WEBINAR

ENERGY STORAGE

Global battery costs: Tracking a disruptive industry with the Curation Battery Cost Curve Model

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Energy Storage NEWS

Global battery cost

Tracking the disruptive battery industry with the Curation Battery Cost Model

Webinar

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Your McKinsey team today …

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… and our work in the battery space

Serve clients across the battery value chain

Have a global team with 170+ battery enthusiasts

Own proprietary assets, models and databases

Connect and convene clients and collaborate with industry-leading associations

The future of batteries: six hypotheses

1

Stationary energy storage systems need bespoke pack solutions, but will use the same cells as electric cars

2

China will remain the global powerhouse for battery cell making, but the growth is in Europe and the US

3

While supplies of some materials could be temporary limited, this will not constrain the growth of the battery industry

4

LFP is here to stay and best suited for stationary storage applications

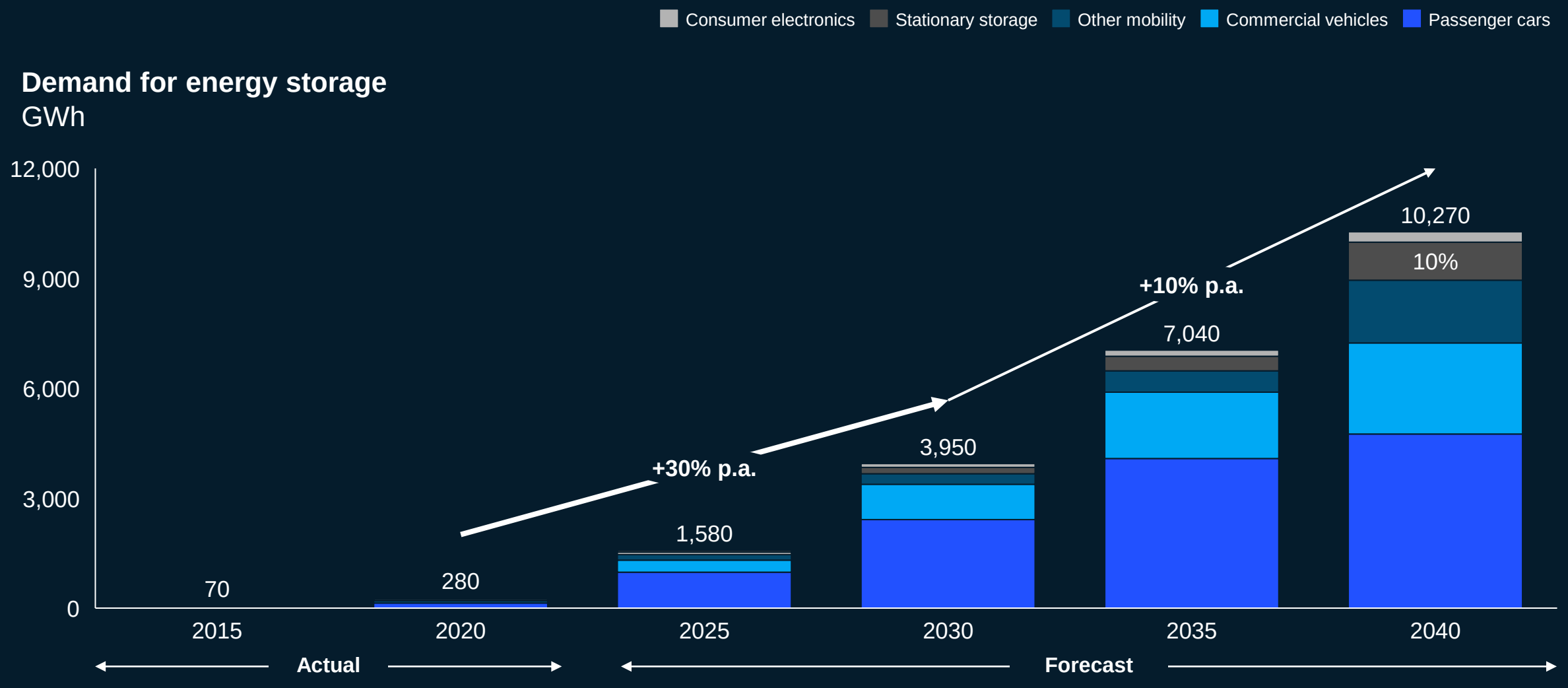
5

Second life in stationary has potential – but needs scale, smart product design and optimized logistics

6

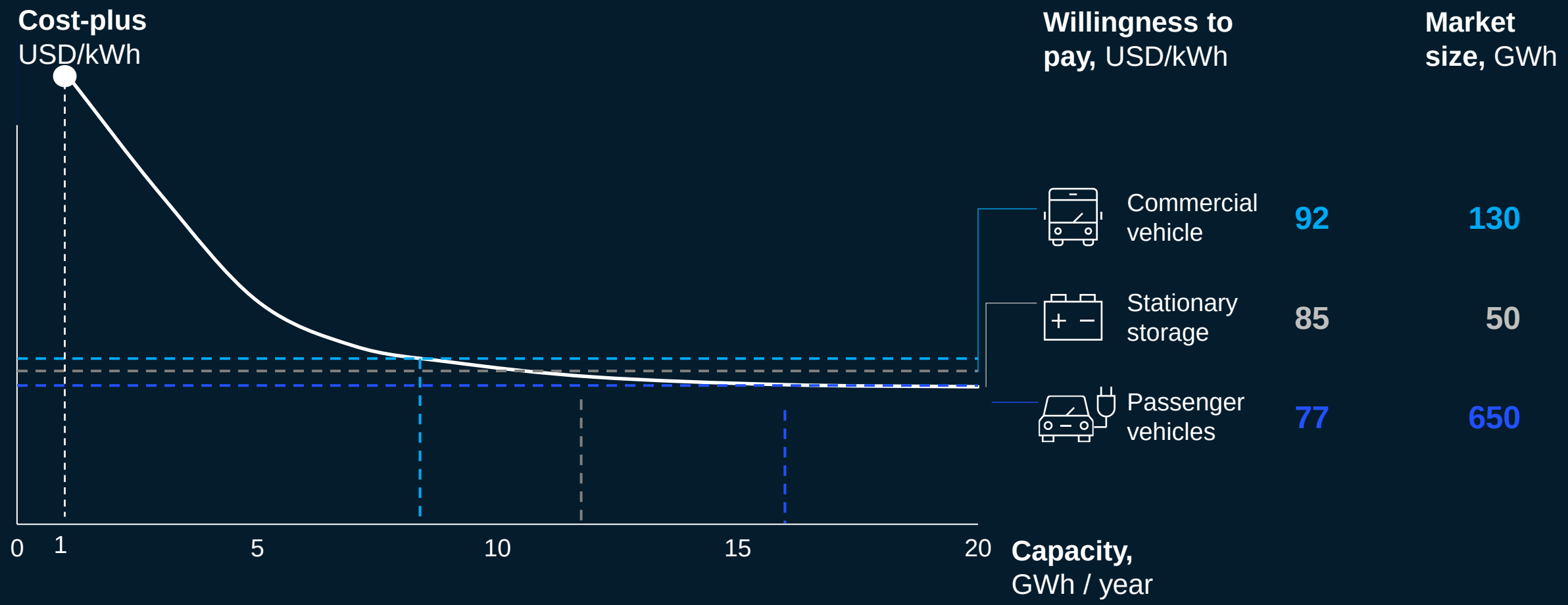
Clean energy and recycled materials can reduce batteries' CO_2 footprint by >80%

1. Demand for lithium-ion batteries will be driven by mobility applications, but other segments account for an important share



1. In stationary energy storage, price pressure makes use of mass-market cells attractive – bespoke solutions feasible on pack level

2025 cell “cost-plus” for various factory sizes vs. willingness to pay



1. Five key dynamics shape the market for battery packs across the different end-use applications

Market dynamics for battery pack production

Growth across segments

Fast-progressing electrification drives size of high-volume segments

Former niches develop into volume segments

In-sourcing in volume segments

Volume OEMs insource pack production

Smaller players and product lines still benefit from external pack producers

New bespoke niches

Clients in niche segments require bespoke solutions, but lack the expertise and scale for in-house production

Increased modularity

Modular battery pack approaches for bespoke pack offerings based on standardized cells

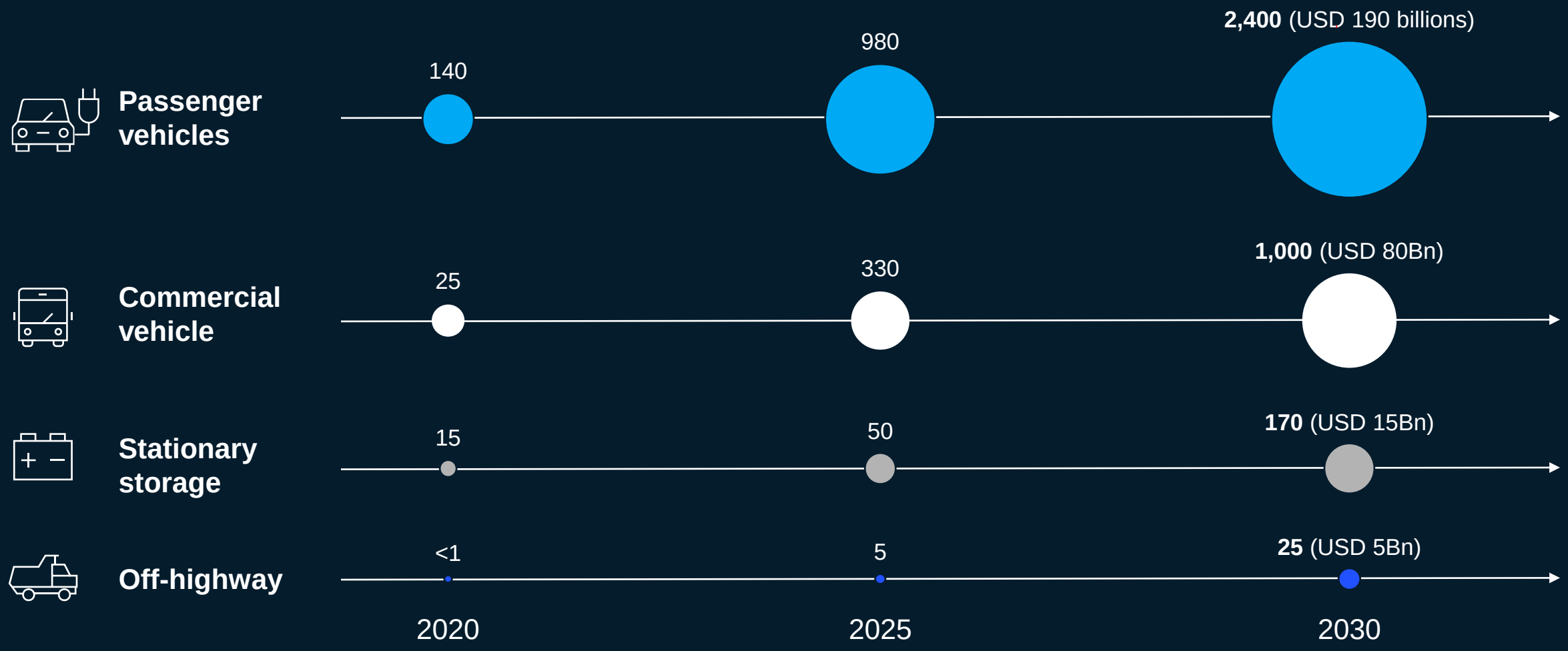
Evolving player landscape

Small players looking to grow

Consolidation expected as scale is critical for competitiveness

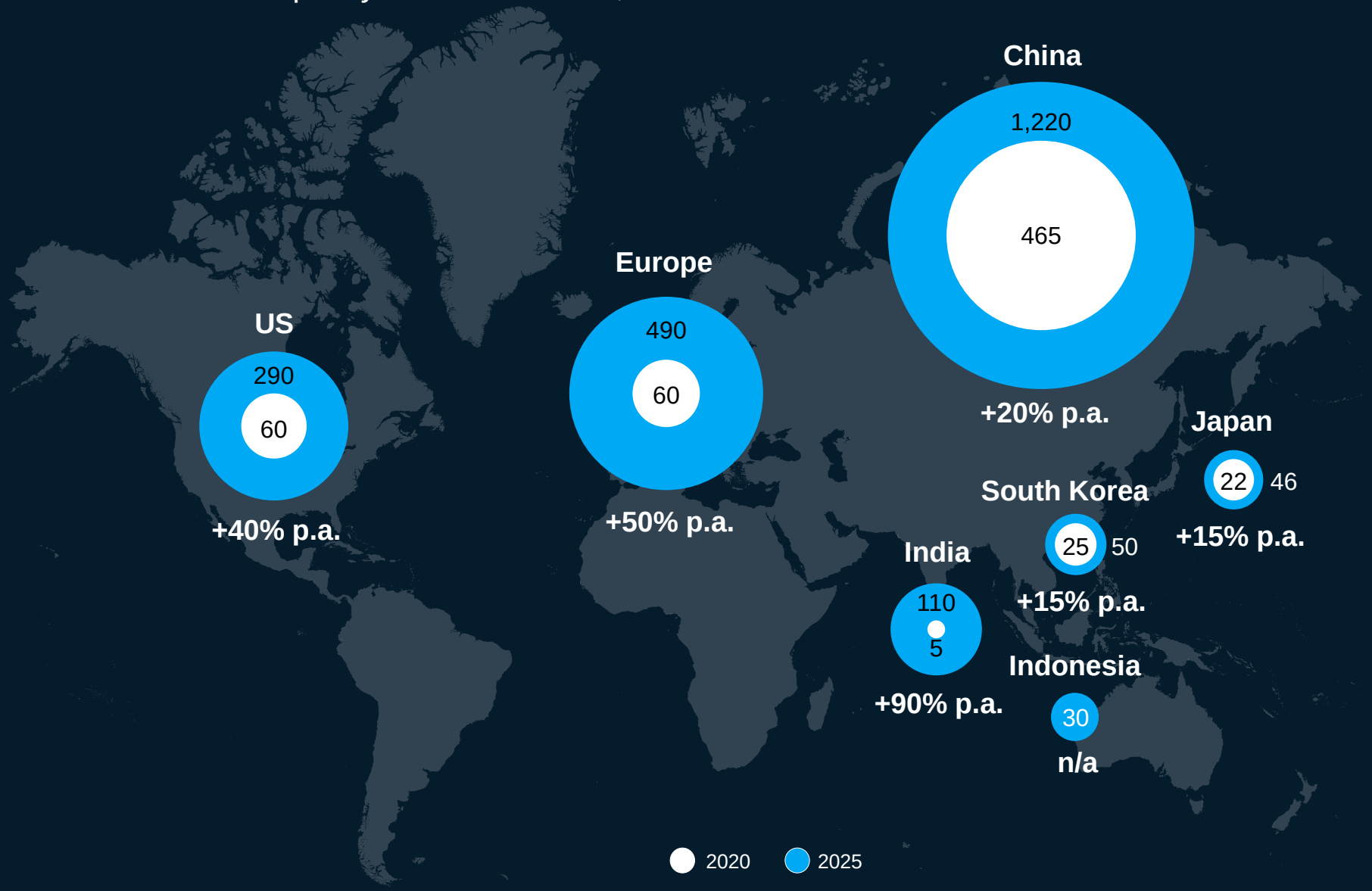
1. With fast-progressing electrification, current niche segments are developing into volume markets

Market size by year and segment (selected), GWh (approximated)



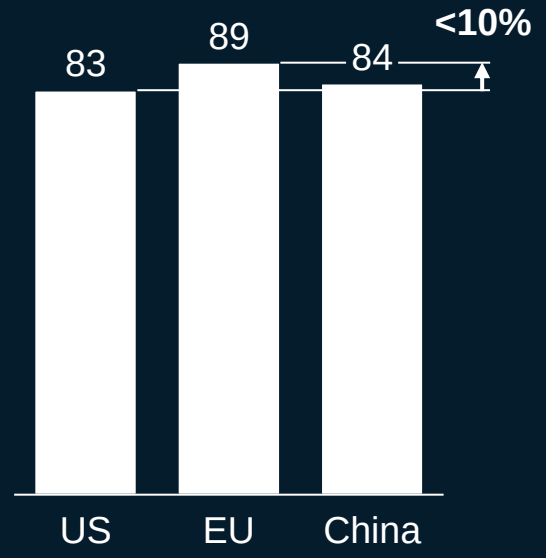
2. New gigafactories have been announced in the EU and US, with cell production localizing to serve regional demand

Global LiB cell capacity announcements, GWh



Estimated battery cost in different regions

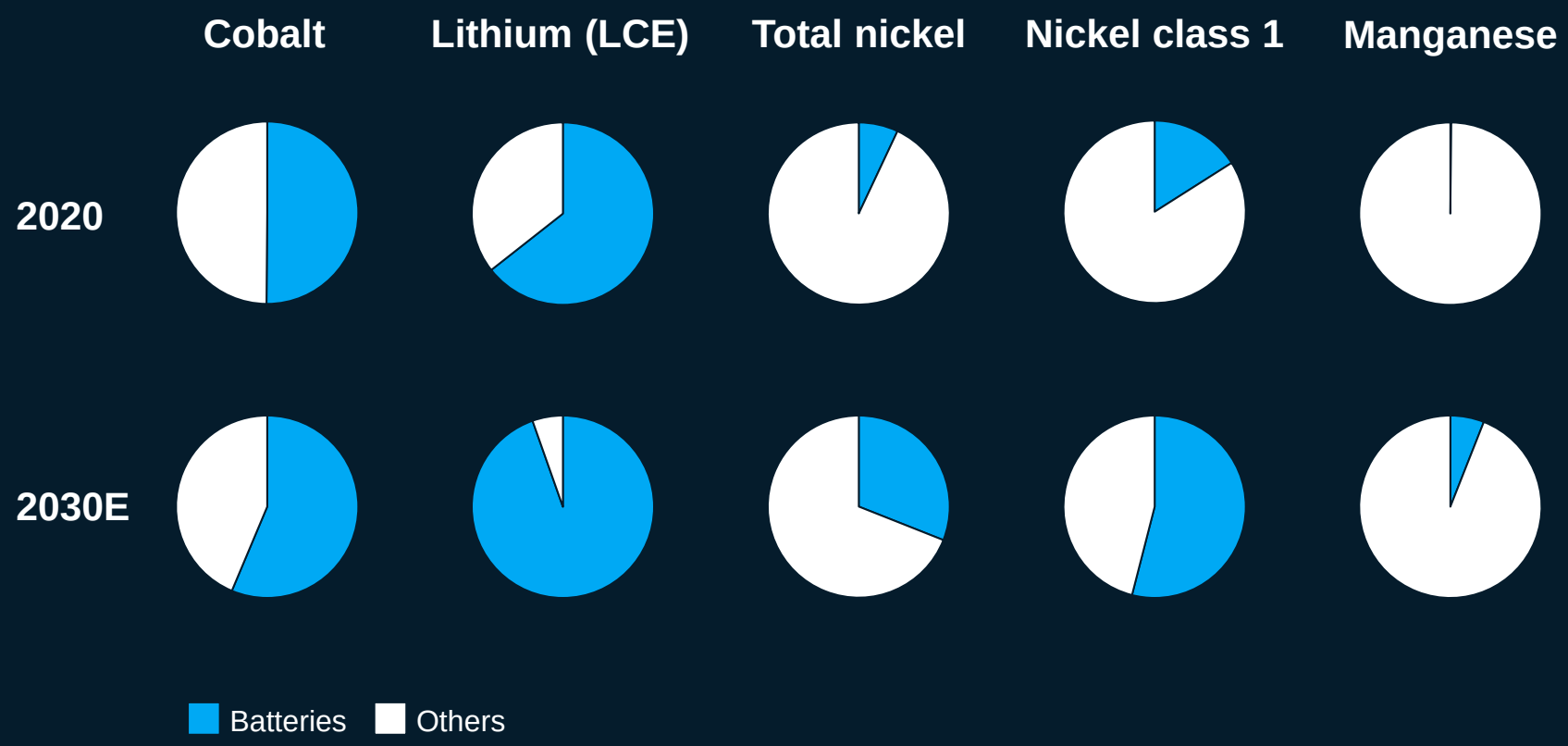
2025 USD/kWh



Cost difference across regions is limited to less than 10%

3. Some raw materials are highly impacted by the battery demand growth, leading to risks of shortage if supply does not keep the pace

Total raw material demand share for batteries vs. other uses, percent



Raw materials supplies could be tight in the short term, leading to price hikes

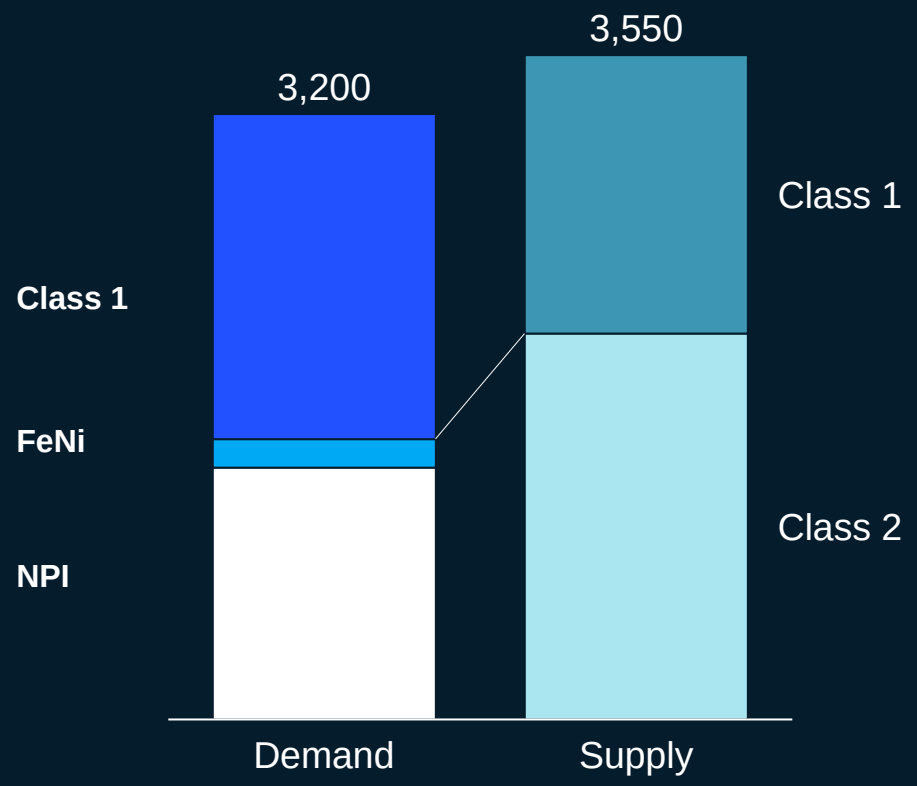
Higher prices will incentivize miners to explore or accelerate development of new resources

OEMs employ both optionality and aggressive sourcing to secure raw materials; opting also for substitution when possible

3. Nickel shortage would impact NMC cell cost most – more than other elements

Global resource balance 2025

Nickel market demand and supply 2030
kilotons of refined metal



Nickel supply is tight but manageable in 2025, but today's supply projections reveal the risk of a shortage in 2030

Battery cell cost+, 2025 China 10 GWh p.a. factory
USD/kWh

Co price, USD/lb \ **Ni price**, USD/kg	21	+100%	+200%
41	84	97	112
+100%	86	100	114
+200%	88	103	117

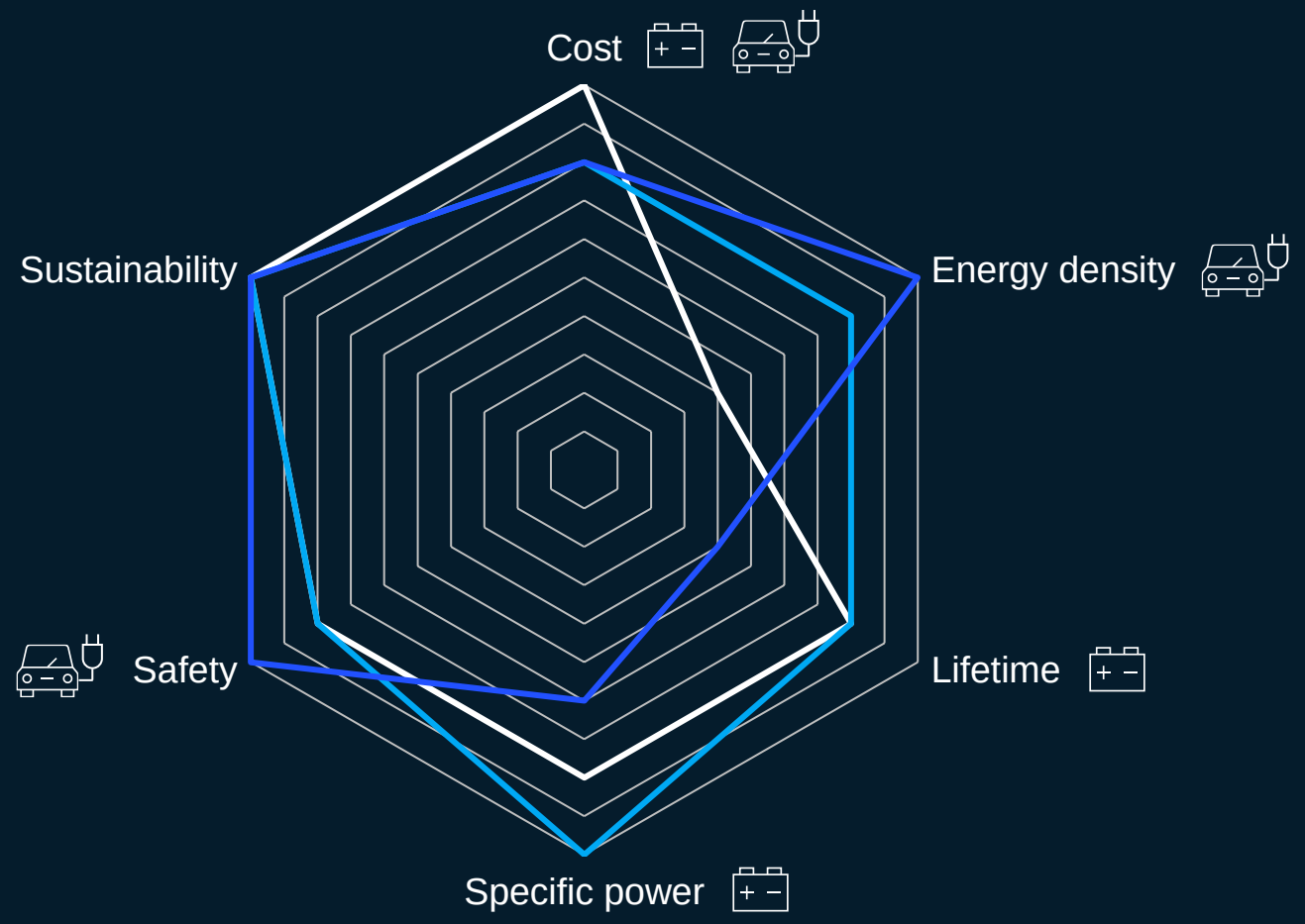
4. LFP fits needs of stationary storage at best cost, while solid states respond to future e-mobility needs

Illustrative

Top 3 parameters for EVs

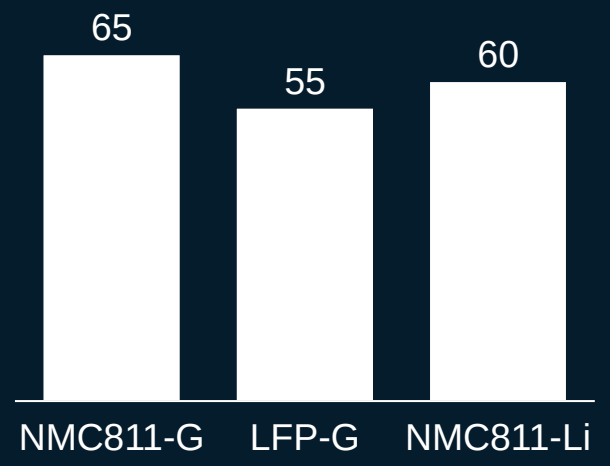
Top 3 parameters for ESS

LFP-G NMC-G NMC-Li



Estimated battery cost

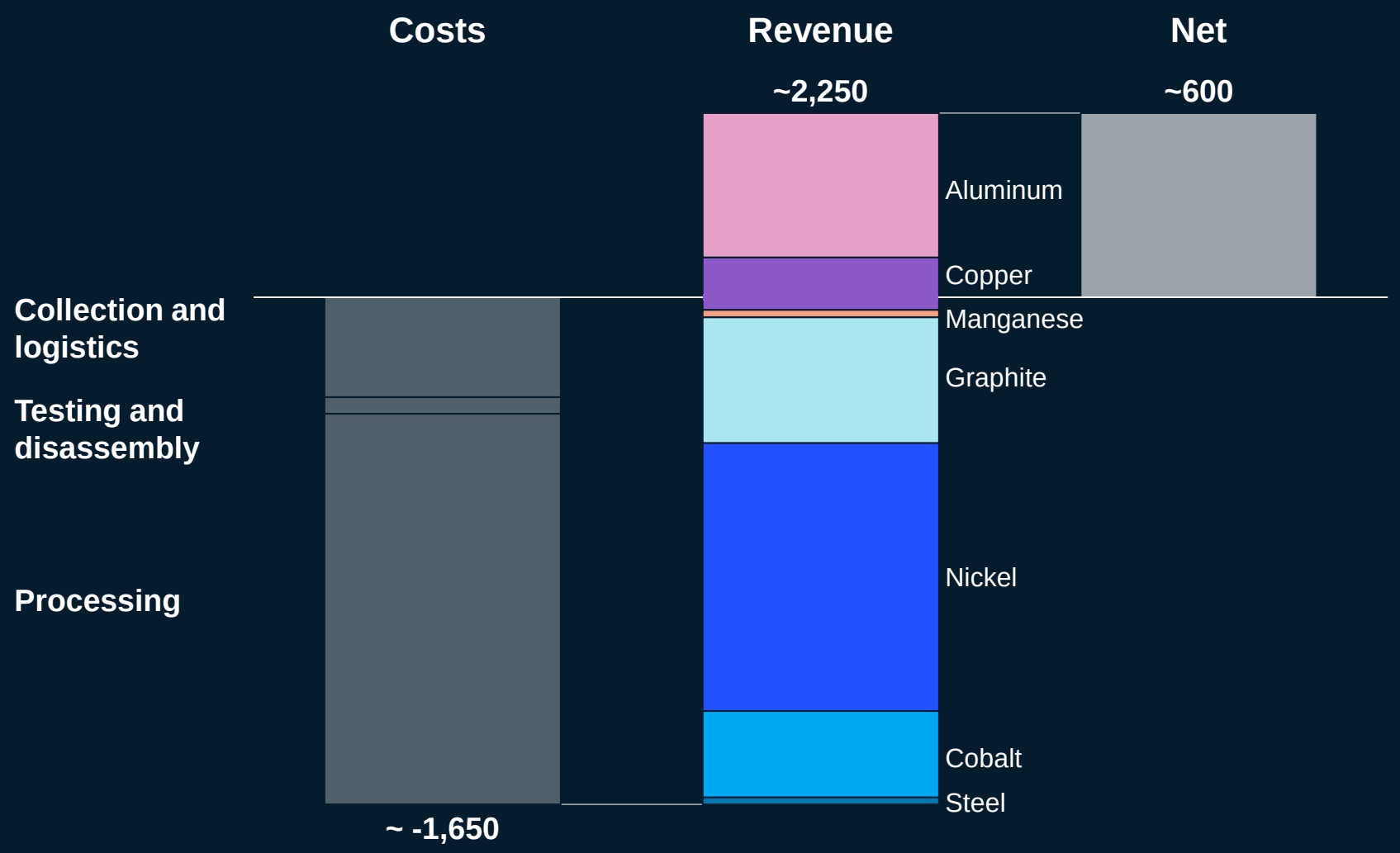
2030 USD/kWh



For ESS applications, LFP is a more interesting choice than NMC with Li anode (with solid-state electrolyte or otherwise)

5. With the right business setup and battery technology, recycling can become a profitable business by 2025

Recycling business case, USD per 80 kWh NMC811 battery



Key assumptions

NMC 811 battery

Mechanical shredding and hydrometallurgy processes

Plant operates at 80% capacity

Hub-and-spoke collection and logistics (distributed shredding)

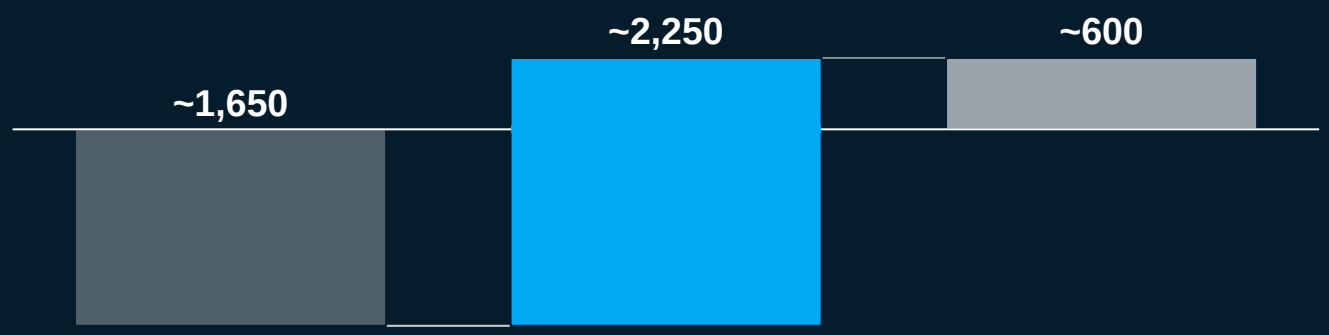
2021 commodity prices

Raw material recovery yields of up to 98%

Testing and disassembly takes 40 minutes

5. Profitability of second-life re-use business models depends on operational excellence and customers' willingness to pay

Recycling in comparison to remanufacturing, USD per 80 kWh NMC811 battery



Key success criteria

Recycling

- Cost-effective logistics
- High level of automation and high plant utilization
- Optimized material recovery yield

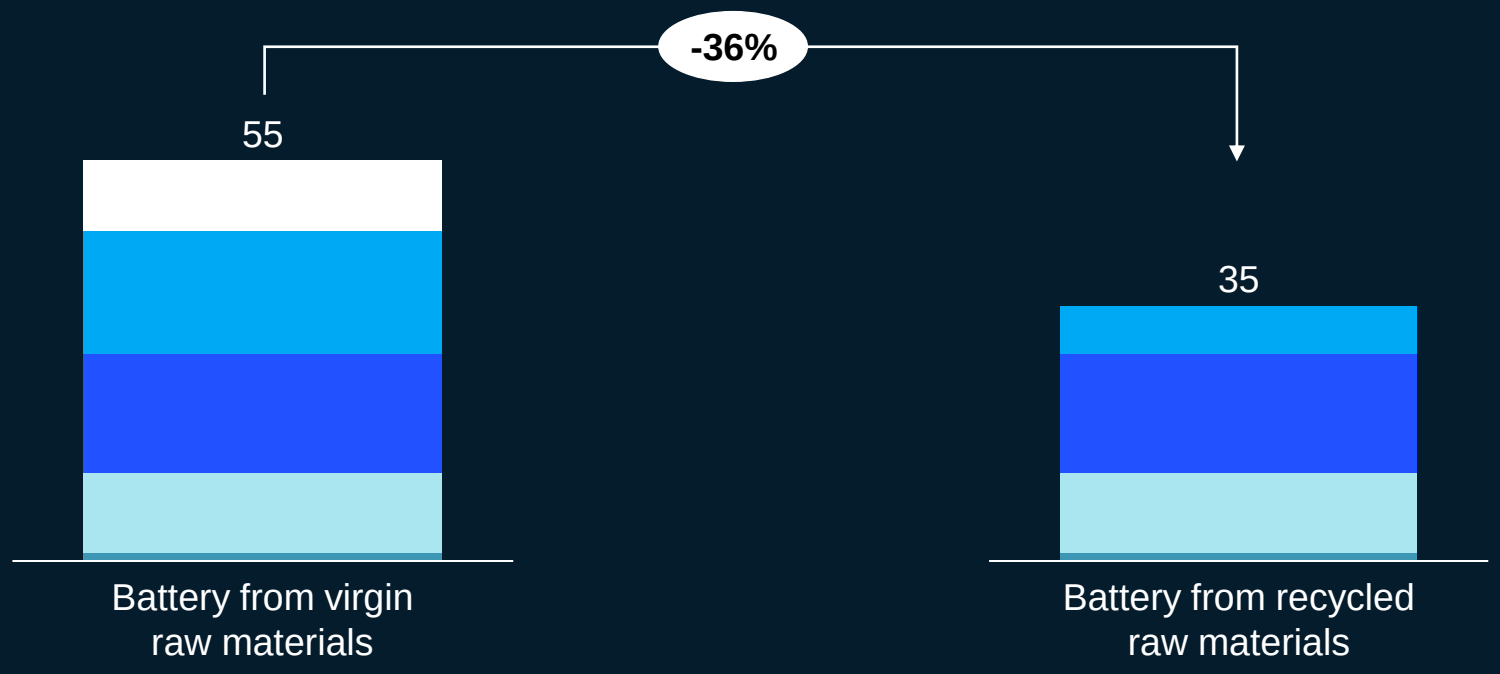
Second-life reuse

- Cost-effective logistics
- Modular design for different second-life applications
- High level of automation and high plant utilization

6. Recycling of battery raw materials can reduce the battery production CO_2 footprint by >30%

Example for NMC622, 2020

Total CO_2e production emissions caused by battery production[1], $kgCO_2e$ per kWh



Value chain step

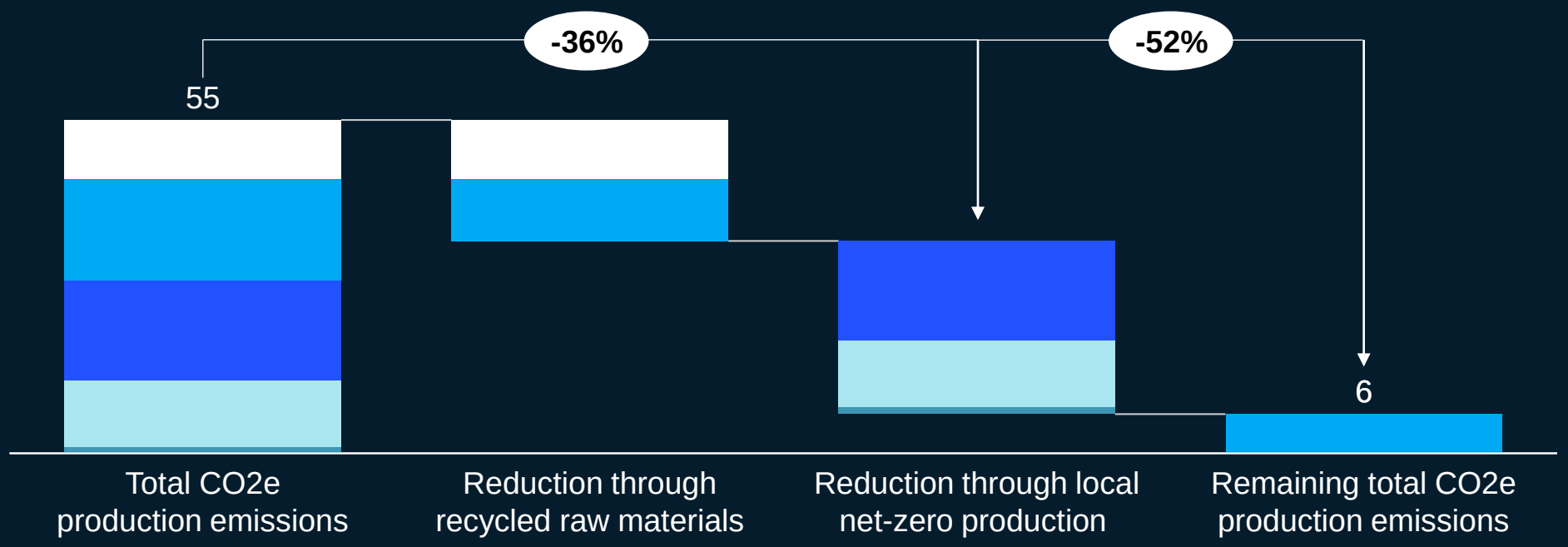
- Raw materials mining
- Raw materials refining
- Active materials and components
- Cell production
- Pack production

1. Assuming mechanical and hydrometallurgical recycling processing

6. Local net-zero production can reduce total battery CO_2 footprint by an additional >50%

Example for NMC622, 2020

Total CO_2e production emissions caused by battery production[1], $kgCO_2e$ per kWh



Value chain step

- Raw materials mining
- Raw materials refining
- Active materials and components
- Cell production
- Pack production

1. Assuming 100% of active materials, cell, and pack production in Europe, excluding application and 2nd Life/ recycling

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