



The impact of all-vanadium flow batteries on vanadium prices

Abstract This paper presents a techno-economic model based on experimental and market data able to evaluate the profitability of vanadium flow batteries, which are emerging as a promising technology for specific stationary energy services. Vanadium flow battery market could be worth around half a billion dollars by end of the decade, with UK Infrastructure Bank among the investors that predict a big future for the industry - however, China dominates global vanadium production and the mineral looks particularly vulnerable to price shocks. Over 66% of global vanadium originates from China, Russia, and South Africa, with China alone controlling nearly half of production. Political tensions, export restrictions, or logistical disruptions in these regions directly disrupt raw material flows. For instance, EU sanctions on Russian As renewable energy adoption accelerates globally, the vanadium flow battery cost per kWh has become a critical metric for utilities and project developers. While lithium-ion dominates short-duration storage, vanadium redox flow batteries (VRFBs) are gaining traction for multi-hour applications. In Vanadium redox flow batteries (VRFBs) possess a range of properties that make them favourable for peak control, supplementary power, and frequency regulation. The energy storage sector itself is also expecting massive growth over the next decade. Despite this, the project pipeline for By 2030, vanadium redox flow batteries (VRFBs) are projected to account for 17% of global vanadium use -- a x6 increase from just 3% in 2020. With steel still dominating vanadium demand (accounting for 94% of US consumption in 2020), this surge in battery use is expected to put significant pressure on vanadium prices. Researchers in Italy have estimated the profitability of future vanadium redox flow batteries based on real device and market parameters and found that market evolutions are heading to much more competitive systems, with capital costs down to EUR260/kWh at a storage duration of 10 hours.

Image: Techno-economic assessment of future vanadium flow batteries

Abstract This paper presents a techno-economic model based on experimental and market data able to evaluate the profitability of vanadium flow batteries, which are emerging as a promising technology for specific stationary energy services. Vanadium flow battery market could be worth around half a billion dollars by end of the decade, but vanadium looks vulnerable to price shocks

All-Vanadium Redox Flow Battery (VRFB) Electrolyte Market

Vanadium, a key raw material for flow batteries, faces price volatility due to concentrated primary production and geopolitical risks. Over 80% of global vanadium production is concentrated in China, Russia, and South Africa. Vanadium Flow Battery Cost per kWh: Breaking Down the Components

As renewable energy adoption accelerates globally, the vanadium flow battery cost per kWh has become a critical metric for utilities and project developers. While lithium-ion dominates short-duration storage, vanadium redox flow batteries (VRFBs) are promising for large-scale energy storage, but their commercialization is hindered by the high cost of vanadium electrolytes. This paper presents a techno-economic model based on experimental and market data able to evaluate the profitability of vanadium flow batteries, which are emerging as a promising technology for specific stationary energy services.

Ebb and Flow: High Vanadium Prices Hinder the Vanadium prices have been driven up almost 580% since Q4 2020 as a result of increasing tightness in the spot market. Supply has been stretched so thin that stockpiles have fallen below ten weeks' worth of consumption. Simultaneously, demand for vanadium is surging as the energy storage sector grows. Enhancing Energy Density and Reducing Cost of Vanadium redox flow batteries (VRFBs) are promising for large-scale energy storage, but their commercialization is hindered by the high cost of vanadium electrolytes. This paper presents a techno-economic model based on experimental and market data able to evaluate the profitability of vanadium flow batteries, which are emerging as a promising technology for specific stationary energy services.

Vanadium: double-edged demand

With steel still dominating vanadium demand (accounting for 94% of US consumption in 2020), this surge in battery use is expected to put significant pressure on vanadium prices.



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