

e-Waste Toolkit

CHOOSING AND HANDLING BATTERIES

Battery Types

The most common type of batteries are chemical batteries; they generate electricity through chemical reactions of different compounds. They are classified into two categories:

Primary/Disposable/Non-rechargeable Batteries: These are single use and can be either alkaline or lithium-metal. Typical applications include occasional and disposable usage where charging becomes impractical.

Secondary/Rechargeable batteries: These can be recharged and reused. They include Lead Acid, Lithium ion, Nickel Metal Hydride, Nickel Cadmium, etc. Solar/off-grid storage solutions use this type of battery.



Examples of Rechargeable batteries

Factors to consider when choosing batteries (lead acid or Lithium ion):

- 1. Energy & power density:** It is important to understand the requirements of the application. The energy density is a measure of how much energy it can store compared to its mass and is measured in Wh/kg. The power density is an indication of how quickly it can output energy compared to its mass, measured in W/kg.
- 2. Charge life & cycle life:** Charge life is the amount of time that potential energy will stay in the battery without trickling out. It is important to consider the amount of time a battery can retain charge. Total life is the number of charge/discharge cycles that a battery will support.
- 3. Durability:** Physical external factors can greatly affect the performance of a battery. Different battery chemistries are more susceptible than others to factors such as impact, temperature, humidity, vibrations, magnetic fields, etc.
- 4. Installation & maintenance:** Whereas some battery installations are direct, it is recommended that an expert be engaged in more complex installations to avoid accidents and eventual damage to the batteries. It is preferable if the battery requires very little maintenance. However, in cases where a more hands-on approach is required (e.g. watering, cleaning, charging, etc.), it is essential that guidelines provided by the manufacturer are followed.
- 5. Disposal:** Transportation of lithium-based batteries is regulated. Disposal of certain battery chemistries is also regulated.¹ This may be a consideration for high volume applications.
- 6. Cost:** There are times when you may need to pass up a battery with better performance characteristics because the application is very cost sensitive.

¹ Regulation on the transport of Lithium metal and Lithium Ion batteries:
<https://www.prba.org/wp-content/uploads/IATA-2019-Lithium-Battery-Guidance.pdf>

Battery Maintenance

General²

1. New batteries should be given a full charge before use
2. Avoid discharging batteries below 80% of their rated capacity.
3. Proper battery sizing will help avoid excessive discharge.
4. Batteries should be kept clean and free of dirt and corrosion at all times.
5. Deep cycle batteries need to be equalized periodically
6. Always use a matched charger and battery pack system.
7. Avoid extreme temperatures as extreme temperatures can substantially affect battery performance and charging.

Lead Acid battery maintenance³

- Lead acid batteries should be brought up to full charge at the earliest opportunity
- Program your voltage set points so that the battery bank charges at the proper voltage.
- Refill flooded lead-acid batteries with distilled water every as needed. Do not overfill
- Regularly check battery state of charge. Apply an equalization charge to flooded batteries every 90 days. (Do not equalize sealed lead-acid or lithium batteries.) Do not attempt to charge a dried out battery.
- Clean terminal connections and cables to prevent corrosion.
- Inactivity can be extremely harmful to all lead acid batteries. If season use is anticipated, we recommended the following:
- Completely charge the battery before storing.
 - Remove all electrical connections from the battery, including series/parallel connectors.
 - Store the battery in as cool a place as possible. However, do not store in a location which will consistently be below 32 degrees fahrenheit. Batteries will discharge when stored, the lower the temperature the lower the self discharge.
 - When not in use, boost every two months.

² Source: <https://batteryworld.co.ke/care-maintenance/>

³ Source: <https://unboundsolar.com/blog/battery-maintenance-tips>

Handling batteries at end of life (EoL)

- Remove battery from the electronic and cover the terminals to prevent current transfer.
- Install proper storage for batteries; these can be plastic or cardboard bin/containers. For Lithium Ion batteries, add sand to avoid thermal runaway.
- Identify a suitable recycling/collection program near you. While recycling programs in Africa are growing, many companies still use recycling facilities located in Europe.

****Do not throw waste batteries into the trash**

Lithium Ion battery recycling

Only a few recycling facilities exist that can handle recycling lithium-based batteries due to their complex composition. Such facilities are currently only located in Europe and North America. One facility used by companies in Africa is:

Li-Cycle

Ontario, Canada

Website: <https://li-cycle.com>

Other recycling facilities will be added to our [online resource list](#) as information about them becomes available.

We invite companies to share information about how they recycle Li-Ion batteries to: clasp1999@gmail.com

Future of Batteries: New Technologies and Innovation

Battery technology is constantly evolving with increased application areas. The below articles provide some useful insights into the future of batteries:

- ECS: [The Future of Batteries](#)
- Pocket Lint: [Future Batteries, coming soon: Charge in seconds, last months and power over the air'](#)
- Wired: [The Batteries of the Future Are Weightless and Invisible](#)
- Saft Batteries: [The Battery Technology that could Power the Future](#)

It is also important to discuss second-life battery options for LiOn:

- Aceleron: [Battery Technology that Empowers](#)
- McKinsey & Company: [Second-life EV Batteries: The Newest Value Pool in Energy Storage](#)
- Green Tech Media: [Second Life: Carmakers and Storage Startups Get Serious About Reusing Batteries](#)
- Nissan Motor Corporation: [Second-life EV Batteries Power Off-grid Adventures](#)



The materials in this e-waste toolkit have been developed for EEP's Africa portfolio in collaboration with CLASP, an international organization improving the energy and environmental performance of the appliances and equipment we use every day.