

# **Economics of stationary electricity storage with various charge and discharge durations**

Claude Crampes\*, Jean-Michel Trochet\*\*

## **Abstract**

Electricity storage encompasses a disparate list of technologies such as pumped-storage hydroelectricity, compressed-air energy storage, chemical batteries and flywheels. These technologies can provide the electricity system with heterogeneous services of energy transfers across months, weeks, days or intradays, power transfers for an hour, a few minutes or seconds, and can assist operators in load following, frequency control, and uninterrupted power supply.

The paper presents a unified economic analysis of these technologies and services. We underline the role of charge and discharge durations as a criterion for economic segmentation of technologies and services. We highlight the complementary value of storage in electricity systems with a high share of low variable cost and low carbon generation (nuclear, hydro, wind power, solar photovoltaic). We also underline the limited substitution value of storage for generation with high variable cost (gas combustion-turbines or gas-oil motor engines), given the high cost of state-of-the-art storage technologies, the current low cost of fossil fuels and low price of carbon emissions.

Keywords: storage, batteries, energy mix, shadow price, charge duration

JEL codes: Q4, C61, D47

---

\*Toulouse School of Economics, University of Toulouse Capitole, Toulouse, France; [claude.crampes@tse-fr.eu](mailto:claude.crampes@tse-fr.eu)

\*\* EDF, Paris, France ; [jean-michel.trochet@edf.fr](mailto:jean-michel.trochet@edf.fr). The views expressed here are our own.