KPMG for

International Lead Association

Consortium for Battery Innovation

Pb 2025 JUNE 25-27

Battery Market Report: 2030 Outlook

KPMG Strategy

June 2025

CONFIDENTIEL

Agenda

0. Battery industry: global outlook

1. Passenger car, commercial vehicle, 2&3-wheelers

2. Other motives: industrial motives

3. Stationnary batteries: BESS & UPS-inverter

Our report provides a comprehensive overview of battery applications, covering most of the market

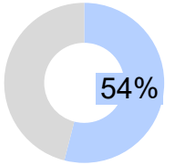
Battery market segmentation

Lead Battery applications

A Motive

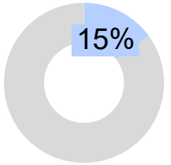
Passenger cars & Commercial vehicles

- Start, Light, Ignition (SLI)
- Traction battery
- Auxiliary battery



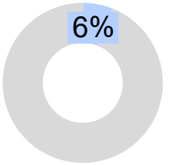
2- & 3-wheelers

- Start, Light, Ignition (SLI)
- Traction battery



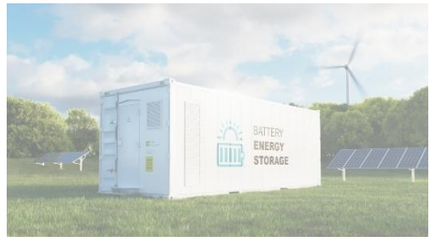
Industrial motive

- Traction battery
- Auxiliary battery

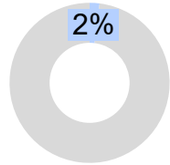


B Stationary

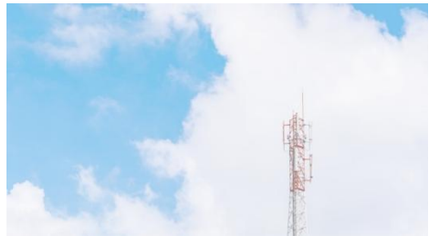
BESS



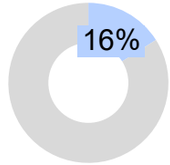
- Front of the meter
- Behind the meter



UPS



- Backup solutions for datacentres, telecoms, etc.



Value share* Application

Sources: KPMG research and analysis | (*) for lead

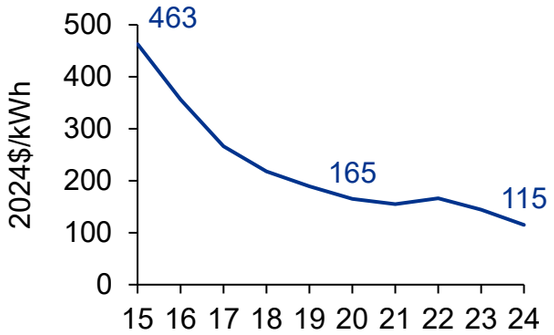
While Li-ion prices continue to decrease, industrials are cutting into their gross margins to gain market share, and keep developing new technologies

Macro trends within the battery industry

Non exhaustive

Decreasing Li-ion battery prices…

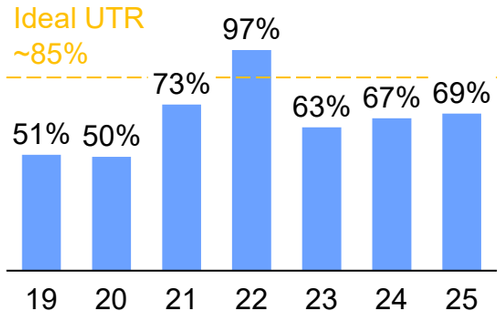
Li-ion battery pack price evolution
[2024$/kWh]



- Li-ion battery prices are still expected to decrease, with the fall in lithium raw material prices since 2022, achieving 30% price reduction at pack level

… partly due to overcapacity..

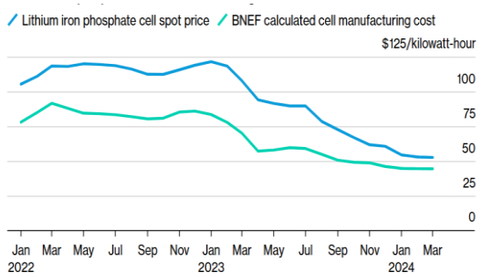
China EV & ESS battery industry effective capacity utilization rate



- China's UTR showed a **modest recovery in H2 2024**, driven by a rebound in demand
- It led to **renewed CAPEX** in li-ion production**, primarily by industry leaders** signaling cautious optimism across the value chain

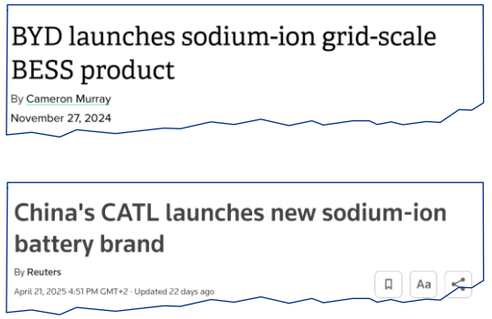
… leading to squeezed margins

BNEF's li-ion makers battery margin estimates



- However, this progress has come at the expense of tighter profit margins, as companies strive to preserve their market share

Advancement in new battery technologies



- **SSB** benefits from China's **$830M investment in R&D**, but **development remains uncertain** – first productions expected in 2027+
- The development of **2nd gen Na-ion is gaining momentum**, sharing the existing li-ion production infrastructure to **accelerate scale-up**

Sources: S&P Global CapitalIQ, Energy News, Reuters, JP Morgan, KPMG research and analysis

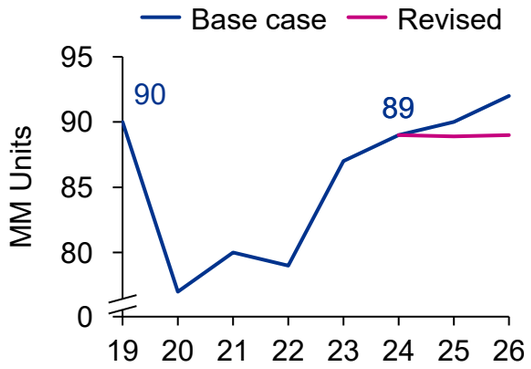
On the global scale, demand and regulations are evolving, and directly impact the development of the industry

Macro trends affecting demand

Non exhaustive

Uncertainty around Trump's tariff

S&P's light vehicle sales forecast revision [April 2025, MM units]



- **High uncertainty** around Trump tariffs and retaliatory trade measures poses structural risks to global demand, **potentially constraining long-term growth** across key sectors

45X hopes to improve US battery manufacturing competitivity

KPMG's view on the 45X and other tax credits

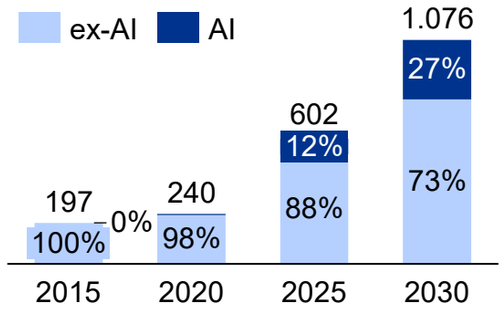
- The 45X credit appears to have received **favorable treatment**, but the inclusion of the broad FEOC rules may make **qualifying for the credit difficult for some industrie**s.(e.g. ties to prohibited foreign entities, % of payments to prohibited entities)

Regulations on recyclability and battery safety

- Europe's battery **recycling market is set to scale rapidly**, with over 1 TWh of scrap expected by 2030
- Globally, **tightening regulations on lithium batteries** reflect mounting safety concerns, adding pressure across the value chain

AI development, and increased demand

Global datacentres power demand [TWh]



- The **rapid rise of data centers** - projected to consume up to 3% of global electricity by 2028, is **driving demand for resilient backup systems** (UPS, BESS)
- In parallel, **nuclear energy is regaining traction** to support base load stability

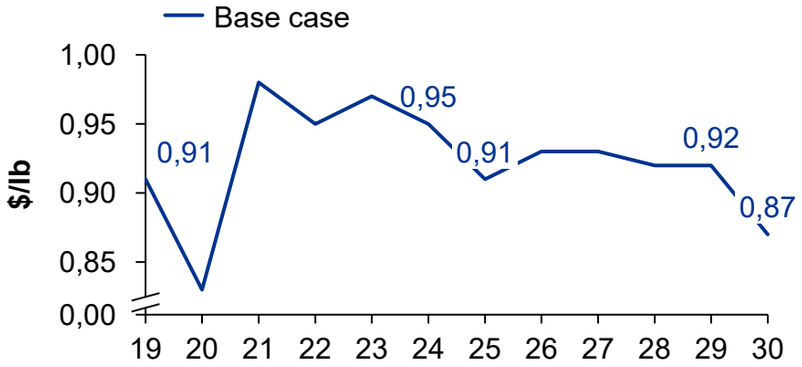
Sources: S&P Global CapitalIQ, Goldman Sachs, Reuters, Bloomberg, KPMG research and analysis

Lead battery industrials strengthen technology to support evolving OEM and customers needs (e.g., quick rechargeability, battery life)

Latest updates from the lead battery industry

Lead price is expected to remain stable over the next years

S&P forecast on lead price
[$/lb]



- Lead prices are expected to remain relatively stable in the near term, supported by **consistent demand** from traditional sectors and constrained by a **well-established recycling supply chain**

Industrials are pushing their pure lead batteries on the market

***EnerSys Seeks to Align With Accelerating Market Shift Toward Its Proprietary Technologies Such as Thin Plate Pure Lead and Lithium-Ion**
Tuesday, April 1, 2025 4:21 PM ET

Introducing the new Leoch HXP series
July 17, 2024
Advanced Battery Solutions for UPS applications and Data Centres

- Utilizing high-purity lead enables manufacturers to **extend battery life** and deliver **superior performance in extreme operating conditions**
- The technology supports **deeper cycling** capabilities and provides **higher power density**, making it well-suited for demanding industrial and energy applications.

Auto battery makers are achieving higher charge acceptance and quicker rechargeability

CLARIOS TO SUPPLY MAJOR AUTOMAKER WITH NEW HIGH-PERFORMANCE AGM BATTERY TO HELP IMPROVE FUEL ECONOMY AND REDUCE CO2 EMISSIONS

'ArcActive Batteries 'on market in two years'
Batteries international

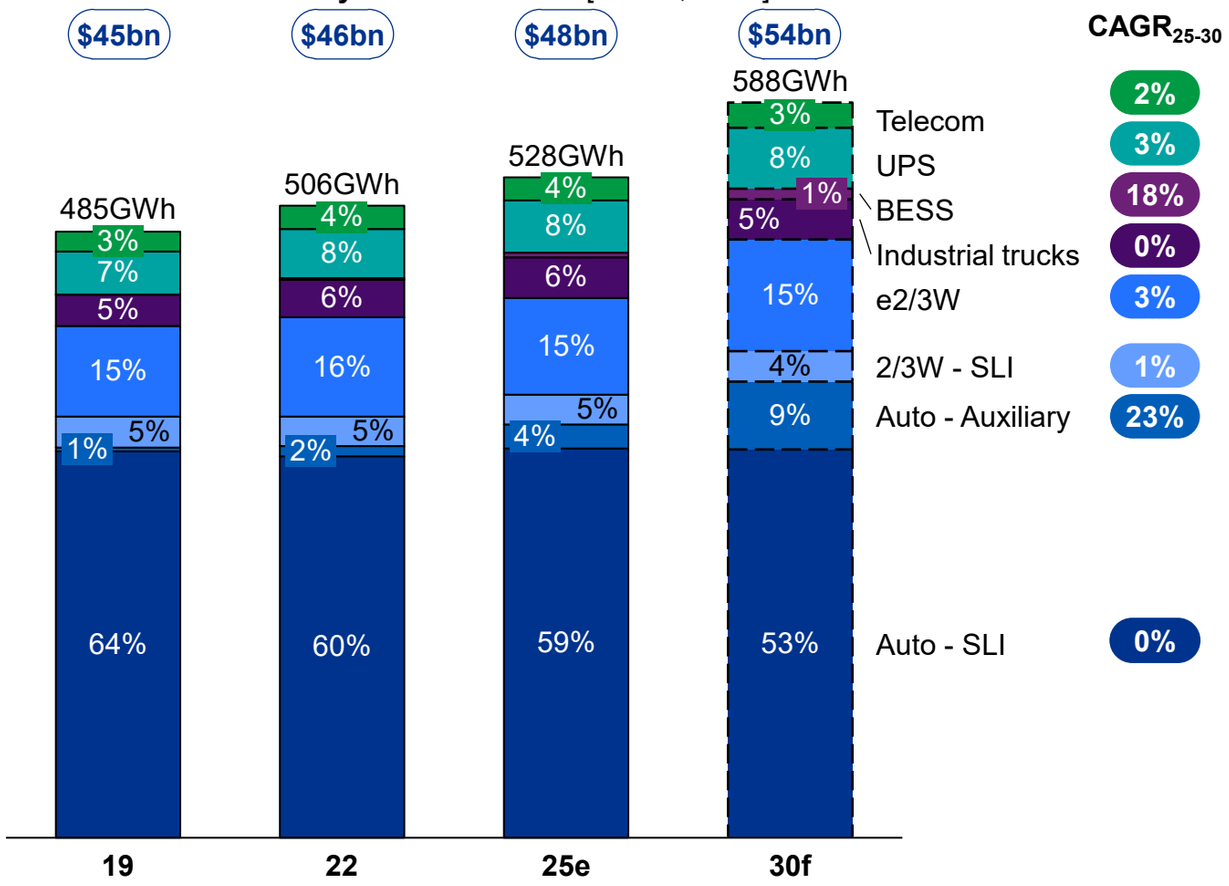
- Demand for this higher battery performance is driven by the need to **offload the constraints on the ICE vehicles**, and to **improve CO2 efficiency**
- It allows **higher trust in auxiliary systems**, ensuring backup power in the event of traction battery failure, as well as peak shaving to stabilize demand

Sources: Company website, press, S&P Global CapitalIQ, KPMG research and analysis

We see the lead battery market continuing to grow at a 2% CAGR over the next five years, fueled by applications such as auxiliary batteries for EVs

Lead battery market

Evolution of lead battery market demand [Global, GWh]



Sources : KPMG research and analysis

KPMG Insights

- At a global level, demand for key battery applications will **remain heavily concentrated in China** (~35% of demand), primarily driven by the country's dominant position in electric vehicle (EV) manufacturing. China's continued investment in EV infrastructure, supply chain localization, and policy support further **cements its leadership in this space**
- Lead batteries are expected to maintain **a steady presence across multiple industries** worldwide. As OEMs evolve and diversify their offerings, **lead batteries will continue to play a vital supporting role**—particularly in applications where cost efficiency, reliability, and established infrastructure outweigh the push for next-generation chemistries

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0. Battery industry: global outlook

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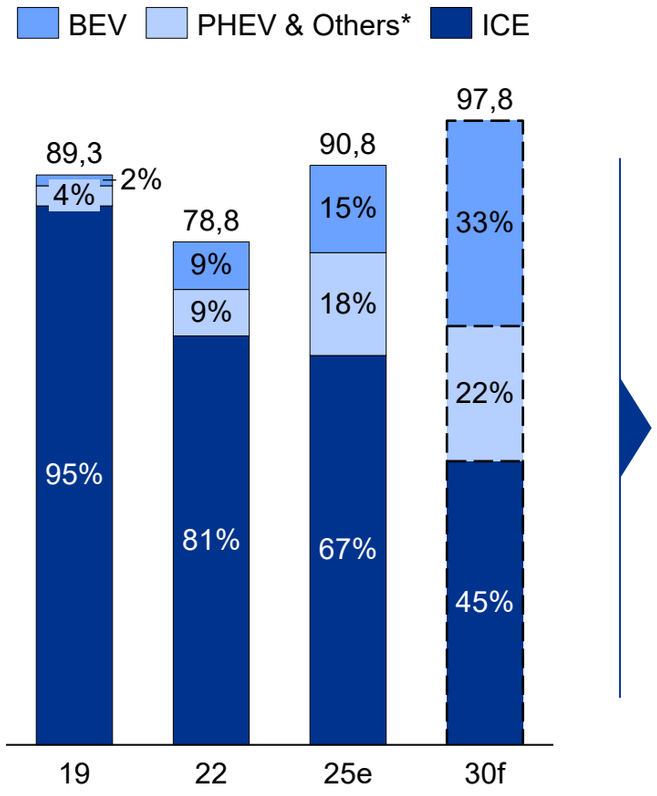
2. Other motives: industrial motives

3. Stationnary batteries: BESS & UPS-inverter

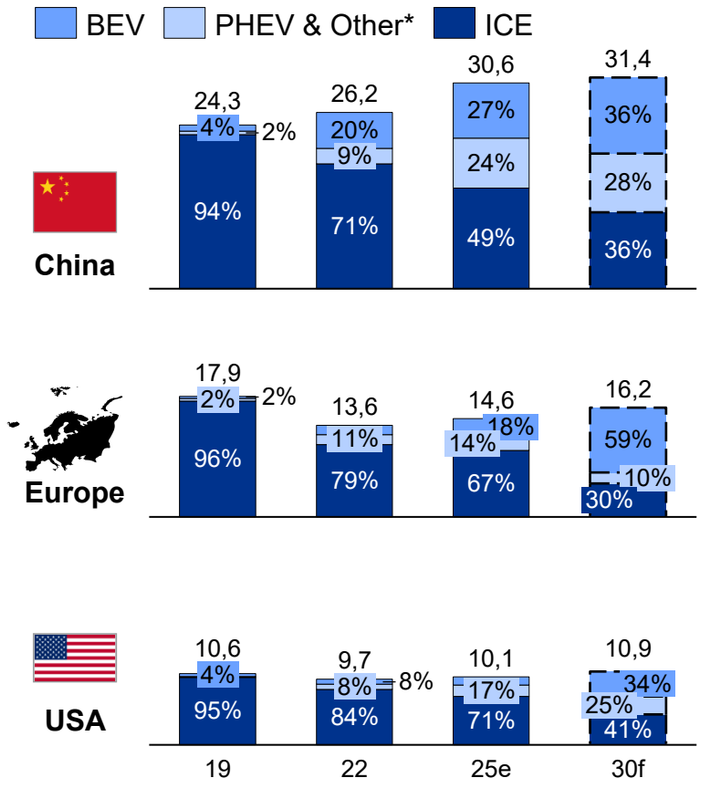
Despite recent headwinds, xEV are still on the way to reach ~55% of car sales by 2030, allowing China to progressively take the lion's share of auto prod.

Passenger & Commercial Vehicle market

Passenger and commercial vehicle sales by powertrain [Global, million units]



Passenger and commercial vehicle production by powertrain and by region [Global, million units]



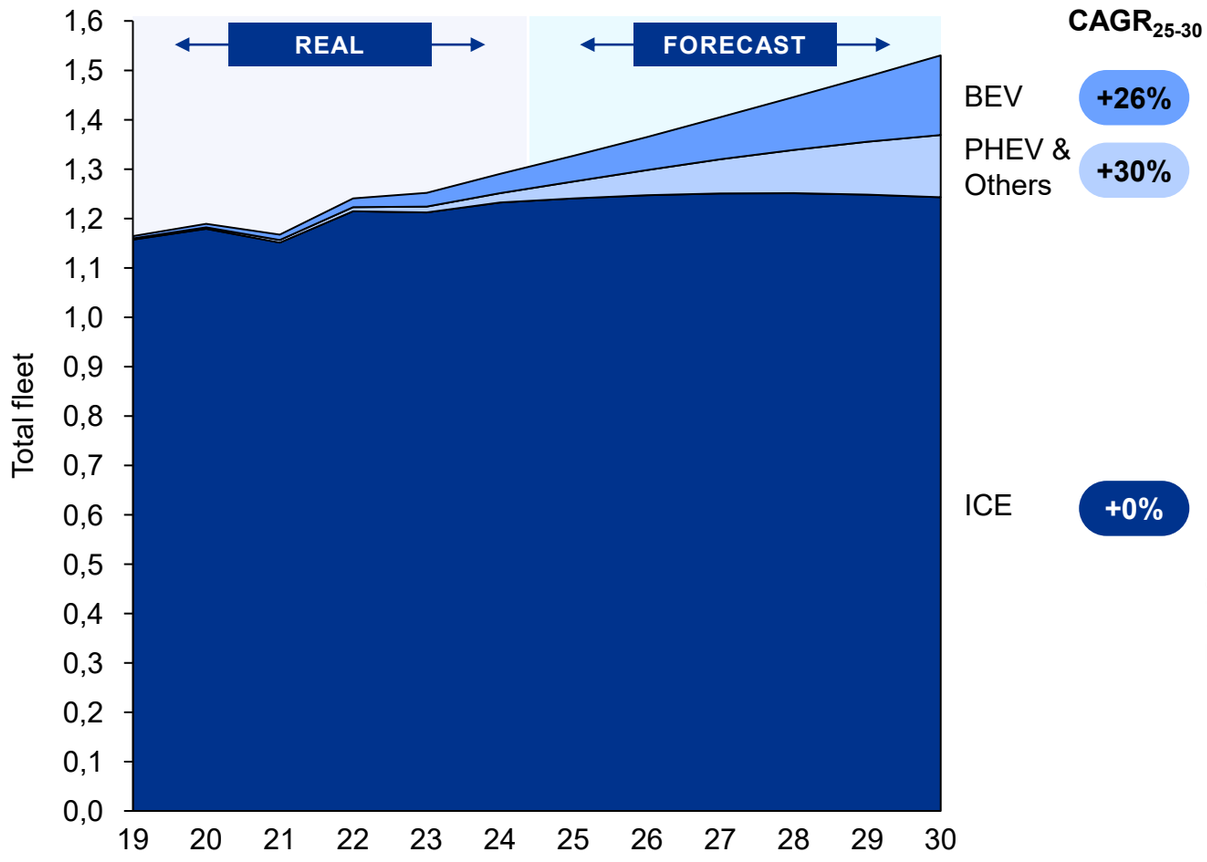
KPMG insights

- **China remains the dominant EV market**, both in terms of **sales and production**. It is expected to maintain its leadership position over the medium term, driven by strong domestic demand and a growing role as a key exporter of battery electric vehicles (BEVs)
- **Emerging markets** such as Thailand, Vietnam, and Brazil are showing accelerating EV adoption, signaling a **broadening of the global demand base**
- Key growth drivers include **rapid technological advancements**, supportive **regulatory frameworks**, and **increased model availability**
  - Notably, electric vehicles now account for approximately one-third of all available car models in 2024, reflecting growing commitment from OEMs to electrification

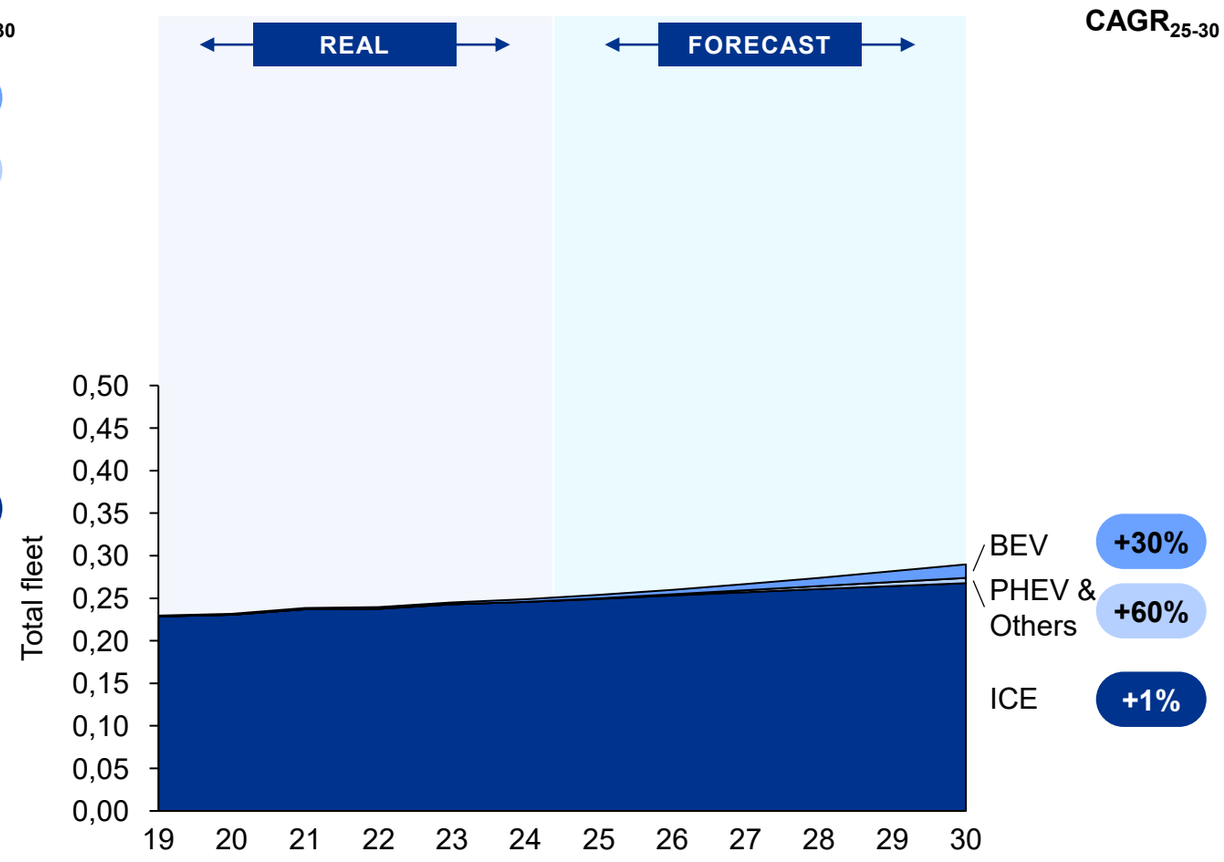
Sources: KPMG research and analysis | BEV = Battery electric vehicles, PHEV = Plug-In Hybrid EV, (*) FCEV, FHEV, PFCEV

By 2030, EV will represent respectively 19% and 8% of the passenger and commercial vehicle fleets

Passenger vehicle fleet outlook [bn vehicle]



Commercial vehicle fleet outlook [bn vehicle]



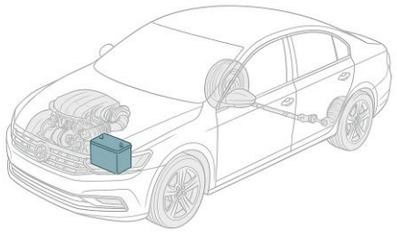
Sources: IEA, KPMG research and analysis | BEV = Battery electric vehicles, PHEV = Plug-In Hybrid EV, (*) FCEV, FHEV, PFCEV

While SLI battery traditionally equip ICE vehicles, electric vehicle typically use two batteries: a traction battery as well as an auxiliary battery

Types of car batteries

ICE

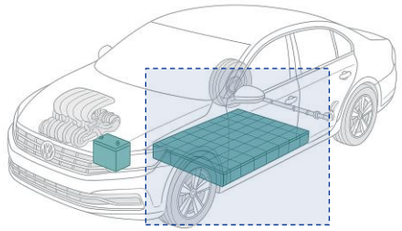
Start, Light, Ignite (SLI)



Low-voltage battery commonly used in internal combustion engine vehicles to **start the engine** and **power electrical systems**

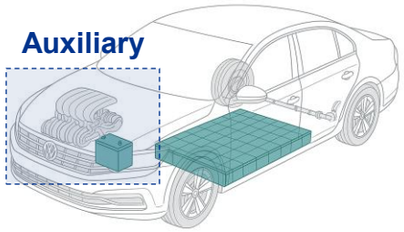
xEV

Traction battery



Main high-voltage battery in an electric vehicle (EV), that powers the electric motor and **provides energy for driving and propulsion**

Auxiliary battery



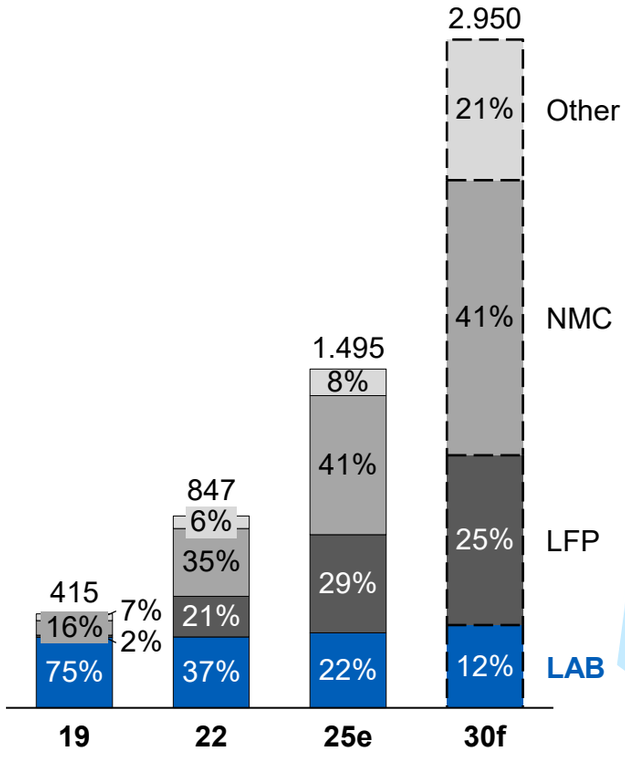
Low-voltage battery (typically 12V) that **powers the vehicle's electronics and accessories**, such as lights, infotainment systems, and control modules

Sources: KPMG research and analysis

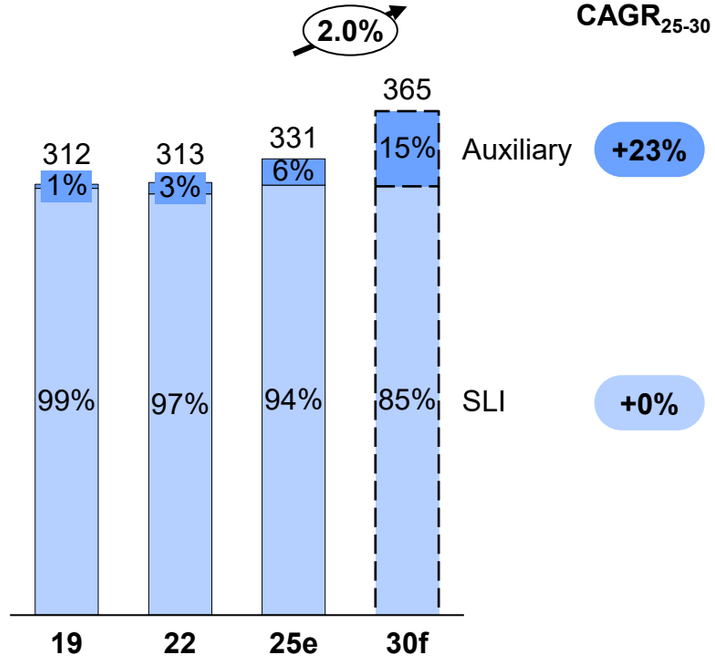
As a result, despite losing market share, we expect lead battery demand to continue growing at a 2% CAGR between 2025 and 2030

Battery demand for the automobile industry [GWh, Passenger & Commercial Vehicles]

Battery demand for passenger and commercial vehicle [Global, GWh]



Lead battery demand for passenger and commercial vehicle [Global, GWh]



KPMG Insights

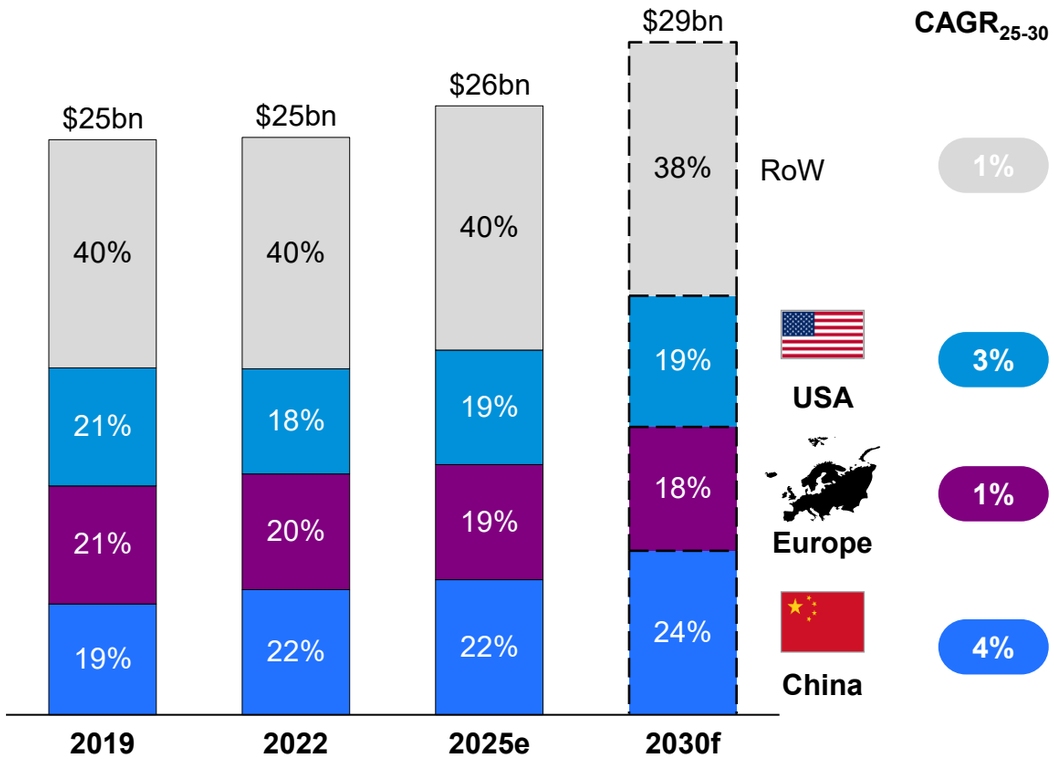
- The **electrification of vehicle systems** is significantly **increasing battery content per car**, with examples like Mercedes integrating up to three batteries in some of its latest luxury sedan models
- Amid uncertainty around Trump's tariffs, auto **OEM are actively revisiting lead-based technologies** to **diversify supply risk**
  - Industry leaders report renewed interest from auto OEMs in lead solutions, particularly for auxiliary applications, where we estimate lead could account for 80-85% of future demand

Sources: KPMG research and analysis

Overall, the battery industry for passenger and commercial vehicles represent a $26bn market, expected to reach ~$30bn by 2030

Automotive lead battery market

Lead battery demand for passenger cars and commercial vehicles
[Global, $bn]



Key drivers of the sector

Drivers		Description	Impact
	Electrification of cars' systems	• With car increasingly relying on softwares, and electrification of systems, **multiple low voltage networks are needed** for power & safety	***High***
	ICE phase-out policies and EV subsidies	• European's action plan for **phase-out of ICE new sales** by 2035, or China's **purchase incentives for EV** are pushing the market toward EV adoption	***High***
	Supply chain constraints	• Limited availability and geopolitical risks tied to critical material sourcing are **driving shifts in battery design**, regional production strategies, and **recycling initiatives**	***Moderate***

Sources: Company reports, KPMG Research and analysis

The 2- and 3-wheeler market encompasses a significant variety of vehicles, predominantly used in Asia, and featuring varying degrees of electrification

2&3-wheeler segments

2-wheelers

Moped / Ebike [CN]*

- A small, low-powered two-wheeled vehicle with both a motor and pedals, **typically limited in speed and <50cc**

Scooter

- Two-wheeled motor vehicle, with **small diameter wheels** and engine sizes that can range from **50cc to 250cc or more**, with electric versions also common, optimized for **urban mobility**

Motorcycle

- Typically, **over 50cc**, with **larger wheels,** and designed for high-speed performance, **long-distance travel**, or off-road capability, depending on the type

3-Wheeler (Autorickshaw and other)

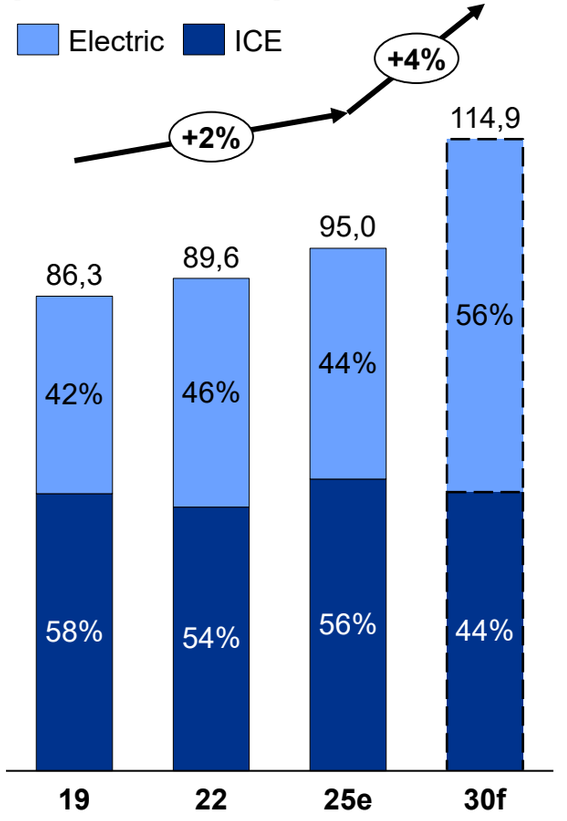
- 3W, commonly **arranged either symmetrically or not**. They can be open or enclosed, and range from **low-powered urban mobility** vehicles to **cargo and passenger carriers**

Sources: KPMG research and analysis | (*) Terminological differences have led to the inclusion of China's GB17761-2018 e-bikes in the market

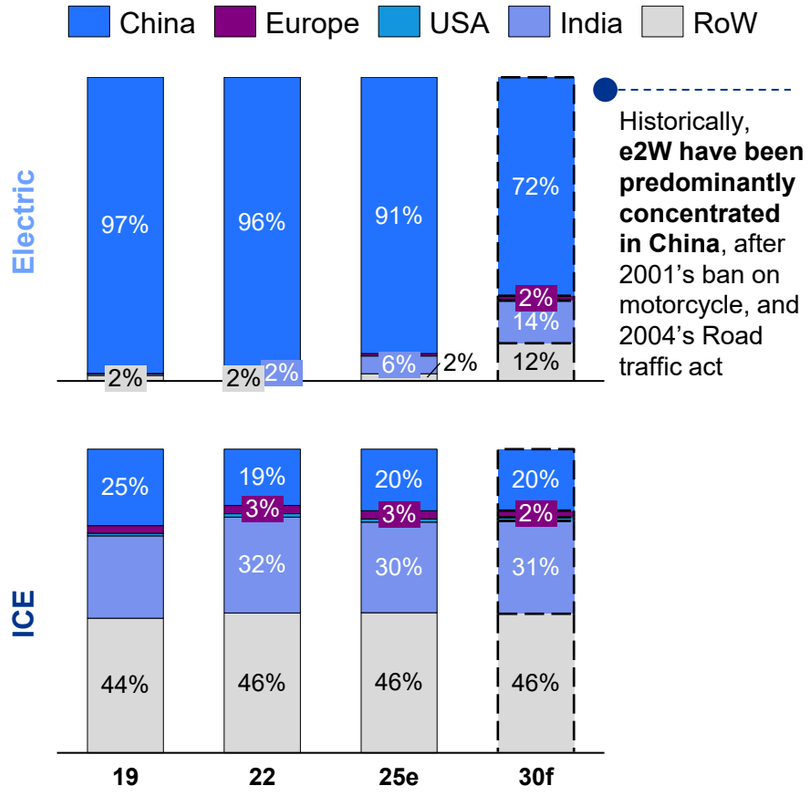
2&3-wheelers mobility is expected to continue growing, mainly driven by Asian demand and production, while shifting towards electric

2&3-wheeler market

2/3-wheelers sales by powertrain
[Global, million units]



2/3-wheelers sales by region
[Global, % of units sold]



Historically, **e2W have been predominantly concentrated in China**, after 2001's ban on motorcycle, and 2004's Road traffic act

KPMG insights

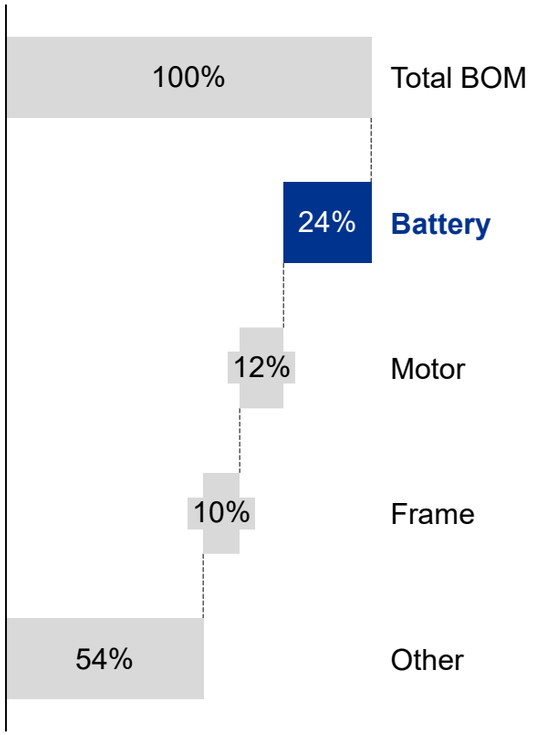
- **India** continues to witness deepening penetration of 2W vehicles into households, driven by a strong shift towards electrification
  - OEMs have successfully reduced e-2W costs by 30% within two years. However, adoption remains constrained by challenges such as limited resale value, range anxiety, and electric 2W costs (x2 vs ICE)
  - In the 3W segment, e-rickshaws are experiencing robust growth, and gained 17pp market share between 22-25. This expansion is fueled by lower prices - 50% to 70% cheaper than ICE variants, primarily enabled by lead-acid battery technology
- **China's** domestic 2W market shows declining volumes following a post-COVID sales surge, indicative of market saturation. Nevertheless, future growth is anticipated through increased exports, as ASEAN countries accelerate their electrification efforts, creating new demand opportunities beyond China's borders

Sources: Statista Market Insights, Broker Reports, IEA, KPMG research and analysis

Batteries make up 25% of the BOM, so most e2/3Ws still use lead batteries, but Li-ion is expected to grow with falling prices and subsidies

Being a strategic component of e2W…

Cost structure of e2W [China, 2022]



… batteries with lower cost tend to gain market share

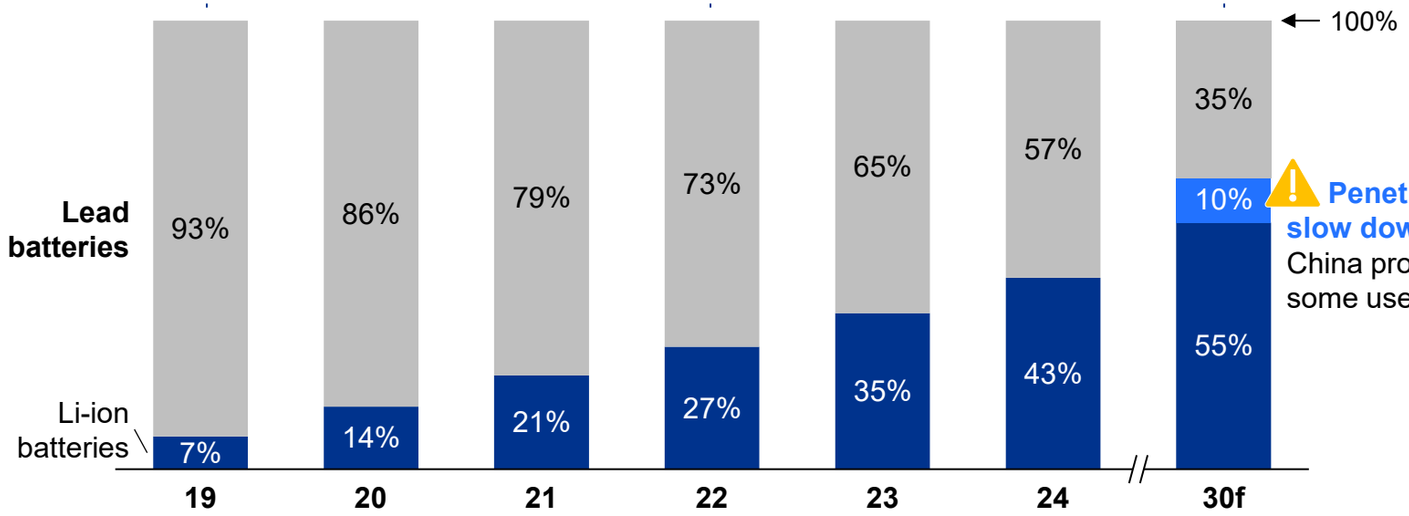
Share of new 2W sales according to their battery technology [Global, % units sold]

China's **new national standard policy** pushed for the development of li-ion batteries

State **subsidies, favouring li-ion batteries** (e.g., FAME2 in India – 2nd 2W market) are pushing for the adoption of li-ion

Penetration of LIB is highly correlated with **their price decreasing**

China's **reconsidering battery size restriction** slows down li-ion growth



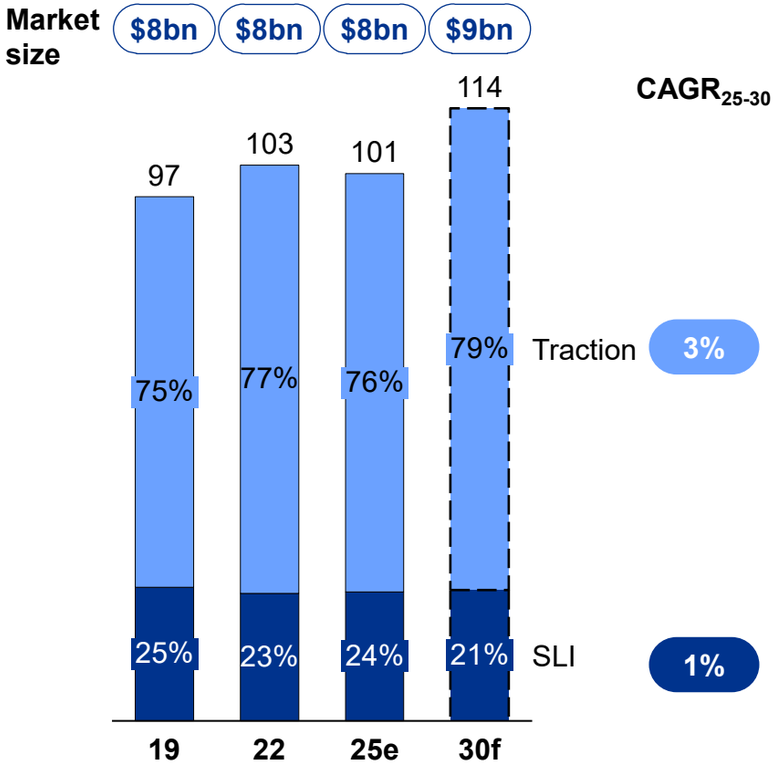
Penetration may slow down due to China promoting lead in some use cases

Sources: LeadLeo, company documentation, KPMG research and analysis

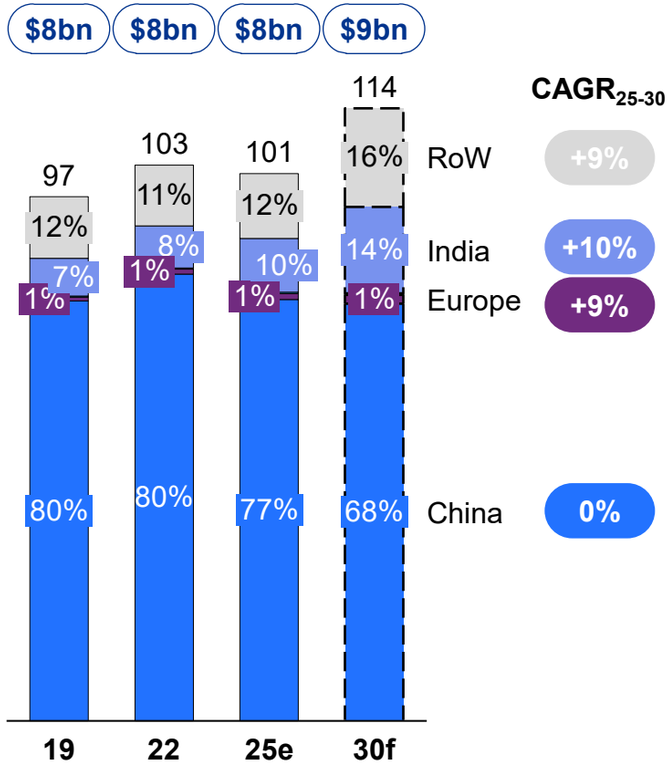
Due to the large installed park of e2&3-wheelers in China, and to the development of new sales, we expect the market to grow at a 2% $CAGR_{25-30}$

Lead battery market for 2/3-wheelers

Lead battery demand for 2/3-wheelers by powertrain [Global, GWh]



Lead battery demand for 2/3-wheelers by region [Global, GWh]



KPMG insights

- Despite a global decline in market share, **lead-acid batteries remain a compelling value proposition** for both OEMs and end-users in the 2/3-wheeler segment, particularly in cost-sensitive markets
  - Lead-acid technology **continues to dominate in specific applications** - most notably in **e-rickshaws,** thanks to its low upfront cost and robust local supply chains
- For 2-wheelers specifically, the share of **ICE vehicles** is expected to decline gradually, with a notable **downturn in the global fleet post-2030**, as adoption of electric fleet advances

Sources: Broker reports, KPMG research and anlysis

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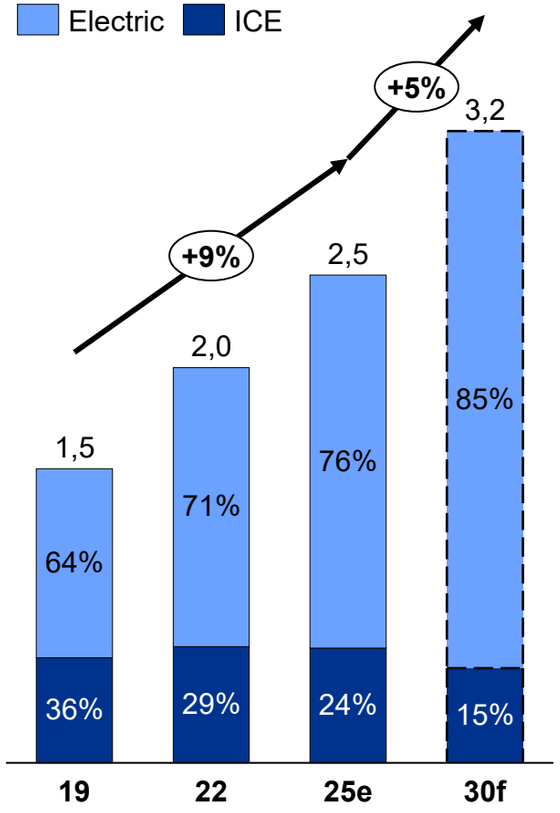
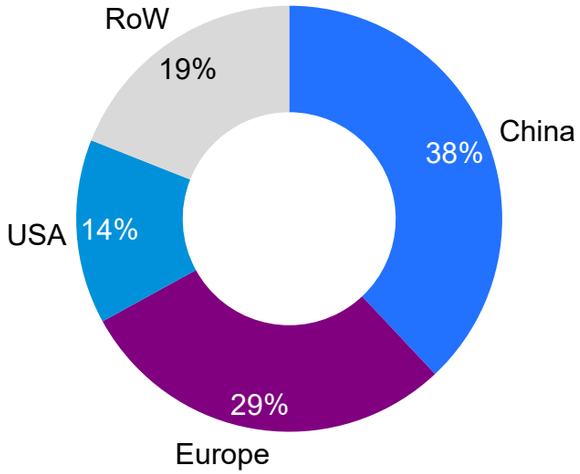
The industrial motive battery market will double between 2019 and 2030, with electrification of sales emerging as a key macro trend

Industrial trucks market

Industrial forklift shipments by powertrain
[Global, million units]



Industrial forklift shipments by region
[1H2024, volume]



~55% **Share of China in the production of forklifts on a global scale**

Main drivers of the market

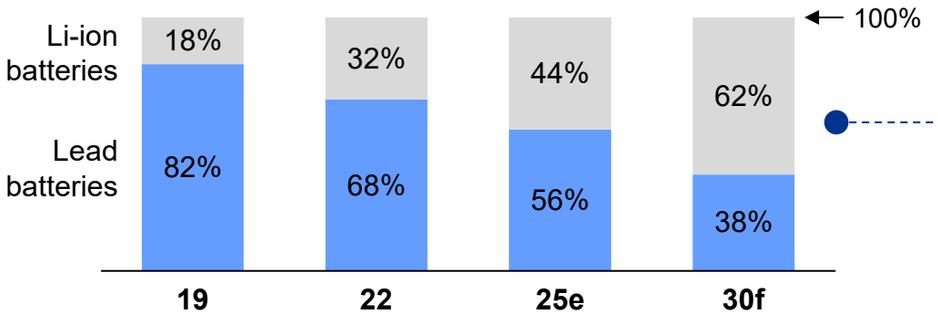
Drivers		Impact
End-market Demand	**Increased ecommerce activity** and penetration across all markets	*High*
	Increased warehouse automation, to provide faster delivery	*High*
Electrification	Improved technologies, and **higher e-forklift penetration in high voltage products**	*Moderate*
	Increased **pressure to reduce emissions**	*Moderate*

Sources: WITS, Kion Group, Toyota Industries, KPMG research and analysis

The industrial motive battery market is dominated by lead technology, but Li-Ion is quickly gaining market share and is expected to reach +60% by 2030

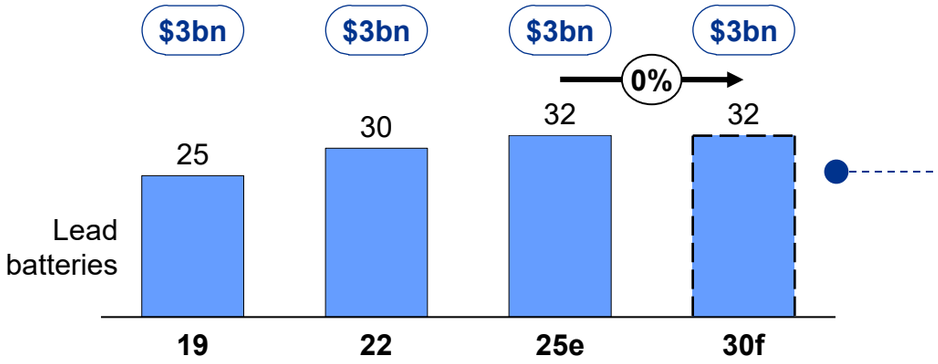
Batteries for industrial trucks

Estimated market mix electric industrial trucks by technology
[Global, % of sales]



As of today, **Li-ion forklift adoption remains limited outside China -** in 2023, they made up 66% of Class 1 forklift sales within China, compared to just 12% in other markets

Lead battery demand for forklifts [Global, GWh]



Lead battery demand is expected to **stabilize globally**, with **growth concentrated in emerging markets**, while new sales decline in mature regions like the U.S.—from ~80% in 2022 to ~50% by 2030

KPMG Insights

- OEMs expect continued **acceleration in the shift toward lithium-ion technology**, with leading players like Kion (2nd largest market player) projecting Li-ion to account for 60% of new forklift orders by 2027
  - In China, **Li-ion forklift sales have grown at a remarkable 87% CAGR** from 2017 to 2023, underscoring strong momentum and rapid adoption
  - **Chinese manufacturers are expanding their presence in Europe**, further accelerating the transition to Li-ion
- However, **lead-acid batteries** are expected to maintain a **strong foothold in emerging markets and high-temperature** environments (e.g., end market industries and countries), where their cost-effectiveness and thermal resilience remain key advantages

Sources: WITS, Kion Group, Toyota Industries, Broker reports, KPMG research and analysis

Agenda

0. Battery industry: global outlook

1. Passenger car, commercial vehicle, 2&3-wheelers

2. Other motives: industrial motives

3. Stationary batteries: BESS & UPS-inverter

We will consider lead battery market evolution for BESS, as well as UPS solutions

Definitions of the segments

BESS

- Often collocated with RE sources, stores energy for later use, and designed for various applications (e.g., load shifting, peak shaving, arbitrage)

UPS-inverter

Telecoms

- Immediate backup power for power outage
- Telecom facilities typically requires large reserve time (4-8h)

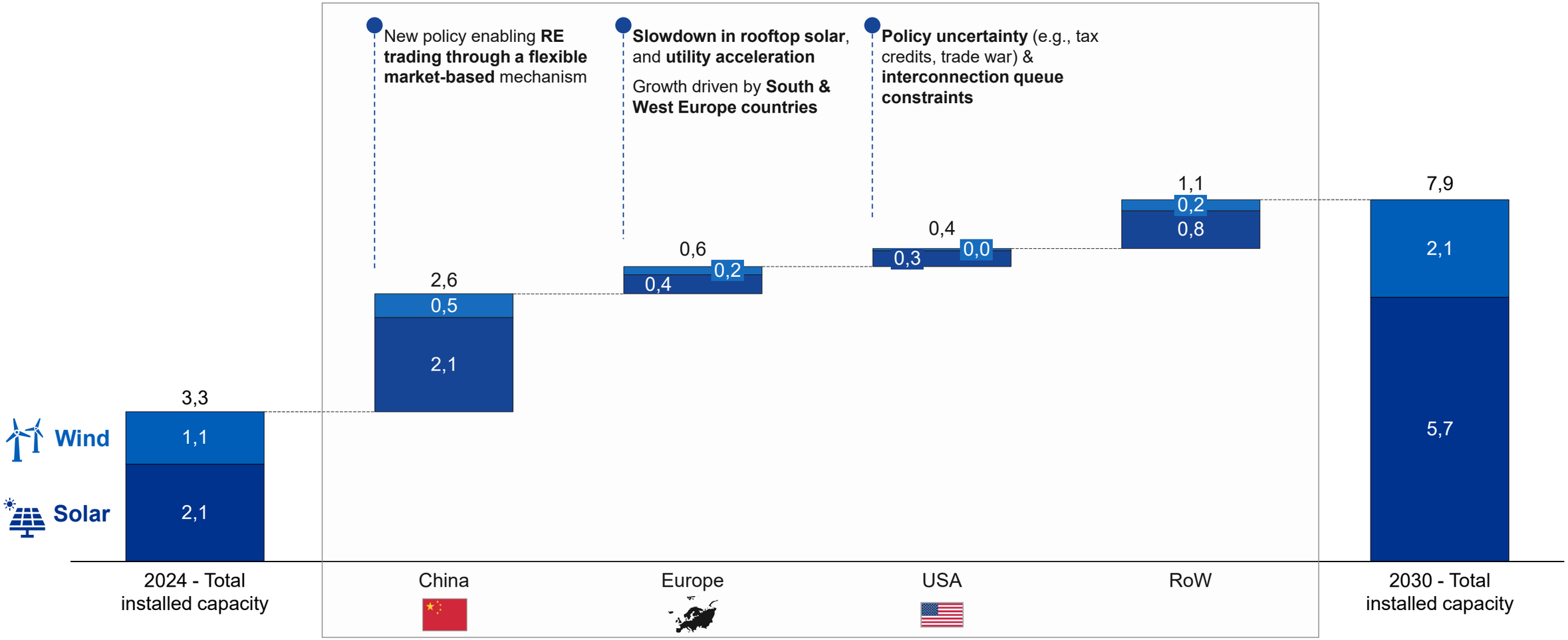
Other Home and Industrial UPS

- Immediate backup power for power outage
- Used in industrial applications (e.g., datacenter, hospitals), or in house (UPS inverter)

Sources : KPMG research and analysis

The world is on its way to add 4.6TW of additional solar and wind capacity, with China concentrating 55% of global additions

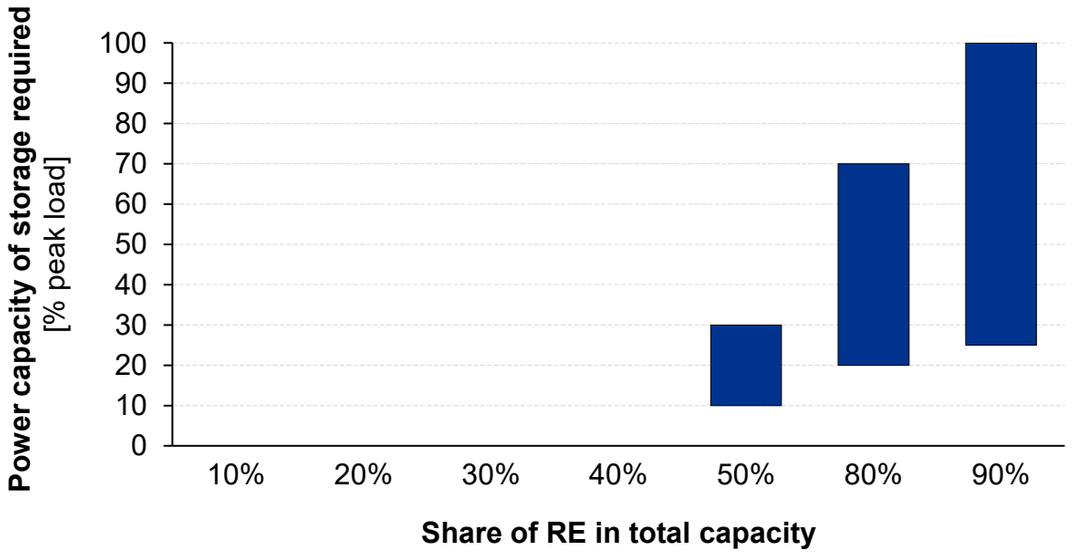
Global solar and wind capacity additions [TW]



Sources: IEA, Rystad Energy, KPMG research and analysis

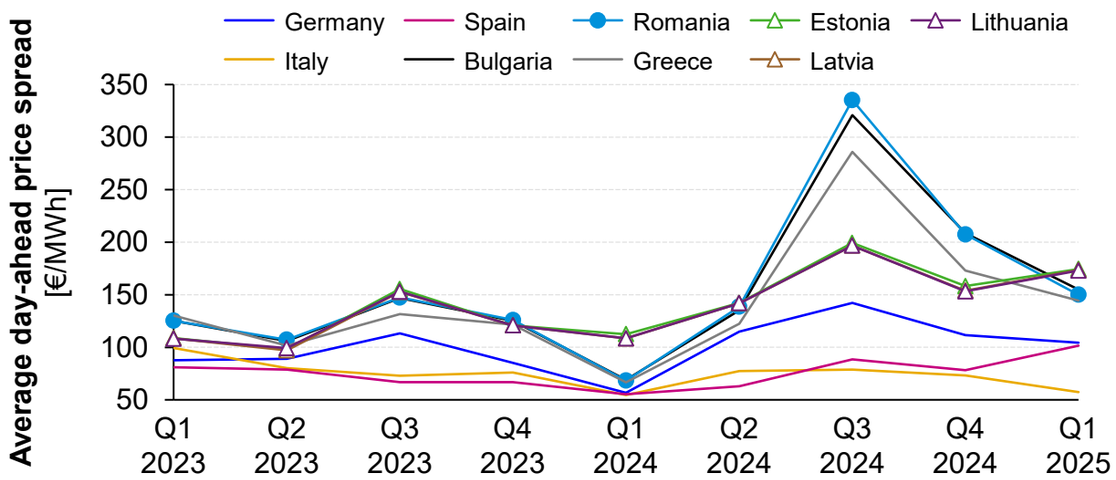
The growth of renewables increases the need for flexibility, and creates value opportunities for energy storage systems

Flexible capacity requirement grow exponentially with vRE



- As renewable energy penetration increases, the intermittency of supply combined with fluctuating demand is **intensifying**, creating a **greater need for flexible energy storage solutions** to balance the grid
- Grid-scale storage capacity must expand significantly to **ensure load balancing and reliability** in renewable-heavy energy systems
  - The recent blackout in Spain highlighted the need to accelerate storage deployment, to enhance grid resilience and prevent future disruptions

Important intraday price spreads are an opportunity for ESS



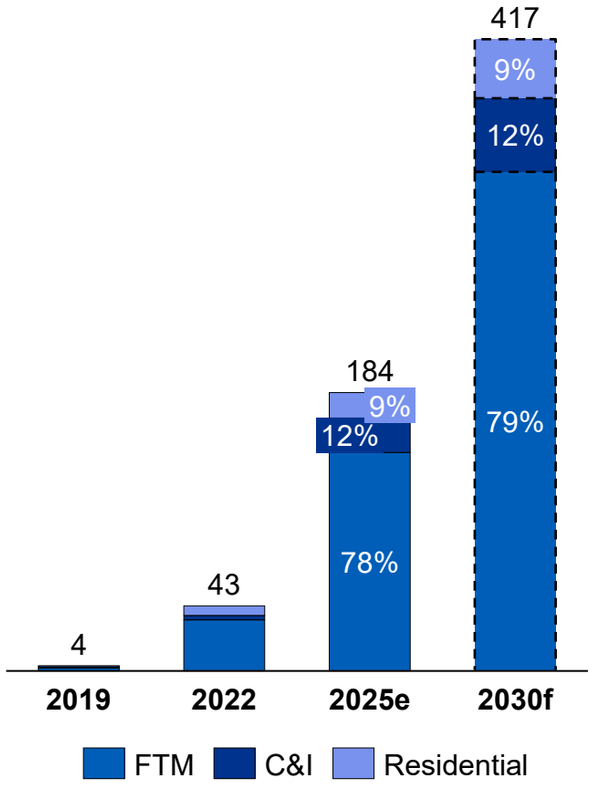
- **Price spreads** between day and evening **increased in 2024 compared to 2023** across Europe, with lower prices during the day due to high solar generation, and a **rise in the evening driven by peak demand**
- Widening price spreads in electricity markets are **creating greater opportunities for energy arbitrage:** Increased storage capacity enables market players to capitalize on peak and off-peak price differentials, enhancing the economic value of energy storage system

Sources: ENTSOE, RBC, KPMG research and analysis

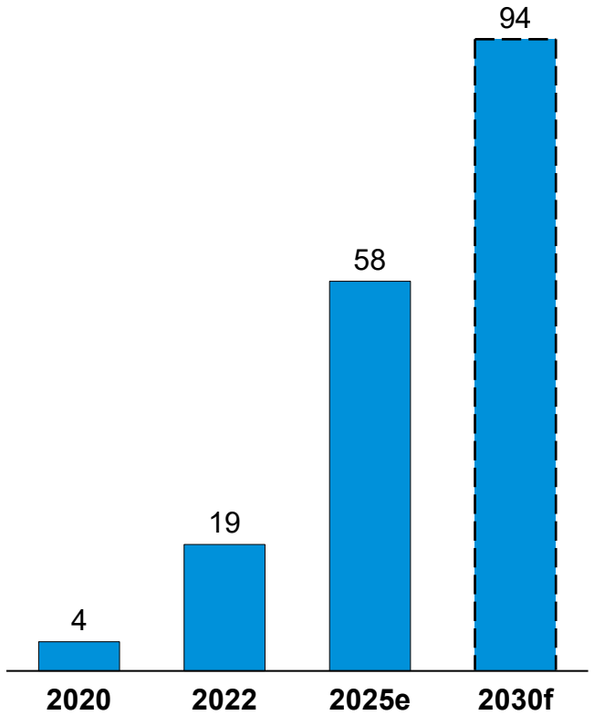
As a result, the BESS market is set to surge, with net additions expected to reach around 420 GWh by 2030

Global BESS additions forecasts

BESS addition per application
[Global, GWh]

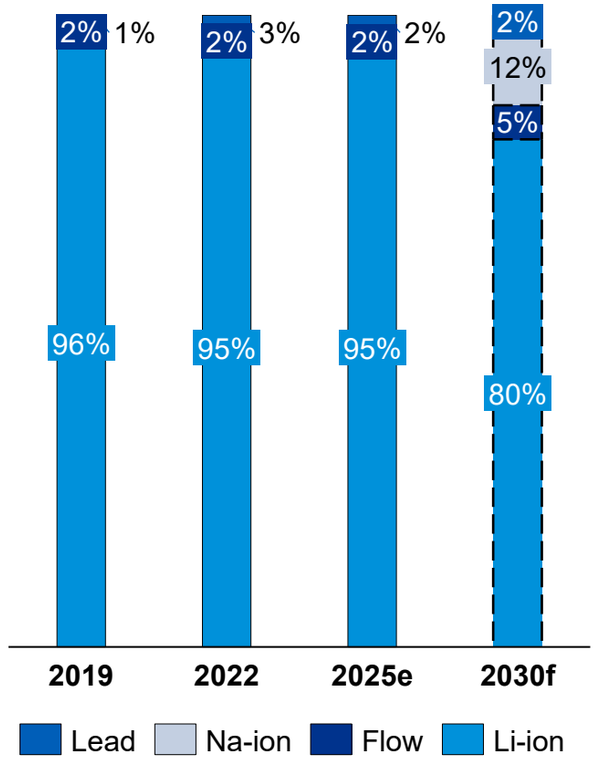


BESS addition value
[Global, $B]



All hardware and software costs, excluding integration and human costs

Technology breakdown of BESS additions
[Global, GWh]

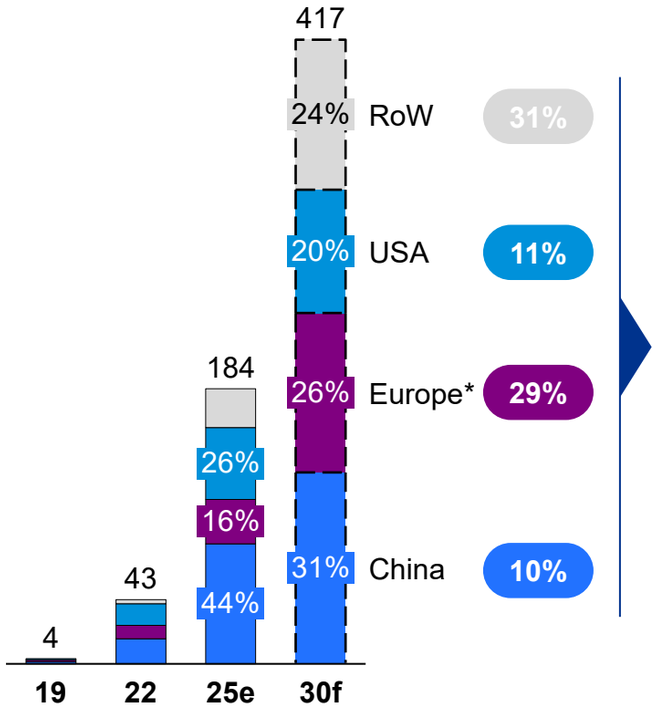


Sources: KPMG research and analysis

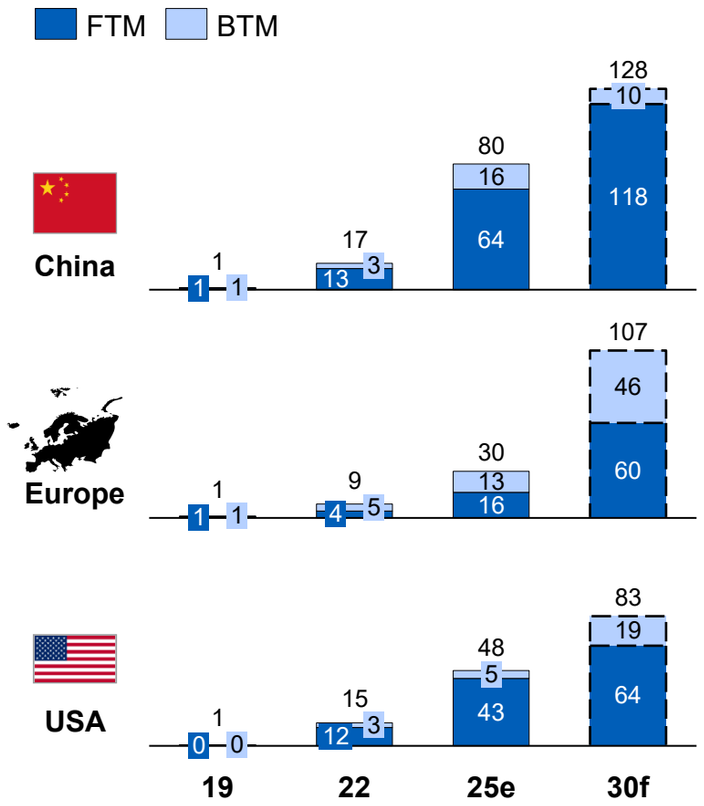
China, Europe, and USA should take the lion's share of the BESS market, while India is expected to become a major player by 2035

BESS market per region

Regional additions of BESS
[Global, GWh]



Regional focus – BESS additions per application
[GWh]



Sources: KPMG research and analysis

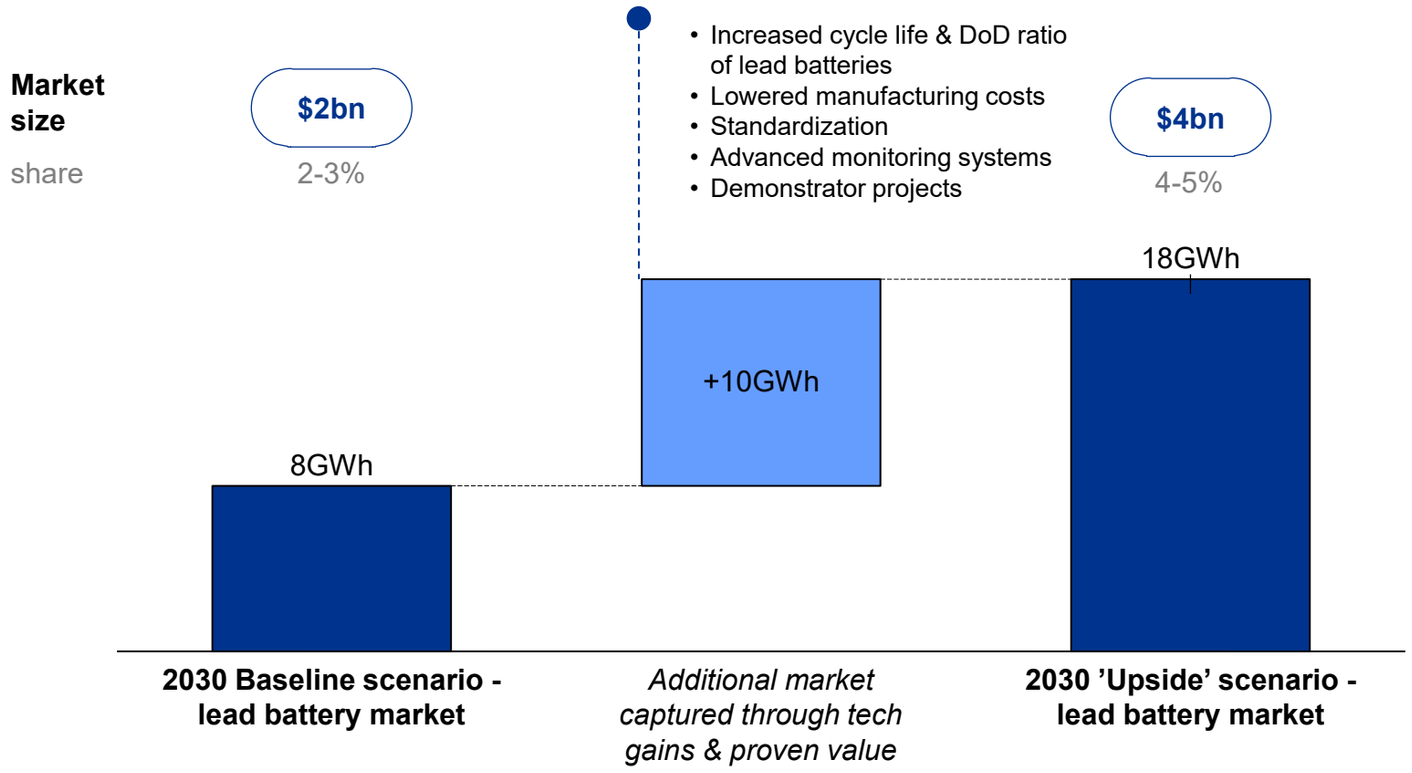
KPMG insights

- **China**: The recent **removal of co-location requirements** for on-grid RE projects, and the introduction of a **new renewable energy trading mechanism**, expected to shift the market **towards higher-quality ESS** and **stimulate domestic additions.** China also manufactures **97% of global production in 2024**.
- **USA**: Ongoing policy uncertainty and varying state-level approaches to RE may **create headwinds for BESS deployment** over the next five years
- **Europe**: **Strong regulatory support** is poised to accelerate market development. Key initiatives include Germany's €1B allocation for energy storage, the UK's frameworks ensuring stable returns, and Spain's €700M subsidy program. These efforts support both BTM and FTM applications
- **RoW**: Select regions are rapidly emerging as key players. For instance, **Saudi Arabia** is projected to deploy 5–10 GWh of BESS capacity in 2025, and **India** is poised to become a major market

Through industry-wide LCoS reductions, lead batteries could significantly expand their market share and represent a 18GWh market by 2030

Two forecast scenarios for lead-based BESS deployments

2030 BESS additions
[Global, GWh]



KPMG Insights

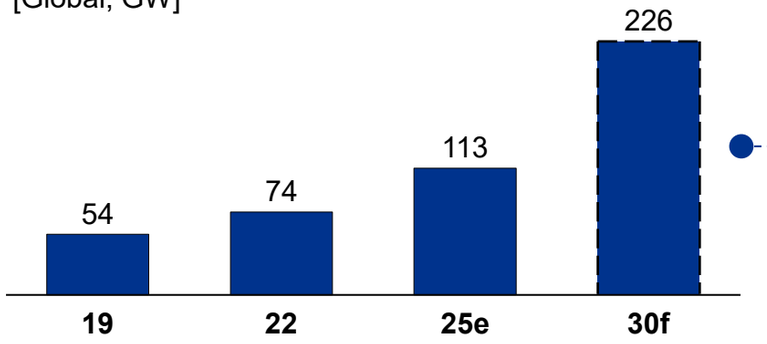
- **By 2035, we estimate that lead batteries could make up to [6-7]% of the market**, by securing the right positioning on key markets:
  - **BTM**, particularly in **EV infrastructure**, lead batteries can take their place as genuine market competitors
  - In emerging economies, particularly India, lead batteries can be adopted to support the deployment of utility-scale RE against a backdrop of rising temperatures
- **The Upside scenario presupposes these prerequisites across the entire lead industry**:
  - Secure R&D investment to achieve Long-Duration Energy Storage systems
  - Secure R&D investment to achieve extended cycle life, with deep discharge cycles
  - Deploy demonstrator projects to prove lead's viability to project developers

Sources: expert interviews, KPMG analyses

Home and industrial UPS market is expected to surge, mainly fueled by the development of data centre and GenAI demand

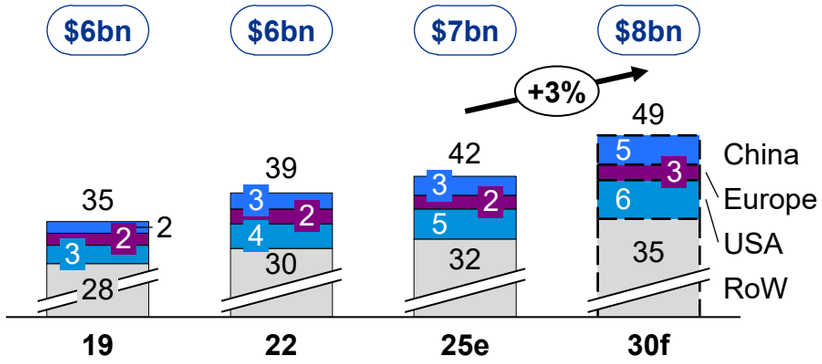
Lead battery demand for UPS

Estimated datacenter capacity evolution
[Global, GW]



GenAI is the fastest-growing segment, driving accelerated data center deployment—especially in the U.S., which **dominates this market**

Estimated lead battery demand for UPS [Global, GWh]



82 Pb 207.2

The demand for UPS is **dominated by the Indian market**, where annual sales go up to ~25GWh/year according to industrials

KPMG insights

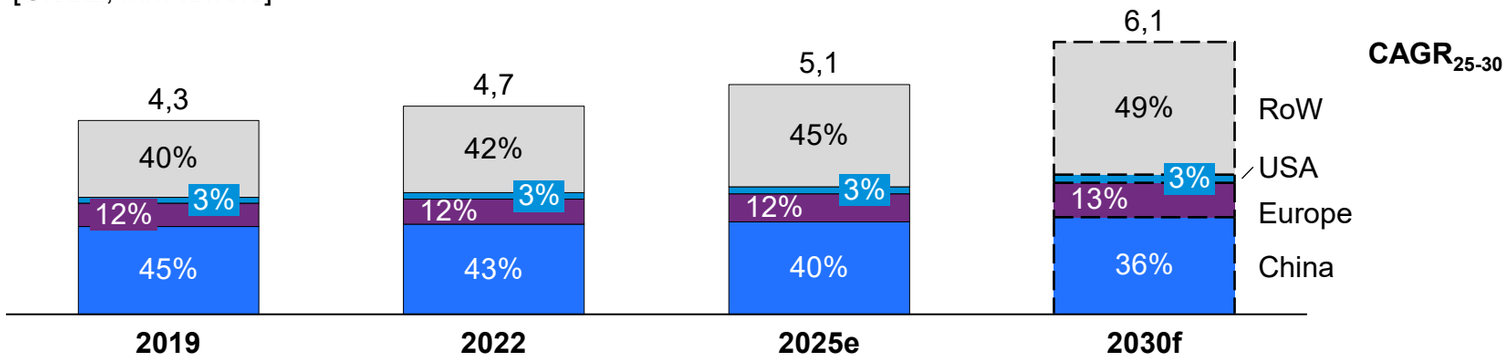
- Around 8 million households in India adopt home inverters each year (World Bank), while industrials size the Indian market at around 25GWh, reflecting **robust growth in residential power backup demand**, yet difficulties to precisely size it
- **Modular UPS systems are gaining traction** due to their improved energy efficiency, now making up over one-third of the Chinese market, and growing at a **12% CAGR worldwide**
- Meanwhile, traditional UPS solutions are facing **increasing competition from BESS**, which are gradually taking over in several use cases
- **The anticipated deployment of Small Modular Reactors** (SMRs) after 2030, driven by rising data center power needs, could **encourage the use of lead-acid batteries**, favored for their safety in nuclear-linked infrastructures.

Sources: Press, Kstar, Company documentation, KPMG research and analysis

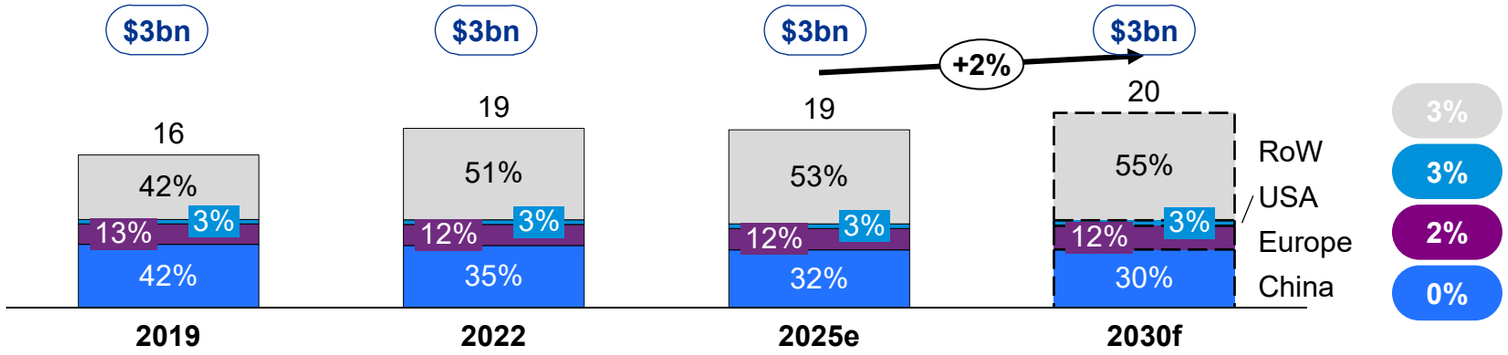
As 4G/5G networks progresses over the various regions, lead battery demand advances to provide UPS services

Lead battery market for telecoms

Estimated number of telecom towers
[Global, MM towers]



Lead battery demand for telecoms [Global, GWh]



KPMG insights

- The rapid **rollout of new wireless networks**, particularly the **shift from 4G to 5G**, is driving the need for a denser network of towers—supporting sustained market growth on a global scale
- At the same time, l**ithium-ion batteries are gaining traction,** particularly in some applications
  - The ongoing expansion of telecom towers is being shaped by emerging trends such **as edge computing**, which requires UPS systems to be **more compact and space-efficient**.
- At the same time, there is a growing need for **seamless integration with hybrid energy systems** and increased attention to cybersecurity as power infrastructure becomes more connected

Sources: Press, Company documentation, KPMG research and analysis

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Thank you!