THE 33RD CLEAN COAL DAY INTERNATIONAL SYMPOSIUM

B. C. Mallick, Principal Chief Engineer,
Central Electricity Authority, Ministry Of Power

STRATEGIC ENERGY TRANSITION

- Policies and Programme
- Recognisation of sources
- Regulations
- Promoting Markets and Competition
- Priority Research Areas

POLICIES AND PROGRAMME

a) **Ambitious targets for Solar and Wind:** solar and wind capacity addition by 2030

b) '**Must-run' priority dispatch status for renewables:** Preference is given to RE power in the merit order dispatch

c) **Renewable Purchase Obligations (RPO):** These are obligations for the purchase of renewable power, specified by State Electricity Regulatory Commissions for distribution companies, open access consumers and captive plants.

d) **Promotion of Hydro Power**: This is being undertaken through several policy measures to tap hydro power potential in the country, including the introduction of Hydro Purchase Obligation.

e) **Energy Storage Obligations**: These are being progressively introduced. According to the policy document, there is a stipulated annual increase in ESO for all obligated entities, beginning at 1% in FY 2023–24 and reaching 4% in FY 2029–30.

f) **Green energy corridors:** These are being developed to strengthen transmission networks in RE rich States.

g) **Policy and financial incentives**: These include solar park development, accelerated depreciation on investment, waiver on transmission charges, and capital subsidy for residential solar roof-top.

h) **Thrust to increase nuclear installed capacity:** Capacity shall be increased

i) **Agricultural solar pumps are being promoted .** The consumption of energy (18%)in the agriculture sector is an important aspect to ensure the food security aspect of the country and the globe, as large energy consumption is required for irrigation pumps.

POLICIES AND PROGRAMME

j) **Manufacturing support** such as production-linked incentives for solar, electric vehicles and battery storage systems.

k) **Establishment** of a 'Renewable Energy Management Centre' for supervision, monitoring and control of RE.

l) **Policy and financial assistance** for promotion of waste to energy measures.

m) **Enabling bundling of thermal and hydro** power with RE to enhance flexibility.

n) **Policies** to support biomass use for power generation.

o) **PAT Scheme:** This will enable alignment with the goals of the NDC, mainly through energy efficiency and conservation activities included under standards and labelling programme for appliances, building efficiency programme, industrial efficiency improvement under **Perform, Achieve and Trade (PAT)** scheme.

p) **National Green Hydrogen Mission:** The Mission will lead to significant de-carbonisation of the economy, Green hydrogen has great potential for the decarbonization of hard-to-abate sectors.

q) **Support to R&D** in carbon capture and utilization.

r) **Developing** storage systems (Pumped Storage Plants, Battery Energy Storage Systems etc.)

RECOGNISATION

Recognize all sources, options and commercially viable technologies, along with new innovations that can help in a time-bound manner in achieving a clean energy transition.

- Expansion of solar, hydro and wind capacities
- More nuclear power capacities addition
- Flexibilisation of coal based plants
- Energy storage system- PSP, BESS
- Increase share of energy from waste and biomass
- Carbon capture utilization and storage (CCUS) technologies in coal based plants

Green hydrogen is likely to play a significant role in decarbonizing energy use in many of the emission intensive industries.

Zero Emission Vehicles (ZEVs) and biofuels also offer a promising potential to transition the sector away from fossil fuels.

PRESENT AND FUTURE GENERATION

PRESENT INSTALLED CAPACITY AND GENERATION

Fuel Type	Year,2023-24			
	Installed capacity		Generation	
	GW	(%)	MU	(%)
Coal and lignite	217.59	49.36	1,294,072	75.26
Hydro	46.93	10.65	134,054	7.80
Small Hydro and Biomass	15.36	3.48	12,902	0.75
Nuclear	8.18	1.86	47,817	2.78
Solar and Wind	127.70	28.97	199,360	11.59
Gas	25.04	5.68	31,302	1.82

Non-fossil: 198 GW 45 (%)

Non-fossil: 394134 MU 23 (%)

PRESENT AND ANTICIPATED INSTALLED CAPACITY

Fuel Type	Actual As on 31.03.2024		Target As on 31.03.2030	
	GW	(%)	GW	(%)
Coal and lignite	217.59	48.57	252	33.20
Hydro	46.93	10.47	54	7.11
Small Hydro and Biomass	16.00	3.57	20	2.64
Nuclear	8.18	1.83	15	1.98
Solar and Wind	134.28	29.97	393	51.78
Gas	25.04	5.59	25	3.29

Non-fossil (2024): 205 GW 46 (%)

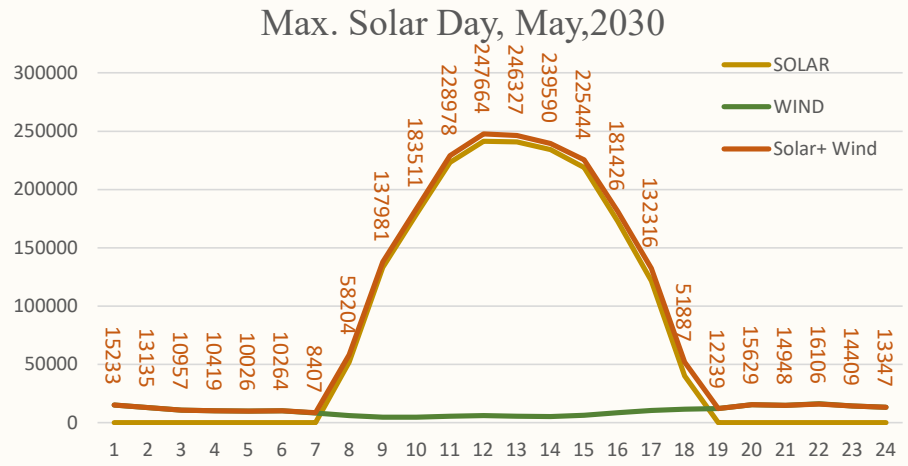
Non-fossil (2030): 482 GW 64 (%)

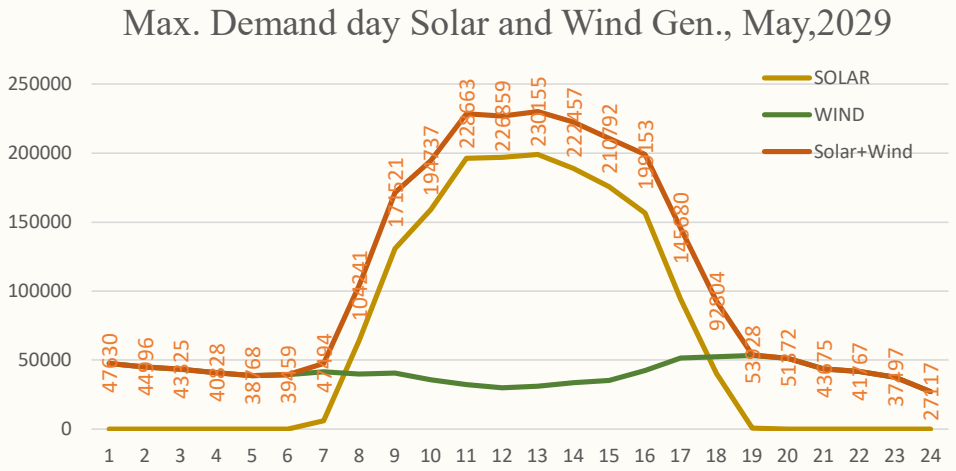
ANTICIPATED GENERATION CAPACITY (GW)

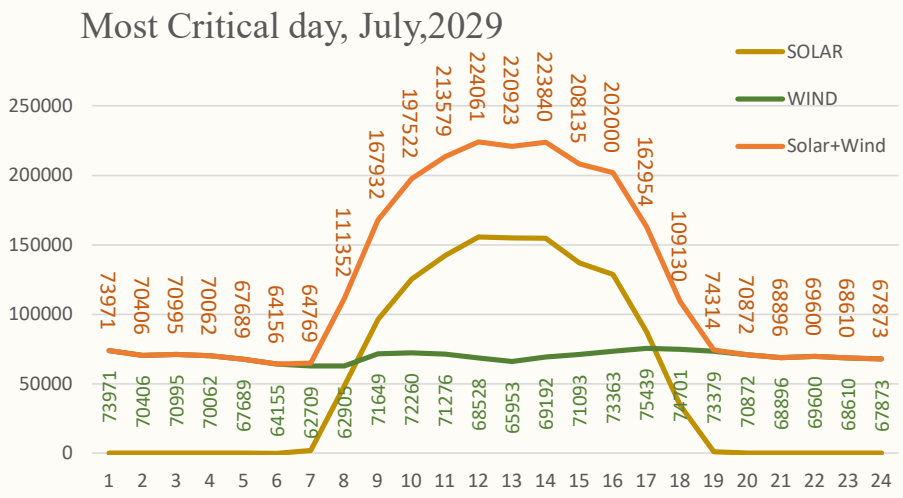
Fuel Type	2029-30	2031-32	2046-47	2049-50
Fossil Fuel	277	285	250	240
Nuclear	15	20	54	54
Hydro#	54	62	92	109
PSP	19	27	116	117
Small Hydro	5	5	6	6
Solar	293	365	1191	1409
Wind	100	122	436	474
Biomass	15	16	23	25
Total Non-Fossil	501	616	1918	2194
Total Installed Capacity	777	900	2168	2434
BESS (MW/MWh)	42/208	47/ 2,36	364/2006	484/2755

GRID BALANCING IN YEAR, 2029-30

SOLAR & WING GENERATION (GW) in 2029-30



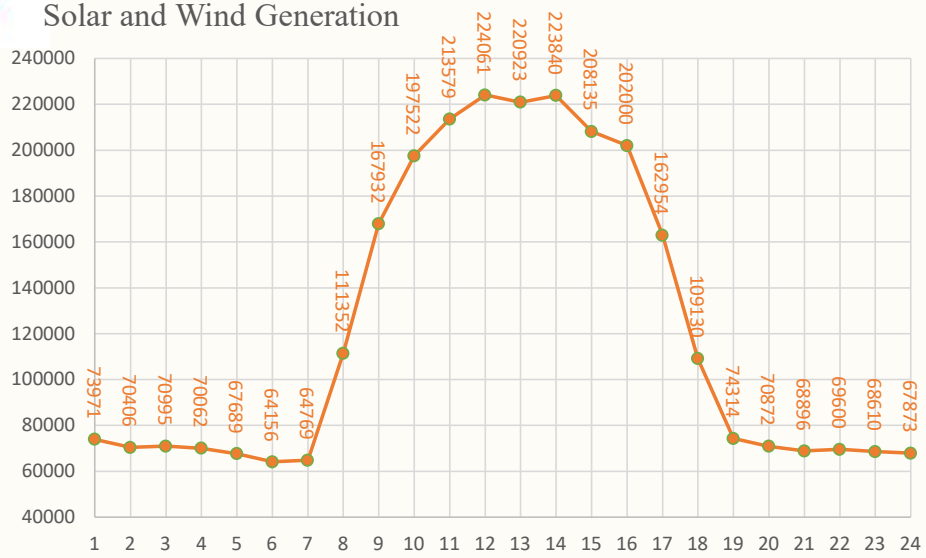




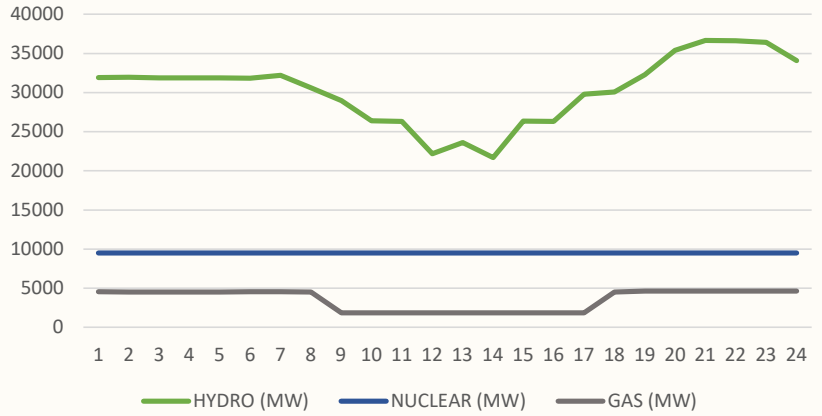
Recommended Battery Storage capacity: 42 GW

MOST CRITICAL DAY BALANCING IN 2029-30

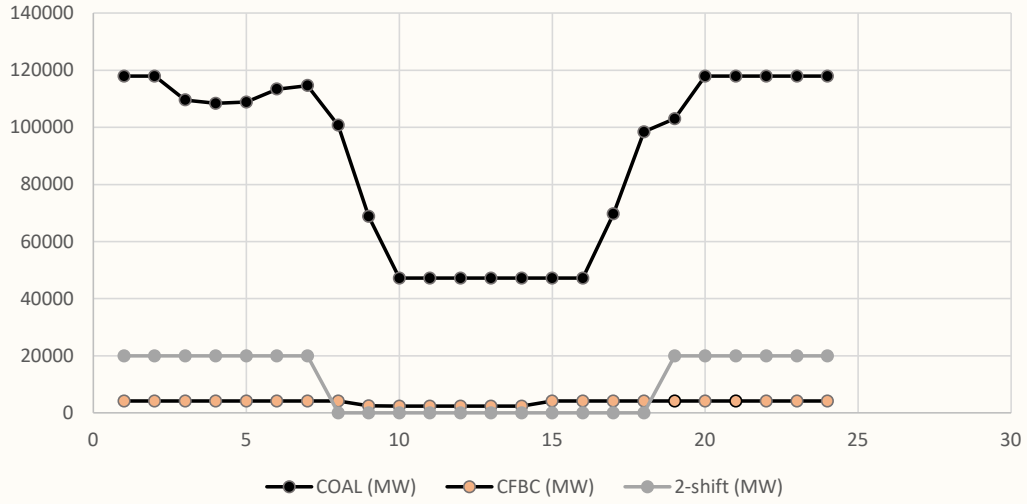
Solar and Wind Generation



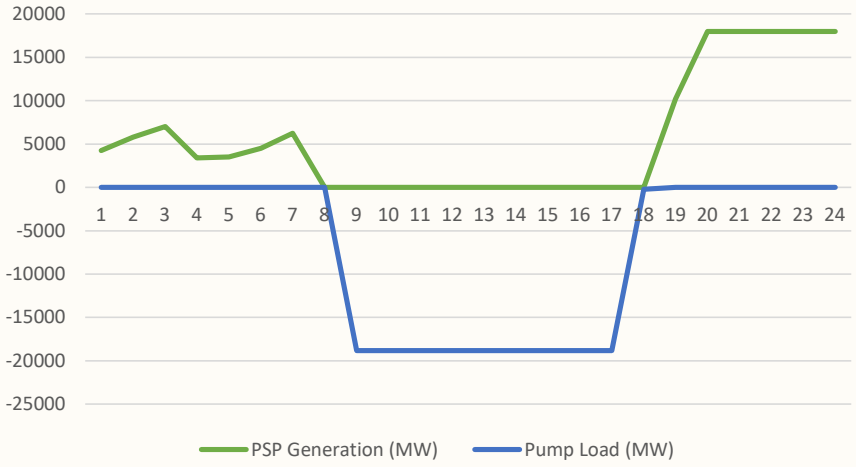
Hydro-Nuclear-Gas Generation



Coal Power plants Generation



PSP Generation and Load



COAL POWER PLANTS ON MOST CRITICAL DAY

The balancing of most critical day by operating flexible coal plants, CFBC and old TPP at 40% MTL, 55% MTL and 2-shift needs Battery storage capacity of 22679 MW.

	Gas Gen. (MW)	Hydro Gen. (MW)	Nuclear Gen. (MW)	Solar & Wind (MW)	PSP Gen. (MW)	Pump Load (MW)	Coal Gen. (MW)	CFBC Gen. (MW)	Old plants Gen. (MW)	Battery Gen./ Load (MW)	Demand (MW)
Max.	4616	36657	9474	224061	17985	0	107110	4200	20000	20240	289178
Min.	1847	21682	9474	64156	0	-18836	42884	2310	0	-22679	250177
MTL(%)							40.04	55.00	0.00		

Max. Coal Gen. (flexible plants+CFBC+Old TPPs in MW)	131310
Synchronished coal capacity (MW)	143137
Coal Capcity needed (MW)	168397
Ramp up rate (MW/Min.)	479
Ramp down rate (MW/Min.)	531
BSS Power (MW)	22679

REGULATION ON TECHNICAL MINIMUM LOAD

CEA has also notified a Regulation regarding Flexible operation of coal based Thermal Power Generating Units on 30.1.2023.

1. The 55% minimum load and 2% ramp rate operating requirement shall have to be implemented by all thermal generating units (Central/State/Pvt) within one year of the notification of the regulation.

2. Power plants shall implement measures, if required, as per the phasing plans by the respective power plants owners to operate thermal unit at 40% minimum load with following ramp rate:

   1% per minute - 40% to 55% and 55% to 40% load
   2% per minute - 55% to 70% and 70% to 55% load
   3% per minute - 70% to 100% and 100% to 70% load

PHASING PLAN

		PILOT PHASE	PHASE I	PHASE II	PHASE III	PHASE IV		Total
			July,2024-Jun,2026	July,2026-Jun,2028	July,2028-Dec,2029	Jan,2030-Dec,2030		
		(40%)	(40%)	(40%)	(40%)	(40%)	2-shifting(age>40 yrs)	
CENTRAL	UNITS	5	28	27	11	43	36	**150**
	CAPACITY(MW)	2490	17510	11850	4730	16850	9910	**63340**
STATE	UNITS	4	27	23	34	45	49	**182**
	CAPACITY(MW)	2760	15910	10480	10590	11810	9915	**61465**
PRIVATE	UNITS	1	41	65	36	14	4	**161**
	CAPACITY(MW)	600	20960	31035	12055	6420	862	**71932**
TOTAL	TOTAL (UNITS)	**10**	**96**	**115**	**81**	**102**	**89**	**493**
	Capacity (MW)	**5850**	**54380**	**53365**	**27375**	**35080**	**20687**	**196737**

BALL & TUBE	UNITS	34
	CAPACITY(MW)	8950
CFBC	UNITS	54
	CAPACITY(MW)	6001
2 - SHIFTING	UNITS	6
	CAPACITY(MW)	378
GRAND TOTAL	UNITS	587
	CAPACITY(MW)	212066

ROADMAP FOR RENEWABLE INTEGRATION IN YEAR, 2030

- CEA **(Flexible operation of coal based thermal power generating units) Regulations, 2023** notified on 30th January, 2023.
- A report on Flexiblization of coal fired Thermal Power Plants – A Roadmap for achieving **40%Technical Minimum Load** has been prepared, published and widely circulated in 2023.
- Phasing plan for achieving 40% upto year 2030 for T**echnical Minimum Load has been notified in Gazette in Dec,2023**
- 40% low load study- successfully completed at Ukai, Sagardighi, Dadri, Mauda, Maithon , DSTPS , Raichur and Ramagundem.
- 10 units have been selected for 40% compliance by December, 2024 under pilot phase

COST OF FLEXING

I. **Capital Expenditure (CAPEX):** One-time expenditure to be incurred in retrofitting of various measures to make the plant capable of low load operation.

II. **Operational Expenditure (OPEX):**

i. Cost due to increase in Net Heat Rate

ii. Cost due to Increased Life Consumption (damage costs)

iii. Cost due to additional oil consumption for additional EFOR

III. **Compensation methodology** for below 55% low load operation upto 40% - Methodology has been approved by MOP and sent to CERC.

COMPENSATION

1. Capital Expenditure: One-time expenditure to be incurred for retrofitting of various measures to make the plant capable of low load operation. An estimated capital investment of Rs 10 crores to 30 crores for each unit shall be required depending on unit's age, size, existing plant's control & instrumentation system etc.

Unit size (MW)	Loading (%)	Increase in tariff (paisa/kWh)	
		Min. capex (10 cr.)	Max. capex (30 cr.)
200	40%	2.56	7.68
500	40%	1.02	3.07
660	40%	0.85	2.56
800	40%	0.64	1.92

3. Cost due to increase in Net Heat Rate: After analyzing the HBD report of major OEMs (BHEL/GE/Siemens) and actual test report of low load operation unit size wise Net Heat Rate increase including it's tariff impacts has been prepared

Unit size (MW)	Increase in tariff (paisa/kWh)			
	Capex =10 crores		Capex = 30 crores	
	Pit head	Non-pit head	Pit head	Non-pit head
200	40.33	54.55	45.45	59.67
500	33.71	47.70	35.76	49.75
660	29.73	41.91	31.44	43.62
800	28.45	40.52	29.73	41.80

2. O&M cost due to increased Life Consumption (damage costs): Flexible operation leads to a higher rate of deterioration of plant's components. This is observed in increased failure rate and more frequent replacement of components.

Capacity (MW)	Loading (%)	O&M cost Increase (%)	Increase in O&M cost (Rs Cr.)	Increase in O&M cost (Paisa/kWh)
200	40%	20.00	14.62	14.88
500	40%	20.00	24.97	10.16
660	40%	20.00	29.66	9.14
800	40%	20.00	32.35	8.23

Unit Size (MW)	Loading (%)	Net Heat Rate increase (%)	Pit head unit	Non-pit head unit
			Variable Tariff increase (Paisa/kWh)	Variable Tariff increase (Paisa/kWh)
200	40%	16.00	21.89	36.11
500	40%	16.00	21.53	35.52
660	40%	14.60	18.74	30.92
800	40%	15.00	18.58	30.65

4. EFOR: The additional EFOR due to regular low load operation of thermal generating units may increase specific oil consumption from 0.5 ml/kWh to 0.7 ml/kWh. Therefore 1.0 paisa per kWh may increase due to EFOR.

PROMOTING MARKETS AND COMPETITIONS

1) Increasing electrolyser manufacturing capacity several fold by 2030 to become a global leader.

2) India envisages becoming a leading exporter of Green Hydrogen (GH) and Green Ammonia (GA) by 2030.

3) Encourage adoption of green hydrogen and green ammonia in hard to abate sectors, and ensuring availability of low-cost green electricity for green hydrogen.

4) Promote co-firing of green ammonia in thermal power plants (TPPs).

5) Green Ammonia/hydrogen firing in exiting GT which will run during non-solar period for grid balancing

PRIORITY RESEARCH AREA

- Alternative to Lithium-Ion batteries storage
- Modifying electric cookers/ pans to suit Indian cooking methods.
- Green hydrogen for mobility (High Efficiency Fuel Cell)
- Development of Carbon Dioxide Removal Technologies /CCUS
- Geo-thermal energy
- Hydrogen/ammonia firing at existing Gas turbine in the country

PROMOTION OF E-MOBILITY

- **Guidelines for EV charging infrastructure :** CEA facilitates drafting of the guidelines and standards for EV charging infrastructure (EVCI) issued by MoP.
- **Ministry of Power is prescribing technical standards/ type of chargers to be used in the country** by issuing the "Charging Infrastructure for Electric Vehicles - Guidelines and Standards"**.**
- **Monthly Report of electricity consumption** by EVs taking data from public charging stations being published.

Thank you