.

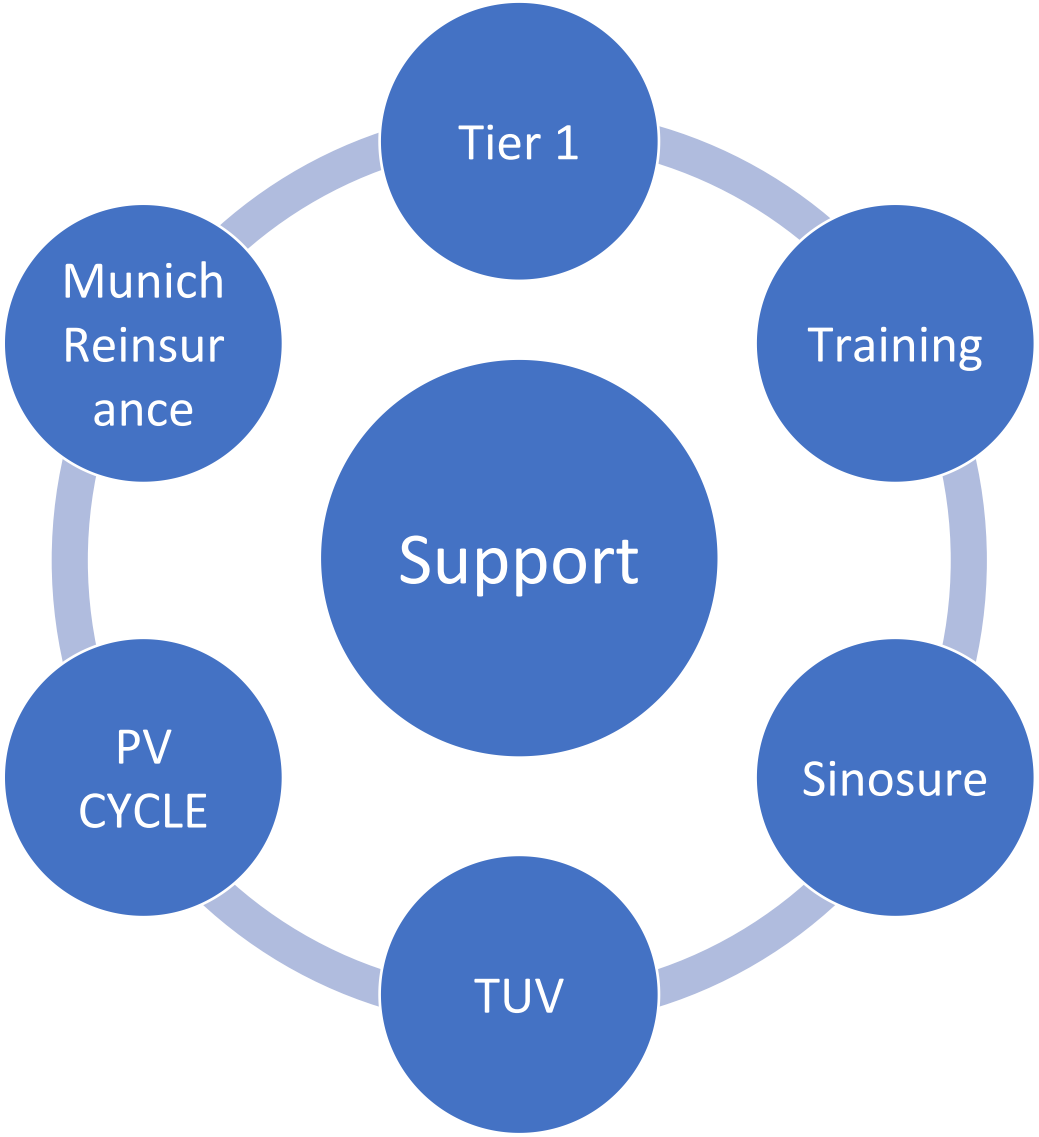
2. Residential Demand

- With the rising costs of electricity in Pakistan and an unreliable grid supply, more industries and commercial organizations are turning to captive solar solutions.
- For projects under 1 MW, net metering regulations came into effect in September 2015.
- Nepra is also set to raise the price paid by net-metered households to inject excess electricity into the grid from PKR 19.32 ($0.089) kwh to PKR 9/kwh
- 2023 236 license approved and totally 400 MW.

3. Commercial Demand

- Due to high electricity cost, many local big groups choose to install solar panel on their factories, like Fauji, Attock.
- The federal government decided in January 2023 to install solar panels on all government buildings in the country in the next four months.

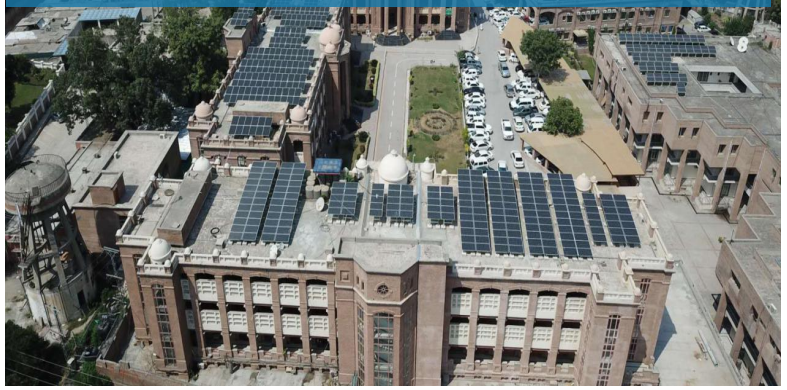
Varied Supports For The Pakistan Market



Example PV Installation Featuring Yingli Solar Panels In Pakistan And Around The World

Client: MUnion Trading Inc
Output: 3.5MW
Location/ year: Pakistan, 2022

Client: Peshwar Government
Output: 460kw
Location/ year: 2020



Client: Pakistan Paraliament House
Output: 1MW
Location/ year: Pakistan, 2016

Client: Xiong'an railway station (high speed rail) Output: 6MW
Location/year: Xiong'an intercity, 2020
The largest railway station in Asia

Client: Kea Energy
Output: 1.5MW Yingli Bifacial
Location/ year: Marlborough, New Zealand, 2021
*Panels purchase with Bitcoin.

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Thank you!

Wendy An: shuhua.an@yingli.com

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The power behind Pakistan's "under the radar" gigawatt-scale market

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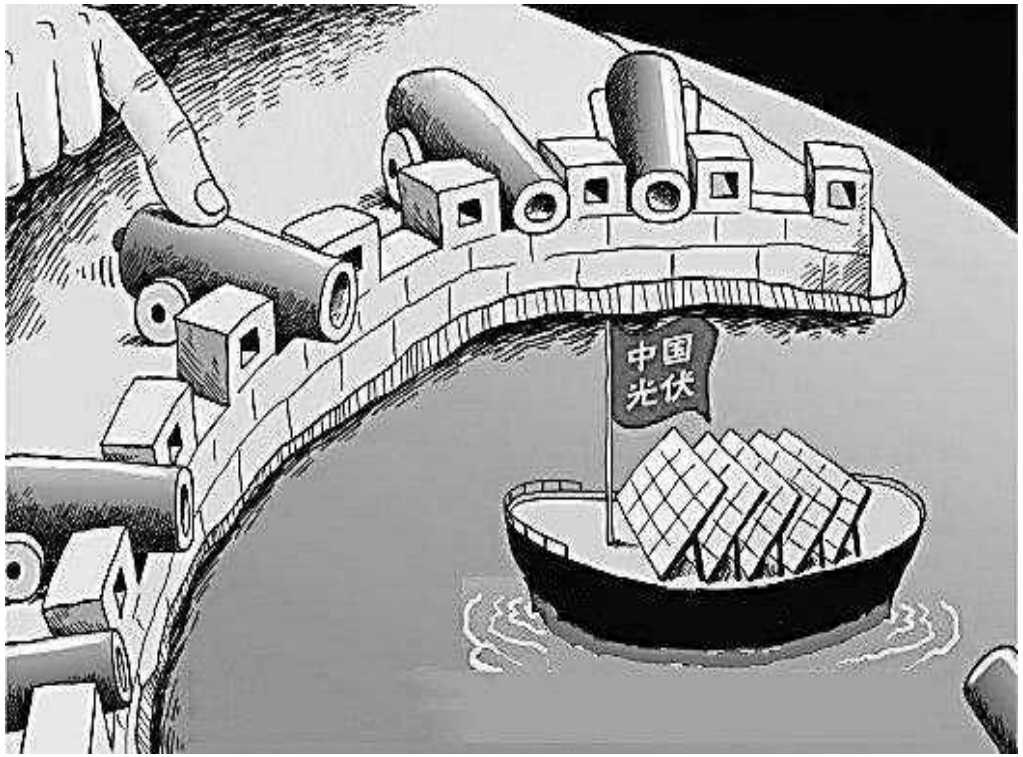
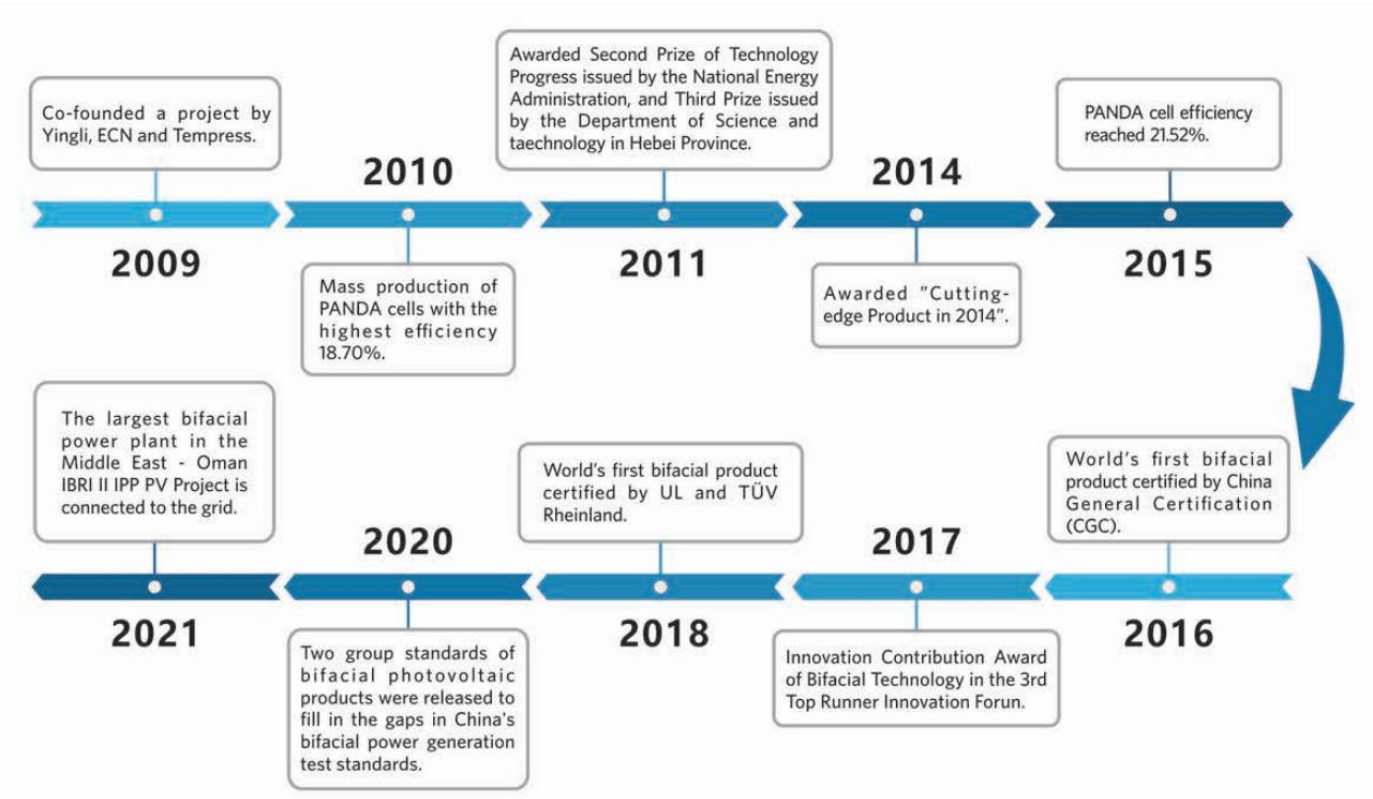
N-type mono-Si bifacial module

PANDA modules sound the horn to break through barriers



Once upon a time, Chinese photovoltaic companies faced many restrictions such as technical barriers and trade barriers.



In 2010, Yingli Solar mass-produced n-type monocrystalline PANDA modules. The mass production and shipment of PANDA modules have broken the monopoly of foreign photovoltaic companies on high-efficiency crystalline silicon technology, marking that Chinese photovoltaic companies have begun to compete for the global high-end photovoltaic market with high-efficiency n-type monocrystalline products.

PANDA 3.0 module innovation technology

N type

PANDA 3.0 technology

Electricity

- New surface passivation system to improve cell Voc
- Low-power laser splitting technology to reduce cell cutting loss
- Multi-busbar stacking slicing technology to reduce internal resistance loss of module
- ……

Optics

- Perfect optical matching technology to improve the bifaciality of cell
- The light utilization technology in the shading area, the invisible technology of ribbon, the multi-film anti-reflection technology, and the optimization of the frame design work together to improve the bifaciality and optical utilization of the module
- …….

Mechanical stress

- Low temperature non-destructive cutting technology to improve the mechanical properties of sliced cells
- Low temperature snow mechanical load test, reflecting the application of modules under the influence of comprehensive factors
- ……

Environmental stress

- Tightened reliability test to reflect the application of modules under the influence of complex factors
- 4 times IEC standard cyclic Salt Mist Corrosion test, reflecting the application of modules in high humidity, heat and high salt mist environment
- ……

PANDA modules lead the application of bifacial power generation technology

PANDA 1.0 module

156 mm wafer + n-type PERT cell + frameless

PANDA 2.0 module

156 mm wafer + n-type IIF cell + frameless/frame

Innovative application

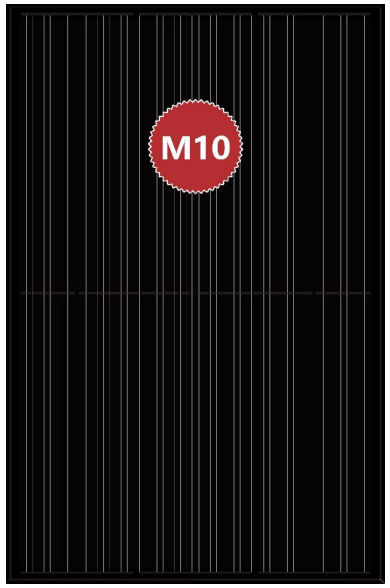
Ground power plant of the first Top Runner base

Project Location: Datong, Shanxi Province, China

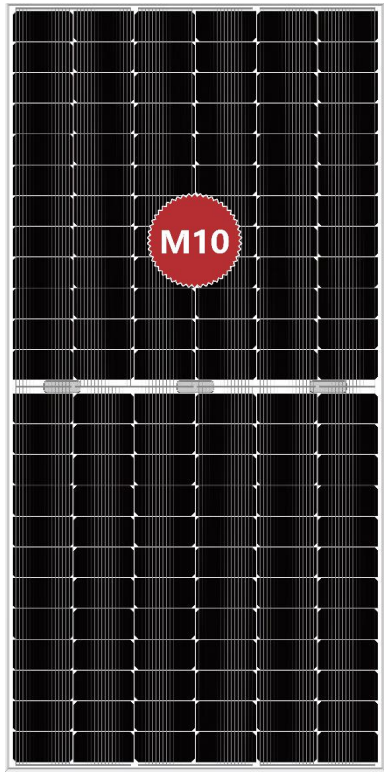
Project significance: The only bifacial power plant (50 MW) in China's first Top Runner base has opened a new era of large-scale application of bifacial products.

PANDA modules add new technology and start a new journey

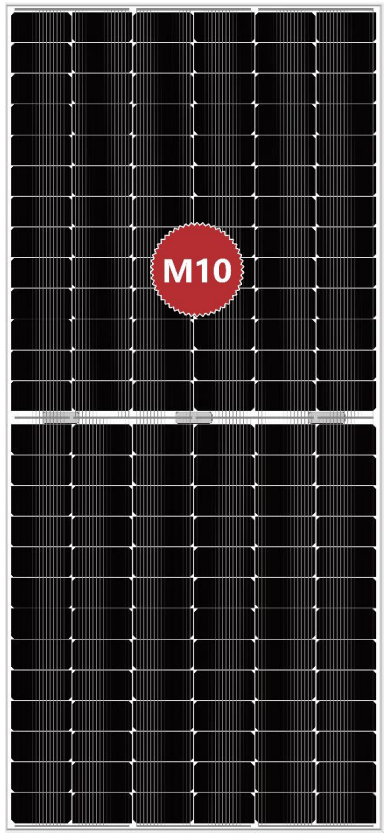
PANDA 3.0 module



415-425 W (Black)



565-575 W



610-620 W

182 mm wafer + n-type TOPCon cell + frame

Backside Yield

The backside of the module effectively uses reflected and scattered light from the environment to generate electricity.

Superior Yield

The large size cell enhances the module's power output, with the excellent temperature coefficient, superior low light performance and comprehensive LID/LeTID degradation suppression technology, allows the module to generate more energy yield once in use.

Excellent Durability

The modules meet IEC standard testing requirements and are resistant to salt mist, ammonia, dust and sand, snail trail and PID risks.

Wide Applications

The glass-glass structure, special material selection and extra-strong frames effectively enhance the mechanical performance of the modules, their compatibility with mainstream trackers and inverters, and their adaptability to harsh environments.

Outstanding Bifaciality

The modules have industry-leading bifaciality for bifacial modules.

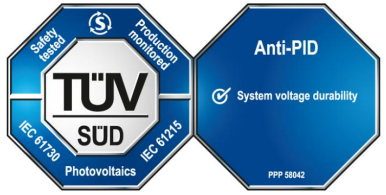
PANDA 3.0 modules obtained international certificates

Basic certification

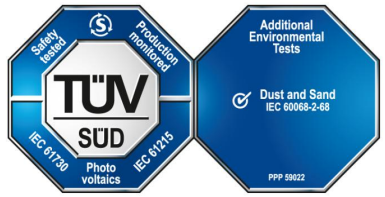
TÜV Rheinland certificate based on IEC 61215 and IEC 61730 standards

TÜV Rheinland certificate based on LVD 2014/35/EU

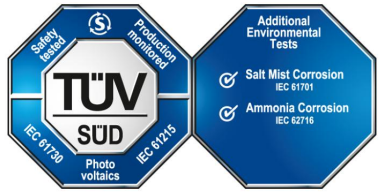
Differentiated certification



TÜV SÜD certificate based on IEC 61215 and IEC 61730 standards: Anti-PID 192 hours



TÜV SÜD certificate based on IEC 60068-2-68 standard: Sand and Dust resistance certification



TÜV SÜD certificate based on IEC 61701 standard: Salt Mist Corrosion resistance certification

TÜV SÜD certificate based on IEC 62716 standard: Ammonia Corrosion resistance certification

PANDA 3.0 modules have obtained basic certificates and differentiated certificates for entering the international market, and began the journey of international application.

TOPCon module yield gain in a typical environment

Type	Reflectivity	Power generation (kWh/kW•year)	System effiency	Yield gain
Monofacial module	/	1413	87.83%	0%
Bifacial - Wet sand	10%	1486	92.34%	5.17%
Bifacial - Dry sand	20%	1536	95.43%	8.70%
Bifacial - Grass	26%	1566	97.28%	10.83%
Bifacial - Old snow	60%	1732	107.64%	22.58%
Bifacial - New snow	95%	1896	117.84%	34.18%

1. Project information: 100 MW bifacial power station in China, with capacity ratio of 1.1:1。
2. Module information: TOPCon monofacial & bifacial module, fixed bracket installed at 35° Angle, front output is 575 W, bifacial module bifaciality is 80%。

Type	Reflectivity	Power generation (kWh/kW•year)	System effiency	Yield gain
Monofacial module	/	1461	85.86%	0%
Bifacial - Wet sand	10%	1525	89.62%	4.38%
Bifacial - Dry sand	20%	1556	91.40%	6.50%
Bifacial - Grass	26%	1574	92.51%	7.73%
Bifacial - Old snow	60%	1677	98.52%	14.78%
Bifacial - New snow	95%	1782	104.70%	21.97%

1. Project information: 100 MW bifacial power station in China, with capacity ratio of 1.1:1。
2. Module information: TOPCon monofacial & bifacial module, flat single axis tracking bracket mounting, front output is 575 W, bifacial module bifaciality is 80%。

PANDA 3.0 modules have been calculated to effectively reduce the LCOE

Module type	144 PERC bifacial module (182 mm wafer)	132 PERC bifacial module (210 mm wafer)	144 TOPCon bifacial module (182 mm wafer)	156 TOPCon bifacial module (182 mm wafer)
Power (W)	545	655	565	610
Quantity (PCS/100 MW)	183486	152672	176991	163934
Bifaciality (%)	65	65	80	80
First year degradation (%)	2.00	2.00	1.00	1.00
Annual degradation (%)	0.45	0.45	0.40	0.40
Temperature coefficient of power (%/°C)	-0.36	-0.36	-0.30	-0.30
BOS (USD/W)(Rate: 6.81)	0.279	0.267	0.275	0.275
LCOE (USD/kWh)(Rate: 6.81)	0.05	0.0489	0.0477	0.0476

1. The LCOE value only considers the full investment scenario, excluding financing costs.
2. The LCOE value is calculated according to the LCOE calculation formula of the "Photovoltaic Power Generation System Performance Specification", in which the discount rate is calculated at 5%, the residual value of the power plant is calculated at 5%, and the value-added tax is deducted in 25 years.
3. The comparison projects are all ground power plants in Baoding, China, and the capacity ratio is considered at 1.1:1. The comparison modules are all bifacial modules, and the module price was the average transaction price in early August, 2022.

Efficient and reliable PANDA 3.0 modules can reduce the LCOE even if there is a price difference with PERC modules.

Innovative application

IBRI Ⅱ ground power plant

Project location: Oman, Middle East
Project capacity: 117 MW
Project significance: A bifacial power plant that significantly reduces the LCOE in the desert environment.

Thank you!

Jiong Zheng:jiong.zheng@yingli.com

英利能源发展有限公司

YINGLI ENERGY DEVELOPMENT CO., LTD.

بسم الله الرحمن الرحيم

BARG ENGINEERING

Solar Consultancy | Energy Efficiency | Design & Supervision

PREPARED BY :

ENGR. SALEEM BARG (M. Eng, P. Eng, PMP)

CEO

BARG ENGINEERING (SMC-PRIVATE) LIMITED,

(PAKISTAN)

BARG ENGINEERING, (PAKISTAN)

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- Address: 31A, Small Industrial Estate, Hayat Abad, Peshawar, KP, Pakistan
- Phone: 091-5828535
- Web Address: www.bargengineering.com
- Email: barg.engineering@outlook.com
- NTN Number: 3966106-7
- PEC Registration #: CONSULT/1571
- KPRA Registration: K3966106-7
- Project Profile Codes:
  - 1201 Buildings & Offices
  - 1203 Urban developments and Roads
  - 1204(i) Urban sewerage and Water supply
  - 1207 Hydroelectric power stations
  - 1210 Renewable Energy sources and Systems.
  - 1220 Energy Planning conservation and development
  - 1235 Surveying, valuation and loss assessment

CHIEF EXECUTIVE OFFICER (CEO)

ENGR. M.SALEEM BARG

Education :

- M.Sc. Electrical (Power + Renewables), 2010 - Ryerson University Toronto, Canada
- B. Sc. Electrical (Power) 1995 - UET, Peshawar, Pakistan
- PMP – Project Management Professional 2010 – Project Management Institute–USA

Work Experience :

- 1997-2010

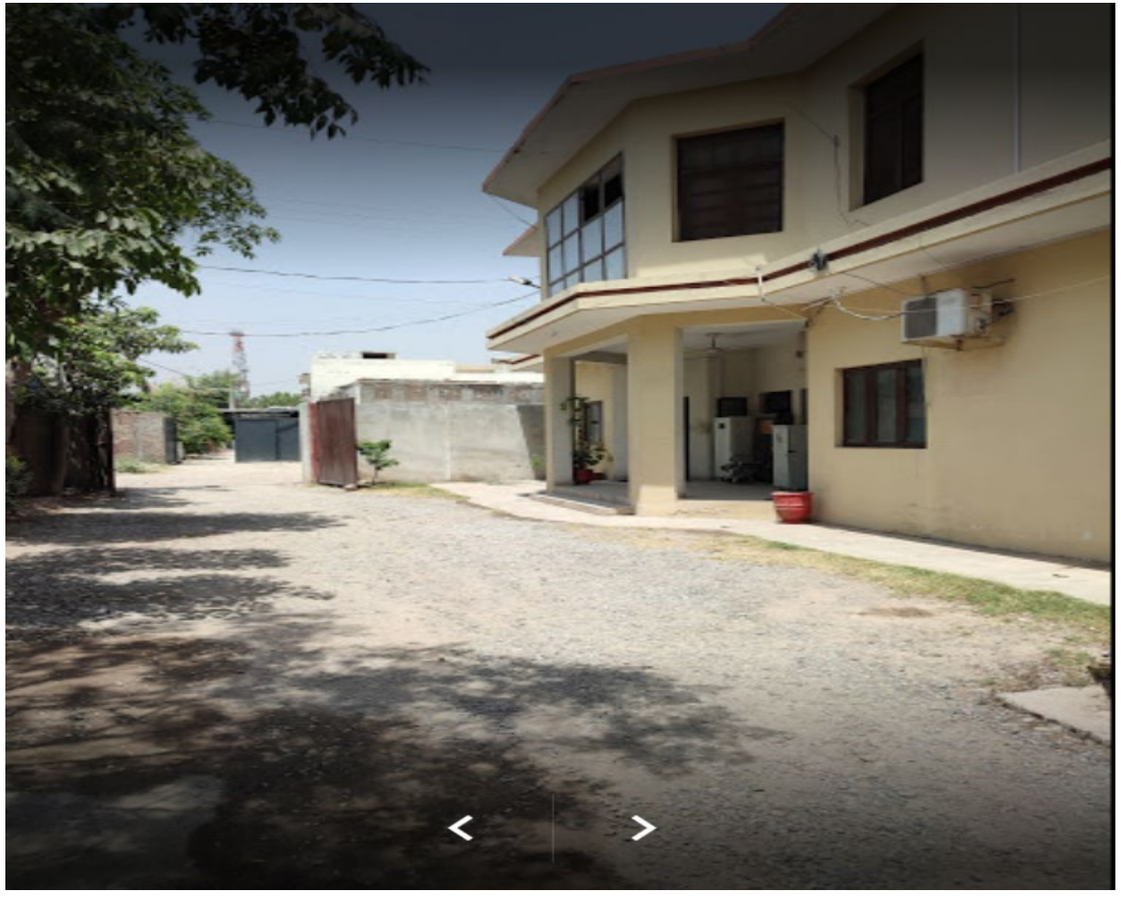
  14-Years With SIEMENS as Automation & Control Engineer (Pakistan, Saudi Arabia, USA, Canada, Germany, China)

- 2010 to date

  12 Years With BARG Engineering Consultancy as Team Leader

BARG ENGINEERING (HEAD OFFICE)

Khyber Pakhtunkhwa, Pakistan



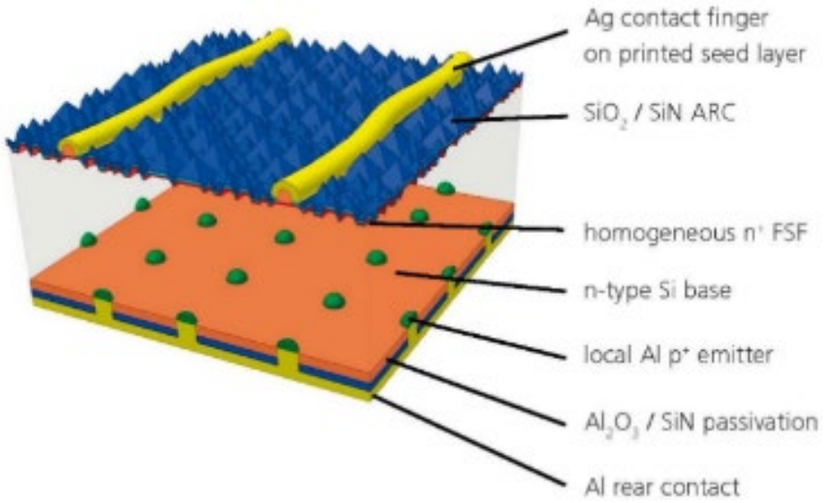
N-Type Solar Panel

INTRODUCTION

- An N-type solar cell consists of
    1. Thin p-type silicon Layer (doped with boron)
    2. Thicker n-type silicon Layer Wafer (doped with phosphorus).

WHY P-TYPE DOMINATED?

- First developed solar cell was N-type.
- Solar technology was originally developed for use in space, where P-type cells were found to be more tolerant to radiation damage.
- Lack of research on N-type at the time the solar industry was developing



ADVANTAGES (N-TYPE SOLAR PANELS)

1. Resistant to LIGHT INDUCED DEGRADATION.
2. LONGER carrier lifetime.
3. LESS PRONE to effects of METALLIC IMPURITIES.
4. High TEMPERATURE TOLERANCE.
5. High EFFICIENCY.

THERMAL CHARACTERISTICS (P-TYPE SOLAR PANELS)

Temperature Coefficient of Pmax	Y	%/°C	-0.35
Temperature Coefficient of Voc	ß	%/°C	-0.27

THERMAL CHARACTERISTICS (N-TYPE SOLAR PANELS)

Temperature Coefficient of Pmax	Y	%/°C	-0.30
Temperature Coefficient of Voc	ß	%/°C	-0.25

Bifacial Solar Panels

YINGLI SOLAR

INTRODUCTION

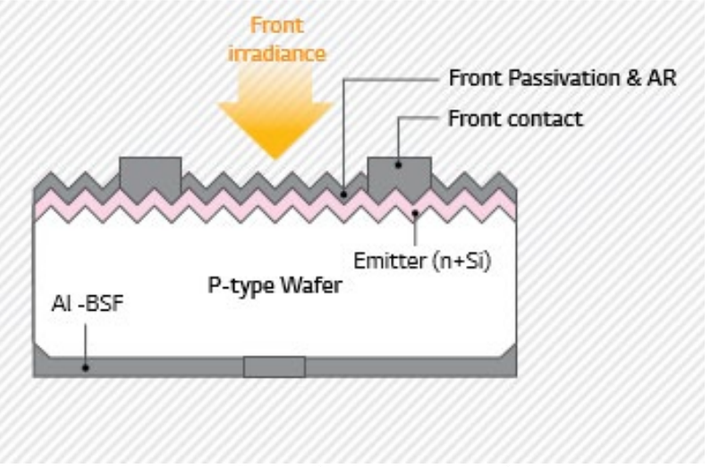
- This PV module can harvest light energy from both the front and backside.
- Theses panels uses glass on Both Sides (Front & Back).

DESIGN

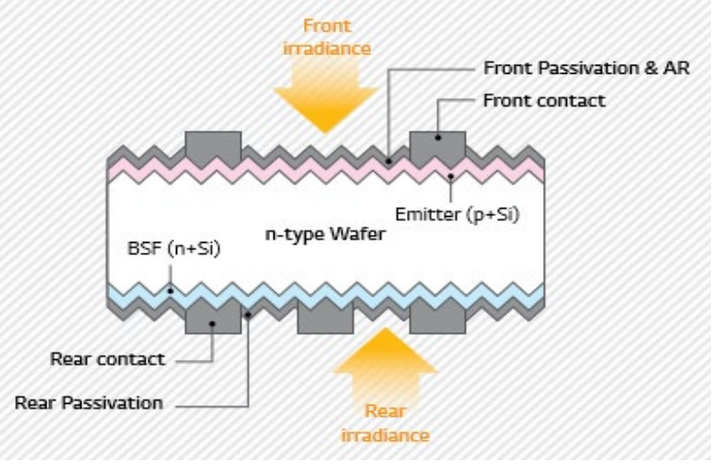
- These modules have backside symmetrical cell structure for reflected sunlight absorption.

MECHANISM

- The backside symmetrical cell structure harvest reflected sunlight from ground or any other surface in addition to direct light energy absorbed from the Sun.
- Total produced energy = Energy from front + Energy from back

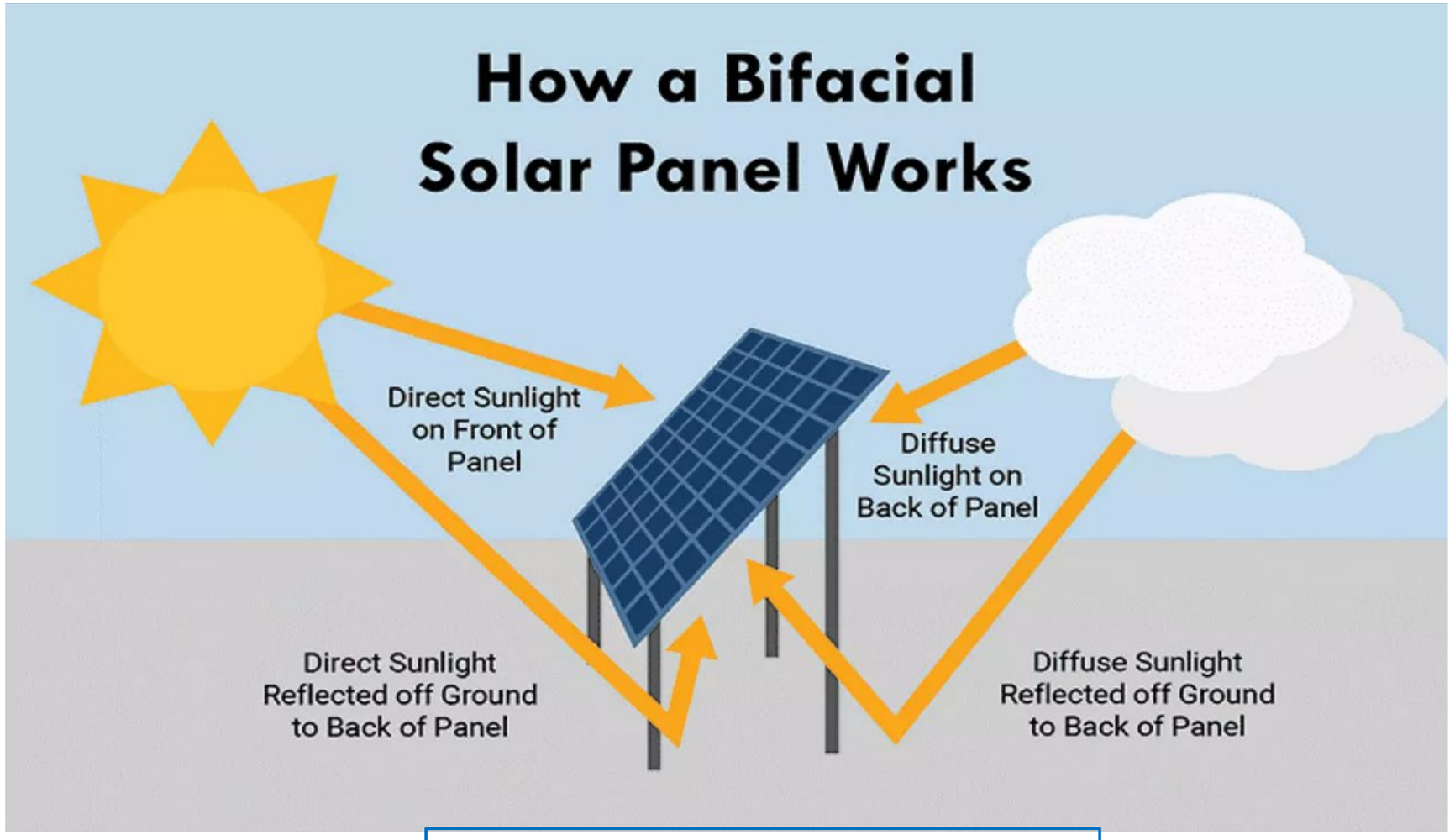


Mono-facial (Conventional)



Bi-Facial

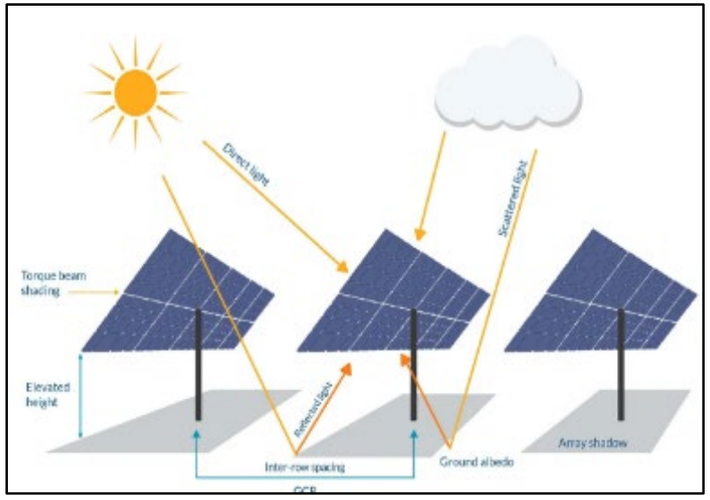
How a Bifacial Solar Panel Works ?

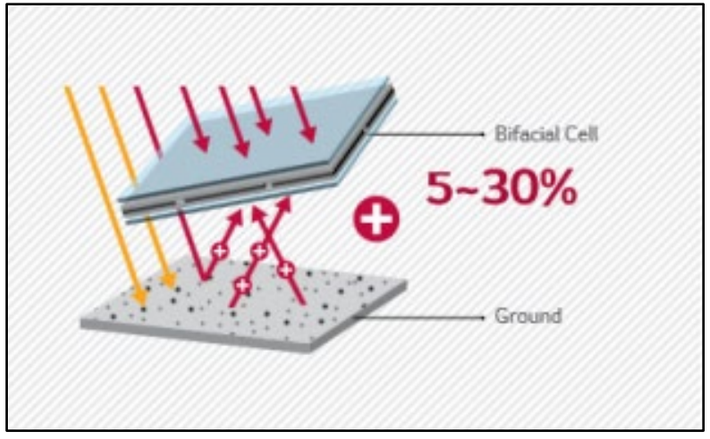


5-30% Extra Power from Back side

ADVANTAGES (BI-FACIAL SOLAR PANELS)

1. Increased efficiency From 21% to 28% at STC.
2. Long life span due to weather and UV resistant tempered glass on both Sides.
3. Bi-facial PV Module Can also be used in Frameless design.
4. High performance in diffused light.
5. In frameless designs, reduced PID is expected.
6. Longer Warranties of up to 30 years.
7. Lesser Panels & Space Required
8. Wide range of Angle of Installation
9. Sufficient Energy Production During bad weather condition / Low Irradiance.

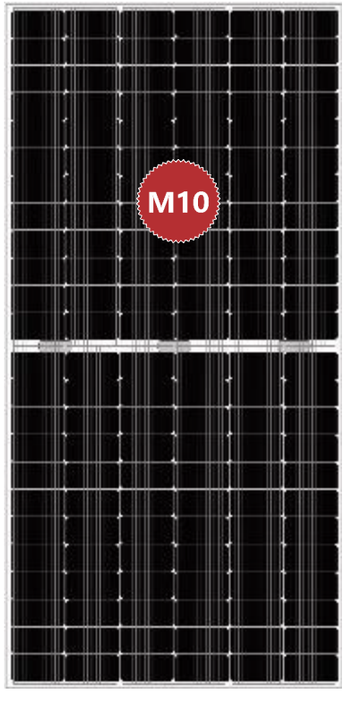




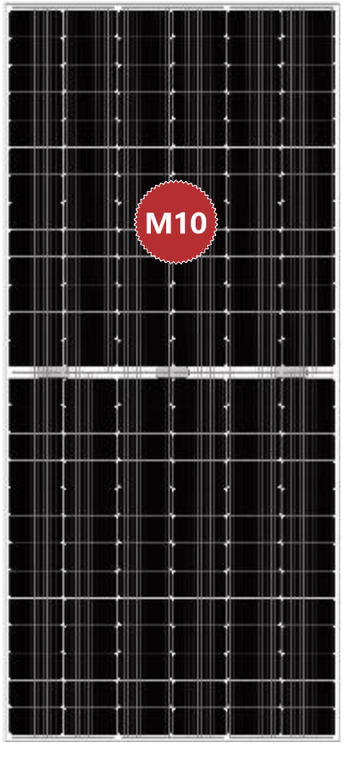
PANDA modules add new technology and start a new journey

PANDA 3.0 module

415-425 W (Black)



565-575 W



610-620 W

182 mm wafer + n-type TOPCon cell + frame

Backside Yield

The backside of the module effectively uses reflected and scattered light from the environment to generate electricity.

Superior Yield

The large size cell enhances the module's power output, with the excellent temperature coefficient, superior low light performance and comprehensive LID/LeTID degradation suppression technology, allows the module to generate more energy yield once in use.

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Outstanding Bifaciality

The modules have industry-leading bifaciality for bifacial modules.

ALBEDO (N-Type, Bi-facial, TOPCon Module)

Type	Reflectivity
Monofacial module	/
Bifacial - Wet sand	10%
Bifacial - Dry sand	20%
Bifacial - Grass	26%
Bifacial - Old snow	60%
Bifacial - New snow	95%

TEST YINGLI SOLAR, CHINA

YINGLI 20 MW SOLAR PROJECT, BAODING, CHINA

PROJECTS COMPLETED BY BARG ENGINEERING IN PAKISTAN (KP) WITH DIFFERENT DEPARTMENTS

Project Photos (PHED, KP)
(Solarization of Drinking Water Supply Schemes from Indus River to Rehman Abad and Shakardara with adjacent Villages Kohat)

- Project Value (Rs)= 356 M
- Consultant Services (Rs) = 15 M
- Completion = Apr-2023

- Project Rehman Abad (14 kM):
- Solar PV Watts = 646.845 kW
- Pumps 5 Nos = 12.5 HP
- Pumps 3+1 Nos = 75 HP
- Pumps 3+1 Nos = 100 HP

- Project Shakardara (34 kM):
- Solar PV Watts = 1520.810 kW
- Pumps 8 Nos = 15 HP
- Pumps 12+4 Nos = 100 HP

Project Photos (WORKS & SERVICES DEPT, FATA) / Solarization of Office Building in FATA Secretariat Shifted to Hospitals

- Value of the Project = Rs: 173 Million
- Total Number of Hospitals = 08
- Completion Date = Jan, 2018
- Project Description : 528 kW Solar System installed

Project Photos (WORKS & SERVICES DEPT, FATA)
Govt.Office at AHQ in All Agencies (5.5kW Each)

- Value of the Project =
  Rs: 45.815 Million
- Total Number of Buildings = 21
- Completion Date = Jan, 2018
- Project Description :
  21*5.5 kW Solar System installed

Project Photos (WORKS & SERVICES DEPT, FATA)
Category-D Hospital in Bazar Zakha Khel, Phase-II Khyber Agency (55kW)

- Value of the Project = Rs: 36 Million
- Total Number of Hospital = 01
- Completion Date = Jan, 2018
- Project Description : 55 kW Solar System installed

Project Photos (PEDO)
District Chitral (TOTAL DC HOME SYSTEMS – 2750-SHS)

- Value of the Project =
  Rs: 246.84 Million
- Total Number of Solar DC Home Systems = 2750
- Completion Date = Nov, 2017
- Project Description :
  PV = 100 W * 2 (200W)
  GEL Batteries = 100 AH * 2
  FANS = 2
  LED Lights =3 (5W Each)

Project Photos (PHED, KP)
(Northern Areas, KPK) (69-Solar Pumps)

- Value of the Project =
  Rs: 345.00 Million
- Total Number of Schemes = 69
- Completion Date = June, 2017
- Project Description :
  10 HP - 35 HP Solar Based Pumps installed


Thank You!

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pv magazine webinars

The power behind Pakistan's "under the radar" gigawatt-scale market

Q&A

30 March 2023

10:00 am – 11:00 am | CET, Berlin
1:00 pm – 2:00 pm | IST, New Delhi
7:00 pm – 8:00 pm | AEDT, Sydney

Jonathan Gifford
Editor in chief
pv magazine global

Uma Gupta
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pv magazine

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R&D Manager
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by Sandra Enkhardt

New propane heat pump for district heating

by Beatriz Santos

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Coming up next...

Thursday, 6 April 2023
11:00 AM – 12:00 PM CEST, Berlin
1:00 PM – 2:00 PM Dubai

Transparent advantage – Why transparent backsheet bifacial modules can beat out the cumbersome competition

Tuesday, 11 April 2023
4:00 PM – 5:00 PM CEST, Berlin
10:00 AM – 11:00 AM EDT, New York City

New tracker design: Multiple motors to tackle multiple challenges

Many more to come!

In the next weeks, we will continuously add further webinars with innovative partners and the latest topics.

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