

India Facts



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Laying the Foundation for a Bright Future Assessing Progress Under Phase 1 of India's National Solar Mission

From tentative beginnings, India's solar energy market is picking up steam. From 17.8 megawatts (MW) in early 2010, cumulative installed capacity reached 506.9 MW at the end of March 2012.¹ The Jawaharlal Nehru National Solar Mission (NSM or Mission), launched in 2010, has catalyzed much of this growth. Even with 300 sunny days a year in most regions, creating a new solar energy market in India is no easy task.

Making headlines in late 2011, competitive bidding for the Mission's second batch of projects under Phase 1 drove prices for grid-connected solar energy as low as ₹7.49 (\$0.15) per kilowatt-hour, approaching grid parity with fossil fuel-powered electricity. Phase 1 also attracted large conglomerates and new players into the solar market. "Bid euphoria," however, is wearing off, and serious doubts remain as to whether the Mission's Phase 1 projects will meet commissioning deadlines. Although several projects have been commissioned since January 2012, concerns about project delays are expected to overflow into future stages of the Mission. As the Mission heads into Phase 2, larger questions loom. It is unclear whether it is on course to achieve 20 gigawatts (GW) of installed solar capacity by 2022, and how the Ministry of New and Renewable Energy (MNRE, the nodal agency for the Mission) and other government agencies, as well as stakeholders—including developers,

financial intermediaries, manufacturers and communities—can be more effective in scaling solar energy to power one of the world's fastest-growing economies.

The Solar Mission follows a phased approach that allows the government to modify guidelines and policies based on the experiences gained and lessons learned in earlier phases. This interim report adopts a "whole-of-system" approach, which identifies multiple stakeholders operating within the Mission and analyzes their successes and challenges. The report examines the commissioning of Phase 1 projects, efforts to increase bankability, the development of a manufacturing base, and the creation of an enabling environment. Addressing these challenges, the report presents findings and recommendations to scale grid-connected solar energy development. The report draws from extensive individual and group stakeholder discussions as well as research and analysis of national, state, and international programs.

The full report can be found online at:
www.nrdc.org/international/india and www.ceew.in/solar

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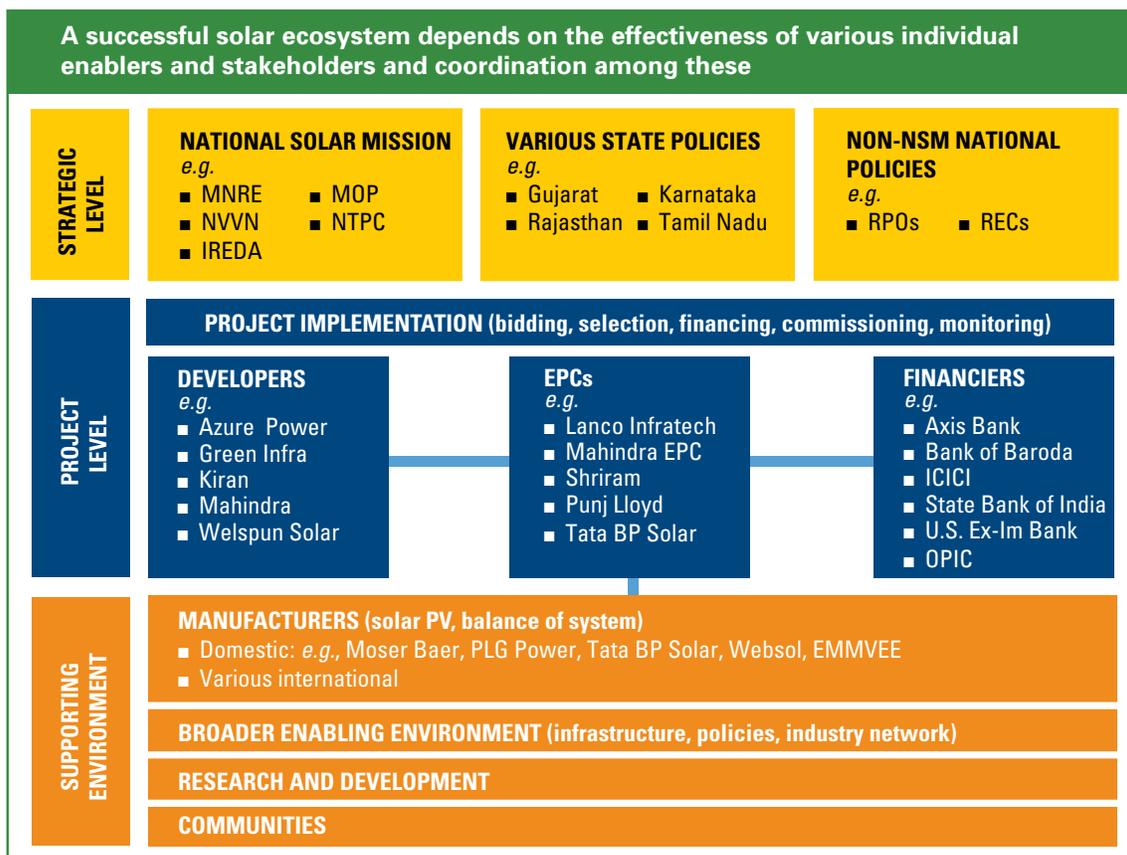


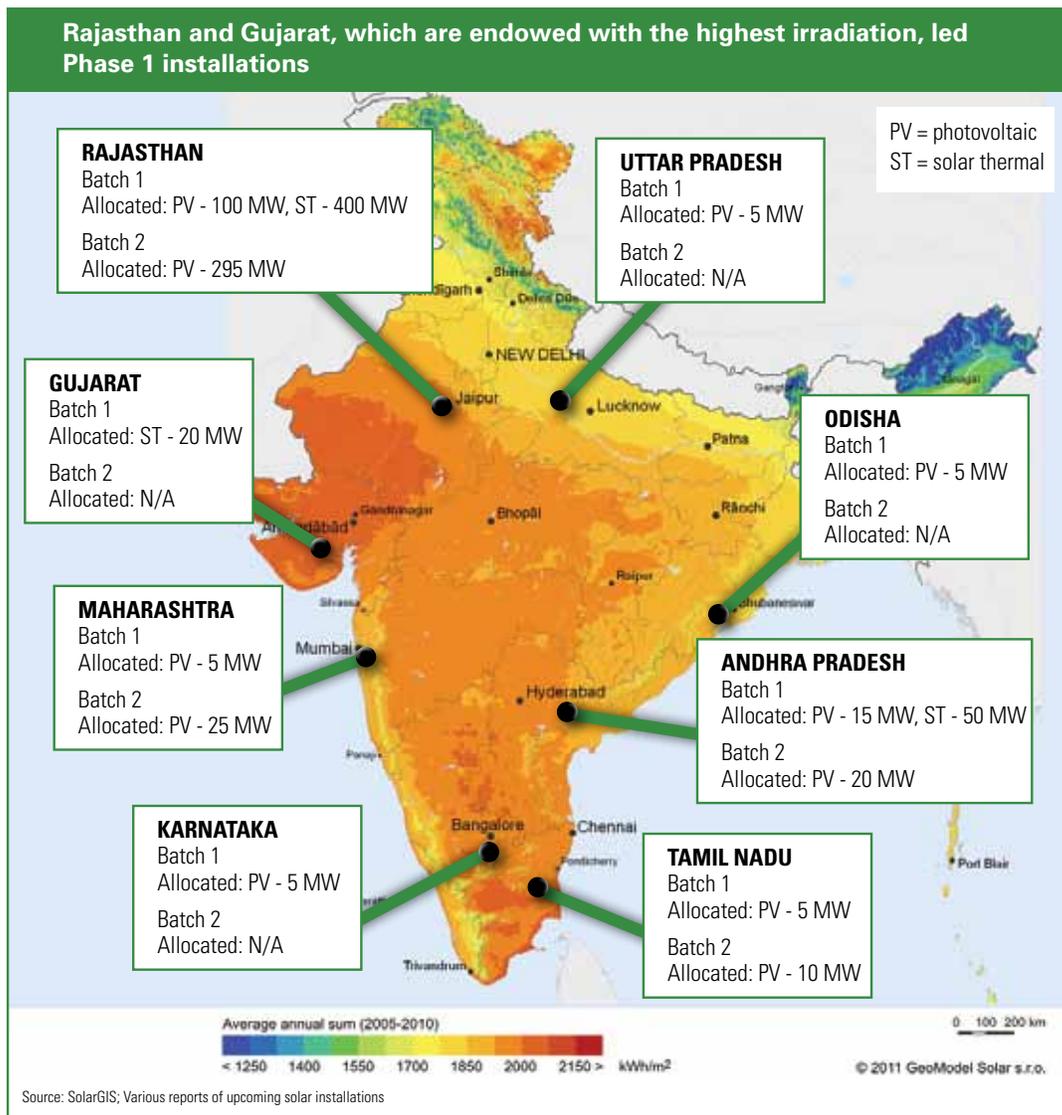
PHASE 1 OF THE NATIONAL SOLAR MISSION: “BUILDING SOLAR INDIA”

During the Mission’s first phase, more than 500 bidders competed for 63 projects allocated during two reverse auctions, driving prices to record lows. New solar energy investments in India increased to more than ₹12,000 crore (\$2.5 billion) in 2011. Phase 1 activities have focused largely on achieving 1,000 MW of solar energy through an equal split between solar thermal and solar PV project technology. Although Indian industries have responded positively to the Solar Mission, it faces several hurdles in moving ahead. To scale solar energy, the central government—with coordinated action by states, developers, financial institutions, manufacturers, research institutes, and communities—needs to develop effective solutions for more credible project bids, enforceable Renewable Purchase Obligations (RPOs) and Renewable Energy Certificates (RECs), strong financial structures, increased domestic manufacturing, and reliable power evacuation and transmission. Moreover, off-grid solar energy, largely a missed opportunity so far, is ripe for investment.

OVERALL FINDINGS

1. The sophistication of solar energy stakeholders is increasing. However, a much greater degree of coordinated stakeholder action is needed to unleash the solar energy market’s potential.
 2. As an overarching policy framework, the National Solar Mission (NSM) aims to increase deployed capacity, enforce regulatory obligations for using renewable energy, create a manufacturing hub in India, and
3. Infrastructure, policy, and market conditions are shaping India’s solar market differently from other solar markets. Unique attributes include the prevalence of ground-mounted solar parks, thin film PV technology used in more than half the projects, and low bid prices that make grid parity possible in the near future.
 4. Overall, stakeholders viewed the reverse auction bidding process as transparent and successful in driving down prices. However, financial institutions, civil society groups, and some developers suggested that in order to draw serious players with an ability to ensure project completion, and attract financing, project selection criteria should be more rigorous. Moreover, for the Mission to remain credible, financial due diligence and continuous monitoring are needed to ensure that commissioned projects are operational at contracted capacity and generating solar power that is transmitted to the grid.
 5. Indian bankers still perceive significant risks in the solar energy market and are largely hesitant to make substantial investments in solar technologies. International lenders, less risk-averse on the technology front, offer lower interest rates but remain skeptical about project completion. To bolster confidence among financiers, a range of funding channels, financial institutions, and other stakeholders must coordinate at program and project levels and provide ancillary support, such as R&D and skill development, to help the solar market mature.





6. State policies have contributed to boosting solar projects in the past two years, especially in Gujarat and Rajasthan. For Phase 2, the central government needs to increase collaboration with states to facilitate RPO and REC compliance, project bidding, financing, power evacuation, transmission, and land acquisition.
7. While the domestic content requirement (DCR) has garnered international attention and raised concerns among some foreign stakeholders, most developers do not identify it as a major barrier to project development. The case for a robust domestic manufacturing base rests on multiple objectives: energy security, technology development, energy access, ensuring product standards, attracting foreign investment, and creating jobs. Even so, many manufacturers expressed the view that the DCR, as currently structured, is not sufficiently stimulating local manufacturing. Manufacturers face other systemic limitations, such as poor infrastructure, lack of raw materials, an undeveloped supply chain, and lack of financing.
8. Many developers have faced difficulties in obtaining clearances to convert land use for solar project development and encountered claims by other parties to government-allocated land. In terms of infrastructure,

some developers have experienced difficulties with power evacuation and transmission lines to substations. Limited availability of skilled labor also remains a barrier to wide-scale project development.

9. To protect local interests and the environment, developers and government agencies need to increase community involvement in the decision-making process, from project planning to operations.
10. All stakeholders agree that while Phase 1 focuses on grid-connected projects, off-grid solar energy provides an even larger opportunity. They state further that stakeholders should work collectively to develop both public and private strategies for large-scale deployment of off-grid projects.

BANKABILITY: FINANCING SOLAR ENERGY PROJECTS

In 2011, investments in India's renewable energy markets rose to approximately ₹51,000 crore (\$10.3 billion),² with more than one-third of the investments directed to solar projects. Investments are expected to double for Phase 2. Yet the greatest challenge for solar energy is project financing. Even for smaller Phase 1 projects, developers struggled to raise capital from multiple domestic, international, and self-

financing sources. While there has been some improvement, most domestic banks still perceive significant risks in solar investments. International and bilateral lending institutions that supported several Phase 1 projects remain interested in supporting additional projects but want more rigorous project selection requirements, such as balance sheets and vetted collateral. Well-structured RPOs, RECs, and innovative funding mechanisms are opportunities for increasing investments in solar energy. In short, with major information gaps and potential market failures, financial markets will not automatically warm up to the solar market without strategic interventions to create a financing ecosystem.

Key Findings for Bankability

1. India's high interest rates impede project development, especially as the costs of solar plants are largely in up-front capital. Overseas financing is more attractive, both for lower interest rates and for longer-term debt, which match the longer payback period of solar loans.
2. Banks have a low comfort level with solar investments because of the lack of information available, and need more data and statistics on project development, deployment, and performance. They also need irradiance measurements from local settings, which are currently not recorded.

3. Financial institutions perceive solar energy in India as a riskier investment because it is a fledgling industry without a proven track record in meeting commissioning deadlines, performance benchmarks, and delivering power.
4. RECs represent an opportunity to support the solar market, but regulators need to strengthen the mechanisms for trading and enforcement since uncertainty about enforcement diminishes investor confidence.
5. Capacity building and networking among banks and other financial intermediaries are needed to increase information sharing and awareness within the financial community. The Ministry of New and Renewable Energy (MNRE) has initiated activities toward awareness building and information dissemination, but much more can be done.

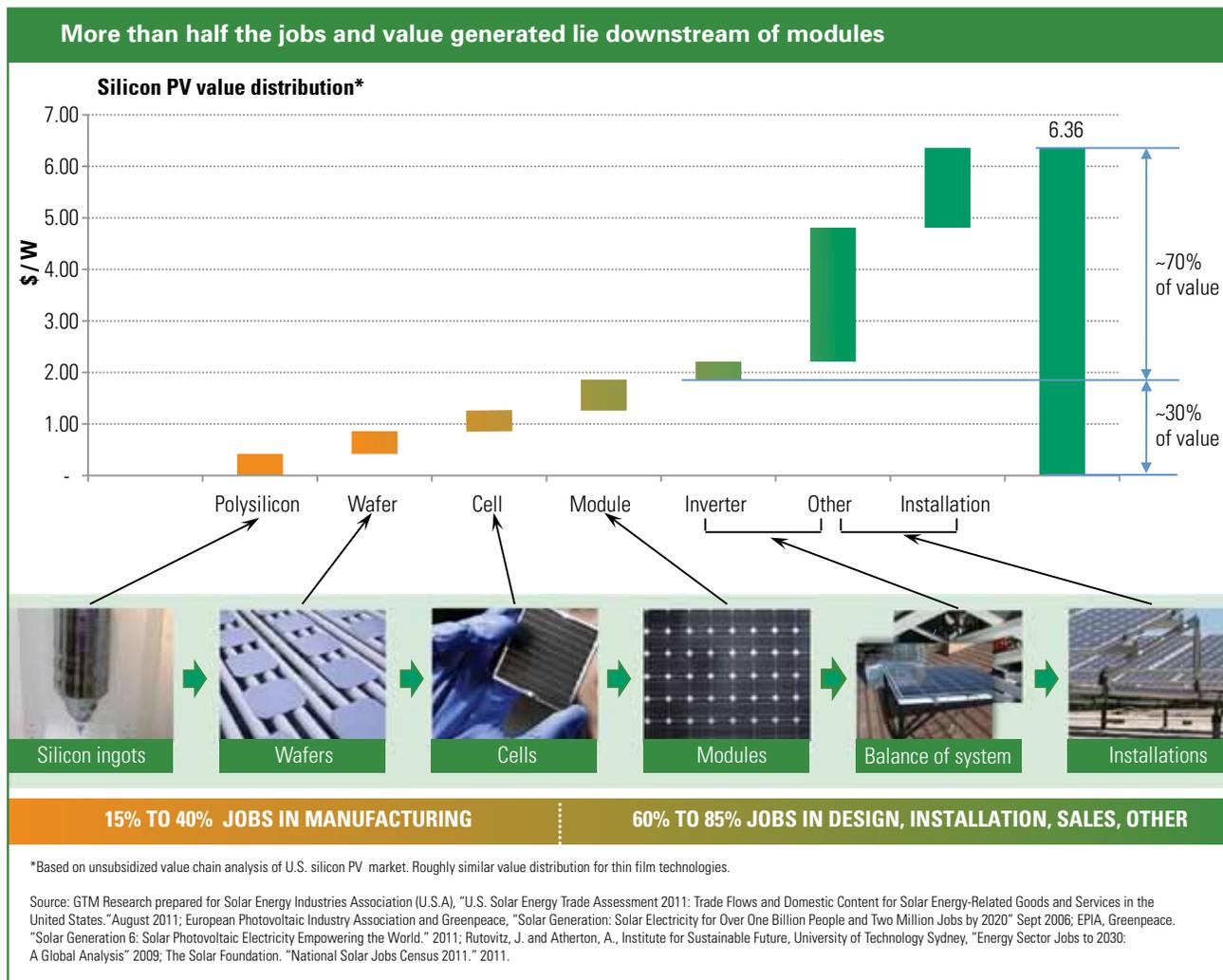
Key Recommendations for Bankability

1. Regulators should diligently enforce RPO mandates and the REC market. National and state agencies should work together closely to ensure effective RPO and REC systems.

A range of private and public institutions have a role in enhancing bankability and overall solar market development		
	INSTITUTIONAL EXAMPLES	ACTUAL/POTENTIAL ROLE
STRATEGIC LEVEL	Indian Public Sector (non-bank) Financial Intermediaries: Reserve Bank of India; IREDA; Life Insurance Corporation	Priority sector lending; Concessional loans; Long-term debt
	Non-Financial Supporting Institutions: Solar Energy Corporation of India; Indian Banks' Association; Solar Energy Centre; BEE; C-WET	Channeling funds; Information provision; Skills; R&D; Component certification
	Multilateral Funding Channels: International Finance Corporation; Asian Development Bank; World Bank; Clean Technology Fund; Green Climate Fund (potentially)	Payment guarantees; Capacity building (esp. due diligence); R&D
PROJECT LEVEL	Indian Banks: Axis Bank; Bank of Baroda; ICICI; IDBI; Indian Overseas Bank; State Bank of India	Debt financing; Non-recourse project finance; Innovative finance (such as IDFs)
	Non-Bank Financial Institutions: IDFC; Infrastructure Debt Funds	Project finance; Support for market upscaling; Bridging finance gaps
	Overseas Funding: US-EXIM; US-OPIC; KfW (Germany); Multilateral Funding Channels	Concessional finance; Long-term debt
	Other: Venture Capital; Private Equity (Domestic and Overseas); Other early stage investors	Market entry support; Market upscaling; R&D
ANCILLARY MECHANISMS AND MEASURES	Fiscal support: NVVN/NTPC (Bundling); CERC (FiT); MNRE (Payment Guarantee Scheme)	Lowering costs; Incentivizing investment; Increasing market confidence
	Market Mechanisms: Carbon Market (CDM and Voluntary Market); Renewable Energy Certificates	Additional revenue support to incentivize investment
	Other: Bilateral Funding; Private Companies; Educational Institutions; National Skill Development Corporation	R&D; Skills development and training

- With the Reserve Bank of India and the Ministry of Finance, MNRE should encourage priority sector lending for large-scale solar projects to help reduce lending rates to as low as 10 percent and to provide higher employment potential for downstream solar activities.

loans, share information, and conduct workshops where bankers, developers, manufacturers, and entities in engineering, procurement, and construction (EPC) can come together to exchange knowledge and experiences about solar investments.



- To provide longer-term debt, the government should enhance funding mechanisms, including the proposed Infrastructure Debt Funds. To further reassure financiers, MNRE should share information on the payment security mechanism (PSM) and clarify how the PSM has been calculated to effectively cover potential default on payment.
- Government agencies and private groups should provide solar resource and project deployment data as soon as they become available. MNRE and the Solar Energy Corporation of India (SECI) should work with developers to establish monitoring and reporting processes that can be implemented before Phase 2. SECI should become a central clearinghouse for all information dissemination relating to the solar ecosystem. A sharing platform for improved irradiance data should be created to disseminate information as it is generated.
- The Solar Advisory Panel and leading financial institutions should create a network of solar finance leaders to develop bank products that support solar energy. Such a network could work together to syndicate

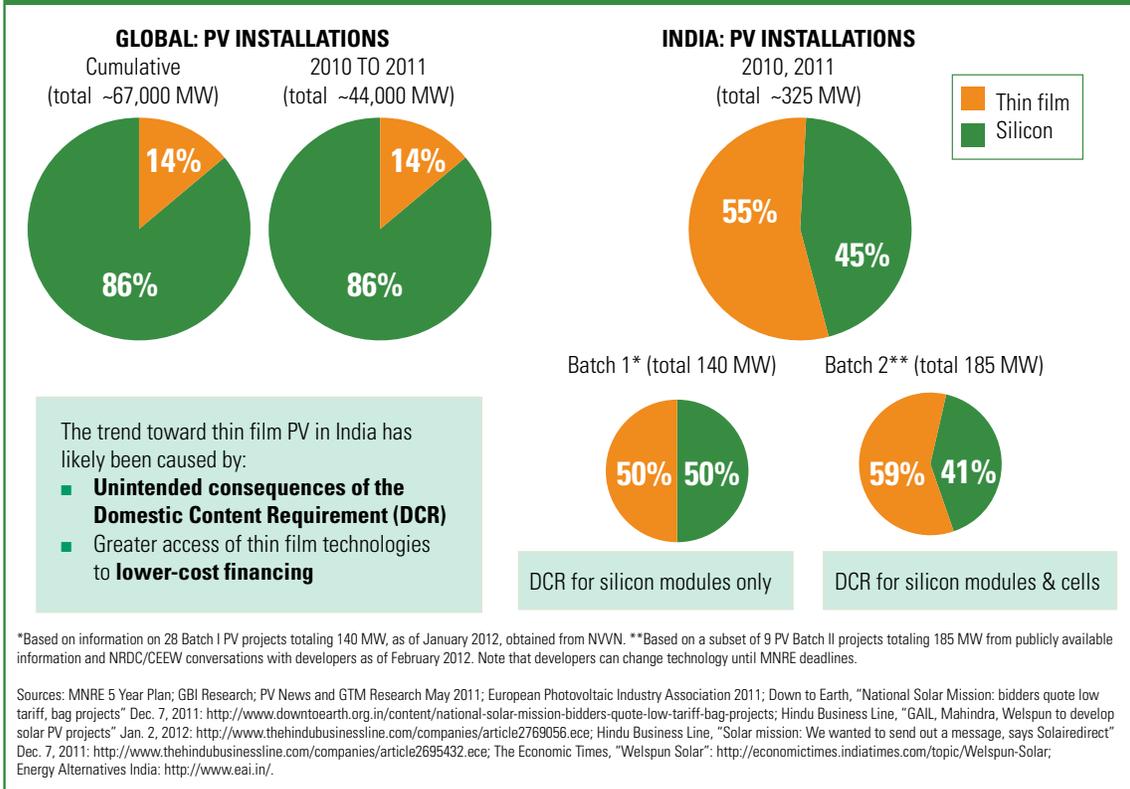
MANUFACTURING: SUPPORTING A DOMESTIC INDUSTRY

Solar cell and module manufacturing offers India a long-term opportunity to become a major manufacturing player, accelerate grid-parity, and build a sustainable solar industry. The Mission's Phase 1 domestic content requirement mandated local manufacturing of crystalline PV modules for Batch I projects, and both cells and modules for Batch II projects, while exempting thin film PV. While most local stakeholders strongly favor domestic manufacturing policies, at this stage it seems that the DCR has been only marginally effective in creating a vibrant domestic manufacturing base.

Key Findings for Manufacturing

- Phase 1's domestic content requirement has contributed to shifting the market toward thin film PV projects due to their exemption from the DCR. Fifty-percent of Batch I projects use thin film and crystalline cells, a larger proportion than in the global PV market. Batch II projects use even more thin film technology, probably because Batch II requirements for domestic crystalline

The mix of PV technologies deployed in the Indian market is markedly different from the mix deployed globally



cell manufacturing have made lower-priced, imported thin film, often coupled with low-cost international financing, more attractive to developers.

2. The Phase 1 domestic content requirement as currently structured has not effectively created the market conditions for local solar PV manufacturing envisioned by the NSM. The DCR has not created a level playing field. Instead it has contributed to a strong thin film bias and has possibly been a detriment to Indian crystalline-based manufacturing.
3. The Indian solar cell manufacturing system requires systemic improvements in infrastructure, domestic low-cost financing, and raw materials.
4. More than half the jobs in the solar value chain and value creation are not in solar manufacturing, nor specifically in cell and module manufacturing. Severe environmental costs linked to unregulated solar manufacturing also exist.
5. A modified DCR could have a positive influence on domestic manufacturing if it is technology-neutral and not overly restrictive.

Key Recommendations for Manufacturing

1. The central government, with stakeholder input, should explore whether incentivizing policies with a broader scope than solely cell and module manufacturing would capture more value and create more solar jobs within the Indian context.
2. MNRE should tailor the DCR to be technology-neutral and market-enabling. MNRE could explore two options: (a) a DCR requiring that all PV modules be manufactured

in India, uniformly enforced across all PV technologies, or (b) a DCR specifying that a certain percentage of solar PV components be manufactured in India.

3. To avoid being restrictive and to lessen the potential for international controversy or trade disputes, MNRE could consider incentives other than a DCR, such as a preferential tariff, to promote domestic manufacturing.
4. Manufacturers should strengthen existing networks, such as SEMI, to explore ways to ease barriers to manufacturing in India. The manufacturing networks could develop policy proposals to address natural resource, finance, and trade limitations.
5. MNRE should work with the Ministry of Environment and Forests to strengthen environmental safeguards to ensure that manufacturing can continue to grow rapidly while protecting community health and the environment.

ENABLING ENVIRONMENT: FACILITATING LAND ACQUISITION, PERMITTING, AND POWER EVACUATION

One of Phase 1's immediate goals is to create an "enabling environment" for solar technology penetration in India. In addition to the broader areas of bankability and manufacturing, our discussions with stakeholders identified four main causes for delays in project implementation: land acquisition issues, concerns with power evacuation, the lack of effective community involvement, and the lack of a comprehensive Solar Mission implementation plan.

Key Findings for Enabling Environment

1. Land acquisition issues, including siting, clearances, and grid proximity, are delaying projects. Currently, land costs represent a small share of total project costs and are not the most significant barrier to land acquisition. While in early stages, solar parks have proved to be effective in facilitating project development and reducing delays.
2. Several developers and financiers have identified power evacuation and access to the grid as issues of concern, and in their absence, it has been difficult to secure financing for projects.
3. Developers are confused about which entity or agency is responsible for last-mile infrastructure, resulting in project delays.
4. Actively involving communities in every stage, from planning to operation, will strengthen solar energy projects. Project developers already recognize that there are co-benefits that can be shared with local communities and that problems can arise if local communities are not engaged throughout the process.
5. To enable industry progress, developers, banks, and other stakeholders have identified the need for a long-term implementation plan that focuses on the entire supply chain, investment in research and development, labor force training, and the provision of sufficient and customized financial incentives.

Key Recommendations for Enabling Environment

1. The central government should closely and systematically coordinate with state governments on project allotment, land acquisition, and project development, particularly for the larger Phase 2 projects. Specifically, MNRE should work with states to develop effective land allocation strategies for solar projects, including strategies to facilitate siting and planning requirements.
2. MNRE should also collaborate closely with the Ministry of Power to plan for transmission infrastructure upgrades within a long-term power planning framework focused on scaling renewable energy.
3. Before bidding for Phase 2 projects begins, MNRE and developers should work together to resolve whether last-mile infrastructure costs should be included in project estimates.
4. To strengthen solar projects, developers should integrate local communities at the planning stage through regular community meetings and engagement.
5. The solar industry should create a network of solar energy groups focused on resolving common industry concerns, interacting with government agencies, developing solutions for the entire solar supply chain, investing in research and development, and increasing the solar energy workforce.

Solar project land development options

Land Ownership	Key Features	Advantages for Developers	Disadvantages for Developers
Developer Purchased & SPV Owned	Project developer purchases land and special purpose vehicle (SPV) entity owns the land as an asset on its balance sheet	<ul style="list-style-type: none"> Full developer flexibility in choice of location according to solar resource and other siting criteria Use of land as part of collateral for project finance Option of sale or renewal at end of project life 	<ul style="list-style-type: none"> High upfront costs Challenging purchase process if land use must be changed, e.g., from agricultural to non-agricultural or multiple land claims Developer has full responsibility for site due diligence and permitting
Lease by Government	<ul style="list-style-type: none"> Government purchases, acquires or otherwise earmarks land for solar development Lease periods typically match project life, e.g., 30 years 	<ul style="list-style-type: none"> Lower upfront investment in land cost Ability to spread land costs over project lifetime and matching of costs with revenues Availability of land with pre-approved clearances and permits Flexible government incentives and leases 	<ul style="list-style-type: none"> Lesser flexibility in siting and choice of location Limited opportunities to lease government land Increased government interactions and processes
Solar Park	<ul style="list-style-type: none"> Government or a private developer purchases or acquires land Solar parks usually include incentives such as permits for developers and provide dedicated power infrastructure 	<ul style="list-style-type: none"> Solar parks provide economies of scale in procurement, permitting, and development of power Well planned solar parks can allow quicker and more reliable project execution with fewer implementation risks for developers 	<ul style="list-style-type: none"> High reliance on solar park developer or government for correct siting and assessment of solar resource Potential cost increase and weaker negotiating position with respect to government and solar park developer

LOOKING AHEAD: THREE POLICY PRIORITIES

While the Indian government and solar energy stakeholders have made significant progress, much more needs to be done. Implementing three key policy priorities this year would enable strong growth under the Solar Mission:

Benchmarks, Transparency, and Monitoring: There is an urgent need to increase the level of information available on the Mission's progress. The government should enforce periodic updates on each project's progress, without which its project selection process and due diligence will be called into question. The government should adopt a common definition of "commissioning" as well as common benchmarks for commissioning projects under the state and national Missions. Moreover, for financiers to become more familiar with technologies, and for component standards to be closely monitored, project technology choices need to be transparent. Finally, irradiance data must be made publicly available to increase confidence and investment in the solar market.

Strategic Financing: Central and state government agencies, with MNRE's leadership, should develop a strategy to optimize the roles of different financial institutions. As the market matures, various institutions should leverage their expertise to grow India's solar market. For example, certain groups should focus on providing project financing,

while others should focus on disseminating information to the market, and others should focus on R&D and skill development. Only when a comprehensive financing strategy is in place will different financial interventions (e.g., priority sector lending, development of the REC market, and the role of infrastructure debt funds) succeed in scaling solar energy investments.

Technology-Neutral Manufacturing: To make domestic manufacturing policies technology-neutral and market-enabling, MNRE could explore the following options: (a) a DCR requiring that all PV modules be manufactured in India, uniformly enforced across all PV technologies; or (b) a DCR specifying that a certain percentage of the solar PV components be manufactured in India; or (c) a preferential incentive to promote domestic manufacturing instead of a DCR to avoid being restrictive and to lessen international controversy.

The NSM has the potential to transform India's energy sector and help power its rapid economic growth while building a sustainable future. India needs continued government and private sector support, increased investment in manufacturing, and increased technology sharing to unleash this potential in the Mission's next phase. The report's recommendations are submitted with a view toward promoting a comprehensive and strategic approach to building a robust grid-connected solar industry in India.

About the Council on Energy, Environment and Water and the Natural Resources Defense Council

The Council on Energy, Environment and Water (CEEW) and Natural Resources Defense Council (NRDC) are partnering to conduct an assessment of the National Solar Mission to accelerate clean energy solutions in India.

CEEW is an independent, not-for-profit policy research institution that works to promote dialogue and common understanding on energy, environment, and water issues in India and elsewhere. www.ceew.in.

NRDC, a leading U.S.-based environmental organization, is working with partners in India on efforts to solve our shared challenges of climate change and clean energy. www.nrdc.org/international/india.

- 1 MNRE press statement, "Generation of Solar Power," March 19, 2012, pib.nic.in/newsite/pmreleases.aspx?mincode=28 (503.9 MW on March 19, 2012; accessed April 2, 2012); Communication from MNRE, March 26, 2012 (clarifying 3 MW increase to 506.9 MW); Natalie Obiko Pearson, "India Misses Solar Target With 20-Fold Jump in Capacity in Year," *Bloomberg*, January 2012, bloomberg.com/news/2012-01-20/india-misses-solar-target-with-20-fold-jump-in-capacity-in-year.html (17.8 MW in 2010; accessed April 2, 2012).
- 2 "2011 Worldwide Renewable Investments Set Record," *Today's Energy Solutions*, January 25, 2012, onlinetes.com/worldwide-renewable-energy-investments-tes-012512.aspx (accessed April 2, 2012).

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