

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

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# Content

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- Introduce Accurec
- (PH)EV put on market analysis: past and prognosis
- Corresponding batteries and critical raw materials
- Lifetime study of (PH)EV batteries
- Recycling technologies and the role of recycling



# Accurec Recycling GmbH

## Company key figures

Headquarter:	DE-Krefeld
Plants:	DE-Mülheim an der Ruhr DE-Krefeld
Employees:	>60
Turnover:	15 Million €



## History

Foundation of Accurec
NiCd capacity 2500 t/a
Capacity 4000 t/a incl. NiMH
R&D Li-ion Project
R&D Li-ion electromobility
Start Li-ion recycling facility and move of headquarter to DE-Krefeld
Expansion and completion of Li-ion recycling process

1995

2003

2006

2012

2015

2016

> 2019



## Business segments

**Service:** National collection service of EOL batteries



**Sorting:** Sorting and disassembly of used batteries



**Recycling:** Pretreatment and Recycling of used batteries



**Research & Development:** metallurgical process development





# Plant Mülheim an der Ruhr

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 Krefeld

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   | <b>1,500 tons</b> |
| - Li-ion automotive | <b>150 tons</b>   |
| - Lithium primary   | 1,000 tons        |





# imodBatt

Industrial **Modular Battery** Pack concept for automotive applications



GV-06-2017

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 770054

**cidetec**  
energy storage



**TYVA**  
énergie+



**HEXAGON**  
studio

**ISEA**

**RWTH AACHEN**  
UNIVERSITY

**Freemens**

**AIT**  
AUSTRIAN INSTITUTE  
OF TECHNOLOGY

**Cleancarb**  
providing sustainable power...



**e.GO**

**ACCUREC**  
RECYCLING GMBH

**PA PROAUTOMATION**  
ROBOTIK - MECHATRONIK

**cea tech**  
**liten**

**RENAULT**

- 1) **CIDETEC**  
San Sebastián, Spain
- 2) **Rescoll**  
Pessac, France
- 3) **Tyva Energie**  
Annonay, France
- 4) **Miba**  
Laakirchen, Austria
- 5) **Hexagon Studio**  
Besiktas Istanbul, Turkey
- 6) **RWTH Aachen University**  
ISEA – Institute for  
Power Electronics and  
Electrical Drives  
Aachen, Germany
- 7) **Freemens**  
Grenoble, France
- 8) **Austrian Institute  
of Technology**  
Wien, Austria
- 9) **Cleancarb Sàrl**  
Kopstal,  
Luxembourg
- 10) **e.GO Mobile AG**  
Aachen, Germany
- 11) **Accurec Recycling  
GmbH**  
Krefeld, Germany
- 12) **Pro Automation  
GmbH**  
Wien, Austria
- 13) **CEA**  
Paris 15, France
- 14) **Renault**  
Boulogne  
Billancourt,  
France



- development **strategies** and methodologies for **maximizing** the material recovery.
- maintaining **highest safety** standards during recycling.
- Develop **design for recycling recommendations** to cover the recycling demands in the development stage of an EV battery system.

**ACCUREC**  
RECYCLING GMBH

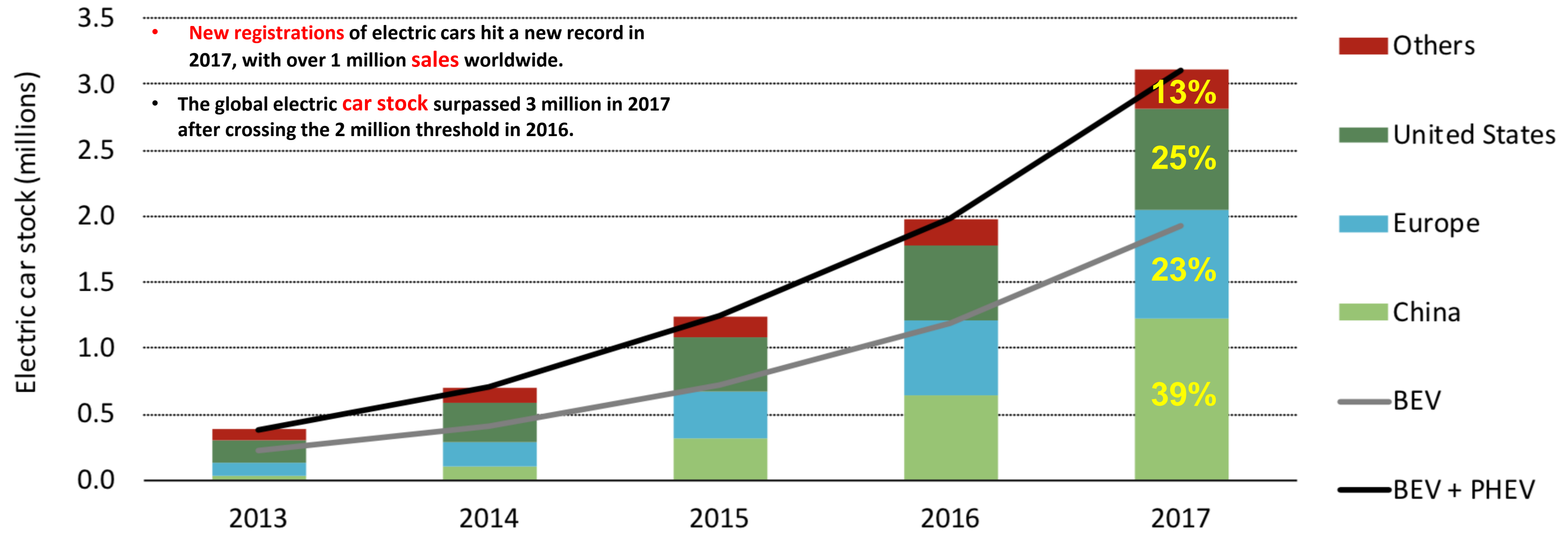
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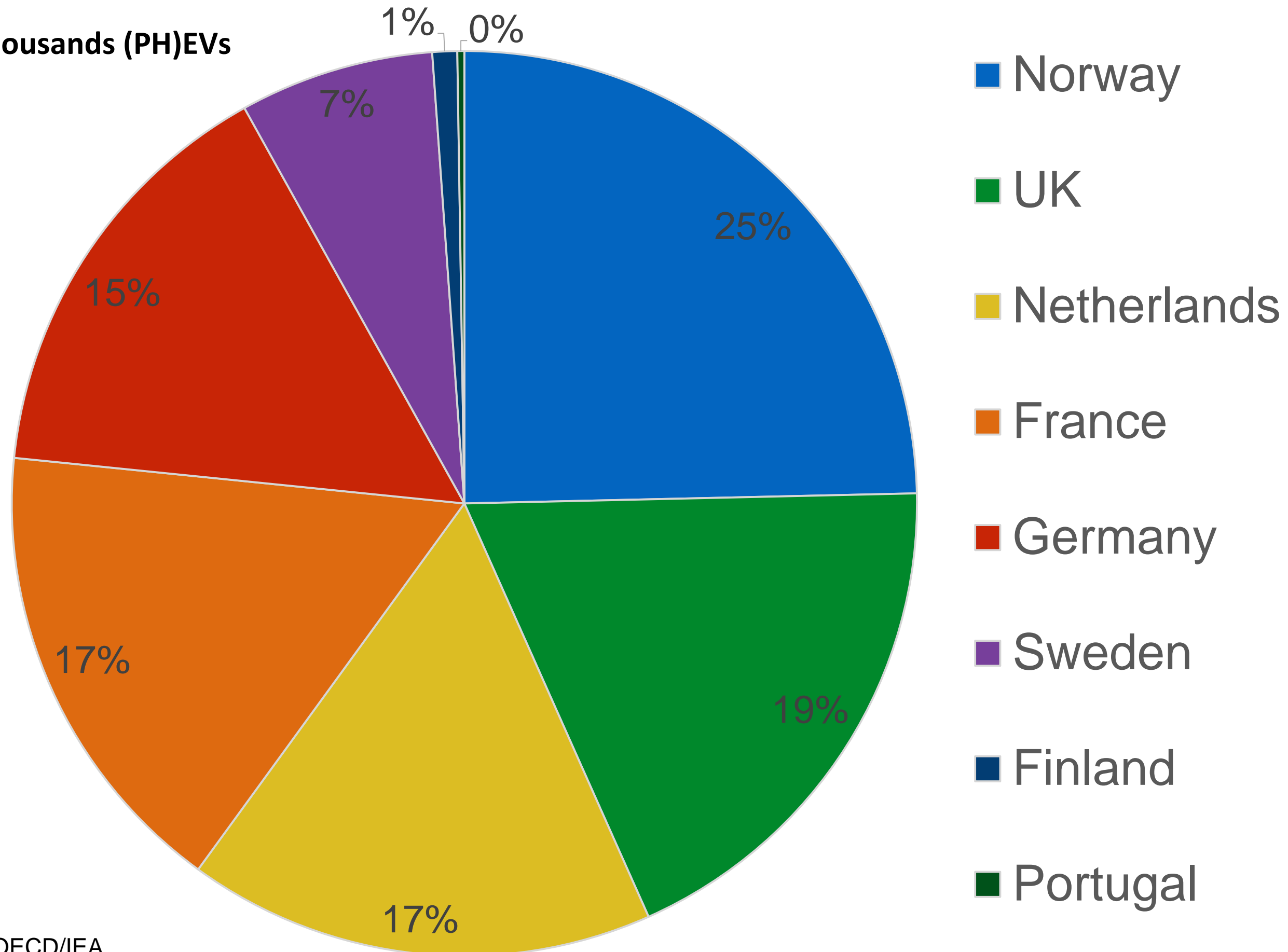


**Figure ES 1 • Evolution of the global electric car stock, 2013-17**



# EU (PH)EV market

715 thousands (PH)EVs

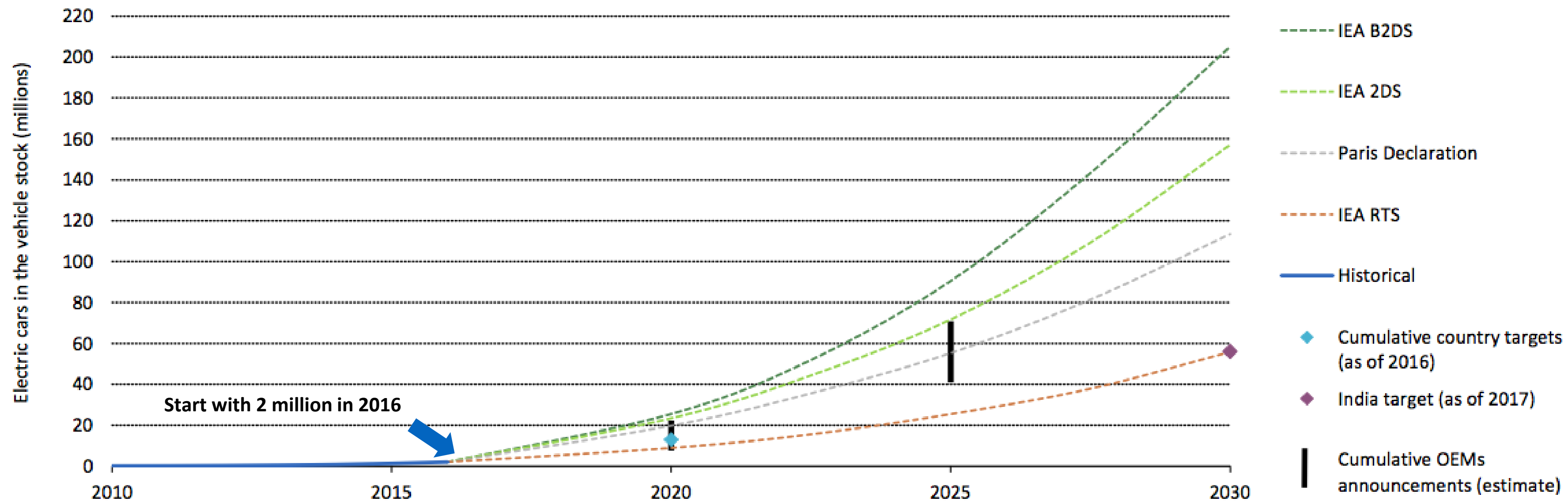


Source: OECD/IEA



# Global (PH)EV market Prognosis

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



Scenario1: The Reference Technology Scenario (RTS): **56 million EVs by 2030.** ➡ CAGR: 26.87%

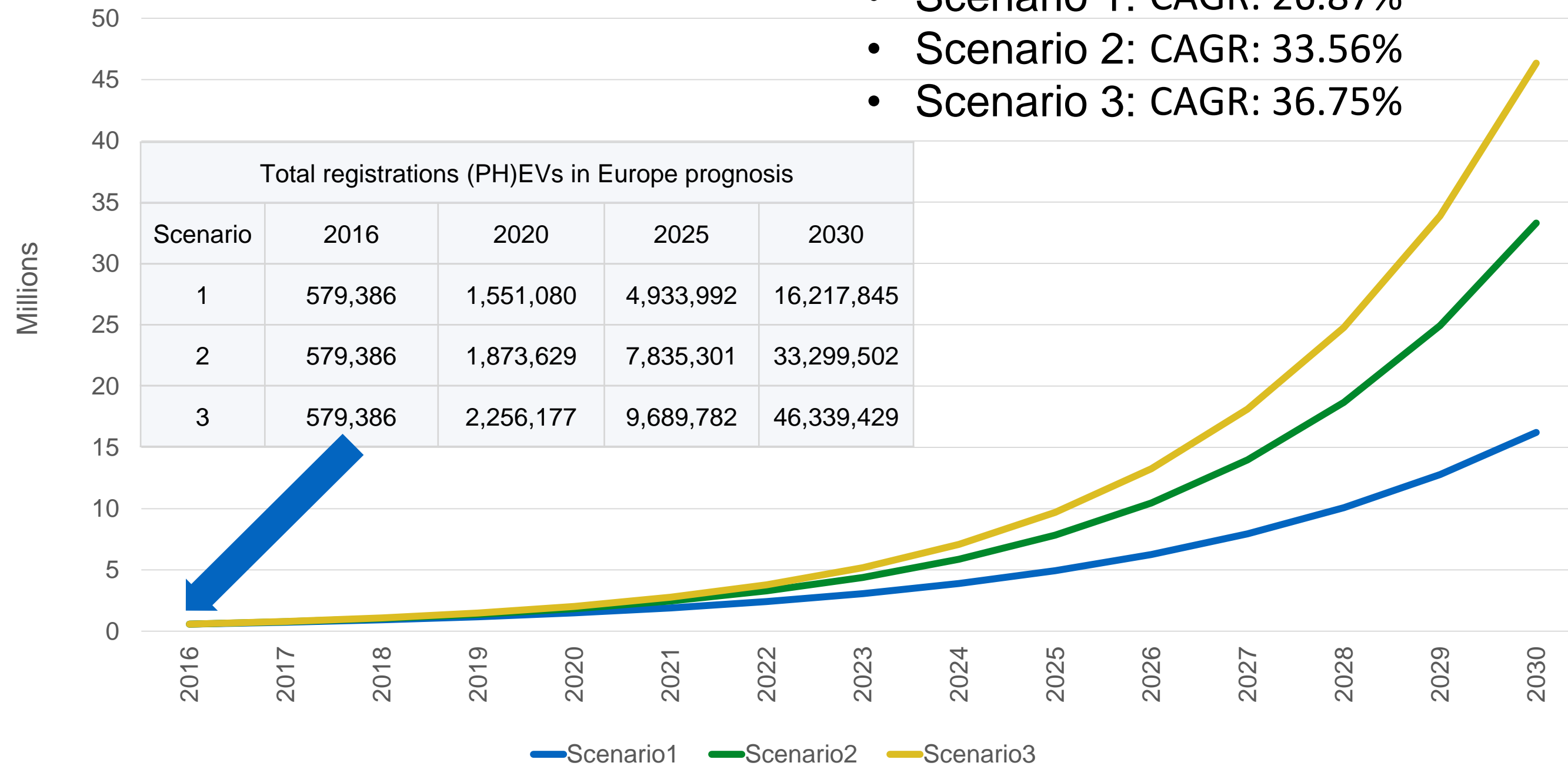
Scenario2: The Paris Declaration on **COP21: 115 million EVs by 2030.** ➡ CAGR: 33.56%

Scenario3: The 2-Degree Scenario: **160 million EVs by 2030.** ➡ CAGR: 36.75%

Source: OECD/IEA

# Europe (PH)EV market Prognosis 2016 - 2030

- Scenario 1: CAGR: 26.87%
- Scenario 2: CAGR: 33.56%
- Scenario 3: CAGR: 36.75%





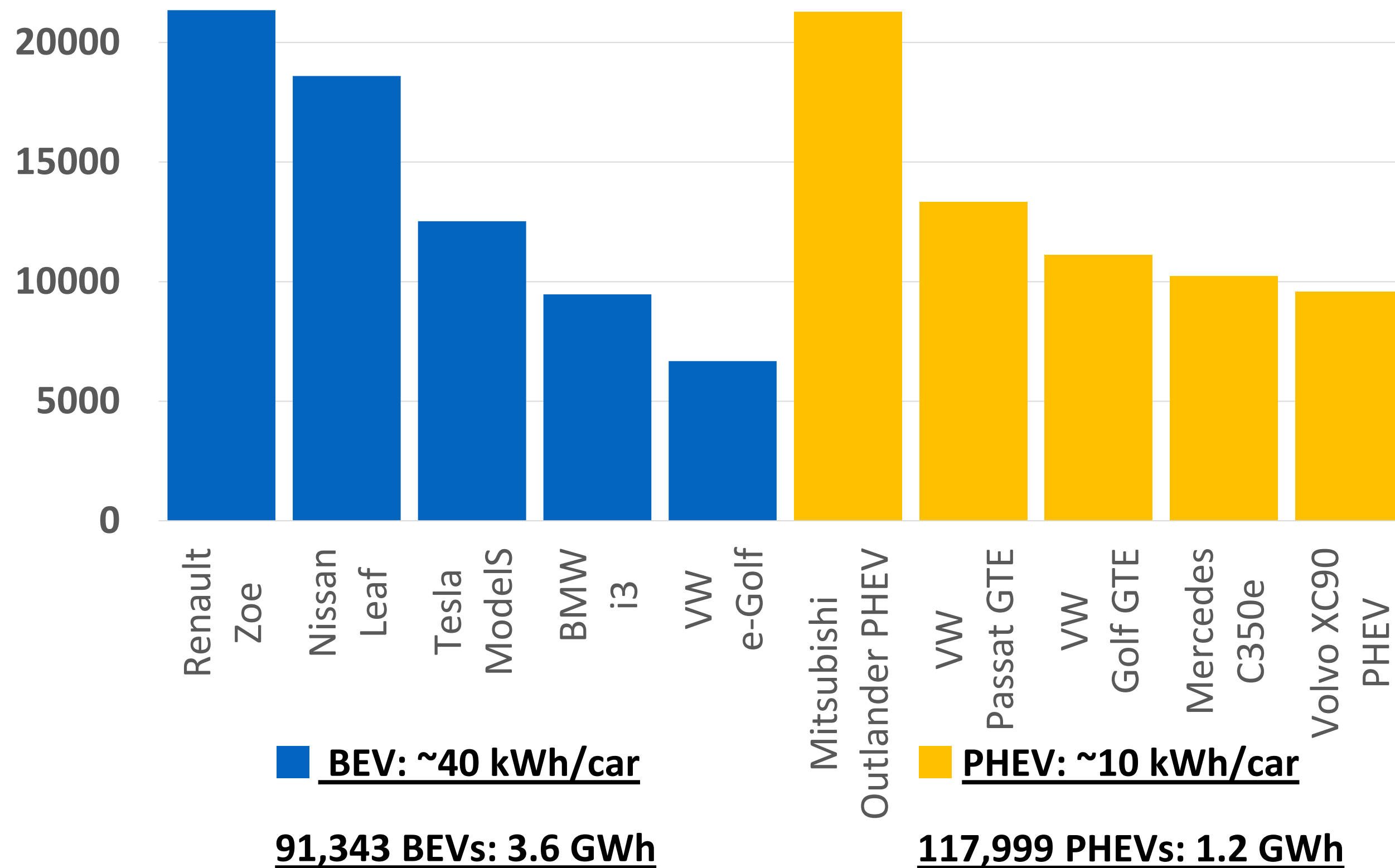
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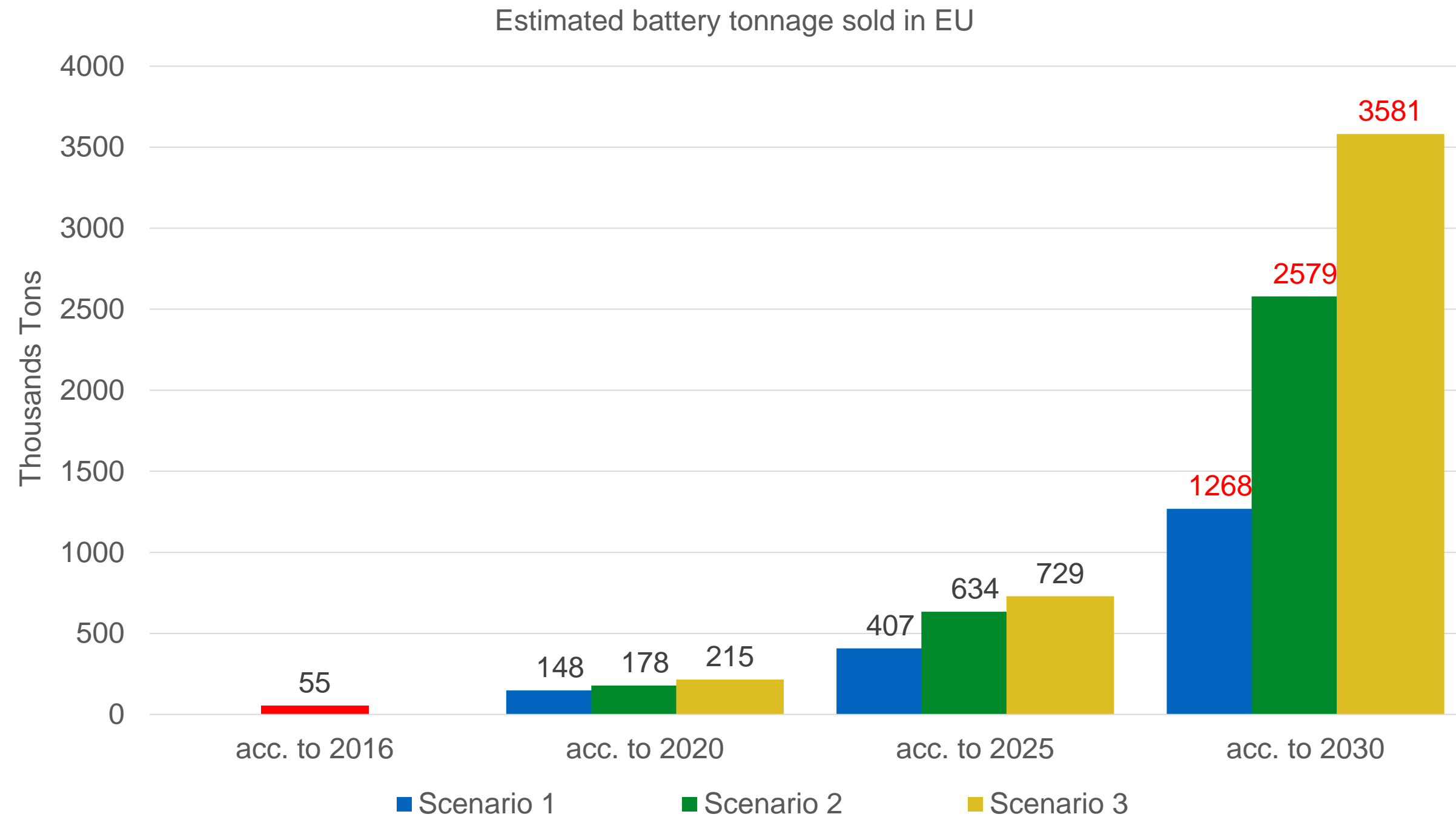
# Li-ion battery put on EU market

- Top 5 best seller of BEV and PHEV (2016) were selected

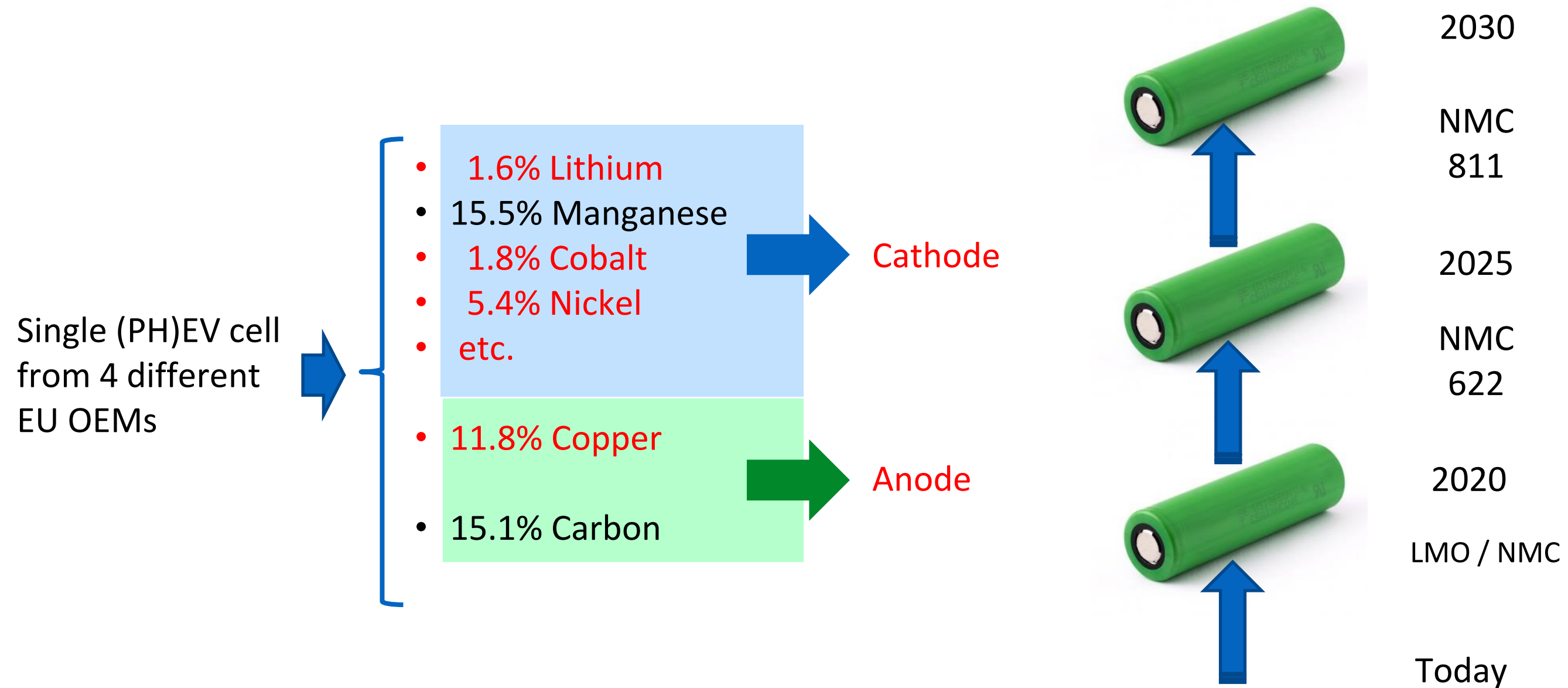




# Li-ion battery put on market

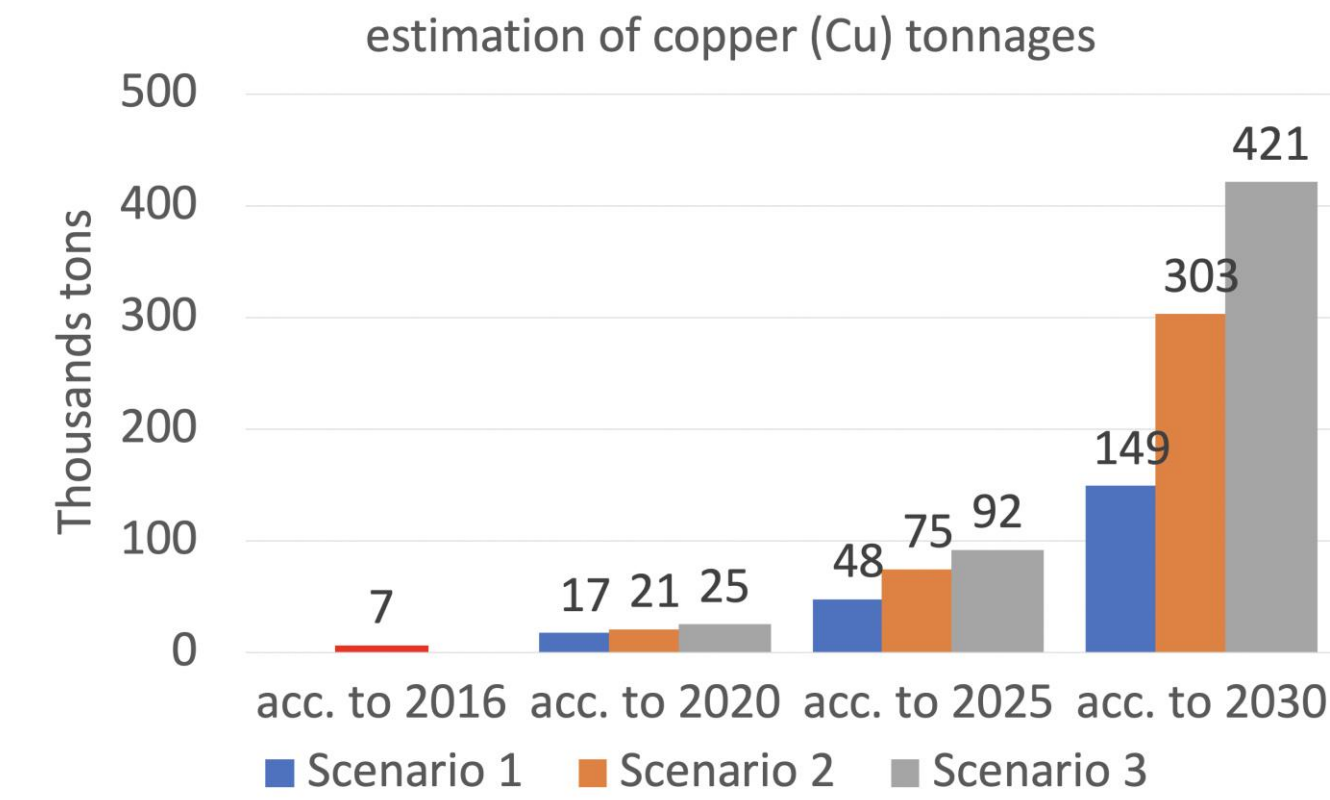
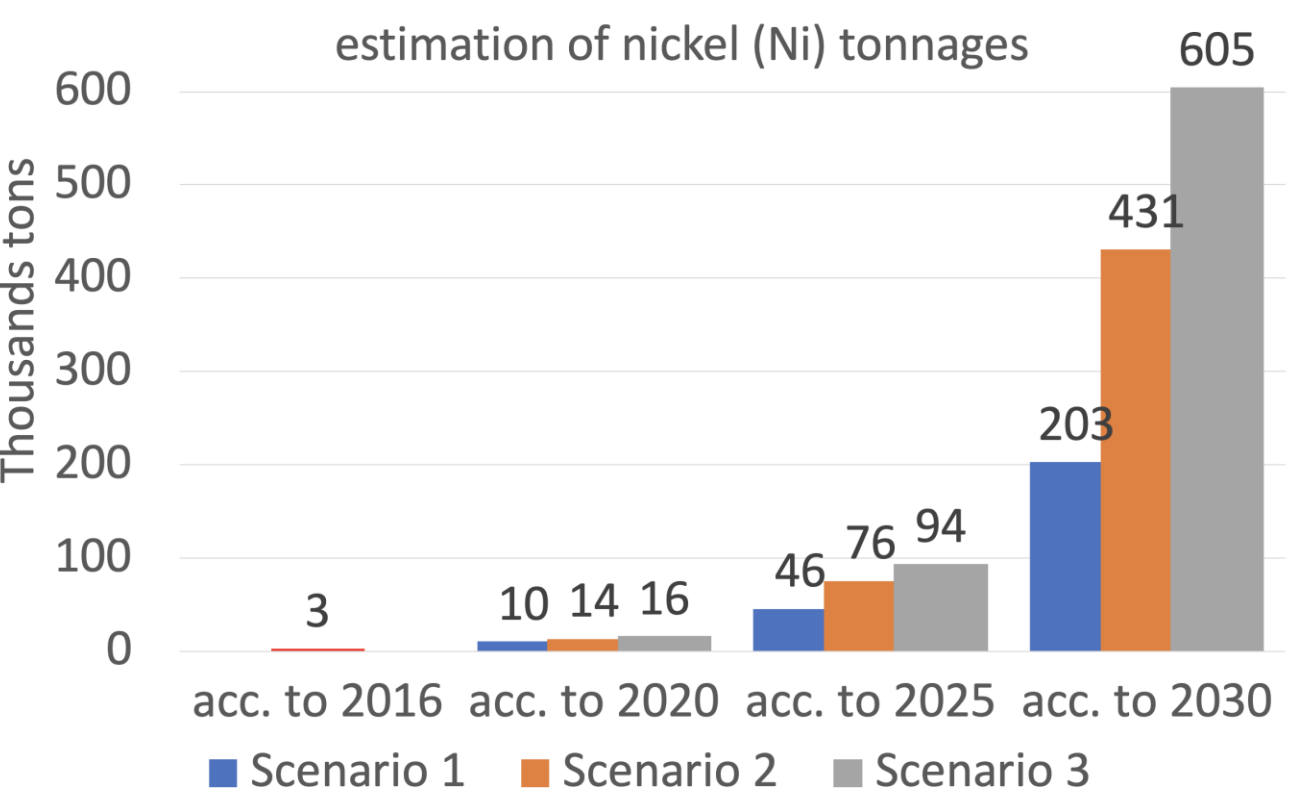
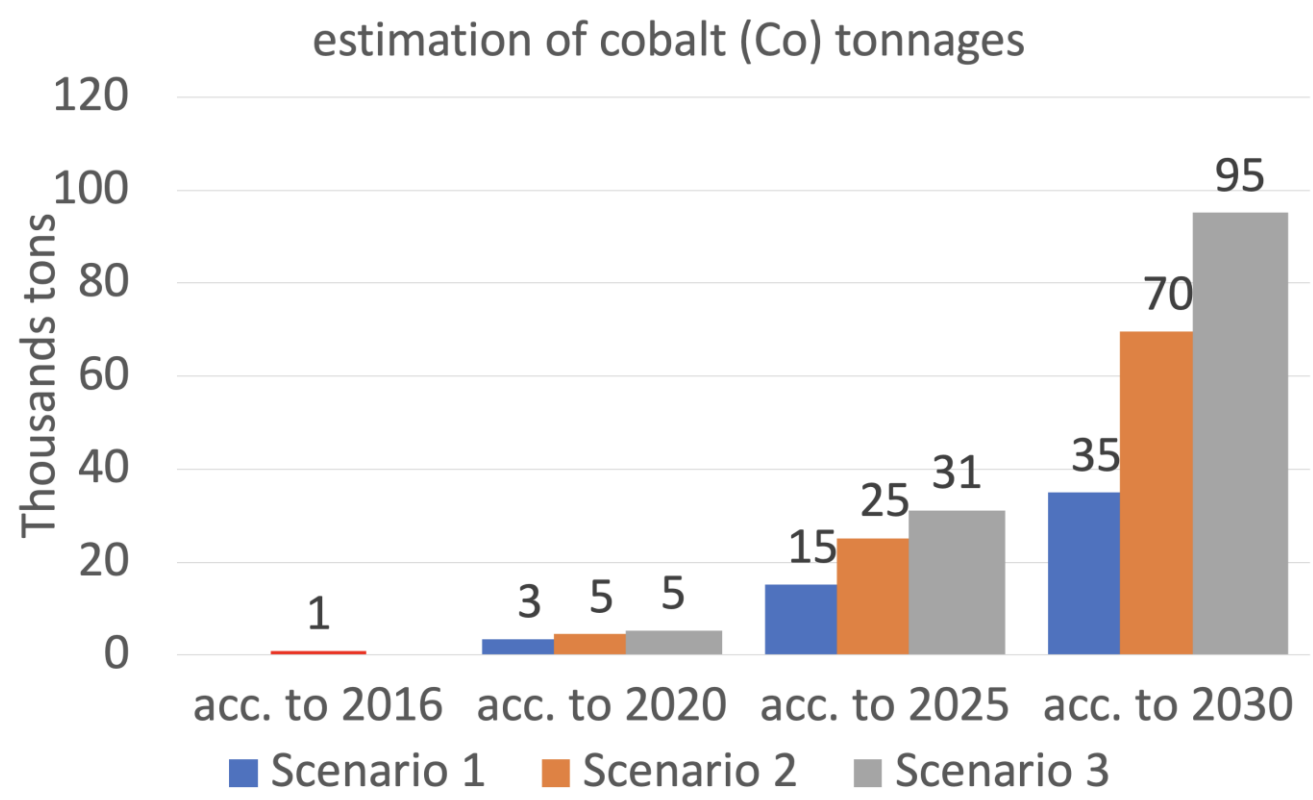
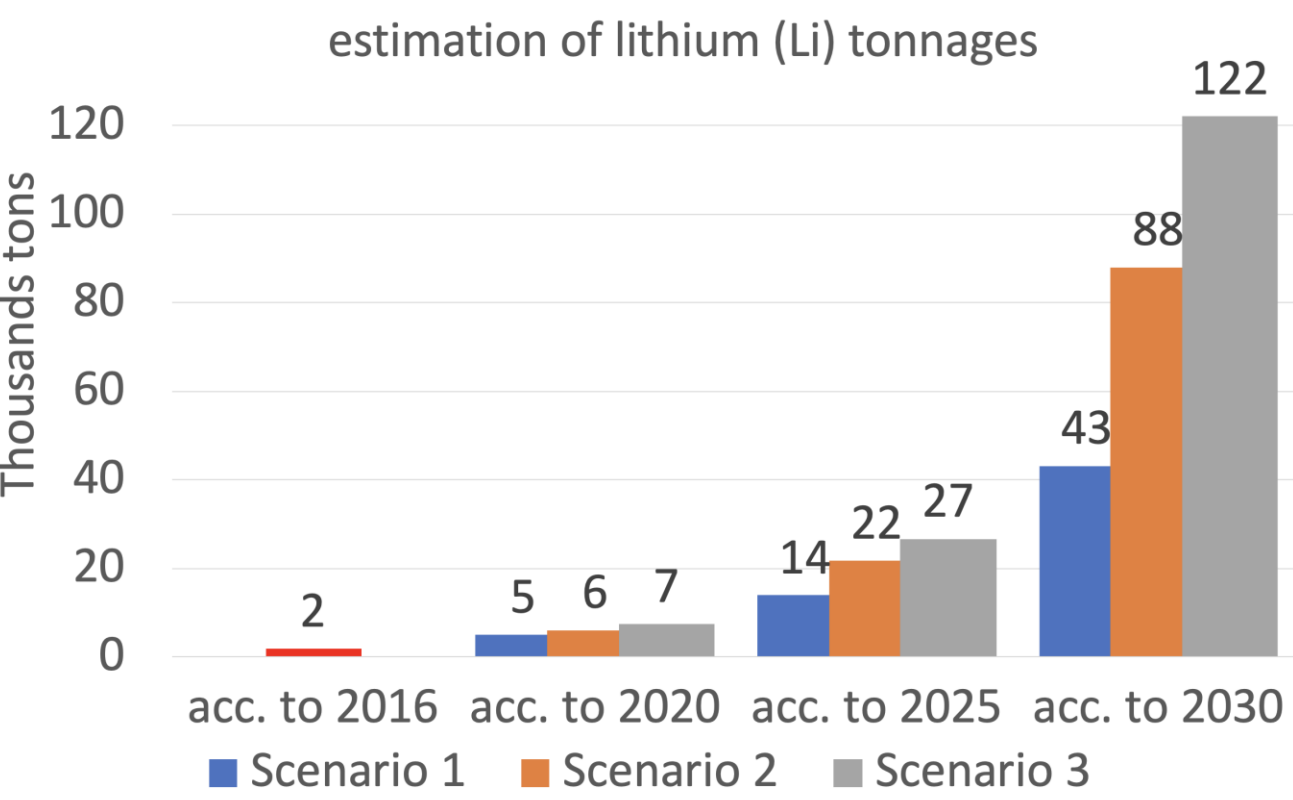


# Li-ion battery and critical raw materials





# Accumulated battery materials POM in EU



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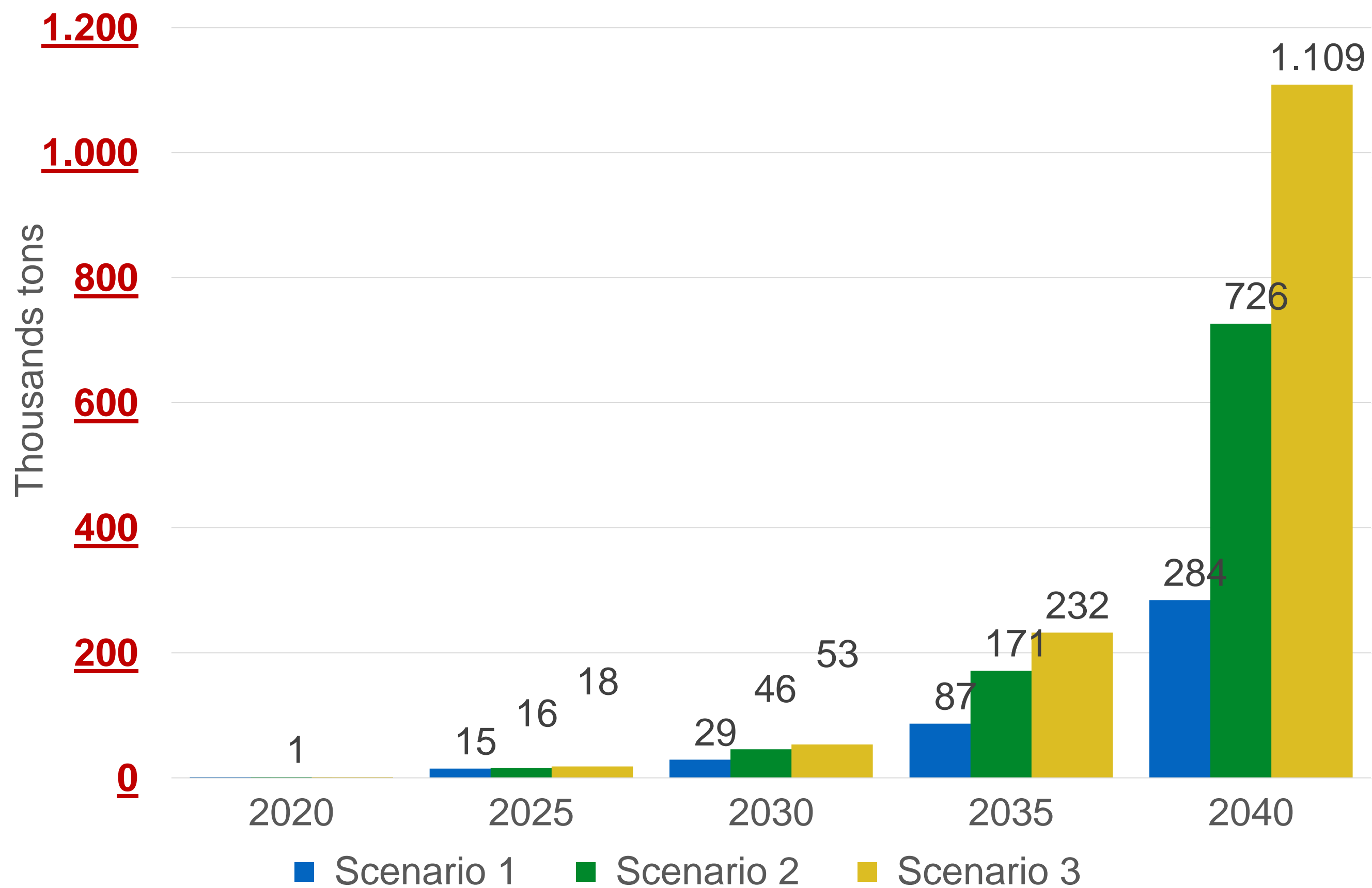
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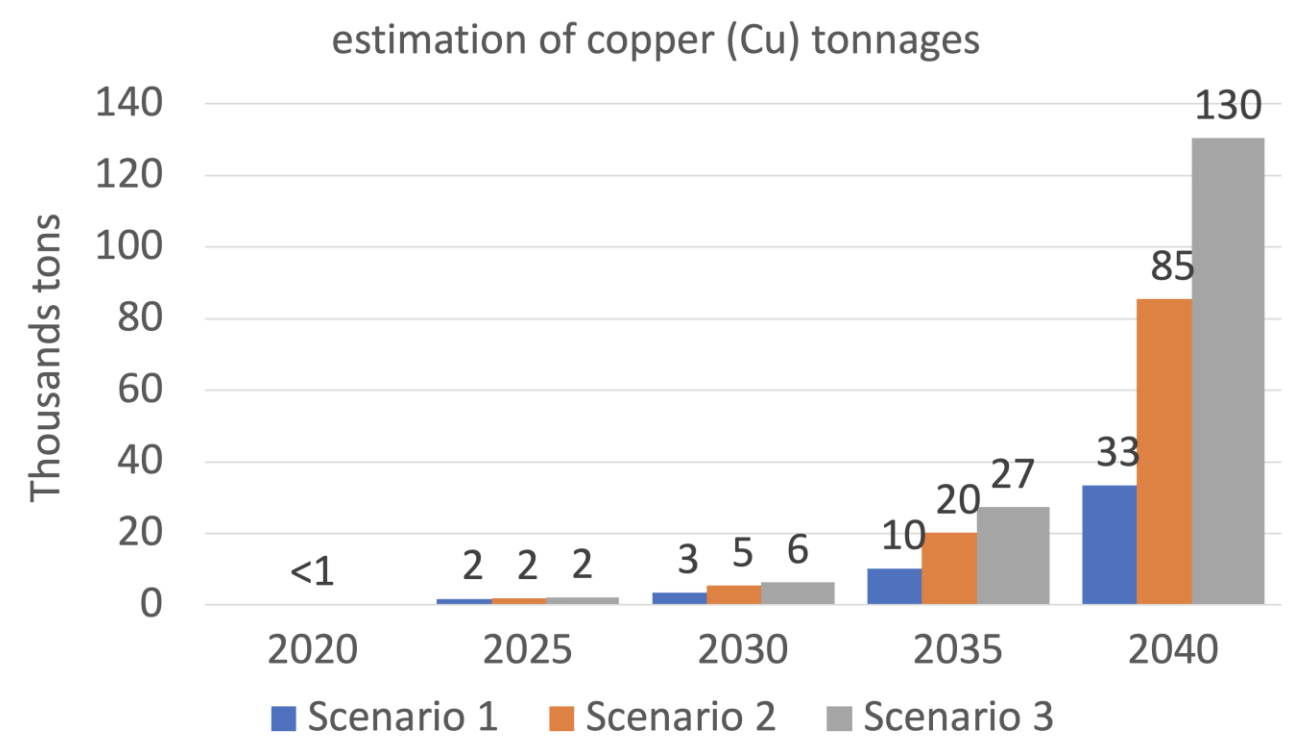
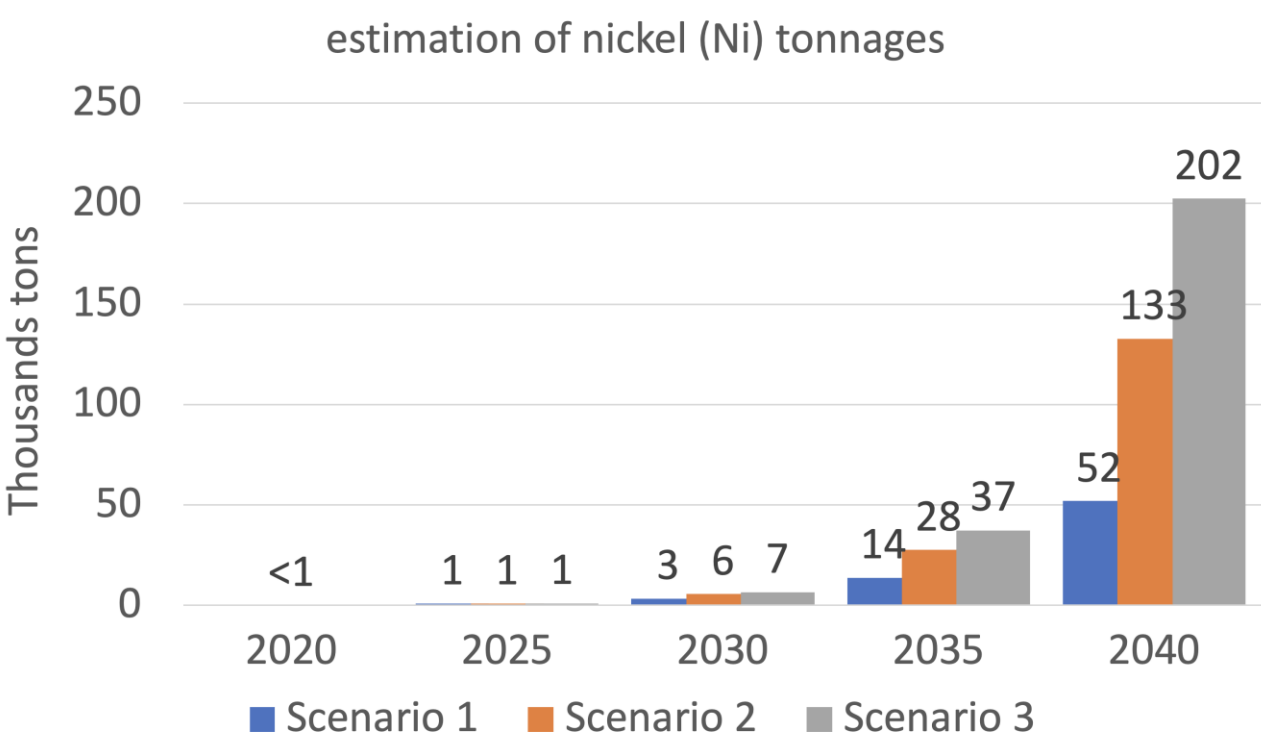
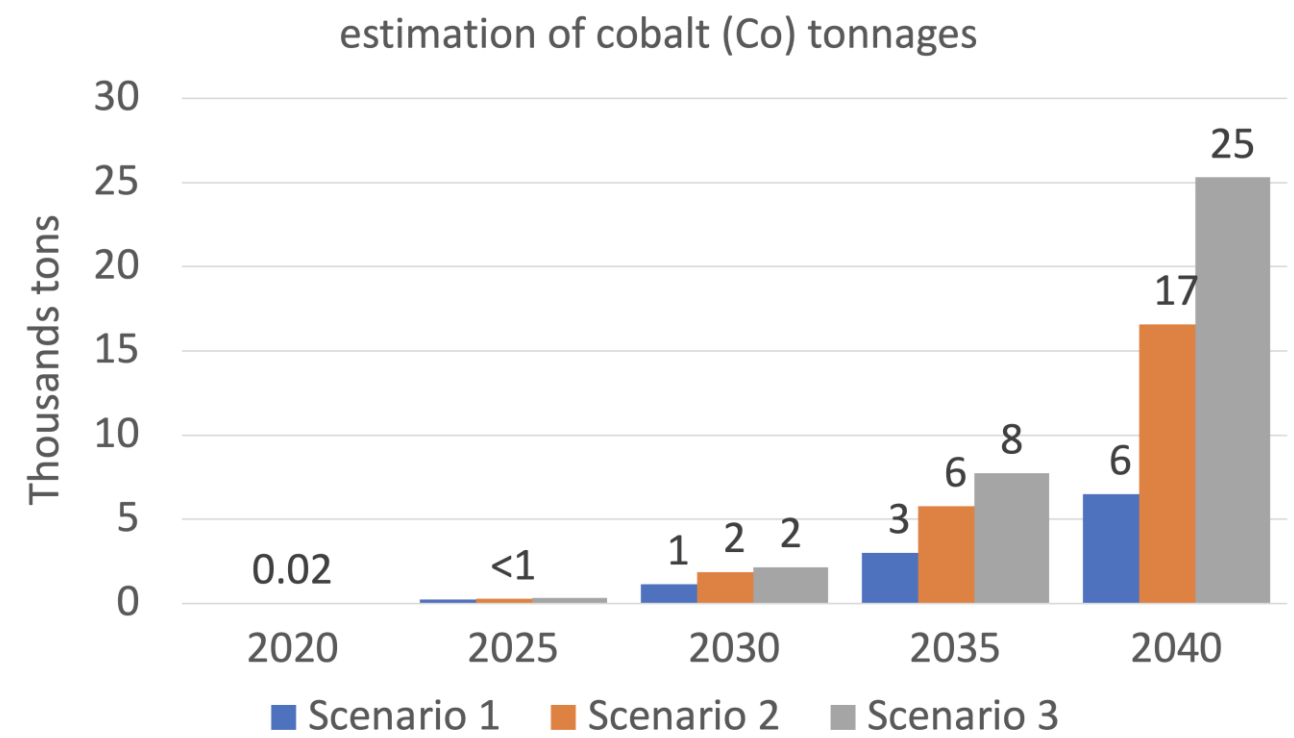
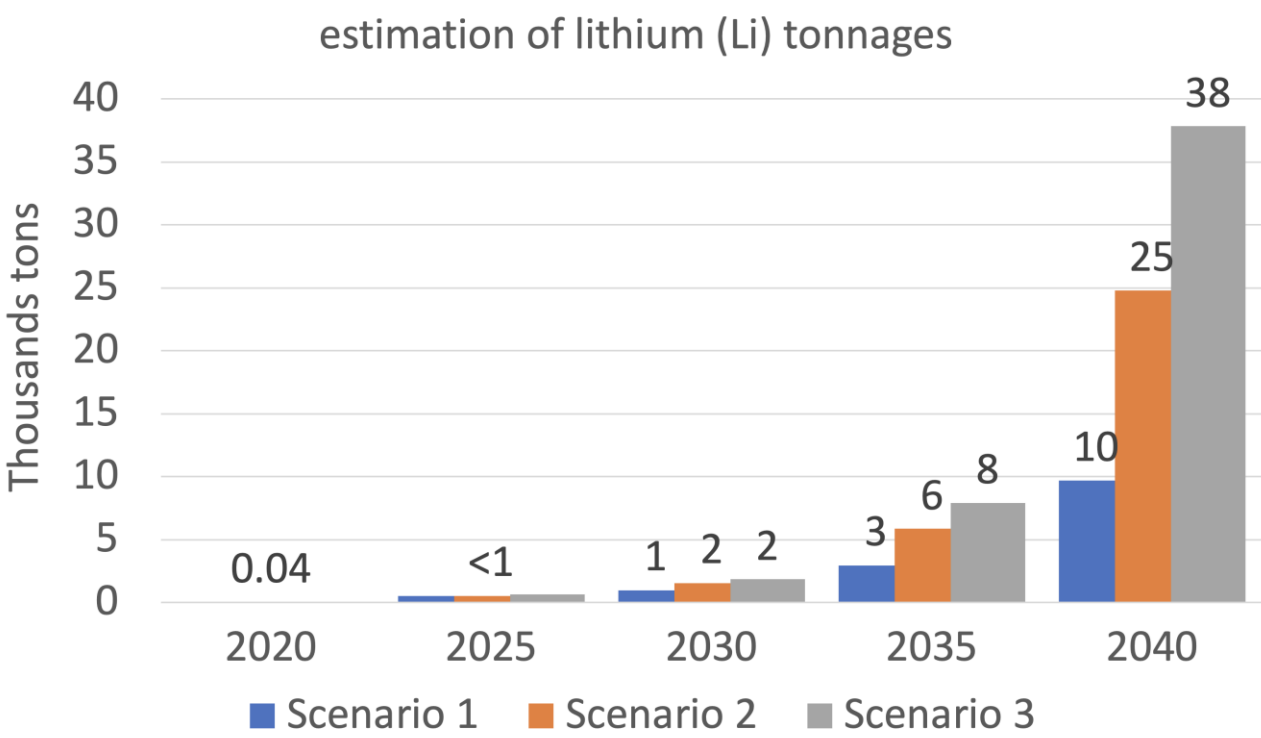
# Li-ion battery lifetime estimation

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

# Expected annual battery tonnage (tons) ready for recycling in EU



# Expected annual materials ready for recycling in EU





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# Available recycling facilities in EU

1.200

## Lithium-ion battery recycling facilities in EU

1.0

	Company	Country	Scale	Process applied	Estimated capacity tons/a	Announced capacity tons/a
1	UMICORE	Belgium	industrial	P + H	4000	7000
2	Accurec	Germany	industrial	T + M	2000	3000
3	Nickelhütte Aue	Germany	industrial	P + H	800*	1000
4	EDI	France	pilot	M	500*	N/A
5	SNAM	France	pilot	T	300*	N/A
6	AkkuSer	Finland	pilot	M	100*	N/A

8

€ Process: T: Thermal; M: Mechanical; P: Pyrometallurgy; H: Hydrometallurgy.  
\*: insufficient information, capacity estimated. N/A: information not available.

400

200

0

2020

2025

2030

2035

2040

■ Scenario 1

■ Scenario 2

■ Scenario 3

1.109

726

284

232

171

53

46

29

18

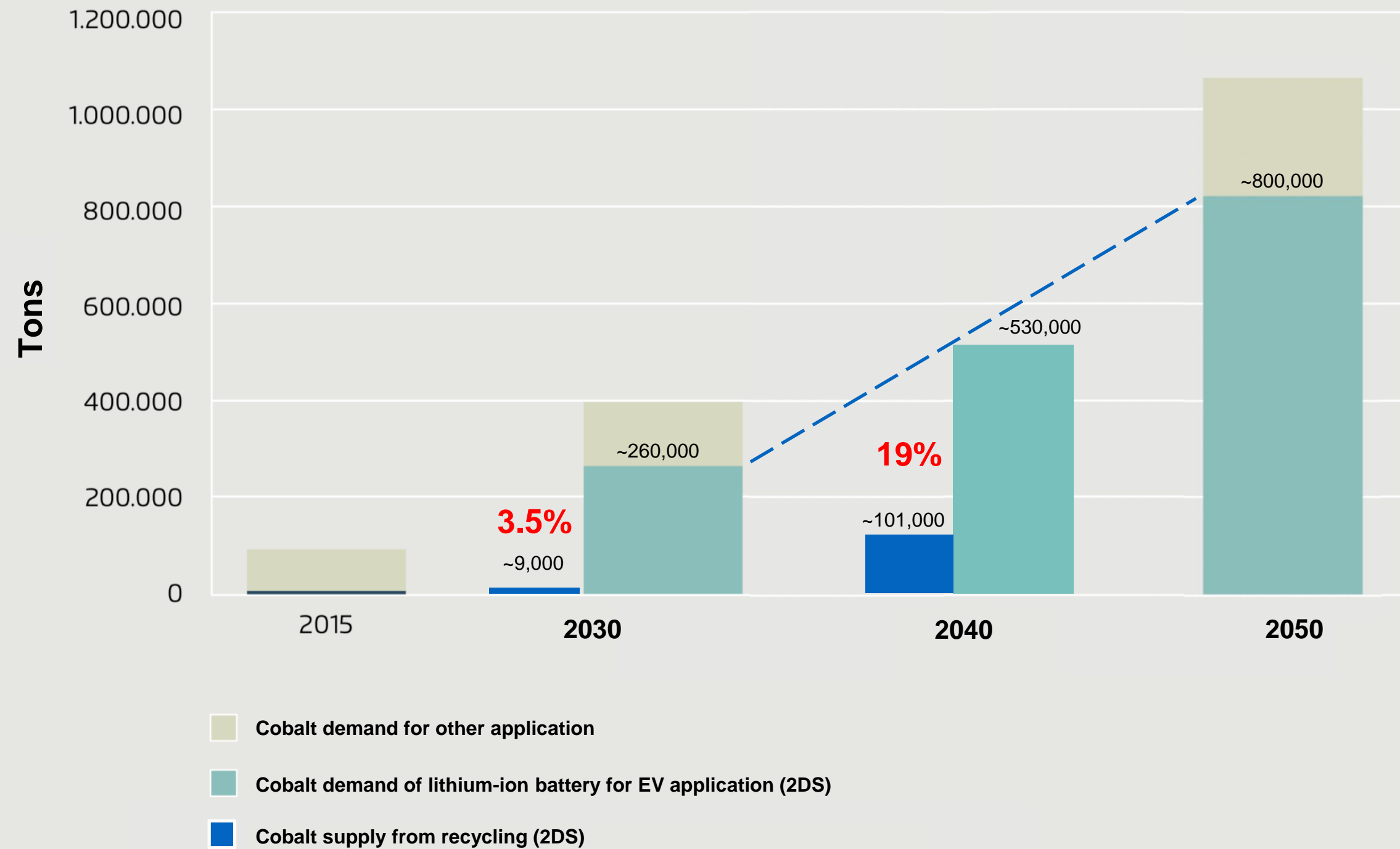
16

15

1

# Recycling supply for raw materials **Global**

Estimated cobalt demand and supply from recycling

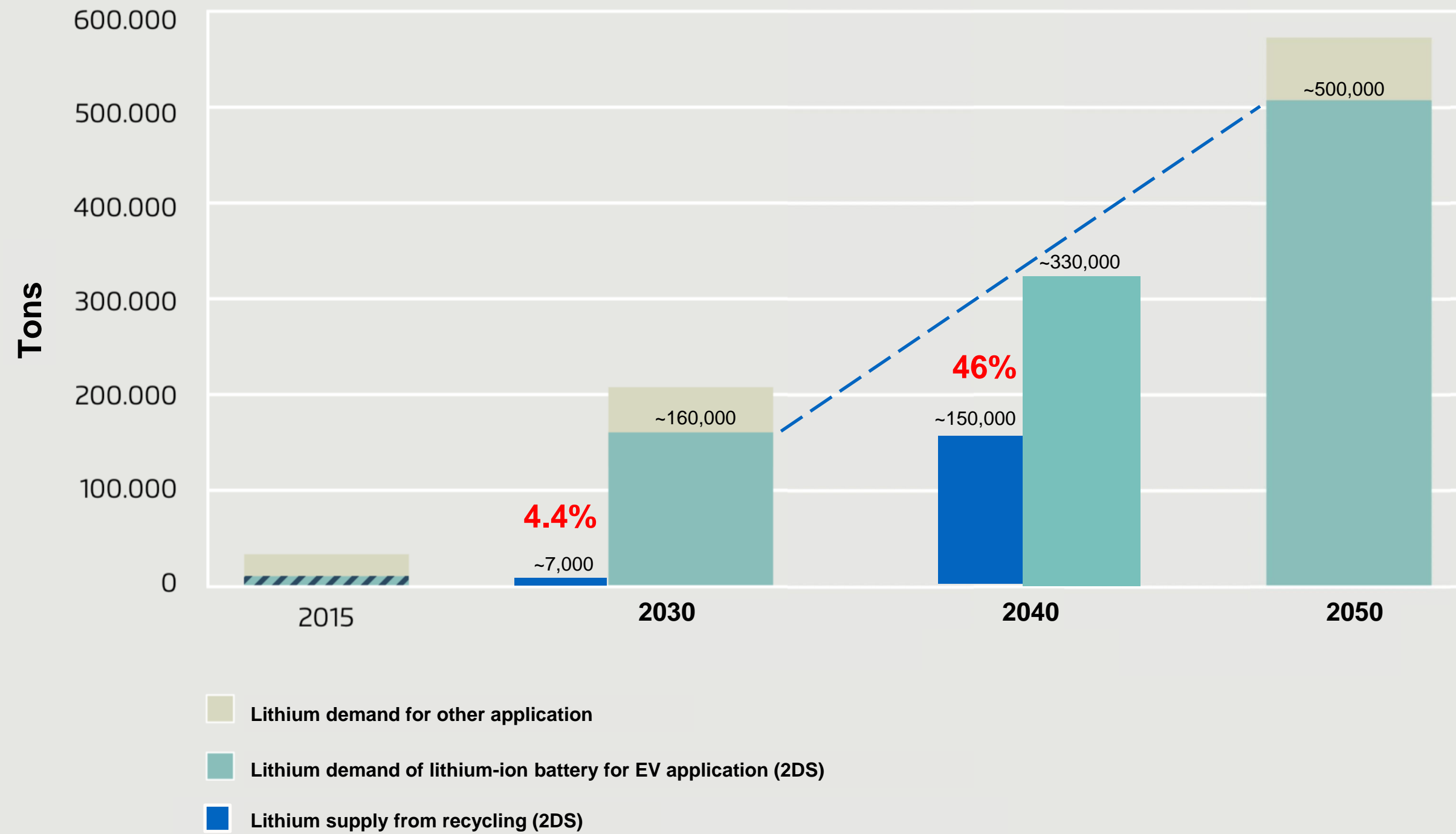


Source: Öko-Institut e.V.



# Recycling supply for raw materials **Global**

Estimated lithium demand and supply from recycling



Source: Öko-Institut e.V.

Accurec Recycling GmbH

Thank you for your attention!

We manage battery resources