Response by the International Lead Association to the Department for Business, Energy & Industrial Strategy Call for Evidence on a Smart, Flexible Energy System, dated 10 November 2016

About the International Lead Association (ILA)

ILA is the global trade association for the lead industry and its member companies are at the forefront of the mining, smelting, refining and recycling of lead. ILA represents the producers of about 3 million tonnes of lead. The association is working towards a vision of a sustainable global lead industry that is recognised for the positive contribution it makes to society. ILA takes a leadership role in promoting responsible care and educating society about the benefits of lead for today's and future generations. Recent studies have shown that lead-based batteries achieve a recycling rate of 99% in the EU and USA.

With offices in the UK and USA, ILA provides a range of technical, scientific and communications support for member companies, downstream users and the wider lead industry. ILA also supports the development of lead-based batteries through the Advanced Lead Acid Battery Consortium which manages the research, development and promotion of lead batteries for markets such as hybrid electric vehicles, start-stop automotive systems and grid-scale energy storage applications.

Lead and its uses

The majority of lead produced (approximately 90%) is used for lead batteries, which are used as an energy storage system in automotive, industrial, renewables, utility energy storage, aerospace, defence and speciality applications. Lead batteries are the most widely used rechargeable battery system by value, by quantity and by application, far exceeding other chemistries including lithium-ion (Li-ion), nickel-metal hydride and nickel-cadmium. This is due to the unique combination of performance, cost, safety, reliability and sustainability provided by lead batteries.

Currently more than 75% of lead produced in Europe, and 100% of lead in the US originates from recycled sources, with the remaining 25% in Europe produced from mined sources. In Europe and North America, 99% of lead batteries are collected and recycled at their end of life, and are fully recyclable, with all components being available for recycling and subsequent reuse in new lead batteries, making lead the most efficiently recycled commodity metal. This ensures that lead is not dispersed to the environment and that all environmental regulations are respected. Lead batteries are recycled in a closed-loop, making it one of the few products already complying with the European Commission's Circular Economy initiative, and contributing to the low environmental footprint of lead batteries.

Policy and Regulatory Barriers to the Use on Energy Storage

This response is directed to questions 1-6 regarding the enablement of energy storage in the electricity network, particularly for smart networks.

The preferred method for storing electricity in local networks is to use batteries. This enables electricity generated from renewable sources, such as wind and solar power, to be stored for load balancing. Batteries are easy to deploy and the power conversion equipment for charging and to convert DC to AC is simple and reliable. There are two important types of battery that can be used in smaller installations appropriate for smart networks; lead and lithium-ion (Li-ion). There is a general presumption that energy storage will mainly be realised with Li-ion batteries and this is clear from the Call for Evidence. This, however, is not the case as both lead and Li-ion batteries can be used. The ILA would like government to ensure that in making regulations regarding smart energy it is not prescriptive with regard to the type of energy storage technology used, particularly batteries.

Battery Technologies

Lead batteries have been in use for energy storage for more than 100 years, but the types used today differ radically from older types. For automotive applications, they have become totally maintenance-free and meet the demands of micro-hybrid cars, demonstrating significant CO_2 savings and enabling car manufacturers to meet current emissions legislation.

For industrial applications, lead batteries provide motive power for industrial trucks, people movers and mobility scooters. They also provide back-up power for telecommunications, data systems and all types of applications where secure power supplies are essential. They are also widely used for storage in electricity networks. Industrial lead batteries have long cycle and calendar lives and although they have moderate energy densities, for static applications as in energy storage, this is not a disadvantage. Modern lead batteries are sealed and need no routine maintenance. Lead also has a strong advantage in terms of cost. It is cheaper than all competitor systems per unit of energy stored and although cost reductions for other chemistries such as Li-ion are anticipated, lead batteries will retain their advantage. Lead batteries are continuing to be developed to meet new applications and the ILA manages an international collaborative pre-competitive research programme – the Advanced Lead-Acid Battery Consortium – which has made major advances to improve their performance.

Li-ion batteries were originally developed in small sizes for portable electronic devices including mobile phones, laptop computers, tablet computers and cameras and have been an enabling technology for these devices. The main advantage is the stored energy density. This has resulted in the use of Li-ion batteries in electric vehicles. Long cycle and calendar lives are possible which is essential for adequate service lives. They are being used for energy storage in electricity networks but, as noted above, high energy density is not important for static installations.

Safety

All batteries are self-contained energy sources and under fault conditions can go into thermal runaway leading to fire and, possibly, explosion. Lead batteries have much lower energy densities than Li-ion batteries and pose a much lower risk if they are abused. They also have aqueous electrolytes which are not flammable whereas Li-ion batteries have organic electrolytes which are flammable - Li-ion batteries involved in a fire may vent and explode. The cells will go into thermal runaway with the active materials reacting together very rapidly and in a venting incident, the electrolyte will be released and ignited. Accidents are rare with both lead-acid and Li-ion batteries, but more prevalent with Li-ion and with more serious hazards. The UN aviation agency ICAO has recently prohibited cargo shipments of Li-ion batteries on passenger aircraft.

Sustainability and Recycling

Sustainability is important for all products and batteries are subject to strict regulation regarding collection and recycling. In the UK, the Waste Batteries and Accumulators Regulations requires that all types of battery are collected at end-of-life and recycled. For lead batteries, collection is highly efficient with high recycling rates in full compliance with all environmental and other legislation. As explained, in Europe more than 99% of lead batteries are collected and recycled at end of life. The recycling industry operates economically without charges to users and provides a net credit at end-of-life. For Li-ion batteries, there are collection and recycling operations in place but they are not economic and there is a charge for reprocessing which is not offset by the value of recovered materials.

Lead batteries are the perfect example of a product designed for complete end of life recycling, with all components available for recycling. A typical lead battery will contain 65% by weight of lead and virtually all of this can be recovered. Plastic cases are recycled to clean granules of polymer that can be re-used. The sulphuric acid is recovered as acid or can be processed to sodium sulphate which can be used in glass making, for detergents and other materials. The overall recovery levels are prescribed in legislation and can be met without difficulty.

In contrast, Li-ion batteries are much more complex in terms of the materials used. They have mixed oxide cathodes with cobalt, nickel, aluminium and manganese, carbon, lithium, copper, aluminium and organic electrolytes. The cases may be stainless steel, plain carbon steel, aluminium or aluminium/polymer laminates. Separating these materials is not presently technically possible at an economic cost. Generally, only cobalt has value and in the types of battery used for energy storage cobalt containing cathodes are too expensive. There will be a net charge at end-of-life to process Li-ion batteries in order to meet the materials recovery levels that are required by legislation.

Another consideration in respect of sustainability is the amount of energy used in manufacturing a product. For Li-ion batteries, it is estimated that the energy used in manufacture is five to six times higher per unit weight and three times higher per unit of energy stored than Li-ion batteries. Correspondingly the quantity of carbon dioxide released during battery manufacture is greater for Li-ion batteries and there are also adverse indications for volatile organic compounds, nitrogen oxides and particulate matter.

Recommendation

It is recommended that regulations regarding energy storage technologies used in electricity networks should not specify or favour any particular technology. If batteries are used, they should be selected on technical and economic grounds, but safety, sustainability and cost must be considered in the selection process. In particular, recycling at end-of-life must be considered at the outset with due regard to legislation and the broader requirements of a sustainable circular economy.

International Lead Association
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For further information, please contact Dr Alistair Davidson (Product and Sustainability Director), International Lead Association, Bravington House, 2 Bravington's Walk, Regent Quarter, London N1 9AF: Tel; 020 7833 8090: Fax; 020 7833 1611: Web; www.ila-lead.com: e-mail; davidson@ila-lead.com.