FUTURE CHALLENGES IN INDIAN POWER SECTOR INCLUDING THE REMEDIAL ACTIONS

Presented by:
Joydeb Bandyopadhyay
Ammi Toppo
Apoorva Anand
Integration of 175 GW Installed Capacity from Renewable Energy Sources by 2022

Low PLF and flexible operation of the Thermal plants

Adequate balancing capacity, steep ramping requirements

Acute shortage of Natural Gas

Underutilized Manufacturing Capacity.

Implementation of the new environmental norms leading to retirements of units.

Large scale disposal of energy storage devices like batteries

CHALLENGES FOR INDIAN POWER SECTOR
• RES CAPACITY (as on 31.03.2017): 57,260 MW.

• 3 TIMES MORE TO BE ACHIEVED WITHIN 5 YEARS.

• FUND REQUIREMENT: AROUND 6,48,050 CRORES

• FUNDING SOURCES: SCHEDULED COMMERCIAL BANKS, FINANCIAL INSTITUTIONS LIKE PFC, REC, LIC.

• BANKS AND INSTITUTIONS ARE MIRED WITH ISSUES LIKE MOUNTING BURDEN OF NPAS AND FISCAL BAIL OUT OF DISCOMS.

• STATE FINANCES ARE ALSO CONSTRAINED FOR GIVING CONSISTENT SUBSIDIES OR GRANTS FOR PROJECTS.
LONG TERM SUSTAINABILITY OF RES PROJECTS GETTING VULNERABLE!

• LOWEST BID PRICE  ₹ 2.44 PER KWH TILL DATE (BHADLA SOLAR PARK).

• COMPETITION GETTING SEVERE: FALLING PROFIT MARGINS AND RETURN ON CAPITAL EMPLOYED.

• RISKS
  • NONPAYMENT OF DUES FOR POWER PURCHASED.
  • REFUSAL OF UTILITIES TO OFF-TAKE POWER.
  • STATES ARE DEFERRING THEIR POWER PROCUREMENT PLANS FROM RES TO BENEFIT FROM THIS TRENDS OF PRICES.

Price plunge

In a February auction, solar project rates touched a record low of Rs2.97 per kilowatt hour (kWh)

Rewa solar park tariff (Rs/kWh)

The rates in the chart refer to the so-called levelized tariff—the value financially equivalent to different annual tariffs over the period of the power purchase agreement. The first-year tariff at Rewa is Rs2.97 per unit.

Source: Bloomberg
GOVERNMENT INITIATIVES – ARE THEY EFFECTIVE?

- **FISCAL INCENTIVES AND SUBSIDIES**: VIABILITY GAP FUNDING FROM NATIONAL CLEAN ENERGY FUND (NCEF), ACCELERATED DEPRECIATION ETC.

- **PAYMENT SECURITY FUND** TO ENSURE VISIBILITY OF CASH FLOWS FOR SOLAR DEVELOPERS THROUGH SECI AGAINST DEFAULTS BY STATE DISTRIBUTION COMPANIES.

- FORMULATED **NATIONAL TARIFF POLICY 2016** MANDATING SOLAR RPOs TO INCREASE TO 8% BY 2022 FOR STATE UTILITIES.

- **EFFECTIVENESS OF INITIATIVES**: DELAYS IN SIGNING OF PPAS, DELAYS IN PAYMENTS ON COMMISSIONED PLANTS, AND FORCED REDUCTION/SHUTDOWN OF THEIR POWER PLANTS HAVE BEEN REPORTED BY DEVELOPERS.

- **POSSIBLE REASONS**:  
  - LACK OF ENFORCEMENT OF RPOs BY STATE REGULATORS.
  - POOR FINANCIAL HEALTH AND CREDIT WORTHINESS OF THE DISCOMS
INTEGRATION OF RES INTO THE GRID

- **INTEGRATION OF SUCH HUGE RES CAPACITY WITHIN THE GRID**

- **CAPITAL INFUSION FOR STRENGTHENING OF TRANSMISSION AND SUB-TRANSMISSION NETWORKS.**

- **GROSS MISMATCH OF THE GESTATION PERIODS OF RES GENERATION AND TRANSMISSION CAPACITIES.**
  - TRANSMISSION LINE GESTATION VARIES FROM 3-4 YEARS BUT THE GESTATION PERIOD OF INSTALLATION OF RE BASED GENERATOR IS TYPICALLY AROUND 12-18 MONTHS.
  - MAY LEAD TO BOTTLENECKING OF POWER OR RE PLANT BEING **FORCED TO BACK DOWN.**
INTEGRATION OF RES INTO THE GRID

• **COST DYNAMICS** still not conducive for **SOLAR ROOF TOPS** (40 GW by 2022) in Indian context as storage batteries are also required for their utilization.

• Distribution and sub-transmission levels need to be strengthened.

• **NET METERING** for the promotion of solar roof tops has been introduced but solar roof tops installation is still not gaining enough traction.

• Also uncertainty and variability of RES generation poses serious challenge to integrity, security and reliability of the grid.
• **INNOVATIVE SOLUTIONS** LIKE ISSUING **GREEN BONDS,** **CLIMATE BONDS** **ETC.** BY PROJECTS FOR THEIR CAPITAL REQUIREMENTS.

• **COMPREHENSIVE REGULATIONS** RELATING TO NET METERING, TIME DIFFERENTIATED TARIFFS FOR END CONSUMER, ANCILLARY SERVICES MAY BE FORMULATED SOON.

• **MULTI-FACETED PLANNING** OF GRID INTEGRATION OF THE RENEWABLE ENERGY CAPACITY CONSIDERING ALL ASSOCIATED FACTORS AND CONTINGENCIES

• **COOPERATION OF STATES** IS ALSO REQUIRED FOR THE PROMOTION OF RES.

• **SUITABLE INTER-STATE AND INTRA STATE TRANSMISSION CORRIDORS** NEED TO BE LAI**D FOR EVACUATION OF POWER FROM RE RICH STATES TO THE LOAD CENTERS. FOR EXAMPLE, **GREEN ENERGY CORRIDOR PROJECT**
• VARIABILITY AND UNCERTAINTY ASSOCIATED WITH RE GENERATION (100 GW FROM SOLAR AND 60 GW FROM WIND).

• GENERATION FROM SOLAR IS HIGHLY VARIABLE DURING THE DAY.

• VARIABILITY OF WIND ENERGY CAN BE SIGNIFICANT OVER THE SEASONS.
**BALANCING THE GRID**

- **DEMAND TO BE MET BY THE CONVENTIONAL GENERATION IN CASE OF ZERO RENEWABLE**: (158 GW - 225 GW)

- **THE NET DEMAND (WITH 175 GW OF RENEWABLE) TO BE MET BY THE CONVENTIONAL GENERATION**: 71 GW - 215 GW.

- **RAMPING REQUIREMENT OF 7500 MW/HOUR FOR ONLY 5% OF TIME FOR ZERO RENEWABLES** WHEREAS WITH 175 GW OF RENEWABLES REQUIREMENT RISES TO 21% OF THE TIME.
• THE GENERATION FROM 160 GW OF WIND AND SOLAR WILL DISPLACE CONVENTIONAL GENERATION.

• SUDDEN CLOUD COVER OR FALL IN WIND VELOCITY MAY AFFECT CONSIDERABLY THE PLANNED LOAD FLOWS WITHIN THE NETWORK.

• GAS POWER PLANTS AND HYDRO POWER PLANTS ESPECIALLY PUMPED STORAGE TYPE HYDRO PLANTS WILL BE REQUIRED.
  • BUT AVAILABILITY OF HYDRO POWER AND HYDRO CAPACITY DEVELOPMENT IS RESTRICTED DUE TO SEVERAL CONSTRAINTS.
  • SHORTAGE OF DOMESTIC GAS FOR POWER SECTOR

• LARGE CAPACITY BATTERIES WHICH ARE IN NASCENT STAGES OF DEVELOPMENT CAN ALSO CONTRIBUTE IN MEETING THE PEAKS.
SHORTAGE OF DOMESTIC GAS

- **UNAVAILABILITY OF SUFFICIENT DOMESTIC GAS** for running power plants (~24 GW)

- Gas supplied to the gas based power plants **28.26 MMSCMD (2015-16)**

- **IMPORTED RLNG**: Uneconomical option for plants - no dispatch

- Around **53.56 MMSCMD GAS** would be required for balancing and peaking requirement of the grid by 2022.

**IN ABSENCE OF GAS:**

- Uphill task for the grid operator to meet demand requirement along with maintaining grid security & reliability.

- Thermal power plants would have to carry out retrofitting to increase their ability to ramp up significantly: **CAPEX REQUIREMENT**
SUGGESTIONS

• ADVANCE AND PRECISE FORECASTING OF RES GENERATION.

• DEMAND SIDE MANAGEMENT – TO ENCOURAGE THE USE OF MAXIMUM RE WHILE THE AVAILABILITY OF ENERGY IS HIGH AND PRICES OF ENERGY ARE LOW.

• FOR OPTIMUM DEMAND RESPONSE, SMART GRID TECHNOLOGIES INVOLVING SMART METERS OR EFFECTIVE COMMUNICATION TECHNOLOGIES ARE REQUIRED.

• INTERCONNECTION OF GRID AT REGIONAL AND NATIONAL LEVEL IS ALSO TO BE IMPROVED.

• FOCUS ON HYDRO POWER DEVELOPMENT CAN BE VERY USEFUL FOR OFFSETTING THE RES VARIABILITY IN FUTURE.
• ENERGY GENERATED BY 175 GW OF RES WOULD BE AROUND 21% OF THE TOTAL ENERGY REQUIRED IN 2021-22.

• PLF OF THERMAL POWER PLANTS MAY FALL TO THE LEVEL OF AROUND 48-50 % IN 2022.
POSSIBLE REASONS

- **RATE OF CAPACITY ADDITION HAS OUTPACED** THE RATE OF GROWTH OF DEMAND IN 12TH PLAN.
  - ENERGY DEMAND CAGR : 4.04 %, INSTALLED CAPACITY CAGR : 10.3 %

- **EXCESS CAPACITY ADDITION IN THERMAL**
  - TARGET WAS FIXED AT 72,340 MW BUT THE CAPACITY ADDITION ACHIEVED WAS 91730.45 MW.

- **DELICENSING OF THERMAL GENERATION** BY ELECTRICITY ACT 2003.

- **UNDER CONSTRUCTION THERMAL CAPACITY** OF MORE THAN 50,000 MW - BENEFIT BY 2022.
  - ADDITIONAL CAPACITY : MAY REMAIN UNDER-UTILIZED SIGNIFICANTLY.

- **PEAKING REQUIREMENT LEADS TO DESPATCH OF THERMAL CAPACITIES FOR SMALL DURATION** TO MEET THE PEAK DEMAND AS RE GENERATION TIME AND PEAK DEMAND TIME DOES NOT COINCIDE AT ALL.
• COAL AND LIGNITE BASED CAPACITY NEED TO BE FLEXIBLE.

• THE HOURLY DESPATCH FROM COAL BASED CAPACITY COULD DROP TO ABOUT 30,000 MW DURING THE TIME OF PEAK SOLAR GENERATION AND WOULD RAMP UP TO AROUND 1,10,000 MW WITHIN 6 HOURS DURING A TYPICAL DAY IN MONSOON. (12,500 MW/HR FOR 10% OF THE DURATION WITHIN A YEAR)
SUGGESTIONS

• THE COST OF COAL BASED GENERATION MAY INCREASE DUE TO SURGE IN OPERATION AND MAINTENANCE COSTS.

• TO PROMOTE FLEXIBILITY AND COMPENSATE FOR THE LOSS OR CAPEX: **SUITABLE FISCAL INCENTIVES** NEED TO BE PROVIDED.

• **NEW TARIFF REGULATIONS** NEED TO BE FORMULATED BY CERC/SERCS IN KEEPING WITH REQUIREMENT OF THE TIMES AHEAD.
• COAL BASED GENERATION CAPACITY ADDITION REQUIRED DURING 2017-22 & 2022-27 - NIL

• LARGE CAPITAL INVESTMENT IN THE MANUFACTURING SECTOR AND SEVERAL JOINT VENTURES BY THE INTERNATIONAL MANUFACTURERS SET UP IN INDIA.

• ADEQUATE INDIGENOUS MANUFACTURING CAPACITY FOR SUPERCritical EQUIPMENT CONSISTING OF 22,700 MW PER YEAR FOR BOILER AND 24,500 MW PER YEAR FOR TURBINE- GENERATOR

• HEAVY INVESTMENT IN THE AREAS ASSOCIATED TO POWER PLANT CONSTRUCTION I.E. BALANCE OF PLANT

• SEVERAL MANUFACTURERS HAVE STARTED REPORTING LACK OF SUFFICIENT ORDERS.

  ➢ CAPACITY UTILIZATION FACTOR FOR SEVERAL MANUFACTURING UTILITIES IS QUITE LOW.

• THIS MAY RENDER THE MANUFACTURING CAPACITY AND ASSOCIATED CAPITAL UNUTILIZED
• FOCUS ON DEVELOPMENT OF RES MAY CONTINUE BEYOND 2022 AS INDIA HAS TO COMPLY WITH ITS INDC.

• REQUIREMENT OF NO ADDITIONAL COAL BASED CAPACITY IN IMMINENT FUTURE MAY DEAL A SEVERE BLOW TO THE LARGE MANUFACTURING BASE FOR THERMAL POWER PLANT’S EQUIPMENT.

• DEMAND PROJECTIONS CARRIED OUT IN 19TH ELECTRIC POWER SURVEY DO NOT CREATE A ROSY PICTURE FOR FUTURE.

➢ SUGGESTIONS

INCENTIVES FOR EXPORTS IN THE FORM OF TAX BENEFITS/ SUBSIDIES FROM THIS SECTOR MAY BE CONSIDERED TO BOOST EXISTING MANUFACTURING BASE.
• **India committed to** **Reduce Emissions Intensity** of GDP by 33 to 35 percent by 2030.

• **Installation of (FGD) Systems** has been made **mandatory by Dec 2017**.

• **Installation of FGD Technology** by plants **entails large capital expenditure** of about 0.5 crore per MW.

• **Thermal Power Stations** have been deferring this CAPEX as they would be **rendered uncompetitive** due to additional incurred cost of generation.

• **No regulation** being framed for the increase in the **tariff of energy** for FGD.
• **SPACE REQUIREMENT** FOR INSTALLATION OF FGD, STORAGE OF LIMESTONE AND GYPSUM, ADDITIONAL WATER REQUIREMENT AND LIMESTONE SOURCE IDENTIFICATION.

• **OPPOSED BY SEVERAL STATE UTILITIES** AS RETIREMENT OF ANY PROJECT WILL AFFECT SEVERAL OF ITS STAKEHOLDERS

• **CRITICAL ISSUES LIKE**
  - **MAN POWER** EMPLOYED IN SUCH PROJECTS WOULD BE **RENDERED JOBLESS**.
  - SHUTTING DOWN THE PROJECT MAY ALSO FACE **LOCAL AGITATION**.

• **DISPOSAL OF THE SCRAP** WHICH MIGHT BE GENERATED IN THE PROCESS.

• **MAINTAINING GRID STABILITY** WITH HIGH RETIREMENTS.
  - AROUND 34,000 MW CAPACITY SHALL BE RETIRED IN THE COMING YEARS./**RECENT ASSESS.**
• Retirement at a large scale will also affect the power procurement plans of the states.

• Further burden the finances of the state if new capacities are planned in place of inefficient ones.

➤ Suggestions

• Phasing out of units over the coming years is carried out in a manner which causes minimal disturbance to the grid.

• To ensure that sufficient new capacity is commissioned before the units are retired.

• The people rendered jobless may be rehabilitated and provided training to be absorbed in generation capacities likely to benefit.
LARGE SCALE DISPOSAL OF ENERGY STORAGE DEVICES

• **BATTERIES** can be quite **useful to compensate** for the **variability** of RES generation.

• **Handling and recycling of batteries** in India governed by: Batteries (Management and Handling) Rules, 2001
  • To collect a minimum of 90% of the batteries sold by them.
  • Compliance of these rules is in dire straits.

• Lead recycling industry is in **nascent stage** in India.

• **Economies of scale** still not achieved despite rampant use of lead acid batteries.

• **Cheap and polluting technologies** are thriving through small operators.

• **Backyard smelting** of used lead acid batteries is rampant
  • Jeopardize the health of the workers and is an **environmental hazard**.

• With onset of electric vehicles and solar roof tops installations, battery use would be more widespread.
LITHIUM ION BATTERY

- LITHIUM ION BATTERIES ARE GAINING ATTENTION FROM BATTERY MANUFACTURERS
- LI ION BATTERY RECYCLING PROCESS IS MORE COMPLICATED
- AN ECO VIABLE TECHNOLOGY FOR LI ION BATTERY RECYCLING IS STILL UNDER DEVELOPMENT
- USED LI-ION BATTERIES MAY END UP IN THE WRONG RECYCLING STREAMS DUE TO LACK OF AWARENESS AND REGULATIONS.
SUGGESTIONS

• SUITABLE METHODOLOGIES NEED TO BE DEVISED FOR SEGREGATING AND RECYCLING LI-ION BATTERIES

• FORMULATE REGULATIONS FOR DISPOSAL/RECYCLING OF DIFFERENT KINDS OF BATTERIES BASED ON ECONOMICALLY AND ENVIRONMENTALLY SOUND PRINCIPLES.

• LABELLING OF BATTERY COMPONENTS BY MEANS OF BAR CODES, RFID CHIPS ETC. CAN BE QUITE USEFUL.

• PROVIDING INCENTIVES FOR GOOD RECYCLING PRACTICES AND PENALTIES FOR THE BAD ONES.

• FORMULATIONS OF STRICT LAWS FOR RECYCLING AND INCENTIVIZING THE CUSTOMERS TO SURRENDER THE USED BATTERIES.
THANK YOU
• THERMAL CAPACITY WILL BE REQUIRED TO BACK DOWN CONSIDERABLY DURING THE TIME OF PEAK SOLAR GENERATION.

• RAMPING UP REQUIREMENT IN THE GRID WILL BE MORE THAN 12,500 MW/HR FOR 10% OF THE DURATION WITHIN A YEAR.

• RETROFITTING BASED ON LATEST TECHNOLOGY IS NEEDED – CAPEX WILL BE REQUIRED.
CHALLENGES AND FUTURE SCENARIO

• HEAVY INVESTMENT IN THE AREAS ASSOCIATED TO POWER PLANT CONSTRN. LIKE BALANCE OF PLANT SYSTEMS SUCH AS COAL HANDLING PLANT, ASH HANDLING PLANT, WATER TREATMENT / DM PLANT, COOLING TOWERS, CW SYSTEM, CHIMNEY, ELECTRICAL SYSTEMS AND SWITCHYARD.

• SEVERAL MANUFACTURERS HAVE STARTED REPORTING LACK OF SUFFICIENT ORDERS.
  • CAPACITY UTILIZATION FACTOR FOR SEVERAL MANUFACTURING UTILITIES IS QUITE LOW.

• THIS MAY RENDER THE MANUFACTURING CAPACITY AND ASSOCIATED CAPITAL UNUTILIZED
  • MAY END UP BEING ADDED TO THE LIST OF NON-PERFORMING ASSETS OF THE BANKS.
• **BACKYARD SMELTING** OF USED LEAD ACID BATTERIES IS RAMPANT
  • **JEOPARDIZE THE HEALTH** OF THE WORKERS AND IS AN **ENVIRONMENTAL HAZARD**.
• WITH ONSET OF ELECTRIC VEHICLES AND SOLAR ROOF TOPS INSTALLATIONS, BATTERY USE WOULD BE MORE WIDESPREAD.
• **RECYCLING FACILITIES OF AMPLE CAPACITY** IS NEEDED TO BE SET UP.
IN ABSENCE OF GAS:

- ARDUOUS TASK FOR THE GRID OPERATOR TO MEET DEMAND REQUIREMENT ALONG WITH MAINTAINING GRID SECURITY & RELIABILITY.
- THERMAL POWER PLANTS WOULD HAVE TO CARRY OUT RETROFITTING TO INCREASE THEIR ABILITY TO RAMP UP SIGNIFICANTLY.