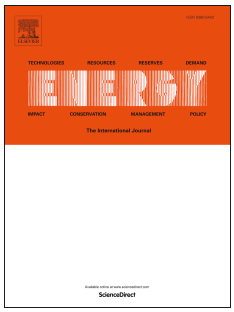
# Accepted Manuscript



The development of techno-economic models for large-scale energy storage systems

Sahil Kapila, Abayomi Olufemi Oni, Amit Kumar

PII: S0360-5442(17)31492-5

DOI: 10.1016/j.energy.2017.08.117

Reference: EGY 11486

To appear in: *Energy*

Received Date: 19 April 2017

Revised Date: 20 July 2017

Accepted Date: 30 August 2017

Please cite this article as: Kapila S, Oni AO, Kumar A, The development of techno-economic models for large-scale energy storage systems, *Energy* (2017), doi: 10.1016/j.energy.2017.08.117.

# The Development of Techno-economic Models for Large-Scale Energy Storage Systems

Sahil Kapila, Abayomi Olufemi Oni, Amit Kumar[1]

*University of Alberta, Department of Mechanical Engineering, 10-263 Donadeo Innovation Centre for Engineering, Edmonton, Alberta T6G 1H9, Canada*

## Abstract

The development of a cost structure for energy storage systems (ESS) has received limited attention. In this study, we developed data-intensive techno-economic models to assess the economic feasibility of ESS. The ESS here includes pump hydro storage (PHS) and compressed air energy storage (CAES). The costs were developed using data-intensive bottom-up models. Scale factors were developed for each component of the storage systems. The life cycle costs of energy storage were estimated for capacity ranges of 98-491 MW, 81-404 MW, and 60-298 MW for PHS, conventional CAES (C-CAES), and adiabatic CAES (A-CAES), respectively, to ensure a market-driven price can be achieved. For CAES systems, costs were developed for storage in salt caverns hard rock caverns, and porous formations. The results show that the annual life cycle storage cost is $220-400 for PHS, $215-265 for C-CAES, and $375-480 per kW-year for A-CAES. The levelised cost of electricity is $69-121 for PHS, $58-70 for C-CAES, and $96-121 per MWh for A-CAES. C-CAES is economically attractive at all capacities, PHS is economically attractive at higher capacities, and A-CAES is not attractive at all. The developed information is helpful in making investment decision related to large energy storage systems.

## Keywords

Cost comparison; energy storage; large energy storage systems; compressed air energy storage; pumped hydro storage

## Acronyms

* Corresponding author. Tel.: +1-780-492-7797
*E-mail address:* Amit.Kumar@ualberta.ca (A. Kumar).