

VIS (2022-23)-PL278-210-401/402

Dated: 08/09/2022

# LENDER'S INDEPENDENT ENGINEER REPORT OF 1400 kW (1200 Kw + 200 Kw) ROOFTOP SOLAR POWER PLANT PROJECT

PROPOSED TO BE SET UP AT  
KULLU, HIMACHAL PRADESH (LOCATION 1)  
AND  
AZADPUR, DELHI (LOCATION 2)

## COMPANY/PROMOTER

M/S INDRAPRASTHA ICE AND COLD STORAGE PRIVATE LIMITED

## REPORT PREPARED FOR

STATE BANK OF INDIA, SME, UDYOG SADAN, DELHI

**Agency for Specialized Account Monitoring (ASM)**  
at [rk@rkassociates.org](mailto:rk@rkassociates.org). We will appreciate your feedback in order to improve our services.

**Project Techno-Financial Advisors**  
NOTE: As per IBA Guidelines please provide your feedback on the report within 15 days of its submission after which report will be considered to be correct.

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- Business/ Enterprise/ Equity Valuations
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- Agency for Specialized Account Monitoring (ASM)
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- Industry/ Trade Rehabilitation Consultants
- NPA Management
- Panel Valuer & Techno Economic Consultants for PSU Banks

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**PART A****REPORT SUMMARY**

1. **Name of Project:** Setting up of 1400 kW (1200 kW + 200 kW) Solar Power Plant Project
2. **Project Location:**

**Location 1:** Indraprastha Ice and Cold storage private Limited, Azadpur Mandi, Delhi (200 kWp)

**Location 2:** Indraprastha Ice and Cold storage private Limited, Kullu, Himachal Pradesh (1200 kWp)
3. **Name of the Company:** M/s. Indraprastha Ice and Cold Storage Private Limited (IICS)
4. **Director's**
  - i. Sanjay Aggarwal
  - ii. Sunila Aggarwal
  - iii. Dharamvir
5. **Prepared for Bank:** State Bank of India
6. **LIE Consultant Firm:** M/s. R.K. Associates Valuers & Techno Engineering Consultants (P) Ltd.
7. **Date of Survey:** 25<sup>th</sup> August 2022 and 26<sup>th</sup> August 2022
8. **Date of Report:** 8<sup>th</sup> September 2022
9. **Purpose of the Report:** Review, evaluate & comment on project implementation & present status details to facilitate bankers to take credit decision on the Project.
10. **Scope of the work provided by the Lender:** To review Project cost, expenditure and examine the current status of installation and commissioning of the project.
11. **Documents perused for Proposal:**
  - a. Project Report
  - b. Copies of Invoices
12. **Annexure with the report:**
  1. MNRE Benchmark Cost
  2. Site Photographs
  3. Analysis reference websites





**PART B****INTRODUCTION**

- 1. NAME OF THE PROJECT:** Installation and commissioning of 1400 kW (1200 kW + 200 kW) of Rooftop mounted Solar Power Plant Project at Azadpur Mandi, Delhi (200 Kw) {LOCATION 1} and at Kullu, Himachal Pradesh (1200 Kw) {LOCATION 2}.

**2. PROJECT OVERVIEW:**

Indraprastha Ice and cold storage (P) limited (*referred to as "IICS" hereinafter*) has proposed to set up Rooftop Solar power plants at rooftop of Under construction cold storage facility at Kullu, Himachal Pradesh and at the rooftop of their cold storage facility at Azadpur mandi respectively. The total project cost proposed for this project is Rs.7.28 Crore. The total project cost includes Rs.1.13 Crore towards rooftop solar power plant installation at Azadpur Mandi and Rs. 6.15 Crore towards rooftop Solar power plant installation at the roof of under construction cold storage facility at Kullu, Himachal Pradesh.

The Delhi cold storage on an average consumes 0.65-0.85 lakh units per month. The 200-kW solar plant will produce around 3 lakh units per annum, which shall easily be consumed by the company.

IICS shall also be installing a solar power plant at its new controlled atmosphere Kullu unit. The company shall install a 1.2 MW solar power plant there. In Himachal, the company has a unit at Shimla. The power rates in Kullu and Shimla are the same since they come under the same Discom (Himachal Pradesh State Electricity Board Limited).

Proposed Capacity of Solar Power Plant	200 kWp
Site Address	IICS, Azadpur Mandi, Delhi
Latitude and Longitude	28°42'45.1"N 77°10'24.6"E

Proposed Capacity of Solar Power Plant	1000 kWp
Site Address	IICS, Kullu, Himachal Pradesh
Latitude and Longitude	31°23'54.4"N 77°36'34.6"E

We have conducted the visits of the project sites on 25<sup>th</sup> August for IICS Cold storage facility located at Azadpur mandi, Delhi and 26<sup>th</sup> August 2022 for IICS Under construction cold storage



facility at Kullu, Himachal Pradesh. During site visit it was observed that works related to these projects have not commenced yet. The company's representatives of both the projects informed that solar power plant erection, installation and commissioning works related to these projects will commence post receipt of sanction of term loans from the concerned Bank.

**3. SCOPE OF THE REPORT:** To verify the Project cost, expenditures and examine the commissioning, installation status of Solar Power Plant set-up by M/s. IICS pvt. Ltd.

- *Industry/ sector research and demand & supply trend is out of scope of the report.*
- *Financial feasibility study of the Project is out of scope of the report.*
- *Providing any kind of design report or map is out-of-scope of the report.*

**4. PURPOSE OF THE REPORT:** To Provide Project Progress Monitoring Report to SBI.

**5. METHADODOLOGY ADOPTED:**

- a. Study of Project Planning documents/ reports to know about the Project.
- b. Additional information, data, documents collection the company.
- c. Study and analysis of the documents and information obtained from the company.
- d. Research about the Project/ sector from the sources in the public domain.
- e. Correlation of the provided information against Industry/ sector benchmarks/ trend.
- f. Information compilation, analysis and reporting.





**PART C****PROJECT LOCATION & SITE APPROPRIATENESS****1. LOCATION's:**

The company has proposed to install Rooftop Solar power plants at IICS Cold storage facility, Azadpur mandi, Delhi and IICS under construction cold storage facility at Kullu, Himachal Pradesh. Location map of both the location is as below:

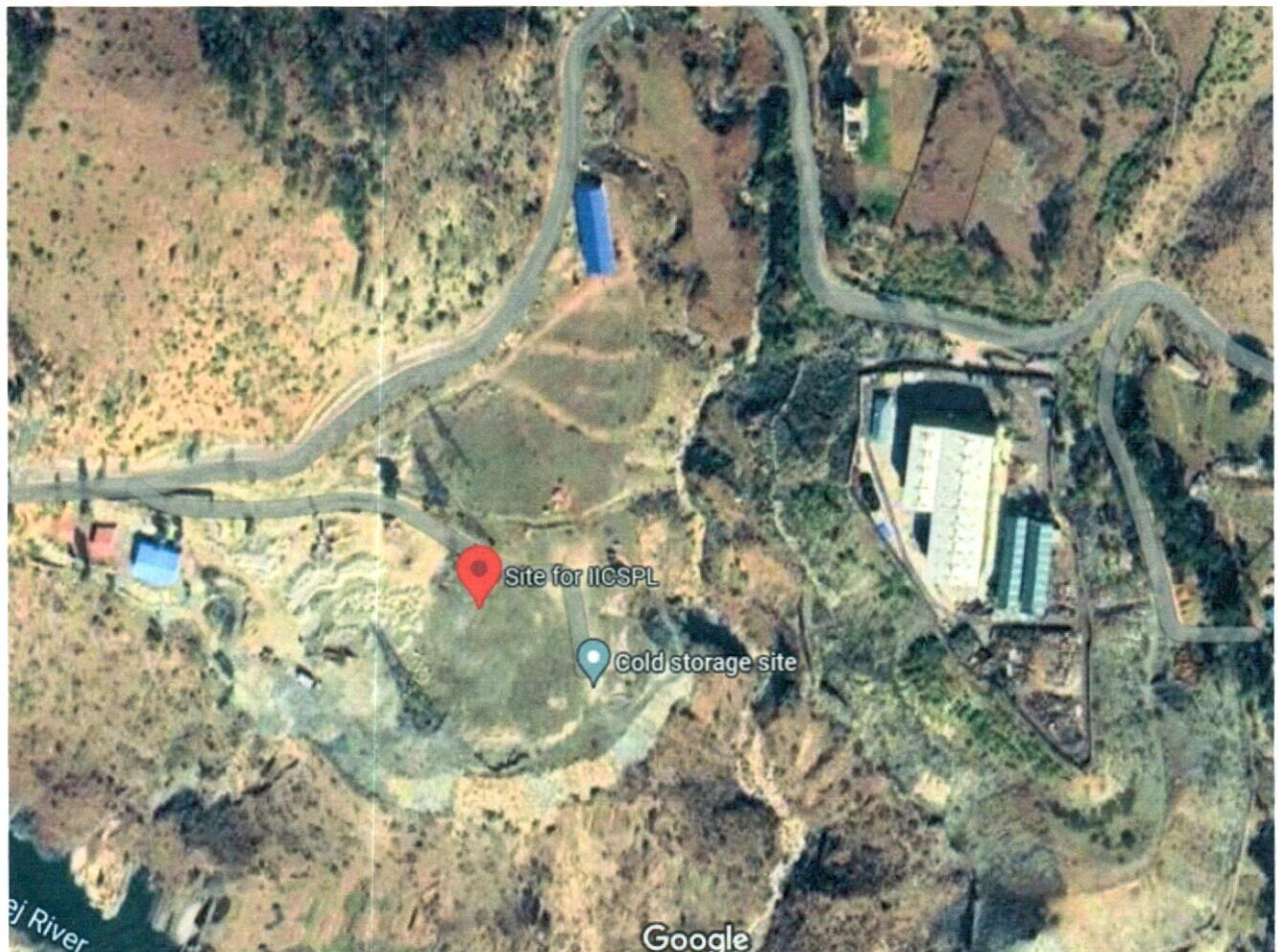
**LOCATION 1: IICS COLD STORAGE FACILITY AT AZADPUR MANDI, DELHI**

**Note:** The Cold storage facility boundary and Rooftop boundary are on approximate basis and are not to scale.





**LOCATION 2: IICS UNDER CONSTRUCTION COLD STORAGE FACILITY AT KULLU, HIMACHAL PRADESH**



**Note:** The Cold storage facility of IISCPL at Kullu, Himachal Pradesh is currently under construction and demarcated facility area is not provided to us.





**2. SITE APPROPRIATENESS:****2.1 SITE APPROPRIATENESS FOR LOCATION 1 (IISCPL, AZADPUR MANDI, DELHI):**

The site appropriateness for a roof top solar power unit is basically based on the weather and solar radiation parameters since annual energy yield of a PV plant is solely dependent on the solar resource of the site.

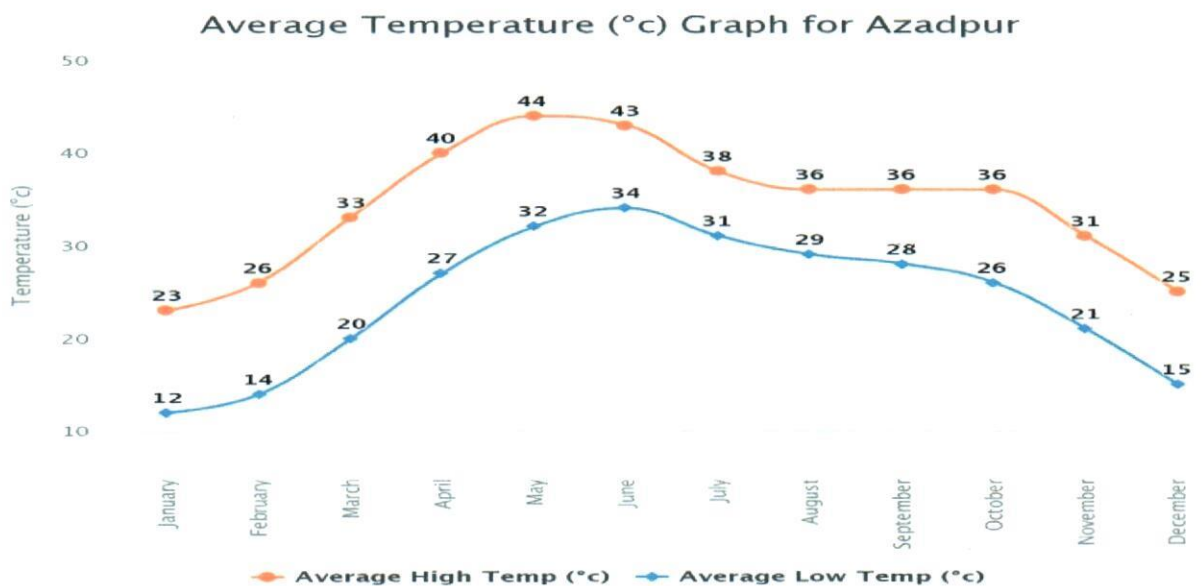
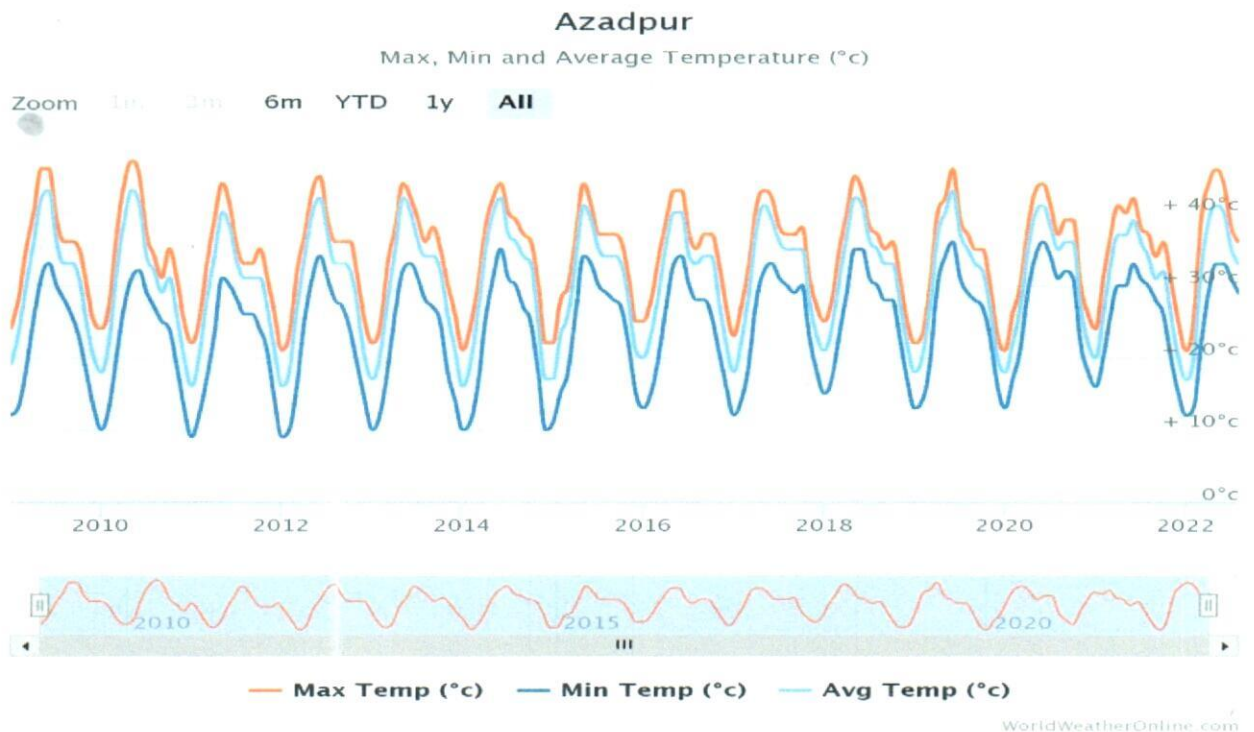
Basically, there are three standard test conditions which are the industry standard for the conditions under which a solar panel are tested and give its efficiency rating

- i. Temperature of the cell – 25°C. The temperature of the solar cell itself, not the temperature of the surrounding.
- ii. Solar Irradiance – 1000 Watts per square meter. This number refers to the amount of light energy falling on a given area at a given time.
- iii. Mass of the air – 1.5. This number is somewhat misleading as it refers to the amount of light that has to pass through Earth's atmosphere before it can hit Earth's surface, and has to do mostly with the angle of the sun relative to a reference point on the earth. This number is minimized when the sun is directly above as the light has to travel a minimum distance straight down, and increases as the sun goes farther from the reference point and has to go at an angle to hit the same spot.



In this regard for doing the site appropriateness following site parameters are being evaluated:

- a. Temperature:** The average temperature is measured as per the Metrological Station statistic available at Azadpur. At an average temperature of 44<sup>0</sup> C, may is the hottest month of the year and at an average temperature of 14<sup>0</sup> C February is the coldest month.



Source: <https://www.worldweatheronline.com/azadpur-weather-averages/delhi/in.aspx>



Temperature tolerance of solar panels is denoted by temperature coefficient, which denotes the decrease in efficiency of the solar panel with increase in temperature. Typically, temperature coefficient of solar panels is about -0.4% to -0.6% / degree C.

All solar cells have a temperature coefficient. As a solar panel increases in temperature, the power output of the solar panel decreases. Generally, monocrystalline solar cells have a temperature coefficient of -0.5%/degC. This means a mono solar panel will lose half of one percent of its power for every degree the temperature rises. Solar panels are all rated at 25degC, however, when solar panels are installed on a roof, they generally reach much higher temperatures.

**EXAMPLE:**

All solar cells have a temperature coefficient. As a solar panel increases in temperature, the power output of the solar panel decreases. Generally, monocrystalline solar cells have a temperature coefficient of -0.5%/degC. This means a mono solar panel will lose half of one percent of its power for every degree the temperature rises. Solar panels are all rated at 25degC, however, when solar panels are installed on a roof, they generally reach much higher temperatures.

Let's say a 250W monocrystalline solar panel installed on a roof is at 65degC. The solar panel's power loss can be calculated as follows:

$$65\text{degC} - 25\text{degC} = 40\text{degC}$$

$$40\text{degC} \times -0.5\% = 20\%$$

$$\text{Therefore, panel power loss} = 20\% \times 250\text{W} = 50\text{W}$$

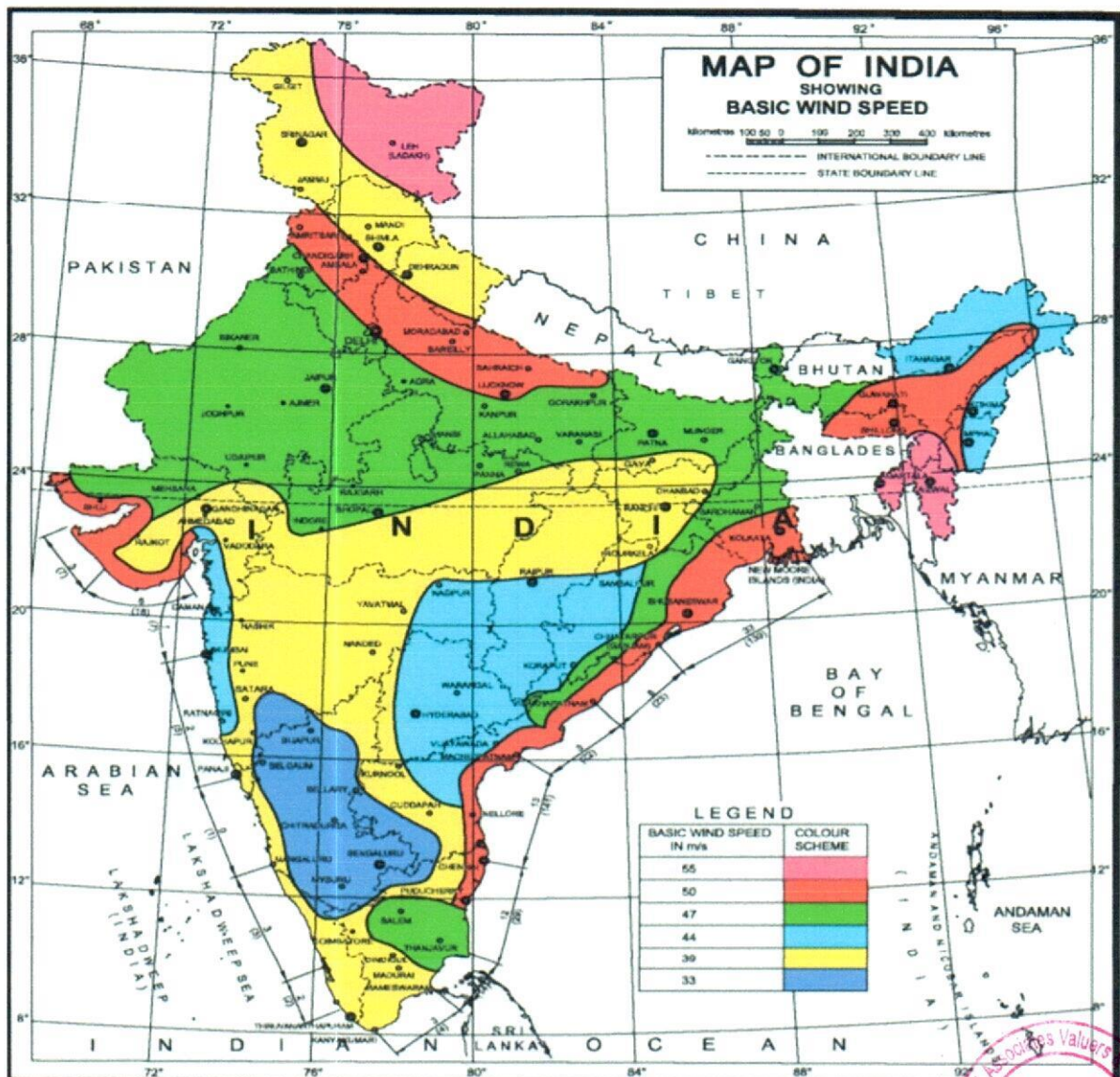
$$\text{Therefore, panel power} = 200\text{W}+$$

At an average temperature of 44°C, May is the hottest month of the year and at an average temperature of 14°C February is the coldest month. There will surely be a reduction in power generated in summer months which can also be seen in the performance ratio infographics given in the PVsyst report and is also covered in the below sections of our report. **However, temperature coefficient is the inherent property of the solar modules and since the reduction of power generation in summer months will be covered with satisfactory power generation in winter months therefore the temperature in Delhi seems to be favorable for this project.**



**b. Wind Speed:** The macro-level wind speed zones of India have been formulated and published in IS: 875 (Part 3) - 1987 titled "Indian Standard Code of Practice for Design Loads (other than earthquakes) for Buildings and Structures, Part 3, Wind Loads". There are six basic wind speeds ' $V_b$ ' considered for zoning, namely 55, 50, 47, 44, 39 and 33 m/s. From wind damage view point, these could be described as follows:

- 55 m/s (198 km/h) - Very High Damage Risk Zone – A
- 50 m/s (180 km/h) - Very High Damage Risk Zone – B
- 47 m/s (169.2 km/h) - High Damage Risk Zone
- 44 m/s (158.4 km/h) - Moderate Damage Risk Zone – A
- 39 m/s (140.4 km/h) - Moderate Damage Risk Zone – B
- 33 m/s (118.8 km/h) - Low Damage Risk Zone





Design Wind Speed ( $V_z$ ) - The basic wind speed ( $V_b$ ) for any site shall be modified to include the following effects to get design wind velocity at any height ( $V_z$ ) for the chosen structure:

- a) Risk level;
- b) Terrain roughness, height and size of structure; and
- c) Local topography. It can be mathematically expressed as follows:

$$V_z = V_b k_1 k_2 k_3$$

$V_z$  = Design wind speed at any height  $z$  in m/s;

$V_b$  = Basic Wind Speed

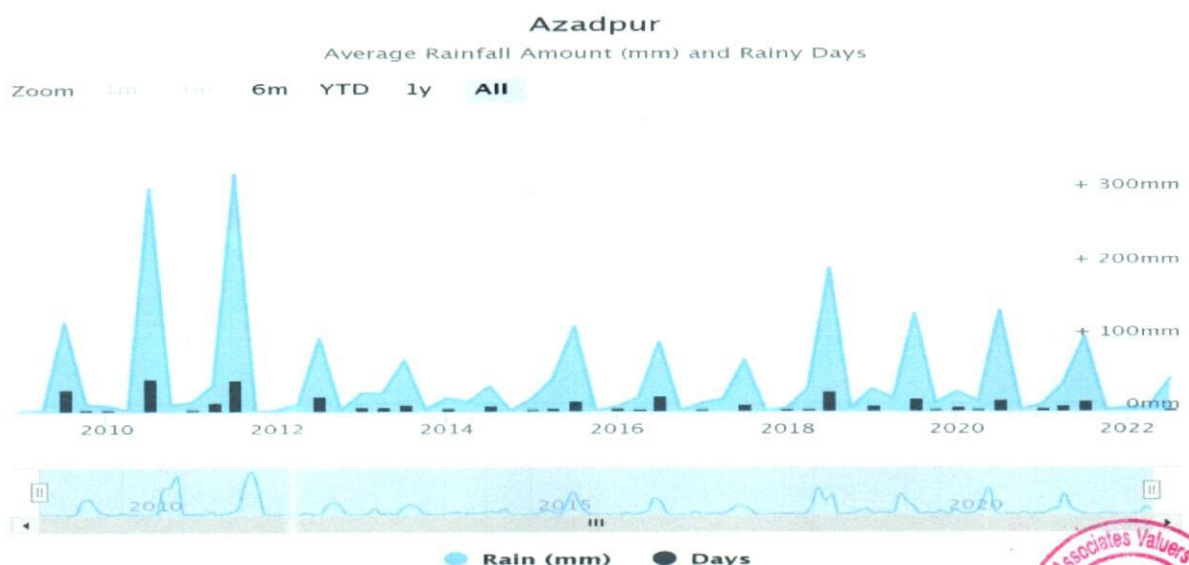
$k_1$  = Probability factor (risk coefficient)

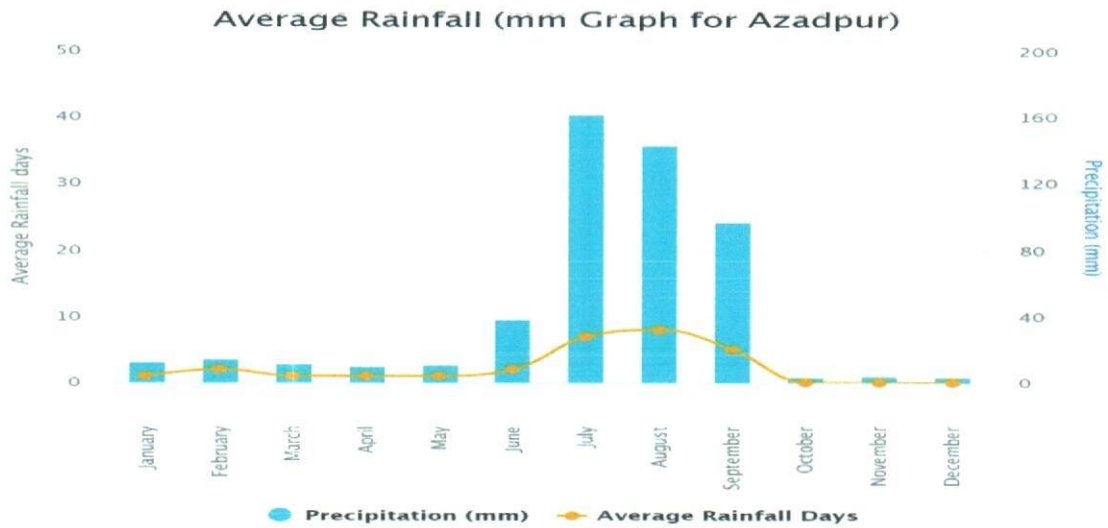
$k_2$  = Terrain, height and structure size factor

$k_3$  = Topography factor

The basic wind speeds are applicable to 10 m height above mean ground level in an open terrain with a return period of 50 years. Azadpur, Delhi lies on 50 m/s band of wind speed. Therefore, Delhi lies in Very High Damage Risk Zone-B. **However, from production point of view the wind velocity can reduce the thermal losses, therefore high basic wind velocity is favorable for PV solar projects.**

- c. **Rainfall:** To show variation within the months and not just the monthly totals, we show the average rainfall for Year 2010 to Year 2022 (as on date)



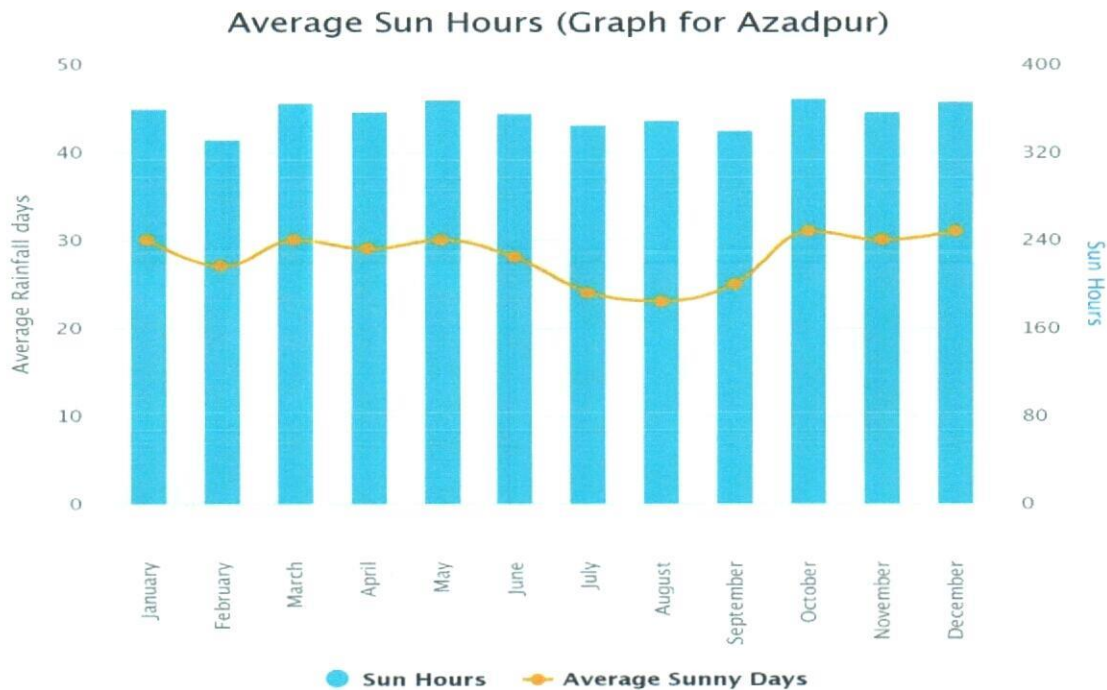


Source: <https://www.worldweatheronline.com/azadpur-weather-averages/delhi/in.aspx>

***While the rain itself will have no impact on the panels, the rain clouds can lower the electricity production. However, the occasional rainstorm could actually be good for solar system's production, because with no extra effort it can naturally clean the panels. Since Delhi falls under low rain zone therefore it is ok for the solar project.***




**d. Average Sun Hours and Sun Days:**

Source: <https://www.worldweatheronline.com/azadpur-weather-averages/delhi/in.aspx>

**{Table: 2}**

AZADPUR, DELHI						
Years	2019		2020		2021	
Months/Days	Sun Day	Sun Hour	Sun Day	Sun Hour	Sun Day	Sun Hour
January	29	357	28	344	29	350
February	22	325	29	343	27	333
March	31	369	27	354	29	353
April	29	359	29	345	29	360
May	31	372	29	360	27	348
June	29	360	29	351	27	346
July	23	358	28	320	22	292
August	24	366	17	308	27	321
September	27	350	30	349	29	299
October	31	366	31	372	30	362

November	27	358	29	356	30	360
December	31	363	31	359	31	352
<b>Total</b>	<b>334</b>	<b>4303</b>	<b>337</b>	<b>4161</b>	<b>337</b>	<b>4076</b>

AVERAGE SUN DAYS	AVERAGE SUN HOURS
<b>336 Days</b>	<b>4180 Hours</b>

As per last 3-year data, average sun days are 336 days and average sun hours in a year is 4180 hours recorded at Azadpur, Delhi zone which is in North Delhi and the subject location for 200 kW solar power plant.

#### e. Irradiation map of Project Location

**Solar irradiance** is the power per unit area (watt per square metre, W/m<sup>2</sup>), received from the Sun in the form of electromagnetic radiation as reported in the wavelength range of the measuring instrument.

**Global Horizontal Irradiance (GHI)** is the total amount of shortwave radiation received from above by a surface horizontal to the ground. This value is of particular interest to photovoltaic installations and includes both Direct Normal Irradiance (DNI) and Diffuse Horizontal Irradiance (DIF).

**Diffuse Horizontal Irradiance** is the amount of radiation received per unit area by a surface that does not arrive on a direct path from the sun, but has been scattered by molecules and particles in the atmosphere. Basically, it is the illumination that comes from clouds and the blue sky.

#### Map data

PVOUT specific	<b>1464.4</b>	kWh/kWp °
DNI	<b>1158.3</b>	kWh/m <sup>2</sup> °
GHI	<b>1711.9</b>	kWh/m <sup>2</sup> °
DIF	<b>927.2</b>	kWh/m <sup>2</sup> °
GTI opta	<b>1862.6</b>	kWh/m <sup>2</sup> °
OPTA	<b>26 / 180</b>	°
TEMP	<b>24.9</b>	°C °
ELE	<b>214</b>	m °

Per year °





### Annual averages

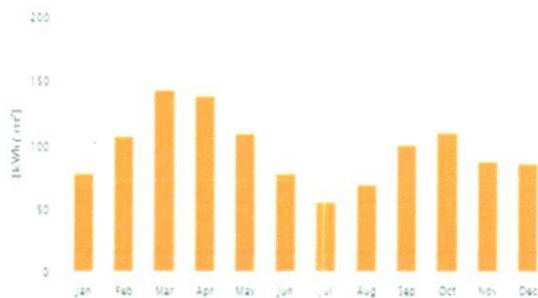
Direct normal irradiation

**1164.7**

kWh/m<sup>2</sup> per year

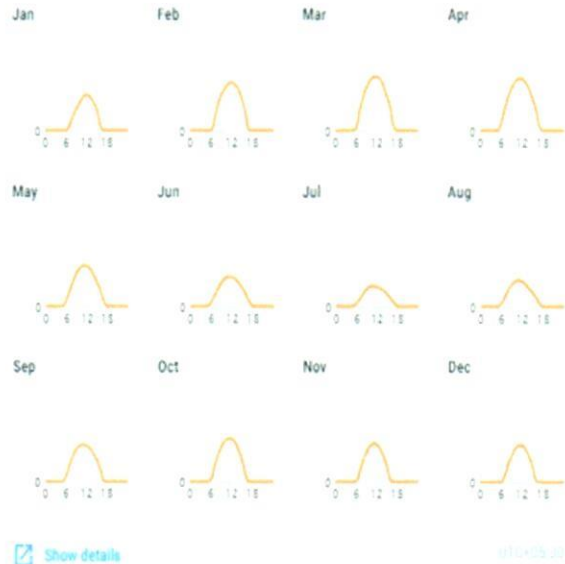
### Monthly averages

Direct normal irradiation



### Average hourly profiles

Direct normal irradiation (W/m<sup>2</sup>)



Source:

<https://globalsolaratlas.info/detail?c=28.71227,77.174149,11&s=28.712528,77.1735&m=site>

- f. Shadow Analysis and Obstruction:** The site of a Roof Mounted location should be free from any nearby building or structure. We have verified through google map location and our site visit conducted on 25<sup>th</sup> August 2022 that there is no obstruction by shadow on the structure from nearby site.
- g. Water Availability:** Plant will require module cleaning during dry spells. Cleaning may require substantial quantities of water approx. 2.0 liters per module depending upon the manpower available and degree of soiling. The company has proposed to use Borewell for the same. Bank to ensure that Groundwater abstraction clearance is available with the company.



**2.2 SITE APPROPRIATENESS FOR LOCATION 2 (UNDER CONSTRUCTION IISCPL, KULLU, HIMACHAL):**

The site appropriateness for a roof top solar power unit is basically based on the weather and solar radiation parameters since annual energy yield of a PV plant is solely dependent on the solar resource of the site.

Basically, there are three standard test conditions which are the industry standard for the conditions under which a solar panel are tested and give its efficiency rating

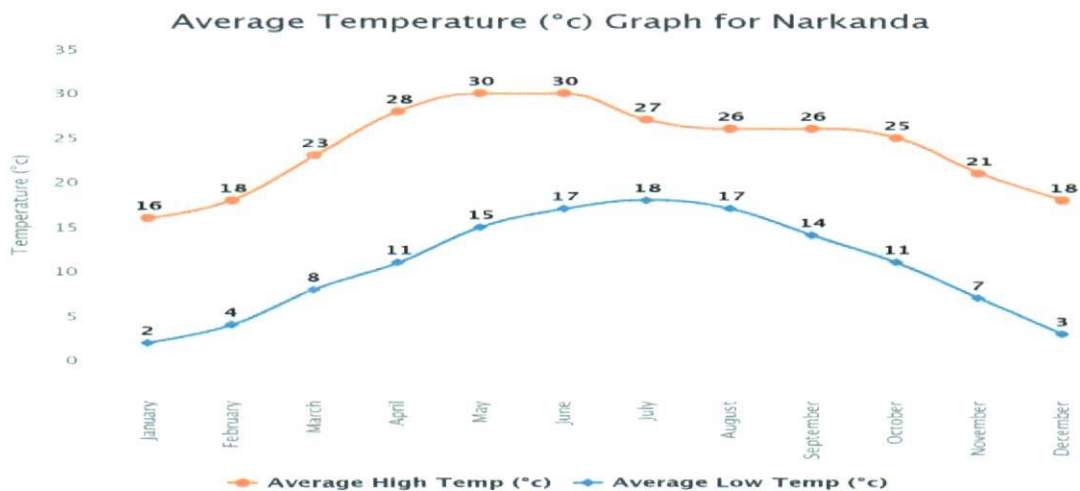
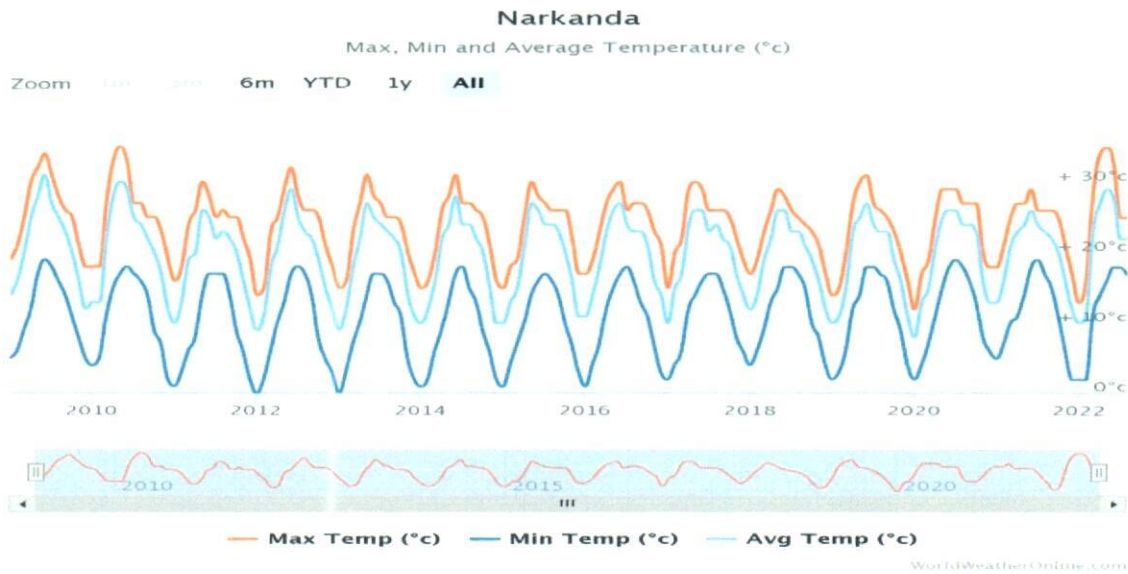
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In this regard for doing the site appropriateness following site parameters are being evaluated:

- a. Temperature:** The average temperature is measured as per the Metrological Station statistic available at Narkanda, Himachal Pradesh. At an average temperature of 30° C, June is the hottest month of the year and at an average temperature of 2° C January is the coldest month.



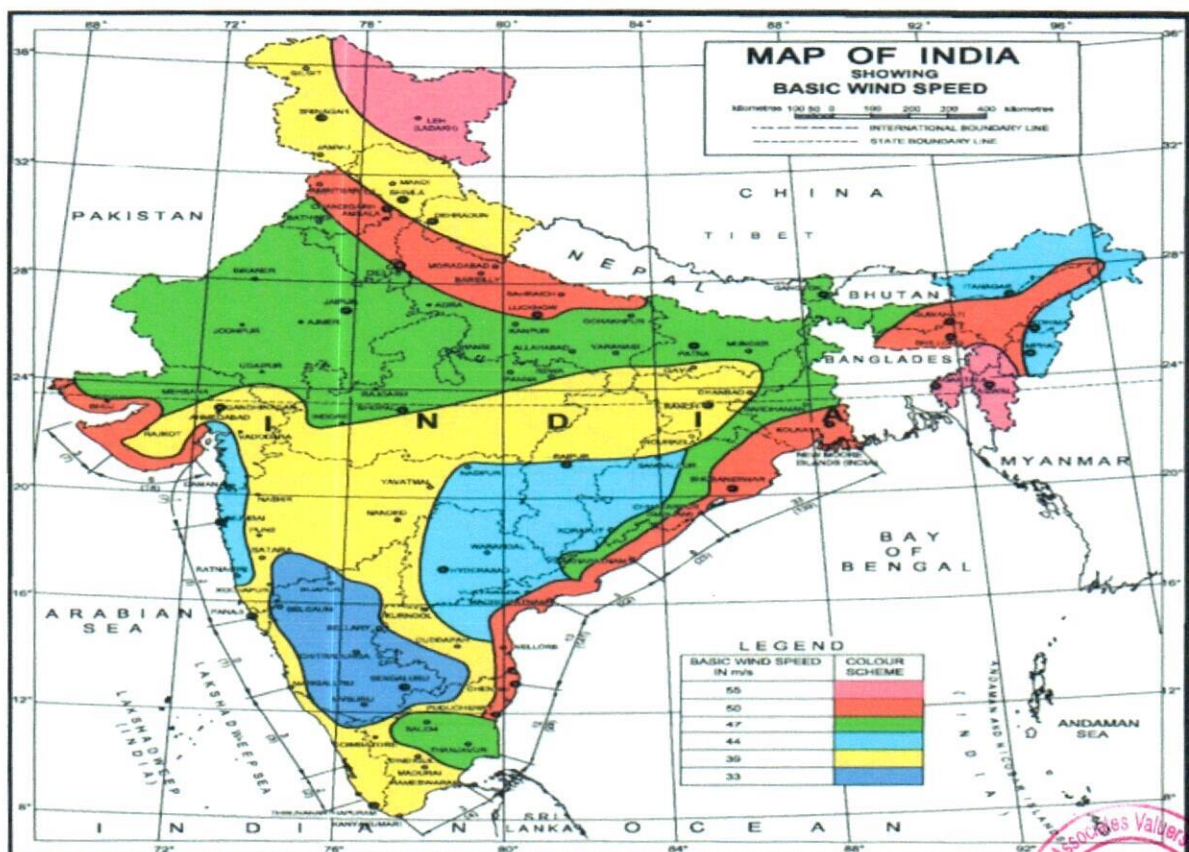
**Source:** <https://www.worldweatheronline.com/narkanda-weather-averages/himachal-pradesh/in.aspx>

At an average temperature of 30° C, June is the hottest month of the year and at an average temperature of 2° C January is the coldest month. There will surely be a reduction in power generated in summer months which can also be seen in the performance ratio infographics

given in the PVsyst report and is also covered in the below sections of our report. **However, temperature coefficient is the inherent property of the solar modules and since the reduction of power generation in summer months will be covered with satisfactory power generation in winter months therefore the temperature in Narkanda Area seems to be favorable for this project.**

**b. Wind Speed:** The macro-level wind speed zones of India have been formulated and published in IS: 875 (Part 3) - 1987 titled "Indian Standard Code of Practice for Design Loads (other than earthquakes) for Buildings and Structures, Part 3, Wind Loads". There are six basic wind speeds ' $V_b$ ' considered for zoning, namely 55, 50, 47, 44, 39 and 33 m/s. From wind damage view point, these could be described as follows:

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Design Wind Speed ( $V_z$ ) - The basic wind speed ( $V_b$ ) for any site shall be modified to include the following effects to get design wind velocity at any height ( $V_z$ ) for the chosen structure:

- a) Risk level;
- b) Terrain roughness, height and size of structure; and
- c) Local topography. It can be mathematically expressed as follows:

$$V_z = V_b k_1 k_2 k_3$$

$V_z$  = Design wind speed at any height  $z$  in m/s;

$V_b$  = Basic Wind Speed

$k_1$  = Probability factor (risk coefficient)

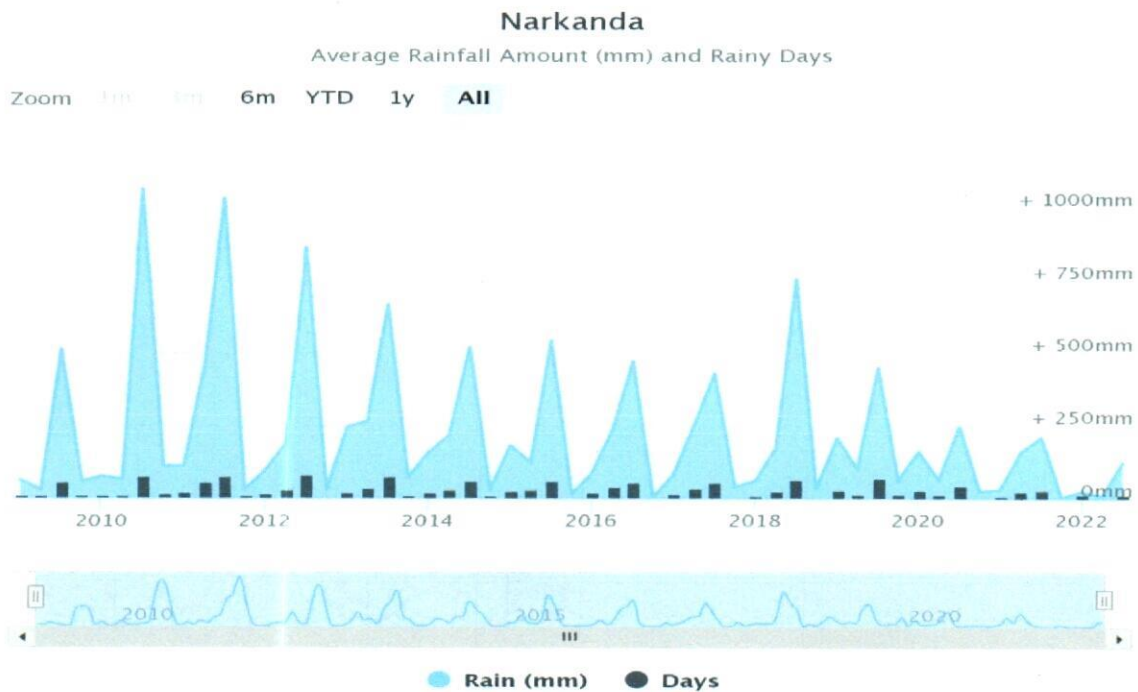
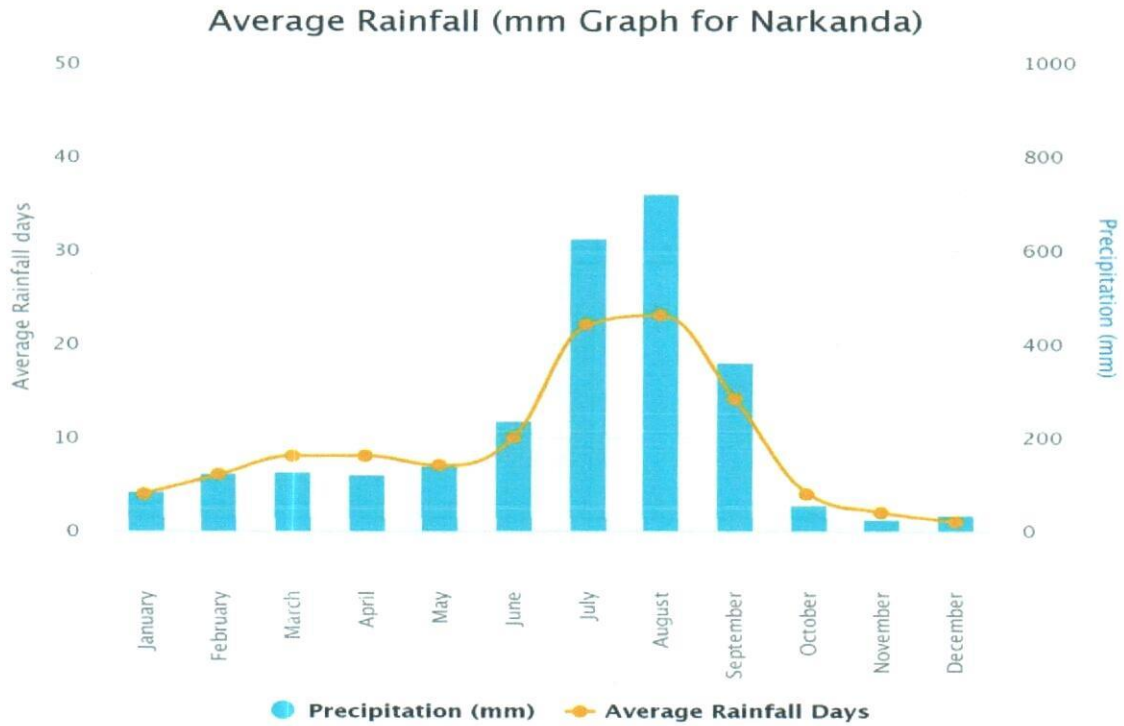
$k_2$  = Terrain, height and structure size factor

$k_3$  = Topography factor

The basic wind speeds are applicable to 10 m height above mean ground level in an open terrain with a return period of 50 years. Narkanda, Himachal Pradesh lies on 39 m/s band of wind speed. **Therefore, Narkanda lies in Moderate Damage Risk Zone-B. However, from production point of view the wind velocity can reduce the thermal losses, therefore moderate basic wind velocity is favorable for PV solar projects.**



- c. **Rainfall:** To show variation within the months and not just the monthly totals, we show the average rainfall for Year 2010 to Year 2022 (as on date)



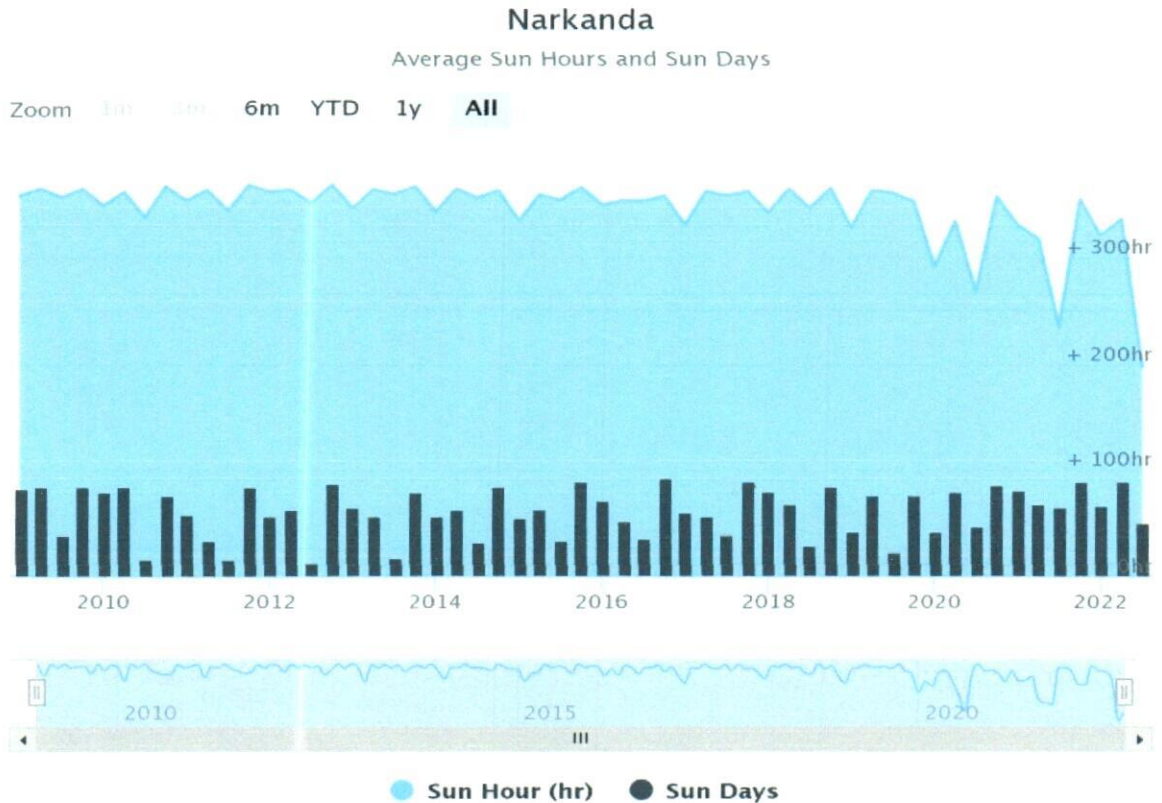
WorldWeatherOnline.com

Source: <https://www.worldweatheronline.com/narkanda-weather-averages/himachal-pradesh/in.aspx>



***While the rain itself will have no impact on the panels, the rain clouds can lower the electricity production. However, the occasional rainstorm could actually be good for solar system's production, because with no extra effort it can naturally clean the panels. Since Narkanda falls under low rain zone therefore it is ok for the solar projects***

**d. Average Sun Hours and Sun Days:**



WorldWeatherOnline.com

Source: <https://www.worldweatheronline.com/narkanda-weather-averages/himachal-pradesh/in.aspx>



{Table: 2}

NARKANDA, HIMACHAL PRADESH						
Year	2019		2020		2021	
Days/Year	Sun Day	Sun Hour	Sun Day	Sun Hour	Sun Day	Sun Hour
January	16	328	5	271	26	335
February	5	302	20	309	25	309
March	21	353	16	293	29	347
April	26	359	26	338	23	311
May	24	369	28	348	23	314
June	25	360	24	315	22	327
July	5	361	19	262	14	244
August	6	362	4	204	21	232
September	12	357	24	336	29	228
October	23	372	31	372	30	359
November	25	348	26	347	30	360
December	27	336	28	350	28	343
<b>Total</b>	<b>215</b>	<b>4207</b>	<b>251</b>	<b>3745</b>	<b>300</b>	<b>3709</b>

AVERAGE SUN DAYS	AVERAGE SUN HOURS
<b>255 Days</b>	<b>3887 Hours</b>

As per last 3-year data, average sun days are 255 days and average sun hours in an year are 3887 hours recorded at Narkanda, Himachal Pradesh.





### e. Irradiation map of Project Location

**Solar irradiance** is the power per unit area (watt per square metre,  $W/m^2$ ), received from the Sun in the form of electromagnetic radiation as reported in the wavelength range of the measuring instrument.

**Global Horizontal Irradiance (GHI)** is the total amount of shortwave radiation received from above by a surface horizontal to the ground. This value is of particular interest to photovoltaic installations and includes both Direct Normal Irradiance (DNI) and Diffuse Horizontal Irradiance (DIF).

**Diffuse Horizontal Irradiance** is the amount of radiation received per unit area by a surface that does not arrive on a direct path from the sun, but has been scattered by molecules and particles in the atmosphere. Basically, it is the illumination that comes from clouds and the blue sky.

Map data			Per year
PVOUT specific	1570.0	kWh/kWp	▼
DNI	1723.2	kWh/m <sup>2</sup>	▼
GHI	1813.8	kWh/m <sup>2</sup>	▼
DIF	702.3	kWh/m <sup>2</sup>	▼
GTI opta	2065.5	kWh/m <sup>2</sup>	▼
OPTA	32 / 180	°	▼
TEMP	21.8	°C	▼
ELE	962	m	▼

#### Annual averages

Direct normal irradiation

**1775.6**

kWh/m<sup>2</sup> per year ▼

#### Monthly averages

Direct normal irradiation



Source:

<https://globalsolaratlas.info/detail?c=31.398191,77.609482,11&s=31.398444,77.609611&m=site>

- f. Shadow Analysis and Obstruction:** The site of a Roof Mounted location should be free from any nearby building or structure. We have verified through google map location and our site visit conducted on 26<sup>th</sup> August 2022 that there is no obstruction by shadow on the structure from nearby site.
- g. Water Availability:** Plant will require module cleaning during dry spells. Cleaning may require substantial quantities of water approx. 2.0 liters per module depending upon the manpower available and degree of soiling. The company has proposed to use Borewell for the same. Bank to ensure that Groundwater abstraction clearance is available with the company.

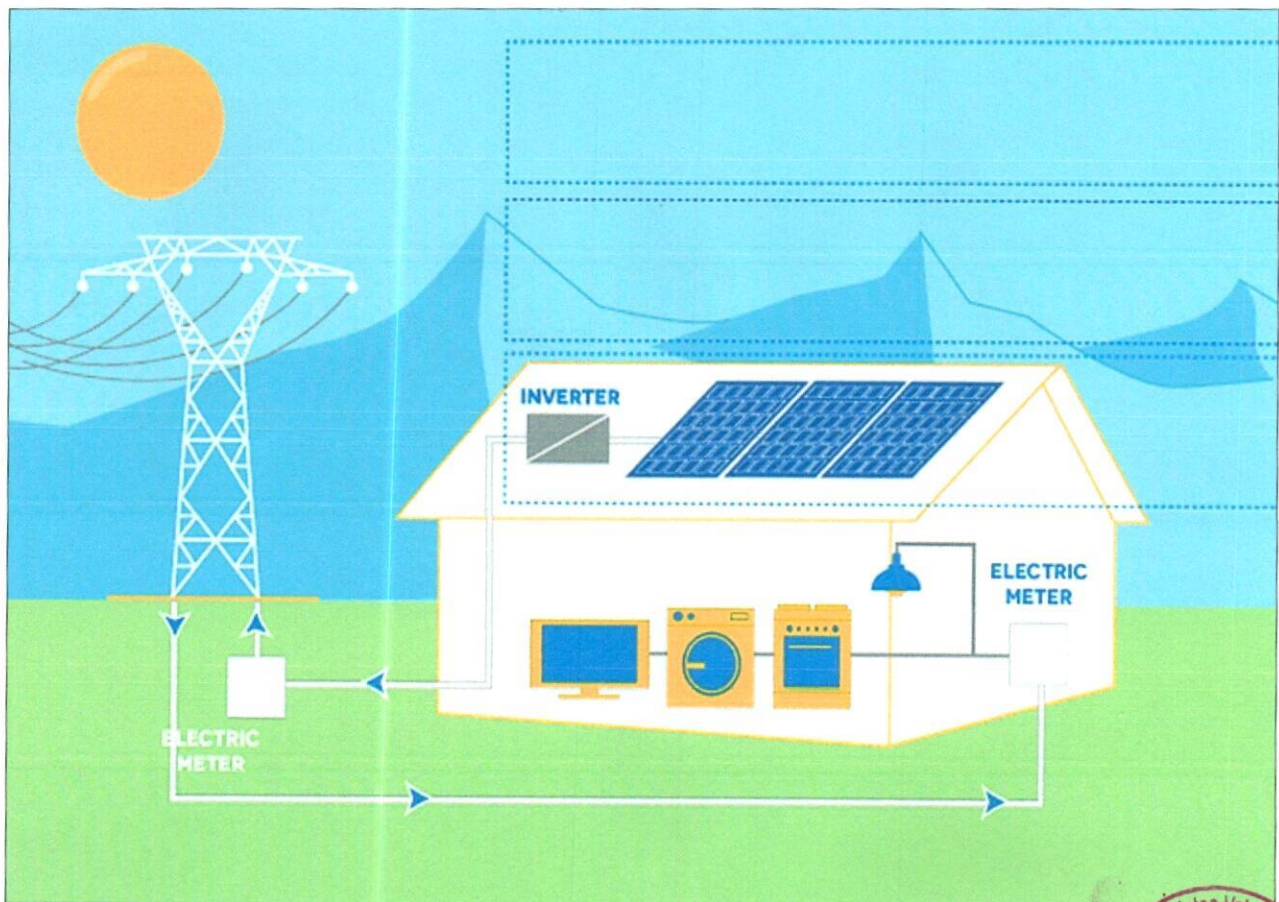




**PART D****PROJECT TECHNICAL DETAILS****1. PLANT CONFIGURATION (LOCATION 1 AND LOCATION 2)**

The solar power harnessing in both the Rooftop Solar Power plant projects will be done by using the below mentioned components in the project:

- i. Solar Panels
- ii. Solar Inverters
- iii. Transformer
- iv. Other ancillary machinery components

**2. SOLAR PV ENERGY PRODUCTION PROCESS:**

**3. COMPONENTS AND ITS TECHNICAL SPECIFICATIONS:****a. Plant Type:** Basically, there are three types of Solar Power Plants:

- **Off Grid Solar Power Plant:** Off grid is a battery based solar power system. In the first priority this system will run your home appliances or connect load (as per solar inverter capacity) and surplus power feed in to the solar battery bank, provided with the solar power system. This type of solar power is recommended where power cut is the major problem.
- **On Grid Solar Power Plant:** On grid solar system is grid (Government electricity supply) connected system. In the first priority this system will run your home appliances or connect load (without any limit). If the connected load will exceed the capacity of installed solar power plant it will automatically use the power from main grid and if the connected load is less, it will supply surplus power to the grid. This type of system is recommended to reduce electricity bills only.
- **Hybrid Solar Power Plant:** Hybrid is a combination of on grid solar system as well as off grid solar system. One side hybrid solar system connects with the main electricity grid and simultaneously it will also provide battery backup to you.

***Indraprastha Ice and Cold Storage (P) Limited has proposed to set-up an On-Grid Rooftop PV Module Solar Power Plant in projects at both the locations. The company has also proposed to use net metering system for the same.***

- b. PV Module Type and Configuration:** Solar panels can be categorized on the basis of various parameters like the number of junctions they have or the generation they belong to. On the basis of the number of junctions, there are single-junction and multi-junction solar panels that differ in terms of the number of layers in the solar panel. Then there is another way of classifying solar panels i.e., with regards to the generation they belong to, which focuses on the material and efficiency of different types of solar panels.





**1<sup>ST</sup> GENERATION SOLAR PANELS**

These are basic solar panels that are made up of Mono-crystalline silicon or polycrystalline silicon and are used in conventional surroundings.

- **Mono-Crystalline solar panels (Mono-Si):** These are made up of mono-crystalline silicon. They have a dark look throughout the panel and rounded edges. These panels have the highest efficiency rate due to the high purity of the silicon used. They are most expensive because of their quality of occupying less space, high power output and long durability.

In India, Mono-Crystalline solar panels are available in a panel efficiency range of 17%, 18% and 19%.

- **Polycrystalline solar panels (Poly-Si):** Their production technology is based on melting raw silicon. Their outer structure has square cells, angles that are uncut and they are blue in colour. They are cheaper than Mono-Si because they occupy more space to generate the same amount of energy as compared to Mono-Si. Polycrystalline solar panel technology is the more prevalent technology in the world. These solar panels are made out of polycrystalline silicon which can be as much as 99.99% pure. These panels have an efficiency of between 13%-17%. Polycrystalline solar cells have lower efficiency and costs than Mono Crystalline solar cells. But that is changing over time and today few brands of polycrystalline solar panels are offering efficiency levels of 20%+. These are blue in Color.

**2<sup>ND</sup> GENERATION SOLAR PANELS**

These panels comprise different types of thin film solar cells that are primarily used to build solar power systems with low power output.

- **Thin film solar panels (TFSC):** These are a less expensive option. They are made by placing one or more films of photovoltaic material onto a substrate. These are cheaper as less material is used in its manufacturing. They are not suitable for residential purpose because they require large spaces to generate sufficient energy. They have shorter warranties in comparison to their 1<sup>st</sup> generation counterparts. They are best suited for the areas that have ample open space for installation.
- **Amorphous silicon solar panels (A-Si):** These types of solar panels use a triple layer technology which is considered to be the best in the thin film variety. They are available at very low costs but provide efficiency of only 7%.

**3<sup>RD</sup> GENERATION SOLAR PANELS**

Solar panels belonging to this generation use organic as well as inorganic materials. These include a variety of thin film panels and some of them, such as 'bio hybrid solar cells', are still in the development phase.

- **Cadmium Telluride solar panels (CdTe):** These solar panels are manufactured using Cadmium Telluride. They are efficient as their manufacturing cost is very low and require very less amount of water to be produced. The primary advantage of these panels is that they can reduce carbon footprints significantly while their only disadvantage is that they can lead to fatalities if ingested or inhaled.
- **Concentrated PV panels (CVP or HCVP):** These panels are the most efficient type of solar panels with an efficiency of 41%. They use curved mirror surfaces and lenses and cooling systems are also integrated to make them more efficient. These are multi-junction solar panels which can be best efficient when they receive sun rays at a perfect angle.

**4<sup>TH</sup> GENERATION SOLAR PANELS**

The fourth-generation solar cell technology is also referred to as the 4G solar cell technology. This technology makes use of the combination of inorganic and organic materials, as a means to boost the efficiency and cost-effectiveness of solar cells. The 4G solar cells are engineered at solar scale and are characterized by the flexibility of conducting polymer films (the organic materials), and the stable nanostructures (inorganic materials).

Indraprastha Ice and Cold Storage Private Limited (IICSPL) has proposed to use either Half cut Mono Crystalline P type PERC bifacial solar cells or Waaree's WSMD series Mono PERC PV modules in both the projects. These PV panels are readily available in Indian markets at lower unit prices with proven lifelong performance. Technical data of the proposed modules is attached below in this report.





#### 4. SURFACE AZIMUTH ANGLE:

The azimuth angle is the compass direction from which the sunlight is coming. For the countries like India which falls in Northern Hemisphere, the best orientation is directly to South. However even if solar panels face outside true south up to maximum  $45^{\circ}$  (south-west, south-east), the annual production goes rather limited reduction (1-3%). The solar radiation that the panel receives is almost the same. However, if the panel are turned at an angle greater than  $45^{\circ}$  compared to true south, production begins to decrease significantly.

*In the PySyst Report provided by the client, Azimuth angle is taken as  $20^{\circ}$  in both the projects.*

#### 5. TILT ANGLE:

**Ideally, a fixed, roof-mounted solar energy system should be at an angle that is equal to the latitude of the location where it is installed.** However, pitch angles between 30 and 45 degrees will work well in most situations. Overall, the angle of rooftop has less impact on solar panel performance than the direction your roof faces. Optimal electricity production occurs when solar panels face south at a tilt equal to  $30^{\circ}$ .

The optimal tilt angle of the panel changes for every month, therefore, it is required to have a tilt adjustment schedule on a seasonal basis so that adjustment frequency of angle will be minimized and the output energy of the panel is maximized. However, this is not always feasible practically to adjust the panel at every tilt angle as it also increases the cost and works in the installation process of the panel.

The monthly optimal angle varies between  $10^{\circ}$  and  $40^{\circ}$  throughout the year. For fixed tilt angle throughout the year, the angle of the latitude is preferred. This is one fixed orientation where the panel almost always intercepts the greatest amount of solar radiation during the year.

*The coordinates for the project at Location 1 are  $28^{\circ}42'44.9''N$   $77^{\circ}10'24.6''E$  and coordinates for the project at Location 2 are  $31^{\circ}23'54.8''N$   $77^{\circ}36'35.3''E$ . However, in the PVsyst Report provided by the client, tilt angle is taken as  $10^{\circ}$  for both the projects.*

**PART E****PHYSICAL PROGRESS AT SITE****LOCATION 1: Azadpur Mandi, Delhi (Observations as per Site visit date 25<sup>th</sup> August 2022)**

- Erection works of solar PV modules in the project have not yet commenced and no fresh material pertaining to this project was found to be delivered to the site.
- The company's representative has showed us the Rooftop location where the project is proposed to be erected. Site Photographs of the same are attached as annexures with this report.
- During site visit it was informed to us that the Rooftop Solar power plant will be installed

**LOCATION 2: Kullu, Himachal Pradesh (Observations as per Site visit date 26<sup>th</sup> August 2022)**

- The company was setting up a 7500 metric ton controlled atmosphere cold storage for apples. Currently the same was under construction. However, the construction of the same out of scope of this report. Bank to take note of this.
- Erection works in the project (Installation and commissioning of 1.2 MW Solar power plant) have not yet commenced and no fresh material pertaining to this project was found to be delivered to the site.
- The company's representative has informed us that installation and commissioning of solar modules will be done on the roof of under construction cold storage facility. Site Photographs of the rooftop is not available. However, the site photographs of under construction cold storage facility on which the installation and commissioning of solar power plant is proposed to be done is attached as annexures with this report.





**PART F****PLANT INFRASTRUCTURE SECTIONS & FACILITY DETAILS****LOCATION 1:** IICSPL facility at Azadpur mandi in Delhi (200 kW Solar Power project)**1. LAND DETAILS:**

For setting up of these Power Plants, Indraprastha Ice and Cold Storage private limited (IICSPL) has proposed to use the roof top of Control atmosphere cold storage for apples at IICSPL facility at Azadpur mandi in Delhi. Therefore, no land parcel is required for erection and commissioning of this Rooftop Mounted solar power plant project.

**2. BUILDING AND STRUCTURAL DETAILS:**

No major Building/ Structures is proposed to be set-up by IICSPL for this project since it is proposed to be setup on the roof of the existing structure at Azadpur mandi, Delhi. However, the basic steel Column mounting structure will be used since the rooftop is made up of RCC and has some low-level obstructions like spilt units, wires, water tanks, etc.

**3. PLANT, MACHINERY AND MISCELLANEOUS FIXED ASSETS:****i. SOLAR PANELS**

- Features of **proposed solar panels** by **Adani power** at both the locations as per Project report:
  - The selected Adani module is the Elan Shine Mono PERC Bifacial PV modules.
  - The module has a capacity of 520-545 Wp peak power and has 144 cells.
  - The Bifacial gain is expected to be around 10-25% of the total power produced.
  - The gain will be due to the bifacial factor and the ground reflection.
  - The Solar PV module provides a warranty for 98% + power output in the first year, thereafter, from year 2 to 30, the maximum decrease in power output shall be 0.55% from module's nominal power output per year, ending with around 82% in the 30th year after the defined warranty start date.
  - The product warranty shall be 12 years.
  - The performance warranty shall be for 30 years.
  - Data Sheet of proposed Adani Power solar module is as below





## ELAN SHINE Series

Bifacial PV Modules  
MBB P-Type PERC Half-cut

ASB-M10-144-AAA (AAA=520-545) | 144 Cells | 520-545 Wp

### Highlights



MBB cell technology - excellent anti-microcracking performance with more balanced interior stress: grid pattern current path, lower cost



Up to 600 Wp at 15% bifaciality Gain\*\*  
Up to  $70 \pm 5\%$  bifaciality Factor



Longer Product life and performance -0.45 year over year degradation with 30 years warranty on power



Least Degradation for LID e, LeTID



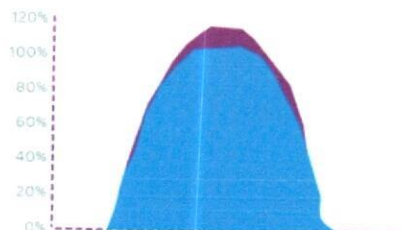
Modules Made with Ga doped wafer, Smart soldering, 10BB



Excellent PID Resistance

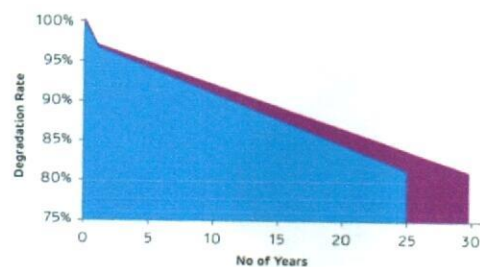
### Higher generation due to bifacial technology

Adani bifacial module Monofacial module



### Warranty based on Power

Adani Linear Warranty STD Linear Warranty

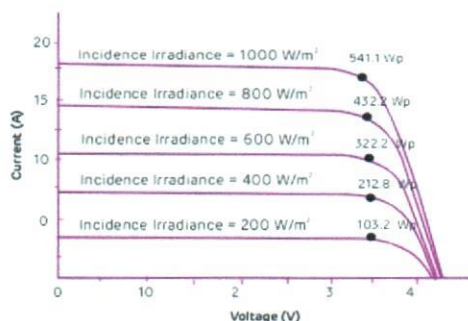




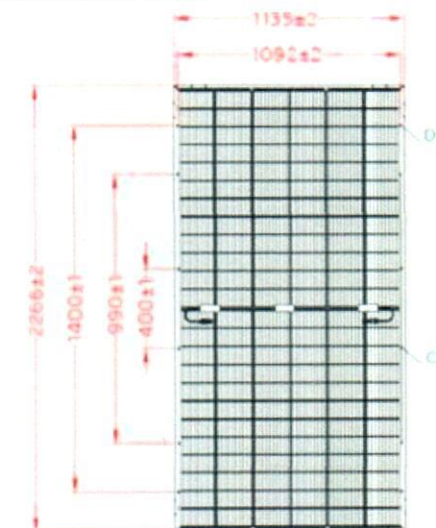
www.adanisolar.com

**adani**  
 Solar

## Technical Data

 Multi irradiance curve for  
 ASB-M10-144-AAA  
 Cell temp. 25°C


Dimensions in mm



### Warranty and certifications

#### Product warranty\*\*

12 years of product warranty

#### Performance guarantee\*\*

 Power degradation < 2.0 % in first year  
 < 0.55 % / year in 2-30 years

Approvals and certificates\*: IEC 61215 Ed2, IEC 61730, IEC 61701, UL 1703, MCS, JET, CEC, CEC-Aus, IEC 62716, IEC 62782, IEC 60068-2-68, IEC 61853, BIS

\*All certifications are under process



### Electrical data – All data measured to STC\*

Electrical Specification	Only front (STC)					
Peak power, (0 ~+ 4.99 Wp)						
P <sub>max</sub> (Wp)	520	525	530	535	540	545
Maximum voltage, V <sub>mpp</sub> (V)	41.19	41.34	41.49	41.64	41.80	41.94
Maximum current, I <sub>mpp</sub> (A)	12.65	12.73	12.79	12.86	12.93	13.01
Open circuit voltage, V <sub>oc</sub> (V)	48.18	48.36	48.57	48.72	48.92	49.07
Short circuit current, I <sub>sc</sub> (A)	13.54	13.62	13.70	13.74	13.84	13.92
Module efficiency (%)	20.22	20.41	20.61	20.80	21.00	21.19

\*STC: Irradiance 1000 W/m², cell temperature 25°C, air mass AM1.5 according to EN 60904-3. Average efficiency reduction of 4.5 % at 200 W/m² according to EN 60904-1. Except P<sub>mp</sub>, all other parameters have a tolerance of ±1.3 %, measurement uncertainty < 3 %.

### Electrical Characteristics with different rear side power gain (Reference 525 Wp Front)

Electrical Specification	P <sub>max</sub> gain from rear side*			
Bifaciality Gain	10%	15%	20%	25%
Peak power, (0 ~+ 4.99 Wp) P <sub>max</sub> (Wp)	575	600	630	650
Maximum voltage, V <sub>mpp</sub> (V)	41.35	41.35	41.36	41.36
Maximum current, I <sub>mpp</sub> (A)	13.89	14.50	15.25	15.75
Open circuit voltage, V <sub>oc</sub> (V)	48.36	48.36	48.36	48.36
Short circuit current, I <sub>sc</sub> (A)	15.01	15.66	16.47	17.01
Module efficiency (%)	22.36	23.33	24.50	25.27

\* Power gain from rear side depends upon the ground reflectance (Albedo) &amp; Bifaciality factor

### Temperature co-efficients (T<sub>c</sub>) and permissible operating conditions

T <sub>c</sub> of open circuit voltage (β)	-0.29% /°C
T <sub>c</sub> of short circuit current (α)	0.045 % /°C
T <sub>c</sub> of power (γ)	-0.35 % /°C
Maximum system voltage	1500 V (IEC & UL)
NOCT	44°C ± 2°C
Temperature range	-40°C to + 85°C

### Mechanical data

Length	2266 mm
Width	1135 mm
Height	35 mm
Weight	33.5 kg
Junction box	IP68; Junction box, MC4 compatible
Cable and connectors	300 mm length cable, MC4 & Amphenol compatible connectors
Application class	Class A (Safety class II)
Superstrate	2.0mm High Transmission ARC, Heat Strengthened Glass
Cells	144 Half-cut mono-crystalline P-type PERC bifacial solar cells; MBB bus bars
Encapsulation	High volume resistivity and low MVTR
Substrate	Semi Tempered Glass-2.0 mm
Frame	Anodized Frame
Mechanical load test as per IEC & UL	5400 Pa-front; 2400 Pa-back*
Maximum series fuse rating	25 A

### Packaging Configuration

Container	40'HC
Pallets / Container	19
Pieces / Container	589

#### Note:

- The specifications included in this datasheet are subject to change without notice.
- The electrical data given here is for reference purpose only.
- Please confirm your exact requirements with the sales representative while placing your order.

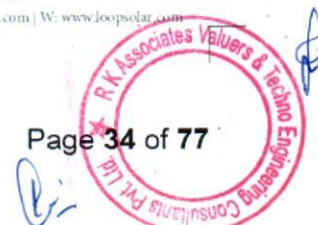
#### \*\* Warranty:

Please read Adani solar warranty documents thoroughly.

#### \*Caution:

Please read safety and installation instructions before using the product.

Authorized distributor: Loop Solar | P: +91-9971136369 | E: info@loopsolar.com | W: www.loopsolar.com



- Features of **proposed solar panels** by **Waaree** at both the locations as per Project report:
  - The selected Waaree module is the WSMD Arka series Mono PERC PV mod-ules. The module has a capacity of 515–545 Wp peak power and has 144 cells.
  - The Solar PV module provides a warranty for 98% + power output in the first year, thereafter, from year 2 to 27, the maximum decrease in power output shall be 0.55% from module's nominal power output per year, ending with around 81.9% in the 27th year after the defined warranty start date.
  - The product warranty shall be 12 years.
  - The performance warranty shall be for 27 years.
  - Data Sheet of proposed waaree solar modules is as below:





## ARKA SERIES

WSMD-515 to WSMD-545

**WAAREE**<sup>®</sup>

One with the Sun



Highest reliability & enhanced crack tolerant 10BB module



Module utilizing Half cut cell for optimum performance



Highly efficient Mono PERC M10 cells



Best in class thermal coefficients



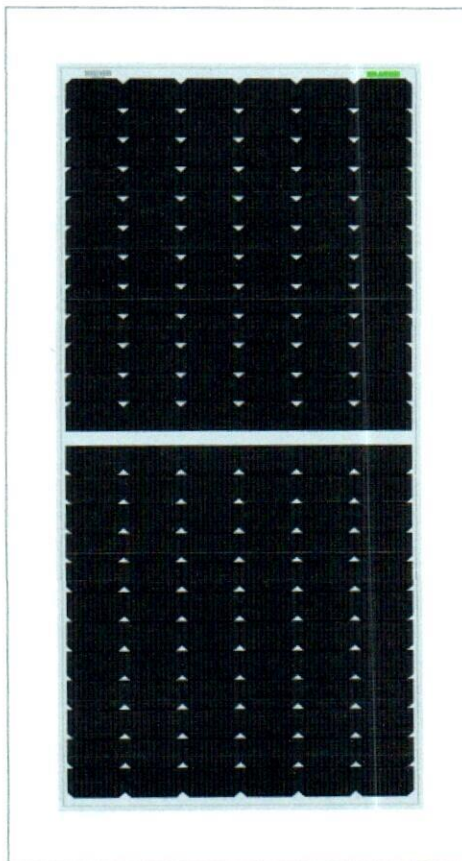
Highest commercial gains, lower LCOE



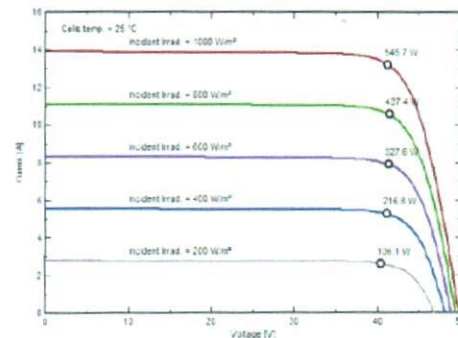
Split junction box improve heat dissipation



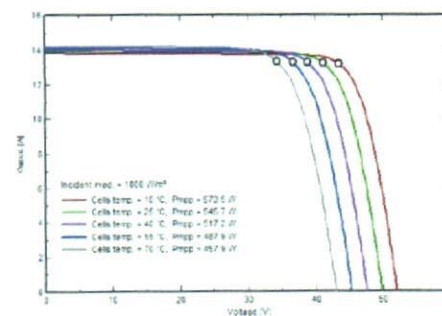
Increase shade tolerance



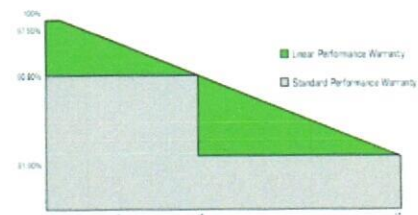
## I-V VARIATION WITH IRRADIANCE



## I-V VARIATION WITH TEMPERATURE



The Graphs are for reference purpose only. Please consult Waaree technical team for further clarifications.



ISO 9001:2015 | ISO 14001:2015 | ISO 45001:2018  
 Independent assessment of factories by BLACK & VEATCH

www.waaree.com

**ARKA SERIES**

WSMD-515 to WSMD-545

**WAAREE**  
 One with the Sun
**ELECTRICAL CHARACTERISTICS**

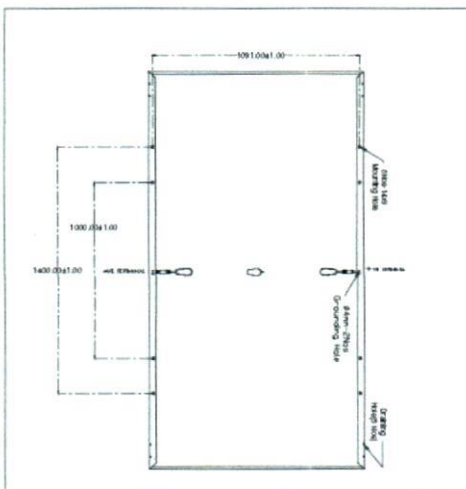
Models	Pmax (W)		Vmp (V)		Imp (A)		Isc (A)		Voc (V)		Module Eff. (%)
	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	
WSMD-515	515	388.3	40.99	37.70	12.57	10.29	13.49	10.89	48.86	45.80	20.01
WSMD-520	520	391.9	41.14	37.90	12.65	10.34	13.55	10.94	49.01	46.00	20.20
WSMD-525	525	395.6	41.29	38.00	12.73	10.40	13.63	11.00	49.16	46.10	20.39
WSMD-530	530	399.2	41.45	38.20	12.80	10.45	13.69	11.05	49.31	46.20	20.59
WSMD-535	535	403.1	41.60	38.40	12.88	10.51	13.76	11.11	49.46	46.40	20.78
WSMD-540	540	406.7	41.75	38.50	12.95	10.56	13.83	11.16	49.61	46.50	20.98
WSMD-545	545	410.4	41.90	38.70	13.02	10.62	13.90	11.22	49.76	46.70	21.17

\*Standard Test Conditions (STC) - 1000 W/m<sup>2</sup> irradiance, Air Mass 1.5 and 25 °C cell temperature. Nominal Operating Cell Temperature (NOCT) - 800 W/m<sup>2</sup> irradiance, Air Mass 1.5, Ambient temperature 20 °C and Wind speed 1 m/s. Average power reduction of 4.5% at 200 W/m<sup>2</sup> as per IEC 60904-1. Measuring Uncertainty: ± 3%.

System Voltage	1500 V	Series Fuse Rating	25 A
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**MECHANICAL CHARACTERISTICS**

Length x Width x Thickness (L x W x T)	2272 mm (L) x 1133 mm (W) x 35 mm (T)
Weight	27.5 kgs
Solar Cells per Module (Units) / Arrangement	144 cells / (12x6    12x6)
Solar Cell Type & Size	Mono PERC, 91 x 182 mm
Front Glass	3.2 mm Low Iron and Tempered glass with ARC coating
Encapsulate	PIG Free & UV Resistant
Junction Box (Protection degree/ Material)	IP68 / Weatherproof PPO
Cable & Connector (Protection degree / Type)	IP68 rated / MC4 compatible
Cable cross - section & Length	4 mm <sup>2</sup> & 500mm
Frame	Anodized Aluminium Alloy

**DESIGN SPECIFICATIONS**

12 Years Product Warranty • 27 Years Power Output Warranty

- The electrical data given here is for reference purpose only.
- Please confirm your exact requirements with the sales representative while placing your order.
- Refer installation Manual instructions & Waaree warranty statement for terms & conditions.
- Waaree Reserves the right to change the specifications without prior notice.

**THERMAL CHARACTERISTICS**

Temperature coefficient of Current (Isc), $\alpha$ (%/°C)	0.05
Temperature coefficient of Voltage (Voc), $\beta$ (%/°C)	-0.27
Temperature coefficient of Power (Pm), $\gamma$ (%/°C)	-0.35
NOCT (°C)	43 ± 2
Operating temperature range (°C)	-40 to 85

Waaree Energies Ltd. is amongst the top Solar Energy Companies and has the country's largest Solar PV Module manufacturing capacity of 5 GW. In addition, it is committed to provide top notch EPC services, project development, rooftop solutions, solar water pumps and also in an Independent Power Producer. Waaree has its presence in over 325+ locations nationally and 68 countries globally.

\*If you need specific product certificates, and if module installations are to deviate from our guidance specified in our installation manual, please contact your local Waaree sales and technical representatives.

WEL/ESP/515-545/144/MP/HQ/03/20.05.2021

www.waaree.com





- Technical Details of PV modules as per PVsyst V6.88 report of Location 1 (IICS Cold storage facility, Azadpur mandi, Delhi) is as below:
  - PV Module: Si-Mono Model
  - Model: TSM-540DE18M(II)
  - Manufacturer: Adani Power
  - No. of PV modules in series: 18 Modules
  - Total No. of PV modules: 380 Modules
  - Total Module area: 960 Sq. mtr.
  - Total Cell area: 2262 Sq. mtr.
  - 1 Module capacity: 540 kWp
  - Total Capacity: 540 wP \* 380 Modules= 205.20 Kw

**Note:** As per PV syst report the company has used Adani power solar modules for analysis. However, the manufacturer of the module is yet to be finalized by the company.

## ii. SOLAR INVERTERS

- Features of **proposed solar inverters** by Solis at both the location as per Project report:
  - Solis is one of the top 3 inverter manufacturers in Asia. The company has opted for 80K PV Solar Inverter - 80K-5G-DC make inverters. The main features of the inverter are as under:
    - Max. 13A per string, support 1.5 DC overloading capability.
    - 10 individual MPPT, lower mismatch loss
    - Efficient logic algorithm, over 99% max. Efficiency
    - String monitoring, shorter O&M time
    - Remote & local intelligent IV scan function
    - Leakage current repression technology
    - Volt-watt work mode integrated
    - DC input reverse alarm
    - Optional anti-PID function integrated
    - Reactive power compensation function.
    - The model has a 5-year warranty which is extendable to 20 years on purchase of extended warranty packages.



- Data sheet of proposed Solis inverters:

[illegible]



# Solis-80K-5G, Solis-(80-110)K-HV-5G

## Solis 5G Three Phase Inverters



### Features:

- Max. 135 per string, support 1.5 DC overloading capability
- 10 individual MPPT, lower mismatch loss
- Efficient logic algorithm, over 99% max. Efficiency
- String monitoring, shorter O&M time
- Remote & local intelligently scan function
- Leakage current repression technology
- Volt-watt work mode integrated
- DC input reverse alarm
- Optional anti-IPD function integrated
- Reactive power compensation function

### Model:

400V	400V	1000V	1000V
Solis-80K-5G	Solis-80K-HV-5G	Solis-100K-HV-5G	Solis-110K-HV-5G



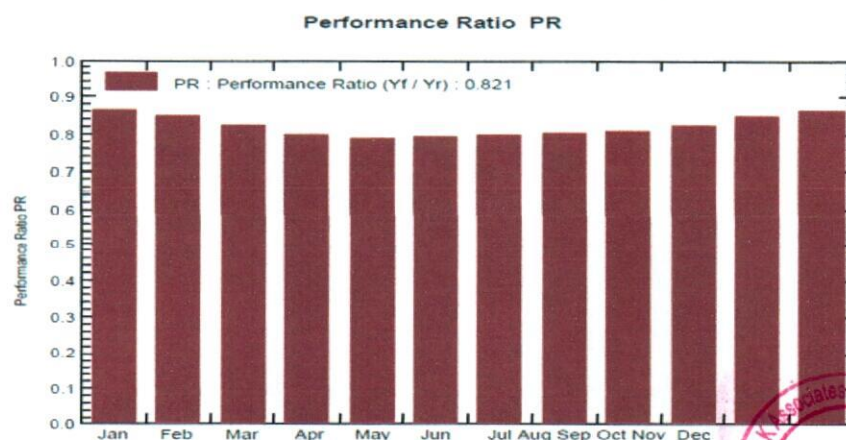


- Technical Details of Solar Inverters as per PVsyst V6.88 report of Location 1 (IICS Cold storage facility, Azadpur mandi, Delhi) is as below:

- Model: Solar Inverter M100\_210
- Company: Solis energy
- Number of Inverters: 2 Units
- Operating Voltage: 590-1000 V
- Nominal Power: 100Kwac

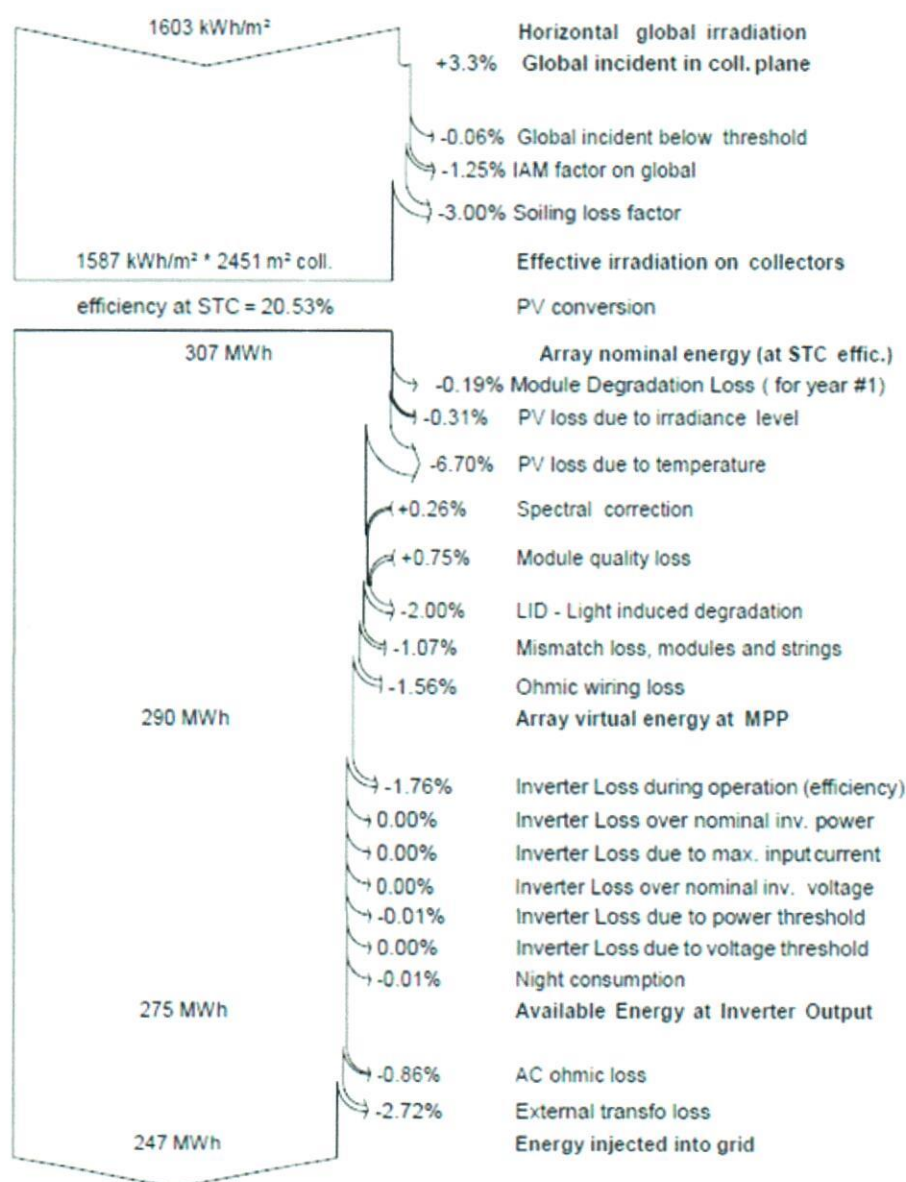
### iii. Important catch points from PVsyst V6.88 Report dated 11<sup>th</sup> June 2022

- Produced Energy: 307.50 MWh/year
- Performance Ratio: 80.18%
- PV Field Orientation
  - Tilt: 10 Degrees
  - Azimuth: 20 Degrees
- No. of Modules: 380 Nos
- Pnom of Modules: 205 kWp
- Nos. of Inverters: 2 Units
- Pnom of Inverters: 200 kW AC
- Produced Energy (EArray): 307.50MWh/Year, Spec. Production: 1500 kWh/kWp/year (EArray: Effective energy at the output of the array)
- Performance Ratio: 80.18 % against industrial accepted standard PR of 75%.
  - The Performance ratio is decreasing in the summers because of increase in temperature losses due to summer heat effect in the region.



- There is a difference between Performance ratio as per graph and performance ratio mentioned under main simulation results which is 80.18%.
- E\_Grid Energy: 246.27 MW per year (Electricity injected onto the grid)
- Horizontal Global Irradiation: 1603.50 kWh/m<sup>2</sup>
- Loss Diagram

Loss diagram over the whole year





**LOCATION 2: UNDER CONSTRUCTION ROOFTOP OF COLD STORAGE FACILITY AT KULLU, HIMACHAL PRADESH****1. LAND DETAILS**

For setting up of these Power Plants, Indraprastha Ice and Cold Storage private limited (IICSPL) has proposed to use the roof top under construction cold storage facility at Kullu in Himachal Pradesh. Therefore, no land parcel is required for erection and commissioning of this Rooftop Mounted solar power plant project.

**2. BUILDING & STRUCTURAL DETAILS:**

No Building/ Structures are proposed to be set-up by IICSPL for this project as this project is proposed to be setup on the roof Under Construction Cold storage facility at Kullu, Himachal Pradesh and construction of this facility is out of scope of this report and company's proposal for Solar rooftop power plant installation as informed by the company.

**3. PLANT, MACHINERY AND MISCELLANEOUS FIXED ASSETS:****i. SOLAR PANELS**

- Features of **proposed solar panels** by **Adani power** at both the location as per Project report:
  - The selected Adani module is the Elan Shine Mono PERC Bifacial PV modules.
  - The module has a capacity of 520-545 Wp peak power and has 144 cells.
  - The Bifacial gain is expected to be around 10-25% of the total power produced.
  - The gain will be due to the bifacial factor and the ground reflection.
  - The Solar PV module provides a warranty for 98% + power output in the first year, thereafter, from year 2 to 30, the maximum decrease in power output shall be 0.55% from module's nominal power output per year, ending with around 82% in the 30th year after the defined warranty start date.
  - The product warranty shall be 12 years.
  - The performance warranty shall be for 30 years.
  - Data Sheet of proposed Adani Power solar module is as below:





## ELAN SHINE Series

Bifacial PV Modules  
MBB P-Type PERC Half-cut

ASB-M10-144-AAA (AAA=520-545) | 144 Cells | 520-545 Wp

### Highlights



MBB cell technology - excellent anti-microcracking performance with more balanced interior stress: grid pattern current path, lower cost



Up to 600 Wp at 15% bifaciality Gain\*\*  
Up to 70 ± 5 % bifaciality Factor



Longer Product life and performance -0.45 year over year degradation with 30 years warranty on power



Least Degradation for LID e, LeTID

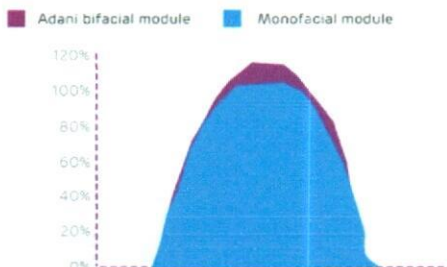


Modules Made with Ga doped wafer, Smart soldering, 10BB



Excellent PID Resistance

### Higher generation due to bifacial technology



### Warranty based on Power

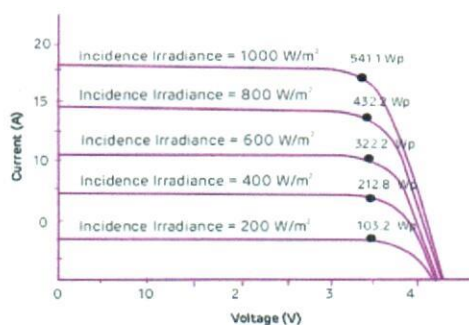




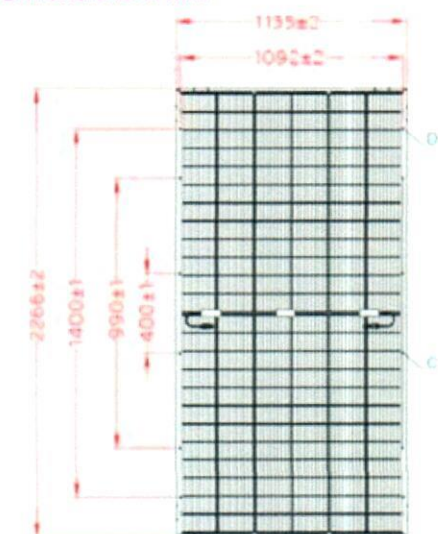
www.adanisolar.com

**adani**  
 Solar

## Technical Data

 Multi irradiance curve for  
 ASB-M10-144-AAA  
 Cell temp: 25°C


Dimensions in mm



## Warranty and certifications

### Product warranty\*\*

12 years of product warranty

### Performance guarantee\*\*

 Power degradation < 2.0 % in first year  
 < 0.55 % / year in 2-30 years

Approvals and certificates\*: IEC 61215 Ed2, IEC 61730, IEC 61701, UL 1703, MCS, JET, CEC, CEC-Aus, IEC 62716, IEC 62782, IEC 60068-2-68, IEC 61853, BIS

\*All certifications are under process



## Electrical data – All data measured to STC\*

Electrical Specification	Only front (STC)					
Peak power, (0 ~+ 4.99 Wp)						
Pmax(Wp)	520	525	530	535	540	545
Maximum voltage, Vmpp (V)	41.19	41.34	41.49	41.64	41.80	41.94
Maximum current, Imp (A)	12.65	12.73	12.79	12.86	12.93	13.01
Open circuit voltage, Voc (V)	48.18	48.36	48.57	48.72	48.92	49.07
Short circuit current, Isc (A)	13.54	13.62	13.70	13.74	13.84	13.92
Module efficiency (%)	20.22	20.41	20.61	20.80	21.00	21.19

 \*STC: Irradiance 1000 W/m², cell temperature 25°C, air mass AM1.5 according to EN 60904-3.  
 Average efficiency reduction of 4.5 % at 200 W/m² according to EN 60904-1. Except Pmp, all other parameters have a tolerance of +/-3 %, measurement uncertainty <3 %

## Electrical Characteristics with different rear side power gain (Reference 525 Wp Front)

Electrical Specification	Pmax gain from rear side*			
Bifaciality Gain	10%	15%	20%	25%
Peak power, (0 ~+ 4.99 Wp) Pmax(Wp)	575	600	630	650
Maximum voltage, Vmpp (V)	41.35	41.35	41.36	41.36
Maximum current, Imp (A)	13.89	14.50	15.25	15.75
Open circuit voltage, Voc (V)	48.36	48.36	48.36	48.36
Short circuit current, Isc (A)	15.01	15.66	16.47	17.01
Module efficiency (%)	22.36	23.33	24.50	25.27

\* Power gain from rear side depends upon the ground reflectance (Albedo) &amp; Bifaciality factor

## Temperature co-efficients (Tc) and permissible operating conditions

Tc of open circuit voltage (β)	-0.29 % / °C
Tc of short circuit current (α)	0.045 % / °C
Tc of power (γ)	-0.35 % / °C
Maximum system voltage	1500 V (IEC & UL)
NOCT	44°C ± 2°C
Temperature range	-40°C to +85°C

## Mechanical data

Length	2266 mm
Width	1135 mm
Height	35 mm
Weight	33.5 kg
Junction box	IP68; Junction box, MC4 compatible
Cable and connectors	300 mm length cable, MC4 & Amphenol compatible connectors
Application class	Class A (Safety class II)
Superstrate	2.0mm High Transmission ARC, Heat Strengthened Glass
Cells	144 Half-cut mono-crystalline P-type PERC bifacial solar cells; MBB bus bars
Encapsulation	High volume resistivity and low MVTR
Substrate	Semi Tempered Glass-2.0 mm
Frame	Anodized Frame
Mechanical load test as per IEC & UL	5400 Pa-front; 2400 Pa-back*
Maximum series fuse rating	25 A

## Packaging Configuration

Container	40'HC
Pallets / Container	19
Pieces / Container	589

### Note:

- The specifications included in this datasheet are subject to change without notice.
- The electrical data given here is for reference purpose only.
- Please confirm your exact requirements with the sales representative while placing your order.

### \*\* Warranty:

Please read Adani solar warranty documents thoroughly.

### \*Caution:

Please read safety and installation instructions before using the product.

Authorized distributor: Loop Solar | P: +91-9971136369 | E: info@loopolar.com | W: www.loopolar.com



- Features of **proposed solar panels** by **Waaree** at both the locations as per Project report:
  - The selected Waaree module is the WSMD Arka series Mono PERC PV mod-ules. The module has a capacity of 515–545 Wp peak power and has 144 cells.
  - The Solar PV module provides a warranty for 98% + power output in the first year, thereafter, from year 2 to 27, the maximum decrease in power output shall be 0.55% from module's nominal power output per year, ending with around 81.9% in the 27th year after the defined warranty start date.
  - The product warranty shall be 12 years.
  - The performance warranty shall be for 27 years.
  - Data Sheet of proposed Waaree solar modules is as below:



## ARKA SERIES

WSMD-515 to WSMD-545

**WAAREE**<sup>®</sup>  
One with the Sun



Highest reliability & enhanced crack tolerant 10BB module



Module utilizing Half cut cell for optimum performance



Highly efficient Mono PERC M10 cells



Best in class thermal coefficients



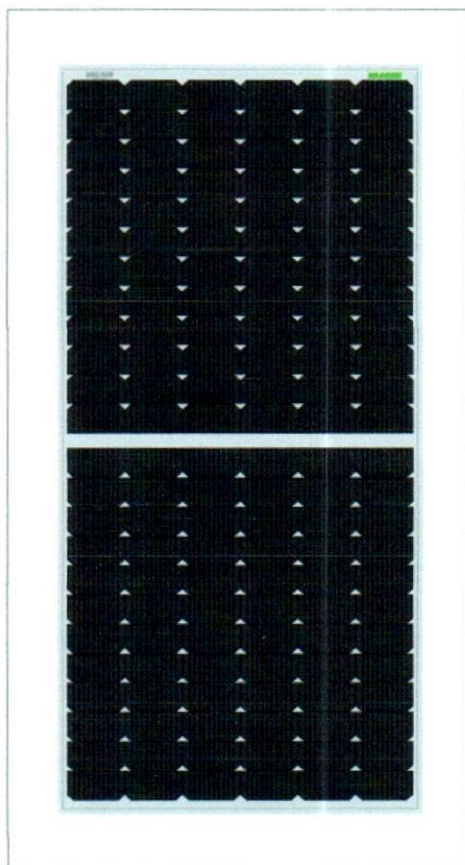
Highest commercial gains, lower LCOE



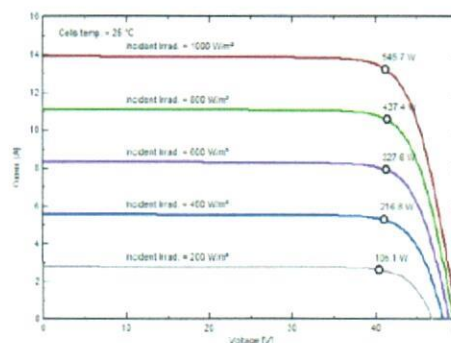
Split junction box improve heat dissipation



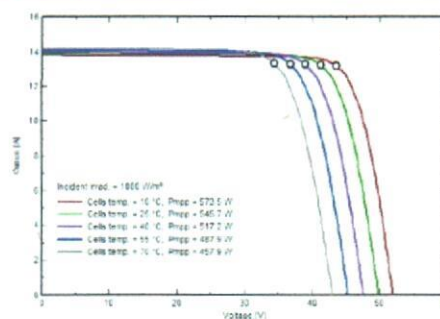
Increase shade tolerance



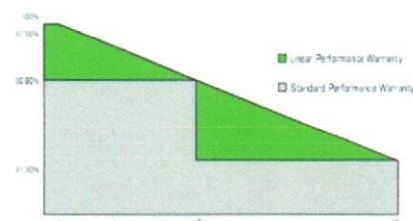
## I-V VARIATION WITH IRRADIANCE



## I-V VARIATION WITH TEMPERATURE



The Graphs are for reference purpose only. Please consult Waaree technical team for further clarifications.



ISO 9001:2015 | ISO 14001:2015 | ISO 45001:2018  
Independent assessment of factories by BLACK & VEATCH

www.waaree.com

## ARKA SERIES

WSMD-515 to WSMD-545

**WAAREE**  
 One with the Sun

## ELECTRICAL CHARACTERISTICS

Models	Pmax (W)		Vmp (V)		Imp (A)		Isc (A)		Voc (V)		Module Eff. (%)
	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	
WSMD-515	515	388.3	40.99	37.70	12.57	10.29	13.49	10.89	48.86	45.80	20.01
WSMD-520	520	391.9	41.14	37.90	12.65	10.34	13.55	10.94	49.01	46.00	20.20
WSMD-525	525	395.6	41.29	38.00	12.73	10.40	13.63	11.00	49.16	46.10	20.39
WSMD-530	530	399.2	41.45	38.20	12.80	10.45	13.69	11.05	49.31	46.20	20.59
WSMD-535	535	403.1	41.60	38.40	12.88	10.51	13.76	11.11	49.46	46.40	20.78
WSMD-540	540	406.7	41.75	38.50	12.95	10.56	13.83	11.16	49.61	46.50	20.98
WSMD-545	545	410.4	41.90	38.70	13.02	10.62	13.90	11.22	49.76	46.70	21.17

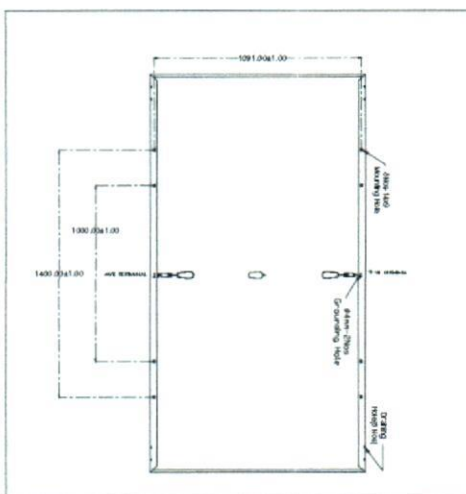
\*Standard Test Conditions (STC) - 1000 W/m<sup>2</sup> irradiance, Air Mass 1.5 and 25°C cell temperature. Nominal Operating Cell Temperature (NOCT) - 800 W/m<sup>2</sup> irradiance, Air Mass 1.5, Ambient temperature 20°C and Wind speed 1 m/s. Average power reduction of 4.5% at 200 W/m<sup>2</sup> as per IEC 60904-1. Measuring Uncertainty ± 3%.

System Voltage	1500 V	Series Fuse Rating	25 A
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## MECHANICAL CHARACTERISTICS

Length x Width x Thickness (L x W x T)	2272 mm (L) x 1133 mm (W) x 35 mm (T)
Weight	27.5 kgs
Solar Cells per Module (Units) / Arrangement	144 cells / (12x6    12x6)
Solar Cell Type & Size	Mono PERC, 91 x 182 mm
Front Glass	3.2 mm Low Iron and Tempered glass with ARC coating
Encapsulate	PID Free & UV Resistant
Junction Box (Protection degree/ Material)	IP68 / Weatherproof PPO
Cable & Connector (Protection degree / Type)	IP68 rated / MC4 compatible
Cable cross - section & Length	4 mm <sup>2</sup> & 500mm
Frame	Anodized Aluminium Alloy

## DESIGN SPECIFICATIONS


**12 Years** Product Warranty • **27 Years** Power Output Warranty

- The electrical data given here is for reference purpose only.
- Please confirm your exact requirements with the sales representative while placing your order.
- Refer installation Manual instructions & Waaree warranty statement for terms & conditions.
- Waaree Reserves the right to change the specifications without prior notice.

## THERMAL CHARACTERISTICS

Temperature coefficient of Current (Isc), $\alpha$ (%/°C)	0.05
Temperature coefficient of Voltage (Voc), $\beta$ (%/°C)	-0.27
Temperature coefficient of Power (Pm), $\gamma$ (%/°C)	-0.35
NOCT (°C)	43 ± 2
Operating temperature range (°C)	-40 to 85

Waaree Energies Ltd. is amongst the top Solar Energy Companies and has the country's largest Solar PV Module manufacturing capacity of 5 GW. In addition, it is committed to provide top notch EPC services, project development, rooftop solutions, solar water pumps and also in an Independent Power Producer. Waaree has its presence in over 325+ locations nationally and 68 countries globally.

\*If you need specific product certificates, and if module installations are to deviate from our guidance specified in our installation manual, please contact your local Waaree sales and technical representatives.

WEL/ESP/515-545/144/MP/HQ/03/20.05.2021

www.waaree.com





- Technical Details of PV modules as per PVsyst V6.88 report of Location 2 (IISCPL, Kullu, Himachal) is as below:
  - PV Module: Si-Mono Model
  - Model: TSM-540DE18M(II)
  - Manufacturer: Adani Power
  - No. of PV modules in series: 19 Modules
  - Total No. of PV modules: 2225 Modules
  - Total Module area: 5621 Sq. mtr.
  - Total Cell area: 2262 Sq. mtr.
  - 1 Module capacity: 540kWp
  - Total Capacity: 540Wp \* 2225 Modules= 1201.50 kW

**Note:** As per PV syst report the company has used Adani power solar modules for analysis. However, the manufacturer of the module is yet to be finalized by the company.

## ii. SOLAR INVERTERS

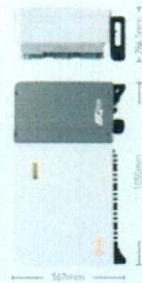
- Solis is one of the top 3 inverter manufacturers in Asia. The company has opted for 80K PV Solar Inverter - 80K-5G-DC make inverters. The main features of the inverter as per project report are as under:
  - Max. 13A per string, support 1.5 DC overloading capability.
  - 10 individual MPPT, lower mismatch loss
  - Efficient logic algorithm, over 99% max. Efficiency
  - String monitoring, shorter O&M time
  - Remote & local intelligent IV scan function
  - Leakage current repression technology
  - Volt-watt work mode integrated
  - DC input reverse alarm
  - Optional anti-PID function integrated
  - Reactive power compensation function.
  - The model has a 5-year warranty which is extendable to 20 years on purchase of extended warranty packages
  - Data sheet of the proposed solar inverter is as below:



80K	100K	120K	140K	160K	180K	200K	220K	240K	260K	280K	300K	320K	340K	360K	380K	400K	420K	440K	460K	480K	500K	520K	540K	560K	580K	600K	620K	640K	660K	680K	700K	720K	740K	760K	780K	800K	820K	840K	860K	880K	900K	920K	940K	960K	980K	1000K	1020K	1040K	1060K	1080K	1100K	1120K	1140K	1160K	1180K	1200K	1220K	1240K	1260K	1280K	1300K	1320K	1340K	1360K	1380K	1400K	1420K	1440K	1460K	1480K	1500K	1520K	1540K	1560K	1580K	1600K	1620K	1640K	1660K	1680K	1700K	1720K	1740K	1760K	1780K	1800K	1820K	1840K	1860K	1880K	1900K	1920K	1940K	1960K	1980K	2000K	2020K	2040K	2060K	2080K	2100K	2120K	2140K	2160K	2180K	2200K	2220K	2240K	2260K	2280K	2300K	2320K	2340K	2360K	2380K	2400K	2420K	2440K	2460K	2480K	2500K	2520K	2540K	2560K	2580K	2600K	2620K	2640K	2660K	2680K	2700K	2720K	2740K	2760K	2780K	2800K	2820K	2840K	2860K	2880K	2900K	2920K	2940K	2960K	2980K	3000K	3020K	3040K	3060K	3080K	3100K	3120K	3140K	3160K	3180K	3200K	3220K	3240K	3260K	3280K	3300K	3320K	3340K	3360K	3380K	3400K	3420K	3440K	3460K	3480K	3500K	3520K	3540K	3560K	3580K	3600K	3620K	3640K	3660K	3680K	3700K	3720K	3740K	3760K	3780K	3800K	3820K	3840K	3860K	3880K	3900K	3920K	3940K	3960K	3980K	4000K	4020K	4040K	4060K	4080K	4100K	4120K	4140K	4160K	4180K	4200K	4220K	4240K	4260K	4280K	4300K	4320K	4340K	4360K	4380K	4400K	4420K	4440K	4460K	4480K	4500K	4520K	4540K	4560K	4580K	4600K	4620K	4640K	4660K	4680K	4700K	4720K	4740K	4760K	4780K	4800K	4820K	4840K	4860K	4880K	4900K	4920K	4940K	4960K	4980K	5000K	5020K	5040K	5060K	5080K	5100K	5120K	5140K	5160K	5180K	5200K	5220K	5240K	5260K	5280K	5300K	5320K	5340K	5360K	5380K	5400K	5420K	5440K	5460K	5480K	5500K	5520K	5540K	5560K	5580K	5600K	5620K	5640K	5660K	5680K	5700K	5720K	5740K	5760K	5780K	5800K	5820K	5840K	5860K	5880K	5900K	5920K	5940K	5960K	5980K	6000K	6020K	6040K	6060K	6080K	6100K	6120K	6140K	6160K	6180K	6200K	6220K	6240K	6260K	6280K	6300K	6320K	6340K	6360K	6380K	6400K	6420K	6440K	6460K	6480K	6500K	6520K	6540K	6560K	6580K	6600K	6620K	6640K	6660K	6680K	6700K	6720K	6740K	6760K	6780K	6800K	6820K	6840K	6860K	6880K	6900K	6920K	6940K	6960K	6980K	7000K	7020K	7040K	7060K	7080K	7100K	7120K	7140K	7160K	7180K	7200K	7220K	7240K	7260K	7280K	7300K	7320K	7340K	7360K	7380K	7400K	7420K	7440K	7460K	7480K	7500K	7520K	7540K	7560K	7580K	7600K	7620K	7640K	7660K	7680K	7700K	7720K	7740K	7760K	7780K	7800K	7820K	7840K	7860K	7880K	7900K	7920K	7940K	7960K	7980K	8000K	8020K	8040K	8060K	8080K	8100K	8120K	8140K	8160K	8180K	8200K	8220K	8240K	8260K	8280K	8300K	8320K	8340K	8360K	8380K	8400K	8420K	8440K	8460K	8480K	8500K	8520K	8540K	8560K	8580K	8600K	8620K	8640K	8660K	8680K	8700K	8720K	8740K	8760K	8780K	8800K	8820K	8840K	8860K	8880K	8900K	8920K	8940K	8960K	8980K	9000K	9020K	9040K	9060K	9080K	9100K	9120K	9140K	9160K	9180K	9200K	9220K	9240K	9260K	9280K	9300K	9320K	9340K	9360K	9380K	9400K	9420K	9440K	9460K	9480K	9500K	9520K	9540K	9560K	9580K	9600K	9620K	9640K	9660K	9680K	9700K	9720K	9740K	9760K	9780K	9800K	9820K	9840K	9860K	9880K	9900K	9920K	9940K	9960K	9980K	10000K
Required for an EC input power	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W	1.74W																																																																																													

## Solis-80K-5G, Solis-(80-110)K-HV-5G

### Solis 5G Three Phase Inverters



### Model:

- 400V Solis-80K-5G
- 480V Solis-80K-HV-5G
- 500V Solis-100K-HV-5G
- 500V Solis-110K-HV-5G

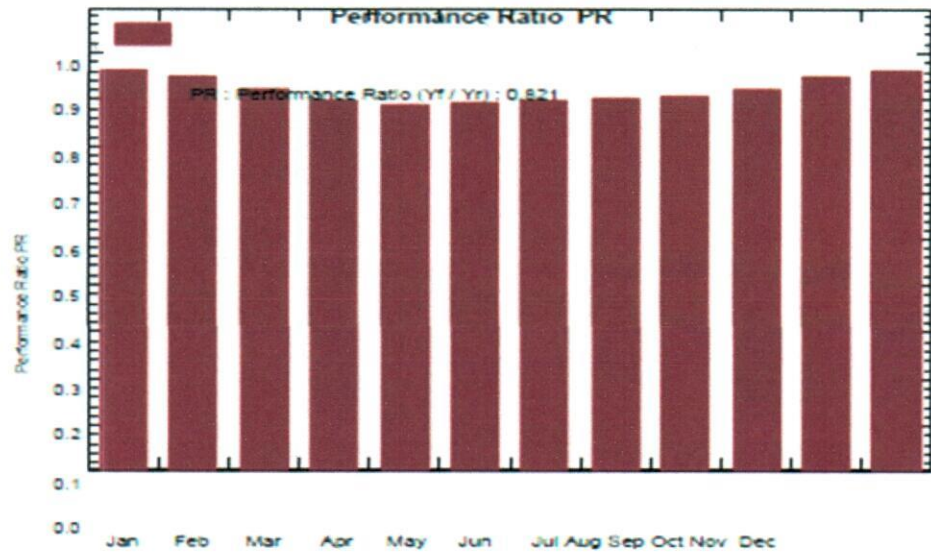
### Features:

- ▶ Max. 13A per string, support 1.5 DC overloading capability
- ▶ 10 individual MPPT, lower mismatch loss
- ▶ Efficient logic algorithm, over 99% max. Efficiency
- ▶ String monitoring, shorter OAM time
- ▶ Remote & local intelligent IV scan function
- ▶ Leakage current repression technology
- ▶ Volt-watt work mode integrated
- ▶ DC input reverse alarm
- ▶ Optional anti-PID function integrated
- ▶ Reactive power compensation function



- Technical Details of Solar Inverters as per PVsyst V6.88 report of Location 2 (IISCPL, Kullu, Himachal) is as below:
  - Model: Solar Inverter M200\_210
  - Company: Solis energy
  - Number of Inverters: 6 Units
  - Operating Voltage: 590-1000 V
  - Nominal Power: 200 Kwac
- iii. Important catch points from PVsyst V6.88 Report dated 11<sup>th</sup> June 2022 for Location 2
  - Produced Energy: 1800 MWh/year
  - Performance Ratio: 80.18%
  - PV Field Orientation
    - Tilt: 10 Degrees
    - Azimuth: 20 Degrees
  - No. of Modules: 2225 Nos
  - Total Pnom of Modules: 1200 kWp
  - Nos. of Inverters: 6 Units
  - Pnom of Inverters: 1200 kW AC
  - Produced Energy (EArray): 1800 MWh/Year (EArray: Effective energy at the output of the array)
  - Performance Ratio: 80.18 % against industrial accepted standard PR of 75%.
    - The Performance ratio is decreasing in the summers because of increase in temperature losses due to summer heat effect in the region.





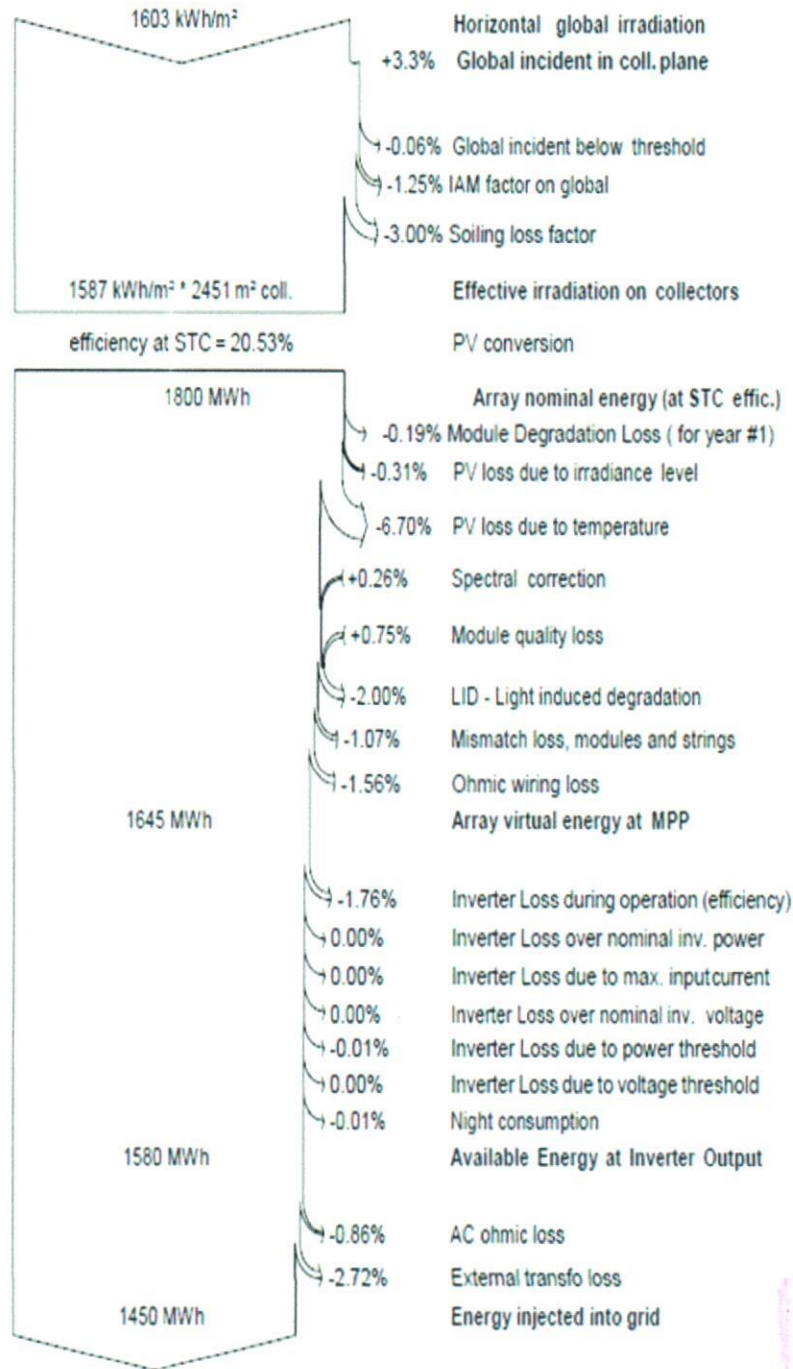
- There is a difference between Performance ratio as per graph and performance ratio mentioned under main simulation results which is 80.18%. Clarification is awaited.

- E\_Grid Energy: 1450 MW per year (Electricity injected onto the grid)
- Horizontal Global Irradiation: 1603.50 Kwh/m<sup>2</sup>
- Loss Diagram over the whole year





## Loss diagram over the whole year



**PART G****MAJOR SUPPLIERS/EPC CONTRACTOR**

The company has **proposed to appoint M/s Sugs Lloyd Private Limited** for erection, implementation and commissioning of the Solar rooftop power plants at both the Location 1 as well as Location 2. As per the PVsyst report the EPC Contractor has proposed to purchase solar panels from Adani Power and Solar inverters from Solis Energy for projects at both the Location 1 as well as Location 2.

Details of the Purchase Order is as below:

Sr. No.	Company	PO No.	PO Amount (Cr.)	Scope of Work
1.	Sugs Loyd	-	-	EPC Contractor
a.	Adani Power	-	-	Supply of 380 Modules for Location 1 and supply of 2225 modules for Location 2
b.	Solis Energy	-	-	Supply of 2 units for Location1 and supply of 6 units for Location 2

**Note:**

1. The company has informed that they have appointed EPC contractor M/s Sugs Loyd private limited erection, implementation and commission of the project. However, we have only received the PVsyst report generated by M/s Sugs loyd Pvt. Ltd. for technical information purpose and Techno commercial Proposal by M/s Sugs loyd Pvt. Ltd. For Bill of quantities of the project.
2. Final Signed contract document was sought from the company. Accordingly, the company has informed that the final contract document is yet to be signed between both the parties and as soon as the contract document is signed the same will be shared with bank. Bank to take note of this.





**PART H****PROJECT COST & MEANS OF FINANCE****1. PROJECT COST FOR PROJECT (200 kW) AT LOCATION 1 (AZADPUR MANDI, DELHI):**

As per the Project report the project cost amounts to Rs.1.13 Crore. Breakup of Rs.1.13 Crore is as below:

Sr. No.	Component	Amount (Cr.)
1.	PV Modules	0.67
2.	Inverter	0.11
3.	Structure	0.19
4.	Balance of System (includes HT Panel, cables, Installation etc.)	0.07
5.	Project Management, Regulatory Registration, Liasing etc.	0.08
<b>GRAND TOTAL</b>		<b>1.13</b>

**Observations & Comments:**

1. The basis of the above estimated cost is as per the project report provided by the company which is including GST.
2. Ministry of New and Renewable Energy which is the nodal Ministry for Solar Projects in India also releases benchmark cost for the purpose of consideration for Project subsidies. Last such benchmark cost for Grid-connected Rooftop Solar Photo-voltaic systems was done in financial year 2021-2022. **No such benchmark cost was released by MNRE for the year 2022-23 inspite of input cost of solar projects has risen since 3<sup>rd</sup> quarter of 2021.** The approved MNRE benchmark cost for Grid-connected Rooftop Solar Photo-voltaic systems for the financial year 2021-2022 for the capacity range >100 kW to 500 kW is Rs. 39,080 per Kilo Watt (kW). However, since then the cost escalation has taken place because of the following reasons:
  - a. Basic custom duty of 40% has been imposed on imported PV modules from April 1, 2022.
  - b. GST rates on PV modules have increased to 12% from previous 5%.

Our analysis for reasons pertaining to increase in CAPEX for solar power plants is covered in Point 3 of this part.

3. The above benchmark cost includes cost of Solar PV panels (with domestic cell and modules), inverter (single/3 phase wherever applicable), balance of system e.g., cable, switches/ circuit breaker/ connectors/ junction box, mounting structure, earthing, lightening arrester, and civil works, installation & commissioning, CMC for 5 years, transportation, insurance, applicable taxes, etc. The above benchmark costs are excluding of net metering cost and battery back-up costs.
4. Detailed breakup of Rs.1.13 Crore is as below:

(Amount in Rs. Crore)						
Sr. No.	Item	Amount	GST (%)	GST	Total Amount	
1.	PV Modules	0.60	12%	0.07	0.67	
2.	Inverter	0.10	12%	0.01	0.11	
3.	Structure	0.16	18%	0.03	0.19	
5.	BOP	0.06	18%	0.01	0.07	
6.	Installation and Commissioning	0.07	18%	0.01	0.08	
<b>Grand Total</b>		<b>0.99</b>		<b>0.14</b>	<b>1.13</b>	

#### 1.1 CURRENT STATUS & TOTAL EXPENDITURE INCURRED TILL DATE FOR PROJECT LOCATION 1:

The project is yet to take off. Therefore, no expenditure has been incurred on the project till 25<sup>th</sup> August 2022.

SR. NO.	PARTICULARS	AMOUNT		INCURRED UP TO 25 <sup>TH</sup> AUGUST 2022	CURRENT STATUS OF EXPENDITURE
		(All figures in cr.)			
1.	Solar Panels	Total allocated amount		0.67	Project erection works are yet to take off. Therefore, no expenditure has been incurred under this head.
		Total Expenses shown by the company		-	
		Total amount Approved by LIE up to 25 <sup>th</sup> August 2022		-	
2.	Solar Inverters	Total allocated amount		0.11	Project erection works are yet to take off. Therefore, no
		Total Expenses shown by the company		-	



## LIE REPORT

INDRAPRASTHA ICE AND COLD STORAGE (P) LTD.

		<b>Total amount Approved by LIE up to 25<sup>th</sup> August 2022</b>	-	expenditure has been incurred under this head.
3.	Structure	Total allocated amount	0.19	Project erection works are yet to take off. Therefore, no expenditure has been incurred under this head.
		Total Expenses shown by the company	-	
		<b>Total amount Approved by LIE up to 25<sup>th</sup> August 2022</b>	-	
4.	Balance of Plant	Total allocated amount	0.07	Project erection works are yet to take off. Therefore, no expenditure has been incurred under this head.
		Total Expenses shown by the company	-	
		<b>Total amount Approved by LIE up to 25<sup>th</sup> August 2022</b>	-	
5.	Installation and Commissioning	Total allocated amount	0.08	Project erection works are yet to take off. Therefore, no expenditure has been incurred under this head.
		Total Expenses shown by the company	-	
		<b>Total amount Approved by LIE up to 25<sup>th</sup> August 2022</b>	-	
6.	Total	Total allocated amount	2.27	Project erection works are yet to take off. Therefore, no expenditure has been incurred under this head.
		Total Expenses shown by the company	-	
		<b>Total amount Approved by LIE up to 25<sup>th</sup> August 2022</b>	-	



## 1.2 SOURCES OF FINANCE & UTILIZATION OF FUNDS FOR PROJECT LOCATION 1:

PARTICULARS	PLANNED AMOUNT	CURRENT STATE OF INVESTMENT
	(Amount in Crore)	
Term Loan	-	-
Own Sources	1.13	0.0
<b>TOTAL</b>	<b>1.13</b>	<b>-</b>

### Comments:

- Term Loan amount is yet to be finalized.
- Project has not commenced yet. Therefore, no expenditure has been incurred on the project.

## 2. PROJECT COST FOR PROJECT (1200 kW) AT LOCATION 2 (KULLU, HIMACHAL PRADESH):

As per the Project report the project cost amounts to Rs.6.15 Crore. Breakup of Rs.6.15 Crore is as below:

Sr. No.	Component	Amount (Cr.)
1.	PV Modules	3.90
2.	Inverter	0.34
3.	Structure	0.78
4.	Balance of System (includes HT Panel, cables, Installation etc.)	0.57
5.	Project Management, Regulatory Registration, Liasoing etc.	0.57
<b>Grand Total</b>		<b>6.15</b>

### Observations & Comments:

- The basis of the above estimated cost is as per the project report provided by the company which is including GST.
- Ministry of New and Renewable Energy which is the nodal Ministry for Solar Projects in India also releases benchmark cost for the purpose of consideration for Project subsidies. Last such benchmark cost for Grid-connected Rooftop Solar Photo-voltaic systems was done in financial year 2021-2022. **No such benchmark cost was released by MNRE for the year 2022-23 in spite of input cost of solar projects has risen since 3<sup>rd</sup> quarter of 2021.** The approved



MNRE benchmark cost for Grid-connected Rooftop Solar Photo-voltaic systems for the financial year 2021-2022 for the capacity range >100 kW to 500 kW is Rs.42,980 per Kilo Watt (kW). The cost of Solar power plant projects above 500 kW is project specific and no benchmark cost is available for those projects. However, since then the cost escalation has taken place because of the following reasons:

- a. Basic custom duty of 40% has been imposed on imported PV modules from April 1, 2022.
- b. GST rates on PV modules have increased to 12% from previous 5%.

Our analysis for reasons pertaining to increase in CAPEX for solar power plants is covered in Point 3 of this part H.

- iii. The above benchmark cost includes cost of Solar PV panels (with domestic cell and modules), inverter (single/3 phase wherever applicable), balance of system e.g., cable, switches/ circuit breaker/ connectors/ junction box, mounting structure, earthing, lightening arrester, and civil works, installation & commissioning, CMC for 5 years, transportation, insurance, applicable taxes, etc. The above benchmark costs are excluding of net metering cost and battery back-up costs.
- iv. Detailed breakup of Rs.6.15 Crore is as below:

(Amount in Rs. Crore)						
Sr. No.	Item	Amount	GST (%)	GST Amount	Total Amount	
1	PV Modules	3.45	12%	0.42	3.90	
2	Inverter	0.30	12%	0.04	0.34	
3	Structure	0.66	18%	0.12	0.78	
5	BOP	0.48	18%	0.09	0.57	
6	Installation and Commissioning	0.48	18%	0.09	0.57	
<b>Grand Total</b>		<b>5.40</b>		<b>0.75</b>	<b>6.15</b>	

- v. The company has informed that they will be installing 1200 kWp of rooftop solar plant Kullu, Himachal Pradesh (Location 2). However, the bank will only consider 1000 kWp for their term loan facility. Bank to take note of this.




## 2.1 CURRENT STATUS & TOTAL EXPENDITURE INCURRED TILL DATE FOR PROJECT LOCATION 1:

The project is yet to take off. Therefore, no expenditure has been incurred on the project till 26<sup>th</sup> August 2022.

SR. NO.	PARTICULARS	AMOUNT	INCURRED UP TO 26 <sup>TH</sup> AUGUST 2022	CURRENT STATUS OF EXPENDITURE
		(All figures in cr.)		
1.	Solar Panels	Total allocated amount	3.90	Project is yet to take off. Therefore, no expenditure has been incurred under this head.
		Total Expenses shown by the company	-	
		Total amount approved by LIE up to 26 <sup>th</sup> August 2022	-	
2.	Solar Inverters	Total allocated amount	0.34	Project is yet to take off. Therefore, no expenditure has been incurred under this head
		Total Expenses shown by the company	-	
		Total amount approved by LIE up to 26 <sup>th</sup> August 2022	-	
3.	Structure	Total allocated amount	0.78	Project is yet to take off. Therefore, no expenditure has been incurred under this head
		Total Expenses shown by the company	-	
		Total amount approved by LIE up to 26 <sup>th</sup> August 2022	-	
4.	Balance of Plant	Total allocated amount	0.57	Project is yet to take off. Therefore, no expenditure has been incurred under this head
		Total Expenses shown by the company	-	
		Total amount approved by LIE up to 26 <sup>th</sup> August 2022	-	



5.	Installation and Commissioning	Total allocated amount	0.57	Project is yet to take off. Therefore, no expenditure has been incurred under this head
		Total Expenses shown by the company	-	
		Total amount approved by LIE up to 26 <sup>th</sup> August 2022	-	
6.	Total	Total allocated amount	6.15	Project is yet to take off. Therefore, no expenditure has been incurred under this head
		Total Expenses shown by the company	-	
		Total amount approved by LIE up to 26 <sup>th</sup> August 2022	-	

## 2.2 SOURCES OF FINANCE & UTILIZATION OF FUNDS FOR PROJECT LOCATION 1:

PARTICULARS	PLANNED AMOUNT	CURRENT STATE OF INVESTMENT
	(Amount in Crore)	
Term Loan	-	-
Own Sources	6.15	0.0
<b>TOTAL</b>	<b>6.15</b>	<b>-</b>

### Comments:

- Term Loan amount is yet to be finalized.
- Project has not commenced yet. Therefore, no expenditure has been incurred on the project.

## 3. ANALYSIS OF INCREASE IN RISING COST OF ROOFTOP SOLAR PROJECTS:

Excerpts of our Secondary research is as below:



#### a. GENERAL REASON FOR INCREASE IN PROJECT

One of the key selling features that have helped solar power become the world's fastest-growing energy source is cost reduction, which had recently encountered a snag due to recent increases in solar module pricing. **PV module components account for roughly 50-55% of the total project cost. Solar module prices have increased by 18% since the beginning of 2021, after plummeting by 90% over the previous decade. Thus, giving a significant rise in project cost of solar power plants.**



The value of projects awarded in the last six to nine months will be impacted by a rise in solar photovoltaic (PV) module prices. The government has imposed a 40% basic customs duty (BCD) on solar modules and a 25% BCD on solar cells beginning April 1, 2022. The price increase is mostly due to a significant increase in the price of polysilicon, a vital input for cell and module manufacturing. Metal prices have recently increased, putting increasing pressure on the overall capital cost of solar generating installations. Chinese module manufacturers have recently hiked their costs by more than a fifth and begun cancelling contracts to provide equipment.

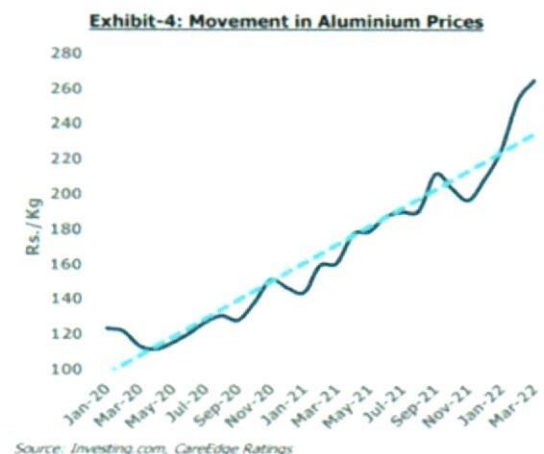




**b. COST OF RAW MATERIALS:**

Polysilicon is a key raw material in solar module manufacturing. Over the years, its price reduction has been a significant factor contributing to the decline in solar module prices, leading to competitive tariffs. However, polysilicon prices increased significantly from \$10 per kg in August 2020 to \$44 per kg in November 2021 (4.4 times increase). This multi fold increase in prices has primarily resulted in higher module prices.

Other disrupting factors in the module supply chain include price hikes for commodities such as glass, steel and aluminum, shortages of containers, and an increase in freight rates. Steel and aluminium prices have increased by around 95% and 115%, respectively, from January 2020 to March 2022. Such disruptions were exacerbated due to various pandemic lockdowns.


**c. IMPACT OF BASIC CUSTOM DUTY (BCD) AND APPROVED LIST OF MODELS AND MANUFACTURERS (ALMM)**

From April 2022 onwards, BCD has been applied on import of solar modules (40%) and cells (25%). As BCD became applicable from April 2022, the developers, to save on costs, have preemptively stocked modules ahead of time. This is reflected by an increase in the imports to 9.7 GW in the fourth quarter of fiscal 2022. Additionally, government mandated solar developers to only use ALMM enlisted modules for government projects, government-assisted projects, those under government schemes and programs (e.g., Component A of PM-KUSUM scheme) as well as open access and rooftop net metering projects. ALMM so far, only contains domestic manufacturers. Anticipating upsurge in demand for domestically manufactured solar modules due to above factors, the leading domestic solar

manufacturers have increased their prices by 3-4 cents (viz. 3-4%) between February and March 2022.

The build-up of module prices under different scenarios is tabulated below:

**Exhibit-5: Module and Cell Price Build-up**

Pre BCD				
Module Cost (Cents/Wp)	BCD@40%	GST@12%	Final Landed Cost (Cents/Wp)	
30	NA	3.6	~34	
Post BCD				
Import of modules				
Module Cost (Cents/Wp)	BCD@40% Cess of 10% on BCD	GST@12%	Final Landed Cost (Cents/Wp)	
30	13.2	5.2	~48	
Import of cells and domestic conversion to modules				
Cell Cost (Cents/Wp)	Conversion Cost (Cents/Wp)	BCD@25% Cess of 10% on BCD	GST@12%	Final Landed Cost (Cents/Wp)
18	14	5.0	4.4	~41

Source: CareEdge Ratings

Thus, we can see a direct increase of approximately 30% being reflected on project CAPEX due to increase in GST rate and imposition of Basic customs duty on Solar modules as well as solar cells.

ALMM factor is not applicable to this project since this is not a government project.

**d. RISING DEMAND FOR SOLAR MODULES:**

Solar power installations have increased at a compounded annual growth rate (CAGR) of 23% from calendar year 2016 to calendar year 2021, as a decline in solar costs have made it competitive compared to other sources of generation. Higher emphasis on procuring power through cleaner sources and global commitment to reduce carbon emissions has supported demand, too. This has resulted in demand outpacing supply over the past few quarters and, in turn, increased the cost of modules. The power crisis in China, which accounts for a major portion of global production, has also impacted the supply of modules.

These inflationary pressures are likely to put upward pressure on the capital cost of solar power projects. At present, the delivered price (on cost, insurance, and freight [CIF] basis) of imported solar modules and cells from China is around \$0.30/Wp and \$0.18/Wp, respectively. Additionally, modules and cells attract BCD of 40% and 25%, respectively, and cess of 10% on BCD. A GST of 12% is applicable on the solar equipment.



**e. INCREASE IN STEEL PRICES**

Other disrupting factors in the PV supply chain include price hikes for commodities such as glass and metals, shortage of containers etc. Such disruptions were exacerbated further due to various Covid-19 induced lockdowns across the world which resulted in halting of manufacturing activity. However, In the year 2022 it is observed that the steel prices are coming down which will give some respite to Solar power projects in due course.

**This increase is giving an upward trajectory to Project CAPEX since the project will be rooftop but will be mounted over steel frames and columns as the roof which is RCC with obstructions like AHU's, Water tanks, pipes etc.**

**f. MISCELLANEOUS**

During Q3 CY2021, several countries including China faced an energy crisis. Main reasons were shortage of coal and associated supply chain disruptions in coal supply. The solar manufacturing industry, still highly concentrated in China, was affected by the rolling blackouts implemented by the government of the energy intensive industries. This crisis compounded an already difficult situation and contributed to increase in module prices in short term. With covid cases surging in China post March 2022, the Chinese government has imposed strict lockdowns across several major provinces. Thus, this hindrance to solar manufacturing in China may affect solar module prices at least in the short term.

**GIST OF OUR ANALYSIS:****PROJECT AT LOCATION 1 (Azadpur Mandi, Himachal)-200 kWp Solar power Plant**

1. After analyzing the above information, the Project cost seems to be reasonable. Main reasons from our analysis are as below:
  - a. 40% BCD on Solar modules imposed in April 2022 which was earlier absent on imported PV modules.
  - b. GST price increase from 5% to 12% on PV modules.
  - c. Increase in steel prices which are gradually coming under control in due course.
  - d. Supply chain disruptions.
2. The company has only verbally informed that all the modules being procured by their proposed EPC contractor M/s Sugs Lloyd Pvt. Ltd. will be imported therefore 40% BCD is considered. Bank to do proper Source due diligence for supply of modules.
3. MNRE Rooftop solar power plant project Benchmark cost 2021-222 was released in public domain on 18<sup>th</sup> August 2021 and the major CAPEX increase reasons like 40%

BCD imposition and GST increase to 12% took place in April 2022 and October 2021 respectively.

**PROJECT AT LOCATION 2 (Kullu, Himachal)-1200 kWp Rooftop solar power plant**

1. After analyzing the above information, the Project cost seems to be reasonable. Main reasons from our analysis are as below:
  - a. 40% BCD on Solar modules imposed in April 2022 which was earlier absent on imported PV modules.
  - b. GST price increase from 5% to 12% on PV modules
  - c. Supply chain disruptions.
2. The company has only verbally informed that all the modules being procured by their proposed EPC contractor M/s Sugs Lloyd Pvt. Ltd. will be imported therefore 40% BCD is considered. Bank to do proper Source due diligence for supply of modules.
3. MNRE Rooftop solar power plant project Benchmark cost 2021-222 was released in public domain on 18<sup>th</sup> August 2021 and the major CAPEX increase reasons like 40% BCD imposition and GST increase to 12% took place in April 2022 and October 2021 respectively.





**PART I****CONCLUSION**

1. The project cost amounting to approx. Rs.1.13 Crore for installation of 200 kWp of Rooftop Mounted solar power plant at Azadpur mandi, Delhi (Location 1) seems to be reasonable considering the economic reasons as discussed in Part H of this report. Major reasons driving the cost of solar power plants is firstly 40% Basic customs duty imposed on Solar PV modules from April 2022 which was earlier absent on PV modules and GST increase to 12% from previous 5%.
2. The project cost amounting to approx. Rs.6.15 Crore for installation of 1200 kWp of Rooftop Mounted solar power plant at Kullu, Himachal Pradesh (Location 2) seems to be reasonable considering the economic reasons as discussed in Part H of this report. Major reasons driving the cost of solar power plants is firstly 40% Basic customs duty imposed on Solar PV modules from April 2022 which was earlier absent on PV modules and GST increase to 12% from previous 5%.
3. As per observations made during the site visits of both the project locations, the geographical factors responsible for efficient power generation in the project seems to be satisfactory and the site is geographically well suited for such type of solar projects. In addition to satisfactory geographical location, the company should implement the installation exercise as per the parameters mentioned in the PVsyst report to keep the project technically efficient.
4. Site inspection for Rooftop Solar power plant proposed to be set up at Azadpur mandi, delhi was carried out on 25<sup>th</sup> August 2022 and it was observed that erection works in the project have not yet commenced and no fresh material pertaining to this project was found to be delivered to the site. The company's representative has showed us the Rooftop location where the project is proposed to be erected. Site Photographs of the same are attached as annexures with this report.
5. Site inspection for Rooftop Solar power plant proposed to be set up at Kullu, Himachal Pradesh was carried out on 26<sup>th</sup> August 2022 and it was observed that the company was setting up a 7,500 metric ton controlled atmosphere cold storage for apples. The company's representative has informed us that installation and commissioning of solar modules will be done on the roof of under construction cold storage facility. Site Photographs of the rooftop is not available since the same is not yet constructed. However, the site photographs of under construction cold



storage facility on which the installation and commissioning of solar power plant is proposed to be done is attached as annexures with this report.

6. Indraprastha Ice and Cold Storage (P) Limited has proposed to set-up an On-Grid Rooftop PV Module Solar Power Plant and to use Mono-Crystalline PERC technology on both the projects.
7. The company has informed that they will be installing 1200 kWp of rooftop solar plant at under construction IICSPL unit location at Kullu, Himachal Pradesh (Location 2). However, the bank will only consider 1000 kWp for their term loan facility. Bank to take note of this.





**PART J****DISCLAIMER**

1. No employee or member of R.K Associates has any direct/ indirect interest in the Project.
2. This report is prepared based on the copies of the documents/ information which the Bank/ Company has provided to us out of the standard checklist of documents sought from them and further based on our assumptions and limiting conditions. All such information provided to us has been relied upon in good faith and we have assumed that it is true and correct in all respect. Verification or cross checking of the documents provided to us has not been done at our end from the originals. If at any time in future, it is found or came to our knowledge that misrepresentation of facts or incomplete or distorted information has been provided to us then this report shall automatically become null & void.
3. This report is a general analysis of the project based on the scope mentioned in the report. This is not an Audit report, Design document, DPR or Techno-financial feasibility study. All the information gathered is based on the facts seen on the site during survey, verbal discussion & documentary evidence provided by the client and is believed that information given by the company is true best of their knowledge.
4. All observations mentioned in the report is only based on the visual observation and the documents/ data/ information provided by the client. No mechanical/ technical tests, measurements or any design review have been performed or carried out from our side during Project assessment.
5. Bank/FII should ONLY take this report as an Advisory document from the Financial/ Chartered Engineering firm and it's specifically advised to the creditor to cross verify the original documents for the facts mentioned in the report which can be availed from the borrowing company directly.
6. In case of any default in loans or the credit facility extended to the borrowing company, R.K Associates shall not be held responsible for whatsoever reason may be and any request for seeking any explanation from the employee/s of R.K Associates will not be entertained at any instance or situation.
7. This Report is prepared by our competent technical team which includes Engineers and financial experts & analysts.
8. This is just an opinion report and doesn't hold any binding on anyone. It is requested from the concerned Financial Institution which is using this report for taking financial decision on the project that they should consider all the different associated relevant & related factors also before taking any business decision based on the content of this report.
9. All Pages of the report including annexures are signed and stamped from our office. In case any paper in the report is without stamp & signature then this should not be considered a valid paper issued from this office.





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**SURVEYED BY****ER. ABHISHEK SHARMA AND MR.****SACHIN PANDEY****DATE: 25<sup>th</sup> & 26<sup>th</sup> AUGUST 2022****PREPARED BY****ER. TEJAS BHARADWAJ****DATE: 8<sup>TH</sup> SEPTEMBER 2022**

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**ANNEXURE 1: MNRE BENCHMARK COST DOCUMENT**

No. 318/38/2018-GCRT  
 Government of India  
 Ministry of New & Renewable Energy  
 \*\*\*

Block No. 14, CGO Complex,  
 Lodi Road, New Delhi  
 Date: 18<sup>th</sup> August 2021

**ORDER**

**Subject: Benchmark costs for Grid-connected Rooftop Solar Photo-voltaic systems for the financial year 2021-22 -reg.**

I am directed to convey the approval of competent authority for issuing of the benchmark costs for Grid-connected Rooftop Solar Photo-voltaic Systems for the financial year 2021-22 as under:

**For General Category States/UTs:**

System Capacity range	Upto 1 kW	>1kW upto 2 kW	>2kW upto 3 kW	> 3kW upto 10 kW	>10 kW upto 100 kW	> 100kW upto 500 kW
Benchmark cost (Rs./kW)	51100	46980	45760	44640	41640	39080

**For Special Category States/UTs** (i.e. North-Eastern States including Sikkim, Himachal Pradesh, Uttarakhand, Jammu and Kashmir, Ladakh, Andaman and Nicobar and Lakshadweep islands):

System Capacity range	Upto 1 kW	>1kW upto 2 kW	>2kW upto 3 kW	> 3kW upto 10 kW	>10 kW upto 100 kW	> 100kW upto 500 kW
Benchmark cost (Rs./kW)	56210	51670	50330	49100	45800	42980

2. The above benchmark cost includes cost of Solar PV panels (with domestic cell and modules), inverter (single/3 phase wherever applicable), balance of system e.g. cable, switches/ circuit breaker/ connectors/ junction box, mounting structure, earthing, lightening arrester, and civil works, installation & commissioning, CMC for 5 years, transportation, insurance, applicable taxes, etc. The above benchmark costs are excluding of net metering cost and battery back-up costs.

3. The benchmark cost for year 2021-22 will be applicable for all LoAs to be issued/empanelment of vendors to be done by the state implementing agencies, under Ph-II of rooftop solar programme of MNRE, after 10 days from the date of issuance of this benchmark cost notification.

(Hiren Chandra Borah)  
 Scientist D  
 E Mail: hiren.borah@nic.in

To  
 All Concerned



**ANNEXURE 2: MERCOM INDIA RESEARCH OF MNRE BENCHMARK COST****Benchmark Costs for Grid-Connected Rooftop Solar Power Projects for the Financial Year 2021-22**

Capacity	Benchmark Cost for States Other Than Special Category States					Benchmark Cost for Special Category States including North Eastern States, Uttarakhand, Himachal Pradesh, J&K and UTs of Andaman & Nicobar Island and Lakshadweep				
	2021-22		2020-21		% of variation	2021-22		2020-21		% of variation
	₹/W	\$/W	₹/W	\$/W		₹/W	\$/W	₹/W	\$/W	
1 kW	51.1	0.69	47	0.63	8.7%	56.12	0.76	52	0.70	7.9%
Above 1 kW to 2 kW	46.98	0.63	43	0.58	9.3%	51.67	0.70	47	0.63	9.9%
Above 2 kW to 3 kW	45.76	0.62	42	0.57	9.0%	50.33	0.68	46	0.62	9.4%
Above 3 kW and Upto 10 kW	44.64	0.60	41	0.55	8.9%	49.1	0.66	45	0.61	9.1%
Above 10 kW and Upto 100 kW	41.64	0.56	38	0.51	9.6%	45.8	0.62	42	0.57	9.0%
Above 100 kW and Upto 500 kW	39.08	0.53	36	0.49	8.6%	42.98	0.58	40	0.54	7.4%

Source: MNRE

Mercom India Research



**ANNEXURE 3:** SECONDARY RESEARCH LINKS FOR HIGH CAPEX AMOUNT

LINK 1: <https://mercomindia.com/solar-project-cost-to-increase-azure-power/>

LINK 2: <https://mercomindia.com/average-cost-large-scale-solar-projects/>

LINK 3: <https://www.pv-magazine.com/2022/07/01/solar-module-price-increases-to-affect-returns-on-4-4-gw-of-indian-solar/>

Link 4: <https://www.pv-magazine-india.com/2022/04/22/solar-module-prices-increased-38-in-the-last-20-months/>

Link 5:

<https://energy.economictimes.indiatimes.com/news/renewable/domestic-solar-modules-cost-to-come-down-by-11-per-cent-in-april/89720315>

LINK 6: <https://www.pv-magazine-india.com/2022/05/25/higher-solar-module-prices-rainy-days-ahead-for-developers/>

LINK 7: <https://www.statista.com/statistics/1219740/india-steel-price-by-city/>





**LOCATION 1 (AZADPUR MANDI, DELHI)**





# LIE REPORT

INDRAPRASTHA ICE AND COLD STORAGE (P) LTD.





## **SITE PHOTOGRAPHS**

### **LOCATION 2 (KULLU, HIMACHAL PRADESH)**





# LIE REPORT

INDRAPRASTHA ICE AND COLD STORAGE (P) LTD.

