ADDRESSING BARRIERS TO SCALING-UP RENEWABLE ENERGY THROUGH INDUSTRY INVOLVEMENT

MAIN REPORT

Report by

IREF
Indian Renewable Energy Federation

An initiative supported by

SHAKTI
SUSTAINABLE ENERGY FOUNDATION

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Organisations:

Indian Renewable Energy Federation (IREF) is a not-for-profit and technology agnostic association established in 2014, committed to function as a policy advocacy body for the promotion of renewable energy in India and make the country as a global leader in the field of clean energy, energy efficiency and energy conservation.

Shakti Sustainable Energy Foundation (Shakti) was established in 2009 and seeks to facilitate India's transition to a cleaner energy future by aiding the design and implementation of policies that promote clean power, energy efficiency, sustainable urban transport, climate policy and clean energy finance.

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List of Acronyms

AD:	Accelerated Depreciation
ADB:	Asian Development Bank
AERC:	Assam Electricity Regulatory Commission
APERC:	Andhra Pradesh Electricity Regulatory Commission
APPC:	Average Power Purchase Cost
AT&C:	Aggregate Technical & Commercial
BARC:	Bhabha Atomic Research Centre
BEE:	Bureau of Energy Efficiency
BoS:	Balance of Systems
BPCL:	Bharat Petroleum Corporation Ltd
B&W:	Banking & Wheeling
CAG:	Comptroller and Auditor General of India
CapEx:	Capital Expenditure
CASE:	Commission for Alternate Sources of Energy
CBG:	Compressed Biogas
C&D:	Construction and Demolition
CEA:	Central Electricity Authority
CEIG:	Chief Electrical Inspector to Government
CERC:	Central Electricity Regulatory Commission
CFA:	Central Financial Assistance
CFR:	Council on Foreign Relations
CNG:	Compressed Natural Gas
COD:	Commercial Operation Date
COP:	Conference of the Parties
CPSE:	Central Public Sector Enterprises
CSO:	Central Statistics Office
CSS:	Cross Subsidy Surcharge
CSTEP:	Center for Study of Science, Technology and Policy
CTU:	Central Transmission Utility
CUF:	Capacity Utilization Factor
DCR:	Domestic Content Requirement
DISCOM:	Distribution Companies
DLC:	District Level Committee
DNES:	Department of Non-Conventional Energy Sources
DNI:	Direct Normal Irradiance
EA 2003:	Electricity Act 2003
EESL:	Energy Efficiency Services Limited
EPC:	Engineering, Procurement and Construction
FiT:	Feed-in-Tariff
FOWPI:	First Offshore Wind Project for India
FY:	Fiscal Year
GBI:	Generation Based Incentives
GEC:	Green Energy Corridor
GERC:	Gujarat Electricity Regulatory Commission
GERMI:	Gujarat Energy Research and Management Institute
GDP:	Gross Domestic Product
GOBAR-DHAN:	Galvanising Organic Bio-Agro Resources Dhan
GoI:	Government of India
GST:	Goods and Services Tax
GUVNL:	Gujarat Urja Vikas Nigam Ltd
GW:	Giga Watt
HC:	High Court
HPCL:	Hindustan Petroleum Corporation Ltd
HT:	High Tension
ICRA:	Investment Information & Credit Rating Agency Limited
IEA:	International Energy Agency
IIT:	Indian Institute of Technology
INR:	Indian Rupee
IOC:	Indian Oil Corporation
IPP:	Independent Power Producer
IREDA:	Indian Renewable Energy Development Agency
IRENA:	International Renewable Energy Agency
ISA:	International Solar Alliance
ISTS:	Inter-State Transmission System
J&K:	Jammu and Kashmir
JBVNL:	Jharkhand Bijli Vitran Nigam Limited
JREDA:	Jharkhand Renewable Energy Development Agency
KERC:	Karnataka Electricity Regulatory Commission
kJ:	Kilo Joules
KPMG:	Klynveld Peat Marwick Goerdeler
KREDL:	Karnataka Renewable Energy Development Ltd
kV:	Kilovolt
kW:	Kilo Watt
kWh:	Kilo Watt hour
Li-ion:	Lithium-ion
LPG:	Liquefied Petroleum Gas
LT:	Low Tension
LVRT:	Low Voltage Ride-Through
LWE:	Left Wing Extremism
MoP:	Ministry of Power
MMTPA:	Million Metric Tons Per Annum
MNES:	Ministry of Non-Conventional Energy Sources

MNRE:	Ministry of New and Renewable Energy
MOSPI:	Ministry of Statistics and Programme Implementation
MP:	Madhya Pradesh
MPERC:	Madhya Pradesh Electricity Regulatory Commission
M-SIPS:	Modified Special Incentive Package Scheme
MSME:	Micro, Small & Medium Enterprises
MSW:	Municipal Solid Wastes
MU:	Million Units
MVA:	Mega Volt Amp
MW:	Mega Watt
MWEQ:	Mega Watt Equivalent
NAFED:	National Agricultural Cooperative Marketing Federation of India
NASA:	National Aeronautics and Space Administration
NCEF:	National Clean Energy Fund
NE:	North Eastern
NEP:	National Electricity Policy
NGO:	Non-Governmental Organisation
NITI:	National Institution for Transforming India
NIWE:	National Institute of Wind Energy
NOC:	No Objection Certificate
NRED:	New and Renewable Energy Department
NREL:	National Renewable Energy Laboratory
NTPC:	National Thermal Power Corporation
O&M:	Operations and Maintenance
OA:	Open Access
OMC:	Oil Marketing Companies
OpEx:	Operational Expenditure
PAP:	Project Affected Persons
PESO:	Petroleum & Explosives Safety Organization
PFC:	Power Finance Corporation
PGCIL:	Power Grid Corporation of India Ltd.
PLF:	Plant Load Factor
PNB:	Punjab National Bank
PPA:	Power Purchase Agreement
PPP:	Public–Private Partnership
PSA:	Power Sale Agreement
PSU:	Public Sector Undertaking
RBI:	Reserve Bank of India
RDF:	Refuse-Derived Fuel
R&D:	Research & Development
RDD&D:	Research, Design, Development and Demonstration
RE:	Renewable Energy
REC:	Renewable Energy Certificate
REMC:	Renewable Energy Management Centre
REN21:	Renewable Energy Policy Network for the 21st Century
RESCO:	Renewable Energy Service Company
RFP:	Request for Proposal
RPO:	Renewable Purchase Obligation
ROI:	Return on Investment
ROR:	Run-of-River
SBI:	State Bank of India
SECI:	Solar Energy Corporation of India
SERC:	State Electricity Regulatory Commission
SERIIUS:	Solar Energy Research Institute for India and the United States
SEZ:	Special Economic Zone
SHP:	Small Hydro Power
SLDC:	State Load Dispatch Center
SME:	Small and Medium-Sized Enterprises
SNA:	State Nodal Agency
SPCB:	State Pollution Control Board
SPV:	Solar Photovoltaic
SREL:	Spectrum Renewable Energy Private Limited
SSEF:	Shakti Sustainable Energy Foundation
STU:	State Transmission Utility
T&D:	Transmission and Distribution
TPD:	Tons Per Day
TRANSCO:	Transmission Company
TSERC:	Telangana State Electricity Regulatory Commission
TSNPDCL:	Telangana State Northern Power Distribution Company Limited
UDAY:	Ujjwal DISCOM Assurance Yojana
UP:	Uttar Pradesh
UPERC:	Uttar Pradesh Electricity Regulatory Commission
UPNEDA:	Uttar Pradesh New & Renewable Energy Development Agency
USA:	United States of America
USD:	US Dollar
UT:	Union Territory
WISE:	World Institute for Sustainable Energy
WHR:	Waste Heat Recovery
WRA:	Wind Resource Assessment
WRI:	World Resources Institute
WTE:	Waste-to-Energy
WTO:	World Trade Organization
1G:	First Generation
2G:	Second Generation
3G:	Third Generation

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I. INTRODUCTION

1. In the 1980s, due to the first Gulf shock, the Indian government started exploring the potential for renewable energy. While the initial intent and efforts were to concentrate on renewable substitutes for petroleum-based fuels, the technology options that were available for power generation were the low hanging fruits. The initial structure was "Commission for Alternate Sources of Energy", abbreviated CASE. This was later converted into the Department of Non-Conventional Energy Sources (DNES), which in 1992, was upgraded to that of a Ministry of Non-Conventional Energy Sources (MNES). This was renamed as the Ministry of New and Renewable Energy (MNRE) in 2007. With the formation of MNRE, India became the first country in the world to have a dedicated ministry for Renewable Energy (RE). The efforts in the first three decades were in the areas of cooking fuel, decentralised power systems largely based on solar technology and grid-connected power generation through wind turbines. There were no specific targets for RE capacity installations.

2. As a part of the Paris Climate Agreement COP-21 Summit (2015), the Government of India announced ambitious and impressive RE targets to have 175 GW installed capacity of RE by 2022 which would place the Indian economy on a low-carbon trajectory in the years to come[1]. The overall RE capacity targets are now being further enhanced to around 325 GW by 2030[2]. Presently, India is running one of the world's largest and most diversified programmes in RE from family-type biogas plants to providing solar lanterns to the poor villagers to the setting up of wind turbines to the high-tech fuel cell-based R&D programmes.

3. The Indian RE sector, of late, has been witnessing a major transformation. In the decade (2007–2017), the renewable energy sector has taken a quantum jump in terms of total installations and its positive impact is visible on the total energy mix of India. The total investment in the Indian RE sector during this decade was about USD 96.8

[1]MNRE, 2017.Working Paper on International Solar Alliance (ISA). See http://mnre.gov.in/file-manager/UserFiles/ISA-Working-Paper.pdf accessed on 6th September, 2018.
[2]IEA, 2015. World Energy Outlook 2015. International Energy Agency, pp. 638-9.

billion. This resulted in the grid-interactive RE installed capacity moving from 7.8 GW in the year 2007[3] to 71.5 GW by July 2018 (Table 1)[4]. India is now the fourth largest country in the world with around 71 GW of RE installations[5] after China (334 GW), the USA (161 GW), and Germany (106 GW)[6].

A. Grid-Interactive RE power

4. Following the Paris Club Agreement, India took up an ambitious plan of adding 175 GW of renewable power. Of this, solar energy (100 GW) comprises a major part of 175 GW target followed by wind (60 GW), biomass (10 GW) and small hydroelectric (5 GW). The target of 100 GW solar is further divided into 60 GW from large grid-connected projects and 40 GW from rooftop systems.

Table 1: Installed Grid Interactive RE Capacity

GRID-INTERACTIVE POWER	Cumulative Achievements (Installed capacity in MW)
Wind Power	34,402.12
Solar Power - Ground Mounted	21,892.42
Solar Power - Roof Top	1,222.65
Small Hydro Power	4,493.2
Biomass - Bagasse Cogeneration	8,700.8
Biomass (non-bagasse) Cogeneration/Captive Power	6,76.81
Waste to Power	138.3
Total	**71,526.3**

Source: MNRE (up to June 2018)

5. According to the Central Electricity Authority (CEA), RE generation showed a year-on-year growth keeping pace with the growth in installed RE capacity. The RE generation was about 12.83 billion units in June 2018 vis-à-vis 10.22 billion units in June 2017 (about 25% growth).

6. Out of 71 GW installed grid-interactive RE capacity (Table 1), wind energy plays a dominant role and comprises 48.5% of total RE installations, followed by solar (32.5%), biomass (12.3%), small hydro (6.4%) and waste-to-energy (0.2%). In the last four years, solar energy has seen a record jump from 3.7 GW in 2014-15[7] to 23 GW by July 2018. However, such focus to scale up solar power may have overshadowed the development of other RE technologies such as wind, biomass and others.

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[3] CEA, July 2018. Executive Summary on Power Sector. Central Electricity Authority, Ministry of Power, Govt. of India. See http://www.cea.nic.in/reports/monthly/executivesummary/2018/exe_summary-07.pdf accessed on 7th September, 2018.

[4] MNRE, July 2018. Physical Progress (Achievements). See https://mnre.gov.in/physical-progress-achievements accessed on 7th September, 2018.

[5] As of June 2018

[6] REN21, 2018. Renewables 2018 Global Status Report. Paris: REN21 Secretariat.

[7] MNRE Annual Report, 2016-17. Ministry of New and Renewable Energy, Govt. of India. See http://mnre.gov.in/file-manager/annual-report/2016-2017/EN/pdf/4.pdf accessed on 7th September, 2018.

7. Most of India's solar potential is estimated to be in Rajasthan (142 GW) and Jammu & Kashmir (111 GW), followed by Maharashtra (64 GW), Madhya Pradesh (61 GW) and then others[8]. The National Institute of Wind Energy (NIWE) has estimated the potential for wind power to be to be 302 GW at 100 meters above ground level. The exploitable wind resources are mostly situated in the Western and Southern parts of the country. Gujarat leads with 84 GW wind potential, followed by Karnataka 55.8 GW, Maharashtra 45 GW, Andhra Pradesh 44 GW, Tamil Nadu 34 GW and then others. The potential of small hydroelectric potential is 21 GW and the biomass and cogeneration bagasse 18.6 GW and 7.3 GW respectively[9]. Waste-to-Energy (WTE), which has become an increasingly important area for urban affairs as well as for power, has a potential of around 2.5 GW.

8. India is divided into five regions – Northern, Eastern, Western, Southern and North-Eastern. The targets for RE installations and achievements thereof vary across these regions and the states within them. The Union Government has set RE targets to be achieved by each state and in each technology (solar, wind, SHP, biomass, etc.) by the year 2022. In terms of total RE targets, Maharashtra has to achieve the highest target of 22 GW, followed by Tamil Nadu (21.5 GW), Andhra Pradesh (18.5 GW), Gujarat (17.1 GW), Karnataka (14.8 GW), Rajasthan (14.3 GW) and others. In terms of total RE installations as of now, Tamil Nadu has the highest installed capacity of 10.8 GW followed by Karnataka has 8.4 GW, Maharashtra 7.9 GW, Rajasthan 6.7 GW and others, as of now[10].

9. Though there is a basic question of the mandate and authority of the Union Government to set out or prescribe targets in a sector like Power that is a subject in the Concurrent List of the Constitution of India, there is a general acceptance more by consensus rather than by acceptance of authority. Moreover, it has emerged from our study, that states were not amply clear on the basis based on which the targets were set. For instance, in the case of solar technologies, Rajasthan has to achieve the solar target of 5.7 GW while its potential is of 142 GW. On the other hand, UP has to achieve 10.6 GW within its limited potential of 22.8 GW. In addition to this, there was a lack of appreciation for the quality of resource endowment in each state such as wind speeds for wind power, DNI for solar power, etc.

10. The year 2017 saw a dip in investments flowing into the Indian RE sector (Fig. 1). From a total of USD 13.7 billion investments made in 2016, there was a 20% drop to about USD 10.9 billion investment flow in the year 2017[11]. Out of this, the solar and wind energy received around USD 6.7 billion and USD 4 billion respectively. The year 2017 was particularly disappointing for the wind energy sector, reasons for which have been discussed in Chapter 4.

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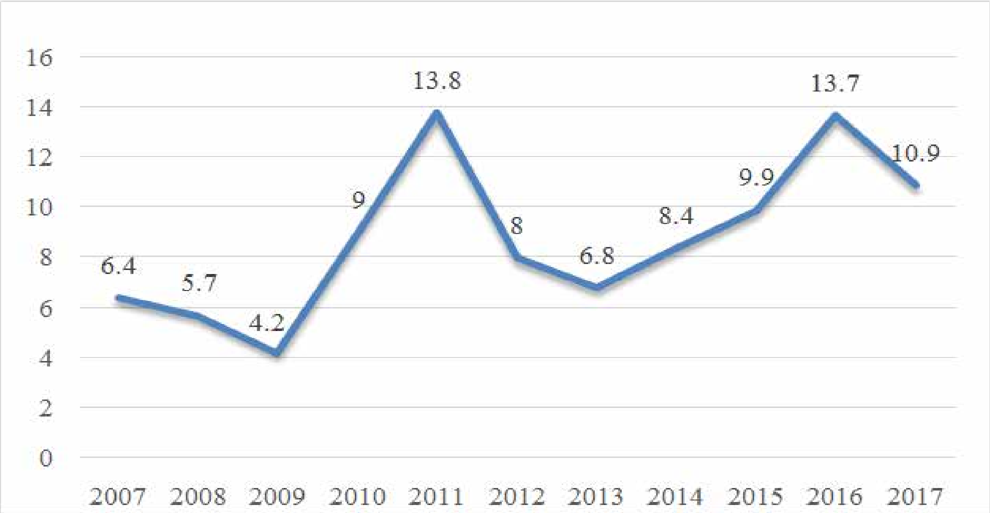
[8]CSO, 2017. Energy Statistics 2017 (24th Issue). Central Statistics Office, Ministry of Statistics and Programme Implementation (MOSPI), Government of India.
[9]CSO, 2018. Energy Statistics 2018 (25th Issue). Central Statistics Office, Ministry of Statistics and Programme Implementation (MOSPI), Government of India.
[10]Ministry of New and Renewable Energy Annual Report 2017-18, Govt. of India.
[11]REN21 report, 2018.

Fig. 1 New Annual Investments in Indian RE sector 2007-2017 (USD Billion)



Source: REN21 (2018)

B. Off-Grid and Captive RE

11. MNRE is also promoting off-grid renewable energy systems and solutions especially in the rural and remote areas of the country. The off-grid systems are significant from the perspective of hot water requirements of the residential, commercial and industrial sector, cooking energy needs in the rural areas, lighting needs in remote areas and sustainable irrigation. Cumulative capacity achievements are given in Table 2.

Table 2: Installed Off-Grid and Captive RE Capacity

Capacities In MW_{EQ}	
Waste to Energy	172.15
Biomass Gasifiers	163.37
SPV Systems	761.55
Total	**1,097.07**

Source: MNRE (up to June 2018)

12. Besides the above, a total of 1,516 water pumping mills and 3,287 kW of aero-generators/wind-solar hybrid systems were installed across the country. Most of the mills are installed in Gujarat (1046) and Rajasthan (222). More than half of the aero-generators and hybrids (1,775 kW) were installed in Maharashtra[12].

C. Collaboration Between Central and State Governments

13. Electricity is listed as Item 38 in the Concurrent List (also known as the Seventh Schedule) of the Constitution of India; meaning, it is under the purview of both the Union and State governments. Uniformity, though desirable, may not always

[12]MNRE Annual Report, 2017-18

be achieved on items in the concurrent list. However, the Union government may formulate policies and set targets for RE, but it would be up to the State Governments to implement it in a way it deems would be appropriate for its State.

14. It has been observed during the last few years that on several occasions that the perceptions of State Governments also appear to be at variance – though not contradictory to the targets and objectives of the Union Government. The approaches of State Governments have differed on the methodology to achieve mission objectives since the needs of each state are different. Given the localised nature of RE resources, the state policies would require to be aligned to its unique needs. Thus, the success of RE adoption depends primarily on the active participation of the States and the collaboration between the Central and State Governments.

15. Though the States may be well within their right to question either the authority of the Union Government to prescribe policies and set targets, they tend to ignore such questions and desist from raising issues largely because of the financial flows from the Union Government. The increased proclivity of the Union Government to dabble in matters that are in the State List and Concurrent List of the Constitution, and silent acquiescence of the States, go beyond the scope of this study. But suffice it to say that the States have come to accept the changes in the power sector.

II. STUDY METHODOLOGY

A. Objectives of the Study Project

16. The identification of key issues in implementing RE plan at the state-level becomes central to achieve the national targets, and hence, the project aims to find the barriers which that are hampering the growth of RE sector in India. Thus, one of the main goals of this study was to identify the gaps in the approaches of the Union and State governments through industry involvement, by identifying key issues related to the implementation of renewable energy and building consensus amongst industry and the governments. The study also aimed to facilitate the creation of an enabling framework for coordinated development and implementation of State policies that scale-up renewable energy to meet the national targets. Investment in the RE sector has largely been from the private sector that would be either facilitated or hindered by the policies and regulations in the states rather than by state investment in the sector. So, it becomes important to study the overall ecosystem to the exclusion of the state's capacity to invest.

B. Study Methodology

17. The project adopted a combination of desk research and field studies using participatory approaches. At inception **Stage 1**, the study team undertook desk research, compiled and collated findings from various studies and data available in public domain identifying various barriers (technical, financial, policy, social and others) for scaling up RE in India.

18. This was followed at **Stage 2** by five regional workshops to validate the issues identified and gather inputs from industry constituents to structure the subsequent field studies and key informant interviews.

19. Data collection in **Stage 3** was done in two parallel tracks:

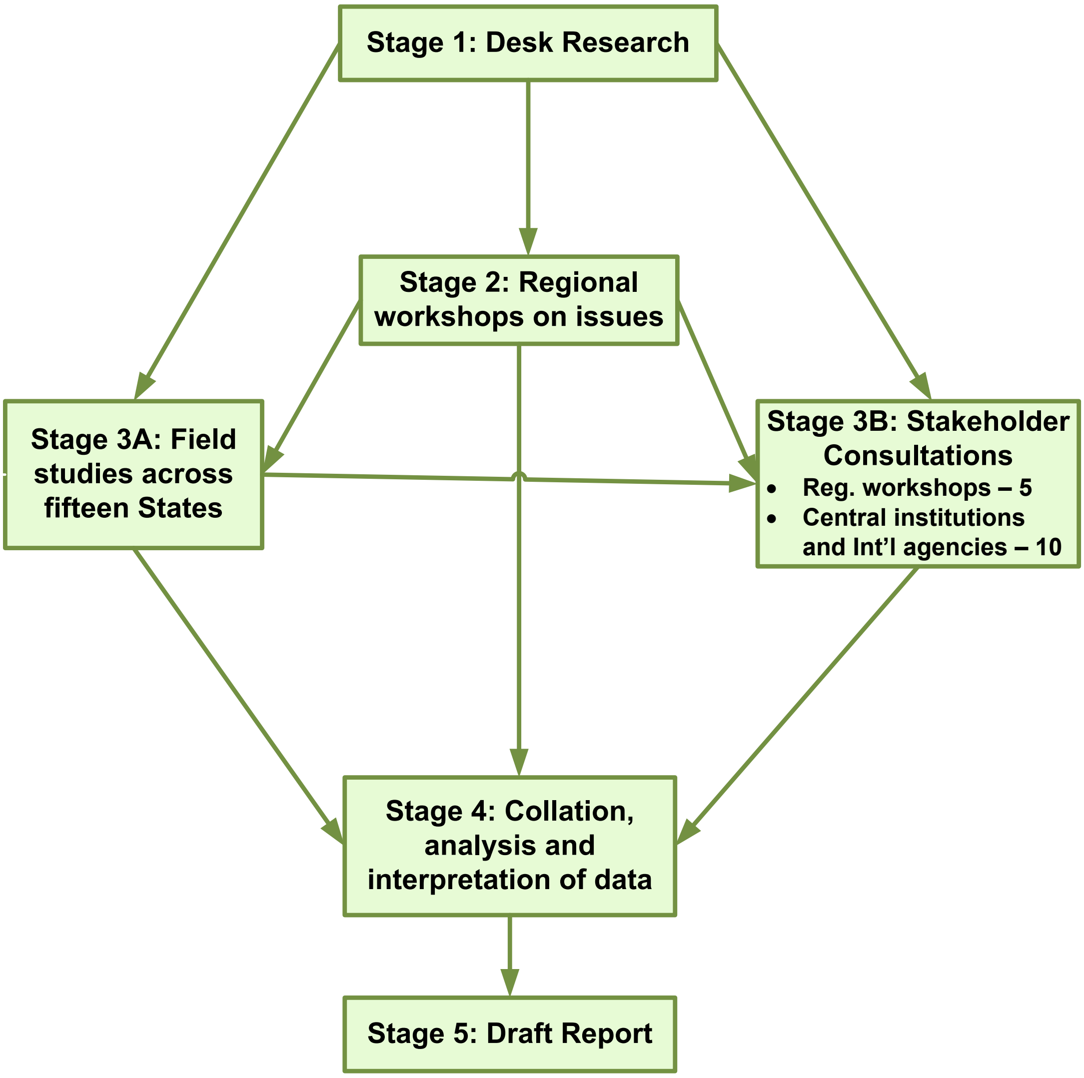
(i) **Stage 3A** field studies across fifteen major states in India, wherein the research team interviewed key informants from the RE industry, system integrators, industry associations, representatives from think tanks and consulting firms in the clean energy space, financiers, electricity regulators, representatives from electricity distribution utilities and state policymakers, NGOs and others.

(ii) **Stage 3B** comprising five regional workshops on thematic issues for stakeholder consultations and key informant interviews with central institutions and international agencies who are supporting RE programmes in India.

20. **Stage 4 and Stage 5** were for collating and analysing a large amount of granular contextual data to draw insights, interpret and report. The sponsors were kept apprised on the progress of work through quarterly narrative submissions.

C. Analytical Framework

Fig. 2: Illustrative Study Methodology



21. **Causal Analysis:** The identification of cause-and-effect relationships plays an indispensable role in policy research (Steinberg, 2007)[13] and some of the central issues in policy analysis can be appropriately described as questions of cause and effect[14]. A structured causal analysis thus holds promise in policy studies, such as the present one to identify barriers, as well as challenges, to scale up Renewable Energy adoption in the country, and hence was chosen as our study methodology.

22. **Representation of Causal Analysis:** A cause and effect diagram, often called a "fishbone" diagram (also called Ishikawa diagram named after one of the great Japanese management thinkers Prof. Kaoru Ishikawa who first made this seminal contribution to the field of management research) is a visual way to look at causes and effects – and in fact results. The fishbone diagram can help researchers identify possible causes of challenges and assist them in sorting ideas into useful categories. Prof. Ishikawa's fishbone, or cause and effect diagram, offered a more structured approach to causal analysis than some other tools that were available for brainstorming causes of a problem (e.g. "Five Whys" tool). The problem or effect is displayed at the head or mouth of the fish, and possible contributing causes are listed on the smaller "bones" under various cause categories[15] (see figure 3). This methodology has been adopted to analyse barriers to scale up key technology areas such as solar and wind in Chapter 3 and 4 respectively.

[13] Steinberg, P.F., 2007. Causal Assessment in Small-N Policy Studies. The Policy Studies Journal, 35 (2), 181-204.

[14] VanMeter, D.S. & Asher, H.B., 1973. Causal Analysis: Its Promise for Policy Studies. The Policy Studies Journal, 2 (2), 103-109. https://doi.org/10.1111/j.1541-0072.1973.tb00135.x

[15] API, undated. How to Use the Fishbone Tool for Root Cause Analysis. See https://www.cms.gov/medicare/provider-enrollment-and-certification/qapi/downloads/fishbonerevised.pdf accessed on 1st September, 2018.

III. SOLAR POWER

A. Identification of the Barriers

23. India's estimated potential for electricity generation from renewables is 900 GW. The target set by the Government of India for capacity addition from RE-based electricity generation is 175 GW by 2022. This comprises 100 GW from solar, of which 60 GW from ground-mounted and 40 GW from rooftop. Solar power solution providers across the country are competing to augment solar generation capacity. The pace of solar capacity installation registered a year-on-year growth of 123% during 2017 (9.6 GW), which was more than double the capacity that was installed during the year 2016 (4.3 GW).

24. If the current trends persist, India is likely to reach 57 GW by 2022 as projected by Bridge to India[16] falling short of the target of 100 MW. At the same time, the Government has announced plans for 30 GW of solar power capacity addition every year till 2028 which, if successful will lead to solar power generation contributing significantly to achieving a total RE installed capacity of 362 GW in the country.

25. As the pace of installation of solar power projects increased during the last few years, expectedly multiple challenges have also emerged. Some of these challenges were not barriers to scaling up the solar power programme when the size of the country's solar programme was small. This study has attempted to identify some of the barriers which are illustrated through a causal analysis (Figure 3) and discussed thereafter.

26. Some of the issues that emerged during the course of this study cannot be considered as "barriers" in the strict sense of the term. They can be seen more as "challenges" especially in the present system of the award of projects by the Central and State agencies.

[16]Singh, S.S., undated. Solar Rooftop Sector in India – Opportunity and Challenges. Solar Quarter. See https://www.solarquarter.com/index.php/1836-solar-rooftop-sector-in-india-opportunity-and-challenges accessed on 27th August, 2018.

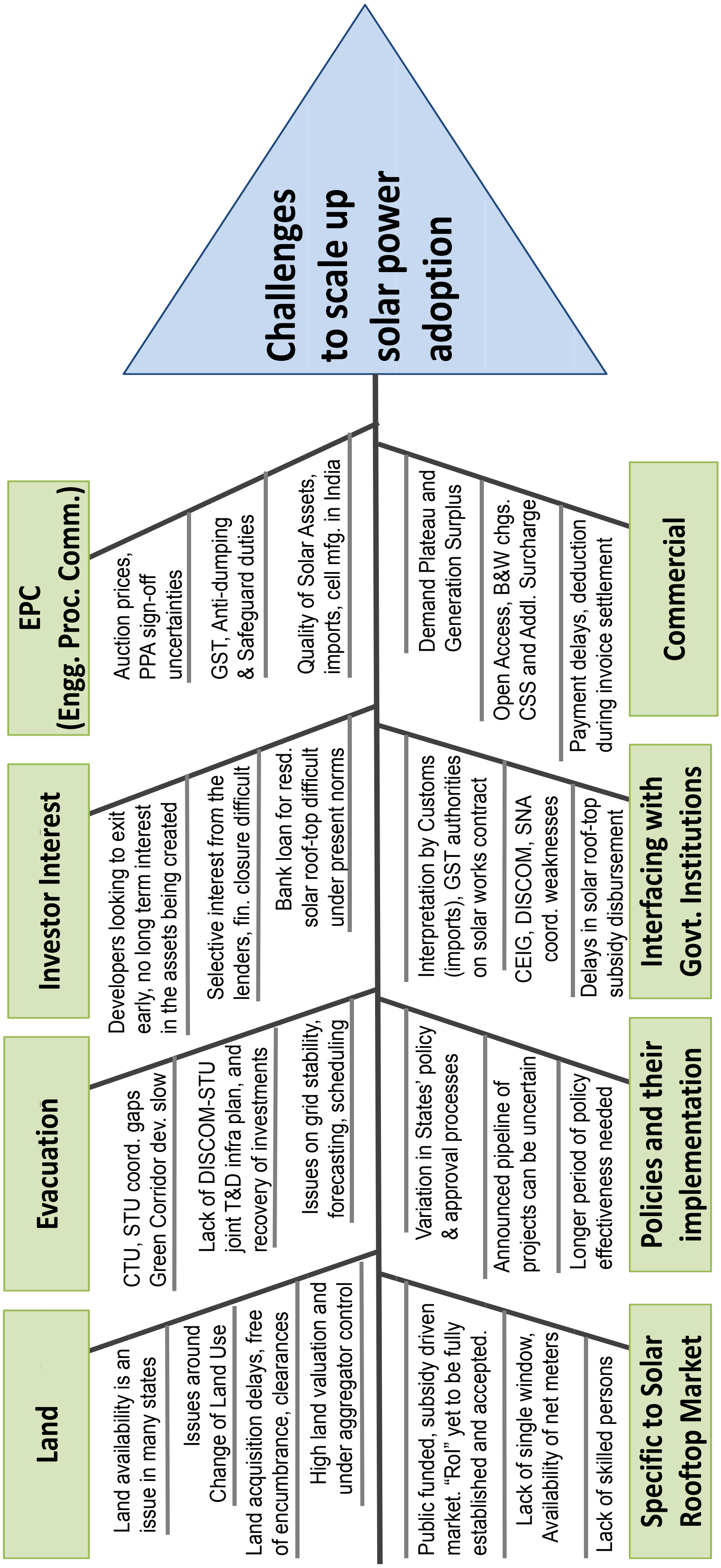


Fig. 3: Identification of Barriers to Scale Up Solar Power Adoption (Illustrative Fish-Bone Diagram)

B. Discussion of the Barriers

Land

27. Constitutionally, the land is in the State list of the Constitution of India. However, most of the states are yet to come out with a comprehensive state-level 'Land Utilization Policy' to balance the land requirements for various sectors in an optimal manner. There is no comprehensive land utilisation policy at the Union level either. The National Land Utilization Policy, which could have been guidance to the states, is yet to be finalised. The lack of an organised and regulated real estate market leads to land price doubling or tripling at the advent of any land surveying activities of potential solar projects.

28. The land records are yet not digitalised and properly maintained. There is a lack of authenticity and documentation in land revenue records in many states due to irregular land use surveys leading to incongruities of land records with the ground realities. Issues like documentation of property records in the local language, missing and unavailable property documents with the revenue authorities, forged documents, cashing on clerical errors in the sale deed, are few to be listed. Further, it takes time to finalise the exact land coordinates and identify the rightful owners to undertake commercial negotiations.

Availability of Land: Adequacy to Meet Scaled-Up Targets

29. Ground mounted solar projects need large tracts of contiguous land parcels. Under the Land Ceiling Act of States, the maximum limit of the land that can be bought/owned is fixed. Mega size solar project requires large parcels of land and to buy land under different names of different companies poses a challenge for the investor[17]. For example, maximum farmland holding in Maharashtra is 27 acres per farmer, so to acquire a large parcel of land, developers have to make deals with multiple landowners individually, ultimately delaying the process[18]. Here again, different States have different laws and different procedures of recording sale and purchase transactions of land. In a few States, one has to acquire permission to convert agricultural land into non – agricultural land, to own and possess land beyond the ceiling etc. In Telangana, developers have sought clarity on land availability for the solar parks, and the high promising solar energy policy 2017 of Assam which has a target of 590 MW of solar power in the state by 2019-20 is yet to take off due to the dearth of land.

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[17]Saurabh, 2018. India Achieves 20 Gigawatts Solar Capacity 4 Years Ahead of Initial Target. Clean Technica, 7th February. See https://cleantechnica.com/2018/02/07/india-achieves-20-gigawatts-solar-capacity-4-years-ahead-initial-target/ accessed on 31st August, 2018.

[18]Jain, K., 2016. Insight on Challenges Faced by EPC Contractors. Energetica India. See http://www.energetica-india.net/download.php?seccion=articles&archivo=2uXp28voB8excnsaZg5zpFKs3UpteVkOtPEpAtr9MdZ1LZQk7KYlPi.pdf accessed on 31st August, 2018.

30. The extent of this challenge can be summarised as making available an additional 66,000 hectares of land by 2022, over-and-above the business-as-usual scenario. This is derived from an assumption that approximately two hectares of land is required to develop one MW of ground-mounted solar power, the solar capacity achievement so far, and projections of achieving 57 GW (Bridge to India report) of ground-mounted solar power by 2022 in a business-as-usual scenario. Considering only 10 GW of solar rooftop would be feasible to achieve by 2022[19], this would need an additional 33 GW of ground-mounted solar power to be installed to fulfil India's overall solar installation target of 100 GW by 2022.

31. A quick review of solar endowed major state policies shows that a majority of these states have put the onus of acquiring land (and changing its purpose of use if needed) on the developers (Table 3).

Table 3: State Policy and the Land Acquisition Clause

S.No.	Policy	Land
1	Gujarat Solar Power Policy 2015	The developer is responsible for obtaining the land for setting up and operating the solar power project.
2	Andhra Pradesh Solar Power Policy, 2015	The developer is responsible for obtaining the land for setting up and operating the solar power project. For tribal land, in addition to the lease rentals, a revenue-sharing mechanism for the landowner is envisaged.
3	Chhattisgarh State Solar Energy Policy, 2012	The developer is responsible for obtaining the land for setting up and operating the solar power project.
4	Rajasthan Solar Energy Policy 2014	The developer will be allowed to purchase agricultural land for developing a solar power plant in accordance with provisions of Rajasthan Imposition of Ceiling on Agriculture Holding Act, 1973; Other private lands may be acquired under Ceiling Act, 1973.
5	The Karnataka Solar Policy 2014-2021	The government of Karnataka contemplates facilitating the deemed conversion of and for solar projects by amending section 95 of land reform act. A separately dedicated cell with staff drawn from the revenue department has been created in KREDL to create land banks for the development of the solar project on a lease basis.
6	Madhya Pradesh Policy for implementation of Solar Power projects	Government land shall be available as 3.0 hectares per MW. Permission from concerned authorities required for the purchase of forest land. For government land, NRED shall take possession of the land and subsequently give permission to use. Private land acquired for solar development is 50% exempted from stamp duty.
7	Telangana Solar Power Policy 2015	Developers to acquire land. There is no ceiling on land acquisition for solar projects and solar parks. The land requirement to be computed at the rate of 5 acres/ MW.

Change of Land Use: The Pros and Cons of Allowing Agriculture Land for Solar Projects

32. Ideally, solar installations should be on land that is waste and barren. Such land is unequally available across States. Many Indian states have large tracts of fertile

[19]Bridge to India, 2017. Indian Rooftop Solar Market Growing at Over 80% Annually. 18th July. See http://bridgetoindia.com/indian-rooftop-solar-market-growing-80-annually/ accessed on 31st July, 2018.

agriculture land which is now being converted to industrial land for setting up solar power plants. Such change of land use, if effected at a much larger scale and without implementing appropriate agricultural productivity improvement measures, can lower the area under cultivation and affect overall national food production outputs. A debate may crop up at a later date as to whether land should be used for food or energy.

Land Aggregator Issues

33. In many states, the IPPs find it difficult to negotiate with multiple landowners. As a result, they engage land aggregators, a euphemism for "middlemen". While many are willing to provide this service at a modest fee, there have been instances of such aggregators being unscrupulous in their financial dealings. More often than not, landowners in rural areas prefer to do the transactions in cash than by through banking channels. This also creates its share of issues around unaccounted money and 'benami' transactions. The IPPs which have a corporate structure also find it difficult to generate and account for such cash requirements.

Land Acquisition Risks and Delays: Are they Likely to Go Up?

34. Land being a state subject, approvals are required from the concerned departments of the state government to procure or lease the land, making it a time-consuming process. It is estimated that six to nine months delays are there for getting clearances. Many developers believe that the single biggest factor for delay in project acquisition is the time-consuming process of land identification and acquisition.

35. Also selecting the right land parcel is based on multiple parameters such as matching topography, soil geology, land-shape and soil characteristics. For instance, loose soil can make solar power project operations and maintenance more expensive.

36. Moreover, issues like encroachment, resettlement and high demand for compensation act as major hurdles in creating delays in land acquisition. In Madhya Pradesh Rewa Ultra Mega Power Project, 63% of the total land earmarked for the project belonged to the Government. There were few scattered built-up structures within the proposed site. The private land parcels were interlocked between the government land parcels and in certain cases due to limited availability of cultivable land, encroachment on the government land at the ground level was present. This led to the payment of higher compensation and administrative issues[20].

37. Similarly, Andhra Pradesh State Government recently announced its plan to establish a solar power project with a capacity of 1,500 MW to overcome power shortage. Land acquisition was done from farmers of the village of NP Kuntamandal of Anandpur

[20]World Bank, 2017. Environmental and Social Management Framework - Solar PV Park. See http://documents.worldbank.org/curated/en/391871468251147962/pdf/SFG1806-REVISED-ESMF-P154283-Box405299B-PUBLIC-Disclosed-9-18-2017.pdf accessed on 19th September, 2018.

district and Galiveedumandal in Kadappa district. Though the land of 11,000 acres was acquired, there was a serious hurdle since the farmers were expecting better / higher compensation than what the government was willing to offer[21].

38. In states like Telangana, there is 100% exemption on the land acquisition taxes like stamp duty to facilitate the solar developers, but there is no provision of land acquisition by the Government for solar projects. Telangana State Industrial Infrastructure Corporation was the nodal agency for a 1,000 MW renewable energy project proposed in Mehboobnagar district and was supposed to acquire land for the project. Due to the difficulty faced in the valuation/compensation to be paid for the acquisition of the land, Government reduced the size of the project from 1,000 MW to 500 MW[22].

Solar Parks: Development Charges

39. Solar parks were designed to reduce the bottlenecks and bring down the cost of large-scale solar development. Developers pay for multiple heads of land development charges like land application fees (non-refundable one time), upfront development fee, annual leases of land, annual operation and maintenance charge, stamp duties for registration and service taxes on all component differently in each state[23].

Table 4: Land Charges in Solar Parks in India (Illustrative Cases)

S.No.	Solar Park	State	Charges
1	Ghani Solar Park	Andhra Pradesh	High development charges of INR 42 lakh per MW. Additional recurring charges for O&M, land lease, water supply charges. A service charge of 15% on all fees.
2	Kadapa Solar Park	Andhra Pradesh	One time development cost of INR 41.2 lakh per MW. Annual O&M charges at the rate of INR 3.2 lakh for the first year which escalates annually at the rate of six per cent thereafter. Water at the rate of INR 10 per kilo-litre fixed. Annual land lease of INR 1,000 per acre
3	Charanka Solar Park	Gujarat	Solar park fees are constantly increasing: from INR 40 lakh to INR 1 crore per MW.
4	Rewa Solar Park	Madhya Pradesh	No upfront park fee, the land lease and internal evacuation infrastructure was built with the world bank loan. Overall the charges are comprehensive and straightforward to the developer.
5	Pavagada Solar Park	Karnataka	Presence of upfront fee, recurring O&M charges and land lease with an annual escalation rate of five per cent.

[21]IndiaSpend Team, 2017. Government's Big Solar Park Push Could Run into Land Hurdle. Hindustan Times, 27th March. See https://www.hindustantimes.com/india-news/government-s-big-solar-park-push-could-run-into-land-hurdle/story-s06wW-s8TYORonMLatj8G7I.html accessed on 19th September, 2018.
[22]Deccan Chronicle, 2017. Telangana Shelves 1,000-Megawatt Renewable Energy Project in Mahbubnagar. 27th March. See https://www.deccanchronicle.com/nation/current-affairs/270317/telangana-shelves-1000-megawatt-renewable-energy-project-in-mahbubnagar.html accessed on 20th September, 2018.
[23]Prabhu, R., 2017. Solar Park Costs on the Rise in India. Mercom India, 9th May. See https://mercomindia.com/mercom-exclusive-solar-park-costs-rise-india/ accessed on 20th September, 2018.

40. Even though solar parks have played a role in bringing the tariff to low levels, incomplete solar park infrastructure, high upfront fees and uncertain yearly charges are adding to the difficulties of the developer and raising project costs. Presence of uniform charges across the country shall be beneficial for the developers.

Evacuation

41. Power transmission systems in India are handled by PSUs controlled by both Central and State Governments. India has demarcated five transmission regions: northern, eastern, western southern, and north-eastern, which are synchronously interconnected and operate as a single National Grid. India has around 3,81,671 circuit kilometer of transmission lines and 7,91,570 MVA of substation transformation capacity[24]. In spite of witnessing impressive power generation growth, evacuation of power remains a concern.

42. Power Grid Corporation of India Ltd. (PGCIL), as the Central Transmission Utility (CTU), is responsible for the inter-state transmission, wheeling of power generated by the central power generating units and inter-state independent power producers (IPP). The State Transmission Utility (STU) is responsible for setting up and strengthening the intra-state transmission infrastructure to ensure intra-state transmission within their respective States.

Scaling Up Transmission Infrastructure

43. While installation of new solar capacity has its share of issues, its evacuation poses an equally formidable challenge. The country's solar power generation capacity has gone up 32 times in just six years of the period. In 2011, it was 0.5 MW which has become 16 GW in 2017[25]. In general, most solar PV projects commissioned till now have faced some issue or other with evacuation infrastructure. There are issues of non-availability of provision for inter-connection and space for modification of additional bays permits for carrying out works at substation premises[26].

44. As discussed at the stakeholder meetings and during key informant interviews, developers brought forward their concerns of further expanding solar footprint without preparing evacuation infrastructure. With about 12,000 MW of solar projects under construction and more in the pipeline, the developers expressed apprehensions that completed projects may not be able to fulfil their generation targets as all

[24]As of November 2017

[25]Singh, H., 2017. Why Renewable Energy Evacuation Demands a Decisive Push. The Economic Times, 26th December. See https://energy.economictimes.indiatimes.com/energy-speak/why-renewable-energy-evacuation-demands-a-decisivepush/2774 accessed on 20th September, 2018.

[26]Saur Energy International, 2017. Chances & Challenges Related to EPC. 17th June. See http://www.saurenergy.com/solar-energy-articles/epc-of-solar-power-plant-chances-challenges accessed on 17th September, 2018.

substation bays were already functioning to their optimal capacity[27]. In such cases, solar power plants would be required to restrict generation which would eventually delay recovery of developers' investments.

45. The developers were also concerned about the solar parks' integration into the grid as the evacuation system and infrastructure were still under preparation. Instances were given where tenders were released without consulting the state electricity regulatory commissions, and when the Power Purchase Agreement (PPA) were brought for approval before the regulatory commissions, they were held up citing lack of transmission infrastructure.

46. Typically, across all countries, there is a longer gestation period to plan and commission transmission infrastructure than what is needed to auction and award solar power plants. India is no exception; it takes almost five years to complete transmission projects while solar generation projects can be commissioned within a year. Going forward, the gap between the installed grid-connected solar generation capacity and the available transmission capacity can be expected to widen in the country. Creation of transmission system infrastructure may not be able to keep pace with the rising pace of solar power generation project auctions, and this widening mismatch of capacities can put immense pressure and strain on the present transmission infrastructure.

System Operation Challenges

47. Solar energy like other forms of Renewable Energy (RE) is erratic and infirm. The country's transmission infrastructure is not fully prepared to evacuate the kind of infirm solar power that is planned to be injected into the grid. Especially, if the solar PV systems are connected at 11 kV, managing them are likely to be more challenging than if the same projects are connected at 33 kV or 132 kV. In some cases, the RE pooling substations are also not connected with SLDCs to have real-time visibility of RE, further causing problems for system operators[28]. With an exponential increase expected in solar projects, there are legitimate concerns from system operators on the current equipment, and effectively managing the challenge of solar generation variability within the grid.

Limitations on Backing Down Conventional Source Generation

48. The significant increase in the injection of solar power in recent years into the national grid has been a cause of concern for conventional power plant operators. Power Grid Corporation of India Ltd. (PGCIL), in a recent report, highlighted that due to the high penetration of solar energy the grid would witness high ramp down

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[27]Chandrasekaran, K., 2018. Renewable Power Developers Headed for Transmission Woes. The Economic Times, 29th April. See https://economictimes.indiatimes.com/industry/energy/power/renewable-power-developers-headed-for-transmission-woes/articleshow/63963937.cms accessed on 20th September, 2018.

[28]Deloitte, 2017. State Renewable Energy Action Plan for Assam. See http://www.indiaenvironmentportal.org.in/files/file/State%20Renewable%20Energy%20Action%20Plan%20for%20Assam.pdf accessed on 20th September, 2018.

and ramp up requirements[29]. The current conventional fossil-fuel (primarily coal-based) generation sources in India are technologically incapable of responding to quickly ramp up and ramp down requirements emerging from such fluctuations. Besides affecting the thermal efficiency of the coal-based generating stations, thereby increasing their unit cost of generation; it can shorten the life of their expensive equipment (boiler, turbine and some items in the balance of plant) installations.

Inter-State Transmission System

49. There is a growing demand from grid operators for new transmission corridors in the country. Majority of the power surplus states are placed in the Southern and Western India. States like Karnataka, Telangana, Tamil Nadu, Andhra Pradesh, Gujarat, Madhya Pradesh etc. are power surplus and there are stranded solar power plants due to less or no need of power within the states from RE. After successfully achieving their RPO obligation, they are not motivated to grow the solar power generation capacity.

50. On the other hand, power deficit states like Kerala, Uttar Pradesh, Punjab could not benefit from a surplus generation in other states due to the lack of inter-state transmission infrastructure. For instance, in 2016, UP had a peak power deficit of 9.7% whereas bordering the state of MP had a peak power surplus of 8.3%. Yet the transmission inter-connectors between the states were operating at full capacity and surplus power of MP could not be used by UP.

51. Furthermore, the developers who face a lack of transmission and evacuation facilities have raised the issue and delayed solar auctions in various states. This has led to deferring of many solar tenders released by CPSEs and states as well. For example, 2,000 MW of solar capacity auction to be conducted by NTPC was deferred[30].

Green Energy Corridor Project

52. To resolve this issue of RE power evacuation from surplus to deficit states, Government of India is progressing with a USD 3.5 billion Green Energy Corridor (GEC) program[31]. The GEC envisages evacuation through 765kV and 400kV transmission lines. The project includes new transmission lines and renewable energy management centres to better forecast the actual generation from a given solar site. Once complete, the GEC is expected to facilitate evacuation from solar parks and large-scale grid-connected solar and wind projects.

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[29] PGCIL Report, undated. Renewable Energy Integration – Transmission an Enabler. Power Grid Corporation of India Limited. See https://www.powergridindia.com/sites/default/files/footer/smartgrid/Renewable%20Energy%20Integration%20-%20Transmission%20an%20Enabler.pdf accessed on 20th September, 2018.

[30] The Economic Times, 2018. Solar Auctions to Delay Further Amid Concerns Over Duty, ISTS Issues. 10th June. See https://economictimes.indiatimes.com/industry/energy/power/solar-auctions-to-delay-further-amid-concerns-over-duty-ists-issues/articleshow/64528204.cms accessed on 19th September, 2018.

[31] Nangia, O.P., 2015. Green Energy Corridors for Evacuation of Gigawatts of RE Power. Akshay Urja. See https://mnre.gov.in/file-manager/akshay-urja/september-october-2015/EN/10-15.pdf accessed on 19th September, 2018.

53. However, the implementation of GEC projects has witnessed significant delays, owing to procedural hurdles and the lack of a push from the developers, particularly in Rajasthan, Gujarat and other solar endowed states. The developers and IPPs do not apply for long-term access in advance (which is desirable from CTU perspective) as they can do so after winning their bids through the auction process. Unlike in solar parks or in lands identified by state governments where the locations are known in advance, developers cannot apply for long-term access in advance since (a) they might not be certain about winning the bid and (b) they would identify, negotiate and acquire the land only after winning the bids.

54. Thus, the timelines to build-up new transmission capacity are not in tune and accordance with the large infusion of new projects in the pipeline. None of the six substations planned under the first phase of the GEC has been commissioned till the end of FY18. For instance, the 1,000 MW substation project at Kayathar in Tamil Nadu was scheduled to be commissioned in the first quarter of 2017, but it has yet not been commissioned. A reason for this could be the inclination of IPPs towards evacuating power to Gujarat and Maharashtra rather than to the North East which has been planned through the corridor.

55. The Standing Committee on Energy presented its findings to the Lok Sabha in its 39th Parliamentary report titled "Demands for Grants of the Ministry of New and Renewable Energy for the year 2018-19." The committee noted for 2017-18 Rs. 500 crores were provided for the installation of 350 ckt-kms of transmission lines and for 2018-19, Rs. 600 crores have been allocated for the installation of 1,900 ckt-kms of transmission lines in 2018-19 which leads to the conclusion that GEC works are likely to be under-funded.

56. The committee observed, "The cumulative target of achieving 3,000 ckt-kms of transmission lines by March 2019, leaves 5,500 ckt-kms of transmission lines to be installed during 2019-20," to reach the stipulated cumulative target of 8,500 ckt-kms of installed transmission lines for the Green Energy Corridor by March 2020". The Standing Committee was thus apprehensive about whether the GEC target is attainable during the remaining period.

Recovering Transmission Infrastructure Investments

57. There is inadequate coordination between the Central and State government agencies and regulatory commissions. One of the areas of such inadequacies is an issue between CTU and STU overlapping investment plans within the endowed region of a State, each forecasting a certain amount of power to be evacuated from projects coming up in the region in the longer term without any binding agreement between the concerned parties. This uncertainty, coupled with the SERC position to allow recovery of additional investments made in (new or strengthening existing) transmission infrastructure, makes it difficult (at times) for STUs to justify routing

public investments for building new transmission infrastructure to support private development of RE projects.

Investor Interest

Sustaining Interest in a Regime of Low Returns

58. Solar project developers have been aggressively bidding in auctions based on low prices of imported modules, and this leads to low returns. After a historic low tariff of Rs. 2.44 per unit was discovered in May 2017 through SECI auction for 500 MW Bhadla Phase-III Solar Park, Rajasthan, many states were expecting tariffs in their auction would also be much below INR 3 per unit (say varying between INR 2.5 – INR 2.9). Auctions which discovered above INR 3 per unit have been cancelled or deferred. States like Gujarat, Maharashtra and Karnataka had to face issues in the running past their auction[32]. While quoting such tariffs were not sustainable for several producers in other states/sites, many of the industry players backed by large financiers have been driven by their interest to build a portfolio of solar assets within a short time. Some of the points that escape the attention of the states relate to the solar insolation, cost of land, evacuation infrastructure, financing cost etc. As a result, their expectations of tariff being low also turn out to be unrealistic and impractical.

59. The prevailing uncertainties have posed difficulties for developers to raise funds at attractive interest rates and contain high project costs. These have resulted in making some projects unviable for successful bidders. A continued regime of low tariffs can negatively impact the government's big target of achieving 100 GW solar by 2022 as more players and investors are required in this sector to stabilise the market. There is a need of $30-40 billion in equity investment in the solar sector for further sustaining the growth which will only come if the returns are lucrative for the investor[33].

Selective Interest from the Lenders

60. A majority of the solar projects are funded through a mixture of debt and equity. However, there is a paucity of long-term debt agreements. RE is classified as a Priority Sector for lending and banks typically classify such lending under infrastructure or energy sectors. The developers' experiences show that banks are not comfortable lending to RE projects because of their lack of expertise in resource assessments in this sector and creditworthiness of State DISCOMs who are typically the power purchasers. This poses a significant challenge to achieve financial closure on time, especially for those projects which are won by mid-sized corporates and new entrants. A few companies that have tied up foreign equity also manage to contract debt from

[32]Chandorkar, A., 2018. Solar Power in India – Several Bright Spots Amidst Periodic Question Marks. Swarajya, 27th April. See https://swarajyamag.com/infrastructure/solar-power-in-india-several-bright-spots-amidst-periodic-question-marks accessed on 17th September, 2018.

[33]Sinha, S., 2016. Solar Power: Pragmatism from Industry and Enabling Infrastructure are Key. Livemint, 6th June. See https://www.livemint.com/Opinion/8hij1SRAEhi1EI64zDwh3L/Solar-power-Pragmatism-from-industry-and-enabling-infrastru.html accessed on 19th September, 2018.

other countries that are available at very low rates of interest. These foreign currency loans work out to be cheaper even with protection measures like swaps, hedging etc. Even with the cost premium for such protection, the cost in Indian Rupees works out to be cheaper.

61. Though the solar PV is a fast-growing sector, is based on relatively simple technology (when compared to coal-based and hydro-electric power plants), and faster to commission so far it has not been easy for developers (and investors) to do business in this sector. The uncertainty in the pipeline of projects, evacuation infrastructure, sustained period of price volatility in auctions leading to the regime of low returns, variability around duties and delay in recoveries (among other challenges) has been some of the causes that have resulted in selective investor/financier interest.

Size of Projects: Preclusion of Smaller Players

62. The grid-connected solar project auctions prescribe minimum bid sizes for 100 MW, 250 MW, 500 MW, etc. These auctions, understandably, are designed to scale up solar power capacity addition to meet the overall country targets of 100 GW within the year 2022 and onward targets till 2030. However, as the sizes of projects increase on a sustained basis, small and medium-sized companies with limited financial capacities are practically getting excluded and the competition is going to get confined to large companies that have access to funds from external sources where both interest cost on debt and return on equity expectations are low than that what prevails in the domestic market.

63. Another finding from the study team's interactions at the field level showed a family owned 100 acres of fallow land (not contiguous to any solar project), who were willing to use it for grid-connected solar power generation. Either due to the present system of a minimum size of bids in the auctions, or unwillingness of State Governments, they could not make any progress. They have also not been able to motivate a solar IPP to develop the land.

Weakening Rupee

64. A weakening rupee will impact investor returns in auctioned solar projects, especially if there is a significant exchange rate variation between the time of bidding and finalisation of module supply agreement. Rating agency In-Ra estimates an increase of 2 paise per unit cost of power for a slide of every rupee to the US Dollar. Currency fluctuations, not being covered by the 'Change in law' or any other clause in the PPA is an additional hit to the bottom-line of the developers already struggling in a regime of low returns[34].

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[34]The Economic Times, 2018. Falling Rupee to Impact Investor Return of Solar Projects: Ind-Ra. 17th May. See https://economictimes.indiatimes.com/industry/energy/power/falling-rupee-to-impact-investor-return-of-solar-projects-ind-ra/articleshow/64207209.cms accessed on 11th September, 2018.

Technology Risk Perception

65. Globally, solar PV generation technologies are still perceived as new and evolving. More so, as solar PV technologies are in the realm of electronics which is the fastest area of technology advancement (and consequently obsolescence). The lifespan of a solar power plant is considered as 25 years which is a very long period for technological advances in the field of electronics. From an investor's perspective, this becomes an area of risk, especially for a country like India which (besides its other complexities) is dependent on import of the products and their technologies for sustaining its solar programme. The adverse implications are (1) Bidders compromising on the quality of panels to get panels at low prices (2) Such panels may not only have efficiencies lower than promised and (3) Rate of degradation of panels being faster. Moreover, there is no certainty of the efficiency of solar panels taking a quantum leap in the future.

Financing for Solar Rooftops

66. **Commercial and Industrial:** The State Bank of India has availed a loan of USD 625 million (about INR 400 crores) from the World Bank for on-lending to viable Grid-Connected Rooftop Solar PV projects undertaken by PV developers/aggregators and end-users, for installation of rooftop solar systems on the rooftops of commercial, institutional and industrial buildings. Implementation of the program by SBI will support the installation of more than 600 MW of rooftop solar capacity.With the World Bank-funded capacity development program, SBI is making efforts to expand and incentivise the market for rooftop solar power by way of low-cost financing. Developers that the SBI will be financing under this Program include Azure Power, Amplus, and Cleanmax among others. The capacity of the projects and programs financed range from 25kW to 16MW[35].

67. A similar loan agreement of $500 million multi-tranche finance facility for Solar Rooftops has been signed between the Asian Development Bank (ADB) and the Punjab National Bank (PNB).The first tranche of $100 million has been released by ADB to PNB who would use these funds to finance large solar rooftop systems on industrial and commercial buildings throughout India.

68. **Residential:** However, bank loan for residential solar roof-top is difficult to obtain under present norms. Loans for installation of solar rooftops in the residential building are classified under the 'home renovation' category attracting a higher rate of interest.

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[35]World Bank, 2017. State Bank of India (SBI) Approves 100MW of Grid-Connected Rooftop Solar Projects Under Word Bank Program. Press Release, 2nd June. See http://www.worldbank.org/en/news/press-release/2017/06/02/state-bank-of-india-approves-100mw-grid-connected-rooftop-solar-projects-under-word-bank-program accessed on 31st August, 2018.

Engineering, Procurement and Commissioning

Quality of Assets

69. Solar panels normally have a life of 25 years. There is a serious concern of adaptability of imported equipment and technologies to the Indian conditions and maintain their performance reliably for 25 years. Ideally, there should be standards and guidelines for testing the quality of the imported equipment, projections of degeneration of efficiency, adaptability to Indian climatic conditions etc. The lack of adaptability could lead to excessive inefficiency or failure of technology and dumping of low-quality equipment into the country.

70. In the total cost of a solar plant, 30% of the total cost is accounted for by the solar PV modules. India has only a few solar cell manufacturers such as Indosolar Limited, Jupiter Solar Power Limited, Tata Solar Ltd, Websol Energy System Limited etc. They have a combined manufacturing capacity of about 1212 MW, but only about 250 MW is operational.

71. The reason behind suboptimal manufacturing is that the cell manufacturing companies in China, Taiwan, Malaysia etc. are 'dumping' their cells in India at a lower cost. Cost of imported solar equipment is lesser than the domestic manufacturing components by 25% to 30% resulting in 90% of the solar equipment being imported into India. Participants in this study have confirmed that cheap solar equipment majorly manufactured from tier-I and tier-II overseas manufacturers are likely to lead to the development of low-quality solar assets in India.

Equipment Insurance

72. In the case of module and equipment failure, it would be nearly impossible to invoke the international insurance covers and obtain claims. Furthermore, they could be conditions in the insurance policies which could enable the overseas producers to evade their obligations leaving the asset in bad condition. Stricter regulations and manufacturer service guarantees were required to ensure asset quality was maintained over the entire life of the project.

Solar Rooftop System

73. The Indian rooftop segment has three key categories of consumers: industrial, commercial and residential. About 74% of the current solar rooftop installed capacity is in the industrial and commercial tariff categories due to the higher rates of grid tariff in those segments as compared to the domestic/residential segment[36]. The Government of India has set a target of achieving 40 GW of solar rooftop installations by the year 2022. After that, by way of support, the Government also instituted multiple

[36]Gupta, S., Sharda, S., & Shrimali, G., 2016. The Drivers and Challenges of Third Party Financing for Rooftop Solar Power in India. *Climate Policy Initiative.*

enablers such as 30% capital subsidy on the rooftop system cost, 40% Accelerated Depreciation benefit, enabling Priority Sector Lending, loan at the rate of interest as of home loans, and net metering regulation. However, as of March 2018, the total installed rooftop solar capacity reached 2.54 GW[37], and it is estimated that by 2022 the solar rooftop capacity will reach around 9.5 GW[38] which is still substantially short of the government's target of 40GW[39].

74. At present, the institutional segment of the solar rooftop market is driven by public expenditure. On the other hand, the private market is price sensitive (industrial and commercial installations through either CapEx or RESCO models), and responsive to the quantum of subsidy being released (residential segment). There was only 353 MW of solar rooftop capacity added in the year 2017-18 indicating a slow-down in the pace of installations. The solar rooftop installation enterprise market continues to be highly fragmented having over 1,000 registered installers, with 35 largest players accounting for less than 35% market share. Only three companies have more than 2% market share: Tata Power Solar (6.4%), Sure Energy (2.5%) and Fourth Energy Partner (2.2%)[40].

Availability of the Actual Rooftop Area

75. In general, houses in India do not have standardised roofs (as in Europe and America) and getting the required shade-free area is a challenge. In many rooftops, there is not enough space for economically feasible solar installations. In a rapidly urbanising India, construction of the houses in adjacent plots over a period as well as multi-storied structures is common which may create shades on existing solar rooftop installations. Even where there is a possibility, a sizeable number of residents do not want to "block their rooftops" with a solar installation as there could be other uses for that space.

76. The other reasons for lack of available rooftop space could be property ownership/ disputes and roof rights in many apartment complexes. In hill states, houses are small sized with inclined roofs making them unfit for commercially viable solar rooftop installations. Local architectural styles in tune with the climatic conditions (e.g. Slanted roofs) also constrain large-scale deployment of solar panels.

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[37] Bridge to India, undated. India Solar Rooftop Map 2018 March. See http://www.bridgetoindia.com/wp-content/uploads/2018/08/india-solar-rooftop-map-March-2018.pdf accessed on 29th September, 2018.

[38] Bloomberg News Energy Finance.

[39] Sushma, U.N., 2017. India's Rooftop Solar Market is on Fire. Quartz India, 7th December. See https://qz.com/india/1148332/rooftop-solar-is-the-fastest-growing-segment-in-indias-renewables-market/ accessed on 29th September, 2018.

[40] Bridge to India, 2017. Indian Rooftop Solar Market Growing at over 80% Annually. 18th July. See https://bridgetoindia.com/indian-rooftop-solar-market-growing-80-annually/ accessed on 25th September, 2018.

Construction Standards

77. It has been reported on various platforms that lack of regulations for product quality certification, intense competition and absence of requisite awareness has increased the problem of poor-quality materials in solar installations across the country[41]. For solar rooftops, only recently has MNRE released a guide on solar rooftop construction standards for civil, mechanical, and electrical works (USAID-GERMI project, November 2017). Field studies show that adoption of these standards on a wider scale is yet to happen.

Reluctant DISCOMs

78. Most of the growth in the solar rooftop segment has taken place in the commercial and industrial tariff categories. The economics works favourably for these tariff categories to generate from their rooftop solar system and reduce drawing of high-cost grid power, even without net metering.

79. For the DISCOMs, commercial and industrial consumers are the main paying consumers. These higher tariff categories (commercial and industrial customers) are a crucial source of cash flows much needed for their sustenance and cross-subsiding other customer categories supplied at or below their respective Cost to Serve. There are no incentives to the DISCOM to support them through these transitions. Hence, they are not very keen on promoting rooftop solar power thus depriving themselves of revenue from commercial and industrial consumers. There are states which have not allowed for rooftop solar systems below 5 kW as against 1 kW in other states. Also, the same is not allowed for a single-phase residential connection as well[42], thereby restricting the residential solar rooftop market.

Net Metering

80. After CERC issued its model net metering regulations in the year 2013, 27 states and UTs also issued net metering policies or regulations. Net metering allows for a two-way flow of electricity wherein the consumer is billed only for the 'net' electricity supplied by the DISCOM. It attempts to provide a fair deal for utilities and the end customer/rooftop owner both and it is easy to understand the unit calculation for the non-technical consumer. However, only a few states have implemented net metering on the ground.

81. For instance, there could be net metering guidelines in place, but the progress could be very slow either because of lack of experience of the staff, the disinclination of the

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[41]Kabeer, N., 2018. MNRE Invites Suggestions on Setting Standards for Rooftop and Off-Grid Solar Projects. Mercom India, 29th May. See https://mercomindia.com/mnre-invites-suggestions-rooftop-off-grid-solar/ accessed on 25th September, 2018.

[42]The Economic Times, 2018. Will Achieve 100GW Solar Target Ahead of 2022: Harsh Vardhan. 7th April. See https://economictimes.indiatimes.com/industry/energy/power/will-achieve-100gw-solar-target-ahead-of-2022-harsh-vardhan/articleshow/63657450.cms accessed on 18th September, 2018.

DISCOMS to encourage or permit net metering or a combination of both. The DISCOMS feel that even in the residential sector, it is only the prompt paying consumers who want to adopt solar since they are economically better off and intellectually inclined. As reported by the rooftop installers, there are procedural uncertainties regarding installations of net meters, prolonged periods of non-availability LT meters and HT meters with the DISCOM. A waiting period of about six months (in some States even longer) for net meter installation is not uncommon. In some states, there has been a virtual suspension in the distribution of net meters by the DISCOMs.[43]

82. Participants from 12 states reported challenges in the method of granting connections. The successful implementation of net metering policy is critical for the solar rooftop to grow in the commercial and industrial segment. This is a challenge for the underlying economics of rooftop installations and a discouraging factor for attracting investments in the segment.

RESCO Models

83. The size of a typical solar rooftop installation in the commercial or industrial segment is around 150-200 kW, costing more than INR 1 crore.[44] In the residential segment, the sizes are around 4-5 kW, costing around INR 4 lakhs. Costs on a KW/MW turn out to be higher than straightforward ground mounted systems that are in multiple MWs since a significant amount is to be spent on additional civil, mechanical, electrical and/or integration works. In general, payback suggested by the rooftop system installers vary between 7 to 10 years which is considered long for industries and commercial establishment to make an upfront capital expenditure in non-core business activities such as the installation of solar rooftop systems. Commercial banks are also reluctant to lend to rooftop solar projects because of high-risk perceptions.

84. Considering these challenges, the OpEx model (also known as RESCO model) has evolved and is being increasingly preferred over the conventional CapEx model. In the RESCO model, the developer builds a solar energy system on a customer's property for no significant upfront charge and realises his revenue through charges on the sale of electricity generated and recovery of operating costs. This mitigates one of the critical challenges (high upfront CapEx financing needs) and lowers the barrier to scale up solar rooftop installations for customers who were interested but earlier hesitant to make high upfront capital expenditure and take the solar assets into their books of accounts. Third party financing models currently support 30% of the total rooftop solar installations.[45]

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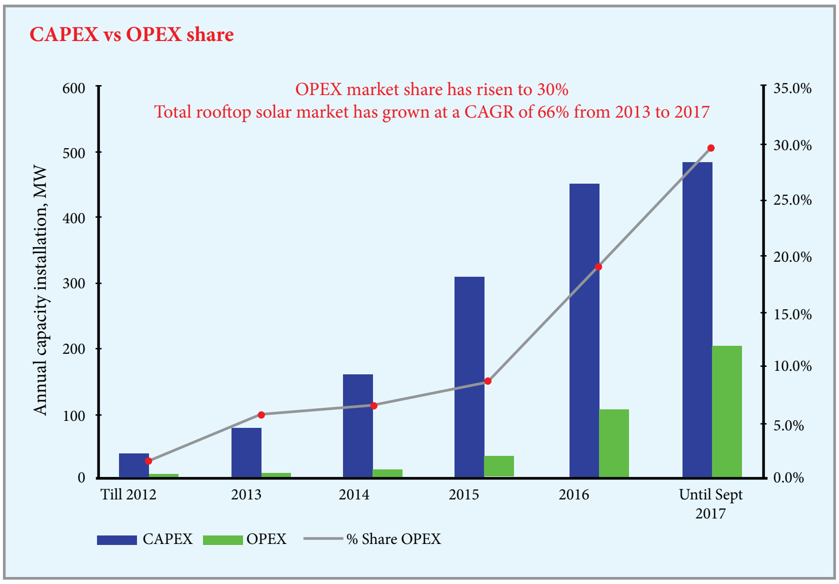
[43]Ramakrishnan, T., 2018. Wind Power Capacity Addition Still Stuck in the Doldrums. The Hindu, 21st April. See https://www.thehindu.com/news/cities/chennai/wind-power-capacity-addition-still-stuck-in-the-doldrums/article23621879.ece accessed on 21st September, 2018.

[44]IEA, 2017. 2016 Snapshot of Global Photovoltaic Markets - IEA PVPS. International Energy Agency. See https://www.elektrotechnik.ch/fileadmin/elektrotechnik.ch/documents/PDF/001WachstumPV_Global.pdf accessed on 22nd September, 2018.

[45]Sanghani, N., 2016. Solar Rooftop in India: Current Scenario and Challenges. Power Watch India, 20th October. See https://www.pressreader.com/india/power-watch-india/20161020/283167198104027 accessed on 22nd September, 2018.

Fig. 4: Graph Representing OpEx Market Share in the Solar Rooftop of India



Source: Bridge to India Report: India Solar Handbook 2017

85. Majority of the states approve of the RESCO model, but there are exceptions (such as Gujarat). In some States, there is a 1 MW cap on net metering, which is a further challenge for RESCO operators. Further, there is a substantial risk of disputes between the customers and RESCO operators over the project period. In the regime of falling prices, customers may get tempted to begin renegotiation or even renege on the contract to buy cheaper power through open access sources (large enterprises). Enforcement of such commercial contracts is generally difficult. Thus, the risks of payment default by the customers increase over time.

Release of Subsidy

86. The process of release of subsidy is lengthy and requires considerable efforts. Almost all states covered in this study have reported subsidy release delays (running into few months) at some point of time or the other.[46]

Role of CEIG

87. The Chief Electrical Inspector to Government (CEIG) has been accorded an important role in approving drawings and carrying out inspections to assure itself about the safety of solar rooftop installations that are above a threshold generation capacity. However, in most States, there is a need to augment staffing and strengthen institutional capacities in the CEIG offices. There have been instances where clearances on technical drawings and Bill of Materials from the same CEIG office have varied between two weeks no iterations to five months with multiple iterations. Overall, the participants in this study agreed to the need for appropriate and continuous training

[46]Maisch, M., 2017. India: UPNEDA Issues Draft Solar Power Policy 2017. PV Magazine, 29th June. See https://www.pv-magazine.com/2017/06/29/india-upneda-issues-draft-solar-power-policy-2017/ accessed on 22nd September, 2018. 8.

for CEIG officials on new rooftop solar equipment (such as inverters) that are coming into the market and implementing other institutional capacity building measures to improve the CEIG processes within the solar rooftop programmes.

Residential Segment: Payback Periods

88. The residential domestic customer tariffs across States are lower than that of commercial and industrial customers. Thus, it is likely that achieving grid parity of energy from residential solar rooftop projects can take another 4-5 years. Hence, establishing attractive economics (including subsidy) and shorter payback periods that would be needed to scale up of solar projects in this customer category would take time. It is an interesting fact to observe that in most of the states, domestic power tariff is subsidised and it leads to longer payback periods. If domestic tariffs were to be fixed on a Cost-to-Serve recovery basis along with an economic rate of return, (i.e. tariffs would be higher than what they are now), the incentive for solar power generation would be even greater.

Information, Education and Communication

89. Indian rooftop segment is relatively young, and the majority of the installer EPC companies have little or no experience. An earlier study conducted by the World Resources Institute (WRI) and Shakti Sustainable Energy Foundation, rooftop customers have significant trust issues while deciding the installer. For instance, the solar scam in Kerala, created a bad press and customers who had experience of such issues are unlikely to promote solar.[47] There is a lack of technical know-how and familiarity with the process, especially among residential customers. Information about costs and benefits of going solar, choice of assets based on quality, grid interconnections and net metering are some of the missing information links between the rooftop owners and the rooftop installers.

90. Solar rooftop commitments are for 25 years, and many customers consider such long-term contractual commitments to be risky mainly because of a lack of trust on agreements, uncertainty about any hidden costs, off-take for long-term consumption, and blocking rooftop for future unforeseen needs.

91. Across the states, it takes 3 to 4 months from the date of application to receiving a grant of connectivity for a residential rooftop system. The requirement of approvals from multiple depart ments such as the state nodal agencies, DISCOMs, CEIG, and urban local bodies causes delays. Lack of clarity in implementation modes through empanelled EPC service providers and supportive utility staff add to the set of challenges. However, states where there is a robust single window clearance through portal-based systems and helpdesks for customer support, have reported these acts as facilitators to increase customer interest in acquiring solar rooftop systems.

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[47]Kenning, T., 2017. Kerala's Dream of Solarising Every Roof. PV Tech, 26th October. See https://www.pv-tech.org/editors-blog/keralas-dream-of-solarising-every-roof accessed on 21st September, 2018.

Policies and their Implementation

Policy Consistency Issues across States

92. India has taken rapid strides to expand its solar generation capacity. Solar power has been given preference by providing them with 'must run' status. The rise of solar power generation in the generation mix without a commensurate rise in the overall demand conditions has, however, had a deflationary impact on coal-based thermal power generation. The plant load factor or capacity utilisation of coal-based thermal power plants which was 76% six years ago has shrunk to just 58% now, threatening thermal efficiencies and economic operations of erstwhile baseload thermal power stations.[48]

93. An attempt to bring some relief to the coal-based thermal power generators was attempted in the National Tariff Policy of the year 2016. The Renewable Energy developers and open access customers were required to pay an additional charge to accommodate the fixed charges due to the stranding of conventional power sources and the developed transmission and distribution assets. It was envisaged as an unavoidable national obligation towards the coal-based thermal power operators who would continue to form the country's energy security backbone, at least for the foreseeable next few decades.

94. On the other hand, based on targets set by GoI-MNRE, Central sector auctions (SECI, NTPC and others), increased RPO trajectories being ordered by the regulators, various State Governments are proposing large-scale solar power plants and solar parks in their respective states. Many developers and sector stakeholders feel that this is creating a policy dichotomy, especially in a situation where (a) the power demand growth is slowing down because of difficult economic conditions, and (b) the Indian economy itself is becoming more energy efficient through technology improvements and aggressive pursuit of demand-side management measures being put in place through BEE, EESL and other entities.

Implementation Issues

95. Policies on solar projects have evolved rapidly due to the Government's commitment to the Paris Agreement 2015 and, at times, as an ad-hoc response to market conditions. The policy-making processes across States have not always involved the private sector developers, SME sector EPC players, and manufacturers. Developers and other market stakeholders believe, to formulate cohesive and meaningful policies, their inputs were required. Thus, many policies promulgations and regulations have bred uncertainty and confusion among stakeholder groups at the implementation level. Most of them reported policy implementation could become a challenge for India to attain its goal of reaching RE capacity of 175 GW by 2022.

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[48] Aiyar, S.S.A., 2017. Dark Side of Solar Success: It May Kill Thermal Power, Banks. The Economic times, 16th April. See https://economictimes.indiatimes.com/industry/energy/power/dark-side-of-solar-success-it-may-kill-thermal-power-banks/articleshow/58202191.cms accessed on 21st September, 2018.

96. One area of policy implementation challenge is setting RPO targets, the status of compliances by obligated units and enforcement, if possible. Though there have been discussions and even announcements of a national RPO target, compliances and enforcement, the implementation processes have not moved forward.

97. Other areas of recent interest have been the sector-oriented policy shifts such as doing away with Generation Based Incentives (GBI), reduction and subsequent abolition of accelerated depreciation, moving away from the 'must run' status to merit-order dispatch, the imposition of 5% GST on solar panels from a zero-tax regime[49] and safeguard duties. There had been litigations regarding the confusion over the application of GST rates for services, supply, contractors and sub-contractors in states like Maharashtra, Karnataka, etc.[50] Studies show that frequent changes in policies can significantly impact and impede the scaling up of the sector.

Effectiveness of UDAY

98. Most state DISCOMs are in precarious financial condition. The presently operational Ujjwal DISCOM Assurance Yojana (UDAY) program was launched by the Ministry of Power in November 2015 to improve the financial condition of DISCOMs. As of December 2017, the AT&C losses in 24 of the UDAY States and UTs stood at 22.73%, an increase of 2% higher than 2016.[51] This shows that on-the-ground effectiveness of UDAY could take a bit more time. As discussed by stakeholders, during the study, UDAY does not provide for any penalty to states for non-compliance and any upfront funding for investing in distribution infrastructure. UDAY also does not address the fact that the financial losses at the DISCOM are partially a reflection of upstream inefficiencies specifically in coal mining, linkages, and electricity generation.[52]

Commercial Issues

Generation Surplus

99. Many states are experiencing a power surplus scenario leading to a drop in exchange price of electricity. Several high paying consumers (industrial and commercial consumers) are using open access to procure inter-state power. Further, the tariff designed for absorbing the loss due to stranded state power sources is not reflective of the proportion of fixed and variabl e cost liability of the DISCOMs. This has resulted in the insufficient recovery of the fixed charges, leading to financial losses on account of stranded capacity incurred due to open access sales.

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[49]Panda, S., 2018. India is Leading the Solar Charge, but its Own Domestic Industry Faces Gathering Clouds. The Print, 19th March. See https://theprint.in/governance/india-may-leading-solar-charge-domestic-industry-clouded/42876/ accessed on 21st September, 2018.

[50]Prateek, S., 2018. Solar Companies Still Waiting for GST Clarity and Refunds. Mercom India, 11th June. See https://mercom-india.com/solar-companies-still-waiting-gst-clarity-refunds/ accessed on 21st September, 2018.

[51]Prateek, S., 2018. AT&C Losses Increased in Many States Under UDAY Program in 2017. Mercom India, 21st February. See https://mercomindia.com/states-atc-loss-uday/ accessed on 21st September, 2018.

[52]Sivaram, V., 2017. India Makes Progress on Solar, But Barriers Remain. Council on Foreign Relations. See https://www.cfr.org/blog/india-makes-progress-solar-barriers-remain accessed on 22nd September, 2018.

100. The increasingly volatile power market is making power procurement planning by State entities difficult and increasing the risk of stranded generation capacity of State sources. The uncertainty, in turn, increases the risk for the DISCOM in the amount of electricity it shall purchase to avoid surpluses or deficit of power. For instance, the Northern Power Distribution Company of Telangana Limited during the year 2016-17, backed down various generators to reduce their generation of energy of 4190 MU due to a reduction in DISCOMs demand. This is mainly due to the consumers of DISCOMs availing of supply through open access for a quantum of 2134 MU. However, the DISCOMs had to pay the fixed costs to the generators even though they had backed down.[53]

RPO Compliance

101. The RPO mechanism compels the DISCOM to purchase a certain percentage of their electricity from RE sources. The quantum of RE and specifically solar power purchase is determined by the SERC. Although solar energy prices are steadily falling there are states where thermal power or hydropower is still cheaper for DISCOMs as compared to solar power. This has led to a scenario where DISCOMs are forced to buy power at higher than their APPC rates from solar power plants to oblige their RPO commitment. Hence, to avoid even more financial stress, DISCOMs have been reluctant to enter into PPAs with developers or IPPs beyond their RPO obligations.

Delay by DISCOMs to Meet Payment Obligations

102. Despite the implementation of policies aimed at revamping the sector, many DISCOMs have been unable to honour their payment obligations to RE developers over the past few years. Many have fulfilled only a portion of their power purchase commitments that too with significant delays of more than six months (which is beyond the 180-day deadline set by RBI in its February 2018 notification).

103. Tariffs have come down by 73% since 2010 and in 2017 touched an all-time low.[54] With such low tariffs, any delays in payments by power procurers become a major challenge for the developer to sustain its operations. Delayed fund flows to the developers put stress on meeting (a) working capital requirements and (b) fulfil debt service obligations. This has lowered the creditworthiness of most State DISCOMs in the auctions market, and developers are increasingly assigning risk premium to state-level bids vis-à-vis central sector bids from SECI and NTPC. However, some of the State DISCOMs have been consistently meeting their payment obligations towards the RE developers and IPPs.

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[53]TSERC, undated. Replies to the Objections / Suggestions Raised on Additional Surcharge to be Levied on Open Access Consumers for FY 2017-18. See http://www.tserc.gov.in/file_upload/uploads/Objections%20Received/surcharges%20obj/Add-Sur/AddlSurchargeFY-17%2018%20TSNPDCL.pdf accessed on 22nd September, 2018.

[54]Prabhu, R., 2017. Mercom Exclusive: Payment Delays are Increasing Risk and Project Costs for Solar and Wind Projects in Many States. Mercom India, 28th March. See https://mercomindia.com/mercom-exclusive-payment-delays-increasing-risk-project-costs-solar-wind-projects-many-states/ accessed on 22nd September, 2018.

Call for Renegotiation of PPAs

104. Low tariffs discovered in the Rewa Ultra Mega Solar Park (February 2017) and SECI Bhadla Phase III Solar Park (May 2017) projects have led State entities (DISCOMs and State Power Holding Companies) to be circumspect if they are paying higher tariffs in the projects which were auctioned earlier. There are also apprehensions (more justifiably than otherwise) that audits in subsequent years may pose questions on the rationale of continued procurement of power at higher prices in a regime of falling prices.

105. This line of thinking has resulted in a call for renegotiation of the existing signed PPAs between developers and DISCOMs, in extreme cases, cancellation of signed PPAs. In one state, it had a negative impact of over 215 MW of grid-connected solar projects. Out of nine companies that had commissioned projects, six were not ready to renegotiate tariff. Also, some 80 MW of the solar project had to face cancellation due to delay in project commissioning and termination of PPAs.[55] Moreover, this has also resulted in litigations at various levels.

106. This issue of renegotiation and cancellation of PPAs was discussed with senior DISCOM officials of various states during key informant interviews. It was understood that demand for renegotiation by some DISCOM officials could also have been privately orchestrated in connivance with some developers who may have had an ulterior motive to exit from their projects which had otherwise become unviable. Such demand could have been construed as unreasonable under the Contracts Act thereby giving the developers an exit option without payment of damages. Most importantly, attempts, compulsion and even coercion to renegotiate prices leads to a major failing to honour the sanctity of contracts. Of course, the private sector has also not covered themselves with ethics since they have tended to exploit such moves by DISCOMs either to walk out of contracts or to edge out their business rivals.

Wheeling, T&D Losses and Banking Charges

107. In any Open Access (OA) transaction between RE generator and its buyer, transmission charges and losses are required to be paid depending upon the location of the generator and the buyer. The Capacity Utilization Factor (CUF) of solar projects as specified in the RE tariff orders issued by CERC and various SERCs are in the range of 19 - 26.5% which is lower than that of the baseload generation.[56] Based on the current mechanism for determining wheeling charges on INR/kW/day basis, many SERCs have determined wheeling charges at almost four-five times the conventional open access charges.

[55] Prateek, S., 2017. UPERC Adopts Renegotiated Tariff of ₹7.02 for Solar Projects Tendered in 2015-16. Mercom India, 27th November. See https://mercomindia.com/uperc-tariff-solar-projects-tendered/ accessed on 22nd September, 2018.
[56] Heeter *et al.*, 2016. Wheeling and Banking Strategies for Optimal Renewable Energy Deployment: International Experiences. National Renewable Energy Laboratory: Technical Report NREL/TP-6A20-65660.

108. RE is an infirm source of energy whose generation varies substantially within the day as well as across months of the year. In this context, Power Banking has an important role to play as a reservoir where excess generation could be parked and drawn from when needed. This mechanism worked well when RE was a small component of the overall generation mix. However, with RE scaling up in the last few years and the coal-based generation stressed, the DISCOMs and grid operators are reluctant to commit to increased drawing provisioning at the earlier terms of settlement which were commercially favourable to promote adoption of RE. Recently, the DISCOMs and SERCs have begun to reduce the banking period and increase the banking charges for the developer. This has, to an extent, adversely affected the buoyancy of RE developer interest.

Table 5: Wheeling and T&D Loss Charges and Banking Charges for Few States

S.No.	State Name	Wheeling and T&D Loss charges	Banking of Power
1.	Telangana	No wheeling and T&D loss charges. Exempted for captive use within the state. Charges applicable for OA.	100% permitted for all captive and OA consumers. Banking charges to be adjusted in kind at the rate of 2% of the energy delivered.
2.	Andhra Pradesh	Generators to bear the wheeling and T&D losses at actual. Wheeling charges for sale outside the state will be as per APERC regulations. No wheeling and transmission charges to the desired location(s) for captive use/third party sale within the state through 33kV system subject to industries maintaining their demand within its contracted demand.	100% permitted for all captive and OA consumers. Banking charges to be adjusted in kind at the rate of 2% of the energy delivered.
3.	Haryana	There is an exemption on wheeling and T&D charges or any other surcharges for T&D up to 10 km. Beyond 10 km, cost to be shared by license and developer. Wheeling charges of 2% of the energy field.	Banking of power is allowed for one year by the licensee/utilities at the rate of 2% of the energy fed to the grid.
4.	Jammu and Kashmir	Transmission & wheeling charges as per J&K SERC for the sale of power within or outside the state.	Banking of power for captive use or OA shall be provided for two months.
5.	Madhya Pradesh	No transmission and wheeling charges for the licensee. For use/sale to the third party as per the decision of the commission. Wheeling charges @ 2% of energy injected to be deducted by the licensee. 4% subsidy on wheeling charges payable by state government to licensee.	Banking allowed 100% at the rate of 2% towards the banking.
6.	Assam	Two-third of charges applicable to consumer as transmission and wheeling charges. Charges are exempted in case of sale to state DISCOM/TRANSCO	Banking of power allowed for one year. There are no banking charges.

Domestic Manufacturing

109. The manufacturing of solar panels starts with the making of poly-silicon from silicon. Poly-silicon is then made into ingots, which are then cut into wafers. Cells are made with wafers, and a string of cells makes a module. In India, only modules and cells are made, and the basic raw material is imported. In fact, there was a significant capacity

to make modules in India by which cells were imported and assembled into modules for re-export. This was mainly to cater to European Union needs who used Indian assemblers because of the cost advantage.

110. But this industry has not only been hit due to lack of demand within India but also due to drying up of such opportunities in the rest of the world mainly due to competition from China. It is a fact that domestic manufacturing in this area has been badly hit. Upstream stages of the solar manufacturing chain are missing. A significant share approximately 80-90% of module manufacturing cost is attributed to raw material alone. Modules account for nearly 30% of a solar power project's total cost. There is a lack of integrated setup, economies of scale and modern technology, resulting in higher production cost for domestic manufacturers. Indian manufacturers face stiff competition from global manufacturers.

111. Solar PV manufacturing in India mainly involves manufacturing cells, assembling modules and assembling (or manufacturing) some of the Balance of Modules such as low iron glass, encapsulants, back-sheet, etc. The ban on development of silicon wafer in India till 2013 has led to a major setback in the development of Indian semi-conductor industry.[57] India does not have a poly-silicon, wafer or ingots manufacturing facility. A bulk of the components used for manufacturing a PV module in India is imported. This comprises glasses, silver paste, and ethylene vinyl acetate.[58] According to MNRE, the country has installed capacity for producing 3.1 GW of cells and 8.8 GW of modules.[59] Out of which, only 1.5 GW of the cell, and 2-3 GW of module manufacturing capacity is being utilised.

112. The 'make or buy' decision for any country has a strategic significance. The various parameters considered for evaluating whether to import or to manufacture domestically are domestic manufacturing capacity, the price of domestically manufactured components in comparison to imported price, technological depth, and percentage of domestic content, raw material availability, raw material requirement and job-generating potential. India with its ambitious goal of 100 GW of Solar power by 2022 is in need of higher capacity of solar module and equipment manufacturing. In the absence of manufacturing, India will need to import $42 billion of solar equipment by 2030, corresponding to 100 GW of installed capacity (KPMG report).

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[57]Gupta, A., 2018. Narendra Modi's India Facing Unique Solar Challenges. See https://amplussolar.com/blogs/narendra-modis-india-facing-unique-solar-challenges accessed on 22nd September, 2018.

[58]Saur Energy International, 2018. India's PV Module Manufacturing Sector Needs Serious Attention. See http://www.saurenergy.com/solar-energy-articles/indias-solar-pv-module-manufacturing-sector-needs-serious-attention accessed on 22nd September, 2018.

[59]Kenning, T., 2017. India's MNRE Calls for Domestic PV Manufacturing Capacity Update. PV Tech, 31st August. See https://www.pv-tech.org/news/indias-mnre-calls-for-domestic-pv-manufacturing-capacity-update accessed on 23rd September, 2018.

Issues of Solar Manufacturers

113. The recent decision of China to scale down the solar targets and subsidies within their country is likely to be a blow to the Indian manufacturers. With module prices coming down by up to 25%, industry experts have suggested that this would render the equipment manufacturers in India uncompetitive and create a threat of partial or complete shut-down of domestic manufacturers.[60]

114. Despite keeping domestic content requirement by the government, the capacity utilisation of domestic PV module production is in the range of 15 - 20%.[61] It is even lower for cell production. There is a lack of demand for domestic PV modules along with uncertainty in long-term contracts with manufacturers. Thus, this also results in higher inventory levels and a further increase in operating and manufacturing cost.

115. The other challenge for a module manufacturing industry is the high-interest rate on capital, comprising 15 - 20% of the total manufacturing cost. Moreover, limited access to cheap loans because of the high-risk environment of the solar industry further raises the cost of manufacturing panels. The relationship between manufacturers and suppliers has come under stress in the last three to four years because of higher demand variability, larger investment and greater agility to capture value in a rapidly growing sector. Another estimate claimed that 90% of the Indian manufacturer under the umbrella of MSME had either closed down or filed for debt restructuring. Indian manufacturers are also subjected to the vagaries of currency fluctuation in international market.[62]

116. India does not have a provision for assistance in the form of incentives or low-interest loan to those buying from domestic manufacturers. Such provisions have supported the development of indigenous manufacturing capacity in countries like China. Also, manufacturers also face a high cost of land and electricity, along with the delay in setting up facilities due to a complex regulatory system for permitting land clearances. At present, there are schemes like Modified Special Incentive Package Scheme (M-SIPS) for providing a subsidy of 20% on capital expenditure in Special Economic Zone and 25% in non-SEZs units. However, the schemes are applicable for all electronics manufacturing, with no separate allocation for solar and there are very few takers of it. The World Trade Organization's ruling that India's DCR contravened its trade agreement has also harmed domestic manufacturers.[63]

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[60]Saluja, N., 2018. Indian Companies Wary of China Dumping Solar Equipment. The Economic Times, 8th June. See https://economictimes.indiatimes.com/industry/energy/indian-companies-wary-of-china-dumping-solar-equipment/articleshow/64513943.cms accessed on 20th September, 2018.

[61]Verma, B., Pavaskar, G., Oluwatola, T., & Curtright, A., 2017. State-level Policy Analysis for PV Module Manufacturing in India. Center for Study of Science, Technology and Policy (CSTEP) and Solar Energy Research Institute for India and the United States (SERIIUS).

[62]CSTEP & WISE, 2015. Addressing the Challenges of RE Manufacturing in India: Horizon 2032. Center for Study of Science, Technology and Policy (CSTEP) and World Institute for Sustainable Energy (WISE).

[63]Clover, I., 2017. Analysis: India's Domestic Solar Manufacturers Facing Tough Climate, Says Mercom. PV Magazine, 21st February. See https://www.pv-magazine.com/2017/02/21/analysis-indias-domestic-solar-manufacturers-facing-tough-climate-says-mercom/ accessed on 15th September, 2018.

117. The country has not made much progress in the promotion of solar thermal systems to generate power especially in the light of cheaper heat storage technologies that could facilitate continued generation of power during the non–sunny hours. It may work out to be cheaper than storing power in batteries with limited life. Moreover, most of the components for solar thermal projects can be made by Indian manufacturers. The government can explore an option of announcing a policy for Solar thermal combined with solar PV by which daytime demand can be met with PV technology and continued generation using stored heat.

Imposition of Safeguard Duty

118. There is uncertainty due to the ongoing request of solar manufacturers for antidumping and allied duties or higher import duties on the import of solar modules. There is a recommendation of safeguard duty of 70% which will support local manufacturer but also result in an increased overall cost of the project and higher tariff. To withhold the uncertainty due to the antidumping and higher duties in the solar market, MNRE has announced exemptions for tenders which were tendered before imposition of such duties.

119. As of September 2018, a safeguard duty of 25% on solar cells and modules imported from China and Malaysia has been imposed by the Government of India following a decision by the Supreme Court. This decision has provided much-needed clarity to developers, central and state agencies to proceed with their planned projects. However, uncertainty persists in the process of approving cost pass-through for projects awarded before duty announcement.[64]

Developing a Solar Fab

120. The challenges in developing solar fab in India are a lack of scale, insufficient government support and an underdeveloped supply chain. Moreover, setting up of solar fab requires consistent, high quality and cheap power supply, large capital, land, raw material and highly skilled engineers. It is difficult for private manufacturers to bring all of these together through its own initiative.

121. For the initial development of a semiconductor solar fab facility, there is a need for a public-private partnership for taking care of domestic requirements of chunks, ingots, wafers, leading to the production of solar cells. Outputs from the fab facility further could be used by other manufacturers in the electronics industry, components and device manufacturers. As a prerequisite and to make such a project viable, the land would need to be allocated at a suitable location at a token cost and high quality' uninterrupted power at very low cost needs to be assured. After that, the project could

[64]Chandrasekaran, K., 2017. Developers Seek Change in Gujarat Solar Policy. The Economic Times, 11th September. See https://economictimes.indiatimes.com/industry/energy/power/developers-seek-change-in-gujarat-solar-policy/articleshow/60468447.cms accessed on 19th September, 2018.

either be fully or partially funded (viability gap) by the Government or developed on a PPP model with appropriate allocation of responsibilities.

Importance of Balance of Systems

122. While much of the policy, power procurement agency and developers' attention stay on reducing the cost of PV panels, their quality, import duties and domestic manufacturing, the importance of Balance of Systems (BoS) in overall project costs are often understated. Typically, BoS includes wiring, switches, racking and mounting systems, inverters, battery banks and civil works. A recent IRENA study[65] expects future cost reductions are expected to be dependent on BoS rather than PV modules. The focus on BoS cost reductions could reduce the global weighted-average installed costs of utility-scale PV systems by 57% between 2015 and 2025. Even larger cost reductions are possible if deployment accelerates and a more rapid shift to best practice BoS costs occurs.

Other Challenges

Forecasting & Scheduling Data

123. Accurate forecasting of generating capacity availability at 15 minutes interval for 24 hours of the day is essential for management of the national and state grids. To determine the viability of solar power plants at a particular location, developers need to procure information regarding the environmental factors such as insolation/irradiance, rainfall, cloud cover, dust factor, etc. This data is fed into software to calculate the amount of energy that shall be generated over a period to determine the performance ratio and CUF of the plant. India does not have an existing solar radiation database. The data is taken from NASA sites and fed into Meteonorm and PVsyst software. Both the data and the software are not indigenous and hold discrepancies of up to seven percent when projecting energy generation. The variation in the data is hard to account in the forecasting models.

Cost of Storage

124. The overall solar optimism is tempered by realism that energy storage systems are not commercially and economically viable yet. Installing an energy storage system increases the overall cost of the power produced. Cost of batteries increases upfront CapEx of a project and incremental costs of hybrid inverters over grid inverters.[66]

125. India has low reserves of cobalt and lithium (primarily found in Chile, Argentina, Bolivia, China, the Democratic Republic of the Congo and USA) which are used in

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[65]IRENA, 2016. The Power to Change: Solar and Wind cost reduction potential to 2025.

[66]Solar Quarter, undated. With Recent Advancements in Energy Storage Technology, How Will Indian Solar Sector Shape Up? See https://www.solarquarter.com/index.php/perspectives/8610-with-recent-advancements-in-energy-storage-technology-how-will-indian-solar-sector-shape-up accessed on 19th September, 2018.

manufacturing lithium-ion (Li-ion) batteries. A shortage of these materials combined with a lack of manufacturing facilities has resulted in India being heavily dependent on the import of Li-ion cells from China.[67]

126. The other challenge of Li-ion batteries is the higher maintenance cost and relatively smaller shelf life that would require battery manufacturers to create an efficient distribution system taking into consideration shelf life and service issues. However, the demand for Li-ion storage systems is set togrow, and thus there is a need to provide favourable fiscal regime to emphasise manufacturing of batteries in the country along with enabling the environment to recycle batteries in India.

R&D Focus

127. Although, India created National clean energy fund (NCEF) in 2011 with an objective of funding research and innovative projects in clean energy technology, it is observed that the utilization of funds from NCEF has been rather low, and disbursement are aligned more with on-going programs or missions of various other ministries and departments than with the stated objectives of the fund. This poses a potential risk of diluting the focus of NCEF with adverse implication for research and innovation in India's clean energy sector source. There are growing calls for the government to deliver alternative supportive policies and finance, particularly in R&D.

[67]Mishra, A., 2018. How to Get India's Clean Energy and EV Push (Back) on Track. 22nd March. See http://energypost.eu/overcoming-operational-bottlenecks-will-be-critical-for-growth-in-indias-renewable-energy-sector/ accessed on 20th September, 2018.

IV. WIND POWER

A. Identification of the Barriers

128. The target set by the Government of India for capacity addition from RE-based electricity generation is 175 GW by 2022, of which 60 GW is to come from the wind sector. NIWE assessments have found that the total wind potential @100m above ground level to be 302 GW of which the Western and the Southern Indian states have much higher potential when compared to other regions of India. All States with above 10,000 MW wind potential are in these two regions: Gujarat has a wind potential of 84,431 MW which is the highest in India, followed by Karnataka 55,857 MW, Maharashtra 45,394 MW, Andhra Pradesh 44,228 MW, Tamil Nadu 33,799 MW, Rajasthan 18,770 MW and Madhya Pradesh 10,483 MW. The cumulative wind power installed capacity crossed 34 GW at the end of March 2018 constituting more than 50% of the country's total grid interactive RE capacity.

129. Some fiscal incentives such as concession in customs duty for import of specific critical components, excise duty exemption, special additional duty exemption, income tax exemption for ten years on profits for power generation, etc. were being provided for promotion of wind power. Those not availing accelerated depreciation are eligible for Generation Based Incentives (GBI). Up until January 2018, around 13,674 MW capacity projects have been registered under GBI. An amount of Rs. 3352 crores have been disbursed under the Scheme till 24th April 2018. Almost all these incentives have been done away with except for the exemption of duty on critical components.

Shift from Feed-in-Tariff to the Auction Regime

130. Till about two years ago, most wind installations came up based on
    (i) Feed-in-Tariff fixed by the State Electricity Regulatory Commissions for sale of power to the DISCOMs;
    (ii) Captive or Group Captive installations where the policies and regulations were mutually beneficial to the developers and captive consumers;
    (iii) Accelerated Depreciation (AD) on capital cost that was beneficial to businesses

with depreciation appetite;

(iv) Generation Based Incentive (GBI) in lieu of AD basically for IPPs so that other investors could also invest;

(v) Renewable Energy Certificate (REC) driven development where power was purchased by DISCOMs at APPC and the RECs were sold on the exchanges.

131. All these methods to increase the wind installation capacity came to a halt with the introduction of a competitive bidding process.

Competitive Bidding Guidelines for Wind Power Procurement

132. The Government of India issued Guidelines under Section 63 of the Electricity Act, 2003 providing a framework for procurement of wind power through a transparent process of bidding including standardisation of the process and defining of roles and responsibilities of various stakeholders. These Guidelines would enable the Distribution Licensees to procure wind power at competitive rates in a cost-effective manner. These Guidelines are applicable for procurement of wind power from grid-connected Wind Power Projects having: (a) Individual size of 5 MW and above at one site with minimum bid capacity of 25 MW for intra-State projects; and (b) Individual size of 50 MW and above at one site with minimum bid capacity of 50 MW for inter-State projects.

133. Key components of the Guidelines include compensation for grid unavailability and backing-down, robust payment security mechanism, standardisation of the bidding process, risk-sharing framework between various stakeholders through provisions like a change in the law, force majeure, measures in case of default of procurer as also by the generator, etc.

Competitive Bidding projects

134. A scheme for setting-up of 1,000 MW Inter-State Transmission System (ISTS) connected wind power projects was sanctioned by MNRE on 14 June 2016. This bidding process by SECI was done to take power from wind surplus states and supply the same to states that do not have the potential for wind power. The first wind bid (1,000 MW) was concluded at a wind tariff of Rs. 3.46 per kWh of wind energy on 23rd February 2017. SECI issued Letters of Award to five selected bidders on 5th April 2017, and the projects are likely to be commissioned by October 2018.

135. The wind tariff in India touched low levels of Rs. 2.64 per kWh in the second (1,000 MW) conducted by SECI on 4th October 2017. MNRE issued another scheme on 22nd November 2017 for setting up of 2,000 MW wind power projects connected to ISTS. The scheme is being implemented by SECI, with PPA duration and Power Sale Agreement (PSA) for 25 years from project Commercial Operation Date (COD). In SECI's third ISTS wind auction (2,000 MW) held on 13 February 2018, tariffs fell even lower to match the lowest solar auction prices of Rs. 2.44 per kWh which was discovered in May 2017. These wind projects are to be commissioned within 18 months from the signing of PPAs.

136. Also, three States namely Tamil Nadu, Gujarat and Maharashtra also issued bids of 500 MW each for installation of wind power projects in these States. Gujarat Urja Vikas Nigam Ltd (GUVNL), invited bids for wind power for 500 MW in June 2017 and the competitive auction for wind power for 500 MW was conducted during December 2017 in which the discovered tariff was Rs. 2.43 per unit. Similarly, in Maharashtra and Tamil Nadu auctions held in March 2018 and August 2017, the discovered tariff was Rs. 2.87 and Rs. 3.43 per unit respectively.

Slowdown in Wind Power Capacity Addition

137. The installed solar capacity grew by 123% to reach a record 9.6 GW in 2017 (more than double the 4.3 GW installed in 2016), the capacity addition in wind power sector has significantly slowed. According to Energy Statistics Report 2018, out of the total installed RE generation capacity, wind power accounted for about 56.39% followed by solar power 21.47% (as on 31 March 2017). In the next year, the commissioned wind power capacity addition during FY 17-18 was only 1.78 GW registering a 70% drop from the previous year's (FY 16-17) commissioning achievement of 5.5 GW. [68]

138. The trend of stagnation has continued into Q1 of FY 18-19. Commentators have attributed this decline and stagnation to the industry needing time to adjust itself to the auction regime, from the earlier FiT regime, and expect a capacity addition to picking up soon as the first projects allocated in auctions near commissioning deadline. ICRA estimates that wind power capacity would be around 3 GW during FY 18-19.

Barriers to Scaling Up: A Causal Analysis

139. However, besides the shift in tariff regime, there have been other challenges facing the wind power sector which are seen to be barriers for scaling up. This study has attempted to identify such barriers to scale up wind power adoption in the country through a causal analysis framework, and the findings have been discussed below. Common findings between wind and solar power (issues around land, evacuation, etc.) that have been discussed in earlier sections have been referred to but not discussed again in detail here.

B. Discussion of the Barriers

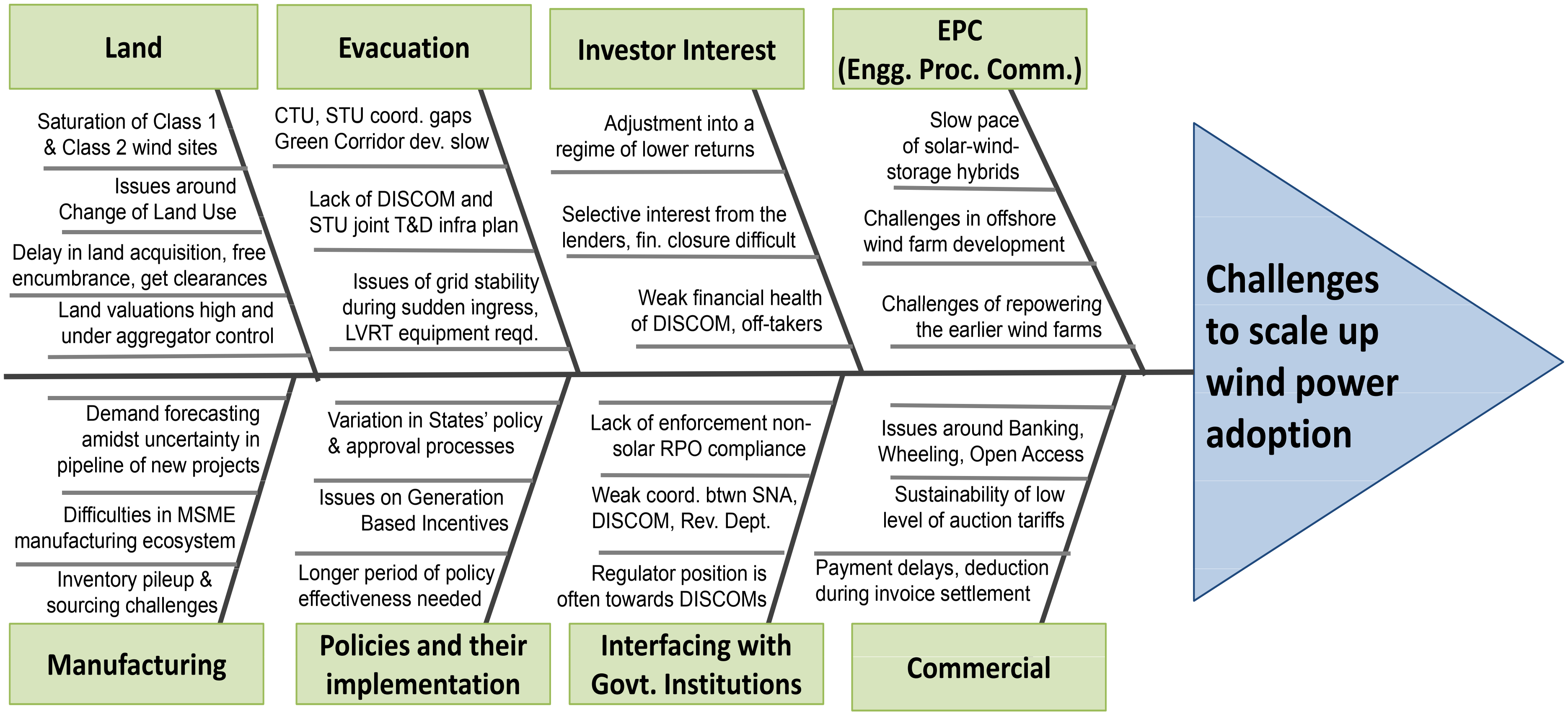
Common Barriers for Both Solar and Wind Power

Land Acquisition

140. Both Government and private land acquisition is increasingly becoming difficult for setting up wind farms. The issues around potential sites, contiguous, large, private land parcels, its valuation, change of land use, obtaining clearances and Right of Way

[68] Indian Wind Turbine Manufacturers Association (IWTMA) industry analytical report.

Fig. 5: Identification of Barriers to Scale Up Wind Power Adoption (Illustrative Fish-Bone Diagram)



issues are similar to those that are facing the solar industry. Also, lands that have wind potential alone are to be identified and acquired. Either there are challenges in identifying such lands and/or negotiating the purchase. With land costs going up, it is either denting the developer's margins or escalating projects' costs and consequently their tariff. Sites that have good potential (such as for wind in Gujarat Kutch region) have already been purchased by land-bank dealers (also known as land aggregators) who are looking to negotiate with developers. Naturally, such intermediaries tend to maximise their profits by overcharging the developer and underpaying the landowner. Moreover, once a bid has been won showing a specific area, the cost is determined in a sellers' market, and the negotiating ability of the buyer is constrained.

Evacuation

141. Two crucial issues emerge in the area of transmission that was similar to the barriers facing the solar power industry: (i) the pace of evacuation infrastructure creation, and (ii) the distance between RE generation sites and the nearest sub-stations which has the capacity and from where the STU or CTU connectivity can be given to RE projects. At the same time, if there are instances where both STU and CTU evacuation infrastructure is available to RE project, the IPP would choose to connect to the CTU (for ISTS there are no open access charges) and not the STU (which would have open access charges within the State). This could lead to under-utilisation of STU assets and recovery of its investments. Such views may be playing out for STU's reluctance to invest in evacuation infrastructure for RE projects where the CTU is taking the lead. Though the Green Energy Corridor (GEC) has been discussed within policy circles for a while, there has been a very slow pace of implementation of projects.

Investor Interest

142. In the competition during auctions and reverse bidding, the margins of developers are drastically reduced. Increasingly, financing firms (who may otherwise have limited inherent technical and management capabilities) are either bidding for new projects or seeking to enlarge their portfolio by acquiring assets in operation. The sense conveyed to the study team by multiple stakeholders was that the number of project owners seeking to maximize returns within their medium-term investment horizon (which typically was much shorter than envisaged asset life of 25 years) were on the increase leading to apprehension about the quality of O&M of these assets after 15-20 years and whether they would be able to generate the expected outputs.

Financial Health of Off-Takers / DISCOMs

143. With wide differences in wind power tariffs across projects, SECI bid prices are setting new benchmarks which most DISCOMs are keen to get on their bids. However, to get such prices for DISCOM bids would be difficult but is not easily accepted by the DISCOMs leading to delays in PPA sign-offs and occasional calls for their re-negotiation.

144. Lingering uncertainties around land costs, evacuation, PPAs, etc. are increasing the risk perception of this business and challenging the sustainability of the IPPs and developers, especially the smaller ones. In the case of wind power, typically the manufacturers are the project developers, and they are yet to adjust to a regime of lower returns which can be sustainable for them.

Variation in States' Policy

145. While friendly policies of a few state governments encouraged a lot of investments in wind sector for captive and group captive power, of late, the states have changed guidelines to the detriment of the sector since "well-paying" consumers reduce their power demand from the DISCOMs. At the same time, Policies and Regulations being different subjects, and regulations are to be independent; most SERC orders have been supportive of state procurer and DISCOM positions, rather than that of the developers.

Commercial

146. Taking the case of a new policy from Tamil Nadu, it proposes to levy of additional charges by the state entity is discouraging for the IPPs and reduction in banking period is a negative factor with captive and group captive (down from earlier six months and end of the year settlement to only one month).

147. Contradictory stance of States: (taking the case of Madhya Pradesh) where, on the one hand, the State Government is charging additional surcharge on RE power developers to compensate backing down of conventional source of fossil fuel-based energy and on the other hand, releasing tenders for mega RE projects in the state in collaboration with SECI to procure more power.

Delayed Payment by DISCOMs

148. There are significant delays in payment by some DISCOMs (5-6 months) to the IPPs; yet, deducting the rebate of 1% which would have been applicable had the payment being made on time by the DISCOM to the IPP (not all states make such delays in payments).

149. Though the PPAs contain provisions of interest for delayed payments, it is hardly honoured in practice.

150. Moreover, wind power generation being seasonal (peak: May – September), it is important that developers' dues are settled by March to prepare them for the upcoming peak season. However, there seems to be little appreciation of this need for working capital by the DISCOM as much of the outstanding remains outstanding.

151. Often, it is argued that the O&M expenditure of wind plants are minimal and the delayed payment scenario does not affect the developers. But more importantly, it is forgotten that the capital costs of these wind farms are funded mostly by debt, and they are under an obligation to service the debt and repay the loans for which the cash flows are inadequate.

Specific Barriers to Wind Power

Land availability is Always an Issue Despite Some Encouraging Policies in a Few States.

152. The States have not been able to exploit their wind potential properly. For example, the state of Rajasthan which has a potential of 18,770 MW and MNRE assigned target of 8,600 MW (as a part of 175 GW target by the year 2022) has vast unutilised areas for setting up of wind farms. To ease the land availability for the RE projects, the State government passed the Rajasthan Land Laws (Amendment) Bill, 2014 for favourable land procurement followed by ease of changing land use. For government/revenue land, there is a limit of 5 Hectare/MW at a concessional rate of 10% of the District Level Committee (DLC) rate. For private land, a developer can purchase land more than ceiling limit. However, the conversion of private land to industrial use is required by paying conversion charges @ 10% of charges levied for industrial purposes. The wind developer can further sublease the land to other parties. Even then, it has been able to achieve only 4,300 MW of installed capacity.

Saturation of High Potential Sites

153. New projects on the high wind potential sites are becoming fewer, and the pipeline of new projects includes Class 3 sites. Tariffs of wind power from these sites are likely to be higher. Also, many of the sites cannot be accessed because of forest clearance issues. For example, in Karnataka, only 4,713 MW of wind power installation could be achieved against a potential of 17,904 MW. The unimplemented capacity, project for which was subsequently cancelled, stands at 6,335 MW. The issues for scaling up revolve around the availability of land at resource endowed sites, change of land use, forest clearance Stage I and Stage II. Recently, there has been an effort to revive the developer's interest in cancelled projects. About 50 such proposals for Wind Resource Assessment (WRA) at identified sites are in the pipeline which, if found feasible, can add 1,500 MW to the pipeline of wind installation projects.

Right of Way

154. The issue of Right of Way for the project has remained for multiple years in this industry. The issue of transportation of Over-Dimension Consignments of equipment from wind turbine manufacturing factory to wind farm sites has also been discussed at various fora from time to time.

155. At the project execution level, local Panchayat bodies levy taxes on wind turbines and extract a price to permit movement of equipment during installation and later for O&M. Such operational issues are beyond the realm of regulations, policy-making and their implementation but have an impact on project costs and schedule.

Grid Stability

156. A closer look within the States showed the wind projects are enduring challenges of arbitrary backdowns and curtailing of intake of wind power by the SLDC. Since wind energy is 'intermittent' in nature and generally, wind power projects do not have any energy storage systems, the sudden ingress of wind leading to an upsurge in wind energy generation affects grid stability. Handling sudden generation surge (say, for Madhya Pradesh, it could be about 1,200 MW) from wind generators becomes a challenge for the System Operator.

157. With more RE power being injected into the grid, which is expected to go up further, maintaining grid stability is increasingly becoming an issue with the system operators. Handling situations like sudden surge in wind power generation, because of ingress of strong winds, are challenging for SLDCs. Technology upgrades (smart-grids) are necessary, as also LVRT for wind turbines. However, such upgrades have their investment and recovery challenges.

158. While grid stability is a reason for asking wind turbines to back down, more often than not, the DISCOMs order such stoppages only on commercial grounds. These happen when they have access to power from cheaper sources, or they prefer shedding load and cut off consumers instead of increasing their liability to pay for the power.

Investor Loss Due to Back Down

159. With SLDCs frequently cutting off wind generators during the wind season, the developers lose money making it less attractive for the investors (examples: Maharashtra, Madhya Pradesh, Tamil Nadu and Karnataka). Discussions with the developers show that there is a low possibility for adding more wind farms in the near future under prevailing circumstances unless ISTS mechanisms provide evacuation facilities.

Technology: Repowering Wind Farms

160. This is a critical issue facing the wind power industry. Many good wind sites and locations/areas are populated with wind turbines of small capacities, and these were installed in the early regime of development of wind power in the country. Newer turbines tend to be larger and installed at greater heights allowing for more capacity per turbine; at the same time, rotating more slowly and alleviating issues such as bird mortality and shadow flicker. Partial repowering by increasing hub heights and rotor diameters would also require investment, albeit less. Now, the turbines of larger capacities are available, it would make eminent sense to repower the existing farms.

161. However, this is subject to challenges related to land ownership, commercial, technical and financial issues. Most importantly, it remains to be seen if the DISCOMs would agree to compensate the developers for the additional investment by way of increased tariff and extended PPA period. From a policy point of view, it is important

to determine tariffs through a more logical and easier Feed-in-Tariff (FiT) regime for projects which were installed in the FiT regime or the repowering would be done through a complicated system of bidding and on projects commissioned in the FiT regime.

162. At present, there is no preference or motivation that is provided to IPPs to make investments to repower older sites with higher capacity turbines. For example, in the case of Karnataka with the present level of additional costs with no change in the existing PPAs, repowering is not attractive for developers. Same is the case with other States. This anomaly needs a policy intervention by the Government after discussions with the developer community, and after that, if such policies are implemented appropriately, this could give a much-needed boost to the sector.

Technology: Off-Shore Wind

163. The bidding process for the First Offshore Wind Project for India (FOWPI), which would be an offshore wind farm, with a capacity of around 1,000 MW in the Gulf of Khambhat, off the coast of Gujarat has been initiated. The wind resource assessment would be done by NIWE. The developers met during this study expect the tariffs to be about 2.5 times that of onshore projects. While there is industry support for the pilot projects, there were question marks on the prospect of scaling up this costlier source of wind power especially during times where DISCOMs are reluctant to sign PPAs based on earlier price discoveries in a declining price regime.

Technology: Solar-Wind-Storage Hybrid

164. Solar-Wind-Storage hybrid demonstration proposal is being developed by M. P. Windfarms (a Joint Stock company) is being sent to Government of Madhya Pradesh and IREDA for funding. Another project has been conceptualised in Andhra Pradesh and is earmarked to be funded by the World Bank. So far, these have remained only concepts and need to be implemented quickly to assess and address complexities that may come up at that stage.

Manufacturing Challenges

165. Wind turbines and their components are mostly manufactured in the country. Amidst uncertainty in the pipeline of new projects, the turbine manufacturers are finding it difficult to forecast demand of their machines. The developers, IPPs and manufacturers have been anticipating a large number of projects from the Government, but clearly, there has been a significant lag in new orders. Further, with the ISTS regime in the horizon, there is an apprehension among the developers and the States (such as Andhra Pradesh) that the 'best sites' would be sold leaving out other sites resulting in longer-term imbalances in wind power development across States.

166. This has been further aggravated by the adverse impact of demonetisation and GST roll-out challenges on the wind turbine manufacturers' supplier ecosystem (many of them MSME). Moreover, such impact has come at a time of low and that too uncertain demand conditions generated by (a) shift from FiT to auction regime, (b) nearing saturation of good sites in the wind resource endowed States. It will take time for the affected ecosystem to revive, and it is likely some of the MSMEs would not be able to sustain.

167. Discussions with wind turbine manufacturers revealed low tariff bids in the recent auctions were based on the distress sale of inventory that was being carried by wind turbine manufacturers. It was not based on any real market being created by lowering the cost of manufacturing or low-cost imports, as is commonly believed. Improved visibility and certainty of longer-term demand either generated or facilitated by the Government/Public Sector projects can sustain the existing levels of operations of the wind turbine manufacturers and the MSME ancillary ecosystem.

Stable Policies and its Implementation

168. Regarding wind energy, Gujarat has the highest potential in the country which is around 84,431 MW at 100m above ground level, but the installed capacity is only 5,537 MW. The focus of the State Government is on tapping solar energy which may have resulted in the somewhat lower trajectory of development of the wind power sector with the RE mix. In another wind resource-rich state of Maharashtra, the Renewable Energy Policy of 2015 covered all RE technologies such as solar, wind, waste-to-energy, biomass, etc., but the wind policy part left key issues on wheeling charges, transmission charges, and electricity duty unaddressed. Wind projects in the State are grappling with the multiple challenges, and annual wind installations have dropped sharply in the last 2-3 years. New projects are lying unutilized due to the non-signing of PPAs by the State utilities, which has negatively impacted pipeline of future projects and financial closures.

169. **Waste Heat Recovery:** At present the power generated through Waste Heat Recovery (WHR) qualifies towards RPO fulfilment for non-solar component of overall RPO compliance. Policy and regulatory deliberations have been in circulation for many years on whether it should continue as such. It is high time that WHR economics is re-evaluated and kept out of RPO compliance calculations of DISCOMs so that more renewable energy generation options are encouraged.

170. Uncertainty prevails around the Generation Based Incentive (GBI) scheme in Andhra Pradesh. Responding to a petition filed by the DISCOMs, on 30th July 2018, the Regulator APERC curtailed the enforcement period of wind tariff order of 2015 thereby negating/ neutralising the benefit of GBI. Previously, a GBI was offered to wind energy generators at Rs. 0.50 per kWh fed into the grid for a minimum of 4 years

and a maximum of 10 years with a cap of Rs. 1 crore. Soon after, on 24th August 2018, the affected developers have obtained a stay from Andhra Pradesh High Court on the regulator's order that reduced tariffs primarily on the ground that APERC does not have the jurisdiction to alter its own orders subsequently.[69]

171. **Longer Period of Policy Effectiveness and Stability Needed:** Wind projects typically have a longer gestation period (about three years, excluding resource assessment) when compared to solar projects (about one year). Thus, wind power policy stability and effectiveness period need to be even longer than that for solar.

Commercial Issues

172. Tariff determination through auctions may have led to the discovery of low prices but has had a detrimental effect on the DISCOMs willingness to honour prior PPAs agreed upon in the FiT regime. For instance, after the price of wind power in Gujarat Urja Vikas Nigam Ltd (GUVNL) tariff-based capacity auction was discovered at Rs. 2.43 per kWh in December 2017, the DISCOMs were reluctant to honour old PPAs at FiT determined by the SERC for 2016-17 at Rs 4.19 per kWh. They were not keen to sign PPAs at a tariff higher than Rs 3.46 per kWh.[70] The developers have been discouraged by this tendency to honour the sanctity of contracts.

173. There has been differential treatment between solar and wind projects on duties. For example, in the case of Madhya Pradesh, while all solar projects are exempt from electricity duty and cess for ten years from the date of commissioning, no such incentive has been provided for wind power projects.

174. Other pertinent issues being faced by the sector, especially in the wake of auctions, are grid connectivity and priority power distribution. The developers who were granted connectivity in existing sub-stations earlier did not go on to win any capacity in the recent auctions, while those who were allotted capacity in these auctions pushed MNRE to seek connectivity approval for future electricity sub-stations. Many of the developers face an egg first or chicken first situation since they cannot tie up land etc. without a successful bid and not make a bid without land arrangement and evacuation permissions.

[69] Saluja, N., 2018. HC Stays Order Slashing Tariffs of Incentivised Wind Power Generators. The Economic Times, 24th August. See https://economictimes.indiatimes.com/industry/energy/power/hc-stays-order-slashing-tariffs-of-incentivised-wind-power-generators/articleshow/65523589.cms accessed on 29th September, 2018.

[70] The Times of India, 2017. Record Level of Wind Power Produced. 22nd June. See https://timesofindia.indiatimes.com/city/ahmedabad/record-level-of-wind-power-produced/articleshow/59259992.cms accessed on 29th September, 2018

V. BIO-ENERGY

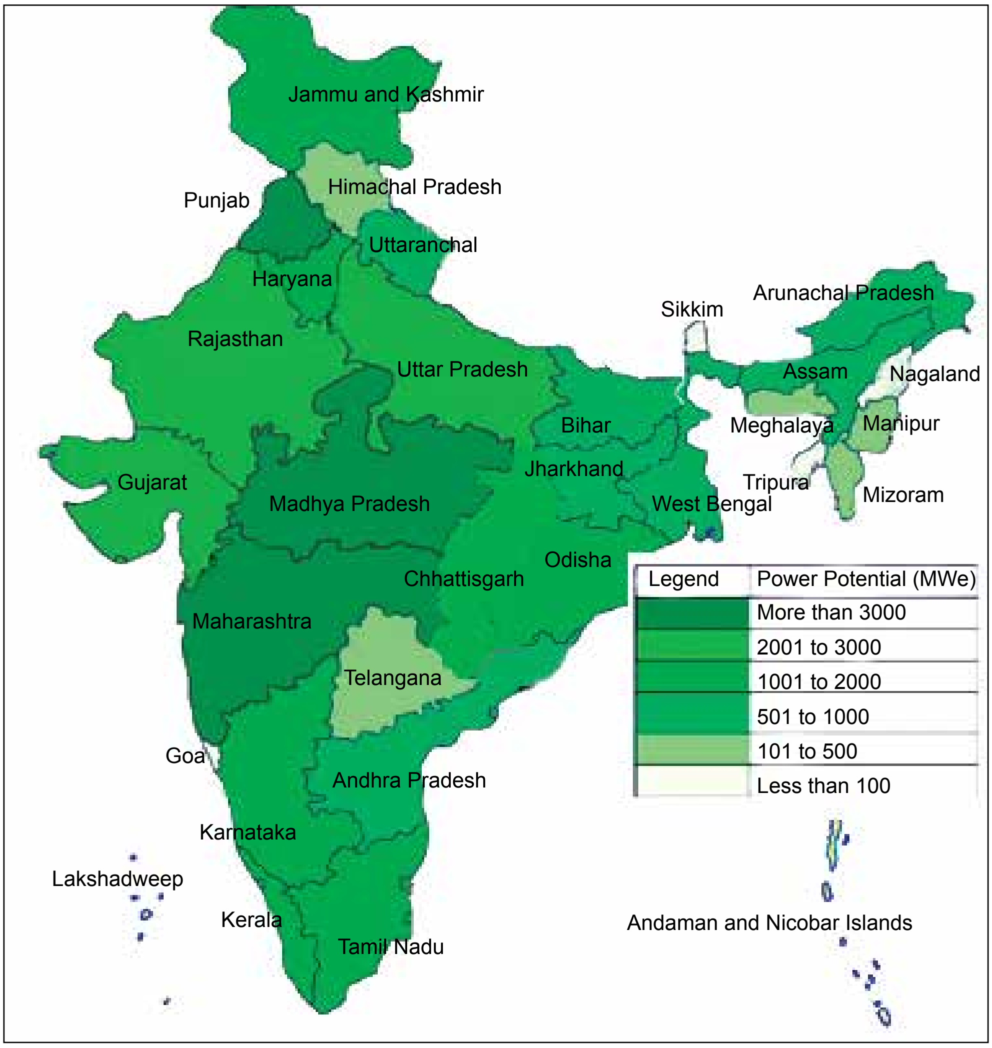
A. Introduction

175. India is very rich in three distinct sources of biomass energy namely energy plantations, agricultural crop residue and municipal and industrial wastes as well as agro-based industrial waste. Being an agricultural country, a large population of cattle and livestock exists in India. Due to this, Indian villages have always been rich in bio-resources, which can easily be converted to energy. About 32% of the total primary energy use in India is still derived from biomass, and more than 70% of the country's population depends upon it for its energy needs. The challenges that this sector is facing are very different for the projects like biomass-based power generation, Waste to Energy Projects and Biogas and Bio-CNG. Therefore, each of these three segments has been discussed separately.

B. Biomass-based Power Generation

176. MNRE has been implementing biomass power/co-generation programs since mid-nineties. According to their recent estimates, the availability of biomass in India is estimated to be about 500 million metric tons per annum (MMTPA), of which the estimated surplus availability is about 120–150 MMTPA. This comprises agricultural and forestry residues which correspond to an electricity generation potential of about 18 GW. Also, the potential of power generation through bagasse cogeneration in sugar mills is estimated to be around 7 GW, with progressively higher steam temperature and pressure and efficient project configuration. Thus, the total estimated potential of biomass power is about 25 GW and state-wise biomass/bagasse potential is presented in Figure 6. States, which have taken a leadership position in implementation of bagasse cogeneration projects, are Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Uttar Pradesh.

177. Over 500 biomass power and cogeneration projects with aggregate capacity of 8,414 MW have been installed in India till the end of 2017. Biomass-based power generation



(Source: http://indien.um.dk/en/innovation/sector-updates/renewable-energy/biomass-energy-in-india)

Fig. 6: Biomass Energy Potential in India

projects receive an investment of about Rs. 600 crores every year, leading to about 5 billion units of electricity being generated. Maharashtra, Uttar Pradesh and Karnataka have more than 1 GW of grid interactive biomass power. Other states with favourable policy and opportunities in Biomass are Punjab and Bihar. MNRE has set a national target of achieving 10 GW of biomass power installations by 2022.

178. MNRE is also promoting multifaceted biomass gasifier-based power plants for producing electricity using locally available biomass resources such as wood chips, rice husk, arhar stalks, cotton stalks and other agro-residues in rural areas. The main components of the biomass gasifier programs are:

- Distributed/Off-grid power for Rural Areas.
- Captive power generation applications in Rice Mills and other industries.
- Tail end grid-connected power projects up to 2 MW capacities.

179. About 150 MW electricity equivalent biomass gasifier systems have been set up for grid and off-grid projects. More than 300 rice mills and other industries are using these gasifier systems for meeting their captive power and thermal applications. Also, about 70 biomass gasifier systems are providing electricity to more than 230 villages in the country.

Technologies in Use

180. Biomass is a complex class of feedstock with significant energy potential. Hence, different technologies need to be applied for energy recovery. Typically, technologies for biomass energy are broadly classified on the basis of principles of thermo-chemistry as combustion, gasification, pyrolysis and biochemistry as anaerobic digestion, fermentation and trans-esterification. Each technology has its uniqueness to produce a major calorific end product and a mixture of by-products.

181. **Combustion:** The most commonly used technology is combustion, similar to that of a thermal plant based on coal, except for the boiler. The technology is based on the conventional Rankine Cycle with biomass being burnt in high-pressure boilers to generate steam which goes to operate a steam turbine coupled with a generator. The net power cycle efficiencies that can be achieved are about 23-25%. The exhaust of the steam turbine can either be fully condensed in the turbine to produce power or bled off partly from the turbine for other heating activities. In some applications, the steam generated from the boilers are fully used for heating purposes and not taken to turbines for generation of electricity.

182. **Cogeneration in Sugar Mills:** Sugar mills have traditionally installed cogeneration units and use bagasse as fuel. The advancements in boiler technology (which now generates steam at higher pressures and temperature from the same quantity of bagasse), has helped the sugar industry generate significantly more electricity and steam which not only meets their captive needs but also allows them to sell the surplus electricity to the grid.

183. **Biomass Gasification:** It is the thermo-chemical conversion of biomass into a combustible gas mixture (producer gas) through a partial combustion route with air supply restricted to less than that theoretically required for full combustion. A gasifier system comprises a reactor where the gas is generated and is followed by cooling and cleaning of the gas. The clean combustible gas is available for power generation in producer gas-engines.

New Supportive Scheme

184. The government provides a one time capital subsidy based on the installed capacity of the project. In the recently published (11th May 2018) “Scheme to Support Promotion of Biomass-Based Cogeneration in Sugar Mills and other industries in the country (up to March 2020)” Central Financial Assistance (CFA) grant approvals are to be accorded

to Biomass-based cogeneration projects with total CFA outgo of Rs. 170 crores to help achieve an installation target of 740 MW during the three-year period 2017-18 to 2019-20. The CFA shall be provided for projects utilising biomass like bagasse, agro-based industrial residue, crop residues, wood produced through energy plantations, weeds, wood waste produced in industrial operations, etc. Municipal Solid Waste is not covered under the program.

185. Under this scheme, the CFA is provided at the rate of Rs. 25 lakh/MW (for bagasse cogeneration projects) and Rs. 50 l akh/MW (Non-bagasse Cogeneration projects). The CFA will be back-ended and will be released in one instalment after successful commissioning, commencement of commercial generation and performance testing of the plant, which will be installing new boiler and turbines. The CFA will be released to the term loan account to reduce the loan component of the promoter and calculated on surplus exportable power as mentioned in Power Purchase Agreement (PPA) / Appraisal Report in case of bagasse cogeneration projects and on installed capacity in case of non-bagasse cogeneration projects.

186. Biomass-based cogeneration projects, which intend to add capacity to the existing plants will also be considered for grant of CFA to the extent capacity is being enhanced. State Nodal Agencies (SNAs) will be provided with Rs. 1 lakh/MW (Maximum Rs.10 lakh per project) as incentive or service charge towards post-installation monitoring of the projects and sending periodic reports to MNRE.

Challenges and Issues

187. Biomass has certain advantages as it does not face site-specific issues of solar and wind. However, it is still not the preferred RE source, due to the uncertainties in biomass supply chains and sustaining the quality of biomass over multiple years. The challenges vary according to the source of biomass.

188. **Bagasse-based Cogen:** If the source is bagasse linked to sugar mills, the sourcing and biomass supply chains have a definitive business model and the economics are established. These projects run successfully. Sugar being a sensitive agro-based industry across many large States, all Governments (Centre and States) regularly intervene to support it and keep its supply chains viable. States like Uttar Pradesh, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra have many bagasse-based power plants running successfully over many years. In Uttar Pradesh, the installed capacity for the sugar mill linked bagasse co-gen projects is 905 MW where plant sizes are 40-45 MW, much higher than the threshold subsidy eligibility (upto 5MW).

189. **Other Biomass Sources:** Biomass-based power generation from other sources, such as rice husk, are facing sustainable supply chain challenges, quality and quantity of biomass being made available at affordable prices. Biomass from agriculture is available only for a short period after its harvesting, which can stretch only for 2-3 months in a year. So, there is a need to have robust institutional and market

mechanism for efficient procurement of the required quantity of biomass, within this stipulated short time, and safe storage till it is finally used. Moreover, the regulatory mechanism of biomass price fixation, which is an important input for tariff setting, needs to evolve. Some of the major challenges in biomass power generation are:

(i) Inadequate information on biomass availability and absence of organised formal biomass markets;
(ii) Problems associated with the management of biomass collection, transportation, processing and storage;
(iii) Issues around tariff set by the regulatory commissions;
(iv) Lack of capability to generate bankable projects on account of financial and liquidity problems, etc.;
(v) Delayed payment/settlements by utilities in some States make small generators strapped for cash.

190. The major challenges in ensuring sustained biomass supply at reasonable prices are attributed to the increasing competing usage of biomass resources leading to higher opportunity cost, unorganized nature of biomass market which is characterized by lack of mechanization in agriculture sector, defragmented land holdings, vast number of small or marginal farmers, and the rapidly rising cost of biomass storage and transportation to power plants. There is also wide variation in tariffs being offered for biomass power plants in different states. Often the biomass sources mentioned in the PPA is not possible to be maintained by the developer in the long run, but the DISCOM shows unwillingness on accepting other options under the same PPA.

191. The inability to secure long-term supply of biomass fuel at prices affordable for the project and sustainable under the PPA regime (as approved by the Regulatory Commission) coupled with the lack of support in developing energy plantations are added challenges. In India, there is no backward integration policy between biomass projects with energy crop plantations and forestry for encouraging scaling up of biomass-based power projects. Often there are land-related issues too. No state has allocated wasteland for Energy Crops & Forestry.

192. While Madhya Pradesh has a provision for allocation of government wastelands for captive energy plantation for operating biomass power plants, none of the projects in the State has been able to develop energy plantations. The reasons behind this are policy and bureaucratic hurdles such as identification of suitable wasteland, obtaining NOC (no objection certificate) from the local community, and long and tedious procedure for allocation of land which further delays the project.

193. There have been issues of unviable preferential tariff in a regime of escalating fuel (biomass) cost. For example, in Madhya Pradesh, there are four such biomass power plants where the plants have been commissioned, but PPAs have not been executed because of tariff disputes. In this case, the total capacity affected is 44.5 MW involving Rs. 200 crores investment mostly from the MSME sector. Already more than five years have gone in the litigation process, and still, the core issues have not been resolved.

194. For small-scale village level biomass-based energy generation projects, there is no purchase guarantee from distribution companies. If such electricity generated were to be treated as DISCOM RE purchase obligation, the total potential of such electricity generation would be modest, yet the impact on APPC would be marginal.

C. Waste-to-Energy

195. Waste-to-Energy (WTE) plant converts municipal and industrial solid waste into electricity and/or heat for industrial processing and heating systems. Waste that is either solid or biodegradable is converted into energy. While power generators work by burning solid waste at high temperatures to generate steam which then drives a turbine to generate electricity, bio waste goes through a process of anaerobic digestion to generate biogas. Bio-gas can be used to generate power or be used as cooking fuel or in similar applications. Since Governments have been promoting power generation, most of the WTE schemes offer incentives for power generation.

196. MNRE estimates a potential for generating about 1,500 MW of power from the municipal solid wastes in the country. With economic development, this potential is likely to increase further to 2,780 MW by 2050. These estimates are based on urban solid waste generated in cities and towns that have municipal corporations and municipalities. These estimates do not take into account such waste generated by industrial processes (unless taken care of by municipal bodies) and the waste in the fast urbanising areas. The state-wise break-up of the potential for power production from MSW, is presented in the following table.

Technologies in Use

197. **Thermal Conversion:** The process involves thermal degradation of waste under high temperature. In this complete oxidation of the waste occurs under high temperature. The major technological option under this category is incineration. Though incineration is less preferred because of emission concerns, it happens to be the commonly used process in India.

198. **Thermo-Chemical Conversion:** This process entails high temperature driven decomposition of organic matter to produce either heat energy or fuel oil or gas. It is useful for wastes containing a high percentage of organic non-biodegradable matter and low moisture content. The main technological options in this category include Pyrolysis and Gasification.

199. **Bio-Chemical Conversion:** This process is based on the enzymatic decomposition of organic matter by microbial action to produce methane gas, alcohol, etc. The major technological options under this category are anaerobic digestion (bio-methanation) and fermentation. Of the two, anaerobic digestion is more common for waste to energy processes, and fermentation is an emerging option.

Table 6: Potential for Recovery of Electrical Energy (MW) from Municipal Solid Wastes

State/ Union Territory	Recovery Potential (MW)	State/ Union Territory	Recovery Potential (MW)	State/ Union Territory	Recovery Potential (MW)
Andhra Pradesh	107	Jharkhand	8	Puducherry	2
Assam	6	Karnataka	125	Punjab	39
Bihar	67	Kerala	32	Rajasthan	53
Chandigarh	5	Madhya Pradesh	68	Tamil Nadu	137
Chhattisgarh	22	Maharashtra	250	Telangana	63.75
Delhi	111	Manipur	1.5	Tripura	1
Gujarat	98	Meghalaya	1.5	Uttar Pradesh	154
Haryana	18	Mizoram	1	Uttarakhand	4
Himachal Pradesh	1	Odisha	19	West Bengal	126

Supreme Court Guidelines 2007

200. Most of the states have referred in their respective guidelines that the projects need to be developed in accordance with the decision of Hon'ble Supreme Court given during the hearing on May 15, 2007, and the recommendations of the Expert Committee referred therein. Key recommendations of the Expert Committee regarding the development of MSW based waste-to-energy projects are given below:

i. The issues such as project development including characterisation of wastes, sizing of projects, technology selection and project design, management model and operational issues including close coordination between Municipal Corporation and the Promoters, financial appraisal and approval of project should be adequately addressed.

ii. Given the problems of treatment and disposal of municipal wastes (solid and liquid) in our cities and towns, which are only likely to increase with the growth of population and urbanisation, an integrated approach to waste processing and treatment will be necessary, as brought out in the MSW Rules, 2000. Therefore, instead of focusing on individual technologies, it would be desirable to take an integrated approach to the management and treatment of MSW, which would necessitate the deployment of more than one technology in tandem.

iii. The selection of technology for solid waste management depends upon the quality of waste to be treated and the local conditions. Therefore, for the segregated waste, which is dedicated in nature, the selection of technology is relatively easier,and its performance and success is beyond doubt. Therefore, it is desirable to have solid waste segregated at source, which is also required as per the MSW Rules, 2000.

201. The Committee has also recommended that projects based on bio-methanation of MSW should be taken up only on segregated/ uniform waste unless it is demonstrated that in Indian conditions, the waste segregation plant/process can separate waste suitable for bio-methanation. As on 31st March 2013, 38.51 MW electricity projects were already sanctioned and commissioned under the Industrial waste power

projects category, and another 126.40 MW electricity projects were already identified (yet to be commissioned).

202. Every state is different when it comes to the policy on generating energy from MSW. The Municipal Corporations also have different approaches to handling the MSW-WTE projects. Differences exist regarding policies related to bidding process parameters, tipping fees, land allotment, the sale of power and tariff, wheeling, power evacuation and grid interfacing and incentives offered.

(i) Ministry of Urban Development has prepared a sample RfP document as a guideline; but the bidding process is not uniform. The process sometimes calls for the entire integrated waste management system, but sometimes only limited to the WTE facility. In case of the WTE only operations, the developer becomes hugely dependent on the municipal bodies for supplying of quality waste material in a timely manner that is one of the prime factors for the success of any WTE project.

(ii) The land allotment is another important factor. In 60% of WTE projects, it has been observed that the issues are around either allotment, physical possession of the land or addressing the rehabilitation and resettlement issues are causing a delay in the project. Moreover, if the project site is within or close to the residential area, getting the environmental clearance or NOC are taking lots of time because of perceived air pollution from the WTE plants.

(iii) Not many states have created public awareness about WTE technologies, and therefore people have their own apprehensions.

(iv) Sale of power and tariff is another decisive factor for the developers. Although the central policy/ regulation mandates the purchase of 100% of available power from WTE projects by the local transmission grid, the tariff is not uniform. And often varies from project to project even in a state depending on the conditions imposed on PPA.

(v) Some states provide subsidy on wheeling charges. Like in MP, a subsidy of 4% is provided by the State Government on wheeling charges for ten years from CoD. Balance amount of wheeling charges to be borne by the developer.

Supportive Policies

203. The MNRE has continued the implementation of Program on Energy from Urban, Industrial and Agricultural Waste/Residues aimed at energy generation from different wastes, such as municipal solid wastes, vegetable and other market wastes, slaughterhouse waste, agricultural residues, and industrial wastes and effluents. The CFA for projects of different categories is given in the form of capital subsidy to the promoters and in the form of Grants-in-Aid for other activities, as given below (2016-17).

204. Other Incentives and Support Measures available to promote/develop the sector are

(i) Provide Concessional Customs Duty and Excise Duty Exemption for initial setting up of grid-connected projects for power generation or production of Bio-CNG from wastes;

Table 7: CFA for Projects of Different Categories

Sl. No.	Wastes/Processes/Technologies	Central Financial Assistance
1	Power generation from Municipal Solid Waste	Rs.2.00 crore/MW (Max. Rs.10.00 crore/project)
2	Power generation or production of bio-CNG from biogas at Sewage Treatment Plant or through Bio-methanation of Urban and Agricultural Waste/ Residues including cattle dung	Rs.2.00 crore/MW or bio-CNG from 12000 m^3 biogas/day (Max. Rs.5.00 crore/project)
3	Biogas generation from Urban, Industrial and Agricultural Wastes/Residues	Rs.0.50 crore/MW eq.(12000 m3 biogas/day with maximum of Rs.5.00 crore/project)
4	Power generation from Biogas (Engine/gas turbine route) and production of bio-CNG for filling into gas cylinders	Rs.1.00 crore/MW or bio-CNG from 12000 m^3 biogas (Max. Rs.5.00 crore/project)
5	Power generation from Biogas, Solid Industrial, Agricultural Waste/residues excluding Bagasse through Boiler + Steam turbine Configuration	Rs.0.20 crore/MW (Max. Rs.1.00 crore/project)

(ii) Preferential tariff (Feed-in Tariff) announced by the CERC /SERC;

(iii) Energy buyback, wheeling & banking;

(iv) Incentives to State Nodal Agencies - Service charge @ 1% of the subsidy restricted to Rs. 5 lakh per project; and

(v) Financial Assistance for Promotional Activities - for organizing capacity building programmes, awareness creation, business meets, seminars/workshops, publication of newsletters, resource assessment, technology validation and performance monitoring and evaluation subject to a maximum of Rs. 3 lakh per activity.

205. In addition to the continuation of the existing policies, the GOI has initiated a few new policies such as Tariff Policy – Power from WTE plants. In compliance with Section (3) of the Electricity Act 2003, Ministry of Power (MoP) notified on 12th February 2005, the Tariff Policy in continuation of the National Electricity Policy (NEP). It was amended, and the same came into effect from 28th January 2016. According to the amended Tariff Policy, Distribution Licensee(s) shall compulsorily procure 100% power produced from all the Waste-to-Energy plants in the State, in the ratio of their procurement of power from all sources including their own, at the tariff determined by the Appropriate Commission under Section 62 of the Act.

206. The Tariff Policy 2016 mandates power distributors to buy all the electricity generated from waste-to-energy plants in a state and the remunerative tariff set for it by the Central Electricity Regulatory Commission (CERC) has helped raise investor interest in this segment. The municipal corporations are expected to receive Rs. 15,000 crore over the next three years under the Swachh Bharat Mission for cleanliness, waste-management and waste-to-energy projects.

207. Ministry of Road Transport and Highways, vide Notification dated 16th June 2015, has amended the Central Motor Vehicles Rules, 1989 and included the provisions for the use of biogas in the form of bio-CNG, provided it satisfy some mandatory quality

checks/criteria, safety standards, etc.

208. Indian standard for biogas (IS 16087-2013) has been formulated which prescribes the requirement and the methods of sampling and test for the biogas (Bio-methane) applications in stationary engines, automotive and thermal applications and supply through the piped network.

209. The Government has revamped the Municipal Solid Wastes (Management and Handling) Rules 2000 and notified the new Solid Waste Management Rules, 2016 on April 8, 2016. Some points regarding the waste to energy projects have been covered by this new version of rules are as follows:
   (i) Ministry of Power shall fix the tariff of power generation from the WTE project and ensure distribution through companies;
   (ii) MNRE shall facilitate infrastructure for Waste-to-Energy plants and provide a subsidy;
   (iii) Industry (cement, power plant, etc.) shall use RDF within 100 km;
   (iv) Waste to Energy plant for waste with 1500 Kcal/kg incineration in cement and power plants.

Overall Issues and Challenges

210. Recovering energy out of waste is a complicated yet resourceful method. India has lagged in this field owing to the lack of sustainable planning and supporting implementation policy frameworks, inadequate funding of technology innovation, provisioning of infrastructure, and institutional inefficiencies in the municipal bodies. One such example is Chandigarh where a (Refuse-Derived Fuel) RDF plant with a capacity of 500 TPD of MSW was installed to produce pellets and other solid fuel. But today, the plant is rarely operated. It is now being retrofitted with MSW drying systems to reduce moisture in the final RDF.

211. The Task Force on Waste to Energy, constituted by the Planning Commission, in its report submitted in 2014 also analysed the issue of waste management in detail and recommended an integrated waste management system. The Report suggested technological options for processing of waste on the basis of the quality of waste and quantum of the population. It estimated that untapped waste has a potential of generating 439 MW of power from 32,890 TPD of combustible wastes including Refused Derived Fuel, 1.3 million cubic meter of biogas per day or 72 MW of electricity from biogas and 5.4 million metric tons of compost annually to support agriculture.

212. Subsequently, the NITI Aayog Task Force on Waste to Energy critically looked at failure/underperformance of the waste processing facilities (WTE) set up. This report has also been pointed out that the challenge is to create an enabling environment for attracting private sector participation and encouraging Public Private Partnerships. The Task Force observed that the major reasons for the failure of plants were:
   (i) Lack of due diligence on the part of investors as well as public sector;

(ii) Non-supply of committed quantity/quality of waste to the plant by the municipal authority;

(iii) Presence of inerts - dust and C&D waste in MSW delivered for processing, making the operations difficult and very expensive;

(iv) The inadequate market for the sale of compost/RDF;

(v) Public outcry against the location of a plant; and

(vi) Lack of financial viability of projects.

Our Findings

213. Some of the common and technology-specific issues have been identified and are as follows:

214. WTE is different in scale and nature from the rest of the renewable energy. For example, as on 30thJune 2018, the target for 2018-19 was 20 MW for WTE and 11,000 MW for solar and 4,000 MW for wind. Therefore, WTE remains a neglected component of the RE sector.

215. **Fuel supply:** Once a WTE plant is commissioned, ideally there should be no issue around the availability of fuel supply. However, the quality of acceptable MSW regarding calorific value, moisture content, etc. are major issues throughout the operation. The movement and supply of waste human-intensive process and also involves a large number of people from the unorganised sector, and that remains one of the risk factors for uninterrupted operation of the plant.

216. **Land-related issues:** Land is one of the major issues, as most of the sites are not demarcated previously. In the absence of government land, if the developer is required to buy the private land, the problem becomes manifold. In some of the states like Bihar, it is allowed by policy to take agriculture land for the WTE projects whereas states like West Bengal do not permit the same. Even if the land is identified and allocated by the government, getting physical possession takes a longer time. Acquiring private land contributes to the increase in the cost as well. Moreover, if the allocated land is close to residential areas, the project is more likely to face objections from local people and often ends up in a stalemate.

217. **Financing:** Due to various uncertainties, financing from lenders/banks is a major issue. Only in April this year (2018), Power Finance Corporation (PFC) for the first time has announced their lending into funding 24 MW Bawana WTE project of Ramky Group. In the absence of such lending, it is high on the project developer's financial capacity, and therefore only a few big players are present.

218. **Institutional issues:** Issues related to policies, regulations, land availability, environmental matters, tariffs, etc. are dealt with by different governments, ministries, agencies, regulators, and there is no uniformity. In fact, many of them contradict one another. No single standard model applies to all the states. Therefore, different revenue sharing model, different sources for Viability Gap Funding, different costs of power and incentives have been proposed for different municipalities.

D. Biogas and Bio-CNG

219. Bio-CNG is the purified form of Bio-Gas where all the unwanted gases are removed to produce >95% pure methane gas. Bio-CNG is similar to natural gas (CV: ~52,000 kJ/kg) in its composition and energy potential. As it is generated from biomass, it is considered a renewable source of energy and thus, attracts all the commercial benefits applicable to other RE sources. Bio-CNG can directly replace every utility of LPG and CNG in India. It has the potential to be the future of renewable fuel because of the abundance of biomass in India. Bio-CNG can be either filled in cylinders or caskets by compressing it for easy industrial or transportation use. It can also be used in specific generators to produce electricity.

220. India currently imports one-third of its energy requirement. The world's third-largest crude oil importer is targeting halving its energy import bill by 2030. The government aims to increase the contribution of gas in India's energy mix to 15% from the current 6.5%. One of the thrust areas is the production of Bio-CNG from biomass sourced from agricultural residue, food waste, industrial waste (Bio-wastes from industries, such as sugar-manufacturing plants and beer distilleries, MSW and energy crops. Bio-CNG is physically and chemically same as CNG that is currently being imported. It has a high calorific value and can be used in blast furnaces; also, it can be converted into electricity.

National Level Programs and Policies

221. **Biogas Power (Off-grid) Program:** Ministry is promoting biogas power for decentralized power generation applications in the capacity range, 3 kW TO 250 kW under this program based on the sufficient quantity of biodegradable waste comprising of a variety of feedstocks such as cattle dung waste, kitchen/ food waste, sago, tapioca, starch, and agro-processing waste, etc. at the project sites. The scheme aims for generation of biogas and use of biogas for generation of power for off-grid/ decentralised applications and also for thermal usage.

222. **Biogas based Distributed / Grid Power Generation Program:** MNRE has approved a program called "Energy from Urban, Industrial and Agricultural Waste/Residue" with modified terms and conditions from 2017-18 to 2019-20 (August 2018). The program aims to promote installation of energy recovery projects from urban, industrial, and agricultural wastes to generate biogas, bio-CNG, enriched biogas, power, as well as thermal energy. To this end, the program will create conducive conditions and environment to develop, demonstrate, and disseminate the utilisation of wastes and residues for energy recovery. The program will also promote biomass gasifier-based power plants for electricity generation to meet industrial captive power and thermal demands of industries such as rice mills. Also, the plants will provide electricity to small villages and hamlets for lighting, water pumping and running micro-enterprises.

223. Under the program, central financial assistance (CFA) will be given in the form of capital subsidy for setting up waste-based energy generation projects. The fund

will also be provided for promotional activities such as research and development, resources assessment, technology up-gradation, performance evaluation, etc.

- A total CFA of Rs 78 crore has been assigned for projects that are set up under the program between 2019 and 2020. The amount of capital subsidy to be disbursed will be calculated on the basis of installed project capacity and will be capped to a maximum of Rs 10 crore per project.
- The state nodal agencies will be provided with an incentive/service charge at the rate of one per cent of the eligible CFA (maximum incentive of Rs 5 lakh per project) to assist with project monitoring during implementation and post commissioning.
- The time-period for project completion has been set as 24 months for waste to energy plants and 12 months for biomass gasifier plants. After the end of this time interval, the contracts will be cancelled, and CFA claims will not be entertained.

BioFuels

224. Ministry of New and Renewable Energy, Government of India, has National Policy on Biofuels in place since 2008. The Indian approach to biofuels, in particular, is somewhat different from the current international approaches that could lead to conflict with food security. It is based solely on non-food feedstock to be raised on degraded or wastelands that are not suited to agriculture, thus avoiding a possible conflict of fuel vs food security.

225. The Cabinet approved the National Policy on Biofuels in May 2018. The Policy categorizes biofuels as “Basic Biofuels”: First Generation (1G) bioethanol and biodiesel, and “Advanced Biofuels” Second Generation (2G) ethanol, Municipal Solid Waste (MSW) to drop-in fuels; Third Generation (3G) biofuels, bio-CNG, etc. to enable extension of appropriate financial and fiscal incentives under each category. The Policy expands the scope of raw material for ethanol production by allowing the use of sugarcane juice, sugar-containing materials like sugar beet, sweet sorghum, starch-containing materials like corn, cassava, damaged food grains like wheat, broken rice, rotten potatoes, etc.

226. Farmers are at risk of not getting the appropriate price for their produce during the surplus production phase. Taking this into account, the Policy allows the use of surplus food grains for the production of ethanol for blending with petrol with the approval of National Biofuel Coordination Committee. With a thrust on Advanced Biofuels, the Policy indicates a viability gap funding scheme for 2G ethanol Biorefineries of Rs. 5000 crore in 6 years in addition to additional tax incentives, higher purchase price as compared to 1G biofuels. The Policy encourages setting up of supply chain mechanisms for biodiesel production from non-edible oilseeds, used cooking oil, short gestation crops, etc.

227. Central Government will provide incentives to all state-run Oil Marketing Companies (OMC). These OMCs has made an agreement of long-term offtake of 2G ethanol under Biofuel Policy India. For this reason, OMCs are assuring suppliers for 15-year offtake contracts. Indian Oil Corporation (IOC) has recently signed an agreement with the Punjab government. Under this agreement, IOC will establish various CNG plants in Punjab in the upcoming five years. In addition to this, OMCs are going to set up 12 advanced biofuel refineries in several states. IOC is currently operating three biofuel plants and plans to increase its capacity from 100 tons to 1200 tons per day in the next two years.

228. Government support for Biogas programs are summarised as:
   (i) Subsidy for installation: ~20% of the cost;
   (ii) Preferential tariff for sale of generated electricity;
   (iii) Fiscal Incentives / Concessions: i) Accelerated Depreciation; ii) Import duty; iii) Excise duty for RE devices and iv) Income Tax;
   (iv) Sponsorship for Research and Development.

229. Other policy measures for the promotion of the biogas program:
   (i) Open access to the electricity grid for the power from renewable sources including AD;
   (ii) Preferential tariffs assigned by State regulators for sale of electricity;
   (iii) RE Power Obligations for Transmission Companies;
   (iv) Captive generation decontrolled;
   (v) Policy framework for pumping upgraded Biogas into gas grids and for price fixation for Bio-CNG.

230. The Union Government is going to roll out the Galvanising Organic Bio-Agro Resources Dhan (GOBAR-DHAN) scheme. It was first announced by the Finance Minister during his 2018-19 budget speech. The scheme focuses on managing and converting cattle dung and solid waste in farms to useful compost, biogas and bio-CNG. Public Sector Oil companies Indian Oil Corporation (IOC); Bharat Petroleum Corporation (BPCL) and Hindustan Petroleum Corporation (HPCL) plan to spend nearly Rs. 10,000 crores to set up Bio-CNG plants across India to promote clean fuel.

Technologies in Use

231. Biogas production is a clean low carbon technology for efficient management and conversion of organic wastes into clean, renewable biogas and organic fertiliser source. It has the potential for leveraging sustainable livelihood development as well as tackling local (land, air and water) and global pollution. Biogas obtained by anaerobic digestion of cattle dung and other loose and leafy organic matters/ wastes can be used as energy source for cooking, lighting and other applications like refrigeration, electricity generation and transport applications.

232. **Success Driven by Policy:** First time in the country during the year 2008-09, a new initiative was taken for technology demonstration on biogas bottling projects in

entrepreneurial mode, for installation of medium size mixed feed biogas plants for a generation, purification and bottling of biogas under a RDD&D policy of MNRE after R&D. Installation of such plants aims at the production of CNG quality of Compressed Biogas (CBG) to be used as vehicular fuel in addition to meeting stationary & motive power, electricity generation, thermal application, etc. needs in a decentralised manner through establishment of a sustainable business model in this sector. There is a huge potential for the installation of such plants in various areas. Under the demonstration phase, the Ministry has sanctioned central financial assistance for a limited number of such projects for implementation following an entrepreneurial mode in different states namely Chhattisgarh, Gujarat, Haryana, Karnataka, Maharashtra, Punjab, Madhya Pradesh, Andhra Pradesh and Rajasthan.

233. So far, 11 numbers of biogas bottling projects of various capacities and technologies have been commissioned in the country after obtaining required licenses for filling and storage of compressed biogas in CNG cylinders from Petroleum & Explosives Safety Organization (PESO), State Pollution Control Board (PCB), etc. IIT Delhi is assigned for technical monitoring & handholding of the consultants/promoters and preparation of documentation on different types of technology, which may emerge out of these projects. Collective capacity of these 11 plants is 35,616 m^3 per day and estimated production of CBG is 14,246 kg/day.

234. **Payback Period:** The Biogas bottling project of 1000 m^3/day capacity installed at Singla Bio-Energy, Vill.–Siaghawali, Teh.-Sadulsehar, Dist.–Sri Ganganagar (Rajasthan) with the investment of Rs. 1.95 crore by the promoters. The payback period was calculated as 5-6 years without subsidy and 3-4 years with a subsidy.

235. Primove Engineering Pvt. Ltd, a clean tech company has built India's first Bio-CNG plant at Pirangut in Pun where Bio-CNG is made using agricultural waste. This Bio-CNG can be used to power automobiles with the same now dispensed under the brand name AgroGas™. It also meets the IS 16087:2016 standards.

236. Primove's technology can produce over 100 million tons of crude equivalent Bio-CNG per year, which is about 50 % of India's fuel imports. With the technology patented by Primove, biomass can be compacted and transported in situ, stored, and distributed easily. This will cut down the costs in the supply chain for Bio-CNG. A typical CNG installation can distribute about 5–10 MT of CNG per day. This daily output of 5 tons of AgroGas™ (Bio CNG) can power about:

(i) 70 buses (70 kg/ fill)
(ii) 500 cars (10 kg/ fill)
(iii) 800 auto rickshaws (6 kg/ fill)
(iv) A combination of the above

237. Spectrum Renewable Energy Private Limited (SREL) developed a large-scale biogas generation and bottling project at Kodoli near Kolhapur in the state of Maharashtra. It is a 100 TPD press mud to biogas and organic manure generation plant. SREL is purifying and enriching about 20,000 m^3 of biogas produced from press mud as

well as spent wash which generates around 8000 kg Bio-CNG which is CNG grade fuel also called as CBG (compressed biogas). This is a price-competitive renewable energy that can be used in vehicles as well as heating application in heat treatment facilities replacing LPG (Liquefied Petroleum Gas), Diesel or other fossil fuels. CBG can also be used for electric power generation. National Agricultural Cooperative Marketing Federation of India (NAFED) will develop a Bio-Compressed Natural Gas (CNG) facility near Azad Mandi, using agriculture waste produced in the area. GPS Renewables, a start-up company based at Bangalore have been installing biogas generation systems in large hotels and kitchens utilising the waste from the kitchens and food waste where the biogas is used on the premises for cooking. The company has been supported by the Department of Bio-Technology with research grants, and they have installed remote monitoring systems in all their installations.

238. **Use for Power Generation:** While it would be a good option to ensure use of Bio-Gas for thermal applications, utilisation for power generation brings down the efficiency. Moreover, the additional capital cost is called for to install power generating equipment. Further, they may get constrained by regulations of the power sector. The state DISCOMs are also not willing to accept a Feed-in-Tariff regime.

Overall Issues and Challenges

239. **Biogas Based Power Generation:** The biogas market in India can be segmented into three major categories.

- **Family-Based (1-6 m^3):** These plants are mainly owned and maintained by the consumer and is distributed mainly across the rural areas of India. These plants are used primarily for generating gas for cooking purposes; however, there have been instances where this has been used for rudimentary lighting purposes. The majority of India's biogas deployments have been in this segment,and a large number of these plants are not functioning. One of the main reasons is lack of maintenance.

- **Community-Based (5-250 kW):** These plants are mainly owned by communities/ societies/NGOs, etc. in rural settings and are used for electricity production. The electricity is generally linked to a small micro or a mini-grid for rural electrification purposes. There have been a lesser number of community-based biogas projects in India. However, there are a few that have been very successful owing mainly two reasons: 1) the plant has a single person who exercises initiative to ensure that the plant runs optimally and takes corrective action when problems arise and 2) there is a strong sense of community among the people who own and run the plant at a village level. Usually, there are one or more persons in the community who know how to operate the biogas plant.

- **Developer Based (250 kW+):** These plants are mainly owned by developers with a structured investment strategy and are used to feed electricity into the grid with secure power purchase agreements with power distribution companies. There has been a systemic lack in structured investments flowing in the sector, largely attributed to many risks involved in the PPA, input feedstock and the marketing of the fertiliser output. The main challenges are feedstock price security, lack of biogas purchase obligations, and national power offtake agreement. One of the major reasons as to why developer-based biogas models are not taking off in India is due to several risks involved along the entire value chain. The government needs to do more to de-risk the entire value chain, right from input feedstock to the output fertiliser.

240. In case of Bio-Gas, one of the main challenges is there is no national player who could demonstrate the end to end management of the project or a typical prototype which can be adopted at the local level across India (specifically rural India) based on the different source of biogas. Till recent times, there were no structured policy interventions. But hopefully, with the new program (2018) of the government, this will be streamlined.

241. Other key issues can be summarised as:
- Supply chain management is not streamlined for biogas production.
- **Financial:** High investment cost in terms of up-front installation cost
- **Regulatory barrier:** Lack of coordination between different government agencies
- Poor dissemination of information regarding the technology and incentives given by the government
- Lack of awareness regarding substrates other than cattle dung for biogas generation

242. **Bio-CNG:** Following are some State-specific issues:
- Under Swachh Andhra Mission, Mahindra Powerol has signed a contract with the Government of A.P. to establish eight Bio-CNG plants that use organic waste as raw material for producing the Bio-CNG as well as bio-fertiliser. The production capacity varies from 10 to 40 ton per day with the plant at Tirupati having highest capacity.
- In Karnataka, no state-specific policy is present which is focused on Bio-CNG yet. But, a bio-CNG bottling plant for the project is proposed to be set up on one-acre compost yard of Hosur Municipality at Thurvarapalli by SK & Co, a Salem-based bio-CNG bottling company. While the initial capacity of the plant will be 20 tons of waste per day, its optimal waste capacity will be 40 tons per day. As per an agreement signed, the Hosur Municipality will have to provide 10 tons per day of waste, while the remaining 10 tons will be met by the private company from their own clientele. The bottling plant is being set up at an estimated cost of Rs. 1.60 crore partly funded by the private party and the rest as local body grant under the Integrated Urban Development Mission.
- Carbon Masters is an innovative energy startup that has successfully developed India's first branded Bio-CNG product named "Carbonlite" for commercial cooking. Carbon Masters is exploring two captive transport solutions – running trucks and a fleet of auto-rickshaws using carbon neutral gas.
- The 40-ton capacity plant can produce 1.6 tons of bio-CNG per 40 tons of wet waste. Their fertiliser production is still in the nascent stage – only up to 1 ton

against the capacity of 8 tons. They hope to increase the production to 6 tons by February 2018 and work with farmers in the area.

- A bio-methanation plant based in the "Nisargruna" technology of BARC was commissioned by Mangalore City Corporation near Urwa Market. The plant can process up to two tons of biowaste per day to produce 100-160 cubic metres of methane gas and up to 200 units of power. The plant is set up by Wipro Eco Energy and utilises kitchen waste from hotels, vegetable and other green wastes.
- In Kerala, a biogas plants became fully operational at Palayam, Thiruvananthapuram. The production capacity of the plant is two tons of fish and vegetable market waste per day, and it can produce 30 kilowatts of electricity.
- In Mahindra World City near Chennai, a bio-CNG plant is functional. The plant works on aerobic digestion of biomass to produce biogas, which can be further enriched to make it an auto grade CNG equivalent. Subsequently, the purified gas is compressed to 200 bars and stored in cylinders to power automobiles. The manure that comes out from the plant is utilised as fertiliser or composted with organic material for producing compost fertiliser.
- In Chennai and Tuticorin cities of Tamil Nadu at least five biogas plants are under construction. All these plants are based on the Nisargruna technology of BARC for bio-methanation of waste into biogas. Four of the plants can process 3 tons of waste per day while one plant in Tuticorin has 1 ton per day processing capacity. These plants are capable of producing 100 kg of manure and 100 units of electricity or methane fuel gas to fill two to three 14.6 kg cylinders per ton of biowaste processed.

243. As it is the banks are reluctant to lend to RE projects, though they are now getting to appreciate wind and solar based power projects. Unfortunately, the financial sector has not understood the full ecosystem of RE projects based on biomass and municipal waste (both solid waste and bio-degradable). Their ignorance and/or unwillingness to lend is even more if the ultimate output is not power generated backed by a PPA. The lenders do not even appreciate non-power generating RE projects that lead to other forms of energy like heat, gas, etc.

VI. SMALL HYDROPOWER

244. Small Hydro Power (SHP) projects are generally run-of-river projects with the little requirement of reservoirs or dams. They are usually based in remote and inaccessible areas fulfilling mostly the local power needs. Unlike large hydropower projects, they are considered as environment-friendly as they do not obstruct the natural flow of a river or a stream. In India, the projects of 25 MW and less are considered as SHP projects. There is also an element of seasonality in a generation unless the projects are located on perennial rivers and rivulets. Most SHP projects are on rivers and streams that are rain fed and have the potential to generate mostly during monsoons. The generation also comes down if the rainfall in the catchment areas is less than normal.

245. Though hydro projects less than 25 MW capacity are within the purview of the MNRE, no logical reasoning or background of such a decision is available. Projects above a capacity of 25 MW are within the mandate of the Ministry of Power. Such projects are mostly in the public sector either of the Union or State governments.

246. MNRE has further classified the SHP projects on the basis of capacity. The ministry has separate schemes for the encouragement of mini/micro and small hydropower projects in the country.

Table 8: Category of SHP Projects

Class	Station Capacity (kW)
Micro Hydro	Up to 100
Mini Hydro	101 to 2,000
Small Hydro	2,001 to 25,000

Source: MNRE

247. The SHP projects are grid interactive as well as off-grid. Compared to the useful life of 25 years of wind and solar projects, the SHP plant life is generally considered to be 35 years long, and the PPAs are signed accordingly between the utility and the developers. Along with the river-based SHP projects, some States (such as Bihar, Punjab and Maharashtra) support irrigation canal-based projects. The private sector plays a significant role in developing the small hydro projects, and they can also assess the potential sites on their own which are defined as self-identified sites.

A. Current Status

248. The SHP potential of India is 21.13 GW at 7,134 sites across the country.[71] Most of this potential exists in Karnataka (3.73 GW) followed by Himachal Pradesh (3.5 GW), Arunachal Pradesh (2.07 GW), Jammu & Kashmir (1.7 GW) and Uttarakhand (1.65 GW). By December 2017, out of the potential of 7,134 sites, 1,089 sites had SHP projects of various capacities. The country's total installed capacity is around 4,493 MW with Karnataka having the highest installed capacity of 1,231 MW, followed by Himachal Pradesh 842 MW, Maharashtra 349 MW, Kerala 219 MW, and Uttarakhand 214 MW. Projects aggregating to about 754 MW are under various stages of implementation across the States.

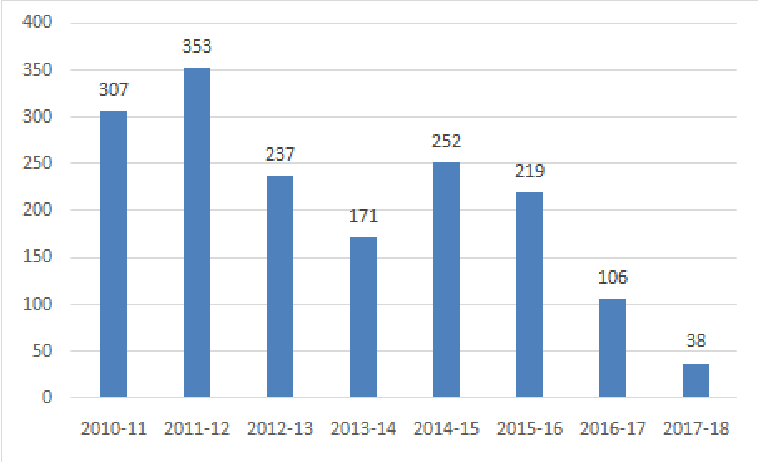
249. SHP constitutes only 5 GW of the country's 175 GW target by 2022, and hence gets overshadowed in the national RE discourse, when compared to solar and wind power.

250. In 2014, the Central Government came out with the scheme to encourage SHP projects[72] by providing central financial assistance (CFA) to the developers for the following activities:
- (i) Resource assessment and support for the identification of new sites;
- (ii) Setting up new SHP projects in the private/co-operative/joint sector etc.;
- (iii) Setting up new SHP projects in the government sector;
- (iv) Renovation and modernisation of existing SHP projects in the government sector;
- (v) Development/upgradation of water mills (mechanical/electrical output) and setting up micro hydel projects (upto 100 kW capacity);
- (vi) Research & development and human resource development.

251. However, there has been a drastic decline in the total SHP installations over the last three years (Fig. 7), and pessimism prevails in the sector.

[71]MNRE Annual Report 2017-18.

[72]MNRE, 2014. Small Hydro Power Programme (upto 25 MW Capacity) – Administrative Approval for the Year 2014-15 & Remaining Period of 12th Plan. 2nd July. See https://mnre.gov.in/file-manager/grid-small-hydro/SHP-Scheme.pdf accessed on 24th Sept. 2018.



Source: MNRE[73]

Figure 7: Annual SHP Capacity Addition (MW) (as on 31st December 2017)

B. Discussion on Barriers to Scaling Up SHP Projects

Environmental Concerns

252. In Uttarakhand, devastating floods in 2013 killed thousands of people and left the State's ecosystem destroyed. This forced the Supreme Court to intervene and put a stop to the development of all kinds of hydropower projects. The top Court's 'stay' order in 2013 has practically stalled the progress of under-construction and future SHP projects. Up to 30 projects were impacted by this judgment. Taking into account the huge investments made by companies, particularly in six projects, the apex court asked the Union government to appoint an expert committee to study the environmental and ecological impact of the projects. These projects are the Lata-Tapovan (171 MW), Jhelum Tamak (108 MW), Kotlibhel 1-A (195 MW), Alaknanda (300 MW), Khironi Ganga (4 MW) and Bhyunder Ganga (24.3 MW). Referring to the findings of the expert body, the Additional Solicitor General assured the court in 2016 that the projects would not affect the flow of river Ganga and would not make an adverse impact on the environment.

253. In Karnataka, due to environmental issues, mini hydro projects in the Western Ghats' districts/forest areas are restricted to a maximum 5 MW, and preferably run-of-river (ROR) projects are encouraged. The RE developer has to make financial provisions for mitigation of adverse impacts as per the approved Environment Impact Assessment plan, Environment Management Plan and mitigation of degradation of the environment, watershed area management, afforestation and soil moisture conservation due to disturbance of ecosystem will be implemented at the project cost. Our field studies show that Karnataka has stopped accepting new SHP proposals from January 2018.

[73]Akhtar, S., 2018. MNRE Presentation. 20th March. See https://www.icds-wcd.nic.in/nnm/Events/NationalWorkshop/MNRE_NW_20-03-2018.pdf accessed on 22nd Sept. 2018.

254. In some cases, there is a mismatch in estimating SHP potential by the state governments and the MNRE. There is a lack of hydrological data in states such as Sikkim (potential decided on the basis of 1975 data) and Assam. The potential calculated by the States are generally based on a desk study involving toposheets as well as catchment area study. The study provides a basis or blueprint to perform a further investigation and cannot be a true indicator of real potential. The States usually do not have financial or technical capability to undertake field surveys and earmark actual potential sites. In Kerala, MNRE estimated potential at 647 MW, whereas ANERT identified its potential to be 331 MW. In Assam, the identified SHP potential by the State is about 117 MW, whereas that by MNRE is 202 MW.

Declining Flows in the River

255. In most states, changes in environmental factors (such as erratic rains) and sand mining are affecting the water flows in their river basins. Deforestation has led to either drying up of many rivulets or drastically reducing their discharge levels. The West Bengal RE policy 2012 stops the diversion of water flow to set up SHPs which may become technical constraints for some of the sites.

256. Environmentalists have raised concerns that existing SHP plants, which are mostly run-of-river (ROR), often re-route water through pipelines and tunnels to increase the pressure and remove silt, leaving long stretches of a river dry. For example, the 10-MW Madhya Meshwar SHP plant uses a 4-km long tunnel along the river. Two other projects in Uttarakhand, Kaliganga I (4 MW) and Kaliganga II (6 MW), use tunnels of 400m and 2 km length, respectively. In fact, the de-silting tank of Kalinganga II project starts form tail-race of Kaliganga I. As a result, multiple projects on the same river can leave longer continuous stretches dry.

257. The CAG audit report (2010)[74] has identified some issues pertaining to SHP development in Uttarakhand: The project developers were not interested in maintaining the downstream flow of water which adversely impacts the river. There was also a high level of muck and silt generation affecting the power generation. The report also concludes that around 38% of the projects were not implementing the afforestation plans. This left the long stretches of the river dry in the downstream areas and hence, disturbing the local ecology and non-replenishment of groundwater aquifers. In Uttarakhand, currently, there is no law or regulation stipulating the maintenance of the minimum environmental flow of water (such as 10% of the lean flow) in the downstream areas for hydropower projects up to 100 MW.

258. The project developers are reluctant to maintain the minimum flow in the river due to technical and financial concerns. For example, the Uttarakhand Tariff Order calculates the tariff based on a PLF of 40%. However, during recent years the State has seen some erratic weather with long dry spells. As a result, SHP plants are not

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[74]CAG Report (2010). Civil – Performance Review: Audit Report for the Year Ended 31 March 2010. Comptroller and Auditor General of India, Govt. of India.

being able to meet the required/prescribed PLF. While the tariff has been revised upwards in the recent amendment, it is not enough to make up for the losses being faced by developers.

259. Overall, developers are finding it difficult to identify a suitable site for project development which would have assured flows for the 35 year PPA period. Further, there are issues of year-round silting in the rivers, which makes operations and maintenance of SHP plants uneconomical. For example, in Himachal Pradesh, periodic de-silting activities alone would enable adequate availability of power from existing stations. Expenditure on account of de-silting would be a recurring expenditure that would not have been taken into account in arriving at the tariff.

Land Acquisition

260. Developers have repeatedly complained about the difficulty in securing land for setting up SHP projects. Developers may have to purchase private land directly from the owners. In Maharashtra SHP policy, the developer can lease government land for setting up the project. However, if no government land is available, they have to arrange the land from private parties at their own cost. Since most SHP potential is based in tribal belts, the process of acquiring land becomes an uphill task for the developer.

261. In Kerala, due to the protracted process of land procurement, the tariff quoted through the competitive bidding process becomes non-viable over a period, and hence the developers lose interest. In West Bengal, the politics around land allotments has made the SHP projects vulnerable. In Madhya Pradesh, the State agencies neither help private developers acquire land for SHP projects nor get forest and environment clearances.

262. In Punjab, while the government helps in procuring irrigation/agricultural land owned by local bodies/gram panchayats, if available, this has to be negotiated by the developer. Since there is no provision for local bodies to become party to the subsequent generation revenue benefits from SHP plants, it does not offer much incentive for gram panchayatsto lease out their land to the developer for setting up SHP project.

263. The sector has also witnessed many movements against land acquisition impacting the development of SHPs. There are issues on rehabilitation and compensation packages for Project Affected Persons (PAP), provisioning for alternative livelihood opportunities, especially in tribal belts, that need to be adequately addressed.

Evacuation Infrastructure

264. Most SHP projects are in remote locations of the country from where local power demand is less and building the evacuation infrastructure is a major development

challenge. It is felt that the cost of developing evacuation infrastructure to the nearest sub-station or the pooling station should be included as a part of the project cost by the developer or borne by the state entity having the technical capability to execute such works promptly. However, there is a divergence in the approaches of the DISCOMs, STUs and the SERCs. There is a need for integrated infrastructure planning and issue resolution through discussions between STUs, DISCOMs and developers. The STUs may be required to play a larger role, in addition to the role being played by the DISCOMs to support the construction of evacuation infrastructure to accelerate the overall development of the SHP sector and the regulators should be amenable to allowing its recovery through tariff and our field studies show that is always not the case.

265. The condition of the existing transmission infrastructure is obsolete and inadequate in the country, leading to high T&D losses, and frequent tripping. While the government is investing in new transmission lines and trying to improve the condition of the existing infrastructure, it will be a while before benefits of such investments fructify.

Difficulty in Achieving Financial Closure

266. Over the years, most SHP projects have been finding it difficult to achieve financial closures. For example, in Chhattisgarh, though there is potential of more than 750 MW, there had been the limited development of only around 26 MW till 2017. One of the developers, which has been allotted four run-of-river SHPs totalling to 77 MW under the IPP route, achieved commercial production of 24 MW project at Gullu during July 2017. The Rehar 24 MW project has received first stage forest clearance and is expected to achieve financial closure during the current year. As the developer had the strength of internal resources, their projects were moving, but other projects which are more dependent on banks and financial institutions have not seen much progress.

Dwindling Developer Interest

267. Our field studies show dwindling developer interest in the SHP sector. Taking the example of Jharkhand, key issues have been listed below, but many of these issues apply to other states as well.

(i) There have been three rounds of bidding for attracting private developers in Jharkhand SHP sector, the last being in November 2016 for the 13 SHP projects totalling to 125 MW identified by JREDA. The response has been lukewarm,and the bidding process could not be concluded.

(ii) According to discussions with consultant officials associated with JREDA in the SHP projects, the key issues they have collected from the developers that have adversely affected their interest in Jharkhand SHP sector are:

- The current depressed scenario of the power sector as many of the corporates who are likely to bid on these projects are distressed in other States / Central projects.

- Onus on forest and land clearances on the developers (some of the lands may be tribal land). This could become difficult in some of the projects. The last bidding process conducted on the basis of an implementation model of minimum 4% free power was a concern.
- The case of re-negotiation of tariff for 1,200 MW solar projects and the reluctance of DISCOM to buy 'expensive' power in a regime of falling power prices has generated scepticism. If such a thing happens here as well, there will be no interest at all. The present atmosphere does not inspire much confidence to believe that the decisions of the cabinet and guidelines from the MNRE would be complied with.
- JBVNL has a poor record of payments. From a developer's perspective, JBVNL ranks low even within the community of DISCOMs where delayed payments are more of a norm rather than an exception.
- Safety and security in sites of LWE affected districts and those around them.

(iii) With such lack of developer interest, the Government of Jharkhand is preparing to pursue developing 16 projects on its own totalling to 161 MW involving an outlay of about Rs. 1,200 crores. With State taking the development ownership of these SHP projects, some of the challenges associated with private initiatives are likely to be overcome, and the prospect of mobilising institutional finance for these projects could improve.

Updated Policies

268. In many states, the existing policies and regulations require revision reflecting the present requirements of the sector. For example, Andhra Pradesh has ten years old mini hydro policy. Similarly, Chhattisgarh has SHP policy, but it is outdated (formulated in 2002) and in urgent need of revision. In some states (such as Tamil Nadu), there is no SHP policy. In Madhya Pradesh, the State has set no SHP target for itself, and there is no urgency to push SHP projects. Tamil Nadu and Odisha are adopting a state-led model of SHP development where sites are to be identified and developed by the state utilities. However, the pipeline of projects is uncertain.

269. In Himachal Pradesh and Uttarakhand, policies to give priority to locals for setting up Mini/Micro hydro projects are in place. In J&K, projects up to 10 MW have been reserved for IPPs that are permanent residents of J&K. Though the basis for this may have been to encourage local development, in practice they have become barriers for building a trusted relationship between local firms and private developers from outside the state who have technology capabilities and financial resources.

Remunerative Tariffs

270. The tariffs awarded by SERCs to the SHP project developers are low at times. For example, in the Andhra Pradesh Tariff Order (23-Aug-2014), tariff declines from Rs. 3.89/unit to Rs.3.10/unit for first 10 years from COD; thereafter rises from Rs. 2.15/unit

to Rs. 3.80/unit from 11th year to 25th year. Given the likely increase in costs during construction as well as restrictions in access of water and other overhead charges, tariff rates need to be revised. Also, the tariff is exclusive of Income Tax and Minimum Alternate Tax and to be paid up to 45% PLF. In Madhya Pradesh, successive tariff reviews have gone back to the original tariff order of 2008. MPERC needs to work on a new tariff order that is in sync with the changing requirements of the industry as well as addresses the increase in infrastructure costs over the years.

271. In Nagaland, the capital cost, as given in the regulations, has been set at Rs. 635 lakh/MW below 5 MW and Rs. 571 lakh/MW for 5-25 MW, for the first year of Control Period. Subsequent revisions have been linked to Indexation. However, this is less as compared to the other North-eastern States where it ranges from approximately Rs. 770 lakh/MW for below 5 MW and Rs. 700 lakh/MW for 5-25 MW. Also, depreciation value is higher as compared to other States at 7% for the first ten years, and balance spread over remaining useful life. The other States offer 5.83% for the first 12 years and balance spread over the useful life.

272. In Gujarat, the GERC tariff order of December 2016 has set the CUF as 42% for tariff determination for the existing control period. However, GUVNL and some project developers have suggested that since the majority of the SHP projects in Gujarat are canal-based, which have higher CUF, GERC should consider a CUF of 60% while determining tariff.

273. In Karnataka, it is obligatory for the developer to sell electricity to the respective DISCOMs in which the project is located, at the tariff determined by KERC. Captive users can sell surplus power only to the distribution companies at a price not exceeding the APPC. Similarly, in Chhattisgarh, the power purchase rate is Rs. 2.25 per unit. At present cost structures, this may not be a motivator for private investors.

274. In a few States, the governments have tended to negotiate a larger share of “free of cost” power generated for their DISCOMs making returns unattractive for high-risk investments. Moreover, the governments do not easily approve the supply of power to third party industries in other states.

Meeting RPO Targets

275. In Maharashtra, the RE Policy states that a project developer will be first required to sell power to a distribution licensee in the State for fulfilling their RPO. It is only after then, he will be allowed to sell power to a third party or use for captive consumption within or outside the State. In the present scenario, where most utilities are not fulfilling the RPO targets and are refusing to sign RE PPAs, this clause is a major roadblock for SHP developer.

276. The Assam Electricity Regulatory Commission (AERC) has drastically reduced the non-solar RPO from 6.75% in 2015-16 to 3% in 2016-17. With limited solar potential

(mostly off-grid) and no wind potential, the non-solar target will need to be met by SHP. With a reduced RPO target, incentive to pursue SHP projects reduces.

277. Kerala has set itself a non-solar RPO target of 9.5% for 2017-18 and 10.25% for 2018-19. With the wind still in nascent stage and SHP being the primary technology through which they can achieve this target, Kerala has been missing its RPO targets repeatedly. However, there are severe SHP development restrictions in many parts of the State.

278. In Uttarakhand, with the RPO target being revised upwards, the onus of meeting the non-solar RPO target (2016-17 – 8%, 2017-18 – 9.5% and 2018-19 – 10.25%) would primarily be from SHP. However, with SHP project development on a slow track, there is no clarity on how the State will comply with these RPO targets.

Geotechnical Challenges

279. A few other points that emerged from the interactions with the developers were related to difficulties in estimating the capital costs with certainty since geo-technical challenges during the phase of construction result in cost over-runs. These are also known as geological surprises that could not be anticipated leading to time overrun, cost overrun and challenges in getting the lenders to enhance the financing norms. Such unforeseen delays emanating from geotechnical conditions also delay construction schedules and commissioning dates, thereby increasing debt service costs.

VII. RECOMMENDATIONS

280. The objective of the study was to understand barriers to the growth of renewable energy in India. This section sets out the key policy recommendations emanating from this study that could address structural issues in the RE sector and common challenges across RE technologies. Appropriate remediation measures could support even greater adoption of RE in the country. Findings and suggestions on important technology areas such as Solar, Wind, Bio-Energy and Small Hydroelectric Power have been set out in the respective preceding chapters.

Increased Empowerment to the Ministry of New and Renewable Energy (MNRE)

281. India was the first country in the world to create an exclusive ministry for the development of the renewable energy sector. However, the institution has not been able to lead progress as fast as it should have been. It is unclear whether the ministry deals with science and technology or development to encourage and facilitate the deployment of renewable energy systems. In fact, MNRE was categorised as a Scientific Ministry at its formation and continues as such. As a result, there have been challenges of limited capacity as well as uncertainties in the approach, focus and capacity of the ministry to lead the sector till recently.

282. While MNRE's initial objective was to work on substitutes for fossil liquid fuels, the Ministry has made extensive efforts to promote renewable power. However, for many years, MNRE has existed with a limited mandate and small budgetary allocations. Time has now come to empower the ministry further and categorise it as aneconomic ministry within the Government of India.

Enhanced collaboration between Central and State Governments

283. Electricity is listed as Item 38 in the Concurrent List (also known as the Seventh Schedule) of the Constitution of India; meaning, it is under the purview of both the Union and State governments. Uniformity, though desirable, may not always be achieved on items in the concurrent list. However, the Union government may issue policies and set targets for RE, but it would be up to the State Governments to implement it in a way it deems would be appropriate for its State.

284. In the past, the initiatives were mostly from the State Governments with the role of the Union Government being limited to that of a facilitator alone. This was largely because power, as a subject, was majorly dealt with by the States and the Union Government's role was confined to the generation of power through central PSUs and related transmission. But at the same time, the Union Government announced a few incentives like Accelerated Depreciation, Capital Subsidy, etc. to fast track growth of renewable power. A few State Governments that were rich in renewable resources like wind (Tamil Nadu, Gujarat, Karnataka, Maharashtra), biomass (Maharashtra, Tamil Nadu, Uttar Pradesh) and small hydro (Karnataka, Himachal Pradesh) encouraged setting up of such generation systems mainly to supplement the availability of power in their distribution systems.

285. Though the reduction of pollution was an incidental benefit, many states did not attach much importance to this aspect. At the same time, they were concerned about the higher cost of renewable power, the unpredictability of generation, limited transmission capacity, etc. The desire and ability of the Union Government was also limited in persuading and incentivizing the States. In this atmosphere, the renewable energy sector grew more by default rather than by any design and plan. Nor was there any major benefit that was perceived or articulated as a result of this growth.

286. While wind energy growth was significant propelled by the Accelerated Depreciation benefit, other sectors like small hydro projects, biomass-based projects never grew despite capital subsidies mainly because of policy and regulatory challenges that existed and still continue. Though the technology to generate power from solar technology was well known for a long time, it never took off due to the very high cost of silicon-based solar modules. At best, solar technology was treated as an option for "home lighting systems" in rural areas where it was not feasible to connect through grids either because of cost or geography. It was considered impractical to have solar systems connected to the grid mainly because of high costs. Two factors led to the acceleration of solar-based power generation initiatives, primarily, the fall in the cost of manufacturing modules over the past decade, particularly in China. Secondly, the country's desire to have a higher percentage of clean energy in the context of the commitments made in the Paris Accord that coincided with the fall in prices.

287. It has been observed during the last few years that perceptions of State Governments also appear to be at variance – though not contradictory – to the targets and objectives of the Union Government. The approaches of State Governments have differed on the methods to achieve mission objectives as the needs of each state are different, and given the localised nature of RE resources, the state policies would require to be aligned to its unique needs. Thus, the success of RE adoption will depend primarily on the active participation of the States and the collaboration between the Central and State Governments.

288. One example of creating a collaborative framework is making land available for RE projects. Almost all the States have different laws, regulations, practices, registration requirements, etc. as far as making land available for industrial projects is concerned. Also, many States have procedures to be followed for conversion of agricultural land to non-agricultural and in few States, it is a very long process. It would be helpful if the GOI gets the States too, agree on a set of guidelines, as far as practicable.

289. Secondly, the recent trend of floating large projects with a reverse bidding process is perceived to be one where the Union Government is increasingly playing a major role thus encroaching upon the role of the States. On the flip side, States have virtually given up encouraging RE projects within their own competence. The attitude appears to be one of abdicating the responsibility of promoting RE within their own states and leaving it to the Union Government to push all the initiatives.

290. It would be ideal for the Union Government to have periodic consultations with the State Governments on policies with major implications. In this way, States can ensure that the challenges they face are sufficiently addressed. Similarly, when targets are to be prescribed, they should have a relationship with the characteristics of the State, including their RE potential, quality of resources, availability of land, etc. The States should be involved in setting the targets, so they remained committed to their achievement.

291. Another important aspect that impedes RE growth is the approach, attitude and tariff-setting methodologies adopted by the State Electricity Regulatory Commissions (SERC). There is no uniformity of approach among SERCs, and there have been instances where they refused to approve PPAs signed by the DISCOMs. In a few cases, SERCs also tend to prescribe the maximum tariff on projects. Though Open Access is an express provision in the Electricity Act, the same is not granted by the SERCs. This affects new initiatives to install RE systems for captive consumption and third-party sales. Similar to the suggestion of policy consultation with States, improved dialogue among regulators (Central and State) and appellate authorities urging consistency in SERC approaches across States, and ensuring robust rationale behind regulatory orders can remove some of the regulatory barriers for RE growth.

Ensuring Longer Duration of Policy Stability

292. RE projects are inherently risky since the availability of the resource cannot be predicted accurately on a year-on-year basis. Even if the resource risk is overlooked, the sector has suffered from policy risks due to the uncertain nature and duration of policy announcements in the past. Investors find it difficult to forecast their returns beyond a few years even at a predetermined utilisation factor because of policy uncertainties. Thus, there is a need to maintain a stable policy environment to attract investments in this sector.

293. Currently, there is no unanimity among various sections of the government regarding the target for RE penetration. Targets identified by different States/Departments vary by a wide margin. As a result, manufacturers and technology suppliers are unable to plan manufacturing facilities, technology purchase or transfer, etc. It is suggested to provide a long-term target (10-15 years) for capacity addition/RE penetration for each of the technologies.

Setting RE Installation Targets for Each State: Is It the Best Way Forward?

294. States have varying resource endowments, and their policies are developed to best suit its needs. In this context, the policy question then becomes (a) how relevant are the Statewise allocation of national targets? And, (b) what should be the basis of national target allocation to the States by technology areas? The policy discourse can then be set forth to understand if every state should have installation targets, or some well-endowed States with much higher potential can undertake installation and generate while other states can contribute by procuring through a national power market according to predefined obligations and be incentivised accordingly.

Generation Surplus

295. With the slow growth in electricity demand reflective of the overall macroeconomic and industrial scenario as well as the Indian economy becoming more energy efficient, many States are experiencing generation surplus scenario. The increasingly volatile power market is making power procurement planning by State entities difficult and increasing the risk of stranded generation capacity of State sources. At the same time, several high paying consumers (industrial and commercial consumers) are using open access to procure inter-state power. Further, the tariff designed for absorbing the loss due to stranded state power sources is not reflective of the proportion of fixed and variable cost liability of the DISCOMs.

296. Energy intensity, defined as the energy input associated with a unit of Gross Domestic Product (GDP), is a measure of the energy efficiency of a nation's economy. The national commitments made in the run-up to the Paris Agreement in 2015, and earlier Planning

Commission studies (estimates based on data before RE power started scaling up and became important in India's energy mix) and have shown that the energy elasticity of GDP growth in India may not fall as much in the future as rising income levels will foster more energy intense lifestyle changes.

297. Under these circumstances, it may be recommended that new integrated energy pathways need to be developed as a part of the Energy Policy and the RE target setting has to be based on realistic scenarios of macroeconomic growth, the energy elasticity of GDP and projected energy intensities that are likely to be achieved through energy efficiency measures, considering technology balance in the overall energy source mix of the country and constraints of land availability in the resource-endowed regions.

Consolidation Among RE Industry Players

298. As the solar industry is relatively new, and typically the asset life is taken to be 25 years, creating data to assess the lifecycle performance of solar assets will take time. Meanwhile, a few solar developers are looking to exit early from their projects and are increasingly having no long-term interest in the underlying assets that are being created. This has created a space for financiers who are looking for acquisition of projects to maximise returns during the operational life of the assets.

299. There is a consolidation taking place among industry players leading to an emergence of few big players through mergers and acquisitions (recent example: Greenko – Sun Edison, Orange Renewables acquisition) who would be able to invest and bid on larger projects that are being auctioned. Such development, in the longer term, may preclude smaller players and mid-sized technology driven investors from bidding who would otherwise have had a longer-term interest both in developing the asset and it's continued O&M.

Stress Building up Among Domestic Players

300. In the wind power sector, the present pattern of reverse bidding has led to the closing of manufacturing facilities along with the loss of business for downstream logistics providers, EPC players, etc. Since the present bids of large sizes confine the demand only for large turbines, most of the manufacturers making turbines of capacities below 1 MW have either closed down or are in the process of closing down. This has affected the employment of nearly 3,000-4,000 persons in the manufacturing sector.

301. Similarly, in the solar sector, units that started manufacturing cells and modules under the SIPS policy have virtually stopped operations. Even those are in the sector of only assembling modules out of cells outsourced from abroad have been affected adversely given the cheap imports. The government needs to develop a policy to encourage domestic manufacturing of RE systems either by offering them capital subsidies or tax breaks.

302. In some cases, the auction participation conditions require prospective bidders to tie up land and evacuation facilities/permissions before submitting the bids. In these cases, it becomes difficult for smaller players or RE technology companies (who do not have tie-ups with land-bank investors) to meet such qualification criteria, especially when there is no guarantee about winning the bid.

303. The large RE projects that are auctioned on the reverse bidding process could be an outcome of a top-down view to achieve ambitious national targets. This has virtually limited the competition to only a few players who have the financial capacity to organise equity and lower cost debt. Many Indian companies – SMEs as well as a few large ones – that may have the resources to set up RE projects either for captive consumption or supply to the grid are excluded from the process of bidding because of the prescribed minimum project capacities. It would be ideal to have scope for such smaller domestic players to participate in the growth of this sector. While the thrust on some of the national programs (such as Green Energy Corridor, ISTS, and some others) continue, States may also be encouraged to adopt a bottom-up approach of harnessing their available endowments economically and incentivised to award more projects optimising RE growth within their constraints.

Timely Payment of Power Procured

304. Some of the DISCOMs have been consistently meeting their payment obligations towards the RE developers and IPPs, but many DISCOMs have not been able to honour their payment obligations in time over the past few years. Many have fulfilled only a portion of their power purchase commitments that too with significant delays in payments of more than six months (which is beyond the 180-day deadline set by RBI in its February 2018 notification).

305. In a low tariff regime, any delays in payments by power procurers become a major challenge for the developer to sustain its operations. Delayed fund flows to the developers put stress on meeting (a) working capital requirement and (b) fulfil debt service obligations. (During this study, an instance of a medium-sized company being dragged on the Insolvency and Bankruptcy route mainly because of the default in payment by a particular discom). This has lowered the creditworthiness of most State DISCOMs in the auctions market and developers are increasingly assigning risk premium to state-level bids.

306. It is suggested that an escrow account mechanism could be set up using a small percentage of DISCOM revenues for honouring payment obligations to the DISCOMs.

307. The recent auctions by SECI have motivated aggressive bidding by developers, mainly because SECI is a central PSU and the risk of default or long delays in payments will be low. But in the backdrop that SECI sells its power on a back to back basis to the State DISCOMs, there could be systemic risks being built up that are presently not

being evaluated. It would be good to have an additional payment guarantee/safety measures built in.

Better Policies Needed to Promote Non-Electrical RE Solutions

308. Electricity Act 2003 addresses the electricity sector in India. However, Renewable Energy encompasses not only electricity but also heating, cooling, cooking, transport, and other applications to ensure universal energy access. It is thus essential to provide legislative support to other forms of energy and new technologies that have not attained visibility and viability.

309. The National Bio-Fuel Policy was approved in May 2018. It indicated a viability gap funding scheme for advanced biofuels such as 2G ethanol bio-refineries of Rs. 5,000 crores in six years. However, there has been no similar indication given for 3G biofuels such as bio-CNG under this policy. The Government of India has announced a scheme for Galvanizing Organic Bio-Agro Resources Dhan (GOBAR-DHAN) in the 2018-19 budget. The scheme focuses on managing and converting cattle dung and solid waste in farms to useful compost, biogas and bio-CNG. However, our recent field studies across States show that the scheme is yet to be operationalised.

310. It is also seen that various ministries of the Union Government are announcing the schemes in the area of bioenergy. There has been a spate of announcements by Ministry of Urban Development, Ministry of Drinking Water Supply and Sanitation, Ministry of Petroleum and Natural Gas, Ministry of Transport. It would be ideal to let the MNRE co-ordinate these policies so that the efforts and initiatives of these ministries are not dissipated.

311. Going forward, as a short-term measure, Government of India may seek to amend Section 3 of EA 2003 to incorporate the National Policy on Electricity from Renewable Energy Sources (since a policy under EA 2003 can only address electricity). This national policy could be drafted by MNRE and remain in force until a comprehensive National Renewable Energy Policy is notified in the longer term.

312. The recent patterns of reverse auctions also come with the rider of a cap on the tariff. This condition of maximum acceptable tariff has become a dampener for potential bidders. More importantly, it goes against the objective of increasing the share of renewable energy as quickly as possible. The objective of attracting good and viable bids is defeated by the cap on the acceptable tariff. As it is, mid-sized domestic companies cannot participate in the process due to the auction project sizes. Hence, only companies with access to cheap foreign capital - both debt and equity - can submit bids below the maximum tariff. Moreover, it is unclear at this stage if bidders are compromising on the quality of equipment to procure them at a low cost and thus, reduce the capital cost and tariff. This could become a major issue in future. The government could revisit the norms of bidding such as removing the cap on bid

prices and minimum project size so domestic companies can participate within their financial capacities.

NCEF Allocations to Promote RE Projects

313. The National Clean Energy Fund (NCEF) was created to extend funding support to research and innovative projects in clean energy technologies through the levy of a cess collected against the production of coal. The guidelines for extending funding support under NCEF are generic. As the fund utilisation guidelines are not specific, the fund has been utilised for projects that could not be sanctioned otherwise in sectors other than renewable energy because of budgetary constraints of the government. The fund can be better utilized for specific purposes, such as (a) carving out of a Partial Risk Guarantee Fund for RE projects, (b) interest subvention to reduce lending rates to RE projects (say) at 5-8%, and (c) funding (last mile) evacuation infrastructure for small-sized RE projects.

Bibliography

VIII. BIBLIOGRAPHY

1. CEA, Dec. 2015. Executive Summary: Power Sector. Central Electricity Authority, Ministry of Power, Govt. of India. See http://www.cea.nic.in/reports/monthly/executivesummary/2015/exe_summary-12.pdf.
2. CEA, July 2018. All India Installed Capacity (in MW) Of Power Stations. Central Electricity Authority, Ministry of Power, Govt. of India. See http://www.cea.nic.in/reports/monthly/installedcapacity/2018/installed_capacity-07.pdf.
3. DIPP, June 2018. Quarterly Fact Sheet: Fact Sheet on Foreign Direct Investment (FDI): From April, 2000 to June, 2018. Department of Industrial Policy and Promotion, Govt. of India. See http://dipp.nic.in/sites/default/files/FDI_FactSheet_23August2018.pdf.
4. MNRE, 2017. Year End Review 2017 - MNRE. 27th December. Ministry of New and Renewable Energy, Govt. of India. See http://pib.nic.in/newsite/PrintRelease.aspx?relid=174832.
5. MNRE, undated. Tentative State-wise break-up of Renewable Power target to be achieved by the year 2022 So that cumulative achievement is 1,75,000 MW. Ministry of New and Renewable Energy, Govt. of India. See https://mnre.gov.in/file-manager/UserFiles/Tentative-State-wise-break-up-of-Renewable-Power-by-2022.pdf.
6. NITI Aayog, 2017. Draft National Energy Policy. See http://niti.gov.in/writereaddata/files/new_initiatives/NEP-ID_27.06.2017.pdf.
7. Kumar, A., & Thapar, S., 2017. Addressing Land Issues for Utility Scale Renewable Energy Deployment in India. TERI School of Advanced Studies.
8. Niranjan, R.S., & Siddiqui, A., 2018. Best Legal Practices in Land Acquisition Issues for Solar/Wind Projects. Energy Next, 20th January. See http://www.energynext.in/2018/01/best-legal-practices-in-land-acquisition-issues-for-solar-wind-projects/.
9. Mehra, P., 2015. Generating Electricity is Important but not at the Cost of the Marine Ecosystem. The Hindu BusinessLine, 24th November. See https://www.thehindubusinessline.com/specials/clean-tech/generating-electricity-is-important-but-not-at-the-cost-of-the-marine-ecosystem/article7912908.ece.
10. Krishnaveni, N., Anbarasu, P., & Vigneshkumar D., 2016. A Survey on Floating Solar Power

System. International Journal of Current Research and Modern Education, 152-158.

11. Vermani, G., 2018. India's Sunny Energy Future – The Rooftop Solar Power. 1st March. See https://yourstory.com/2018/03/indias-sunny-energy-future-rooftop-solar-power/.

12. Kamat, R., undated. Mapping India's Rooftop Solar Potential. Power Today. See http://www.powertoday.in/News/Mapping-Indias-Rooftop-Solar-Potential-/111905.

13. MoP, 2017. Growth in Transmission Sector. Ministry of Power, Government of India. See https://powermin.nic.in/sites/default/files/uploads/Growth_in_Transmission_sector_Eng.pdf.

14. Chatterjee, A., 2018. UDAY: Discoms' AT and C Losses Rise Again. Financial Express, 19th February. See https://www.financialexpress.com/economy/uday-discoms-at-and-c-losses-rise-again/1070984/.

15. Renewable Watch, 2017. Patchy Progress. June. See https://renewablewatch.in/2017/06/04/patchy-progress/.

16. Mathur, V., & Pandey, A., 2017. Untying the Gordian Knot: Catalysing Green Energy Investments in Emerging and Developing Economies. Observer Research Foundation, Issue Brief, 216, 1-8. See https://www.orfonline.org/wp-content/uploads/2017/12/ORF_Issue_Brief_216_Private_Capital.pdf.

17. Mathur, V., Pandey, A., & Roy, A., 2017. Mobilising Private Capital for Green Energy in India. Observer Research Foundation, Special Report, 50, 1-16. See https://www.orfonline.org/wp-content/uploads/2017/12/SR50-Energy.pdf.

18. Gulia, J., 2015. The Open Access Solar Market in India: Evolution and Challenges. Bridge To India, 8th October. See https://bridgetoindia.com/the-open-access-solar-market-in-india-evolution-and-challenges/.

19. Singh, D., 2017. Newer Challenges for Open Access in Electricity: Need for Refinements in the Regulations. Brookings India, IMPACT Series No. 042017-02. See https://www.brookings.edu/wp-content/uploads/2017/04/open-access_ds_042017.pdf.

20. MNRE Annual Report, 2017-18. Ministry of New and Renewable Energy, Govt. of India. See https://mnre.gov.in/file-manager/annual-report/2017-2018/EN/pdf/chapter-4.pdf.

21. Renewable Watch, 2017. Grid Locked. August. See https://renewablewatch.in/2017/08/25/grid-locked/.

22. Patil, M., 2017. Canal-Top Solar Power Plants: One Example of Narendra Modi's Gujarat Model That's Working Well. Firstpost, 29th January. See https://www.firstpost.com/india/canal-top-solar-power-plants-one-example-of-narendra-modis-gujarat-model-thats-working-well-3225926.html.

23. Gopal, S., 2018. Indian Solar Sector Funding Fell 65% Last Quarter. India Climate Dialogue, 25th April. See https://indiaclimatedialogue.net/2018/04/25/trade-barriers-could-slow-down-indias-solar-sector/.

24. Behera, N., & Dash, J., 2018. Tata Power, Adani, ReNew Power Jostle for Space in Odisha to Set Up Units. Business Standard, 23rd April. See https://www.business-standard.com/article/economy-policy/tata-power-adani-renew-power-jostle-for-space-in-odisha-to-set-up-units-118042300793_1.html.

25. Prateek, S., 2018. National Average Power Purchase Cost of ₹3.53/kWh Proposed for Open Access. Mercom India, 27th April. See https://mercomindia.com/national-average-power-purchase-cost/.

26. Prateek, S., 2018. Over 80% of Recent Solar Auctions in India Won by Larger Solar Developers. Mercom India, 20th April. See https://mercomindia.com/solar-auctions-india-larger-developers/.

27. Prateek, S., 2018. Lack of Clarity on Safeguard Duty Pass-Through Option is Stifling Solar Project Development. Mercom India, 18th April. See https://mercomindia.com/pass-through-option-safeguard-duty-stifled-projects/.

28. The Economic Times, 2018. Power Ministry Urges Battery Producers to Set Up Plants in India. 23rd March. See https://energy.economictimes.indiatimes.com/news/power/power-ministry-urges-battery-producers-to-set-up-plants-in-india/63433129.

29. Vijayakumar, S., 2017. TN Ranks Low in Ease of Doing Solar Business. The Hindu, 10th May. See https://www.thehindu.com/news/national/tamil-nadu/tn-ranks-low-in-ease-of-doing-solar-business/article18416466.ece.

30. Susheel, T., 2017. At 65 MW, Bhagwanpur Solar Power Facility Becomes Largest in U'Khand. The Times of India, 21st April. See https://timesofindia.indiatimes.com/city/dehradun/at-65-mw-bhagwanpur-solar-power-facility-becomes-largest-in-ukhand/articleshow/58303345.cms.

31. Prateek, S., 2017. 5 MW Solar Project Commissioned in Uttar Pradesh at Renegotiated Tariff. Mercom India, 7th August. See https://mercomindia.com/5-mw-solar-project-commissioned-mahoba-uttar-pradesh/.

32. Dey, A., Khattar, R., & Verma, G., 2016. Why Rajasthan Will Drive India´s Solar Revolution. Solar Today. See http://www.solartoday.co.in/News/Why-Rajasthan-will-drive-India-s-solar-revolution/98760.

33. Sinha, P., 2018. The Future of Renewable Energy in India. The Economic Times, 3rd May. See https://energy.economictimes.indiatimes.com/energy-speak/the-future-of-renewable-energy-in-india/3016.

34. Lempriere, M., 2018. A 100% Renewable India: Can it be Done? Power Technology, 10th April. See https://www.power-technology.com/features/100-renewable-india-can-done/.

35. Kenning, T., 2017. Wärtsilä Believes Energy Storage is 'Only Answer' to India's Grid Problems. Energy Storage, 11th October. See https://www.energy-storage.news/news/waertsilae-believes-storage-is-only-answer-to-indias-grid-problems.

36. Singhvi, S., 2017. Southern Region to Lead the Nation in Grid Integration of Renewable Energy. Bridge To India, 29th May. See https://bridgetoindia.com/southern-region-lead-nation-grid-integration-renewable-energy/.

37. Chaudhuri, S.R., 2017. Bengal's Fragmented Land Holdings a Roadblock for Solar Power Projects: Minister. Hindustan Times, 17th August. See https://www.hindustantimes.com/kolkata/bengal-s-fragmented-land-holdings-a-roadblock-for-solar-power-projects-minister/story-wAXGUpJjVXvvjT1f0maQ8N.html.

38. Chandrasekaran, K., 2018. Lack of Land Title Means No Payment for Solar Producers. The Economic Times, 29th May. See https://economictimes.indiatimes.com/industry/energy/power/lack-of-land-title-means-no-payment-for-solar-producers/articleshow/64375208.cms.

39. Chandrasekaran, K., 2018. Retro Karnataka Charges Irk Green Power Companies. The Economic Times, 24th May. See https://economictimes.indiatimes.com/industry/energy/power/retro-karnataka-charges-irk-green-power-companies/articleshow/64294305.cms.

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