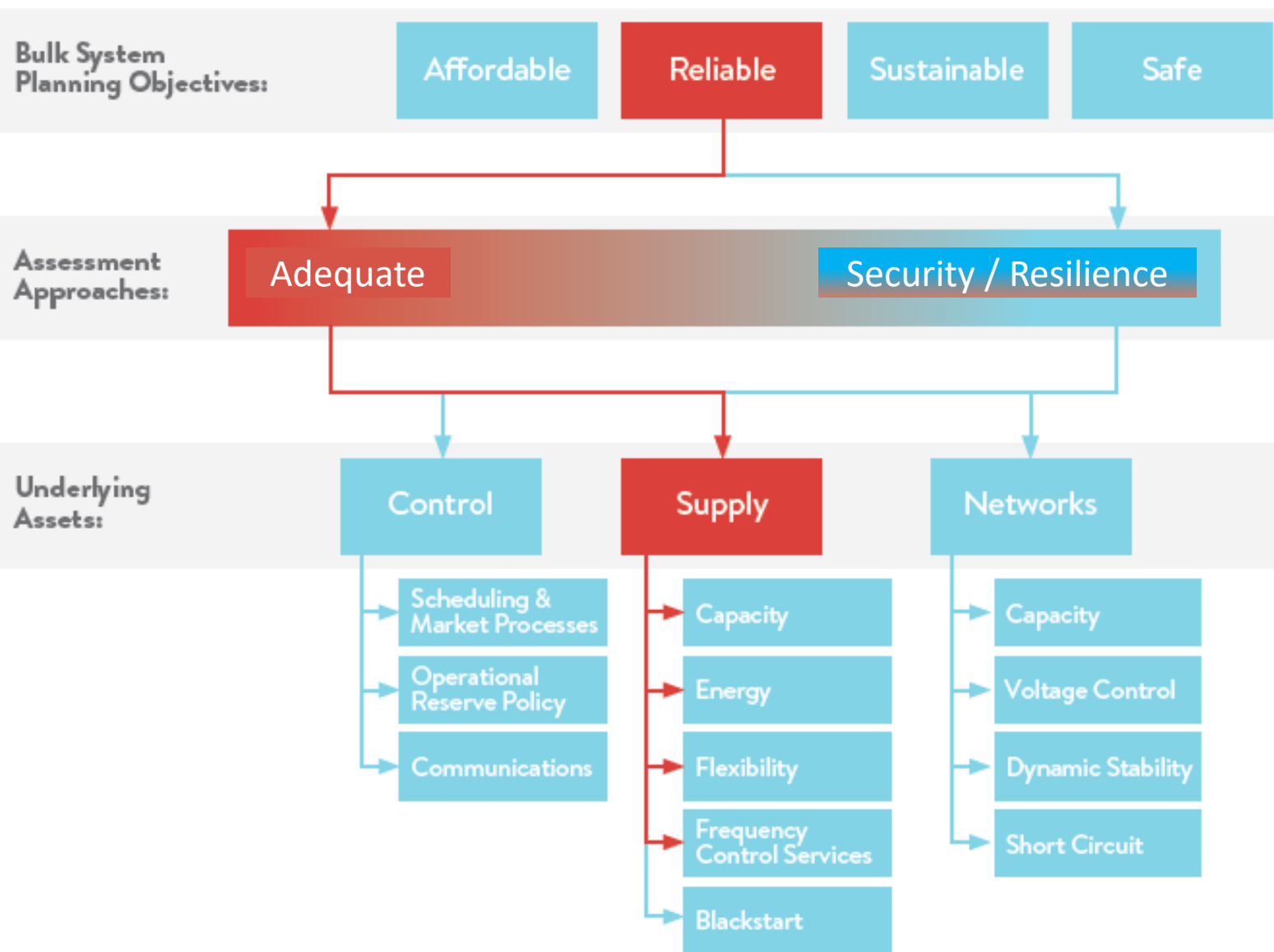


Short-Term Resource Adequacy & Operational Challenges

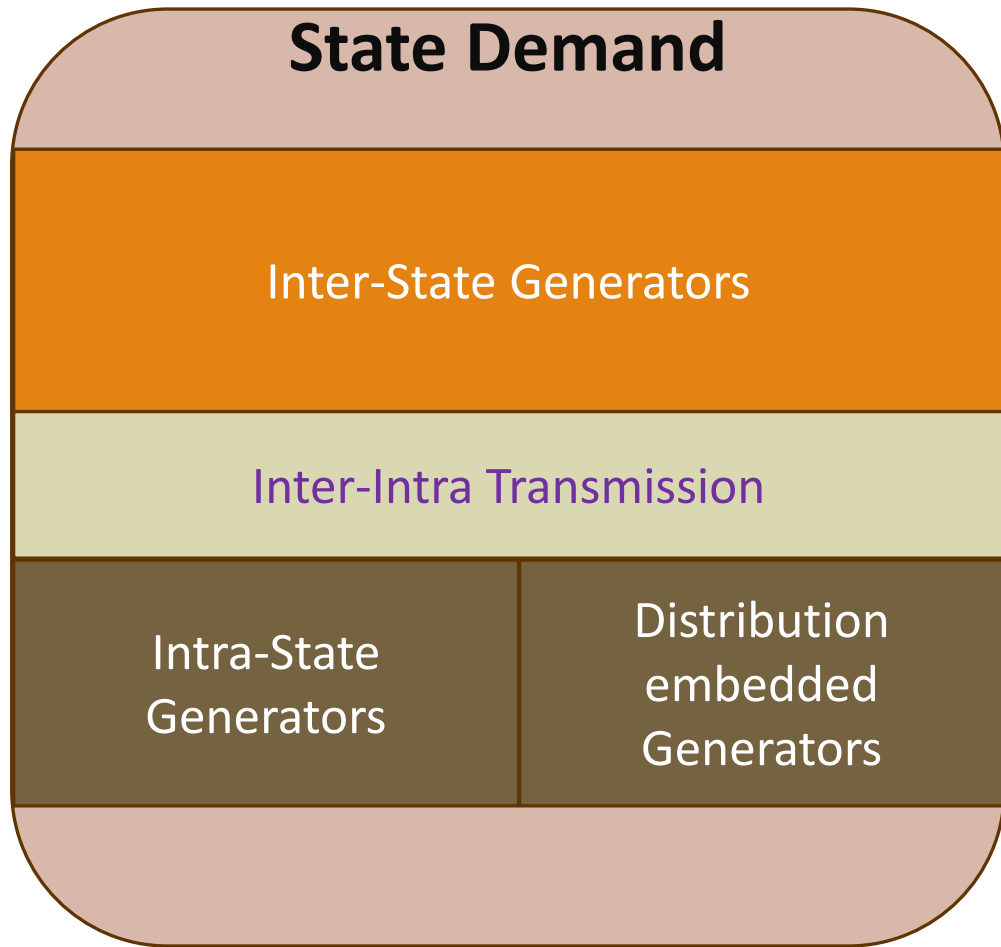
SLDC, Maharashtra

5th December' 2024



Adequate
<p>Philosophy: determine the expected performance of a system over the range of foreseeable conditions.</p> <p>Assessment Metrics: Expected frequency, duration, energy lost margins, pass/fail tests.</p>
Resilient
<p>Philosophy: Identify how a system anticipates, absorbs, adapts to, and/or rapidly recovers from extreme scenario.</p> <p>Assessment Metrics: An array of case specific metrics that can include load and energy not served.</p>

DEMAND-RESOURCE MANAGEMENT



- **CC Factor for Hydro plants :-**

$$\frac{(\text{Installed Capacity}) \times (1 - \text{Auxiliary Power}) \times (\text{Availability})}{\text{Sum of RE Capacity for top 'x' hours}}$$

- **“Resource Adequacy (RA)”** means a mechanism to ensure adequate supply of generation to serve expected demand reliably in compliance with specified reliability standards for serving load with an optimum generation mix with a focus on integration of environmentally benign technologies after taking in to account the need, inter alia, for flexible resources, storage systems for energy shift, and demand response measures for managing the intermittency and variability of renewable energy sources.

- Time horizon for Short Term RA is up to one year:

- Seasonal
- Month ahead
- Week ahead
- Day ahead
- Intra-Day

- **CC Factor for Thermal, Nuclear, Gas plants :-**

$$\text{Capacity Credit of Conventional Sources (Coal, Gas, Nuclear)} = \text{Installed Capacity} \times (1 - \text{Auxiliary Power}) \times \text{Availability}$$

- **CC Factor for Solar and Wind :-**

$$\frac{(\text{Sum of RE Generation for top 'x' hours})}{(\text{Sum of RE Capacity for top 'x' hours})}$$

What are the alternative definitions

NERC:

The ability of the electricity system to supply the aggregate electric power and energy requirements of the electricity consumers at all times, taking into account scheduled and expected unscheduled outages of system components.

Source: NERC, “Long Term Reliability Assessment 2020”, Dec. 2020

CIGRE:

A measure of the ability of a power system to meet the electric power and energy requirements of its customers within acceptable technical limits, taking into account scheduled and unscheduled outages of system components.

Source: CIGRE, “The Future of Reliability,” Tech. Brochure No 715, 2018

ENTSO-E

An assessment of the ability of the system “... to supply current and projected demand levels for electricity at Union level, at the level of the Member States, and at the level of individual bidding zones, where relevant...”

Source: ENTSO-E Methodology for the European resource adequacy assessment, Art1, Oct. 2020

EPRI

The Objective of Resource Adequacy Assessment :*Resource adequacy studies assess whether a power system has an appropriate set of supply resources to maintain continuous service to demand, with a desired level of certainty.*

Six Principles of RA for Modern Power Systems

Principle 1: Quantifying Size, Frequency, and Duration of Capacity Shortfalls is Critical to Finding the Right Resource Solutions.

Principle 2: There is No Such Thing as a Perfect Capacity Resource

Principle 3: Modelling Chronological Operations Across Many Years is Essential

Principle 4: Load Participation Fundamentally Changes the RA Construct

Principle 5: Neighboring Grids and Transmission are a Critical Aspect of RA

Principle 6: Reliability Criteria Should be Transparent and Economic

CHALLENGES

Source Side

- **Plant Outages: -**
 - Planned Outages
 - Forced Outages
 - Partial Capacity Availability
- **Weather Effects : (Untamable resources)**
 - Variability
 - Uncertainty
 - Extreme Weather events
 - Nisarg & Tauktae Cyclone
 - Solar Eclipse
 - Weather effects on presumed stable sources
- **Energy Limited Sources :**
 - BESS / Storages
- **Behind the meter sources :**
- **IBR Behaviour :**
 - MVAR support / compliance to standards with present mix on ground
- **Net Load Ramping :**
 - Flexibility needs

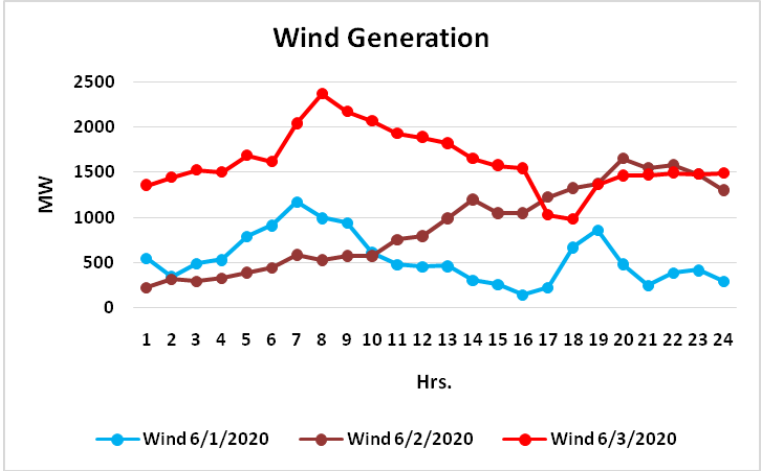
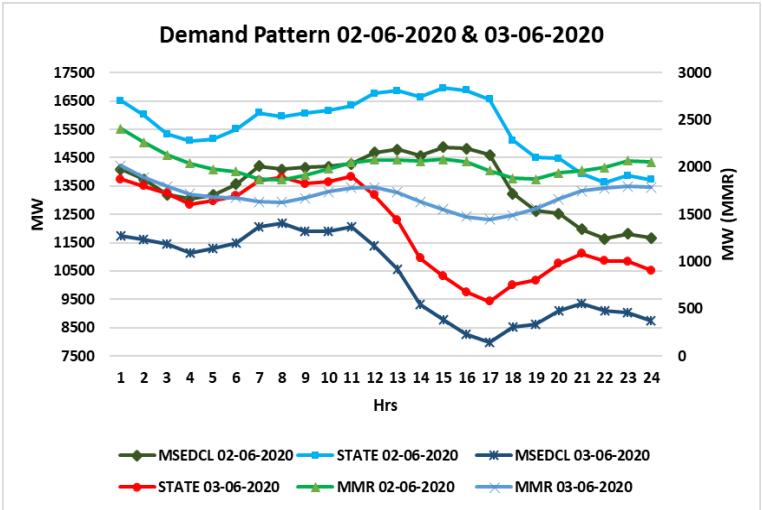
Network Side

- **Network Availability: -**
 - Inter-State TTC/ATC
 - Intra-State Constraints
 - Transmission Constraints
 - Generation Constraints
 - Evacuation
 - Voltage constraints
 - Power system behaviour in neighbouring state / region

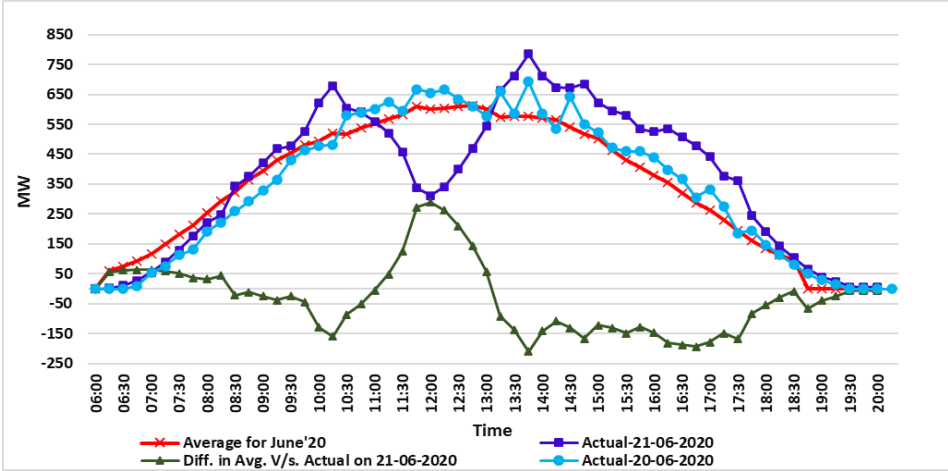
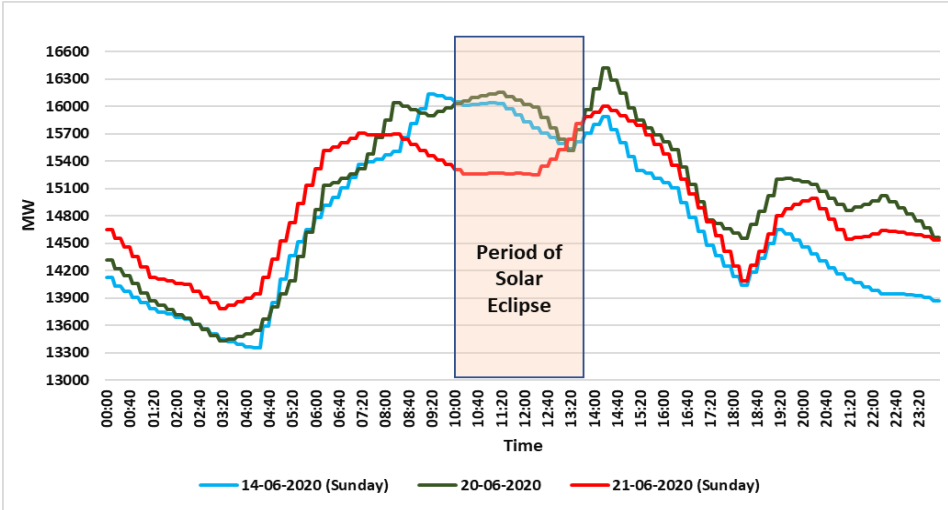
Control Side

- **Weather: -**
 - Forecasting accuracy
- **Dispatch Approach**
- **Reserves**
- **Ancillary service mechanism**
- **Market**
- **Real time information availability**
- **Capacity building**
- **Consumer behaviour**
- **Demand response (Tamable loads)**
- **Demands which can physically move (EV)**
- **Increased granularity (5 Min time block)**
- **Increased dynamism than routine LGBR exercise**

EXTREME WEATHER EVENTS:

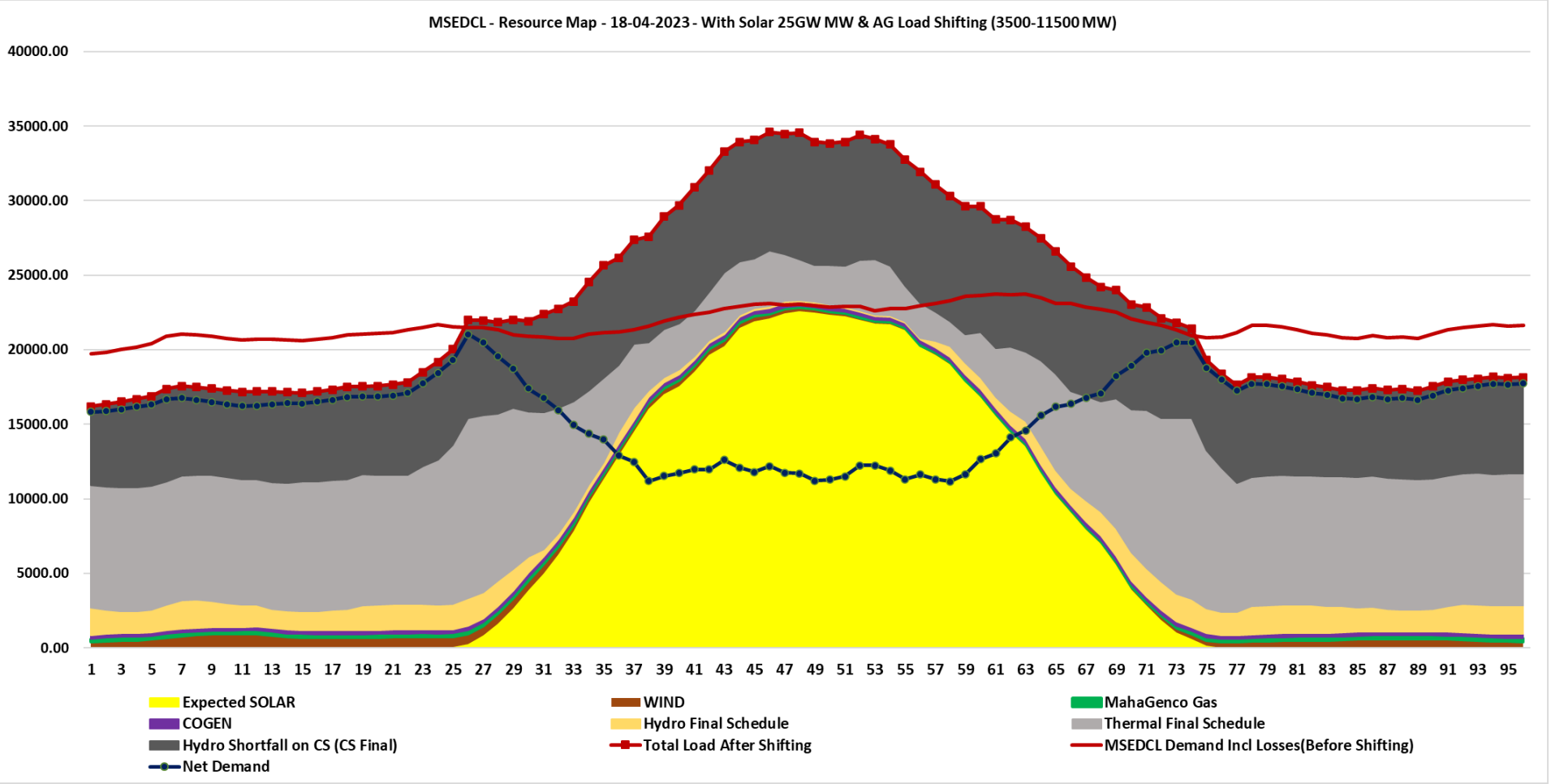


Nisarg Cyclone
2nd & 3rd June' 2020



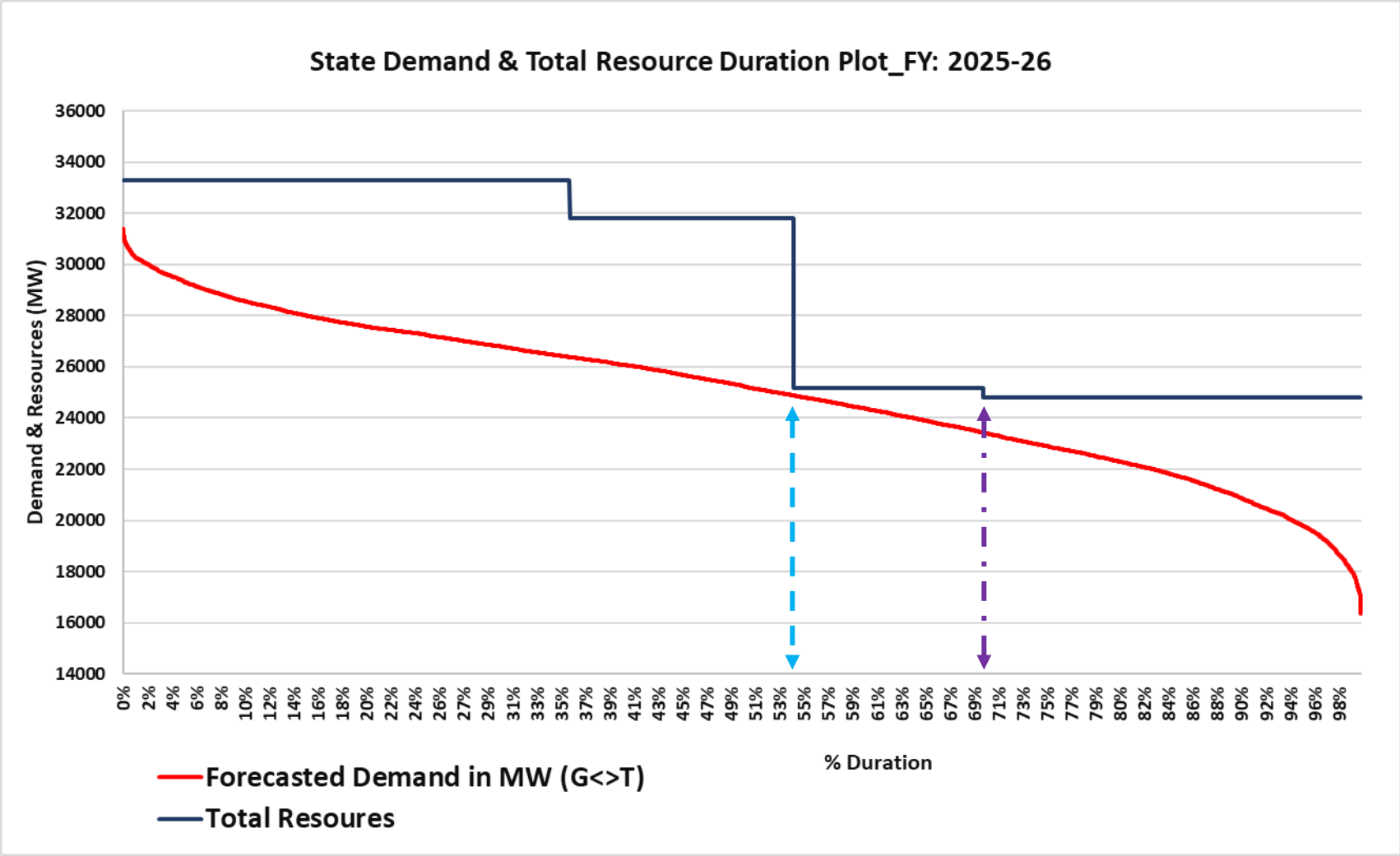
Annular Solar Eclipse
21st June' 2020

NET LOAD RAMPING WITH MSKVY 2.0:

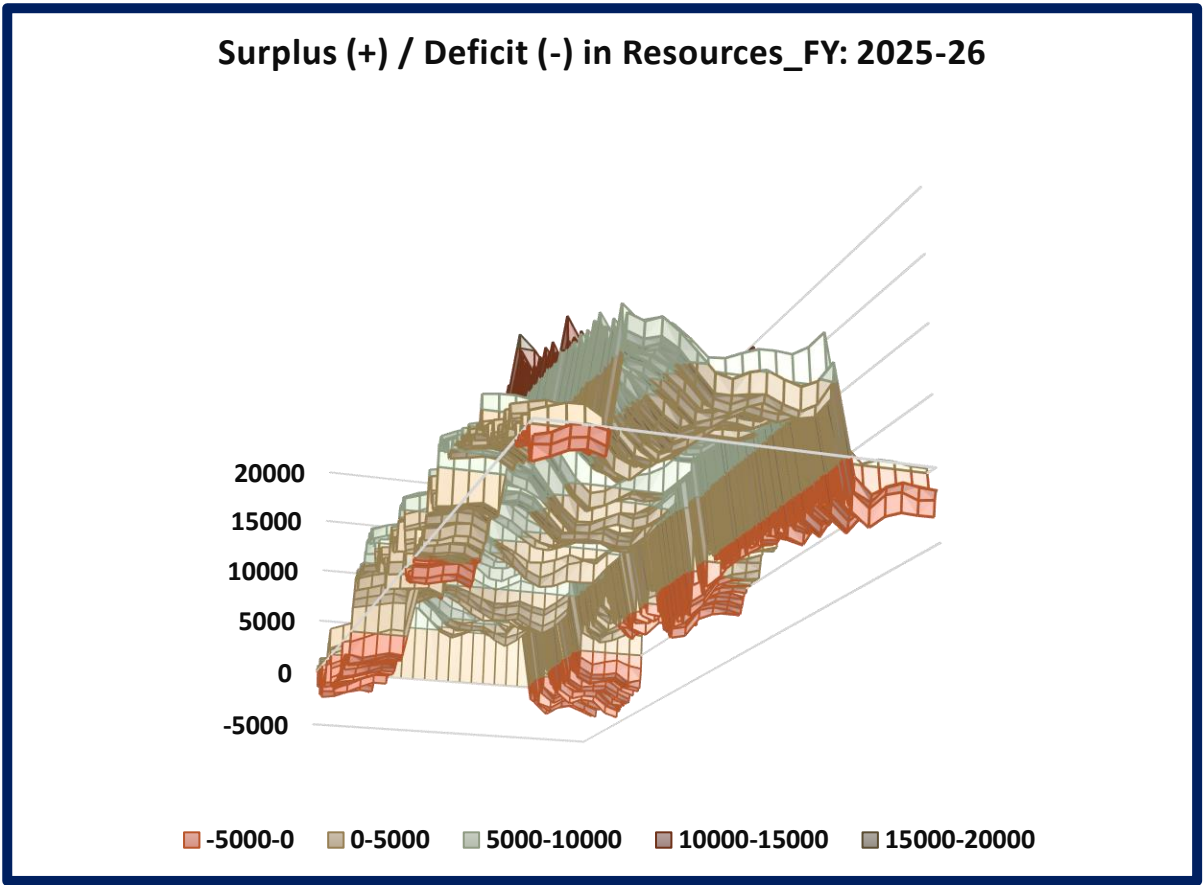
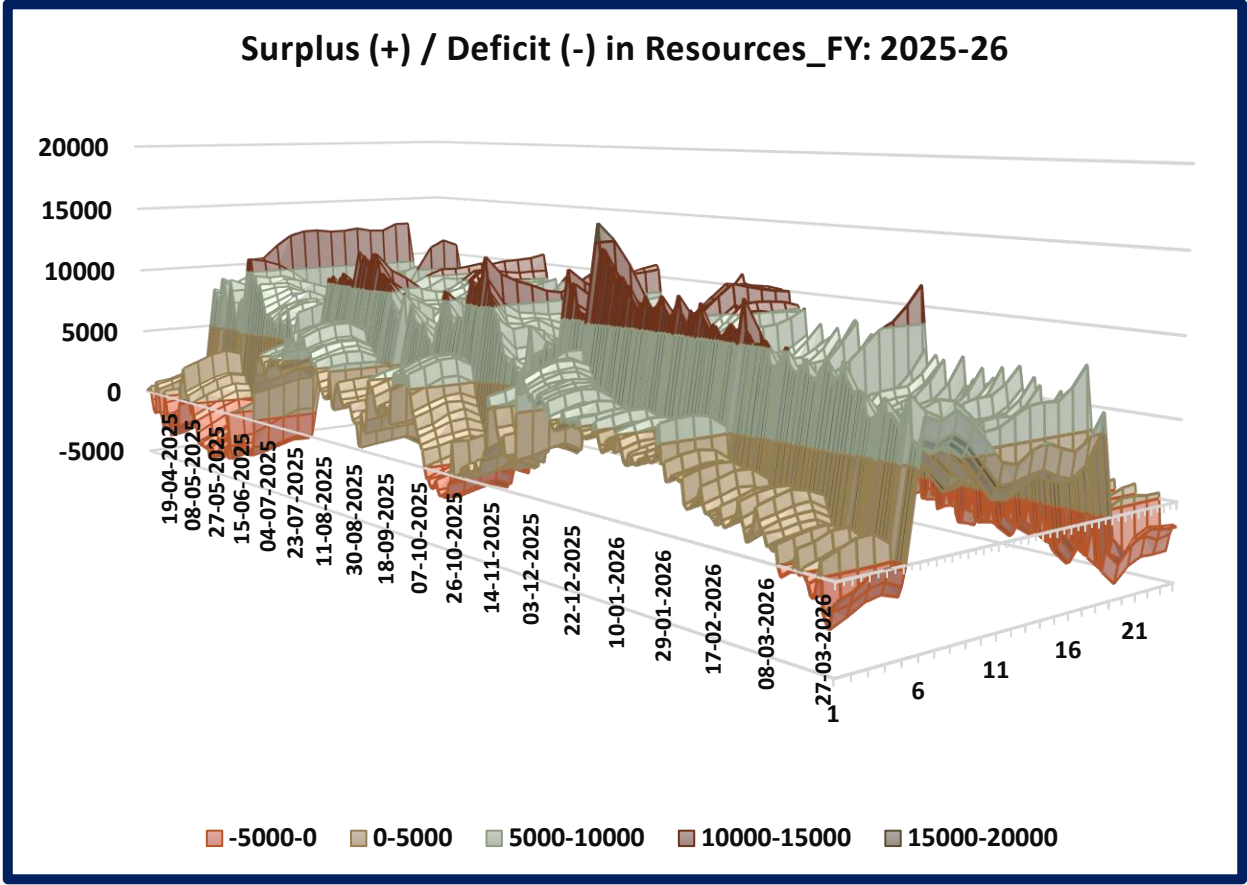


Solar Generation: 25 GW
Shifting of AG load during Day time: 11.5 GW
Sever impact on Intra-State Thermal Generators to meet ramping requirements

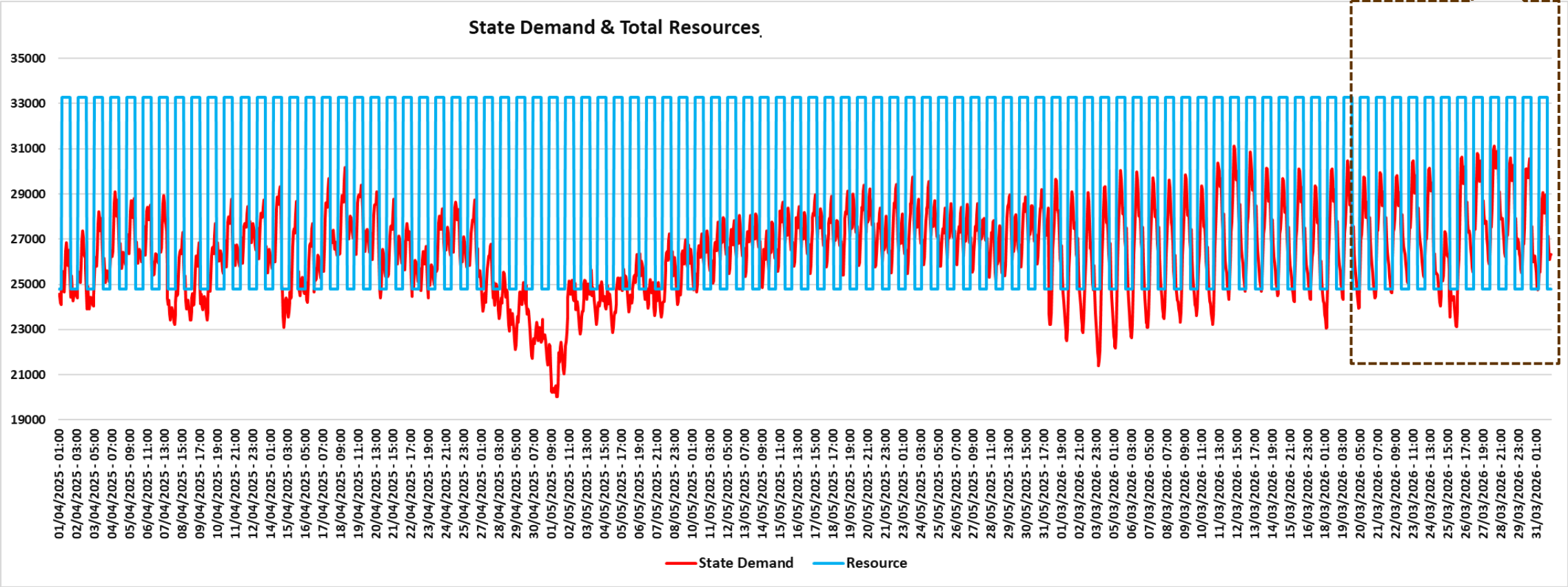
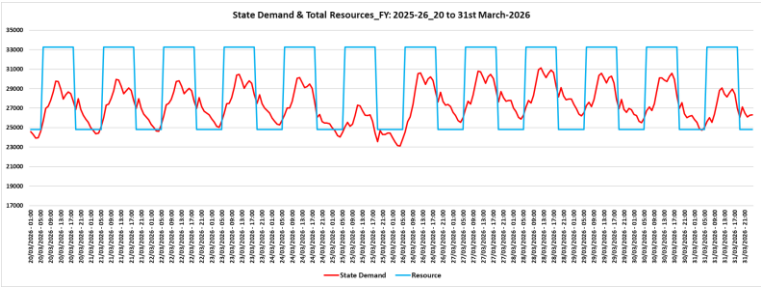
HOURLY TIME DURATION PLOT OF STATE DEMAND & TOTAL RESOURCES (FIRST ITERATION –NOT FINAL)



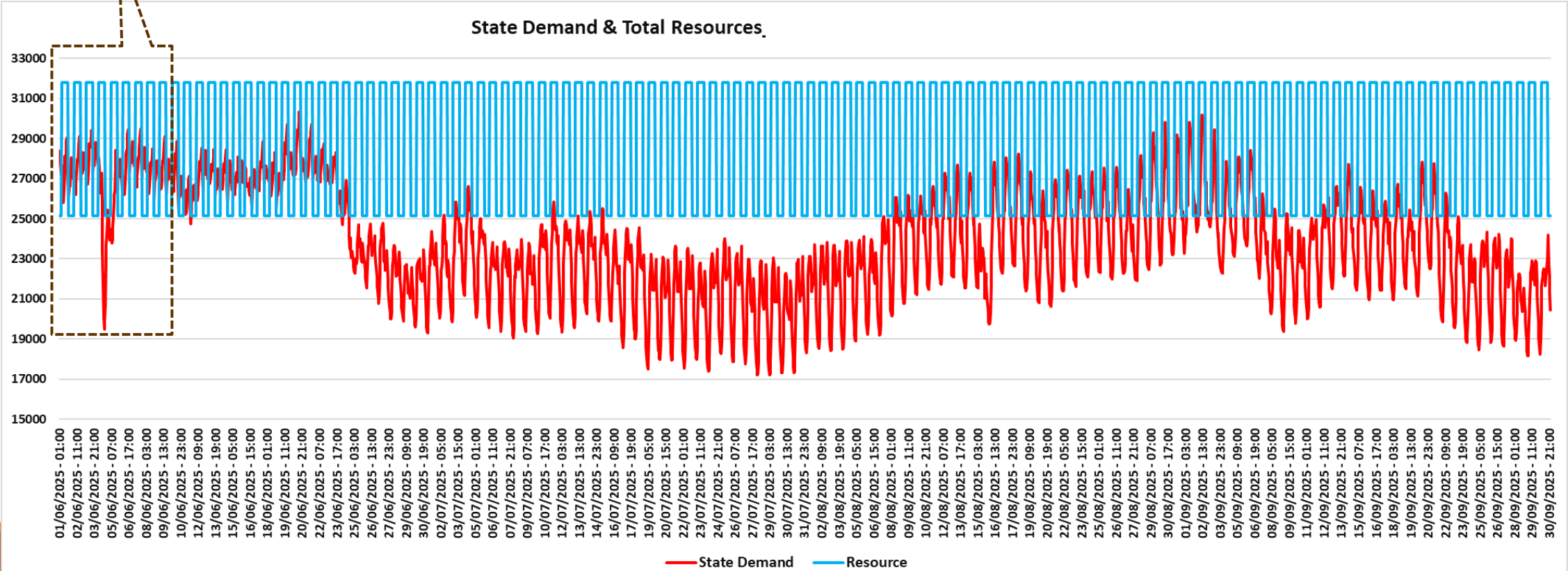
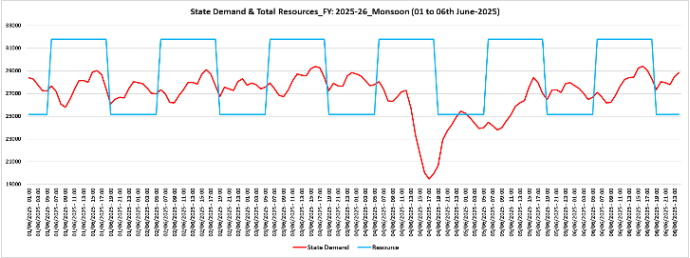
HOURLY SURPLUS (+) / DEFICIT (-) IN RESOURCES



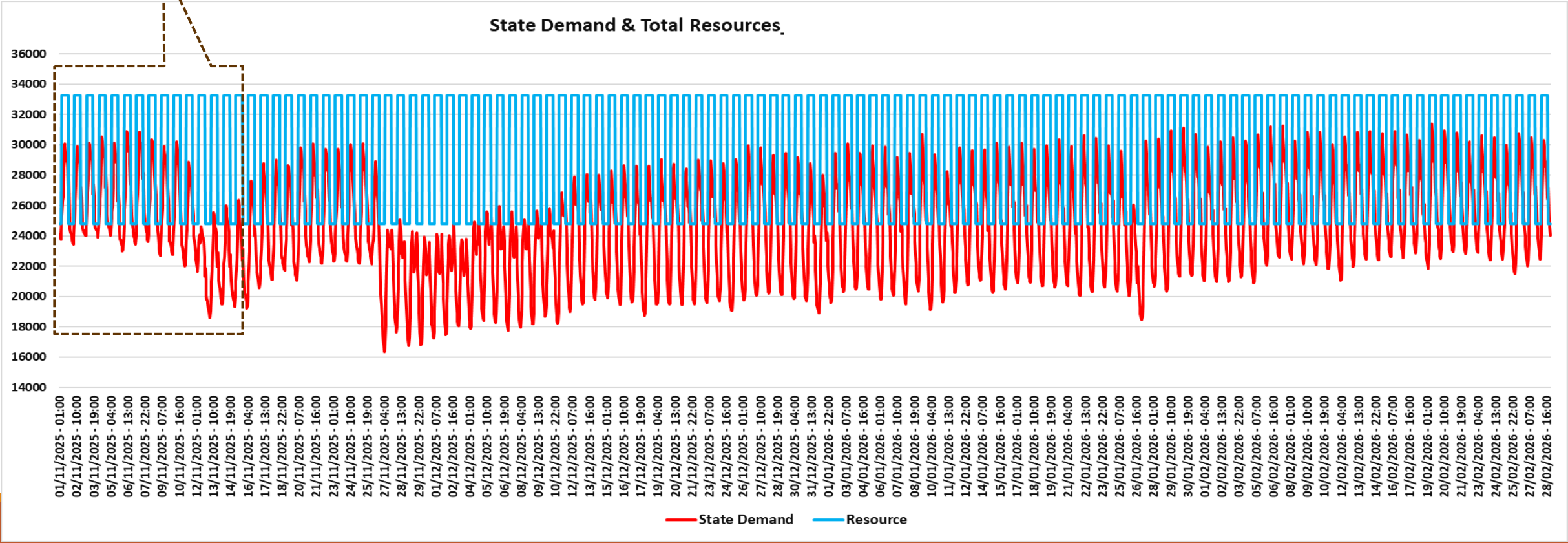
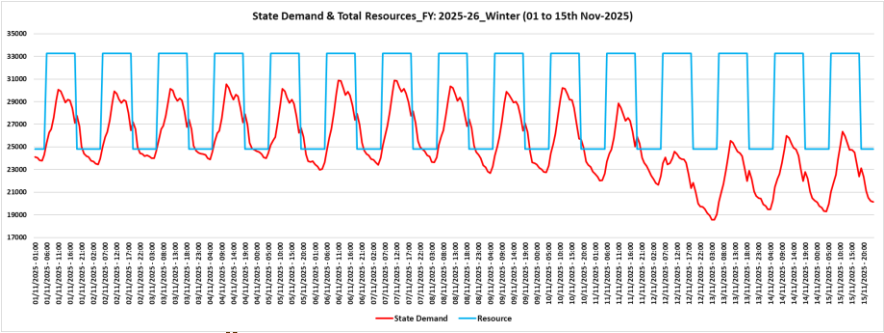
STATE DEMAND & TOTAL RESOURCES_SUMMER MONTHS (MARCH, APRIL & MAY)



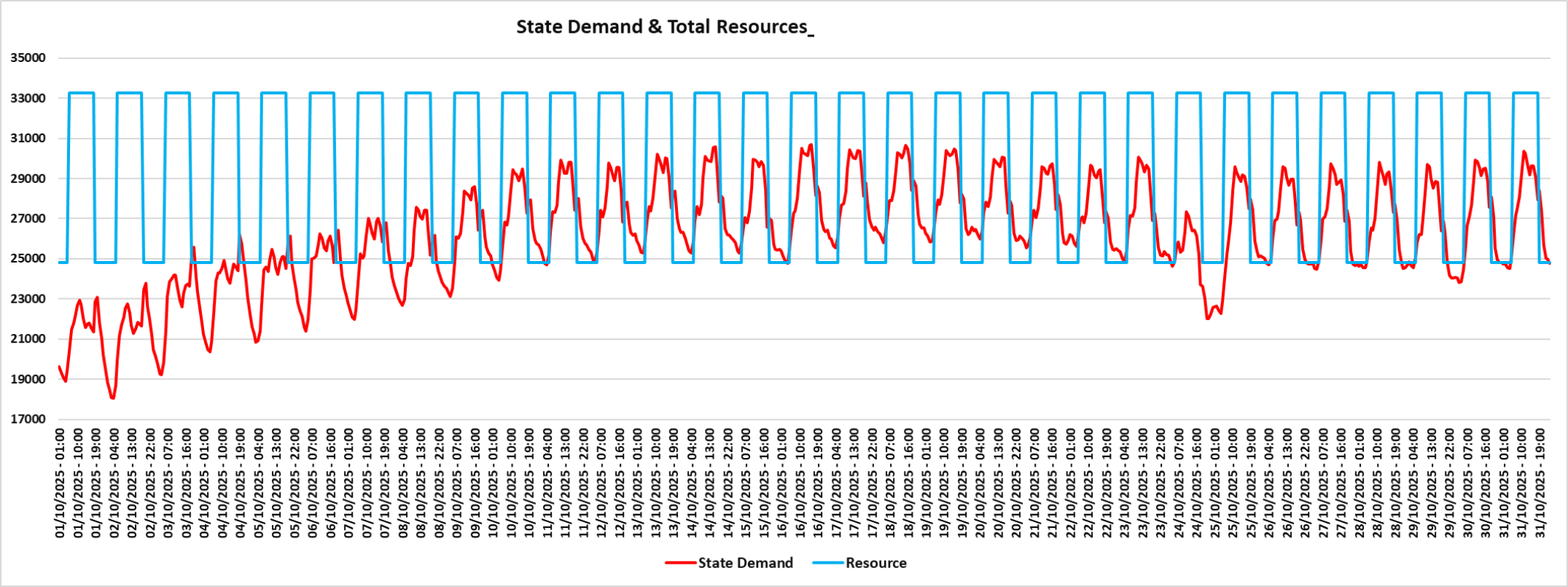
STATE DEMAND & TOTAL RESOURCES_MONSOON MONTHS (JUNE TO SEPT)



STATE DEMAND & TOTAL RESOURCES_WINTER MONTHS (NOV, DEC, JAN & FEB)



STATE DEMAND & TOTAL RESOURCES_OCTOBER



**THANK
YOU**