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Seawater Battery Technology 2027–2047: Market, Trends and Outlook

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Abstracts

Seawater batteries use natural seawater as the electrolyte and sodium source. The rechargeable version, first demonstrated in 2015, separates a sealed non-aqueous negative electrode compartment from flowing seawater using a NASICON ceramic that conducts sodium ions while remaining stable in water. Sodium is drawn from the seawater on charge and returned on discharge, with oxygen reduction and evolution occurring at an open positive electrode.

The technology has two structural advantages. The active cathode material is supplied by the ocean at zero cost, removing the largest line item in a conventional cell. And a water-immersed cell has no thermal runaway pathway, which matters in applications where fire risk drives siting, insurance and permitting decisions. The open cathode also permits desalination, carbon mineralisation and hydrogen or chlor-alkali co-production, though these have been demonstrated separately rather than simultaneously.

Three constraints are structural and permanent. Deployment is limited to coastal, offshore or seawater-supplied sites. Round-trip efficiency is capped at 60–80% by the voltage gap inherent to oxygen electrochemistry. Seawater intake, filtration and anti-fouling impose a parasitic load and a cost floor with limited learning-curve potential. Cell energy density of 20–75 Wh/kg constrains footprint but does not disqualify the technology from stationary duty.

The technology sits at TRL 4–6. Cycle life has been demonstrated to 100–200 cycles in most published work, against a commercial threshold near 4,000, and no multi-year field data in real seawater exists. The comparison set has moved: lithium-ion reached USD 70/kWh at pack level for stationary storage in 2025, sodium-ion operates at 85–92% efficiency with signed multi-gigawatt-hour supply agreements, and iron-air targets

installed costs below USD 20/kWh for 100-hour duration. Two industrial problems gate commercialisation. Large-format NASICON must be manufactured at acceptable yield and cost, and it has no equipment path from the battery industry. Durability must be demonstrated over years in real seawater, which cannot be accelerated in a laboratory. Neither is a scientific obstacle; both require sustained engineering investment.

The addressable market is correspondingly narrow. Marine navigation aids are commercially available. Island and coastal microgrids, where the incumbent is diesel and fresh water has local value, follow. Desalination-coupled plants, coastal data centres and offshore wind installations open later, subject to certification and durability evidence. The supplier base is concentrated in Korea, with one dedicated cell developer, one qualified ceramic supplier and one commercial channel partner.

Seawater Battery Technology 2027–2047: Market, Trends and Outlook assesses the rechargeable sodium–seawater battery as a commercial technology. It distinguishes it from seawater-activated primary batteries and from saltwater-electrolyte batteries using manufactured brine, which are frequently aggregated with it in published market data and which account for most of the discrepancy between market valuations for this category. **Contents include:**

Lithium-ion pricing and characteristics as comparison baselinePost-lithium requirements and entry gates for stationary storageSodium-based battery families; sodium-ion as both supply chain and competitorSeawater battery overview, properties, comparison with sodium-ionCommercial prospects; environmental and safety assessment; global R&D trendsSeawater battery technology

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