

10<sup>th</sup> Edition of India Smart Utility Week (ISUW) 2024



## LONG DURATION ENERGY STORAGE SYSTEMS

*“Advanced Grid-scale Energy Storage Technologies”*

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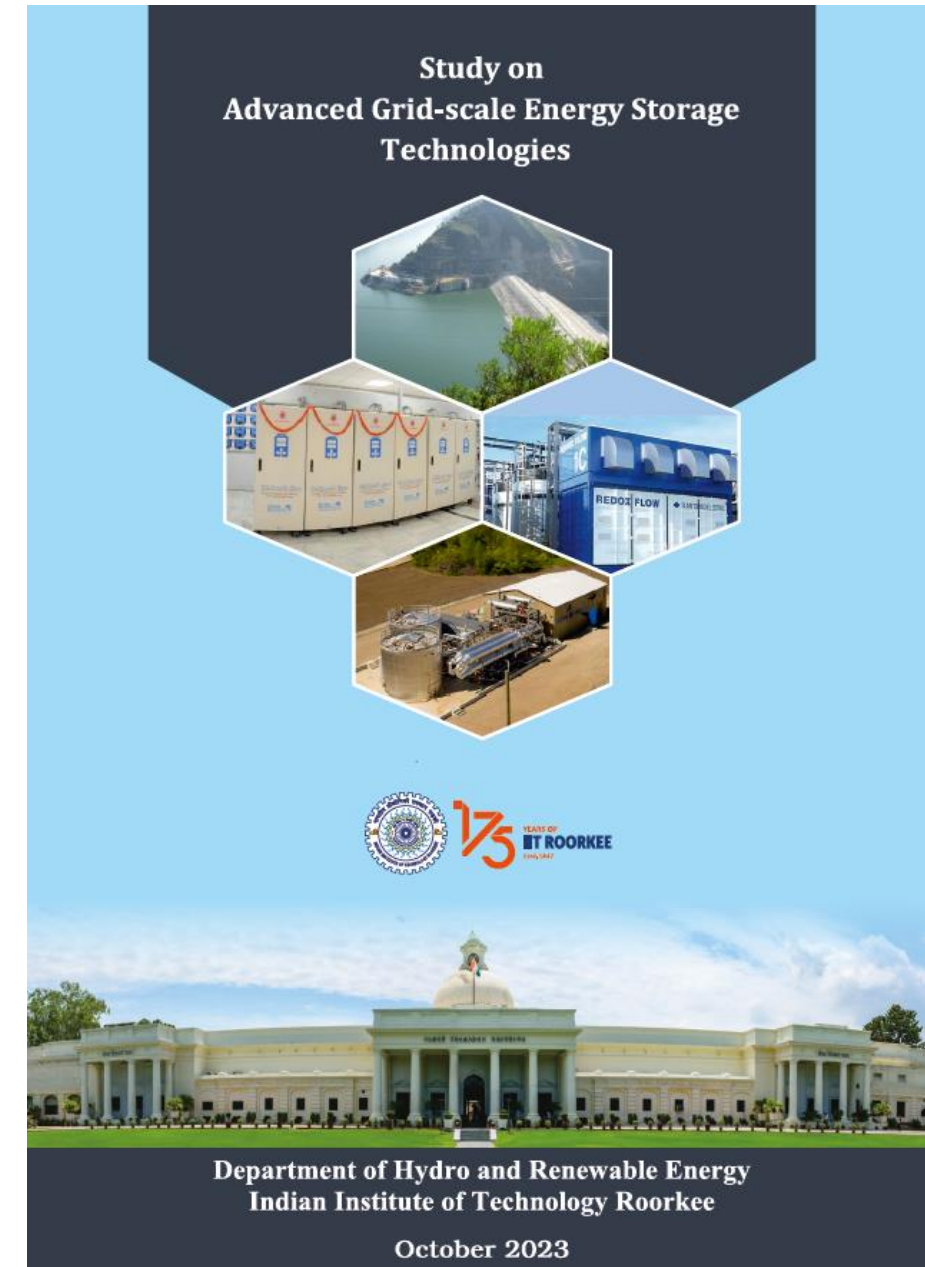


# Study Objectives

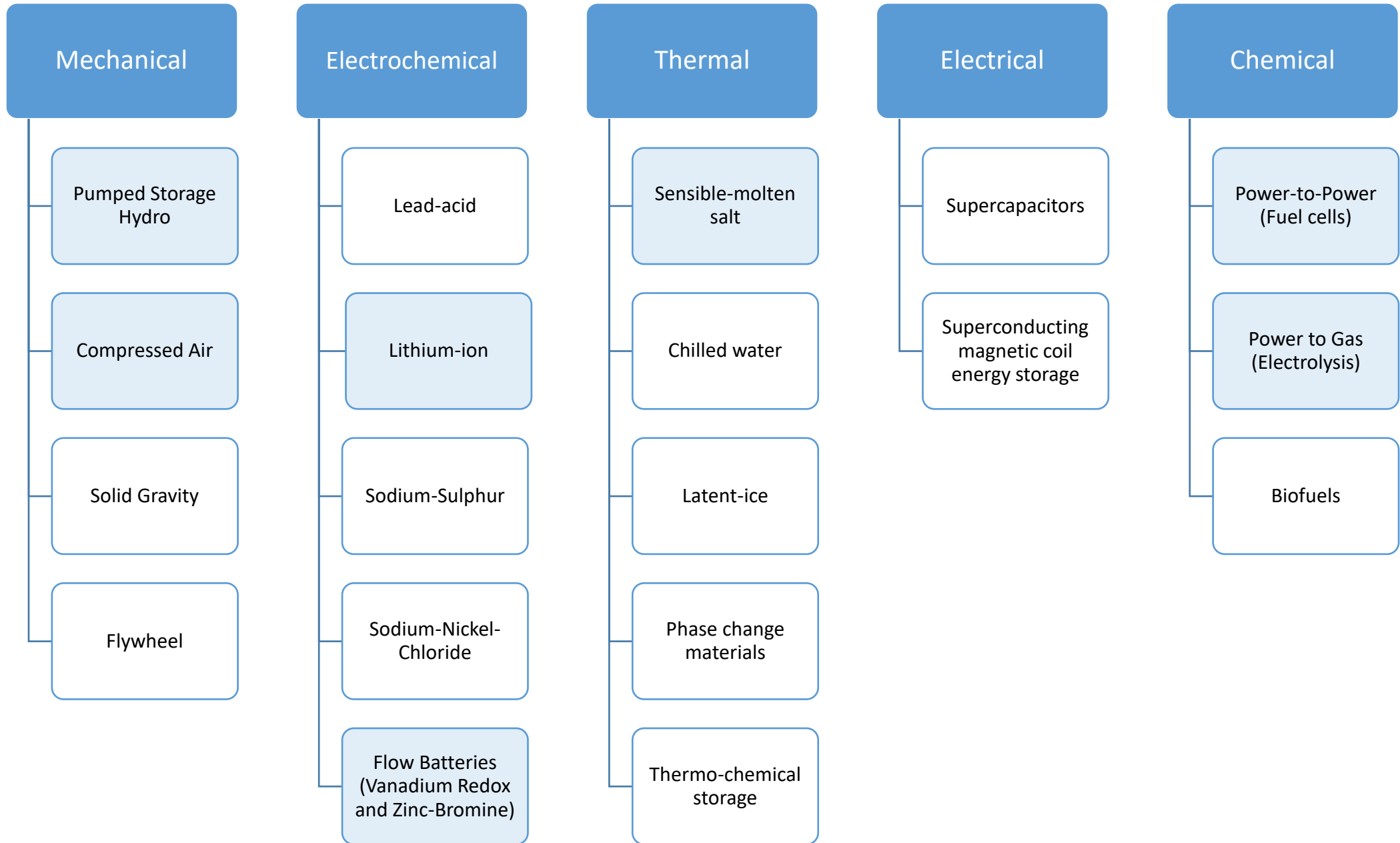
- Assessment of grid scale energy storage technology options for Indian conditions.
- Development of indigenized cost matrix for grid scale energy storage technologies.
- Assessment of domestic manufacturing of these technologies and critical elements of their value chain; assessment of import substitution potential.
- Lifecycle cost of storage and life cycle emission of the energy storage options.
- Policy and regulatory recommendations to incentivize and prioritize storage technologies in India for achieving energy decarbonisation goal.

Completed during September 2022 – July 2023.

[https://iitr.ac.in/Departments/Hydro%20and%20Renewable%20Energy%20Department/static/special\\_publ/Advanced\\_grid-scale\\_energy\\_storage\\_technologies\\_Nov\\_2023\\_HRED\\_IIT\\_Roorkee.pdf](https://iitr.ac.in/Departments/Hydro%20and%20Renewable%20Energy%20Department/static/special_publ/Advanced_grid-scale_energy_storage_technologies_Nov_2023_HRED_IIT_Roorkee.pdf)



# Energy Storage Technologies



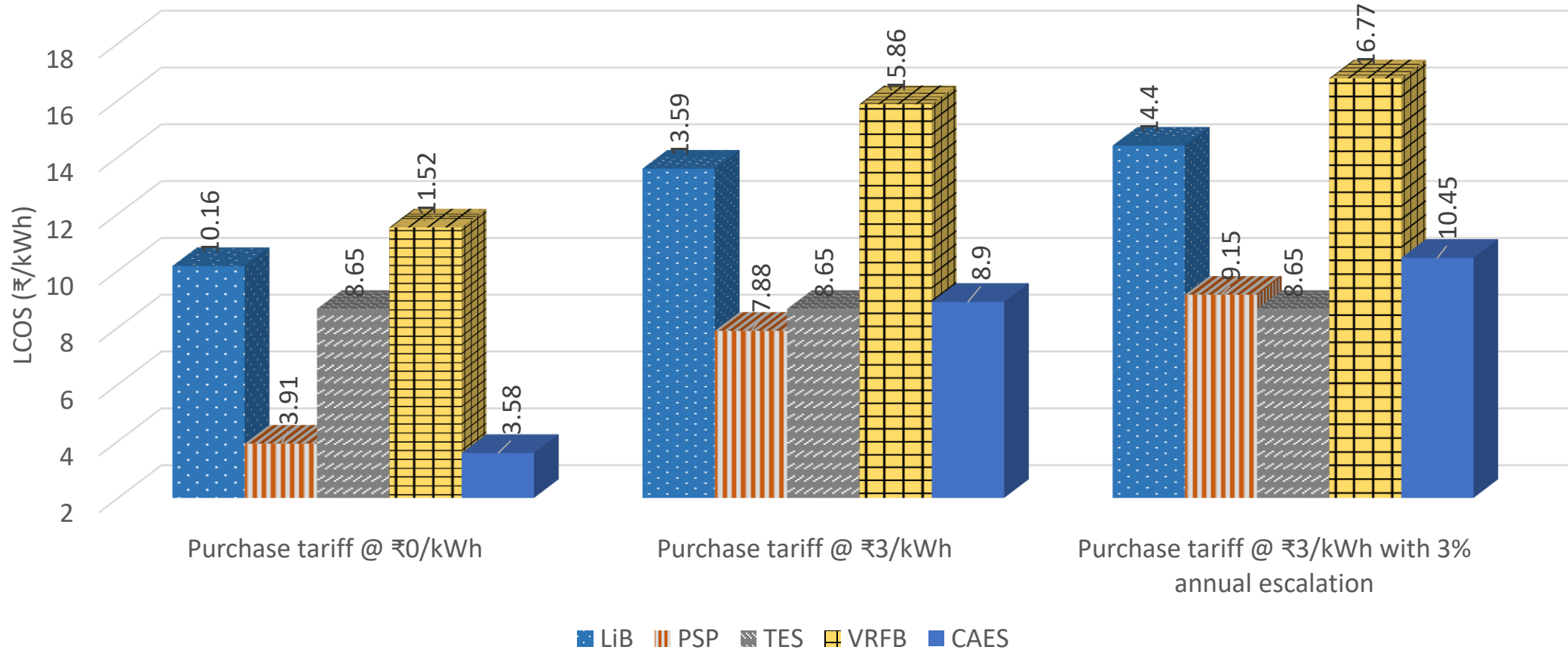
# Assumption for Economical Analysis

Storage Technology	Round-trip Efficiency	Lifetime (Years)	CAPEX	Project construction time (years)	LCoS most sensitive parameter
Pumped Hydro Storage	80%	40	₹ 4 Crores/MW	5	Electricity Buy price
Compressed Air ES	60%	40	₹ 4 Crores/MW	5	Electricity Buy price
Lithium-ion Battery	90%	8	₹ 18,450/kWh	1	CAPEX
Molten Salt Storage	80%	25	₹ 24 Crores/MW	3	CAPEX
Vanadium Redox Flow Battery	83%	24	₹ 26,650/kWh	1	CAPEX

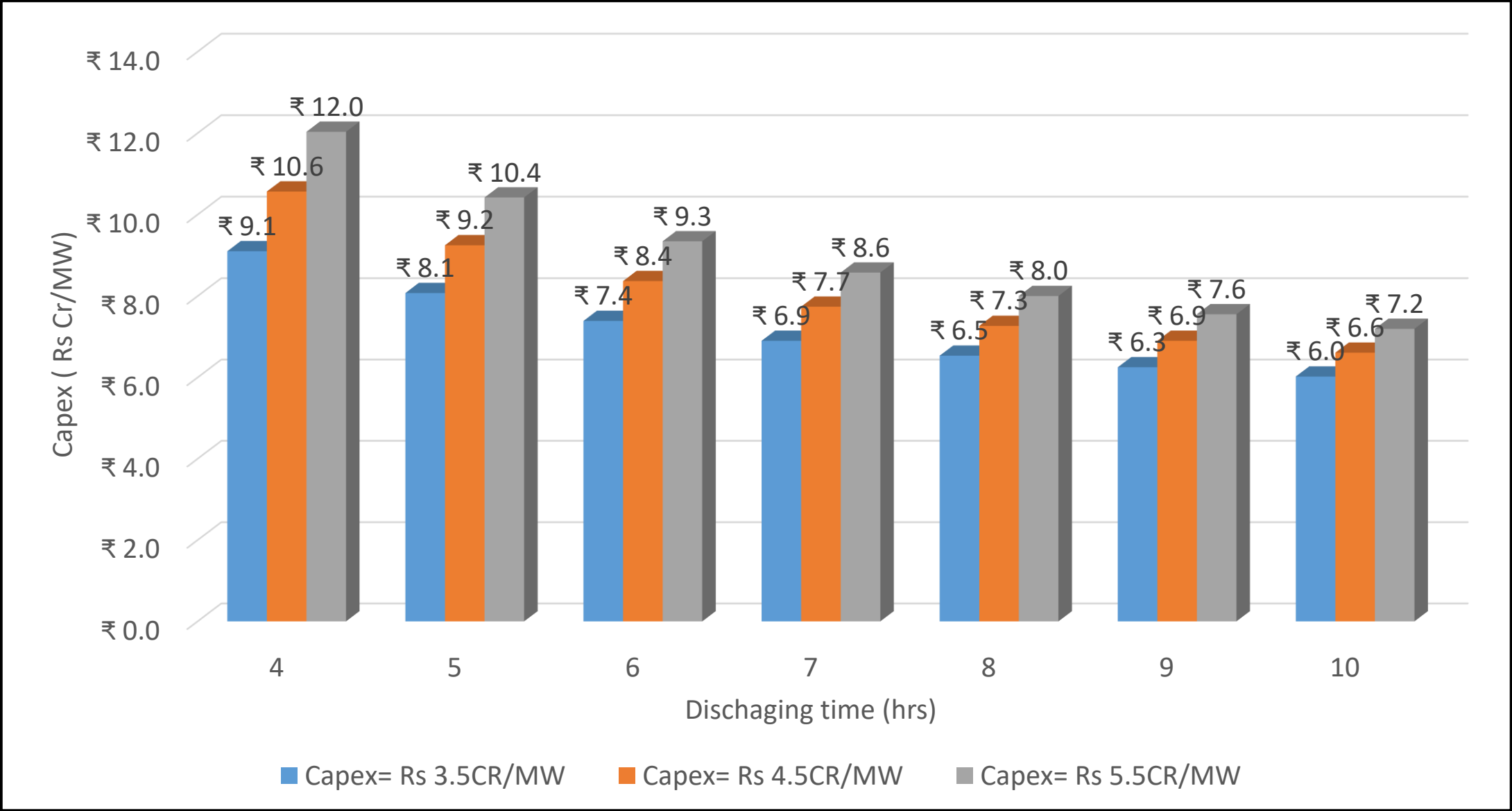
One Charging and discharging cycle per day of 4 hours.  
However for PSP and thermal this may go up to 8-10 hours

Equity	30%	Return on Equity	16.5%
Interest on loan	9%	Discount rate	11.75%

# Life cycle cost of storage (LCOS)

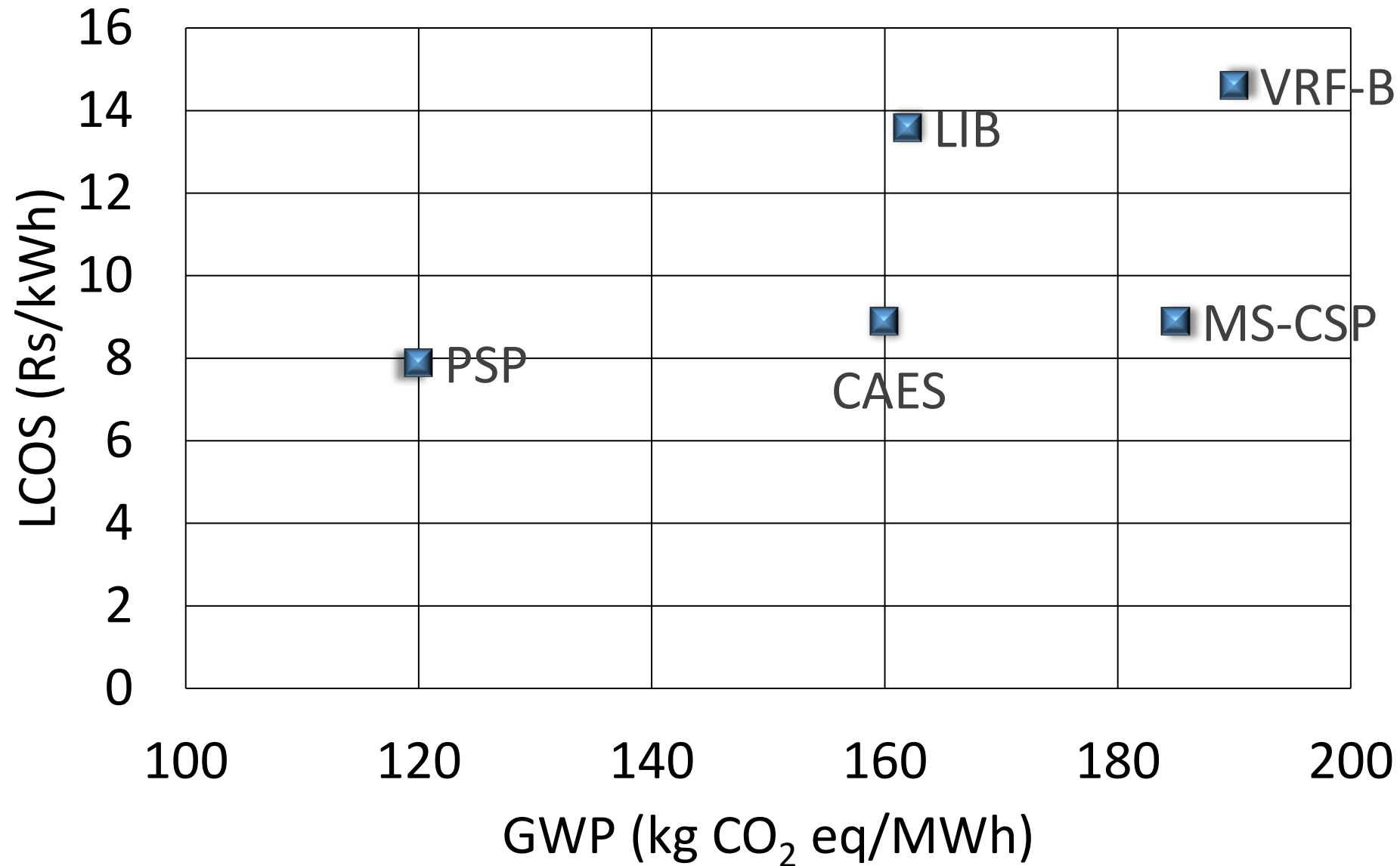


# Sensitivity analysis of LCOS for PSP with CAPEX



Input Electricity Cost Rs. 3 per unit

# Levelised Cost of Storage vs Global Warming Potential



# Recommendations

- **To frame appropriate regulations** to monetize ancillary services and develop peak and off-peak tariffs. These actions to be finalized by regulatory bodies.
- **Allotment of technology and sites:** A transparent process for meeting energy storage requirements at state, regional and national level.
- **Supply chain and manufacturing drivers**
- **Financial institutions to** treat storage projects at par with RE projects.
- **GoI to provide R&D support** for developing globally competitive energy storage technologies.
- **Pilot plants** be supported.
- **CERC & SERCs to declare and enforce energy storage obligation (ESO)** for all RE power for GENCOs and DISCOMs as declared for RPO.
- To develop **Model Regulations** for all the State Regulators.
- **Market-based mechanisms** to identify right price for energy & capacity





# Thank You

