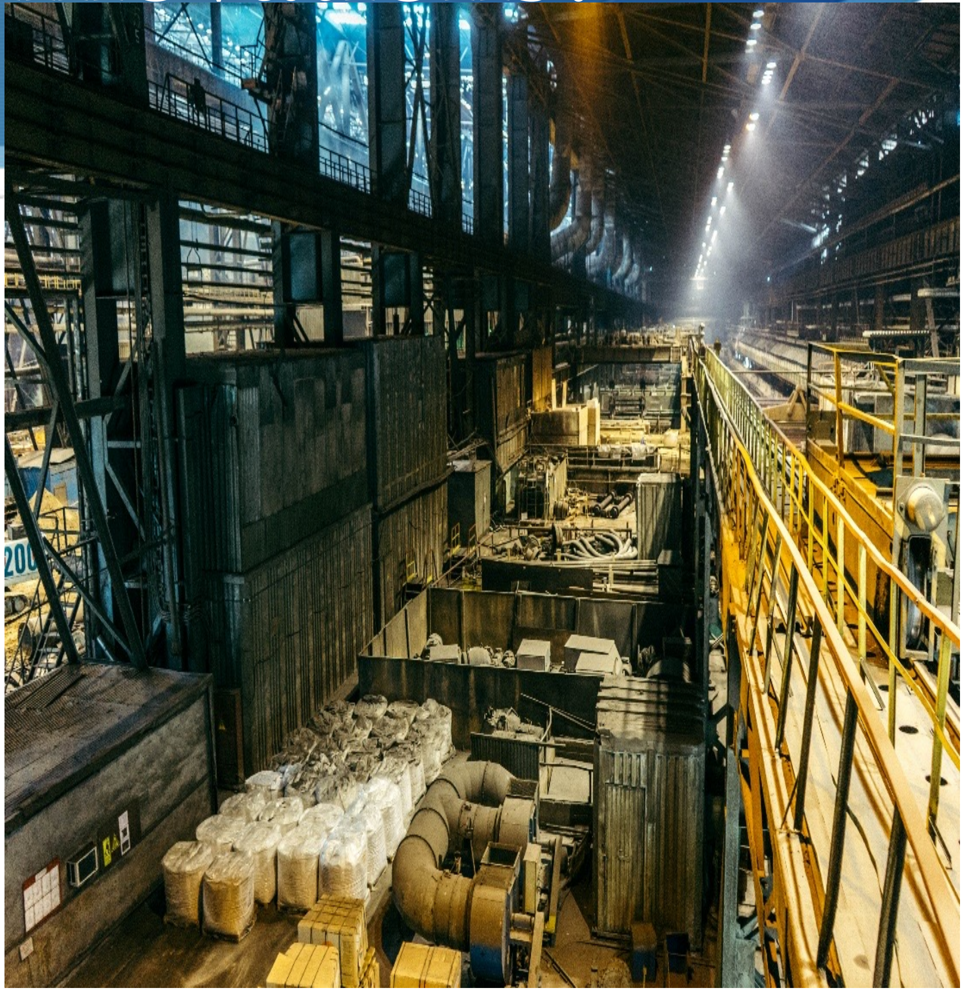
EV batteries and a circular economy: building a safe and sustainable green revolution

Why we need evidence-based law and regulation

Met4Tech

Should we regulate brave new industrial innovations?



Common criticisms

Expensive

Too much 'red tape'

Stifles economic growth

Reduces profits

Hampers innovation

Hurts competitiveness

Etc...

Headlines

NEWS WEBSITE OF THE YEAR

The Telegraph

Coronavirus News Politics Sport Business Money Opinion Tech Life Styl

Subscribe now
Free for one month

Log in

Brexit Conservatives Labour Lib Dems SNP US politics

Post-Brexit Britain should light a bonfire of EU red tape to fuel economic growth, say MPs

Abandon 'excessively cautious' approach to innovation, and instead measure risk against the potential rewards, urges task force

By Harry Yorke, WHITEHALL EDITOR *and* James Crisp, EUROPE EDITOR

15 June 2021 • 10:30pm

The crusade against 'red tape':

“Imagine a city where hundreds of thousands of people live. In the centre is a huge industrial plant which produces chemicals. One night there is an explosion in the plant. A deadly gas settles over much of the city and the sleeping people. By morning, thousands are dead.

In the decades that follow, many thousands more die from the effects of the gas, or from birth deformities; hundreds of thousands more have their lives ruined; and the land and water around the plant are poisoned”

Bhopal Gas Disaster (India, December 1984)

- 40 tons of toxic methyl isocyanite gas (MIC) released from Union Carbide plant
- 500,000 people exposed, 3,000 immediate deaths
- Ongoing birth deformities, miscarriages/stillbirths, cancers, lung and heart disease
- Over 20,000 died since from associated conditions (Guardian, 8 Dec 2019) https://www.theguardian.com/cities/2019/dec/08/bhopals-tragedy-has-not-stopped-the-urban-disaster-still-claiming-lives-35-years-on
- Mortality rate for exposed victims remains 28% higher than average (cancer x2, kidney diseases x 3)
- Site still contains hundred of tons of toxic waste and residues continue in city water

Technology as key driver of UK's green transition

UK first country to set out legal targets for reducing greenhouse gases

- **2008:** Climate Change Act: legally binding targets to reduce GHG emissions by at least 80% by the year 2050
- **2019**: amended Climate Change Act targets, now net zero by 2050
- **2020:** Ten Point Plan for a Green Industrial Revolution. Seven out of ten rely on technology (e.g. aim for 40GW offshore wind- will require 24,000-26,000 tonnes of rare earth magnet material)

Sustainable technology transitions

- Technology critical metals are the building block materials for the green economy
- World Bank projects climate ambition will rapidly accelerate demand for metals. EV and energy storage materials demand will grow more than 1000 per cent by 2050
- For EV batteries, the EU will need 18x more lithium; 5x more cobalt in 2030; 60x more lithium and 15x more cobalt in 2050
- A typical electric car requires six times the mineral inputs of a conventional car
- An onshore wind plant requires nine times more mineral resources than a gas-fired plant
- Less than 3% of RE minerals are recycled

EU CRMs: concentrated supply chains

- European Commission list: 30 (2020) from 14 (2011)
- China provides 98 % of the EU’s supply of REEs
- Turkey provides 98% of the EU’s supply of borate
- South Africa provides 71% of the EU’s needs for platinum

Met4Tech

However… no thought to future technology metals supply until recently

- 2021 UK Government Net Zero strategy: CMs get a mention
- 2022: Critical Minerals Intelligence Centre; UK critical minerals strategy

CONTRAST WITH

- USA: Strategic and Critical Materials Stockpiling Act; Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals (2017)
- EU: EU adopted a Raw Materials Initiative (RMI) in 2008

Met4Tech challenge

How will we continue to provide the minerals to manufacture digital and green technology products?

Met4Tech

More mining? Social and environmental implications

Materials demand will have to be supplemented by circular economy approaches

How can law and regulation help to facilitate a circular economy?

EV batteries: sustainability, safety and legal challenges of governing new technologies

Dilemmas of governing unknown risks and unintended consequences

Will traditional legal principles still work in new evolving landscape?

The EV battery challenge

- EV transition well underway

11m EVs on world's roads (2020) ↑ 145m by 2030

250,000 EVs on UK roads (2019) ↑ 2.7m-10.6m by 2030

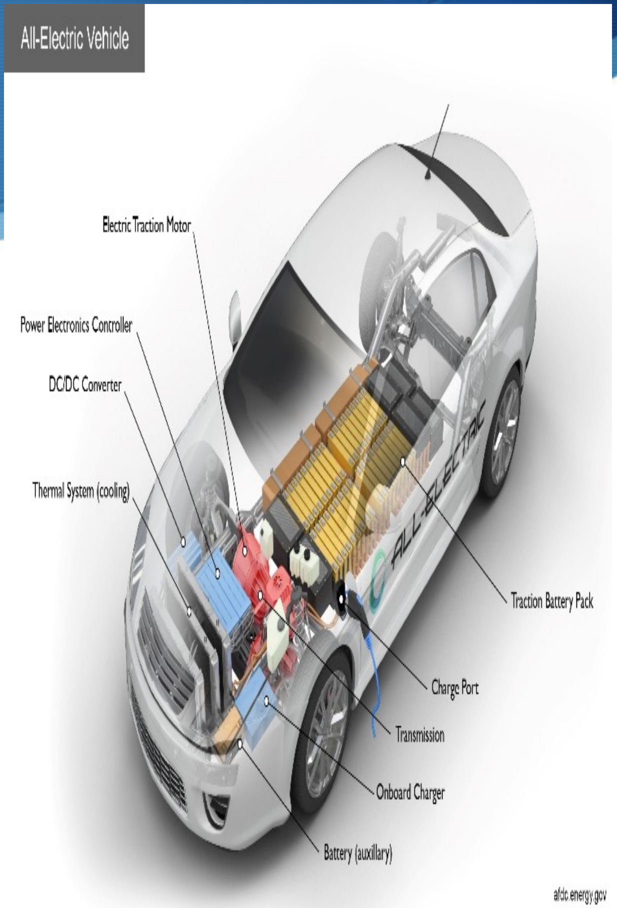
UK EoL EV batteries: 16,000 tonnes to process by 2028

- Still no clear idea of EV battery management: recycling barriers, design barriers, second use barriers, materials supply concerns, inadequate data

EVs are key to cleaner air and climate change goals

The imminent EV battery problem

- EV LIB amongst costliest components (40-50%): add significantly to EV price
- Environmental cost: valuable minerals, mining for cobalt, lithium, nickel
- ‘Retired’ EV batteries will still have 80% capacity left
- Large, powerful, high risk of explosion and toxic fumes
- Recycling barriers: poorly designed for end of life (e.g. Tesla), complex/varying chemistries, no UK infrastructure
- Reluctance about second use: no manufacturer control over battery maintenance and health
- How can we maintain environmental balance and circular economy goals while supporting technological innovation?



CE challenges and need for policy drivers

- Proper end of life management is crucial for both environment and human health
- BUT: Low rates of EV LIB flows at present reduce profitability, reduce industry interest
- Too late to start thinking about recycling only when flows increase: policy drivers essential

Background

- IEA: By 2030, 11-16 million tons of spent EV batteries will be discarded after first use
- Some projections suggest between 70k-105k end-of-life LIBs by 2025 in the UK alone
- Optional pathways for retired LiBs: recycle immediately after first use, vs reuse-then-recycle
- Contrasting views of manufacturers on second use: Nissan v Tesla

Coherent waste management strategies

The recycling-reuse dilemma for EV batteries

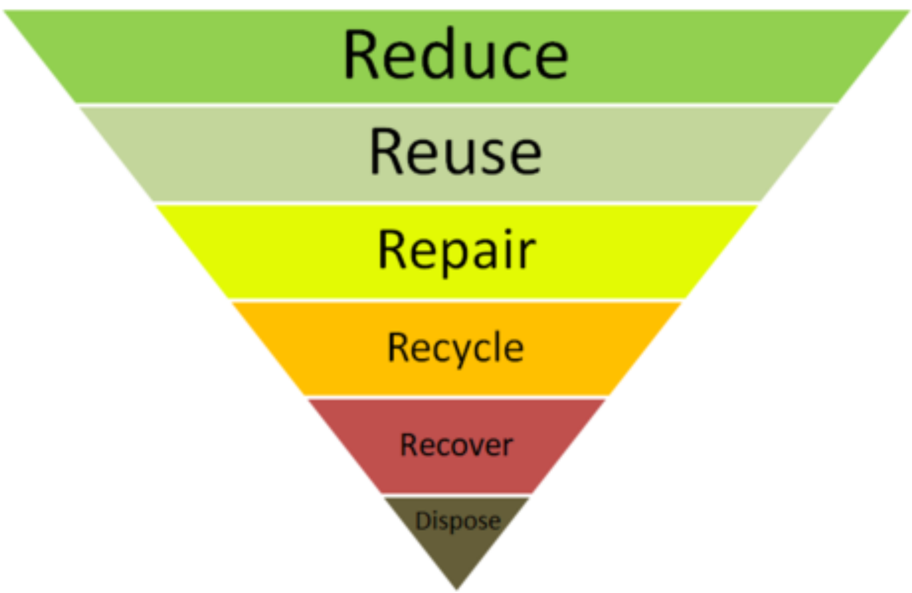
- Optional pathways for retired EV LiBs: recycle or reuse before recycling? Barriers in both pathways
- Contrasting views of manufacturers e.g. Nissan v Tesla
- Traditional waste hierarchy (EU Waste Framework Directive) prioritises second use over recycling

Recycling barriers

- Recycling could provide significant indigenous supply of TCMs.
- BUT: technological, economic, infrastructure and regulatory barriers; diverse battery chemistries, no labelling requirements
- Many materials lost in system, LIB recycling processes still evolving
- Not an EV problem alone: less than 3% of rare-earth materials recycled worldwide
- Crude battery recycling targets mean that the most valuable battery materials are not reclaimed in recycling processes

Second use barriers: does the waste hierarchy work here?

- Written into Waste Framework Directive



Met4Tech

But… will new innovations challenge traditional waste management principles?

- Disruptive effects on LIB recycling industry: LIB second use could tie up critical battery materials for further 15 years or more…
- Waste strategy must be dictated by economic and lifecycle data on relative merits and demerits: but new products come with inadequate data

Second use concerns

- Regulatory structures fail to direct clear lines of responsibility for the safe repurposing of EV batteries
- Unclear battery ownership and liabilities in the repurposing value chain
- Without this clarity, risk that large numbers of repurposed LIBs may not find their way to appropriate recycling.

The problem: appropriate end of life (EoL) management crucial

1. **Sustainability**: Circular economy goals demand effective harnessing of remaining value before disposal e.g. through reuse or materials recovery (cobalt, lithium, nickel, graphite, copper)
2. **Safety**: Many hazardous materials. Additionally, EV LIBs also have high residual power, thus vulnerable to explosions and toxic gaseous emissions. Safe disposal crucial

UK (ESA) DATA- WASTE FACILITY FIRES LINKED TO lithium batteries

Year	No of fires	Known or thought to be caused by LIB	%	Fires with unknown cause
2016/17	334	80	24	
2017/18	510	129	25	313
2018/19	728	160	22	440

Safety challenges

- London Fire Brigade attends on average 24 fires each **week** caused by LIBs, chargers and cables
- Risks amplified for repurposed LIBs: safety crucially affected by battery SoH, damage and ageing. Batteries subjected to repeated charge and discharge cycles more prone to battery failure and explosions.
- LIB firefighting challenges: risk to fire services, rescuers, bystanders

Regulatory solutions for LIB circular economy and safe EoL: how effective policies can help

Better critical materials governance: carrots and sticks

- **Incentives** to bring valuable critical metals back into supply chain

Extended producer responsibility schemes: the 'polluter pays' principle

Eco-design and standards

Permitting and licensing regimes: how do you find the right balance? What values to prioritise?

Extended Producer Responsibility

- "EPR" widely used for variety of waste streams
- Producer responsible for the management of waste 'end of life'
- EPR may be helpful given:
  - Cost barriers to recycling
  - Waste volumes
  - Security of critical materials
- Can be supported by tradable instruments

Met4Tech

Eco-design is crucial: future-proofing product design

- End-of-life management begins at the start of product
- Regulations and standards that increase product lifetime: prevention as a waste management strategy (durable, removable, repairable)
- Products designed for disassembly and recycling
  - Some EV battery designs prohibitively difficult/hazardous to remove or disassemble
- Need to think about whole picture in circular rather than linear terms: supply, durability, repairability, product lifetime, recyclability
- **Sustainable technology dependent on investing NOW in future circularity of product**

Better liaison between scientists and regulators

- Evidence-based legal frameworks for optimum battery and materials stewardship
- Balanced circular economy policies: collection targets, recycling and recovery targets, producer responsibility, level playing field
- Policies that support scientific innovation while minimising hazards from new technologies
- Improved recycling technologies and processes that focus on efficient recovery of the most critical materials: e.g. new EU proposal for EV LIB recycling

The unique EV opportunity

The shift to electric mobility offers a novel opportunity to hardwire circular economy values into a major technology transition.

Also an opportunity to engineer shift towards an economic model which emphasises wider values beyond just economic growth, to also include values such as sustainable resource management, human wellbeing and environmental protection.

An opportunity we cannot lose!

Good environmental regulation

Protects	Mitigates climate change threats, drives sustainability goals	Creates level playing field
Drives growth and innovation (e.g. materials supply risks)	Proportionate	Integrated
Transparent	Based on risk assessment and data (e.g. BAT)	"In regulation, as in so much else, less is more"?

Policy driven incentives

- Economic case for recycling currently not robust: low material flows, price of virgin material currently competitive with recyclates (especially when social/environmental cost of extraction is ignored)
- However, this will change as demand for materials rise
- Domestic recycling rather than transshipment in a circular economy
- Policy interventions could consider,
  - incentives to recycle e.g. on decommissioning
  - increased taxes on use of critical raw materials,
  - regulatory design with targets and tradeable instruments

Met4Tech