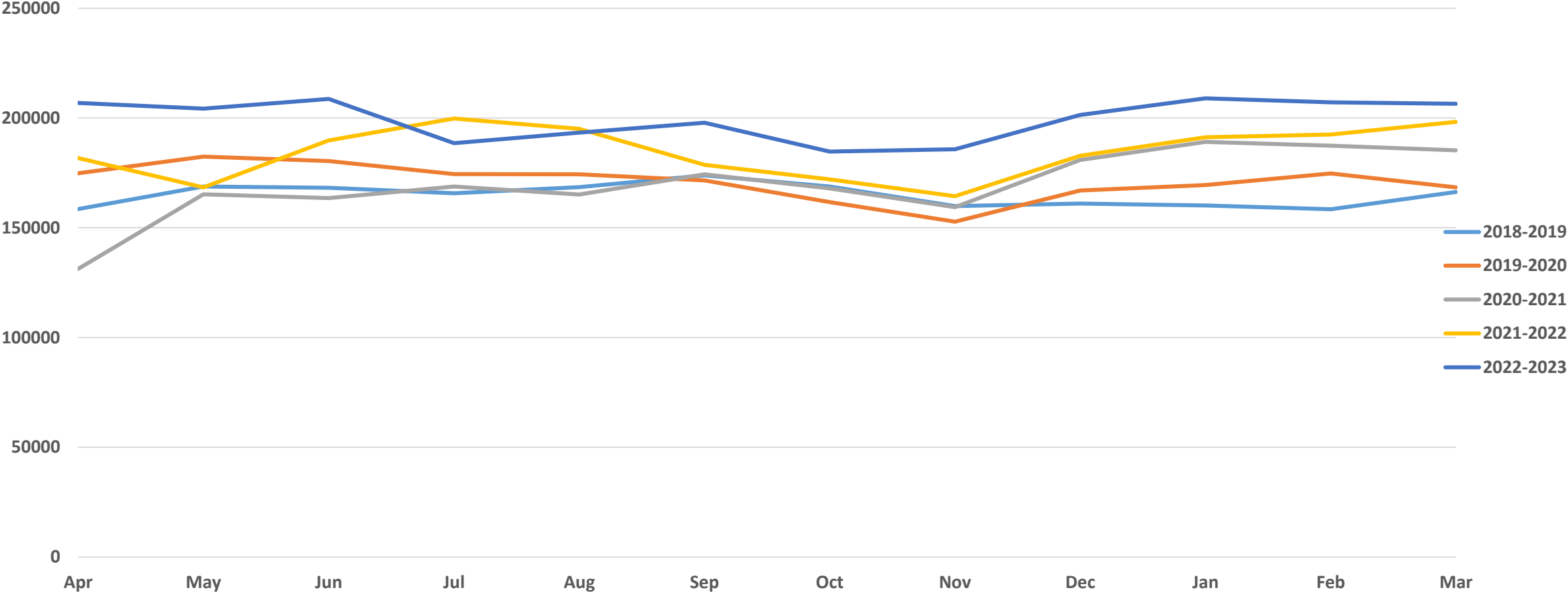


Policy Framework Challenges to RE integration - Role of Flexibility and Storage (Hydro, Pumped Storage and Battery)

Historical demand pattern

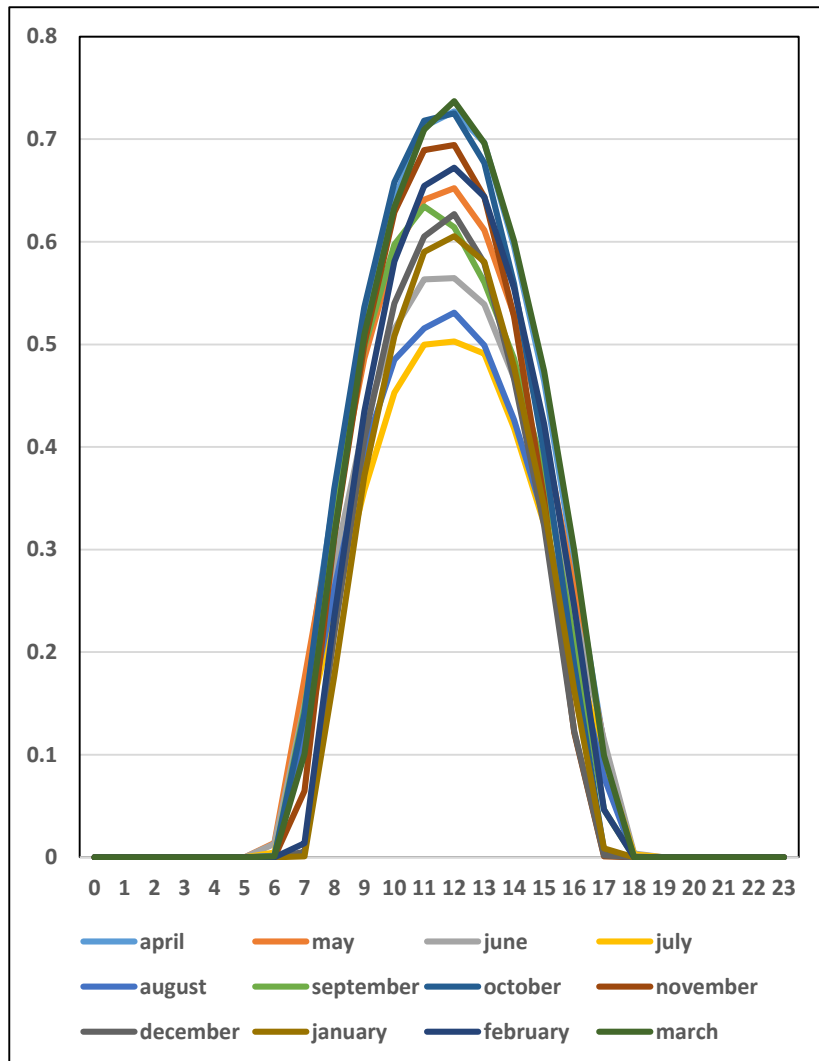
Hourly Month Wise Average Demand Pattern in MW



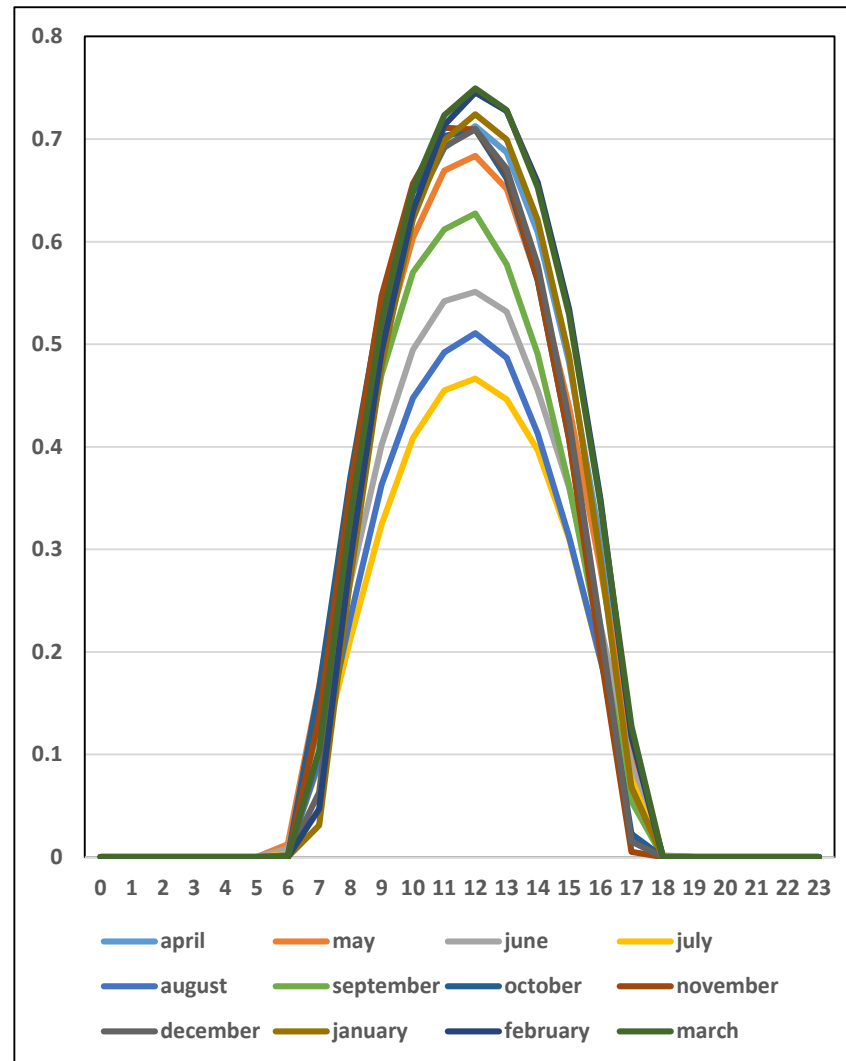
2018-19 and 2019-20 demand pattern is similar to 2022-23 while 2019-20 & 2020-21 demand pattern is different due to COVID.

Hourly Solar Generation profile Region wise

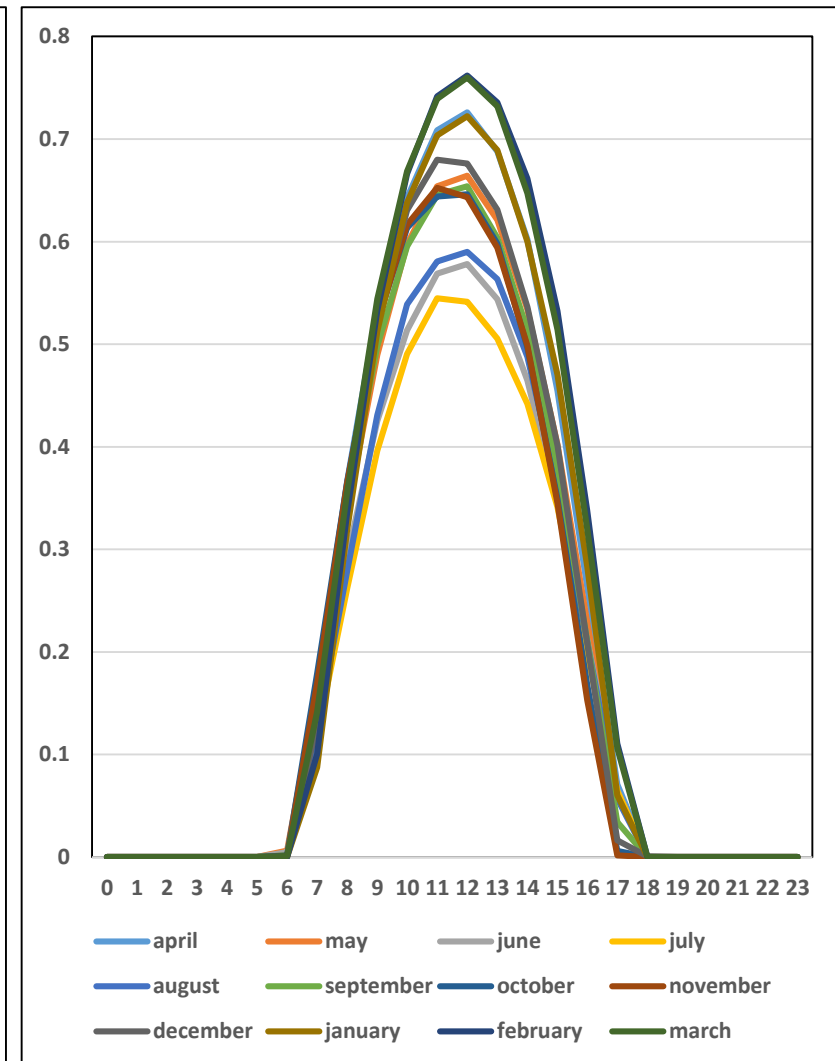
NR REGION



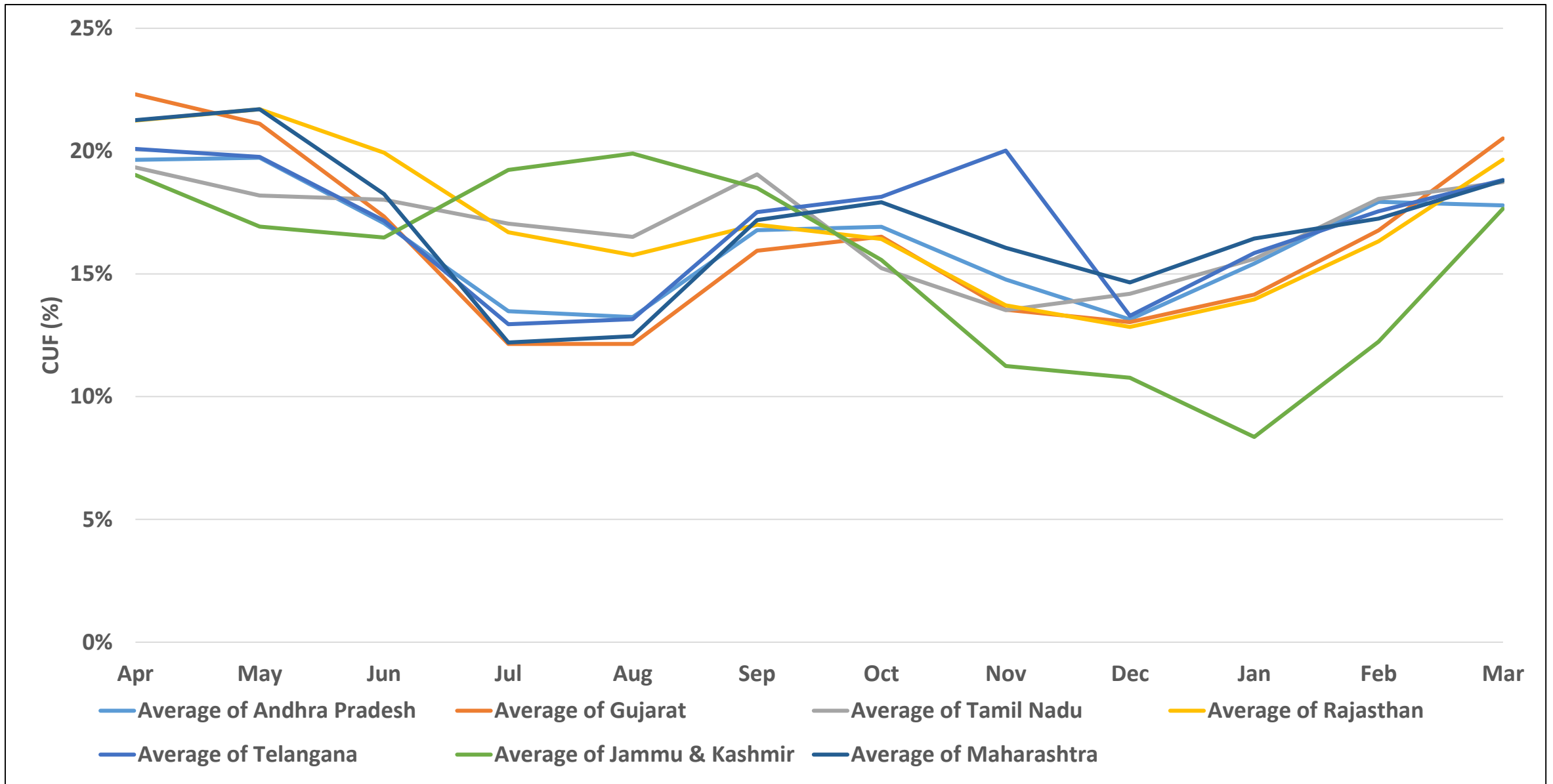
WR REGION



SR REGION

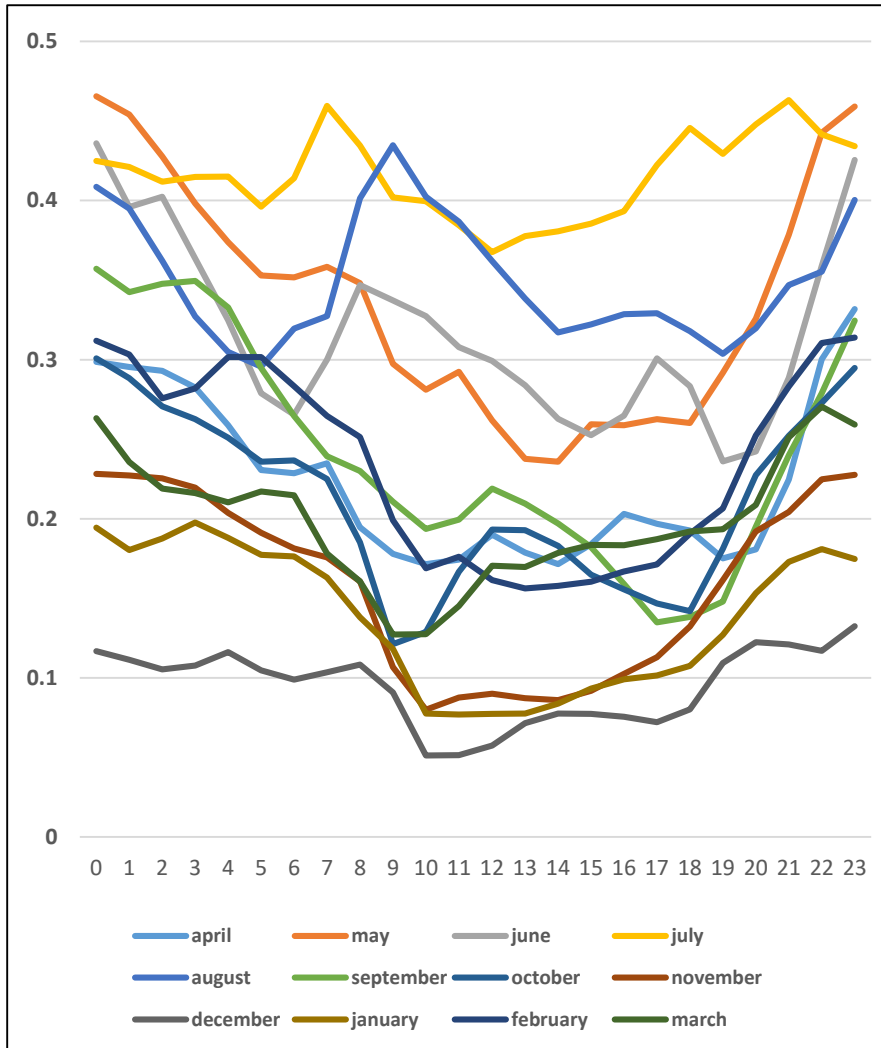


State Wise Solar CUF(%) variation

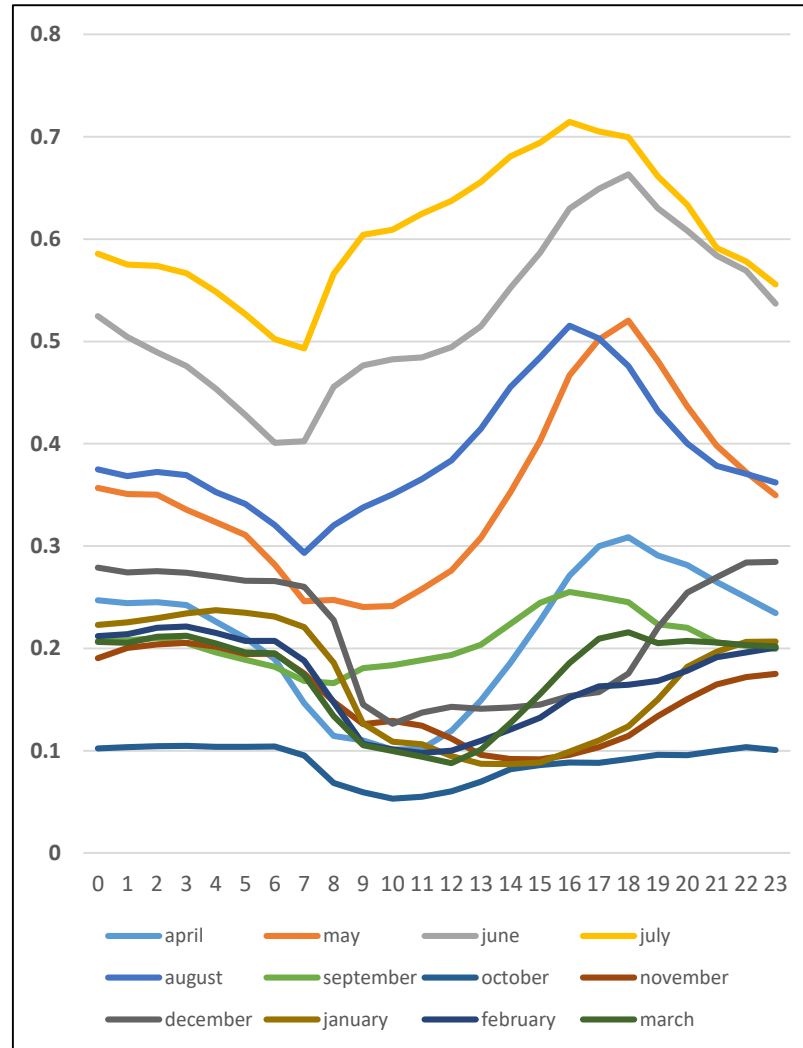


Hourly Wind Generation profile Region wise

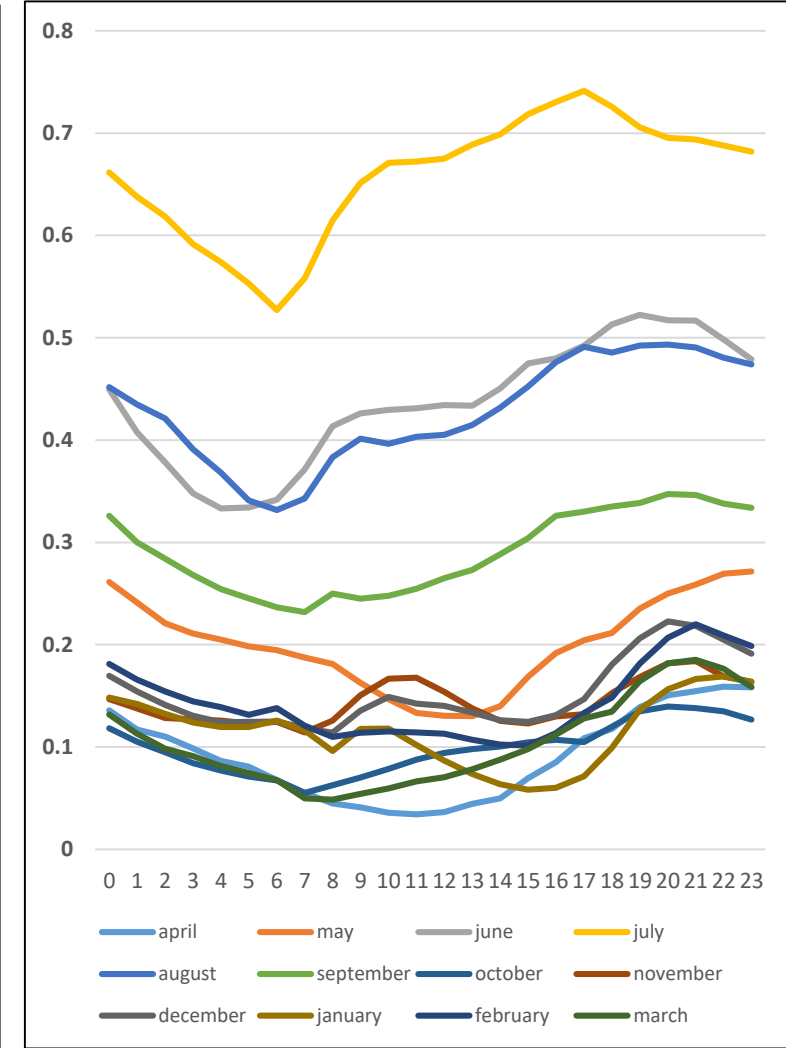
NR REGION



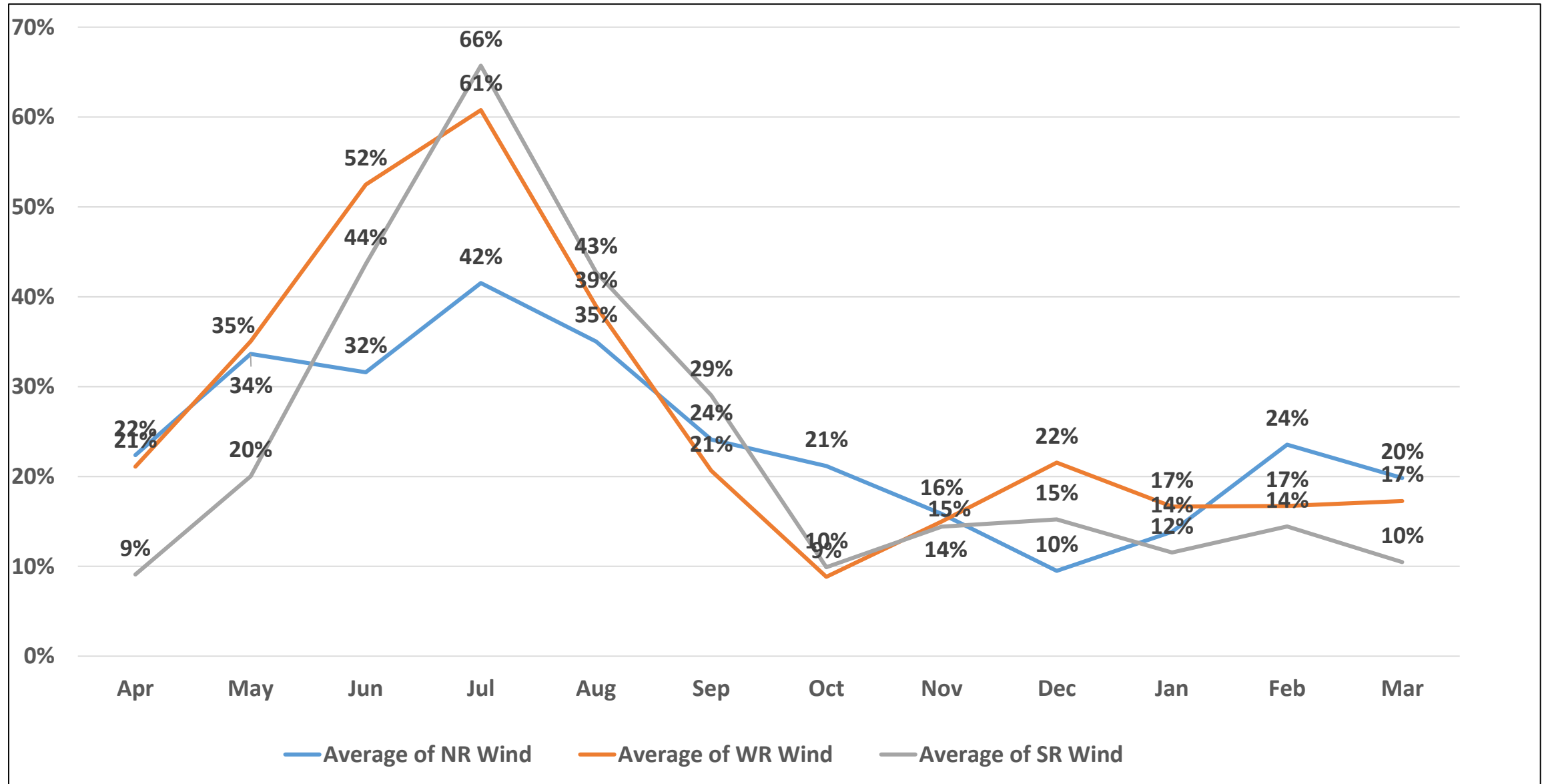
WR REGION



SR REGION



Wind CUF(%) variation Month Wise



BROAD INPUTS (1 / 3)

Load profile:

- Average hourly load profile of previous years(2018-19 & 2019-20) analyzed for future load profile

Solar & Wind profile:

- Actual hourly generation profile of solar & wind of various states of each region.

Seasonal Hydro Profile:

- Average of actual monthly hydro generation of the existing hydro power plants for previous years(2019-22) .

Variable cost for Existing coal capacity:

- Based on the ARR of various discoms and Merit India website.

Fuel Constraints:

- Domestic gas availability as per gas generation during 2021-22.
- Peaking support from gas considered : 4-8 GW.

BROAD INPUTS (2/3)

Future investment options

- Capacity (super critical / ultra-super critical) identified for development
- Location specific hydro and PSP projects concurred or are under S&I stage
- the plants which have been accorded administrative approval and financial sanctions

Year on year investment limits for different technologies:

- 25-32 GW per year for Solar
- 7-10 GW per year for Wind

Technical Constraints:

- 55% for All coal based Plants, heat rate deterioration at part load operation
- Must Run status for RE
- Limited flexibility in nuclear generation
- Seasonal availability of Biomass based on previous years generation.
- Actual Storage hours of hydro/PSP generators modelled.

BROAD INPUTS (3 / 3)

Investment & O&M Cost:

- Year Wise trend of reduction of CAPEX & OPEX considered for different technologies(esp. for Off Shore Wind, BSES, and Solar)
- CAPEX value of Hydro & PSS candidate considered as per most recent project cost details furnished by developers.

Fuel Cost:

- Plant wise coal cost based on the distance from the mines
- Increase in fuel cost: 1% per annum for coal, 2% for gas

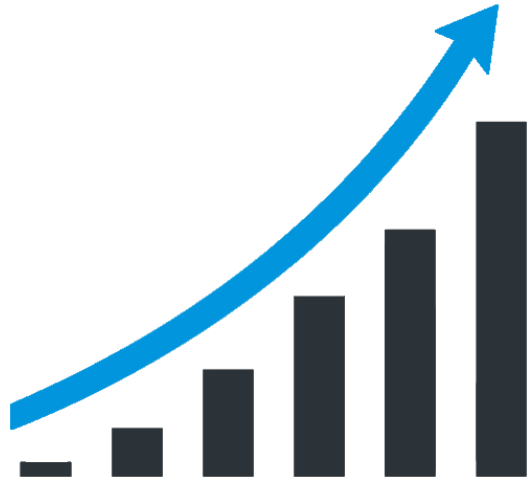
Transmission Capacity:

- Existing Inter regional transmission considered as on 2021-22.
- Additional candidate inter regional transmission link modelled

Emission Factors:

Fuel wise emission factors(Kg CO₂/MT) modelled for different fossil fuels.

DEMAND PROJECTIONS- 20th ELECTRIC POWER SURVEY



Year	PEAK DEMAND(GW)	ENERGY REQUIREMENT(BU)
2026-27	277.2	1907.8
2029-30	334.8	2279.7
2031-32	366.4	2473.8
2036-37	465.5	3095.5
2041-42	574.7	3776.3

Year	PEAK DEMAND (% growth)	ENERGY REQUIREMENT (% growth)
2021-22 to 2026-27	6.42	6.67
2026-27 to 2031-32	5.74	5.33
2031-32 to 2036-37	4.91	4.59
2036-37 to 2041-42	4.30	4.06

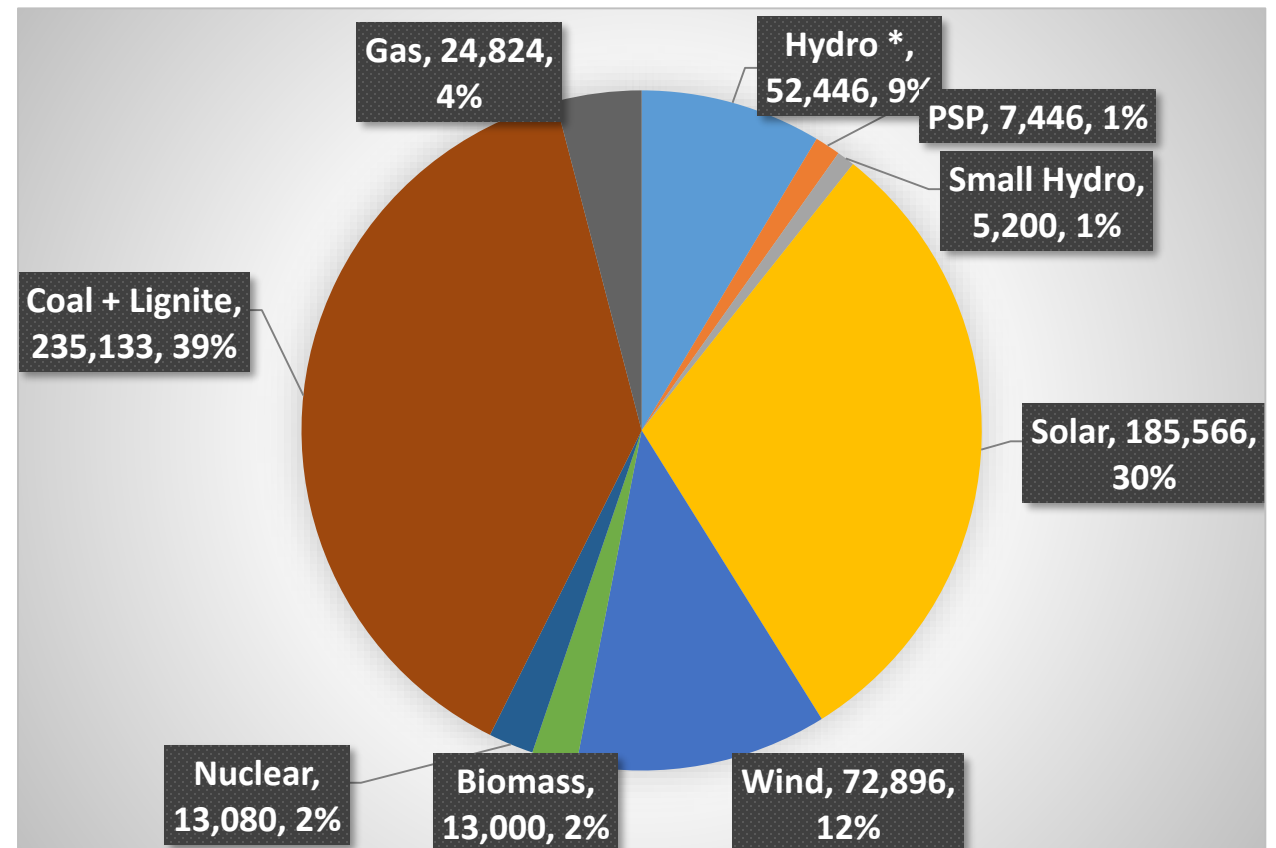
FINAL NEP RESULTS

2022-27



PROJECTED INSTALLED CAPACITY in 2026-27

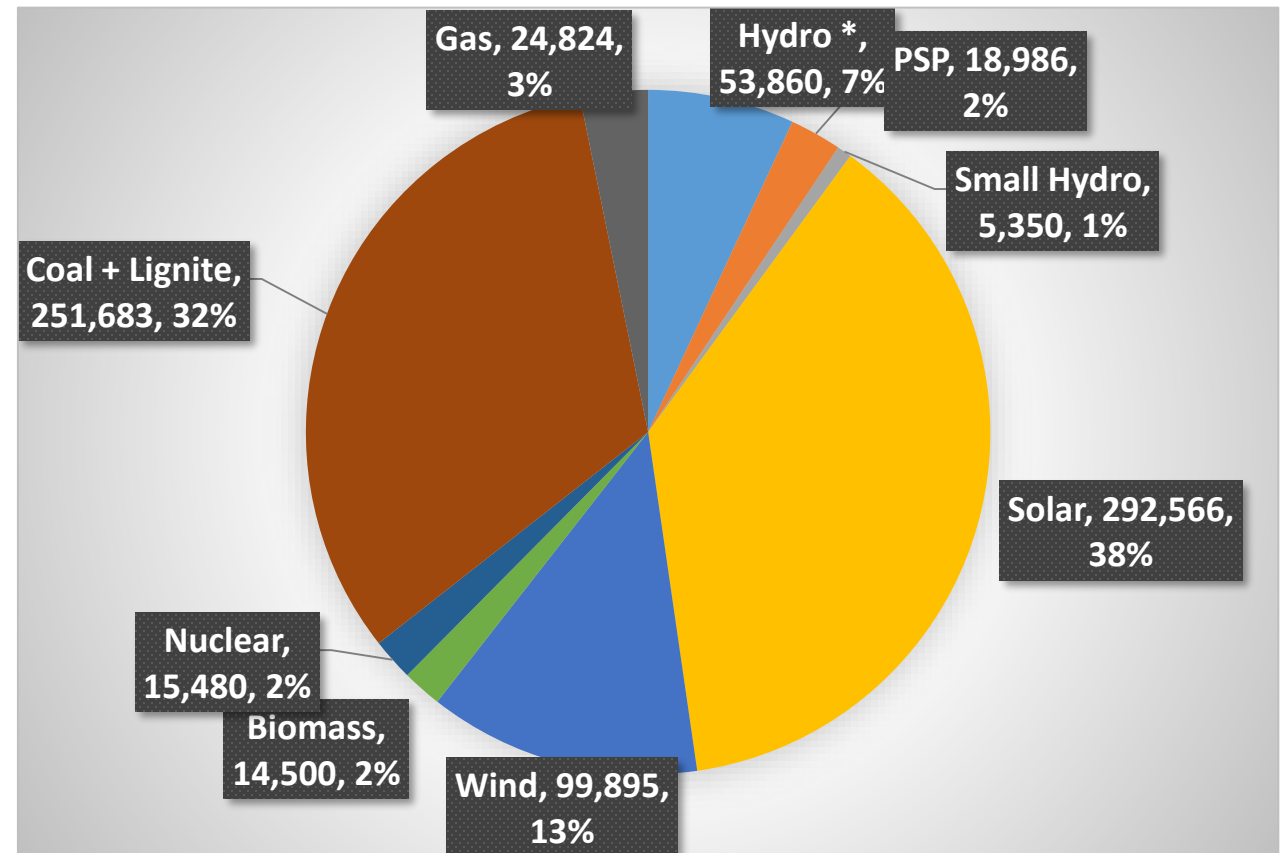
- Projected Total IC as on 31.3.2027 is **609.6** GW
- Battery Energy Storage system(GW/GWh):
8.7/34.8



* Excluding 5856 MW of Hydro Imports from Nepal and Bhutan.

PROJECTED INSTALLED CAPACITY by 2029-30

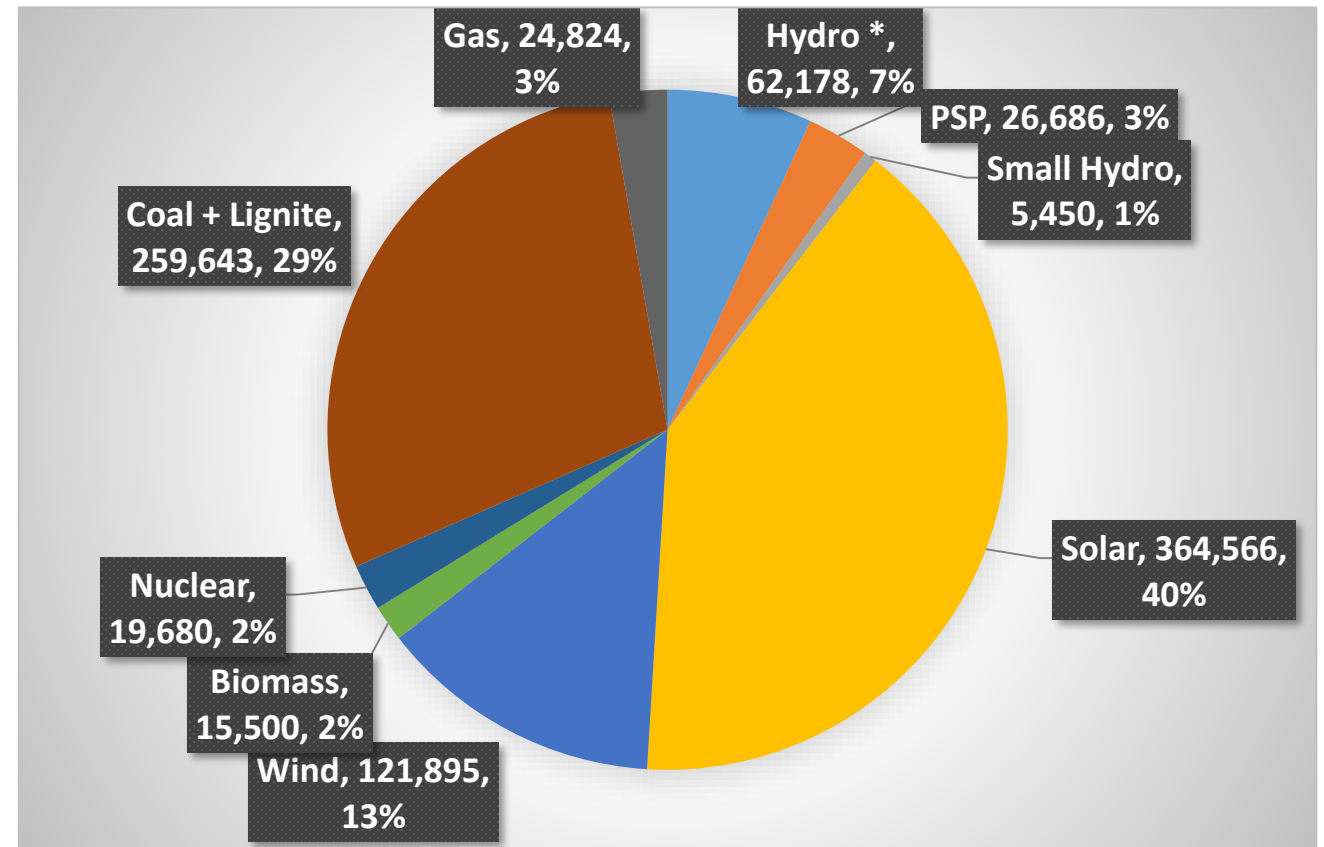
- Projected Total IC as on 31.3.2030 is **777GW**
- Battery Energy Storage system: **41.6GW/208.3 GWh**



* Excluding 5856 MW of Hydro Imports from Nepal and Bhutan.

PROJECTED INSTALLED CAPACITY by 2031-32

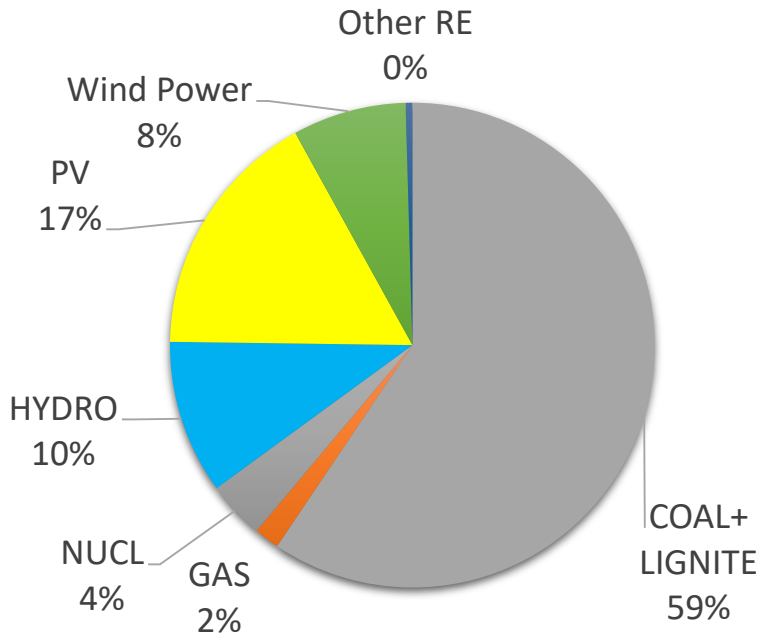
- Projected Total IC as on 31.3.2032 is **900.4 GW**
- Battery Energy Storage system: **47.3 GW/236.2 GWh**



* Excluding 5856 MW of Hydro Imports from Nepal and Bhutan.

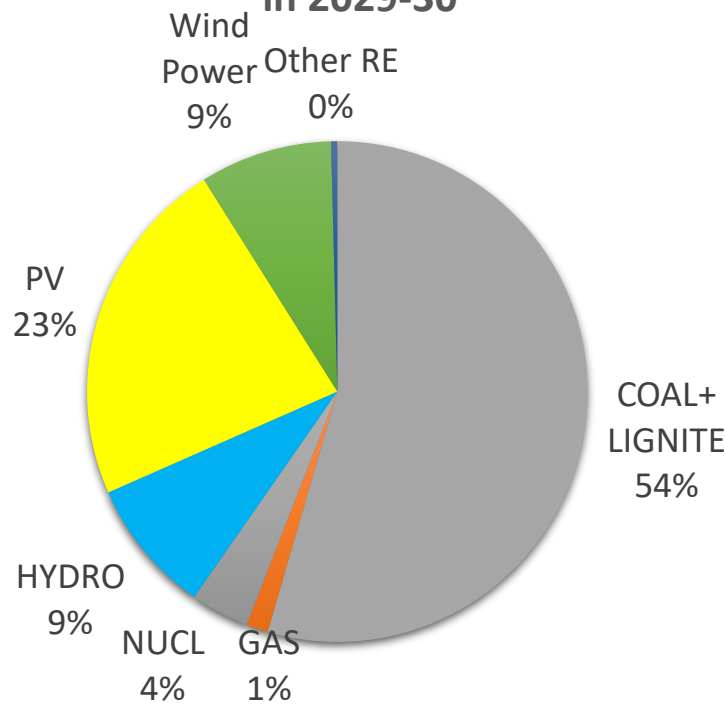
Projected Gross Generation 2026-27, 2029-30 and 2031-32

Source wise Projected Gross Generation
in 2026-27



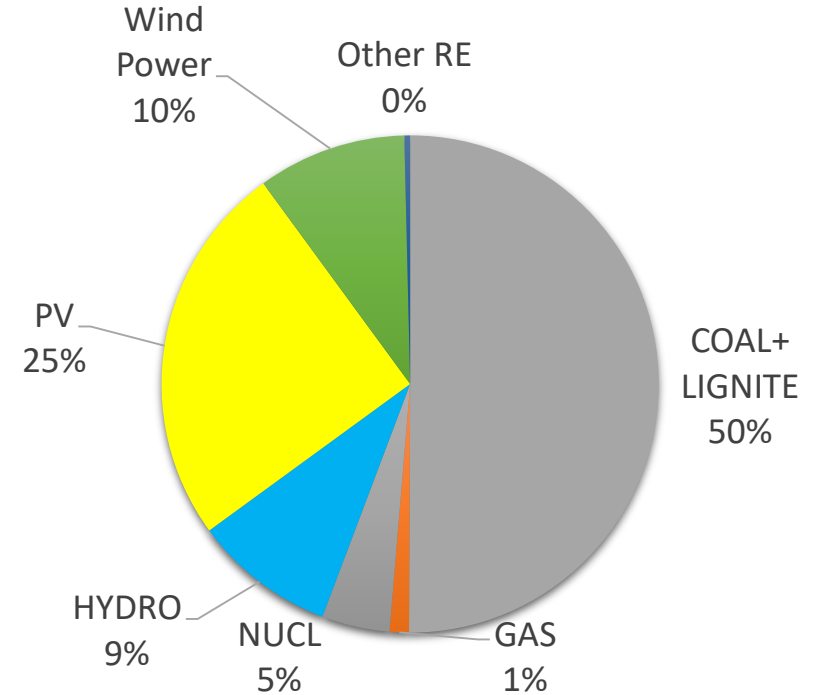
Total:2025 BU

Source wise Projected Gross Generation
in 2029-30



Total:2440.7 BU

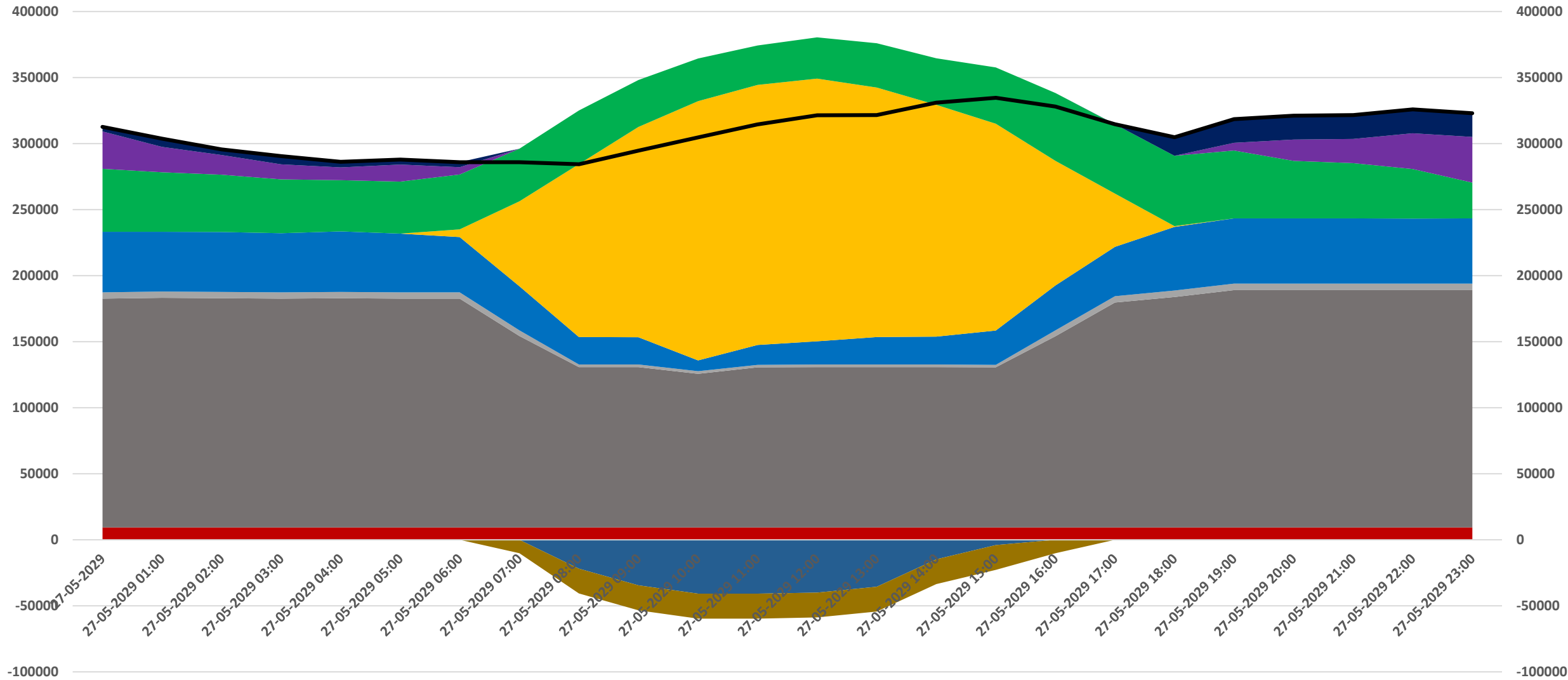
Source wise Projected Gross
Generation in 2031-32



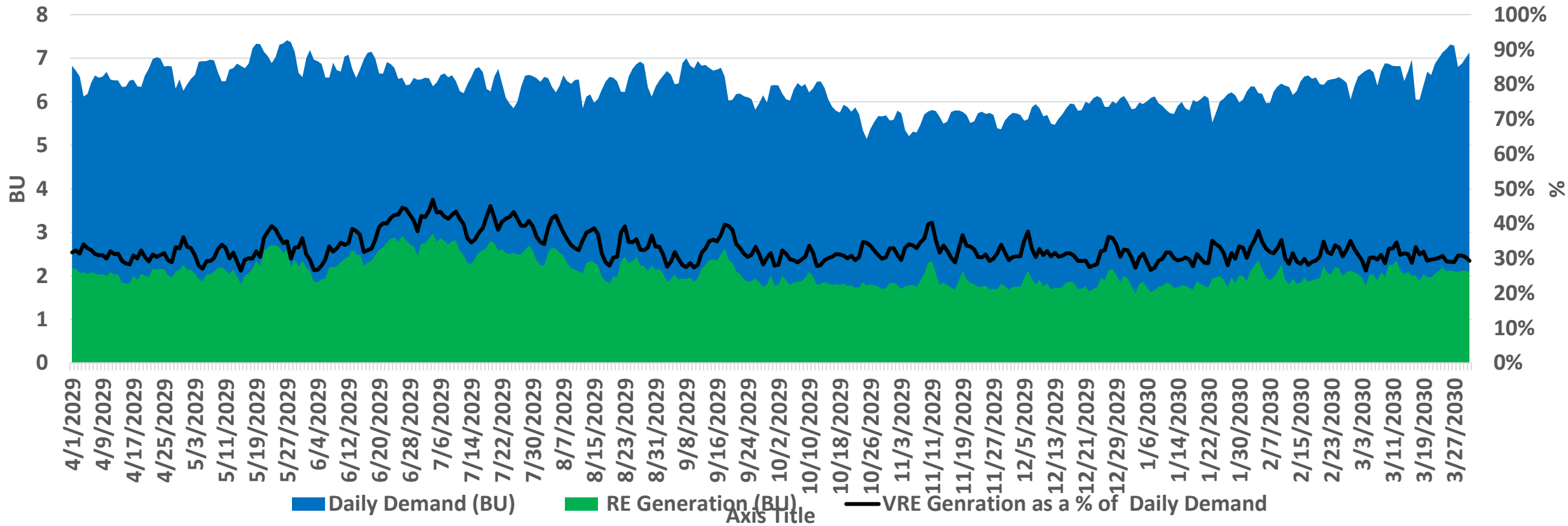
Total:2665.7 BU

Generation Dispatch on Peak Demand Day(2029-30)

Hourly Source Wise Dispatch on Peak Demand day in 2029-30



Daily Demand(BU) met from Daily VRE(Solar+Wind) Generation in 2029-30

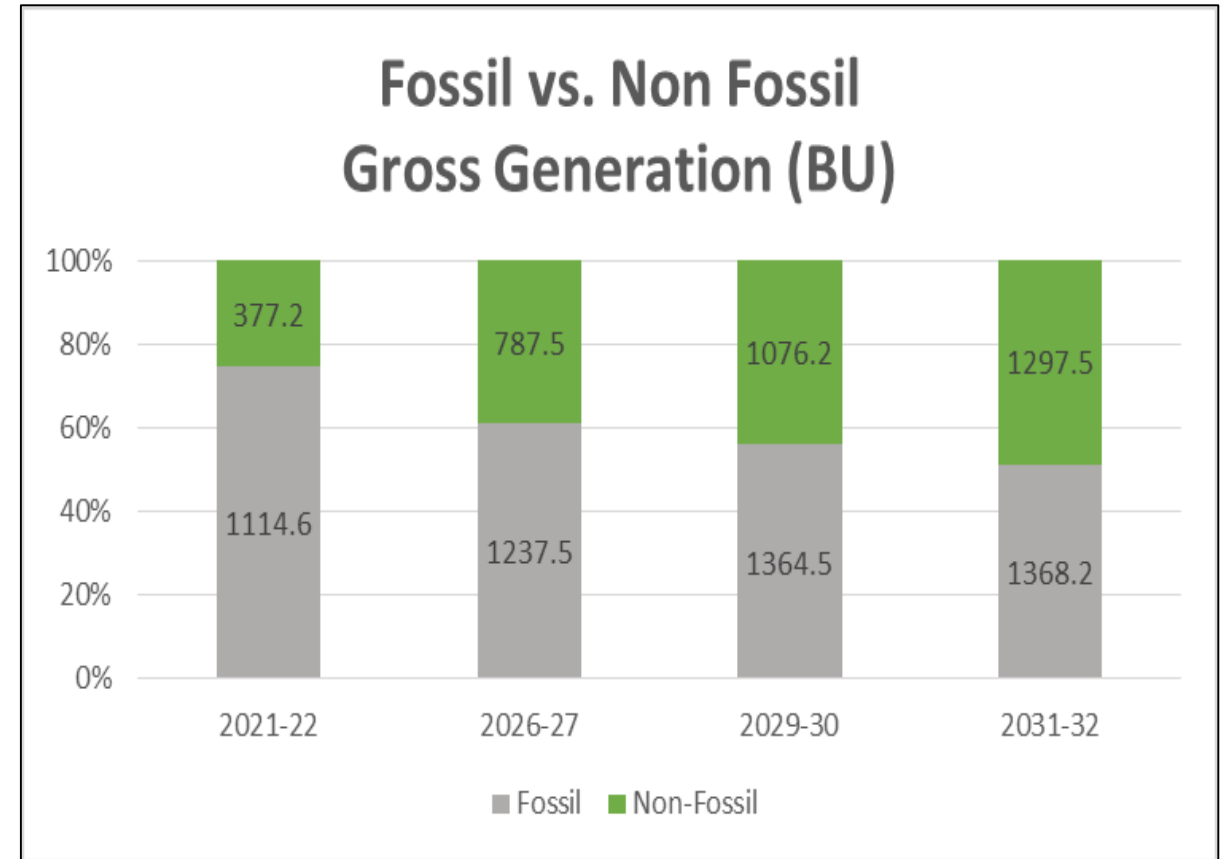
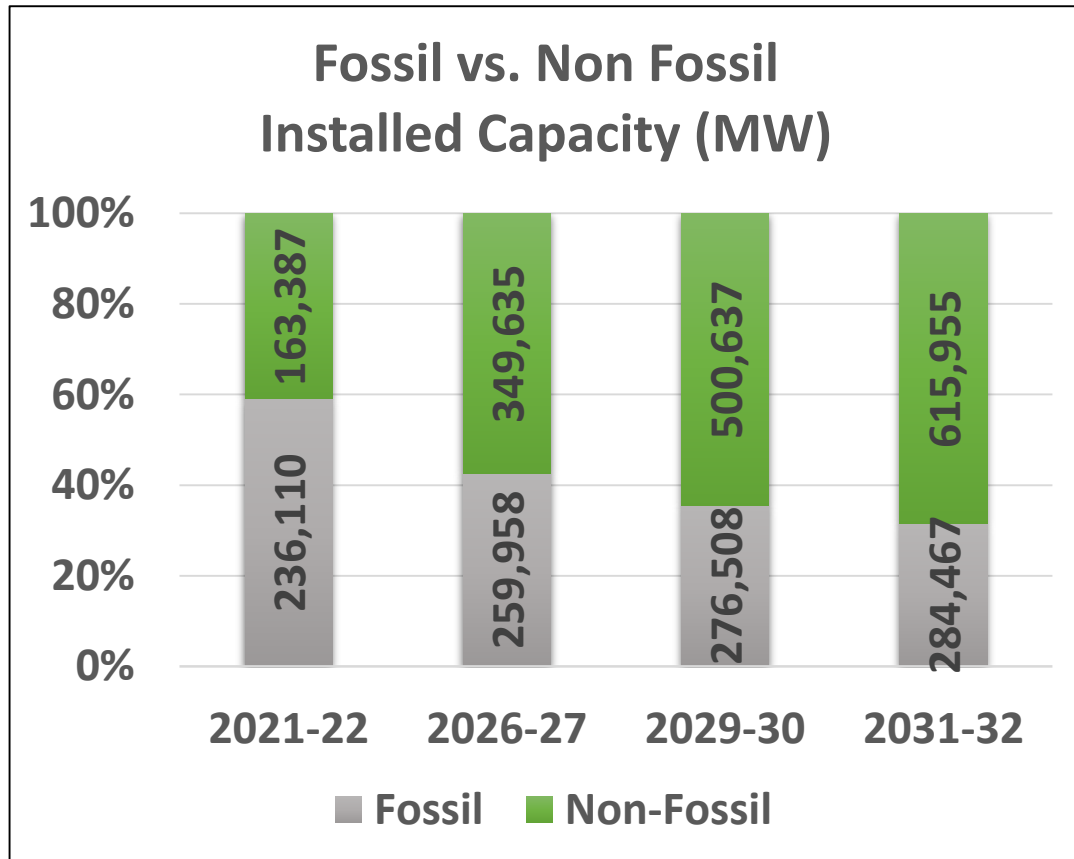


Energy Storage Requirement

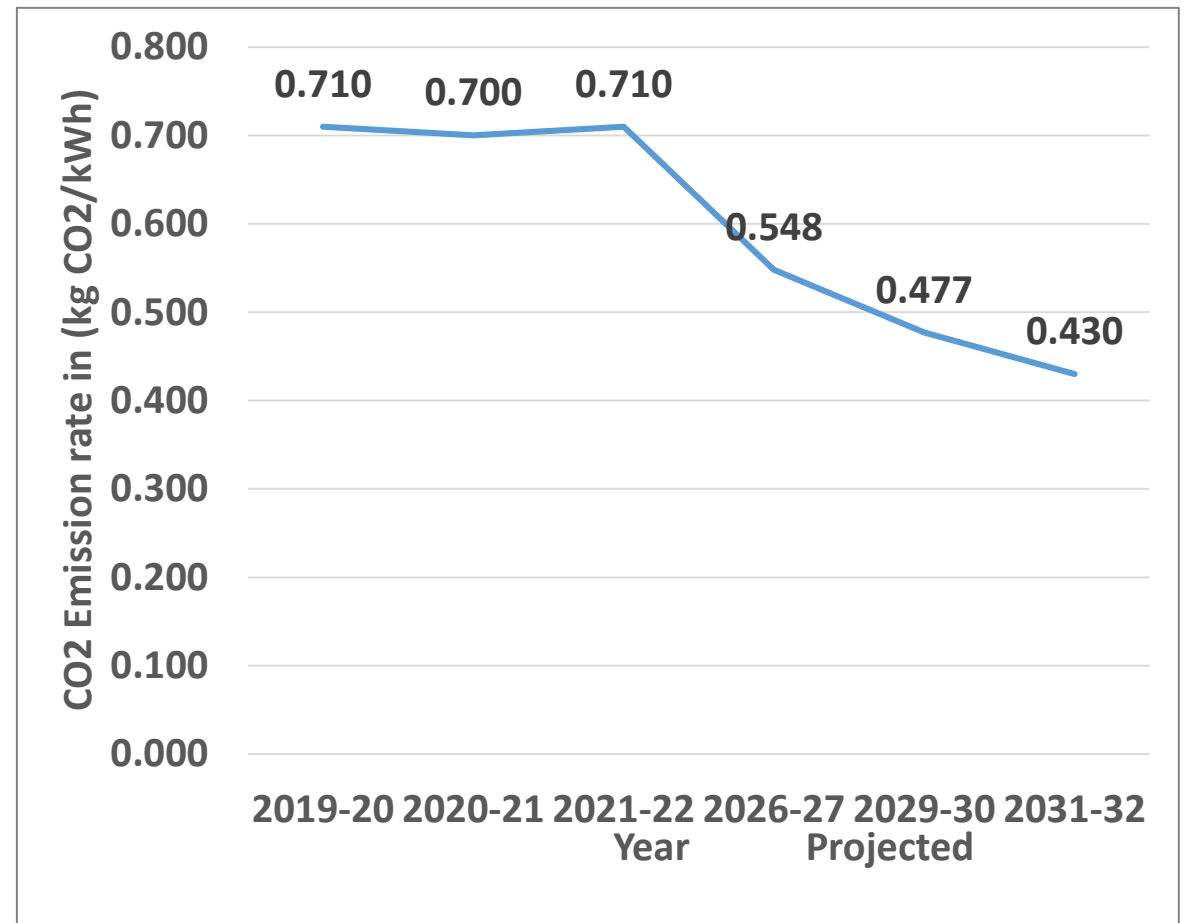
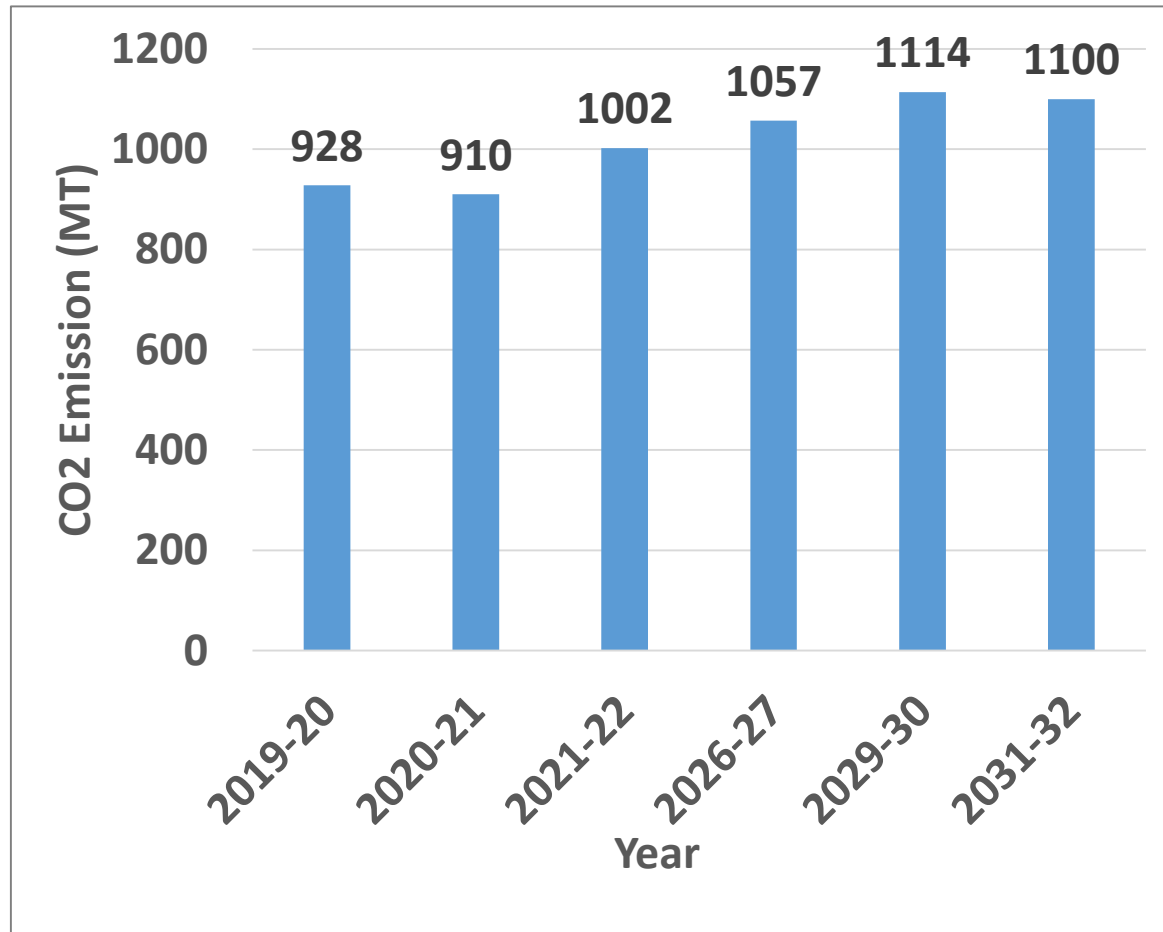
Year	PSP (GW/GWh)	BESS (GW/GWh)	TOTAL (GW/GWh)
2026-27	7.45/47.6	8.68/34.72	16.13/82.32
2029-30	18.98/128.15	41.65/208.25	60.63/336.4
2031-32	26.69/175.18	47.24/236.22	73.93/411.4

NDC Targets

Fossil vs Non-fossil Projected Installed Capacity(GW) & Gross Generation (BU)



Likely Reduction in CO2 Emissions by 2031-32



Policy Framework for Promotion of BESS & PSP

1. Energy Storage Obligation (ESO) Trajectory

- MoP in 2022 has issued the ESO Trajectory till 2029-30.
- The trajectory to be followed for ESO given as below:

F.Y.	Storage (on Energy basis)
2023-2024	1.0 %
2024-2025	1.5 %
2025-2026	2.0 %
2026-2027	2.5 %
2027-2028	3.0 %
2028-2029	3.5 %
2029-2030	4.0 %

- At least 85% of the total energy stored in the Energy Storage System (ESS), on an annual basis, to be procured from renewable energy sources.

2. Waiver of Inter State Transmission System Charges for storage projects 12 years

- ❑ **ESS project shall have to draw a minimum of 51% of the annual energy from RE**
- ❑ **Trajectory of ISTS waiver**

Period of Commissioning	Inter-State Transmission Charges
31.06.2025	100% of the applicable ISTS charges
01.07.2025 to 30.06.2026	25 % of the applicable ISTS charges
01.07.2026 to 30.06.2027	50 % of the applicable ISTS charges
01.07.2027 to 30.06.2028	75 % of the applicable ISTS charges
From 01.07.2028	100 % of the applicable ISTS charges

3. Ancillary services from ESS

- ❑ **CERC (Ancillary Services) Regulations, 2022**
 - **Makes ESS eligible to provide Secondary Reserve Ancillary Service (SRAS) and Tertiary Reserve Ancillary Service (TRAS)**

4. National Framework for Promoting Energy Storage

- ❑ Issued by MoP in September 2023
- ❑ To comprehensively support the development and deployment of ESS.
- ❑ Contains a gist of all the acts, rules, resolutions and orders passed to support ESS deployment in the Country till date.

5. Guidelines for Procurement and Utilization of BESS

- ❑ **Ministry of Power vide resolution dated 10.03.2022**
- ❑ Issued detailed guidelines for procurement and utilization of BESS
 - as part of generation, transmission, or distribution assets, or along with ancillary services.

6. MAHIR

❑ National Mission on advance and high-impact research (MAHIR)

- On the latest and emerging technologies in energy sector
- Jointly set up by MoP and MNRE for a period of five (5) years from 2023-24 to 2027-28,
- Launched on 07.06.2023.
- **One of the Areas identified for Research:** Alternatives to Lithium-Ion storage batteries.

7. RE Bundling Scheme: Scheme for Flexibility in Generation and Scheduling of Thermal/Hydro Power Stations through bundling with RE and Storage Power

❑ MoP order dated 12.04.2022

❑ Eligible generating stations

- ✓ All new and existing Coal/Lignite/Gas based Thermal Generating Stations
- ✓ Hydro Power Stations

❑ May establish RE power plant:

- Co-located or at new locations.
- RE can be in combination of BESS.

❑ Such RE may be utilized to supply power against their existing PPAs.

❑ Such RE shall also count towards the RPO compliance of the DISCOMs.

8. Replacement of DG sets with RE/storage

- ❑ **The Electricity (Rights of Consumers) Amendment Rules, 2022 Notified by MoP on 20.04.2022**
 - Provides for **replacement of DG sets with RE/ Storage in 5 years** or as per the timelines given by SERCs.

9. Introduction of High Price Day Ahead Market (HP-DAM)

- ❑ **MoP vide note dated 11.10.2022**
- ❑ Sellers with high cost of generation would be allowed to participate.
- ❑ HP DAM has been **launched on 9th March 2023.**
- ❑ BESS have been included in the list of eligible generators to participate in the HP DAM.

10. Harmonized Master List for Infrastructure

- ❑ ESS Included in the Harmonized Master List of Infrastructure vide DEA notification dated 11.10.2022.
- ❑ ESS recognized **as an essential infrastructure**
- ❑ This ensures easier access to
 - institutional credit,
 - concessional funds and
 - reduces developer's cost of borrowing for projects related to these sub-sectors.

11. Guidelines for assessment of resource adequacy

- ❑ The Electricity (Amendment) Rules, 2022 mandate that a guideline for assessment of resource adequacy shall be issued by the Central Government in consultation with CEA.
- ❑ The guidelines for developing Resource Adequacy Plan (RAP) has been issued on 28.06.2023 which incorporates ESS as an element of planning in the power sector planning process.

12. VGF Scheme for BESS

- ❑ Approved by Union Cabinet in Sept 2023.
- ❑ Envisages development of 4,000 MWh of BESS projects by 2030-31
- ❑ Initial outlay of Rs.9,400 crore, including a budgetary support of Rs.3,760 crore.
- ❑ The scheme targets achieving a LCoS ranging from Rs. 5.50-6.60 per kWh.
- ❑ Financial support of upto 40% of the capital cost as budgetary support in the form of VGF.

Status – VGF for first trench of 1000 MWh of BESS

- ❑ 500 MWh by NVVN - Bids invited - Pre bid meeting scheduled
- ❑ 500 MWh by SECI - No progress so far as SECI sought some changes in guidelines – matter under consideration in MoP

13. PLI for grid scale BESS

- ❑ Notified by Department of Heavy Industries (DHI) in June, 2021
 - Envisaging to set up
 - ✓ a cumulative Advanced Chemistry Cells (ACC) manufacturing capacity of 50 GWh for ACCs
 - ✓ and an additional cumulative capacity of 5 GWh for Niche ACC Technologies.

- ❑ **10 GWh has been recently earmarked for grid scale stationary storage application only.**
 - MNRE in consultation with CEA and other stakeholders carried out the necessary changes required to be made in the existing RfS of DHI to suit the bidding process of 10 GWh capacity earmarked for Grid Scale Storage Battery Cells and forwarded to DHI on 04.06.2024.

 - DHI vide its letter dated 03.07.2024 asked MNRE to prepare a Note on the proposed changes required to be carried out in existing RfS of DHI for taking the approval of EGoS.

Initiatives taken to boost development of PSPs

Ministry of Power issued **Guidelines to promote development of PSPs in the country** on 10th April, 2023. The main initiatives may be categorized as under:

- Administrative
- Regulatory
- Financial

Administrative Initiatives to boost development of PSPs (Contd..)

- **Reduction in time line for concurrence of PSPs** from 150 days to
 - 50 days – projects awarded under TBCB, projects developed as IREP, merchant and captive plants
 - 90 days – Other PSPs
- **“Single window clearance cell” set up in CEA in order to expedite the concurrence process of DPRs of HEPs/ PSPs**
 - Nodal officers nominated by CWC & GSI.
 - It is proposed to examine DPRs of off stream close loop PSPs with help of experts of CPSUs.
- **Rationalization of EC process for PSPs**
 - Standalone PSPs categorized as a separate category
 - Off Stream PSPs appraised based on specific Terms of Reference issued by the Central Government for PSPs – 1 season data/ 2 season data collection
 - PSPs which meet certain criteria specified as B2 category

Administrative Initiatives to boost development of PSPs

- Defining transparent procedure for allotment of project sites as under
 - On nomination basis to CPSUs and State PSUs
 - Allotment through competitive bidding
 - Allotment through Tariff Based Competitive Bidding (TBCB)
 - Self - identified off-stream Pumped Storage Projects – allotment not required
- Cancellation of allocation of project if construction doesn't start within a period of 2 years from the date of allotment, extendable by 1 year where delay in start of construction is attributable to pending EC & FC
- In case of Self identified off-stream PSPs, it has been arrived that those projects which are to be developed on private land, needn't require allotment from State Govt. In case of involvement of public land, allotment would be done through Swiss challenge method.

Financial Initiatives to boost development of PSPs

- Budgetary Support for Enabling Infrastructure
- Waiver of ISTS charges
- Exemption from Free Power obligation/ water cess/ upfront royalty
- Avoidance of double taxation on power supplied by PSPs
- Financial institutions like PFC, REC, and IREDA shall treat PSPs at par with other renewable energy projects while extending long term loans of 20-25 years tenure.
- No requirement of Local Area Development Fund.

Regulatory Initiatives to boost development of PSPs

- Energy Storage Obligation
- Monetization of Ancillary services
- PSPs to be allowed to participate in the proposed high price segment of the day ahead market (HP-DAM)
- 80% power generated in conventional mode during monsoon period be offered to the Home State at the rate of secondary energy fixed by CERC
- Unutilized contracted capacity be transferred to other interested entities and gains made shall be in the ratio of 50:50.

Initiatives in pipeline for Development of PSPs

- PSP Guidelines are being revised inline with Government's vision for Ease of Doing Business
 - Pre DPR Chapters are being reviewed.
 - Timelines for concurrence of DPR are being reduced
 - Provision for starting early excavation for faster execution of the project
- Standard Bidding Document for PSPs under finalization
- Draft guidelines for procurement of power from Pumped Storage Projects prepared and shared with MoP for approval

THANK YOU

THANK YOU

Likely Coal based PLF and Coal Requirement

Year	Likely Gross PLF of Coal based capacity (%)	Likely Coal Requirement[@] (in MTonnes)
2026-27	58.4	895.3
2029-30	60.3	1019.6
2031-32	58.7	1054.2

Likely Projected CO₂ Emissions

Year	Likely CO₂ Emissions (MTonnes)	Emission Factor (kg CO₂ / kWh)
2026-27	1057	0.548
2029-30	1114	0.477
2031-32	1100	0.430