

CASE STUDY: RAIL APPLICATIONS



ADVANTAGES OF SODIUM-ION BATTERIES OVER LITHIUM-ION

The rail industry is transitioning to hybrid locomotives, auxiliary power systems, and trackside energy storage to improve efficiency and sustainability. Sodium-ion batteries (SIBs) offer greater safety, durability, and cost-effectiveness than lithium-ion (LIBs), making them an ideal choice for rail applications.

1. RELIABLE PERFORMANCE IN RAIL OPERATIONS

Challenge: Trains and trackside storage must operate in extreme weather and handle frequent charge cycles without performance loss.

- **Better Cold & Heat Tolerance:** Works from -30°C to $+60^{\circ}\text{C}$, outperforming lithium in harsh climates.
- **Longer Cycle Life:** Lasts 3,000+ charge cycles, ideal for regenerative braking systems.
- **High Charge Efficiency:** Over 90% round-trip efficiency at pack and module level, improving energy recovery and storage.

2. SAFER ENERGY STORAGE FOR RAIL NETWORKS

Challenge: Battery failures in tunnels, enclosed carriages, or trackside storage pose a serious fire risk.

- **Minimal Fire & Explosion Risk:** No thermal runaway, unlike lithium-ion.
- **Non-Flammable Electrolytes:** Some variants use water-based solutions, removing combustion hazards.
- **Lower Risk of Overcharging:** More tolerant to voltage fluctuations, ensuring safer battery management.

3. COST SAVINGS & LOWER MAINTENANCE

Challenge: Rail operators need affordable, long-lasting batteries with minimal upkeep.

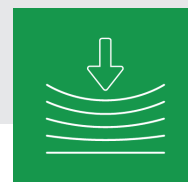
- **Cheaper Materials:** Sodium is widely available & cost-effective.
- **Longer Lifespan:** Lasts 3-5x longer than lead-acid, reducing replacement costs.
- **Low Maintenance:** No complex monitoring or hazardous handling required.

CONCLUSION

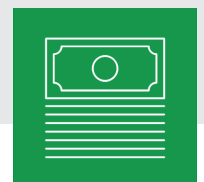
Sodium-ion batteries provide a safer, more resilient, and cost-effective alternative for rail electrification and energy storage.



Safer



Resilient



Cost effective

Batri design, develop, and manufacture battery materials and cells targeted at the sodium-ion battery industry. The materials utilise locally sourced supply chains and reduce the reliance on imported materials.



Batri's Composite Carbon anode material engineered for sodium-ion batteries

Offering higher power performance while remaining cost effective. Our anode material delivers outstanding:

- initial capacity
- superior initial coulombic efficiency (ICE)
- extended cycle life
- impressive capacity retention and exceptional stability across a wide range of currents



BATRI MATERIALS



We are pioneering a new era of energy storage with our sodium-ion battery cells

Using locally sourced, abundant, and sustainable resources like sodium, carbon, aluminium, our cells deliver exceptional performance while reducing reliance on imports and scarce materials.

Our cells are safer than lithium due to non-toxic and non-flammable electrolyte systems. Due to differing cell chemistries sodium batteries can be fully discharged to 0 V allowing for safer transportation.



BATRI CELLS

Supported by:

