

The role of battery recycling in raw material supply for EV application

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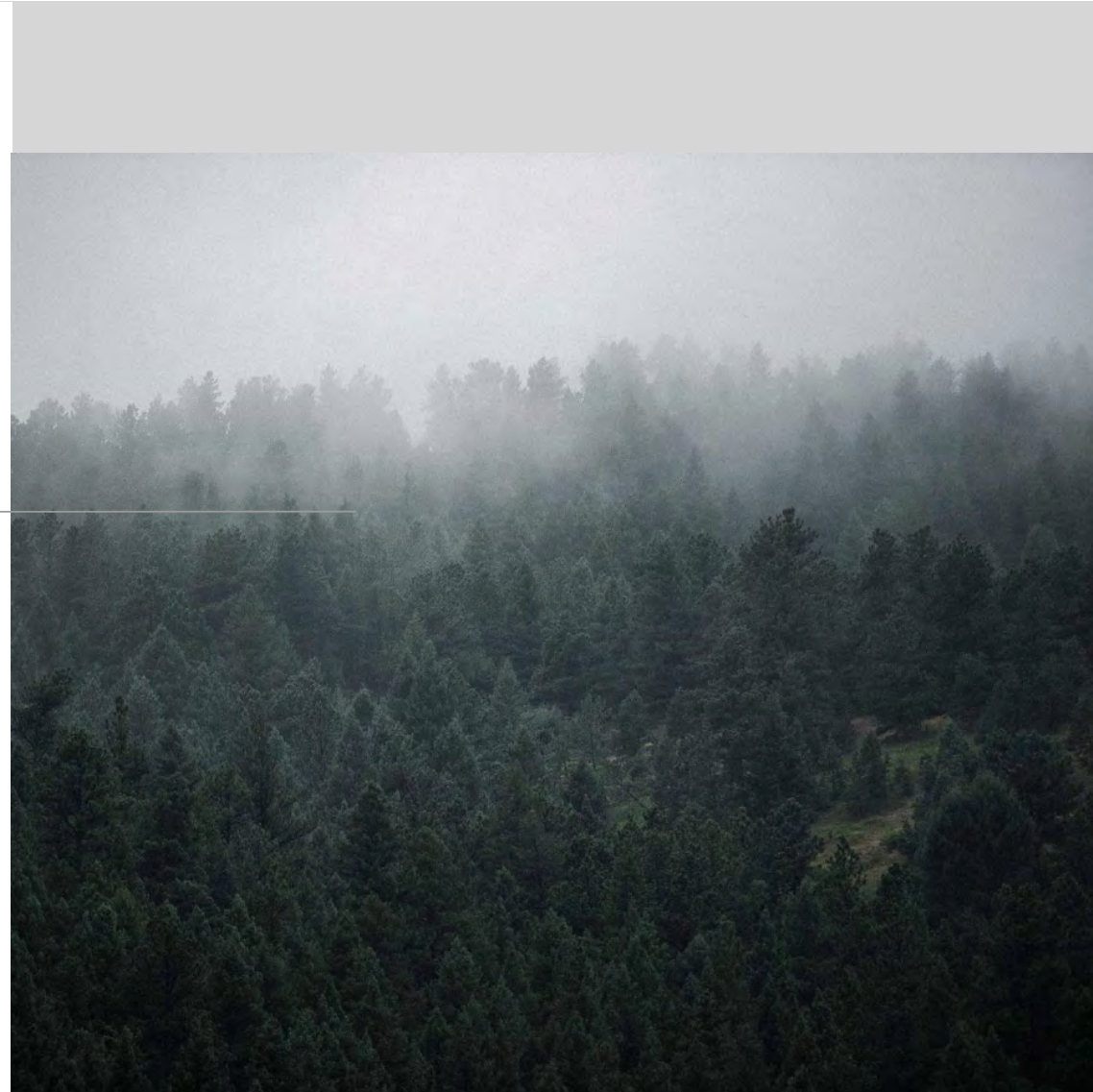


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Vienna Austria

ACCUREC[®]
RECYCLING GMBH



Content

- Introduction Accurec
- Electric vehicle market: past and prognosis
- Corresponding battery and raw material
- Lifetime expectation of electric vehicle batteries
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- Potential raw material supply from recycling

Accurec Recycling GmbH

Company key figures

Headquarter: DE-Krefeld

Plants: DE-Mülheim an der Ruhr
DE-Krefeld

Employees: >64

Turnover: 16 Million €



History

Foundation of Accurec

1995

NiCd capacity 2500 t/a

2003

Capacity 4000 t/a incl. NiMH

2006

R&D Li-ion consumer Project

2012

R&D Li-ion EV electromobility

2015

Start Li-ion recycling facility
and move of headquarter to
DE-Krefeld

2016

Expansion and completion of
Li-ion recycling process chain

> 2019

Business segments

Service: National collection service of EOL batteries



Sorting: Sorting and dismantling of EOL batteries



Recycling: Recovery of materials from used batteries



Research & Development: improvement recycling process



Plant Mülheim an der Ruhr

NiCd/NiMH

Capacity: 4,000 t/a

Battery recycling plant:

- NiCd
- NiMH
- Sorting of mixed household batteries

Key figures **2018**:

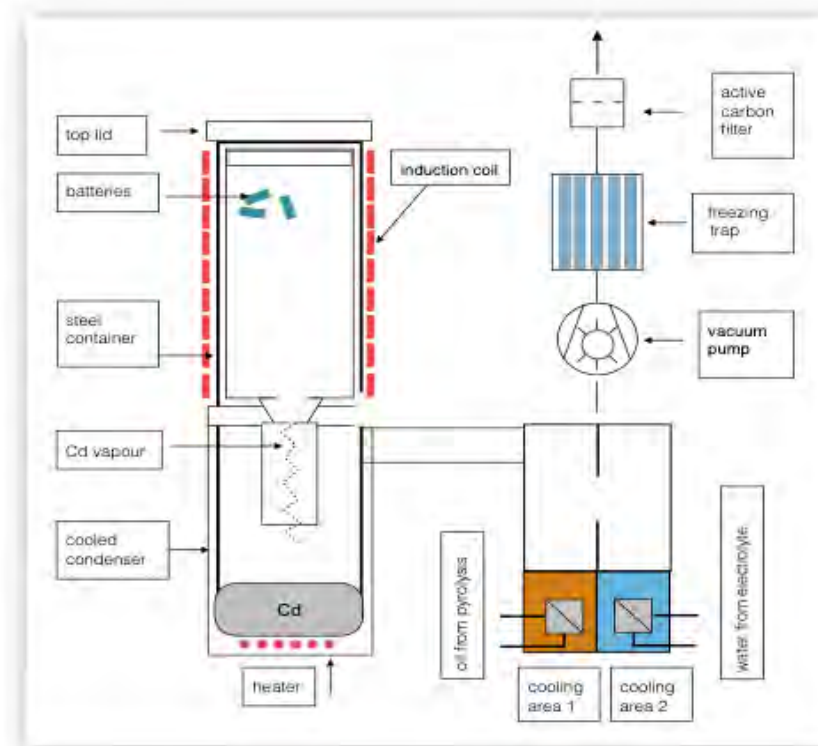
- NiCd 1,500 tons
- NiMH 500 tons
- Mixed HH battery 2,000 tons



Plant Mülheim an der Ruhr



NiCd/NiMH



key characteristics:

- One step process
- Ultra low emission ($< 0,01 \text{ g/h Cd}$)
- High process stability and safety
- Highly energy efficient
- SCOEL Cd $< 1 \mu\text{g/m}^3$

Plant Krefeld

Li-ion

Legal capacity: 60,000 t/a

Dedicated battery recycling plant for:

- Li-ion portable
- Li-ion automotive
- Li-Primary

Key figures **2018**:

- Li-ion portable **1,500 tons**
- Li-ion automotive **150 tons**
- Lithium primary 1,000 tons

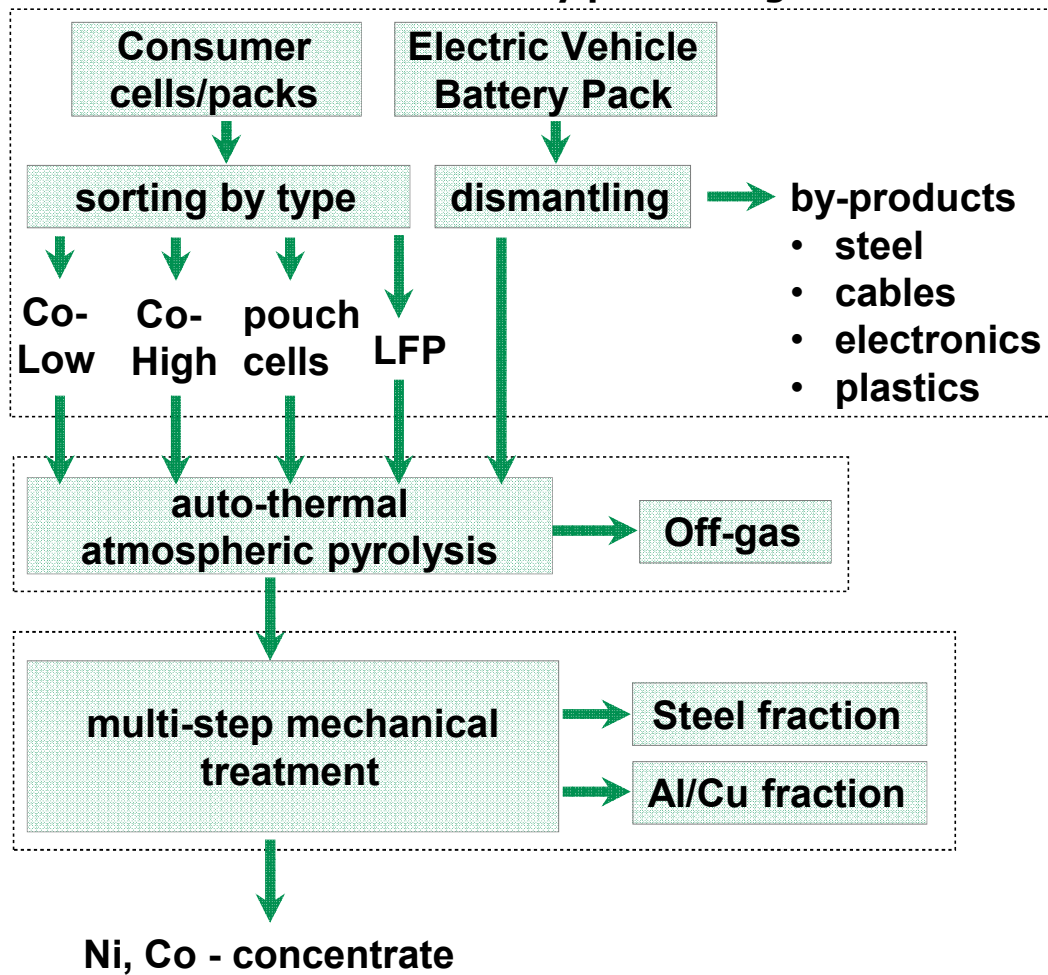


Plant Krefeld

Li-ion



Advanced Li-Ion battery processing



Plant Krefeld

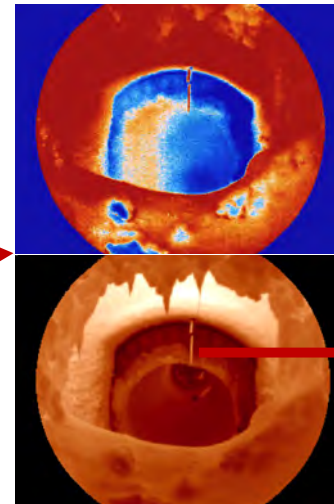
Li-ion

Li-ion batteries

Abfall Waste

Nachbrennkammer
Post Combustion Chamber

Rauchgas
Flue gas



max.
600°C

Ausgemauerter Drehrohrofen
Brick lined Rotary Kiln

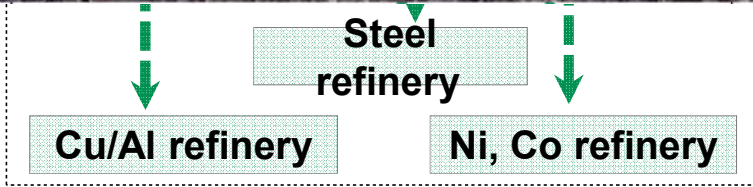
Nassentschlacker
Wet deslagger



multi-step mechanical treatment

Plant Krefeld

Li-ion

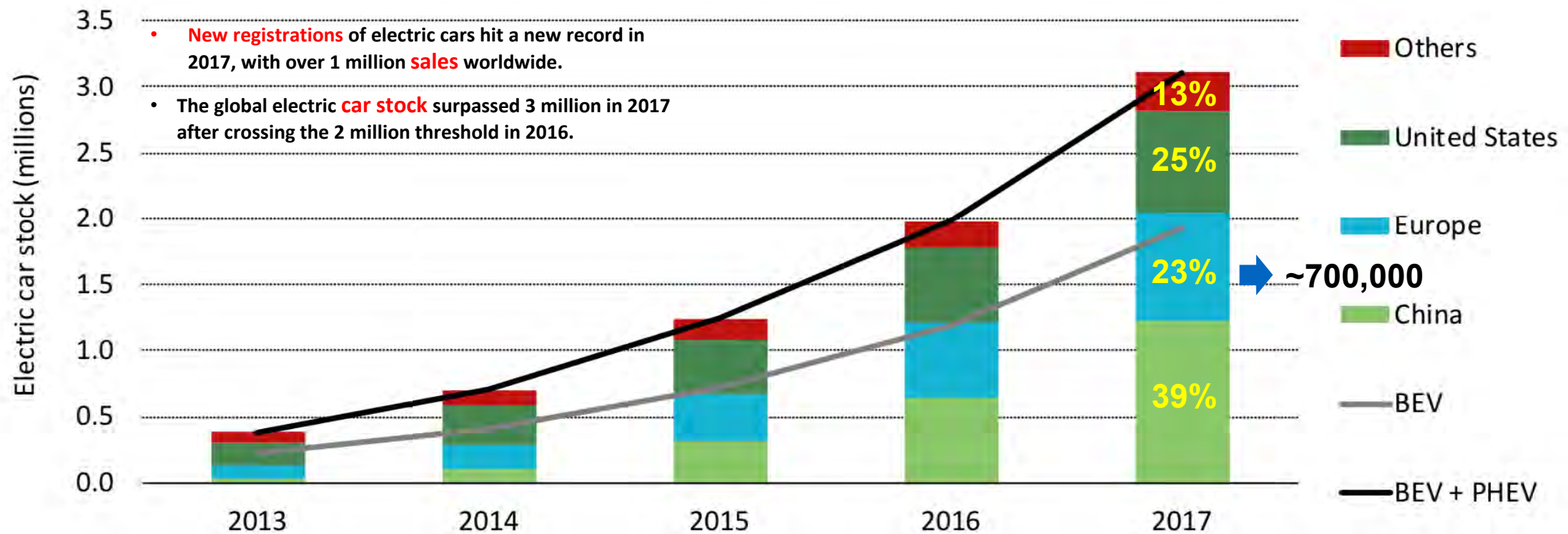


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Global electric vehicle market

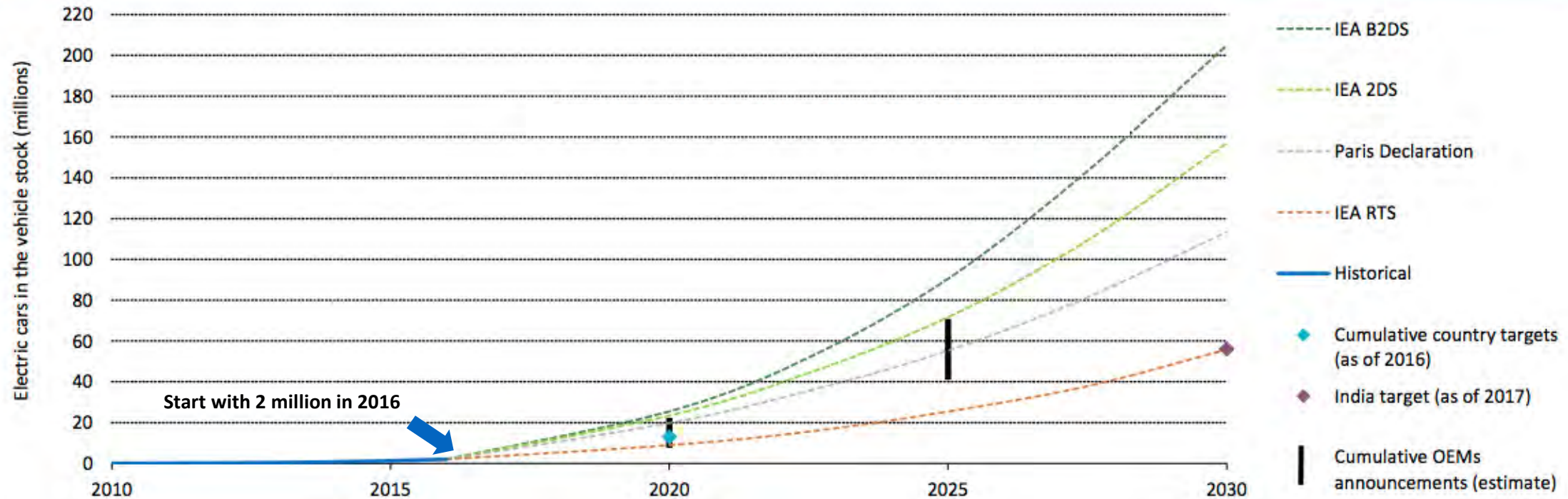
Figure ES 1 • Evolution of the global electric car stock, 2013-17



Source: OECD/IEA

Global electric vehicle market Prognosis

Figure 9 • Deployment scenarios for the stock of electric cars to 2030



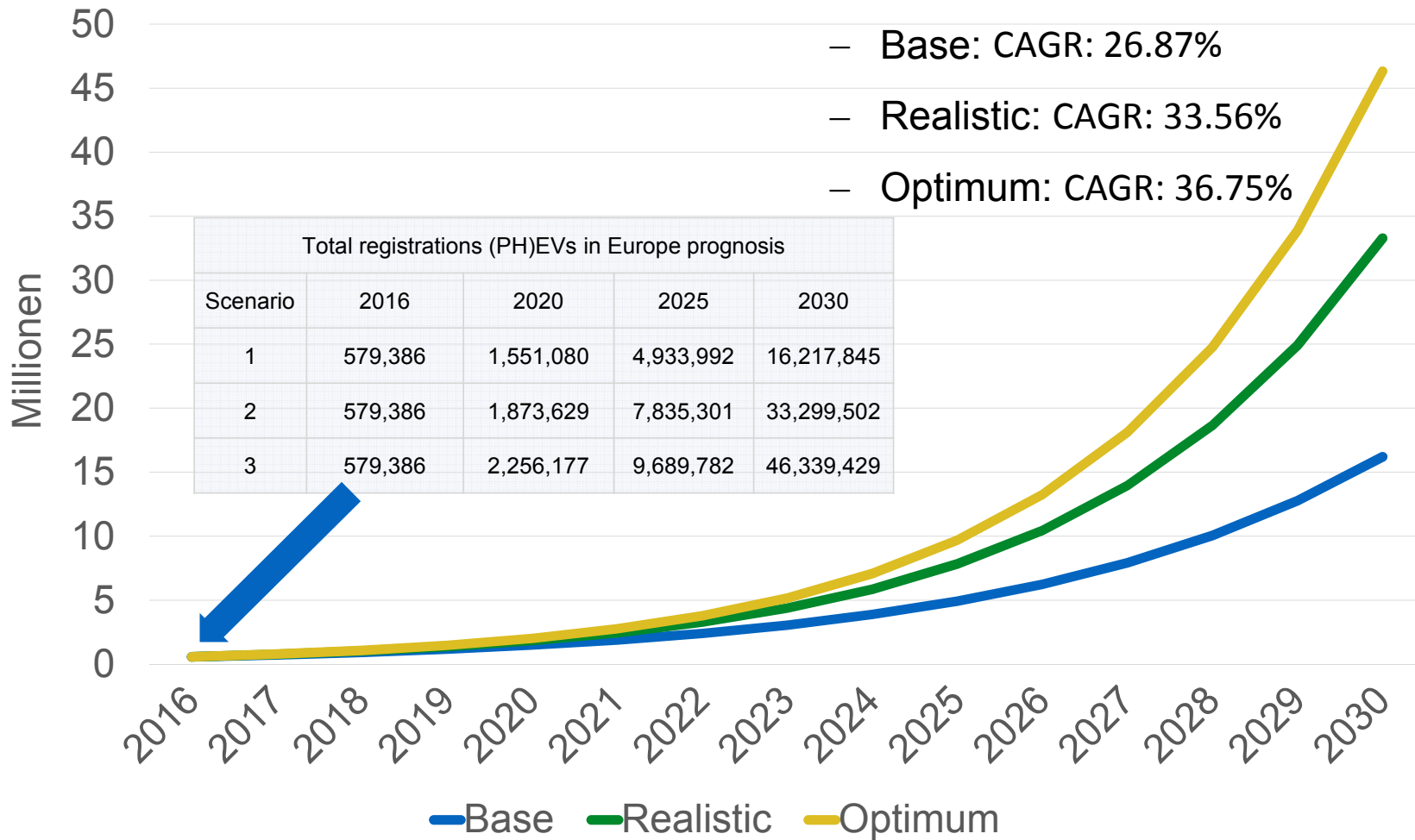
Base Scenario: The Reference Technology Scenario (RTS): **56 million EVs by 2030.** → CAGR: 26.87%

Realistic Scenario: The Paris Declaration on COP21: **115 million EVs by 2030.** → CAGR: 33.56%

Optimum Scenario: The 2-Degree Scenario: **160 million EVs by 2030.** → CAGR: 36.75%

Source: OECD/IEA

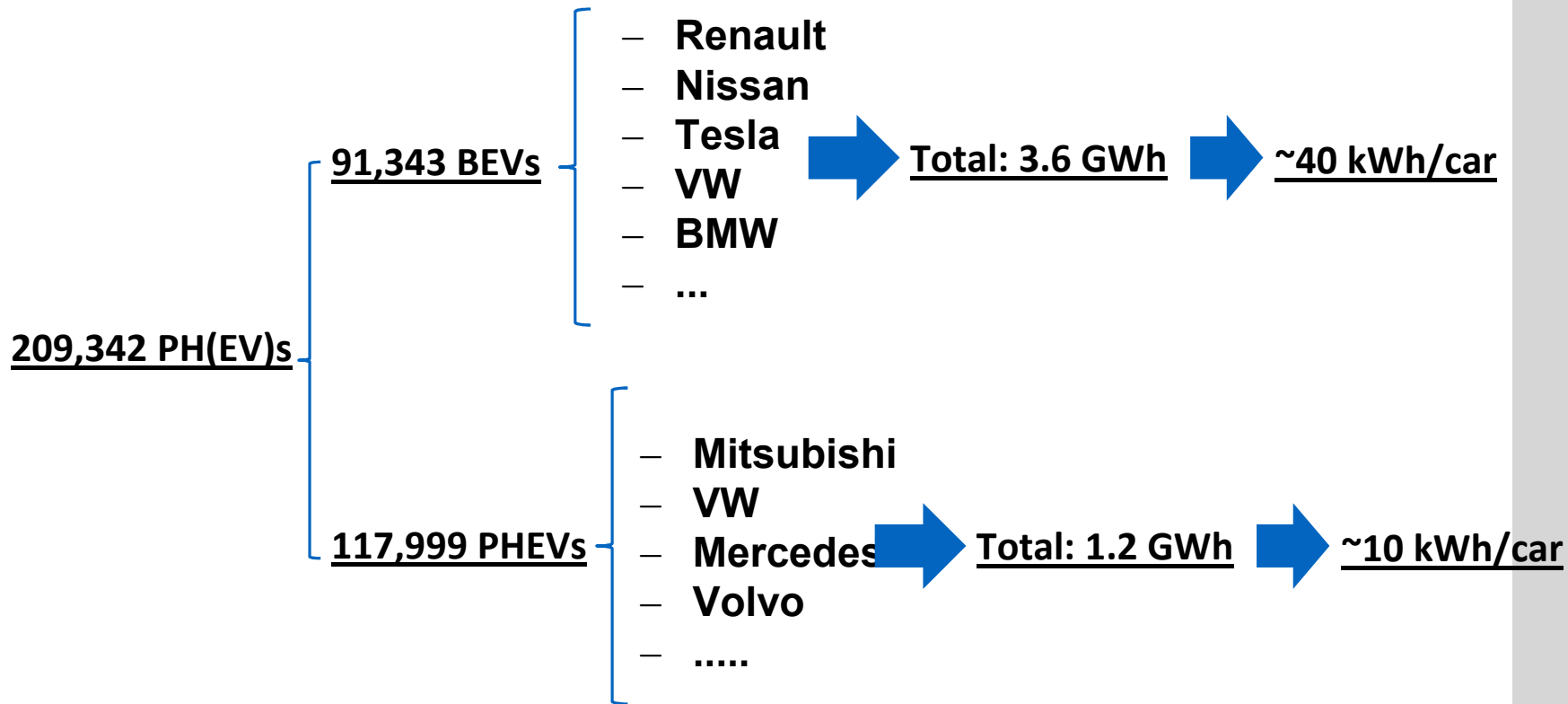
Europe electric vehicle market Prognosis 2016 - 2030



Content

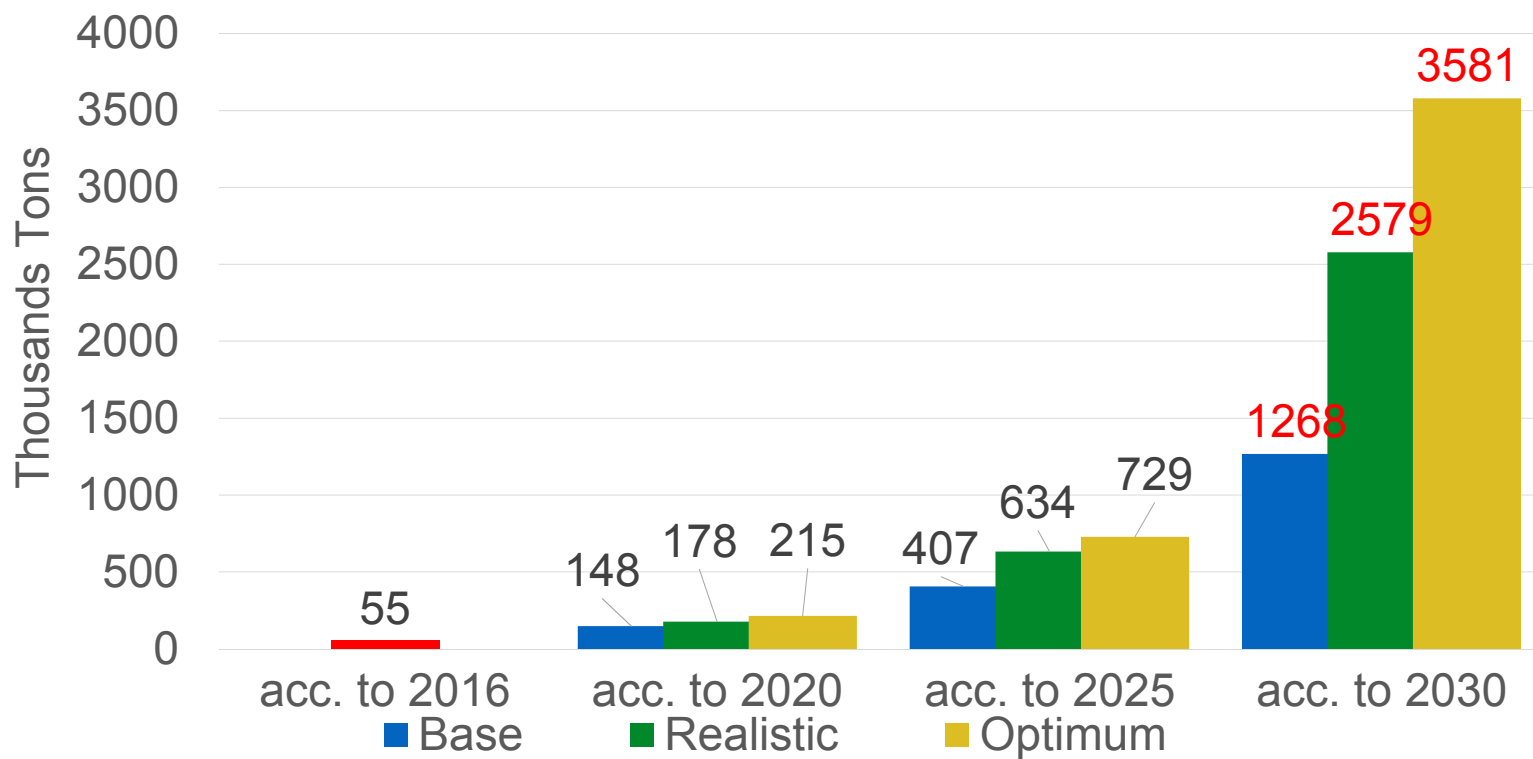
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Li-ion battery put on EU market (case study: 2016)



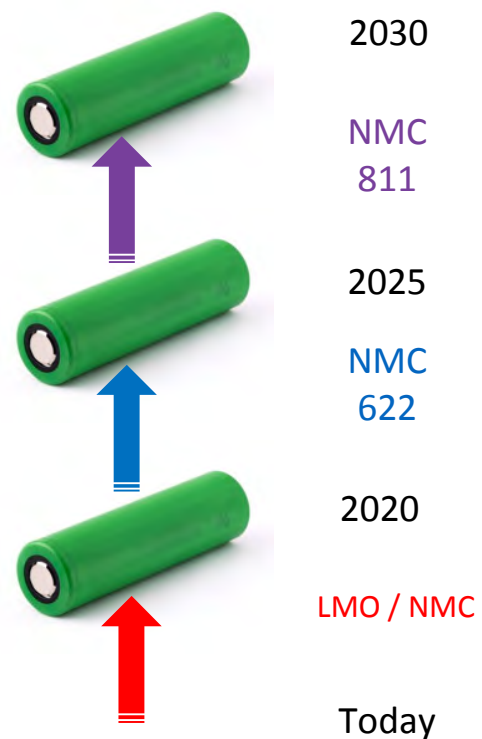
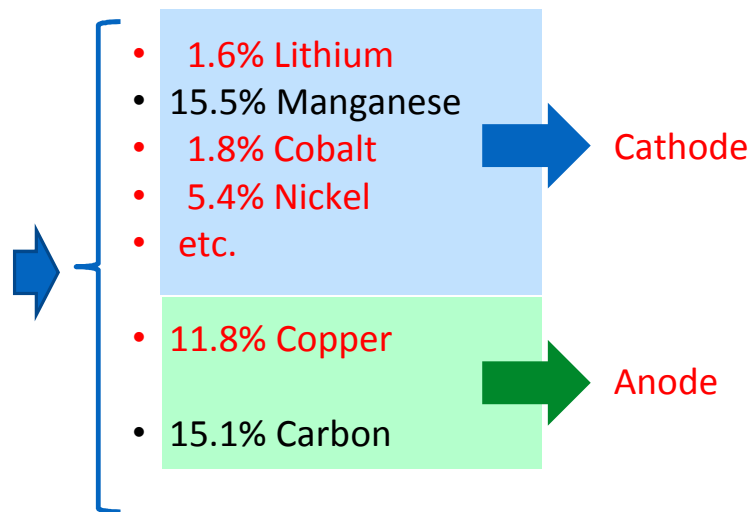
Li-ion battery put on market

Estimated battery tonnage sold in EU



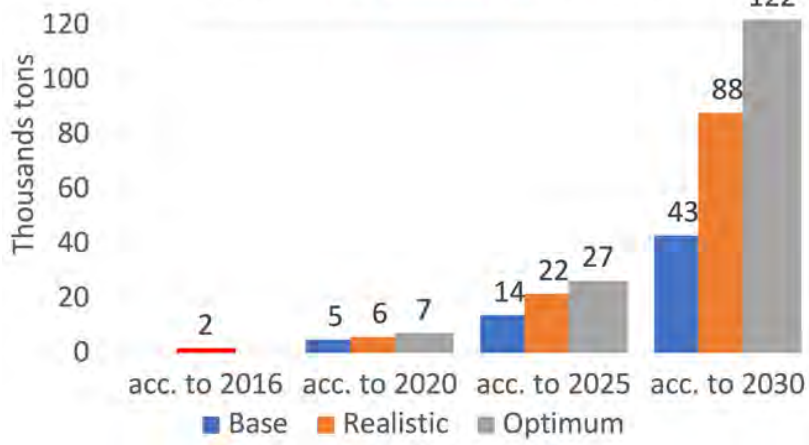
Li-ion battery and critical raw materials

Several single cells from 4 different European EV OEMs

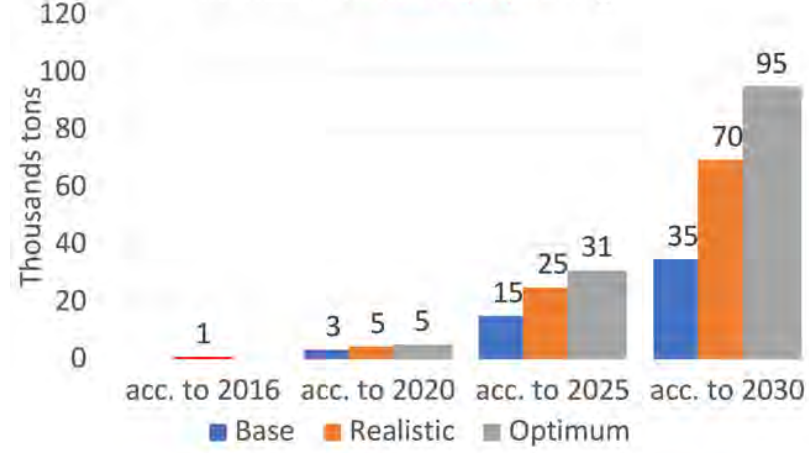


Accumulated battery materials POM in EU

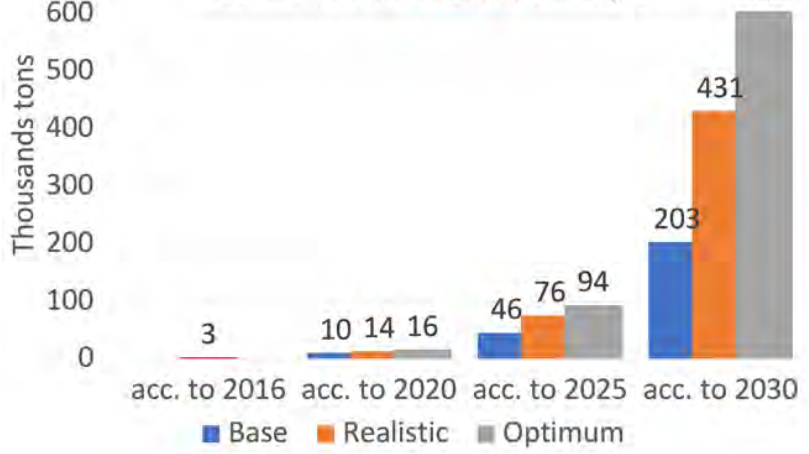
estimation of lithium (Li) tonnages



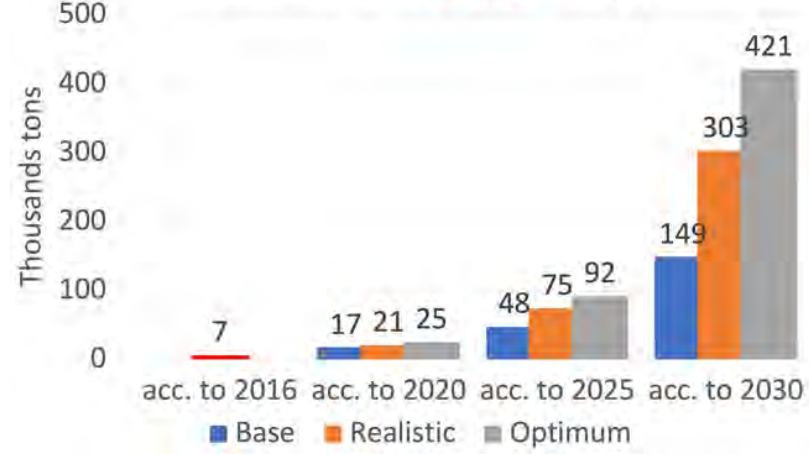
estimation of cobalt (Co) tonnages



estimation of nickel (Ni) tonnages



estimation of copper (Cu) tonnages



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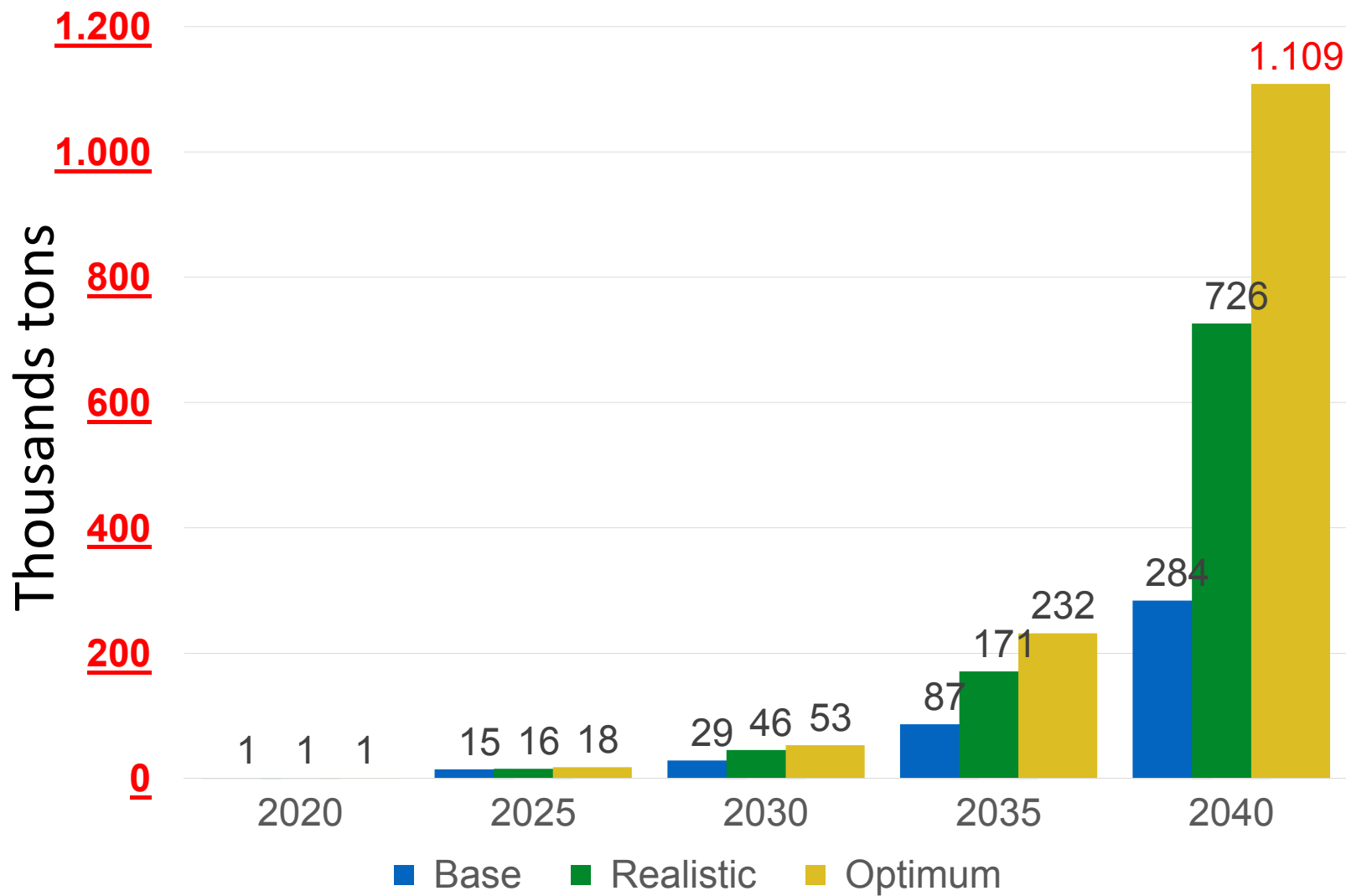
Li-ion battery lifetime estimation

Reach end-of-life after..... years	percentage
6	5%
8	25%
10	40%
12	25%
14	5%

Content

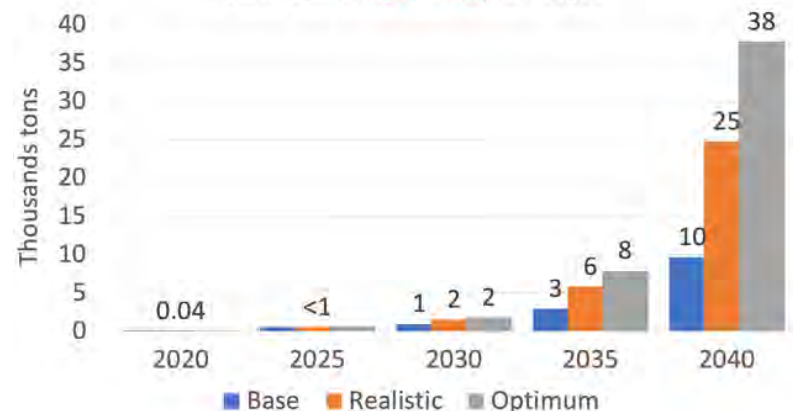
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Expected annual battery tonnage ready for recycling in EU

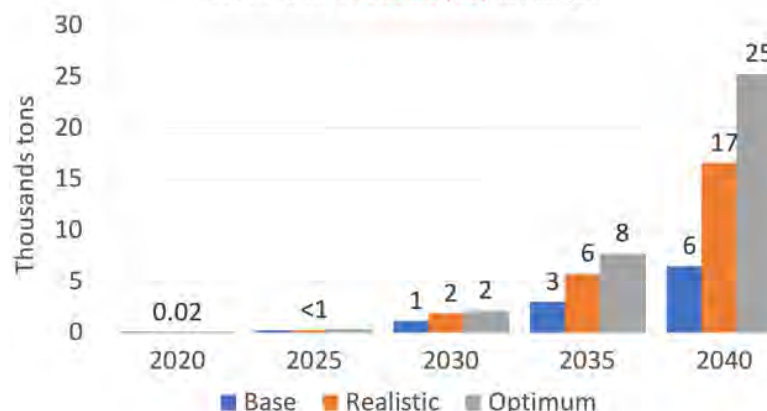


Expected annual materials ready for recycling in EU

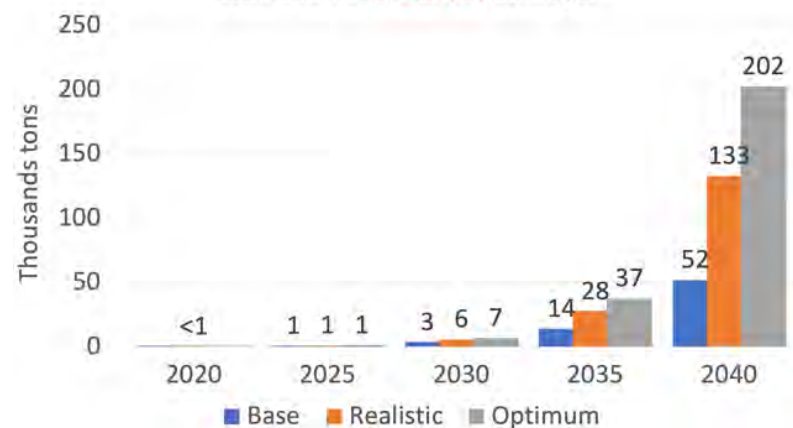
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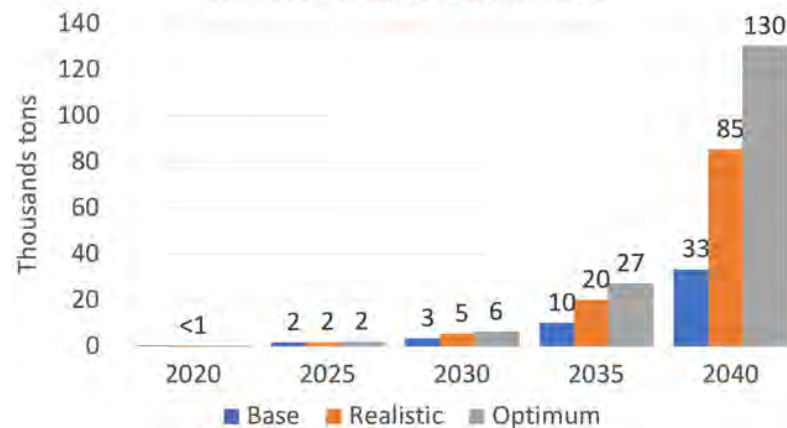
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estimation of copper (Cu) tonnages

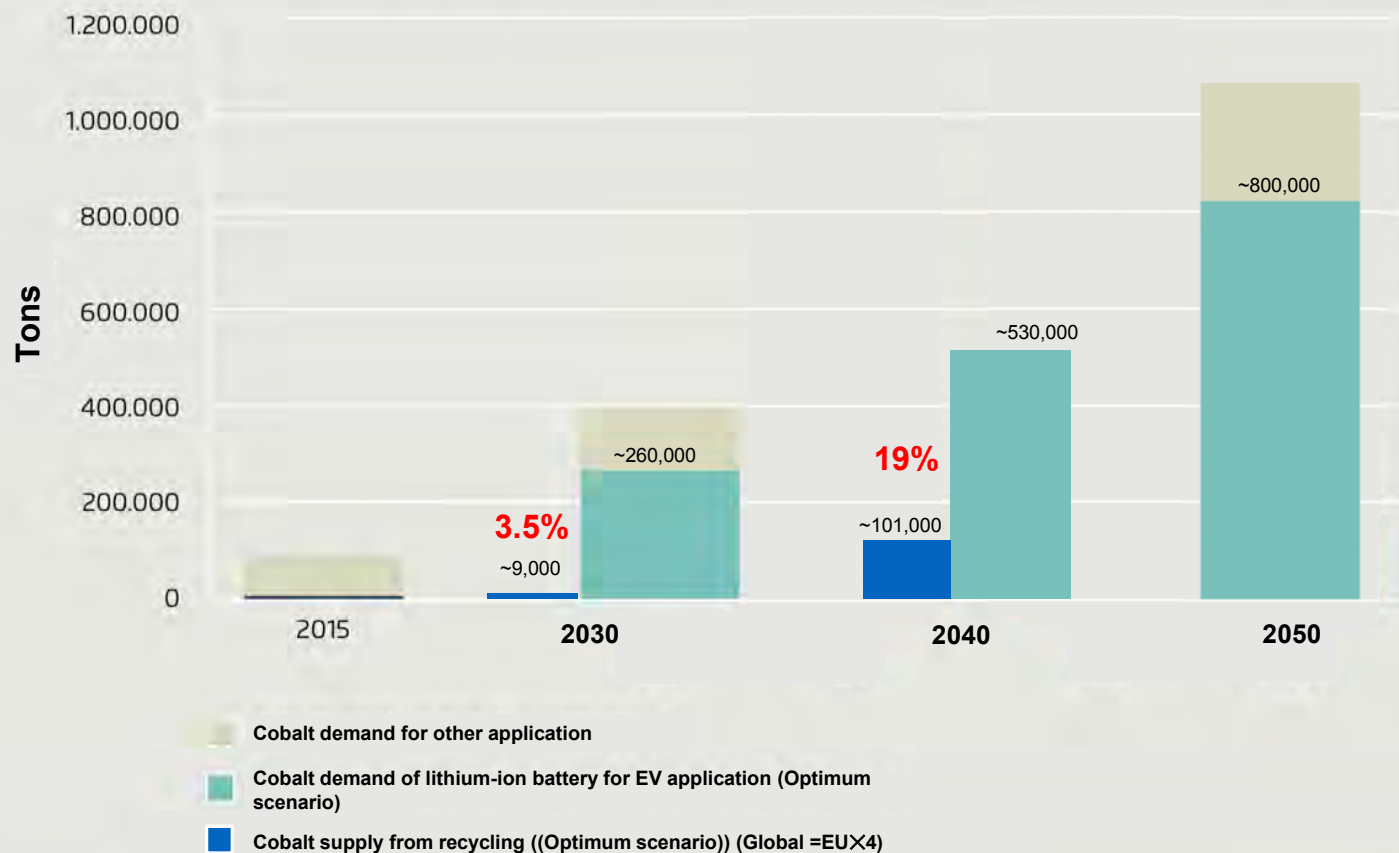


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Recycling supply for raw materials **Global**

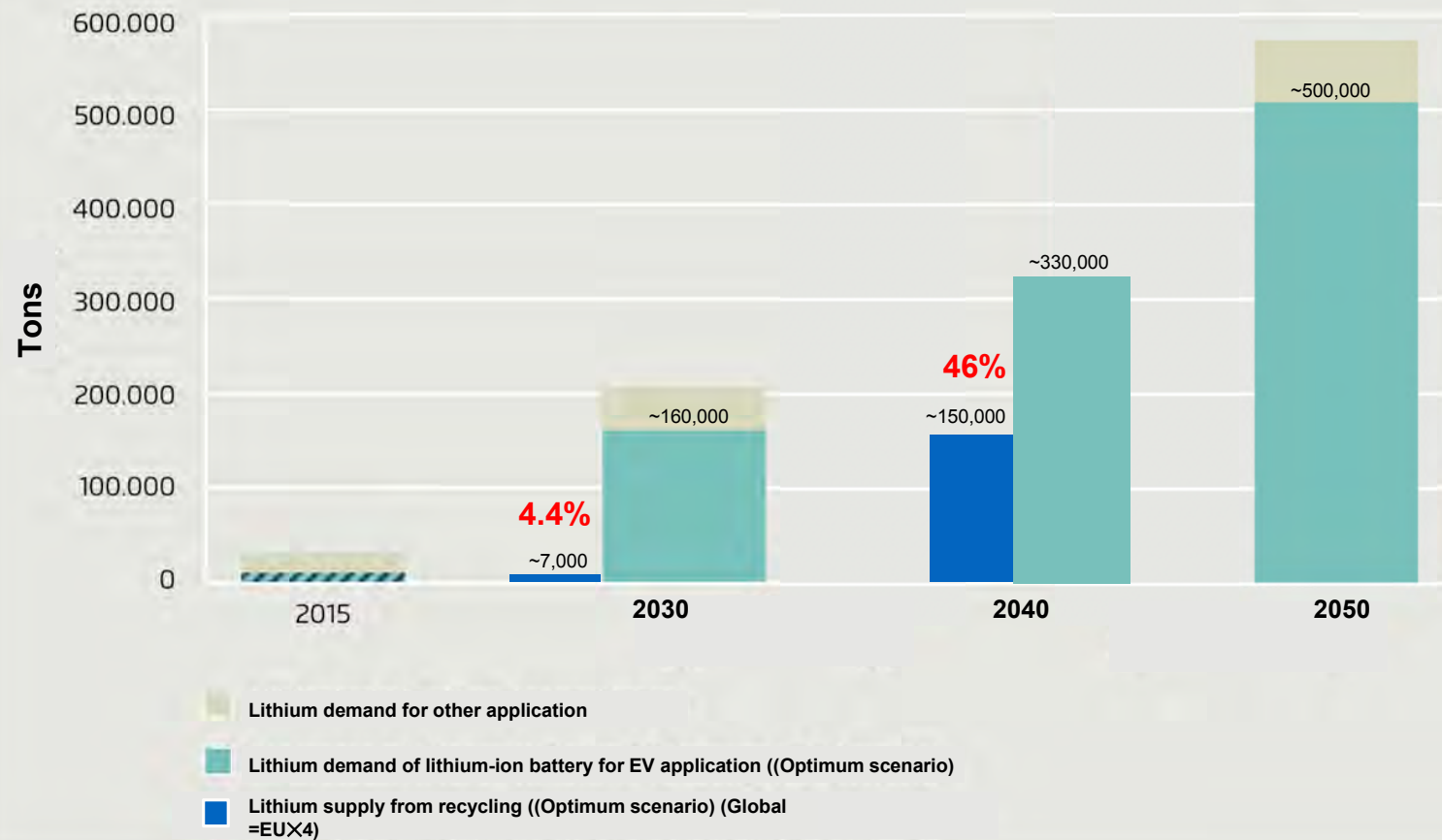
Estimated cobalt demand and supply from recycling



Source: Öko-Institut e.V.

Recycling supply for raw materials **Global**

Estimated lithium demand and supply from recycling



Source: Öko-Institut e.V.

DEMOBASE

DEsign and MOdelling for improved BATTERY Safety and Efficiency

Funded by the
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IFP Energies nouvelles

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SRL

K&S GmbH Projektmanagement

MA S.p.A

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Thank you for your attention!

We manage battery resources