Coal Retirement Strategies in India: Repurposing Coal Plants into Thermal Energy Storage

Serena Patel, serenap@mit.edu, MIT Technology and Policy Program & Electrical Engineering and Computer Science

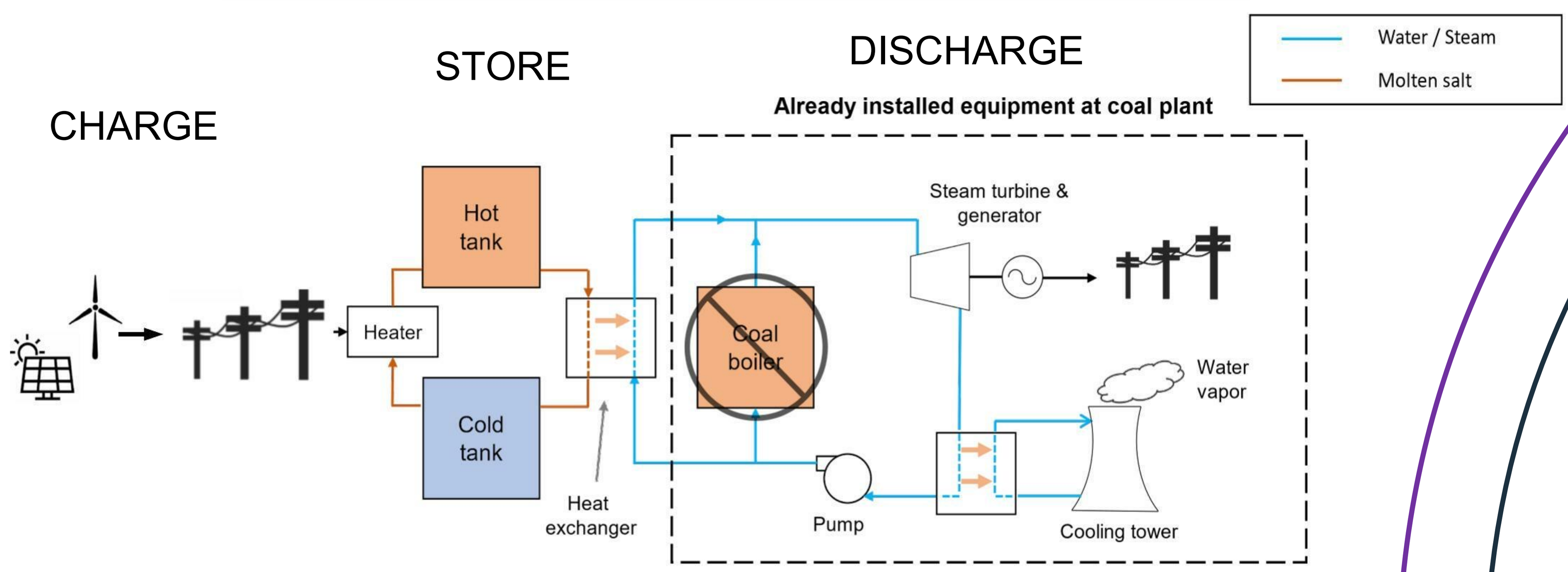
Advised by Dr. Dharik Mallapragada, Dr. Robert Stoner, and Karthik Ganesan

Introduction

Research questions:

- What are the **key technical and economic drivers** of coal plant conversion to provide grid-scale energy storage?
- What is the **fleet-level techno-economic potential** of repurposing in India?

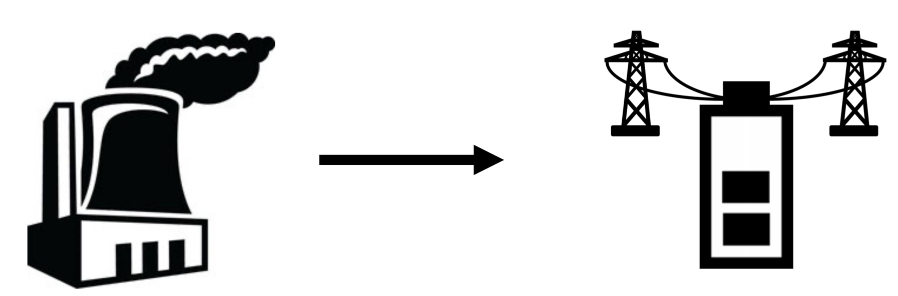
Proposed Coal Plant Conversion into Thermal Energy Storage (TES)



The **stranded asset risk** associated with the coal transition falls disproportionately on economies with large, young coal fleets.

Repurposing coal plants into thermal energy storage is a creative technical solution that has unique role to play in **Just Energy Transition** planning as countries like India and climate financing agencies aim to equitably support economic growth along with **clean, reliable, affordable electricity**.

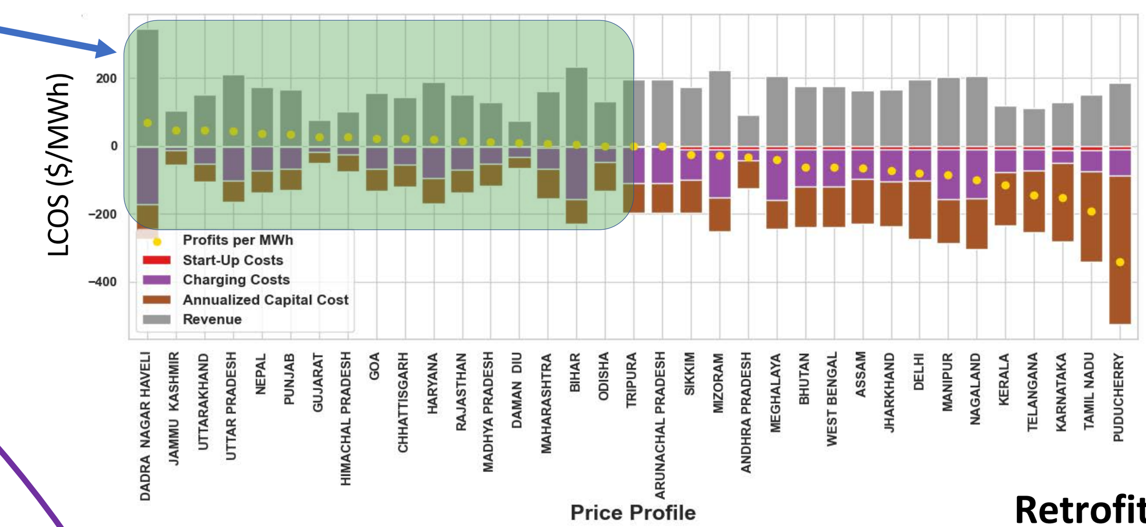
Fleet level analysis suggests **significant techno-economic potential for repurposing**, indicating the need for inclusion in coal retirement strategies



Results

Levelized Cost of Storage (LCOS) Breakdown under Different Price Profiles

Profitable regions with renewables

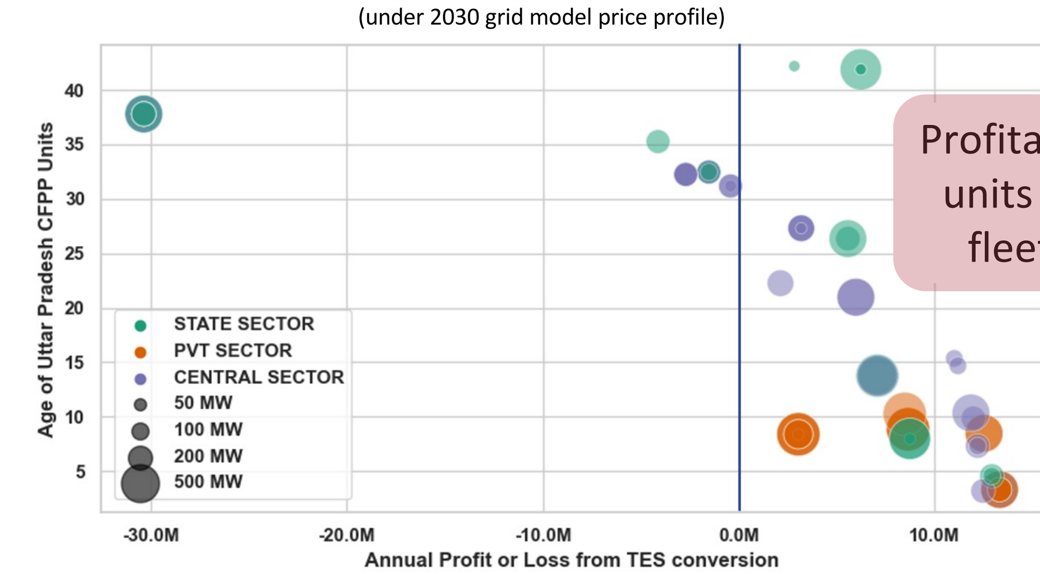


- LCOS driven by **charging costs** and **capital costs**
- Maximum profits up to **$70/MWh**

- **77% (17 GW) of coal plant units have positive NPV** showing economic potential for retrofits
- Other factors should include: employment impacts, land use, grid system value

Retrofit Readiness of Uttar Pradesh Coal Fleet

(under 2030 grid model price profile)

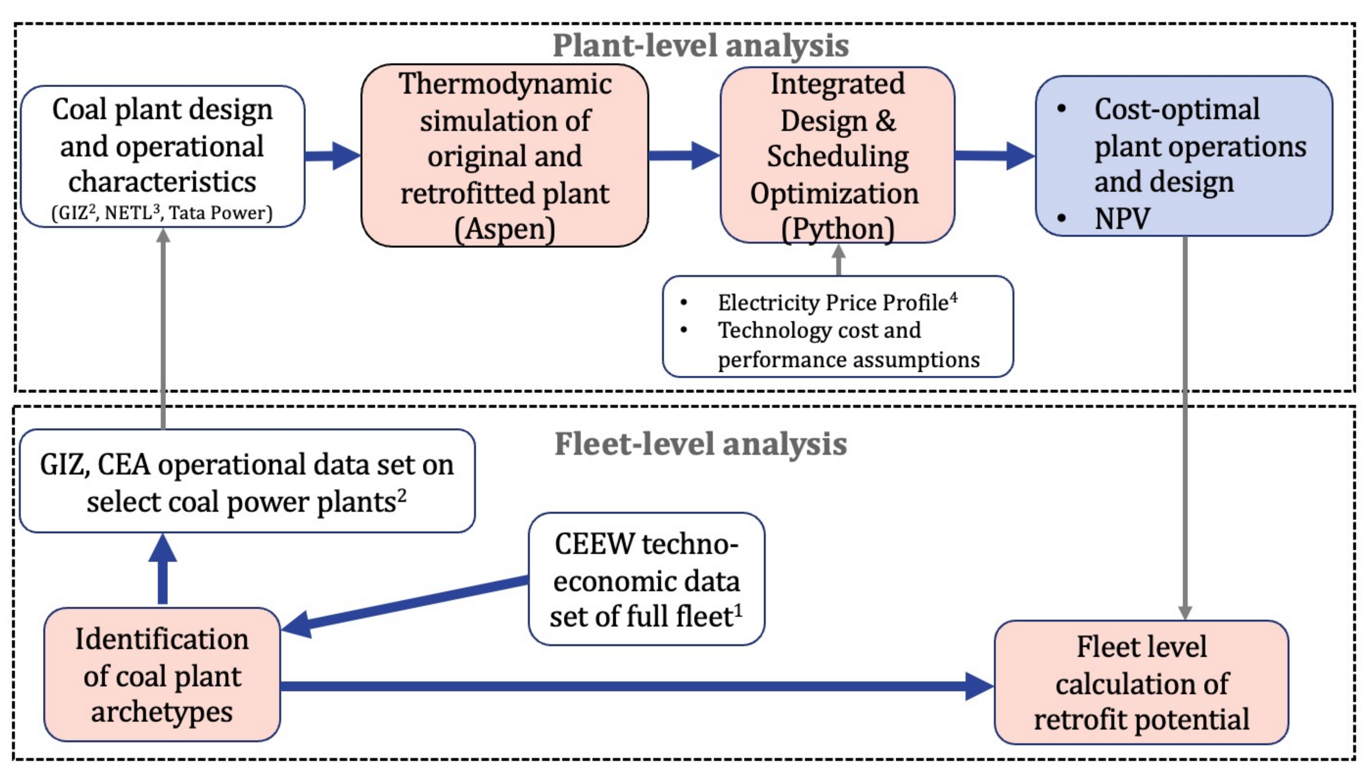


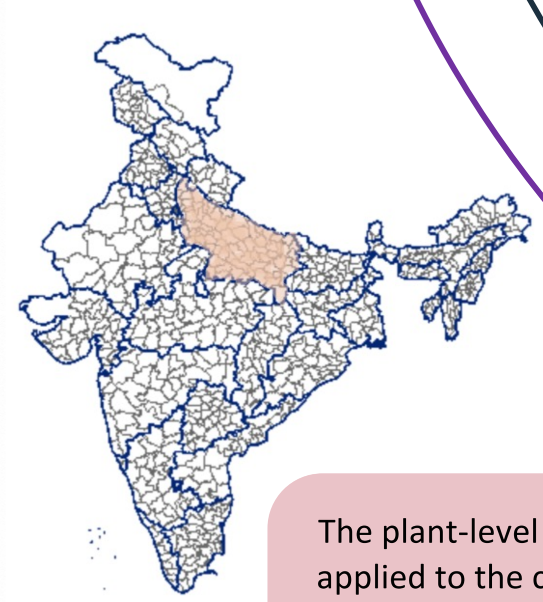
Profitable units in fleet

Data and Methods

Plant-level sensitivities:

- Technological advances in higher temperature TES
- Inclusion of an industrial end-use co-process
- Spatial variability of electricity prices.





The plant-level analysis was then applied to the coal power fleet in **Uttar Pradesh**, a state with high installed capacity of coal plant designs that are representative for the country.

Conclusion

Plant design

- Optimal durations of TES range from **5-7** hours, **up to 8.5 hours** overall
- TES co-production of constant **industrial process heat** is economically beneficial
- Cost-effective with existing molten salts, but higher temperature salts may not be as valuable if **limited by existing infrastructure**
- TES design and operational costs are **sensitive to volatility in electricity price profiles** (proxy for renewable heavy grids)

Fleet-level

Younger plants owned by **Central government and private owners** yield highest NPVs because they have longer remaining lifetimes and are more efficient

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