# Electric Vehicle as a Flexible Load

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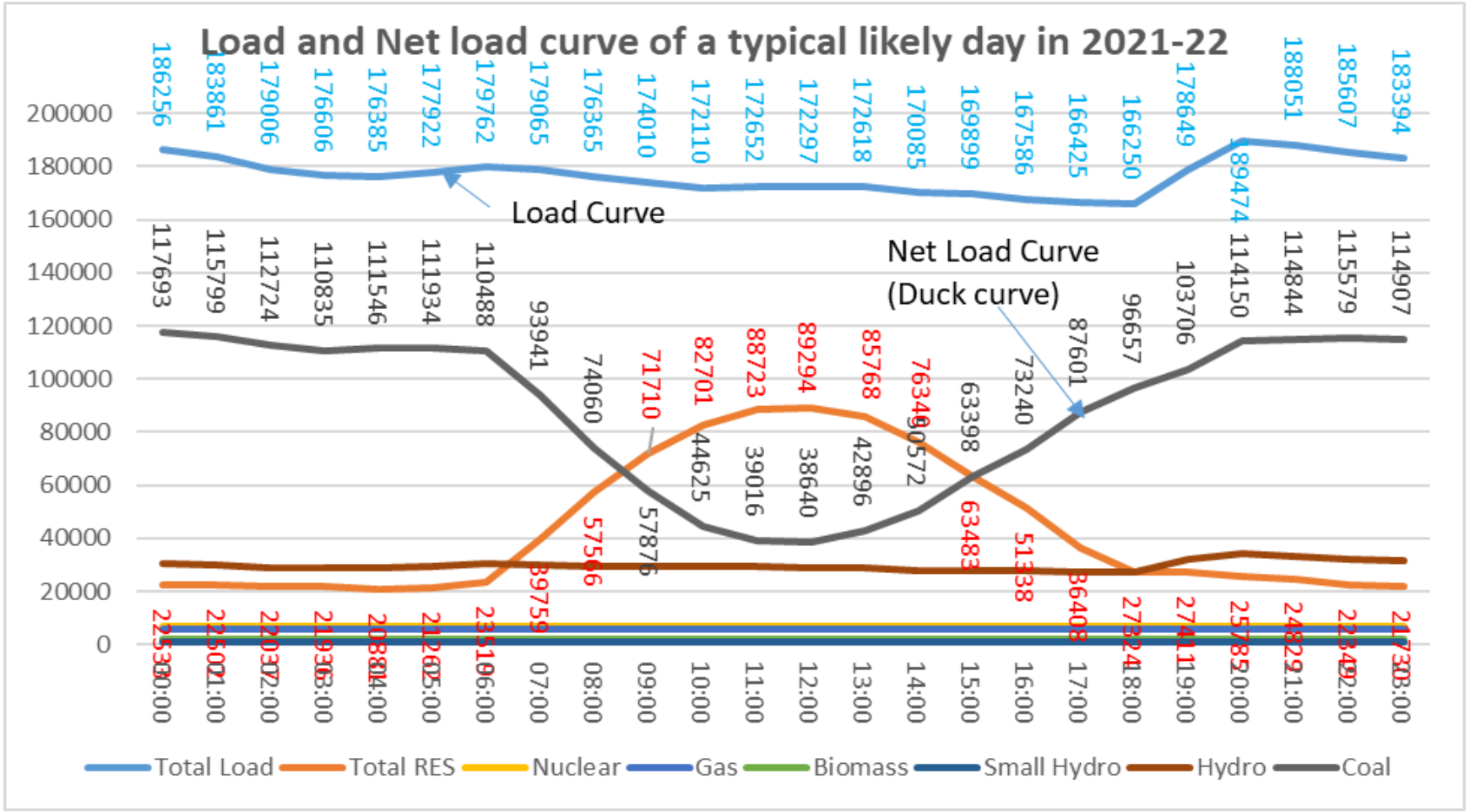
# INTRODUCTION

- India is keen to attempt to work towards a low carbon emission pathway
- India has to reduce the emissions intensity of its GDP by 33 to 35 per cent by 2030 from 2005 level and to create an additional carbon sink of 2.5 to 3 billion tonnes of CO2 equivalent through additional forest and tree cover by 2030
- Thrust on renewable energy, promotion of clean energy, enhancing energy efficiency, developing climate resilient urban centres and sustainable green transportation network are some of the measures for achieving this goal

# THE PRESENT & FUTURE SCENARIO OF ELECTRICITY SUPPLY-DEMAND DYNAMICS

- At present most of the generation is dispatch able and load is almost passive. The status for the RE generation is a must run status.
- At the end of the year 2021-22, it is expected that, out of total 479 GW of All India installed capacity, 175 GW (37 % of the total IC) would be from RE sources.The RE generation capacity will be non-dispatchable and the load is expected to be almost passive load.

# The all India expected load curve for a typical day during the year 2021-22,



# Continued….

- Considering the high variability and intermittency of generation from renewable, efficient and economical grid operation becomes one of the critical challenges in India‘s Power system.
- CERC & SERCs have taken several initiatives to ensure integration of variable RE generation.
  - **Framework for forecasting, scheduling and deviation settlement for wind and solar has been put in place.**
  - **To enable thermal generators to provide balancing support, necessary regulatory framework has been provided defining technical minimum for such plants and commensurate compensation for flexing such (thermal) generation up to technical minimum.**
  - **The CERC has issued Suo Motu order delineating the road map for operationalizing reserves.**
  - **SERCs are also taking necessary steps in this regard in their respective states**

# Continued…….

- In order to reduce the difference in maximum and minimum load to be met from the coal during the day, some measures flexible generation may be made operational in the grid.
- The temporal shifting of Renewable energy generation with the help of energy storage like battery storage and pump storage may also be be helpful
- As the capacity of RE generation into the grid increase, some additional measures are also to be identified to reduce the same.

➢Flexible load in the form of flexible loads in buildings, Electric vehicle charging, and battery electric storage, may be effective in providing flexibility to the grid.

# EFFECT OF EVs ON POWER SYSTEM

- Generation: Increase in the energy requirement & All India peak demand
- Transmission : There may be change of direction and quantum of power flow on Inter-state and Intra State transmission lines.
- System operator :The system may require more system services, such as frequency control ancillary services, and the need to maintain reserve power capacity, if EV loads coincides with peak times.
- Distribution level:

➢ The DISCOMS may have to procure more power & network augmentation may be required

➢ Voltage drop below a statuary limits at distribution level.

➢ Some assets which can experience thermal limits/overloads.

➢ Power quality may also be affected.

➢ In addition, EVs in contrast with other loads on distribution networks, are not stationary.

# EV LOAD AS A FLEXIBLE LOAD

- As the EV load penetration increases, they can provide following:
  - ✓flexibility services via Demand Side Response (DSR)
  - ✓active role in increasing the flexibility of power systems.
  - ✓The EV load as a flexible load can coincides with RE generation/off- peak time, can also lower the ramping requirements of the remaining generation fleet or can also reduce the peak load.
  - ✓it can increase opportunities for integration of variable renewable energy resources into the generation mix, as well as reducing cost associated with the adaptation of power systems to increased EV uptake.
  - ✓Electricity markets mayalso facilitate the EV load to participate for grid balancing.

# Enabling EVs as a flexible load can happen in three main ways

- **Direct load control**, where the utility has the ability to directly control the electricity demand and has the right to discontinue it.
- **Dynamic pricing arrangements** that provide a price signal directly to customers so they can voluntarily react to the prices.
- **Participation through an aggregator** in electricity markets where price signals incentivize flexibile/DSR activity of EVs as load.

# The changes /modifications required in the policies and regulations to accommodate EV as flexible load

**Enable EVs as flexible load requirs to be done in a phased manner with different level/size of integration of EVs into the grid.**

- **Grid-compliant charging**

This is the phase where EVs are connected to the grid for their charging needs, EVs comply with the local requirements and regulations. The charging power is below the thresholds prescribed by grid operators.

- **Level 1 – Controlled charging**

The charging power and timing of charging can be shifted remotely. Dynamic electricity pricing levels needed to incentivise charging behaviour. Smart charging may be introduced.

- **Level 2 –Aggregated controlled charging**

The market may also allow the participation of small loads including EVs through aggregators.

- **Level 3 – Bidirectional charging**

EVs can also feed electricity back to the grid. This allows for the use of EVs as a distributed electricity storage mechanism, and enhances the attractiveness for EVs as a frequency response measure. Bidirectional charging requirements may be included in the standardisation of EVSE and EVs.

- **Level 4 –Aggregated bidirectional charging**

The enhanced flexibility capacities of EVs are managed by aggregators to be able to compete in the flexibility market with larger capacities. Aggregators need to be allowed as a market player, benefits from bidirectional flexibility should be rewarded through electricity market dynamics

# Progress till date…

- Eight Indian states namely, Andhra Pradesh, Delhi, Karnataka, Kerala, Maharashtra, Telangana Uttarakhand and Uttar Pradesh have issued their individual draft/final electric vehicle policies till June 2019 focusing mainly on manufacturing and deployment of electric vehicles in their respective states.
- Twelve State Electricity Regulatory Commissions (SERCs) have also issued tariffs for EV charging. These are Andhra Pradesh, Chhattisgarh, Delhi, Gujarat, Haryana, Jharkhand, Karnataka, Madhya Pradesh Maharashtra, Punjab, Telangana and Uttar Pradesh.
- The Joint Electricity Regulatory Commission for Union Territories also issued electricity tariff for EVs in Chandigarh.
- While Delhi, Punjab, Andhra Pradesh, Uttar Pradesh, Telangana, Chhattisgarh and Madhya Pradesh have refrained from adding fixed charges component to their EV tariffs,
- Maharashtra, Jharkhand, Haryana, Karnataka, Gujarat and Chandigarh have kept fixed capacity charges.
- Delhi, Maharashtra, Uttar Pradesh and Telangana have applied “Time-of-Day” (ToD) rebate/surcharge as part of their EV tariffs as a means to influence EV charging behavior

# CONCLUSION

- Exciting yet challenging times lie ahead. Though the future electricity systems seems technically feasible, however, it requires identification of appropriate generation, storage (battery and pump storage) and flexible loads at suitable location.
- Electric Vehicle as a Flexible load needs potential analysis as a pilot project for future implementation.
- Regulators may also have to strive to do required regulatory changes for successful implementation of the concept.
- All the measures well planned and well placed into the system, would certainly help safe, reliable, economic and flexible operation of the grid with different types of energy resources.