

Solar Power and India's Energy Future

Energy prices in India are climbing, and supply, while growing, is not keeping pace with steep demand. Solar power, despite initial challenges, is becoming a multibillion-dollar opportunity.



Coal is becoming more difficult to obtain, sources of domestic gas are shrinking, and there is more focus than ever on sustainability. The result: Stakeholders are scaling back expectations that conventional energy sources can fulfill India's power needs. India's renewed focus on solar power—led by the Jawaharlal Nehru National Solar Mission (JNNSM)—could not have come at a better time.

Solar will become a crucial component of India's energy portfolio in the next decade—perhaps more so than it is in most other countries. We believe a solar market can develop fairly quickly—going from nothing to several billion-dollar solar-centric firms within a decade.

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While some players have already begun preparing, most have yet to place a bet on solar, given the uncertainties within the sector. Success in solar energy will require a long-term commitment and a sound understanding of local dynamics.

We recently studied India's nascent solar-energy initiatives, combining our research and observations with perspectives gleaned from dozens of interviews with developers, manufacturers, investors, value-chain, regulators, and policy makers at both the state and national levels. Our research led us to three major conclusions:

- **India's solar market could be worth billions of dollars over the next decade.** India's solar potential is real enough—and the support environment improving fast enough—to forecast a \$6 billion to \$7 billion capital-equipment market and close to \$4 billion in annual revenues for grid-connected solar generators over the next decade.
- **Project execution, financing, and localization are crucial.** A frugal cost base will be at the core of successful Indian solar ventures. As the number of projects and players increases, procurement effectiveness will become a hygiene requirement. Longer-term value will come from efficiently executed projects, low-cost (and often innovative) financing, and localization.
- **Local players will dominate the downstream solar industry.** In contrast to the global nature of the upstream industry (solar modules), we expect local, or at least well-localized players to dominate the downstream side, including project development, installation, and distribution, in the initial years. Given sufficient time to fine-tune their business models, global players entering India for the first time can prosper. Entering and learning the ropes early will be important for both local and global players.

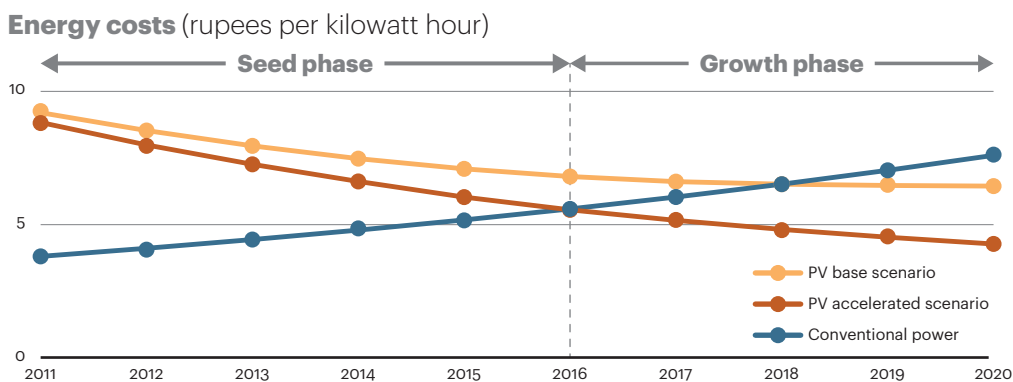
¹ A future paper will focus on equally attractive off-grid opportunities.

Two Chapters to the Solar Growth Story

As recently as 2009, the JNNISM's target to reach 20 gigawatts (GW) by 2022 appeared overly ambitious. Today, few doubt that the JNNISM will not only meet its target, but also exceed it. Based on our estimates, the combination of electricity demand growth, fossil fuel cost and availability challenges, and supportive environmental regulations could increase solar power capacity to more than 50 GW by 2022. The solar industry's structure will rapidly evolve as solar reaches grid parity with conventional power between 2016 and 2018 (see figure 1).

Figure 1

Solar power will achieve grid parity with conventional power between 2016 and 2018



Notes: PV base scenario is a 6 percent yearly cost decrease, and the accelerated scenario is 8 percent. Conventional price assumes 8 percent yearly increase. PV is photovoltaic.

Source: A.T. Kearney analysis

This growth story has two chapters: the seed phase, where independent solar power producers receive government support, followed by the growth phase, where rising demand and favorable economics lead to rapid industry growth, attracting larger utilities. In the seed phase, before solar power reaches grid parity, the subsidy-driven market will have projects awarded through competitive bidding. Implementation challenges and regulations, including renewable purchase obligations (RPOs), renewable energy certificates (RECs), and net metering, will ease in this phase, and investor confidence will rise. These factors will combine to bring on the subsequent growth phase, when the sector more than triples in size.

We expect a shift in demand patterns and in the way industry players view solar's feasibility in the period 2016-18. Solar will be seen more as a viable energy source, not just as an alternative to other renewable sources but also to a significant proportion of conventional grid power. The testing and refinement of off-grid and rooftop solar models in the seed phase will help lead to the explosive growth of this segment in the growth phase.

The Seed Phase: Edging Toward Grid Parity

Global prices for photovoltaic (PV) modules are dropping, reducing the overall cost of generating solar power. In India, this led to a steep decline in the winning bids for JNNISM projects. With average prices of 15 to 17 cents per kilowatt hour (kWh), solar costs in India are already among

the world's lowest. Given overcapacity in the module industry, prices will likely continue falling over the next four years before leveling off. By 2016, the cost of solar power could be as much as 15 percent lower than that of the most expensive grid-connected conventional energy suppliers. The capacity of those suppliers alone, nearly 8 GW in conventional terms, corresponds to solar equivalent generation capacity potential of 25 to 30 GW. Due to implementation challenges, however, it's unlikely that all of this potential will be realized by 2016.

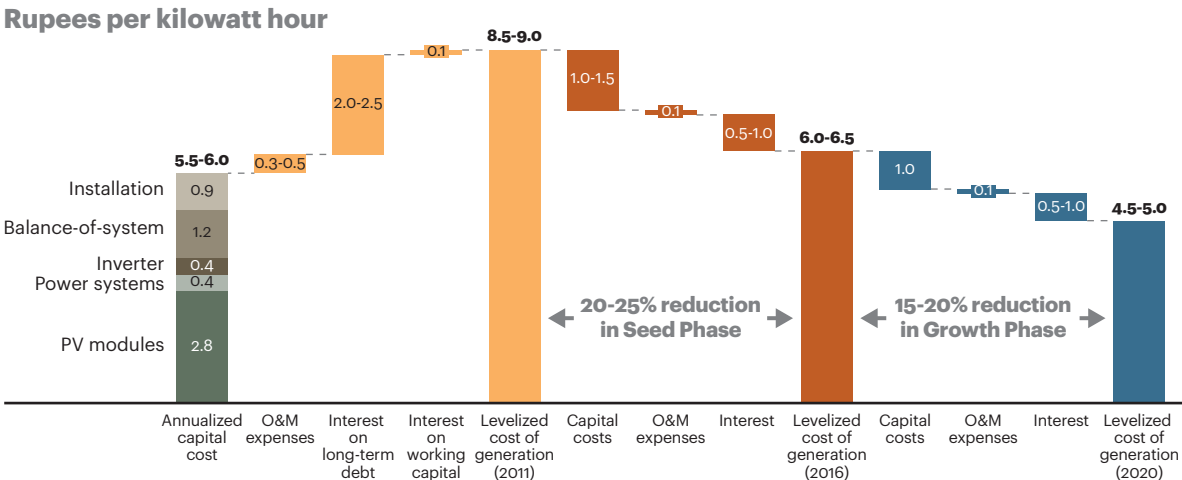
The competitive bidding model, which has been successful, will likely continue through the seed phase. The JNNSM will be crucial to the sector during this phase, as will state-run programs such as those in Gujarat and Rajasthan. In all, we expect 12 to 14 GW of capacity to be added during the seed phase—almost entirely in the form of grid-connected utilities. The total capacity added in the off-grid space during this phase may be less than 1 GW. However, heading into the growth phase, as solar power becomes more competitive than other forms of alternative energy, we expect off-grid capacity to rise exponentially.

Grid parity will be an inflection point, leading to two major shifts in the solar market. First, thanks to favorable project economics, grid-connected capacity will rise at a much faster rate than before, and second, regulations and policy measures will be refined to promote off-grid generation.

The Growth Phase: From Nervous Rapids to Raging River

The market will see a significant change after 2016. Lower solar costs combined with rising prices of grid power will convince offtakers (including distribution companies, private firms using open access, and firms putting up their own captive capacity) that solar power is economically viable (see figure 2). This shift will signal the start of the growth phase, during which grid-connected solar capacity will rise rapidly to about 35 GW by 2020 as developers build capacity to meet both RPO requirements and demand from offtakers seeking cost-efficient alternatives to conventional power.

Figure 2
Solar production costs will drop 20-25 percent in the seed phase and 15-20 percent in the growth phase



Notes: PV base scenario is a 6 percent yearly cost decrease, and the accelerated scenario is 8 percent. Conventional price assumes 8 percent yearly increase. PV is photovoltaic.

Source: A.T. Kearney analysis

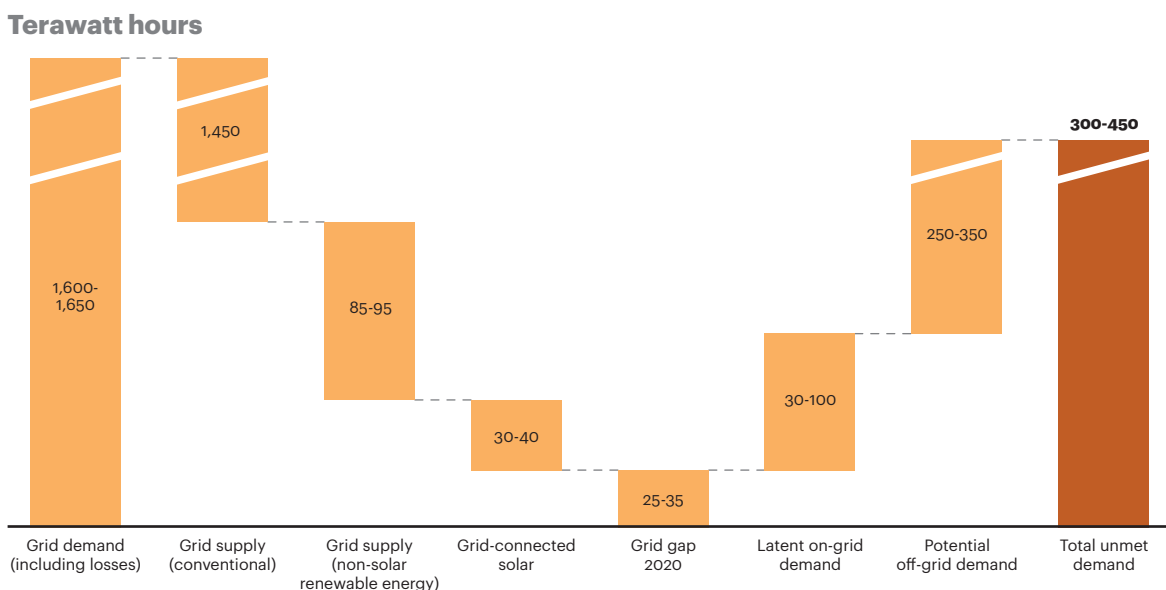
Government support will fall at the beginning of the growth phase. The bid-driven system will need to change, as technology and cost structures stabilize with the likely introduction of feed-in tariffs. The frameworks for RPOs and REC frameworks could change as well; however, solar-specific RPOs are likely to remain for the next decade and potentially see a steady rise to a national average of 3 percent. The premium for solar RECs is likely to reduce, while RECs may also tend towards a single structure across renewable energy sources after grid parity is achieved.

The JNNSM’s target to reach 20 GW by 2022 once appeared overly ambitious. Today, few doubt it will meet that target.

Meanwhile, the off-grid and rooftop segments will grow exponentially as price parity with consumer tariffs makes solar power an economically viable alternative, particularly for urban and semi-urban consumers. Distributed generation in rural areas and support for latent urban demand has the potential to reach 4 GW by 2020 and increase rapidly to more than 10 GW over the next three to four years.

The Indian rooftop and distributed generation market will evolve differently from the rest of the world, largely because the typical Indian rooftop and the typical distributed generation consumer pose unique challenges that require innovative solutions. Examples of such challenges include the typical size, infrastructure available, and security and theft issues. Once the domestic business model is in place, however, the potential is huge. We expect a slow initial build-up of demand, and strong acceleration thereafter (see figure 3).

Figure 3
Solar can fill India’s supply gap while tackling unmet demand



Source: A.T. Kearney analysis

The Seed Phase: Impact on the Sector

As India's solar sector evolves during the seed phase, participants across the value chain will go through a steep learning curve as solar edges closer to grid parity. Independents will likely participate enthusiastically while larger players hold back until the market stabilizes—a tactic that may increase entry costs. Let's look in depth at how the evolution might look:

Independent developers will thrive in solar as utilities have a slow start. The seed phase will see an evolution of business models, as multiple government programs support different types of solar models. JNNSM, for example, focuses strongly on competitive scale-based economics, while states such as Gujarat support their own conventional models, apart from unique schemes like the canal or rooftop models. As the rules of the game await better definition, many large energy players and utilities may initially decide to play it safe, even though investment requirements will be small compared with conventional power. In this scenario, independent solar power producers (ISPPs) could garner the lion's share of the evolving market—a scenario that creates a launching pad for growth and the foundation for more attractive valuations as the market consolidates in the future.

While players may face growing pains in the seed phase, **the experience will yield strong dividends as the growth phase unfolds.**

Overall, the developer market will likely deliver more than \$2 billion in annual revenues for solar-power generators by 2016. The small size of project awards combined with capital constraints means that capacity will be spread across ISPPs. In other words, there will be several small and medium-sized players but no clear market leaders.

Standalone EPC players will cater to ISPPs and corporations. The above scenario will increase demand for engineering, procurement, and construction (EPC) players, as developers opt to outsource turnkey projects due to a lack of internal expertise. EPC players can look forward to \$3 billion in annual sector revenues by 2017, thanks to a wide client base of utilities, small independents, and niche players.

The EPC market will remain fragmented. With project sizes typically ranging from 10 to 25 MW, small and medium-sized players will have few constraints competing against larger national and international ones. Scale-driven procurement efficiencies will diminish as rapidly declining costs and improving technology options inhibit the long-term framework agreements that characterize conventional-energy procurement structures.

Manufacturing will still be dominated by imports. One area of the solar market won't be dominated by small local companies: manufacturing of modules. Given global overcapacity in this segment, module-manufacturing facilities likely will not be built in India unless mandated by local regulations. If that happens, the lower-cost economics of Indian manufacturers could delay grid parity by two to three years. Nonetheless, global players have already started setting up bases for balance of systems (BoS) in India, a trend that is likely to continue.

By all appearances, the manufacturing space is likely to be dominated by multinationals, which already have significant experience and expertise in the field. We could see domestic players providing less value-adding components of the system.

Rise of Utilities in the Growth Phase

As the solar sector achieves critical mass and technology and costs stabilize relative to the seed phase, the developer and EPC markets will likely evolve rapidly to be dominated by integrated utilities, similar to the case in conventional energy today.

Utilities will extend to solar, seeking balanced portfolios. Once the growth phase begins in earnest, solar projects will get larger, with some of the largest approaching 100 MW. This increased scale, along with regulations and attractive sector economics, will draw interest from larger utilities. This means consolidation is likely, with utilities acquiring a majority share—as much as 60 percent—of the grid-connected market by 2020 through acquisitions of ISPPs. Independents will continue to play a strong role in serving smaller private-sector offtakers, where the market will remain fragmented.

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With a wider range of options for selling power, margins will improve for players that find the right mix in their sales portfolios. The valuations for smaller ISPPs looking to exit during the growth phase will be driven primarily by the quality of their project portfolios.

The EPC market will consolidate, with in-house EPC arms gaining share. As in most mature sectors of the power industry, integrated utilities and larger independent developers will eventually build their own internal EPC capabilities to improve project viability and returns during the solar growth phase. For standalone EPC firms, this means a shrinking customer base. To stay viable, they will need either to embrace forward integration into developing generation capabilities or focus on the demand for captive projects, which will form a smaller part of the market.

The largest independent EPC firms that specialize in project implementation will be well-positioned to enter the generation space—a low-risk option, as operational complexity and manpower requirements are relatively low for solar projects. For smaller EPC firms struggling to find low-cost financing, the development space may be less attractive, and independent captive projects set up by private industries may be the best way to maintain revenues. To generate reasonable returns, these players will have to aggregate demand from multiple projects to optimize scale economies.

Size will enable manufacturing localization. On the manufacturing side, there may be opportunities for players to establish local capacity after the industry matures in India and capacity consolidation occurs globally. Such a move could also provide a base from which to export to other locations in South Asia. This strategy is a challenge now, as inefficient

infrastructure and supply chains, high energy costs, and inconsistent regulatory support make competing with imports difficult. But as local demand increases, the negative factors may be reversed, setting the stage for a resurgence of manufacturing opportunities.

Prizes at Stake

India's nascent solar-power market has the potential to grow to include a handful of billion-dollar companies across the value chain by 2020. Making an effort to understand local conditions and adapting operating models accordingly will give early adopters a major advantage.

Two to three large utilities will likely dominate the developer space. In addition, a couple of independent solar players could also emerge from the competitive growth phase to build billion-dollar businesses. Standalone EPC may not be a scale opportunity by 2020, as larger players extract value through in-house EPC arms. Niche market areas could continue to enable profitable EPC businesses. A few multi-hundred-million-dollar opportunities could also be created in BoS by current global leaders and some local companies.

Three Elements to Winning in Solar

Global procurement is unlikely to remain a differentiator as more players achieve scale and become adept at it. Creating value in the Indian market, therefore, requires efficient execution, financing, and localization.

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Execution. Given the substantial front-end costs of solar projects, delays can wreak havoc on profitability. Even under the most suitable conditions, managing power projects in India is tough—projects are often slowed by infrastructure issues and unreliable local vendors. In addition, stakeholder management at the national, state, and local levels often stands in the way of ensuring efficient project execution and sustained operation. Therefore, building a team of talented project managers and experienced troubleshooters will be crucial.

Financing. Innovative means of financing will create win-win situations for all stakeholders and drive significant upfront value for project developers. Differentiated models could include teaming with technology providers from low-cost financing countries—Japan, for example—or with consumers seeking sustainability benefits or tax credits. A pool of low-cost project equity developed from retail or other cost sources can add up to a distinct advantage.

Localization. Local design and engineering will play a major role in India's solar market. Inverter and balance-of-system designs that incorporate local requirements and eliminate unnecessary elements that are geared more toward global markets can generate significant benefits. Eventually, global players will see the benefits of manufacturing locally and specifically for the Indian market. Competition from local players could further drive down systems costs.

An Open Market

Although India's solar market appears well suited for local players, it's currently open to global players as well. Indeed, global firms that tailor their broad expertise to serve unique local needs in a frugal way could actually extract significant value. At the same time, local players can bridge capability gaps by striking appropriate alliances, or by recruiting strong teams or individuals. A partnership of foreign technology and local EPC can help both parties climb up the steep learning curve fast, but mechanisms will need to be put in place to ensure that the risks and upsides are shared equally. Both parties involved will need a long-term view of the market, with lessons learned from initial projects built into subsequent ones.

Local or global, the leaders in this market will likely be those that get in the thick of things from the beginning, as the cost of entry rises significantly with grid parity nearing. A well-thought-out plan to make an immediate impact through short-term portfolio building and to build a growing advantage through planning for long-term scalability will be crucial tools for tapping into the multi-billion-dollar potential of India's solar market.

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