Modelling and Thermodynamic Analysis of Small Scale Compressed Air Energy Storage Systems with Thermal Recovery

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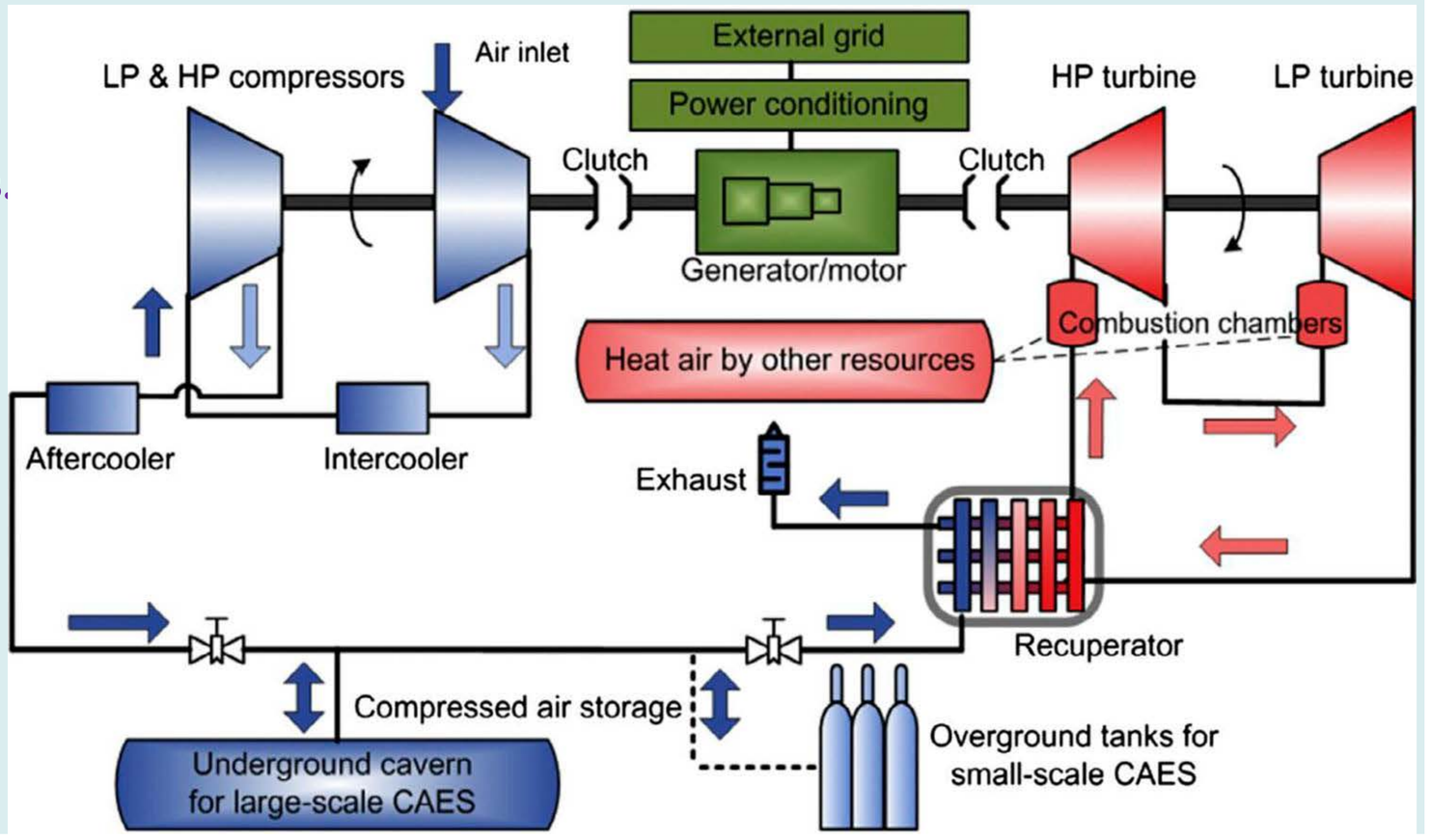
The growth in energy demand worldwide is ever increasing, thus increasing fossil fuel consumption. Use of fossil fuels in electrical energy generation have environmental impacts like global warming,CO2 emissions etc., This necessitated use of alternate renewable energies like solar, wind to meet energy requirements. But the limitation of renewable energy sources are that they are intermittent in supply, uncertainty of availability etc., lead to difficulties in ensuring stability in electrical grid networks. These constraints led to the development of various energy storage technologies so that available surplus energy from renewable sources can be stored and released as and when needed. CAES has the advantage of achieving for large capacity plants.

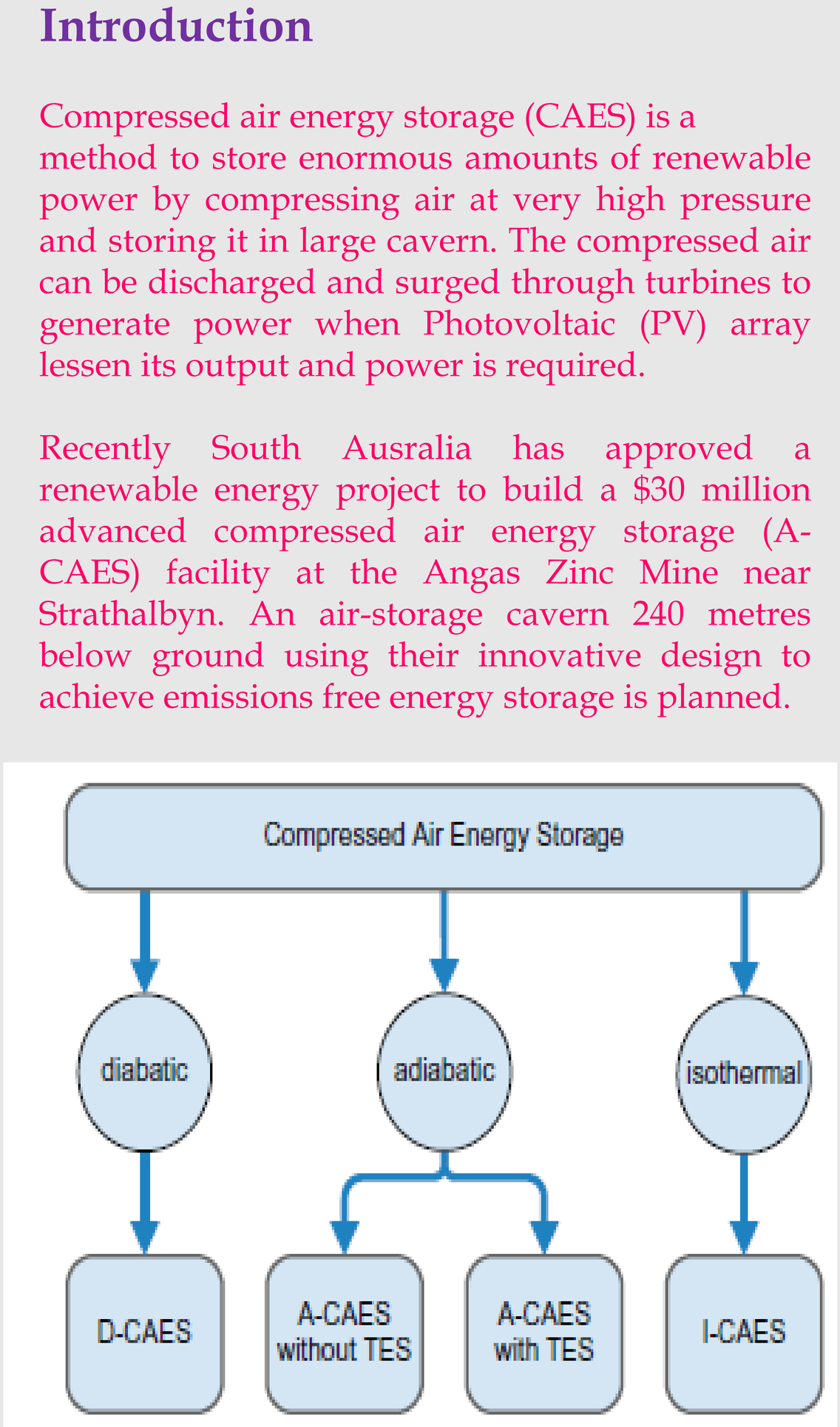
The aim of this paper is to model and analyse a small scale compressed air storage system useful for standalone and micro-grid applications. The economics of CAES is also discussed. Thermodynamic analysis of the charging and discharging cycles in the storage tank is modelled and analysed for a small capacity CAES. A thermodynamic study on the proposed system covering all components like compressor, expander is also done and related models analysed.

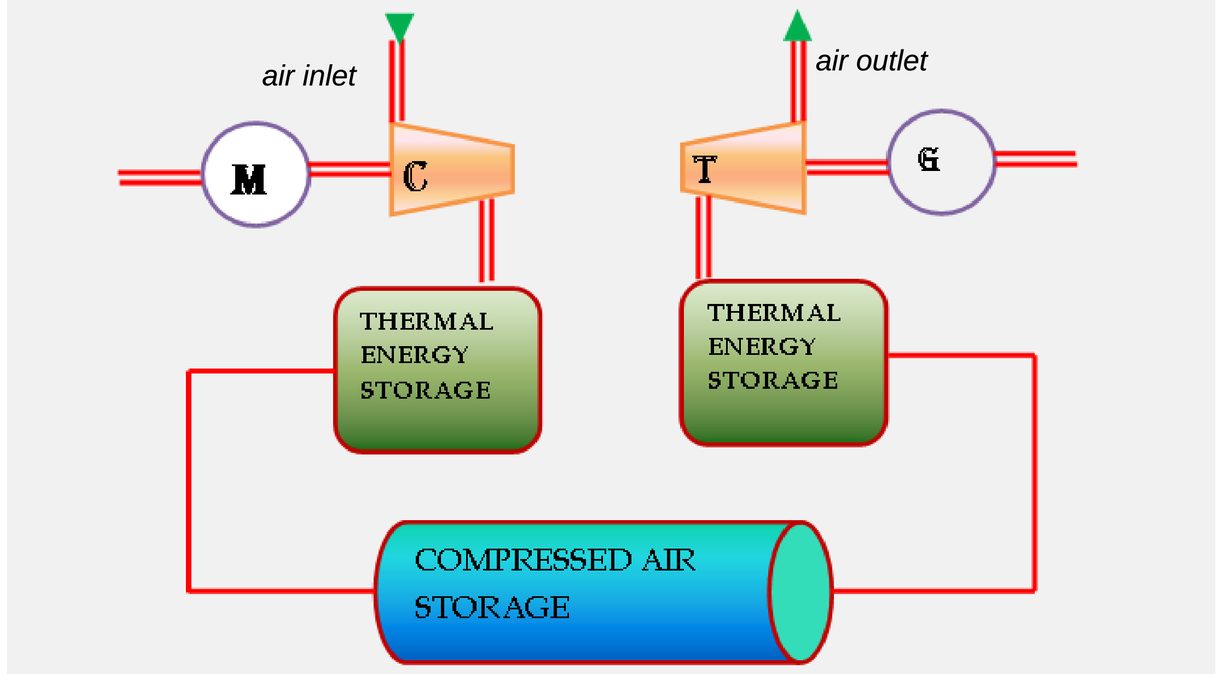


Introduction

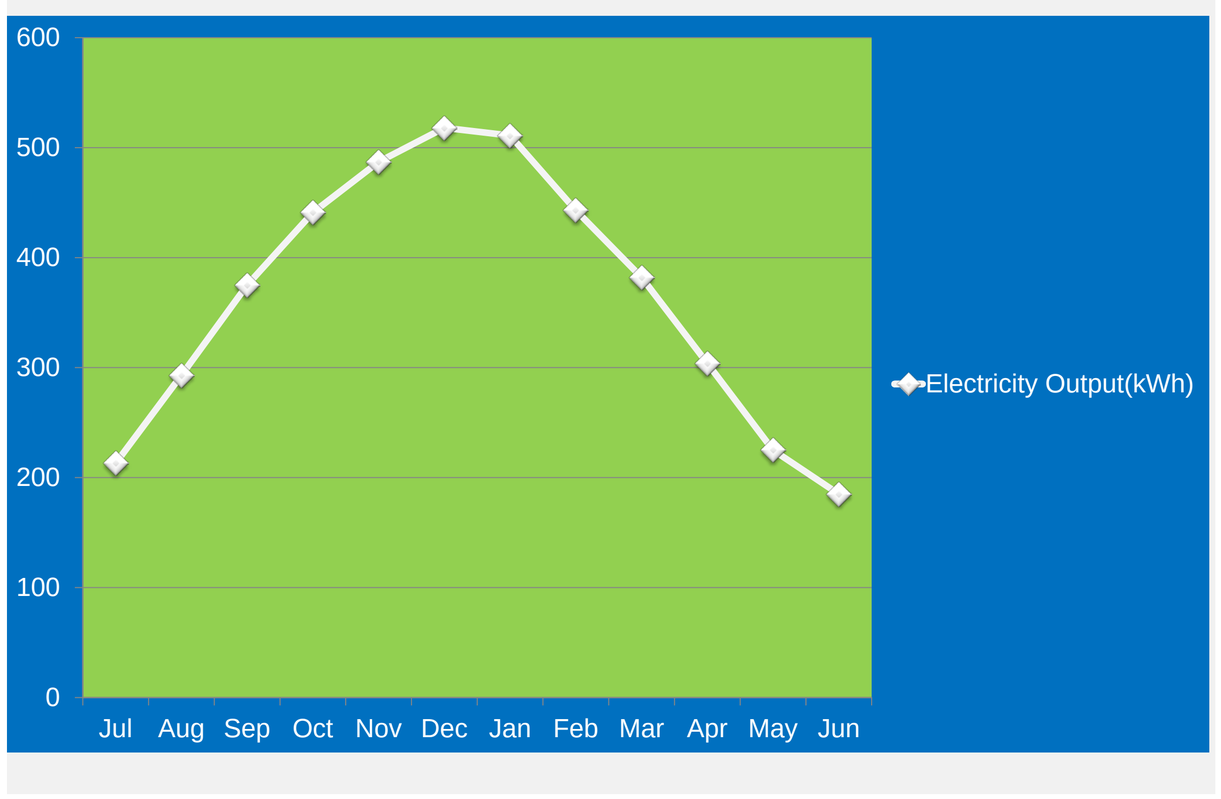
Compressed air energy storage (CAES) is a method to store enormous amounts of renewable power by compressing air at very high pressure and storing it in large cavern. The compressed air can be discharged and surged through turbines to generate power when Photovoltaic (PV) array lessen its output and power is required.

Recently South Ausralia has approved a renewable energy project to build a $30 million advanced compressed air energy storage (A-CAES) facility at the Angas Zinc Mine near Strathalbyn. An air-storage cavern 240 metres below ground using their innovative design to achieve emissions free energy storage is planned.





	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Electricity Output (kWh)	213	293	375	441	487	518	511	443	382	304	225	185



Simulation and Modelling of CAES integrated with small scale PV system has been carried out to analyze the storage capacity and utilization of generated power on demand from the excess PV energy.

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