

Now Available

# SOLAR PLANT PERFORMANCE IN INDIA 2016-17

- ❖ Report (PDF)
- ❖ Data-set (Excel)

# Solar Plant Performance in India 2016-17

## Table of Contents

1. **Solar Sector Power Overview**
  - ❖ Size and Growth
  - ❖ Grid-connected Solar Segment
  - ❖ Rooftop Solar Segment
  - ❖ Key Growth Drivers
  - ❖ Recent Developments
  - ❖ Assessment of Key Challenges
  - ❖ Future Outlook
  - ❖ Assumptions and Caveats
2. **Review of Solar Plant Performance**
  - ❖ Key Demographics
  - ❖ Overall Performance Trends
    - Year-wise Performance
    - Project Size-wise Performance
    - State-wise Performance
    - Technology-wise Performance
    - Developer Type-wise Performance
3. **Plant Performance by Year of Commissioning**
  - ❖ Year-wise Distribution of Plants Tracked
  - ❖ Annual Trends
  - ❖ Seasonality Trends
  - ❖ Conclusion
4. **Plant Performance by State**
  - ❖ Assumptions and Caveats
  - ❖ Overview
  - ❖ Yearly Generation per MW
  - ❖ Interstate Comparison
  - ❖ Annual Trends
  - ❖ Intra-state Comparison
5. **Project Performance by Plant Size**
  - ❖ Size-wise Distribution of Plants Tracked
  - ❖ State-wise Number of Tracked Projects and Installed Capacity by Plant Size
  - ❖ Comparative Performance Analysis
  - ❖ Seasonality Trends
  - ❖ Performance Analysis Based on Highest CUF Achieved
  - ❖ Conclusion
6. **Plant Performance by Technology**
  - ❖ Distribution of Plants Tracked
  - ❖ Annual Trends
  - ❖ Seasonality Trends
  - ❖ Conclusion
7. **Solar Trackers**
  - ❖ Overview
  - ❖ Profiles of Key Solar Tracker Providers
    - Scorpius
    - NexTracker
    - Smarttrak
8. **Plant Performance by Developer Type**
  - ❖ Share of Tracked Capacity by Developer Type
  - ❖ Performance of Plants Developed by Integrated Solar Project Developers
  - ❖ Performance of Plants Developed by Independent Power Producers
  - ❖ Performance of Plants Developed by Power Generation Companies
  - ❖ Performance of Plants Developed by Diversified Players
  - ❖ Comparative Performance Analysis
  - ❖ Conclusion
9. **Plant Performance by Key Developers**
  - ❖ Current Market Share of Developers
  - ❖ Summary of Key Developers in Plants Tracked
  - ❖ Trends in Average Annual CUFs
  - ❖ Performance of Key Developers
    - ACME Solar
    - Adani Power
    - Azure Power
    - Essel Infra
    - First Solar
    - Hero Solar Energy
    - Hindustan Cleanenergy Limited
    - NTPC
    - Renew Power
    - Tata Power Renewable Energy Limited
10. **Plant Performance by Key Module Manufacturers**
  - ❖ Solar Module Manufacturing Scenario in India
  - ❖ Share of Key Module Manufacturers in Plants Tracked
  - ❖ Trends in Average Annual CUF
  - ❖ Performance of Plants by Module Manufacturers
    - BHEL
    - Canadian Solar
    - First Solar
    - Hanhwa Q Cells
    - Moser Baer
    - ReneSola
    - Tata Power Solar
    - Trina Solar
    - Vikram Solar
    - Waaree Energies
11. **Plant Performance by Key EPC Contractors**
  - ❖ Current Market Share of EPC Contractors
  - ❖ Share of Key EPC Contractors in Plants Tracked
  - ❖ Comparative Performance Analysis
  - ❖ Performance of Key EPC Contractors
    - Gamesa Solar
    - Lanco Solar
    - Larsen & Toubro
    - Mahindra Susten
    - Premier Solar
    - Rays Power Infra
    - Sterling & Wilson
    - Tata Power Solar
    - Ujaas Energy

## 12. Plant Performance by Key Inverter Manufacturers

- ❖ Current Market Share of Key Inverter Manufacturers
- ❖ Profiles of Key Inverter Manufacturers
  - ABB
  - Delta
  - Hitachi
  - Huawei
  - Schneider Electric
  - SMA
  - Sungrow
  - TMEIC

## 13. Module Degradation

- ❖ Key Factors for Degradation
- ❖ Types of Degradation
- ❖ Global versus Indian Scenario
- ❖ Case Studies - Global
- ❖ Case Studies - India

## 14. Case Studies

- ❖ KVR Construction
- ❖ Welspun Solar Madhya Pradesh Private Limited
- ❖ Rajgarh Solar
- ❖ Waaneep Solar Private Limited
- ❖ Azure Tahliwala (Tahliwal Jattan)
- ❖ SolaireDirect, Dharangwala, Fazilka
- ❖ Sand Land Real Estate
- ❖ Visual Percept Solar Projects
- ❖ ACME Solar Technologies (Gujarat)
- ❖ Sai Sudhir Solar Plant (Kalyandurg)
- ❖ Welspun Solar Energy Private Limited
- ❖ Premier Solar

## 15. Database of Plants Tracked

*(This includes month-wise power generation, developer, location, size, EPC contractor, etc.)*

### **About Us**

**India Infrastructure Research** is a division of **India Infrastructure Publishing Private Limited**, a company dedicated to providing information on infrastructure sectors through magazines, conferences, newsletters and research reports. It publishes five magazines - **Indian Infrastructure**, **Renewable Watch**, **Power Line**, **tele.net** and **Gujarat Infrastructure**.

**India Infrastructure Research** publishes research reports in the areas of power, oil & gas, ports & shipping, roads & bridges, telecommunications, aviation, and water. Our reports are acknowledged as high-quality, user-friendly, up-to-date, accurate and comprehensive sources of information.

Our clients include most organisations involved in the infrastructure sectors – multinationals, top Indian corporates, commercial and investment banks, consulting companies, public sector companies, government agencies, multilateral agencies, and legal firms.

# Solar Plant Performance in India 2016-17

## List of Tables and Figures

### List of Tables

State-wise commissioning status of grid-connected solar power projects as of October 2016  
State-wise and Category-wise Installed Solar Rooftop Capacity in India as of September 2016 (MW)  
Tendering status of ground-mounted solar projects under central and state schemes for commissioning in 2016-17 and 2017-18 (as of October 2016)  
State-wise Targets for achieving 100 GW of Installed Solar Power Capacity by 2022  
Expected capacity to be commissioned in 2016-17 (MW)  
Andhra Pradesh Location-wise DNI and CUF  
Chhattisgarh Location-wise DNI and CUF  
Gujarat Location-wise DNI and CUF  
Haryana Location-wise DNI and CUF  
Jharkhand Location-wise DNI and CUF  
Karnataka Location-wise DNI and CUF  
Madhya Pradesh Location-wise DNI and CUF  
Maharashtra Location-wise DNI and CUF  
Odisha Location-wise DNI and CUF  
Punjab Location-wise DNI and CUF  
Rajasthan Location-wise DNI and CUF  
Tamil Nadu Location-wise DNI and CUF  
Rank of Countries with Solar Trackers by 2019  
Market Share of Top 5 Companies  
Scorpius Trackers Project Portfolio  
NexTracker Product Portfolio  
Smartrak Product Portfolio  
Smartrak Project Portfolio  
Market Share of Top Project Developers  
Summary of Key Developers in Plants Tracked  
ACME Solar Select Project Portfolio  
Adani Power Select Project Portfolio  
Azure Power Select Project Portfolio  
Essel Infra Select Project Portfolio  
First Solar Select Project Portfolio  
Hero Solar Energy Select Project Portfolio  
Hindustan Cleanenergy Limited Select Project Portfolio  
NTPC Select Project Portfolio  
Renew Power Select Project Portfolio  
Tata Power Renewable Energy Limited Select Project Portfolio  
Share of Key Module Manufacturers in Plants Tracked  
BHEL Key EPC Projects Executed  
Canadian Solar Select Project Portfolio  
First Solar Select Project Portfolio  
Hanhwa Q Cells Select Project Portfolio  
Moser Baer Select Project Portfolio  
ReneSola Select Project Portfolio  
Tata Power Solar Select Project Portfolio  
Trina Solar Select Project Portfolio  
Vikram Solar Select Project Portfolio  
Waaree Energies Select Project Portfolio  
Market Share of Top EPC Contractors  
Share of Key EPC Contractors in Plants Tracked  
Gamesa Solar Select Project Portfolio  
Lanco Solar Select Project Portfolio  
Larsen & Toubro Select Project Portfolio  
Mahindra Susten Select Project Portfolio  
Premier Solar Select Project Portfolio  
Rays Power Infra Select Project Portfolio  
Sterling & Wilson Select Project Portfolio  
Tata Power Solar Select Project Portfolio  
Ujaas Energy Select Project Portfolio  
Market Share of Top Inverter Manufacturers  
ABB Product Portfolio  
Delta Product Portfolio  
Hitachi Product Portfolio  
Huawei Product Portfolio  
Schneider Electric Product Portfolio

SMA Product Portfolio  
Sungrow Product Portfolio  
TMEIC Product Portfolio  
Degradation by Technology  
Visual Degradation  
Module Degradation Rates at Different Climatic Conditions (Global)  
Module Degradation Rates at Different Climatic Conditions (India)  
Actual versus expected solar module degradation by various field and laboratory studies  
Solar module warranties by key module manufacturers  
KVR Construction Project Parameters  
Welspun Solar Madhya Pradesh Private Limited Project Parameters  
Rajgarh Solar Project Parameters  
Waaneep Solar Private Limited Project Parameters  
Azure Tahlilwala -I (Tahlilwala jattan) Project Parameters  
SolaireDirect, Dharangwala, Fazilka Project Parameters  
Sand Land Real Estate Project Parameters  
Visual Percept Solar Projects Project Parameters  
ACME Solar Technologies (Gujarat) Project Parameters  
Sai Sudhir Solar Plant (Kalyandurg) Project Parameters  
Welspun Solar Energy Private Limited Project Parameters  
Premier Solar Project Parameters

### List of figures

Growth in Installed Solar Power Capacity  
State-wise Installed Solar Power Capacity (as of October 2016)  
Plan to achieve 100 GW of Solar Power Capacity by 2022  
Average Monthly CUF of Projects Tracked  
Year-wise Average Monthly CUF of Projects Tracked  
Average Quarterly CUF of Projects Tracked  
State-wise Average Monthly CUF of Projects Tracked  
Technology-wise Average Quarterly CUF of Projects Tracked  
Developer Type-wise Average Monthly CUF of Projects Tracked  
Annual Trends in CUF of Projects Commissioned during 2011-2016  
Average Quarterly CUF of Projects Commissioned in 2011  
Average Quarterly CUF of Projects Commissioned in 2012  
Average Quarterly CUF of Projects Commissioned in 2013  
Average Quarterly CUF of Projects Commissioned in 2014  
Average Quarterly CUF of Projects Commissioned in 2015  
Average Quarterly CUF of Projects Commissioned in 2016  
State-wise Share of Actual Installed Capacity  
State-wise Share of Tracked Installed Capacity  
Yearly Generation per MW (2013)  
Yearly Generation per MW (2014)  
Yearly Generation per MW (2015)  
Yearly Generation per MW (2016)  
State-wise Distribution of Tracked Projects  
State-wise Average Net Exported Power and CUF in 2013  
State-wise Average CUF in 2013  
State-wise Average Net Exported Power and CUF in 2014  
State-wise Average CUF in 2014  
State-wise Average Net Exported Power and CUF in 2015  
State-wise Average CUF in 2015  
State-wise Average Net Exported Power and CUF in 2016  
State-wise Average CUF in 2016  
Solar Direct Normal Irradiance Map of Andhra Pradesh  
CUFs of Projects Tracked in Andhra Pradesh from 2013-16  
Solar Direct Normal Irradiance Map of Chhattisgarh  
CUFs of Projects Tracked in Chhattisgarh from 2013-16  
Solar Direct Normal Irradiance Map of Gujarat  
CUFs of Projects Tracked in Gujarat from 2012-16  
Solar Direct Normal Irradiance Map of Haryana  
CUFs of Projects Tracked in Haryana from 2012-15  
Solar Direct Normal Irradiance Map of Jharkhand  
CUFs of Projects Tracked in Jharkhand from 2012-16  
Solar Direct Normal Irradiance Map of Karnataka

# List of Tables and Figures

CUFs of Projects Tracked in Karnataka from 2012-16	ACME Solar's Plant-Wise Yearly Performance in CUF Terms
Solar Direct Normal Irradiance Map of Madhya Pradesh	Adani Power's Plant-Wise Yearly and Monthly Performance in CUF Terms
CUFs of Projects Tracked in Madhya Pradesh from 2012-16	Azure Power's Plant-Wise Yearly Performance in CUF Terms
Solar Direct Normal Irradiance Map of Maharashtra	Essel Infraprojects' Plant-Wise Yearly Performance in CUF Terms
CUFs of Projects Tracked in Maharashtra from 2012-16	First Solar's Plant-Wise Yearly and Monthly Performance in CUF Terms
Solar Direct Normal Irradiance Map of Odisha	Hero Solar Energy's Plant-Wise Monthly Performance in CUF Terms
CUFs of Projects Tracked in Odisha from 2012-16	Hindustan Cleanergy's Plant-Wise Monthly Performance in CUF Terms
Solar Direct Normal Irradiance Map of Punjab	NTPC's Plant-Wise Monthly Performance in CUF Terms
CUFs of Projects Tracked in Punjab from 2012-16	ReNew Power's Plant-Wise Monthly Performance in CUF Terms
Solar Direct Normal Irradiance Map of Rajasthan	TPREL's Plant-Wise Yearly Performance in CUF Terms
CUFs of Projects Tracked in Rajasthan from 2013-16	Market Share of Top Module Manufacturers
Solar Direct Normal Irradiance Map of Tamil Nadu	Player-wise Average Annual CUFs (%) during 2013
CUFs of Projects Tracked in Tamil Nadu from 2012-16	Player-wise Average Annual CUFs (%) during 2014
Distribution of Tracked Projects by Plant Size in Terms of Number of Projects	Player-wise Average Annual CUFs (%) during 2015
Distribution of Tracked Projects by Plant Size in Terms of Capacity	Player-wise Average Annual CUFs (%) during 2016
State-wise No. of Projects and Installed Capacity by Plant Size (1-5 MW)	BHEL's Plant-wise Monthly Performance in CUF Terms
State-wise No. of Projects and Installed Capacity by Plant Size (5-10 MW)	BHEL's Plant-Wise Yearly Performance in CUF Terms
State-wise No. of Projects and Installed Capacity by Plant Size (10-20 MW)	Canadian Solar's Plant-Wise Yearly Performance in CUF Terms
State-wise No. of Projects and Installed Capacity by Plant Size (20 MW and above)	First Solar's Plant-Wise Yearly Performance in CUF Terms
Average Quarterly CUF of Projects Commissioned by Plant Size	Hanwha Q Cells' Plant-Wise Yearly Performance in CUF Terms
Year-Wise Average Quarterly CUF of 1-5 MW Sized Plants	Moser Baer's Plant-Wise Yearly Performance in CUF Terms
Year-Wise Average Quarterly CUF of 5-10 MW Sized Plants	ReneSola's Plant-Wise Yearly Performance in CUF Terms
Year-Wise Average Quarterly CUF of 10-20 MW Sized Plants	Tata Power Solar's Plant-Wise Yearly Performance in CUF Terms
Year-Wise Average Quarterly CUF of > 20 MW Sized Plants	Trina Solar's Plant-Wise Yearly Performance in CUF Terms
Highest CUFs Achieved across Various Plant Size Categories	Vikram Solar's Plant-Wise Yearly Performance in CUF Terms
Share of Solar Technologies Deployed across Projects in Terms of Number of Projects	Waaree Energies' Plant-Wise Yearly Performance in CUF Terms
Share of Solar Technologies Deployed across Projects in Terms of Capacity	Market Share of Top EPC Contractors
State-wise technology adoption (share of capacity)	Player-wise Average Annual CUFs (%) during 2013
Technology Adoption across Plants with Capacity between 1to 5 MW	Player-wise Average Annual CUFs (%) during 2014
Technology Adoption across Plants with capacity between 5-10 MW	Player-wise Average Annual CUFs (%) during 2015
Technology Adoption across Plants with capacity between 10-20 MW	Player-wise Average Annual CUFs (%) during 2016
Technology Adoption across Plants with capacity above 20 MW	Lanco Solar's Plant-Wise Yearly Performance in CUF Terms
Market Share of Crystalline Silicon Module Providers (based on projects tracked)	Larsen and Toubro's Plant-Wise Yearly Performance in CUF Terms
Market Share of Thin-Film Module Providers (based on projects tracked)	Mahindra Susten's Plant-Wise Yearly Performance in CUF Terms
Average Quarterly CUFs Achieved by Plants based on Crystalline and Thin-Film Technology	Premier Solar's Plant-Wise Yearly Performance in CUF Terms
Technology Adoption in Andhra Pradesh	Rays Power Infra's Plant-Wise Yearly Performance in CUF Terms
Technology Adoption in Chhattisgarh	Sterling and Wilson's Plant-Wise Yearly Performance in CUF Terms
Technology Adoption in Gujarat	Tata Power Solar's Plant-Wise Yearly Performance in CUF Terms
Technology Adoption in Haryana	Ujaas Energy's Plant-Wise Yearly Performance in CUF Terms
Technology Adoption in Jharkhand	Market Share of Top Inverter Manufacturers
Technology Adoption in Madhya Pradesh	Effect of Shading on Degradation
Technology Adoption in Odisha	Share of Factors Affecting Degradation
Technology Adoption in Rajasthan	Monthly CUF of KVR Construction Project
Market Share of Top Five Tracker Companies	Monthly CUF of Welspun Solar Madhya Pradesh Project
Distribution of Projects Across Developer Type in terms of Capacity	Annual CUF of Welspun Solar Madhya Pradesh Project
Distribution of Projects Across Developer Type in terms of Number of Projects	Monthly CUF of Rajgarh Solar Project
Share of Key Integrated Solar Power Developers in Projects Tracked	Annual CUF of Rajgarh Solar Project
Share of Key IPPs in Projects Tracked	Monthly CUF of Waaneep Solar Project
Share of Gencos in Projects Tracked	Annual CUF of Waaneep Solar Project
Share of Key Diversified Players in Projects Tracked	Monthly CUF of Azure Tahlwala-I Project
Monthly Trend in the Average CUF of Plants Developed by Integrated Project Developers	Annual CUF of Azure Tahlwala-I Project
Average, Peak and Off-peak CUFs of Plants Developed by Integrated Project Developers	Monthly CUF of SolaireDirect Fazilka Project
Month-wise Trend in the Average CUF of Plants Owned by IPPs	Annual CUF of SolaireDirect Fazilka Project
Average, Peak and Off-peak CUFs of Plants Owned by IPPs	Monthly CUF of Sand Land Real Estate Project
Monthly Trend in the Average CUF of Plants Owned by Power Generation Companies	Annual CUF of Sand Land Real Estate Project
Average, Peak and Off-peak CUFs of Plants Owned by Power Generation Companies	Monthly CUF of Visual Percept Solar Project
Month-wise Trend in the Average CUF of Plants Owned by Diversified Players	Annual CUF of Visual Percept Solar Project
Average, Peak and Off-peak CUFs of Plants Owned by Diversified Players	Monthly CUF of ACME Solar Technologies (Gujarat) Project
Quarter-wise Trend in CUFs across Different Developer Types	Annual CUF of ACME Solar Technologies (Gujarat) Project
Year-wise Trend in Average CUF across Developer Types	Monthly CUF of Sai Sudhir Solar Plant (Kalyandurg)
Market Share of Top Project Developers	Annual CUF of Sai Sudhir Solar Plant (Kalyandurg)
Player-wise Average Annual CUFs (%) during 2013	Monthly CUF of Welspun Solar Project (Anantapur)
Player-wise Average Annual CUFs (%) during 2014	Annual CUF of Welspun Solar Project (Anantapur)
Player-wise Average Annual CUFs (%) during 2015	Monthly CUF of Premier Solar Project (Deogarh)
Player-wise Average Annual CUFs (%) during 2016	Annual CUF of Premier Solar Project (Deogarh)

I would like to purchase the “Solar Plant Performance in India 2016-17” report:

Format (PDF)	Price
Site Licence (Single Location)	Rs 60,000
Service tax (15%)	Rs 9,000
<b>Total</b>	<input type="checkbox"/> <b>Rs 69,000</b>
<hr/>	
Enterprise Licence (Multiple Locations)	Rs 90,000
Service tax (15%)	Rs 13,500
<b>Total</b>	<input type="checkbox"/> <b>Rs 103,500</b>

I am enclosing a cheque/demand draft for Rs \_\_\_\_\_, vide cheque/demand draft no. \_\_\_\_\_ drawn on \_\_\_\_\_ dated \_\_\_\_\_ in favour of “India Infrastructure Publishing Pvt. Ltd.”

Signature

.....

Name (Block Letters) \_\_\_\_\_

Designation \_\_\_\_\_

Company \_\_\_\_\_

Mailing Address \_\_\_\_\_

Telephone \_\_\_\_\_ Mobile \_\_\_\_\_

Fax \_\_\_\_\_

E-mail \_\_\_\_\_

**Wire transfer details:**

**Beneficiary** : India Infrastructure Publishing Pvt. Ltd.  
**Bank Name** : The Hongkong and Shanghai Banking Corporation Ltd  
**Bank Address** : R-47, Greater Kailash –1, New Delhi 110048  
**Account No.** : 094179587002  
**Swift Code** : HSBCINBB  
**IFSC Code** : HSBC0110006

**Contact details:**

**Aayushi Lahoti**  
 Manager- Information Products  
 India Infrastructure Publishing Pvt. Ltd.  
 B-17, Qutab Institutional Area, New Delhi 110016, India  
 Tel: +91-11-46038153, 41034600, 41034601; Fax: +91-11-26531196  
 Mobile: +91-7838751085  
 Email: a.lahoti@indiainfrastructure.com