CEPS ENERGY CLIMATE HOUSE

Circular economy perspectives for future end-of-life EV batteries

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20 February 2018

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Independent European **think tank** with the objectives of:

- Policy-oriented research
- Forum for discussion

Strong in-house research capacity and an extensive network of partner institutes throughout the world

Extensive portfolio of work in the **circular economy** field:

- CEPS **Task Force** on the ''Role of Business in the Circular Economy''
- Circular Impacts **Horizon 2020** project
- CEPS is acting as a Knowledge Partner in the **Green Growth Knowledge Platform** (GGKP)

Purpose of CIRCULAR IMPACTS

Transition to a more circular economy is a key EU ambition
➢**Circular Economy Action Plan**

-The potential evidence on the impacts of such a transition is **dispersed**
-The overall impacts of that transition are **very unclear**
-Impact assessments are developed under **time pressure**
-The work needs to be integrated in existing policy processes **eg. the European Semester**

Authors of IAs need a quick overview on the available **available evidence**
➔**CIRCULAR IMPACTS**

CIRCULAR IMPACTS ecologic CEPS WAGENINGEN UNIVERSITY & RESEARCH

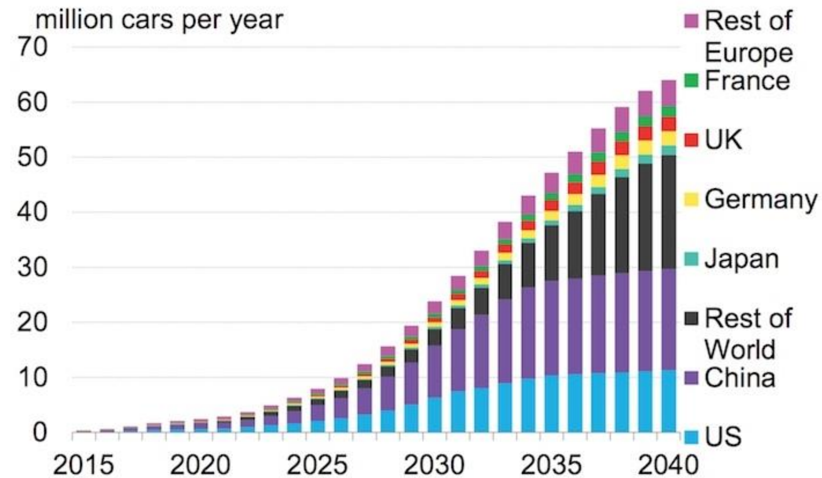
Future end-of-life EV batteries

Electric vehicles - **key technology**

Lithium-ion batteries

Materials with **economic importance**

Driving demand for lithium-ion batteries



Source: Bloomberg (2017)

The case study:

- **provides evidence**
- Focuses on the **potential benefits**

What will happen to this large number of batteries when they reach their end of life?

Defining the scenarios

	Scenario 1*	Scenario 2*
Collection rate within the EU	60%	85%
Lithium recycling efficiency rate	57%	94%
Cobalt recycling efficiency rate	94%	99%
Nickel recycling efficiency rate	95%	97%
Aluminium recycling efficiency rate	98%	98%

* To show examples of the economic and environmental impacts of increasing collection and recycling rates

European Commission's (2016) SET-Plan Action no.7 – Declaration of Intent *"Become competitive in the global battery sector to drive e-mobility forward"*

JRC (2017) report *"Lithium ion battery value chain and related opportunities for Europe"*

Directive (2006/66/EC) on *batteries and accumulators and waste batteries and accumulators*

Assumption

Assumption		Source
Lifetime of EV batteries	8 years	Tesla and Nissan warrant their batteries against malfunction and defect for 8 years.
Length of second-life	10 years	Neubauer et. al. (2015) 'Identifying and overcoming critical barriers to widespread second use of PEV batteries'
Percentage of batteries used for second-life	27%	Bloomberg New Energy Finance (2017) 'Lithium-ion battery costs and market' presentation by Claire Curry
Average weight of cobalt in an EV battery	66 g/kWh	Based on data from Bloomberg on the materials in NCA and NMC lithium-ion batteries
Average weight of lithium in an EV battery	69 g/kWh	Based on data from Bloomberg on the materials in NCA and NMC lithium-ion batteries
Average weight of nickel in an EV battery	468 g/kWh	Based on data from Bloomberg on the materials in NCA and NMC lithium-ion batteries
Average weight of aluminium in an EV battery	40 kg	Per average battery, based on figures from UBS
Price of cobalt	81,000 $/tonne	Based on February 2018 prices from The London Metal Exchange
Price of lithium	9,100 $/tonne	Based on 2017 price from Metalary
Price of nickel	13,625 $/tonne	Based on February 2018 prices from The London Metal Exchange
Price of aluminium	2,138 $/tonne	Based on February 2018 prices from The London Metal Exchange

Key messages

- Estimate approx. **1 million** end-of-life EV batteries in the year 2030
- We estimate approx. **6 million** end-of-life EV batteries in the year 2040
- Value created from raw materials recovered through recycling - creates opportunities to reduce imports of these materials from outside the EU
- Increasing collection and recycling efficiency rates from Scenario 1 to Scenario 2 results in a 50% increase in recovered raw materials
- The recycling industry is a key sector where value can be created through jobs and recovered materials
- Environmental benefits:
  - 1kg of CO_2 saved per kg of battery recycling
  - Reduction in resource depletion

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Thank you

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