Fact Sheet

What types of batteries are there?

Classifying batteries

Batteries can be classified in many ways, including:

- The chemicals that generate the battery's energy
- Whether they are single-use (primary) or rechargeable/ multiple use (secondary)
- Shape and size, e.g., button, AA, AAA, etc.
- The use/ purpose of the battery, e.g., electric vehicle batteries, home energy storage, toy batteries, etc.

It is important to check the specifications of each battery to make sure it's fit for use. Check the battery size and the symbols that indicate battery chemistry. Battery manufacturers also have safety data sheets.

The lifespan of primary batteries varies depending on the amount of usage, and the device being used.

Table 1[i]. Common types of primary batteries

Type	Uses
Dry cell/ Alkaline	Consumer devices
Lithium iron disulfide ($LifeS_2$)	Alternative to alkaline
Lithium-thionyl chloride ($LiSOCl_2$ or LTC)	Fracking
Lithium manganese dioxide ($LiMnO_2$ or Li-M)	Medical devices, road toll sensors, smoke alarms
Lithium sulfur dioxide ($LiSo_2$)	Defense systems

The lifespan of secondary batteries is around three to five years for consumer products, and eight to ten years for electric vehicle (EV) batteries, depending on use and care.

Most EV manufacturers offer an eight year or limited kilometer warranty on their batteries – whichever comes first[ii]. Energy storage batteries have a lifespan between 5 – 15 years, depending on the product and recharge rate.

Table 2[iii]. Common types of secondary batteries

Type	Uses
Lead-acid	Car batteries, UPS
Nickel-cadmium (NiCd)	Power tools, aviation, medical devices
Nickel-metal-hydride (NiMH)	Medical devices, hybrid cars
Lithium-ion (several types)	Mobile phones, laptops, electric vehicles, energy storage batteries

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B-cycle Battery Recycling

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Button batteries

Button batteries, also known as 'button cell', or 'coin' batteries are generally single-use, and are commonly found in devices like watches, hearing aids, calculators, remote controls, thermometers, kitchen scales and other devices.

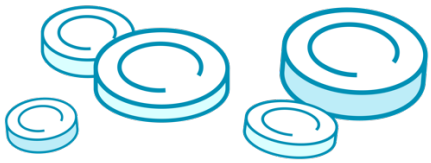

Figure 1. Button cell batteries. Source: https://en.wikipedia.org/wiki/Button_cell

Button cell batteries can come in a variety of chemistries including a zinc or lithium anode, and a manganese dioxide, silver oxide, or carbon monofluoride cathode[iv]. Their casings are generally made from stainless steel.

Dry cell batteries

Alkaline batteries are a type of dry cell battery. They are single-use and commonly found in devices like torches, remote controls, smoke alarms and clocks.

They come in two main shapes, cylindrical (AAA, AA, C or D), and rectangular (9 and 12 volts).

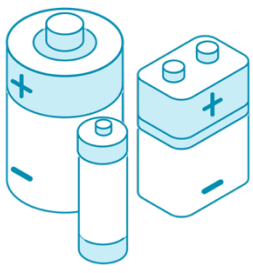

Figure 2. Dry cell batteries. Source: https://www.openimpulse.com/blog/2013/08/batteries-and-accumulators-demystified/

Dry cell batteries generally have a zinc anode and a carbon cathode. Cadmium, lead, and nickel are also used in different types of dry cell batteries[v].

Alkaline batteries have an alkaline electrolyte of potassium hydroxide (KOH) instead of an acidic ammonium chloride or zinc chloride electrolyte.

Lithium batteries

Lithium batteries can be either single use or rechargeable, and are recyclable. They are an alternative to dry cell batteries, as they come in similar shapes and sizes. Compared with dry cell batteries, lithium batteries have a longer life, are slower to discharge and are lighter in weight[vi].

Figure 3. Lithium battery. Source: RS online

Lithium batteries have a metallic lithium anode. Other components vary, though usually these batteries contain a manganese dioxide electrolyte[vii].

Lithium-ion batteries are rechargeable and are found in devices like mobile phones, laptops, tablets, medical equipment, and EVs.

Rarely, lithium-ion batteries can short-circuit, leading to a thermal runway and fire[viii].

Caution should be taken to reduce the risk of damage, by avoiding excess vibration, elevated heat, or charging at temperatures below freezing[ix].

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Lead-acid batteries

Lead-acid batteries were the first rechargeable batteries available for commercial use[x]. These heavy-duty batteries are mostly found in cars, though they are also used for storage in back-up power supplies.

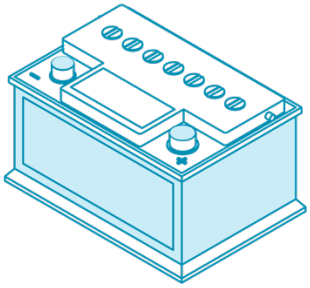

Figure 4. Lead-acid battery.
Source: https://www.everybattery.com.au/online/product/eb-43/

Lead-acid batteries are close to 100% recyclable[xi]. Due to their high content of lead, they should never be disposed of into landfill.

Nickel-cadmium (NiCd) batteries

Nickel-cadmium (NiCd) batteries are one of the most hardy battery types. They can be charged quickly, are robust in construction, have a long shelf-life and are easy to store and transport[xii].

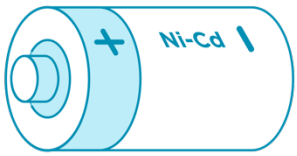

Figure 5. NiCd battery. Source:
https://batteryspecialists.com.au/blogs/news/what-is-a-nicd-battery-nicd-batteries-explained

Despite their advantages, use of NiCd batteries is limited and reducing due to the toxicity of cadmium, especially if disposed of into landfill[xiii].

Nickel metal hydride (NiMH) batteries

Nickel metal hydride (NiMH) batteries were first developed in the 1960's, but they have had some issues with stability[xiv].

These issues were resolved by the 1980s, and today NiMH batteries are a readily available rechargeable battery for use in EVs[xv] and in general consumer products[xvi].

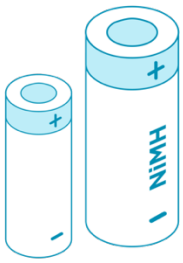

Figure 6. Nickel Metal Hydride batteries. Source:
https://ind.gpbatteries.com/products/rechargeable-nimh.html

As rechargeable batteries, NiMH batteries are more environmentally friendly than NiCd. However, they can lose their charge quickly, going 'flat' after only a few weeks[xvii].

Flow batteries

Flow batteries are used for high-capacity grid energy storage for renewable energy sources like wind and large-scale solar[xviii].

As electricity is generated, it is stored in tanks of liquid electrolyte. This is then pumped through electrodes to extract the electrons for use as electricity[xix].

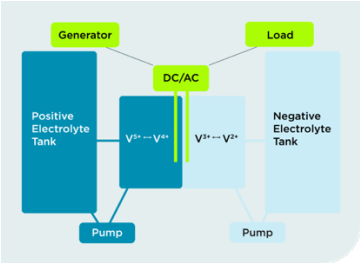

Figure 7. Flow battery diagram. Source: Wikimedia Commons.

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Sodium nickel chloride batteries

Sodium nickel chloride batteries can be either single use or rechargeable. They are used in grid energy storage and EVs[xx].

They operate at high temperatures, between 270-350 degrees Celsius[xxi], and can take three to four days to cool down[xxii].

These batteries are also known as 'ZEBRA batteries', after the Zeolite Battery Research Africa Project where they were developed[xxiii].

Aqueous hybrid batteries

Aqueous hybrid batteries are manufactured by Aquion Energy Inc. and are an emerging technology. They are classified as non-hazardous and are also known as 'saltwater batteries' as they use a saltwater-based electrolyte[xxiv].

Mercury batteries

On 7 March 2022, the Australian Recycling and Waste Reduction (Mandatory Product Stewardship—Mercury-added Products) Rules 2021 will come into force.

These rules aim to reduce the risks to human health and our environment from mercury. They will prohibit the import, export, and manufacture of certain mercury-added products.

This includes batteries, except for button zinc silve oxide and zinc air batteries with a mercury content <2%

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