

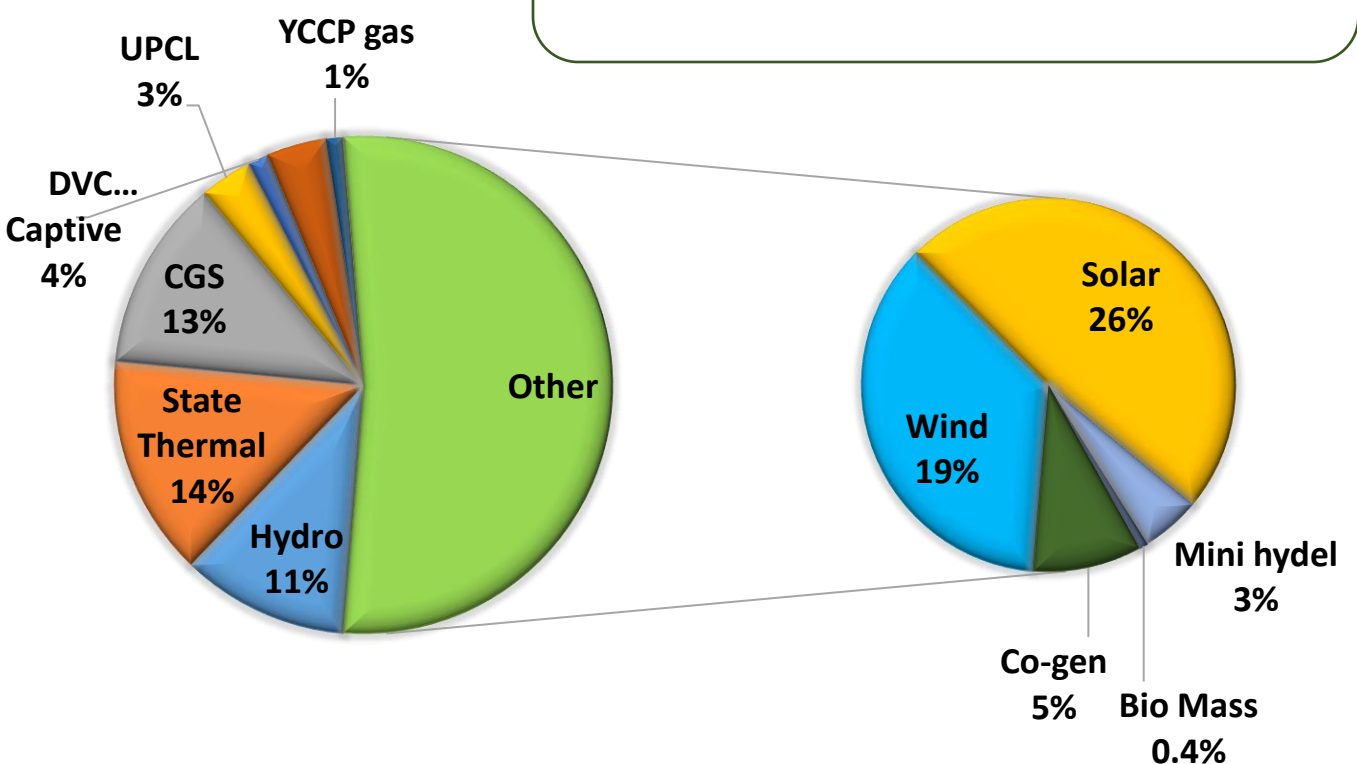
Capacity Building on Resource Adequacy for Karnataka- Operational Challenges with RA

State Resources (Nov-24)

Conventional Share:47% RE share:53%

Source	Installed Capacity in MW
State owned Hydro	3798
State owned Thermal	5020
State share with CGS	4352
UPCL(IPP)	1200
LTA(DVC)	450
Captive (Mini thermal)	1376
YCCP gas	370
Conventional total	16566
Wind	6660
Solar	8924
Mini hydel	940
Bio Mass	139
Co-generation	1731
RE Total	18394
Total	34960

Max demand:17220 MW – 12.03.24
Max consumption in a day: 331.88MU 04



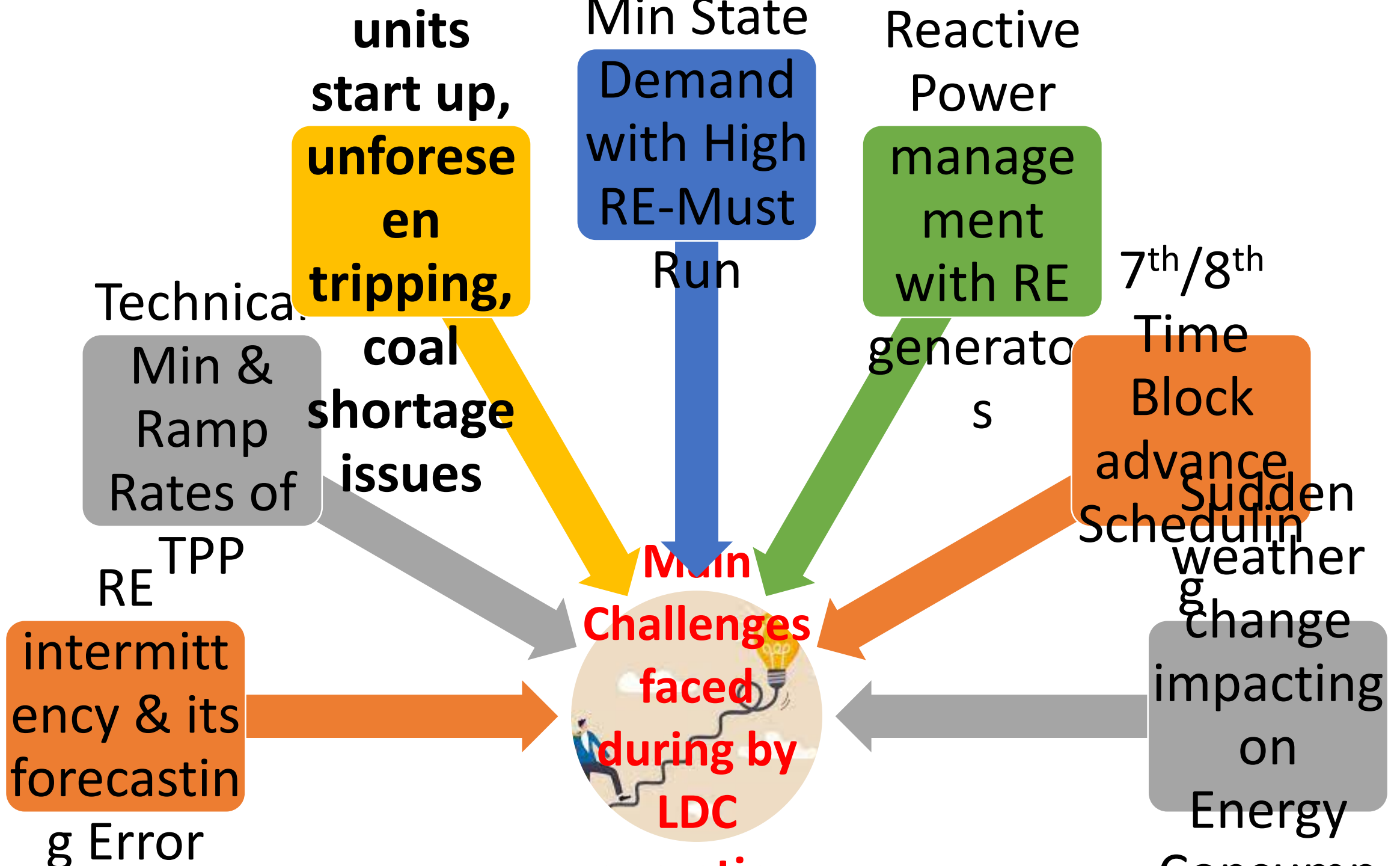
Role of STU/SLDC

Provide inputs such as Hourly Demand and generation profile, future demand projection for formulation of LT NRAP

Aggregate the total contracted capacities at the state level and submit the information to the respective RLDC

Submission of ST-DRAP to GRID INDIA for vetting

SLDC to carry out assessments of resource adequacy (ST-DRAP) for operational planning, at the state level



Challenges in Grid operation

- Karnataka is one of the largest producers of green energy mainly from Solar and Wind sources. Overall RE installed capacity is 53% of total installed capacity.
- Operational Challenges with High Penetration of Renewable Energy at the State Level
 - Grid Stability & Frequency control.
 - Stress on Grid Infrastructure due to high RE Integration.
 - Balancing Supply-Demand in Real-Time with uncertainty of RE generation.
 - RE forecasting uncertainties and special status of Must Run.
 - lack of sufficient large-scale energy storage systems.
- The wind generation varies from 500MW to 2000 MW w.r.t forecasted schedule and Solar generation also varies to an extent of 1000MW in a time block w.r.t forecasted schedule. Which is a challenge for system operators to maintain deviation within the allowable limit.

Challenges in Resource Adequacy Plan data collection from ESCOMS

- Actual demand met by the state / distribution licensee in hourly/ time block wise for last 5 years
- Estimated load growth during the planning period
- Technical parameters of conventional generation plants viz. Name of plant, location (State/Region), Capacity (MW) (for existing and planned capacities), Auxiliary Consumption , Maximum and Minimum Generation Limits, Ramp Up and Ramp Down Rate (MW/min), Minimum up time and down time, Plant Availability Factor etc.
- Under-construction capacity/retirement of generation capacity/contracted capacity/bilateral contracts.

- Capacities and generation profile of renewable generation
- Capital costs, variable costs, O&M costs, reserve offers, start up and shut down Cost of generators.
- Historical forced outage rates and planned maintenance rates of generation capacities
- Tie line details and transmission expansion plans
- Spinning reserve requirements
- Energy Storage Obligation targets, etc

State level plans to address the challenges

- Storage solution-PSP, BESS, Firm Despatchable RE and also Distributed storages.
- Encouraging off grid solar generation for irrigation pump sets with subsidies.
- Resilient Resource adequacy plan for next 10 years
- Energy Mix- proper Combination of both base generation and peak generation plan.
- Accurate demand and RE forecasting by using AIML technique.
- Working on intra state level ancillaries
- Establishing Strong and resilient transmission corridor.
- Attraction of public private partnership investment on transmission (TBCB), Generation (IPPs) & Distribution (ease out business of open access).
- Power sector reforms wherever necessary.

Peak Demand Based on Agriculture Load Shifting

Year	Projected Peak Demand (MW)	Day-time Energy (%)	Night-time Energy (%)	Peak Demand Updated (MW)	Energy (MU)
2024-25	16271	50.0%	50.0%	16579	92648
2025-26	17574	50.5%	49.5%	18075	100066
2026-27	18967	51.0%	49.0%	19690	107998
2027-28	20755	51.5%	48.5%	21745	118181
2028-29	22105	52.0%	48.0%	23372	125868
2029-30	23693	52.0%	48.0%	25051	134910
2030-31	25315	52.0%	48.0%	26765	144142
2031-32	26911	52.0%	48.0%	28453	153230
2032-33	28813	52.0%	48.0%	30464	164064
2033-34	30914	52.0%	48.0%	32685	176022
2034-35	33310	52.0%	48.0%	35218	189667

Summary of Cumulative Planned Generation (Installed Capacity) for Long-Term PPA with ESCOMs

Year	PKL Planned		KPEL Planned			KREDL Planned			PRDC Recommendations				Total Generation Capacity				
	Firm MW	PSP MW/hrs	Thermal MW	PSP MW/hrs	Solar MW	Solar MW	Wind MW	BESS MW/hrs	Solar MW	Wind MW	Firm MW	BESS MW/hrs	Firm MW	Solar MW	Wind MW	BESS MW/hrs	PSP MW/hrs
2024-25	84	0	370	0	0	753	0	1000/2	1800	1300	0	1000/2	454	2553	1300	2000/2	0
2025-26	84	0	370	0	270	2793	0	1000/2	3600	2600	0	2000/2	454	6663	2600	3000/2	0
2026-27	1305	0	370	0	270	4293	1000	1000/2	3600	2600	0	2000/2	1675	8163	3600	3000/2	0
2027-28	2526	1000/8	370	0	270	5293	2000	1000/2	3600	2600	0	2000/2	2896	9163	4600	3000/2	1000/8
2028-29	2826	1000/8	370	0	270	5493	2200	1000/2	5400	3900	0	2000/2	3196	11163	6100	3000/2	1000/8
2029-30	3526	1000/8	370	2000/6	270	6493	3200	1000/2	5400	3900	1000	2000/2	4896	12163	7100	3000/2	1000/8 + 2000/6
2030-31	3526	1000/8	370	3500/6	270	7493	4200	1000/2	5400	3900	2000	2000/2	5896	13163	8100	3000/2	1000/8 + 3500/6
2031-32	3526	1000/8	1970	3500/6	270	7493	4200	1000/2	9400	4900	2000	2000/2	7496	17163	9100	3000/2	1000/8 + 3500/6
2032-33	3526	1000/8	1970	3500/6	270	7493	4200	1000/2	12400	6900	2000	4000/2	7496	20163	11100	5000/2	1000/8 + 3500/6
2033-34	3526	1000/8	1970	3500/6	270	7493	4200	1000/2	17400	8900	3000	5000/2	8496	25163	13100	6000/2	1000/8 + 3500/6
2034-35	3526	1000/8	1970	3500/6	270	7493	4200	1000/2	17400	8900	3000	5000/2	8496	25163	13100	6000/2	1000/8 + 3500/6

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Sl no	Description
1	Discount Rate(%)
2	Interest rate(%)
3	Fuel Cost escalation rate(%)
4	Capital Cost & O&M cost of upcoming projects
5	Planned/ underconstrution projects detail
6	Outage rates of plants

Sl no	Description
1	Banking arrangement detail if any
2	Interstate Tranmission capacity & Flow limit
3	Scenario Analysis(higher demand, net zero, solar roof top etc)
4	operational constraints if any
5	Future Solar & Wind CUF expected, RTC power availbility etc.

year	Peak Demand(MW)	Energy requirement(GWh)
2022-23		
2023-24		
2024-25		
2025-26		
2026-27		
2027-28		
2028-29		
2029-30		

Note: Demand & RE pattern for last 4-5 Year is required							
Time	State Ex bus Demand(MW)	Generator Wise Solar generation(MW)			Generator Wise Wind generation(MW)		
		Solar gen 1	Solar gen 2	Solar gen n	Wind gen 1	Wind gen 2	Wind gen n
01-04-2021							
01-04-2021 00:15							
01-04-2021 00:30							
01-04-2021 00:45							
01-04-2021 01:00							
01-04-2021 01:15							
01-04-2021 01:30							
01-04-2021 01:45							
01-04-2021 02:00							
01-04-2021 02:15							

Time	Generator wise Dispatch for last 2-3 Years preferably 5 years		
	generator 1	generator 2	generator n
01-04-2021			
01-04-2021 00:15			
01-04-2021 00:30			
01-04-2021 00:45			
01-04-2021 01:00			
01-04-2021 01:15			
01-04-2021 01:30			
01-04-2021 01:45			
01-04-2021 02:00			
01-04-2021 02:15			
01-04-2021 02:30			
01-04-2021 02:45			
01-04-2021 03:00			
01-04-2021 03:15			
01-04-2021 03:30			
01-04-2021 03:45			



THANK

YOU !