Summary Table of Future Batteries

Most future batteries function wonderfully in a theoretical world, but many fail to meet the eight basic requirement of the so-called Octagon Battery. Short cycle life and limited load currents often prevent commercialization of the breakthroughs. While futuristic batteries may find a niche market, many never step outside the lab and see the light of day, not to mention advance to power the electric powertrain. This touches with emotions and is as far as the battery can go.

Chemistry	**Lithium-air**	**Lithium-metal**	**Solid-state Lithium**	**Lithium-sulfur** Li-S	**Sodium-iron** Na-ion
Type	Air cathode with lithium anode	Lithium anode; graphite cathode	Lithium anode; polymer separator	Lithium anode; sulfur cathode	Carbon anode; diverse cathodes
Voltage per cell	1.70–3.20V	3.60V	3.60V	2.10V	3.6V
Specific Energy	13kWh/kg theoretical)	300Wh/kg	300Wh/kg (est.)	500Wh/kg or less	90Wh/kg
Charging	Unknown	Rapid charge	Rapid charge	0.2C (5h)	Unknown
Discharging	Low power; inferior when cold	High power band	Poor conductivity when cold	High power (2,500W/kg)	Unknown
Cycle life	50 cycles in labs	2,500	100, prototypes	50, disputed	50 typical
Packaging	Not defined	Not defined	Prismatic	Not defined	Not defined
Safety	Unknown	Needs improvement	Needs improvement	Protection circuit required	Safe; shipment by air possible

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History	Started in 1970s; renewed interest in the 2000s. R&D by IBM MIT, UC, etc.	Produced in the 1980s by Moli Energy; caused safety recall	Similar to Li-polymer that started in 1970	New technology; R&D by Oxis Energy, Bosch and others.	Ignored in the 1980s in favor of lithium; has renewed interest
Failure modes	Lithium peroxide film stops electron movement with use. Air impurity causes damage.	Dendrite growth causes electric short with usage	Dendrite growth causes electric short; poor low temperature. performance	Sulfur degrades with cycling; unstable when hot, poor conductivity	Little research in this area
Applications	Not defined; potential for EV	EV, industrial and portable uses	EES, wheeled mobility; also talk about EV	Solar-powered airplane flight in August 2008	Energy storage
Comments	Borrowed from “breathing” zinc-air and fuel cell concept	Good capacity, fast charge and high power keep interest high	Similar to lithium-metal; may be ready by 2020; EVs in 2025	May succeed Li-ion due to lower cost and higher capacity	Low cost in par with lead acid. Can be fully discharged.

***Table 1:** Summary of most common future batteries.*

Readings are estimated and may vary with different versions and newer developments. More information on BU-212: Future Batteries. Readings are estimated and may vary with newest development.

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