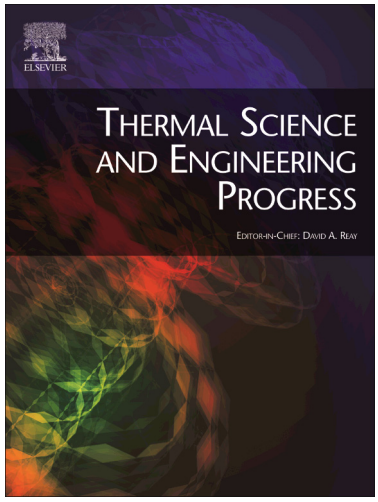


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# Economic Evaluation of installation of standalone wind farm and Wind+CAES system for the new regulating tariffs for renewables in Egypt

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## Abstract

Compressed Air Energy Storage (CAES) is widely recognized as a viable solution for large-scale grid integrated renewable energy systems in terms of load levelling to solve/minimize the intermittency effect of renewable energy systems especially with increased penetration of renewables to the grid. This study assesses the economic value of adding compressed air energy storage (CAES) plant to a renewable energy system and how this impacts the overall financial appeal of the system at hand, taking Egyptian grid as a case in point. Numerical modelling using MATLAB was performed to analyse the benefits of adding a CAES system to planned wind farms in Egypt by 2020 for both load-levelling as well as optimizing economic benefit. The results show that the addition of a CAES system would increase the profitability for the new Tariff for wind systems set by the Egyptian government with a NPV of $306m compared to a NPV of $207m of a stand-alone wind system at the end of 25 years of operation. Also, the economic benefits increase if the government provides subsidies for new installations of renewable energy systems, or by lowering the interest rates.

## Keywords:

Compressed Air Energy Storage (CAES), Economic Assessment, Energy Storage systems, Wind Energy, Large scale renewable energy

## Nomenclature

| | |
|---|---|
| $AC_w$ | Annual costs of the wind farm [$] |
| $AT_{CAES2}$ | annual O&M costs of CAES [$] |
| $c_c$ | specific compressor cost ($/MW) |
| $c_t$ | specific turbine cost ($/MW) |
| $C_w$ | capital cost for wind farm [$] |
| $\eta_c$ | polytropic efficiency of the compressors |
| $IC_{CAES}$ | Initial capital cost of CAES [$] |
| $m_t$ | mass flow rate during expansion [kg/s] |
| $m_c$ | mass flow rate during compression [kg/s] |
| $P_{max}$ | maximum allowable pressure in cavern [bar] |
| $P_{min}$ | minimum allowable pressure in cavern [bar] |
| $P_{cav}$ | pressure of air in the cavern [bar] |