End of Life Electric Vehicle Batteries
– a Waste Industry perspective of the issues

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Legislation

→ Relevant Legislation for dealing with Waste Batteries



- The Waste Batteries and Accumulators Regulations 2009
- The Batteries and Accumulators (Placing on the Market) Regulations 2008
- The Hazardous Waste Regulations 2005 – England and Wales
- The Special Waste Regulations 1996 (Scotland); The Special Waste Amendment (Scotland) Regulations 2004; The Waste (Scotland) Regulations 2011
- The Hazardous Waste Regulations (Northern Ireland) 2005
- The Environment Protection Act 1990, Part II
- The Environmental Protection (Duty of Care) Regulations 1991
- The Controlled Waste (Registration of Carriers and Seizure of Vehicles) Regulations 1991
- The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009
- ADR – European Agreement Concerning the International Carriage of Dangerous Goods by Road
- The Classification, Labelling and Packaging Regulations 2010
- The Transfrontier Shipment of Waste Regulations 2007
- Landfill Regulations 2002
- Environmental Permitting (England and Wales) Regulations 2012
- Waste (England & Wales) Regulations 2011

Key Legislation

- → The Hazardous Waste Regulations 2005 – England and Wales
  - Most batteries are hazardous, with a few exceptions – although these may become fewer. The move seems to be for all batteries to be treated as hazardous.
  - Sets the rules for how hazardous waste is moved – with consignment note, to a licensed site etc.

- → The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009
- → ADR – European Agreement Concerning the International Carriage of Dangerous Goods by Road
  - Sets rules on how Dangerous Goods are packed and transported, both within the UK, and across state boundaries (by Road, Sea, Air etc)

- → The Transfrontier Shipment of Waste Regulations 2007
  - Sets rules on whether and how Hazardous Waste is moved between countries



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Key Legislation

→ The Waste Batteries and Accumulators Regulations 2009



- Defines Automotive, Industrial and Portable Batteries
  - » Automotive – Starting Lighting and Ignition *only*
  - » Industrial – designed for professional/industrial use; used to power an electric vehicle; sealed but not portable.
  - » Portable – Hand-carried, sealed, not industrial.
- EV batteries are Industrial – and for Industrial batteries:
- Landfill and Incineration banned – therefore assumed 100% recycling.
- Introduces Producer Responsibility for batteries – and makes the producer responsible for any costs
- Introduces the requirement for all waste batteries to be recycled to a standard – the Recycling Efficiency
  - » Nickel cadmium – 75%
  - » Lead Acid 65%
  - » Other 50%
- Over 2 years of discussion just on RE definition and still not finalised.

Recycling Efficiency

→ $$RE = \frac{\text{Output fraction}}{\text{Input fraction}} \quad [\text{mass \%}]$$

- → BUT
  - → On a dry weight basis
  - → Including fluids and acids
  - → Including the mass of the external jacket
  - → Excluding the mass of the external casing of battery packs

- → AND Including
  - → Carbon – if it was in the battery in the first place
  - → Oxygen – if it was in the battery in the first place
  - → Slag – if it is suitable and used for recycling purposes (but not landfill construction or backfilling)



Note on Recycling

- → Recycling is chemistry specific for all batteries
- → There are many different types of “Lithium batteries”
  - Some Automotive Lithium Ion chemistries:-
    - » Lithium Ion Phosphate
    - » Lithium Cobalt Oxide
    - » Lithium Manganese Oxide Spinel
    - » Lithium Nickel Cobalt Manganese
    - » Lithium Titanate Oxide
    - » *...and then there’s all the Lithium polymer chemistries*
- → *Waste Industry needs to know the precise chemistry to have a chance of getting the shipment and terms right!*

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Options for End-of Life EV batteries

→ Whose Battery Is it?

Fundamental to deciding what happens

- Motor Manufacturer
- Recycler
- Waste Industry

All may have different views on how they want to deal with the battery



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Options for End-of Life EV batteries

→ Current Recycling Options for Recycling EV (combined data: Axeon and G&P)

Company (Location)	Status
SNAM (France)	Pilot plant
Umicore ***LiBri Project*** **(Belgium)**	Pilot Plant for Li–ion . G&P – full working plant?
Accurec (Germany)	Development stage
Recupyl (France)	Full working plant. G&P – Pilot plant?
Toxco (USA)	Full working plant
Chemetall ***Lithorec Project*** **(Gernany)**	Pilot plant
Valdi (France)	Development stage

- NB: Recycling Efficiency of all of these processes is as yet unknown

Thank you for your kind attention.

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