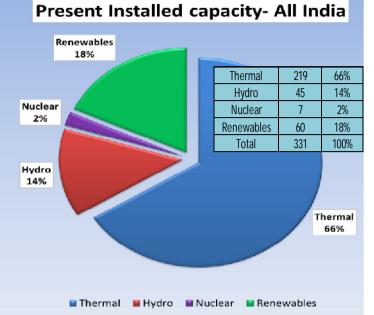
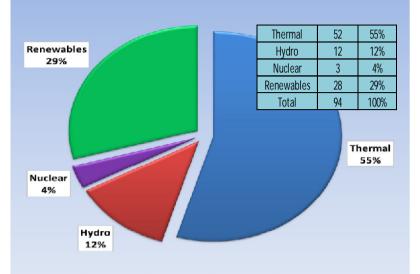


#### Flexible generation for RE penetration in SR Abraham Varghese, SRLDC, POSOCO, Bengaluru



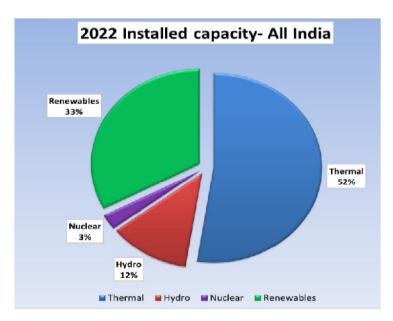
#### Present Installed capacity

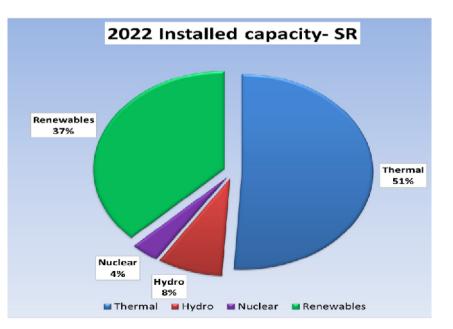




Thermal Hydro Nuclear Renewables

#### Projected Installed capacity in 2022





Present Installed capacity- SR



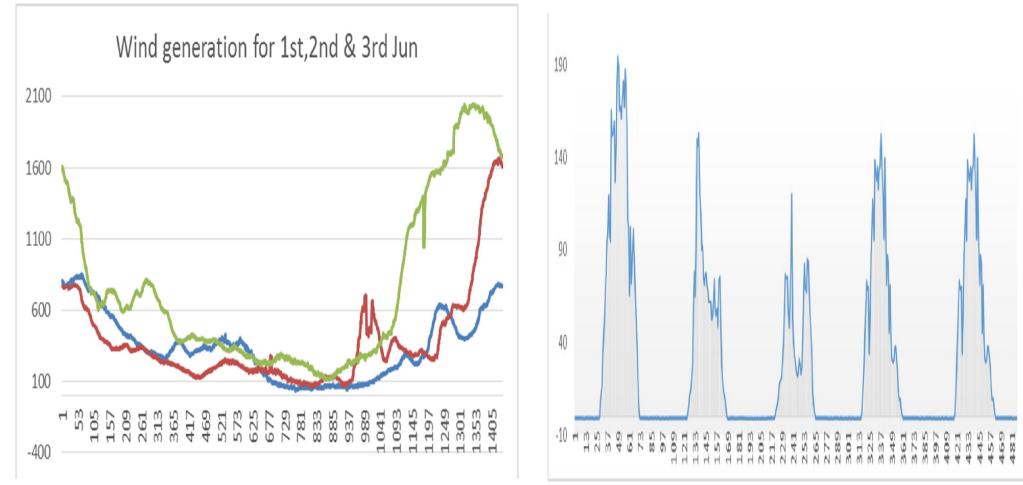


# RE integration-System Operator's preview

- Variability of loads & unforeseen generator outage
- Variability from RE generators
- Forecastable RE generation can be scheduled and others including 'not visible' RE cannot be scheduled
- System operator is continuously balancing the **generation including the forecasted RE** with the **load**, keeping a flexibility for the unscheduled RE & for any variation in the scheduled RE
- SO's main challenges are i) sharp ramp up/down of 'net load' ii) integrating high RE during low demand time iii) frequent changes or shorter despatch for conventional generators iv) System reliability concern



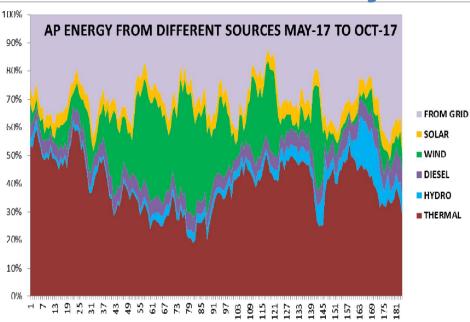
# Type of Wind & Solar generation variations

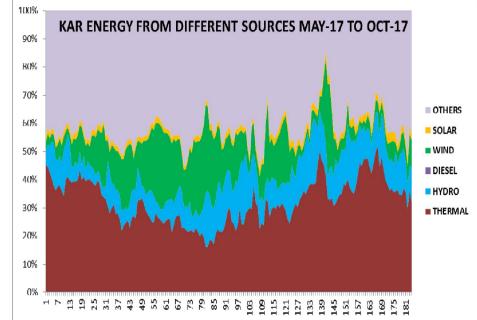


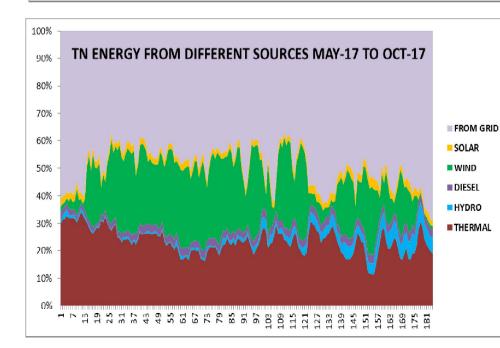
Wind generation variations-AP State

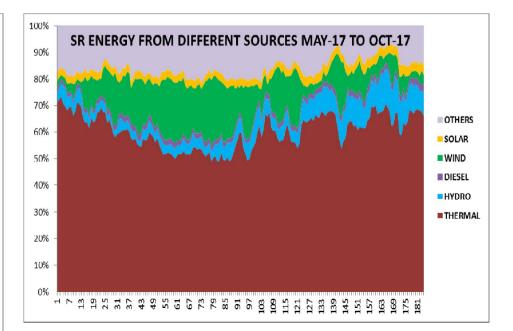
#### Solar generation variations-250 MW park

# State-wise analysis on flexible generation for RE penetration from May17 to Oct17





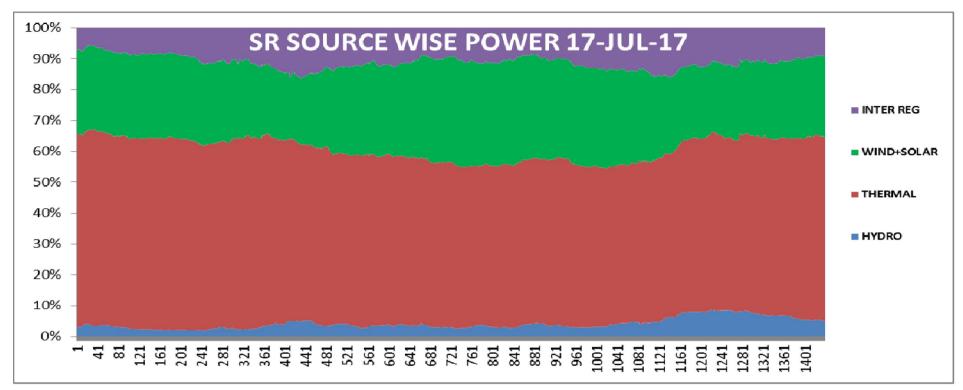






#### Flexible generation on Maximum wind Day 17-JUL-2017





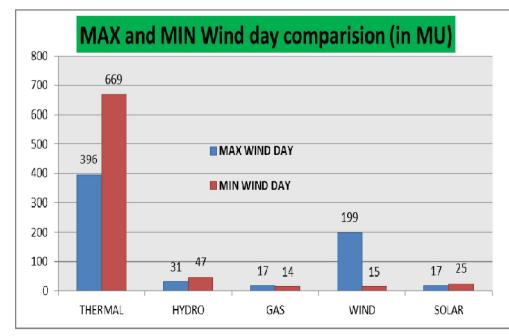
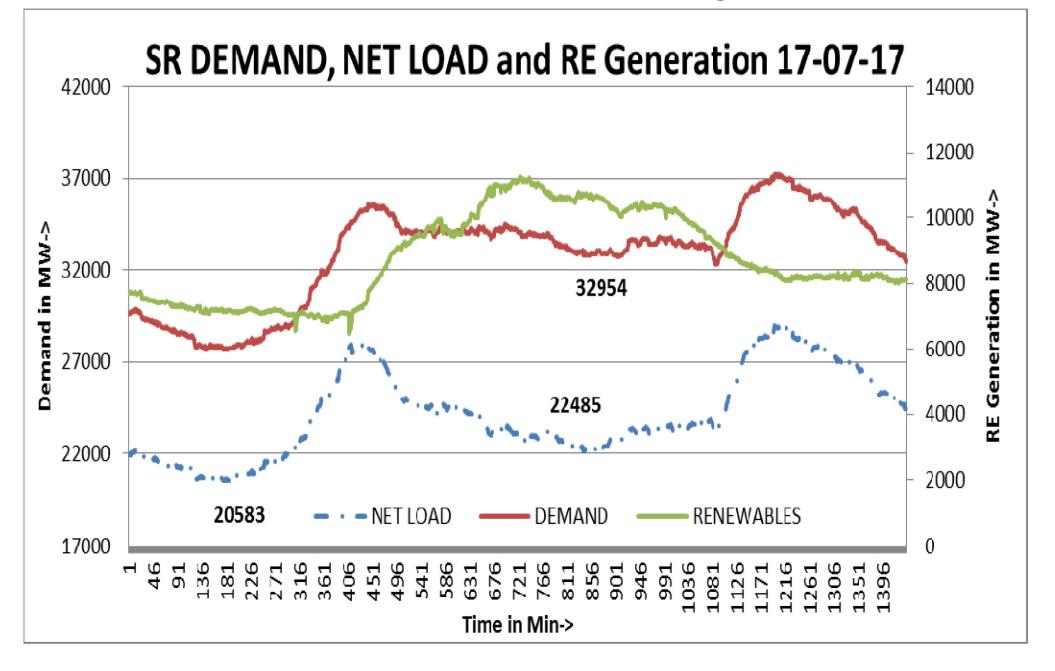


Fig in MW	HYDRO	THERMAL		WIND & Solar		INTER REG	DEMAND
17-Jul-17 12:04:00	992	17367		11236		2924	34051
	3%	51%		33%		9%	100%
Fig in MU	HYDRO	THERMAL		/IND & Solar		INTER REG	DEMAND
17-Jul-17	31	396		199		118	807
	4%	49%		25%		15%	100%

# 'Net Load' on Maximum wind Day 17-JUL-2017

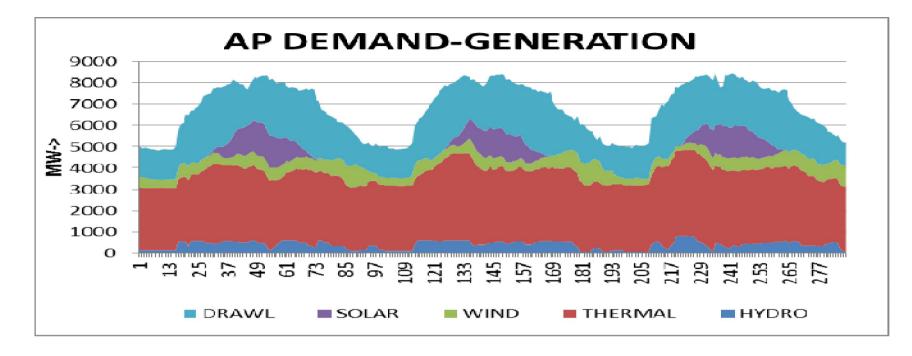


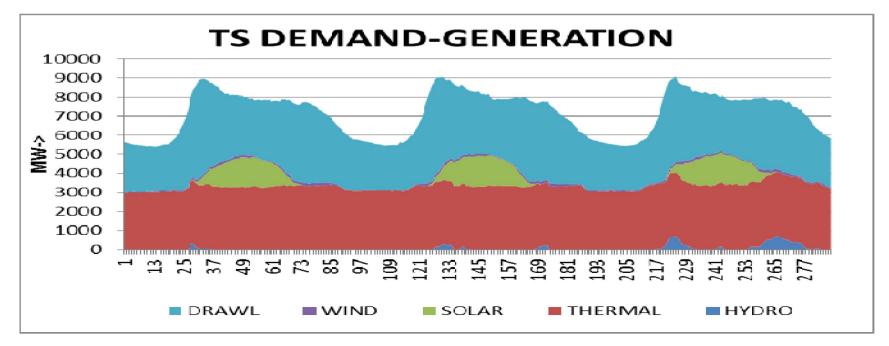


# All time maximum penetration of renewables in Southern Region

State	Instantaneous RE Penetration (MW)	RE Generation (MW) / Demand (MW)	Over the day RE penetration (in Million units)	RE Generation (Mu) / consumption (Mu)
AP	<b>69</b> %	3,809 / 5,509	48 %	64.46 / 133.30
Karnataka	47 %	2,627 / 5,558	<b>29</b> %	46.53 / 158.63
Tamil Nadu	48 %	4,931 / 10,242	36 %	103.30 / 290.60
Southern Region	39 %	12,995 / 33,387	27 %	216.20 / 807. 50

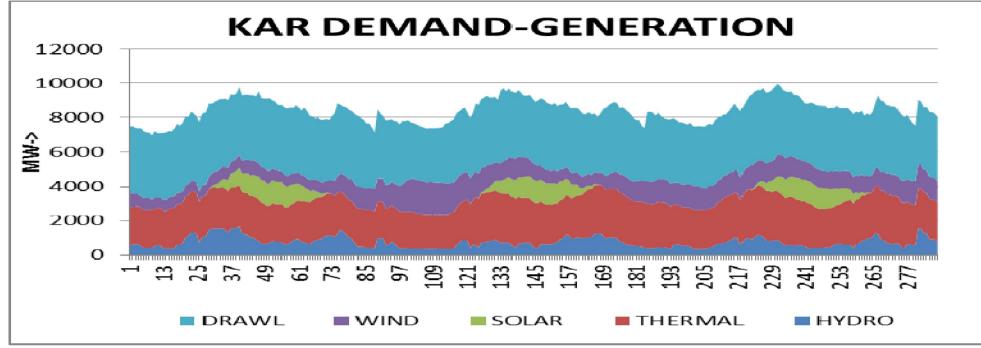
#### State-wise analysis on flexible generation for Solar penetration

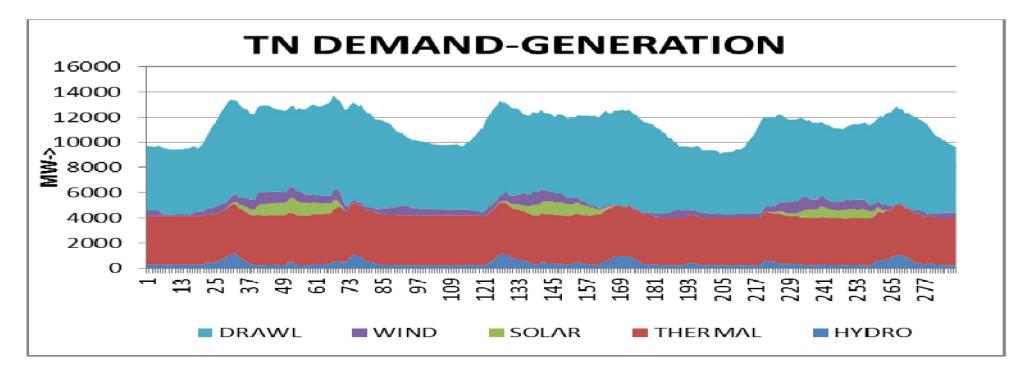




State-wise analysis on flexible generation for Solar penetration

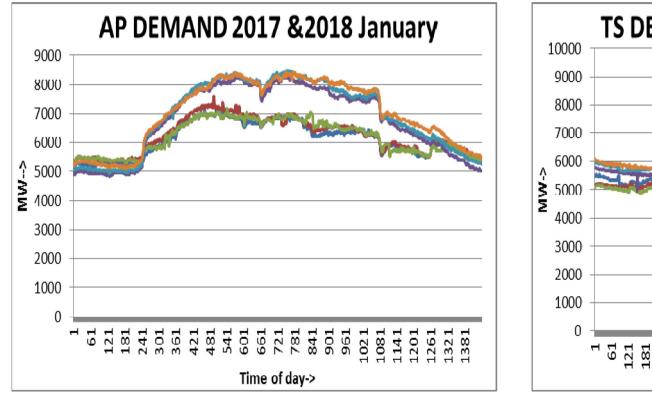


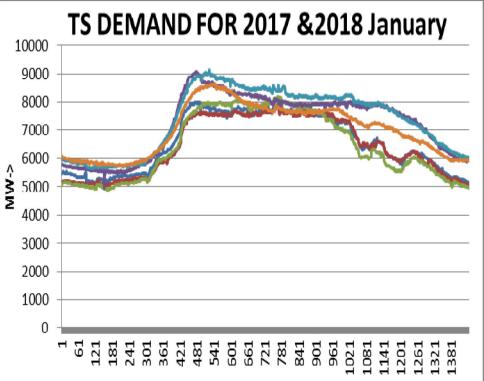


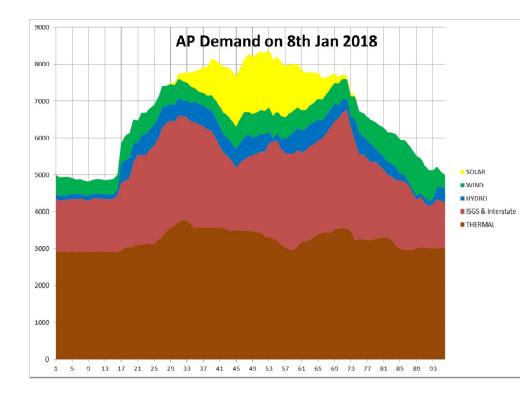


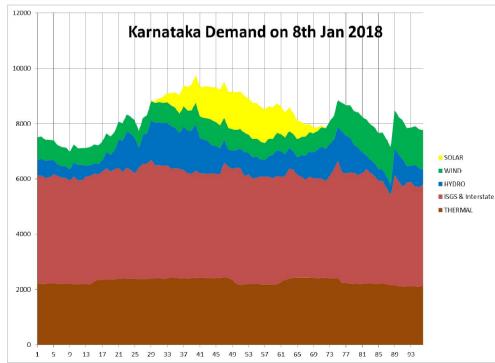


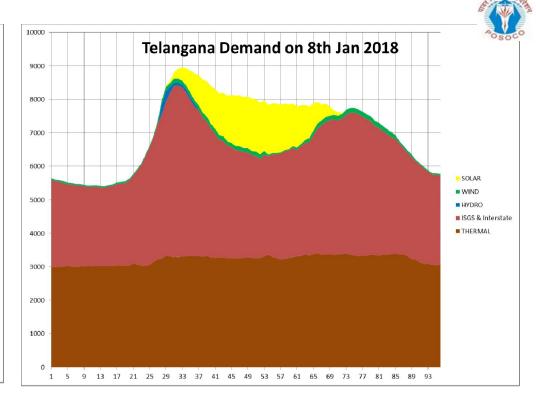
## Flexibility through meeting higher Demand

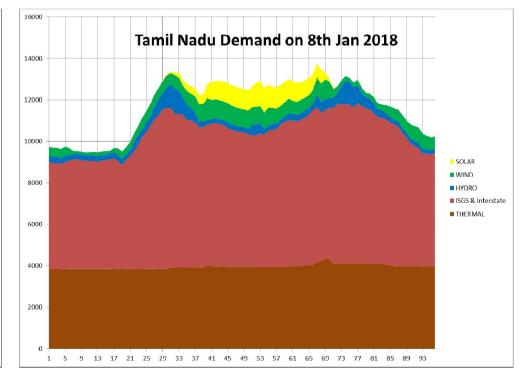




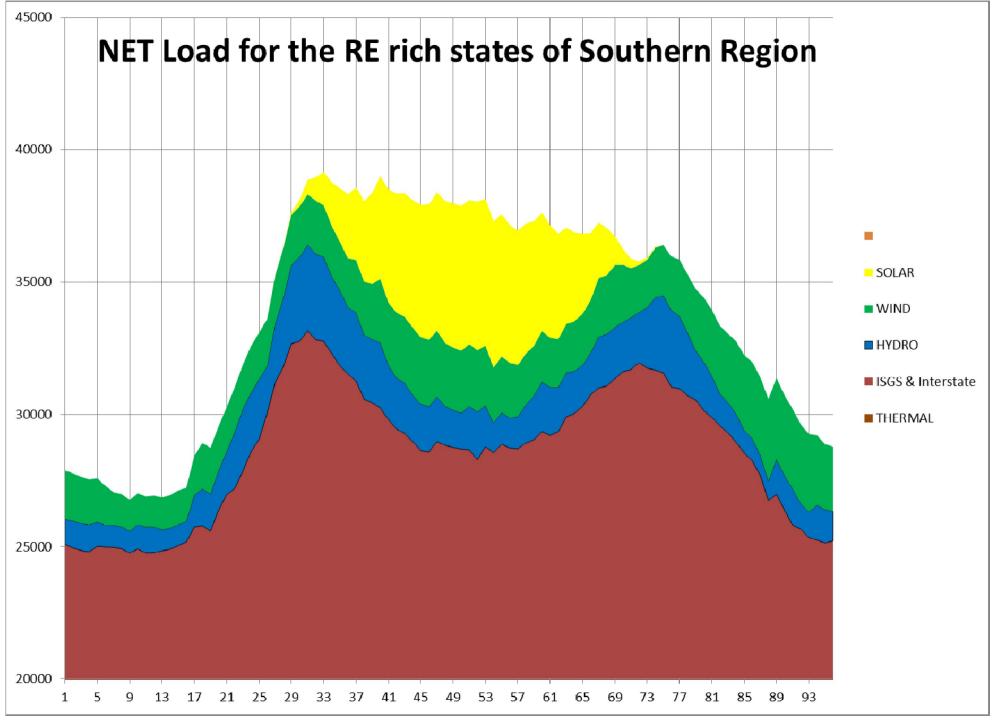














# Conclusion

- RE penetration in Southern region states are generally **bringing down the power deficit**. The higher RE penetration is achieved by flexibility of conventional generators and meeting higher demand.
- Central/State governments are unveiling the action plan for implementation of **EV and energy storage policy**
- Plan for **sufficient flexibility** including for more flexible pump storage and other storage system
- Mechanism for inter-state transactions of RE surplus power, consideration of Reliability aspects, accurate RE forecasting, total RE generation visibility at LDC's, the changing role of the network with introduction of DGR & storage system are **some of the challenges with higher penetration of RE**