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Centre for Environment Education

Policy Brief

Informing the Indo-German Solar Energy Partnership

Insights from five stakeholder consultations in
India on solar policy



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 HEINRICH BÖLL STIFTUNG
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Project Director: Kartikeya V. Sarabhai

Project Co-Ordinator: Rixa Schwarz

Project Team: Ashwin Wasnik, Pooja Dave, Purvi Vyas, Rixa Schwarz

Authors: Purvi Vyas, Rixa Schwarz

Design: Hardik Raval, Hitesh Vaza

Production: Mukesh Panchal

Photographs: Rixa Schwarz

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CEE is an internationally acclaimed institution in the field of Environment Education (EE) and Education for Sustainable Development (ESD). It has considerable experience and expertise in addressing its primary mandate of improving public awareness and understanding of the environment with a view to promoting the conservation and sustainable use of nature and natural resources.

Its programmes are facilitated through 40 regional, state and project offices across the country with its headquarters located at Ahmedabad and affiliates in Australia. Over the past thirty years, CEE has been working in the field of EE. It has developed innovative programmes, educational material, undertaken demonstration projects and built capacities in the field of environmental education. Recognizing the complexity and vastness of work in the field of ESD, CEE works in partnership with a range of organizations at the national, regional and international level. The strategy is to collaborate with others to build synergies, achieve a multiplier effect, enhance effectiveness and widen the range of programmes.

The views expressed in this paper are intended for discussion and do not necessarily represent the views of the Centre for Environment Education nor of the project partners.

Summary

Ambitious solar targets like India's goal to achieve 100 GW solar electricity by 2022 require supportive policy environments. At India's incipient solar boom the solar policies request constant revisions according to the needs of the hour. Five stakeholder consultations in rural Gujarat (two), Ahmedabad, Bengaluru and Delhi from December 2016 to March 2017 provided insights from farmers and salt pan workers, household consumers, manufacturers and service providers, consultants, government, think tanks, scientist and NGOs on current requirements on solar policy improvements. These inputs lead to a row of political recommendations which seek to inform national solar regulations, the Indo-German solar energy cooperation including the Indo-German Solar Energy Partnership and India's multilateral solar policy engagement.

The most urgent need among the expressed concerns is the wide-ranging capacity building need, such as building a skilled workforce and providing certificate systems as well as informative online platforms on solar adoption. Further, quality-related technology improvements, simplified administrative processes and sufficient financial support through meaningful subsidies were mentioned in the five consultations carried out by CEE in partnership with GERMI. The distinctly suggested policy focus for a successful solar boom in India lies on solar rooftop support.

1. Introduction

India's ambitious solar power target of achieving 100 gigawatt (GW) by 2022 is part of its climate action plan while it aims to ensure energy security for all, economic growth and development. The discrepancy between today's 12 GW installed solar power capacity¹ and the 2022 target is still considerable, if not to say huge. The same holds for the solar rooftop target of 40 GW (compared to today's 1 000 MW). A multitude of measures like solar energy policy frameworks, increased investment, technology improvement and on-ground efforts undertaken by the central and state governments, the private sector, research institutes, NGOs and communities are contributing to achieving the targets. The dropping prices for solar energy foster this development and allow for commercial and non-commercial solar energy utilisation across India. However, such ambitious solar targets need a supportive policy environment to be achieved. Half way through the National Mission on Solar Energy, nevertheless, there is a need to accelerate the transition process. A boosting solar energy development for an Indian energy transition towards renewable energy meets the objectives of the Paris Agreement and the Sustainable Development Goals (SDGs).

The Indo-German Solar Energy Partnership as one means to support and intensify the solar revolution in India is a timely intervention, founded on the long tradition of cooperation on energy, climate change and sustainable development between the two nations. The memorandum of understanding signed by the German and the Indian governments in October 2015 for this partnership envisaged continued technical and financial support of earlier cooperation to boost the use of solar energy in India. The major focus lies in the field of solar rooftop followed by the development of solar parks or solar zones near the Green Energy Corridors and solar off-grid applications. The technical assistance includes components of the capacity building, setting technical standards, setting up the administrative and legal framework, operational and infrastructure aspects, market mechanisms and business models based on Germany's initiatives and learnings, especially from its solar rooftop experience.^{2,3} At the Indo-German government consultation in summer 2017 both countries agreed to continue the annually 1 billion Euro extensive cooperation on renewable energy, environment and resources, smart cities, capacity building and other topics. Indo-German cooperation on solar projects and transmission grids of the recent years has led to 5.5 million avoided tCO₂.⁴

Centre for Environment Education (CEE) organized five solar energy consultations with support from Heinrich Böll Stiftung India (HBF) and in Partnership with Gujarat Energy Research & Management Institute (GERMI). The stakeholder consultations

¹ MNRE, 2017: Commissioning Status of Solar Power Projects as on 31st January, <http://mnre.gov.in/file-manager/UserFiles/grid-connected-solar-power-project-installed-capacity.pdf>

² MNRE, 2015: Memorandum of Understanding on the Indo-German Solar Energy Partnership, <http://mnre.gov.in/mous/MoU-with-Germany-on-Solar-Partnership.pdf>

³ GIZ Indo-German Environment Partnership: <http://www.bmz.de/20170530-1>

⁴ BMZ, 2017: Pressemitteilung zu Regierungskonsultationen, <http://www.bmz.de/20170530-1>

sought inputs from a wide range of stakeholders on challenges, gaps and learnings from different experiences across the country in fostering the use of solar energy. This bottom-up consultative approach aimed at helping to bridge the gap between policy formulation and implementation and build momentum for adoption of solar energy systems, informing national solar policy, the Indo-German bilateral solar cooperation and possibly also the International Solar Alliance and other solar partnerships.

The present policy brief summarizes the outcomes of the stakeholder consultations' discussions and concludes with practical policy recommendations.

2. Stakeholders' insights on the status quo of policy for solar energy adoption in India

CEE approached a diverse group of stakeholders including farmers and salt pan workers, household consumers, manufacturers and service providers, consultants, government, scientist, think tanks and NGOs to participate in five consultation events to share their perspectives on solar energy utilization and policy. The five stakeholder consultations were held in Dhundi /Anand and Halvad (both rural Gujarat), Ahmedabad, Bengaluru and Delhi from December 2016 to March 2017.

This chapter recaps the main insights from the stakeholder discussions in the rural and urban events. All stakeholders articulated the need for revising financial support policies, raised technology concerns and highlighted capacity building demands as well as the need for adjustment of the current administrative processes for solar power adoption. The interlinkages of poor technological quality of solar cells, at times inaccurate installation of the panels and their incorrect maintenance lead to reluctance of investments in solar energy projects - aspects which the participants suggested to be addressed by comprehensive capacity building. The explicit call for more relevant subsidies through simpler and standardized administrative processes was unmistakable. The vehemently suggested policy focus for a solar policy improvement in India lies on solar rooftop support. The funding for 30% capital subsidy for rooftop solar installations should be extended and supported by technology and capacity building measures.

2.1. Finance

Existing initiatives

Insufficient financial support in terms of total amount, criteria for receivers and non-transparent subsidy processes is commonly identified as the largest bottleneck for solar installation in India. Government of India estimated an investment need of Rs. 6,00,000 cr Rupees⁵ to achieve the solar energy targets. Currently, India has about 14 GW of solar projects under development and more than 6 GW capacity projects wait

to be auctioned.⁵ National funds, as well as foreign investment, banks and other actors have started addressing these financial requirements of the solar sector through differing schemes regarding technology and recipient. Government subsidies for solar rooftop for institutional, social and residential sectors remain the main financial support. Solar PV subsidies vary based on grid-feed and off-grid, project size and location, battery support and other criteria. Indian Renewable Energy Development Agency (IREDA) provides e.g. subsidies according to Ministry of New and Renewable Energy's Rooftop PV and Small Solar Power Generation Programme (RPSSGP) but also for large scale solar parks. For solar water pumps government subsidy of up to 48% is routed through National Bank for Agriculture and Rural Development (NABARD). On the other hand, the NABARD subsidy scheme for Solar Home Lighting Systems in rural areas has recently been stopped. Solar water heating systems (solar thermal) are supported through subsidies and loans.

Increasingly, public sector banks identified by the government provide funding for solar rooftops as a part of the home loans and home improvement loans. The Indian Renewable Energy Development Agency Limited is a government enterprise, a non-banking financial institution that supports renewable energy projects including solar. Also micro-finance agencies provide solar subsidies. The private sector progressively invests in solar power, too. The World Bank is working with Indian organizations to develop financial models and guidelines to evaluate solar project proposals. KfW (Kreditanstalt für Wiederaufbau) provides soft loans under the Indo-German Solar Energy Partnership. Auctions involve private players.

Further, different innovative models are used by the non-governmental or private organization on smaller scale. For example, SELCO is promoting a model where the customers rent solar portable light from a local community member. The pilot solar pumps cooperative in Dhundi, Gujarat, is getting paid for transferring surplus energy in the grid, with which the pilot seeks to avoid over-consumption of groundwater.

The consultations mentioned several existing financial mechanisms beyond these above examples but more importantly discussed learnings and ways to overcome current barriers. The emphasis has been on diversification of funding sources, allocating subsidies where they are needed and eventually, gradually moving towards the self-sustaining market for solar technology.

Subsidy provision

Finance related aspects have been highlighted by all stakeholders from consultants to consumers in the five consultations. For consumers such as private residents and farmers, the primary concern still is the upfront cost of the solar system which demands substantial investment. The tendency to compare the solar electricity source with the conventional energy sources - which is highly subsidized with no visible maintenance cost and responsibility for consumers - can result in

⁵ GOI, 2015: Press release, <http://pib.nic.in/newsite/PrintRelease.aspx?relid=122566>

⁶ Solar Quarter, 2017: Media feed, <http://www.solarquarter.com/index.php/industry-insights/2728-investment-scenario-in-indian-solar-sector-driving-growth>

environmentally and economically misleading energy choices. Real pricing for both conventional and renewable energy is required for correctly informed consumer choices. In the consultants' and installers' views, the solar sector by far is not yet self-sufficient. Thus, the subsidy given by the government for solar rooftops has given a kick-start to the adoption of solar technology as it enables citizens recovering their investment in a limited duration (typically 3-4 years). Given the current subsidy structure and criteria for a cap to provide fixed monetary support, large firms are at a disadvantage with their expensive but quality products which cannot compete with small-scale integrators offering solar products at cheaper rates but quality may get compromised. Minor changes in criteria for subsidy provision can remove inherent bias from the market and enables large-scale firms to compete with small-scale integrators ensuring the quality of products for customers. Rural stakeholders stated the will to revise existing policy to enable farmers with conventional electricity connection to receive the solar energy subsidy.

Improvements in existing subsidy provision framework and alternatives

Pilot studies of implementation of rural and agricultural solar products that consider sustainability concerns - like the example of the Dhundi Solar Cooperative in Gujarat - are important as they give valuable practical learnings which can inform policy revisions. The Dhundi pilot has helped to create interest among farmers to understand the process of forming a solar cooperative and implemented solar water pumps with an attempt to avoid over-pumping of scarce groundwater. The consultants strongly suggested reducing the subsidy over time for energy generation from conventional sources and diverting that fund for the provision of subsidy for solar systems. Nevertheless, even solar energy subsidies were recommended to be phased out in the long run. Some consumers are willing to pay 5-15 percent of the total cost of installation of a solar system from their own pocket. Customers value meeting their own energy requirements over financial benefits. Other consultants pointed out that the 30 % capital subsidy given on solar rooftop unit by the government is insufficient considering the variable external costs like location of the site for solar panels installation, general wear and tear or maintenance costs, and requirement of a technical person at the site. Also, the fixed feed-in tariff for a specific duration of 25 years does not take into account the fluctuating prices of renewable energy and it is not necessarily always a win-win situation for consumers as well as electricity distribution companies. The approach of charging different day and night tariffs to consumers and putting heavy tariffs in place for industrial sector will enable electricity distribution companies to overcome their financial crisis. Various agencies especially government organizations engaged in transition processes require a subsidy for changing conventional energy systems (e.g. grid integration). Financial benefits and incentives like subsidy and feed-in tariff have nevertheless attracted consumers to harnessing renewable energy

Making solar energy affordable to more citizens e.g. through the creation of second-hand markets for solar technology is recommended especially for rural areas. Transparency in flow of subsidies and wins of the involved actors are requests which participants mentioned at several discussions.

Processes encouraging adoption of solar systems

The consultants and installers as well as residents and city municipalities stated that the current complicated and bureaucratic application process for solar rooftop subsidies is cumbersome. Delays in granting the subsidy become a demotivating factor. All stakeholders considered access to information and timely updates on policies and subsidies through a platform like the online portal is crucial. To enhance the quality of the process, it is suggested to set up a feedback process which enables customers to share their review regarding experience with installers or channel partners, comparable to the cab services Uber or Ola. For the provision of the subsidy amount, it is recommended that the government opts for a direct bank transfer method to the customer's account or providing subsidy directly to the manufacturers like in the LED light campaign. For consumers without rooftop spaces who want to generate and utilize solar power, options like community or collaborative solar plants or renting roof space are possible. However, such a clause requires to be incorporated in the solar policies. Tweaking the current building regulations can allow and give a push to the adoption of solar rooftops.

Availability of finance and de-risking of investment

Considering the sources and criteria for finance, large solar parks are at an advantage due to their promising returns and lower risk compared to small-scale solar projects and solar rooftops. However, if lower interest rates on the funds are granted to developers for large solar parks it will make this business more lucrative and eventually benefit consumers allowing them to pay lower power tariff. By approving solar rooftop as an asset, bank loan at a lower interest rate is a suitable option for finance. Other potential sources of finance are pension funds, insurance investment, tapping corporate social responsibility funds, income tax rebates, solar bonds, direct investment opportunity for citizens in the solar sector and utilization of the National Clean Energy Fund to provide third party risk guarantee to financial institutions.

The alternative mechanism or business model like renting solar systems, women self-help groups offering loans and money lenders providing finance at appropriate terms and conditions can add up to the efforts of larger institutions. It is suggested that layers of multi-lateral funds with national and private funds would be beneficial as it covers different types (e.g. solar parks versus solar rooftops) and context specific solar system requirements like low-interest levels from corporates to invest in rural areas.

2.2. Technology

Existing initiatives

The speedy technology development is seen as the backbone of the solar revolution in India. Government of India is promoting the necessary improvement in the advancement of solar technology, both photovoltaic and solar thermal (especially concentrated solar thermal). Four Centres of Excellence in solar energy are designated by the Ministry of New and Renewable Energy (MNRE) and different

academic institutions as well as R&D departments of companies conduct research on silicon and organic solar cells, performance, and reliability of panels, smart control systems for solar rooftops and solar passive architecture and green building technologies. The consultations highlighted the kind of technological improvement required in solar systems in use rather than novel advancement in the technology. Stakeholders' concerns are associated with the quality assurance of solar systems and availability of reliable solar products in the country. Moreover, the shortage of small-scale systems, building integrated solar solutions and the lack of choice of products was criticised repeatedly at the stakeholder consultations. In order to make solar technology accessible to more citizens, it is suggested to develop a range of quality solar products fitting in different affordability price brackets.

Availability of technology and its quality assurance

The stakeholders in all five consultations unanimously agreed for the betterment of the solar technology to harness clean energy. Rural stakeholders stressed on development of context specific solar technologies. For instance, the solar pump used in the Dhundi village, Gujarat which has high groundwater table does not work in the dry Kutch region due to lower groundwater table. There is a need for deliberation and experimentation in the use of solar technology in order to address specific queries. The consultants and installers stated that there are limited reliable brands for solar panels available in the country. Thus, a large number of panels are imported from China for which a quality assurance is uncertain. Other components of solar systems like inverters and batteries for storage require improvement for which there is a shortage of quality products in the market. To maintain the quality of solar products it has been suggested to strengthen testing laboratory facilities and introduce ISO certification specifying technicalities (e.g. performance, reliability).

The emphasis has been on improving batteries by replacing harmful substances like cadmium and lead by lithium ion or finding recycling options. Storage becomes even more crucial in case of fulfilling needs of power deficit states and regions requiring energy transfer and non-electrified regions and villages that demand decentralised solutions. However, there is a case on collaboration for transfer of energy from a solar park in Madhya Pradesh to Delhi metro rail which does not have energy storage facilities. This requires upgradation of infrastructure especially grids and heavy financial investment. Grid expansion and variable renewable energy (VRE) integration remain critical challenges in India for upscaling the centralized renewable energy use with transmission via the national grid.

The rural stakeholders, especially women based in remote locations, stated that they are in the need of storage facilities to use off-grid solar power at night. Improved storage capacity would foster the requests for more decentralized mini-grids than stand-alone systems. Such systems can for instance be used for street lighting in rural areas, where the common issue of battery theft can be bridged with mini-grid solutions. Even in urban and suburban areas, mini-grid supported street lightning has benefits over grid-connected systems as long as frequent blackouts keep occurring.

Net metering systems and their criteria in solar policies differ between Indian states. Different net metering options include group net metering (for example in Pondicherry) and virtual net metering (for example in Delhi) for collaborative harnessing solar energy (mostly used due to lack of spaces on rooftops) and load distribution net metering to reduce power shortage and avoid transfer and distribution losses. All these metering options need to be implemented through simple technological solutions with context-specific choices for suitable metering systems. Standardized systems help mainstream net, virtual net and load distribution net metering.

2.3. Capacity Building

Existing concerns

All five stakeholder consultations highlighted an enormous demand for further capacity building measures. In fact, capacity building was perceived as most urgent support at this state of solar power adoption in India. Stakeholders pointed out that capacity building for the solar boom is required on a large scale, starting with developing a solar-supportive mindset which is built on the knowledge that solar electricity can to a very large extent power a country like India. Also, information sharing on practical knowledge is required from frontrunner examples and their best practices to very specific information for solar consultants, funders, installers, business men, private people and political decision makers.

By initiatives like Make in India and Skill Council for Green Jobs, Government of India has acknowledged the importance of capacity building and promotes it also through the National Solar Mission, the Indo-German cooperation and by initiating the International Solar Alliance. Expert knowledge and a skilled workforce are significant to lead India towards 100 GW solar power by 2022. The learnings from the past phase of the National Solar Mission coincide with concerns raised in the consultation that quality and functioning of the solar system suffers due to lack of qualified personnel in the supply chain, administrative and other essential process. In remote locations, lack of availability of skilled personnel to repair solar system has led to abandoning its use. It also emerged in the consultation that lack of enough information and awareness about solar technology is hampering its adoption.

Stakeholders and their capacity building requirements

The solar rooftop installers (integrators and government approved channel partners), funders and investors like bankers and officials from the distribution companies and government officials have been identified in the consultation as crucial groups with the immediate capacity building needs. Solar panel installers require training to understand technicalities of the system, installation techniques, and gain knowledge on the availability of a variety of products in the market and on the provision of appropriate advice to customers on the basis of sound knowledge. This may include regular processes of installing solar panels in the right angle and direction as well as

maintenance advice for cleaning the panels without damaging the surfaces. It is advised to make training programmes mandatory for installers. For ensuring the durability of the solar system, not only installers but also solar consultants need to be constantly trained about new technological developments.

Awareness programmes are recommended for bankers to familiarize them with the functioning and feasibility of solar systems for individual use as well as large scale power generation to unlock the funding potential. Once the confidence is established in the functionality of the system, training programmes for introducing relevant financial models are imperative for this group.

For distribution companies (DISCOMs), technical training is essential covering various aspects including technical intervention for integration of solar energy with the conventional system, different net metering options, data monitoring and inferring required information. The needs include the development of alternative business models for DISCOMs when widening their portfolio from fossil fuel based electricity production to the inclusion of renewable options. The Ministry of Power's Ujwal DISCOM Assurance Yojana (UDAY) scheme needs to be widened in its approach to introduce options for the financial and operational reform of DISCOMs in India. In this regard, treating solar energy as an opportunity was also suggested to capacity build political decision makers.

It has also been highlighted that engagement of influential professionals like architects and electricians can encourage them to gain necessary technical knowledge and accelerate the integration of solar technology in the housing sector. Demonstration or seeing solar system in use ("seeing is believing") has proven successful for a majority of stakeholders but especially influenced household customers to get convinced and adopt solar power.

It was also suggested to improve communication among stakeholders and strengthen access to relevant information (such as change in policy, a list of approved installers) to support a faster energy transition. Both rural and urban stakeholders had queries regarding maintenance aspects. Thus, it is suggested to educate consumers on maintenance or even a checklist of dos and don'ts could be created. To enable consumers to make informed choice, a star rating (similar to electrical appliances) or reliability index can be framed giving information about solar panels. Online platforms can act as review portals providing full disclosure to common masses on aspects related to quality, efficiency, lifespan and ways to maintain solar panels. Other ways that can be employed to raise general awareness about solar systems are endorsement through medium like radio and television and endorsement by celebrities.

Existing initiatives

Currently existing capacity building programmes are offered by the government, non-government and private organizations. The National Institute of Solar Energy, an autonomous institution of the Ministry of New and Renewable Energy (MNRE) offers a three-month fully sponsored 'Suryamitra' skill development programme at different locations in the country for technicians, installers and service providers. The state

government agency, Gujarat Energy Research and Management Institute (GERMI) offers the 'National Certification Programme for Rooftop Solar PV. Gesellschaft für Internationale Zusammenarbeit (GIZ) as a part of the 'ComSolar'⁷ project has supported MNRE through various capacity building initiatives including for example training programmes on large- scale solar power plants for professionals, study tours for government officials regarding solar rooftops in Germany, and setting up demonstration project - e.g. the solar rooftop at the M. Chinnaswamy Stadium for cricket in Bangalore, Karnataka.

The Barefoot College, a non-governmental organization in Tilonia, Rajasthan trains semi-literate and illiterate women from rural regions to become solar engineers who successfully electrify villages by installing and maintaining solar panels⁸. Similar initiatives to these few selected examples need to be strengthened and increased in number as well as be adjusted to meet the manifold needs to tap the nationwide capacity building shortages.

2.4. Solution-Oriented Processes and Other Observations

Existing concerns

The stakeholders highlighted several concerns related to existing solar policy and processes and gave relevant suggestions for improvements. The following chapter lists topics and solutions from central planning to local implementation. Central and state solar policies should be aligned to be more effective. In cooperation between the centre government and the state governments the nationally valid targets must be translated into state targets. Supportive policy tools for state level implementation need to be developed.

Standardization and incentives in policy formulation

Comparable standards set for solar panels and standards for implementation can guide solar projects ensuring its overall quality. The clauses of the policies are revised frequently which leads to poor understanding of impacts. Implementation of a policy for a longer duration and its evaluation will yield constructive learnings. Along with standardization of policies, incorporating flexibility is important as it gives room for addressing context- specific issues. Convergence of solar policies with other policies like for example education policy by bundling use of solar energy with the promotion of digital equipment for schools can accelerate adoption of solar technology. The preliminary outcome of a study conducted by academicians suggests that the current approach of motivating consumers i.e. incentive from feed-in tariff

⁷MNRE, BMZ, GIZ: ComSolar, <http://www.comsolar.in/what-we-do/demonstration-projects/rooftop-photovoltaic-sports-stadiums/>

⁸Barefoot College: <https://www.barefootcollege.org/solution/solar/>

to adopt solar rooftops is not effective. This is because changes in the pricing policy affect the incentive consumers receive. Rather promoting solar systems as a means to fulfil their household energy requirement is advisable. Thus, it is essential to identify and incorporate appropriate incentive in policy formulation encouraging people to leapfrog. It is absolutely significant to understand on-ground energy requirement scenarios and important available source of finances for implementation of any solar project. To make solar energy a lucrative option for industries and corporates, the creation of special economic zone enabling them to source power from any entity other than specified electricity provider will create required circumstances for the transition towards solar energy. In special economic zones additional sustainability aspects than solar energy should be applied.

The electricity distribution companies concern is losing their customers leading to financial disadvantage. However, ways like working on the pricing policy e.g. different day and night tariff or cap on surplus energy that can be fed into the grid can be a solution. To enable smooth and transparent dealings between customers and electricity providers, availability of information on import and export of surplus energy in billing processes would prove beneficial. Solar adoption would be made easier if procedures of engagement between stakeholders and actors were standardized and made transparent. Examples are billing systems.

Data and feedback for informed policy formulation

Stakeholders suggested monitoring the production and consumption of electricity (from conventional and renewable sources) and creating a database to enable dynamic planning for the energy sector. It was further discussed that data availability is a shortcoming for solid solar policy planning. Stakeholders suggested starting to collect for better information on needs and utilization of solar energy, financial, technological and capacity building support requirements and other useful data in order to keep adjusting solar policies in an informed manner.

Another set of information that should be collected for improvements is feedback from consumers on installers and manufacturers and other solar stakeholders. Consumer feedback platforms were suggested to collect feedback on manufacturers, providers, consultants, installers and others for improvements in meeting customers' needs.

The clearly suggested policy focus to foster solar adoption in India lies on solar rooftop support. Solar rooftops were identified as the driving force for solar adoption. Suitable subsidies (probably during a transition phase before subsidies would be phased out) would make it possible.

Gaining stakeholders' support

In this regard, stakeholders found it essential to address the banks' reluctance to invest in solar - especially for small-scale solutions and rural areas. Financial de-risking measures should regard technology and financial tools, minimizing the risk of paying or not-paying consumers and especially de-risking for the rural sector as well as rooftops. Stakeholders perceived this is both required and feasible.

Last but not least, stakeholders underlined the need to foster political will for solar to create solar policy that leads to a true Indian solar boom that transforms the energy generation of the country long-lastingly. The enthusiasm of Prime Minister Modi for solar energy needs to spread. Likewise, the real-economy based statements by Energy Minister Piyush Goyal on solar energy becoming cheaper than coal in the near future⁹ need to trickle down via chief ministers and state environment and energy ministries to administrations and implementers at DISCOMs as well as private persons. A wide range of decision makers need to engage in a pan-India solar policy stimulation for the breakthrough of the Indian solar boom. This would create the indispensable mindset to see business models in solar energy and options for solar energy generation on every other rooftop.

3. Political Recommendations

The five solar energy stakeholder consultations resulted in numerous suggestions towards solar policy improvement. The following condenses the plenty expressed recommendations in thematic clusters according to the priority in which they were articulated. Many of them are relevant for national policy as well as for bi- and multi-lateral cooperation.

Information Sharing and Capacity Building

1. Fostering a **supportive mindset**, political will and mainstreaming solar energy generation as “the new normal” among the involved stakeholders from politicians, private sector actors and DISCOMs, bankers, scientists, technicians and consumers by keeping continued priority on solar energy policy in general and solar rooftop policies in particular
2. **Institution building** for expert knowledge and skilled workforce and to set standards for solar certificates for consultants, installers, manufacturers, and many other drivers of solar energy boom
3. Creation of **quality-controlled information sharing platforms** (i) for solar stakeholders' knowledge exchange and (ii) for customers' step-by-step guidance for solar energy utilisation and their guidance in choosing service providers and solar products

Solution-Oriented Processes

4. Establishment of closer **cooperation between central and state policy development** for coherent targets and accelerated implementation through appropriate support for each state

⁹ <http://www.climatechangenews.com/2016/04/18/solar-is-now-cheaper-than-coal-says-india-energy-minister/>

5. Creation of **guidelines and standards for solar implementation**, particular for procedures between local DISCOMs and costumers with own solar rooftops for smooth and transparent billing systems
6. Regular pre-studies for the selection of **appropriate (financial) incentives and other motivations** for specific target groups. Feed-in tariffs have not always proven to be consumers' first choice. Many feel rather motivated to quickly meet the energy requirements of their households in a cost-effective manner
7. Initiation of a comprehensive **database on solar energy generation**, local solar potentials, subsidy provision and other useful information for public access
8. Setting a **distinct focus on solar rooftop policy** by e.g. **de-risking financial investment** in solar rooftop installations of different sizes and by different stakeholders (private companies to private persons) or development of business models for rooftop solar which also keep the utilities' interests in mind.

Solar Technology Improvement

9. **Manufacturing guidelines for quality improvement and quality control processes** like ISO certification as well as **quality guaranteeing incentives** for manufacturers like top-runner approaches
10. Fostering **innovation for a broader range of solar products** through competitions, international technology exchanges, enhanced R&D on Indian needs, among others. This includes creative approaches for mainstreaming appropriate and flexible net metering options
11. Improving **research on storage** in regard of storage capacity, reduced battery prices, increased environmental performance including reuse and recycling of batteries and their components
12. **Grid expansion and grid improvement for Variable Renewable Energies**, for example via continued Indo-German cooperation on Green Corridors
13. Initiating a **star rating for solar products** to foster high quality products and guide the purchase decisions of the consumers
14. Decentralized solutions, especially mini-grids, need more attention in solar policy in order to achieve the energy for all goal

Subsidies and Other Financial Mechanisms

15. **Introduction of real prices** (including subsidies, environmental and health costs) for conventional and renewable energy and the according design of tariffs -systems of day and night tariff and variations between commercial and private rural and urban customers
16. **Simplification of subsidy application processes** for faster approvals with greater flexibilities for a wider range of technologies and applicants to be supported and easier payment methods by direct bank transfer and increased transparency

17. Policy adjustments for **making subsidies available where they are required**, e.g. for small-scale rooftop systems. Preparations for a solar subsidy phase-out in the long run, when no longer required
18. Stronger **diversification of sources for solar subsidies**, considering multi-lateral funds, bilateral cooperation, national and private funds
19. **Creation of second-hand markets for solar technology** to especially supply the rural areas or to meet smaller requirements that otherwise hardly meet the requirements of existing subsidy schemes

CEE

Centre for Environment Education

Thaltej Tekra, Ahmedabad-380054, Gujarat, INDIA
Phone: +91-79-26858002 to 09 Fax: +91-79-26858010
Website: **www.ceeindia.org**