India's Solar Mission: Procurement and Auctions

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Competitive bidding adopted under the Jawaharlal Nehru National Solar Mission is an appropriate process for megawatt-scale solar power procurement, given the changing prices of solar power and the limited paying capacity of India's consumers and taxpayers. MW-scale plants may be useful to kick-start the solar photovoltaic industry in India. However, promoting such plants while photovoltaic costs are relatively higher than other renewable energy sources may not be financially and strategically prudent. India's focus needs to be on the development of decentralised solar-installed capacity in rural areas where it will have the most social impact.

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In 2010, the Government of India (GOI) announced the Jawaharlal Nehru National Solar Mission (JNNSM) and its target of developing 22,000 megawatts (MWs) of solar capacity by 2022. In its phase I plan till 2013, the mission aims to develop 500 MWs of concentrated solar thermal (CST) power plants and 500 MWs of solar photovoltaic (PV) plants, 100 MWs of rooftop solar PV and 200 MWs of off-grid solar PV capacity.

The authors had previously argued (Deshmukh et al 2010) that (a) the government should focus on decentralised solar PV applications to provide access to electricity for basic services like lighting rather than allocating disproportionately larger subsidy to MW-scale PV plants; and (b) if the government were to pursue large-scale grid-connected solar capacity, project selection should be through a competitive bidding process.

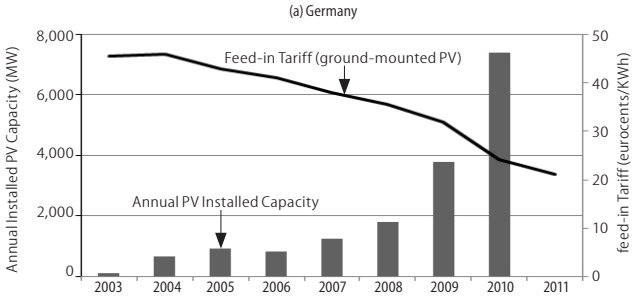
In 2010, the National Thermal Power Corporation's (NTPC) power trading arm, the NTPC Vidyut Vyapar Nigam (NVVN), did conduct a reverse auction[1] (a competitive bidding process) for the first 150 MW of large-scale PV and 470 MW of CST. The auction resulted in quotes that were on an average 25% and 32% lower than the Central Electricity Regulatory Commission (CERC) 2010 declared tariffs for PV and CST respectively (Emergent Ventures 2011; CERC 2010). Following the low bids, there have been some concerns raised about the possibility of some projects not materialising and the use of sub-standard equipment. In this article, we present the auction results and address the above criticisms by providing some recent international experiences. Further, we argue that India's strategic interests lie in the development of decentralised solar applications, especially those that provide basic energy services in rural areas.

Solar Procurement

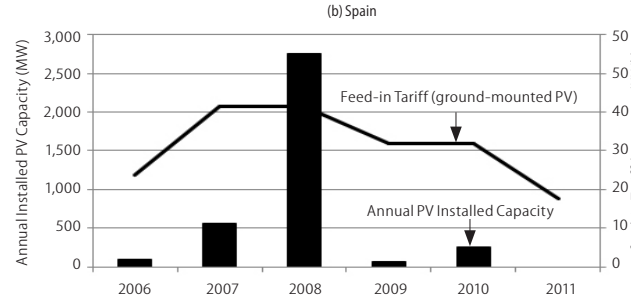
Although its costs have been dropping over the years, solar power is still far more expensive compared to conventional as well as other renewable energy (RE) generation options. Due to these high prices, utilities and governments around the world are devising ways to promote solar deployment while maintaining the financial burden to an acceptable level. With rapidly changing solar prices, it is difficult to set an appropriate price. While a low price may not elicit enough interest, a high price may result in a high response and a large installed capacity, thus exposing utilities to a high and unexpected financial impact.

Price and quantity are the two critical parameters for solar procurement. The price is the preferential generation-based tariff offered to project developers. The quantity is the total or annual solar capacity sanctioned for installation. Ideally, price and quantity cannot be both fixed since it leads to the issue of fair project selection. To limit the financial impacts, governments often fix the quantity or "cap"

Figure 1: Annual Installed PV Capacity and Feed-in Tariffs (Ground Mounted Systems)



Sources: BMU (2010), IE-JRC (2009),IE-JRC (2010), PV News (2010).



Sources: (IEA 2010), IE-JRC (2010), IE-JRC (2009), PV News (2010), Reuters 2011.

for installed capacity. Subsequently, they have to select the projects based on certain criteria such as first-come-first-serve basis, random selection, or through price-based competitive bidding. The last option also helps "discover" the price. We look at recent experiences of some countries and that of India.

Germany: Germany fixes the price for solar power in the form of feed-in tariffs (FITs) over 20 years. Higher FITs are offered for smaller size systems, usually rooftop, while the least are offered to ground-mounted systems greater than one megawatt. The quantity is somewhat controlled by imposing a strict annual degression rate, which is a percentage reduction in feed-in tariffs based on the quantity or solar capacity installed during the previous year. Figure 1(a) shows the reducing feed-in tariffs against the annual installed solar PV capacity. Due to recent drop in solar PV prices, Germany reduced its feed-in tariffs twice during 2010. Even then, the annual installed solar PV capacity exceeded 7,400 MWs, equal to about a third of solar capacity addition expected under JNNSM in the coming decade. This translates to a large financial commitment for Germany's electricity consumers over the next 20 years.

Spain: Spain set the price for solar procurement by offering FITs for 25 years. However, unlike Germany, it also fixed the quantity in the form of a cap, to limit the financial impact on its utilities. To circumvent the issue of project selection, as noted earlier, the Spanish government decided to accept all projects till one year after 85% of the annual cap was met. When the Spanish government increased its FITs for PV by 75% in 2007 to provide a boost to its solar sector, 2,661 MW of PV were installed, exceeding the annual cap of 1,200 MW two times over (Figure 1b). The additional capacity of 1,461 MW meant a large unexpected financial commitment of a net present value of several billion euros over the next 25 years.

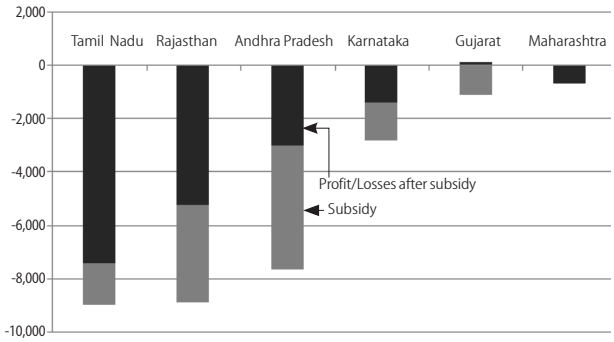
Further, the Spanish government had and continues to keep electricity consumer tariffs low and reimburses utilities for the deficit by paying through the national budget, i e, taxpayer monies. Spain was one of the worst hit countries during the financial crisis with a high budget deficit. Although the deficit was not all due to support for renewable energy, the government could not keep offering high FITs for solar energy generation (Craig 2009). In September 2008, it slashed the FITs by 23%. The Spanish PV market collapsed with only 70 MW of installed capacity being added in 2009. Further, the Spanish government is even considering retroactive cuts to FITs for existing projects, a move that breaches contracts and provides considerable uncertainty to the Spanish solar sector.

California, USA: In December 2010, the California Public Utilities Commission in the United States introduced the Renewable Auction Mechanism to procure renewable energy projects of less than 20 MW, which mainly include solar. Under this mechanism, the required installed capacity will be fixed and projects selected based on least cost rather than first-come-first-served basis at a set feed-in tariff (CPUC 2010). The programme aims to use standard terms and conditions to lower transactional costs and provide contractual transparency needed for effective financing.

India's JNNSM

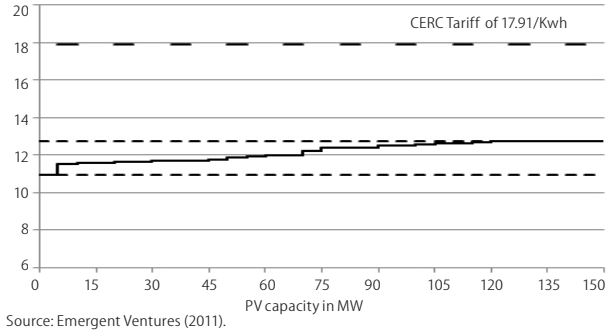
India could not afford to just set the price for solar without a cap on installed capacity, since experience in Germany showed that a large quantity can be installed in spite of adjusting the price on a continual basis. Hence, under the phase I of JNNSM, India chose to fix the quantity at 1,000 MW for large-scale solar installed capacity, in order to insulate against excessive demand for putting up solar projects. This was essential, given the limited paying capacity of both its utilities and government. The financial health of India's state-owned electricity utilities (that form the bulk of utilities) is poor; their aggregate losses

Figure 2: Financial Health of State-Owned Utilities in Some Indian States in 2008-09
(Crore)



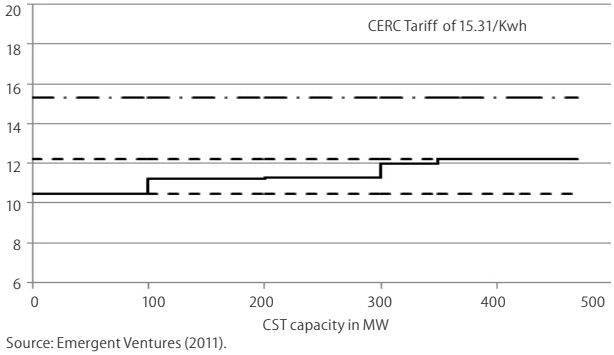
Source: PFC (2010).

Figure 3: Results of the Reverse Auction for 150 MW of Solar PV under JNNSM
(PV Tariffs in/kWh)



Source: Emergent Ventures (2011).

Figure 4: Results of the Reverse Auction for 470 MW of Solar CST under JNNSM
(CST tariffs in kWh)



Source: Emergent Ventures (2011).

(without accounting for state government subsidies) touching a phenomenal Rs 53,000 crore in 2008-09 (Figure 2 for losses of utilities in major states) (PFC 2010). The reason is similar to the Spanish case where all the costs incurred by utilities are not passed on to the consumers. Hence, any further impact on utility expenses can put a strain on not just electricity consumers but also taxpayers (in the form of government subsidies).[2]

Initially, the GOI intended to offer a fixed feed-in tariff over 25 years, set by the Central Electricity Regulatory Commission (CERC). However, seeing the large response from the industry, the GOI chose to select projects using a reverse auction mechanism. This mechanism is similar to the one adopted later by California as discussed earlier.

Auction Results

Under the reverse auction mechanism, the first 150 MW of PV (Figure 3) and 470 MW (Figure 4) of CST projects were selected based on the maximum "discount" that they offered on the CERC declared feed-in tariff. The auction received a very high response with applications received for 5,126 MW capacity, which was eight times more than the 620 MW target (MNRE 2011).[3] The weighted average of quoted tariffs for the selected PV projects was Rs 12.16 per unit, while that for the seven selected CST projects was Rs 11.41 per unit. Figures 3 and 4 show the capacity-wise bids of the selected projects and the range of the tariffs in comparison to the CERC FIT.[4] These tariffs were computed by assuming that the project promoters are not availing the benefit of accelerated depreciation.[5] The PV and CST tariffs were on an average 32% and 25% lower than the 2010-11 CERC set feed-in tariffs (Rs 17.91/kwh for PV and Rs 15.31/kwh for CSP; (CERC 2010)) respectively. This reduction in tariffs for the first 620 MW of solar projects will result in a total savings of Rs 4,700 crore (NPV at 10% discount rate over 25 years) for the consumers, indicating success of the auction.

Low Tariff Bidding Concerns

The large discounts in tariffs have led to several concerns being raised within and outside the solar industry. These include underbidding by firms, which may hinder financial closure and timely completion of projects. It may lead to subsequent underperformance due to the usage of substandard equipment. Critics point to "inexperienced" players such as knitwear and animation firms figuring in the list of successful bidders (Pearson 2010).

Such concerns are legitimate but are not reason enough to abandon competitive bidding. The government has introduced significant bond amounts at different stages of the project development (average bond value of Rs 1.62 crore per MW for PV and Rs 0.87 crore per MW for CST). Firms that do not commission their projects within the stipulated time (12 months for PV and 28 months for CST) stand to lose significant amounts of money relative to their initial capital investments (MNRE 2010). Further, since the tariffs are generation-based, any under-performance would result in losses to the project developer, thus providing enough incentive to ensure appropriate performance. The government needs to facilitate transparency in monitoring of the progress of projects, so that all stakeholders can ensure that projects are being developed, while penalisation and bond appropriation is enforced on project developers in the event of breach of agreements. The yet-to-be-built capacity can then be procured in the following rounds of bidding.

Critics also argue that competitive bidding is not appropriate at this nascent stage of the solar industry and that the solar power should have been procured at feed-in tariffs set by the CERC. However, this would have raised the question of project selection. Given the high response from the solar industry, project selection based on first-come-first-served basis or

random lots would not have ensured fair play, nor would it have addressed the concerns of timely completion or adequate performance of projects.

A drawback of the auction mechanism is that the process may keep out small project developers. However, the auctions are being held only for large MW-scale solar plants (5-100 MW), with required investment over Rs 10-12 cr/MW. Smaller grid-connected PV projects (<2MW) including rooftop PV are being procured at CERC set feed-in tariffs and have a target of 100 MW for phase I of the JNNSM.

Other Solar Programmes

Apart from the JNNSM, the state government of Gujarat has signed power purchase agreements for 968 MW of solar projects[6] under its own Solar Power Policy 2009 (GOG 2009). Gujarat is procuring the solar power at a fixed "levelised" feed-in tariff of Rs 12.54 per kwh and Rs 9.29 per kwh for PV and CSP respectively, which includes the benefit of accelerated depreciation (GERC 2010). These tariffs are higher than the average quoted tariffs under the JNNSM (especially considering the benefit of accelerated depreciation), but significantly lower than the CERC 2010 tariffs. Rajasthan too is planning to develop an additional 300 MW of MW-scale solar projects by 2013 and another 400 MW by 2017 under its own solar energy policy (GOR 2010). The state plans to use competitive bidding for this solar procurement. Maharashtra is also forming its own solar policy to develop 500 MW of MW-scale solar over the next three years (Pearson 2011).

Given this significant push for solar power presently underway in India, the debate on solar procurement mechanisms is important. However, while solar power costs are high, it is even more important to ask what strategic objectives will India achieve by providing this deployment support for the proposed quantum of solar capacity as well as the type of solar applications. Pushing for grid-connected solar power through solar-specific Renewable Purchase Obligation (RPO) targets, as was recently done through the tariff policy amendment[7] without considering the rate of solar power cost decline will unnecessarily cost the Indian consumer while providing little strategic advantage to the country.

Solar Deployment Support

India's deployment support for solar power should be strategic, not only in terms of procurement but also applications. There is a disproportionate focus on MW-scale solar projects in all of India's solar programmes. Focus on MW-scale CST plants is justified due to the limitations of project size for that technology. However the emphasis on MW-scale PV plants in India is questionable mainly for the following reasons.

Creating large domestic demand for PV when its costs are still much higher than other RE options is not necessary for the development of India's domestic PV manufacturing industry. China and Taiwan developed their PV industries without providing any significant deployment support and in 2010, accounted for roughly 60% of the world's PV cells manufacturing (Hering 2011). Their industries rely almost entirely on export markets, PV equipment being easily shipped across continents. In fact, not mandating domestic content in India's early phase of solar deployment could lead to Indian subsidies going towards imports.

Further, the reduction in PV costs depends on the size of the global PV market and most importantly on research breakthroughs. Domestic demand for PV will not have any significant effect on global PV prices since the Indian PV market is very small compared to the global market.[8]

Finally, PV technology's biggest advantage is its use in small-scale and decentralised applications. Most countries encourage decentralised PV applications by providing higher incentives compared to MW-scale applications. More than 99% of Germany's PV installations between January 2009 and August 2010 (accounting for 85% of the 8.7 GW installed capacity during that time period) were less than 1 MW in size.[9] India, with its 70 million un-electrified rural households[10] and 0.8 million un-electrified schools (DISE 2010), should focus on subsidising decentralised PV applications that provide much needed access to electricity and clean lighting, in a way that the rural poor consumer's tariffs are not more than their grid connected counterparts. PV demand from such decentralised applications, which would be in the range of several gigawatts, should be India's contribution to the global PV market. does have a 200 MW target for off-grid solar PV under the phase I of JNNSM, with 40 MW allocated in 2010-11 (Ministry of New and Renewable Energy (MNRE) 2011a). However, without appropriate performance-based incentives, robust monitoring and verification procedures, consumer grievance redressal mechanism and ensuring future grid-interaction as and when the grid is extended, the long-term sustainability of these projects and their effectiveness in providing electricity services remains to be seen.

Conclusions

Competitive bidding adopted under the JNNSM is an appropriate process for MW-scale solar power procurement, given the changing prices of solar and the limited paying capacity of India's consumers and taxpayers. Some plants may not materialise due to potential underbidding and inexperience, but the bid bond amounts that project developers stand to lose are significant. However, the government needs to be strict about bond appropriation in the event of breach of contracts. Although MW-scale plants may be useful to kick-start the solar PV industry in India, promoting such plants as long as PV costs are relatively higher compared to other RE may not be financially and strategically prudent. Strategically, India's focus needs to be the development of domestic manufacturing and R&D industry and decentralised solar installed capacity in rural areas where it will have the most social impact. As the government readies to auction the remaining 300 megawatts of large-scale PV, it is important to remember the primary objective of the JNNSM –

> To scale up deployment of solar energy and to do this keeping in mind the financial constraints and affordability challenge in a country where large numbers of people still have no access to basic power and are unable to pay for high cost solutions (GOI 2010).

NOTES

1 In a reverse auction, the sellers compete to obtain business as opposed to a typical auction where buyers compete to obtain a good or service. While prices in a typical auction increase over time, prices in a reverse auction decrease over time.

2 Although NVVN will "bundle" the first 1,000 MW of solar power with an equivalent capacity of NTPC's cheap unallocated coal power, the scheme only provides an incentive for utilities to buy the bundled power, more for the relatively cheap coal power than the clean but intermittent solar power. The entire high cost of solar power will still need to be borne by the consumers.

3 According to MNRE 2011, NVVN received applications for 3,311 MW capacity for CST and 1,815 MW capacity for solar PV.

4 The highest and lowest quoted tariff for the selected PV projects was Rs 12.76 and 10.95 per unit. The highest and lowest quoted tariff for the selected CST projects was Rs 12.24 and 10.49 per unit.

5 If a project developer were to avail the benefit of accelerated depreciation, their final tariff will be calculated by accounting for this benefit as calculated in the CERC 2010 regulations.

6 Personal Communication with GEDA officials *Details of Solar Power Project Developers Who Have Signed PPA,* May 2011.

7 Para 6.4 (1) of the National Tariff Policy states that minimum renewable energy percentages have to be decided only after taking into account their, "impact on retail tariffs"; however the next section (modified) 6.4 (1) (i) goes on to prescribe actual targets for solar RPOs (0.25% by the end of 2012-13 and 3% by 2022) without considering the evolution of solar costs and their resulting impact on retail tariff. For the modified tariff policy please see www.powermin.nic.in/.../pdf/Amendment_to_the_Tariff_Policy_notified_under_section3_of_the_Electricity_Act2003_Resolution.pdf

8 Phase I targets of JNNSM (1,300 MWs over three years) and Gujarat's allotment of 968 MW (for the state solar policy over a period of four years till 2014) are significantly small compared to the global annual PV installation of 18,200 MW in 2010 alone. The global solar market is expected to continue growing exponentially in the coming years.

9 Prayas analysis of German PV installation data available at Bundesnetzagentur.de.

10 Estimated based on 2001 Census Data available at http://censusindia.gov.in/ and RGGVY state wise progress reports, available at http://rggvy.gov.in/rggvy/rggvyportal/plgsheet_frame1.jsp; accessed 2 April 2011.

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