



HARNESSING THE POWER OF THE SUN

www.ravingroup.com

RAVIN.

ELECTRICITY FOR A BRIGHTER TOMORROW.

A specialist across power and electricity sector, Ravin Group, with an experience of over 7 decades, has carved a niche for itself in the domestic and global markets, as the Electricity Expert. With a view to stay ahead of the curve, Ravin has managed to make its mark and light up lives with its comprehensive solutions and futuristic approach wherever they go and will continue to do so for years to come.



At Ravin, the focus is on providing world class, safe and cutting-edge products and services to satisfy the ever-increasing electricity needs. The products and services, across the electricity spectrum, are laced with technologically advanced solutions that allow us to actively build a safe and strong future for the electrified world.

Ravin Group has a diversified portfolio across the electricity value chain, with its prowess in the manufacturing of **Electric Cables, EHV Cables & EPC Services, Power Equipments, Moisture Management Systems and Solar Energy Solutions.**

OUR VALUES DEFINE US

Our strongly imbibed core values of Safety, Dependability and Sustainability comes across as our strength and the basis of our growth and development across the decades of our operation.



SAFETY to the users, the public in general, our employees and the environment is our priority. Safety coincides with production and quality and is an integral part of our business. A series of pioneering safety innovations has made Ravin a leader in safety over the past few years.



DEPENDABILITY is living up to our word and fulfilling our promises. Our customers and communities deserve our respect, honesty, and expert abilities. When a project is completed, our goal is to be remembered as a trusted partner that delivered the promised results. And to be relied on again.



SUSTAINABILITY for us is an approach that integrates people, planet and profit, resulting in a greener and safer tomorrow. Our aim is to promote a responsible culture and implement robust corporate systems to meet our sustainability goals.

ACHIEVEMENTS

- **Best Infrastructure Brand Award**, 2016 by The Economic Times
- **Export Excellence Awarded** by EEPC since 2001
- Group CMD, **Mr. Vijay P Karia** awarded with **Inspiring Entrepreneurs of India**
- Group CMD, **Mr. Vijay P Karia** awarded with **Asia's Most Promising Business Leaders**



Unmatched Engineering Finesse



In providing a unique approach to process design, construction and project management, Ravin's engineering expertise, production and process knowledge can provide a range of services to meet requirements like:

- Feasibility Study
- Customised Manufacturing
- Installation
- Design
- Equipment Supply
- Commissioning

Through our process, engineering prowess and reputation, we can deliver a diverse range of process solutions to both domestic and overseas markets.

Our customer base extends to major national and international companies, worldwide private and public sector clients, all of whom have benefited from our ability to adapt technologies and tailor our services to meet the specific requirements of the project.



BUSINESS OFFERINGS

Electric Cables

India's first integrated provider of electricity distribution cables, Ravin group has become a powerhouse supplier of world class electric cables and equipments to the power generation and distribution sector. With manufacturing facilities in India and UAE and a presence in more than 50 countries, Ravin group are expert manufacturers of a wide range of electric cables of various capacities ranging from 1.1 kV to 220 kV and specialties including variable frequency drive, fire survival, low smoke zero halogen, solar and wind cables, among many more.



Electric Cables up to 220 kV



Large scale Termination and Jointing Projects

Ehv Projects And EPC Services

Ravin Group provides a wide range of solutions including designing, manufacturing, cable laying, installation, jointing, termination and maintenance of Extra High Voltage Cables for power transmission directly from power plant sites to primary distribution networks. With its stellar expertise, Ravin Group installs pre-moulded joints and terminations for all voltages from 11 kV onwards to 400kV in India with the support of a fully trained and certified jointing team and an extensive experience of thousands of joints and terminations.

Power Equipment

Ravin Group also offers a high end Molecular Moisture Management System. It includes an on-line molecular sieve that is designed to lower the ppm level of water in the oil to maintain the natural hydrostatic equilibrium, and hence, significantly reduce the water content within the solid insulation. This on-line process not only reduces insulation ageing, but also improves the dielectric strength of the oil and health of the transformers.



Moister Management Systems

Solar Energy Solutions

Ravin's global approach and research in technology is aimed towards delivering sustainable and efficient solar solutions across the globe. Ravin has introduced an innovative and path-breaking tracking system which is a device that orients various solar energy generating components towards the direction of the sun. The revolutionary tracking systems help maximize the energy yield by 15% to 35%, thus increasing the ROI.



#Stealmorefromthesun

The **tracking systems** include the following design solutions, suited for various applications:

- Single Axis and Dual Axis Tracking System
- Unipolar Tracking Systems
- Rooftop and Ground Mounted Tracking Systems
- Mobile Solar Power Generation Station with a Tractor Trolley



Single/ Dual Axis Trackers



Unipolar Trackers



Ground Mounted Trackers



SMS 5.4 Mobile Solar Power Generator



Solar Water Pump being used for irrigation

Solar Water Pumping Solutions

Ravin also offers an advanced Solar Water Pumping System with **built in automatic tracking mechanism** to maximize the system output. Some of its features include:

- Non-polluted, clean and efficient energy
- Fully Unattended Automated Operation
- No electricity or fuel costs
- Easy installation on roof or ground
- Long life of over 20 years; Low maintenance
- Solutions for upto 200 meters water head
- Pump Capacity from 0.74 Hp to 24 Hp

Ravin Projects & Services

The energy market has changed dramatically over the past few years as a consequence of deregulation, privatisation and unbundling of generation and transmission. The new network owners mainly focus on the cost-effectiveness of their assets. This applies to new network investments but, certainly, also includes the optimisation of usage of the existing underground network.

Ravin specialises in providing total management of major projects and offers its customers a complete turnkey approach, from system planning to final testing and post-sales services. Installation design and methods, co-ordination and scheduling of installation activities, are crucial to achieve a reliable and satisfactory system.



Ravin operates to the highest accreditation and safety standards to meet the demands of the most complex project environments. Turnkey approach, worldwide experience, top class customers references and strong focus on innovation represent the winning recipe that makes Ravin a leader in energy systems.

As India marches towards the 21st Century, power becomes an essential ingredient for infrastructural development. With rapid urbanisation around the corner to sustain the industrial growth, the necessity of expertise in generation, transmission & distributions of power becomes a key in energy scenario in India in the coming decade.

Our installation team consists of a highly qualified and experienced Engineers, who work with clients and manufacturers to identify the quickest and most cost effective power solutions. Our team has been trained and experienced in various countries around the world, and they carry with them over **250** years of cumulative experience in specialty jobs. We have an experience of installation of more than 150 kms of EHV cables and 300 joints and terminations at voltages **greater than/equal to 220 kV**.

We provide our customers with a comprehensive system packages which encompasses system design including design, supply of quality materials, installation, testing, commissioning and finally ensuring full safety and reliability of the installation.



We have an impressive client list Pan India. Some of the jobs which we have undertaken are as follows:

Completed Jobs

Client	Voltage	Type of Job
Reliance Power - Samalkot	400 kV	Installation of terminations
NTPC - SAIL - L & T	220 kV	Supply of Cable, and accessories Laying of cable and Installation of accessories (18 terminations and 4 km cables)
Reliance Infrastructure Ltd.	220 kV	Supply of Cable, and accessories Laying of cable and Installation of accessories (54 nos terminations, cable 4 km)
Reliance Infrastructure Ltd.	220 kV	Supply of Cable, and accessories Laying of cable and Installation of accessories (54 km cables and 210 joints and terminations)
Mahagenco, Vaitarna	132 kV	Supply of accessories Laying of cable (3 km) and installation of accessories
Dhaka Electric	132 kV	Jointing in Oil-filled cable for Dhaka Electric
Crompton Greaves	66 kV	Installation of GIS terminations for Torrent Power in Surat
Iljin Electric	66 kV	Installation of outdoor terminations for MRVC
Universal Cables	66 kV	Installation of outdoor terminations for MRVCL
Mahatransco, Vasai	110 kV	Supply and installation of accessories, Shifting of existing cable and installation of accessories
Uttam Galwa, Wardha factory	220 kV	Supply of accessories Jointing and termination services
Siemens	220 kV	Supply of accessories Jointing and termination services
Reliance	66 kV	Call centre operations for jointing services

The Need for Energy



India is a rapidly growing economy which needs energy to meet its growth objectives in a sustainable manner. 50% of the Indian population does not have access to electricity.

- The areas which have access are facing acute problems of load shedding depriving the industries of electricity.
- Increasing cost of diesel coupled with high maintenance cost of associated equipment like inverters and batteries have made it out of reach for the common man.
- India is one of the countries in the world with the lowest per capita consumption of electricity with some states having much lower per capita consumption than the national average.
- Over and above this, absence of a Centralised Grid for the entire consumption of electricity in most parts of the country means that electricity generated from natural or renewable sources in the north or north east cannot get transmitted to the south, and hence India places a lot of emphasis on thermal sources of generation.

The options available for generation of electricity are:

- Thermal
- Nuclear
- Renewable
 - Solar
 - Hydro
 - Wind
 - Tidal
 - Biomass
 - Biofuel

In terms of fuel, coal-fired plants account for 68% of India's installed electricity capacity. After coal, renewal hydropower accounts for 18%, Nuclear 2% and Renewable for about 12%.

Effects of Thermal / Nuclear / Hydro

The generation of electricity from Thermal, Nuclear & Hydro comes with a price to environment and human life.

- Coal-fired Power Plants are the major source of emissions and release Suspended Particulate Matter (SPM), which include SO_2 , NO_2 , into the environment. SPM when released in the air spreads as far as 25 km, which cause respiratory problems and related ailments to humans, animal habitat, and also badly affects the photosynthesis process of plants.
- Fly ash which is produced by coal-fired plants, though stores in landfills makes the surrounding soil alkaline and non-productive.
- Other effects include changes in flow of ground water. These power plants emit billions of tonnes of CO_2 into the environment which causes global warming.
- Nuclear Power Plants generate a lot of nuclear waste which is not only difficult to manage but take years to lose its radioactivity. The areas around these power plants are known to be contaminated with hazardous radioactive wastes.
- Radiation leaks caused due to nuclear accidents can contaminate areas ranging from 20 sq km to 40 sq km, which affect not only humans but also the livestock and the soil, leaving land infertile for centuries.
- As radioactive materials decay, they release particles that damage the body and leads to cancer.



Renewable Energy

Generation of electricity through renewable sources seems to be the apt answer for environmental concerns. Apart from the fact that it will reduce our dependence on fossil fuels, it also produces clean and green energy, with negligible Carbon Footprint. Renewable Energy comes from resources, such as sunlight, wind, rain, waves and geo thermal heat, which are continuously replenished.

Why Solar?

Today, the world is facing a threat to exhaustion of fossil fuels. Sun, which is the biggest source of power in our galaxy, is omni present, with its abundant energy, and is the most and only reliable source of power. This makes solar power the best alternative to the conventional sources of energy, which is not only cleaner and greener, but if harnessed well, also dependable.



Solar Power

Sunlight is composed of photons, which contain various amounts of energy corresponding to different wavelengths of light. Photons on striking a solar cell, when absorbed by an electron in the atom of the cell, transfers its energy to the electron, which in turn leaves its normal position, causing a potential difference, thereby causing a flow of electricity



Solar Constant

It is the amount of incoming solar electromagnetic radiation per unit area, measured on the outer surface of Earth's atmosphere on a plane perpendicular to the rays. The solar constant includes all types of solar radiation, not just the visible light. It is estimated to be roughly 1,366 Watts per square metre (W/m^2).

Solar Spectrum

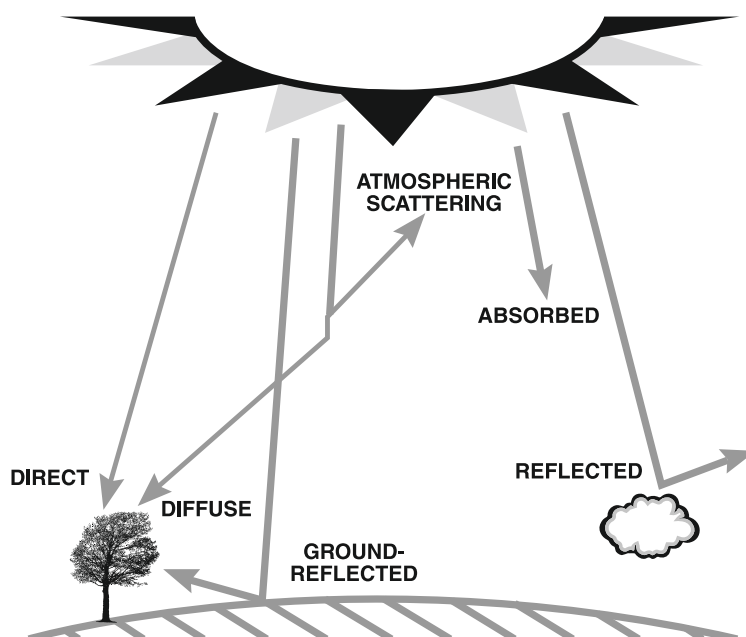
The sun's total energy is composed of 7% ultraviolet radiation, 47% visible radiation and 46% infrared (heat) radiation.

Direct Radiation

It is the shortwave radiation that is able to penetrate through the atmosphere without having been affected by constituents of the atmosphere in any way.

Diffused Radiation

It is a shortwave radiation that has been scattered by gases in the atmosphere. Scattering is a process whereby a beam of radiation is broken down into many weaker rays redirected in other directions.



Solar Insolation

Together, direct and diffuse shortwave radiation accounts for the total incoming solar radiation or **insolation**.

Albedo

A portion of the incoming solar radiation is absorbed by the surface and a portion is also reflected away. The proportion of light reflected from a surface is the **albedo**.

Different Technologies of Solar

Concentrated Photovoltaic (CPV)

To generate electricity, this technology makes use of lenses to concentrate a large amount of sunlight onto a small area of solar photovoltaic material, to achieve higher power output and improved conversion efficiency. The cells used are high efficiency Multi Junction Solar Cell. CPV systems require dual axis tracking systems, as this technology requires direct radiation of the sun falling on the cell, which necessitates the orientation of cell towards the sun.

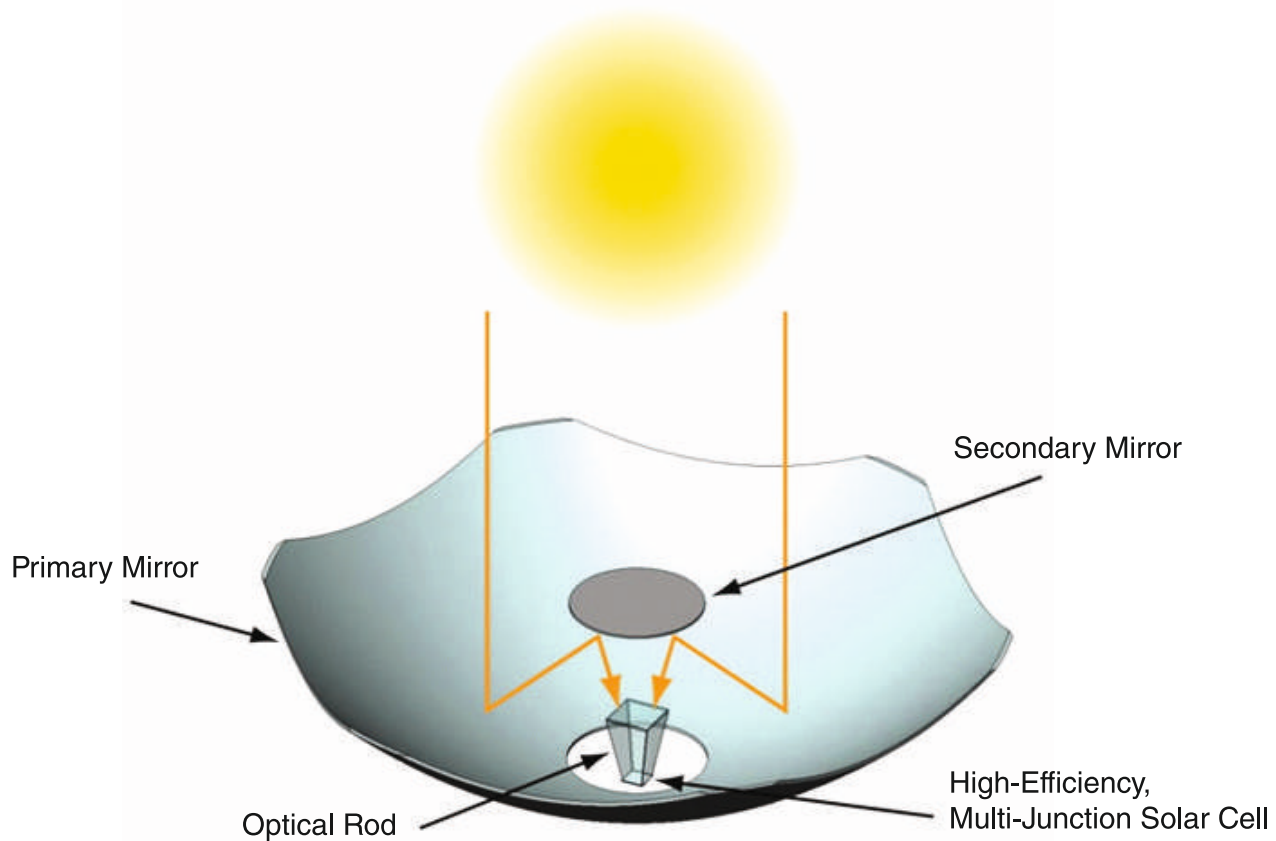


Diagram of a Type of CPV Technology

Concentrated Solar Power - CSP (Thermal)

This technology harnesses the infra-red (heat) part of the sun's rays to convert into electricity. CSP deploys mirrors or lenses that are used to concentrate a large amount of sunlight onto a small area. Tracking devices which help in tracking the sun are required to concentrate sunlight to a small area. The concentrated light is converted into heat, which is then used to run a conventional power plant.

There are mainly 4 types of concentrating technologies viz. parabolic trough, dish stirling, concentrating linear Fresnel Reflector and Solar Power Tower.

Photovoltaics (PV)

It is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect. Photovoltaic power generation employs solar panels or modules. Solar PV Modules are made up of PV Cells, which are most commonly manufactured from silicon. These PV cells, that form a PV Module, are connected in a series to achieve a desired output voltage and/or parallel to provide desired current capability. These PV Modules when connected in series and parallel are called an array.

Types of PV Technologies Available

■ Crystalline Panels

Monocrystalline or CSI cells consists of silicon which has unbroken continuous crystal lattice.

PolyCrystalline or nc-Si cells is material consisting of multiple small silicon crystals.

Crystalline Panels, both Mono & Poly are the oldest and most widely used technologies around the world.

■ Thin Film Panel

Thin film modules are fabricated by depositing extremely thin layers of photosensitive materials on to a low - cost backing such as glass, stainless steel or plastic. There are three types of Thin Film Modules that are manufactured at the moment viz. Amorphous - Asci or Micromorphous - μ ci, Cadmium Telluride - Cdte, Copper Indium Gallium (de) Selenide - CIGS

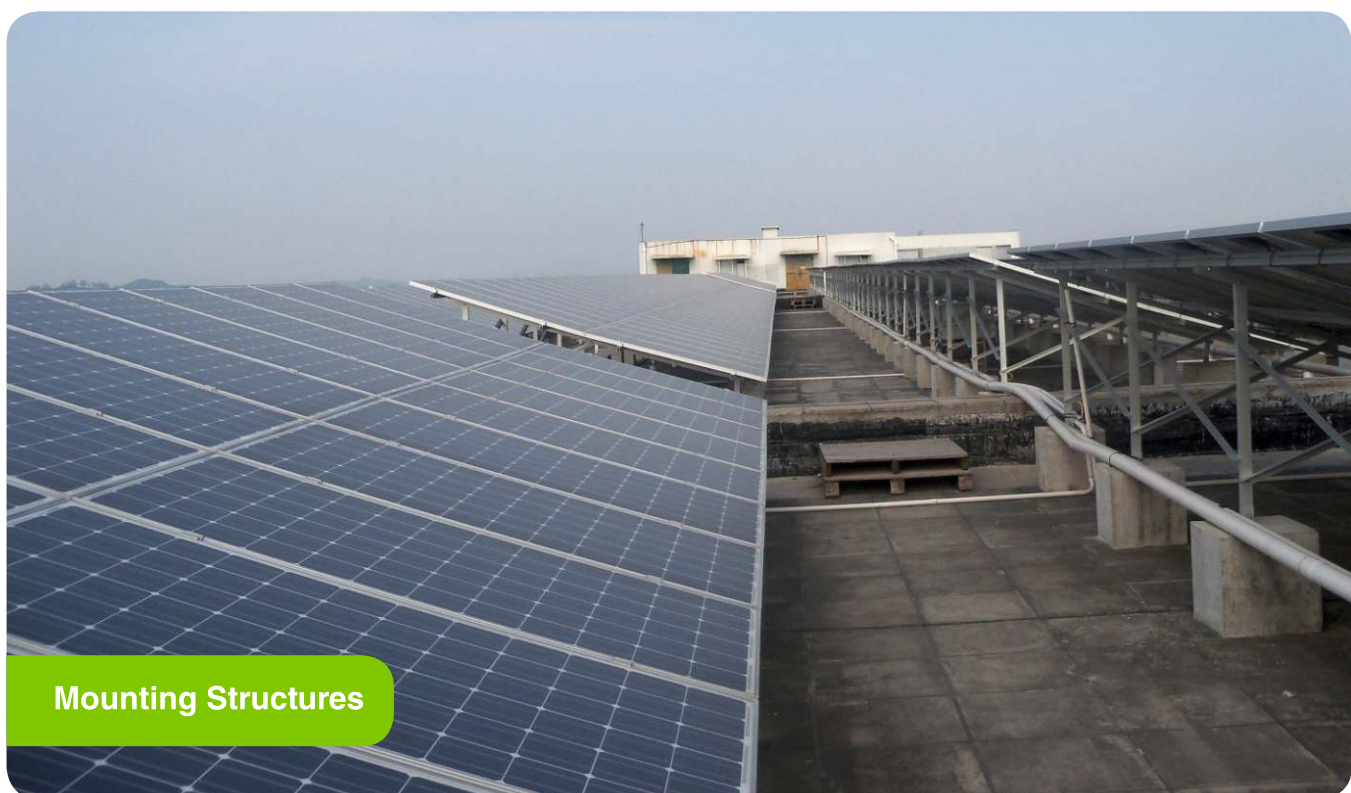
Solar Photovoltaic System consists of various Solar Modules (connected in series and parallel), Inverters (to convert DC Power to AC Power), Mounting Structures or Trackers, Cables and various other components.

Inverters

An inverter is an electrical device that converts variable Direct Current out of photovoltaic solar array to provide a synchronised AC for injection into local grid or off-grid electrical network.

Mounting Structures

In a typical solar plant layout, which mostly use Fixed Mounting structures, rows of Solar Modules are mounted, at fixed tilt angles, while facing a fixed angle of orientation, which are generally optimised for that PV Plant according to its location. This helps to maximise the total annual incident irradiation and total annual energy yield.



Govt. Policies - Jawaharlal Nehru National Solar Mission (JNNSM)



- Launched in 2010, JNNSM has been the key driver for growth of Indian solar industry
- It targets installation of 20 GW of grid connected and 2 GW of off-grid solar power by 2022 both (PV and CSP).
- In India, Ministry of New and Renewable Energy provides 30% upfront subsidy
- 80% accelerated depreciation that gives you tax benefit
- Emerging policies of Net Metering
- The mission aims to achieve grid tariff parity by 2022 through:
 - Large scale utilisation, rapid diffusion and deployment at a scale which leads to cost reduction
 - R&D, Pilot Projects and Technology Demonstration
 - Local manufacturing and support infrastructure

Mission Road Map

Segment	Target for Phase I (2010-13)	Cumulative Target for Phase 2 (2013-17)	Cumulative Target for Phase 3 (2017-22)
Grid solar power (large plants, roof top & distribution grid plants)	1100 MW	4000 MW - 10,000 MW	20,000 MW
Off-grid solar applications	200 MW	1000 MW	2000 MW
Solar Thermal Collectors (SWHs, solar cooking/cooling, Industrial process heat applications etc.)	7 Million Sq. Mt.	15 Million Sq. Mt.	20 Million Sq. Mt.
Solar Lighting System	5 Million	10 Million	20 Million

Utility Scale Solar PV Projects



- Ravin with its vast experience of EHV projects also specialises in setting up of large size utility scale Solar PV Plants.
- Ravin provides its customers a comprehensive service package which encompasses system design, design and selection of components and compatible accessories, supply of quality materials, installation, testing, commissioning and finally ensuring full safety and reliability of the installation.
- Ravin's designs and projects team consists of highly qualified and experienced engineers and project managers, who assist with all aspects of design, structural optimisation and project implementation, regardless of the project size, to scale production and delivery to meet customers' needs.
- Ravin offers end-to-end customised solutions of Mega Watt-sized Solar PV Plants.

Roof Top Solar PV Projects

- Ravin helps you to get the best out of the unused open spaces.
- Any rooftop can be converted into a power plant with Ravin Roof Top Solar PV installations, which are clean & simple.
- As far as the roofs are in good condition, Roof Top Solar PV Systems can be installed on any roof, which will help in harnessing the ever abundant energy of the sun into electricity.
- Ravin has expertise in installing various types of Roof Top Solar Installations, these can be systems mounted on your Sloping Roofs, Solar Tiles, Systems with Single / Dual Axis Tracking.



Normal

- Sloping Roofs
- Sloping Tiles
- Flat Roofs



Roof Top Solar Installation (Flat Roof)

Solar PV Tiles Installed on a Sloping Roof



Tracking

- Single
- Dual

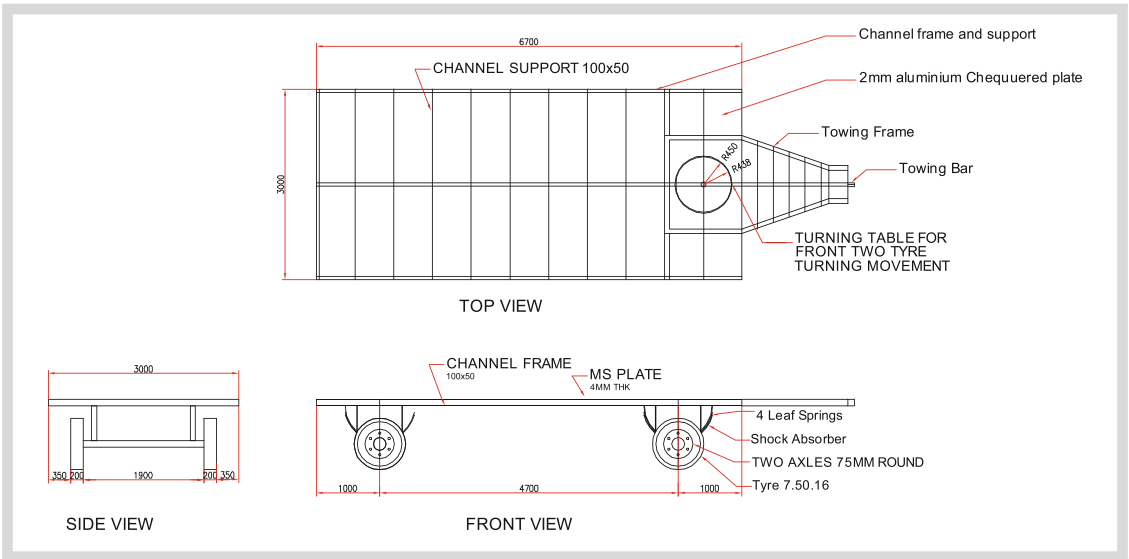


Roof Top Solar PV Plant with Dual Axis Trackers

Improvement in the Current Solar Installation by use of Tracker Systems



Solar Mobile Generating Station



TECHNICAL SPECIFICATIONS OF TROLLEY

Trolley Width: 3000mm	Trolley Length: 6700mm
Braking Arrangement: Provided	Load Carrying Capacity: 5000kgs
Ground Clearance: 250mm	Galvanised Structure
4 Tyres: 7/50/16	Axles: 2 nos
Leaf Springs & Shock Absorbers: 4 nos	Turn Table For Front 2 Tyre Movement



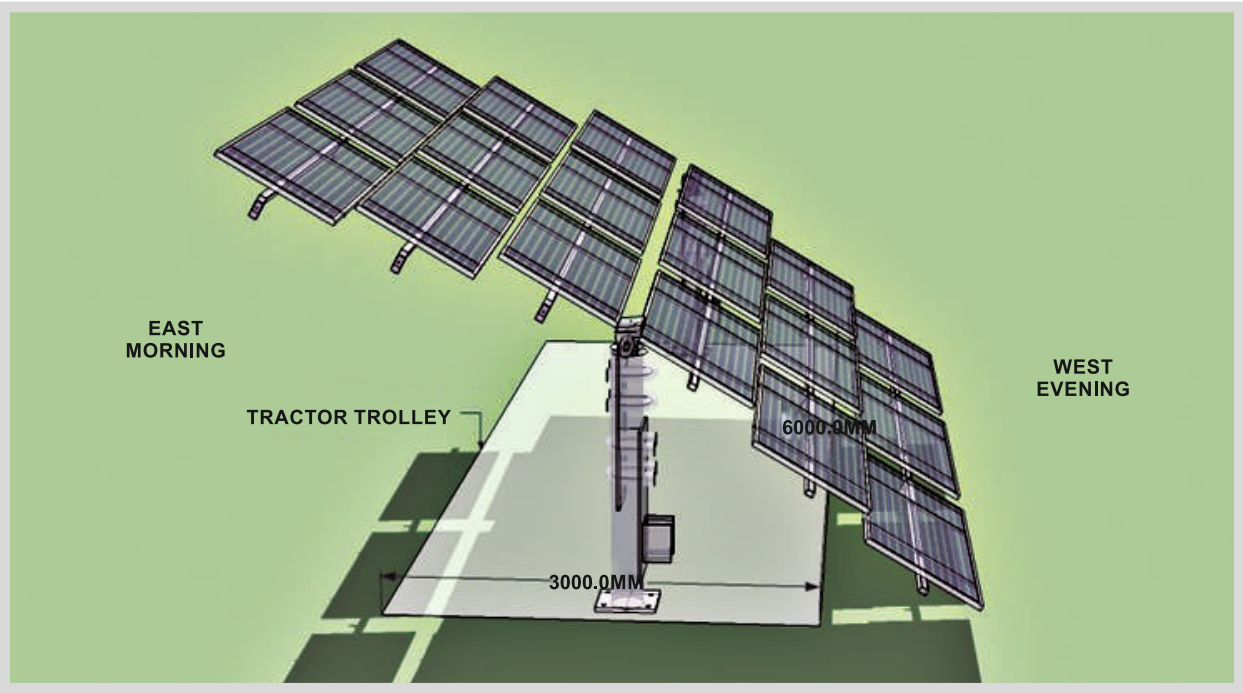
FULLY AUTOMATED TRACKING

The **SMS 5.4** solar mobile generating unit will provide uninterrupted power wherever there is sun. If you are looking for reliable, low cost, onsite, continuous supply of power then **SMS 5.4** is your solution.

COMPLETE SOLAR POWERED SOLUTION

- Plug and play
- Tracked system, gives enhanced generation
- Convenient to use
- Quick deployment
- Easily transportable
- Provides reliable power
- BTS for communication (optional)

SOLAR MOBILE GENERATING STATION



ENVIRONMENTALLY FRIENDLY	FLEXIBLE SOLUTIONS	OPERATIONAL FEATURES
No toxic emissions	Replacement to DG set	Automatic operation
No environment clearances required	Can be deployed in farms where there is no electricity for irrigation	No manual intervention
Green clean technology	Power for construction sites, hospitals, mela, bill boards, army camps	Option for off grid & on grid
Reducing green house gas emissions	Disaster management	Tracked systems for enhanced generation

TECHNICAL SPECIFICATIONS (AUTOMATED TRACKING SYSTEM)

PV Plant capacity	5490Wp	18 numbers of 305Wp modules
Off grid system: 600Wp	Battery bank: 48V- 200Ah	Grid connect inverter: 5 KW-3phase
Pump: 5 Hp through VFD drive (optional)	Automatic tracking	Self GPS calculations
Double feedback mechanism	48V DC system: mobile BTS application (optional)	Fully automatic operation from sunrise to sunset
Fully portable multi-utility power plant	Can generate 22+ units a day	

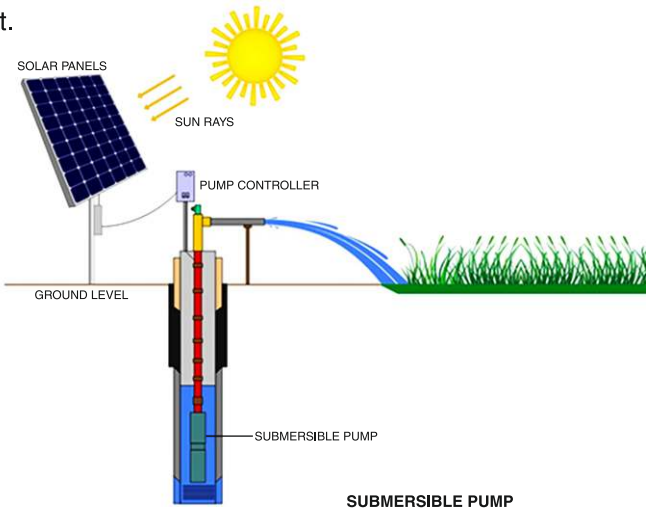
SOLAR PUMPING SOLUTIONS



Ravin offers Smart solar water for society building and agriculture.

Features:

- Built in Automatic tracking mechanism to maximize system output.
- Clean and efficient
- Fully unattended automated operation
- No electricity/fuel costs.
- Easy installation of roof/on ground.
- Long life over 20 years.
- Low maintainance.
- Solutions upto 200 meters water head.
- Pumpcapacity from 0.74 Hp to 24.8 Hp.



Water Output (Ltrs /Day) at Deep well (Submersible) Pumping System

SPV Capacity	2.7 kWp	3 kWp	4.8 kWp
Maximum Dynamic head in meters	25	70	70
Total head in meters	20	50	50
Water Output in Ltrs/Day	1,35,000	57,000	90,000

SOLAR PUMPING SOLUTIONS

RAVIN SOLAR PUMP VFD PANEL

FEATURES:

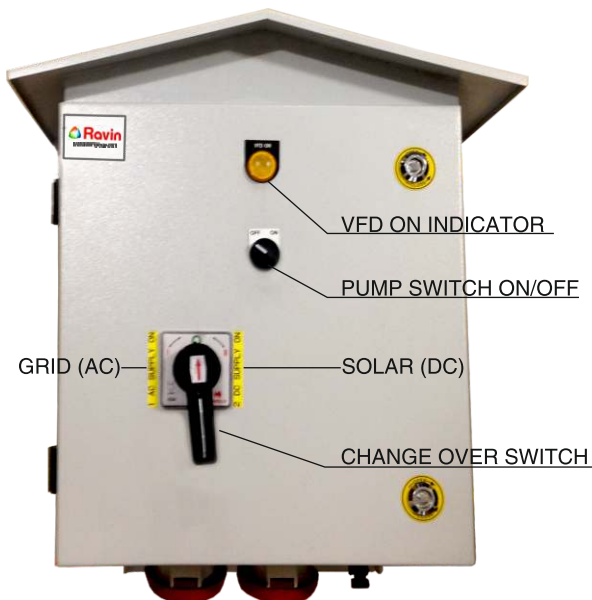
- Optimized Output Frequency control:** Optimized output frequency pattern is calculated by base frequency, base frequency voltage and Output frequency at VOK level voltage.
- Dry Run Function:** This function will help prevent the motor from remaining rotating without enough water flow or with a blockage in the pump.
- Automatic operation function:** This function enables VFDs to operate automatically without turning on its switch.

PROTECTION:

- Over Voltage
- Under Voltage
- PTC thermistor
- Short circuit Current
- Over current
- Output surge protection

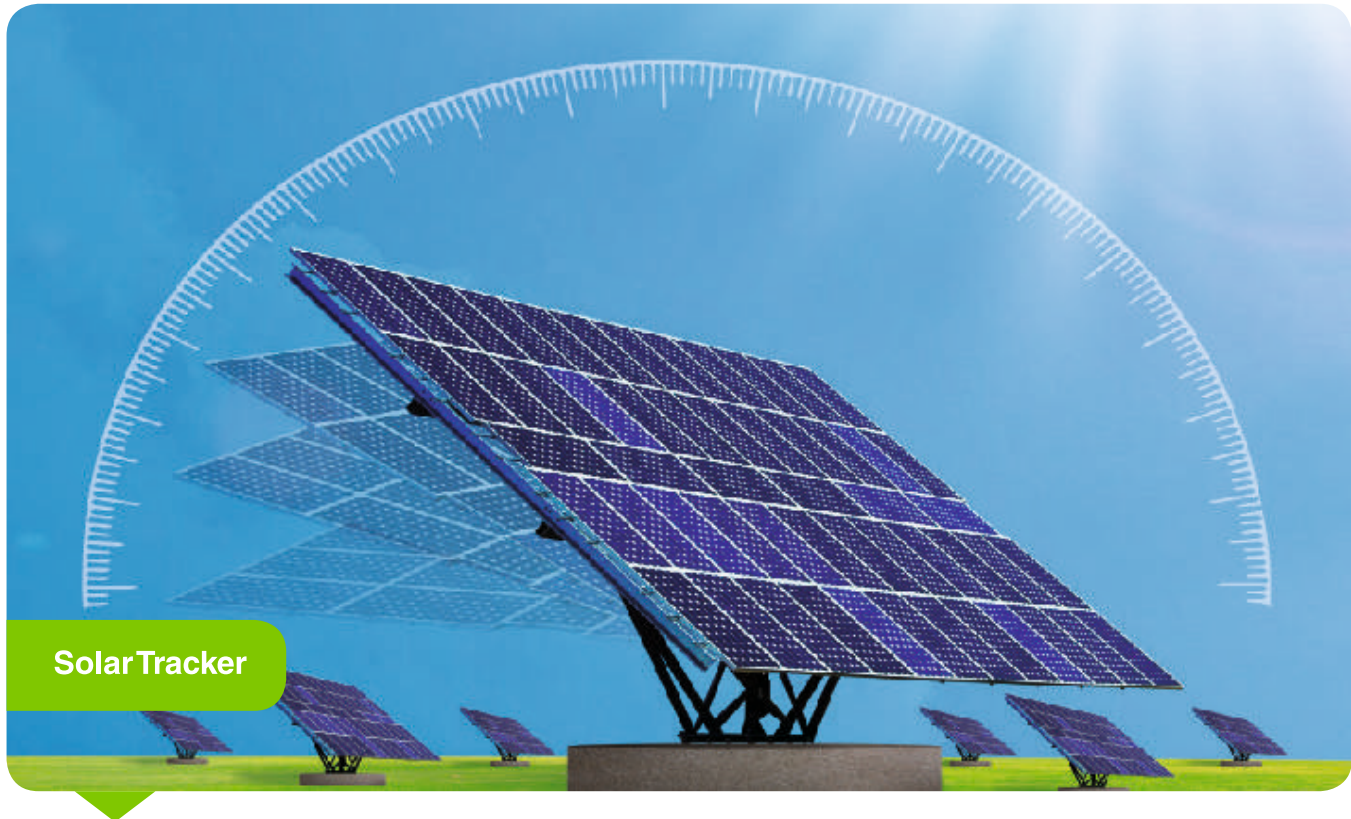
	VFD RATING	7.5 HP	5 HP
SR NO	PARAMETERS	VALUES	VALUES
1	Maximum DC input Voltage	250 to 740	250 to 740
2	MPPT Range	250 to 740 VDC	250 to 740 VDC
3	Maximum AC Output voltage	380 to 480 VDC	380 to 480 VDC
4	Rated O/p Current	11 Amp	7 Amp
5	Output Frequency	50 Hz/60 Hz	50 Hz/60 Hz
6	Efficiency	>96%	>96%
7	Cooling System	Forces air cooling	Forces air cooling
8	Surrounding air Temp	-10 C to 50 C	-10 C to 50 C
9	Humidity	Up to 95 % RH – 90 %	Up to 95 % RH – 90 %

CONTROL PANEL



FEATURES

Degree of protection	Ip54
Door	Projected
Door swing	100-120 Degree
Panel mounting	Wall mounting
Remote monitoring	Parameters like Solar Voltage, Motor Voltage, Motor Current, Solar power, Frequency Water flow status



Solar Tracker is a device that is designed to harness the maximum amount of Solar Energy from the Sun, by orienting or aligning the payload towards the sun. Apart from being used to focus the arrays of photovoltaic (PV) solar cells directly to the sun, they are also used for focussing mirrors, reflectors or lenses that are used for concentrated solar power units.

- Through the day, the sun keeps changing its angle constantly. These trackers help the PV arrays, mirrors, reflectors and other devices track the sun, and minimise the angle of incidence by ensuring that the sun's rays fall in a more or less perpendicular angle
- These devices use energy generated from the solar power plant itself, to continually orient the solar device towards the sun, however, this energy input is more than offset by the increased efficiency gained through the use of the tracker
- Trackers help in producing more energy as the Solar Panels or Mirrors (CSP) will be fully exposed to sunlight
- Tracker performs the tilting and turning operation by following the sun movements using Astrological Predictions
- The tracking system helps in collecting energy from the sun for the longest period of the day ensuring the most accurate alignment to the sun, which shifts with the season
- Tracking System includes Galvanised Steel structures with motors, actuators or hydraulics along with PLC driven Micro Controller

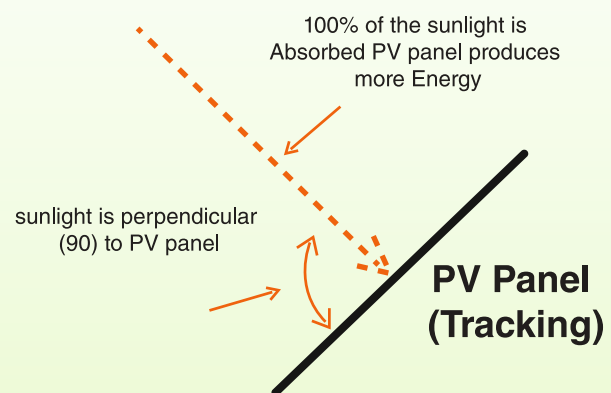
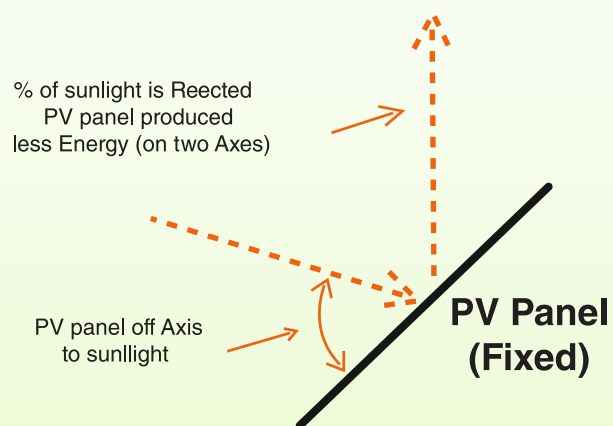


How Solar Trackers work?

- The strategy of tracking is based on the location (latitude and longitude) of the array and date/time data and location data.
- This data, which can be established within a microprocessor at the time of installation, includes a clock, along with a well-chosen solar position algorithm, and can determine the position of the sun, even if it is obscured by clouds or other obstacles.
- This helps the array to be positioned accurately regardless of weather, so when the sun comes out, the array will already be correctly positioned.
- A tracking device can help a solar cell to take advantage of the early morning sunlight.
- The tracker then slowly moves the panel throughout the day, following the sun to gain maximum exposure to the sun.
- A tracker (dual axis) based solar system can enhance generation by 15% to 35% as compared to a fixed tilt solar system.



The Tracking Advantage

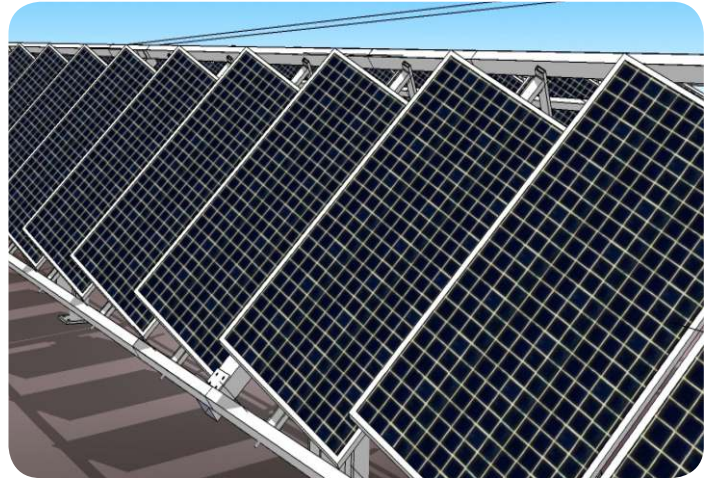


Types of Solar Tracking Systems

- Single Axis Tracking System
- Dual Axis Tracking System

A **single axis system** is most commonly used for most standard PV Power Plant. Single axis solar trackers rotate in one direction moving back and forth. These types of trackers usually have simple levers which can be used to tilt the panels depending on the season, so that it can harness the maximum energy from the sun.

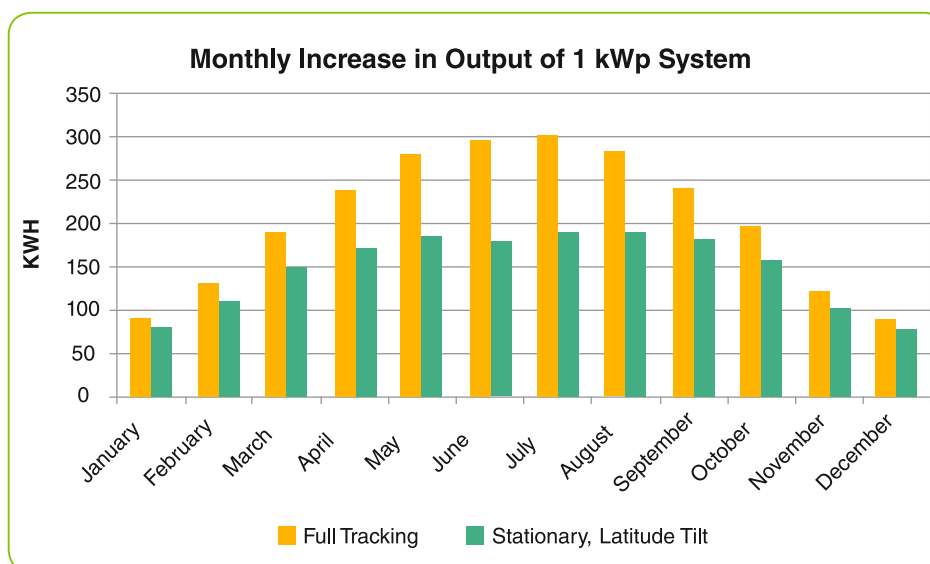
This is the type of tracking system apt for **residential solar arrays**, as well as many smaller commercial arrays. As compared to Dual Axis Trackers, single axis trackers allow much lesser exposure to the sun's rays, their main advantage lies in the price as compared to Dual Axis Tracking Systems.



Dual axis systems are typically used in concentrated solar power systems as well as Solar Photovoltaic Power Systems, where it becomes necessary to completely orient the mirrors or solar modules towards the sun to ensure maximum generation.

Dual axis systems - as indicative of the same - move in two directions, on both the horizontal and the vertical axis making complete use of the sun's rays for the entire day.

With a Dual Axis Tracking System more energy can be generated from a given land area, as compared to Fixed tilt installation or Single Axis.



Solar DC Cables

Solar DC Cables, also known as PV Cables, interconnect Solar Panels with other electrical components of a Solar Plant. Solar DC Cables are designed to be UV resistant and weather resistant, to withstand a temperature range of -40°C to +120°C. These cables are also designed to withstand voltage drops. These cables have maximum permissible DC voltage of 1.8 kV. The Insulation & Sheath is generally made up of XLPO, which helps the cable to withstand thermal & mechanical loads. Additionally, these cables also are salt resistant and are resistant to acids and alkaline solutions.

Ravin Solar DC cables are under Type approved by TÜV according to latest version 2 Pfg1169/08.2007.

Ravin DC Cables Specifications:

Conductor: EC Grade Flexible Class 5 copper, according to IEC 60228 (DIN VDE 0295)

Insulation: XLPO

Sheath: XLPO

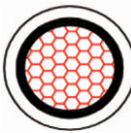




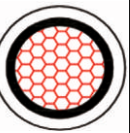
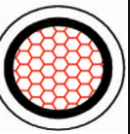
Sheath Colour: Black, Red, Blue

Specification: TÜV 2 Pfg1169/08.2007

No. of Cores: Single

Sizes: 1.5 mm² to 400 mm²



DESCRIPTION		Unit	1C x 1.5mm ²	1C x 2.5mm ²	1C x 4mm ²	1C x 6mm ²	1C x 10mm ²	1C x 16mm ²	1C x 25mm ²
Cable Details									
Flexible Annealed Tinned Copper Conductor, XLPO Insulated & Overall Black Coloured XLPO Sheathed 1100 V LT Cable Generally Conforming to IS 7098-1 & TUV Specifications-2 Pfg 1169/08.2007									
Construction Details (Material)									
2.1	Conductor		Annealed Tinned Copper	Annealed Tinned Copper	Annealed Tinned Copper	Annealed Tinned Copper	Annealed Tinned Copper	Annealed Tinned Copper	Annealed Tinned Copper
2.2	Insulation		XLPO	XLPO	XLPO	XLPO	XLPO	XLPO	XLPO
2.5	Sheath		XLPO	XLPO	XLPO	XLPO	XLPO	XLPO	XLPO
Dimensional Details									
3.1	Number of Cores		1	1	1	1	1	1	1
3.2	Conductor Cross-Sectional Area	mm ²	1.5	2.5	4	6	10	16	25
3.3	Approximate Overall Diameter	mm	5.0 ± 0.5	5.5 ± 0.5	6.0 ± 0.5	6.5 ± 0.5	7.5 ± 0.5	8.5 ± 0.5	10.5 ± 0.5
3.4	Conductor :								
3.4.1	Conductor Flexibility class		Class - 5	Class - 5	Class - 5	Class - 5	Class - 5	Class - 5	Class - 5
3.4.2	Maximum wire size used in conductor	mm	0.26	0.26	0.31	0.31	0.41	0.41	0.41
3.4.3	Shape		Circular	Circular	Circular	Circular	Circular	Circular	Circular
3.5	Insulation:								
3.5.1	Average Thickness		0.7	0.7	0.7	0.7	0.7	0.7	0.9
3.5.2	Minimum Thickness		0.53	0.53	0.53	0.53	0.53	0.53	0.71
3.5.3	Core Identification		Colour of Insulation	Colour of Insulation	Colour of Insulation	Colour of Insulation	Colour of Insulation	Colour of Insulation	Colour of Insulation
3.6	Outer Sheath :								
3.6.1	Nominal Thickness	mm	0.90	0.90	0.90	0.90	0.90	0.90	1.00
3.6.2	Colour		Black or as agreed	Black or as agreed	Black or as agreed	Black or as agreed	Black or as agreed	Black or as agreed	Black or as agreed
Electrical Parameters									
4.1	Rated DC Voltage	V	1800	1800	1800	1800	1800	1800	1800
4.2	Maximum Conductor DC Resistance at 20°C	Ω/km	13.7	8.21	5.09	3.39	1.95	1.24	0.795
4.3	Permissible Current Rating in Air at 60°C	A	30	41	55	70	98	132	176
4.4	Single cable on Surface	A	29	39	52	67	93	125	167
4.5	Two Cables adjacent on surface	A	24	33	44	57	79	107	142
Other Parameters									
5.1	Thermal characteristics								
5.1.1	Ambient Temperature	°C	-40 to +90	-40 to +90	-40 to +90	-40 to +90	-40 to +90	-40 to +90	-40 to +90
5.1.2	Maximum Temperature at Conductor & Duration	°C	120°C (20000h)	120°C (20000h)	120°C (20000h)	120°C (20000h)	120°C (20000h)	120°C (20000h)	120°C (20000h)
5.1.3	Short Circuit temperature	°C	250°C (Max. 5 Sec)	250°C (Max. 5 Sec)	250°C (Max. 5 Sec)	250°C (Max. 5 Sec)	250°C (Max. 5 Sec)	250°C (Max. 5 Sec)	250°C (Max. 5 Sec)
5.2	Chemical characteristics								
5.2.1	Mineral Oil Resistance		EN 60811-2-1	EN 60811-2-1	EN 60811-2-1	EN 60811-2-1	EN 60811-2-1	EN 60811-2-1	EN 60811-2-1
5.2.2	Ozone Resistance		EN 50396 part 8.1.3, Method B	EN 50396 part 8.1.3, Method B	EN 50396 part 8.1.3, Method B	EN 50396 part 8.1.3, Method B	EN 50396 part 8.1.3, Method B	EN 50396 part 8.1.3, Method B	EN 50396 part 8.1.3, Method B
5.2.3	Weathering-UV Resistance:		ASTM G 154	ASTM G 154	ASTM G 154	ASTM G 154	ASTM G 154	ASTM G 154	ASTM G 154
5.2.4	Acid & Alkaline Resistance		EN 60811-2-1	EN 60811-2-1	EN 60811-2-1	EN 60811-2-1	EN 60811-2-1	EN 60811-2-1	EN 60811-2-1
5.3	Fire resisting characteristics								
5.3.1	Flame retardant		IEC 60332-1-2	IEC 60332-1-2	IEC 60332-1-2	IEC 60332-1-2	IEC 60332-1-2	IEC 60332-1-2	IEC 60332-1-2
5.3.2	Low smoke emission		< 30% as per ASTM D-2843	< 30% as per ASTM D-2843	< 30% as per ASTM D-2843	< 30% as per ASTM D-2843	< 30% as per ASTM D-2843	< 30% as per ASTM D-2843	< 30% as per ASTM D-2843
5.3.3	Halogen (Acid) gas emission		Max 0.5% as per IEC 60754-1	Max 0.5% as per IEC 60754-1	Max 0.5% as per IEC 60754-1	Max 0.5% as per IEC 60754-1	Max 0.5% as per IEC 60754-1	Max 0.5% as per IEC 60754-1	Max 0.5% as per IEC 60754-1
5.3.4	Oxygen Index		>32 as per ASTM D-2863	>32 as per ASTM D-2863	>32 as per ASTM D-2863	>32 as per ASTM D-2863	>32 as per ASTM D-2863	>32 as per ASTM D-2863	>32 as per ASTM D-2863
Packaging									
6.1	Standard Delivery Length	m	100 Coil	100 Coil	100 Coil	100 Coil	100 Coil	100 Coil	100 Coil
6.2	Tolerance on Order Quantity	%	± 5	± 5	± 5	± 5	± 5	± 5	± 5
Applicable Standards									
7.1	Cable		IS 7098-1	IS 7098-1	IS 7098-1	IS 7098-1	IS 7098-1	IS 7098-1	IS 7098-1
7.2	Conductor		IS 8130	IS 8130	IS 8130	IS 8130	IS 8130	IS 8130	IS 8130
7.3	Insulation		TUV-2 Pfg 1169/08.2007	TUV-2 Pfg 1169/08.2007	TUV-2 Pfg 1169/08.2007	TUV-2 Pfg 1169/08.2007	TUV-2 Pfg 1169/08.2007	TUV-2 Pfg 1169/08.2007	TUV-2 Pfg 1169/08.2007
7.4	Sheath Material		TUV-2 Pfg 1169/08.2007	TUV-2 Pfg 1169/08.2007	TUV-2 Pfg 1169/08.2007	TUV-2 Pfg 1169/08.2007	TUV-2 Pfg 1169/08.2007	TUV-2 Pfg 1169/08.2007	TUV-2 Pfg 1169/08.2007
Installation Guidelines									
8.1	Minimum Bending Radius	mm	6 x Overall Dia.	6 x Overall Dia.	6 x Overall Dia.	6 x Overall Dia.	6 x Overall Dia.	6 x Overall Dia.	6 x Overall Dia.
8.2	Safe Pulling Force	N/mm ²	50	50	50	50	50	50	50

1C x 35mm ²	1C x 50mm ²	1C x 70mm ²	1C x 95mm ²	1C x 120mm ²	1C x 150mm ²	1C x 185mm ²	1C x 240mm ²	1C x 300mm ²	1C x 400mm ²
									
Annealed Tinned Copper	Annealed Tinned Copper	Annealed Tinned Copper	Annealed Tinned Copper	Annealed Tinned Copper	Annealed Tinned Copper	Annealed Tinned Copper	Annealed Tinned Copper	Annealed Tinned Copper	Annealed Tinned Copper
XLPO	XLPO	XLPO	XLPO	XLPO	XLPO	XLPO	XLPO	XLPO	XLPO
XLPO	XLPO	XLPO	XLPO	XLPO	XLPO	XLPO	XLPO	XLPO	XLPO
1	1	1	1	1	1	1	1	1	1
35	50	70	95	120	150	185	240	300	400
12.5 ± 0.5	14.5 ± 0.5	16.5 ± 1.0	18.5 ± 1.0	20.0 ± 1.0	22.5 ± 1.0	25.5 ± 1.0	28.5 ± 1.0	31.5 ± 1.0	35.0 ± 2.0
Class - 5	Class - 5	Class - 5	Class - 5	Class - 5	Class - 5	Class - 5	Class - 5	Class - 5	Class - 5
0.41	0.41	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Circular	Circular	Circular	Circular	Circular	Circular	Circular	Circular	Circular	Circular
0.9	1	1.1	1.1	1.2	1.4	1.6	1.7	1.8	2.0
0.71	0.8	0.89	0.89	0.98	1.16	1.34	1.43	1.52	1.7
Colour of Insulation	Colour of Insulation	Colour of Insulation	Colour of Insulation	Colour of Insulation	Colour of Insulation	Colour of Insulation	Colour of Insulation	Colour of Insulation	Colour of Insulation
1.10	1.20	1.30	1.50	1.60	1.70	1.90	2.10	2.20	2.40
Black or as agreed	Black or as agreed	Black or as agreed	Black or as agreed	Black or as agreed	Black or as agreed	Black or as agreed	Black or as agreed	Black or as agreed	Black or as agreed
1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
0.565	0.393	0.277	0.21	0.164	0.132	0.108	0.0817	0.0654	0.0486
218	272	369	483	568	658	764	922	1082	1318
207	258	350	458	539	625	726	876	1028	1252
176	219	297	389	458	531	616	744	873	1063
-40 to +90	-40 to +90	-40 to +90	-40 to +90	-40 to +90	-40 to +90	-40 to +90	-40 to +90	-40 to +90	-40 to +90
120°C (20000h)	120°C (20000h)	120°C (20000h)	120°C (20000h)	120°C (20000h)	120°C (20000h)	120°C (20000h)	120°C (20000h)	120°C (20000h)	120°C (20000h)
250°C (Max. 5 Sec)	250°C (Max. 5 Sec)	250°C (Max. 5 Sec)	250°C (Max. 5 Sec)	250°C (Max. 5 Sec)	250°C (Max. 5 Sec)	250°C (Max. 5 Sec)	250°C (Max. 5 Sec)	250°C (Max. 5 Sec)	250°C (Max. 5 Sec)
EN 60811-2-1 EN 50396 part 8.1.3, Method B ASTM G 154 EN 60811-2-1	EN 60811-2-1 EN 50396 part 8.1.3, Method B ASTM G 154 EN 60811-2-1	EN 60811-2-1 EN 50396 part 8.1.3, Method B ASTM G 154 EN 60811-2-1	EN 60811-2-1 EN 50396 part 8.1.3, Method B ASTM G 154 EN 60811-2-1	EN 60811-2-1 EN 50396 part 8.1.3, Method B ASTM G 154 EN 60811-2-1	EN 60811-2-1 EN 50396 part 8.1.3, Method B ASTM G 154 EN 60811-2-1	EN 60811-2-1 EN 50396 part 8.1.3, Method B ASTM G 154 EN 60811-2-1	EN 60811-2-1 EN 50396 part 8.1.3, Method B ASTM G 154 EN 60811-2-1	EN 60811-2-1 EN 50396 part 8.1.3, Method B ASTM G 154 EN 60811-2-1	EN 60811-2-1 EN 50396 part 8.1.3, Method B ASTM G 154 EN 60811-2-1
IEC 60332-1-2 < 30% as per ASTM D-2843	IEC 60332-1-2 < 30% as per ASTM D-2843	IEC 60332-1-2 < 30% as per ASTM D-2843	IEC 60332-1-2 < 30% as per ASTM D-2843	IEC 60332-1-2 < 30% as per ASTM D-2843	IEC 60332-1-2 < 30% as per ASTM D-2843	IEC 60332-1-2 < 30% as per ASTM D-2843	IEC 60332-1-2 < 30% as per ASTM D-2843	IEC 60332-1-2 < 30% as per ASTM D-2843	IEC 60332-1-2 < 30% as per ASTM D-2843
Max 0.5% as per IEC 60754-1	Max 0.5% as per IEC 60754-1	Max 0.5% as per IEC 60754-1	Max 0.5% as per IEC 60754-1	Max 0.5% as per IEC 60754-1	Max 0.5% as per IEC 60754-1	Max 0.5% as per IEC 60754-1	Max 0.5% as per IEC 60754-1	Max 0.5% as per IEC 60754-1	Max 0.5% as per IEC 60754-1
>32 as per ASTM D-2863	>32 as per ASTM D-2863	>32 as per ASTM D-2863	>32 as per ASTM D-2863	>32 as per ASTM D-2863	>32 as per ASTM D-2863	>32 as per ASTM D-2863	>32 as per ASTM D-2863	>32 as per ASTM D-2863	>32 as per ASTM D-2863
100 Coil ± 5	100 Coil ± 5	100 Coil ± 5	100 Coil ± 5	100 Coil ± 5	100 Coil ± 5	100 Coil ± 5	100 Coil ± 5	100 Coil ± 5	100 Coil ± 5
IS 7098-1 IS 8130 TUV-2 Pfg 1169/08.2007 TUV-2 Pfg 1169/08.2007	IS 7098-1 IS 8130 TUV-2 Pfg 1169/08.2007 TUV-2 Pfg 1169/08.2007	IS 7098-1 IS 8130 TUV-2 Pfg 1169/08.2007 TUV-2 Pfg 1169/08.2007	IS 7098-1 IS 8130 TUV-2 Pfg 1169/08.2007 TUV-2 Pfg 1169/08.2007	IS 7098-1 IS 8130 TUV-2 Pfg 1169/08.2007 TUV-2 Pfg 1169/08.2007	IS 7098-1 IS 8130 TUV-2 Pfg 1169/08.2007 TUV-2 Pfg 1169/08.2007	IS 7098-1 IS 8130 TUV-2 Pfg 1169/08.2007 TUV-2 Pfg 1169/08.2007	IS 7098-1 IS 8130 TUV-2 Pfg 1169/08.2007 TUV-2 Pfg 1169/08.2007	IS 7098-1 IS 8130 TUV-2 Pfg 1169/08.2007 TUV-2 Pfg 1169/08.2007	IS 7098-1 IS 8130 TUV-2 Pfg 1169/08.2007 TUV-2 Pfg 1169/08.2007
6 x Overall Dia. 50	6 x Overall Dia. 50	6 x Overall Dia. 50	6 x Overall Dia. 50	6 x Overall Dia. 50	6 x Overall Dia. 50	6 x Overall Dia. 50	6 x Overall Dia. 50	6 x Overall Dia. 50	6 x Overall Dia. 50

Our Services

Site Evaluation/Feasibility Study:

- Detailed Site Evaluation by Ravin's Expert Technician and Engineer
- Structural analysis by using a Specialised Software to assess the limitations of **roof**
- Shading/Solar simulation analysis to ensure the maximum productivity by a Ravin's experienced design team

Custom Designed Solar System:

- Ravin's experienced in-house Engineering team custom designs your Solar Energy system based on the unique layout
- Complete set of mechanical and electrical drawings to be handed over
- Ravin will also produce a 3-D rendering of the project which helps design and installation team as well as giving the client a much better understanding of the project

Expert Installation:

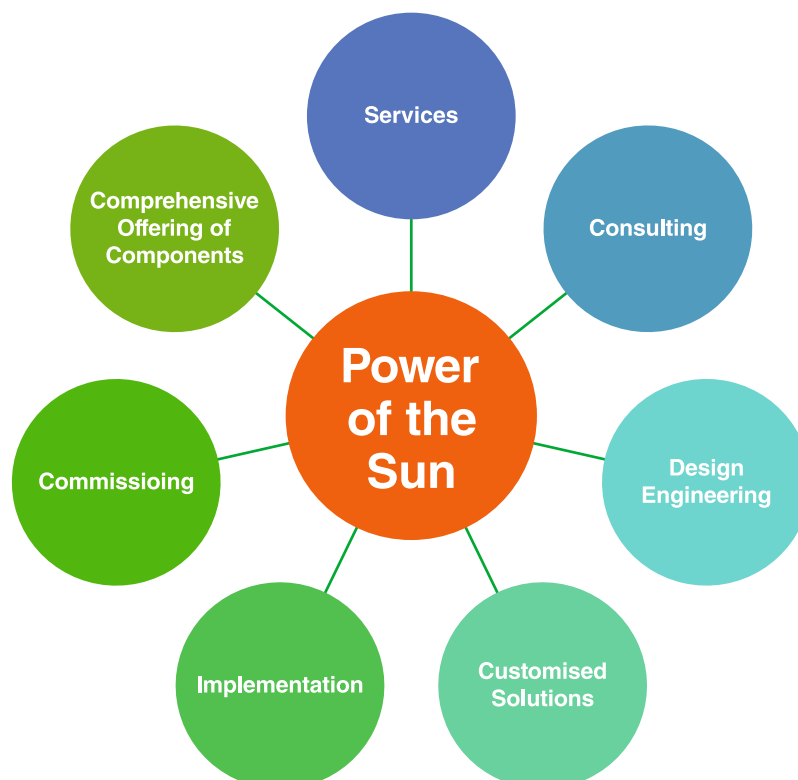
- Ravin's certified installation team has extensive experience and is committed to building your company's system to exceptional high standards of workmanship and safety
- Our systems are fully integrated and use only high quality components from reputed and experienced manufacturers

Monitoring:

- For most commercial projects, we set up a highly efficient monitoring system, so that both clients and we can constantly keep track of how system is performing
- The monitoring system gives us instant access, allowing us to immediately assess the Solar Energy system and give instant alerts on any performance issues

Operation & Maintenance:

- We offer long-term agreements to perform maintenance for the life of your system
- We always thrive for Clients' satisfaction and Ravin's after sales support team will help neutralising any technical issues within a short span of time



Typical Simulation report for a 1 MW Solar PV Plant

Grid-Connected System: Main Results

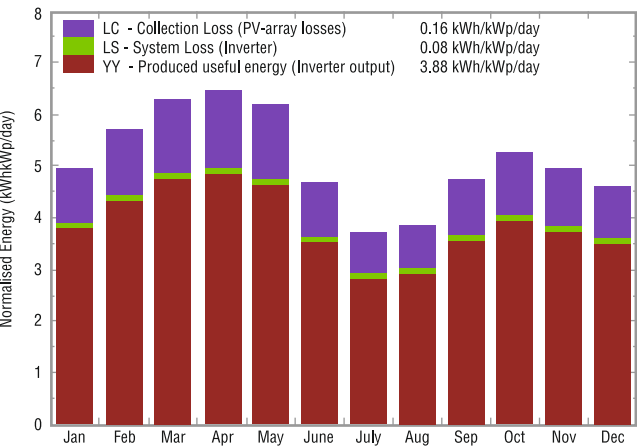
Project: 1 MWp
Simulation Variant: 1 MWp

Main System Parameters		System Type	Grid-Connected	
PV Field Orientation		Tilt	10°	Azimuth -15°
PV Modules		Model	Series 280 - 330 Wpnom 300 Wp	
PV Array		Nb. of Modules	3340	Pnom Total 1002 kWp
Inverter		Model	PVI-Central-500-TI	Pnom 500 kW ac
Invert Pack		Nb. of Units	2.0	Phome Total 1000 kW ac
User's Needs		Unlimited Load (Grid)		

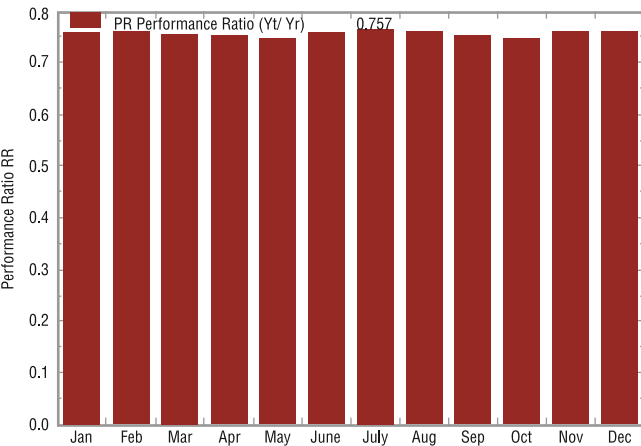
Main Simulation Results

System Production Produced Energy **1417862 kWh/ year** Specific Prod. 1415 kWh/ / kWp/ year
Performance Ratio PR 75.7 %

Normalized Productions (per Installed kWp): Nominal Power 1002 kWp



Performance Ratio (PR)



1 MWp - Balance and Main Results

	GlobHor kWh/ m²	T Amb °C	GlobInc kWh/ m²	GlobEff kWh/ m²	EArray kWh	E_Grid kWh	EffArrR %	EffSysR %
January	143.0	25.50	154.2	149.3	120680	118114	12.08	11.82
February	152.0	25.90	180.1	155.3	124844	122350	12.03	11.79
March	192.0	27.00	195.1	189.4	151064	148187	11.95	11.72
April	198.0	28.00	194.0	187.8	148944	146052	11.85	11.62
May	202.0	28.80	192.5	186.2	147266	144431	11.80	11.58
June	147.0	27.70	140.4	135.2	108807	106676	11.96	11.73
July	120.0	26.70	115.9	111.5	90558	88666	12.06	11.80
August	122.0	26.90	119.5	115.2	93084	91039	12.02	11.76
September	142.0	28.30	142.2	137.4	109357	107540	11.92	11.67
October	158.0	30.00	163.1	158.1	124801	122437	11.81	11.59
November	139.0	28.50	148.2	143.8	115154	112970	11.99	11.76
December	132.0	27.30	143.3	138.7	111605	109400	12.02	11.78
Year	1847.0	27.56	1868.4	1807.8	1446663	1417862	11.95	11.71

Legends: GlobHor Horizontal Global Imidiation EArray Effective Energy at the ouput of the Array
T Amb Ambient Temperature E_Grid Energy Injected into Grid
GlobInc Global Incident in Coll Plane EffArrR Effic. Eout Array/ Rough Area
GlobEff Effective Global, Corr. for IAM and Sahlings EffSysR Effic. Eout System/ Rough Area

Typical Simulation report for a 1 MW Solar PV Plant

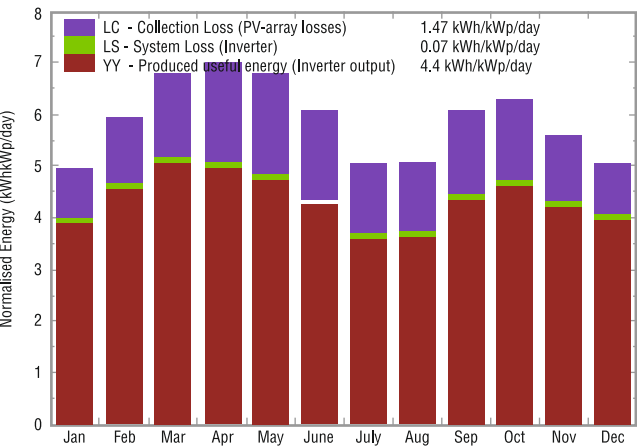
Grid-Connected System: Main Results

Project: 20 KWp
Simulation Variant: New Simulation Variant

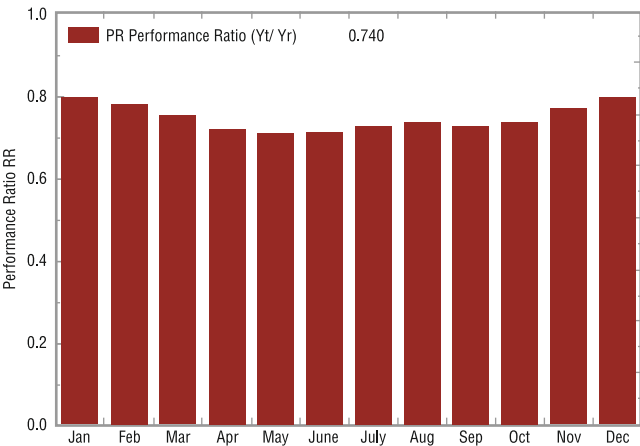
Main System Parameters		System Type	Grid-Connected	
PV Field Orientation		Tilt	20°	Azimuth - 0°
PV Modules		Model		Phom 280 Wp
PV Array	Nb. of Modules	72	Pnom Total	20.16 kWp
Inverter	Model		Pnom	20.00 kW ac
User's Needs	Unlimited Load (Grid)			

Main Simulation Results				
System Production	Produced Energy	32359 kWh/ year	Specific Prod.	1605 kWh/ / kWp/ year
	Performance Ratio PR	74.0 %		

Normalized Productions (per Installed kWp): Nominal Power 20.16 kWp



Performance Ratio (PR)



1 KWp - Balance and Main Results

	GlobHor kWh/ m²	T Amb °C	GlobInc kWh/ m²	GlobEff kWh/ m²	EArray kWh	E_Grid kWh	EffArrR %	EffSysR %
January	118.0	14.70	155.5	150.7	2526	2486	11.63	11.44
February	131.1	17.30	168.2	163.5	2671	2627	11.37	11.18
March	188.0	22.70	211.7	205.8	3244	3191	10.97	10.79
April	207.0	28.80	211.8	205.9	3108	3058	10.51	10.34
May	222.0	32.50	212.5	206.4	3069	3019	10.34	10.17
June	197.0	32.90	183.8	178.2	2665	2620	10.37	10.20
July	167.0	30.30	158.4	153.2	2340	2300	10.57	10.39
August	160.0	29.90	158.8	153.8	2371	2335	10.70	10.54
September	171.0	29.50	183.8	178.6	2718	2675	10.59	10.42
October	165.0	26.20	197.1	191.6	2964	2916	10.76	10.59
November	129.0	20.90	168.1	164.0	2648	2606	11.21	11.03
December	115.0	16.00	158.6	153.6	2567	2527	11.59	11.41
Year	1976.1	27.56	2169.1	2105.1	32892	32359	10.85	10.68

Legends: GlobHor Horizontal Global Imidiation
T Amb Ambient Temperature
GlobInc Global Incident in Coll Plane
GlobEff Effective Global, Corr. for IAM and Sahlings
EArray Effective Energy at the ouput of the Array
E_Grid Energy Injected into Grid
EffArrR Effic. Eout Array/ Rough Area
EffSysR Effic. Eout System/ Rough Area

Who Can Avail Our Services?

■ For setting up a new SPV Plant:

Solar PV Plants are an apt solution for factories with large roofs or large open areas, Industries with huge requirement of power, owners of large parcels of lands, Car Parks, Residential Premises, Telecom Towers, Malls, Hospitals, Installation on open spaces like **canals**.

■ For SPV Plant already Installed:

Improvement in the generation of a Current Solar Installation by use of Tracker Systems:

For existing Solar PV plants, installing a tracking system might be a great option, as it would enhance the generation from solar by 15% to 35%, as the tracking system will keep the panels aligned towards the sun. A typical Solar System would be working at a fraction of its capacity unless fitted with a Tracking System. The other advantage of Ravin Tracking Systems is that with a nominal increment in the plant's investment, the SPV Plant generation increases anywhere between 15% and 35%.



Why Partner Us?



With a global approach and comprehensive research, Ravin helps in delivering world-class solutions with a high degree of innovation and quality. Backed by a cutting-edge technology and high levels of customer-centricity, Ravin provides clients with the highest degree of quality standards. The project management team at Ravin also ensures that each component exhibits outstanding electrical and mechanical properties that makes it the preferred choice for customers across the globe.



B - 403, 4th Floor, Akruti Trade Centre, Road No. 7, MIDC, Andheri (E), Mumbai - 400093.
T +91 22 30816666, **F** +91 22 30816661, **E** sales@ravingroup.com, **W** www.ravingroup.com