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Harvesting the sun to address southern region power woes

CII - Conference on solar power

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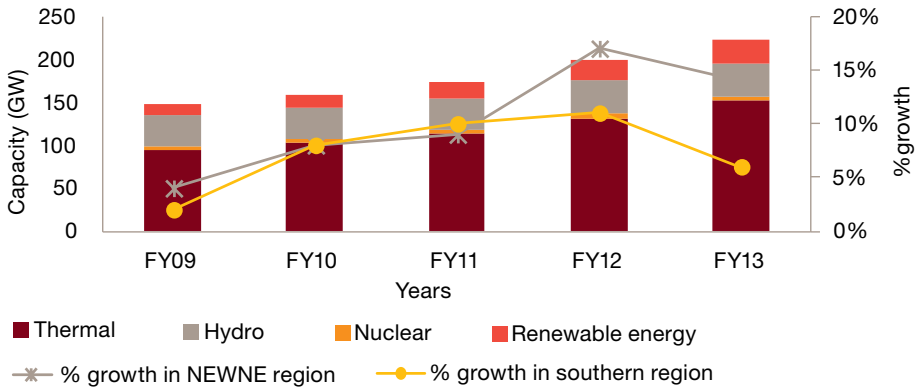
Overview

India, which has been traditionally dominated by conventional energy sources, has the fifth largest power generation capacity in the world. As on September 2013, the country's generation capacity stood at 228 GW, out of which the southern states contribute close to 25%.

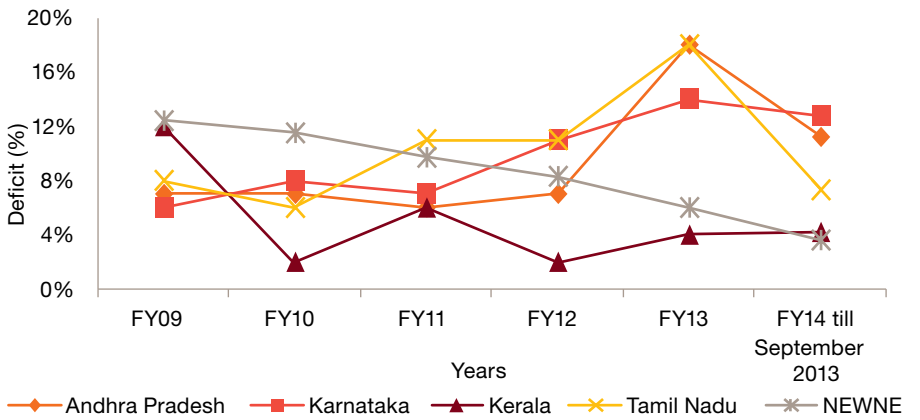
Installed generation capacity (GW)



Source: Central Electrical Authority (CEA)

The southern region of India comprising of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu, has seen an increasing power deficit situation over a period of time. The power deficit in the southern region peaked at 15.5%, unlike the improving deficit scenario of the northern, eastern, western and north-eastern (NEWNE) region of India where the deficit is 6.1%. Barriers such as fuel shortage, lack of sufficient capacity addition and delay in integrating the southern with the NEWNE grid, have been the key reasons for the widening power deficit within the region.

Energy deficit (in %)



Source: CEA

High deficit situation in the southern region has led to some of the states resorting to scheduled and unscheduled load shedding as well as adopting restriction and control (R&C) measures. Load shedding ranges from a few hours within the capital cities in the region to more than eight hours in Tier-II cities, and even more in the rural areas in summer season. Moreover, demand from industrial as well as commercial consumers in the region is controlled by way of setting up a cap on allowable energy, while demand in the states of Tamil Nadu and Andhra Pradesh is controlled through R&C measures. Stringent penalties are imposed on consumers not complying with R&C guidelines.

Power shortages have crippled regular operations of industries and commercial consumers. Businesses are forced to either cut down production or use captive power generation or buy power from the exchange due to the power cuts.

With the use of alternate options, the cost of power generation through diesel or heavy furnace oil is around three to four times more expensive than grid power. This is in addition to the capital cost incurred while purchasing the generation equipment and inverters. Industrial consumers today consider that having in place a power backup is a necessity, and are ready to incur the capital and operating costs so as to ensure reliability, despite its effect on the profitability of the companies. Small size businesses which cannot afford high cost arrangements like power generation through diesel, procure from power exchange, has to rely on grid connected power and are forced to cut down their production due to load shedding.

Need for energy supply diversity

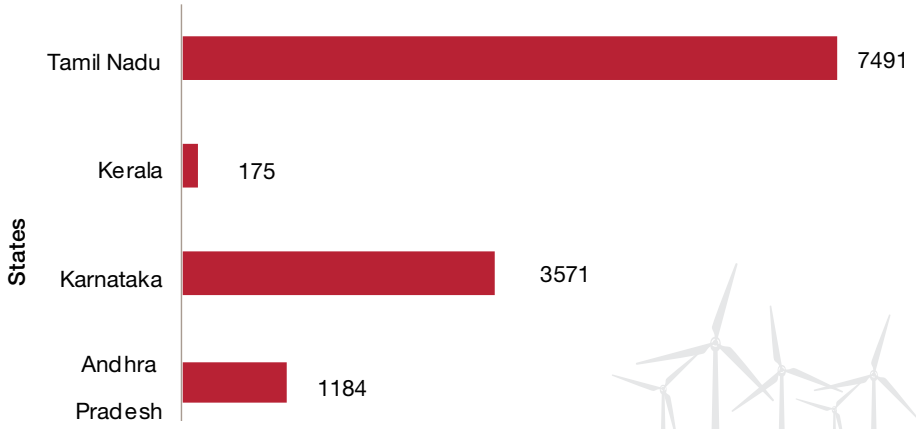
Currently, obstacles such as widening deficit, increasing cost as well as unavailability of conventional fuels, long gestation period for setting up of conventional power plants, impact on the economy due to the import of fossil fuels is a challenge to the energy security scenario of the nation. This situation is paving the way for the country to consider alternative sources of energy which are quick to install, environmental friendly, locally available and need not be imported.

The southern region is endowed with significant renewable energy generation potential which is estimated to be over 51GW (excluding solar). Till March 2012, around 12.4 GW has been installed, which is a commendable 44% of the country's total installed renewable energy generation capacity.

The southern states have varying levels of renewable energy penetration. Tamil Nadu, one of the forerunners in harnessing renewable energy, has installed a capacity of 7.4 GW, which is the highest in the country, and accounts for approximately 31% of the total installed capacity in India.

Wind energy has been the biggest contributor to the share of renewable energy in southern region. Tamil Nadu has again been the forerunner in harnessing wind energy, while other states in the region are catching up.

Installed renewable capacity (MW) as on August 2013



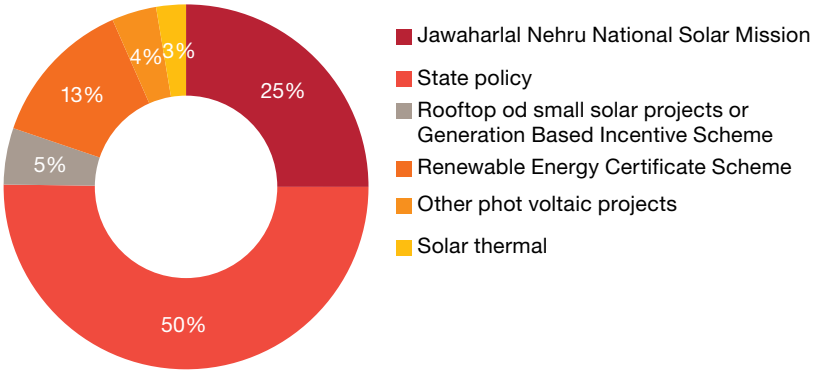
Source: Ministry New and Renewable Energy (MNRE)

Market for solar power: Unique to south India

India has a vast potential for solar power generation, since around 58% of the total land area receives an annual average global irradiation of above 5 kWh/m2/ day. The total installed capacity of grid-interactive solar energy as on October 2013 was 2079.97 MW. This forms over 8% of the total installed capacity of renewable energy.

The 12th Five Year plan's strategy for the period 2013-17, aims to develop an ambitious 10,000 MW of solar energy.

Installed capacity of grid-interactive solar power (in MW) as on October 2013



Source: MNRE

Currently, the top three states in the country with installed solar generation capacity include, Gujarat, with an installed capacity of over 852 MW, Rajasthan with 608 MW, and Madhya Pradesh with 220 MW. Apart from good radiation, successful adoption of solar power in these states can be attributed to encouraging policies as well as supportive regulations rolled-out by the respective state governments. Other states such as Uttar Pradesh, Punjab are also following suit, and are introduding various policies as well as competitive tariffs in order to attract private investments in solar power generation projects.

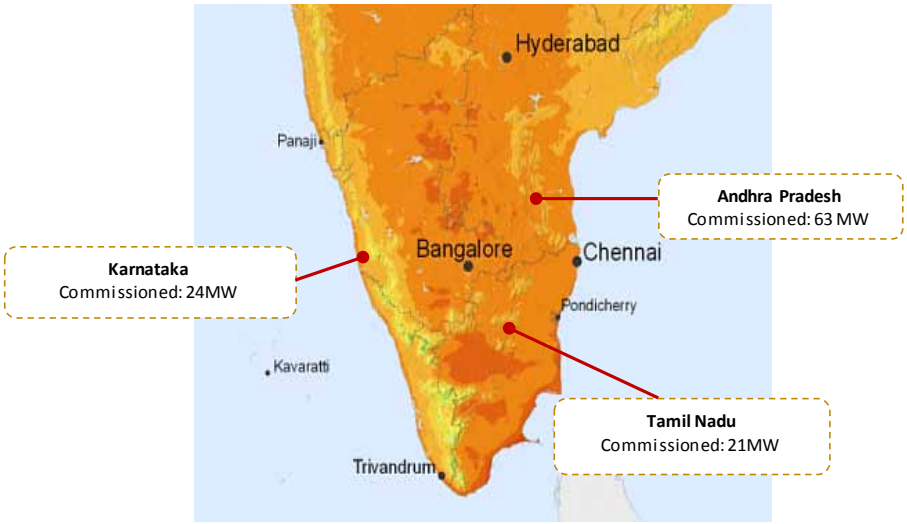
Southern states such as Andhra Pradesh, Tamil Nadu, Karnataka and Kerala have reported a decent average solar irradiation of 5.0 to 6.0 kwh/m2/day, with around 300 clear sunny days in a year. Despite being a resource rich region, the combined total installed grid connected solar capacity in the southern states constituites a mere 5.2% of the country's installed solar power capacity.

Even if only 0.5% of the wasteland is used in the region, the realisable potential is above 15, 000 MW. The southern region can increase its solar capacity installation considerably, installing in excess of its current announced targets.

With developments such as reduction in the cost of generation from solar power projects over the last five years, backed by policies such as the Jawaharlal Nehru National Solar Mission (JNNSM), mandatory solar purchase obligation (SPO) as well as proactive state-specific solar policies supporting development of roof top, decentralised and large utility scale projects, the region is poised to spearhead a massive deployment of solar power projects and thereby drive investments within the sector.

Solar irradiation and grid interactive solar capacity (MW) as on October 2013

Solar irradiation and grid interactive solar capacity (MW) as on October 2013



Source: Solargis, MNRE

Policy and regulatory framework for solar power

Power generation from renewable sources is constantly on the rise in India, with the share of renewable energy in the country's total energy mix rising from 7.8% in FY08 to 12.3% in FY13. Wind power has led the renewable energy capacity addition within the country, registering a growth of 34% in the last decade, and its installed capacity reaching 19.93 GW in October 2013. This growth can be attributed to a conducive policy and regulatory framework in the form of preferential tariffs, renewable purchase obligations (RPO), renewable energy certificate(REC) mechanism as well as fiscal benefits such as accelerated depreciation and generation based incentives (GBI) to wind power developers. The states of Tamil Nadu and Karnataka are among the leading states in India in wind power with a total installed capacity at 7.2 GW and 2.1 GW respectively. Similar success, if replicated in the solar space, may address the energy shortage problem of these states.

Currently, growth in solar can be associated with various promotional policies both at the national as well as the state level. JNNSM has been driving solar installations within the country since its launch in 2009. It aims to achieve a grid-cost parity for solar energy and install 20 GW of grid connected solar power by 2022. The southern region has been proactive in terms of policy formulation. Karnataka was the first among the southern states to formulate a comprehensive solar policy. Other states such as Tamil Nadu, Andhra Pradesh and Kerala have announced their respective solar policies in recent times.

Tamil Nadu

With a vision of developing Tamil Nadu as the world leader in solar energy, the government of Tamil Nadu along with the state nodal agency Tamil Nadu Energy Development Agency (TEDA) drew up the Tamil Nadu Solar Energy Policy in 2012. The policy envisages a solar capacity addition of 3,000 MW through utility scale, solar roof top projects and the REC mechanism by 2015.

Key policy aspects

Solar purchase obligation

The state has obligated various consumer categories (HT I to V and LT V category) in order to meet the solar purchase obligation of 3% till December 2013 and 6% from January 2014 onwards. Being a first of its kind, where the obligation rests directly on the consumers, this SPO is expected to drive solar power investments within the state.

The FY13 energy consumption of obligated consumers within the state is 22,381 MUs. The obligation will translate to a solar capacity requirement of 426 MW at 3% SPO and 852 MW at 6% SPO.

Key supporting incentives

The incentives offered by the state government for the development of the solar energy sector under the solar energy policy include the following:

- The GBI scheme for capacity addition of 50 MW is targeted for domestic solar rooftop installations. A incentive of 2 INR per unit for the first two years, 1 INR per unit for the next two years, 0.5 INR per unit for the next two years for all solar as well as hybrid plants installed before 31 March 2014 will be provided.
- Net-metering is allowed to promote rooftop penetration
- Exemption from the payment of electricity tax to an extent of 100% on electricity generated from solar power projects, used for self-consumption or sale to utility will be permitted for five years.
- Exemption from demand cut to the extent of 100% of the installed capacity assigned for captive use purpose will be permitted.
- Guaranteed single-window clearance in 30 days

The charges for open access transactions, that is, for energy supply through a third-party or a captive, are to be finalised by the state. Investments within the sector are likely to gain momentum once the applicable open access charges are announced by the regulator.

States progress: A 1000 MW competitive bid process

In December 2012, the Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO) announced a 1,000 MW tender for solar projects within the state. Towards this, letter of intents to the tune of 499 MW were issued, and the capacity tied up is expected to go up as Letter of intent (LoIs) were signed with bidders to implement bid capacity or higher. TANGEDCO determined a tariff of 6.48 INR per kWh, with 5% escalation for acceptable bids, which is considered feasible by many independent power producers (IPPs) as well as developers claiming accelerated depreciation benefits.

Key points

Capacity offered: 1,000 MW

Letter of intent issued: 499 MW

PPA: Twenty years with the TANGEDCO

Tariff: 6.48 INR per kWh, with 5% escalation for the first 10 years

Status: PPA yet to be signed

While letter of intent (LoIs) has been allocated, the PPAs are yet to be signed. The expedition of signing a PPA will help achieve financial closure and support the business decisions of developers who have timed the project for both normal as well as accelerated depreciation benefits.

Rooftop solar

For rooftop solar systems of 1 kW, a capital subsidy of 30% is to be provided by the government of India and 20% by the state government. The state government of Tamil Nadu has announced this additional subsidy for solar rooftop projects in the month of October 2013. With this announcement, an investor now needs to bring in only the remaining 50%. This subsidy will be given on a first come, first serve basis to the first 10,000 customer. It will be given only to grid-connected, without battery systems, and only for domestic consumers (LT-1A category). Solar power generated is to be consumed within the building.

Net metering guidelines

Tamil Nadu Electricity Regulatory Commission (TNERC) has recently announced its guidelines for net metering implementation within Tamil Nadu. According to these guidelines, two separate meters will be installed for metering purpose. While one meter will be for measuring solar power generation, the other meter will be for export or import measurement. However, solar generation meter is optional for consumers not availing the GBI.

An annual cap has been set for the amount of energy residential photo voltaic (PV) system owners can supply to the local grid under the net metering scheme. The electricity generated by a residential PV system will be capped commercially at 90% of the electricity consumption by the eligible consumer at the end of a settlement period, and the excess energy generated beyond the 90% cap will be treated as lapsed. Furthermore, at the local distribution level, connectivity to rooftop PV systems will be restricted to 30% of the distribution transformer capacity on a first come, first served basis.

The settlement period is 12 months between August and July each year. As the settlement period ends immediately after the summer season, any excess generation accumulated during the summer season might get lapsed.

Solar tariff and open access regulation

Recently, the TNREC has released a draft consultative paper on solar tariff for solar PV, Solar thermal and kilowatt (kW) scale systems. A solar PV tariff of 5.78 INR per kWh with no escalation was proposed. The tariffs proposed for solar thermal and kW scale systems are 8.34 INR per kWh and 8.15 INR per kWh respectively.

It is to be seen if the tariff will be revised considering the dynamics of capital, financing as well as operational costs, and other factors such as the capacity utilisation factor, the area required, technology (domestic as well as global), keeping in view that among the consumers, both IPPs as well as investors are keen to implement solar power projects within the state.

Andhra Pradesh

The state has drawn out a solar policy with an aim to encourage investments in grid and off-grid solar power projects. The policy has given greater emphasis on development of projects under the third-party, captive or REC route.

Key supporting incentives

The state government has provided a host of incentives to solar power generators within the state in order to encourage solar power generations. These incentives include the following:

- Wheeling and transmission charges are not applicable for the sale of power within the state.
- Cross-subsidy surcharge is not applicable for intra-state open access sale and captive use.
- Hundred per cent banking facility will be permitted for 12 months. Towards this, banked energy cannot be redeemed between the months of February and June.
- All solar power projects will be exempted from paying electricity duty for captive consumption and third party sale.
- Value added tax (VAT) for all the inputs required for solar power projects will be refunded.
- The Industries Department will provide incentive in terms of refund of stamp duty as well as registration charges for the land purchased for setting up a solar power project.

As per the policy, incentives proposed are valid for a period of seven years from the date of implementation. Such communication regarding the certainty of a policy is an aspect investors give huge importance, and is a driving factor for mobilising investments within the sector.

States progress: A 1000 MW competitive bid process

Andhra Pradesh announced bids to the tune of 1,160 MW of solar PV projects which was oversubscribed by 570 MW, thereby totaling up to 1,730 MW. Project sizes were of five and 10 MW each. The highest bid was 15.99 INR per kWh and the lowest bid was 6.49 INR per kWh. The locations, for which bids have been submitted, have been allocated a total capacity of 920 MW only by Andhra Pradesh Transmission Company (APTRANSCO). Among the 121 locations bid for, there is a possibility that the capacities bid for in these locations may not actually lead to complete fill up of capacity for each location.

So far, under the solar policy, the state has received offers for only 418 MW, thereby leaving a large gap in its planned target.

Key points

Capacity offered: 1,000 MW

Letter of intent issued: 144 MW

PPA: Twenty years, with the DISCOM

Tariff: 6.49 INR per kWh

Status: PPA yet to be signed

Decentralised solar power

The state has a total capacity of 11 MW sanctioned under the off-grid standalone solar plants, and the installed capacity as on September 2010 is only 139 KW. The New and Renewable Energy Development Corporation of Andhra Pradesh (NEDCAP) has been working closely with a number of organisations in order to improve the awareness about decentralised solar power systems among industrial as well as domestic consumers.

The state government intends to provide solar pump sets to agriculturists on a huge subsidy basis, and this benefit will be extended only to those villages which do not have a conventional grid. Under the Solar Photovoltaic Lanterns programme, around 22,000 solar lanterns will be distributed during the financial year 2013-14. The state government will subsidise each lantern to the extent of 500 INR to all categories of beneficiaries. Solar water heating as well as lighting systems are also gaining popularity among industrial consumers. Recently, the Warangal Municipal Corporation has installed a 27 KW rooftop solar PV power system in order to run the office lighting system.

Net metering guidelines

The state government has announced a policy for encouraging net metering within the state. This facility is only provided to three phase consumers. Compensation for surplus energy pumped into the system is a pooled cost as decided by the Andhra Pradesh Electricity Regulatory Commission (APERC) from time-to-time, and settled on a half-yearly basis. Such a payment is made for the period of seven years, starting from the date of setting up of the project. The state has decided to provide 20% subsidy for systems up to 3 kW in addition to the 30% Ministry of New and Renewable Energy (MNRE) subsidy. A detailed set of technical guidelines related to the installation and safety procedures have also issued.

Karnataka

Karnataka has come up with a Karnataka Renewable Energy Policy 2009-14 in 2009, wherein a target of 126 MW of solar power was envisaged up to 2013-14. This included the power that the state was likely to receive under the JNSSM. After the enactment of the Karnataka RE policy, Karnataka Electricity Regulatory Commission (KERC) issued the renewable purchase obligation (RPO) regulations in order to encourage the initiation of solar projects within the state. The state government thereafter decided to implement a dedicated solar policy, and has subsequently formulated the Karnataka Solar Policy 2011-16 for the development of solar projects. The Karnataka Renewable Energy Development Limited (KREDL) as the state nodal agency is responsible for implementing this policy.

Key aspects of the policy include the following:

- Proposal to install 200 MW of solar-based projects by 2015-16, for procurement by Electricity Supply Companies (ESCOMs), added at an annual capacity of 40 MW
- The minimum capacity shall be 3 MW and maximum 10 MW for solar PV-based projects. For solar thermal projects, the minimum capacity shall be 5 MW
- The capacities will be allotted through a competitive bid process, under the reverse bidding route, with a maximum tariff based on the KERC tariff order as of 13 July 2010
- Captive power plants and the sale of power to third parties are not a part of the 200 MW capacity. Wheeling as well as open access charges will be applicable as determined by the KERC or Central Electricity Regulatory Commission (CERC).
- An additional 50 MW is reserved for central or state-owned undertakings for setting-up solar projects in the state for the purpose of bundling with thermal power from outside the state, at government approved rates.
- Solar energy generators can sell electricity to the ESCOMs at a pooled cost of power purchase as determined by the KERC or CERC, and sells the RECs to obligated entities.

States progress: A 200 MW competitive bid process in the last two years.

The state auctioned 80 MW of solar energy in 2011 and a further 130 MW in 2013 to meet it RPO. Phase 1 capacity included a 10 MW solar thermal project.

Except for a 10 MW solar PV project that has been commissioned, other project are currently under construction. The state has extended the deadline for completion of project under phase I to March 2014.

Key points

Capacity offered: 200 MW

PPA: Twenty-five years with respective ESCOMs

Tariff:

- Phase 1: 7.94 to 8.50 INR per kWh
- Phase 2: 5.51 to8.05 INR per kWh

Status: Ten MW commissioned under Phase 1, and PPA to be signed for 130 MW of Phase 2

Feed-in-tariffs for solar plants

Karnataka Electricity Regulatory Commission has recently introduced tariffs for grid connected projects.

Type of solar plant	Tariff (INR per kWh)
Solar PV plants	8.40
Rooftop and small solar plants	9.56
Rooftop and small solar plants with 30% capital subsidy	7.20

Source: KERC solar tariff order 2013

However, results of both the phases in the bid process indicate that the KERC's benchmark as well as average tariff in the market differ, while the tariff recently announced by the KERC may only serve as a benchmark for future capacity allotments under the reverse bidding process.

In case of small and rooftop solar plants, there is generally no reverse bidding process. Although Karnataka is yet to announce a specific net metering or rooftop policy, similar policies announced in other states in the region indicate that projects falling under this category have been allocated on a first-come-first-serve basis. Specific net metering guidelines will encourage consumers as well as investors to look into rooftop projects with renewed interest.

Kerala

Kerala Solar Energy Policy 2013

In order to mainstream solar energy in Kerala and ensure optimal usage of available solar potential in the region, the state government of Kerala formulated its Solar Energy Policy 2013.

Key policy aspects include the following:

- To achieve a solar installed capacity of 500 MW by 2017 and 1,500 MW by 2030
- To promote the use of solar water heating system (SWHS) and solar steam systems
- For off-grid systems, the policy seeks to ensure bank finance at attractive rates, and provides generation-based incentives rather than capital subsidies
- The Kerala State Electricity Regulatory Commission (KSERC) shall notify the normative preferential tariff of solar power for procurement by the Kerala State Electricity Board (KSEB) in case of offsite commercial installations. For all agencies that consume grid power and have installed solar installations with some form of government subsidy, only net metering shall be applicable.
- The government of Kerala will assess as well as help developers identify the land areas suitable for solar installations
- Incentives in the form of exemption of open access charges, wheeling as well as transmission charges within the state are applicable

Kerala Off-grid Rooftop Programme

Kerala has one of the highest population densities in the country and does not have any sizable area of barren land. This makes the development of utility scale ground mount solar PV projects difficult to implement. States geography imposes challenges on solar power generation, thereby making it a lesser attractive option as compared to the neighboring states of Tamil Nadu, Karnataka and Andhra Pradesh. Hence, in such a scenario, the off-grid rooftop PV systems become an attractive proposition for state.

Kerala has launched an off-grid solar rooftop programme known as the 10,000 Solar Rooftop Programme. Households interested in putting up solar PV systems (of 1 kWp, off-grid) can apply to the state nodal agency, the Agency for Non-Conventional Energy and Rural Technology (ANERT). Households within the state will receive a 30% subsidy from the MNRE, and in addition, another 39,000 INR from the government of Kerala through the ANERT. As of May 2013, a total of 11,590 applications for these systems have been received by ANERT.

Key aspects of this programme as follows:

- Each rooftop power plant (solar array) shall be of 1 kWp capacity
- Only off-grid power plants are covered under this programme
- State will give additional subsidy of 39000 INR per system to beneficiary
- Central government subsidy of 81,000 INR or 30% of the cost of the power plant (whichever is less) is expected
- Applicants must be willing to meet the remaining expense of around 1 lakh INR
- A total of 10,000 of such systems will be installed in the state totaling 10 MW solar PV capacity
- All the installation has to meet the specifications of the central government as well as implement projects through empanelled vendors

Encouraging projects under the open access route

With increasing retail tariffs, industrial as well as commercial consumers are considering options to hedge their energy costs. Consumers are currently pursuing the open access based sourcing under a third-party or group captive routes in order to procure energy directly from the generators. These options also help consumers meet their respective renewable or solar purchase obligations. An open access-based power procurement process has been a success in states such as Tamil Nadu.

The solar policies and open access (OA) regulations within the southern states support procurement of solar energy through OA mechanisms. While the applicable charges for solar OA transactions are defined in states such as Andhra Pradesh, Karnataka and Kerala, Tamil Nadu has proposed the applicable charges in a draft order which is yet to be finalised. While Karnataka has come up with a complete waiver on open access charges and has paved the way for 100% banking, other southern states have also extended the specific benefits for solar projects set-up under the open access route.

State	Transmission and wheeling charges	Transmission and wheeling losses	Banking	CSS on third-party	Other incentives
Andhra Pradesh	Not applicable	Normal transmission and wheeling losses applicable	Hundred per cent banking permitted. No redemption of banked units between the months of February and June, and also during ToD hours	Not applicable	Electricity duty exempted
Karnataka	Not applicable	Not applicable	Hundred per cent banking permitted	Not applicable	None
Kerala	Not applicable	Not applicable	Conditional banking as per the policy	-	Electricity duty exempted
Tamil Nadu (proposed)	Thirty per cent of the applicable charges	Normal transmission and wheeling losses applicable	Not yet finalised	Fifty per cent of the applicable cross subsidy surcharge	Electricity tax exempted for five years for captive, and a 100% demand cut

Source: PwC Analysis, Tariff order

REC mechanism

The REC mechanism has been framed in order to promote renewable energy development and assist the obligated entities to meet the RPO obligation by way of purchasing the 'green' component of the renewable energy. Till 30 November 2013, 308.87 MW of solar PV capacity and 3 MW of solar thermal capacity are accredited under the REC mechanism in the country. Out of this capacity, only 42.6 MW is accredited from the southern states. Similarly out of 262 MW of solar PV capacity registered under the REC mechanism in the country, only 14.8 MW is registered from the four states of southern India.

Capacity addition under the REC mechanism is not significant, primarily due to the fact that the current demand for solar RECs is much lower than the supply available. This has resulted in the building up of a large amount of unsold inventory of solar RECs, and as a result, the clearing prices have remained at the floor price level of 9.3 INR per kWh. The outstanding inventory of solar RECs till end of November 2013 is 54,506 RECs as against the average monthly redemption which has been within the range of 1,703 RECs to 9,257 RECs in 2013. Lower demand due to the lack of strict compliance to the renewable purchase obligation. Some states have come forward to enforce the RPO because of which demand for Solar RECs has picked up since September 2013.

The secondary aspect is related to regulatory support to such projects. Issues such as uncertainty in the open access charges applicable, the matter of extension of concessional charges to such projects and the REC eligibility have all contributed to the ambiguity for developers to undertake projects under REC mechanism. Clarity on OA charges applicable, stringent compliance enforcement and revision of RPO targets, keeping in line with market expectations, will encourage investments in REC-based projects.

Conclusion

Undoubtedly, with a basic policy and regulatory framework in place, if certain market fundamentals are addressed, in the future, solar energy can play a significant role for a secure and diversified mix of energy in the southern region of India. Currently, the region is chalking out a roadmap to position itself as a hub for solar power. Despite its highs and lows, policy-backed projects will continue to be the largest driver for new capacity addition in the coming years, while business models will be explored in order to match the market requirements.

Transmission and evacuation infrastructure plans

Renewable energy generation in India is concentrated within a few states, and within a couple of districts in those states. Generation capacity has increased rapidly over time, but the evacuation infrastructure development has been able to keep pace with the generation infrastructure.

Currently, certain pockets of the state transmission network are yet to support evacuation of renewable energy at its peak generation. With additional capacity likely to be added at the sites with good potential which are situated far away from load centres, the network is bound to face congestion. Investors today focus on setting up projects even in good potential sites, even after considering the evacuation challenges.

Wind as well as solar generation sources are infirm generation sources, and are deemed as a must run. However, it has been observed that wind power generating sources in states of Tamil Nadu and Karnataka have been asked to back-down leading to significant loss of revenue as well as electricity generation. Key reasons towards this step are as follows:

- Inadequate evacuation infrastructure
- Load management of grid, owing to the infirm nature of the generation

This problem, if not tackled, will also affect the solar generation sources which are coming up in a huge way, over the next few years. As per the CEA, 32,713 MW of renewable energy generation capacity is expected to be added in 12th Five Year Plan which includes around 16,500 MW from Tamil Nadu, Karnataka and Andhra Pradesh. These three states are expected to add close to 5,000 MW of solar power capacity by FY17. It is therefore important for the southern region to address the evacuation-related issues in order to maximise the utilisation of the RE sources.

Management of renewable energy

Understanding the need for strengthening the transmission evacuation, the forum of regulators and the Power Grid Corporation of India Limited (PGCIL) in July 2012 proposed the need for a 'Green Energy Corridor' for evacuating renewable energy generation in the RE-rich states. PGCIL has proposed to augment an inter-state transmission system, an intra-state transmission System, and a last mile connectivity system to the state transmission utility (STU) network, and strengthening within state for conveyance of ISTS transfer.

Intra-state transmission system proposed by the RE-rich states

State	Transmission line	Additional Substations
Tamil Nadu	• 1,440 ckms of 400 kV line • 91 ckms of 230 kV line • 45 ckms of 110 kV line	• 1 no. of 400/230 kV S/s (830 MVA) • 1 no. of 230/110 kV S/s (300MVA)
Andhra Pradesh	• 460 ckms of 400 kV line • 582 ckms of 220 kV line	• 1 no. of 400/220 kV S/s (1260 MVA) • 5 no. of 220/132 kV S/s (1120MVA)

Source: PGCIL, (As per the DPR, excluding elements for conveyance to ISTS)

Proposed connectivity system to the STU network (intra-state)

State	Transmission line	Additional Substations
Tamil Nadu	• 1,620 ckms of 230 kV line • 2,840 ckms of 110 kV line	• 10 no. of 230/33 kV S/s (2900 MVA) • 22 no. of 110/33 kV S/s (4400 MVA)
Karnataka	• 630 ckms of 220 kV line • 1,160 ckms of 132 kV line	• 4 no. of 220/33 kV S/s (1200 MVA) • 9 no. of 132/33 kV S/s (1750 MVA)
Andhra Pradesh	• 900 ckms of 220 kV line • 1600 ckms of 132 kV line	• 5 no. of 220/33 kV S/s (1600 MVA) • 12 no. of 132/33 kV S/s (2450 MVA)

Source: PGCIL, (As per the DPR, excluding elements for conveyance to ISTS)

Proposed system strengthening within the state for conveyance of ISTS transfer

State	Transmission line	
Tamil Nadu	• 1,240 ckms of 400kV line • 1,500 ckms of 230kV line	• 6 no. of 400/230/110 kV S/s (6925 MVA) • 4 no. of 230/110 kV S/s (2650 MVA)
Karnataka	• 720 ckms of 220 kV line	-
Andhra Pradesh	• 260 ckms of 400 kV line • 1,178 ckms of 220 kV line	• 2 no. of 400/220 kV S/s (2205 MVA) • 4 no. of 220/132 kV S/s (600 MVA) • 400/220 kV S/s Augmentation (3465 MVA) • 220/132 kV S/s Augmentation (1450 MVA)

Source: PGCIL, (As per the DPR, excluding elements for conveyance to ISTS)

Some of the proposed inter-state transmission systems corridors in the southern region are as follows:

- Establishment of a plus 500 kV, 2500 MW New Pugalur - Hyderabad HVDC Bipole
- Establishment of a 400 kV Srisailam - Kurnool New Double Circuit (D/c)
- The New Pugalur - Udumalpet 400 kV D/c
- The New Pugalur - Vagarai 400 kV D/c (quad)
- The New Pugalur - Pugalur 400 kV D/c (quad)
- The Hyderabad – Hyderabad(New) 400 kV D/c (quad)
- The LILO of Tuticorin Pool-Salem 765 kV line at New Pugalur (initially to be operated at 400 kV)
- Establishment of a +500 kV, HVDC terminal stations (2500MW), each at New Pugalur and Hyderabad
- Establishment of 400 kV substations at New Pugalur and Hyderabad

On a positive note, work towards building the Green Energy Corridor has been initiated, and the Government of India has received its first tranche of soft loan from Germany under Indo-German Bilateral Development Cooperation Program in November 2013. Considering the fact the gestation period of RE projects is much shorter than the time required to plan and construct evacuation infrastructure, it is critical to accelerate the construction process in order to accommodate energy from the RE projects.

Grid integration for renewables

Generation of power from solar and wind energy are variable in nature, and high levels of penetration as observed in the RE-rich states, such as the four states of southern India, can impact the stability of the grid which is required to operate within a tight frequency band as well as other operating parameters.

Rather than curtailing the generation of power by requesting RE projects to back-down their generation or imposing penalties by calling for strict adherence to forecasting, it is important to develop systems as well as infrastructure which can help in managing the grid effectively

Forecasting of generation

- Forecasting of generation from RE sources can help the system operator in managing other generation sources and demand
- Forecasting can be done by the RE generator or the system operator, as done in Europe. RE generators must not be penalised for giving inaccurate forecast.
- Since the forecasting systems are not matured and the accuracy of forecast is better at the grid scale rather than individual farm level

Peaking power and hydro generation

- The state must try to manage the grid by utilizing gas-based peaking power stations, and storage-based hydro power plants in order to scale up and down the generation so as to accommodate the variable RE generation.

Smart grid

- Smart grids can help in managing the grid instability by efficient control of demand and other generation sources.

Real-time markets

- As per the industry, having in place a real-time market, in addition to existing Day Ahead Market (DAM) will help provide opportunity to the states to handle variable generation from RE sources

Solar energy when compared to the other infirm renewable energy generation sources is easier to forecast. Various mathematical models have evolved over time, which can fairly estimate the generation. Accuracy is expected to be low at the farm level, but when aggregated at a district or state grid level, the level of accuracy is expected to be considerably high.

The CEA report on grid integration of RE power also suggests having in place renewable energy management centres in each state, and regional load dispatch centres which will conduct a real-time forecast of the RE generation, and work with load dispatch centres in effective control of the grid.

Currently, owing to the inadequate integration of the northern with the southern grid, and also the inadequate integration of various states transmission networks, it has been difficult to manage excess or under generation in a specific RE-rich state. However, with the commissioning of the Raichur- Sholapur 765 kV link line and strengthening of the inter-state transmission system as a part of the Green Energy Corridor, surplus energy could be exported to the energy-deficit states, which could also manage the stability of grid.

Financing of solar projects

Renewable energy projects, including solar projects are highly capital-intensive in nature. Therefore raising finance is the most important activity for the development of the project, as financial costs form the biggest component of the overall operational cost, and is the major cash out flow for the project until the debt is repaid.

The viability of the project greatly depends on obtaining cheaper cost of funds and timely financial closure.

Financing of grid connected MW scale projects

It has been observed that solar project developers find it difficult to raise finance. The lenders as well as equity investors have a high-risk perception about solar power projects, resulting in difficulty in raising funds.

Higher risk perception of projects results in increased cost of financing in terms of higher cost of debt as well as the security required to be offered. It also results in delay in raising funds due to increased due diligence efforts.

Risk perceived	Factors	Mitigation
Construction risk	• Land acquisition	The government can assist companies in identifying and assisting in land acquisition or can provide government land for lease.
	• Project developers face hurdles while obtaining evacuation approval and obtaining right of way for installing evacuation infrastructure	The government can support project developers in providing quicker evacuation approvals and assist developers in addressing ROW- related issues. Another option is that government can build evacuation infrastructure and the cost can be borne by the project developer.
Operations risk	• Reduced generation owing to frequent plant down time	There is a need for quality in project execution and O&M. Investors have to strike a balance between the capital cost of project and quality, in order to minimise the downtime during the life of the project
	• Generation not as per the projections	A good solar resource assessment (SRA) prepared using long-term data and quality information is required to predict the long-term PLF in a more accurate manner. Also, a good SRA reduces the generation uncertainty and is critical a document for lender or investor appraisal.
	• Curtailment of generation due to congestion in evacuation infrastructure	The states must plan evacuation infrastructure taking into consideration a long-term view of possible growth in generation and demand from consumers.

Commercial risk	• PPA risk- delay or default in payments	Strong payment security in the form of an unconditional irrevocable letter of credit or a bank guarantee can be taken from the buyer (state utility or OA consumer) in order to reduce any risks related to payments risk. It is important to evaluate the credit rating of the consumer before entering into a PPA.
	• Policy changes and change in revenues in OA-based models	Increase in OA charges after project commissioning can drastically reduce the net realisation, and therefore, affect the project viability. The government must ensure policy certainty and not change the policies or regulations which affect the viability of operational projects.
	• REC-based projects	Strict enforcement of RPO on utilities as well as other obligated entities in the states is required
Promoter risk	• Equity	Projects sponsors must secure the required equity for the project before approaching the lenders.
	• Track record and credit rating	Experience in successfully executing power projects along with experienced management can give comfort to the lenders Good credit rating of the promoters will be a positive factor in raising funds

It has been observed that financing of JNNSM-based and a couple of state projects have been easier when compared to others. This is because of the quality of PPAs and the generation performance.

Debt financing for solar thermal generation projects is observed to be relatively difficult given its lower installed base in the country. As per the industry, more support is required for solar thermal projects from the government, including providing finance till the capabilities and the required ecosystem gets built over the period of time in the country.

Most of the project risks are directly or indirectly related to the lack of supporting policy and regulations from the government. Strong policy support which can help in mitigating risks is required in order to enable easy access to cheaper finance to project developers

Owing to inherent risks in the development of solar as well as other renewable energy projects today few projects have raised finance on a non-recourse basis. Project developers are made to give securities as well as collaterals in the form of corporate or personal guarantee, bank guarantees and in some cases, hard collaterals such as land over and above project land and assets.

Debt financing

Unlike other renewable power projects, solar power projects have access to multiple sources of debt financing which include conventional long-term debt from banks and financial institutions, funding from export credit agencies and development finance agencies.

Sources	Details	Issues
Indian Banks and NBFCs	• Primary source of financing • Available for projects of various sizes	Higher cost of funds
Export credit agencies	EXIM banks of various countries have come forward to finance projects executed with equipment, sourced from their respective countries. These banks only provide debt to the tune of the amount equal to the imported items which form close to 40 to 50% of the project cost.	Remaining amount has to be raised from Indian banks Owing to increased volatility in the USD-INR exchange equation, the cost of hedging has reduced the competitiveness of foreign currency loan. Further, hedging is only available for larger size projects being developed by promoters with strong profiles.
Development finance institutions	Various Development Finance Institutions such as the IFC, OPIC, JICA, kfW, etc have financed solar projects in India at lower interest rates. (in USD terms)	Owing to increased volatility in the USD-INR exchange equation, EXIM funds are increased, thereby resulting in the net cost of debt increasing by 100 to 300 bps

Other financing strategies

Construction risk is considered to be most critical risk as per lenders and investors. The projects are considered to have a low risk profile after commissioning. Project developers therefore have an option to refinance the project with cheaper funds.

Developers with a good track record can also opt to issue long-term fixed rate bonds at the construction stage or during operations for refinancing. Government can also support by offering tax incentives on such solar bonds.

Post-commissioning, any good quality project under preferential tariff will generate annuity kind of returns. Considering the lower risk profile, future cash flows can be securitised and the money can be utilised to repay the debt or to invest in other projects.

Project developers in few cases have availed supplier credit which enables them to pay the equipment supplier in installments after commissioning. This strategy allows payment of the capital cost from the operational revenues. However, it has been observed that the duration of credit provided by suppliers have reduced over the period of time.

Equity financing

The country has seen increased investor interest in renewable energy industry. While wind energy sector being a mature industry has seen several equity deals, the solar industry has also attracted numerous investments.

Timeline	Target company	Investor	Deal type	Deal value (in million USD)	Segment
November 2013	NavSemi Energy Pte Ltd	Alpha Technologies	Acquisition	NA	Equipment
October 2013	Claro Energy	Minority stake purchase	Angel investors	NA	Solar Power Solutions
June 2013	A 5MW solar power project	Fortum	Acquisition	NA	IPP
January 2013	Megatech Power Equipments Pvt Ltd	Consul Consolidated Ltd	Acquisition	NA	Solar Power Solutions
January 2013	HHV Solar	Swelect Energy Systems Ltd	Minority stake purchase	3.99	Module manufacturer
June 2012	Sunborne Energy	NA	Minority stake purchase	5	IPP
February 2012	Eversun Energy	Tecpro Systems	Acquisition	NA	Solar EPC
February 2012	Enelek Power	Blue Circle Services Ltd	Acquisition	NA	Solar thermal solutions
February 2012	Alex Astral Power Pvt Ltd	Shree Ganesh Jewellery House	Acquisition	20.29	IPP
January 2012	Gadhia Solar	Zephyr Peacock Management India	Minority stake purchase	7.31	Solar thermal solutions

Source: ISI Emerging Market

Deals took place not only in the area of power generation, but also on the equipment and solutions side.

In order to have increased investments into the solar energy sector of the country, it is important to have low-risk, good quality generation projects backed by supportive policy and innovation along various segments of the value chain by the technology companies.

Financing of decentralised solar generation

Solar power generation can work as a decentralised solution, thereby maximizing the benefits for the consumer. Decentralised generation projects include rooftop or ground mount systems in the size of 1 kW to close to a MW being set-up to supply power to the industrial or commercial and retail consumers.

Various business models have evolved in the developed economies as well as in India, which are based on decentralised power generation through solar. Widely used business models are as follows:

- Set-up, own and operate for captive consumptions
- Projects set-up by an IPP within the premises of the consumer and energy sold through a PPA
- Solar generation assets are leased to the consumer for self-consumption under a financial lease or hire purchase

MNRE in the JNNSM scheme outlined financing support for decentralised power generation sources which is in addition to the capital subsidy. As per the scheme, MNRE through Indian Renewable Energy Development Agency Limited (IREDA) and other agencies such as the National Bank for Agriculture and Rural Development (NABARD), National Housing Board (NHB), Small Industries Development Bank of India (SIDBI), etc directly or through commercial banks (refinanced by IREDA, NABARD, NHB, SIDBI, etc) will provide loans, at not more than 5% to the approved projects.

Project developers can however opt for long-term debt from commercial banks through balance sheet funding. While the market size of the IPP model implementing the decentralised solar generation projects within the developed economies is matured, in India, the market is still in its nascent stage. The market will grow as more IPP-based decentralised generation projects come up, validating and improving the business models over the period of time.

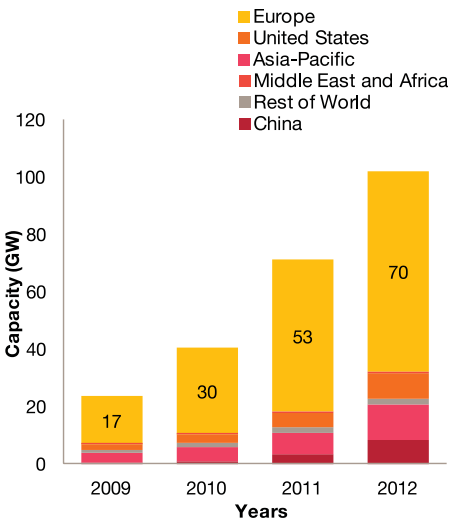
It is important from the lenders and investors perspective to have business models established in order to understand the risks and appropriately price the funds. Till that time, it is important for the government to continue supporting the decentralised power generation market with required funding.

Global outlook

Europe is highest solar installation with more than70 GW solar capacity by 2012, representing about 70% of the global cumulative PV capacity. Markets outside Europe China (8.3 GW), US (7.8 GW), Japan (6.9 GW), Australia (2.4 GW) and regions such as Africa, Middle East, South East Asia and Latin America are emerging with potential frameworks that may change the topography of solar power projects in the near future.

In contrast the segment being largely driven by feed-in tariff (FiT) based projects, presently and also in future market are likely to be structured based on business model that can drive regional price expectations to a level that makes solar power compete with fossil fuels.

Evolution of global PV cumulative installed capacity 2009 -2012 (GW)



Source: Global Market Outlook 2013, EPIA

Measures taken by market leaders to promote the solar sector

Japan

Details		Solar PV
Procurement category	10 kW or more	Less than 10 kW (purchase of excess electricity)
Tariff (per kW)	40.0 yen	42.0 yen
Duration	20 years	20 years

Japan approved its FiT scheme for renewable energy in 2011. This Act obliges electric utilities to purchase electricity generated from renewable energy sources (solar PV, wind power, hydro power, geothermal and biomass) based on a fixed-period contract with fixed price. Costs incurred in purchasing renewable energy sourced electricity shall be transferred to the electricity customers, who pay a 'surcharge for renewable energy' proportional to electricity usage.

China

As one of the largest markets for renewables in the world, China though slow to develop its own solar energy market, has quickly gained momentum and reached approximately 8.3GW by 2012 since its start in 2010. Early 2013, China raised its solar target for the fourth time in two years to 35 GW by 2015. At around the same time, China also announced a 10 GW installation goal for 2013.

Government subsidies for solar PV projects in China are granted through special programs, such as the PV Building Demonstration Programme, Golden Sun Programme and FiT.

In addition to the state council's policy detailed policies related to solar Feed-in-Tariff, tax incentives, development of distributed generation infrastructure and simplifying project approval procedures are announced.

Legislative measures like the Electricity Act (1996), Interim Regulation on the On-grid Tariff (2005), Renewable Energy Law (2006), Regulations on the Administration of Renewable Power Energy (2006) provide the basic framework for securing development and defining rules on pricing of renewable power and the relevant government subsidies in China.

The National Development and Reform Commission on Perfection of Policy in the second half of 2013 seeks revision of current FiT to encourage the development of solar PV in China.

Germany

Since inception in 2000, The Renewable Energy Sources Act promotes renewable energy notably solar PV, wind power and biomass through FiT.

The EU Directive[1] sets out an EU wide target of achieving 20% of the final energy consumption from renewables by 2020. Germany's final target is 18% by 2020.

In addition the country targets to achieve the following levels by 2020: Green house gas reduction (40% below 1990 level); renewable heat target (14% of thermal energy from renewable energy sources) and renewable energy target (30%). National Renewable Energy Action Plan (NREAP) targets 51.7 GW solar installations by 2020.

1990 - 1999

- **Stromeinspeisungsgesetz (StrEg), 1990:** PV receives 90% of retail electricity price (8.45 - 8.84 Euro cents per kWh)
- **100,000 roofs programme, 1999.** Receives interest free loan

2000 - 2004

- **2000: Erneuerbare Energien Gesetz (EEG):**
  PV receives 51 cents/kWh)
  350MW program cap
  5MW system cap for roof tops
  100kW system cap for free standing
- **2002:** PV cap programme cap raised to 1000MW
- **2004:** EEG amended
  New rates between 46 - 62 Euro cents per kWh Programme and system size cap removed

2008 - 2010

- **2008 - 2010:** EEG amended
- National FiT registry created

2011

- **Coridor revision proposal**

Module prices, internationally are generally not stable

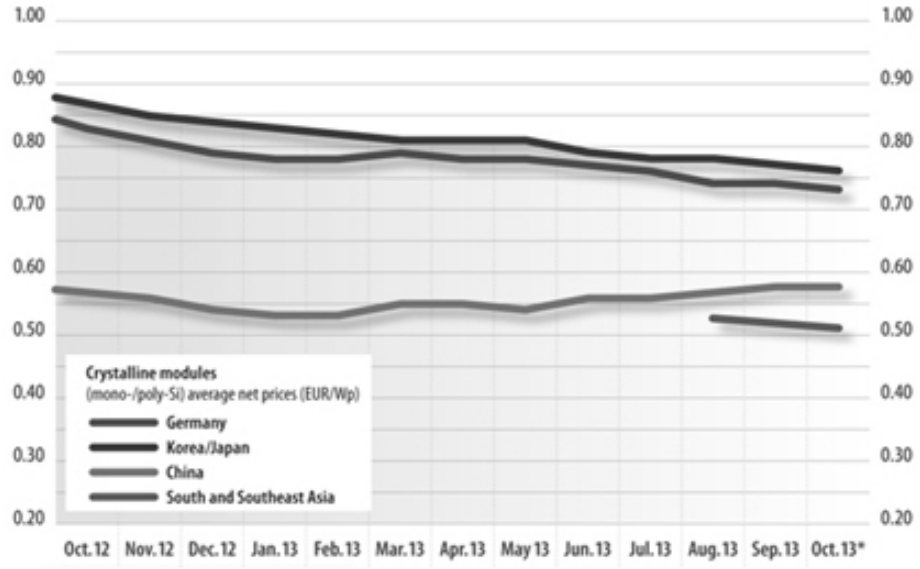
The real case for solar energy as a near term alternative to fossil energy is largely pegged on the view that the cost of solar energy have come down rapidly in recent years and will continue to do so in the coming years, largely dictated by the module prices.

As seen from the spot market price in the EU, though solar module prices have dropped substantially in recent years, much of the decline in recent years is due to overproduction and dumping from regions like China. However balance-of-system (BOS) and other costs that now represent a larger share of installed project costs can become the next barrier.

By October 2013, there are two price levels which are increasingly visible for module supplies from Asia - one for modules from Chinese production which is subject to the EU agreement and thus a restriction on imports; and the other one from the rest of Asian region – for which there are no regulatory barriers. Global supply chain for photovoltaic modules is seen to stabilise since third quarter, 2013 with the EU's anti-dumping tariffs on the Chinese solar modules driving up prices.

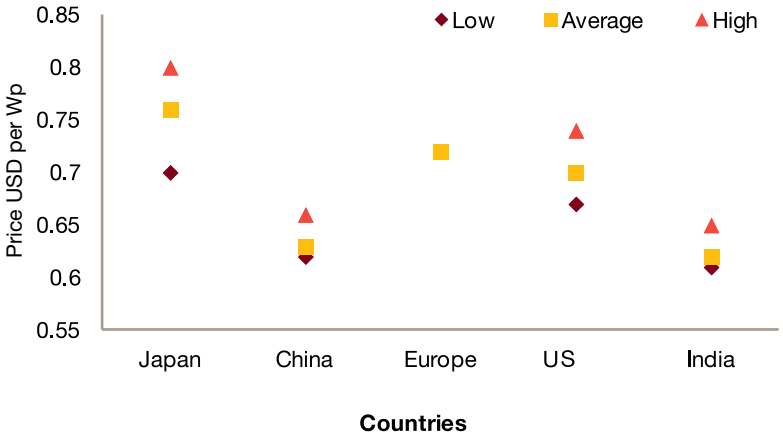
Such trade conflicts might mean low cost modules for commercial use may became scarce and the cost of solar energy components increase in the year 2014.

EU spot market module price trend (mono/poly) and average net price (Euro/Wp)



Source: pv-magazine

Module price USD per Wp by region - Qtr 3, 2013 Tier 1, Chinese supplier



Source: PVXchange

Can projects built in India continue to stand out from global competition?

With entry barriers to the EU, the strategy of global manufacturers appears to shift towards performance of the modules sold at similar prices and focus on service and the associated global operations cost. Overseas manufacturers might prefer to focus on enhancing their product and incorporate additional quality assurance measures in their manufacturing operations in order to ensure generation commitments. This means good quality modules comes at a price to projects in India.

However, lack of any major breakthrough in solar installation and developmental methods, technology improvements, procedural and deployment hurdles for large scale projects is likely to remain costly and labour intensive atleast with respect to India. It is increasingly becoming clear that modules below 250 Wp (for crystalline technology) are losing priority in utility scale projects in India. Reductions in cost can come incrementally, in response to scaling up of domestic solar manufacturing capacities and sustained subsidies in order to realise the full potential.

Scaling solar without heavy subsidies will require bringing both module and installation costs dramatically, significant breakthroughs in electricity transmission and evacuation, storage options and pursuit for centralised solar plants that can benefit from economies of scale and high irradiation, if specific locations with high insolation level are concentrated for development.

As a long-term strategy, developing better and cost competitive technologies, introducing solar subsidies may be justified. But heavily subsidised projects may not ideally represent a true strategy to replace fossil energy.

The need for a competitive ecosystem in India

Currently, the total solar PV module production capacity in India is approximately 2 GW while the cell manufacturing capacity is around 850 MW. Bulk of India's solar PV industry is dependent on imports of critical raw materials as well as components, including silicon wafers.

Most Indian companies are either standalone module companies or standalone cell companies (for example, Jupiter, Indosolar, Euro Multivision). Few companies are into both cell as well as module production (for example, Tata Power Solar, Moser Baer, Websol). Presently, some companies are attempting to have their presence in the upstream wafer manufacturing and poly-silicon production, but the capacities are insignificant and projects are met with delays. Due to lack of integration, Indian companies do not have the leverage to keep their manufacturing costs down. The top Chinese manufacturing companies alone have a module and cell production capacity more than the total installed capacity in India. Due to this scale, these large companies are able to reduce their unit costs by significant levels.

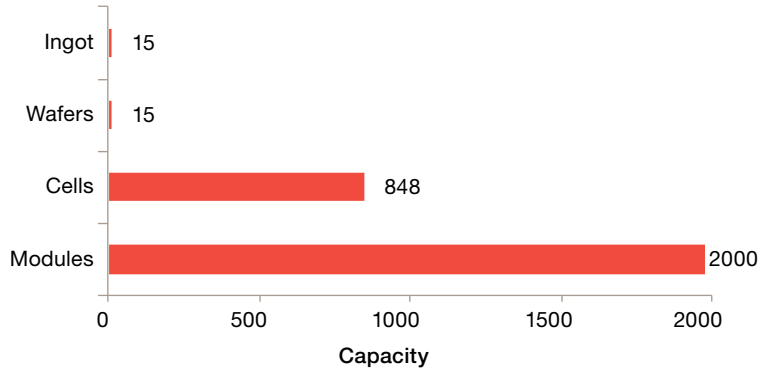
Solar modules have been priced aggressively in the global market, below the level which can be supported by the domestic manufacturers, resulting in under- utilisation of domestic capacity. The huge capacity build-up by Chinese manufacturers resulted in serious demand-supply imbalance in the global PV market. Over 50 solar PV companies announced bankruptcy or exit the solar market globally (key players include Bosch, Siemens, Q Cells, Solyandra, Siemens, Abound Solar, Conergy, etc.).

Transforming India into a solar energy hub will include a leadership role in low-cost, high quality solar manufacturing, including balance of system components.

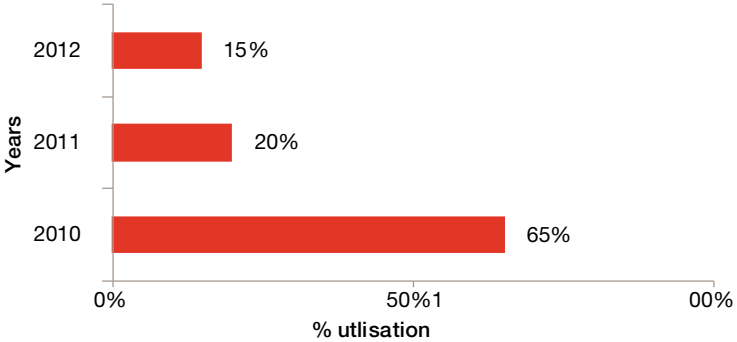
Conducive policy initiatives: A boost to India's manufacturing sector is required given the competitive global manufacturing market, positioning India as a manufacturing hub requires developmental goals, support from the central as well as state government, enhancement of technology and investment in R&D initiatives, pipeline of future projects that gives opportunities for domestic manufacturers to compete in the global landscape.

In support of a strong domestic manufacturing sector, inspite of policy directives and incentives at the central and the state level, no large scale development has taken place in solar photovoltaics and solar thermal manufacturing, largely due to the focus on specific segments of the ecosystem, like generation projects.

Domestic solar PV manufacturing capacity (MW)



Domestic manufacturing capacity utilisation (%)



Source: Market Research

Policies stimulating solar manufacturing ecosystem

Semiconductor Policy, 2007

The Semiconductor Policy announced by the government of India in 2007 provides a special incentive package to attract investments for setting up semiconductor fabrication and other micro and nanotechnology manufacturing industries. The incentives are for all semiconductors not only those exclusive to solar photovoltaic's and solar thermal technology.

A key benefit is the grant of the SEZ status. The special incentive package shall be available as per the SEZ Policy.

Karnataka Semiconductor Policy 2010

The government of Karnataka through the Karnataka Semiconductor Policy 2010 has given an impetus to the growth of semiconductor industries in the state. The policy specifically encourages and provides assistance to solar PV manufacturing units under the Karnataka Renewable Energy Policy.

Highlights of the policy include the following:

- Location of land with access to infrastructure such as ports and airports in close proximity; Karnataka Power Corporation Limited (KPCL) and KREDL also taking steps to develop solar farms on JV and PPP mode in districts such as Bijapur, Gulbarga, Raichur and Bellary
- Fiscal incentives to micro, small, medium manufacturing enterprises (MSMEs)
- Exemption of stamp duty for MSME, large, mega projects (100% for Zone 1 and Zone 2; 75% for Zone 3)
- Exemption from entry tax (ET) (100% exemption from payment on plant and machinery, capital goods, for the first three years from the commencement of project implementation; on raw materials, inputs, component parts and consumables for five years from the commencement of commercial production)
- Interest subsidy for micro manufacturing enterprises: interest at 5% on term loan
- Hundred per cent exemption of electrical duty and tax for three to five years

Indian government incentives for semiconductors

Types of unit	Threshold NPV of investments	Incentives in SEZ	Incentives in non SEZ
Fab unit	2500 crore INR	20% of capital expenditure	25% of capital expenditure + exemption from countervailing duty
Eco system unit	1000 crore INR	20% of capital expenditure	25% of capital expenditure + exemption from countervailing duty

Andhra Pradesh Electronic Hardware Policy 2012-2017

Andhra Pradesh has instituted a policy to promote electronics, including solar PV modules and cells.

Highlights of the policy are as follows:

- Hundred per cent reimbursement of stamp duty, transfer duty and registration fee paid on sale, lease deeds, mortgages and hypothecations on the first transaction
- Two and a half per cent reimbursement of stamp duty, transfer duty and registration fee paid on sale, lease deeds, mortgages and hypothecations on the second transaction
- Admissibility of industrial power category tariff
- Four and a half per cent to micro, 40% to small, 25% to medium and 10% to large-scale industry limited to 30 lakh INR of power subsidy on power bills for a period of five years from the date of commencement of commercial operations
- Reimbursement and grant of 50% exhibition subsidy for participating in national and international exhibitions limited to 9 sq m space
- Twenty per cent investment subsidy limited to 20 lakh INR for micro and small industries and additional 5% incentive subsidy for women, SC, ST entrepreneurs
- Three per cent interest rebate limited to 5 lakh INR per year for five years
- Ten per cent subsidy on new capital equipment for technology upgradation limited to 25 lakh INR as one-time availment by the eligible company
- Fifty per cent subsidy on the expenses incurred for quality certification limited to 4 lakh INR [Conformity European (CE),China, Compulsory Certificate (CCC), UL Certification, ISO, CMM Certification, SA, RU, etc]
- Twenty-five per cent subsidy on cleaner and green production measures limited to 10 lakh INR
- Hundred per cent tax reimbursement of VAT and CST, for the new units started after the date of issue of this policy, for a period of five years from the date of commencement of production for products made in AP and sold in AP
- Twenty-five per cent rebate in land cost limited to 10 lakh INR in industrial estates, industrial parks, SEZs, hubs, parks and clusters
- Fifty per cent reimbursement and grant of cost involved in skill upgradation and training the local manpower limited to 2,000 INR per person

Tamil Nadu Solar Policy 2012

Tamil Nadu Solar Policy provides added incentives to attract and encourage solar manufacturing in the state. The policy states that capacity of about 1000 MW/ annum of local manufacturing will result in direct and indirect job creation. Highlights of incentives are as follows:

- Appropriate tax incentives as per Tamil Nadu Solar Policy
- Creation of solar manufacturing ecosystem that includes solar research centres, test facilities, resource assessment facilities
- Exclusive solar manufacturing parks in the state and preference in existing industrial SEZs

In sum, support to manufacturing is important to set the platform for solar power to play an important role in meeting energy security and clean energy considerations of India. Domestic content requirement in JNNSM Phase II Batch I for 375 MW by the government of India is seen as an encouragement for local manufacturers. Yet, the need of the hour is to ramp up domestic manufacturing facilities in for the next few years.

Further upstream, cells, wafers and poly-silicon will not see much growth unless there is strong drive from the government through policy and regulatory support. In addition, the state governments can identify potential sites for developing solar parks with basic infrastructure in place.

Key areas that policies can look into include:

- Priority sector lending status for solar manufacturing, to promote investment in manufacturing and access to debt funding
- Access to lower cost funds to improve the cost competitiveness of the domestic players
- Provision of land and suitable infrastructure including reliable power supply to house the entire manufacturing eco-system (wafers, cells, modules and balance of systems).

A vertical integration in the manufacturing process, from sand to module, lowers the production cost. India today does not have this advantage and is largely dependent on imports for crucial materials such as silicon wafers, encapsulating material and high transmission glass. The key challenge is the imposition of import duty on input items in the manufacturing process of solar cell and modules, whereas there is no import duty on finished solar equipment (solar modules).
To make the country a manufacturing hub, policy must decide its objective: to drive a market that is import driven or create a robust domestic manufacturing base.

Building projects based on sustainable technology choices

With increase in retail tariffs and decrease in solar panel costs, solar projects are becoming cost-competent to retail supply tariff in selective states, but to be commercially viable, technology should achieve higher efficiency levels at current cost, maximize generation from existing capacities and should improve operations and management practices.

Technology selection best suited to the requirement

The best technology for a solar power plant depends on the specific application and the requirement. A broad variety of technologies is expected to continue to characterise the technology portfolio, depending on the specific requirements and economics of the applications–tariff structure, meteorological conditions, land availability, evacuation levels, future aspirations of policymakers and others.

Crystalline vis-à-vis thin film technology: Both crystalline as well as thin-film technologies have gained significant traction in the last few years and have come out as proven technologies. In India, both the technologies have fairly equal installations. In the Indian environment, the effect of dust, soiling, climate and degradation are crucial factors for the success of any technology.

Solar thermal technology: Concentrated solar power (CSP) is advantageous in that it is utility scalable technology, is dispatchable and is firm RE option. With the inherent energy storage capability in the form of heat that can be used to generate electricity up to hours later and with further support from additional thermal storage systems or a hybrid system design, CSP plants can continue to produce stable electricity even when cloud block the sun or the sun sets. So it is much less challenging to integrate CSP than wind or PV generation into power systems. Although CSP has better performance for grid integration, but is relatively challenging technology and current high cost limit its large-scale deployment. One disadvantage of CSP is that it requires strong direct sunlight. As a result, adequate CSP resources are generally limited to semi-arid, hot regions or deserts. In particular, India does not have conducive ecosystem for the development of CSP because very less projects have been undertaken with this technology.

Concentrated solar power (CSP) could have a unique role in India's energy mix with its potential be hybrid and its ability to easily add storage could unlock dispatchable and base-load power, setting the stage for larger renewable energy penetration.

Solar trackers: Optimising the energy produced and making the most of scarce resources such as land have become increasingly important as developers look for higher profit. Solar trackers which move the panels to follow the trajectory of the sun can increase solar power production by up to 25% compared to a fixed-tilt system. Projects based on trackers have been implemented in India under the JNNSM scheme and it is to be seen with further localisation how IPPs and developers will deploy projects based on trackers with programmes demanding higher PLF.

Localisation: A solution to the manufacturing sector for solar power generators

Capital costs of solar installations have fallen drastically in the last five years. This has seen many states adopt the technology. Economies of scale, technological innovation and the learning curve affect the attempt to drive costs further down.

It may be noted that within the overall system costs, the proportion of non-module system costs is increasing. In fact, the cost reduction possibilities in the non-module segment of system costs could well determine the timing of grid parity. The cost reduction trends for non-module system costs can be achieved through low-cost financing, local sourcing of materials, localised assembly and production of invertors.

Accelerating R&D initiatives to make technology competitive

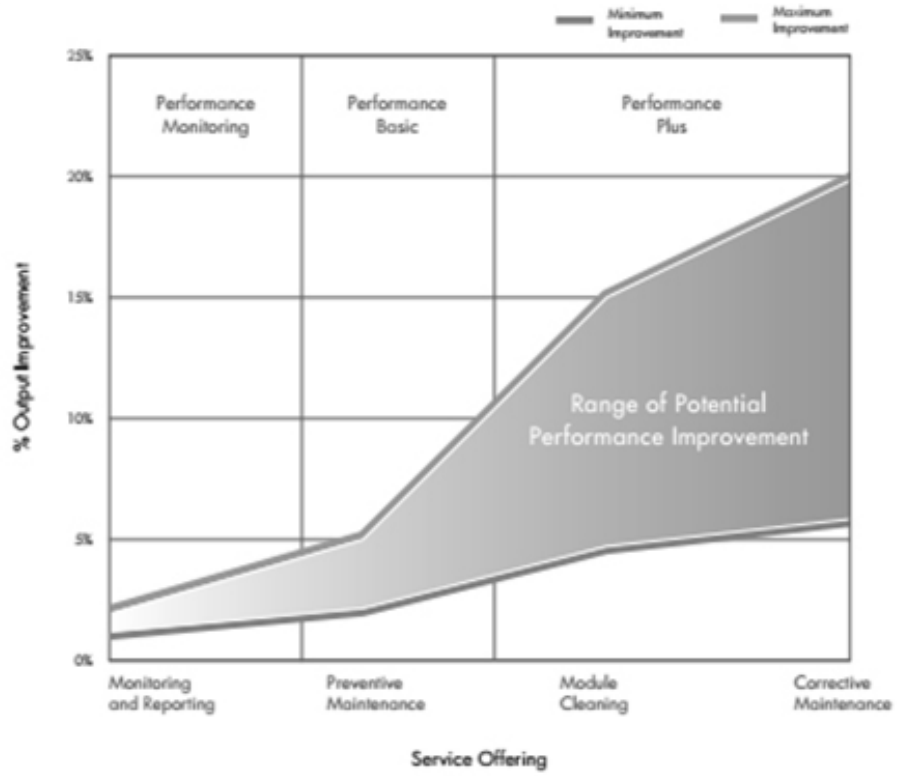
With the aim of achieving further significant cost reductions and efficiency improvements, R&D is predicted to continuously progress in improving existing technologies and developing new technologies. Currently, innovation in the solar sector is happening in developed parts of the world such as the US and Europe. Slowdown in Europe will reduce further innovation. The US has been able to identify a significant amount of shale gas reserves which can be made commercially available at around 3 USD per mmbtu. There is less incentive for them to invest in solar which is relatively costlier than the newly found shale gas reserves. On the other hand, India which is struggling to source coal and gas required for conventional power plants has to depend on imports and has no option but to get the most out of wind, solar and other renewable technologies. The country needs to support and gain leadership in terms of innovation in solar technologies.

R&D for the indigenisation of technology and quality standards for both manufacturing as well as solar project implementation most suited to India should be undertaken to focus on optimising energy generation from existing devices and applications, reducing integration and other plant BOS costs, and improving efficiency of generation devices.

Considering solar can provide options for storage, the focus should also be on developing cost-effective storage technologies which would address both variability and storage constraints, through the use of better and improved materials.

It may be noted that the Indian Institute of Science (IISc), Bangalore and the National Renewable Energy Laboratory (NREL), Golden, Colorado, USA have undertaken the project for SERIIUS, the Solar Energy Research Institute for India in order to accelerate the development of solar electric technologies by lowering the cost per watt of photovoltaics (PV) and concentrated solar power (CSP). There needs to be increase in such initiatives and efforts in order to commercialise such developments.

Range of improvement in output through O&M



Source: SunPower

Effective operation and maintenance

Like any other project, solar power projects require higher plant uptime to consistently operate at peak performance. System monitoring, preventive maintenance, maintenance of critical spares and addressing repairs are crucial for a plant owner, to reduce downtime and derive maximum value over the lifetime of the installation.

Operating a solar plant entails managing a broad variety of elements including plant performance and reliability, safety and risks, spares and receivables, generation guarantees and warranty enforcement.

As we understand, maintenance regimes play a critical role in solar power projects. While corrective maintenance regimes remain common in practice, preventive and condition based maintenance strategies represent a growing trend. It's estimated that by usage of Tier 1 module supplier for development of solar project can increase the generation upto 15%.

In India, realising this critical aspect, some IPPs and EPCs have invested in house teams in order to standardise O&M practices across their facility portfolios and are working to systematise remote monitoring and efficiently identify, diagnose and resolve problems across a wide portfolio of systems.

As the solar industry struggles with the uncertainty in panel pricing, it is turning to the optimisation of system energy output in order to make the economic case for solar power projects an attractive investment.

Securing and diversifying the energy mix by distributed generation

Distributed generation (DG) refers to electricity produced at or near the point of consumption. For a large and dispersed rural based country like India, decentralised power generation systems offers a better solution.

Distributed solar energy can be located on rooftops or ground-mounted, and typically connected to the local utility distribution grid, thereby avoiding transmission and distribution costs. Solar PV is ideal for small-scale projects, and also for places without access to electric grid.

Government policy initiatives

The government of India has adopted an integrated energy policy which aims to provide energy security to all its citizens through conventional as well as alternative sources of energy. Some of the policies adopted by the Indian government are as follows.

- The Electricity Act, 2003 has given a thrust to distributed generation particularly in the context of rural electrification. The Act specifies distributed generation and supply through stand-alone conventional and renewable energy systems.
- The National Electricity Policy recommends under the rural electrification component, that to provide a reliable rural electrification system, wherever conventional grid is not feasible, decentralised distributed generation facilities (using conventional or non-conventional sources of energy) together with local distribution network be provided.
- Two specific schemes, the Rajiv Gandhi Grameen Vidyutikaran Yojna and the Remote Village Electrification Scheme, will provide up to 90% capital subsidy for rural electrification projects using decentralised distributed generation options based on conventional and non-conventional fuels.
- The JNNSM policy document mentions implementation of 2 GW of solar rooftop installations by 2022. JNNSM Phase II also promotes off-grid solar especially for improved energy access for remote areas, encouragement of heating and cooling applications, replacement of diesel and kerosene, distributed generation, industrial process heat applications, solar water irrigation pumping systems, etc. The policy target is as follows:
  - Twenty thousand villages, hamlets, bastis and padas to be electrified by deployment of off-grid electricity generation projects
  - Deployment of around 10 lakh off-grid lighting systems
  - Development of solar cities as well as inclusion of more
  - Deployment of 25,000 solar pumps by the end of FY 2017
  - Deployment of around 25,000 solar integrated telecom towers
  - Target of 15 to 20 cities where solar water heaters will become the main source of heating water replacing electric geysers
- SECI is promoting rooftop programme by conducting competitive bidding has already allotted 5.5 MW in four cities in the Phase I of the rooftop programme in April 2013. The SECI has also invited bidders to take part in the allocation process for 11.1 MW in six cities in Phase II. The bidder has to quote a cost in INR/Wp terms based on which the SECI will provide a capital subsidy of 30%.
- MNRE also promotes off-grid through subsidy schemes where it provides 30% of capital subsidy of the benchmark costs for rooftop applications (100 MW a year), and also through 'solar cities' which aim to reduce 10% of city dependence on conventional energy at the end of five years.
- Distributed generation projects can also avail accelerated depreciation benefit, wherein they can avail 80% depreciation benefit in the first year of operation.

- Further, all southern states are promoting rooftop and distributed generation projects:
  - The Tamil Nadu Solar Policy aims 350 MW of rooftop capacity in three phases of 100, 125 and 125 MW (per year) during 2013-2015. Apart from this, the state will also implement 300 MW from government buildings and government schemes for rural and urban lighting.
  - Kerala launched its 10,000 rooftop power plants programme for 2012-2013. Apart from the MNRE's 30% capital subsidy, the state is offering a discount of 39,000 INR per system. The unique aspect of the programme is that the policy support is completely for off-grid PV systems, whereas all other programmes in the country have opted for a grid-tied system.
  - The KREDL along with the SECI is implementing 1297 numbers of 0.5kW and 646 numbers of 1kW grid connected rooftop systems in Karnataka.
  - Andhra Pradesh has also announced its intention of promoting rooftop solar systems through a net-metering mechanism. NEDCAP, the state nodal agency is also helping in bringing awareness for solar distributed generation, solar lanterns, etc.

Need to prioritise in-situ generation for self-consumption with a net-metering approach

Countries such as the US, Japan and Germany have high rooftop solar installations and are estimated to meet as high as 20% of their total electricity requirement from solar rooftops.

States such as Gujarat and Karnataka have been promoting solar rooftops with feed-in-tariffs. Cities are experimenting with policies to encourage distributed solar to offset peak electricity demand and stabilise the local grid through rooftops. Though it puts the additional challenge of monitoring and verification on distribution utilities, states have now come up with the solar rooftop policy of self-consumption with net metering policy to help the seamless integration of the technology with the grid.

With net-metering, consumers can install rooftop PV and first use the solar generation for their own consumption, and feed in only excess rooftop PV generation into the utility grid. They will continue to draw their power requirement from the grid as and when needed. Consumers with high tariffs and high energy use will benefit most from it. Bill savings from such avoided costs will determine the viability of rooftop PV with net metering.

Rooftop and decentralised generation projects with net-metering support allow southern states to deal with a high-deficit situation apart from offering other benefits:

- Decentralised generation can be set up in various sizes by retail, industrial or commercial consumers as rooftops for captive consumption and sale of excess power through net metering.
  - Consumers can also get relief from R&C measures and load shedding by establishing decentralised solar projects in states such as Tamil Nadu and Andhra Pradesh.
  - Solar generation is higher in summer when the power deficit is generally high and is more predictable than other infirm renewable energy sources.
- Decentralised generation can also help to meet demand in remote locations and villages, where grid connected power is not available. These solutions can especially benefit agricultural consumer in rural areas.
- Decentralised generation gets consumed locally without significant T&D losses. This helps offset transmission and distribution equipment needed to deal with new load behaviour and rising electricity demand (e.g. congestion).
- Solar heating solutions can displace some electricity and fossil fuel based heating solutions. Distributed solar system can decrease the dependency on diesel gen-sets, which are used by most industries connected to grid power due to unreliability use.
- It reduces land otherwise required for utility sized project.

Need for a robust, coordinated and inclusive approach

Given the immense market potential of rooftop and distributed generation applications, an integrated approach that involves seamless collaboration among partners across the value chain is important. The following will need specific focus:

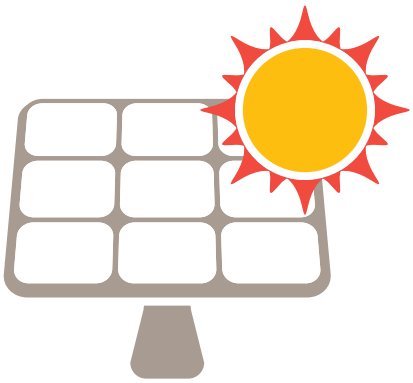
- National Building Codes need to have the framework for the establishment of green buildings, in order to make it mandatory for buildings to implement solar application with proper standards and guidelines.
- Until now, the most preferred route for distributed solar PV has been the corporate financing route. However, with the expected large-scale adoption of captive solar PV power plants, both project finance and asset finance routes can be expected to come into place.
- Unlike large-scale projects, the decentralised market will require solutions that have to be developed based on customer requirements and setting up logistical infrastructure to reach the customer. For example, a solar rooftop solution that provides quality performance at lowest possible costs at the consumer end is the need of the hour.
- Energy-efficient design standards that include building integrated PV (BIPV) into building architecture to generate electricity, allow entry of natural light and provide heat insulation are needed.
- Innovative solutions such as solar walls for drying and heating applications in many agro-processing industries work both as a standalone system as well as a preheat to traditional mechanical operations. Such systems reduce our dependence on fuelwood or fossil fuels required for drying.
- Standalone, off-grid street lighting with built-in automated controls for remote application can provide reliable outdoor lighting for streets, villages, open spaces, etc.

Enabling frameworks will ensure a sustained push for the solar sector

The developer-centric Indian solar market challenges the role of the policy and regulators, leading to an approach that has to consider choices at every level of the market. The health of the industry can improve if focus is kept on the sector ecosystem.

Given the severe power shortage in southern India and R&C measures forcing industrial consumers to look for alternative sources of energy, it is imperative for all four states to encourage investments in both grid connected utility scale as well as rooftop and decentralised solar energy projects through continuous policy support to encourage innovation in the sector.

Solar power projects have come a long way what with the cost of solar PV systems considered to be barrier to PV adoption on a decreasing trend and technology improvements taking place, they have become economically competitive. As a long-term strategy to develop better and cost competitive technologies, introducing solar subsidies may be justified. But heavily subsidised projects may not ideally represent a true strategy to replace fossil energy.



Effective implementation of central and state policies

While the NSM catalyses solar energy growth and as the mission steps into Phase 2, appreciation for the unique roles solar PV (utility scale / distributed generation) and CSP can play in the energy mix are key to the development of each technology.

Solar power's ability to easily achieve scale and commissioning timelines coupled with the potential to add storage options can unlock dispatchable and base-load power, setting a stage for larger penetration if fundamental policy and regulatory measures are undertaken and supported at the state level.

The southern states have introduced policies and set optimistic targets for capacity addition, but implementation awaits policy directives. Andhra Pradesh, Karnataka and Tamil Nadu were expected to be the key market drivers for new installations in 2014. If PPAs can be signed for the allocated capacities in these three states, the planned capacities can be quickly commissioned. Similarly, if policy guidelines are implemented effectively, larger interest can be generated among investors.

Initiating steps to improve the solar eco-system within the states

Each technology has its own advantages. From the context of the Indian market, technology improvement and cost reduction can be structured to drive primary factors--localisation, economies of scale, manufacturing innovations, R&D and technology improvements, increasing efficiency and reducing cost.

Overall, solar PV system costs are also driven by factors such as exchange rate fluctuations and interest rates. With an increase in the cost of imported elements in the solar PV system, the impact of any exchange rate depreciation will have an adverse impact on overall system costs and the resultant power tariffs. Specific localisation support initiatives will reduce such exposures.

Enabling the open access market

While various incentives are offered to support solar energy procurement through OA mechanisms, the following aspects may be better addressed in order to mobilise investments.

- Investors setting up projects for the supply of power under OA mechanisms are concerned about the certainty of applicable OA charges for the life of the projects. Any rapid change in the OA charges or banking facility after commissioning will affect the viability of the project. Communications regarding certainty of applicable OA charges for the life of the projects can help take investment decisions.
- Consumers procuring under third-party and group captive mechanisms are unable to draw energy during scheduled and unscheduled power-cuts and when R&C measures are imposed. Consumers are required to have dedicated feeders to continue to draw the energy. It is difficult for every OA consumer to have dedicated feeders. States may structure mechanisms that allow OA consumers to continue drawing energy.

Land and infrastructure

Solar policies of Tamil Nadu, Andhra Pradesh and Karnataka state that the responsibility to acquire land for any project lies with the developer. Land availability being a major challenge for developers, government support in obtaining clearance will be a major motivator for developers to set up solar plants. Respective governments can endeavour to suitably identify land to be offered to developers and facilitate acquisition for grid connected solar installations.

Overcoming grid connectivity issues

The southern states are facing hurdles in obtaining evacuation approvals for large-scale deployment of capacities (solar parks). Securing load flow approvals, ROW and clearances is causing delays in project execution and increase in the cost for developers. Industry expects support from relevant transmission and distribution utilities as well as state nodal agencies in creating required evacuation infrastructure.

With southern states facing huge power deficits and R&C measures forcing industrial consumers to look for alternate sources of energy, the time is right for the solar energy segment to take off. Initially, the high cost of solar PV systems was considered a barrier to PV adoption but with cost of PV systems decreasing and the cost of diesel fuel increasing, PV systems are becoming economically competitive. Also, a significant demand in southern states comes from the capital cities where most of the load centres are located. Here, decentralised energy systems can play a role in reducing the dependency on grid connected power. Thus, a shift of focus towards the use of solar power will help industrial and domestic consumers gain access to power even in peak consumption time.

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