

Data Center VRLA Battery End-of-Life Recycling Procedures

White Paper 36

Revision 1

by Raymond Lizotte

> Executive summary

Contrary to popular belief, the recycling of lead-acid batteries, which are the most common batteries found in data centers, is one of the most successful recycling systems that the world has ever seen. Reputable battery manufacturers, suppliers, and recycling companies have teamed up to establish a mature and highly efficient lead-acid battery recycling process. This paper reviews battery end-of-life options and describes how a reputable vendor can greatly facilitate the safe disposal and recycling of VRLA lead-acid batteries.

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Introduction

Data center professionals rely on lead-acid batteries as a reliable and cost effective energy storage resource. However, some of the basic components of these batteries (e.g., lead, sulfuric acid) are potentially toxic if mishandled. Data center owners risk stiff penalties if these batteries are improperly disposed of. Fortunately, battery manufacturers, vendors, and recyclers recognize that spent lead-acid batteries hold financial value and have greatly facilitated their safe disposal.

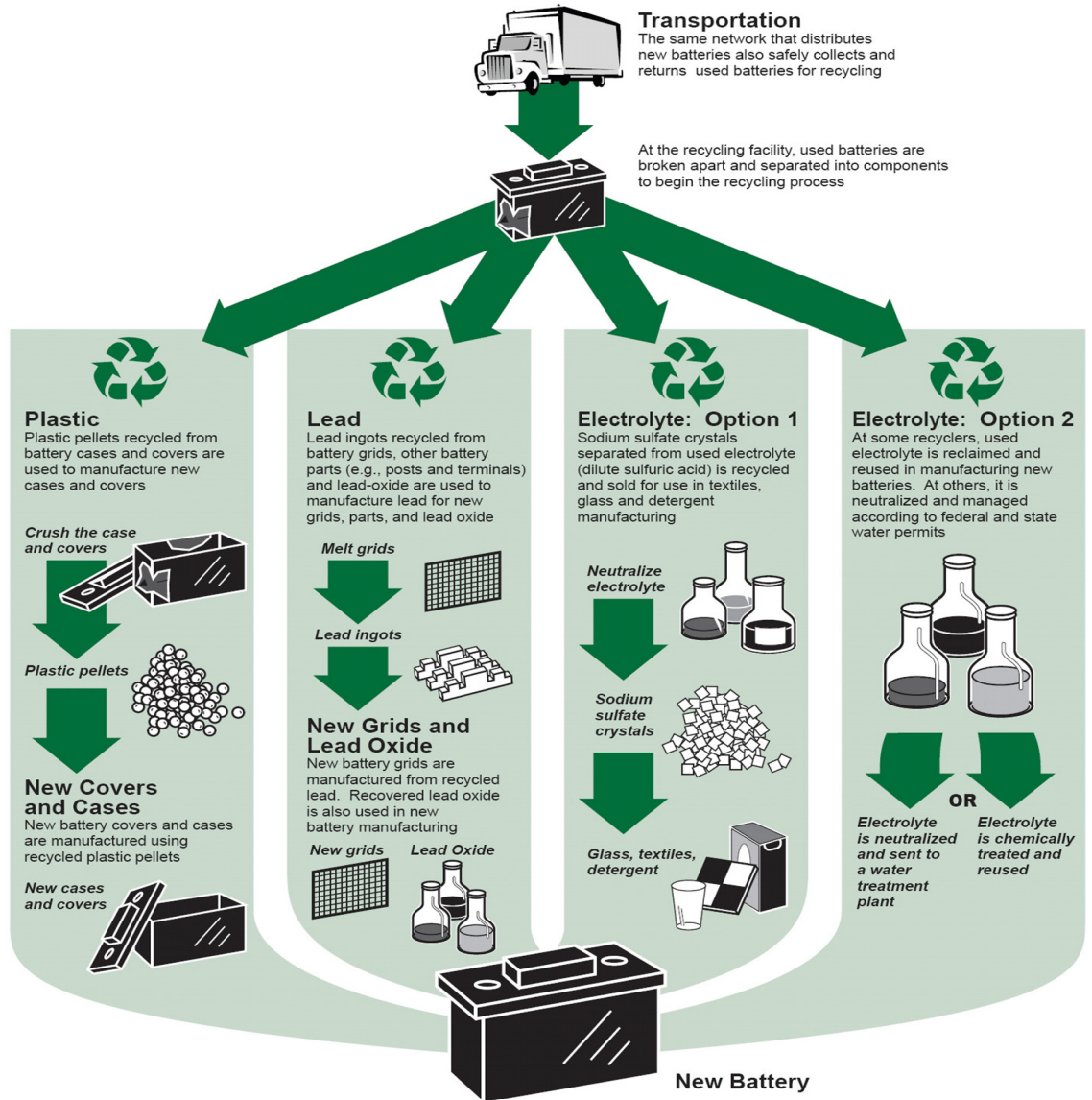


Figure 1
Lead-acid battery recycling process

Graphic courtesy of Battery Council International and accessed June 8, 2008

<http://www.batterycouncil.org/LeadAcidBatteries/BatteryRecycling/tabid/71/Default.aspx>

In fact, for the past two decades, lead acid batteries have topped the list of the most highly recycled consumer products with recycling rates exceeding 95% (see **Figure 1**). This compares to a recycling rate of 42% for all paper and a recycling rate of 52% for aluminum

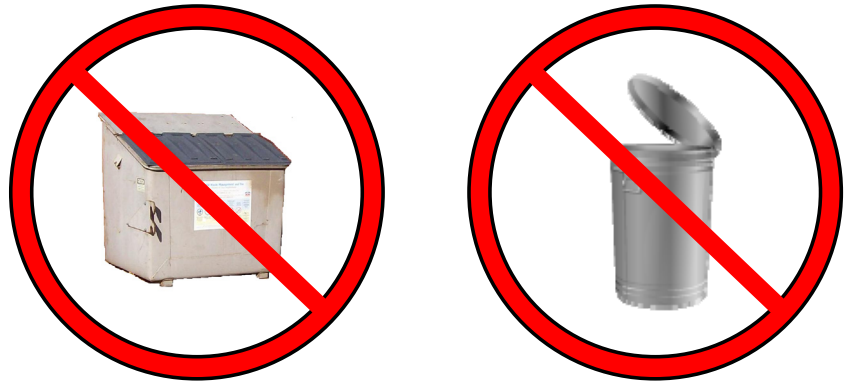
cans.¹ This white paper reviews how data center professionals and other consumers of batteries can assure that the lead-acid batteries in their data centers are properly disposed of and recycled.

The Electricity Storage Association (ESA) estimates that sales of industrial batteries, as might be used in data center applications, amount to \$5 billion each year.² Data center batteries reside inside of cabinets, in racks on the data center floor, and even in separate dedicated rooms. Over 97% of industrial batteries are of the lead-acid type. The batteries primarily addressed in this paper are of the valve regulated lead-acid (VRLA) type, which are the most common type of batteries found in data centers. Each year APC by Schneider Electric purchases and distributes more than 20 million kilograms (44, 092,452 lbs) of batteries.

Batteries are regulated at the local, state, federal, and international levels, and a myriad of compliance legislation exists that must be adhered to. Fortunately, data center professionals don't need to concern themselves with the risk, cost, and complexity of the battery disposal issue if they involve legitimate partners when retiring spent batteries.

Figure 2

Stiff penalties exist for improper disposal of lead-acid batteries



Enlist a reputable battery disposal partner

Data center owners should avoid self disposal of batteries. Simply throwing out a spent lead-acid battery is illegal and environmentally irresponsible. Furthermore, when selecting a partner to dispose of lead acid batteries (e.g. a battery manufacturer, a UPS vendor, a recycler), the data center owner needs to be somewhat careful with whom they entrust their batteries. Safe disposal of lead can be costly and lead-acid battery recycling requires strong measures which take into account occupational safety and stringent environmental controls. Unfortunately, unscrupulous brokers have been known to send battery scrap to poorer countries with non-existent occupational safety and environmental regulations. Most mainstream UPS vendors have established positive reputations over the years when it comes to proper battery disposal. Many of their customers return spent batteries and the vendor is able to send large quantities of batteries to certified smelting and recycling facilities. Some smaller UPS vendors, however, do not allow for battery removal when they design their products. The batteries are sealed in the unit without any battery doors to allow for battery replacement. This makes it difficult for anyone to extract the battery for proper disposal purposes. In addition, the owner of the equipment may not even realize that the metal boxes contain lead-acid batteries and may unknowingly dispose of the materials improperly.

¹ <http://www.batterycouncil.org/LeadAcidBatteries/BatteryRecycling/tabid/71/Default.aspx> accessed March 18, 2010

² http://www.electricitystorage.org/technologies_applications.htm accessed March 18, 2010

Batteries in data center UPS applications can be single batteries, shelves containing interconnected single batteries, battery cartridges containing multiple batteries in a single container, or shelves containing interconnected battery cartridges (see **Figure 3**).



Figure 3

Examples of data center and UPS battery cartridges

End-of-life options

In almost all cases, a battery reaches end-of-life without incident. Such a battery is considered “intact”. Intact batteries are no more dangerous than other data center equipment when handled correctly. When small quantities of intact batteries are sent for reclamation, the rules in North America that apply to hazardous material transportation and disposal are typically relaxed. Therefore, both new and spent batteries that are intact can be shipped as long as the battery is packaged such that the termination can’t cause a short. In Europe, an intact spent battery is considered hazardous waste and must be treated as such according to national regulations.

Occasionally, a battery experiences stresses that can cause the case to swell, crack, or lose a cap. Batteries in this condition are considered “damaged”. These damaged batteries are subject to more stringent regulations than are “intact” batteries. Damaged batteries pose the risk of hazardous material release. Data center professionals and other consumers with damaged batteries should consult a regulatory expert (such as the [Office of Hazardous Materials Safety](#)) immediately for instructions on proper transportation and disposal.

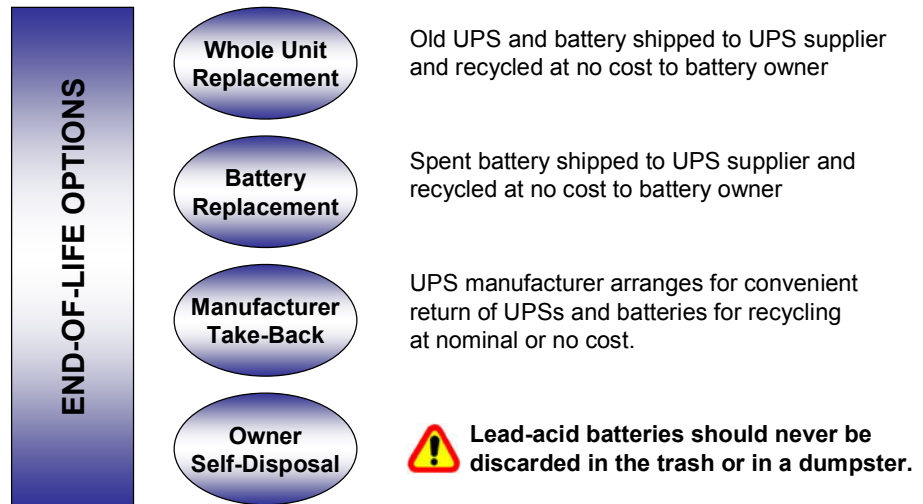
In the United States, the lead-acid battery recycling system is considered one of the most successful examples of product recycling. Data centers can generate thousands of pounds of waste batteries while a household consumer may have only the single battery to contend with. Regardless of quantity, all battery owners have to ensure environmentally safe disposal of their batteries. The UPS manufacturers are uniquely positioned to assist data center professionals and consumers in performing this disposal function.

The role of the UPS supplier

UPS manufacturers, like APC, offer data center professionals and consumers with intact spent batteries a wide range of end-of-life options that are cost effective and easy to implement. The option chosen depends upon the unique situation of the battery owner (see **Figure 4**).

Figure 4

Battery end-of-life options



When the battery owner deems that the entire UPS unit (and not just the battery) requires replacement, many UPS manufacturers, such as APC, will offer incentive programs that include free shipping and free disposal of both UPS waste equipment and batteries when the owner purchases a new UPS system. The APC-specific program is called [Trade-UPS](#) and allows the customer to acquire a new system at a discounted price (see link for more details).

If only a replacement battery is needed, APC provides free recycling to customers when new replacement batteries are purchased. In the case of new replacement batteries and the UPS Trade-UPSs program, APC includes prepaid postage. The postage tag can be used in conjunction with the existing new replacement battery or UPS box to ship the spent, intact battery to a qualified recycler (if the battery weighs less than 125 lbs / 56.7 kg). The battery owner is given clear guidance and instruction regarding how to handle and package the spent battery for safe transport.

As a battery distributor, APC has created or participated in collection programs that provide customers with designated collection points as a means to drop off their spent batteries. For the bigger 3-phase batteries (this includes both VRLA and flooded / vented batteries) APC either refers the user to the battery manufacturer or partners with the battery manufacturer to provide battery end-of-life services.

Three types of collection programs are offered by battery manufacturers and distributors:

- 1. The battery manufacturers and distributors** retain a battery recycler to collect and recycle batteries generated by their customers within a specific jurisdiction. For example, APC has retained recycling companies in North American and in each European Union country to provide recycling services to North American and European customers. When a customer in these countries requires battery recycling, APC refers them to the battery recycler designated for their country.
- 2. A third-party designated by the manufacturer / distributor** is responsible for collection in order to broaden the scope of collection within a specific jurisdiction. For example, the U.S. retailer Staples allows customers to drop off waste electronics at any of their 1,500 locations for a nominal fee. These third-party collection programs typically provide more drop off locations, which simplifies the task of recycling electronics and batteries.
- 3. A trade association** such as the Portable Rechargeable Battery Association ([PRBA](#)) runs a collection program. This trade association provides members with far reaching collection and recycling opportunities. The PRBA's Commercial Small Sealed Lead

Acid (SSLA) Battery Collection Program, for example, allows battery owners, through its network of 60,000 participating facilities, to drop off, free of charge, any spent battery weighing up to 25 lbs (11.3 kg). PRBA then coordinates with recycling organizations to have the batteries properly recycled.

If battery owners choose to dispose of the batteries themselves, options are still available that result in spent batteries being collected for recycling. Lead-acid batteries have been determined to be unsuitable for disposal as municipal solid waste because they contain toxic heavy metals, plastics and battery acid with corrosive properties. A typical lead-acid battery contains about 21 lbs (9.5 kg) of lead, three pounds of plastic, and one gallon of sulfuric acid. These items can be toxic if handled improperly.

In the U.S., many municipalities operate hazardous waste collection centers or hold hazardous waste collection events where owners of spent batteries can drop them off. APC provides municipalities with expertise and guidance on managing lead-acid batteries at their collection events. With the mature recycling infrastructure available, spent lead-acid batteries should never end up improperly discarded.

The battery recycling process

The first step of the battery recycling process is determining if the spent battery is “intact” or “damaged”. This determination ultimately doesn’t affect the recycling process – intact and damaged batteries are recycled in the same way. Damaged batteries are subject to stringent regulations that control their handling, packaging and shipment and should be sent directly to the battery recycler.

Intact batteries undergo an evaluation upon collection to determine if the batteries are suitable for reuse. Larger UPSs utilize batteries that are encased in cartridges (referred to at APC as replacement battery cartridges or RBCs) that are capable of holding multiple batteries (see **Figure 3**). It is not unusual for an RBC to fail because only a few of the individual batteries within the cartridge are spent. The other batteries inside may function quite well. In these cases, a battery refurbishing company would then take apart the RBC, analyze the individual batteries and, if an individual battery is good, designate that battery as functional and offer it for resale on the secondary market.

Once the spent batteries are received by the battery recycler— typically a secondary lead smelter – the recycling process begins in earnest. First the batteries are crushed into nickel-sized pieces. The plastic components are then separated out as are the lead components. This plastic is sent to a plastics processing plant for manufacture into new plastic products, most of which are casings for new batteries. Battery plastic tends to be the same plastic that has been recycled over and over again (see **Figure 1**).

The lead, which is a fairly valuable metal, is sent to a smelter where it is converted into lead ingots. The smelter has scrubbers and filters that capture any non-lead materials. The gaseous components of sulfuric acid go up flues where they are cooled and condensed and then filtered into a pure enough form to be resold. Some of the smelter organizations sell the sulfuric acid as a commodity.

The price of lead often determines whether a spent battery cartridge furthers its life as a refurbished battery on the secondary market or if its life ends in a lead smelter. When the price of lead is high almost all batteries go the smelting route. When lead prices shift lower, instances of reuse become more common.

Conclusion

The lead-acid battery recycling system is almost an ecological closed loop. Polypropylene is recycled into more battery plastic. The sulfuric acid is collected and resold as commodity acid. The lead is smelted and returned back to batteries or applied to other uses of lead.

The recycling of batteries is highly regulated at the local, state, national, and international levels. Fortunately, data center owners are not required to be familiar with the large volume of regulations involved. By partnering with a reputable UPS supplier or battery manufacturer, most battery owners can safely dispose of their spent batteries free of charge.



About the author

Raymond Lizotte is a Senior Environmental Engineer within the APC by Schneider Electric Environmental Stewardship Office. He directs the company's efforts to develop products that conform to emerging product focused rules, such as the European Restrictions on Hazardous Substances in Electronics (RoHS) directive. He has been involved in environmental product design for the past 20 years. Ray studied environmental engineering at MIT where he graduated with a BS in 1985.



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