Accelerating post-pandemic economic recovery with clean energy infrastructure and jobs in India

June 2021

Click Here to open

FICCI

SED Fund

EY
Building a better working world

FOREWORD

The Federation of Indian Chambers of Commerce and Industry (FICCI), in collaboration with Ernst & Young (EY), is proud to present this report – Accelerating post-pandemic economic recovery with clean energy infrastructure and jobs in India.

The report covers clean energy opportunities currently under development - project pipeline and underscores the significance of those projects in terms of economic recovery and development, jobs, and environment. It provides key recommendations for stimulus actions required to overcome some of the impediments to the clean energy growth in India especially taking into consideration the post-COVID recovery plans.

On the back of a highly conducive policy environment, a steady inflow of capital, falling prices and new technologies, India has seen an exponential growth in its renewable energy sector in the past seven years. The government has provided clear intentions for a clean energy transitioning by declaring an ambitious target of 175 GW of renewable energy by 2022 and 450 GW by 2030.

The current installed renewable energy generation capacity stands at 94 giga-watt (GW) and about 84 GW of ISTS projects are under various stages of implementation and bidding.

India's energy growth story will be driven by renewable energy in the days to come which will form a key pillar of India's climate commitments and achievement of sustainable development goals. Though our renewable energy story has been one of great admiration and success, many challenges remain. The Covid-19 pandemic has been a major disruption in this process.

Given the significance of renewable energy, it is crucial to have all the necessary building blocks in place to drive the growth of the industry, especially post pandemic. Overcoming the key challenges will create a more enabling environment for the entire renewable energy ecosystem in India. This report assesses the potential of the current pipeline of renewable energy projects in India, including utility scale and decentralised generation, and manufacturing of solar photovoltaic cells and modules, and lithium-ion batteries. The report assesses the impact on jobs, environment, and economic development. It looks at how clean energy projects need to be prioritised for India's economic recovery in a post-pandemic scenario. We hope this report will help in propelling the Government of India and the industry plans to drive the next wave of renewable energy growth in India and stimulate policy direction in this regard.

We thank the contributors from the FICCI Renewable Energy CEOs Council and others from industry and government for their valuable insights.

Mr Dilip Chenoy

Secretary General, FICCI

FOREWORD

Scientists, experts and policymakers are increasingly mindful that climate change risks pose a much bigger threat to India's economic development goals than the shocks induced by the current pandemic. The 'Assessment of climate change over the Indian region', a report of the Ministry of Earth Sciences, Government of India, has projected an alarming picture of the rise in average surface temperature, Indian ocean warming, changes in rainfall, droughts, sea level rise, tropical cyclones and changes in the mighty Himalayas by the end of this century. The current urgency to deal with the pandemic induced economic contractions contains a risk for 'lock-ins'. Stimulus spending should therefore embed climate proofing instruments for economic recovery. A balanced stimulus is imperative to strengthen the economic fabric ahead of future climate-related shocks.

Ernst & Young LLP (EY) is collaborating with the Federation of Indian Chambers of Commerce and Industry (FICCI), the voice of India's business and industry, to shape concrete policy recommendations for balancing economic recovery and climate neutrality goals in the post COVID stimulus efforts by Government of India. Through this collaboration, EY and FICCI teams have identified over 600 'shovel-ready' clean energy investment opportunities in the pipeline with tremendous potential for accelerating post-pandemic economic recovery, creating jobs and ultimately contributing towards India's long-term climate objectives.

This report is a culmination of above efforts to emphasize what is at stake in terms of the economic development, capital mobilisation, self-reliance, jobs and environment in the critical thematic areas of clean energy infrastructure (viz. Utility scale RE power generation, Rooftop Solar PV deployment, Decentralized RE power generation, Original RE equipment manufacturing and EV Charging Infrastructure). The project pipeline identified here has the potential to accelerate ~INR 2 Lakh crore of equity and ~INR 4 Lakh crore of project finance debt but more importantly support close to ~15 lakh fresh jobs in the immediate future. Further, the stimulus measures summarised can help advance the clean energy project pipeline and help frame the next leg of post-pandemic stimulus action.

It is critical that the new energy infrastructure boost economic recovery and self-reliance without reversing the trends of GHG emission, air pollution and other climate change related shocks in the post COVID economic recovery era.

Together, we can seize this opportunity and create a positive impact for the economy and society as whole. It is an opportunity not worth wasting.

Somesh Kumar

Partner & Leader (Power & Utilities)
EY India

Acknowledgements

The authors would like to thank 'SED Fund' for sponsoring this initiative. SED Fund was established in May 2018 as a philanthropic initiative to support the Sustainable Development Goals (SDGs) by backing the best efforts of governments and civil society to support economic development according to principles of sustainability, equity and diversity.

The authors appreciate and express gratitude to all the stakeholders (see below) for attending a stakeholder consultation meeting in March 2021 and sharing project level information and insights that helped shape the recommendations in this report. The analysis and conclusions of this report are those of EY and FICCI. They are a summary of the contributions derived from primary research and literature reviews. The recommendations are not biased or do not necessarily reflect the opinion of any / all stakeholders acknowledged. EY and FICCI are solely responsible for the content of this report.

Ministry of New and Renewable Energy, Government of India

Adani Green Energy Limited

Aditya Birla Renewables Limited

Amp Energy India

Amplus Energy Solutions Private Limited

Azure Power India Private Limited

Bharat Heavy Electricals Limited

Inox Wind Limited

Panasonic Energy India

ReNew Power Private Limited

SB energy

Sembcorp Energy India Limited

Sprng Energy Private Limited

Vector Green Energy Private Limited

We acknowledge contributions from

Somesh Kumar
Partner & Leader - Power & Utilities
Strategy and Transactions (SaT), EY India

Mohammad Saif
Director- Power & Utilities
Strategy and Transactions (SaT), EY India

Yuvaraj Dinesh Babu Nithyanandam
Executive Director - Power & Utilities
Strategy and Transactions (SaT), EY India

Kanv Garg
Director- Power & Utilities
Strategy and Transactions (SaT), EY India

Shuboday Ganta
Vice President- Power & Utilities
Strategy and Transactions (SaT), EY India

Aditya Prakash
Senior Associate - Power & Utilities
Strategy and Transactions (SaT), EY India

Vimanyu Ganesh Sahu
Senior Associate - Power & Utilities
Strategy and Transactions (SaT), EY India

Utkarsh Mathur
Executive- Power & Utilities
Strategy and Transactions (SaT), EY India

Sidhant Sharma
Analyst- Power & Utilities
Strategy and Transactions (SaT), EY India

Rita Roy Choudhury
Assistant Secretary General
FICCI

Nishit Jain
Senior Assistant Director
FICCI

We acknowledge sponsorship from

Vikas Mehta
Executive Director
SED Fund

Kartikeya Singh
Director of Programmes
SED Fund

Acronyms

AC	Alternate Current
ACC	Advanced Chemistry Cell
C&I	Commercial & Industrial
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
CFA	Central Financial Assistance
CPSU	Central Public Sector Undertakings
DCR	Domestic Content Requirement
DHI	Department of Heavy Industries
DIC	designated ISTS customers
DISCOM	Distribution Company
DRE	Distributed Renewable Energy
EESL	Energy Efficiency Services Limited
EPC	Engineering, Procurement and Construction
EV	Electric Vehicle
FICCI	Federation of Indian Chambers of Commerce & Industry
GT&D	Generation, Transmission & Distribution
GW	Gigawatt
ICAR - CAZRI	Indian Council of Agricultural Research Central Arid Zone Research Institute

IEA	International Energy Agency
IPP	Independent Power Producer
IREDA	Indian Renewable Energy Development Agency Limited
ISTS	Inter State Transmission Network
kW	kilowatt
LOA	Letter of Award
LTA	Long-term access
MNRE	Ministry of New and Renewable Energy
M-SIPS	Modified Special Incentive Package Scheme
MSME	Micro, Small & Medium Enterprises
MW	Megawatt
NHPC	National Hydroelectric Power Corporation Limited
NTPC	National Thermal Power Corporation Limited
OEM	Original equipment manufacturer
OPEX	Operating Expenditure
PBI	Procurement based incentive
PERC	Passivated Emitter and Rear Cell
PHC	Primary Health Center
PLI	Production Linked Incentive
PM-KUSUM	Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan
PPA	Power purchase agreement

PSU	Public sector undertakings
PV	Photovoltaic
R&D	Research and Development
RE	Renewable Energy
REIL	Rajasthan Electronics & Instruments Limited
RESCO	Renewable Energy Service Company
RTC	Round-the-clock
RTPV	Rooftop Solar Photovoltaic
RTS	Rooftop Solar
SECI	Solar Energy Corporation of India Limited
SERC	State Electricity Regulatory Commission
SPV	Special Purpose Vehicle
UT	Union Territory
WHO	World Health Organization

Executive summary

This report has identified over 600 'shovel-ready' low carbon investment opportunities in the pipeline with tremendous potential for post-pandemic economic recovery and job creation in India. An assessment of what is at stake in terms of the economic development, capital mobilisation, self-reliance, jobs and environment is also presented for the first time in each of the critical thematic areas of low carbon infrastructure. Further, the stimulus measures summarised in this report can help advance the low carbon project pipeline and help frame the next leg of post-pandemic stimulus action.

Theme: Utility scale RE power generation

Stimulus action

- Clarity on waiver of inter-state transmission charges and losses on supply of solar and wind power beyond June 2023
- Set up a mechanism to rediscover tariffs for stranded projects without PPA
- Establish a robust coordination mechanism between Central off-takers and State governments toward firming up long term power procurement plans
- Expand the domestic lending base for hybrid RE power projects in pipeline
- Promote electrification of end use to boost demand growth

Project pipeline and impact

- 332 projects
- 84 GW of pipeline capacity
- INR 1.27 lakh crore equity
- INR 2.97 lakh crore debt
- 8.7 lakh fresh jobs
- 4,109 MT avoided CO_2 emissions

Theme: Rooftop Solar PV deployment in residential, C&I sectors

Stimulus action

- Boost demand for rooftop solar deployment in the institutional sectors, especially rural health centres and schools
- Promote net metering in all categories of consumers up to 1 MW of sanctioned load
- Promote third party owned business models for accelerated RTPV capacity addition in the domestic category
- Set up contactless digital platforms for reducing transaction costs and enhancing consumer experience of ease of doing rooftop solar

Project pipeline and impact

- 166 projects
- 18 GW of pipeline capacity
- INR 24 thousand crore equity
- INR 56 thousand crore debt
- INR 5,839 crores capital subsidy
- 4.37 lakh fresh jobs
- 622 MT avoided CO_2 emissions

Executive summary

Theme: Decentralized RE power generation (PM-KUSUM)

Stimulus action

- Generation based incentives for decentralized grid connected solar PV systems co-located with crops on agriculturally productive land parcels
- Dedicated financing facility for improving farmer access to low cost debt funds and boosting commercial viability of 1-2 MW scale ground mounted Solar PV projects on CAPEX mode

Project pipeline and impact

- 44 projects
- 14.5 GW of pipeline capacity
- INR 13 thousand crore equity
- INR 29 thousand crore debt
- INR 7,050 crore capital subsidy
- 1.25 lakh fresh jobs
- 550 MT avoided CO_2 emissions

Theme: Original RE equipment manufacturing

Stimulus action

- Boost demand for high efficiency solar PV modules and Advanced Chemistry Cells (ACC) battery solutions
- Formulate and target new PLI schemes toward coal dependent states

Project pipeline and impact

- 12 projects
- INR 15 thousand crore equity
- INR 34 thousand crore debt
- 40,000 fresh jobs

Theme: EV Charging Infrastructure

Stimulus action

- National / state level policy frameworks to promote and incentivise electric utility investment in EV charging infrastructure
- Restructure markets to create alternate revenue streams for EV charge point operators and investors

Project pipeline and impact

- 4,180 stations
- INR 107 crore equity
- INR 248 crore debt
- INR 834 crore subsidy
- 13,263 fresh jobs

Content

Objectives and methodology

1

Objectives and methodology

EY is collaborating with the industry to inform the assessment of post COVID economic recovery plans by prioritizing 'shovel-ready' low carbon investment opportunities in the pipeline. These investment opportunities help achieve the right balance between economic recovery and climate neutrality goals in the post COVID stimulus action by Government of India. The principal objectives of this collaboration are as follows:

- Identify 'shovel ready' low carbon investment opportunities under development - 'project pipeline'
- Assess what is at stake in terms of impact on economic recovery and development, jobs and environment
- Build consensus on stimulus action to prioritize green investment opportunities in the post-COVID economic recovery plans

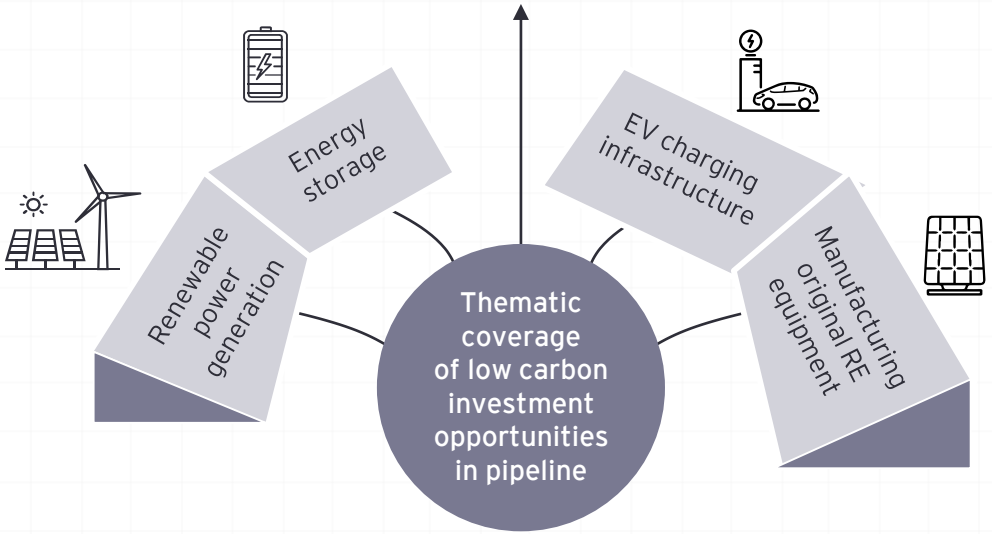
EY and FICCI teams have identified over 600 'shovel-ready' low carbon investment opportunities in the pipeline with tremendous potential for economic recovery, jobs and ultimately contributing toward India's long-term climate objectives. Project level information was gathered from primary and desktop research tools including online surveys and stakeholder consultations / interviews with project developers, OEMs, investors etc. Proprietary databases were also leveraged to identify the long list of infrastructure projects in the pipeline.

The "shovel-ready" projects identified have the desired potential to create social, environmental and economic value in the immediate future. As the purpose of the report is to uncover a pipeline of ready-to-invest projects, we have focused on projects that are expecting financial close in the short term.

Limitations

The project pipeline identified in this report represents just a fraction of the overall low carbon infrastructure investment under development in India. The project pipeline was put together from our assessment of the status of their development until February 2021. These projects illustrate the huge potential that exists across India to underpin a green and resilient recovery from the COVID-19 economic crisis. This is only a fraction of all projects with climate benefits under development in India at various levels of maturity. It is important to note that the project pipeline identified in this report is illustrative and should not be read as a full policy/commercial endorsement.

~ 660 low carbon infrastructure projects in the pipeline



Sources: EY's own tracking of RE auctions from central and state agencies, projects emerging from Government schemes promoting clean energy transition; National Infrastructure Pipeline hosted by Invest India; Other proprietary databases

Setting the context for low carbon stimulus action

2

A balanced stimulus is imperative to strengthen the economic fabric ahead of future climate-related shocks

Returning to "business as usual" will not deliver a sustained long-term economic recovery

With massive stimulus packages unveiled around the world, governments, businesses and societies as a whole have both a responsibility and self-interest to not only look for near-term measures to shore-up livelihoods and employment, but also to take a step back and reflect on the political and economic driving forces leading to the current crisis.

G20 countries committed to supporting environmentally sustainable recovery from COVID-19 induced economic contractions

In April 2020, G20 countries including India committed for environmentally sustainable recovery measures. Now, they must seize this opportunity to walk the talk. Encouragingly, an international poll revealed that a majority of citizens seek increased focus on environmental issues as a continued priority as we emerge from the COVID-19 crisis (IPSOS MORI, 2020). 81% of Indian respondents agreed that government actions should prioritize climate change in the economic recovery post COVID-19.

Low-carbon stimulus can spur economic recovery and job creation

Faced with the COVID-19 recession, governments do not have to compromise economic priorities for the sake of environmental ones. By carefully designing low-carbon stimulus packages, they can address both sets of priorities at once. For example, government spending on renewable energy and energy efficiency has been proven to create more jobs than spending on fossil fuels, which are increasingly becoming less competitive in major markets.

Stimulating low carbon economic recovery can boost India's self reliance in various sectors of the economy

India has pioneered the development of many low carbon technologies and solutions. Accelerating clean energy transition can boost energy security and make India self-reliant in the energy and transportation sectors while creating millions of new jobs. Stimulus measures focusing on a just transition can help the traditional fossil fuel industry minimize disruption to their workers and quickly adapt to emerging markets. Solar powered livelihood solutions are already driving self reliance in many segments of the rural economy.

The 'Assessment of Climate Change over the Indian region', a report from the Ministry of Earth Sciences, Government of India, has projected an alarming picture of the rise in average surface temperature, Indian ocean warming, changes in rainfall, droughts, sea level rise, tropical cyclones and changes in the mighty Himalayas by the end of this century. These climate change projections are based on a warming scenario called RCP8.5, which is most likely the worst case scenario in a business as usual sense. The policymakers should be mindful that climate change risks pose a much bigger threat to India's economic development goals than the shocks induced by the current pandemic.

The current urgency to deal with the pandemic induced economic contractions contains a risk for 'lock-ins'. Stimulus spending should therefore embed climate proofing instruments for economic recovery such as clean energy transition, low carbon resilient infrastructure, climate smart agriculture etc. A well balanced stimulus is imperative to strengthen the economic fabric ahead of future climate-related shocks.

Creating a low-carbon stimulus program: EU Green Deal and lessons from other international experiences

As per the International Energy Agency (IEA), green stimulus programs implemented after the global financial crisis of 2008–09 provide useful lessons for the design of Post COVID stimulus efforts. Policy makers need to reflect on the urgency of the unemployment challenge of COVID-19, and leverage existing clean energy investment frameworks in an ambitious manner. Previous stimulus programs have demonstrated that more private investment can be leveraged with well-targeted and well-functioning policy frameworks, thus lowering the need for budgetary support.

Modular technologies that benefit from learning-by-doing proved to be more suitable targets for a short-term stimulus than large, complex engineering projects with lengthy project development times. However, infrastructure projects often face delays and can be held up by the deteriorating financial health of utilities. "Shovel-ready" projects, in this context, are proven to have powerful positive macroeconomic spill overs.

European Union Green Deal

The Union's ambition to become the first climate-neutral bloc in the world by 2050 is at the heart of the European Green Deal. In July 2020, as part of the COVID recovery efforts, European governments approved more than €500 billion stimulus toward climate action.

Reflecting on the importance of tackling climate change in line with Union's commitments to implementing the Paris Agreement and the United Nations Sustainable Development Goals, the bloc leaders reached a consensus that at least 30% of the recovery expenditure must support climate objectives. An effective methodology for monitoring climate-spending and its performance, including reporting and relevant measures in case of insufficient progress, will ensure that the package as a whole contributes to the implementation of the Paris Agreement. In order to address the social and economic consequences of reaching climate neutrality by 2050 and the Union's new 2030 climate target, a Just Transition Mechanism, including a Just Transition Fund, will be created. The allocation for the Just Transition Fund for the period 2021–2027 is €7.5 billion.

The projects financed under the European Green Deal Investment Plan will contribute to the emergence of new, clean energy and circular economy industries and they will create high quality jobs for a competitive European economy fit for the 21st century.

The funds and programmes contributing to the European Green Deal Investment Plan (such as InvestEU or the Just Transition Fund) will provide tailored financing to a wide range of projects. Both small projects (e.g. individual household energy renovation) and larger ones (e.g. installation of a network of electric vehicle charging stations) will be able to benefit through dedicated programs and products. The investment support will be adjusted to the level of risk that specific projects carry. Some examples of such projects include modernizing district heating services in Budapest, supporting the installation of solar panels on private homes and making industrial companies more energy efficient in Lithuania, or modernizing the electricity and heat supply in Zagreb.

The Just Transition Mechanism will focus on the social and economic costs of the transition in the most impacted regions and finance projects ranging from creation of new workplaces through support to companies, job search and re-skilling assistance for jobseekers who lost employment due to the transition, but also renovation of buildings and investments in renewable energy, district heating networks and sustainable transport.

Source: European Commission

Lessons for India

Policy makers need to reflect on the urgency of the challenges posed by COVID-19 and leverage on the existing clean energy programs for quick economic recovery.

Labour intensive 'shovel ready' low carbon infrastructure projects having strong interactions with the hard-hit construction industry must be at the focus of the post COVID green stimulus efforts.

Pipeline of utility scale renewable power generation projects

3

Utility scale renewable power generation projects ready for implementation

Introduction

India's renewable energy (RE) based grid interactive power generation capacity has increased over 5 times since 2010 taking the cumulative installed capacity to ~92.97 GWp (as of February 2021). Wind and solar PV constitute 38.78 GWp and 39.06 GWp of the installed power generation capacity respectively in the current scenario. Together they dominate the overall RE based power generation capacity mix with over 80% contribution. The IEA in its latest renewables market update (2020) forecasts India to be the largest contributor to the renewables upswing in 2021, with the country's annual additions almost doubling from 2020.

Shovel ready projects for implementation

There are over 300 utility scale RE based power generation projects in the pipeline led by both public and private sector. These projects include solar PV, wind, biomass and hybrid RE projects under different stages of development. Together these projects constitute ~84 GW of contracted capacity in pipeline.

India is witnessing a gradual transition from plain vanilla solar PV and wind power auctions toward hybrid RE auctions by blending solar PV, wind, biomass, storage and stranded thermal power generation assets. Round-the-clock (RTC) supply of hybrid renewable power is increasingly adopted in RE auctions to help Distribution Companies (DISCOMs) / bulk buyers manage the intermittency / variability otherwise associated with plain vanilla Solar PV or wind power projects. RE auctions designed for RTC renewable power supply mandate a minimum capacity utilization factor of 80% for the contracted capacity without any obligation to purchase surplus power.

Contracted capacity of utility scale RE projects in pipeline (MW)

RE Technology	Project announcement year				Total (MW)
	2018	2019	2020	2021	
Biopower	-	39	141	-	**180**
Floating Solar PV	150	262	119	600	**1,131**
Hybrid *(Solar-Biomass)*	–	54	-	–	**54**
Hybrid *(solar-storage)*	–	-	180	–	**180**
Hybrid *(Solar-Wind)*	–	1,880	2,755	–	**4,635**
Hybrid *(solar-wind-coal-storage)*	–	–	5,000	–	**5,000**
Hybrid *(solar-wind-storage)*	–	–	1,600	–	**1,600**
Solar PV	3,900	8,978	43,955	6,175	**63,008**
Wind	3,010	2,248	3,363	-	**8,621**
Grand Total	**7,060**	**13,461**	**57,112**	**6,775**	**84,408**

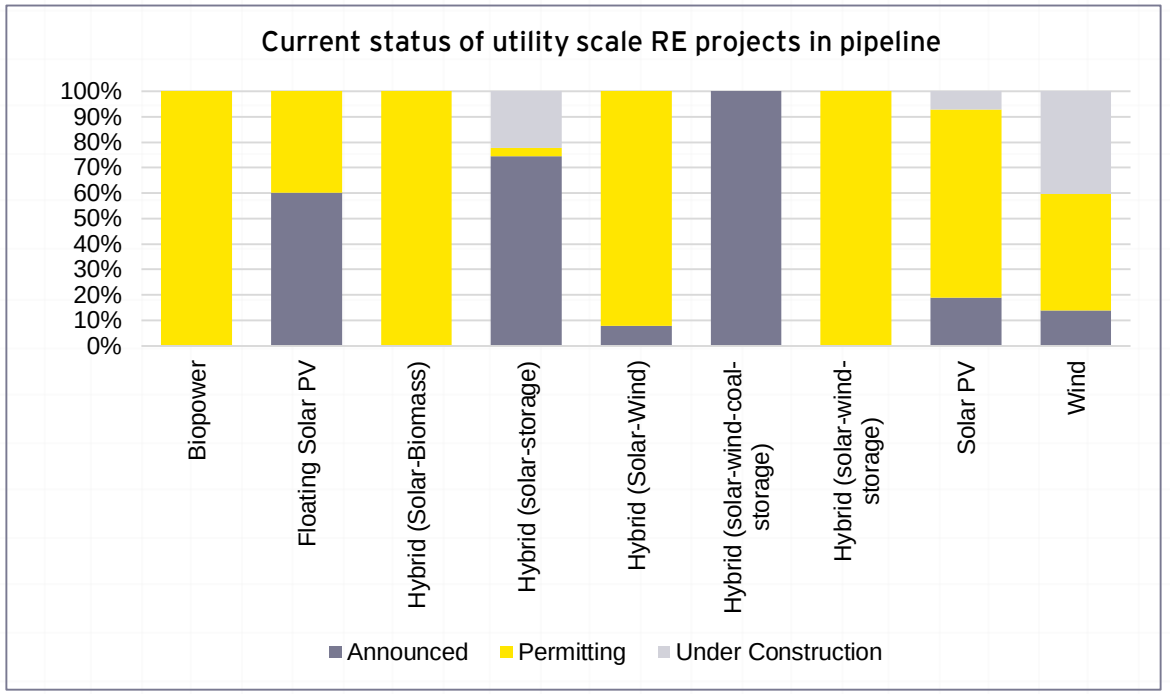
*Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI Auctions

The total installed capacity comprising of individual plain vanilla RE sources (viz. solar, wind etc.) in a typical RTC hybrid renewable power project is multiple times (4–5) higher than the contracted capacity. Take for example, the auction results announced last year for RTC supply of 400 MW hybrid renewable power (RTC-I) by blending solar PV, wind and energy storage. We estimate the total installed capacity of solar PV modules and wind turbine generators together under this project could be ~4 times the contracted capacity (i.e. 400 MW AC). Another similar auction is under progress for supply of 5,000 MW of RTC power from grid-connected renewable energy sources blended with coal based thermal power projects (RTC-II). This auction may also witness installed capacity of individual RE sources in the range of 4–5 times the contracted capacity. Blending in hybrid renewable power projects is allowed either in front of the meter (delivery / interconnection point) or behind the meter. Behind the meter blending is akin to co-located systems where hybridization of power shall be done prior to or at the delivery point. Whereas, in front of the meter blending may involve multiple injection points in the grid for different sources / components of generation located anywhere in the country.

Contracted capacity of utility scale RE projects in pipeline (MW)

RE Technology	Project pipeline status*			Total (MW)
	Announced	Permitting	Under Construction	
Biopower	-	180	-	180
Floating Solar PV	680	451	-	1,131
Hybrid *(Solar-Biomass)*	-	54	-	54
Hybrid *(solar-storage)*	134	6	40	180
Hybrid *(Solar-Wind)*	360	4,275	-	4,635
Hybrid *(solar-wind-coal-storage)*	5,000	-	-	5,000
Hybrid *(solar-wind-storage)*	-	1,600	-	1,600
Solar PV	11,850	46,648	4,510	63,008
Wind	1,200	3,932	3,489	8,621
Grand Total	**19,224**	**57,145**	**8,039**	**84,408**

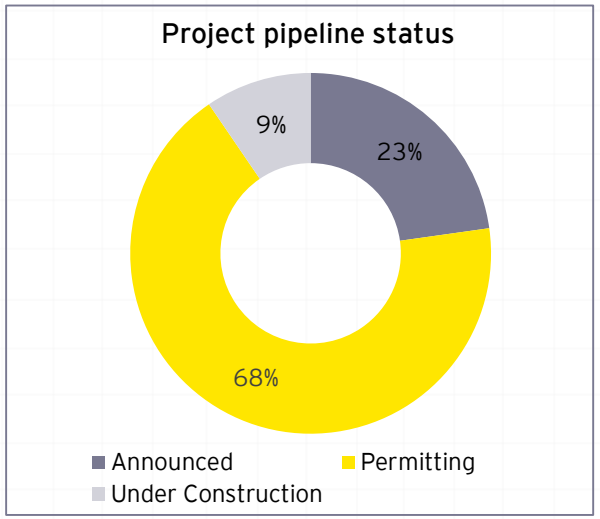
Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI



Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI

Overall, ~68% of the contracted capacity is under permitting stage, meaning that these projects have successfully completed auctions / competitive discovery of tariffs and under various stages of signing power purchase agreement (PPA), power sale agreement (PSA), tariff adoption and power procurement approvals from regulators, financial closure, land acquisition and permission for grid interconnection. About ~23% of the project capacity is under 'announced' stage, meaning that these projects still need to discover tariffs competitively and select project developer. Only ~9% of the project capacity is 'under construction' meaning that these projects have completed plant material order and started plant erection. These under construction projects account for ~40% of wind project capacity in pipeline and less than 5% of plain vanilla solar power project capacity in pipeline.

In 2021, India is likely to add ~4.8 GW of solar PV power capacity (installed) and ~3.2 GW of wind power capacity largely driven by auctions held in the years 2018–19. Whereas in 2022, India is likely to add ~7.5 GW of solar PV power capacity (installed) and ~1.6 GW of wind power capacity largely driven by auctions held in the years 2018–20. The project pipeline that is likely to get commissioned beyond 2022 has a disproportionately large capacity (installed) of solar PV in the range of ~77 GW and wind power capacity of ~6.8 GW in comparison.



Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI

Solar PV power capacity (installed) in pipeline MW (AC)						
RE Technology	Project commissioning (estimated)					Total (MW)
	H1 2021	H2 2021	H1 2022	H2 2022	Beyond 2022	
Floating Solar PV	-	-	-	427	704	1,131
Hybrid *(Solar-Biomass)*	-	-	-	48		48
Hybrid *(solar-storage)*	-	-	-	40	140	180
Hybrid *(Solar-Wind)*	-	-	125	-	2,175	2,300
Hybrid *(solar-wind-coal-storage)*	-	-	-	-	20,000	20,000
Hybrid *(solar-wind-storage)*	-	-	-	-	2,200	2,200
Ground mounted Solar PV	3,300	1,540	4,186	2,716	51,266	63,008
Total	**3,300**	**1,540**	**4,311**	**3,231**	**76,484**	**88,866**

Wind power capacity (installed) in pipeline MW (AC)						
RE Technology	Project commissioning (estimated)					Total (MW)
	H1 2021	H2 2021	H1 2022	H2 2022	Beyond 2022	
Hybrid *(Solar-Wind)*	-	-	100	-	2,235	**2,335**
Hybrid *(solar-wind-storage)*	-	-	-	-	600	**600**
Wind	2,915	250	1,499	-	3,957	**8,621**
Total	**2,915**	**250**	**1,599**	**-**	**6,792**	**11,556**

Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI

For the first time, 2020 witnessed auctions led by SECI for competitive discovery of tariffs for 1,200 MW peak power supply and 400 MW of RTC supply of hybrid renewable electricity integrated with energy storage. Another 5,000 MW auction for RTC supply of hybrid renewable electricity is on the block. Apart from this, several other auctions are announced / conducted for solar-storage hybrids in remote locations, union territories and islands. Most of the energy storage capacity from these hybrid RE power projects are expected to commission beyond 2022.

Energy storage capacity in pipeline MWh (AC)						
RE Technology	Project commissioning (estimated)					Total (MWh)
	H1 2021	H2 2021	H1 2022	H2 2022	Beyond 2022	
Hybrid *(solar-storage)*	-	-	-	120	225	**345**
Hybrid *(solar-wind-storage)*	-	-	-	-	6,700	**6,700**
Hybrid *(solar-wind-coal-storage)*	-	-	-	-	25,000	**25,000**
Total	**-**	**-**	**-**	**120**	**31,925**	**32,045**

Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI

Utility Scale RE Project Pipeline with Energy Storage Capacity

Project name or scheme (Auction / Tender)	Year of announcement	Project capacity contracted (MW AC)	Project capacity (Installed) ESS (MWh AC)	Project Location
1,200 MW Peak power supply	2020	900	3,500	Pan India
1,200 MW Peak power supply	2020	300	1,200	Pan India
400 MW Hybrid RTC-I	2020	400	2,000	Pan India
5,000 MW Hybrid RTC-II	2020	5,000	25,000	Pan India
100 MW Solar, 150 MWh BESS	2020	100	150	Chhattisgarh
14 MW Solar, 42 MWh BESS	2020	14	21	Leh and Kargil
20 MW Solar, 50 MWh BESS	2020	20	50	Leh
4 MW Floating Solar, 2 MW BESS	2020	4	2	Andaman
Lakshadweep Solar PV Park	2020	1.95	2.15	Lakshadweep
Rajnandgaon Solar PV Park	2020	40	120	Chhattisgarh

Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI

Utility Scale RE Project Pipeline with Energy Storage Capacity

Project name or scheme (Auction / Tender)	Project promoter type (Private/Public/TBD*)	Project status	PPA tariff (INR/kWh)
1,200 MW Peak power supply	Private	Permitting	6.12
1,200 MW Peak power supply	Private	Permitting	6.85
400 MW Hybrid RTC-I	Private	Permitting	3.6
5,000 MW Hybrid RTC-II	TBD	Announced	TBD
100 MW Solar, 150 MWh BESS	TBD	Announced	TBD
14 MW Solar, 42 MWh BESS	TBD	Announced	TBD
20 MW Solar, 50 MWh BESS	TBD	Announced	TBD
4 MW Floating Solar, 2 MW BESS	Private	Permitting	Not reported
Lakshadweep Solar PV Park	Private	Permitting	Not reported
Rajnandgaon Solar PV Park	Public	Under Construction	Not reported

Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI

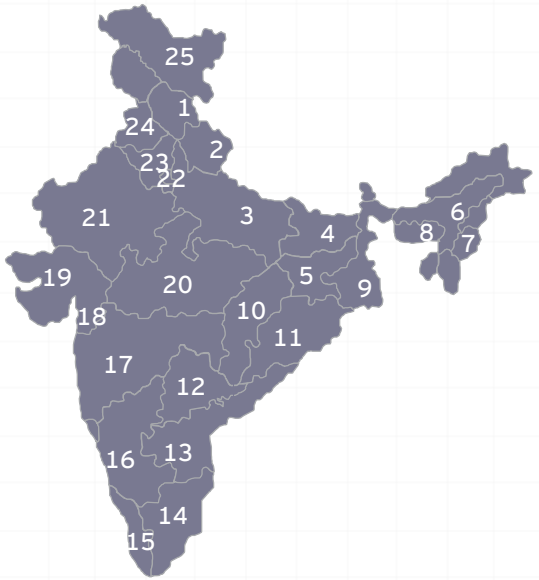
*To Be Determined meaning these projects are yet to complete competitive discovery of tariffs and select project developer

A significant majority of biopower capacity in pipeline is expected from waste to energy projects planned in 2019-20 for sustainable solid waste management in cities. About ~131 MW of contracted capacity is expected to commission beyond 2022 and a small capacity of ~55 MW is expected in 2022. A majority of waste to energy projects are promoted by public sector enterprises, mostly municipal corporations in major cities of New Delhi, Bengaluru, Ghaziabad, Surat, Ahmedabad, Mumbai, Jalandhar etc.

Biopower capacity (installed) in pipeline MW (AC)						
RE Technology	Project commissioning (estimated)					Total (MW)
	H1 2021	H2 2021	H1 2022	H2 2022	Beyond 2022	
Biopower	-	-	15	40	125	**180**
Hybrid *(Solar-Biomass)*	-	-	-	-	6	**6**
Total	**-**	**-**	**15**	**40**	**131**	**186**

Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI

Rajasthan, Andhra Pradesh, Leh, Gujarat, Karnataka, Maharashtra, and Madhya Pradesh are the top locations emerging for maximum RE power generation projects in pipeline (see graphic). About ~34% of the contracted capacity in pipeline and poised for connecting to the inter state transmission network (ISTS) will finalize its location anywhere in India in due course of project development.



1. Himachal Pradesh (265) (0) (0)
2. Uttarakhand (40) (0) (0)
3. Uttar Pradesh (889) (0) (0)
4. Bihar (8) (0) (0)
5. Jharkhand (173) (0) (0)
6. Assam (197) (0) (0)
7. Manipur (100) (0) (0)
8. Meghalaya (20) (0) (0)
9. West Bengal (421) (0) (0)
10. Chhattisgarh (202) (0) (150)
11. Odisha (501) (0) (0)
12. Telangana (240) (0) (0)
13. Andhra Pradesh (9353) (250) (0)
14. Tamil Nadu (173) (526) (0)
15. Kerala (290) (72) (0)
16. Karnataka, 14. Tamil Nadu (225) (225) (0)
16. Karnataka (2712) (1982) (0)
17. Maharashtra (3772) (424) (0)
18. Dadra & Nagar Haveli (3) (0) (0)
19. Gujarat (2963) (4273) (0)
20. Madhya Pradesh (2753) (452) (0)
21. Rajasthan (13440) (473) (0)
22. Delhi (3) (0) (0)
23. Haryana (133) (0) (0)
24. Punjab (98) (0) (0)
25. Ladakh (7534) (0) (71)
26. Lakshadweep (2) (0) (2)
27. Andaman & Nicobar Islands (8) (0) (2)

Pan India project capacity in pipeline whose locations are yet to be determined

41602 | 2880 | 31700

* Decimal values are rounded up

Source: EY analysis

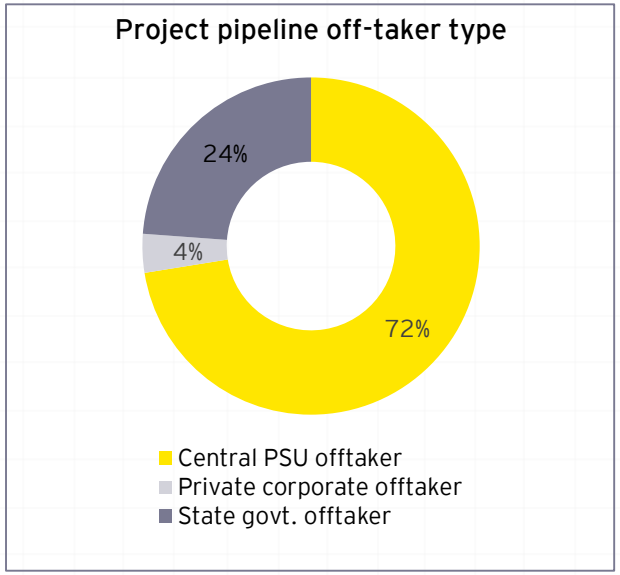
How to read the chart?
(Positional number) (Name of State)
(Solar Cap) (Wind Cap) (ESS Cap)

Legends
- Installed Solar Capacity (MW Ac)
- Installed Wind Capacity (MW Ac)
- Installed Energy Storage System (ESS) (MWh Ac)

Project location for ISTS connected projects are typically optimized for grid connectivity and availability of land in a solar / wind resource abundant region. In this regard, several RE auctions led by SECI for plain vanilla solar and wind power projects identified Rajasthan, Gujarat and most recently Ladakh as preferred locations. Furthermore, a few states such as Gujarat, Andhra Pradesh, Maharashtra and Madhya Pradesh have proactively auctioned projects led by state owned enterprises for meeting the growing power demand.

Projects with central public sector undertakings (PSU) off-takers (viz. SECI, NTPC, NHPC, Indian Railways etc.) account for 72% of the overall contracted capacity in pipeline, followed by projects with state off-takers (24%) and projects focusing on corporate renewable procurement (4%).

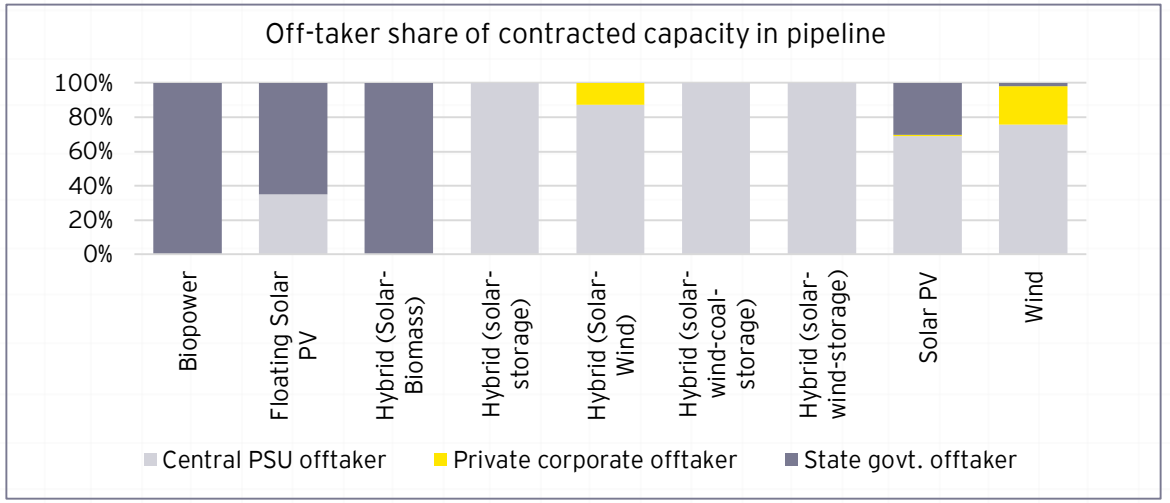
Wind power project pipeline has the highest share of private / corporate off-takers followed by solar-wind hybrid project pipeline. Whereas biopower, floating solar and hybrid (solar-biomass) project pipeline is largely driven by state govt. off-takers. Plain vanilla Solar PV, Wind and Hybrid RE project pipeline is largely driven by central PSU off-takers.



Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI auctions

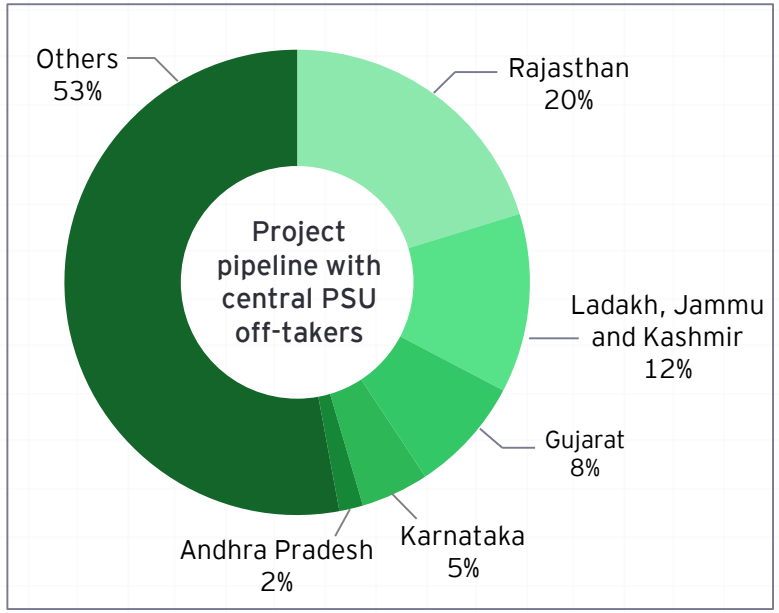
Contracted capacity of utility scale RE projects in pipeline (MW)				
RE Technology	Project pipeline off-taker type			Total (MW)
	Central PSUs	Private / Corporate	State owned enterprises	
Biopower	-	–	180	180
Floating Solar PV	397	–	734	1,131
Hybrid *(Solar-Biomass)*	-	–	54	54
Hybrid *(solar-storage)*	180	–	–	180
Hybrid *(Solar-Wind)*	4,050	585	–	4,635
Hybrid *(solar-wind-coal-storage)*	5,000	–	–	5,000
Hybrid *(solar-wind-storage)*	1,600	–	–	1,600
Solar PV	43,411	621	18,976	63,008
Wind	6,522	1,925	175	8,621
Grand Total	**61,159**	**3,132**	**20,117**	**84,408**

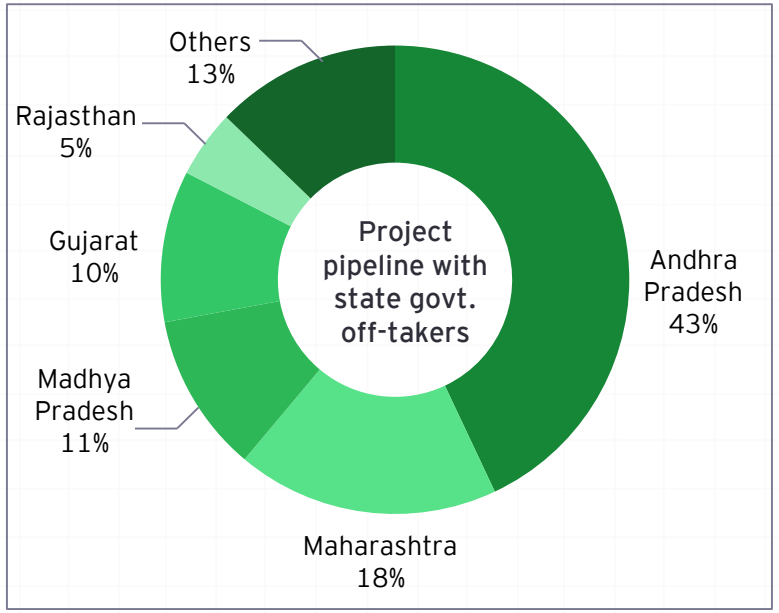
Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI

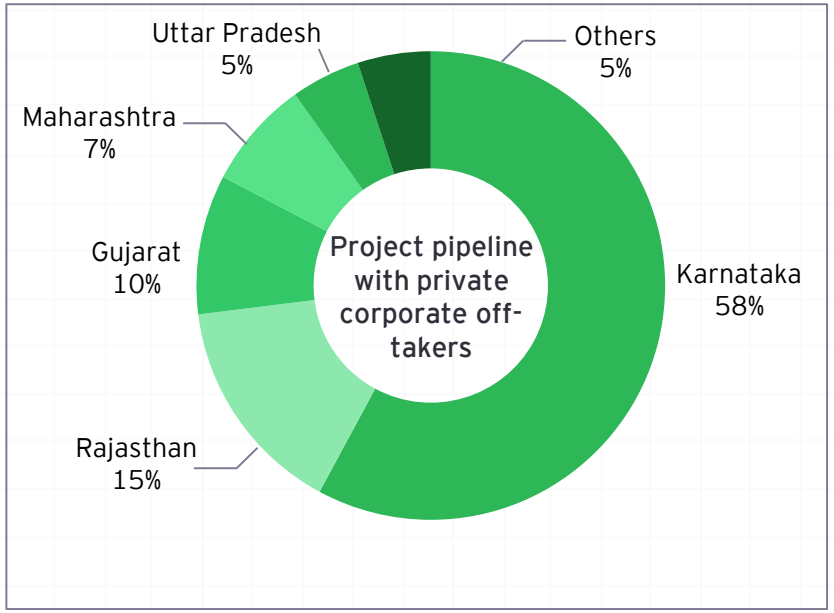


Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI

Among those projects in pipeline with central PSU off-takers, Rajasthan, Ladakh, Gujarat and Karnataka are emerging as top locations for the project developers. Whereas among those projects in pipeline with state govt. off-takers, Andhra Pradesh, Maharashtra, Madhya Pradesh, Gujarat and Rajasthan are emerging as top locations for the developers. Further among those projects in pipeline with private / corporate off-takers, Karnataka is emerging as the top location.

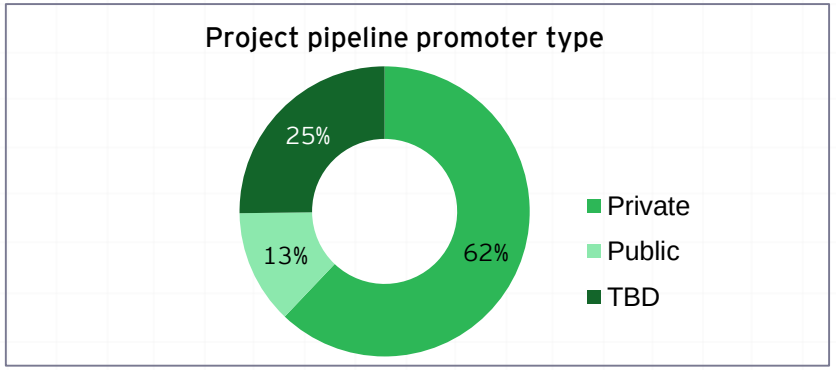






*Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI

Among those utility scale RE projects in pipeline, ~62% of the contracted capacity is led by private sector investments. These projects can be characterized as captive units for self-consumption or as Independent Power Producers (IPPs) governed by PPAs with the off-takers. Project pipeline representing ~25% of the contracted capacity is yet to select project promoters by way of reverse auctions for competitive tariff discovery. Whereas, project pipeline representing ~13% of the contracted capacity is being developed by PSUs for captive generation or having to enter into PPAs with the off-takers.

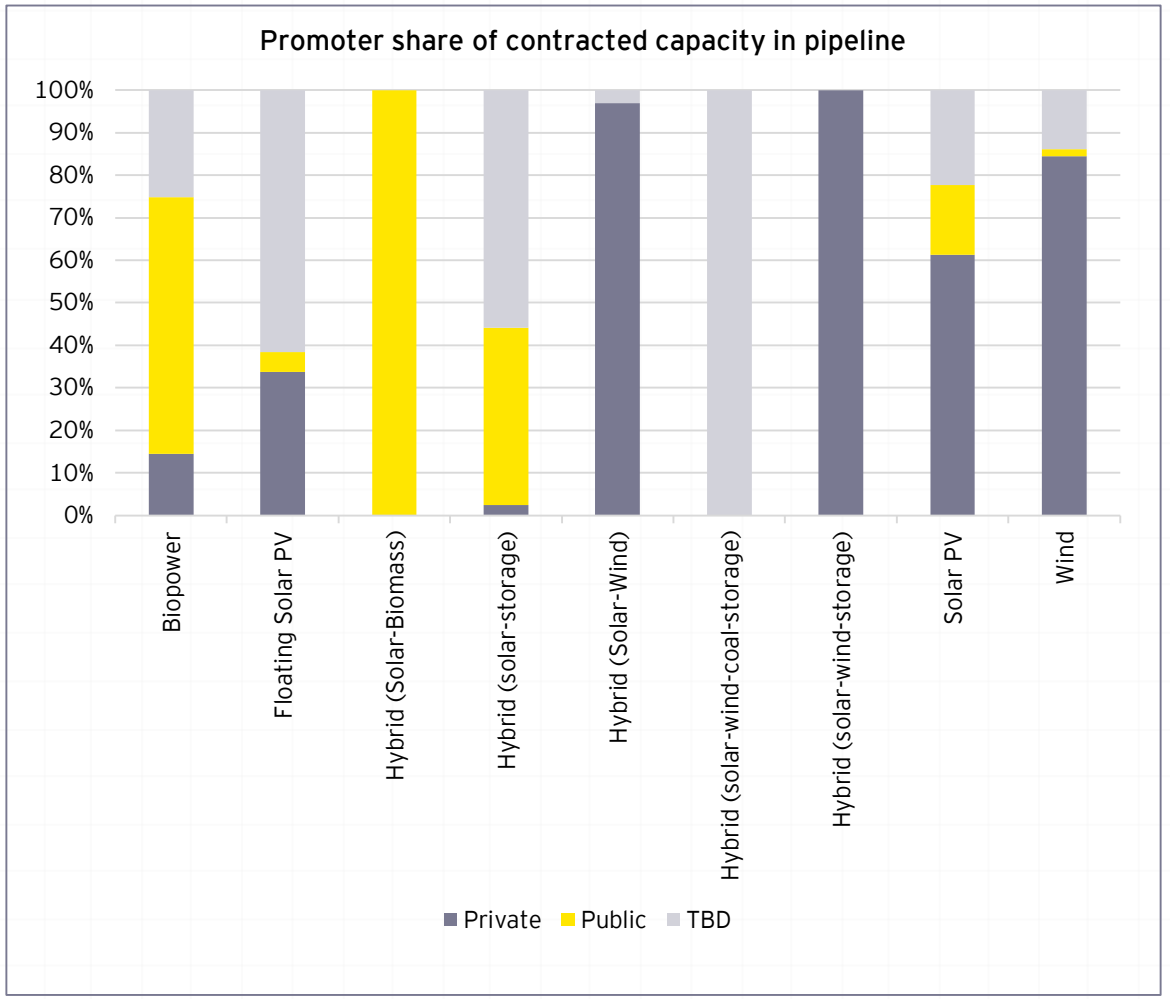


Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI

Contracted capacity of utility scale RE projects in pipeline (MW)				
RE Technology	Promoter type leading the project pipeline			Total (MW)
	Private	Public	TBD*	
Biopower	26	109	45	180
Floating Solar PV	382	52	697	1,131
Hybrid *(Solar-Biomass)*	-	54	-	54
Hybrid *(solar-storage)*	6	40	134	180
Hybrid *(Solar-Wind)*	4,495	-	140	4,635
Hybrid *(solar-wind-coal-storage)*	-	-	5,000	5,000
Hybrid *(solar-wind-storage)*	1,600	-	-	1,600
Solar PV	38,614	10,343	14,051	63,008
Wind	7,283	139	1,200	8,621
Grand Total	**52,406**	**10,736**	**21,267**	**84,408**

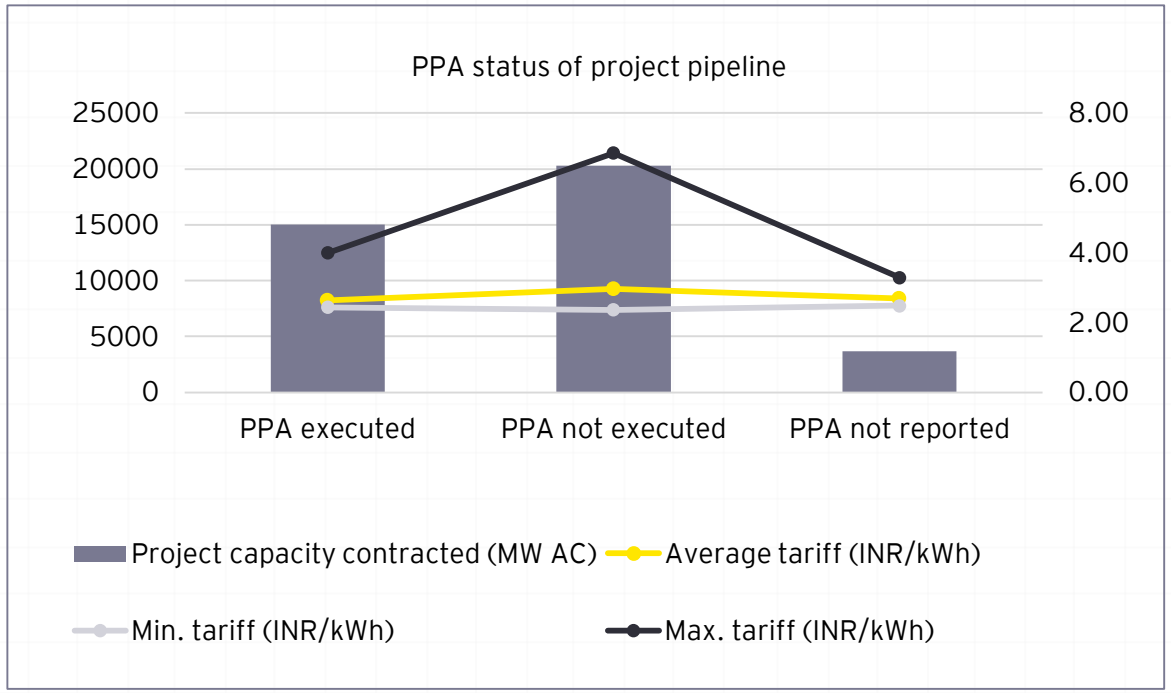
Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI

*To Be Determined meaning these projects are yet to complete competitive discovery of tariffs and select project developer



Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI
To be Determined meaning these projects are yet to complete competitive discovery of tariffs and select project developer

Authorities / off-takers after issuing Letter of Award (LOA) have executed PPAs for projects with ~15 GW of contracted capacity in pipeline. These projects have successfully managed to find buyers for the tariff discovered through auctions. Only plain vanilla solar PV, wind and a few hybrid (solar-wind) projects have managed to advance beyond the LOA stage. Approx. ~20 GW of contracted capacity from auctions held in the years 2018, 2019 and first half of 2020 still remain stranded without PPAs. This does not include projects which are yet to complete auctions/ tariff discovery. Notably, ~18 GW of this stranded capacity pertains to plain vanilla solar PV projects auctioned largely in first half of 2020, out of which ~12 GW capacity pertains to manufacturing linked Solar PV projects announced in January 2020.



Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI

PPA status / Year of auction	Contracted capacity of Utility scale RE projects in pipeline (MW)					Grand Total (MW)
	Floating Solar PV	Hybrid (Solar-Wind)	Hybrid (Solar-wind-storage)	Solar PV	Wind	
Executed	-	1,065	-	8,800	5,129	14,994
2018	-	-	-	3,400	3,010	6,410
2019	-	840	-	2,980	2,119	5,939
2020	-	225	-	2,420	-	2,645
Not executed	-	970	1,600	17,704	-	20,274
2018	-	-	-	500	-	500
2019	-	-	-	600	-	600
2020	-	970	1,600	16,604	-	19,174
Not reported*	150	-	-	3,536	-	3,686
2018	150	-	-	-	-	150
2019	-	-	-	3,536	-	3,536

PPA status	Average PPA tariff of RE projects in pipeline (INR / kWh)					Average (INR / kWh)
	Floating Solar PV	Hybrid (Solar-Wind)	Hybrid (Solar-wind-storage)	Solar PV	Wind	
Executed	-	2.65	-	2.61	2.69	**2.64**
Not executed	-	3.00	5.52	2.66	-	**2.96**
Not reported	3.29	-	-	2.49	-	**2.69**

*Not reported refers to project information not available in public domain
Project pipeline which have not received LOA are not included in this assessment
Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI

Investment mobilization

Utility scale RE power projects in pipeline would need INR ~4.25 lakh crores (US$ ~60 billion, 1 INR = 0.014 US$) of capital infusion for operationalization. This translates into INR 1.27 lakh crores (US$ ~18 billion) of equity infusion and INR 2.97 lakh crores (US$ ~42 billion) of debt infusion at 30:70 ratio. Much of this capital infusion is expected from the private sector increasingly backed by private equity investors, sovereign wealth funds and other specialized institutional investors.

Capital Investment - Equity

~INR 1,27,399 crores

For 84 GW of utility scale RE projects in pipeline

Capital Investment - Debt

~INR 2,97,264 crores

For 84 GW of utility scale RE projects in pipeline

Capital infusion for utility scale RE projects in pipeline (INR crores)

RE technology	Total CAPEX outlay	Equity mobilization	Debt financing
Biopower	3,216	965	2,251
Floating Solar PV	4,858	1,457	3,401
Hybrid *(Solar-Biomass)*	324	97	227
Hybrid *(solar-storage)*	1,148	344	803
Hybrid *(Solar-Wind)*	22,435	6,731	15,705
Hybrid *(solar-wind-coal-storage)*	1,07,500	32,250	75,250
Hybrid *(solar-wind-storage)*	20,750	6,225	14,525
Solar PV	2,21,291	66,387	1,54,904
Wind	43,142	12,943	30,199
Grand Total	**4,24,663**	**1,27,399**	**2,97,264**

Project commissioning (estimated)	Private sector mobilization (INR crores)		Public sector mobilization (INR crores)		TBD* (INR crores)	
	Equity	Debt	Equity	Debt	Equity	Debt
H1 2021	7,838	18,288	-	-	–	–
H1 2022	4,798	11,195	2,208	5,153	–	–
H2 2021	1,824	4,256	168	392	–	–
H2 2022	3,184	7,428	504	1,175	22	51
Beyond 2022	47,212	1,10,161	9,202	21,471	50,440	1,17,694
Grand Total	**64,855**	**1,51,328**	**12,082**	**28,191**	**50,462**	**1,17,745**

Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI

*TBD is To Be Determined meaning these projects are yet to complete competitive discovery of tariffs and select project developer

Employment potential

About ~ 8.7 lakh fresh jobs will be created for operationalizing the 84 GW pipeline of utility scale RE projects. About 10% of these jobs will emerge in 2021-22 and the remaining 90% beyond 2022. Further, a dominant portion of these jobs will emerge in the private sector from operationalizing solar PV and hybrid RE projects.

Fresh jobs created

~ 8,70,775 jobs

For 84 GW of utility scale RE projects in pipeline

Fresh jobs created from utility scale RE projects in pipeline

RE Technology	Estimated timeline for project commissioning					Total no. of fresh jobs created
	H1 2021	H2 2021	H1 2022	H2 2022	Beyond 2022	
Biopower	-	-	645	1,720	5,362	7,727
Floating Solar PV	-	-	-	3,870	6,376	10,246
Hybrid *(Solar-Biomass)*	-	-	-	693	-	693
Hybrid *(solar-storage)*	-	-	-	363	1,268	1,631
Hybrid *(Solar-Wind)*	-	-	1,629	-	30,807	32,436
Hybrid *(solar-wind-coal-storage)*	-	-	-	-	1,81,267	1,81,267
Hybrid *(solar-wind-storage)*	-	-	-	-	22,918	22,918
Solar PV	29,909	13,958	37,939	24,616	4,64,640	5,71,062
Wind	14,470	1,241	7,441	-	19,644	42,795
Total	**44,379**	**15,199**	**47,654**	**31,262**	**7,32,282**	**8,70,775**

*Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI

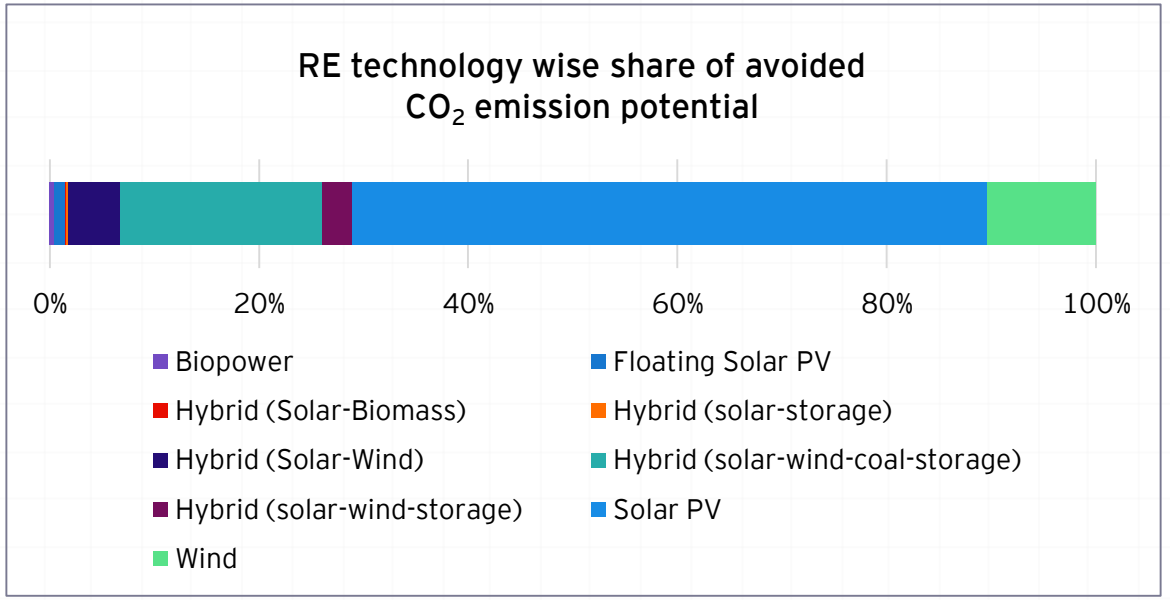
Environmental benefits

Over ~4,109 Million tonnes of CO2e emissions are expected to be avoided over the operating lifetime of 84 GW capacity of grid connected utility scale RE projects in pipeline.

Avoided CO_2 emissions
(cumulative over project lifetime)

~4,109 million tonnes CO_2e

For 84 GW of Utility scale RE projects in pipeline



*Source: EY analysis from CEA 2020, GlobalData, CEEW-CEF 2020, SECI

Stimulus action to fast track implementation of utility scale RE project pipeline

1 Clarity on waiver of inter-state transmission charges and losses on supply of solar and wind power beyond June 2023

The project pipeline for utility scale RE power generation indicates ~76 GW of solar, 7 GW of wind, 32 GWh of energy storage and 131 MW of biopower capacity expected to commission beyond 2022.

The Ministry of Power (MoP), Government of India vide its order dated 15 January 2021 has superseded earlier orders and waived inter-state transmission (ISTS) charges and losses on transmission of electricity generated from solar and wind projects till 30th June 2023. This waiver is applicable to solar, wind, hybrid power plants with or without storage for a period of 25 years from the date of commissioning subject to meeting the specified criteria.

Moreover, the CERC (Sharing of Inter-State Transmission Charges and Losses) Regulations, 2020 have come into force with effect from 1 November 2020. Under these regulations, the transmission charges for designated ISTS customers (DICs) shall have national, regional, transformer and AC System Components for full recovery. Further, the 'National Component - Renewable Energy' shall comprise of the yearly transmission charges for transmission systems developed for renewable energy projects as identified by the Central Transmission Utility. The yearly transmission charges for the national component shall be shared by all drawee DICs and injecting DICs with untied long-term access (LTA) in proportion to their quantum of long-term access plus medium-term open access and untied LTA respectively.

The CERC (Sharing of Inter-State Transmission Charges and Losses) Regulations, 2020 have rendered the 'waiver of ISTS charges and losses on solar and wind power' obscure and ineffective. This is because the states which plan to buy electricity in bulk from solar and wind projects via ISTS corridors would have to increase their quota of LTA with the central transmission utility. This incremental quota of LTA will attract more ISTS charges than usual for those buyers as per the regulations despite the waiver granted by the order of the ministry. In other words, the waiver granted by the ministry is by the order of the ministry. In other words, the waiver granted by the ministry is obscuring the real cost of power purchase from solar and wind projects transmitted via ISTS corridors.

In the current scenario, the RE resource rich states of western and southern India namely Gujarat, Rajasthan, Tamil Nadu, Andhra Pradesh, Karnataka, Madhya Pradesh and Maharashtra prefer to meet their growing demand for renewable electricity from projects located within the state boundary. Some experts may argue that the waiver of ISTS charges and losses on solar and wind power will help resource rich states transform into export hubs for renewable electricity in the country. However, the states importing low cost renewable electricity from resource rich states would have to account for the increased ISTS charges arising from the CERC regulations and therefore will be cautious in evaluating such options in their long term power procurement plans.

Stimulus action

Clarify whether the waiver of ISTS charges and losses on electricity generated from solar and wind projects will extend beyond 30 June 2023 and for how much period. There is a sense of growing uncertainty within the industry that is already grappling with challenges on several fronts to commission the projects as planned. The utility scale RE auctions planned in 2021–22 may not witness the same degree of competitiveness in tariff discovery if this clarity is not provided

2 Set up a mechanism to rediscover tariffs for stranded projects without PPA

Our analysis of the utility scale RE power project pipeline indicates that projects with ~20 GW of contracted capacity from auctions held in the years 2018, 2019 and first half of 2020 remain stranded without PPAs. Notably, ~18 GW of this stranded capacity pertains to plain vanilla solar PV projects auctioned largely in first half of 2020, out of which ~12 GW capacity pertains to manufacturing linked solar PV projects announced in January 2020. Average tariff discovered for all the stranded projects are 12% higher than those for which PPAs are executed. More importantly, the recent auction results announced for plain vanilla solar PV projects in Rajasthan and Gujarat have discovered record low tariffs (<= INR 2.0 / kWh). When compared against these record low tariffs, the average tariff discovered for stranded projects is a whopping 48% higher.

This is one of the most critical challenges, ironically, emerging from falling tariff prices. The state owned DISCOMs, who are the ultimate purchasers of power see the tariffs fall every month or so, and therefore are disincentivized to tie themselves up to long term contracts. This means that there are now a significant number of projects in the pipeline for which long term PPAs have either not been executed, or not become effective, hence stranded.

The central off-takers can explore a tariff rediscovery mechanism for stranded projects in consultation with the project promoters (having first right of refusal). This can turn around many stranded projects with better deals to the DISCOMs, already stressed with high power purchase cost. A national committee representing all stakeholders could devise a robust mechanism for rediscovering tariffs and prioritize these stranded projects in the power purchase plans of the states.

3 Establish a robust coordination mechanism between Central off-takers and State governments toward firming up long term power procurement plans

Utility scale power purchase in India adopts a competitive bidding process, where the tariff is discovered through an auction under Section 63 of the Indian Electricity Act, 2003. Since the tariffs are discovered through a notified process, there is no regulatory supervision of the tariff discovered per se. However, regulatory approval is required for the following:

- Approval of the bid process (procurement approval);
- Approval to the DISCOM to acquire a certain quantity of power (the capacity approval); and
- Approval of the trading margin between and central off-takers and the DISCOM. Usually the CERC has jurisdiction over the procurement approval and the trading margin approval whereas the State Electricity Regulatory Commission (SERC) has jurisdiction over the capacity approval.

The outcome of this structure has been that for hundreds of MW of projects for which LOAs have been awarded post completion of tenders and PPAs executed, either the PSA is not executed, or, even if the PSA has been executed, the capacity approval has been indefinitely delayed.

Even the trading margin which central off-takers have been charging, has been the source of endless dispute.

In the long term, a robust coordination mechanism between Central and State governments involving PSUs, DISCOMs and other stakeholders working toward firming up power procurement plans with regulatory approvals (ex-ante) for the planned RE projects would significantly ease the pressure of getting these projects through PPA and other regulatory approvals (ex-post) after tariff discovery through auctions. Various stakeholders need to come together and take this as a priority not just for environment but also for economic revival.

4 Expand the domestic lending base for hybrid RE power projects in pipeline

The Government of India in its recent budget for FY 20–21 announced capital augmentation of SECI and Indian Renewable Energy Development Agency Limited (IREDA) with equity infusion of INR 1,000 crores and INR 1,500 crores respectively. This is a commendable initiative and is welcomed by stakeholders at large.

Green banks and windows: A recent report from the Center for American Progress (CAP) and India's Council on Energy, Environment and Water (CEEW) has recommended that the Government of India should assess potential platforms to develop or deploy catalytic finance instruments within or alongside key existing public sector financial institutions. According to the report, such green window mechanisms would help expand clean energy markets within the purview of the specific financial institutions – for example, IREDA. The report also mentions that IREDA has signalled its interest in operationalizing a green window facility, to be capitalized by an initial US$20 million and to be augmented by another US$80 million from other agencies. The green window is geared toward catalytic financial interventions to crowd in private sector capital for underserved clean energy market segments.

Our recommendation is that IREDA and other domestic financial institutions should establish such Green windows specifically catering to high risk Hybrid RE power projects in the pipeline. These projects blend solar, wind, energy storage and stranded thermal power generation capacity for peak power supply or round the clock supply of renewable electricity.

5 Promote electrification of end use to boost demand growth

According to the Central Electricity Authority (CEA), installed capacity for power generation has grown at a Compound Annual Growth Rate (CAGR) of 6.7 % from FY 01 to FY 20. However the peak demand for the same period has grown at a CAGR of 4.4%. Rapid growth in infirm solar and wind power capacity addition and slower than anticipated demand growth are the primary contributors for the widening gap. The incidence of the COVID pandemic has further exacerbated the problem of slower demand growth in the present scenario.

There are ample opportunities for boosting electricity demand inorganically, meaning nudging specific end use applications to adopt fuel shift from fossil to electricity.

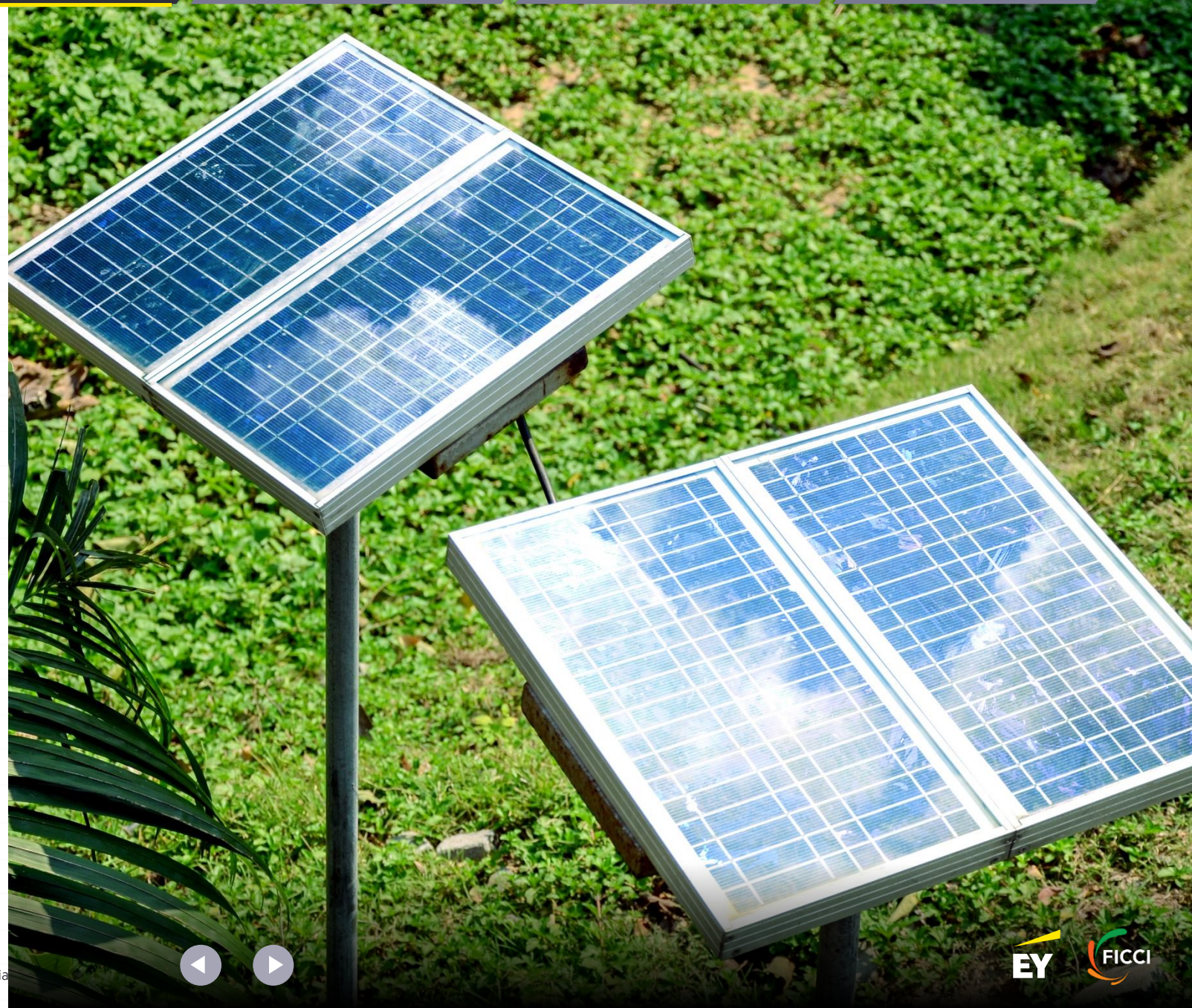
The power sector stakeholders stand to gain the most from the demand boost driven by electric mobility transition in passenger and commercial vehicle segments. Subsidies and incentives targeted for electric mobility transition will have higher economic value from bridging the demand supply gap in the power sector. Stranded project pipeline facing subdued demand will have greater opportunities to operationalise their assets planned.

McKinsey & Company estimates that almost half of the energy fuel commodities consumed in the industrial sector can be electrified with technology available today. Electrification of the fuel that industrial companies use for energy has several benefits. Although, electrically driven equipment is only slightly more energy efficient than the conventional options, it has lower operation (labour) and maintenance costs. With low carbon electricity supply, the greenhouse-gas emissions of the industrial site can lower significantly.

Up to a heat demand of approximately 400 degrees Celsius for industrial applications such as washing, rinsing, food preparation, drying, evaporation, distillation etc., electric alternatives to conventional equipment are commercially available. Electric heat pumps for low and medium temperature heat demand and electric powered mechanical vapor recompression equipment for evaporation are already used on some industrial sites.

The government should incentivise industries adopting these processes to gradually electrify their operations. The initial cost of electrification could be significantly higher for Micro, Small & Medium Enterprises (MSMEs) but with government support targeted for technologies demonstrating lower lifecycle costs, the resulting electricity demand growth could significantly bridge the demand supply gap in the power sector.

Similarly in the residential sector, government could target promoting induction cooktops over gas stoves in both urban and rural areas to propel electricity demand growth. This will not just enhance the revenue for electric utilities but also reduce the import dependency of petroleum products for LPG. The Saubhagya scheme launched by the central government in 2017 has already achieved much of its goals for expanding last mile connectivity for electrification of villages and individual households in rural areas. Given that the electricity distribution utilities are serving a large expanse of rural consumers, there is a strong business case to boost electricity demand in rural areas for all kinds of home appliances (including electric cooktops) to reduce LPG cost burden for consumers, import burden and dependency for the government and simultaneously shore up revenues for electric utilities, a win-win-win.



Pipeline of distributed renewable power generation projects

4

Grid Connected Solar Rooftop Program - 18 GW of distributed rooftop solar deployment announced for residential, institutional and other commercial sectors

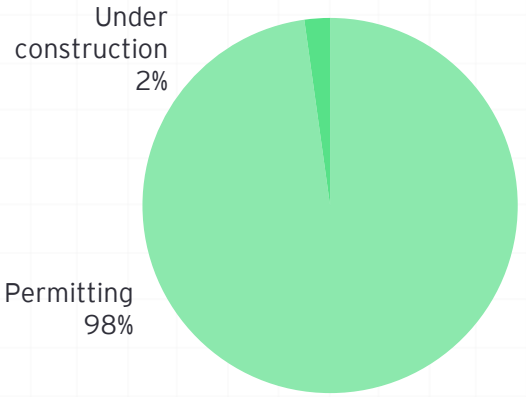
Introduction

The Ministry of New and Renewable Energy (MNRE), Government of India, notified the operational guidelines for implementation of Grid Connected Solar Rooftop Program - Phase 2 in August 2019. The Component-A of this program aims to deploy 4 GW of Rooftop Solar PV (RTPV) systems in the Residential Sector with Central Financial Assistance (CFA) in the form of capital subsidy (up to 40%). At the same time, Component-B aims to incentivize state DISCOMs for achievements above baseline, up to 18 GW of total capacity addition in any sector.

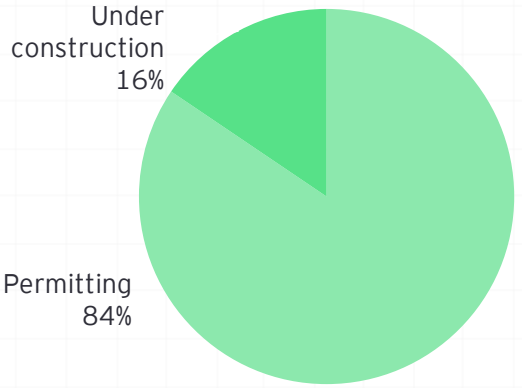
Shovel ready projects for implementation

~2,500 MW capacity of RTPV capacity is currently allocated by MNRE to various state nodal agencies (mostly DISCOMs) for implementation under component A. A majority of these projects are still under development with nodal agencies deliberating the right business models for maximum participation from all stakeholders, especially end users and investors. Another ~1.1 GW capacity of rooftop solar projects are allocated and developed under component B with about 600 MW being developed for the residential sector and the remaining 400 MW projects in other sectors. CAPEX model of development dominates in this project pipeline under both components. However, Renewable Energy Service Company (RESCO) model of development leveraging private sector investments is increasingly tested for faster adoption. A variety of other innovative business models such as rent a roof/lease model, community model, utility model, through a Special Purpose Vehicle (SPV) having share of Utility, plug-in Rooftop Solar (RTS) model and others are also being explored.

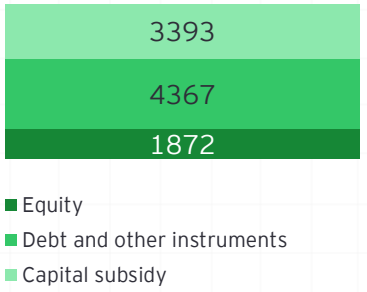
Project pipeline status – Component A (% of allocated capacity)



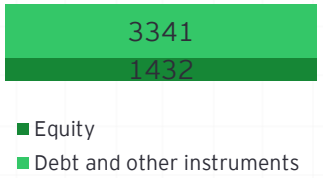
Project pipeline status – Component B (% of allocated capacity)



Investment mobilization for allocated capacity (INR crores) – Component A



Investment mobilization for allocated capacity (INR crores) – Component B



Source: EY analysis based on MNRE SPIN portal

Investment mobilization

In the prevailing conditions, we can expect the MNRE program to spill over until 2025 to achieve the overall target of 18 GW. This is because the state nodal agencies for implementation would gradually test innovative business models and streamline the process for solicitation of market participants, tariff discovery and capacity allocation, PPA execution, construction and commissioning, monitoring and evaluation. For the allocated capacity already under development, a total of INR 11,134 crores (US$ ~1.6 billion) of capital investment will be mobilized in 2021–22 (excluding the subsidy). Further, another INR ~69,400 crores (US$ ~9.7 billion) is expected to be mobilized for building the remaining capacity announced under the MNRE program. Both public and private sector players are expected to raise funds to meet this massive capital expenditure. The Government of India through MNRE will provide capital subsidies to the tune of ~INR 5,800 crores (US$ ~0.8 billion) under component A.

Capital Investment - Equity

~INR 24 thousand crores

For 18 GW of rooftop solar PV projects announced by MNRE

Capital Investment - Debt

~INR 56 thousand crores

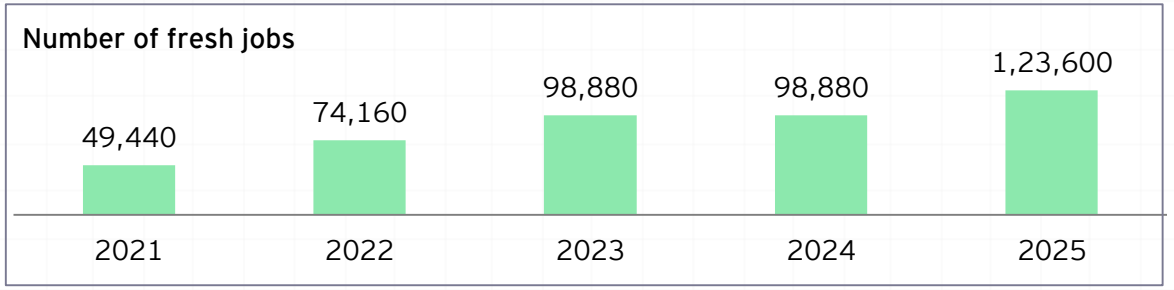
For 18 GW of rooftop solar PV projects announced by MNRE

Item	2021	2022	2023	2024	2025	Total
Annual Installed Capacity (GW)	2	3	4	4	5	**18**
Equity mobilization (INR crores)	2,686	4,029	5,372	5,372	6,715	**24,175**
Debt mobilization (INR crores)	6,268	9,402	12,535	12,535	15,669	**56,409**
Capital subsidy (INR crores)	1,214	2,312	2,312	0	0	**5,839**

Source: EY analysis based on MNRE SPIN portal

Socio economic benefits

Over 4.5 lakh fresh jobs will be created in building 18 GW capacity of grid connected rooftop solar PV systems announced under the program. For the allocated capacity already under development, about ~90,000 jobs will be created in 2021–22. These jobs will emerge in both public and private sectors along the value chain of project development, construction and commissioning, operations and maintenance of rooftop solar PV systems all across the country.



Source: EY analysis based on MNRE SPIN portal

Environmental benefits

Over ~622 million tonnes of CO2e emissions are expected to be avoided over the operating lifetime of 18 GW capacity of grid connected rooftop solar projects commissioned under the program.

Fresh jobs created

~4.37 lakh jobs

For 18 GW of rooftop solar PV projects by 2025

Avoided emissions (cumulative over project lifetime)

~622 million tonnes CO_2e

For 18 GW of rooftop solar PV projects announced by MNRE

Stimulus action to fast track implementation of rooftop solar project pipeline

1 Boost demand for rooftop solar deployment in the institutional sectors, especially rural health centres and schools

As per the Parliamentary Standing Committee's latest assessment, only 56.45% schools have adequate electricity access. Rural Health Statistics (2019) indicates that 26.3% of the rural sub-centres and 4.8% of rural Primary Health Centers (PHCs) do not have access to electricity supply, which is not only imperative for the functioning of healthcare facilities but also a vital determinant of essential healthcare services delivery.

Rural health centers and schools are largely vulnerable to irregular power supply and frequent interruptions adversely impacting the delivery of essential healthcare and education in rural communities. Despite having diesel generators for power backup, their operations are restricted due to inadequacy of funds for diesel. Sometimes in remote locations, the supply of diesel is interrupted during monsoons or bad weather. As per the World Health Organization (WHO), unreliable electricity access leads to vaccine spoilage, interruptions in the use of essential medical and diagnostic devices, and lack of even the most basic lighting and communications for maternal delivery and emergency procedures. The quality of energy access in healthcare and education facilities may have crosscutting impacts, for example, retention of health workers, improved enrolment / attendance of students and teachers in government schools who often live right alongside these facilities.

Experience from Chhattisgarh, Odisha (Kalahandi) and Karnataka (Karuna trust) have shown that health centres with rooftop solar systems provide 24-hour healthcare services treating a greater number of patients. Regular access to electricity has also enabled them to have reliable supply of water, safe refrigeration for vaccines, and powered theatre equipment, fans, and baby warmers.

There are ~1.5 lakh health centres (viz. sub-centres, primary health centres and community health centres) across the country with potential for ~564 MW of rooftop solar deployment. Similarly, there are approx. 6,82,000 rural primary schools managed by government with potential for ~2 GW of rooftop solar deployment.

Stimulus options:

- Dedicated capacity allocation for rooftop solar deployment in rural schools (2 GW) and health centres (500 MW) with generation based incentives
- Extend low cost credit line for financing rooftop solar projects in the institutional sectors
- Set up institutional mechanism at central and state levels for demand aggregation and investment related actions under OPEX mode in both health and education sectors

Stimulus benefits - (Cumulative over Solar PV system operating lifetime)

Item	Value
Direct savings in electricity costs of health centres	INR 5,875 crores (US$ ~0.8 billion)
Direct savings in electricity costs of rural government elementary schools	INR 21,284 crores (US$ ~3 billion)
Fresh jobs created in rural communities	61,800 fresh jobs
Avoided CO_2 emissions	86 million tons of CO_2e
Total capital investment toward rooftop Solar PV systems in health centres and rural government elementary schools	INR 11,200 crores

Source: EY analysis

Other cross cutting benefits:

- 6 hours of daily reliable electricity for powering health centres and school infrastructure
- Conducive learning environment (e.g. thermal comfort, drinking water, clean toilets etc.) for students and teachers
- Improved enrolment, attendance of students and teachers in Government schools, retention of health workers
- Infrastructure for evening classes and computer aided learning when integrated with cost effective battery back up solutions
- Reduced vaccine spoilage and interruptions in the use of essential medical and diagnostic devices

2 Promote net metering in all categories of consumers up to 1 MW of sanctioned load

The Ministry of Power, Government of India recently notified the Electricity (Rights of Consumers) Rules, 2020. The section 11 of these rules outlines the right of 'Consumer as prosumer' in order to promote investments toward decentralized renewable energy systems for self consumption. The rule 11 (4) states that the 'regulations on Grid Interactive Roof top Solar PV system and its related matters shall provide for net metering for loads up to ten kW and for gross metering for loads above ten kW'. The Ministry of Power has further issued a draft amendment to the Electricity (Rights of Consumers) Rules, 2020 dated 9th April 2021, which allows net metering for rooftop solar systems of loads up to 500 kW or up to the sanctioned load, whichever is lower and net billing (gross metering) or net feed-in for above 500 kW. This amendment is much appreciated and perceived as a quintessential policy enabler for the emerging 'PROSUMER' driven markets for RTPV systems. The government should gradually allow net metering for all consumer categories up to 1 MW.

It is needless to say that such policies limiting the consumer's right to avail net metering create artificial market barriers in the process of realizing the full potential for investments and employment generation in the power sector's transition toward clean energy. The energy landscape is changing rapidly driven by 3Ds - decarbonization, decentralization and digitization. Electricity generation is rapidly becoming more decentralized and closer to the end consumer. RTPV generation will naturally grow to contribute substantially more than utility scale systems, which are constrained by land availability, evacuation infrastructure and their suboptimal utilization. This transition will materialize through the following "tipping points" felt across all functions and by all stakeholders. Understanding the when, what, and how of the tipping points creates opportunities for electric utilities and other stakeholders.

- The levelized cost of round the clock electricity from decentralized solar PV power generation integrated with battery storage will reach parity with the full retail price of grid-supplied electricity before 2025.
- The cost of transporting and distributing electricity exceeds the cost of generating and storing it locally before 2040.

The centralized grid as we understand currently will gradually transition from being main source of power supply to a flexible reserve for banking surplus energy from decentralized RE systems. C&I consumers will find decentralized renewable energy (DRE) solutions integrated with storage more competitive in the immediate future. Electric utilities across generation, transmission and distribution (GT&D) segments, will be on the front line bracing the impact of this transition. Turning disruption into growth opportunities, testing new and innovative business models, reforms and restructuring focusing on the clean energy transition must become key imperatives for the survival of electric utilities.

3 Promote third party owned business models for accelerated RTPV capacity addition in the domestic category

Under the Grid connected Rooftop Solar Program - phase 2 component A, most of the DISCOMs have largely adopted the consumer owned model with utility acting as an aggregator to implement the sanctioned RTPV capacity. Going forward, DISCOMs must look beyond consumer owned models to attract more households, especially in the lower slabs of consumption (less than 100 units per month).

Kerala State Electricity Board (KSEB) has successfully aggregated over 200 MW of RTPV demand from households in the lower slabs of consumption by offering compensation for access to roof space in the form of monthly energy credit. DISCOMs in other states must take a cue from this success and act fast to unlock value in the RTPV market. Perceived threats from revenue loss can be turned into a growth opportunity if DISCOMs channel their CAPEX into supplying RTPV electricity to individual households.

The Government of India through MNRE must initiate a massive capacity building program for DISCOMs in order to build capabilities for the delivery of new functionalities required for the RTPV market. Recognizing the future investment opportunities emerging from the transition, new service-oriented utility centric business models must be tested continuously.

The Grid connected Rooftop Solar Program could provide incentives NOT just for RTPV capacity addition but for making DISCOM's own investment / CAPEX toward promoting RTPV energy for residential consumers.

4 Promote contactless digital platforms for reducing transaction costs and enhancing consumer experience of ease of doing rooftop solar

Ease of doing rooftop solar at state level is one of the principal bottlenecks for achieving the 18 GW capacity addition target under MNRE Phase 2 scheme.

We believe the following factors determine the ease of doing rooftop solar along the project lifecycle and directly translates into transaction cost for all market participants including consumer, state nodal agency, vendor and financial institution.

- Consumer access to information about fundamentals of rooftop solar technology, vendors and products available in the market, total cost of ownership and benefits, subsidy availing process from state nodal agency, installation, operation and maintenance practices
- Consumer acquisition / demand aggregation – lead generation, consumer identification and professional site level assessment of rooftop solar system yield, size and cost etc.
- Consumer access to cost effective retail debt financing products equivalent to home loan products
- Vendor access to cost effective working capital loans
- Grant of net metering and grid interconnection for proposed rooftop solar systems from grid operators
- Enforcing post installation protocols for system performance monitoring, operation and maintenance

All of the above factors are largely managed with significant human intervention in most of the states. This entails a significant transaction cost (approx. INR 5,000–10,000 per consumer) for all the market participants, which is unaccounted for in the current MNRE benchmark costs for availing subsidy and other regulated cost frameworks.

In this scenario, contactless digital platforms can play a crucial role of seamlessly integrating these activities and reducing the overall transaction cost for market participants. The consumer experience of availing rooftop solar will significantly improve thereby unlocking huge value for next generation solutions and services from DISCOMs.

If we can consider a total of 45 DISCOMs in the country, the total cost for setting up contactless digital platforms can be approximately INR 45 crores. In contrast, the present transaction cost with human intervention is estimated INR ~500 crores for all market participants if we consider only the 4 GW target for the residential sector.

PM-KUSUM: 10 GW of decentralized grid connected renewable energy capacity addition under Component A

Introduction

MNRE, Govt. of India, has notified the guidelines for implementation of 'PM-KUSUM' (Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan) Scheme for implementation of DRE systems, solar agriculture water pumps and solarization of existing grid connected agriculture pumps. The scheme is structured under three separate components serving different market segments including but not limited to marginal farmers, landowning farmers and grid connected agriculture consumers.

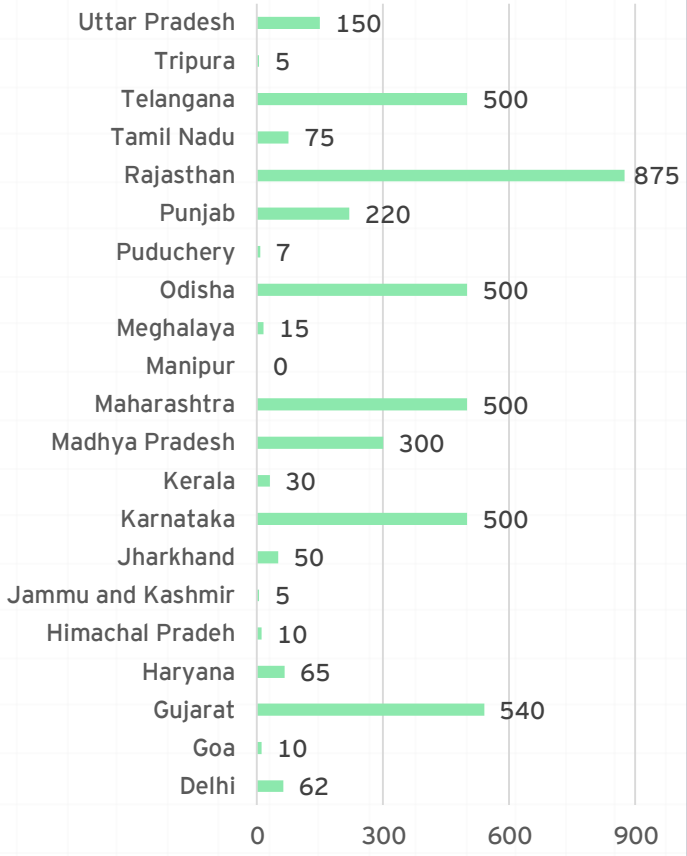
The Component-A of the KUSUM supports setting up of 10 GW of decentralized ground mounted grid connected renewable energy power plants for providing additional source of income for land owning farmers. MNRE will provide procurement based incentive (PBI) to the DISCOMs @ 40 paise/kWh or Rs.6.60 lakhs/MW/year, whichever is lower, for buying renewable power under this scheme. The PBI will be given to the DISCOMs for a period of five years from the commercial operation date of the plant.

Shovel ready projects for implementation

4.4 GW capacity of decentralized ground mounted grid connected renewable energy power projects are currently sanctioned by MNRE to various state nodal agencies (mostly DISCOMs) for implementation under component A. A majority of these projects are still under development with nodal agencies inviting landowners/farmers, Solar EPC companies and developers to gauge their interest in project financing and development. Both CAPEX and OPEX models are allowed for maximum participation from stakeholders. Landowners are allowed to develop ground mounted grid connected Solar PV power projects on agriculture farmlands for dual use of power generation and farming.

Investment mobilization for sanctioned capacity (INR crores) – Component A

State wise sanctioned capacity in MW



Source: EY analysis from MNRE allocations to various states

Investment mobilization

In the prevailing conditions, we expect the program to spill over until 2022 post COVID. This is because the state nodal agencies for implementation (DISCOMs) would test and streamline the process for solicitation of market participants, capacity allocation, PPA execution, construction and commissioning, monitoring and evaluation before rapidly scaling up capacity addition. For the sanctioned capacity already under development, a total of INR 15,005 crores (US$ ~2 billion) of capital investment will be mobilized in 2020–21 from the landowners and other project developers. Further, another INR ~19,100 crores (US$ ~2.6 billion) is expected to be mobilized for building the remaining capacity announced under the program. Private sector funds will be largely utilized to meet this massive capital expenditure.

Capital Investment - Equity

~INR 10,230 crores

For 10 GW of ground mounted solar PV projects announced under KUSUM-A

Capital Investment - Debt

~INR 23,875 crores

For 10 GW of ground mounted solar PV projects announced under KUSUM-A

Item	2021	2022	Total
Annual Installed Capacity (GW)	4.4	5.6	**10**
Equity mobilization (INR crores)	4,500	5,730	**10,230**
Debt mobilization (INR crores)	10,505	13,370	**23,875**
Capital subsidy (INR crores)	460	585	**1,045**

Source: EY analysis

Socio economic benefits

~90,900 fresh jobs will be created in building 10 GW capacity of decentralized ground mounted grid connected renewable power projects announced under KUSUM component A. For the sanctioned capacity already under development, about ~40,000 jobs will be created in 2020–21. These jobs will emerge in rural areas with private sector investments along the value chain of project development, construction and commissioning, operations and maintenance of solar PV systems all across the country.

Source: EY analysis

Environmental benefits

Over ~400 million tonnes of CO2e emissions are expected to be avoided over the operating lifetime of 10 GW capacity of grid connected ground mounted solar PV projects commissioned under the program.

Fresh jobs created

~90,900 jobs

For 10 GW of ground mounted solar PV projects announced under KUSUM-A

Avoided emissions (cumulative over project lifetime)

~400 million tonnes CO_2e

For 10 GW of ground mounted solar PV projects announced under KUSUM-A

PM-KUSUM: 2.24 GW of decentralized grid connected renewable energy capacity addition under Component C

Introduction

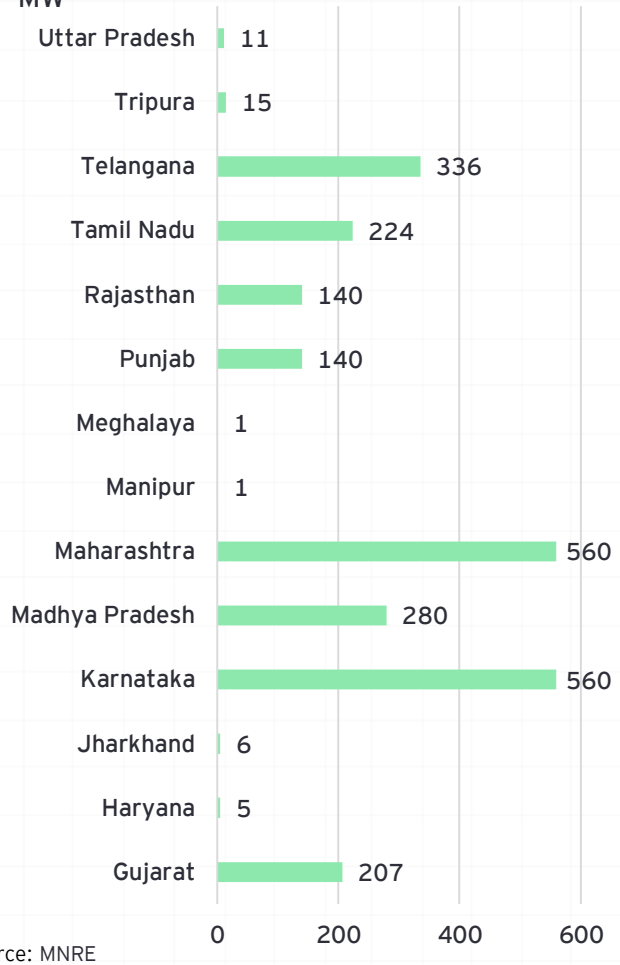
MNRE, Govt. of India, has notified the guidelines for implementation of 'PM-KUSUM' scheme. Scheme is for implementation of DRE systems, solar agriculture water pumps and solarization of existing grid connected agriculture pumps. The Component-C of the KUSUM targets solarization of 4 lakh grid connected pumps by 2020–21. A total of 50% pumps are to be solarized as feeder level while remaining 50% shall be solarized as an individual pump solarization. The scheme supports setting up of 4.48 GW of decentralized ground mounted grid connected renewable energy power plants for providing additional source of income for land owning farmers. This component will be implemented initially on pilot mode for 2,484 MW capacity and later scaled up based on the learnings. MNRE will provide a Central Financial Assistance (CFA) of 30% of estimated cost for feeder level solarized pump, however an additional 30% state subsidy will be provided only for individual pump solarization. The feeder solarization capacity can be twice as much as the installed pump capacity. The estimated cost shall be worked out based on maximum agricultural pump capacity of 7.5 HP.

Shovel ready projects for implementation

2.48 GW capacity of decentralized ground mounted grid connected renewable energy power projects are currently sanctioned by MNRE to various state nodal agencies (mostly DISCOMs) for implementation under component C. A majority of these projects are still under development with nodal agencies inviting landowners/farmers, Solar EPC companies and developers to gauge their interest in project financing and development. Both CAPEX and OPEX models are allowed for maximum participation from stakeholders. Landowners are allowed to develop ground mounted grid connected Solar PV power projects on agriculture farmlands for dual use of power generation and farming.

Investment mobilization for sanctioned capacity (INR crores) – Component C

State wise sanctioned capacity in MW



Source: MNRE

Investment mobilization

In the prevailing conditions, we expect the program to spill over until 2022 post COVID. This is because the state nodal agencies for implementation (DISCOMs) would test and streamline the process for solicitation of market participants, capacity allocation, PPA execution, construction and commissioning, monitoring and evaluation before rapidly scaling up capacity addition. For the sanctioned capacity already under development, a total of INR 4,200 crores (US$ ~0.6 billion) of capital investment will be mobilized in 2020–21 from the landowners and other project developers. Further, another INR ~3,400 crores (US$ ~0.5 billion) is expected to be mobilized for building the remaining capacity announced under the KUSUM-C program. Private sector funds will be largely utilized to meet this massive capital expenditure.

Capital Investment - Equity

~INR 2,260 crores

For 4.48 GW of ground mounted solar PV projects announced under KUSUM-C

Capital Investment - Debt

~INR 5,340 crores

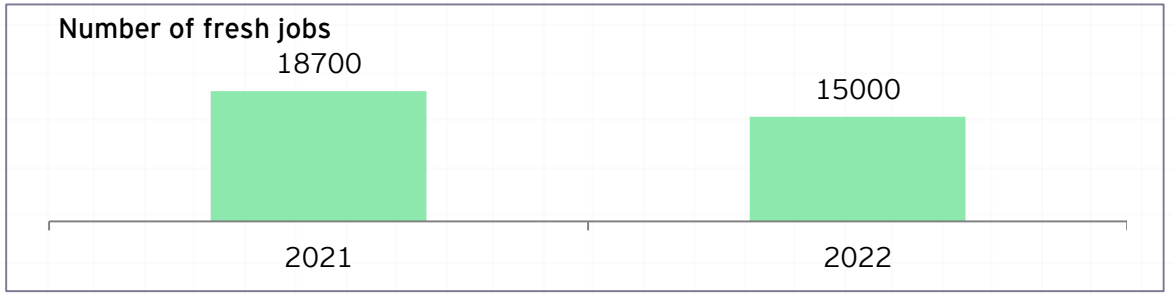
For 4.48 GW of ground mounted solar PV projects announced under KUSUM-C

Item	2021	2022	Total
Annual Installed Capacity (GW)	2.48	2	4.48
Equity mobilization (INR crores)	1,260	1,000	2,260
Debt mobilization (INR crores)	2,940	2,400	5,340
Capital subsidy (INR crores)	3,900	3,150	7,050

Source: EY analysis

Socio economic benefits

~33,700 fresh jobs will be created in building 4.48 GW capacity of decentralized ground mounted grid connected renewable power projects announced under KUSUM component C. For the sanctioned capacity already under development, about ~18,700 jobs will be created in 2020–21. These jobs will emerge in rural areas with private sector investments along the value chain of project development, construction and commissioning, operations and maintenance of solar PV systems all across the country.



Source: EY analysis

Environmental benefits

Over ~150 million tonnes of CO_2e emissions are expected to be avoided over the operating lifetime of 4.48 GW capacity of grid connected ground mounted solar PV projects commissioned under the program.

Fresh jobs created

~33,700 jobs

For 4.48 GW of ground mounted solar PV projects announced under KUSUM-C

Avoided emissions (cumulative over project lifetime)

~150 million tonnes CO_2e

For 4.48 GW of ground mounted solar PV projects announced under KUSUM-C

Stimulus measures for accelerated economic recovery

1 Generation based incentives for decentralized grid connected ground mounted solar PV systems co-located with crops on agriculturally productive land parcels (hereinafter referred as agro-PV projects)

PM-KUSUM component A is designed to provide alternate / additional source of income and livelihood from decentralized renewable power generation for:

- Farmers of cultivable land
- Farmers or landowners of wasteland / barren / uncultivable land

The first category of farmers would have to design and develop solar PV systems for co-location with crops on agriculturally productive land parcels. This will require elevated structures and a more dispersed solar PV array arrangement to permit sufficient sunlight for crop cultivation, thereby increasing the capital cost. A variety of innovative agro-PV solutions are emerging from successful demonstrations in Germany, Japan, South Korea, China, France, the United States and India. The Indian Council of Agricultural Research - Central Arid Zone Research Institute (ICAR-CAZRI) has successfully commissioned Solar PV systems co-located with a variety of crops in Jodhpur.

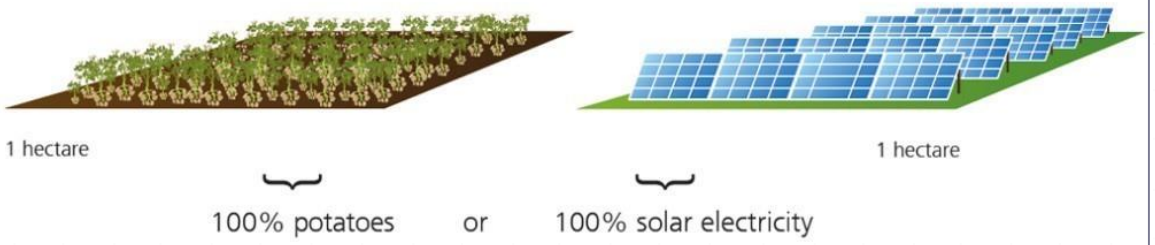
The operational guidelines of PM-KUSUM component A proposes competitive reverse bidding process for capacity allocation by DISCOMs, with a ceiling tariff as per latest tariff order of the respective SERC. This would necessitate that the SERCs determine the tariff for co-located agro-PV systems developed on agriculturally productive land separately. Otherwise, the commercial viability of projects for first category of farmers will be at risk. So far, SERCs have determined tariff for ground mounted solar PV systems developed on barren land only. Additionally, DISCOMs have to conduct the competitive reverse bidding process in two separate tranches of capacity allocation for projects proposed on barren and agriculturally productive land parcels. This will ensure a level playing field for all the participants.

Moreover, DISCOMs may shy away from higher cost of power procurement from co-located agro-PV systems developed on agriculturally productive land. In this scenario, generation based incentives for promoting co-located agro-PV systems will reduce the burden on DISCOMs and at the same time make these investments economically attractive.

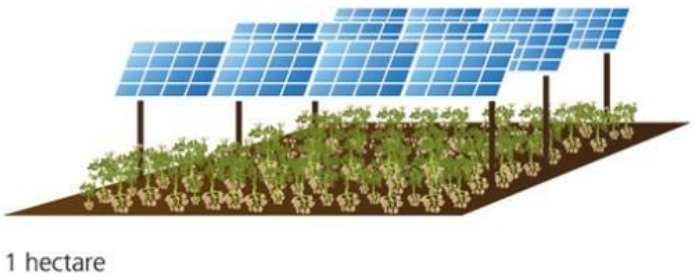
As per a recent IRENA report (2019) that provides the future outlook of Solar PV markets, agro-PV systems combine solar PV and agriculture on the same land and consists of growing crops beneath ground mounted solar panels. Although the concept was in existence for long, it has received little attention until recently, when several researchers have confirmed the benefits of growing crops beneath the shade provided by the solar panels. These include higher electricity production, higher crop yields and less water used. Many types of food crops, such as tomatoes, grow better in the shade of solar panels, as they are spared from the direct sun and experience less water loss via transpiration, which also reduces water use while maintaining the same level of food production. A key advantage for solar panels is that their efficiency is increased. Cultivating crops underneath reduces the temperature of the panels, as they are cooled down by the fact that the crops below are emitting water through their natural process of transpiration.

The land use impact from solar energy expansion is likely to have cross cutting implications on the food security and land productivity of the country. In this regard, it is worthwhile to examine the alternative use cases of land acquired for solar energy generation and device policy pathways to reduce the land use impact. KUSUM scheme Component A can be a perfect test bed to scale up adoption of agro-PV solutions.

Separate land use on 1 hectare cropland: 100% potatoes or 100% solar electricity



Combined land use on 1 hectare cropland: 186% land use efficiency



Source: Fraunhofer Institute for Solar Energy Systems ISE

Stimulus options:

Generation based incentive of up to INR 0.5 per kWh over and above tariff determined through competitive reverse bidding for 1 GW deployment of agro-PV projects under Component A pilot phase.

Stimulus benefits

Item	Value
Budgetary expenditure toward generation based incentive	INR 1,250 crores
Fresh jobs created in rural communities	7,416 jobs
Avoided CO_2 emissions	35 million tons of CO_2e
Total capital investment toward 1 GW agro-PV projects	INR 4,200 crores

Source: EY analysis

Other cross cutting benefits:

- Additional source of income from power generation for farmers whose livelihood rests entirely on agriculture income
- Additional income from improved crop yield as a result of cultivations under the shade of Solar PV array
- Enhanced productivity of farmlands resulting from dual use of farming and solar power generation in the same land parcel
- Reduced threat to food security from solar power generation on farm lands

2 Dedicated financing facility for improving farmer access to low cost debt funds and boosting commercial viability of 1–2 MW scale ground mounted Solar PV projects on CAPEX mode (own investment from farmers)

PM-KUSUM component A is designed to provide alternate / additional source of income and livelihood from decentralized renewable power generation for:

- Farmers of cultivable land
- Farmers or landowners of wasteland / barren / uncultivable land

The MNRE operational guidelines for component A allows both CAPEX and OPEX mode of developing decentralized grid connected ground mounted Solar PV projects. Under CAPEX mode, farmers can invest in solar PV power plants by arranging own funds, collaborate with EPC contractors/System Integrators for setting up ground mounted solar PV power plants on turnkey basis, operate and maintain the plant during the PPA tenure.

The guidelines propose competitive reverse bidding process for capacity allocation, with a ceiling tariff determined by the respective SERC. The capital cost and cost of capital are the two critical determinants of this ceiling tariff. Typically SERCs adopt 14% rate of return on equity and 10.5% interest rate on debt with 70:30 debt to equity ratio while determining these tariffs. Therefore, farmers willing to invest own funds will need access to low cost debt instruments to remain competitive. This is one of the principal bottlenecks for driving investments under CAPEX mode.

The Hon'ble Finance Minister, Government of India, recently announced INR 1 lakh crore Agri Infrastructure Fund as stimulus funding to mobilize medium - long term debt financing for investment in viable projects for post-harvest management infrastructure and community farming assets through incentives and financial support.

Credit guarantee coverage will be available for eligible borrowers from this facility for loans up to INR 2 crore. The fee for this coverage will be paid by the Government. Moreover, all loans under this financing facility will have interest subvention of 3% per annum up to a limit of INR 2 crore. However, there is no clarity as to whether decentralized renewable power generation projects developed under PM-KUSUM scheme will be eligible for financing under this facility. Farmers willing to invest under CAPEX mode will need debt financing between INR 2.5–5 crores for setting up 1–2 MW grid connected ground mounted Solar PV projects.

Stimulus options:

Establish a dedicated financing facility of ~INR 25,000 crore on the lines of Agri Infrastructure Fund to enable farmers access low cost debt financing for setting up 5 GW of decentralized renewable energy projects on CAPEX mode under PM-KUSUM component A.

Amend Agri Infrastructure Fund guidelines for making decentralized renewable power generation projects developed under PM-KUSUM scheme eligible for borrowing under this facility.

Item	Value
Direct annual savings in access to electricity	INR 235 crores
Fresh jobs created in rural communities	61,800 jobs
Avoided CO_2 emissions	86 million tons of CO_2e
Investment to boost rural economic activity	INR 9,000 crores

Source: EY analysis

Pipeline of projects for original RE equipment manufacturing

5

Solar PV cell and module manufacturing

Introduction

As per the MNRE, Government of India, the current installed capacity for manufacturing solar PV cells and modules in India is ~3 GW and 10 GW respectively. The Modified Special Incentive Package Scheme (M-SIPS) scheme of the Ministry of Electronics & Information Technology, Government of India provides for 20–25% subsidy for investments in capital expenditure for setting up of electronic manufacturing facility such as solar PV cells and modules. On the demand front, the government schemes including Central Public Sector Undertaking (CPSU) scheme, MNRE phase 2 of grid connected rooftop solar scheme and the PM-KUSUM scheme mandate domestic content requirement for sourcing solar cells and modules. Additionally, the Production Linked Incentive (PLI) schemes announced by the Ministry of Commerce & Industry, Government of India, will have a huge role to play in achieving size and scale in manufacturing by incentivising incremental production for 13 key sectors. The total budgetary outlay for funding PLI in all 13 sectors is estimated INR 1.97 lakh crores or US$26 billion. On average 5% of the production value is provided as an incentive.

Shovel ready projects for implementation

Approx. ~8 GW capacity of projects for manufacturing solar PV cells and modules are currently in pipeline at various stages of development. These projects are envisaged in the states of Gujarat and Tamil Nadu with a CAPEX outlay of INR 21,307 crores creating direct employment potential for ~30,000 fresh jobs in the next 2–3 years. The MNRE has notified basic customs duty of 40% and 20% on imported solar PV modules and cells respectively with effect from 1st April, 2022. This is likely to reduce demand for imported solar PV modules and cells, especially for utility scale projects. In this context, the project pipeline identified will benefit from the potential rise in demand from project developers thereby raising the investor interest to fast track these projects.

Project Pipeline for Manufacturing Solar PV cells and modules

Scheme	Project promoter type	Project Status	Production Capacity (MW)	Project location	Year of announcement
SECI Manufacturing linked Solar Auction	Private	Permitting	1,000	Not reported	2020
	Private	Permitting	2,000	Gujarat	2020
NA	Private	Announced	2,000	Gujarat	2020
NA	Private	Announced	3,000	Tamil Nadu	2020

Project Pipeline for Manufacturing Solar PV cells and modules (cont.)

Scheme	Estimated date of project commissioning	Total CAPEX outlay *(INR crores)*	Equity mobilization *(INR crores)*	Debt financing *(INR crores)*	Number of jobs created
SECI Manufacturing linked Solar Auction	Beyond 2022	3,200	960	2,240	4,475
	Beyond 2022	6,400	1,920	4,480	8,950
NA	Beyond 2022	6,400	1,920	4,480	8,950
NA	Beyond 2022	5,307	1,592	3,715	7,542
	Total	**21,307**	**6,392**	**14,915**	**29,917**

Source: EY analysis

Lithium Ion Battery Cell manufacturing, module and pack assembly lines

Introduction

Energy storage will play a crucial role in providing the necessary flexibility for Indian power system, which is at the cross roads for decarbonisation with massive renewable energy capacity addition planned with intermittent sources such as solar and wind. While there are a number of long-standing storage technologies, such as pumped hydro, and some emerging technologies, such as compressed air or stacked concrete blocks, the majority of investment to date has been directed toward large-scale lithium-ion batteries, such as those found in electric vehicles, mobile phones and laptops.
Uptake of the technology has been driven by dramatic cost reductions. The PLI scheme will have a huge role to play in achieving size and scale in advance cell chemistry battery products manufacturing.

Shovel ready projects for implementation

Several projects targeting different components in the value chain of lithium ion battery manufacturing are currently in pipeline. All of these projects are led by private sector and located in Gujarat, Karnataka, Haryana and Tamil Nadu. ~INR 27,000 crores of capital infusion is expected for operationalizing the project pipeline. These projects will play critical role in hybrid RE power project development in future that integrates battery energy storage for peak power supply or round the clock supply. Over 10,000 fresh jobs will be created for operationalising the project pipeline.

Project Pipeline for Manufacturing Lithium Ion Batteries

Product	Project promoter type	Project Status	Production Capacity	Project location	Year of announcement
Lithium Hydroxide	Private	Announced	20,000 LCE *(Lithium Carbonate Equivalent)*	Gujarat	2019
Lithium Ion Battery Cell	Private	Under construction	30 Million cells per annum	Gujarat	2019
Lithium Ion Battery Active Materials, Cell, Pack Assembly, Recycling	Private	Under construction	10 GW per annum	Gujarat	2019
Li-ion pouch cell battery modules	Private	Permitting	1.5 GWh per annum	Gujarat	2020
Lithium-ion Polymer (LIP) batteries	Private	Land acquired		Haryana	2020
Lithium Ion Batteries	Private	Announced		Karnataka	2020
Lithium Ion Batteries and EVs	Private	Announced		Karnataka	2020
Lithium-ion Battery Cell and Pack Assembly Line	Private	Land acquired	1000 MW	Tamil Nadu	2021

Source: EY research

Stimulus measures for accelerated economic recovery

1 Boost demand for high efficiency solar PV modules and advanced chemistry cells (ACC) battery solutions

The government of India in its budget for 2020-21 announced PLI for domestic manufacturing of high value products in 13 sectors including the high efficiency solar PV modules and advanced chemistry cell batteries with budgetary allocations of INR 4,500 crores and INR 18,100 crores respectively. This is a welcome step to boost research and development efforts by existing domestic Original Equipment Manufacturers (OEM) players, attract new investments and make domestically manufactured products competitive in the global supply chain context.

Considering the top 7 domestic solar PV module manufacturers in 2019, high efficiency mono-Si PV modules constituted only 13% of PV production, while 87% comprised of multi-crystalline (or multi-Si) PV modules. However, the share of mono Passivated Emitter and Rear Cell (PERC) modules is expected to increase to 25–30% of all utility-scale solar installations in 2020.

The government must also gradually intervene to boost demand for high efficiency solar PV modules, cells and advanced chemistry cells battery solutions in its existing schemes. The existing schemes including CPSU scheme, MNRE phase 2 of grid connected rooftop solar scheme and the PM-KUSUM scheme mandate domestic content requirement (DCR) for sourcing solar PV systems.

Each of above schemes mandating DCR can have a mechanism to incentivize adoption of high efficiency PV modules. The current benchmark capital costs for solar PV systems for availing subsidy under the rooftop scheme has no incentive for adopting high efficiency modules / cells. The government's order on benchmark cost does not differentiate between PV systems adopting mono-Si and multi-Si efficiency modules / cells. In a race to secure the lowest cost for consumers, the state nodal agencies and the technology vendors are incentivized to supply only multi-Si modules in the current scenario.

Stimulus action

- Amend the benchmark cost orders under rooftop and KUSUM schemes to differentiate between PV systems adopting mono-Si and multi-Si efficiency modules / cells.
- Formulate an incentive mechanism under these schemes to adopt high efficiency PV modules and ACC battery solutions

2 Formulate and target new PLI schemes toward coal dependent states

India's coal dependent states namely Chhattisgarh, Jharkhand, Odisha, West Bengal and Madhya Pradesh rely heavily on the levies (e.g. Coal Cess, Royalties, GST and other duties) imposed on the delivered price of coal to buyers. The coal mining and transportation industry in these states together support lakhs of formal employees, contractual jobs, unorganized small scale subsistence coal miners and others directly and indirectly reliant on coal mining for their livelihoods.

Coal fired power generation was already under intense pressure from overcapacity, low electricity demand growth, and increasingly competitive renewables before the incidence of COVID, which further exposed the coal value chain's vulnerabilities to economic uncertainty. The increased uncertainty could cause severe social and economic problems in these coal dependent states with limited progress in economic diversification and millions of people depending on coal mining directly or indirectly for their livelihoods.

To mitigate these uncertainties, a just transition away from coal dependence across India's coal belt is both prudent and necessary. Policy interventions such as PLI schemes that are promoting self-reliance for emerging clean energy technology alternatives to coal must focus on strengthening economic resilience of coal dependent states from the diminishing returns in the coal value chain. The need for expanding access to alternative, sustainable livelihoods in these states cannot be overstated.

The government could explore new PLI schemes dedicated for coal dependent states for producing polysilicon wafer/ingots, which is a critical raw material for high efficiency products in the solar PV value chain. In addition, PLI schemes could also focus on mining and chemical refining of mineral ores such as lithium, cobalt, nickel and rare earth elements all of which are critical for supporting India's self reliant clean energy transition. The Indian Minerals Yearbook for 2019 published by the Bureau of Mines indicates reserves of nickel, cobalt and molybdenum (rare earth metal) in Jharkhand, Odisha and Madhya Pradesh.

The PLI schemes targeted for coal dependent states will provide much needed investments from public sector undertakings and the private sectors for diversifying the economies away from coal. This will also boost restructuring employment, providing alternate livelihoods, workforce re-skilling etc.

Stimulus action

PLI schemes dedicated for coal dependent states for the following:

- Production of polysilicon wafers/ingots
- Mining of nickel, cobalt and rare earths
- Chemical refining of above raw mineral ores to produce industry grade metals and alloys

Pipeline of EV charging infrastructure projects

6

Electric Vehicle (EV) charging infrastructure

Introduction

Undoubtedly, India's electric mobility ambitions should prioritize charging infrastructure for accelerated transition. Adequate and accessible EV charging infrastructure is a necessary precondition for the mass adoption of EVs. This transition is governed by both central and state policies in India. Currently, 12 states have EV policies (drafted and approved) while the Faster Adoption and Manufacturing of Electric Vehicles in India (FAME II) scheme operates at the central level. The government has allotted INR 1,000 crore (~US$ 135 million) for charging infrastructure under the FAME II policy. Charging stations are to be set up in phases, with the first phase focussing on megacities and national highways and corridors. The subsequent phases will focus on million-plus cities, state capitals, union territories (UTs), and smart cities. The EV charging infra density targets laid out are as follows:

- At least one public charging station in every 3x3 km grid
- One charging station every 25 km on both sides of highways and roads
- One fast charger every 100 km on highways and roads

Shovel ready projects for implementation

The Department of Heavy Industries (DHI), Government of India, sanctioned 2,636 new charging stations across 62 cities and 24 states and UTs in January 2020. Maharashtra, Karnataka and Tamil Nadu got highest number of allocations in that order. Rajasthan Electronics & Instruments Limited (REIL), Energy Efficiency Services Limited (EESL), Power Grid Corporation (PGCIL), and National Thermal Power Commission (NTPC) are the leading project promoters who got the highest allocations for developing EV charging stations. A recent analysis by CEEW outlines several other EV charging infra projects announced by both central and state level authorities. The Ministry of Heavy Industries and Public Enterprises, Government of India, subsequently sanctioned 241 additional charging stations in September 2020 taking the total to 2,877 stations allocated to 22 public sector entities. The DHI later invited proposals for availing incentives under FAME II scheme for the deployment of minimum 174 EV charging stations on 1,775 kms stretch of expressways and 1,370 stations on 13,370 kms stretch of highways in October 2020. Recently, the Ministry of Power announced that it would set up charging infrastructure across 69,000 petrol pumps in India.

Many Indian states are also complementing these efforts with their own policies to meet local charging demand. In September 2020, the Uttar Pradesh government identified locations for charging station facilities under smart city projects in the eight cities of Lucknow, Varanasi, Prayagraj, Kanpur, Aligarh, Saharanpur, Bareilly, and Jhansi. Private companies like Ather, Lithium Urban, Magenta, Okaya, and Tata Power are also expected to scale up their charging station networks over the next few years. Some states like Andhra Pradesh, Bihar, Delhi, Telangana, and Uttar Pradesh have set concrete targets for EV charging infrastructure rollout. The Andhra Pradesh and Uttar Pradesh EV policies have targets of 0.1 and 0.2 million charging stations, respectively, to be built by 2024. Bihar and Delhi policies specify charging station density targets - Delhi aims to have chargers located every 3 km, whereas Bihar aims to have chargers located at every 50 km on all highways. State EV policies primarily rely on capital subsidies to realize these targets. Reimbursement of the net state's goods and services tax (SGST) are provided in states like Andhra Pradesh, Delhi, and Karnataka. Interest free loans are also provided by the Karnataka state government to those setting up charging stations. Tamil Nadu provides 100% exemption from electricity tax to charging stations. Eleven Indian states provide special EV tariffs for public charging stations. The Delhi government provides a grant of up to 100% on charging equipment set up by building owners, whereas Uttar Pradesh provides 25% rebate on the market rate for land procured for charging points.

Project Pipeline (sanctioned) for setting up EV charging stations under FAME II

Project location	No. of EV charging stations	Total CAPEX Outlay *(INR crores)*	Capital Subsidy *(INR crores)*	Equity *(INR crores)*	Debt *(INR crores)*	Number of jobs created
Andhra Pradesh	266	76	53	7	16	798
Assam	20	6	4	1	1	60
Bihar	37	11	7	1	2	111
Chandigarh	70	20	14	2	4	210
Chhattisgarh	25	7	5	1	1	75
Delhi	72	21	14	2	4	216
Gujarat	228	65	45	6	14	684
Haryana	50	14	10	1	3	150
Himachal Pradesh	10	3	2	0	1	30
Karnataka	172	49	34	4	10	516
Kerala	131	37	26	3	8	393
Madhya Pradesh	159	45	32	4	10	477
Maharashtra	317	90	63	8	19	951
Meghalaya	40	11	8	1	2	120
Odisha	18	5	4	0	1	54
Puducherry	10	3	2	0	1	30
Rajasthan	205	58	41	5	12	615
Sikkim	29	8	6	1	2	87
Srinagar	25	7	5	1	1	75
Tamil Nadu	256	73	51	7	15	768
Telangana	138	39	28	4	8	414
Uttar Pradesh	207	59	41	5	12	621
Uttarakhand	10	3	2	0	1	30
West Bengal	141	40	28	4	8	423
Total	**2,636**	**751**	**526**	**68**	**156**	**7,908**

Project Pipeline (announced) for setting up EV charging stations on expressways and highways under FAME II

Project location	No. of EV charging stations	Total CAPEX Outlay *(INR crores)*	Capital Subsidy *(INR crores)*	Equity *(INR crores)*	Debt *(INR crores)*	Number of jobs created
1,775 kms of Expressways	174	50	35	4	10	522
13,370 kms of national highways	1,370	390	273	35	82	4,110
Total	**1,544**	**440**	**308**	**39**	**92**	**4,632**

Source: EY research, Department of Heavy Industry

Stimulus measures for accelerated economic recovery

1 National / state level policy frameworks to promote and incentivize electric utility investment in EV charging infrastructure

The EV charging infrastructure deployment under Fame-II scheme is currently largely led by central public sector enterprises involved in electronics manufacturing, energy services, electricity transmission and generation markets. A few projects are also allocated to local transport and municipal corporations at the state level. Apart from this, several private sector automotive OEMs, EV start ups and few vertically integrated electric utilities have been leading their own deployment efforts to facilitate wider adoption of EV models and diversify services into emerging markets.

International best practices show successful deployment from local electric utilities involved in distribution and retail sales making such investments part of regulated capital expenditure and cost recovery through tariffs. Adequate policy mechanism should be in place to ensure that such investments by Indian DISCOMs are subject to regulatory jurisprudence to avoid unnecessary burden on consumers. There are ample opportunities for Indian DISCOMs to gradually diversify services toward EV charge point operations, leverage synergies with renewable energy integration and generate sustainable alternate revenue streams.

DISCOMs should plan and initiate asset monetisation drives by simply leasing the real estate located in prime locations identified by private players. DISCOMs can also opt for revenue sharing models wherein utility investment can be targeted toward setting up electrical infrastructure components such as transformers, transformer pads, service meters, service panels, cables, conductors, smart grid devices etc. Strategic public private partnerships with OEMs of automotive components and EV chargers / EV supply equipment can be explored for leveraging the benefits from higher economies of scale.

Type of Business models	Investment/cost items				Revenue items			
	Land/ location	EVSE equipment	Electrical infrastructure	Other add on services *(e.g. advertising, parking)*	Revenue from rent/lease of location	Revenue from sale of electricity	Revenue from EV charging sessions	Revenue from other add on services
Utility fully-owned (end-to-end)	Utilities	Utilities	Utilities	Utilities	Utilities	Utilities	Utilities	Utilities
Utility providing access to location only	Charging operators	Charging operators	Charging operators	Charging operators	Utilities	Utilities	Charging operators	Charging operators
Utility providing access to location and investing in electrical infrastructure	Charging operators	Charging operators	Utilities	Charging operators	Utilities	Utilities	Charging operators	Charging operators, Utilities
Utility investing in land and electrical infrastructure	Utilities	Charging operators	Utilities	Charging operators	NA	Utilities	Charging operators, Utilities	Charging operators, Utilities

Utilities Charging operators

Source: EY analysis

It's not a "chicken and egg" situation anymore. Most experts acknowledge that without proper EV charging infrastructure, EVs would not take off in the way they need to. The challenge is that the business case for investment may not stack up in a traditional sense. Understanding how to position the business case, and which levers to pull, can unlock investment channels to accelerate infrastructure rollout. And that's a trigger in the national journey toward decarbonization.

2 Restructure markets to create alternate revenue streams for EV charge point operators and investors

On average, the payback period for investment in public EV charging infrastructure is 10+ years. The business case needs rethinking to support predicted EV growth. There are significant commercial, structural and operational levers to reduce latency, enhance revenues and cut costs. Re-modelling the business case can boost the investment risk profile, give greater appeal to mainstream debt financiers and enable infrastructure to scale.

The conventional business case struggles to justify EV charging infrastructure investment. Poor cashflow and returns are jeopardizing the case for investment in public EV charging infrastructure. EY research finds that a typical charging station, with two slow (6.6kW) and two fast (50 kW) chargers, will take five years to yield positive cashflow. Our analysis shows that the payback periods for charging infrastructure investments are longer than 10 years.

The need for EV charging investment and deployment is irrefutable. But the uncertainties combine to make public charging infrastructure risky and an unattractive investment. In fact, more than three-quarters (76%) of total capital inflows into EV charging companies in 2019 is equity, grants/subsidies or venture capital. To achieve scale, debt financing is critical. Simply put, the business case needs to improve.

It is critical to understand the levers that can increase revenues and reduce costs to make the business case more appealing to mainstream debt investors.

Revenue enhancement and cost-reduction levers

Revenue levers

Smart charging services
Revenues from grid flexibility services, such as demand response through coordinated charging and discharging of EVs

Advertisement
Auxiliary revenue stream from advertisements at the charging locations

Retail colocation
Setting up EV charging stations alongside pre-existing retail stores

Network interoperability
Opening up propriety-registered charging stations to all drivers, irrespective of their subscription contract with other networks

Vertical coinvestment
Getting players from dependent industries in the product(s) vertical value chain to coinvest in the asset

Neutral hosts
Capex reduction by finding partners that provide real estate and fund charger costs in lieu of a fixed revenue share

Cost levers

Source: EY analysis

Impact of levers

Levers	Revenue enhancement	Cost reduction	IRR improvement
Smart charging services	32%		8%
Advertisement	6%		7%
Retail colocation	12%		6%
Network interoperability	20%		4%
Vertical coinvestment		35%	5%
Neutral hosts		47%	12%

* In the figure above, revenue enhancement accounts for the incremental revenue each lever adds in the 10th year. Cost reduction takes into account the capex reduction achieved under these levers. Smart charging services considers Internal Rate of return (IRR) improvement when compared with the base case.

EY Global Analysis

References

1. https://www.iea.org/articles/green-stimulus-after-the-2008-crisis
2. "Assessment of Climate Change over the Indian Region", A Report of the Ministry of Earth Sciences (MoES), Government of India, 2020
3. "Rural health Statistics (2018-19), Government of India, Ministry of Health and Family Welfare, Statistics Division
4. https://mnre.gov.in/the-ministry/physical-progress
5. https://pib.gov.in/PressReleasePage.aspx?PRID=1622459
6. https://pib.gov.in/Pressreleaseshare.aspx?PRID=1696498
7. Educational statistics at a glance, Government of India, Ministry of Human Resource Development, Department of School Education & Literacy, Statistics Division, 2018
8. Neeraj Kuldeep, Madhura Joshi, Akanksha Tyagi, Tanmay Bishnoi, Sameer Kwatra, Anjali Jaiswal, and Praveen Saxena. 2019. Powering Jobs Growth with Green Energy. Council on Energy, Environment and Water, Natural Resources Defense Council, and Skill Council for Green Jobs.
9. "State of the Decentralized Renewable Energy Sector in India", 2018-19, Clean Energy Access Network, Shakti Sustainable Energy Foundation
10. https://economictimes.indiatimes.com/small-biz/productline/power-generation/heres-whats-in-for-the-residential-sector-in-the-implementation-of-phase-ii-of-grid-connected-rooftop-solar-programme/articleshow/71705334.cms?from=mdr
11. "Identifying barriers for rooftop solar uptake in MSMEs and development of a mitigating financial framework" Sustainable Partnership for Rooftop Solar Acceleration In Bharat – EY, Published in January 2020
12. https://about.bnef.com/blog/solar-power-finds-ripe-new-market-in-crop-protection/#:~:text=The%20fusion%20of%20agriculture%20and,slices%20away%20performance%20from%20both.
13. "Future of Solar Photovoltaic", "Deployment, investment, technology, grid integration and socio-economic aspects", A Global Energy Transformation paper, IRENA, November 2019
14. Renewables 2020 Analysis and forecast to 2025; IEA 2020
15. Monthly summary for the cabinet for the month of November 2020; MNRE, Govt. of India
16. CEEW-CEF Market Handbook Q1&2, 2020-21
17. Plant wise details of Underconstruction renewable energy projects and status of associated transmission network; CEA 2020
18. https://www.americanprogress.org/issues/green/reports/2021/02/18/495999/renewed-u-s-india-climate-cooperation/
19. India's Power Outlook, Volume 3, Unpacking-the-Impact-of-Electricity-Demand, Vasudha Foundation, Feb'21
20. https://www.pib.gov.in/PressReleasePage.aspx?PRID=1671912
21. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1710134
22. https://ieefa.org/wp-content/uploads/2021/01/Viability-Assessment_New-Domestic-Solar-Module-Manufacturing-Units_January-2021.pdf
23. https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/plugging-in-what-electrification-can-do-for-industry
24. https://cef.ceew.in/masterclass/analysis/do-indian-ev-policies-adequately-support-charging-infrastructure-to-fuel-mobility-transition
25. https://dhi.nic.in/writereaddata/UploadFile/EoI%20EV%20Charging.pdf
26. https://www.thehindu.com/news/national/govt-plans-to-set-up-charging-infrastructure-across-69000-petrol-pumps/article33162526.ece
27. https://energy.economictimes.indiatimes.com/news/renewable/nlc-india-coal-india-jv-to-invest-in-3000-mw-solar-power-projects/81661875
28. https://www.ey.com/en_gl/power-utilities/how-to-make-ev-charging-pay
29. "Electric Vehicle Charging Infrastructure and Impacts on Distribution Network", Greening the Grid (GTG) – Renewable Integration and Sustainable Energy (RISE) Initiative, USAID and Ministry of Power, Government of India, June 2020
30. https://jmkresearch.com/renewable-sector-published-reports/viability-assessment-of-new-domestic-solar-module-manufacturing-units/
31. https://solarrooftop.gov.in/grid_others/phase2SanctionList
32. https://www.pib.gov.in/PressReleasePage.aspx?PRID=1644529#:~:text=Prime%20Minister%20Shri%20Narendra%20Modi,and%20post%2Dharvest%20agriculture%20infrastructure
33. https://www.meity.gov.in/writereaddata/files/MSIPS%20Notification.pdf
34. Presentation on Soura Scheme, KSEB, MNRE, 2020
35. COVID-19 and a Just Transition in India's Coal Mining Sector, Johns Hopkins SAIS, The Initiative for Sustainable Energy Policy (ISEP), August 2020
36. https://mnre.gov.in/img/documents/uploads/file_f-1615355045648.PDF

EY offices

Ahmedabad
22nd Floor, B Wing, Privilon
Ambli BRT Road, Behind Iskcon
Temple, Off SG Highway
Ahmedabad - 380 015
Tel: + 91 79 6608 3800

Bengaluru
12th & 13th floor
"UB City", Canberra Block
No.24 Vittal Mallya Road
Bengaluru - 560 001
Tel: + 91 80 6727 5000

Ground Floor, 'A' wing
Divyasree Chambers
11, O'Shaughnessy Road
Langford Gardens
Bengaluru - 560 025
Tel: + 91 80 6727 5000

Chandigarh
Elante offices, Unit No. B-613 & 614
6th Floor, Plot No- 178-178A
Industrial & Business Park, Phase-I
Chandigarh - 160 002
Tel: + 91 172 6717800

Chennai
Tidel Park, 6th & 7th Floor
A Block, No.4, Rajiv Gandhi Salai
Taramani, Chennai - 600 113
Tel: + 91 44 6654 8100

Delhi NCR
Golf View Corporate Tower B
Sector 42, Sector Road
Gurugram - 122 002
Tel: + 91 124 443 4000

3rd & 6th Floor, Worldmark-1
IGI Airport Hospitality District
Aerocity, New Delhi - 110 037
Tel: + 91 11 4731 8000

4th & 5th Floor, Plot No 2B
Tower 2, Sector 126
Gautam Budh Nagar, U.P.
Noida - 201 304
Tel: + 91 120 671 7000

Hyderabad
THE SKYVIEW 10
18th Floor, "SOUTH LOBBY"
Survey No 83/1, Raidurgam
Hyderabad - 500 032
Tel: + 91 40 6736 2000

Jamshedpur
1st Floor, Shantiniketan Building,
Holding No. 1,
SB Shop Area, Bistupur, Jamshedpur
– 831 001
Tel: + 91 657 663 1000

Kochi
9th Floor, ABAD Nucleus
NH-49, Maradu PO
Kochi - 682 304
Tel: + 91 484 433 4000

Kolkata
22 Camac Street
3rd Floor, Block 'C'
Kolkata - 700 016
Tel: + 91 33 6615 3400

Mumbai
14th Floor, The Ruby
29 Senapati Bapat Marg
Dadar (W), Mumbai - 400 028
Tel: + 91 22 6192 0000

5th Floor, Block B-2
Nirlon Knowledge Park
Off. Western Express Highway
Goregaon (E)
Mumbai - 400 063
Tel: + 91 22 6192 0000

Pune
C-401, 4th floor
Panchshil Tech Park, Yerwada
(Near Don Bosco School)
Pune - 411 006
Tel: + 91 20 4912 6000

FICCI offices

Jammu and Kashmir State Council

Punjab, Haryana & Himachal Pradesh Regional Advisory Council
Punjab, Haryana & Himachal Pradesh
Regional Advisory Council
SCO-20-21, Sector-9D, Madhya Marg
Chandigarh - 160009

Rajasthan State Council
202 Rajputana Tower
A-27-B, Shanti Path, Tilak Nagar
Jaipur - 302 004

FICCI Uttar Pradesh State Council
P - 135, Nehru Enclave,
Gomti Nagar,
Lucknow - 226010

North-East Advisory Council
7th Floor, "Amrit Enclave",
M. R. Dewan Road,
Opp. East Point Tower,
Bamunimaidam,
Guwahati-781021, Assam

Gujarat State Council
A-311, Safal Pegasus,
100 Feet Ring Road, Prahladnagar,
Ahmedabad-380015

Madhya Pradesh State Council
33, Nadir Colony, Shamla Hills,
Bhopal – 462013

Chhattisgarh State Council
R/12, Sector - 2, 1st floor, Opp. Durga
Samiti Ground
Avanti Vihar, Raipur,
Chhattisgarh - 492001

FICCI Jharkhand State Council
C/o Ms Sujata Sinha,
"Shrey" A/351, Road No. 5, Ashok
Nagar, Ranchi-834002 (Jharkhand)

West Bengal State Council
Shubham Building,9th Floor,
Unit No: 901 & 902, 1, Rawdon Street
Kolkata 700 017

Odisha State Council
555, Saheed Nagar,
Bhubaneswar-751022 (Odisha)

Maharashtra State Council
Krishnamai Cooperative Housing
Society Ltd Ground Floor,
Plot No. 33-B Pochkhanwala Road,
Worli, Mumbai - 400 030

Andhra Pradesh State Council
8-2-601, Plot # 13
4th Floor, NNR Arcade
Road Number 10, Banjara Hills
Hyderabad – 500 034

Karnataka State Council
S-715, South Block, Manipal Centre,
47, Dickenson Road,
Bangalore, 560 042.

Tamil Nadu State Council
Hariram Building II Floor No 37/6 (Old
No 16/6), College Road, Chennai - 600
006, Tamil Nadu

Kerala State Council
7th Floor, Alpha Plaza Building,
K.P. Vallon Road, North End
Kadvanthra Junction
Cochin - 682 020

Ernst & Young LLP

EY | Building a better working world

EY exists to build a better working world, helping to create long-term value for clients, people and society and build trust in the capital markets.

Enabled by data and technology, diverse EY teams in over 150 countries provide trust through assurance and help clients grow, transform and operate.

Working across assurance, consulting, law, strategy, tax and transactions, EY teams ask better questions to find new answers for the complex issues facing our world today.

EY refers to the global organization, and may refer to one or more, of the member firms of Ernst & Young Global Limited, each of which is a separate legal entity. Ernst & Young Global Limited, a UK company limited by guarantee, does not provide services to clients. Information about how EY collects and uses personal data and a description of the rights individuals have under data protection legislation are available via ey.com/privacy. EYG member firms do not practice law where prohibited by local laws. For more information about our organization, please visit ey.com.

Ernst & Young LLP is one of the Indian client serving member firms of EYGM Limited. For more information about our organization, please visit www.ey.com/en_in.

Ernst & Young LLP is a Limited Liability Partnership, registered under the Limited Liability Partnership Act, 2008 in India, having its registered office at 22 Camac Street, 3rd Floor, Block C, Kolkata - 700016

EYIN2105-002
ED None

This publication contains information in summary form and is therefore intended for general guidance only. It is not intended to be a substitute for detailed research or the exercise of professional judgment. Neither EYGM Limited nor any other member of the global Ernst & Young organization can accept any responsibility for loss occasioned to any person acting or refraining from action as a result of any material in this publication. On any specific matter, reference should be made to the appropriate advisor.

RG

About FICCI

Established in 1927, FICCI is the largest and oldest apex business organisation in India. Its history is closely interwoven with India's struggle for independence, its industrialization, and its emergence as one of the most rapidly growing global economies. A non-government, not-for-profit organisation, FICCI is the voice of India's business and industry. From influencing policy to encouraging debate, engaging with policy makers and civil society, FICCI articulates the views and concerns of industry. It serves its members from the Indian private and public corporate sectors and multinational companies, drawing its strength from diverse regional chambers of commerce and industry across states, reaching out to over 2,50,000 companies. FICCI provides a platform for networking and consensus building within and across sectors and is the first port of call for Indian industry, policy makers and the international business community.

Disclaimer

This document has been published for information and illustrative purposes only and does not constitute professional advice. FICCI neither accept or assume any responsibility or liability to any reader of this publication in respect of the information contained within it or for any decision readers may take. Any use of this report other than as a whole and in conjunction with this disclaimer is prohibited. This report may not be copied in whole or in part. The information contained in this report is not intended to address the circumstances of any particular individual or entity. Although the report endeavours to provide accurate and timely information, there can be no guarantee that such information is accurate as of the date it is received or that it will continue to be accurate in the future. No one should act on such information without appropriate professional advice.