

# RENEWABLE ENERGY REFRESHER

## BERGEN GROUP NEWS LETTER



## QUALITY ASSURANCE OF ENCAPSULATION (LAMINATION) IN HIGH VOLUME PV MODULE MANUFACTURING

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Indian PV industry is well poised to get into Giga Watt (GW) scale manufacturing factories due to recently announced Production Linked Incentive (PLI) and Basic Custom Duty (BCD) protection from April 2022. In India, cumulative PV module manufacturing capacity is though more than 10 GW but except Adani, Warree and Vikram none of the factories are more than 1 GW capacity. The newer announced factories, however, are all going to be of 1GW-10GW capacities. In PV module markets, there is always going to be extreme price pressure and at the same time higher quality and performance guarantees will be required.

In such situations, winners will be those, whose factories will be designed for higher yield (less rejection) and lower variability. Higher yield will ensure lower cost of production and lower variability will enhance the reliability leading to reduction of degradation rate per year enabling the manufacturer to give longer lifetime guarantees.

In module manufacturing encapsulation (lamination) is one of the two key processes, stringing of cells and lamination. In lamination process the encapsulant EVA is cross linked at high temperature under vacuum. The extent of cross linking decides the quality and long-term reliability of the modules. Generally, this is ensured by measuring by a destructive process offline on sample basis by measuring gel content and it is time consuming process. Instead, a new technology of measuring the extent of cross linking online by a non-destructive technique X-Link of Laytec, Germany is being deployed in modern module manufacturing lines. This technique can be used on-line as well as offline, however, measurement time is drastically reduced and feedback is available on-line, so rejection can be significantly reduced by adjusting the process. X-Link has proved to be the most suitable quality control technology for industrial module encapsulation.

# ZERO GAP TECHNOLOGIES FOR MODULE MANUFACTURING

Presently in module manufacturing, 72 Half Cut cells (144 half cut pieces) technology have almost become standard. This technology has drastically reduced the thermal losses and has helped the industry to move large-format wafers (182 MM - 210 MM) as these full cells carry very large currents. In addition to the reduction in thermal losses, this technology also reduces cell-to-module power loss (CTM loss).

Next in line, the driver for technological change in Module manufacturing is going to be the techniques to improve Module level efficiency by reducing the spacing between the pieces of the cell. The effort is to reduce this gap to Zero. The gaps between the cells provide a cushion to interconnection media and save the cells from mechanical and thermal stresses in real-world operating conditions.

These gaps are, however, the burden on the module efficiency in the form of inactive area. PV manufacturers would like to use every inch of the module for active sunlight absorption. With innovations in materials development, Module producers have been trying to reduce this gap, whereas a few have been successful in eliminating the inter-cell spacing completely.

Tiling ribbon, micro gap, and shingling are the front runners of the zero-gap technologies. Out of these shingling is a real zero-gap technology, wherein cells are connected to each other in a similar fashion to a shingle structure of tiles placed on the roof. That means the cells are connected to each other directly by placing them on each other without any need for ribbons. Standard cell dimensions. However, cannot be used here, the cells have to be sliced into small strips and have to be glued over each other. This technology is still evolving as the gluing material is not easily available in addition to sorting out several other issues like stress management with a suitable encapsulant, special metallization design, etc.

Tiling ribbon is yet another zero-gap technology, wherein a round ribbon of about 0.35 MM diameter is used instead of flat ribbons. In this case, stringers are equipped with special functionality to press the round wire to make it flat with a thickness of less than 0.1 MM. The ribbon is pressed exactly to a length where it would bend to connect the top of the next cell. Instead, of placing the cells side by side, these overlap at the edges with an overlapping area of less than 0.1 mm. It is like shingling but avoids the slicing of cells into small pieces. It will, however, still need the wires and stringing.

The other variant of the tiling technology is the micro-gap technology developed by longi. Here gap is not reduced to zero but to a minimum spacing of about 0.6 mm. In this technology segmented ribbon is used wherein the major part is triangular which also helps in reflecting the light and a flat portion. This has been termed as smart soldering technology. Longi claims 0.3% efficiency gain at the module level.

*Dr. D.N. Singh*

CEO

Bergen Solar Power and Energy Ltd.

## THE PV GLASS PRICE ROLLER COASTER

The raw materials price volatility which has affected the solar industry this year has been reflected in a string of positive "profit warnings" from Chinese group Xinyi.

In an update to the Hong Kong Stock Exchange yesterday, PV panel glass maker Xinyi Solar told shareholders first-half net profits are expected to at least double, compared to the HK\$1.41 billion (US\$182 million) previously anticipated.

While the news will be welcomed by investors, Xinyi Solar pointed out the rise in the average selling prices for solar glass witnessed-compared to the first six months of last year-would lift profits despite the fact prices have fallen "substantially" in the current three months window.

With the solar glass price currently on the downward slope, Xinyi Solar warned: "The performance of the group's solar glass segment for the remaining months of 2021 could be affected."

Sister company Xinyi Energy also announced an uplift in solar electricity revenues thanks to solar projects it has acquired since July with its net profits for the first six months of this year expected to come in 20-40% higher than the HK\$438 million predicted.

But it was the performance of the solar glass business controlled by Xinyi Glass shareholders which was cited as one of two contributors to an anticipated 260-290% uplift in first half net profits at the float glass maker, which is effectively Xinyi Solar's parent.

Whilst rising income from float glass sales was also mentioned, photovoltaic products will contribute significantly to a thumping rise in profit to HK\$4.98-5.39 billion (US\$642-694 million).

The Xinyi updates came hours after fellow Chinese manufacturer flat glass announced plans to issue up to RMB4 billion (US\$625 million) worth of convertible bonds, with RMB2.8 billion (US\$437 million) of the proceeds earmarked for solar glass production and distributed solar product capacity.

Flat glass said the proposed fundraising exercise, which will be voted on by shareholders at its AGM, would generate RMB1.95 billion towards the RMB2.39 billion cost of a solar glass factory to make 750,000 tons per year of ultra-thin, ultra-high transparent products. Some RMB197 million (US\$30.8 million) would pay most of the RMB207 million cost of a fab to produce 15 million square meters of solar PV ultra-white glass, and RMB658 million (US\$103 million) would be put towards RMB 665 million worth of solar generation capacity.

With the figures rounded off by PV magazine, Flat glass said RMB1.2 billion from the bond issue would be added to its working capital.



The Union Finance Minister Nirmala Sitharaman announced the Economic relief from Pandemic package and declared several sops for power distribution companies (DISCOMS), including Rs.3.0 trillion (\$40.82 billion) outlay for relief based result linked power distribution program

Earlier this year, Sitharaman had presented the 2021-22 budget in the Parliament and challenging times affected by the COVID-19 Pandemic.

In her budget speech, Sitharaman had mentioned that the viability of discoms was "a serious concern". A revamped reforms-based result linked power distribution sector program was expected to be launched with an outlay of Rs.3.05 trillion (\$41.92 billion) over 5 years.

According to the minister, the program would assist discoms in infrastructure creation, including prepaid smart meters, feeder separation, and degradation systems tied to financial improvements.

## ZHONGHUAN LOWERS WAFER PRICES

Wafer producer Zhonghuan Semiconductor will reduce all its prices in July. The price for its G12 (210 MM) wafers will fall RMB0.69 (US\$0.107) to RMB7.53 per piece (US\$1.166). The M6 (166MM) and G1 (158.75MM) products will be sold for at RMB4.72 (US\$0.731) and RMB4.62 (US\$0.715), respectively, marking a RMB0.41 (US\$ 0.063) reduction for each.



## GOLDEN GLASS 1.2 GW HJT LINE

Manufacturer Golden glass is planning to set up a 1.2 GW heterojunction cell and module production line in the Wujiang District of Suzhou City in Jiangsu Province. The company wants to invest RMB832 million (US\$129 million) in the factory and to start construction "soon", with completion being scheduled with eight months. Manufacturing is expected to start by the end of February. Golden glass said the new lines will be highly automated and compatible with large wafers, including 182 MM and 210 MM products.

## PV ENERGY STORAGE AND GREEN HYDROGEN

Module maker Trina Solar has joined forces with energy company China Petrochemical Corp (Sinopec) to reduce the carbon footprint of Sinopec's gas stations. The partners plan to deploy distributed PV, energy storage and green hydrogen facilities at the gas stations after a pilot project was developed at a Sinopec station in Jiangsu province. That facility can generate 140 MWh of clean power annually and can sell excess electricity to the Grid.

## US GOVT. TO BLOCK SOLAR IMPORTS LINKED TO POLYSILICON PROVIDERS.

The US government is set to block the imports of solar solar products with links to the Xinjiang region of China in response to allegations of the use of forced labour. Various media reports claim that the measures, set to be confirmed today by the US Department of Commerce and US customs and Border Protection, will see the US prohibit the import of metallurgical-grade silicon produced by Hoshine Silicon Industry, one of the world's largest producers of raw polysilicon, as well as products using the raw material.

Also named as being included in the measures are Xinjiang - based subsidiaries of East hope, GCL New Energy Material and Daqo New Energy, as well as Xinjiang Production and Construction Corps.

While the US authorities have yet to publish any concrete details of the legislation, media reports cite sources familiar with the matter stating that customs and Border Protection will issue withhold and release orders (WRO) that will essentially block products made directly by companies featuring on the list of barred entities as well as products featuring components or materials produced by them. The WROs would mean products would be held at US ports unless companies can prove the goods have no connection with forced labour.

## KERALA COMMISSION APPROVES PPA FOR KSEB-TATA POWER SOLAR PROJECT



In recent order, the Kerala State Electricity Regulatory Commission (KSERC) approved the Power Purchase Agreement (PPA) signed between the Kerala State Electricity Board (KSEB) and TATA Power Company for procuring 110 MW of Solar Power at the rate of Rs.2.97 per KWh. KSEB was granted permission by the commission to sign a PPA with TP Saurya, a wholly owned subsidiary of TATA Power Company and directed KSEB to submit a copy of the PPA with the Commission.

## Solar panels by the side of a lake

A 500 kW solar project by the side of the Bada Talab in Bhopal, Madhya Pradesh, uses 1,540 PV panels supported through cantilever frame. The installation runs 1.2 km.

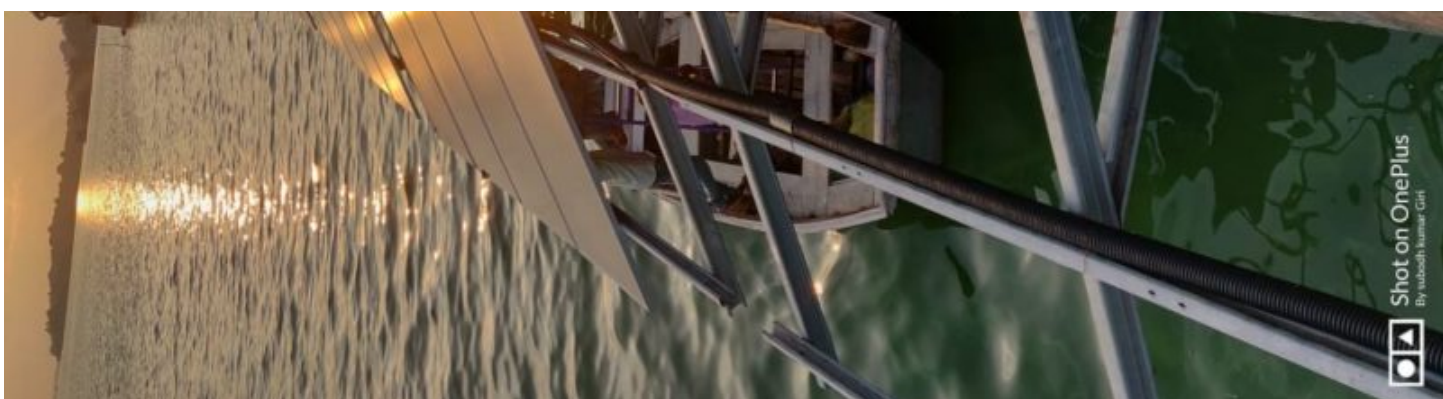
The Indian State of Madhya Pradesh hosts a 500 kW solar project by the side of a lake without using any foundation for the PV panels. The project at Bada Talab in Bhopal uses cantilever (a beam anchored at only one end to vertical support) frame to support the panels on the retaining wall of the lake.

The project uses 1,540 solar panels running for 1.2 km by the side of the lake.



“The project illustrates that rooftop solar program really means decentralized solar program and is not limited to rooftops,” said Manu Srivastava, principal secretary of the Madhya Pradesh government's New and Renewable Energy Department, announcing the PV installation as the winner of an award by India's Ministry of Housing & Urban Affairs.

The entire operations were completed in just 100 days. “Some operations were done at night since the lake is by the side of VIP Road, one of the busiest roads of Bhopal. The staff climbed onto a suspended scaffolding platform. During the installation, the water level was at its highest and solar panels were installed by staff standing on boats,” Srivastava said.



## INDIA'S RELIANCE AIMS TO ENABLE ATLEAST 100 GW OF SOLAR THROUGH RENEWABLES PUSH

Industries will construct an integrated PV module factory and look to enable more than 100 GW of Solar by 2030 as part of a US\$10.1 billion clean energy plan. The strategy, announced by Managing Director Mr. Mukesh Ambani in a shareholder meeting, will also see the company build a battery storage manufacturing unit as well as green hydrogen and fuel cell activities, all at a complex in the Indian state of Gujarat.



"Reliance's first integrated solar factory will convert raw silica to polysilicon which will then be converted to ingots and wafers to make solar cells that will be finally assembled into modules. A significant part of the 100 GW of PV that the company aims to enable will come from rooftop solar and decentralized installations in India.

This plant will be complemented by an energy storage factory, with the company planning to collaborate with global leaders in battery technology, exploring electrochemical technologies that can be used for large-scale grid batteries.

In addition, Reliance will build an electrolyzer factory to manufacture modular electrolyzers to produce green energy hydrogen for domestic use and export. It will also construct a fuel cell plant, as Ambani touted the potential of fuel cell engines to power heavy transport, data centers, emergency generators, microgrids and industrial equipment. The company will invest INR600 billion (US\$8.09 billion) on the four plants over the next three years.

A further INR 150 Bn (US\$ 2.02Bn) will be invested in value chain, partnerships and future technologies, including upstream and downstream industries, with the company set to establish a renewable energy project management and construction division as well as a renewable energy project finance division.

India's government is aiming to build the country's PV manufacturing supply chain as it bids to reach 280 GW of installed solar by 2030. According to the Ministry of New and Renewable Energy, India has annual manufacturing capacities of 9 GW-10 GW for PV modules and around 2.5 GW for cells, meaning deployment heavily depends on imports.

# NEWS UPDATE

## INDIA COULD ADD 13.75 GW OF PV MODULE CAPACITY BY LATE 2022

The Indian government's efforts to restrict PV equipment imports and expand domestic manufacturing are starting to bear fruit. JMK Research says in a newly published report that India could create 13.75 GW of solar module production capacity and 6.9 GW of cell output over the next 18 months.

Module manufacturers with 1 GW+ capacity have proposed cumulative capacity additions of 9 GW of modules and 6.4 GW of cells. This also includes Vikram Solar's plan to set up a 3 GW fab for modules, cells, and wafers in Tamil Nadu over the next four to five years.

Two key manufacturers have already achieved a certain degree of expansion recently. In April, Tata Power Solar expanded its cell manufacturing capacity. Earlier this month, Premier Energies also expanded its module manufacturing capacity from 500 MW to 1.25 GW with the addition of 750 MW of cell capacity.

"M6 wafer-based modules are expected to become mainstream in new domestic rooftop solar capacity additions soon. Also, domestic manufacturing capacity for bifacial modules is expanding as manufacturers foresee high growth potential in demand for these modules, especially from the residential rooftop market," said JMK.

The new capacity announcements follow the government's introduction of the Basic Customs Duty (BCD) and a Production-Linked Incentive (PLI) scheme to reduce solar import dependence and scale domestic manufacturing capabilities. India meets more than 80% of its solar module demand through imports from other Asian countries such as China, Vietnam, and Malaysia. In 2020, the nation imported \$1,527 million worth of solar cells and modules.

India's ambitious installation target of an additional 280 GW of solar by 2030, along with its high dependence on solar imports, calls for the rapid development of the domestic PV manufacturing industry, which currently has 16 GW of cumulative module capacity. The manufacturing capacity for polysilicon, ingots, and wafers is non-existent, primarily due to high production costs. However, the lack of scale and integration of PV manufacturing has been a critical barrier to India's solar program.

## Nissan to Invest £1 Billion in EV and Battery Manufacturing

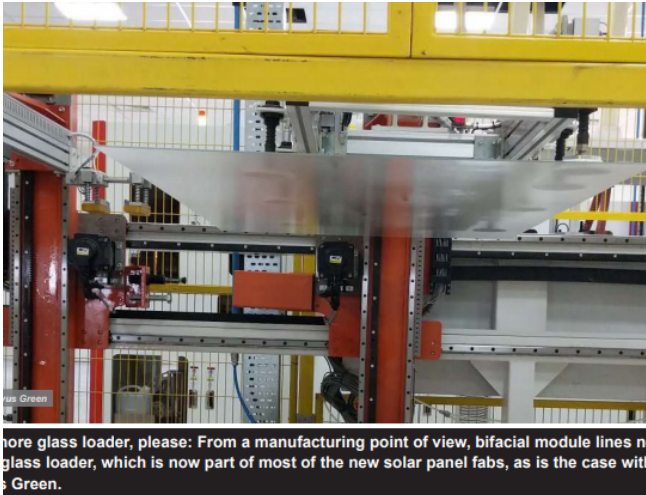
Nissan has unveiled its plan to transform its flagship Sunderland manufacturing facility into a £1 billion (~\$1.37 billion) new-generation all-electric vehicle (EV) and gigafactory for EV batteries. The shift from petrol and diesel through the initiative is expected to generate 6,000 new jobs at the firm and among suppliers. The company aims to build ten solar farms to power the project to achieve carbon neutrality by 2040. An increase in production at the plant is expected to generate 1,650 new jobs and support thousands more in the U.K. supply chain.

London-based impact investor CDC Group has invested \$50 million in ACWA Power's 100 MW Redstone solar project in South Africa. AfDB, FMO, DEG, and DBSA will fund the project that aims to supply 200,000 South African households with clean energy and cut down 480,000 tons of carbon per year. The project has a 12-hour full-load energy storage capacity which allows for the storage of heat energy harvested from the sun to provide energy supply during peak demand periods and help prevent power interruptions and load shedding.

The Competition Commission of India has approved the acquisition of SB Energy Holding Limited by Adani Green Energy Limited (AGEL). Adani Green Energy had signed a share purchase agreement to acquire a 100% stake in SB Energy India from Soft Bank Group (80%) and Bharti Group (20%) in May 2021. The transaction is one of the largest acquisitions in the renewable energy sector in India. The transaction values SB Energy India at an enterprise valuation of about \$3.5 billion (~₹260 billion). SB Energy India has a total renewable portfolio of 4,954 MW spread across four states in India.

## BI-FACIAL TECHNOLOGY

Source: Taiyang News



**Bi-facial Manufacturing is not complex anymore. At the cell level the effort to tweak PERC to bifacial is negligible.**

**PERC has established itself as the new standard in solar cell technology. It's good news for bifacial as well, as it is very easy to upgrade**

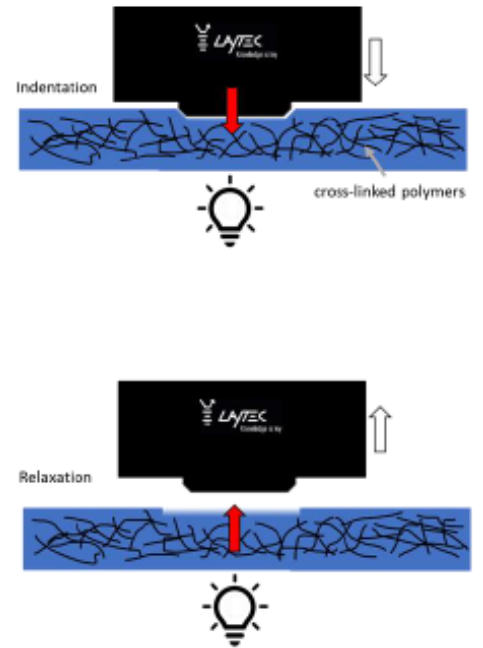
**PERC's bifacial capability is perhaps one important feature that has also helped the technology to spread wider and reign longer than many anticipated.**

**PERC is now so well established that it may not be necessary to discuss its basics. PERC is the most simple and cost-effective candidate for bifacial. But unlike other advanced cell structures, PERC is not bifacial by default. That's because the standard PERC cell structure contains an opaque local BSF-forming layer of aluminum paste on the rear side. However, the step to turn PERC into a bifacial solar cell is rather simple, i.e. apply an aluminum grid instead of spreading paste over the full area. This requires specific aluminum pastes designed for printing fingers rather than the products used for full area prints. Now, there are several paste makers that are offering aluminum pastes that can support bifacial PERC.**

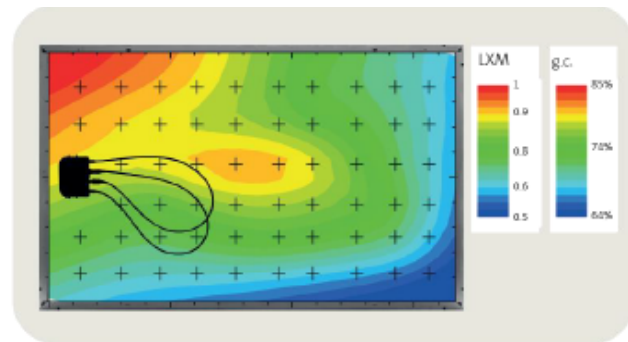


## LAYTEC X-LINK

- Manual or in-line operation.
- Production / type modules
- Facilitates high resolution
- mapping of EVA cross linking



- Statistical Process Control
- 100% in-line control of EVA cross-linking
- Quality Assurance in mass production



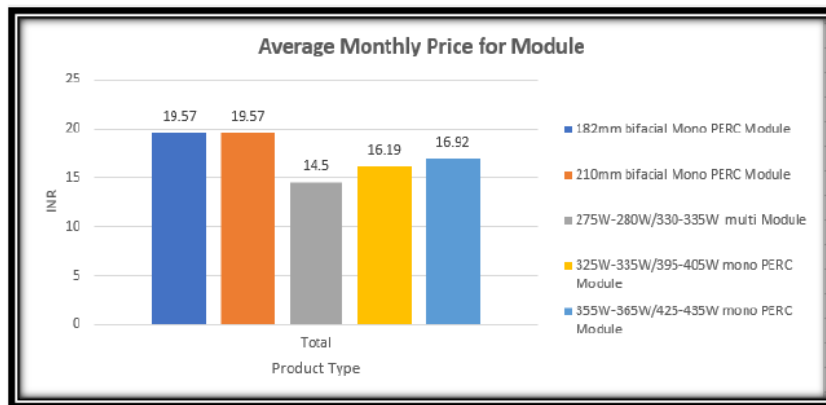
## X-link Global Customers



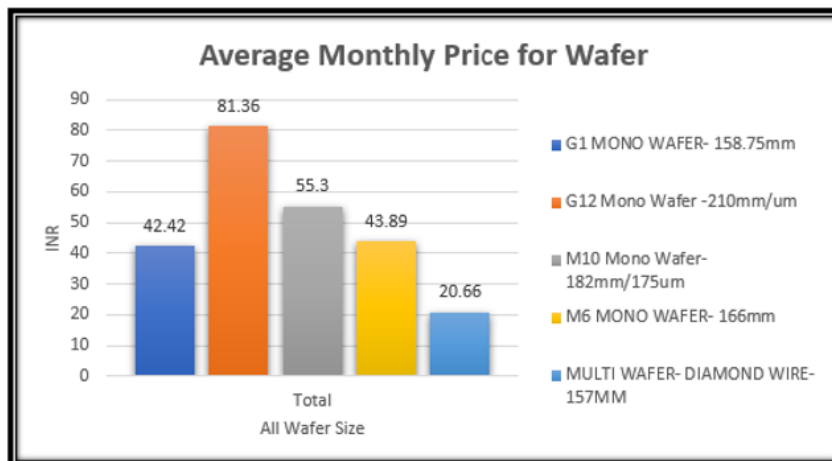
# MARKET ANALYSIS

## Price update

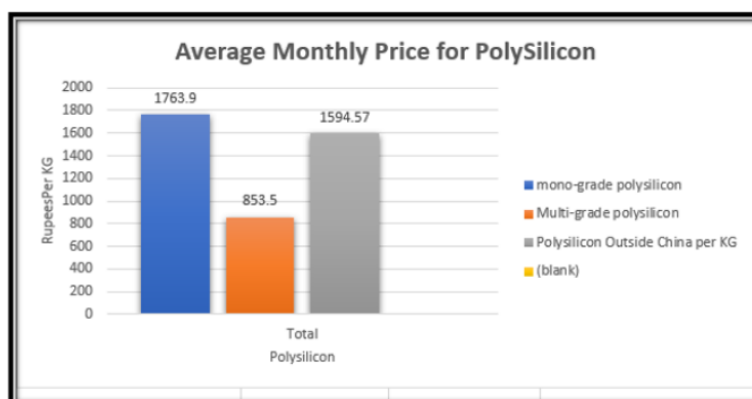
- Module Spot Price Update- Multi/Mono



- Wafer Spot Market Price Update- Multi SI/MonoG1M6



- Polysilicon Spot Price Update-Virgin poly (spot, contract)/Granular



# EDITORIAL TEAM



**Rajinder Kumar Kaura**  
**CMD**

With nearly 43 years of contributions in conventional and non conventional power and electronics field, he is pioneer and pathfinder in developing solar & electronic industry in India. His contributions in bridging the gap in standards of living between rural and urban population through generation of solar power and skill development has earned him tremendous respect and recognition by countries like Norway, Japan, Germany, etc. besides States and Central Organizations.



**Dr. D.N. Singh**  
**CEO**

Dr. D.N. Singh is a one of the most prominent leaders in Solar PV and Semiconductor technology and widely known professional in India and abroad. He has a total of 46 years of experience in Industries, research and academia. He has published over 40 research papers in International and National journals. He has been invited speaker at PV Cell Tech and PV Module Tech international conferences. Dr. Singh is Vice President of Microelectronic Society of India, Member IEEE and Member of National Nano-Technology working group.



**Dronveer Kaura**  
**Director**

After completion of academics from the Ohio State University, USA, he returned to India to share the knowledge gained in his academic and serve the nation. He founded and engaged himself and his team in Industrial Automation Projects to follow industry 4.0 standards and keep India intact and way forward in the state of art technology of Automation. Under his guidance and knowledge sharing, we could develop a efficient solution for Robot Automation in the field of automobile to boost per day production. He is currently pursuing PhD in Hydrogen Fuels & Technology.



**S.K. Kaul**  
**Vice President**

Having more than 38 years of experience in the field of Manufacturing, Operation, Material Management & Factory Administration and looking after complete solutions & supply of Capital Equipment technology for the manufacturing of Printed Circuit Boards, Electronic Assemblies, Photovoltaic Cells & Photovoltaic Modules and undertaking the turnkey installation of the solar based power projects.