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Challenges in Solar Power Development in India

Introduction

It always comes as a surprise to non-specialist observers that, despite the fact that India has 300 days of sunlighton average, solar power plays an almost insignificant role in the Indian energy mix. What they fail to see is the technological, financial, institutional and structural complexity that needs to be mastered to harness this seemingly simple and environmentally benign source of energy as the Jawaharlal Nehru National Solar Mission (JNNSM or NSM) launched by the government of India in 2010 clearly demonstrates. At the industry level, the NSM has given the initial boost the industry requires but many key issues concerning data, technology and finance need to be addressed. At the broader strategic level, it is not clear what objectives India seeks to achieve in committing to invest a significant sum of its scarce resources in the solar sector. The NSM states that it aims to 'scale up deployment of solar energy keeping in mind the financial constraints and affordability challenge in a country where large numbers of people do not have access to basic power and are unable to pay for high cost solutions. What remains missing in the statement are the strategic goals such as the development of a globally competitive solar manufacturing industry or the provision of decentralized energy services to the poor who cannot afford to pay for high cost energy. For the NSM to have a clear direction, these objectives must be clarified at this early stage of the mission.

Background

The grid-connected capacity (all Photovoltaic) in India stood at 37MW in July 2011, which is only 13MW more than the installed capacity at the beginning of the year. Though small, this is progress and the pace of progress is likely to increase in the next few years. The solar industry is set to grow significantly in the next ten years, driven mainly by the ambitious NSM, various state level initiatives, Renewable Purchase Obligations (RPOs) as well as by falling technology costs.

The NSM targets an installation of 20GW of grid-connected and 2GW of off-grid solar power by 2022. In the first of a total of three phases, from 2010 to 2013, the governmentaims to set up 1,000MW of grid-connected power plants, encouraging the more developed Photovoltaic (PV) technology as well as Concentrated Solar Power(CSP) equally with 500MW each[1]. In addition, 200MW of off-grid and 100MW of tail end and other small-grid solar power are to be installed[2].

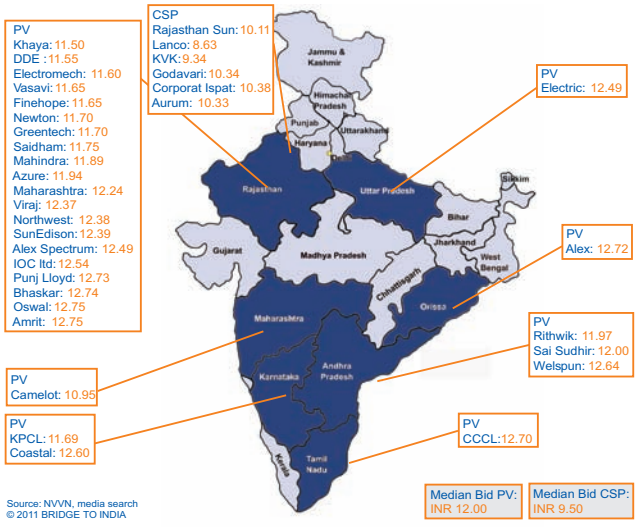
Encouraging the spread of solar power generation (both CSP and PV) and aiming for grid-parity (currently at around INR 5 or $0.12 per kWh) by 2022 and parity with coal power generation (currently at around INR 4 or $0.10 per kWh) by 2030, is a key element in India's comprehensive, long term energy supply strategy. As of December 2010, solar power generation in India costs around INR12 ($0.30) per kWh, or over three times as much as power from coal. At the moment, bankability remains a key challenge for projects as they try and obtain non-recourse project finance. Indian banks are still on a learning curve as they are yet to fully understand solar technology in India. They are unconvinced about the reliability of the technology and are skeptical about plant

performance and profitability.International banks are wary of the significant market risks and have adopted a 'wait and watch' policy leaving most of the early risks to the Indian banks.

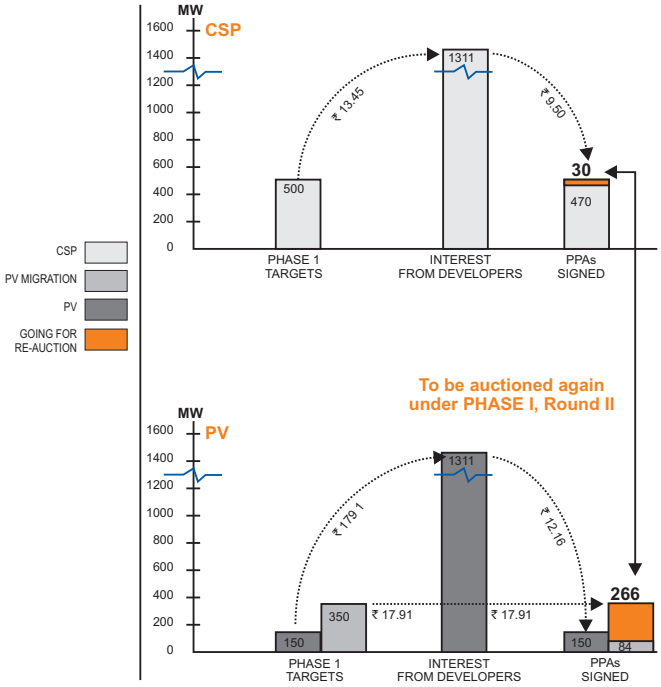
For the financial year 2010-2011, the government originally offered a feed-in tariff of INR17.91 ($0.44) per kWh for PV projects, rooftop projects as well as projects migrated from previous incentive programs to the NSM, and INR15.40 ($0.38) for CSP. Power Purchase Agreements (PPAs) would have a validity of 25 years. In June 2010, the Central Electricity Regulatory Commission (CERC) estimated that the tariff would allow investors an internal rate of return (IRR) on equity of about 16-21% after taxes[3]. On September 18th 2010, the application deadline for projects under the first phase of the NSM, more than 400 project developers put forward bids for the 650MW on offer. Of this, 150MW was for PV generation and 500MW was for CSP. The maximum size for a CSP bid was 100MW and for a PV bid 5MW. Given the oversubscription of the first round for projects, the governmentdecided to award contracts based on competitive bidding to those project developers that offered the highest discount on the initial tariff of INR 17.91 ($0.44) for PV and INR 15.40 ($0.38) for CSP. Companies offering the highest discount to the tariff rate prescribed by the Central Electricity Regulatory Commission (CERC) were selected to produce 620MW under the first phase. Thirty projects worth 150MW for PV and seven projects worth 470MW for CSP were selected.

The first phase of the NSM has a target of 1,000MW of installed capacity by 2013. PPAs worth 234MW for PV (including migration projects worth 84MW) and 470MW for CSP have been signed so far. The NTPC VidyutVyapar Nigam Limited (NVVN), the governmentagency implementing the Mission, is set to allot the remaining capacity of 296MW in the next months, though the exact date is unknown.

Overview of FIT in INR of 37 JNNSM bid winners (all PV-projects of 5 MW)



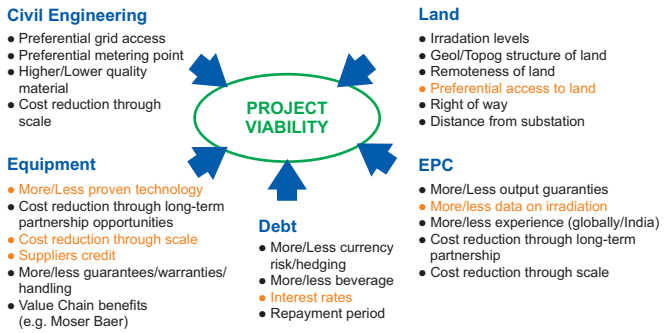
NSM First Phase: Projects available in Round II



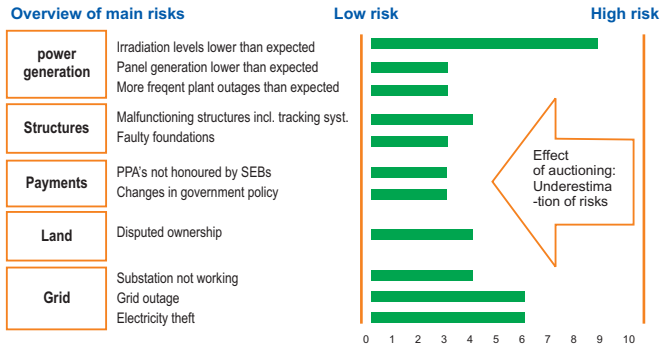
According to the MNRE, competitive bidding in Round 1 allowed them to achieve a 30% reduction in costs from lower tariffs. As a result, this round too will likely be allotted through an inverse bidding auction. This is despite criticism from the industry that bidding leads to a competitive environment that favors players with a short-term, capex-focus over more serious, long-term, generation-focused players. For this second batch of Phase 1 of the NSM, the governmentis considering allotting PV projects of up to 25MW per project with the minimum capacity remaining at 5MW[4]. If finalized, competitive bidding could see greater participation by larger companies which can execute and finance larger projects and reduce costs through scale effects (especially in project development and financing). Also, for banks and export credit agencies such as KfW-IPEX, larger projects are easier to finance as higher investment volumes allow for a commercially viable, thorough due-diligence process. Previously, they have stayed away from the NSM projects as the 5MW project size did not justify their transaction costs.

There is a risk that the bidding process has led to an overly optimistic assessment of the many imponder-ables in the market. These are, for example, the actual on-site irradiation or the performance of plants under Indian conditions. A fear echoed by some leading industry experts is that developers have underestimated costs, risks and the complexity of setting-up solar power plants. There is also a danger that as a result of the highly competitive auctioning process, project quality will suffer and plants will not generate the estimated amount of power.

Main Levers for making projects to be viable



Source: Expert interviews, BRIDGE TO INDIA analysis



The Photovoltaic Segment

For PV, the highest discount offered on the CERC tariff in the auction of the first batch of the first phase of the NSM was INR 6.96 ($0.17) per unit and the lowest successful discount was INR 5.15 ($0.12) per unit[5]. The tariff range is INR10.95 to INR12.76 ($0.27 to $0.31) per unit with an average tariff of INR12.16 ($0.30) per kWh. With a 32.1% fall, the new tariff is significantly lower than the feed-in-tariff announced by CERC earlier in the year. Some of the successful bidders include well known players such as SunEdison, Azure Power Rajasthan, Mahindra Solar One and IOC Ltd. However, most of the successful bidders are less well-known companies. The promoters behind these companies are unknown. Some of the larger industrial houses were not awarded projects as they did not bid aggressively. A possible reason is that the 5MW cap on projects made them too small to be of any interest. Such companies are instead looking at 10-15MW size projects available under state programs. A total of 21 successful NSM bids are for projects in Rajasthan. Eight of these are for a single district, Nagaur, followed by five in Jodhpur and four in Jaisalmer. Other projects are located in the states of Tamil Nadu, Andhra Pradesh, Karnataka and Maharashtra[6].

Selection of PV projects under the first phase of the NSM does not require any technical experience of the project developers, as companies are not assessed on the basis of their expertise in solar project development. Instead, the policy requires a bank guarantee of INR3m ($75,000) per MW as well as unconsolidated, audited annual accounts for the last four years as evidence of the net financial worth of the companies. As a result, a number of unknown players have been allotted projects.

Concentrated Solar Power Segment

The challenges to CSP projects are more severe than for PV. There is no domestic manufacturing base for CSP equipment in India and there are only a handful of experienced technology providers abroad. As such, developers are finding it difficult to find reliable, low-cost options, a necessity to make their projects viable at the low tariffs following the NSM auction. With an absence of CSP technology in India and a lack of projects for reference, banks are exceptionally wary of funding CSP projects.

For CSP projects, the highest discount offered was INR 4.82 ($0.12) per unit and the lowest successful discount was INR 3.07 ($0.07) per unit[7]. All CSP projects have made use of accelerated depreciation of 80% in the first year. The base feed-in-tariff before the discount was INR 13.45 or $0.33 (without accelerated depreciation the feed-in-tariff was INR 15.40 or $0.38). The new tariff range taking into account accelerated depreciation is therefore INR 8.63 to 10.38 ($0.21 to 0.25) per unit. With an average tariff of INR 9.50 ($0.23) per unit, the new tariff is 29.3% lower than the original base feed-in-tariff.

In spite of the recent rise of the CSP industry, both globally and in India, the technology still remains in the hands of a select few, thereby keeping costs high. The components used in CSP projects have not reached economies of scale and lack competitive pressures. There are not more than four to five manufacturers worldwide for most components. There needs to be a continuous deployment of the technology to support indigenization and bring down costs.

CSP power plants have a need for auxiliary power which is often unavailable or unreliable in remote areas. This power is needed to stop the heat-exchange fluids from freezing at night. In order to meet this requirement, projects have to provide for an alternative power supply which increases project costs. The government would do well to address this problem either by providing monetary support or by ensuring access to reliable auxiliary power.

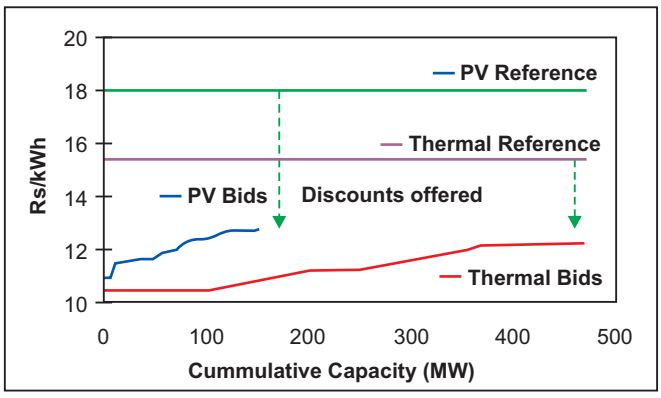
Key Industry Risks & Suggested Policy Interventions

- The first and most important risk is the lack of reliable irradiation data, without which it is difficult to calculate the generated output and therefore, the return on investment. There are so far only a few projects in the country that provide actual generation

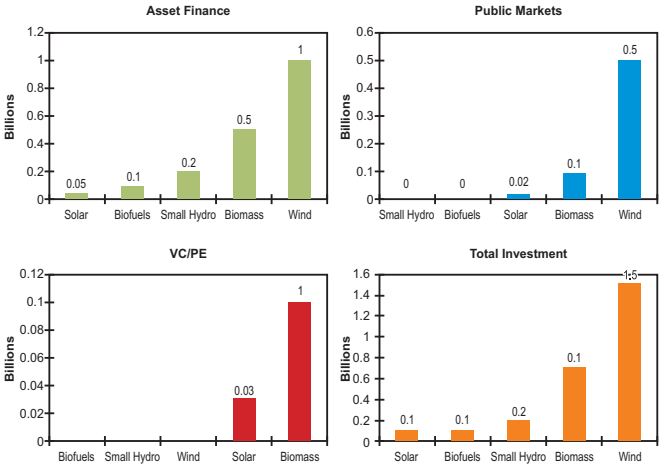
data as a reference.Currently, there is an up to 30% variation between the satellite data provided for example by the National Renewable Energy Laboratory (NREL) of the U.S. Department of Energy and the MNRE on the one side, and on the ground measurements on the other. At the moment, the Indian Meteorological Department manages a network of 45 radiation monitoring stations across India, of which New Delhi, Patna, Jaipur and Thiruvananthapuram have data loggers installed. In addition to these stations, the MNRE is currently in the process of establishing 50 new stations across the country through the Centre for Wind Energy Technologies (CWET) in Chennai. CWET is an autonomous body under the MNRE and has pioneered wind data measurement, monitoring and modeling. It is expected to take over a similar role for Indian solar radiation monitoring as well. Reliable data over a sustained period of time from different monitoring stations across the country would enable players to mitigate the risks.

- Bankability remains an issue for the vast majority of projects with signed PPAs at the moment in India. Project developers are finding it challenging to attain financial closure. Especially difficult is obtaining non-recourse debt financing.The need to keep capital costs low in order to make projects viable continues to create challenges for players in the Indian market. The low feed-in tariffs that result from competitive bidding will create questions around project viability in the eyes of the banks. In addition, Indian developers continue to struggle to obtain financing for projects due to their lack of a track-record in solar.

Supply Curve for JNNSM Phase 1Round 1 Bidding



- For projects under the NSM, banks are especially wary of the heavily discounted tariffs that have arisen from the bidding process. The present tariffs are among the lowest in the world for solar, and banks are concerned that the project risks have been underestimated in order to win bids. Banks are also wary of the small margins that projects are looking to operate on in order to be viable at such low tariffs. Pre-selection of the developers based on technical criteria, and not just on financial criteria, could help avoid unrealistic bidding by developers.



Source: REN21, 2010

- Another issue with regard to financing is that Indian banks are structurally geared only for working capital loans that are typically short-term (6-8 years). This does not work for solar projects that typically require longer-term loans of up to 15 years. In addition, the cost of financing in India is very high with interest rates going up to 12%. High interest rates reduce project viability. The banking industry will likely develop financial products or financing terms that address these challenges. In the meantime, financial assistance from the government in the form of long-term loans and lower interest rates could help the industry.

- In order to successfully raise debt from banks, project developers are required to provide comprehensive and accurate Detailed Project Reports (DPRs) that form the basis for a strong business case for their projects. Many developers do not have prior experience in the solar sector and are unable to produce such reports at the standard and detail required by banks. Further, there is a reluctance on the part of the developers to invest in good feasibility studies of sites prior to bidding for the PPAs. A consolidated government body providing standards for project feasibility studies and DPRs would go a long way in allowing developers to be better prepared for executing their projects after obtaining their PPAs.

- The pricing of Renewable Energy Certificates (RECs) is posing a challenge for the mechanism to be viable. The Central Electricity Regulatory Commission (CERC) has announced a fall in the prices of RECs from the year 2012. They will earn a forbearance price of INR13.69 per kWh and a floor price of INR9.88 per kWh as opposed to a forbearance price of INR17 per kWh and a floor price of INR12 per kWh available

at present. The industry sees such a move as a signal that prices of RECs will consistently be reduced in the future, creating uncertainty on their price over time. This could see developers staying away from developing projects through the REC route. There is a need to introduce a policy change that would guarantee a long-term REC price-band, in order to make developers comfortable about this mechanism.

- With limited projects under the NSM, there may be a lack of accurate information on the project parameters for benchmarking the success of the technology in India and deriving learnings for the future. There is a need to diligently benchmark projects during construction and post the date of completion, without any deviations. The governmentshouldset up a focused program to ensure this, in the same manner as projects are required to setup monitoring stations on-sight.

- Reliable transmission infrastructure remains a significant problem for the industry as a whole. In large parts of the country, the necessary transmission network is not in place. In areas where the grid exists, efficiency is often poor and there can be high transmission losses. Significant policy corrections are needed if the industry is to tide over such bottlenecks. The lack of evacuation infrastructure is currently posing a significant challenge for projects nearing completion. In Gujarat, for example, the Gujarat Energy Transmission Corporation (GETCO) is creating delays in providing the right infrastructure. Their expertise and technology is not yet adequate to integrate solar into the grid. There needs to be a focused effort by the government to speed up the provisioning of the requiredgrid infrastructure in order to ensure that projects are executed on time.

- Competitive bidding of projects under the NSM has led to aggressive bidding by developers. Close to 50MW of PV projects have not been able to attain financial closure due to doubts over their viability. Many of the players are new and unknown and there is a danger that they have underestimated the risks in order to provide high discounts. Clearly, bank guarantees are not enough to discourage developers from being aggressive with their discounts. The MNRE should also include technical requirements into the pre-selection of developers to avoid this issue.

- Solar projects require long term loans as the life span of the power plant runs over 25 years. Further, given the highly competitive tariffs arising out of the bidding process under the NSM, developers cannot afford to take on debt at the high interest rates prevalent in the economy. The governmentshould provide financial assistance in the form of long-term loans at favorable interest rates for the industry to take off successfully.

- Since large-scale solar project development is still new in India, government agencies are yet to get familiar with the technology. Often, relevant government departments are unsure about the permits and clearances that need to be provided for solar power plants. The issue is aggravated in the case of projects under the NSM as these are centrally funded projects that need to be implemented at the state level. A consolidated government body providing information on the permits and streamlining the allotment of clearances will allow developers to execute projects on time and avoid penalties.

- For CSP projects in particular, there are only a few projects under the NSM and no history of any CSP deployment in the country. This leaves limited room for assessing the performance of the technology in Indian conditions. The government needs to support the development of demonstration and research projects in order to be able benchmark project performance.

- There is very limited indigenous production of CSP technology. Even internationally, the technology remains in the hands of a select few, keeping the costs of the technology high. Special focus needs to be paid to this industry in order to ensure its balanced development along with PV. The government should consider absorbing "one-time technology costs" in projects to support large scale deployment of the technology. This will support indigenization of the technology and bring down costs.

- The continuity and clarity on the future of the NSM policy is missing, particularly beyond the year 2013. The industry could benefit from a road map with the time lines for bidding. The allocation of projects for different phases, as well as different batches, should be announced in advance with clear timelines.

Conclusion

The fact that the euphoria over the NSM among the policy makers and the environmentalists is not echoed by prospective lenders clearly indicates that the mission carries significant risks. At the industry level, prospective NSM players face risks concerning data availability and data accuracy, bankability, inadequate support and transmission infrastructure, lack of policy clarity and continuity. The sobering fact here is that apart from the question of bankability which may be unique to the solar industry, other risks are common to all energy and infrastructure projects in India and one can hope that

these issues will be addressed as the Indian industry matures. However, the pace of these improvements may not be in line with the needs of the industry, which is detrimental to attracting private investment.

At the national level, the strategic policy objectives of the NSM remain unclear. Is one of the strategic objectives to develop a globally competitive PV manufacturing industry in India? If that is the case, it is not necessary that a huge domestic demand for PV is created through the Renewable Purchase Obligations (RPOs), especially in the light of the fact that an artificially created PV market will not only come at the expense of subsidies but also displace alternative renewable energy sources such as biomass and small hydro power which are far cheaper. China, which currently accounts for about 60 percent of the world's PV manufacturing capacity, dependsalmost entirely on the export market to develop its domestic PV industry. Unless domestic content is mandated in the early phase of the NSM, Indian subsidies could go to imported components. On the other hand, domestic content requirements will make solar power more expensive than it already is.

The disproportionate focus on MW scale projects at a huge cost is unlikely to provide electricity to the rural poor. While MW scale plants are justified for CSP projects due to technological limitations, MW scale projects for PV excludes the deployment of small scale PV can be the key to rural electrification. In fact the largest advantage of PV systems is that they are small, portable and decentralized, attributes that can be a key to rural lighting solutions. The same holds true for commercial captive power solutions with, for example, businesses currently relying entirely on expensive power from diesel gen-sets or for telecommunication towers. On the other hand, installing grid-connected larger plants may be a necessary intermediate step to accelerate the implementation of the technology by reducing costs through a more rapid scalability.

When over INR 2,400 billion ($60 billion) is to be invested in creating and sustaining a solar industry, it is very important that India is clear about its industrial and strategic objectives. Large scale solar development is at its initial stages in the country. It is understood that the appropriate policy support from the government is crucial for the industry to successfully take off. Through the NSM, the government has exhibited a clear intention to do what it takes to ensure that solar power develops in a viable and sustainable manner. In order to successfully achieve this objective, it is crucial that the governmentgoes the extra mile in ensuring that the aforesaid policy shortcomings are addressed in a constructive manner.

Distinguished participants

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Endnote:

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2. MNRE National Solar Mission, Guidelines for Off-Grid and Decentralized Solar Applications, June 2010
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