ZORLU SOLAR
(Clean Energy for the Long Run)

Ref:ZSPL/NEPRA/TRF/2022/1

The Registrar
National Electric Power Regulatory Authority
NEPRA Tower, Attaturk Avenue (East)
Sector G-5/1, Islamabad

22nd February 2022

Subject: Submission of the Tariff Petition of 100 MWp Solar Power Project of Zorlu Solar Pakistan Limited.

Dear Sir,

Pursuant to the relevant provisions of the NEPRA Rules read with the provision of the NEPRA Act and the NEPRA Tariff Standards and Procedures Rules 1998 and NEPRA letter No. NEPRA/ADG(Trf)/TRF-100/ZSPL-2017/1082 dated 19th January we hereby submit the Tariff Petition including Annexures in triplicate and soft copy (CD) together with,

A) The Bank Draft No.25739517 of Amount Rs-1,121,666/- (One Million One Hundred Twenty One Thousand Six Hundred Sixty Six Only) as requisite for fee for tariff Petition as communicated by NEPRA

B) Board Resolution of Zorlu Solar Pakistan Limited

C) Affidavit of Mr Syed Mumtaz Hassan

For & On Behalf of Zorlu Solar Pakistan Limited
Yours Sincerely,

Syed Mumtaz Hassan
Country Manager

Receive Management copy
along with cheque Rs 1121666

REGISTRAR
Dy. No. 185
23-2-2022

BEFORE

THE NATIONAL ELECTRIC POWER REGULATORY AUTHORITY (NEPRA)

TARIFF PETITION

FOR NEPRA'S APPROVAL OF REFERENCE GENERATION TARIFF FOR

ZORLU SOLAR PAKISTAN LIMITED
FOR 100 MWP SOLAR POWER PROJECT

AT
QAUID E AZAM SOLAR POWER PARK (EXTENSION), LAL SOHANRA, BAHAWALPUR, PUNJAB

22nd February 2022

Zorlu Solar Pakistan Limited
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01 Details of the Petitioner

1.1 Petitioner's Name and Address

Zorlu Solar Pakistan Limited
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Tel: +922135291682, +92 21 35875366
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1.2 Representatives of Petitioner

Mr. Syed Mumtaz Hassan
Authorized Representative, Zorlu Solar Pakistan Limited

1.3 Project Sponsors

Zorlu Group

02 Grounds of the Petition

2.1 Legal Context and Project Background

Under the Regulation for Generation, Transmission and Distribution of Electric Power Act (XL of) 1997 (the **NEPRA Act**), the National Electric Power Regulatory Authority (**NEPRA** or **Authority**) is responsible, inter alia, for determining tariffs and other terms and conditions for the supply of electricity through generation, transmission and distribution. NEPRA is also responsible for determining the process and procedures for reviewing tariffs and recommending tariff adjustments. Further, pursuant to the enabling provisions of the NEPRA Act, the procedure for tariff determination has been prescribed in the NEPRA (Tariff Standards and Procedure) Rules, 1998 (the **NEPRA Rules**).

Zorlu Solar Pakistan Limited (**ZSPL**) filed its tariff petition to NEPRA on 28 May 2019 for 100 MWp solar power project to be set up at Quaid-e-Azam Solar Park, Bahawalpur (the **Project**). Notice of Admission was published in the daily national newspapers on 05 October 2019, while the hearing for the Project was held on 23 October 2019. Based on the hearing and submission, the Authority determined tariff for the Project on 15 January 2020 (the **Determination**).

Following issuance of the Determination, ZSPL continued to work on development and financing of the Project in order to achieve Financial Close. However due of the outbreak of the global pandemic of COVID-19 starting from early 2020 (which severely impacted the ordinary course of business, economic and social life globally including Pakistan) and due to government imposed lockdowns, movement of people and materials were impacted and global supply lines disturbed.

Despite these challenges, ZSPL used all reasonable endeavors to achieve Financial Close as stipulated in the previous Determination. Nonetheless, some issues beyond the control of ZSPL presented challenges for the Project, and time was lost due to the lockdowns and consecutive restrictions to stop the pandemic caused irreversible delays. In order to achieve Financial Close, ZSPL required a Letter of Support (**LOS**) by Alternative Energy Development Board (**AEDB**) following the Determination. ZSPL had submitted the requisite performance guarantee of US$ 250,000 and paid applicable processing fee of US$ 100,000 to AEDB, however the LOS was not issued in time by AEDB.

Further, ZSPL had submitted its petition for the earlier Determination in May 2019 using Tier-1 mono C-Si solar panels of 365 Wp nameplate capacity each. ZSPL was then required to modify its generation license according to the equipment specifications given in the Tariff Determination. However, due to the changes in solar panel technology mass production of 365 Wp modules had been stopped and ZSPL filed a modification of Generation License on 26 November 2020 using Tier-1 mono c-Si with nameplate capacity of 545 Wp.

After consultations with the Authority, ZSPL was requested to evaluate the options for changing project design to tracking system including bifacial modules based on the technological advancements in solar industry. After detailed evaluations, the Authority approved the modification of Generation License based on bifacial modules and single-axis tracking system on 07 January 2022.

As per the Alternative & Renewable Energy Policy 2019, notwithstanding the expiry of the RE Policy 2006, the projects granted letters of intent/letters of support under the RE Policy 2006 before its expiry shall continue to be governed by the Cabinet Committee on Energy's (CCOE) decision in case number CCE-12/04/2019(V) (as amended from time to time) and shall be dealt with accordingly. Since ZSPL is included in the Category-II Projects, it shall be implemented under the RE Policy 2006 under the cost plus regime. Further, ZSPL 100 MWp solar project has been included in the Indicative Generation Capacity Expansion Plan (IGCEP) as approved by the Authority on 24th September,2021.

Based on the above, ZSPL hereby submits its tariff petition for determination by the Authority as per the NEPRA Act and Rule 3 of the NEPRA Rules.

2.2 Basis for Request of Tariff Determination

ZSPL hereby submits petition before NEPRA for determination of tariff, keeping in view the following:

(a) All Project approvals including LOI, land, environment and interconnection has already been submitted in the earlier petition dated 16 May 2017.

(b) Binding EPC arrangement for supply, construction, erection and commissioning of the Project already submitted under the earlier petition dated 16 May 2017.

(c) Project debt funding has been arranged (on the basis of earlier debt equity structure approved by NEPRA in the Determination dated 25 January 2018 and lenders have taken their internal approvals, and sponsors have committed the required equity for the Project.

2.3 Submission

Pursuant to the relevant provisions of the NEPRA Rules, read with the provisions of the NEPRA Act and the Rules and Regulations made thereunder ZSPL hereby submits following for consideration of the Authority:

- **Change in technology and resultant impact on project development cost, EPC cost and Capacity factor**
- **Change in international commodity prices and cost of transportation including but not limited to changes in solar module prices**

This petition is submitted on the basis that the expiry of Determination was due to the reasons not attributable to the Company and therefore only contains information relating to the aspects of the Project which is either (i) impacted by the change in technology, (ii) change in international commodity prices and (iii) more advantageous for the benefit of the consumers. All other information is as contained in the previous tariff petition dated 28 May 2019 and as determined by NEPRA in the Determination dated 15.01.2020 (both the previous tariff petition and Determination to be read as if incorporated in full herein).

03 Issues for Authority's Consideration

The issues discussed under this section are requested to be considered by Authority, keeping in view the following facts:

a) The levelized reference tariff of the Project (based on the Determination) was USc 3.7738/kWh.

b) Due to long lasting impact of COVID-19 pandemic, the overall investment risk profile is significantly deteriorated globally including Pakistan. Unexpected additional costs have been incurred by the investors during the pandemic.

c) ZSPL Determination was issued in 15 January 2020, and the reasons behind filing this petition is due to the impact of the COVID-19 pandemic, unavailability of the previously approved solar modules, and delay in obtaining required permits/approvals/documents by GoP and therefore not attributable to ZSPL.

d) There is substantial increase in global commodity and energy prices in the previous year, and the proposed tariff by ZSPL is substantially lower than

Keeping in view the above it is requested to kindly allow continuation of already approved terms and conditions of the previous Determination, except for the matters discussed hereunder:

3.1 Solar Module

ZSPL has submitted previous tariff petition according to EPC design based on Monocrystalline 365 Wp solar modules from Tier-1 manufacturers on fixed tilt structures, which was selected because of the strong track records and mass manufacturing data available in 2019. However, binding contract for the supply of solar panels could only be finalized after determination by the Authority and necessary milestones are achieved. Unfortunately, these milestones for the Project is delayed beyond our expectations due to reasons not attributable to ZSPL (delay in determination of tariff, delay in determination of review motions, delays on issuance of Letter of Support, and consequently signing of EPA and IA, government shutdowns and restrictions due to COVID-19 pandemic etc.), and therefore the binding agreements with the manufacturers couldn't been finalized by the EPC Contractor.

Solar energy technologies and in particular solar module manufacturing are evolving rapidly in last decade, major solar panel manufacturers are introducing new models of solar panels in every couple of months with enhanced features and advantages in order to keep up with the market trends, and they revise their manufacturing plans accordingly. Since ZSPL's submission of previous tariff petition in May 2019, Tier-1 manufacturers have introduced number of new products in the market. As a result of the same, our EPC Contractor have informed us that the proposed Monocrystalline panels at 365 Wp capacity by Tier-1 manufacturers has become obsolete and not available for mass production in the market due to considerable time passed since the initial design selected (e.g. May 2019). Letter from the major Tier-1 manufacturers are attached herewith as Annexure-A1

Following discussions with the Authority, ZSPL has changed power plant characteristics accordingly with technological advancements in solar industry; previous fixed-tilt structure has been abandoned for one-axis tracking system including 640-645 Wp bifacial modules from Tier-1 manufacturer. Accordingly, ZSPL has applied for Modification of Generation License which

has been approved by the Authority on 7 January 2022 on the basis of single axis tracking system with bifacial modules, which provides comparative advantages in terms of increased energy yield and capacity factor.

Since the Determination of the Authority in 15 January 2020, the impact of the COVID-19 pandemic has been seen after intermittent lockdowns around the globe during the year. This has affected the entire supply chain of the manufacturing including the solar industry. Especially due to lockdowns in China –being the main manufacturer of the solar modules globally– and in major economies such as USA and EU countries, the supply demand balance have deteriorated during the year. As global economy started to recover from the impact of pandemic in 2021 with the support of substantial monetary expansions, commodity prices has been skyrocketed. This had significant impact on the prices of solar modules, which is substantially dependent on the commodity prices such as silicon, glass, silver etc.

According to Rystad Energy – a global independent energy research and business intelligence company *"Driven by core component price inflation, manufacturing cost for photovoltaic modules have surged from below $0.20 per watt peak (Wp) in 2020 to between $0.26 and $0.28/Wp during the second half of 2021-a near 50% increase in a year. Significant driver of this surge is a more than 300% hike in cost of polysilicon, a core component in PV manufacturing. In addition, other raw materials –silver, copper, aluminum and glass- have also climbed steadily since January 2020, increasing the pressure on module prices."* Link to report and commodity index by Rystad Energy is herewith attached in Annexure-A2

ZSPL has checked the prices of solar modules from different sources, including the manufacturers, online sources such as BNEF and PVinsight etc. and compare the current prices with the prices applicable at the time of previous Determination. Based on BNEF solar module spot price index, average price for monofacial monocrystalline module on 26 January 2022 is reported to be US$ 0.268 million per MW in comparison to US$ 0,211 million per MW on 13 January 2020 (e.g. the date of previous Determination which accounts for an increase of approximately 5.7 million USD like for like basis from the previous Determination.

It is also worth noting that, ZSPL has changed the solar modules from monofacial to bifacial basis. Because bifacial modules require glass-to-glass lamination, solar cells on the backside of the module etc., it is relatively more expensive than the monofacial modules, however this increased costs provides an additional boost in the energy yield. The relatively higher cost of bifacial modules has been acknowledged by the Authority in its earlier determinations. It is understood from previous determinations that, Authority in similar projects, which it granted tariff at the similar dates, already accounted a cost difference of 0,02 million USD per MW between monofacial and bifacial modules.

Extract of BNEF solar module spot price index for the reference dates is attached as Annexure-A3.

Furthermore, ZSPL has requested official quotations from various Tier-1 Manufacturers to verify the applicable spot price above. which concurs the same. Official quotation letters from manufacturers are also attached herewith as Annexure-A4 and submitted under the terms of confidentiality, as it requires the approval of the manufacturer to publicly disclose their official prices.

Conclusively, due to the change in solar module from monofacial and bifacial c-Si technology, and increase in the global commodity prices since the previous Determination, considering the official quotations received from Tier 1 manufacturers as appended, the cost of solar modules is increased in total by approximately 7 million US$ in comparison to previous Determination.

3.2 Mounting Structure

As discussed in previous sections, in compliance with the Modification of Generation License

approved by the Authority, ZSPL has changed the mounting structure from previous fixed tilt structure to single-axis tracking system Due to its more sophisticated mechanical, and electrical design principles and additional components like motors, sensors etc., tracking systems are inherently more expensive than the fixed tilt structures, but in return provides a significant increase in the energy yield of the power plant. Based on the initial design by the EPC Contractor, the cost of mounting structure is estimated to be increased by approximately 5.5 Million US$ compared to the previous fixed tilt structure which also includes the change in the material prices since previous Determination.

It is worth mentioning that the cost difference between fixed tilt and tracker systems has already been acknowledged by the Authority in its earlier determinations for solar projects. It was stated in previous Determination that "*...Earlier, the Authority has kept the difference of USD 0.04-0.05 million per MW between the cost of tracking and fixed structures due to both electrical and mechanical factors... ....*"

Further, it needs to be considered that, since the date of previous Determination, the commodity prices have been increased significantly. As it may be seen in Figure-1 below, global steel prices have increased from 3.821 CNY/t (~552.8 US$/t) on 14 January 2020 to 4.789 CNY/t (~757.2 US$/t) on 19 February 2022 which accounts for an increase of approximately 37% in US$ terms. Considering steel comprises a significant portion of the mounting structure, the increase in the steel prices have had a significant impact on the cost of mounting structures.

Figure-1- Steel Prices (source: www.tradingeconomics.com)

In light of the above, the combined impact of the change in technology from fixed tilt to single axis tracker system and the increasing commodity (steel) prices since the previous Determination, the cost of mounting structure has increased approximately 5.5 million US$ from the previous Determination and hence the same is humbly requested to be approved by the Authority.

3.3 Inverter

As mentioned in its previous Tariff Petition, purchase of inverters from Siemens has already been completed for 20 x Siemens WSTECH 4000 kW inverters for the Project. Therefore, technical specifications and costs for inverters remained same as in the previous Determination dated 15 January 2020. Although there are additional costs incurred for the storage of the invertors due to delays not attributable to ZSPL, these additional costs have not been accounted and no increase for the cost of inverter is included in this Tariff Petition.

3.4 Balance of System

In compliance with the generation license modification approved by the Authority, EPC Contractor has proposed a revised design based on Tier-1 monocrystalline bifacial modules of 640-645 Wp on a single-axis tracking structure. The proposed design has significant impact on the cost of Balance of Systems, due to the fact that, the solar modules has different capacity, dimensions and weight in comparison to the previous 365 Wp monofacial modules and implementation of tracking system which has following resultant impacts on the basic design features:

- Total number of solar modules are changed due to increased capacity per module
- Design and layout of each table is changed according to the new module and system type (tracker)
- Number of tables and required foundations, electrical design and layout in each string is changed according to the new mounting structure design

Overall site layout, land used within the project boundaries and electrical design/ cabling has changed as a consequence of above changes. The above design changes have consequent impact on the cost of following BoS components:

- Installation of Solar Modules
- Foundation Works
- Extra Cleaning and Leveling
- Electrical Balance of Works/DC Cabling
- Transportation

Each of above cost items are discussed in more detail in the following paragraphs.

3.4.1 Module Installation

The physical characteristic comparison of 365 Wp and 640-645 Wp modules is given below table.

ITEM	365 WP Modules	640-645 Wp Modules
Weight	22 kg	38.7 kg
Dimensions	1956 x 991 x 35 mm	2384 x 1303 x 35 mm
Packaging Configuration	30pcs per pallet 720pcs per 40'HC	31pcs per pallet 527pcs per 40'HC

As can be seen from the above table, the new bifacial modules are heavier and larger than 365 Wp modules. The generic data sheets of 640-645 Wp modules are attached and highlighted as Annexure B for the reference of the Authority. The dimensions and weight stated above might slightly change based on manufacturers related data sheets as per the time of production of the equipment.

In the proposed design, the total number of **155,688 modules (640-645 Wp)** will be used as opposed to **273,840 modules (365 Wp)** in the case of previous design which represents approximately **43%** decrease in number of modules. However, due to larger size, heavier weights of the revised bifacial modules and installation on a tracker system is more complex than a fixed system, man-hour for installation of each module is estimated to increase by **35%** neutralizing the impact of total cost saving on the account of module installation to approximately **7%** in comparison to previous Determination which accounts for approximately **75 k US$** savings from total installation costs.

3.4.2. Foundation Works

As a result of soil study and as mentioned in earlier petitions, ZSPL had to construct mini concrete piles instead of direct ramming for Project, as the soil is sandy-silt and lean clay and the bearing capacity of the ground is very low.

As mentioned in the previous tariff petition, approximately 90,000 mini-piles already complete at the project site and the cost of the mini-pile has already been incurred by ZSPL. The representatives of NEPRA have observed the same during their visit to project site on 11th July 2021.

Due to the change in technology from fixed tilt to single-axis tracker in order to comply with Authority's directives in the Generation License modification, constructed mini-piles will no longer be utilizable because of change in orientation of the mounting structures from East-West to North-South direction. Further, due to the weight of the proposed modules and the design characteristics of the tracker system, the calculated loads on the foundations will be substantially higher in the new design; therefore, previously constructed *mini*-piles cannot be used for the tracker system. Furthermore, with the proposed 7 m pitch distance configuration, it is likely that around 9400 of mini-piles will needed to be removed due to the overlap with new foundations. In total 28,284 new foundations will be installed on the Project site.

As mentioned earlier, ZSPL already incurred cost for the mini-piles needed for the previous fixed tilt design, and cost of this additional 28,284 foundations required for the trackers will increase the Balance of System Costs in comparison to the previous Determination. ZSPL respectfully submits that, the change from fixed tilt structure to single axis tracker is proposed by the Authority and ZSPL has accepted this change on the basis that the cost already incurred for fixed tilt system which cannot be utilized for tracker will be allowed by the Authority, and it will not cause any additional burden for ZSPL. Therefore, it is humbly requested that the Authority to allow the cost of additional foundation works (including the removal of overlapping foundation) of 1,585 million US$ in the EPC cost.

3.4.3. Extra Cleaning and Leveling

The most significant change in the design due to shifting from fixed tilt to single axis tracker is changing the orientation of the modules/strings. Fixed structures are generally placed in East-West direction with an optimal tilt angle in order to capture the highest irradiation while the sun moves from East to West during the day. However, in case of tracking systems, it is just the opposite. The modules are placed in South-North direction perpendicular to movement of sun, so that the tracking system may follow this movement during the day. Please see Figure-2 below for visualization of this.

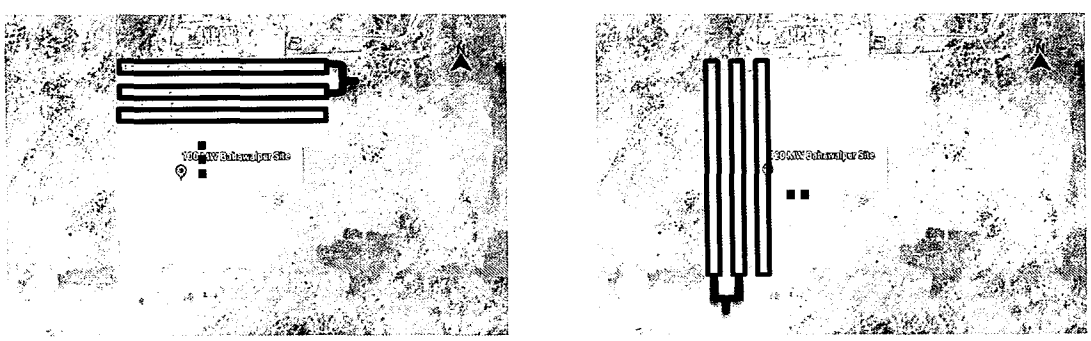


Figure-2 Fixed Tilt v.s. Tracking

Further, the revised site configuration in South-North direction with 7 m pitch distance requires more area then previously used area within the allocated project boundaries. Please see the black highlighted areas in Figure-3 below, which represents the additional area to be cleaned and levelled as a result of changing to single-axis tracking system.

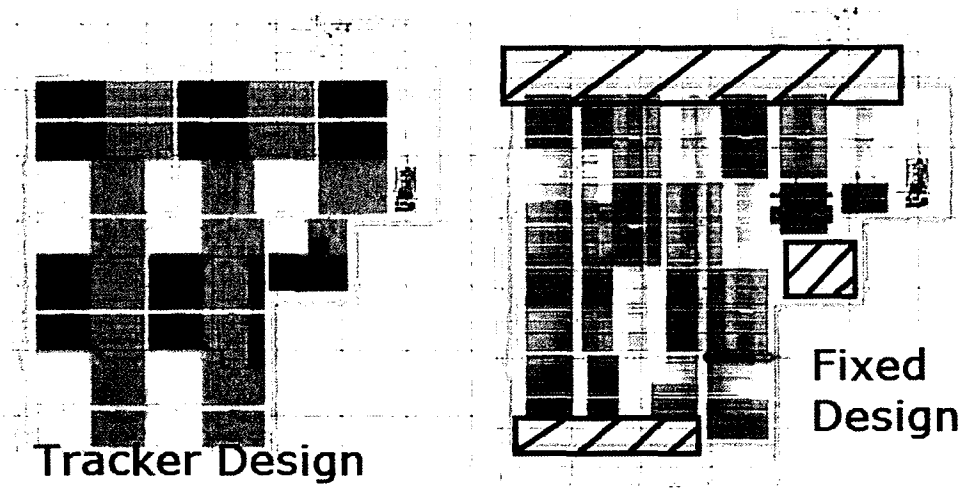


Figure-3- Project Layout for single-axis tracking and fixed-tilt

Images below in Figure-4 below shows the condition of the extra land to be utilized within the project boundaries. In total, additional 306,040 m^2 is to be cleaned and area of 296,000 m^2 is to be levelled due to design change to single-axis tracking in compliance with generation license modification. This results in an increased cost of 750 k US$ approximately, hence is requested to be approved by the Authority.

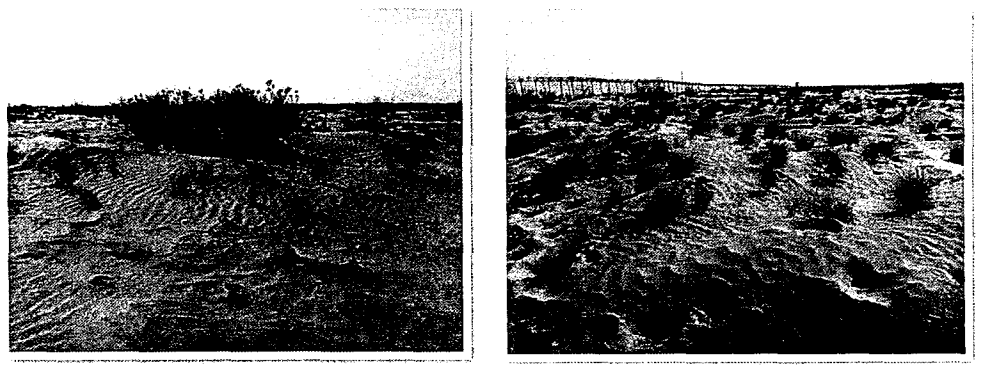


Figure-4- Images from the Project Site

3.4.4. Electrical Balance of System

Several components of Electrical Balance of System has been required to be altered due to change in plant design from fixed tilt to single-axis tracking.

First, cost of communication infrastructure works has been increased since tracking system operates on backtracking technology and requires instant online communication to optimize shading losses.

Further, DC cabling costs along with conduit costs for underground DC cabling, as well as cable carrying equipment is increased mainly due to increase in the cross section of the DC cables. As

per the previous design on fixed tilt structure with 365 Wp modules, 1,303,520 meters of DC cabling with 1x4mm2 cross section was required in order to protect the system from voltage drops since the maximum output currents of 365 Wp modules was 9,28A. In the proposed single-axis tracker bifacial solution due to the increased capacity of each module, more compact electrical design can be implemented, reducing the total length of DC cabling to 1,220,027 meters, accounting for approximately 6% reduction in length. However, due to higher max output current of the 640-645 Wp modules at 17.2A, the thicker cross sectioned DC cables are required (870,000 m of 1x6 mm2 and 350,000 m of 1x10 mm2) in the revised design in order to reach the maximum DC voltage drop of 1.5%, which is the industry standard for solar power plants. Since the unit price of 1x10 mm2 and 1x6mm2 cables are substantially higher than 1x4mm2 cables, although there is a 6% reduction in the length of cables, the total amount of materials used for DC cabling is increased.

In addition to increased cross sections and increased total material usage for DC Cables, increase in commodity prices (especially copper prices) is another major driver for increase in the cost of DC cables. As it can be seen in Figure-5 below, copper prices have been increased from 2,868 USD/lbs on 14 January 2020 to 4,522 USD/lbs on 19 February 2022, an increase of approximately 37% in US$ terms. Coupled with the increased material usage, this have resulted an increase of approximately **64%** in total cost of DC cables.

Figure-5 Copper Prices (source: www.tradingeconomics.com)

Furthermore, as per the revised design required medium voltage aluminum cabling lengths has decreased around 15% comparing with the previous design, however there is also a sharp increase in global aluminum prices since the Determination which had significant impact on the cost of MV cables as well. As given in Figure-6 below, aluminum prices have increased from 1836 USD/ton as of 14 January 2020, to 3262.5 USD/ton on 19th February, resulting an increase of approximately **78%**. Therefore, despite of 15% reduction in the quantity, the cost of MV cables has increased by approximately **51%.**

Figure-6 Aluminum Prices (www.tradingeconomics.com)

The impact of increased commodity prices is not only limited to DC and MV cabling, but the all major electrical BoS components such as SVC, Ethernet, fiber-optic and string cables, HV transformators, have been impacted. Further, a significant portion of these equipment is sourced from China, and approximately **8%** appreciation of CNY against US$ from 6.880 in 13 Jan 2020 to 6.3247 in 19 February 2022 (please see Figure-7 below) coupled with increasing commodity prices, has increased the cost of these equipment by approximately 20% in average.

Figure-7 USD/CNY exchange rate (source: www.tradingeconomics.com)

In the light of above mentioned changes and developments in global trade, total cost of electrical works and DC cabling has increased by 2.2 million US$, compared to previous Determination.

3.4.5. Transportation

The COVID-19 pandemic has severely disrupted global supply chains, slowing flows of raw materials, parts and consumer goods. Shortages of freight capacity - both ocean and air - have pushed up shipping costs globally, with the pandemic also extending port waiting times due to labour shortages and traffic disruption. As per Statista Global Container Freight Index, freight rates have been increased from 1,514 US$ in January 2020 to 9,806 US$ in January 2022 representing an increase of approximately **548%** in average globally. (Please see Figure-8 below).

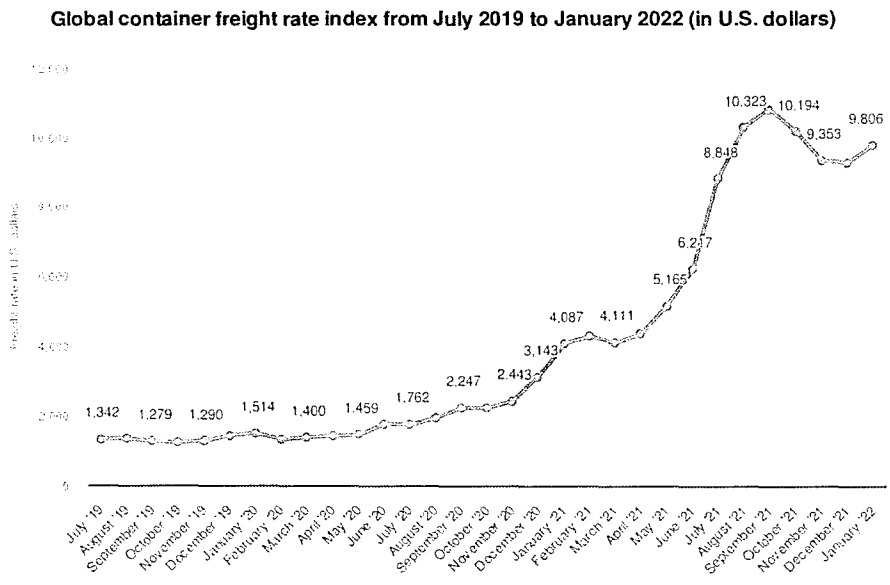


Figure-8- Global Container Freight Index (source: www.statista.com)

DHL, one of the major global logistics company do not expect the freight charges to ease in 2022 as per the article by Reuters (attached herewith and marked as Annexure-C).

It is pertinent to mention here that, neither the solar module prices provided by the online sources such as BNEF or PVinsight, nor the prices submitted by ZSPL for the solar modules above or in previous petitions, include the cost of transportation. Previously, the freight charges represent a less significant portion of the total cost of solar energy systems, however, due to this incredible increase in freight charges, it accounts for a significant cost element now. According to Rystad Energy, this represent a cost increase *"from US$ 0,005 per Wp in September 2019 to US$ 0,03 per Wp in October 2021"*, which corresponds to an increase of 2.5 million US$ for a 100 MWp project.

Based on these developments, ZSPL have re-worked the logistic costs for the project based on the specifications of revised bifacial solar modules, tracking system and other components of the plants. Below table in Figure-9 shows the comparison of number of container to be needed for logistics operation as per previous project design given in Determination and this instant Petition.

Items	640-645 Wp Bifacial Modules with Single Axis Tracker Design	365 Wp Monofacial Modules with Fixed-tilt Design
Solar Modules	296	381
Inverters	20	20
Trackers	139	186
Others	51	54
TOTAL	**506**	**641**

Figure-9- Number of Containers required for the Project

As per the data sheets of 365 Wp and 640Wp/645Wp modules, a single 40" container can carry 720 pcs of 365 Wp and 527 pcs of 640-645 Wp modules. Considering the total number of modules used for the Project of 273,840 pcs and 155,688 pcs for 365 Wp and 640-645Wp modules respectively, the number of container required to be transported for solar modules decreases from 381 containers (e.g. =273,840/720) to 296 containers (e.g. = 155,688/527)

Further as per the initial designs, a total of 139 containers will be required for the transportation of trackers, whereas it was 186 containers in the case fixed tilt structures, aggregating a decrease of 135 containers in total.

Despite of this decrease in the total number of containers, an average increase of more than 6 times in the per container freight charges, the total cost of ocean freight transportation has increased by approximately 3,7 times in comparison to the previous Determination, which accounts for 2,3 million US$ in total.

3.5. Total Impact on EPC Cost

In light of above, the total cost impact on the EPC Costs in comparison with the EPC Cost allowed by the Authority in its previous Determination is summarized below in Figure-10:

Section	Cost Item	Previous Determination (in million US$)	Change in Current Tariff Petition (in million US$)	Rationale for Change
3.1	Solar Modules		7,000	- Change in Solar Module Prices globally - Authority's earlier determination for the cost difference between bifacial and monofacial modules
3.2	Inverters		0,000	- No Change as the same inverters are used in this Petition
3.3	Mounting Structures		5,500	- Change in design from fixed tilt to tracker - Authority's earlier determination for the cost difference between tracker and fixed tilt structures -Impact of increase in global commodity prices
3.4	Balance of System		6,760	As Detailed Below
3.4.1	*Module Installation*		*(0,075)*	*-Reduced number of modules vs. increased man-hour per module installation*
3.4.2	*Foundation Works*		*1,585*	*-Change in design from fixed tilt + monofacial module to tracker + bifacial module*
3.4.3	*Extra Cleaning and Levelling*		*0,750*	*-Change in design from fixed tilt + monofacial module to tracker + bifacial module*
3.4.4	*Electrical Works/Cabling*		*2,200*	*-Change in design from fixed tilt + monofacial module to tracker + bifacial module* *- Change in global commodity prices*
3.4.5	*Transportation*		*2,300*	*- Change in global freight charges*
TOTAL EPC COST		**49,350**	**68,610**	

Figure-10 Summary EPC Costs

Based on the above, ZSPL humbly request the Authority to approve EPC Cost of 68,610 million US$ which includes the cost of change in design in line with Authority's earlier determinations and in compliance with Generation License Modification as approved by the Authority, also incorporating the additional impact of the changes in prices due to pandemic.

3.6. Capacity Factor

As a result of change in technology from fixed tilt structure with monofacial modules to single-axis tracker with bifacial modules, Capacity Factor of the Project has been increased from 19.75% to 22.97% corresponding to estimated annual energy generation of 201,218,000 kWh per annum at P50. Details of the associated assumptions along with a PVsyst study is provided in Solar Resource Assessment Report as attached in Annexure-D.

Authority in its earlier determinations for similar projects have already awarded tariff for projects with bifacial modules and single axis tracker system with capacity factors ranging between 23,20% and 23,27%. However, it must be noted that, all of these projects are located in south region (e.g. Sindh Province) where annual irradiation is higher than ZSPL Project (e.g. Bahawalpur, Punjab). As exhibited in the Figure-11 below, ZSPL's proposed capacity factor is better than the capacity factor already allowed by the Authority for comparable projects taking into account the difference in GHI. Therefore, the same is kindly requested to be approved by the Authority.

Project Name	Capacity Factor (%)	Difference in CF (%)	Location	Annual GHI (kWh/m2)	Difference in GHI (%)
Zorlu Solar Pakistan Ltd	22,97%		Bahawalpur, Punjab	1934,6	
Siachen Energy Ltd	23,20%	1,00%	Thatta, Sindh	1992	2,97%
Helios Power (Pvt) Ltd	23,27%	1,31%	Sukkur, Sindh	1987,6	2,74%
HNDS Energy (Pvt.) Limited	23,27%	1,31%	Sukkur, Sindh	1987,6	2,74%
Meridian Energy (Pvt.) Limited	23,27%	1,31%	Sukkur, Sindh	1987,6	2,74%

Figure-11- Capacity Factor in comparison with similar projects

It is therefore requested by the Authority to approve a capacity factor of 22.97% for the Project, based on Monocrystalline bifacial module technology on a tracking system structure.

3.7. Project Development Cost

Authority in its Determination dated 7th September 2020 has already allowed Project Development Cost of 1,7 million US$, considering the impact of prolonged development period. However, the Project is further delayed due to reasons not attributable to ZSPL, including the impact of Covid-19 pandemic, delay in governmental approvals, as well as the change in technology. Although ZSPL submitted the Performance Guarantee to AEDB on 19th February 2018 which is extended up to April 2022, the LOS has not been issued by AEDB before the deadline for financial closing. Further, ZSPL is required to change the design and technology of the Project in order to comply with the Authority's decision on Modification of Generation License. Due to the changes in the project design, certain technical, and financial studies as well as project agreements will be required to be revised including but not limited to feasibility study, solar resource assessment, financial model, project and financing agreements which will result in additional cost for ZSPL. Furthermore, as a result of extended project development period, additional administrative expenses (such as payrolls, travel expenses, office expenses etc.) will be incurred by ZSPL in addition to extra costs for generation license modification, annual license

fees for extended periods of development and tariff petition fees. Consequentially, these will result in an increase of 0,4 million US$ in addition to already approved Project Development Cost of 1,7 million US$ in previous Determination, increasing the total Project Development Cost to 2,1 million US$, and hence the same is requested to be allowed by the Authority.

3.8. Financing:

ZSPL has already aligned financing for the Project from a consortium of international financiers such as IFC and ADB. Term Sheet for financing has already been submitted to Authority in the previous petition and is attached again herewith and marked as Annexure-E for ease of reference.

The Authority in its Determination has already approved financing at 80:20 Debt to Equity ratio based on a loan of 14+1 years tenor at LIBOR + 4,25% interest rate. Authority in its recent determinations have also approved the same terms to other solar projects, therefore, ZSPL humbly request the Authority to keep the terms of financing as already allowed in its Determination.

3.9. Other Assumptions

As mentioned in Section 3 above, it requested that the Authority may consider this Petition as a continuation of the earlier Determination, and allow the assumptions already allowed in its earlier Determination (except the economic assumptions and indices i.e. LIBOR, Exchange rate, Pak CPI and US CPI). The tariff assumptions allowed by the Authority are reproduced in below table for ready reference, and the Authority is requested to allow the same for the sake of equality and justice.

Description	Already Allowed in Determination	Assumptions for this Petition
Insurance During Construction	0.4% of the EPC Cost	0.4% of the EPC Cost
Financing Costs	2% of the Debt Amount excluding the impact of IDC and Financing Cost	2% of the Debt Amount excluding the impact of IDC and Financing Cost
Capitalized Degradation	3.62% of the EPC Cost	3.62% of the EPC Cost
O&M Cost	US$ 0.900/MWp	US$ 0.900 /MWp
Insurance During Operation	0.4% of the EPC Cost	0.4% of the EPC Cost
Tariff Period	25 years	25 years
Debt Equity Ratio	80:20	80:20
LIBOR Rate	1,9055%	0,3663%
Spread Margin (Foreign)	4.25%	4.25%
US$/PKR exchange rate	155,35	175,1
Discount Rate for Levelization	10%	10%
Return on Equity	14%	14%
True up conditions	Same as per the earlier Determination except for the change in exchange rate provided above	
Sharing Mechanism	As allowed in the earlier Determination	
Indexation	As allowed in the earlier Determination taking into account the change in the reference index applicable at the time of Authority's determination	

04 Project Cost, Tariff and Conclusion

4.1 Revised Project Cost

Changes in EPC Cost and Project Development Costs mentioned in Section 3 above have consequential impact on other cost components resulting is revised Project cost as follows:

Investment / Cost	US$ Million
EPC Cost	68.610
Capitalized Degradation	2.484
Non-EPC & Project Development Cost	2.100
Pre-COD Insurance Cost	0.274
Financial Charges	1.136
Interest During Construction	0.980
Total Project Cost	**75.584**

4.2 Financing Terms

The following terms for financing the debt portion of the Project Cost have been assumed for the calculation of Reference Tariff Table:

Cost Head	Terms
Total Value of Debt @ 80% of total project Cost US$ 75.584 million	60.467
Base Rate (LIBOR)	0.3663%
Spread	4.25%
Debt Markup	4.6163%
Repayment Period	14 years
Grace Period	Up to 12 months
Re-Payment Schedule	Quarterly

4.3 Summary of Reference Generation Tariff

A summarized Reference Generation Tariff table setting out the two bands is provided below. An exchange rate of US$ 1 = 175,1 PKR has been used:

Years	1 – 14 (PKR/kWh)	15 – 25 (PKR/kWh)
O&M	0.7832	0.7832
Insurance	0.2388	0.2388
ROE	1.6572	1.6572
Debt Servicing	5.1238	-
Total	**7.8031**	**2.6792**

4.4 Reference Generation Tariff

Year	O&M	Insurance	ROE	Loan Repayment	Interest Payment	Total Tariff	Total Tariff
	PKR/kWh	PKR/kWh	PKR/kWh	PKR/kWh	PKR/kWh	PKR/kWh	US¢/kWh
1	0,7832	0,2388	1,6572	2,7418	2,3820	7,8031	4,4564
2	0,7832	0,2388	1,6572	2,8706	2,2532	7,8031	4,4564
3	0,7832	0,2388	1,6572	3,0054	2,1184	7,8031	4,4564
4	0,7832	0,2388	1,6572	3,1466	1,9773	7,8031	4,4564
5	0,7832	0,2388	1,6572	3,2944	1,8295	7,8031	4,4564
6	0,7832	0,2388	1,6572	3,4491	1,6747	7,8031	4,4564
7	0,7832	0,2388	1,6572	3,6111	1,5127	7,8031	4,4564
8	0,7832	0,2388	1,6572	3,7807	1,3431	7,8031	4,4564
9	0,7832	0,2388	1,6572	3,9583	1,1656	7,8031	4,4564
10	0,7832	0,2388	1,6572	4,1442	0,9797	7,8031	4,4564
11	0,7832	0,2388	1,6572	4,3388	0,7850	7,8031	4,4564
12	0,7832	0,2388	1,6572	4,5426	0,5812	7,8031	4,4564
13	0,7832	0,2388	1,6572	4,7560	0,3679	7,8031	4,4564
14	0,7832	0,2388	1,6572	4,9793	0,1445	7,8031	4,4564
15	0,7832	0,2388	1,6572	0,0000	0,0000	2,6792	1,5301
16	0,7832	0,2388	1,6572	0,0000	0,0000	2,6792	1,5301
17	0,7832	0,2388	1,6572	0,0000	0,0000	2,6792	1,5301
18	0,7832	0,2388	1,6572	0,0000	0,0000	2,6792	1,5301
19	0,7832	0,2388	1,6572	0,0000	0,0000	2,6792	1,5301
20	0,7832	0,2388	1,6572	0,0000	0,0000	2,6792	1,5301
21	0,7832	0,2388	1,6572	0,0000	0,0000	2,6792	1,5301
22	0,7832	0,2388	1,6572	0,0000	0,0000	2,6792	1,5301
23	0,7832	0,2388	1,6572	0,0000	0,0000	2,6792	1,5301
24	0,7832	0,2388	1,6572	0,0000	0,0000	2,6792	1,5301
25	0,7832	0,2388	1,6572	0,0000	0,0000	2,6792	1,5301
					AVERAGE TARIFF	**5,5486**	**3,1688**
					LEVELIZED TARIFF	**6,8376**	**3,9050**

Assumptions:
Financing Rate: 4.6163%
LIBOR rate 0.3663%
Spread: 4.25%
US$ Exchange rate: PKR 175,1
Capacity Factor: 22.97%

4.5 Debt Repayment Schedule

Quarters	Principal Repayment - US$	Principal Repayment - Tariff Component (Rs/kWh)	Interest - US$	Interest - Tariff Component (Rs/kWh)	Instalments US$	Installment - Tariff Component (Rs/kWh)
1	774.188	0,6664	697.837	0,6007	1.472.025	1,2672
2	783.122	0,6741	688.902	0,5930	1.472.024	1,2672
3	792.160	0,6819	679.865	0,5853	1.472.025	1,2672
4	801.302	0,6898	670.722	0,5774	1.472.024	1,2672
5	810.550	0,6978	661.475	0,5694	1.472.025	1,2672
6	819.904	0,7058	652.121	0,5614	1.472.025	1,2672
7	829.367	0,7139	642.658	0,5532	1.472.025	1,2672
8	838.938	0,7222	633.087	0,5450	1.472.025	1,2672
9	848.620	0,7305	623.405	0,5367	1.472.025	1,2672
10	858.414	0,7390	613.611	0,5282	1.472.025	1,2672
11	868.320	0,7475	603.704	0,5197	1.472.024	1,2672
12	878.341	0,7561	593.683	0,5111	1.472.024	1,2672
13	888.478	0,7648	583.547	0,5023	1.472.025	1,2672
14	898.732	0,7737	573.293	0,4935	1.472.025	1,2672
15	909.104	0,7826	562.921	0,4846	1.472.025	1,2672
16	919.596	0,7916	552.429	0,4756	1.472.025	1,2672
17	930.208	0,8008	541.816	0,4664	1.472.024	1,2672
18	940.944	0,8100	531.081	0,4572	1.472.025	1,2672
19	951.803	0,8193	520.222	0,4478	1.472.025	1,2672
20	962.787	0,8288	509.238	0,4384	1.472.025	1,2672
21	973.899	0,8384	498.126	0,4288	1.472.025	1,2672
22	985.138	0,8480	486.887	0,4191	1.472.025	1,2672
23	996.507	0,8578	475.518	0,4093	1.472.025	1,2672
24	1.008.008	0,8677	464.017	0,3994	1.472.025	1,2672
25	1.019.641	0,8777	452.384	0,3894	1.472.025	1,2672
26	1.031.408	0,8879	440.617	0,3793	1.472.025	1,2672
27	1.043.311	0,8981	428.713	0,3691	1.472.024	1,2672
28	1.055.352	0,9085	416.673	0,3587	1.472.025	1,2672
29	1.067.532	0,9190	404.493	0,3482	1.472.025	1,2672
30	1.079.852	0,9296	392.173	0,3376	1.472.025	1,2672
31	1.092.314	0,9403	379.711	0,3269	1.472.025	1,2672
32	1.104.920	0,9512	367.105	0,3160	1.472.025	1,2672
33	1.117.672	0,9621	354.353	0,3050	1.472.025	1,2672
34	1.130.570	0,9732	341.455	0,2939	1.472.025	1,2672
35	1.143.618	0,9845	328.407	0,2827	1.472.025	1,2672
36	1.156.816	0,9958	315.209	0,2713	1.472.025	1,2672
37	1.170.167	1,0073	301.858	0,2599	1.472.025	1,2672
38	1.183.671	1,0189	288.354	0,2482	1.472.025	1,2672
39	1.197.332	1,0307	274.693	0,2365	1.472.025	1,2672

40	1.211.150	1,0426	260.875	0,2246	1.472.025	1,2672
41	1.225.127	1,0546	246.898	0,2125	1.472.025	1,2672
42	1.239.266	1,0668	232.759	0,2004	1.472.025	1,2672
43	1.253.568	1,0791	218.457	0,1881	1.472.025	1,2672
44	1.268.035	1,0916	203.990	0,1756	1.472.025	1,2672
45	1.282.669	1,1042	189.356	0,1630	1.472.025	1,2672
46	1.297.472	1,1169	174.553	0,1503	1.472.025	1,2672
47	1.312.446	1,1298	159.579	0,1374	1.472.025	1,2672
48	1.327.592	1,1428	144.432	0,1243	1.472.024	1,2672
49	1.342.914	1,1560	129.111	0,1111	1.472.025	1,2672
50	1.358.412	1,1694	113.613	0,0978	1.472.025	1,2672
51	1.374.089	1,1829	97.936	0,0843	1.472.025	1,2672
52	1.389.947	1,1965	82.078	0,0707	1.472.025	1,2672
53	1.405.988	1,2103	66.037	0,0568	1.472.025	1,2672
54	1.422.214	1,2243	49.811	0,0429	1.472.025	1,2672
55	1.438.628	1,2384	33.397	0,0287	1.472.025	1,2672
56	1.455.230	1,2527	16.794	0,0145	1.472.024	1,2672

Assumptions:
Financing Rate: 4.6163%
LIBOR rate 0.3663%
Spread: 4.25%
US$ Exchange rate: PKR 175,1
Capacity Factor: 22.97%

05 Prayer

In light of the foregoing, it is respectfully prayed that the earlier Determination may be reviewed based on the proposed technology and related factors as per the details given throughout this Petition.

In order to achieve financial closing, the Authority is also requested to allow a further period of 12 months for financial close of the Project.

Authority is requested to allow (a) change in technology, (b) increase in EPC cost and Project Development Cost, increase in capacity factor based on the change in technology.

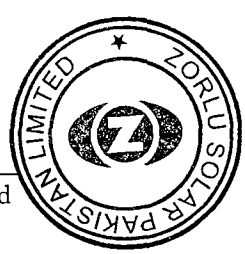
Authority is further requested to maintain original decision (as per the Determination) with regard to financing assumptions, debt equity structure, return on equity, other costs and all indexations, escalations, adjustments and sharing mechanism. Any other relief that the Petitioner may be entitled to, be also allowed to the Project in the interest of justice.

Authority is also requested to approve a reference tariff table based on assumptions (LIBOR rate and Exchange rate parity) as requested in the petition.

Further any taxes, stamp duties, fees and levies (sales tax of non-refundable nature) etc. of federal, provincial, local or district governments, which are not factored in the tariff calculation are requested to be allowed as pass through.

Authority is kindly requested to process the Tariff Petition at the earliest thereby enabling ZSPL to proceed further with the development process.

Respectfully submitted on the behalf of Petitioner.



Zorlu Solar Pakistan Limited
Dated: 22nd February 2022

Annexure A1 –Previous Letters from Module Manufacturers

JA SOLAR

To whom it may concern

With respect to your request for proposal for the 365Wp serial modules for you 100MW Pakistan/Bahawalpur Project, we would like to kindly inform you that we are not able to supply 365 Wp serial modules on the requested date (May-June 2021) due to the upgrading of the production line in accordance with higher watt capacity modules. However, we can propose your company to use the new series production 500W+ modules for your 100 MW Bahawalpur project.

JA SOLAR INTERNATIONAL LIMITED

JA SOLAR INTERNATIONAL LIMITED
Address: Room D, 10/F, Tower A, Billion Centre, 1 Wang Kwong Road, Kowloon Bay, Kowloon, Hong Kong.

晶科能源
www.jinkosolar.com

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晶科大厦
200072
Jinko Building, #99
Shouyang Road, Jingan District,
Shanghai 200072, China

电话:(86)21-5180 8777
传真:(86)21-5180 8600
Tel:(86)21-5180 8777
Fax:(86)21-5180 8600

To: **Zorlu Enerji Elektrik Uretim A.S.**

Subject: Jinko Support Letter for Pakistan/Bahawalpur

We, **Jinko Solar Co., Ltd.,** together with its affiliates (collectively "**Jinko**"), hereby state that subject to written purchase agreement to be agreed in future by both parties, we are willing and able to confirm that:

With respect to your request for proposal for the 365Wp serial modules for you 100MW Pakistan/Bahawalpur Project, Jinko would like to kindly inform you that we are not able to supply 365 Wp serial modules on the requested date (May-June 2021) due to the upgrading of the production line in accordance with higher watt capacity modules. However, we can propose your company to use the new series production 500W+ modules for your 100 MW Bahawalpur project.

No party under this letter shall have the authority, nor shall any party hereunder hold itself as having the authority, to assume, create or undertake any obligation of any kind whatsoever, expressed or implied, on behalf of or in the name of any other party without prior written consent of such other party.

Please note that nothing contained herein shall create any binding obligation on any party hereunder unless a binding and definitive agreement is reached by Zorlu Enerji Elektrik Uretim A.S. and Jinko. However, Jinko looks forward to working with Zorlu Enerji Elektrik Uretim A.S. in advancing this opportunity.

Kind regards,

Technical Service Department

组件事业部客户服务部

Dec. 25th 2020

Wallisellen, 24.12.2020

To: Zorlu Enerji Elektrik Üretim A.Ş.

Dear Sir/Madam

With respect to your request for proposal for the 365Wp serial modules in regard to your 100MW Pakistan/Bahawalpur Project, we are afraid to inform you that we may not be able to supply you with 365Wp serial modules on the requested date (May-June 2021) due to the upgrading of the production line in accordance with higher watt capacity modules. However, we can propose you to use the new production series of 500Wp+ modules for your 100 MW Bahawalpur project.

We apologize for any inconveniences and remain at your disposal for any further clarifications.

Yours faithfully,

DocuSigned by:
4FC6EAADB4774F6...
Gonzalo de la Vina
Head of Europe

DocuSigned by:
Federico Marostica
A97A46751555485...
Federico Marostica
Special Attorney

Birkenweg 4 | 8304 Wallisellen | Switzerland
T +41 43 299 68 00 | F +41 43 299 68 10 | europe@trinasolar.com
Register No.: CHE-1 1 5.204.635 | Commercial Register: Handelsregisteramt des Kantons Zürich
Managing Directors: Gonzalo de la Vina, Vincenzo Costanzelli, Li Yan

DS
FM

LONGi Solar

Date: 28th Dec 2020

To ZORLU ENERJİ ELEKTRİK ÜRETİM A.Ş.

With respect to your request of proposal for the 365Wp serial modules for your 100MW Bahawalpur Project in Pakistan.

We would like to kindly inform you that we will not be able to supply 365 Wp serial modules on the requested date (May-June 2021) due to the upgrade of the production line in accordance with a more advancing technology and higher power output of solar PV modules.

Instead, we strongly propose your company to use the new series product LR5-72HPH 500W+ modules for your 100 MW Bahawalpur project to keep pace with the time.

LONGi Solar Technology Co., Ltd

LONGi Solar Technology Co., Ltd. Add: Floor 3 - 5, Block B, Innovation Incubation Center, Xi'an Service Outsourcing Industrial Park, No. 8989 Shangji Road, Economic & Technological Development Zone, Xi'an, China
Tel: 4009696199
Fax:+86-029-86686228

Annexure A2 – Solar PV Commodity Index by Rystad Energy

Most of 2022's solar PV projects risk delay or cancelation due to soaring material and shipping costs

October 26, 2021

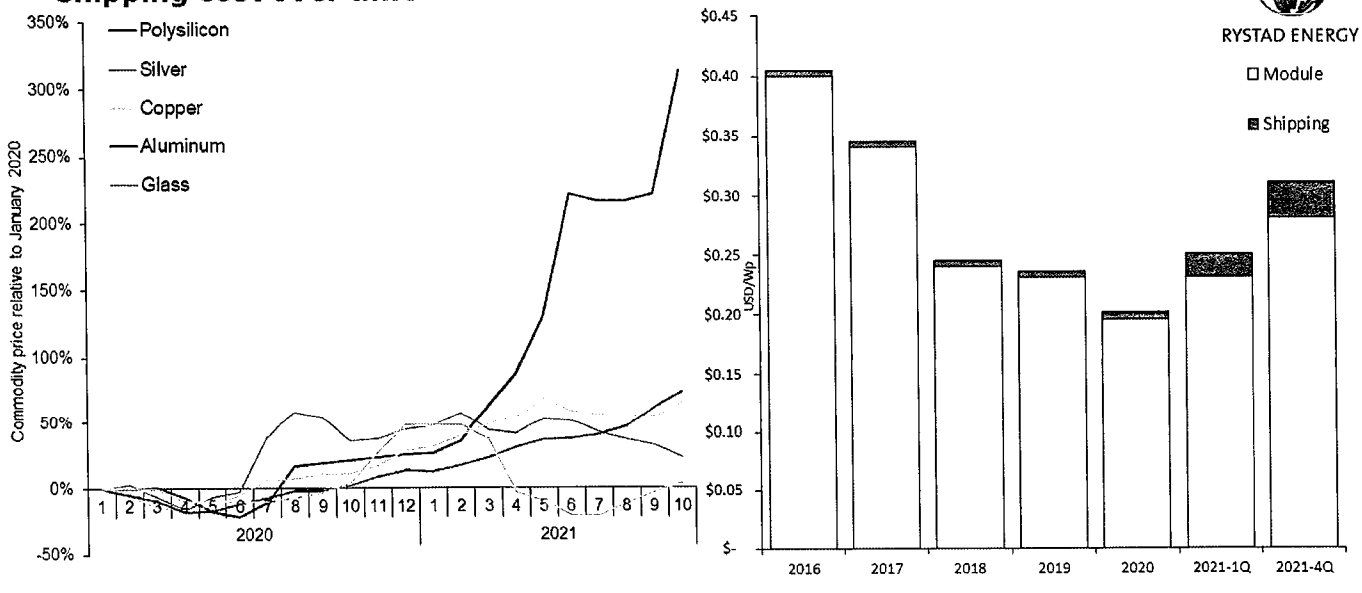
The surging cost of manufacturing materials and shipping could threaten 50 gigawatts (GW) – a staggering 56% – of the 90 GW of global utility PV developments planned for 2022, a Rystad Energy analysis shows. Commodity price inflation and supply chain bottlenecks could lead to the postponement or even cancelation of some of these projects, impacting demand and consumer pricing for solar-generated power.

Driven by core component price inflation, manufacturing costs for PV modules have surged from below $0.20 per watt peak (Wp) in 2020 to between $0.26 and $0.28 per Wp in the second half of 2021 – a near 50% increase in a year.

A significant driver of this surge is a more than 300% hike in the cost of polysilicon, a core component in PV manufacturing. In addition, other raw materials – silver, copper, aluminum and glass – have also climbed steadily since January 2020, increasing the pressure on module prices.

"The utility solar industry is facing one of its toughest challenges just days ahead of COP26. The current bottlenecks are not expected to be relieved within the next 12 months, meaning developers and offtakers will have to decide whether to reduce their margins, delay projects or increase offtake prices to get projects to financial close," says David Dixon, senior renewables analyst at Rystad Energy.

Solar PV commodity price increases since 2020/Solar PV module and shipping cost over time



Source: Rystad Energy RenewableCube; Rystad Energy research and analysis

Learn more about Rystad Energy's RenewableCube.

In addition to materials cost inflation, shipping is another element in the supply chain causing considerable challenges for developers and module suppliers. The cost of shipping continues to rise, playing more of a role in overall production capital expenditure. Before 2021, the cost of PV shipping had a minimal impact on the overall production cost. However, pandemic-era shipping delays and bottlenecks have resulted in a near 500% increase in prices, from $0.005 per Wp in September 2019 to $0.03 per Wp in October 2021.

Modules and their associated shipping costs typically comprise between a quarter and a third of the total project capex and together represent the single-largest item of a project's cost. When the cost of modules – and shipping – increases, it can significantly impact project economics.

Rystad Energy performed a sensitivity analysis to determine the levelized cost of electricity (LCOE) for different plant sizes comparing last year's module and shipping costs with current costs. The results show that the LCOE of new projects has increased by between 10% and 15%, a major cost bump for most of the projects planned for 2022. Seeing their projects at risk, developers may have to resort to negotiating higher power purchase agreements (PPA) or absorbing some of the cost inflation, accepting higher project costs and lower margins.

For more analysis, insights and reports, clients and non-clients can apply for access to Rystad Energy's Free Solutions and get a taste of our data and analytics universe.

##

Contacts

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Senior Analyst
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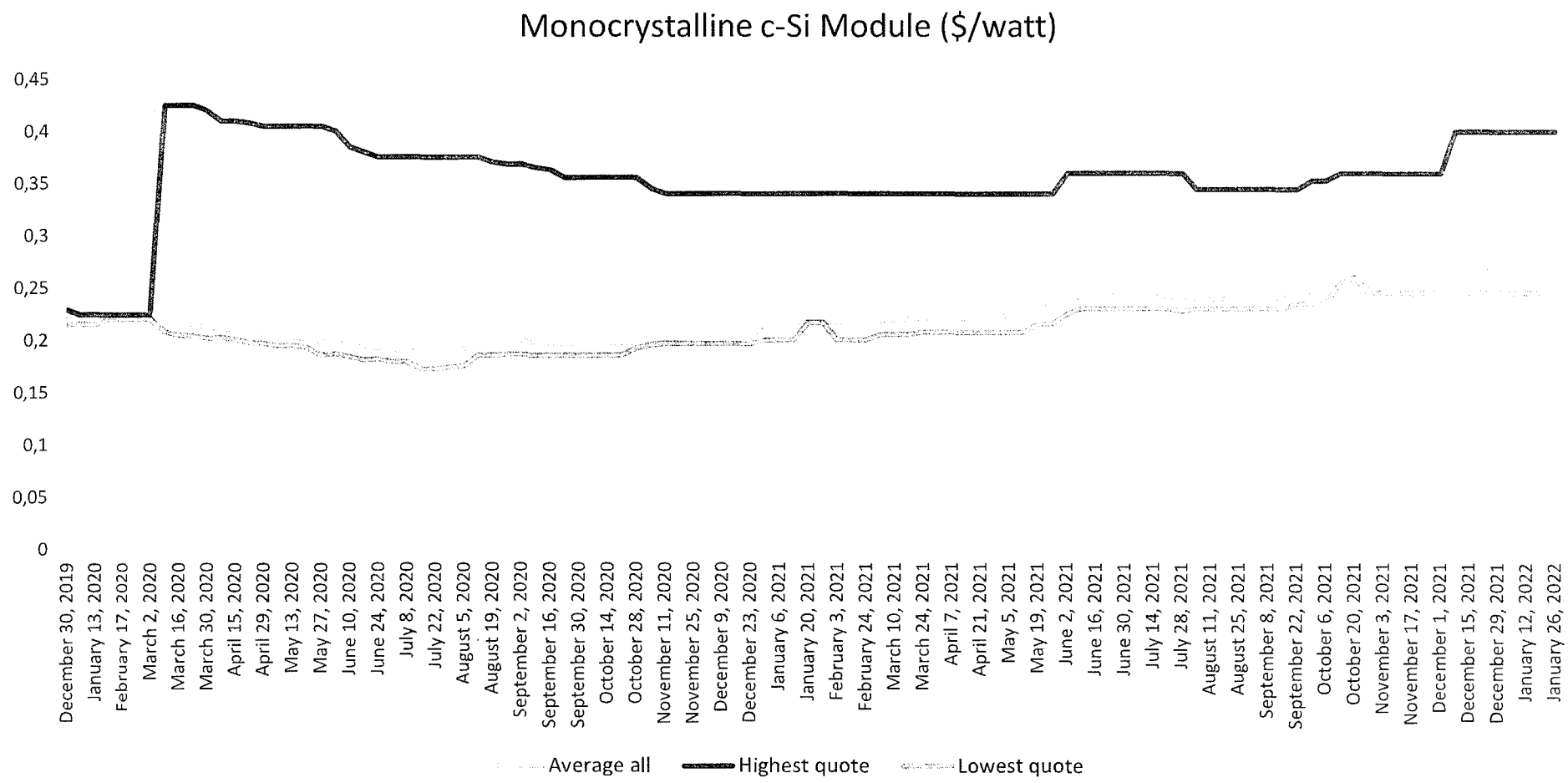
Phone: +1 708 513 4214
elliot.busby@rystadenergy.com

About Rystad Energy

Rystad Energy is an independent energy research and business intelligence company providing data, tools, analytics and consultancy services to the global energy industry. Our products and services cover energy fundamentals and the global and regional upstream, oilfield services and renewable energy industries, tailored to analysts, managers and executives alike. Rystad Energy's headquarters are located in Oslo, Norway with offices in London, New York, Houston, Aberdeen, Stavanger, Moscow, Rio de Janeiro, Singapore, Bangalore, Tokyo, Sydney and Dubai.

‹ Previous Press Release Next Press Release ›

Annexure A3 – BNEF Solar Module Spot Price Index


Monocrystalline c-Si Module ($/watt)
0,45
0,4
0,35
0,3
0,25
0,2
0,15
0,1
0,05
0
December 30, 2019
January 13, 2020
February 17, 2020
March 2, 2020
March 16, 2020
March 30, 2020
April 15, 2020
April 29, 2020
May 13, 2020
May 27, 2020
June 10, 2020
June 24, 2020
July 8, 2020
July 22, 2020
August 5, 2020
August 19, 2020
September 2, 2020
September 16, 2020
September 30, 2020
October 14, 2020
October 28, 2020
November 11, 2020
November 25, 2020
December 9, 2020
December 23, 2020
January 6, 2021
January 20, 2021
February 3, 2021
February 24, 2021
March 10, 2021
March 24, 2021
April 7, 2021
April 21, 2021
May 5, 2021
May 19, 2021
June 2, 2021
June 16, 2021
June 30, 2021
July 14, 2021
July 28, 2021
August 11, 2021
August 25, 2021
September 8, 2021
September 22, 2021
October 6, 2021
October 20, 2021
November 3, 2021
November 17, 2021
December 1, 2021
December 15, 2021
December 29, 2021
January 12, 2022
January 26, 2022
Average all
Highest quote
Lowest quote

Date	Unit	Average all	Highest quote	Lowest quote
December 30, 2019	$/watt	0,224	0,23	0,215
January 6, 2020	$/watt	0,22	0,225	0,215
January 13, 2020	$/watt	0,221	0,225	0,215
February 10, 2020	$/watt	0,222	0,225	0,22
February 17, 2020	$/watt	0,222	0,225	0,22
February 24, 2020	$/watt	0,222	0,225	0,22
March 2, 2020	$/watt	0,222	0,225	0,22
March 9, 2020	$/watt	0,219	0,425	0,208
March 16, 2020	$/watt	0,217	0,425	0,205
March 23, 2020	$/watt	0,215	0,425	0,204
March 30, 2020	$/watt	0,213	0,42	0,202
April 8, 2020	$/watt	0,212	0,41	0,203
April 15, 2020	$/watt	0,21	0,41	0,201
April 22, 2020	$/watt	0,208	0,408	0,198
April 29, 2020	$/watt	0,206	0,405	0,197
May 6, 2020	$/watt	0,205	0,405	0,195
May 13, 2020	$/watt	0,204	0,405	0,195
May 20, 2020	$/watt	0,201	0,405	0,193
May 27, 2020	$/watt	0,199	0,405	0,186
June 3, 2020	$/watt	0,198	0,4	0,187
June 10, 2020	$/watt	0,195	0,385	0,184
June 17, 2020	$/watt	0,194	0,38	0,181
June 24, 2020	$/watt	0,193	0,375	0,182
July 1, 2020	$/watt	0,191	0,375	0,179
July 8, 2020	$/watt	0,19	0,375	0,179
July 15, 2020	$/watt	0,188	0,375	0,172
July 22, 2020	$/watt	0,189	0,375	0,172
July 29, 2020	$/watt	0,19	0,375	0,174
August 5, 2020	$/watt	0,192	0,375	0,175
August 12, 2020	$/watt	0,193	0,375	0,185
August 19, 2020	$/watt	0,198	0,37	0,185
August 26, 2020	$/watt	0,199	0,368	0,186
September 2, 2020	$/watt	0,2	0,368	0,186
September 9, 2020	$/watt	0,198	0,365	0,185
September 16, 2020	$/watt	0,197	0,363	0,185
September 23, 2020	$/watt	0,196	0,355	0,185
September 30, 2020	$/watt	0,196	0,355	0,185
October 7, 2020	$/watt	0,196	0,355	0,185
October 14, 2020	$/watt	0,197	0,355	0,185
October 21, 2020	$/watt	0,197	0,355	0,185
October 28, 2020	$/watt	0,197	0,355	0,192
November 4, 2020	$/watt	0,197	0,345	0,195
November 11, 2020	$/watt	0,199	0,34	0,196
November 18, 2020	$/watt	0,202	0,34	0,196
November 25, 2020	$/watt	0,202	0,34	0,196
December 2, 2020	$/watt	0,203	0,34	0,196
December 9, 2020	$/watt	0,203	0,34	0,196
December 16, 2020	$/watt	0,203	0,34	0,196
December 23, 2020	$/watt	0,203	0,34	0,196
December 30, 2020	$/watt	0,216	0,34	0,2
January 6, 2021	$/watt	0,217	0,34	0,2
January 13, 2021	$/watt	0,217	0,34	0,2
January 20, 2021	$/watt	0,217	0,34	0,216

January 27, 2021	$/watt	0,217	0,34	0,216
February 3, 2021	$/watt	0,217	0,34	0,2
February 10, 2021	$/watt	0,217	0,34	0,2
February 24, 2021	$/watt	0,217	0,34	0,2
March 3, 2021	$/watt	0,218	0,34	0,205
March 10, 2021	$/watt	0,219	0,34	0,205
March 17, 2021	$/watt	0,22	0,34	0,205
March 24, 2021	$/watt	0,221	0,34	0,207
March 31, 2021	$/watt	0,22	0,34	0,207
April 7, 2021	$/watt	0,221	0,34	0,207
April 14, 2021	$/watt	0,221	0,34	0,207
April 21, 2021	$/watt	0,221	0,34	0,207
April 28, 2021	$/watt	0,221	0,34	0,207
May 5, 2021	$/watt	0,224	0,34	0,207
May 13, 2021	$/watt	0,226	0,34	0,207
May 19, 2021	$/watt	0,23	0,34	0,215
May 26, 2021	$/watt	0,233	0,34	0,215
June 2, 2021	$/watt	0,239	0,36	0,225
June 9, 2021	$/watt	0,242	0,36	0,23
June 16, 2021	$/watt	0,243	0,36	0,23
June 23, 2021	$/watt	0,243	0,36	0,23
June 30, 2021	$/watt	0,243	0,36	0,23
July 7, 2021	$/watt	0,242	0,36	0,23
July 14, 2021	$/watt	0,242	0,36	0,23
July 21, 2021	$/watt	0,242	0,36	0,23
July 28, 2021	$/watt	0,242	0,36	0,228
August 4, 2021	$/watt	0,24	0,345	0,23
August 11, 2021	$/watt	0,24	0,345	0,23
August 18, 2021	$/watt	0,24	0,345	0,23
August 25, 2021	$/watt	0,24	0,345	0,23
September 1, 2021	$/watt	0,24	0,345	0,23
September 8, 2021	$/watt	0,241	0,345	0,23
September 15, 2021	$/watt	0,241	0,345	0,23
September 22, 2021	$/watt	0,243	0,345	0,235
September 29, 2021	$/watt	0,248	0,353	0,235
October 6, 2021	$/watt	0,248	0,353	0,235
October 13, 2021	$/watt	0,273	0,36	0,255
October 20, 2021	$/watt	0,276	0,36	0,26
October 27, 2021	$/watt	0,276	0,36	0,245
November 3, 2021	$/watt	0,276	0,36	0,245
November 10, 2021	$/watt	0,278	0,36	0,245
November 17, 2021	$/watt	0,278	0,36	0,245
November 24, 2021	$/watt	0,278	0,36	0,245
December 1, 2021	$/watt	0,277	0,36	0,245
December 8, 2021	$/watt	0,275	0,4	0,245
December 15, 2021	$/watt	0,271	0,4	0,245
December 22, 2021	$/watt	0,271	0,4	0,245
December 29, 2021	$/watt	0,269	0,4	0,245
January 5, 2022	$/watt	0,268	0,4	0,245
January 12, 2022	$/watt	0,267	0,4	0,245
January 19, 2022	$/watt	0,268	0,4	0,245
January 26, 2022	$/watt	0,268	0,4	0,245

Annexure A4 – Official Quotation Letters from Module Manufacturers

RISEN ENERGY CO., LTD.

Meilin Tashan Ind.Zone,Ninghai,Ningbo,Zhejiang315609,China
Tel : 86-574-59953215 Fax : 86-574-6517 3959
Mobile: +86 15921328360
E-mail : liuj@risenenergy.com

Quotation

To : ZORLU DOGAL ELEKTRIK URETIMI A.Ş.

Attn. : Ogeday Ormanlıoğlu
From : Risen Energy CO., LTD Date 11th Feb. 2022

Mono Perc	Module type	RSM132-8-650BMDG
TÜV SÜD Qualified. IEC61215 Qualified. IEC61730	Quantity	100MW
	Rated power inWatts-Pmax(Wp)	**640,645,650W**
	Open circuit voltage(Voc)	**45.49**
	Maximum Power Voltage(Vmpp)	**37.87**
	Short circuit current(Isc)	**18.18**
	Maximum Power Current(Impp)	**17.17**
	Panel Efficiency	**20.9%**
	Solar cell	Mono
	No.of cells and connections	132cells(6*11+6*11)
	Dimension of Module(mm)	2384*1303*35mm
	Weight	40kg
	Certificate	IEC 61215, 61730, 60068, 61804, 61701, 72716.
	Tolerance	0--3%

Terms and Conditions

Price	**USD0.265/W exwork, or USD0.266/W FOB Ningbo seaport or USD0.285/W CIF Karachi+USD80000/100MW inspection expense**
Payment Terms	10% downpayment, balance is Irrevocable LC at sight.
Delivery time:	45days production time,delivery from factory in Q1 2023,LC to be established 4 weeks before production starts
Warranty	RISEN provide 12 years product & workmanship warranty and 30 years limited linear power output warranty from delivery date and the power degradation during the 1st year shall be ≤2% of rated power and from 2nd to 30th year, the annual power degradation shall be ≤0.45% of rated power.

Valid of quotation is until 30th June 2022.

Prepared by

KerryLIU Senior Sales Manager MEA
Risen Energy Co.,Ltd

09.02.2022

NON-BINDING PV MODULES SUPPLY PROPOSAL

For:

Zorlu Enerji A.Ş.
Mr. Polat Yeter

1 Product

Photovoltaic Solar Module: (Monocrystalline Perc) Vertex Series

2 Nominal Power

Powermix with all positive tolerance of +5Wp. Power mix depending on availability

3 Warranty

Limited Manufacturer's Warranty downloadable from the website www.trinasolar.com:

Monofacial Backsheet : Material Defects and workmanship : 12 years , Power output : 25 years linear warranty.
Bifacial Dual Glass: Material Defects and workmanship : 12 years , Power output : 30 years linear warranty.

4 Delivery Schedule and pricing

Deliveries to be done approximately as follows:

Product	Order Volume (MW)	Incoterm	Price (USD/W)	Delivery
TSM-DEG21C.20 Bifacial Dual Glass 640,645,650W	100	FOB China Port	0.264	Q1-2023_

5 Payment terms:

5.1 FOB:

- 10 % prepayment of the total amount by TT at the signature of the contract.
- Remaining 90% by bank guarantee or confirming payable after 30 days of the delivery date. Bank guarantee or confirming must be opened prior the delivery date.

5.2 CIF:

- 10 % prepayment of the total amount by TT at the signature of the contract.
- Remaining 90% by Letter of Credit or confirming payable after 30 days of the BOL date. Bank guarantee or confirming must be opened prior the shipment date.

5.3 DAP/DDP:

- 10 % prepayment of the total amount by TT at the signature of the contract.

- Remaining 90% by bank guarantee or confirming payable after 10 days of the delivery date. Bank guarantee or confirming must be opened prior the shipment date.

6 Price Guidance Expiry

This Non-Binding Proposal will expire five (5) business days after the date mentioned in the header and is subject to availability.

7 Confidentiality

The Buyer undertakes that it and its directors, officers, employees, representatives, advisors, agents, contractors or affiliates and their directors, officers, employees, representatives, advisors, agents, contractors will fully respect the confidentiality of the aforementioned Non-Binding Proposal. Accordingly, the Buyer hereby undertakes to treat the aforementioned Non-Binding Proposal and all other information or data obtained under or in connection with the aforementioned Non-Binding Proposal confidential with the same degree of care applied to its own most valuable business secrets, and will not divulge such information to any person other than - on a strict need to know basis - its directors, officers, employees, representatives, advisors, agents, contractors, affiliates and their directors, officers, employees, representatives, advisors, agents and contractors, and will use such information solely for the purpose of evaluating a purchase agreement with Trina Solar.

The foregoing commitments of the Buyer shall survive any rejection or conclusion of the purchase agreement with Trina Solar, and shall continue for a period of one year from the date on which the aforementioned Non-Binding Proposal becomes effective. The aforementioned Non-Binding Proposal shall be effective from the signing date by both parties and shall date back to the initial disclosing date.

8 Non-binding and subject to completion

Except for this Clause 8 "Non-binding and subject to completion" and Clause 7 "Confidentiality", none of the clauses stipulated in this Non-binding PV Modules Supply Proposal shall be binding upon the Parties.

Annexure B – Datasheet for 640-645 W Tier-1 Bifacial Module

Mono Multi Solutions

BIFACIAL DUAL GLASS

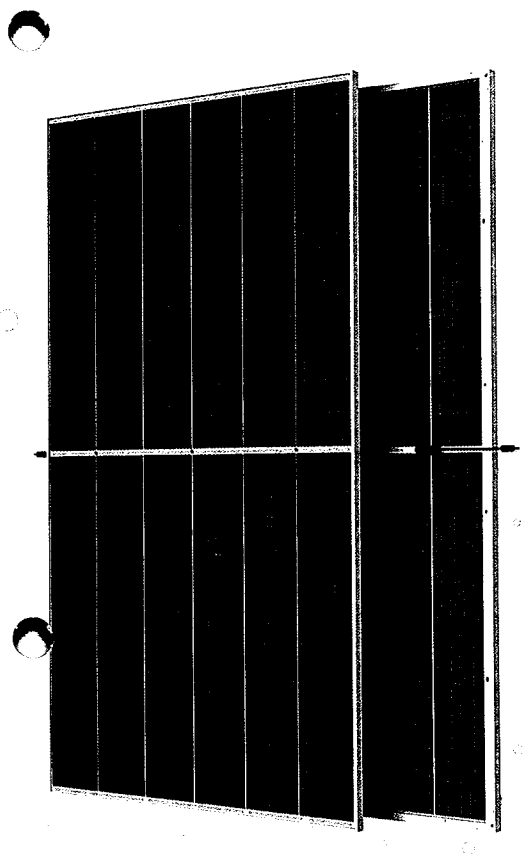
PRODUCT: TSM-DEG21C.20

POWER RANGE: 640-665W

665W
MAXIMUM POWER OUTPUT

0~+5W
POSITIVE POWER TOLERANCE

21.4%
MAXIMUM EFFICIENCY



- Lower LCOE (Levelized Cost Of Energy), reduced BOS (Balance of System) cost, shorter payback time
- **Lowest guaranteed** first year and annual degradation;
- **Designed for compati**bility with existing mainstream system **components**

High power up to

- **Up to 21.4% module** efficiency with high density interconnect **technology**
- **Multi-busbar technol**ogy for better light trapping effect, lower series **resistance and improve**d current collection

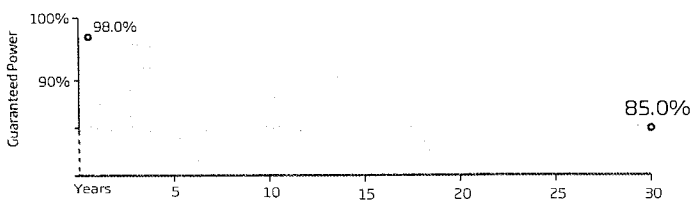
High reliability

- **Minimized micro-cracks** with innovative non-destructive cutting **technology**
- **Ensured PID resistance** through cell process and module material **control**
- **Resistant to harsh en**vironments such as salt, ammonia, sand, high **temperature and high** humidity areas
- **Mechanical performance** up to 5400 Pa positive load and 2400 Pa **negative load**

High energy yield

- **Excellent IAM (Incident** Angle Modifier) and low irradiation **performance, validated** by 3rd party certifications
- **The unique design** provides optimized energy production under **inter-row shading conditions**
- **Lower temperature** coefficient (-0.34%) and operating temperature
- **Up to 25% additional** power gain from back side depending on albedo

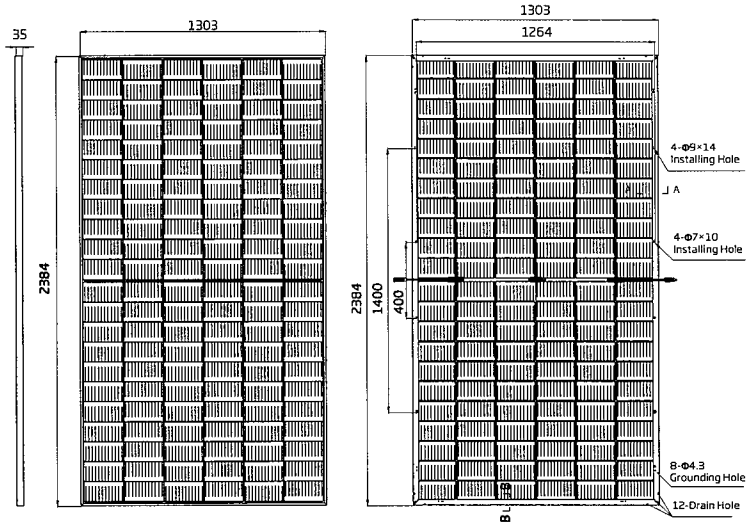
Solar's Vertex Bifacial Dual Glass Performance Warranty

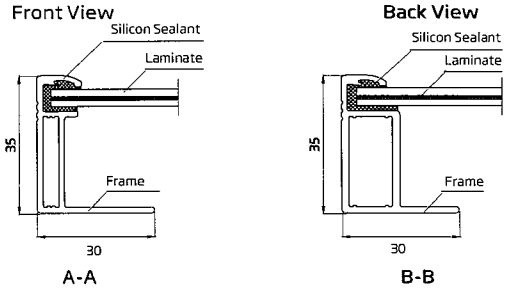


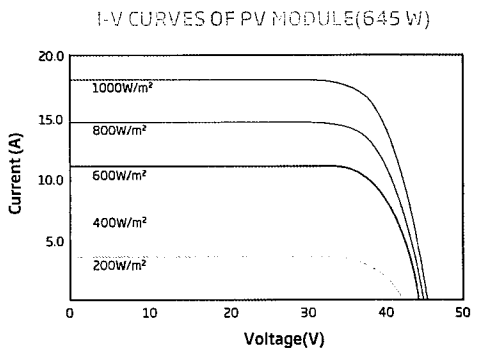
Comprehensive Products and System Certificates

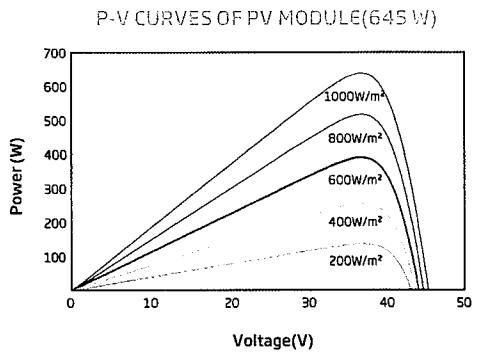
IEC61215/IEC61730/IEC61701/IEC62716/UL61730
ISO 9001: Quality Management System
ISO 14001: Environmental Management System
ISO14064: Greenhouse Gases Emissions Verification
ISO45001: Occupational Health and Safety Management System

BIFACIAL DUAL GLASS









Peak Power Watts-PMAX (Wp)*	640	645	650	655	660	665
Power Tolerance-PMAX (W)	0 ~ +5					
Maximum Power Voltage-VMPP (V)	37.3	37.5	37.7	37.9	38.1	38.3
Maximum Power Current-IMPP (A)	17.19	17.23	17.27	17.31	17.35	17.39
Open Circuit Voltage-Voc (V)	45.1	45.3	45.5	45.7	45.9	46.1
Short Circuit Current-Isc (A)	18.26	18.31	18.35	18.40	18.45	18.50
Module Efficiency η_m (%)	20.6	20.8	20.9	21.1	21.2	21.4

STC: Irradiance 1000W/m2, Cell Temperature 25°C, Air Mass AM1.5. *Measuring tolerance: ±3%.

Total Equivalent power -PMAX (Wp)	685	690	696	701	706	712
Maximum Power Voltage-VMPP (V)	37.3	37.5	37.7	37.9	38.1	38.3
Maximum Power Current-IMPP (A)	18.39	18.44	18.48	18.52	18.56	18.60
Open Circuit Voltage-Voc (V)	45.1	45.3	45.5	45.7	45.9	46.1
Short Circuit Current-Isc (A)	19.54	19.59	19.63	19.69	19.74	19.79
Irradiance ratio (rear/front)	10%					

Power Bifaciality:70±5%.

Maximum Power-PMAX (Wp)	484	488	492	495	499	504
Maximum Power Voltage-VMPP (V)	34.7	34.9	35.1	35.2	35.4	35.6
Maximum Power Current-IMPP (A)	13.94	13.98	14.01	14.05	14.10	14.16
Open Circuit Voltage-Voc (V)	42.5	42.7	42.9	43.0	43.2	43.4
Short Circuit Current-Isc (A)	14.71	14.75	14.79	14.83	14.87	14.91

NOCT: Irradiance at 800W/m², Ambient Temperature 20°C, Wind Speed 1m/s.

Solar Cells	Monocrystalline
No. of cells	132 cells
Module Dimensions	2384×1303×35 mm (93.86×51.30×1.38 inches)
Weight	38.7 kg (85.3 lb)
Front Glass	2.0 mm (0.08 inches), High Transmission, AR Coated Heat Strengthened Glass
Encapsulant material	POE/EVA
Back Glass	2.0 mm (0.08 inches), Heat Strengthened Glass (White Grid Glass)
Frame	35mm(1.38 inches) Anodized Aluminium Alloy
J-Box	IP 68 rated
Cables	Photovoltaic Technology Cable 4.0mm² (0.006 inches²), Portrait: 280/280 mm(11.02/11.02 inches) Length can be customized
Connector	MC4 EVO2 / TS4*

*Please refer to regional datasheet for specified connector.

NOCT (Nominal Operating Cell Temperature)	43°C (±2°C)	Operational Temperature	-40~+85°C
Temperature Coefficient of PMAX	- 0.34%/°C	Maximum System Voltage	1500V DC (IEC)
Temperature Coefficient of Voc	- 0.25%/°C		1500V DC (UL)
Temperature Coefficient of Isc	0.04%/°C	Max Series Fuse Rating	35A

12 year Product Workmanship Warranty
30 year Power Warranty
2% first year degradation
0.45% Annual Power Attenuation
(Please refer to product warranty for details)

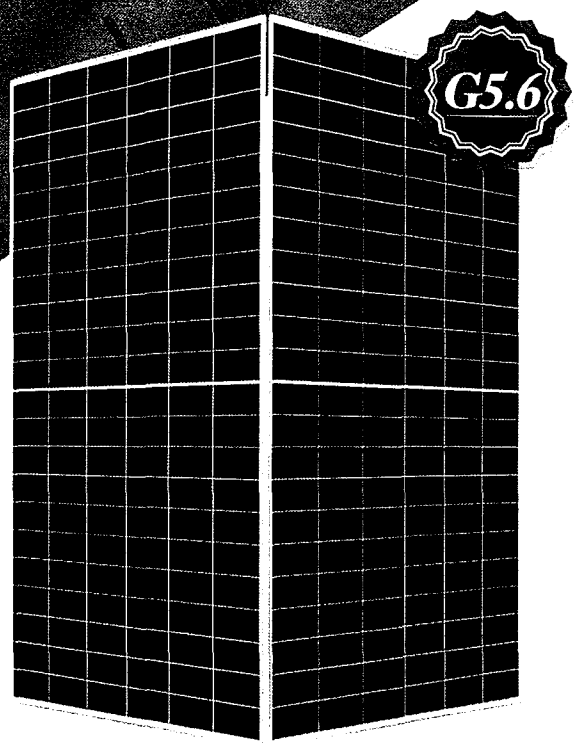
Modules per box: 31 pieces
Modules per 40' container : 527 pieces

CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.

Version number: TSM_EN_2021_A

TITAN

HIGH PERFORMANCE
BIFACIAL PERC MONOCRYSTALLINE MODULE



ISO9001
ISO14001
OHSAS18001
IEC TS 62941

★ As there are different certification requirements in different markets, please conta ct your local Energy sal es representative for the specific certificates applicable to the products in the region in which the products are to be used.

RSM132-8-635BMDG-660BMDG

132 CELL
Mono PERC Module

635-660Wp
Power Output Range

1500VDC
Maximum System Voltage

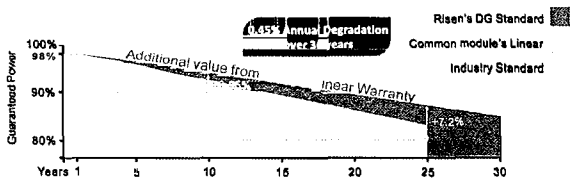
21.2%
Maximum Efficiency

KEY SALIENT FEATURES

- Global, Tier 1 bankable brand, with independently certified state-of-the-art automated manufacturing
- Bifacial technology enables additional energy harvesting from rear side (up to 30%)
- Industry leading lowest thermal co-efficient of power
- Industry leading 12 years product warranty
- Excellent low irradiance performance
- Excellent PID resistance
- Positive tight power tolerance
- Dual stage 100% EL Inspection warranting defect-free product
- Module Imp binning radically reduces string mismatch losses
- Excellent wind load 2400Pa & snow load 5400Pa under certain installation method
- Comprehensive product and system certification
  - IEC61215:2016; IEC61730-1/-2:2016;
  - ISO 9001:2015 Quality Management System
  - ISO 14001:2015 Environmental Management System
  - ISO 45001:2018 Occupational Health and Safety Management System

LINEAR PERFORMANCE WARRANTY

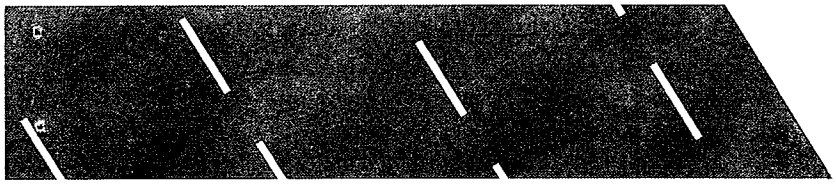
12 year Product Warranty / 30 year Linear Power Warranty



★ Please check the valid version of Limited Product Warranty which is officially released by Energy Co., Ltd

Preliminary
For Global Market

THE POWER OF RISING VALUE



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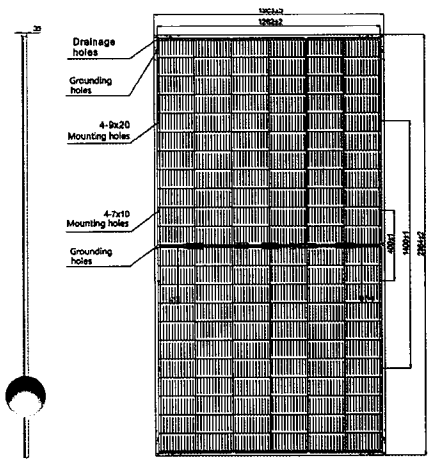
Dimensions of PV Module



ELECTRICAL DATA (STC)

Model Number	RSM132-8-635BMDG	RSM132-8-640BMDG	RSM132-8-645BMDG	RSM132-8-650BMDG	RSM132-8-655BMDG	RSM132-8-660BMDG
Rated Power in Watts-Pmax(Wp)	**635**	**640**	**645**	**650**	**655**	**660**
Open Circuit Voltage-Voc(V)	44.89	45.09	45.29	45.49	45.69	45.89
Short Circuit Current-Isc(A)	18.03	18.08	18.13	18.18	18.23	18.28
Maximum Power Voltage-Vmpp(V)	37.32	37.51	37.69	37.87	38.05	38.23
Maximum Power Current-Impp(A)	17.02	17.07	17.12	17.17	17.22	17.27
Module Efficiency (%) ★	20.4	20.6	20.8	20.9	21.1	21.2

STC: Irradiance 1000 W/m², Cell Temperature 25°C, Air Mass AM1.5 according to EN 60904-3.
Bifacial factor: 70%±5 ★Module Efficiency (%): Round-off to the nearest number

Electrical characteristics with 10% rear side power gain

Total Equivalent power-Pmax (Wp)	699	704	710	715	721	726
Open Circuit Voltage-Voc(V)	44.89	45.09	45.29	45.49	45.69	45.89
Short Circuit Current-Isc(A)	19.83	19.89	19.94	20.00	20.05	20.11
Maximum Power Voltage-Vmpp(V)	37.32	37.51	37.69	37.87	38.05	38.23
Maximum Power Current-Impp(A)	18.72	18.78	18.83	18.89	18.94	19.00

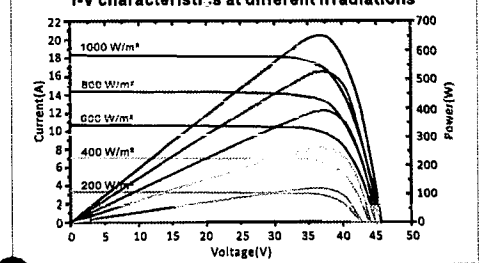
Rear side power gain: The additional gain from the rear side compared to the power of the front side at the standard test condition. It depends on mounting (structure, height, tilt angle etc.) and albedo of the ground.

ELECTRICAL DATA (NMOT)

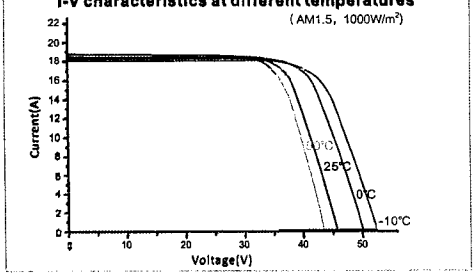
Model Number	RSM132-8-635BMDG	RSM132-8-640BMDG	RSM132-8-645BMDG	RSM132-8-650BMDG	RSM132-8-655BMDG	RSM132-8-660BMDG
Maximum Power-Pmax (Wp)	481.0	484.9	488.6	492.4	496.2	500.0
Open Circuit Voltage-Voc (V)	41.75	41. 93	42.12	42.31	42.49	42.68
Short Circuit Current-Isc (A)	14.78	14.83	14.87	14.91	14.95	14.99
Maximum Power Voltage-Vmpp (V)	34.63	34.81	34.98	35.14	35.31	35.48
Maximum Power Current-Impp (A)	13.89	13.93	13.97	14.01	14.05	14.09

NMOT: Irradiance at 800 W/m², Ambient Temperature 20°C, Wind Speed 1 m/s.

RSM132-8-660BMDG
I-V characteristics at different irradiations



I-V characteristics at different temperatures
(AM1.5, 1000W/m²)



MECHANICAL DATA

Solar cells	Monocrystalline
Cell configuration	132 cells (6×11+6×11)
Module dimensions	2384×1303×35mm
Weight	40kg
Superstrate	High Transmission, Low Iron, Tempered ARC Glass
Substrate	Tempered Glass
Frame	High strength alloy steel
J-Box	Potted, IP68, 1500VDC, 3 Schottky bypass diodes
Cables	4.0mm² (12AWG), Positive(+)350mm, Negative(-)350mm (Connector Included
Connector	Twinsel PV-SY02, IP68

TEMPERATURE & MAXIMUM RATINGS

Nominal Module Operating Temperature (NMOT)	44°C±2°C
Temperature Coefficient of Voc	-0.25%/°C
Temperature Coefficient of Isc	0.04%/°C
Temperature Coefficient of Pmax	-0.34%/°C
Operational Temperature	-40°C~+85°C
Maximum System Voltage	1500VDC
Max Series Fuse Rating	35A
Limiting Reverse Current	35A

PACKAGING CONFIGURATION

	40ft(HQ)
Number of modules per container	527
Number of modules per pallet	31
Number of pallets per container	17
Box gross weight[kg]	1290

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Annexure C – DHL expects freight rates to stay high in 2022 Reuters

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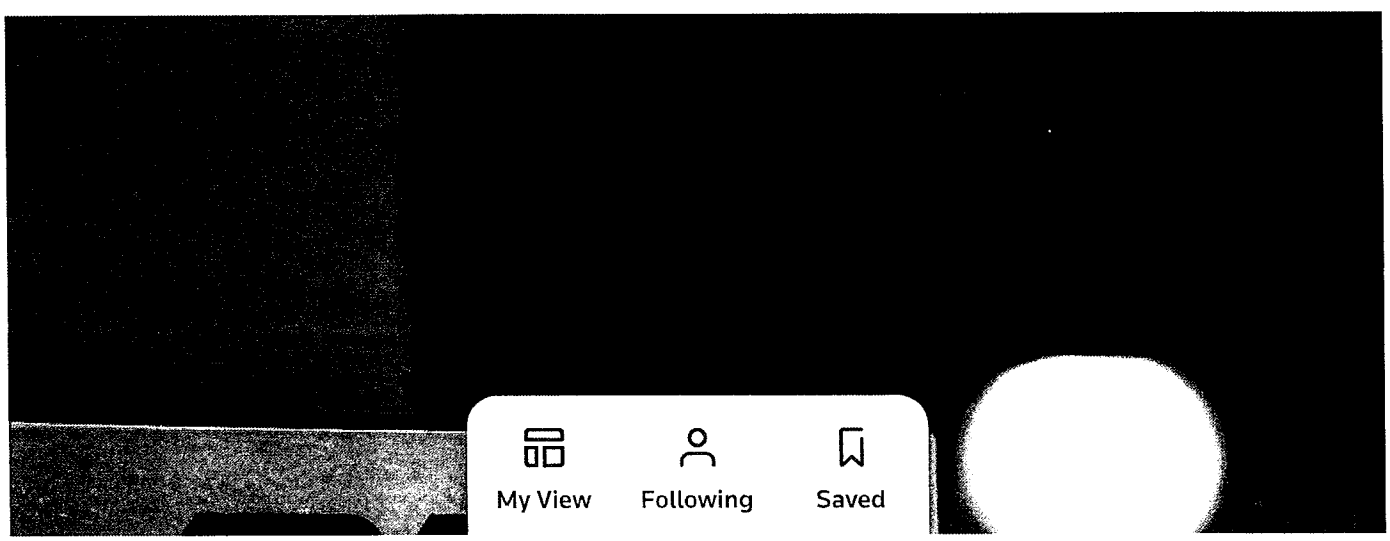

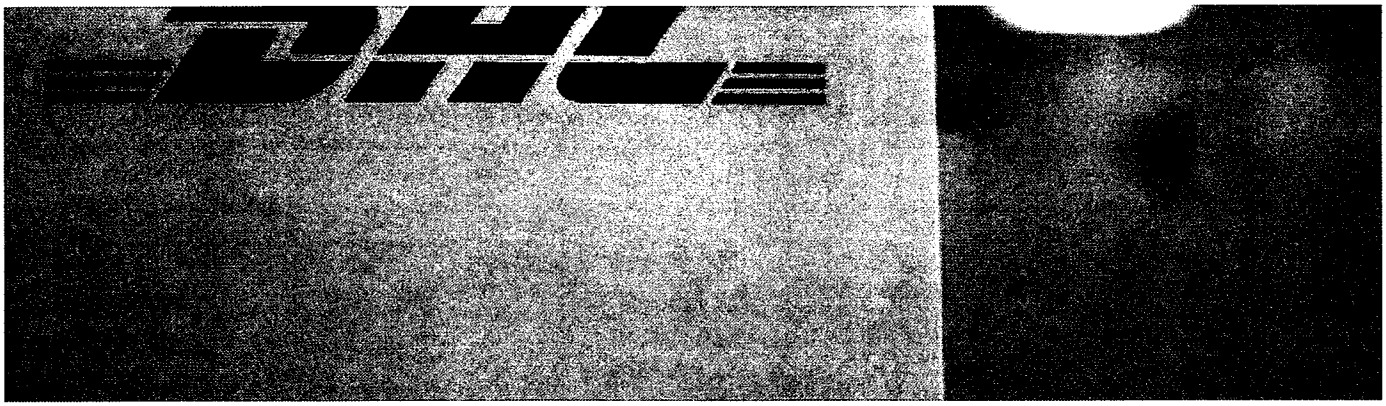

Delivery packages are seen inside the new DHL Express hub of German postal and logistics group Deutsche Post DHL at the Roissy Charles de Gaulle airport in Tremblay-en-France near Paris, France, October 5, 2021. REUTERS/Sarah Meyssonnier

DUESSELDORF, Jan 20 (Reuters) - German logistics company Deutsche Post DHL does not expect freight costs to ease this year and is advising customers to agree longer-term contracts as a hedge, the head of the DHL freight business said in an interview.

"The short-term rate will rise a little in air and ocean freight, the long-term rate will probably remain at the 2021 level," Tim Scharwath told Reuters.

"In air freight, the rate might even go up a little bit more in the short term, there is even tighter capacity there."

The COVID-19 pandemic has severely disrupted global supply chains, slowing flows of raw materials, parts and consumer goods.

Shortages of freight capacity - both ocean and air - have pushed up shipping costs globally, with the pandemic also extending port waiting times due to labour shortages and traffic disruptions.

U.S. rival FedEx Corp (FDX.N) cases of the Omicron coronavirus variant has caus shipments transported on

aircraft. **read more**

"In sea freight, we will not return to the rates we had before the coronavirus crisis," Scharwath said.

"If you want to sell a stool for 10 euros from China, then this can become a problem due to the transport costs," he said. "This will also force a review of some business models."

Scharwath recommended that customers sign contracts for two to three years to hedge against future price rises: "You buy stability through long-term commitment."

The DHL freight unit expects the high rates to continue to buoy profits in 2022: "Our goal is to keep the operating result at least at the high level we had in the first nine months of 2021," Scharwath said.

The division, which employs more than 42,000 people and was once the group's problem child, has become a profit generator under Scharwath's direction.

He wants to keep the operating margin above 5.5% by 2025. The unit recorded a margin of 5.7% in the first nine months of 2021.

DHL says its freight division is the market leader in the air freight market ahead of Kuehne+Nagel **(KNIN.S)**, and number two in sea freight among logistics firms behind that company.

(This story corrects spelling of name in paragraph 2 and 7)

Reporting by Matthias Inverardi, writing by Emma Thomasson, editing by Zuzanna Szymanska and Thomas Escritt

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Annexure D – Solar Resource Assessment

ZORLUENERJi

SOLAR RESOURCE ASSESSMENT REPORT

100 MW SOLAR PV PROJECT IN BAHAWALPUR-PUNJAB-PAKISTAN

ZORLU

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ZORLU

1. Executive Summary

Zorlu Solar Pakistan (Pvt) Limited (ZSPPL) is a project company for 100 MW Solar power project. The site is in Bahawalpur, Punjab. Project Company has a Letter of Intent (LOI) from Punjab Power Development Board, Government of Punjab.

To conduct the assignment, ZSPPL reviewed solar resource from different commonly used meteorological database and modelled conceptual PV plant design in PVsyst. Based on the preliminary findings from site assessment, Solar GIS is selected for the solar resource and energy yield calculation.

The long term annual average solar resources i.e., Global Horizontal Irradiation (GHI) estimated based on 16 years of solar data (1999-2017) is found to be 1,934.6 kWh/m^2. This level of solar resource can be considered attractive for the development of PV project.

Final irradiance on site is given in below table.

Month	GHI (kWh/m^2)
January	104.5
February	125.1
March	180.8
April	199.8
May	211.7
June	190.5
July	177.7
August	179.9
September	180.1
October	163.3
November	116.8
December	104.3
Annual	**1934.6**

Table 1. Representative Irradiance

Topographic map of the project is developed through site survey as well as assessment team performed site survey. Based on the map and site visit, the Project site is flat in general and has no shading due to terrain or natural objects. There is also neighboring solar farm constructed in surrounding. However, no adverse impacts from the neighboring solar farm are foreseen.

Micrositing has been performed for the panels considering the topology of the site, construction of the roads, project boundaries as well as substation area. Annual energy has been estimated after considering derating over project life cycle.

For the energy estimation, following equipment is considered:

Panels: Tier 1 PV Module Bifacial Monocrystalline 640-645 W

Inverters: WSTECH APS 4000

The calculations are performed in professional software PVSyst 6.86 and all losses have been taken into account. The energy yield estimation considers a preliminary conceptual design comprising of bifacial monocrystalline solar PV module from Tier 1 PV Module manufacturer and central inverter from WSTECH. The conceptual configuration is presented in section 4 of this report.

The 100 MWp solar PV in Bahawalpur is expected to produce 201,218 MWh during its first year of operation. The corresponding capacity factor is estimated as 22.97%. The detail loss estimation and energy yield at different Probability of Exceedance (POE) are presented in section 5.3.3 of this report.

Based on the Resource Assessment, site is feasible for the Project development.

2. Project Background

Zorlu Solar Pakistan (Pvt) Limited (ZSPL) is a Special Purpose Entity SPE of Zorlu Enerji Elektrik Uretim A.S. The 100 MW Solar PV Project by Zorlu Solar Pakistan (Pvt) Limited is in Bahawalpur, Punjab-Pakistan. The land has been allotted by the Government of Punjab to Zorlu Solar Pakistan (Pvt) Limited. The Land is located in a Solar Park where 1000 MW to Solar is planned, and 400 MW is already constructed and in operation. The total land area of the Project is 500 acres. The proposed site is located at latitude of 29°16'27.23"N and longitude of 71°47'41.85"E with elevation of around 117 to 128 meters.

2.1. Scope of Work

The following scope of work is covered within this study:

- Site Visit,
- Solar data evaluation,
- Energy yield estimation,
- Estimation of Losses,
- Estimation of uncertainty for the solar project at exceeding probabilities (P50, P75, P90).

3. Site Review

In general, solar power plant generation for a specific site are closely connected to the physical conditions of the terrain such as topography, land use and shading objects. Therefore, it is important to account for the detailed description of the site and the surrounding environment.

3.1. Location

The Solar PV Project is in Punjab province, Bahawalpur. Site is located with high dense irradiance zone also marked in the below map. Distance of site is approximately 855 km from Karachi, Pakistan's commercial

hub and main coastal/port city. The Project site consists of 500 acres of land, which has been allocated by the Government of Punjab to the project company. The N5 or National Highway is the major road that connects Karachi to Bahawalpur.

The Project site has no vegetation only consisting of small shrubby bushes and have rough terrain. The Location of the Project is shown in **Figure 1.**

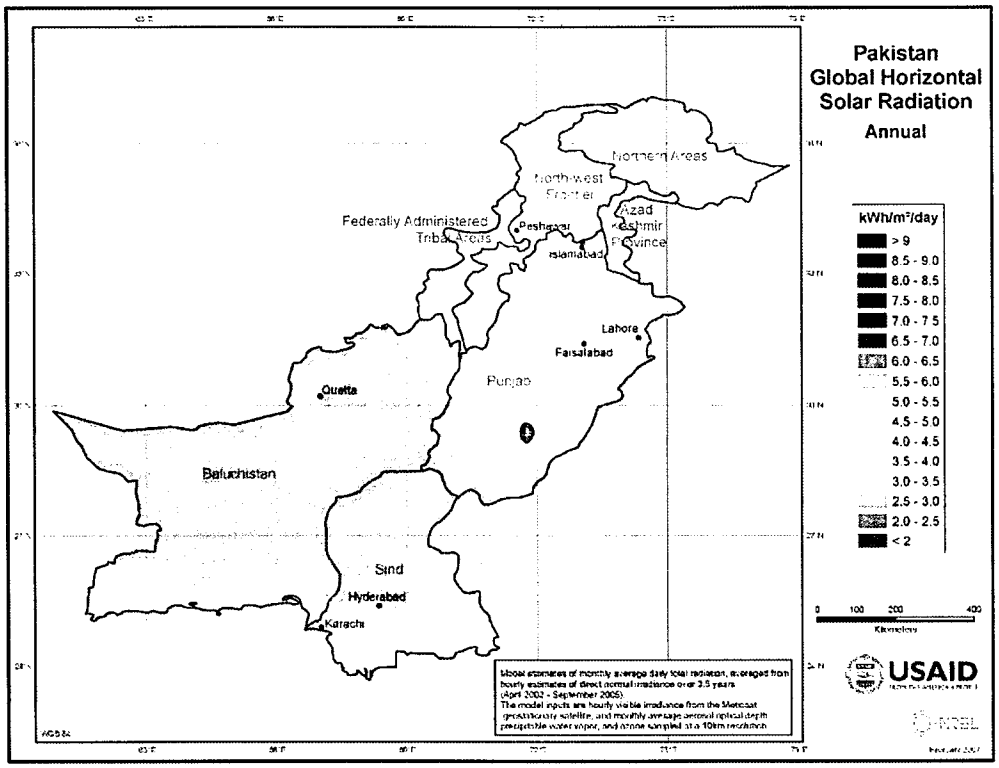

Figure 1. Global Horizontal Solar Radiation and Location Project Site

The project site coordinates are as listed in the table below:

Boundary Point	Geodetic	
	Latitude	Longitude
Boundary 1	29°16'50.10"N	71°47'19.98"E
Boundary 2	29°16'50.10"N	71°48'22.08"E
Boundary 3	29°16'30.54"N	71°48'22.08"E
Boundary 4	29°16'30.54"N	71°48'9.66"E
Boundary 5	29°16'20.76"N	71°48'9.66"E
Boundary 6	29°16'20.76"N	71°47'57.24"E
Boundary 7	29°16'1.20"N	71°47'57.24"E
Boundary 8	29°16'1.20"N	71°47'13.98"E

Table 2. Project site coordinates

3.2. Photographical Documentation

The following pictures provide impressions of the site area gathered during the site visit during Feb, 2017. From the pictures and site visit, it can be stated that site is near to flat with little roughness.

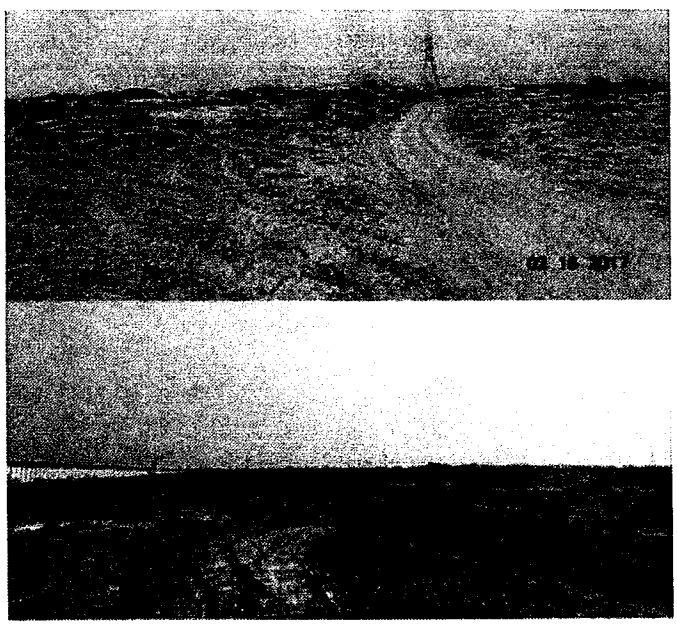

Figure 2. Site impression

Following picture is from the site visit in 2020 after land clearance, leveling, and construction of mini piles:

Figure 3. Current site view

3.3. Climate and Conditions

The climate of the Project area can be broadly classified as arid, moderate, hot, and humid. The mild winter is restricted to the November-February period. The summer extends from May to September, which overlaps the short spells of the main rainy season during July-August. The weather tends to be very humid during June, July, and September and is pleasant during March and April.

The climate of this area is characterized by fluctuating temperatures and sparse rainfall. The summer seasons are hot and humid with average temperatures ranging between 32ºC to 37ºC. The temperature in summer seasons may reach up to 50ºC. The winters are pleasant with average temperature in the range of 12ºC to 20ºC. The months of July and August generally observe the annual monsoon rainfalls. The meteorological stations of are located near the Project area. However, the meteorological data from Bahawalpur station is also representative of the prevailing climatic conditions of Project area. The climate information of Bahawalpur is shown in **Table 3.**

Month	Average ambient temperature (Celsius)
January	12.55
February	18.00
March	23.90
April	30.37
May	35.33
June	36.86
July	36.99
August	34.56
September	31.43
October	26.96
November	21.52
December	15.38
Annual	**27.03**

Table 3. Average Ambient Temperatures in Bahawalpur Region (°C)

3.4. Land Characteristics

The Solar PV Project is in Bahawalpur, having approximately 835 km distance from Karachi, Pakistan's commercial hub and main coastal/port city. The Project site consists of 500 acres of land, which has been allocated by the Government of Punjab to the project company. The N5 or National Highways is the major road that connects Bahawalpur to Karachi.

The project Site has eight corners as shown in figure below.

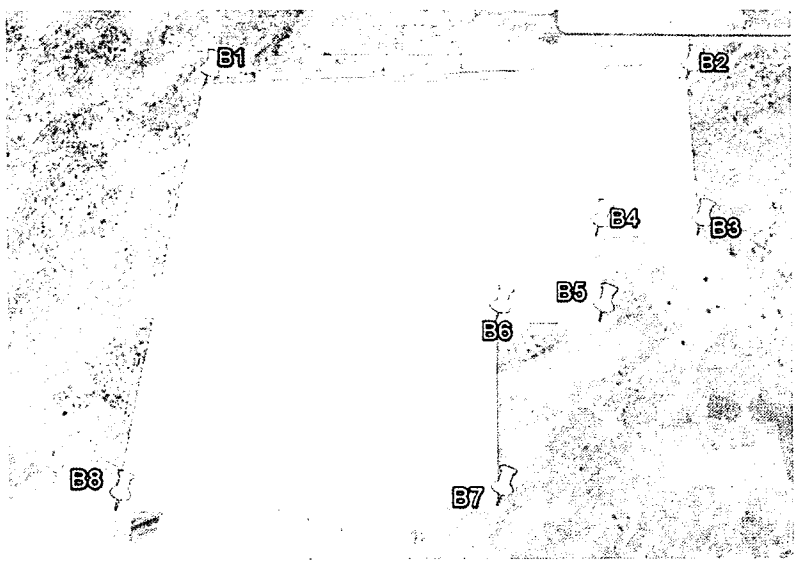

Figure 4. Site Morphology

3.5. Shading Objects

The terrain at the project Site is almost flat. There are no buildings, no tall trees. Based on the current site visit and construction in the surrounding, no as such shading is expected from the surroundings. Since land is nominated for the solar farms therefore it is assumed no future construction will take place that can cause shadow on the solar panels.

3.6. Available Infrastructure

3.6.1. Access Roads

The major track from Karachi to the site is one-way road, however, the distance of last few kilometers before Site is two-way road. The terrain is flat. The Port Qasim is the one of the major ports of Pakistan and it is the expected point of delivery of equipment for the proposed solar power project. Aerial distance between the Port and site is 660 km. Total track length between Port Qasim Karachi and site is approximately 855 km. The track from Port to the Site is good but site access road that is not more than 2 km to the site needs minor development. The load bearing capacity of the bridges between the port and the site is good and is enough to bear the load of trucks carrying heavy equipment. EPC contractor will carry out details of such investigations during construction.

3.6.2. Water

There are two main sources of water in the area, sub-soil or ground water and the surface water. The groundwater is mostly found at the depth of 30 - 40 meters and in most of the cases, it is highly brackish. The nearest source of fresh water is Bahawalpur Canal that is situated at about 6 kilometers north of project area. Water course from this canal irrigates some parts of the forest area situated at the boundary and is the sole source of surface water for occasional irrigation to agricultural fields.

3.6.3. Grid Connection

The key electrical components of the plant shall include the PV panels, cabling, inverters, step up transformers and switchgear.

The conversion of solar radiation into electrical energy (DC power) shall be performed using the PV panels. The PV panels shall be split in multiple groups since that will allow for the use of lower current carrying capacity cables and shall offer more redundancy in contingency conditions.

The DC electricity from the panels shall be converted into 50 Hz AC via the inverters. There may be some support apparatus such as junction boxes between the inverter and the panels.

The output voltage of the inverter can be classified as low voltage (LV), and therefore, shall require stepping up to medium voltage level (MV) i.e. 33 kV. This shall be achieved using step up transformers.

Once stepped up to 33 kV through a transformer, the power shall be transmitted to the sub-station where it will be stepped up to the local utility's grid voltage (i.e. 220 kV). The sub-station will serve as the inter-connection point to the utility transmission grid system.

3.6.4. General Soil Condition

First impression of site showed that the soil is soft. The upland consisted of flat plains sloping from north-west to south-west. The general altitude of the Site ranged from 117 to 128 meters above the sea level. Within the site, difference of elevation was only 11 meters. After construction, all slopes, sand dunes are removed, and land has been flattened to have minimum shading on panel.

4. Technical Assessment

4.1. General Plant Concept and Electrical System

The Project is foreseen to be installed with a total DC installed capacity of 100 MWp DC. The total available land area is 500 Acres.

The overall plant design is not finalized as yet, and a number of components are still open to a range of manufacturers. Despite this, the design is established, with most important parameters fixed.

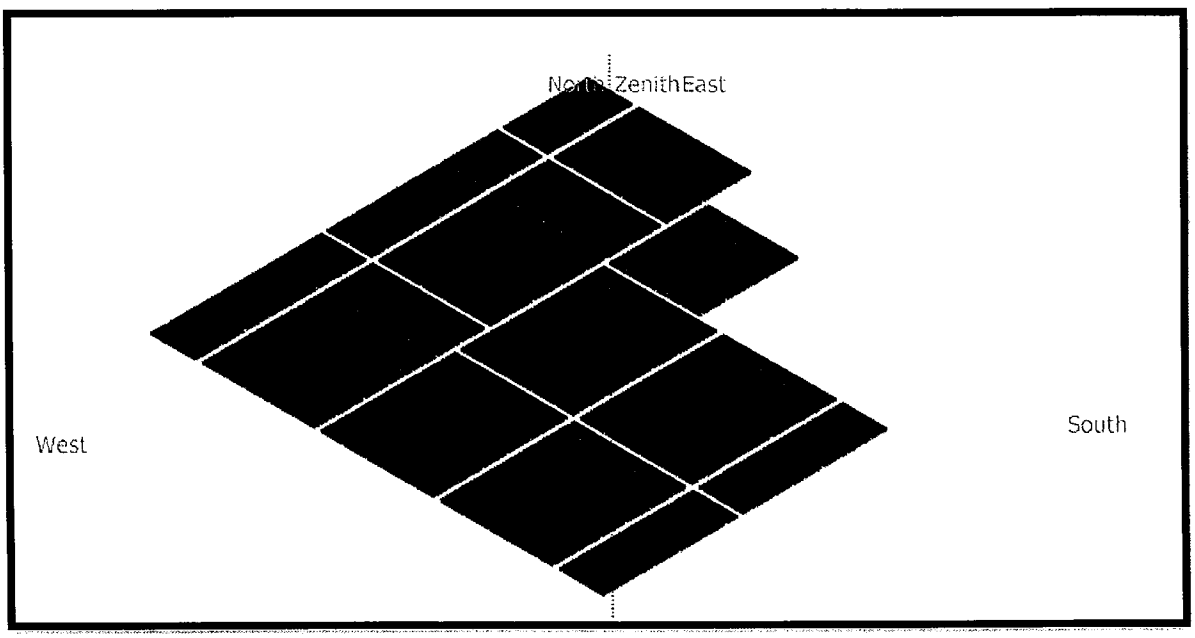

Figure 5. General Plant Layout (source: PVSYST)

The key figures of the Zorlu Solar PV Plant are summarized in the table below:

Parameter	Value
System Type	One Axis-Tracker installed bifacial system
Module Type	645Wp (45.55 MW) 640Wp (54.45 MW)
Inverter Rating	4000 kW
Solar Field	
Modules per string # 1 (In series)	26
Modules per string # 2 (In series)	26
Solar Plant	
Total Number of Modules	155,688
Total number of Inverters	20
Strings/Inverter (Array # 1)	2,716
Strings/Inverter (Array # 2)	3,272
Rated DC Solar Capacity (kWp)	99,993
Nominal AC Capacity (kW)	80,000
DC/AC Ratio	1.25

Table 4. Key parameters for solar power plant

Modules from the Tier 1 PV manufacturer with a power rating of 645 Wp and 640 Wp, are being considered to install for the Project. Tracker has been configured in its 1 modules in portrait option (1V) capable to undertake 2 strings of 26 modules in a row, with a maximum capacity of 104 modules per every individual tracker.

4.2. Main Components

4.2.1. PV Modules

The modules for the Project are from Tier 1 PV manufacturer and following is list of certifications:

- IEC61215: Crystalline Silicon Terrestrialphotovoltaic Modules
- IEC61730: Module Safety Qualification
- IEC61701: Salt Mist Corrosion
- IEC62716: Resistance to Ammonia
- UL61730: Harmonized PV Module Safety Standard
- ISO 9001: Quality Management System
- ISO 14001: Environmental Management System
- ISO14064: Greenhouse Gases Emissions Verification
- ISO45001: Occupational Health and Safety Management System

Parameters	Value
Manufacturer	Tier 1 PV Manufacturer
Nameplate Power (Panels)	645 Wp* 640 Wp*
Power Tolerance	0-5%
Efficiency at STC	20.6-20.9%
Maximum System Voltage	1500 V
Type of Cell	Bifacial Monocrystalline
Voltage at Max Power Point (Vmpp)	37-38.3 V*
Current at Maximum Power Point (Impp)	18-19.3 A*
Open Circuit Voltage (Voc)	45.1-46.1 V*
Short Circuit Current (Isc)	19.1-20.1 A*
Nominal Operating Cell Temperature (NOCT)	43°C (±2°C)
Temperature Coefficient on Power (Pmpp)	-0.34%/°C
Height × Width × Thickness (mm)	2384×1303×35 mm
Weight (kg)	38.7 kg
No. of Modules (645 Wp)	70616
No. of Modules (640 Wp)	85072
Total Number of Panels	155688

(*) Subject to small variations.

Table 5. Projected Technical Characteristics of PV Modules by Tier 1 PV Manufacturer

Standard Test Conditions (STC) are taken for all stated values in the above table, besides those where other conditions are specified. STC consists of 1000 W/m2 irradiance, cell temperature of 25°C, and air mass of 1.5.

The selected modules are evaluated based on four different categories: Experience of the manufacturer and technology, sustainability, bankability, quality, certifications, and warranties. The following sections provide details on module evaluation based on these categories.

4.2.2. Inverter

The inverter for the Project is WSTECH with following specifications:

Parameters	WSTECH APS 4000
DC Input	
Vmax Dc	1500 V
Mpp range (@P_{acr} and V_{acr})	836-1500 V
Max. Input Current DC	4880 A
AC Output	
Rated AC power at 25°C/ 50°C	4000 kW / 3666.6 kW
Nominal AC Voltage	550 V
Minimum efficiency	98.49 %
Frequency	50/60 Hz
Power Factor	0.98
Ambient Condition and Classification	
Ambient Temperature (operating)	-10 ~ +60 °C
Maximum relative humidity	0.95
Altitude (m)	1500 (max)
IP protection	IP65

Table 6. Main Inverter Approximate Characteristics

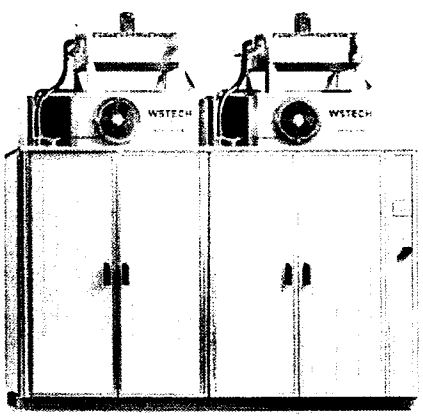

Figure 6. WSTECH Inverter APS 4000

5. Solar Resource and Energy Yield Assessment

5.1. Solar Resource and Energy Yield Assessment Review

5.1.1. Existing Solar Irradiance Data

The proposed site is located at latitude of 29°16'27.23"N and longitude of 71°47'41.85"E with elevation of around 117 to 128 meters. The annual average solar irradiation on horizontal plane (GHI), estimated at Project site by Solar GIS corresponds to 1935kWh/m². The Blue spot in the Figure above shows the site location.

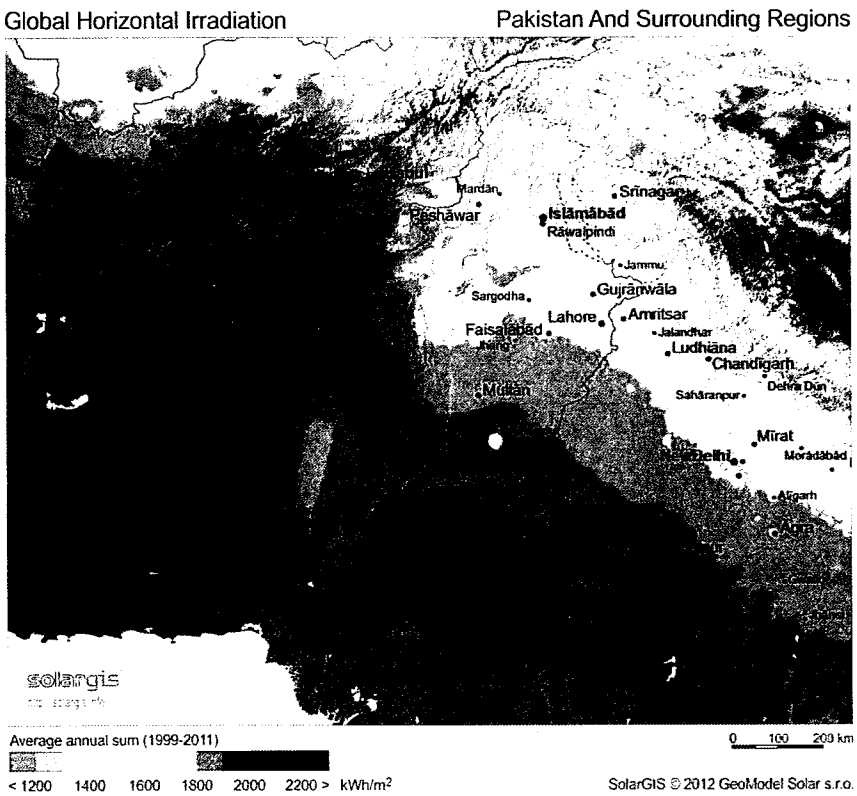

Figure 7. GHI Solar Resource Map of Pakistan (source: SolarGIS)

5.1.2. Review and Quality Checking of Various Data Resources

The major sources for solar resource estimation considered are based on the following databases:

- Solar GIS
- Meteonorm 7.0, modelled hourly solar data
- NASA SSE, satellite data

Geo Model Solar operates high-resolution meteorological database – Solar GIS. The database consists of the following primary parameters:

- Solar radiation: Global Horizontal Irradiance (GHI) and Direct Normal Irradiance (DNI)
- Meteo: Air Temperature at 2 meters (TEMP), Relative Humidity (RH), Wind Speed (WS) and Wind Direction (WD) at 10 meters.

Meteorological data is available globally. Solar radiation data is available mostly for Europe, Africa, Asia, West Australia, and North and South America. Solar GIS covers complete data of Pakistan.

Solar radiation primary parameters are derived by advanced and scientifically validated models, which use satellite data from the Meteosat (© EUMETSAT, DE) and GOES (© NOAA, USA) mission, and outputs from the MACC and GFS atmospheric models (© ECMWF, UK and © NOAA NCEP, USA). An independent Expert Survey (International Energy Agency, SHC Task 36 – Data cross-comparison) has identified the Solar GIS as the best database in the industry, in terms of accuracy, reliability and data representativeness.

Solar radiation is calculated by numerical models, which are parameterized by a set of inputs characterizing the cloud transmittance, state of the atmosphere and the terrain conditions. In the Solar GIS approach, the clear-sky irradiance is calculated by the simplified SOLIS model, developed by Ineichen. This model allows fast calculation of clear-sky irradiance from the set of input parameters. Sun position is a deterministic parameter and is described by the numerical models with satisfactory accuracy.

The key factor which determines short-term variability of all-sky irradiance is clouds. Attenuation effect of clouds is expressed by the means of a parameter called cloud index, which is calculated from the routine observations of meteorological geostationary satellites. Spatial resolution of satellite data used in SolarGIS is about 4 km x 5 km at mid-latitudes (3 km at sub-satellite point) and the time step is 15 and 30 minutes. To retrieve all-sky irradiance in each time step, the clear-sky global horizontal irradiance is coupled with cloud index. Effect of clouds in SolarGIS is calculated from the Meteosat and GOES satellite data in the form of cloud index (cloud transmittance). The Solar GIS algorithms are based on the Heliosat-2 calculation scheme and the Perez approach, which has been updated and supplemented by multispectral data processing. The cloud index is derived by relating irradiance recorded by the satellite in several spectral channels and surface albedo to the cloud op-tical properties. Several improvements have been introduced to better cope with specific situations such as snow, ice, or high albedo areas (arid zones and deserts), and with complex terrain.

The Solar GIS database also includes air temperature data at 2 meters, which are calculated from NOAA NCEP data sources, and validated by ground measurements. Air temperature is available for the period from January 1994 to the present time. The data are disaggregated by Solar GIS method to reflect variability induced by high-resolution terrain. Spatial resolution of the final output database is 1 km.

In Solar GIS, typical uncertainty of GHI yearly summaries is lower than ±3.5% (probability of occurrence is 80% for 89 validation sites). In mountains, tropical humid climates, complex coastal zones, high latitudes,

snow regions, and regions with high aerosol concentrations (air pollution) the uncertainty can be as high as ±7.0%.

Month	GHI (kWh/m^2)	Global Incident of Collector Plane (kWh/m^2)	Ambient Temperature (°C)
January	104.5	130.3	12.55
February	125.1	160.6	18
March	180.8	227.5	23.90
April	199.8	254.4	30.37
May	211.7	251.9	35.33
June	190.5	219.4	36.86
July	177.7	200.2	36.99
August	179.9	212.0	34.56
September	180.1	226.5	31.43
October	163.3	209.3	26.96
November	116.8	147.1	21.52
December	104.3	134.0	15.38
TOTAL	**1934.6**	**2364.2**	**27.03**

Table 7. Table documenting monthly GlobHor, GlobeInc, Ambient Temperature.

5.2. Energy Yield Estimation

5.2.1. Approach and Methodology

ZSPPL used PVSyst 6.86 for the plant modelling and estimation of energy yield for the project considered in this study.

PVSyst stands among one of the most widely used simulation tools in the PV industry for grid connected and stand-alone PV systems. It is developed by the Centre of Energy at the University of Geneva, Switzerland. PVSyst allows for the detailed definition of PV plant including special geometries such as ground slopes, near shading objects, combination of different electrical configuration, etc.

The following technical parameters are required as input in PVSyst for the energy yield estimation:

- Site characteristics (geographical location, land characteristics: slope)
- Meteorological data sets (GHI, Tamb, Wind Speed)
- Module orientation (tilt, azimuth)
- Technical characteristics of plant component (module, inverter)
- Array configuration (no. of modules per string, no. of strings per inverter)
- Array layout (distance between two rows, width of the row)
- Losses assumptions (soiling, module quality, mismatch losses, cable losses, etc.)

The PVSyst plant performance result is then deducted by considering the irradiation adjustment (based on solar resource assessment) and self-consumption losses. The estimated plant performance and energy yield is presented.

According to the information provided by the Client, commercial metering is foreseen to be installed in the substation which is adjacent to the Project site.

The uncertainties on solar irradiation data are considered based on the information provided along with the solar resource data and the solar resource assessment. Further uncertainties on assumptions estimated based on the ZSPPL's experience. The long-term energy yield and Probability of Exceedance on energy yield is calculated by considering estimated uncertainties and annual degradation of the modules.

5.2.2. Major Modelling Input

The meteorological data and technical characteristics of components considered as input for the energy yield estimation is presented in section above. The following table shows the major plant configurations considered in the energy yield estimation. Any changes to the solar plant configuration and technical characteristics of components will have a direct and significant impact on the energy output of the Project.

Parameters	
Orientation	South
Surface terrain	Rough plains-desert
Mounting structure	One-axis tracker
Module type	Monocrystalline Bifacial
Module power	640 Wp*-645 Wp*
Modules in series (Array-1)	26
Modules in series (Array-1)	26
Total number of modules	155,688
Inverter type	WSTECH APS 4000
Number of inverters	20
Nominal AC power of one inverter (kW)	4000
Total peak power (kWp)	99,993
Total AC power (kW)	80000

(*) Subject to small variations.

Table 8. Major Project Characteristics – Input

5.2.3. Modelling of Losses

A description of the losses mechanism in PV system is presented in this section. The described losses outline the significant, non-negligible losses which may pose a risk if the plant is not designed properly. Estimated values for each loss factor are compared to the value assumed in the provided yield estimation by the Client and discussed in detail.

Albedo

The ground reflectance (also called albedo) is the fraction of solar radiation incident on the ground that is reflected. The Reflected radiation causes reduced radiation on the modules. Considering nature of bifacial modules, albedo effect has positive effect on power generation.

Albedo value depends upon the type of area. A typical value for grass-covered areas is 20%. Snow-covered areas may have a reflectance as high as 70%. For desert terrain, one like our Project's Site, albedo is expected to be around 20-30% depending on the micro-structure of the sand grains.

Soiling

When a module is placed outdoors, airborne particulates (e.g. dust, debris) settle on the glass surface of the module, similar to dust settling on glass automobile windshields. These particulates block the amount of light reaching the module and therefore reduce the power produced by the module. The modules produce more power when exposed to more light. The reduction in power from particulate build up can range from 1%-3%.

A module installed in a wet weather climate would have less "soiling" than a module installed in a drier climate. From the assessment of site and satellite data, an average annual GHI difference observed is approximately 6%. Knowing the fact that ground stations were not regularly cleaned. Therefore, cleaning solar panels can reduce soiling loss. For the site, soiling is restricted to 1% and increase in soiling loss will be controlled by frequently cleaning of solar panels. Therefore, soiling of 1.0% is most feasible.

Horizon

The horizon analysis measures the effect on reduction of global solar irradiation at the site due to far shading effect. Based on the site location, there are no far shading objects, hence, the losses due to horizon effect is considered as zero.

Near Shading

PV systems are dependent on the sun light. Power output is drawn down if any shade is present on the PV arrays. Near shading are partial shadings which affect only a part of the PV field. This partial shading could be because of closer row to row alignment, surface geometry, external shading objects such as trees, buildings, poles etc.

In the case of the project site, site is flat and has no buildings or trees in surroundings. Therefore, near shading loss for front site of the bifacial module is calculated around 3%.

Losses due to Irradiance Level

Efficiency of Solar module is given at Standard conditions. These standards conditions are (1000 W/m², 25°C, AM1.5). Since conditions on site are changing which also impact the efficiency of solar modules. This reduced efficiency leads to "Irradiance loss". A loss due to Irradiance level has been estimated less than 1%.

Losses due to temperature

The PV cell temperature is the temperature of the surface of the PV array. During the night it is the same as the ambient temperature but in full sun the cell temperature can exceed the ambient temperature by 30°C or more. Cell temperature is calculated based on energy balance equation of Duffie and Beckman (1991) considering solar absorption of PV array, solar transmittance, solar radiation striking earth, electrical conversion efficiency, coefficient of heat transfers to surrounding and ambient temperature.

Relation between the ambient temperature of site and corresponding cell temperature for the site is plotted on the annual data averaged on the time series. Production difference occurred due to temperature is calculated increasing during day hours and reducing in nighttime. Impact of power output of the plant by the factor equivalent to the temperature coefficient of power for the module is considered to calculate the loss due to temperature.

Long term monthly temperature is plotted for the site is shown in below figure. From the figure 8.

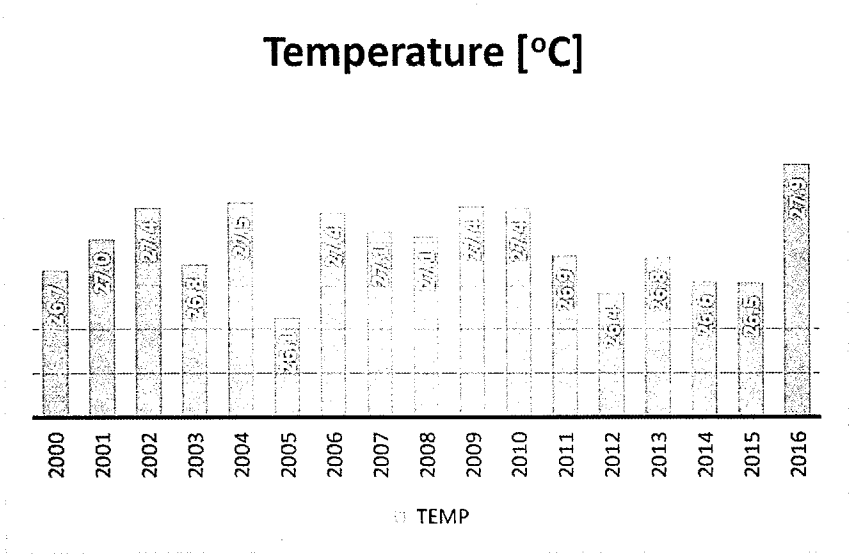

Figure 8. Long term temperature.

Considering the long-term temperature data, loss due to high temperatures is calculated as 8.7%.

Mismatch Losses

Mismatch accounts for manufacturing tolerances that yield PV modules with slightly different current-voltage characteristics. Consequently, when connected electrically, they do not operate at their peak

efficiencies. Therefore, mismatch losses from modules and strings are 0.7% while mismatch for back irradiance is slightly higher with 1.1%.

It is also suggested to Project Company to ensure implementation of sorting techniques at the time of equipment delivery.

DC and AC Cabling Losses

Voltage drops within the PV system DC wiring accounts for system power losses between the modules and inverter. Typical solar grid is based on the combination of series and parallel connections and losses depend upon the quality of the electrical connections and wire selection. The wires used to connect the modules create a slight resistance in the electrical flow, decreasing the total power output of the system, like low pressure water flowing through a long water hose. As per standard guidelines, these losses are typically in the range of 1%-3%. The exact losses shall be derived from the load flow studies based on the selected hardware for the projects.

Plant Availability

It is the time during which O&M contractor will keep plant available. This factor shall be derived from the O&M contract. For calculations, the unavailability is taken as 0.64%.

Summary of Losses Estimation

The table below summarizes the estimation of losses value for the Project. From the overall loss's estimation, the Project can be considered attractive.

Losses Type	(%)	Calculated [C] or Defined [D]
Near shadings front	-3.08	C
IAM factor on global	-0.38	C
Soiling losses	-1.00	D
Losses due to irradiance level	+0.33	C
Losses due to temperature	-8.73	C
Mismatching losses at MPP	-0.7	D
Module quality loss	+1.00	D
Inverter loss	-1.80	C
Technical unavailability loss	-0.64	D

Table 9. Losses Estimation Summary

5.2.4. Energy Yield Results

The table below shows the energy yield estimation results for the Project operation during the first year. The results are mainly presented in terms of annual energy production, specific yield, and performance ratio.

Parameter	Value
Installed DC power (kWp)	100,000
Irradiation on horizontal plane (kWh/m^2)	1934.6
Energy yield (MWh)	201,218
Specific yield (kWh/kWp/year)	2012
Capacity factor (%)	22.97

Table 10. First Year Plant Performance Summary

5.3. Long Term Energy Yield Estimation

The long-term energy yield estimation is based on first year energy yield results incorporated with manufacturer's specifications for first year module degradation and linear annual degradation. Long-term energy yield is also prepared at different Probability of Exceedance levels (P50, P75 and P90). The results are discussed and presented in the following sections:

5.3.1. Degradation

The age de-rating factor primarily represents weathering of the PV modules. The performance loss is performance warranty during the product life cycle. The average performance de-rating for Year-1 is 2.0% and then 0.5% for rest of the project life cycle.

5.3.2. Uncertainty Estimation

Uncertainties	Value (%)
Irradiance	3
Annual meteo variability	2.5
Deviation from module specs	1
Inverter and transformer losses	0.5
Mismatch and soiling losses	1
Degradation estimation	0.5
Total uncertainty	**2.96**

Table 11. Uncertainties – Energy Yield Estimation

5.3.3. Probability of Exceedance

The probability of Exceedance describes how confident a calculated result is; in this case, the energy production. Beside the 50% (P50) confidence level, common PoE levels for financial calculations and institutions in the renewable energy sector are 75% (P75) and 90% (P90). Applying P50 to financial cash-

flow models is currently accepted industry standard for photovoltaic power plants and the P50 is the value which the investor can expect over a longer period of, say 10 to 20 years. Nevertheless, as a mean to measure the risk in the first years of plant operation, some institutions prefer a more conservative prognosis.

The table below shows the summary of year 1 plant performance at different POE levels for the Project.

Year of operation	Annual Yield P50 (MWh)	Annual Yield P75 (MWh)	Annual Yield P90 (MWh)
0	201,218	197,205	193,585
1	200,191	196,199	192,597
2	199,165	195,193	191,610
3	198,138	194,187	190,622
4	197,112	193,180	189,634
5	196,085	192,174	188,647
6	195,058	191,168	187,659
7	194,032	190,162	186,671
8	193,005	189,156	185,684
9	191,978	188,150	184,696
10	190,952	187,144	183,708
11	189,925	186,137	182,721
12	188,899	185,131	181,733
13	187,872	184,125	180,745
14	186,845	183,119	179,758
15	185,819	182,113	178,770
16	184,792	181,107	177,782
17	183,765	180,100	176,794
18	182,739	179,094	175,807
19	181,712	178,088	174,819
20	180,686	177,082	173,831
21	179,659	176,076	172,844
22	178,632	175,070	171,856
23	177,606	174,064	170,868
24	176,579	173,057	169,881
AVRG	**188,899**	**185,131**	**181,733**

Table 12. Annual Breakdown of Long Term Energy Yield (25 Years)

ZORLU

6. Conclusion and Recommendations

- Site is flat having no buildings, trees, or any obstruction in surrounding that could hinder the production.
- Selected slope/tilt angle for the site +/- 55 degrees (*) for Tier 1 modules with single-axis tracker system.
- Capacity factor of is 22.97% for the first year.
- The irradiance of Site is workable for installation of Solar PV Plant.

Annexure E – Term Sheet

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18 May 2017

Zorlu Solar Pakistan (Pvt.) Limited

National Electric Power Regulatory Authority

Dear Sirs

100MW solar photovoltaic power plant to be developed by Zorlu Solar Pakistan (Pvt.) Limited ("**Zorlu**") in Pakistan (the "**Project**") - Tariff Petition - Financing Term Sheet

We are instructed to act for the Asian Development Bank, International Finance Corporation and ECO Trade & Development Bank (together, the "**Banks**") in relation to the financing of the Project.

We attach a term sheet reflecting the proposed terms of the financing for the Project. The Banks confirm that they have obtained initial concept clearance to provide project financing to Zorlu in relation to the Project on the basis of this term sheet. The term sheet and the provision of the financing remain subject to each of the Banks obtaining board and management approval and completing their due diligence on the Project, including legal, technical, environmental and financial due diligence.

This letter is provided to you to assist Zorlu in obtaining approval of its Tariff Petition. It is not legally binding and the Banks make no representation regarding the Project or their participation therein. This letter does not indicate (and should not be construed as indicating) that the Banks are committed to provide financing to Zorlu or the Project, nor the terms of any such financing.

Yours sincerely

Shearman & Sterling LLP

Shearman & Sterling LLP

Att

For submission to NEPRA: 18 May 2017

ZORLU SOLAR I: INDICATIVE LOAN TERM SHEET FOR PROPOSED FINANCING OF THE 100 MW SOLAR PHOTOVOLTAIC POWER PLANT TO BE LOCATED IN BAHAWALPUR, PUNJAB PROVINCE, PAKISTAN

This Term Sheet is a summary of the principal terms that may apply to the proposed financing of the Project. All figures, terms and conditions are subject to change.

This Term Sheet does not constitute an offer or a commitment by the Lenders. Each Lender's decision to invest in the Project is contingent upon approval by its management, credit committee and/or Board of Directors and execution of final documentation in form and substance satisfactory to all Lenders.

1.	Borrower	Zorlu Solar Pakistan (Pvt.) Limited (the "**Borrower**").
2.	Sponsor	Zorlu Enerji Elektrik Uretim A.S. ("**Zorlu Enerji**"), which holds directly 100% of the issued share capital in the Borrower.
3.	Guarantor	Zorlu Holdings A.S. (the "**Guarantor**")
4.	EPC Contractor	Zorlu Industrial Pakistan Ltd. ("**Zorlu Industrial**"), as the onshore EPC Contractor and Zorlu Enerji, as the offshore EPC Contractor. The Guarantor will provide a completion guarantee up until the Project Completion Date, on terms similar to recent Pakistan precedent involving the parties.
5.	O&M Operator	Zorlu O&M Pakistan Limited ("**Zorlu O&M**")
6.	Project	The development, financing, design, engineering, procurement, manufacture, construction, equipping, permitting, testing, commissioning, insurance, completion, placing into operation and maintenance of a 100MW solar photovoltaic power plant to be located in Bahawalpur, Punjab province, Pakistan (the "**Project**").

7.	***Lenders***	***Indicative Commitment***[1]	***Interest/Mark-up***[2]
	International Finance Corporation ("**IFC**")	Up to [US$26,250,000][3] by way of a term A Loan facility	3-month US$ LIBOR plus spread

1 Commitments are based on a 75:25 debt-to-equity ratio.

2 The final loan spread will depend on the Lenders' assessment of the investment risk and support/security arrangements.

			of [4.60% - 4.75%]
8.	Asian Development Bank ("**ADB**")	US$40,000,000 by way of a term A Loan facility[4]	3-month US$ LIBOR plus spread of [4.60% - 4.75%]
9.	ECO Trade and Development Bank ("**ETDB**")	[US$11,000,000] [5] by way of a term loan facility	3-month US$ LIBOR plus spread of [4.60%-4.75%]

10. Purpose of Facilities

To finance the cost of developing and constructing the Project (i) in accordance with a budget and financial model to be agreed and (ii) reflecting project costs that are recoverable through the tariff mechanism approved by NEPRA ("**Eligible Project Costs**"), including (subject to (i) and (ii)): professional expenses and consultant's fees, financing costs, insurance premia, taxes, the cost of obtaining consents and permits, and all other agreed costs and expenses incurred in connection with the Project.

11. Principal Repayment/ Maturity

Principal repayment shall be in quarterly repayments reflecting a mortgage-style repayment profile as per the attached Repayment Schedule. The door-to-door tenor from signing of the Common Terms Agreement to final repayment of all facilities will not exceed [15] [6] years. The first repayment date shall be on the earlier of (i) 12 months after signing date and (ii) COD plus 3 months.

12. Fees

Front-end Fee: 1.50% of the amount of the A Loan Facility and the term loan Facility/ies (the "**Facilities**"), to be paid no later than the earlier of:

(i) 30 days after signing of the Common Terms Agreement; and

(ii) before issuance of the disbursement request for the first disbursement under the Facilities.

Commitment Fee: 1.00% per annum on the undisbursed amount of the Facilities, to be paid quarterly in arrears and commencing to accrue upon signing of the Common Terms

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3 Pending confirmation of Eligible Project Costs. IFC's commitment will be limited to 25% of Eligible Project Costs.

4 Up to $20 million of which may be provided by ADB as trustee of the Leading Asia's Private Sector Infrastructure (LEAP) Fund (an ADB administered trust fund by Japan International Cooperation Agency).

5 Subject to further internal approval of ETDB.

6 Final tenor of the loan is subject to final internal approval of Lenders and Base Case model.

		Agreement. **Others**: any other costs and expenses incurred to syndicate and thereafter supervise the term loans, including in connection with a secure web-based syndication system, and such other fees in connection with the Facilities to be set out in definitive documentation.
13.	Interest/Mark-up Payment Dates	Quarterly (dates to be agreed).
14.	Default Rate	2% per annum above the applicable Interest/Mark-up Rate.
15.	Debt-to-Equity Ratio	No higher than 75:25 subject to results of financial model and solar analysis and approval by NEPRA of the Project Costs to be financed.
16.	Debt Service Reserve/Major Maintenance Reserve	An offshore (US$) debt service reserve account ("**DSRA**") shall be established by the Borrower with an Account Bank. The minimum required balance shall be sized to cover 6 months of principal repayment and interest. Major maintenance reserve account ("**MMRA**") to be established if required by Lenders taking into account the Lenders' technical advisor's recommendations.
17.	Sponsor Support	Eligible Project Costs will be funded on 75:25 debt to equity basis. If the Facilities have been utilised to fund more than 75% of Project Costs that are ultimately approved by NEPRA in the tariff, and the outstanding balance under all Facilities is higher than the debt permitted by the Final Tariff Determination, after true-up, then the excess amount (the "**Excess Debt**") will be prepaid by (i) the Borrower, to the extent there are sufficient funds for prepayment and then (ii) by the Sponsor, to the extent the funds available to the Borrower are insufficient, prior to Project Completion Date. The initial equity required to fund the Project Costs (the "**Base Equity**") shall be contributed pro rata to disbursements of debt. In addition to the Base Equity and the obligation to fill up the DSRA before the first repayment date, the Sponsor will undertake to provide additional contingent equity in specified circumstances up to an aggregate amount to be agreed (the "**Contingent Equity**").
18.	Share Retention	For so long as any part of the Facilities is outstanding or any

		amount is available for disbursement under the Financing Documents, the Sponsor and the Guarantor shall be subject to share retention undertakings in respect of shares held directly or indirectly in the Borrower. Details to be agreed in the definitive documentation.
19.	Other Payments	Borrower to pay or reimburse the Lenders in respect of: (i) increased costs resulting from a change of law or regulations; (ii) unwinding/breakage costs, ie, any cost or loss in unwinding funding arrangements resulting from prepaying the Lenders or from failing to borrow or prepay in accordance with a request for disbursement or notice of prepayment; (iii) withholding taxes, if any (tax gross-up); (iv) all taxes (including stamp taxes) or other charges payable on any of the Financing Documents; (v) legal fees and expenses relating to (A) the preparation, execution, implementation, administration and enforcement of the Transaction Documents, (B) the protection of Lenders' interests under the Financing Documents, and (C) the release of the Security after repayment of the Facilities; (vi) annual portfolio supervision fee to be agreed; (vii) amounts (to be agreed with the Borrower at the time) to compensate the Lenders for additional work required in connection with any restructuring; and (viii) any other expenses/fees for processing waivers and amendments and/or fees for technical, environmental, social and other consultants as agreed with the Borrower.
20.	Prepayments / Cancellation	Customary and appropriate for the Project, reflecting the Lenders' respective policies and requirements.
21.	Representations; Conditions of Disbursement; Covenants; Events of Default	Customary and appropriate for the Borrower, Guarantor and Sponsor, reflecting the Lenders' respective policies and requirements and subject to certain customary exceptions (relating to materiality and actual knowledge) and legal qualifications to be agreed in the documentation, based on the recent Pakistan precedent involving the same parties.
22.	Security	(i) A first ranking mortgage on the movable and immovable

		assets of the Borrower. (ii) Assignment of all project documents (including EPA, Implementation Agreement and GOP Guarantee), and to the extent permitted under the relevant laws, all licenses, consents, permits, etc. associated with the Project. (iii) A first ranking pledge of all shares in the Borrower. (iv) Any other security as is customary and appropriate for a project finance transaction of this nature.
23.	Governing Law	English Law (e.g. Common Terms Agreement, Accounts Agreement, Facility Agreements, Sponsor Support Agreement and Intercreditor Agreement) and Pakistan Law (certain Security Documents) as appropriate.
24.	Dispute Resolution	The Borrower, Sponsor and Guarantor shall submit to the exclusive jurisdiction of the English courts (under the English law documents) or the Pakistani courts (under the Pakistan law documents) in accordance with Lenders' respective policies and requirements; or the parties will agree to have disputes resolved by arbitration in London under the rules of arbitration of the London Court of International Arbitration with the seat of the arbitration being London, as agreed in detailed documentation.

Repayment Schedule[7]

Quarter	Principal Repayment (in % of Total Loan Amount)
1	1,225%
2	1,241%
3	1,257%
4	1,273%
5	1,290%
6	1,307%
7	1,324%
8	1,341%
9	1,358%
10	1,376%
11	1,394%
12	1,412%
13	1,430%
14	1,449%
15	1,468%
16	1,487%
17	1,506%
18	1,526%
19	1,546%
20	1,566%
21	1,586%
22	1,607%
23	1,628%
24	1,649%
25	1,670%
26	1,692%
27	1,714%
28	1,736%
29	1,759%
30	1,782%
31	1,805%
32	1,828%
33	1,852%
34	1,876%
35	1,900%
36	1,925%
37	1,950%

[7] The repayment schedule is illustrative and may be adjusted based on revised NEPRA determinations, actual amounts advanced, LIBOR rates and FX rates from time to time.

38	1,976%
39	2,001%
40	2,027%
41	2,054%
42	2,080%
43	2,107%
44	2,135%
45	2,162%
46	2,191%
47	2,219%
48	2,248%
49	2,277%
50	2,307%
51	2,337%
52	2,367%
53	2,398%
54	2,429%
55	2,461%
56	2,489%
TOTAL	**100,0%**