BRIDGE TO INDIA

INDIA SOLAR HANDBOOK

June 2014

The complete industry overview for solar energy in India

Disclaimer

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June 2014, New Delhi

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Introduction: Is India a good market for solar?

India is a very good market for solar. In fact, going by its vast population, high irradiation, the growing energy demand and power deficit, limited access to fossil fuels and the large number of un-electrified villages, it should be one of the best markets.

The answer is yes. India is a very good market for solar. In fact, going by its vast population, high irradiation, the growing energy demand and power deficit, limited access to fossil fuels and the large number of un-electrified villages, it should be one of the best markets.

However, it is also a difficult market. Regulations and policies are often confusing, non-transparent or unreliable. Competition is fierce and sometimes irrational. Most customers are highly price sensitive – often at the expense of a minimum of quality. Financing solar plants is challenging, as banks are still reluctant to provide non-recourse or consumer loans. Legal risks around PPAs are difficult to manage in a country where court cases drag on for years. In addition, many international investors have been unsettled by the fluctuations of the Indian Rupee.

India is a good example for a "new" solar market. One where the certainties of government support are exchanged for a fundamentally sound, but more complex commercial proposition. This new market place is in flux and not yet fully developed. There are still government incentives, such as capital subsidies or renewable purchase obligations. And they sway the market in their direction. At the same time, solar is beginning to play a role independently from them, by replacing expensive diesel or grid power. The task for all market participants is to focus on the end consumers and to develop business models that create value for them.

It has been said many times before: India is a strategic market. The question is: when will the bright solar future arrive in the present? Our view is that it might still take another two years or so.

In 2010 and 2011, when the National Solar Mission was announced and the European markets dipped, India was viewed with great enthusiasm by the Indian and international solar community. This enthusiasm has waned over the following years, often leading to disappointment. Other markets, such as Japan, Chile, the US or China have taken the limelight. In the meantime, however, India has built its case: it has achieved a base of 2.5 GW of solar PV, evolved its policies and created a solar ecosystem of installers, manufacturers, developers, financiers and researchers. For a country of India's size and promise, this can only be a first step.

It has been said many times before: India is a strategic market. The question is: when will the bright solar future arrive in the present? Our view is that it might still take another two years or so, before we will see a hockey stick uptake in solar demand. Until then, there will still be steady growth of around 1 GW per year. The result of the elections that were just held, will certainly help. This is a good time to engage with the Indian market.

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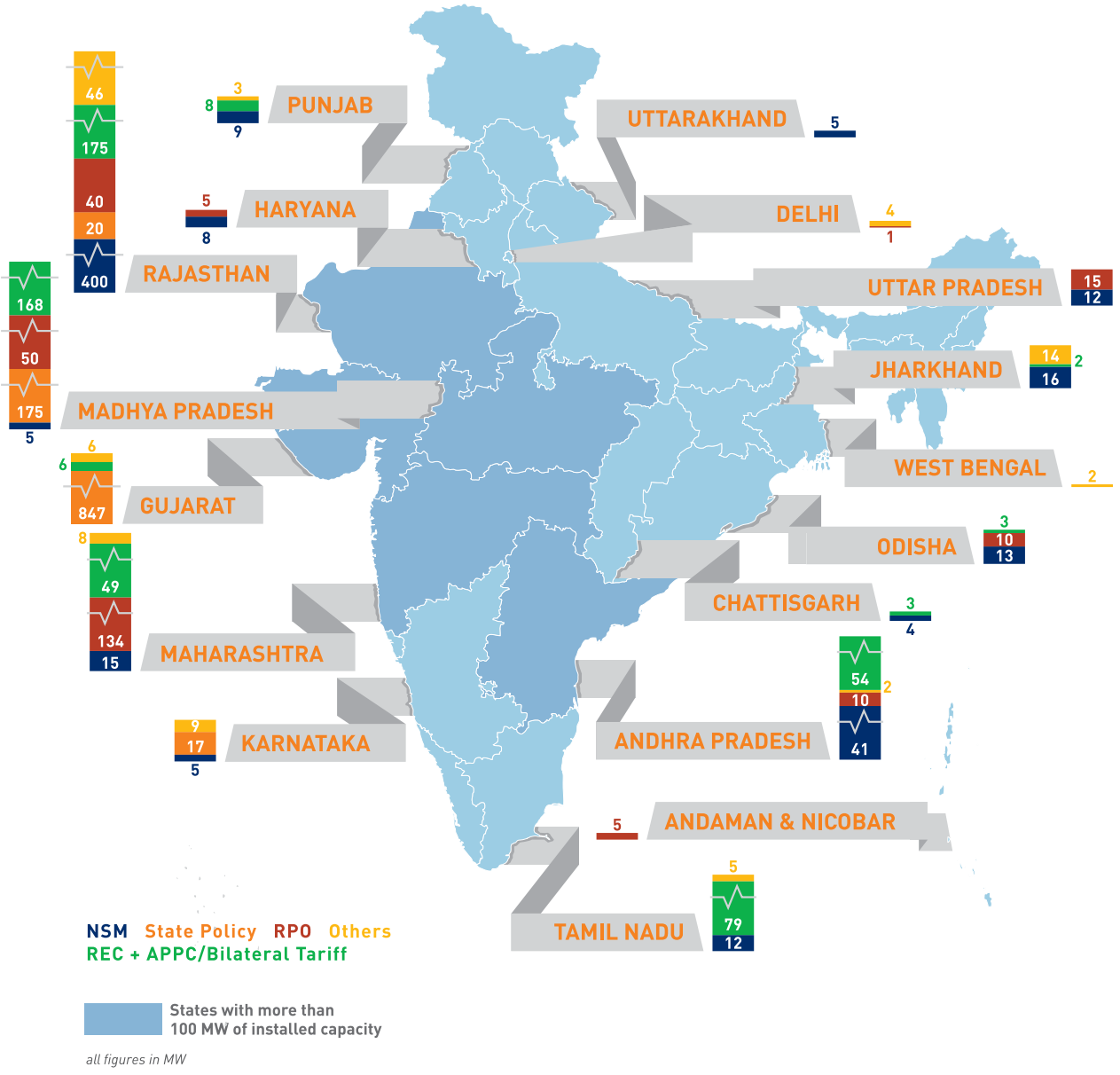
India in international perspective

Over 2.5 GW of installed PV capacity

Current total grid connected installed capacity map (as on May 10th 2014)[1]

COMMISSIONED (MW)

Total PV capacity: 2,517 MW



all figures in MW

1 BRIDGE TO INDIA project database

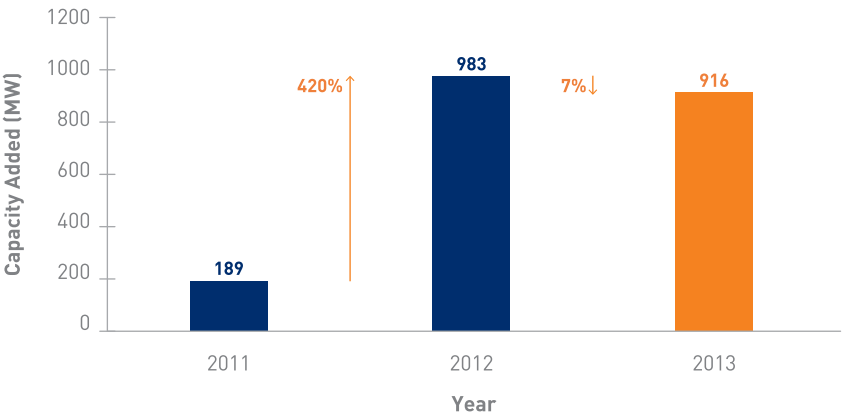
Where the market currently stands

As of May 2014, India has an installed capacity of 2.5 GW. 70% of it is found in the deserts of the western states of Gujarat and Rajasthan and almost all of it is incentive-driven, utility-scale and grid connected.

As of May 2014, India has an installed capacity of 2.5 GW. 70% of it is found in the deserts of the western states of Gujarat and Rajasthan and almost all of it is incentive-driven, utility-scale and grid connected. The past years' capacity build-up has largely been driven by the first phase of the National Solar Mission (NSM) and the Gujarat Solar Policy.

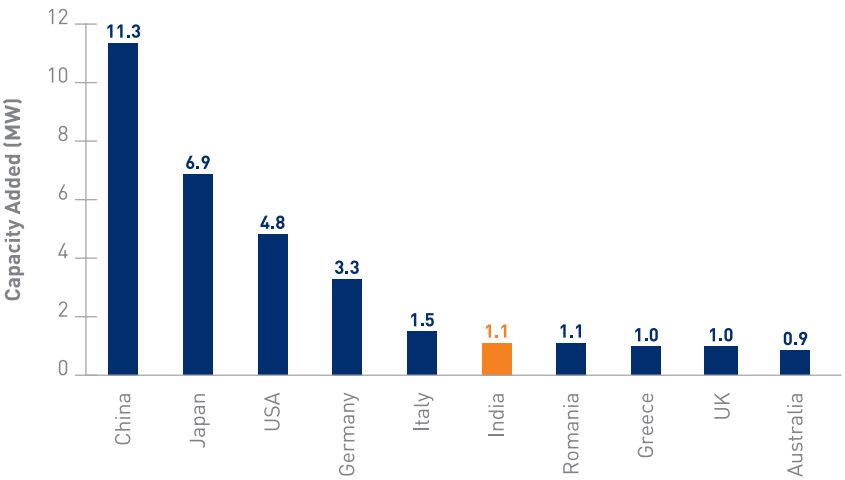
In 2013, there has only been 916 MW of new solar installations. This is 6.8% less than in 2012. Despite this relatively slower year, India still ranked sixth in global capacity additions for 2013.

Solar capacity additions in India (2011 to 2013; MW)[2]



Country wise solar capacity addition in 2013 (in GW)[3]

India still ranked sixth in global capacity additions for 2013.



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2 BRIDGE TO INDIA project database

3 IEA PVPS, Snapshot of Global PV (1992-2013); **bit.ly/1fwoM3s**.
There is disparity between IEA data and BRIDGE TO INDIA data. This may be due to the fact that most data from India is reported in financial year terms (April to March). BRIDGE TO INDIA data is bottom up, based on individual commissioned project.

In addition to the NSM and the Gujarat policy, several other states such as Rajasthan, Tamil Nadu and Andhra Pradesh started their allocation process. But the process has often been marred by delays and uncertainties. Phase two of the NSM has also been delayed from its scheduled start in the first half of 2013. As a result, the market had been particularly slow in the first half of 2013. However, since then, the announcements of various state level policies and the allocations under phase two of the NSM have brought fresh excitement to the market.

The announcements of various state level policies and the allocations under phase two of the NSM have brought fresh excitement to the market.

A total of 695 MW of Power Purchase Agreements (PPAs) have been signed under state policies since the last edition of the Indian Solar Handbook in June 2013. These PPAs have been signed in Punjab (250 MW), Andhra Pradesh (180 MW), Uttar Pradesh (110 MW), Karnataka (80 MW) and Rajasthan (75 MW). Most of these projects have not been commissioned yet. Several additional states have started new allocation processes in the first half of 2014. These include Madhya Pradesh (100 MW), Chhattisgarh (100 MW), Haryana (50 MW), Karnataka (50 MW), Uttarakhand (50 MW) and Odisha (20 MW). These states will likely sign PPAs by the third quarter of 2014.

In addition to the state policies, PPAs for 700 MW of utility-scale solar projects have been signed under the NSM with another 50 MW from the waitlist expected to be signed by July 2014. By the end of 2014, another 1,500 MW of allocations are due to be announced under batch two of phase two.

Next to the established utility-scale market, the rooftop solar market is also beginning to grow. 50 MW of grid-connected rooftop projects were allocated under the NSM in 2014. In addition, several states initiated rooftop solar policies and allocations in 2013. Kerala has implemented a policy for 10,000 rooftop installations of 1 kW each. Gujarat announced a 25 MW rooftop policy, under which projects have been allocated in five cities. Tamil Nadu has announced a generation based incentive (GBI) for 50 MW of grid-connected rooftop projects.

Government policies have so far been the prime driver for the solar energy sector in India. However, there has also been a gradual move from an incentive-driven market to a parity-driven market.

Further, net metering policies have been announced in Gujarat, Andhra Pradesh, Uttarakhand, Tamil Nadu and West Bengal. The states of Delhi, Kerala, Karnataka and Punjab have published draft net metering policies. For the first time in India, net metering will permit end-users to feed power (in this case excess solar power) back into the grid. This is a significant change in the rules and functioning of the grid and proper implementation will likely take some time.

Government policies have so far been the prime driver for the solar energy sector in India. However, there has also been a gradual move from an incentive-driven market to a parity-driven market. Solar plants that do not sell power to the utilities, such as captive power plants and plants with a private PPA mechanism, have contributed 240 MW to the Indian solar market in 2014. These plants often bet on additional income from Renewable Energy Certificates (RECs).

Global overview: Asian countries emerge as solar leaders

The European market, which has led demand for solar over the past decade, is passing the baton to Asia. Most European countries have cut incentives and solar is shifting to parity-driven demand. Asian markets, especially in China, Japan and India in addition to the US, Chile and Middle Eastern and North African (MENA) countries will provide the market with most current growth opportunities.

Overview of international markets

	Average solar resource/ irradiation	Solar target	Capacity installed in 2013	Installed capacity (as on December 2013)	FiT /other incentives	Tax incentives and subsidies	Quota obligation or green certificates	Net metering	Market characteristics and key drivers	Future trends
Leading markets										
India	5.1	20 GW on grid and 2 GW off grid by 2022	1.1 GW	2.3 GW	State level FiT	Yes	RPO (not enforced)	State level	Market driven by utility scale projects. Push provided by solar policies rolled out by different states.	Solar will become competitive with increased cost of conventional power.
China	3.61	50 GW by 2020	11.3 GW	18.3 GW	National level FiT	Yes	No	No	Market largely driven by utility scale projects. Nation wide FiT law and incentives at the provincial levels were instrumental in creating a push.	Surge in utility scale projects with the introduction of FiT.
Japan	3.63	33 GW by 2020	6.9 GW	13.6 GW	National level FiT	Yes	No (replaced by FiT in 2012)	No	Market is largely driven by residential consumers. Nation wide FiT will encourage greater demand for utility scale projects.	Surge in utility scale projects with the introduction of FiT.
U.S.	4.68	Different RPS for states	4.8 GW	12 GW	State level FiT	Yes	State level RPS obligation	State level	Market largely driven by utility scale projects. Increased demand from residential consumers also added to the capacity.	Surge in third party owned residential rooftop installations.
Germany	2.9	52 GW by 2020 (35 % and 80% of electricity from renewables by 2020 and 2050, respectively)	3.3 GW	35.5 GW	National level FiT	Yes	No	No	Market is driven by the FiTs Commercial and residential consumers are the key drivers of the market.	
Italy	3.81	23 GW by 2017	1.5 GW	17.6 GW	National level FiT	No	No	Yes for systems <200 kW starting January 2013		
Australia	4.16	20% by 2020	0.9 GW	33 GW	State level FiT	Yes	Yes	Yes	Market largely driven by residential consumers.	Demand from the residential market could be saturated by 2017.

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In 2013, 36.9 GW of new solar PV capacity was installed globally. Asia, led by China and Japan, emerged as the leader, accounting for over 56% of this[4]. The European market added only 10.8 GW (29%). This is a reduction of over 50% from 2011 levels. 2013 was the first year since 2003 when Europe was not the leading PV market region. India has been comparatively slower than other large markets, but its strong fundamental ensures that it stays on the radar. General elections have just been concluded in India and there are high expectations from the new government to accelerate the solar market.

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4 IEA PVPS, Snapshot of Global PV (1992-2013); **bit.ly/1fwoM3s**.

	Average solar resource/ irradiation	Solar target	Capacity installed in 2013	Installed capacity (as on December 2013)	FiT /other incentives	Tax incentives and subsidies	Quota obligation or green certificates	Net metering	Market characteristics and key drivers	Future trends
Other emerging markets										
MENA (Morrocco, Saudi Arabia, Egypt)	Morocco: 5.4 Saudi Arabia: 5.7 Turkey: 4.45	Morocco 2 GW by 2020; Egypt 8% of electricity needs from solar and hydro by 2020; Saudi Arabia 16 GW solar PV and 25 GW CSP by 2032		N/A	Egypt: FiT	Morocco: No Saudi Arabia: No Egypt: Yes	No	No	Market mainly driven by government aided utility scale projects. Announcement of policy targets for solar by the governement has genetrated investor interest.	
South Africa	5.92	8.4 GW by 2030		N/A	National level FiT	Yes	No	No	Newly announced governement projects have generated investor interest.	Energy deficieny of the country will further drive the market. Proposal of carbon tax, if implemented, may create demand among commercial consumers.
Thailand	4.95	25% of overall energy from renewables by 2022; 2 GW solar by 2022		360 MW	National level "adder" premiums	Yes	No	No	Market largely driven by utility scale projects.	'Adder' premium program along with supporting solar policies have created investor confidence in the country.
Chile	4.62	20% of electricity from renewables by 2025		3.6 MW	No	No	No	No	Growing energy needs of the mining industry and high prices of conventional energy have created a demand for solar.	Proposal of carbon tax may push demand for solar.

Sources:
Installed capacity: IEA; PVPS report - A Snapshot of Global PV 1992-2013
Irradiation data: Surface meteorology data and solar energy data provided by RETS screen and NASA satellite data
Policies: IEA/IRENA; Renewable Policies and Measures Database and REN21 Renewables 2012 Global Status Report
BRIDGE TO INDIA research and analysis

Why India?

Solar is the only energy source that has the potential to become the backbone of the country's energy supply in the long term.

Unlike many other solar markets, India is fundamentally an energy deficient country. The average peak power deficit over the last seven years ending in 2013 was more than 10%[5]. Per capita energy consumption is still very low. With economic growth and a changing life style, the demand for energy will continue to rise for decades to come.

Conventional power generation sources are unable to meet the rising demand, as plants and projects stall due to unavailability of fuels or environmental and social concerns. It is highly unlikely that India will be able to add new conventional power projects at a fast enough pace to be able to keep up with demand.

At the same time, India increasingly imports oil, gas and coal. The government is only too aware that this reduces its energy security and puts significant stress on the budget and India's balance of trade. It is, therefore, imperative for India to invest more in renewable energy sources. Among these, solar is the only one that has the potential to become the backbone of the country's energy supply in the long term. There is sufficient space available to build thousands of GWs of solar power and with more than 300 days of sunshine, India ranks among the highest irradiation receiving countries in the world.

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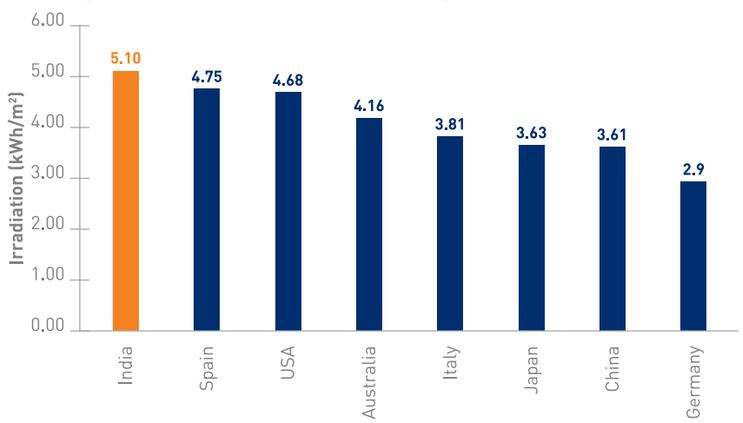
5 Central Electricity Authority: Load Generation Balance Report 2013-14; **bit.ly/1evyRKl**

Average solar irradiation in leading markets[6]



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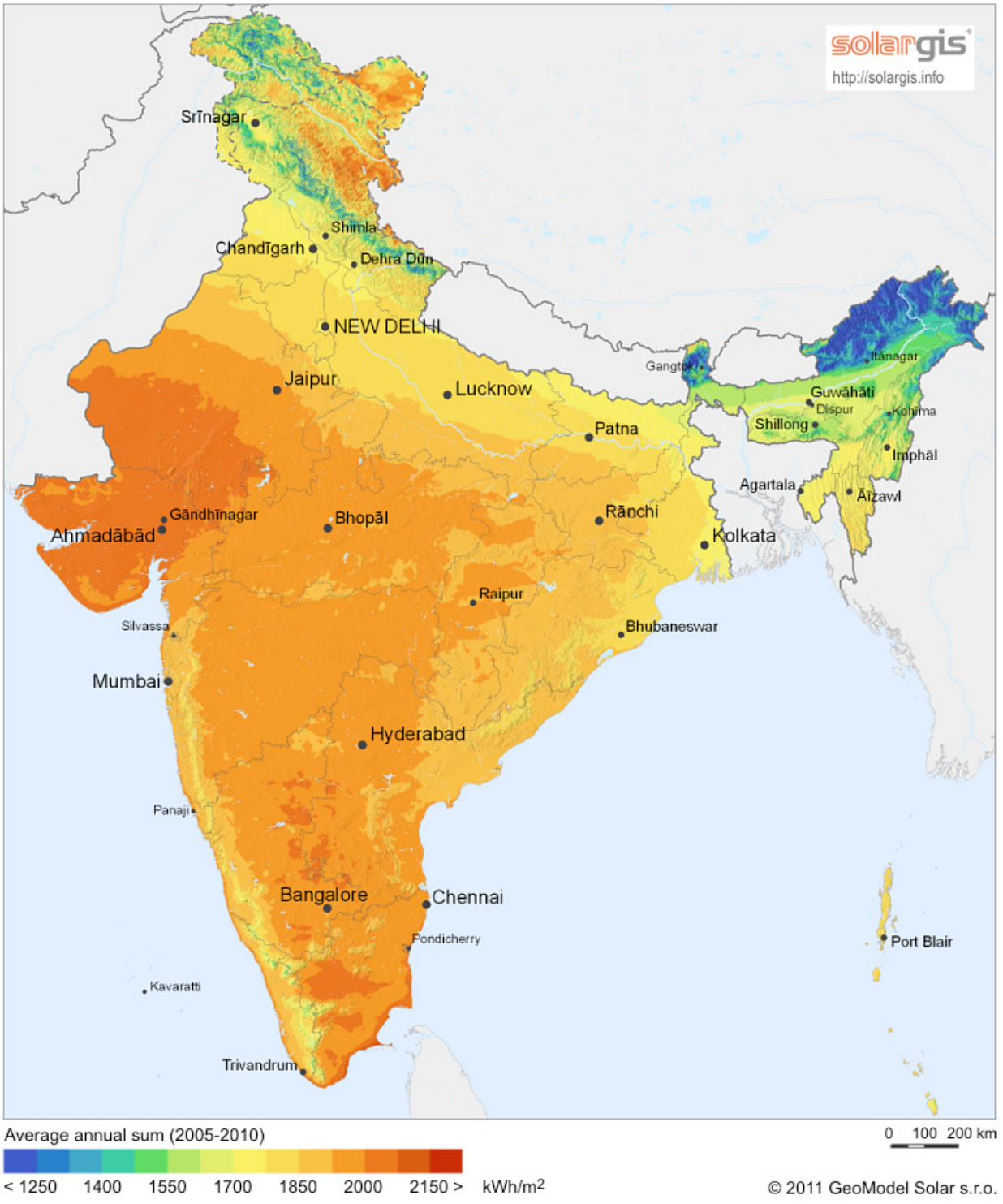
6 Surface meteorology data and solar energy data provided by RETS screen and NASA satellite data.

Global horizontal irradiation data of India

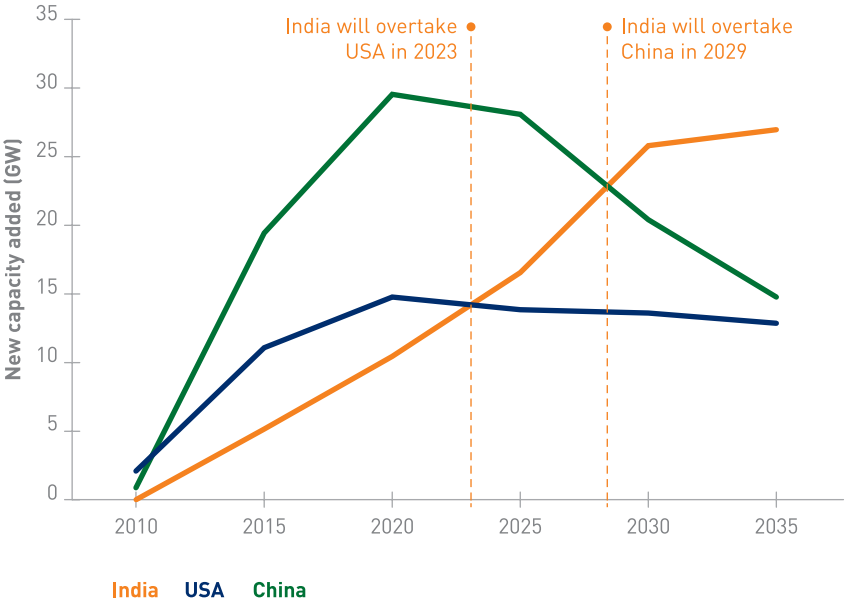


India will in the near future provide a huge market for non-incentivized solar power at the utility and distributed levels.

India will overtake both the US and Chinese market in terms of yearly installations to become the world's leading solar market by 2030.

India will in the near future provide a huge market for non-incentivized solar power at the utility and distributed levels[7]. Ideally, the government and regulators should provide a robust framework for grid interconnection and net metering regulations. However, even if this fails and there is no market by design, there will be a market by default. Just think of the roughly 60 GW[8] of installed (and costly) diesel power across the country. The market represents a large-scale privatization of power infrastructure and is a direct function of the failure of utilities to provide reliable grid power. Based on the strong fundamentals, the International Energy Agency (IEA) predicts India will overtake both the US and Chinese market in terms of yearly installations to become the world's leading solar market by 2030.

Projected year-on-year solar PV capacity additions in India, China and the US till 2035[9]



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7 BRIDGE TO INDIA will soon publish three reports to look into this market from different perspectives: One will compare the benefits and drawbacks of centralized vs. distributed solar power plants (with Tata). A second is looking at the technical challenges of implementing large-scale distributed solar power in India (with Prayas Energy and IIT-Mumbai). The third is assessing a potential solar strategy for an individual Indian state (with Greenpeace). These can be downloaded from the website (www.bridgetoindia.com) shortly.

8 BRIDGE TO INDIA market research

9 IEA Energy Outlook; **bit.ly/1g2oAch**

Government initiatives

The Indian government has been supportive for the deployment of solar energy. Incentives have so far been provided mostly to utility-scale, grid connected projects in the form of FiTs or viability gap funding (VGF). Tax incentives, such as accelerated depreciation (AD) also play a role. Capital subsidies for off-grid and rooftop projects and the demand-side RPO/REC measure have not yet been successful.

Overview of policies

	Policy targets	Off-taker	Financial incentives	Expected commissioning in 2014	Announced or expected allocations in 2014	Exemptions from open access charges	Other key benefits	DCR
NSM	20 GW till 2022	SECI	Viability Gap Funding (VGF) based on reverse bidding	45 MW	1,500 MW	Will depend on the state in which the project is being executed.	Will depend on the state in which the project is being executed.	375 MW out of the 750 MW allocated for DCR
Tamil Nadu solar policy	3 GW till 2015	• Obligated entities (as defined by the state)[10] • State distribution company	Preferential tariff based on reverse bidding for a part of the target			No exemption	• Single window clearance • GBI for residential consumers	None
Uttar Pradesh solar policy	500 MW till 2017	State distribution companies	Preferential tariff based on reverse bidding	50 MW	300 MW	Exemption on wheeling/ transmission charges	Evacuation infrastructure construction by the state	None
Andhra Pradesh solar policy	Not driven by target	• Third-party power consumers • Obligated entities	None	50 MW	None	Exemption on wheeling/ transmission charges	Banking of power permitted with fee	None
Karnataka solar policy	200 MW till 2016	State distribution companies	Preferential tariff based on reverse bidding	42 MW	50 MW	No exemption	None	None
Rajasthan solar policy	750 MW till 2017	State distribution companies	Preferential tariff based on reverse bidding	75 MW	None	No exemption	• Availability of government land at a low lease price • Cost of transmission line to be borne by the government	None
Punjab solar policy	1 GW till 2022	State distribution companies	Preferential tariff based on reverse bidding	50 MW	300 MW	No exemption	Exemption on land stamp duty	None
Madhya Pradesh solar policy	800 MW (timeline not provided)	State distribution companies	Preferential tariff based on reverse bidding	50 MW	100 MW	No exemption	Solar parks to be created for policy allocations	None
Chhattisgarh solar policy	500 MW to 1000 MW by 2017	State distribution companies	Preferential tariff based on reverse bidding	None	100 MW	No exemption	Exemption from electricity and stamp duty	None
Gujarat solar policy	Target exceeded	State distribution companies	Preferential tariff based on reverse bidding	None	None	No exemption	Solar park infrastructure provided	None
Uttarakhand solar policy	500 MW till 2017	State distribution companies	Preferential tariff based on reverse bidding	None	50 MW	Exemption on cross subsidy charges	• Availability of government land on lease for offer of free electricity • Exemption on land stamp duty	None
Odisha solar policy	135 MW till 2015	State distribution companies	Preferential tariff based on reverse bidding	None	20 MW	No exemption	Availability of government land at a low lease price	None
Haryana solar policy	Not specified	State distribution companies	Preferential tariff based on reverse bidding	None	50 MW	No exemption	Projects can be set up anywhere in India	None

10 Obligated entities

FiT

Various state policies and phase one of the NSM have allocated projects through the FiT mechanism. Until 2013, all the utility-scale projects have been incentivesed through FiTs. It continues to be the preferred measure under various state policies.

VGF

Under batch one of phase two of the NSM, the incentives are offered in the form of VGF. It is a capital subsidy provided to the project developers in order to help them reach a viability threshold at a pre-fixed tariff. The disbursement is linked to performance measures.

Subsidies

In addition to incentives for utility scale projects, the NSM has set a target of allocating 200 MW of grid-connected rooftop solar projects by offering subsidies. The Ministry of New and Renewable Energy (MNRE) provides up to 30% capital subsidy for roof top systems (off-grid) and for projects up to 500 kW. A few states in India such as Kerala, Tamil Nadu and Uttarakhand have announced an additional state subsidy of 20% on top of the MNRE subsidy, bringing the total to 50%. This can be a significant financial driver for smaller projects. The problem is that the disbursement of the MNRE subsidy was stalled for the last 1.5 years, thus paralyzing this market segment.

An income tax holiday is offered on ten years of profit of a solar project.

Tax holiday and accelerated depreciation

A company can claim 80% accelerated depreciation in the first year of installation under section 80 IC of the Indian Income Tax Code, leading to savings on income tax. This benefit can be claimed by both commercial and non-commercial entities. However, the plant needs to be directly on the balance sheet of the company availing the accelerated depreciation. This makes the model attractive to integrated Indian companies with different business interests, but largely unavailable to focused solar companies and international investors.

An income tax holiday is offered on ten years of profit of a solar project. During this period only Minimum Alternate Tax (MAT) of 18.5% is to be paid instead of the normal tax rate of 30-33%. The MAT paid can be set off with the income tax after the period of ten years.

As per the RPO requirements, 15% of all power in the country has to be sourced from renewable energy sources by 2020. For solar power in particular, the RPO requirement is 3%.

Renewable Purchase Obligations (RPOs) and Renewable Energy Certificates (RECs)

The government of India, through the Central Electricity Regulatory Commission (CERC), has introduced a Renewable Purchase Obligation (RPOs) for all renewables, as per the requirements of the National Action Plan on Climate Change (NAPCC)[11]. As per the RPO requirements, 15% of all power in the country has to be sourced from renewable energy sources by 2020[12]. For solar power in particular, the RPO requirement is 3%. Individual state electricity regulatory commissions (SERCs) have taken up this directive and have set specific state targets. In addition, the government has introduced a market for tradable Renewable Energy Certificates (RECs) for fulfilling RPO obligations. Under the REC mechanism, developers are eligible to receive one certificate for every 1,000 MWh of renewable electricity fed into the grid. Obligated entities can buy these certificates to fulfill their obligation.

This policy has, however, not yet hit the ground. So far the RPOs are not met by the obligated entities (utilities, open access buyers of power and large captive power producers) and this failure is only rarely penalized. As a result, the RPO market and the concordant Renewable Energy Certificate (REC) market are

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11 MNRE: Development of Conceptual Framework For Renewable Energy Certificate Mechanism for India; **bit.ly/1ow3Put**

12 Renewable energy sources consist of wind power, solar power, bio energy and small hydro power (< 25MW).

deflated and on-hold. As renewables approach various market parities and are no longer in need of incentivisation, the time window for fixing the RPO/REC mechanism closes.

Corporate Social Responsibility (CSR)

As a part of a regulatory overhaul in favor of distributed solar, several state governments are incentivizing rooftop solar systems through net metering schemes.

Under the Companies Bill of India, there is a provision that asks companies to spend 2% of their operating profits on CSR activities[13]. Under the bill, any investment into solar plants or the purchase of solar power can be considered as a CSR activity. The government of India is planning to make CSR spending compulsory for all corporates.

Net metering

As a part of a regulatory overhaul in favor of distributed solar, several state governments are incentivizing rooftop solar systems through net metering schemes[14].

Until May 2014, four Indian states: Gujarat, Andhra Pradesh, Uttarakhand, Tamil Nadu and West Bengal have finalized the net metering policies. Another four states: Delhi, Kerala, Karnataka and Punjab have net metering policies in a draft stage. Gujarat has announced a gross metering mechanism, under which all units of electricity produced from a solar installation are sold to the grid.

Overview of net metering polices of Indian states

	Date of announce-ment	Capacity target	Eligibility	Type of metering (net/ gross)	Financial incentives	System size	Tariff for surplus energy
Gujarat	September 2011	Phase 1: 5 MW Phase 2: 60 MW (planned)	All rooftops	Gross		Not specified	₹11.21/kWh and ₹11.78/ kWh
Andhra Pradesh	March 2013	50% of distribution transformer capacity	3 phase customers	Net	20% subsidy for residential customer (single and three phase) for rooftop solar systems up to 3 kW of capacity	Not specified	APPC tariff
Tamil Nadu	November 2013	30% of distribution transformer capacity	All rooftops	Net	Generation Based Incentive	Not specified	

13 Lok Sabha Secretariat: Corporate Social Responsibility; **bit.ly/S8RA9W**

14 Under net metering, developers push power onto the grid during times of low or no internal demand. Under gross metering, all the units of electricity produced from the solar installation are sold to the grid.

	Date of announce-ment	Capacity target	Eligibility	Type of metering (net/ gross)	Financial incentives	System size	Tariff for surplus energy
Uttarakhand	Not specified	5 MW by 2015	All rooftops	Net		300 W - 100 kW for systems with battery backup and 300 W - 500 kW for systems without battery back up	₹9.2 (€0.11, $0.15)/kWh
West Bengal	August 2010	16 MW by 2017	Institutional consumers such as hospitals and government departments	Net		Not specified	Solar injection is permitted only up to 90% of yearly electricity consumption
Kerala (draft)		50% of distribution transformer capacity	All rooftops	Net		Not specified	APPC tariff
Punjab (draft)		Not specified	All rooftops	Net		System size between 1 kW - 500 kW and less than 80% of the sanctioned load	Solar injection is permitted only up to 90% of yearly electricity consumption
Delhi (draft)		15% of distribution transformer capacity	All rooftops	Net		Sanctioned load of the customer	Solar injection is permitted only up to 90% of yearly electricity consumption
Karnataka (draft)		Not specified	All rooftops	Net			

Steps required for accelerated market growth

Conducive regulatory mechanism for de-central generation

Implementation of net metering policy across states will lead to a surge in adoption of solar PV by small consumers.

Regulations related to power generation in India have been formulated with a traditional, centralized overall power supply model in mind. This means that for interconnection to the grid, a power generator must account for open access charges, cross-subsidy surcharge, transmission charges, transmission losses, wheeling charges, wheeling losses, etc.

This is not conducive to decentralized generation using solar PV, where smaller amounts of power are generated de-centrally and consumed in the vicinity (typically within the same sub-station area). The various charges relating to the transmission grid should be removed or minimized for solar PV below a certain threshold (e.g. 1 MW). Also, there needs to be uniformity across states for such levies. For example, the cross subsidy surcharge ranges from ₹0.53 (€0.01, $0.01)/kWh to ₹2.84 (€0.04, $0.05)/kWh, depending on the state, type of consumer and the type of feeder.

Implementation of net metering policy across states will lead to a surge in adoption of solar PV by small consumers. Policy implementation will ease peak power deficits in India.

Stricter RPO enforcement

One of the key challenges faced by the solar power sector in India is the degree of uncertainty surrounding the enforcements of RPOs.

One of the key challenges faced by the solar power sector in India is the degree of uncertainty surrounding the enforcements of RPOs. The RPOs are fixed and enforced at a state level, and though most states have a solar RPO they are not taking any steps to actively enforce them. In order to enforce RPOs effectively, states have to put in place a stringent penalty structure, wherein the penalty is higher than the forbearance price of solar RECs. Alternatively, adequate incentives can be provided to obligated entities to meet their RPOs (as practiced in countries like the UK and Australia).

Re-adjustment of the REC mechanism

The solar REC mechanism is yet to gain popularity in the Indian solar market. Trading has so far been erratic and disappointing. The primary reason is the lack of RPO enforcement and the uncertainty surrounding the price of the RECs beyond 2017. In addition to fixing the RPO mechanism, improvements can be made on the REC mechanism itself, too. Various proposals, such as letting the price range freely or creating "vintage" RECs to account for the fact that the cost of renewables is falling currently are under consideration.

Easier access to finance

In future, India needs more non-recourse infrastructure finance as well as easy consumer finance options.

Availability of finance has been a key challenge in the Indian solar market. The primary reason for this has been the bankability of off-takers and apprehension about the power generation of solar plants over time. The latter was due to a lack of precise on-ground irradiation data and a limited track record of plants in India. Many projects in India are actually not performing as expected. Project developers need to focus more on the quality of material and components as well as execution and maintenance of projects. In addition, it is vital that they gather detailed performance information. The availability of more and more performance data for previously executed plants and the building up of track records is already improving the financing market. In future, India needs more non-recourse infrastructure finance as well as easy consumer finance options.

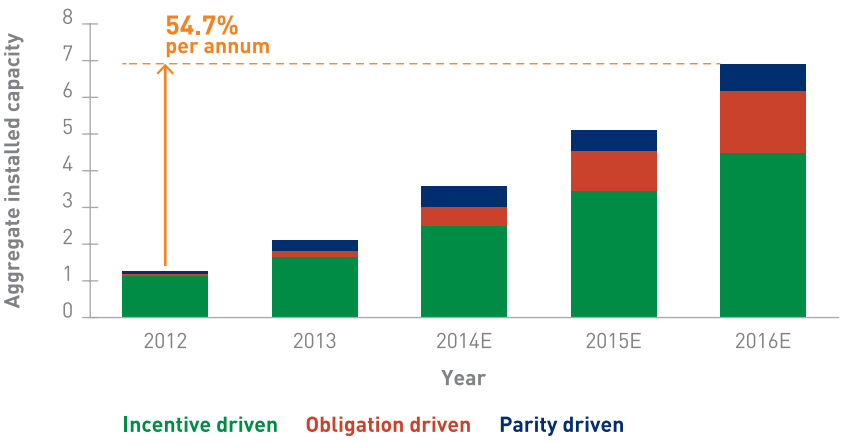
What is the expected demand in India?

The solar industry in India has gone from a mere 22 MW of installed capacity in 2010 to 2.5 GW (cumulatively) in May 2014.

The solar industry in India has gone from a mere 22 MW of installed capacity in 2010 to 2.5 GW (cumulatively) in May 2014. Most of this growth has been driven by central and state solar policies offering FiT that are typically arrived at through a competitive auctioning process. Most existing projects are utility scale. We expect this to continue, but in future the utility market will be complemented by a growing distributed, parity driven market, in which solar power solutions compete with diesel and grid power, often without government support. In the demand forecast, we differentiate between utility-scale and distributed solar plants.

Utility scale projects

Projected aggregate utility-scale solar installations (cumulative; GW)[15]



In future, the utility market will be complemented by a growing distributed, parity driven market.

We categorize utility size projects under three broad categories: incentive driven, obligation driven and parity driven. The incentive-driven market includes measures like FiTs or subsidies. It is the part of the market that is pushed by government policies on the supply side. The obligation driven market relies on RPOs and is driven by demand measures. There is a possible overlap between the two markets, when governments set in motion solar projects or policies and use those to meet their state utility's RPO requirements. It is difficult to foresee how large this overlap will be. Our guess is that it will happen often, hence making the incentive-driven market more substantial than the obligation driven market. The parity driven market focuses on solar solutions that are competitive with alternatives without government support. We assume that such projects, which deliver solar power directly to the end customer, will not be eligible to generate RECs in future as this would allow for significantly above-market rate returns.

Projected total market size for utility scale segment by 2016

6.9 GW

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Incentive driven market

Rajasthan is expected to overtake Gujarat in terms of total installed capacity within the year 2015.

This segment continues to provide a majority of the viable project development opportunities in the market. Until 2013, Gujarat led the chart in terms of total installed capacity with over 850 MW installed solar capacity. However, with most new projects under the NSM planned for the neighboring state of Rajasthan, Rajasthan is expected to overtake Gujarat in terms of total installed capacity within the year 2015[16].

Projected total market size for incentive driven projects by 2016

Obligation driven market

Instead of allocating projects through a policy, states may set up their own plants to generate solar power in order to meet their RPO requirement. Several states such as Maharashtra, Madhya Pradesh, Andhra Pradesh, Rajasthan etc. have done this in the past. Captive thermal power producers have a solar-specific RPO requirement. Requirements for thermal captive power producers are enforced by the state regulators. Industries such as mining, chemicals and cement have large captive power plants. Vedanta Aluminum, Jindal Stainless, SAIL, Aditya Birla Group, National Aluminum Company Ltd (NALCO) and Bharat Aluminum Company Ltd. (BALCO) among others are the largest obligated entities in India.

Projected total market size for obligation driven projects by 2016

Parity driven market

As larger consumers pay high tariffs, buying solar power from utility scale solar projects has become viable in many parts of the country.

Under this segment, projects are set up for selling power to a third-party consumer at a pre-decided tariff.

Under the Electricity Act 2003, open-access sale of power has been permitted for power developers[17]. Under the act, there is a provision for the use of existing transmission and distribution lines for the sale of this power. Typically the consumers with connected loads of over 1 MW are allowed to buy the power from the open market. As these larger consumers pay high tariffs, buying solar power from utility scale solar projects has become viable in many parts of the country. This becomes especially viable if the investor is able to claim accelerated depreciation benefits. In most cases, project developers are developing solar parks in which several investors and power consumers are brought together to achieve economies of scale. In most cases, power

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17 The Gazette of India; **bit.ly/1nXTpnA**

consumers are part investors into the project. This segment does not require any government incentive and is being completely driven by market forces.

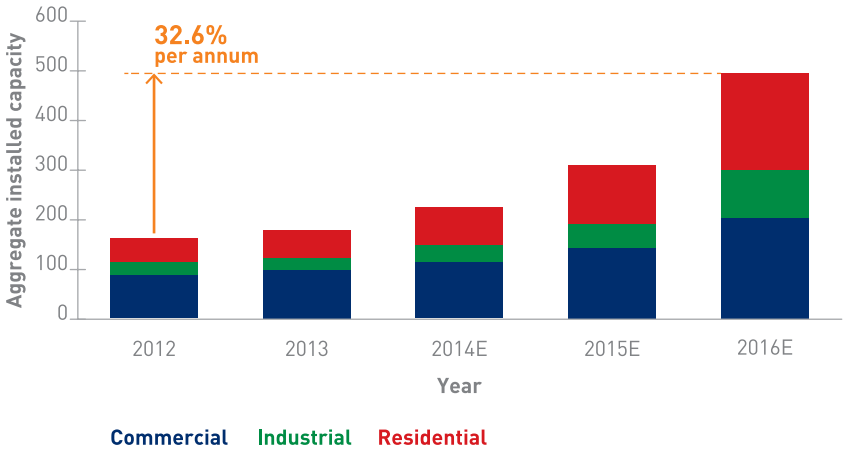
Projected total market size for parity driven projects by 2016

Distributed systems

In the market for distributed systems, we are here only looking at rooftop solar and telecom segments. Other off-grid applications, such as street lights, water pumps, micro-grids and rural lighting are not included here. They are also an interesting segment, but smaller and diffused.

Rooftop projects

Projected aggregate rooftop solar capacity (MW)[18]



The prime drivers for rooftop projects are parity and policy. Several states, such as Gujarat, Tamil Nadu, Kerala and Karnataka have rooftop solar policies. Besides state polices, the NSM also targets allocation of 200 MW rooftop project by 2015. However, such policy driven projects are not included in our analysis. Under this segment, we are considering only parity driven rooftop projects.

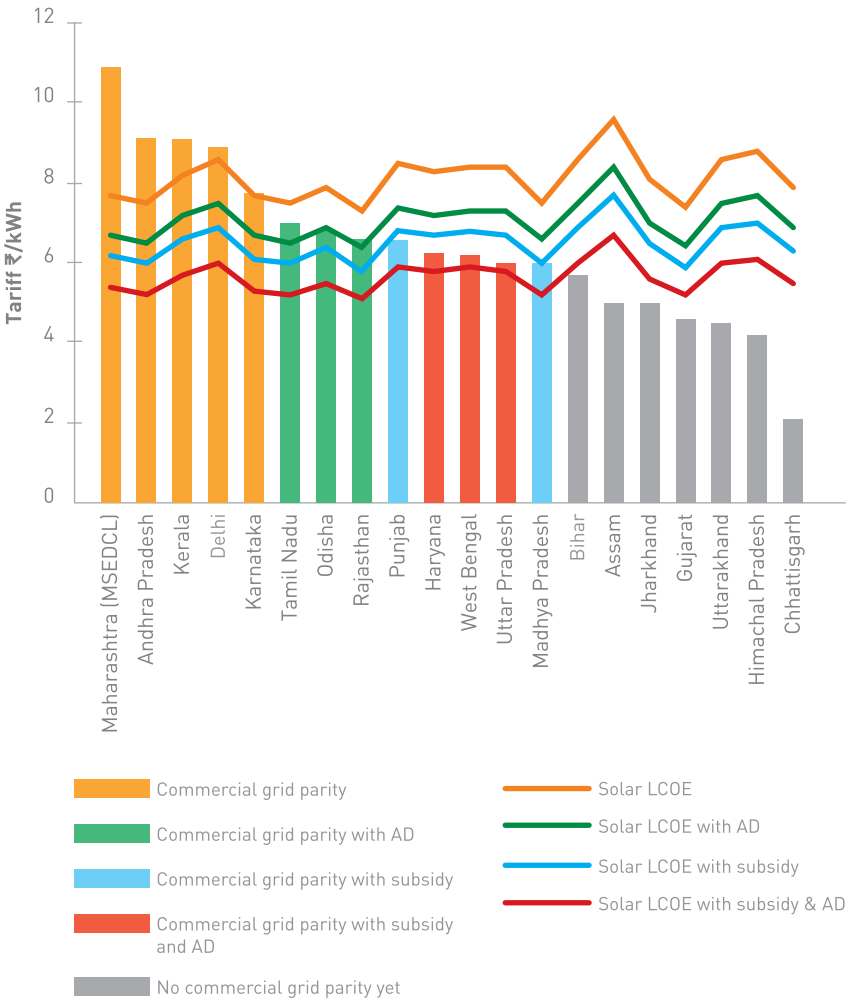
Projected total market size for rooftop segment by 2016

Commercial

Commercial consumers in India pay the highest tariffs among all power consumer categories. The commercial consumers such as malls, office spaces and retail outlets pay as much as ₹11 (€0.14, $0.18)/kWh in certain locations. With rising energy prices, cost reduction through solar power has become an option. Solar is also a green option, provides on site energy (energy security) and helps hedge against unpredictable grid tariff developments.

Solar is a green option, provides on site energy (energy security) and helps hedge against unpredictable grid tariff developments.

State-wise commercial tariff (LT) vs. levelized cost of energy (LCOE) of solar power (<10 kW system; ₹/kWh)[19]



Even without the capital subsidy, solar power is already cheaper than grid power for commercial consumers in Maharashtra, Delhi, Andhra Pradesh, Kerala, Tamil Nadu, Karnataka and Odisha.

Based on BRIDGE TO INDIA's analysis (refer to the graph), even without the capital subsidy, solar power is already cheaper than grid power for commercial consumers in Maharashtra, Delhi, Andhra Pradesh, Kerala, Tamil Nadu, Karnataka and Odisha. Commercial consumers in other states such as Gujarat, West Bengal, Uttar Pradesh, Rajasthan and Madhya Pradesh can also reduce their energy costs if they go through the subsidy route. We expect that 45%

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of Indian states will achieve commercial parity by 2016 following which, the segment will witness accelerated growth.

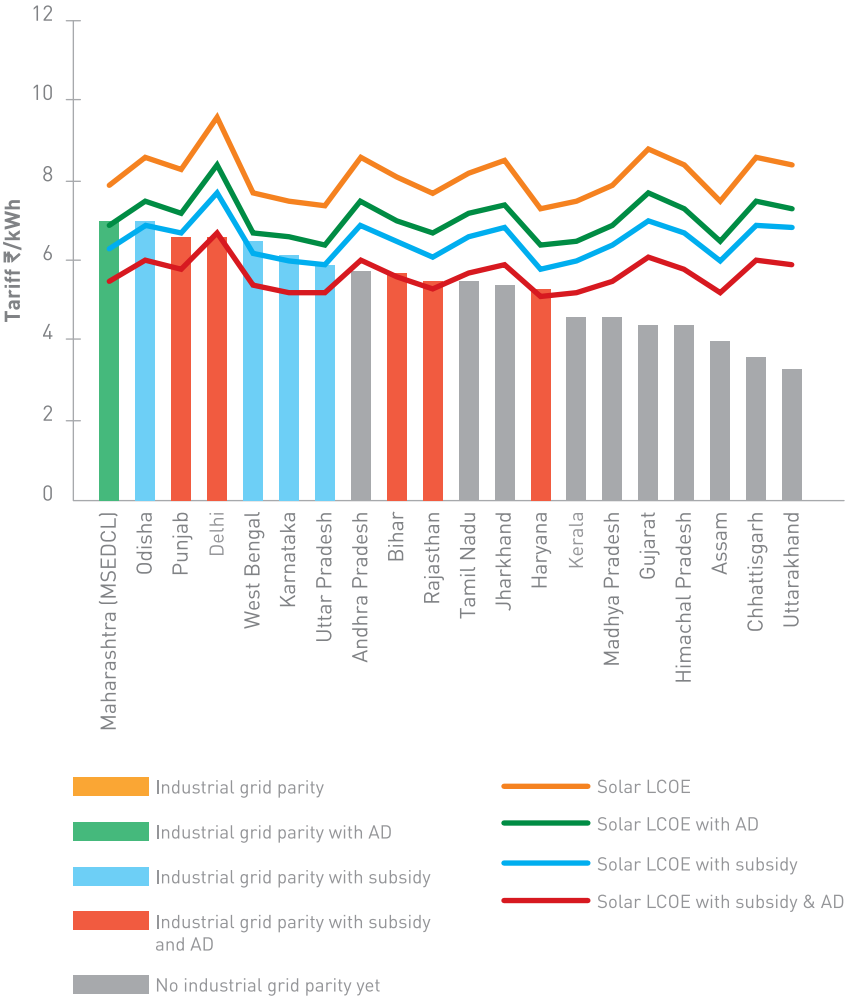
Projected total market size for commercial rooftop segment by 2016

The high load requirement and available rooftop space in the industrial segment is typically more than that of the commercial segment.

Industrial

The tariffs for industrial users are generally 10-15% lower than commercial tariffs and reach ₹8 (€0.10, $0.13)/kWh in certain locations. The industrial segment is likely to scale up later than the commercial segment. However, the high load requirement and available rooftop space in the industrial segment is typically more than that of the commercial segment.

State-wise industrial tariff (HT) vs LCOE of solar power (100 kW system, ₹/kWh)[20]



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States like Maharashtra, Odisha, Punjab and West Bengal are fairly close to parity with industrial tariffs without subsidies and it already makes sense to use solar power with subsidies in these locations.

Projected total market size for industrial rooftop segment by 2016

The main driver for adoption of solar is a desire in many parts of the country to become less dependent on unreliable grid power.

Residential

Residential power consumers are usually charged less than industrial and commercial consumers. The highest tariffs are around ₹7 (€0.09, $0.12)/kWh. Overall, this segment has the highest consumer base in India. The main driver for adoption of solar is a desire in many parts of the country to become less dependent on unreliable grid power. While the potential is huge, the market is still at a nascent stage. It is also fragmented and dominated by local installers. In the coming years, incentives such as net metering and capital subsidy will likely give the segment a boost. However the major acceleration will come only after the grid parity is widely reached.

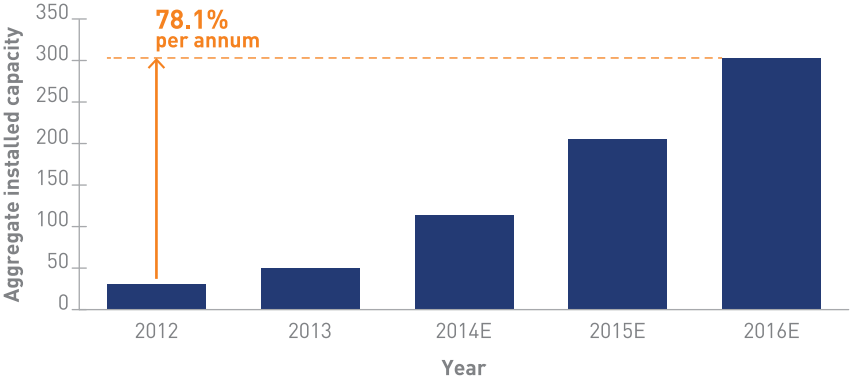
Projected total market size for residential rooftop segment by 2016

India will have one million telecom towers by 2017. 40% of the currently installed towers are situated in regions with less than 12 hours of grid supply on average.

Telecom towers

India will have one million telecom towers by 2017. 40% of the currently installed towers are situated in regions with less than 12 hours of grid supply on average.[21]

Actual and projected cumulative installed solar capacity in the telecom sector (MW)[22]



21 Tata Strategic Management Group, Green Telecom Towers – An Attractive Option for a Sustainable Tomorrow; **bit.ly/1jkYrIR**

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The heavy reliance on diesel has made the telecom tower segment a front-runner among diesel parity driven solar markets. On top of this, the Department of Telecom (DoT) has mandated Renewable Energy Technology (RET) targets for telecom towers. Operators are obligated to switch 50% of the telecom sites in the rural areas and 20% of telecom sites in urban areas to a renewable technology by 2015[23]. Maintenance challenges, security of installations and the high requirements for reliability of power have been key constraints hampering the growth of this segment.

There is an immense opportunity for off-grid solar power solutions in India. More than 300 million people do not have access to grid electricity.

Projected total market size for telecom towers segment by 2016

302 MW

Other markets

There is an immense opportunity for off-grid solar power solutions in India. More than 300 million people do not have access to grid electricity[24] and another 300 million face prolonged power cuts on a daily basis. Most of this population lives in agricultural, rural areas.

Water is usually pumped by diesel pumps for irrigation. As of May 2014, around ten million diesel pumps are in operation. Solar-electric irrigation pumps are a good alternative to such diesel pumps. Diesel water pumps have a life span of only five years and securing a consistent supply of diesel in rural areas is a challenge. Solar-electric water pumps have a longer lifetime and do not need to be supplied with fuel. They can be a good replacement.

As of May 2014, around ten million diesel pumps are in operation. Solar-electric irrigation pumps are a good alternative to such diesel pumps.

However, there are challenges to the adoption of solar in the off-grid market. High upfront costs of solar installations and a general lack of financing options is the most important hurdle. Although unreliable in most cases, for all the places where the grid has reached, agricultural consumers get grid based power at subsidized rates.

Apart from solar water pumps, the market for micro grids for rural electrification, solar lanterns and very small solar home lighting systems also has significant untapped potential. Residents of un-electrified villages currently depend on subsidized kerosene for their energy needs.

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23 Telecom Regulatory Authority of India; **bit.ly/1gLyxIH**
24 World Bank; **bit.ly/1jtZaaL**

Glossary

APPC	Average Pooled Purchase Cost
BALCO	Bharat Aluminum Company Ltd.
CERC	Central Electricity Regulatory Commission
CSR	Corporate Social Responsibility
DCR	Domestic Content Requirement
DoT	Department of Telecom
FiT	feed-in tariff
GBI	Generation Based Incentive
LCOE	Levelized Cost of Energy
MAT	Minimum Alternate Tax
MENA	Middle Eastern and North African
MNRE	Ministry of New and Renewable Energy
NALCO	National Aluminum Company Limited
NAPCC	National Action Plan on Climate Change
NSM	National Solar Mission
PPA	Power Purchase Agreement
PV	Photovoltaic
REC	Renewable Energy Certificate
RET	Renewable Energy Technology
RPO	Renewable Purchase Obligation
VGF	Viability Gap Funding

About BRIDGE TO INDIA

BRIDGE TO INDIA is a consulting company focusing on the solar market in India. The company was founded in 2008 and is based in New Delhi, Bangalore, Munich and Hamburg. BRIDGE TO INDIA offers solar market Intelligence, strategic consulting and project development services to investors, companies and institutions. As part of market intelligence, we provide comprehensive, analytical and up-to-date research on the Indian solar market through various reports. Our strategic consulting expertise lies in assisting large Indian and international clients to engage in the solar market in India. We also offer solar PV project development services with a strong focus on commercially attractive rooftop business models.

At BRIDGE TO INDIA, we seek to provide innovative and business-driven solutions for our clients. We do so by combining strong subject specific knowledge in our core areas related to solar energy with an interdisciplinary approach, bringing together the financial, technical, socio-economic, regulatory and entrepreneurial aspects of business.

Our services

Market Intelligence

As part of Market Intelligence, we provide comprehensive, analytical and up-to-date research on the Indian solar market. Our various reports provide an analysis of the state of solar in India in the form of market updates, overviews, guide books and studies on key topics. Through our weekly updates, blogs, social media channels and our online news portal www.IndiaSolarMarket.com, we provide in-depth and strategic market insights to key solar players who are looking at the Indian market as part of their long term strategy.

Strategic Consulting

Our Strategic Consulting expertise lies in assisting international clients to engage in the Indian market in the field of renewable energy, especially solar energy. We develop viable, successful and customized business models, strategies and specific opportunities that are adapted to the Indian market. Our clients include REC Group, BOSCH, JETRO, IBC Solar and Enerparc amongst others.

Project Development

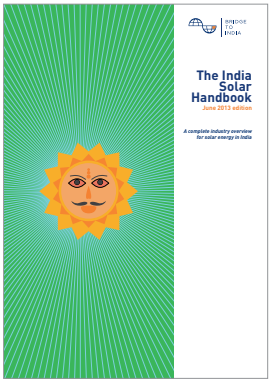
Through Project Development, we develop sustainable business models around captive use of solar power. BRIDGE TO INDIA engages with power consumers to augment their conventional power (grid and diesel) needs with solar PV. These captive use models require no investment from the power consumer's side during the life-time of the PV plant.

Our reports

India Solar Compass

The India Solar Compass is a quarterly market analysis report on the developments in the Indian solar market. It contains the latest key insights and analysis of the state of Indian policies, projects, industry and financing.

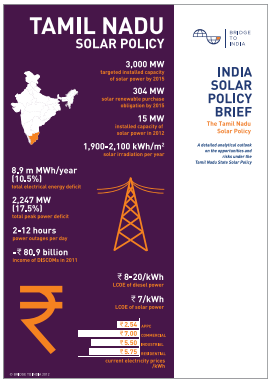
http://bridgetoindia.com/our-reports/india-solar-compass



India Solar Handbook

The India Solar Handbook is a bi-annual introductory report on the Indian solar market. It provides an extensive examination on the Indian solar market by answering critical questions on the market.

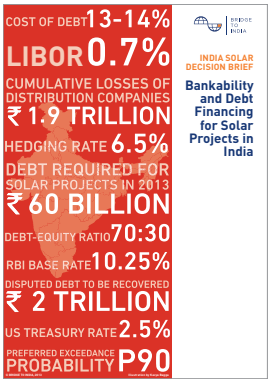
http://bridgetoindia.com/our-reports/the-india-solar-handbook



India Solar Policy Briefs

In our India Solar Policy Briefs, we analyze the fast developing policy landscape and bring clarity to key aspects, such as investment opportunities, power demand, and payment security and allocation procedures.

http://bridgetoindia.com/our-reports/india-solar-decision-briefs



India Solar Decision Briefs

In our India Solar Decision Briefs, we give in-depth analysis on specific aspects of the market. Our latest report with Greenpeace analyzes the potential for rooftop solar in Delhi.

http://bridgetoindia.com/our-reports/policy-briefs

BRIDGE TO INDIA

BRIDGE TO INDIA is a consulting company with an entrepreneurial approach based in New Delhi and Munich. Founded in 2008, the company focuses on renewable energy technologies in the Indian market. BRIDGE TO INDIA offers market intelligence, strategic consulting and project development services to Indian and international investors, companies and institutions. Through customized solutions for its clients, BRIDGE TO INDIA contributes to a sustainable world by implementing the latest technological and systemic innovations where their impact is the highest.

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