

Pathways to profitability for the EU Battery Recycling Industry

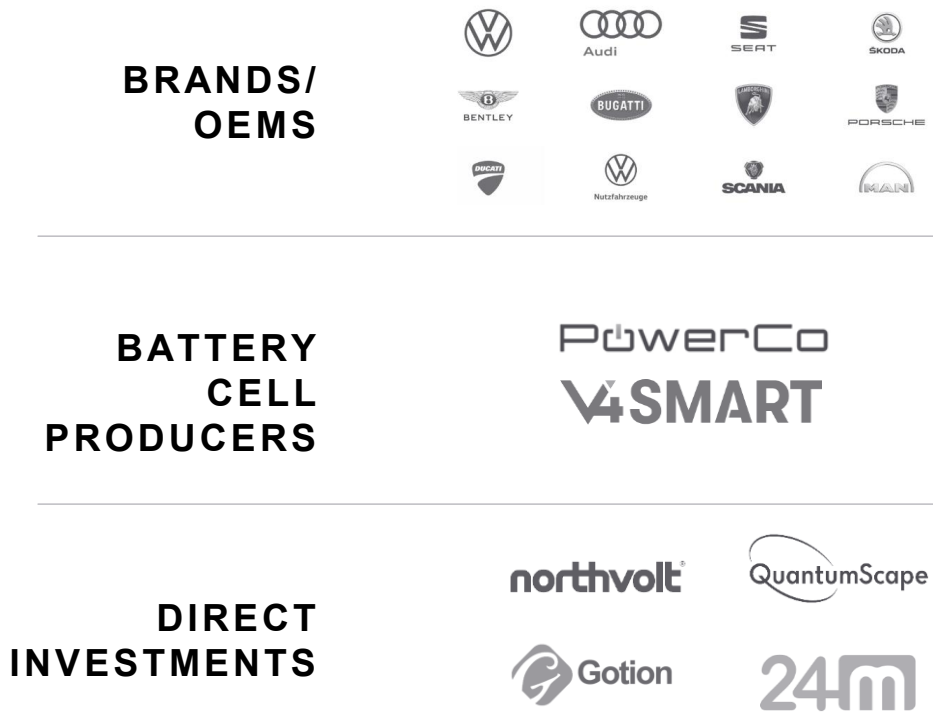
› E-Waste World Expo 2026

Frankfurt | June, 2026

Porsche Consulting



Porsche Consulting utilizes its large battery network in VW Group ...



Porsche Consulting

100%
Porsche

150+
Battery projects

1
Globally dedicated

... and with external partners in the battery industry

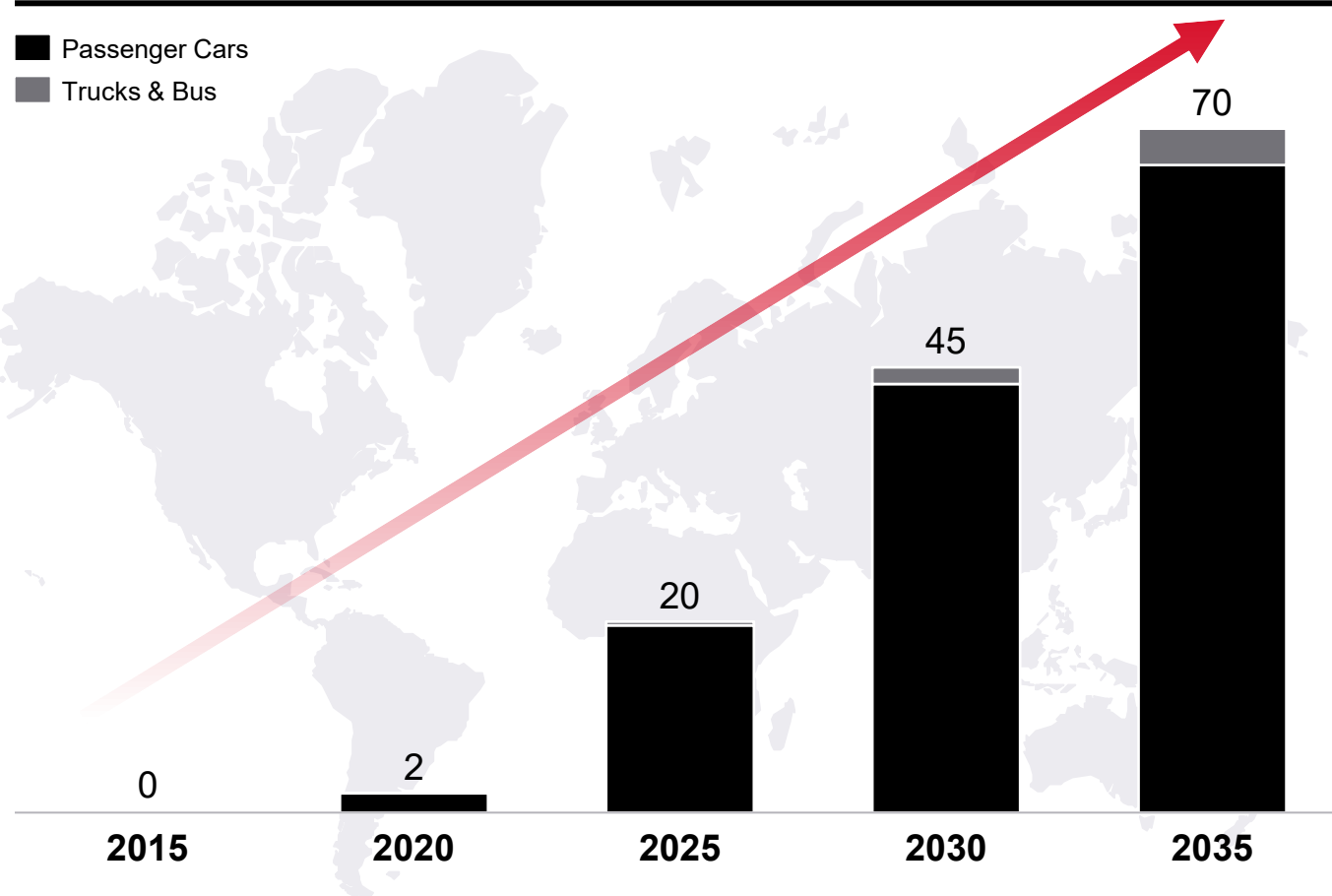
- OEMs | Passenger cars, trucks, heavy-duty machinery, agriculture, aviation, stationary
- System manufacturers
- Cell manufacturers
- Material suppliers
- Mining companies
- Recycling companies
- Equipment manufacturers
- Technology start-ups
- Privat equity companies

The rapid ramp-up of NEV production leads to high battery return volumes ~50 Mio. tons through 2035

GLOBAL BEV PRODUCTION VOLUME

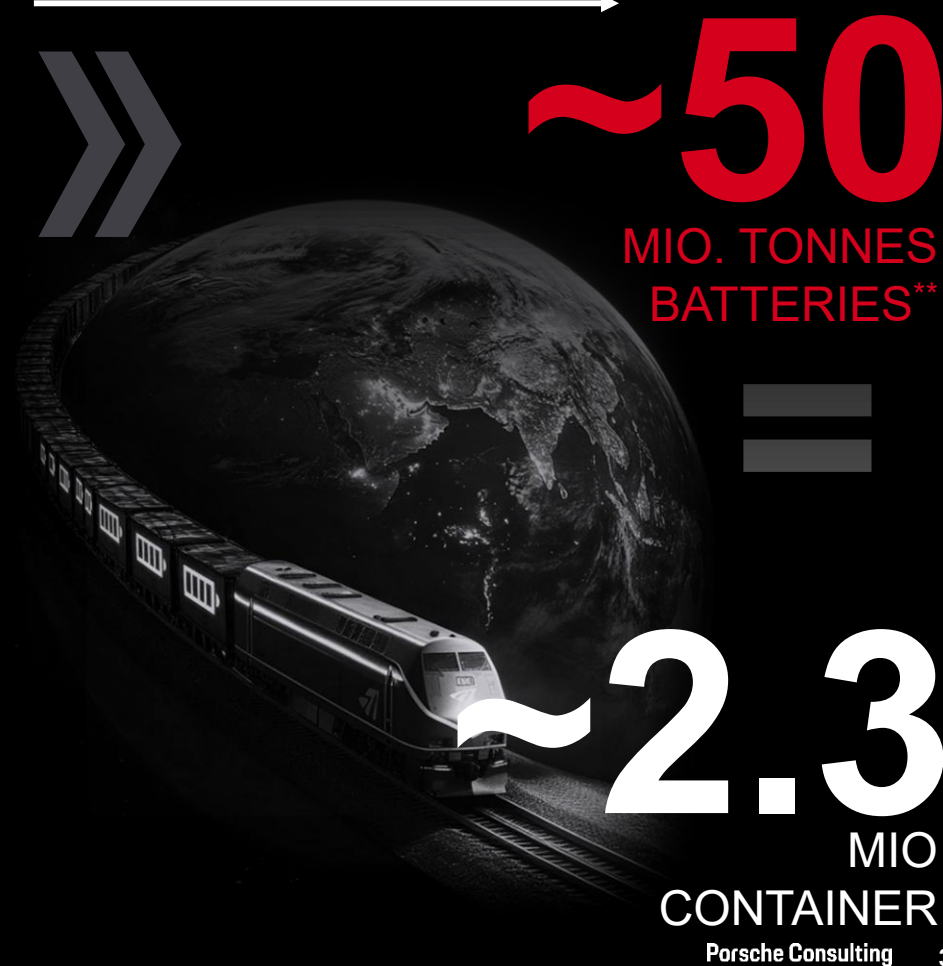
Mio vehicles*

- Passenger Cars
- Trucks & Bus

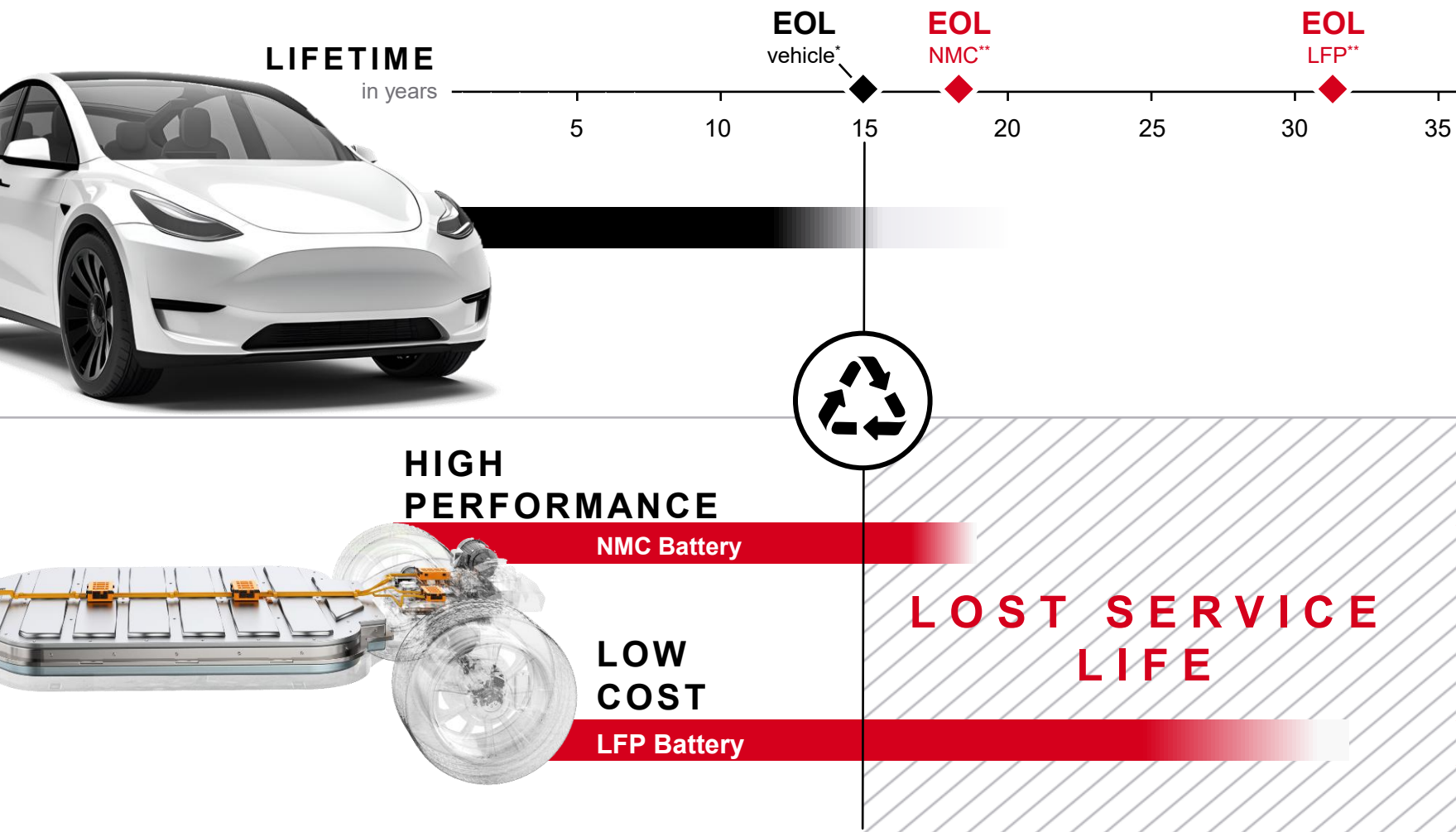


* incl. BEV and PHEV, automotive, truck and bus | ** Incl. scrap, Average battery pack energy density growing from 170 Wh/kg in 2023 to 190 Wh/kg in 2035
Source: Porsche Consulting Battery Aftermarket Model (base demand scenario, low scrap scenario)

RETURN VOLUMES CUMULATED UNTIL 2035**



Batteries survive lifetime of vehicles – early recycling destroys remaining battery values



Recycling after vehicle EOL potentially destroys significant battery service life – **HOLISTIC AFTERMARKET APPROACH NECESSARY.**

NMC

» ~20%

Destruction of remaining service life through recycling***

LFP

» >50%

EOL = End-of-life | NMC = Nickel Manganese Cobalt | LFP = Lithium iron phosphate | * Assumption based on Weibull Distribution with $\lambda=15$ years | ** moderate user profiles and temp. zones, EOL battery defined after SOH <70%, theoretical cycle life for LFP 5500 and NMC 2800 cycles assumed, 20% of theoretical cycle life achievable under operating conditions, losses due to fast charging, driving and calendric ageing | *** After end-of-vehicle life
Source: Porsche Consulting

is not the only solution!



► **RE-PAIR**
SAME PRODUCT
SAME APPLICATION

RE-USE

NEW	PRODUCT
SAME	APPLICATION

RE-PURPOSE

NEW PRODUCT
NEW APPLICATION

RE-CYCLE
ONLY MATERIALS
RECOVERY

Three questions will be addressed by this presentation

Which battery **return volume** do we expect in **Europe in the next 10 years?**

1

How can **aftermarket players** compete in **volume access?**

2

What are additional levers to **improve battery end-of-life economics?**

3

As volumes scale, battery returns shift from predictable NMC scrap to complex, uncertain, and economically challenging EOL flows



Feedstock Complexity

Cell & pack scrap dominant feedstock

End-of-Life batteries dominant feedstock

Warm-Up (until 2035)

Scaling (2035+)

LOW

NMC Scrap dominant, C2M & C2P

HIGH

New incidents, chemistries and system designs

Profitability

HIGH

NMC

CHALLENGING

LFP & SIB

Volume uncertainty

Ramp-Up Gigafactories

BEV Market Slow Down

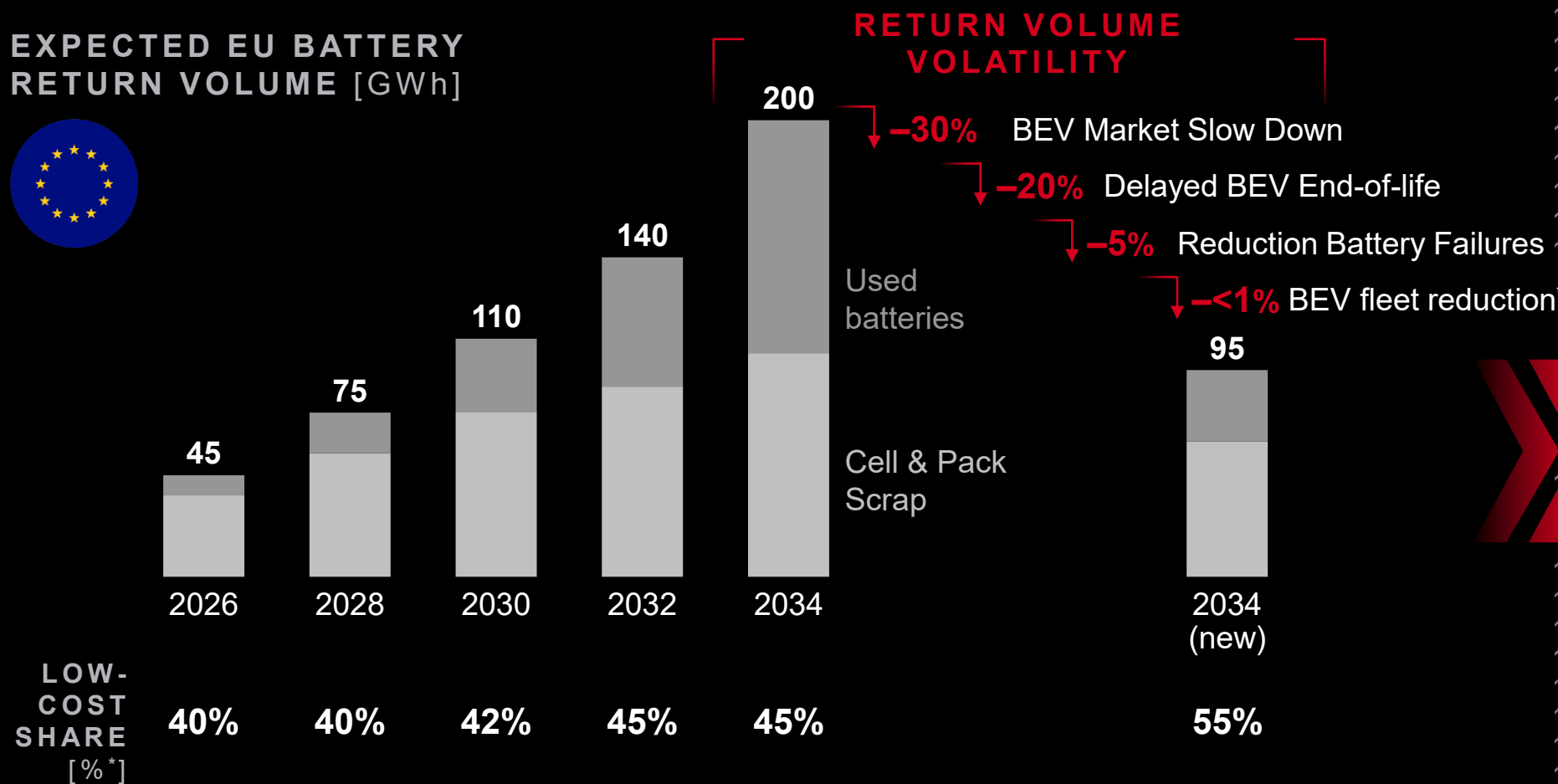
Delayed BEV EOL

Reduction Battery Failures

BEV fleet reduction**

The return volumes until 2034 are decreasing and include a higher share of LFP

EXPECTED EU BATTERY RETURN VOLUME [GWh]



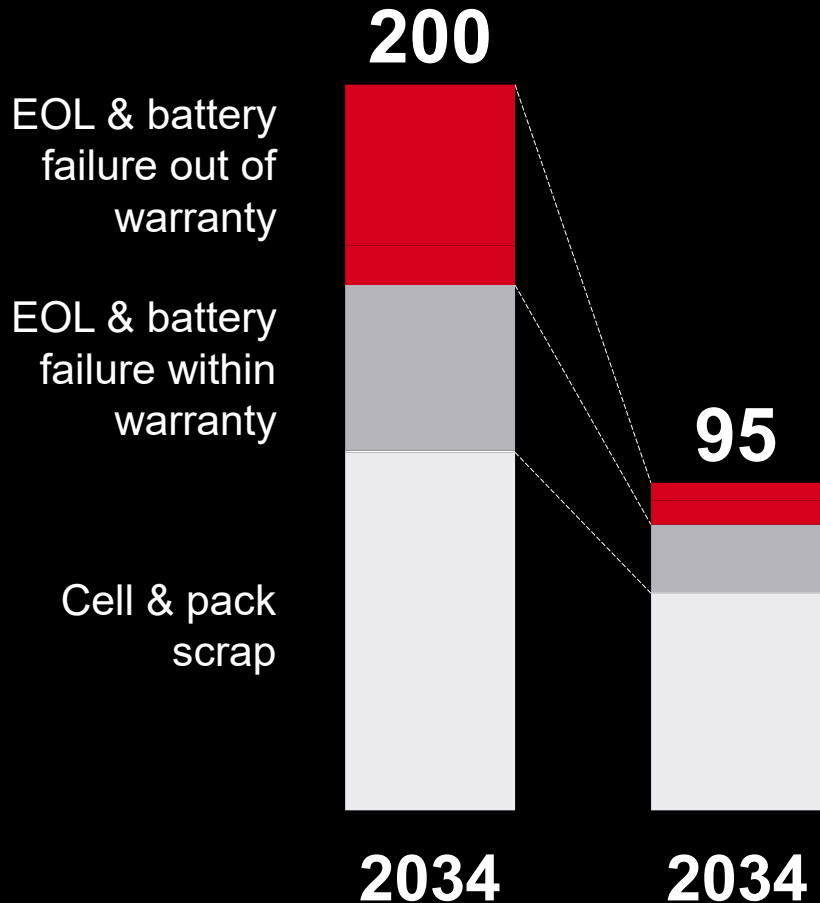
KEY CHALLENGES

Growing competition for uncertain feedstock volumes

Growing share of low-cost chemistry urges alternatives to recycling

Third party aftermarket player with highest return volume risk

RETURN VOLUME [GWh]



[excl. volatility risk]

[incl. volatility risk]

VOLATILITY

PRIMARY ACCESS

-90%

Third party access

-55%

OEM

-40%

Cell & pack producer

IMPLICATION

Third parties are most affected by return volume volatility

VALUE CHAIN PARTNERING & TAKE BACK STRATEGIES required to secure feedstock access

Attractive End-of-life battery take-back strategy provides competitive edge in battery access



**Battery
rent**



**Battery as a
service**



**Disposal
bonus**



**Longlife
warranty**



**Third party
buy-back**

PLAYER
EXAMPLE



n/a



RATIONALE

Customer leases the battery for a monthly fee; ownership remains with the OEM

Customer receives battery supply in exchange for a monthly fee, while the OEM remains the owner

OEM purchases end-of-life vehicles, including batteries, from customers at a fixed price

Customer can have the battery replaced in case of defined performance loss or failure

OEM purchases batteries from end-of-life vehicles from independent workshops, etc.

THIRD PARTY
ACCESS

DIFFERENTIATI
ON THIRD
PARTY

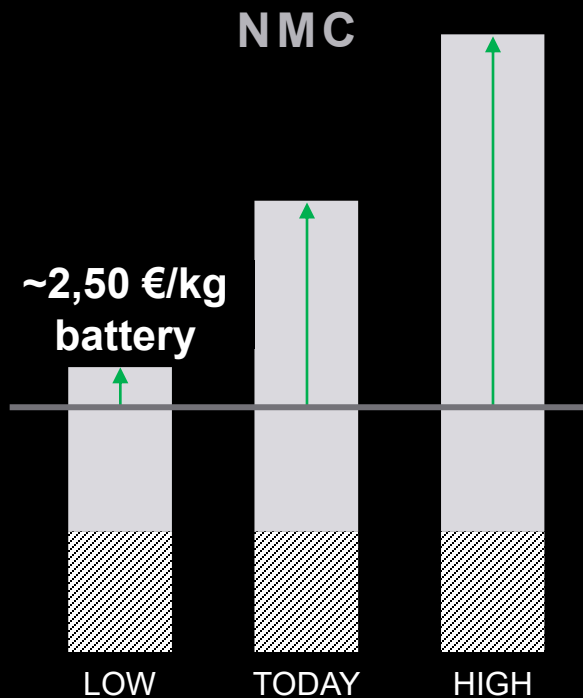
Most likely OEM ownership model

Customer
convenience

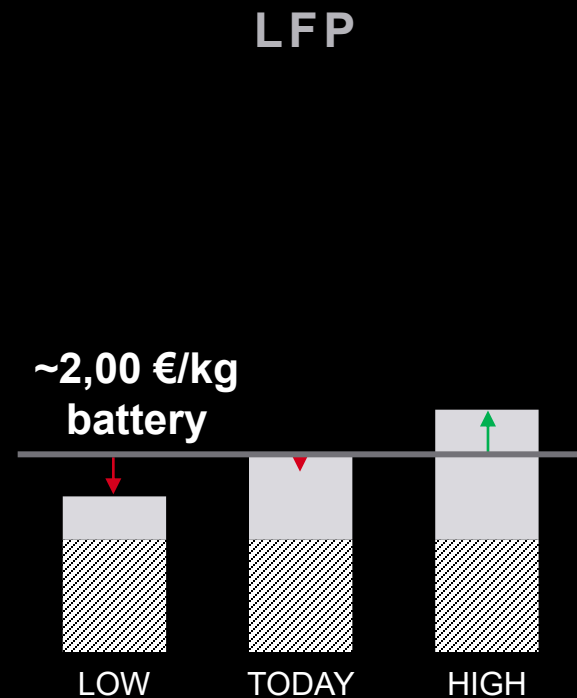
Financing model &
EOL value
creation

SoH Diagnosis &
battery valuation

Depending on raw prices, NMC recycling in Europe likely to be profitable, LFP recycling not



Profitability likely



Profitability challenging

Recycling Business Case highly depending on raw material scenarios

NMC with positive Business Case

For LFP Recycling additional value pools such as 2nd life are required

2nd life application already well established in Chinese battery aftermarket



		China benchmark (percentage of responses)			
RE-X OPTION	DESCRIPTION	Leading Western EV OEM	Leading Local EV OEM	Leading Cell Manufacturer	Leading Recycler
			DEEP DIVE		
Re-use 	Reuse in the same vehicle	75%	20%	0%	<1%
2 nd life 	Reuse in alternative application (e.g., BESS)	25% BESS	50% BESS & streetlights	50%	15%
Recycling 	Material recovery	N/A	30%	50%	85%

OEM follows three-tiered approach in establishing a battery Re-X network China-wide

Leading Local
EV OEM

OVERVIEW EXCLUDING OEM DEALERS

RE-X PROCESS

KEY INSIGHTS

01
Take-back



70% Take-back EOL
by Dealerships

02
Battery diagnostic



51x Battery Diagnostic
Center in China

SoH >80%

03.1
Re-Use



5x Re-Use Center in China
(mostly disconnected from 2nd life center)

SoH 20%–
80%

03.2
2nd life



3x 2nd Life Center in China
2nd life application in BESS & streetlights

SoH <20%

03.3
Recycling



2x Recycling Center in China
Recycling by JV Partner and third-party

Solution/ Call for action

Which battery return volume do we expect in EU for the next 10 years?

How can aftermarket players compete in volume access?

What are additional levers to improve battery EOL economics?

“Know your feedstock”

- › Gain transparency on dependencies of volume complexity
- › Adapt and optimize processes early according to market developments

1

“Secure volume access”

- › Start partnering with cell & pack manufacturer
- › Establish off-take agreements with OEM

2

“Establish second life”

- › Develop scalable second life business model
- › Benchmark Chinese cost and scaling advantages

3

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