



ELBC

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THE RECHARGEABLE BATTERY MARKET AND MAIN TRENDS 2023-2030

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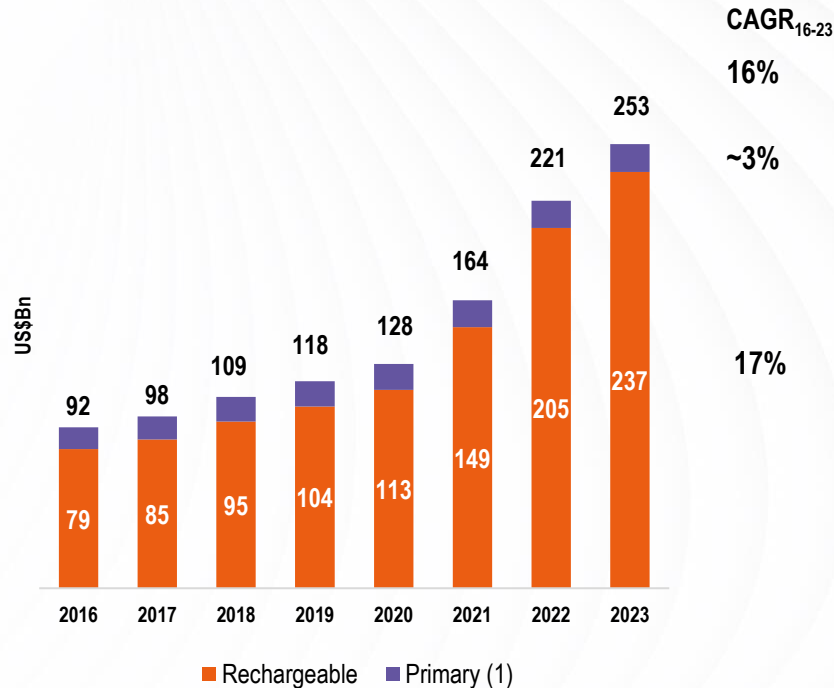
September 2024



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ENERGY



Battery market in value 2016-2023, worldwide, US\$ Bn



(1) Non rechargeable – Source: AT Kearney, Duracell, Avicenne
Based on selling price from manufacturer to retailer

WORLD BATTERY MARKET OVERVIEW

Total Battery market Worldwide is >250 Bn

MACRO-TRENDS DRIVING THE BATTERY MARKET

Battery is a key technology for new concepts of mobility and energy (e.g. electric mobility, stationary storage) supported by the following trends:

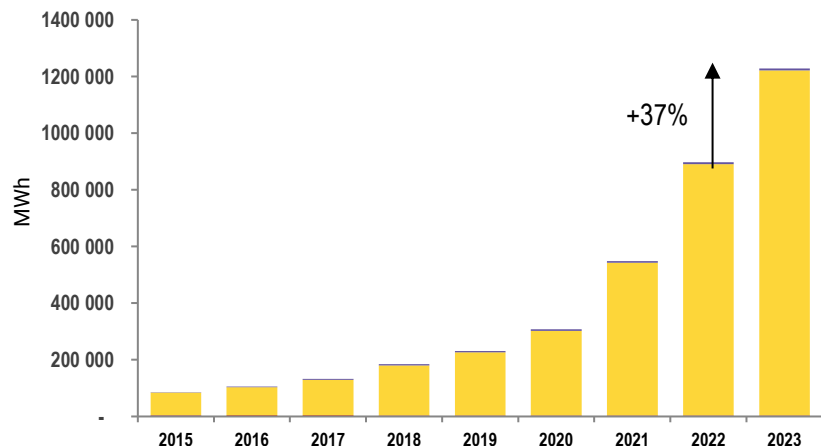
- Population increase and city growth challenging existing mobility and energy solutions
- Shift in energy production with an increasing focus on renewable energies as an alternative to fossil fuel and nuclear
- Global awareness regarding global warming pushing for adoption of green solutions(global objective of CO2 emissions reduction, government regulations and incentives, social pressure for environmental-friendly solutions)



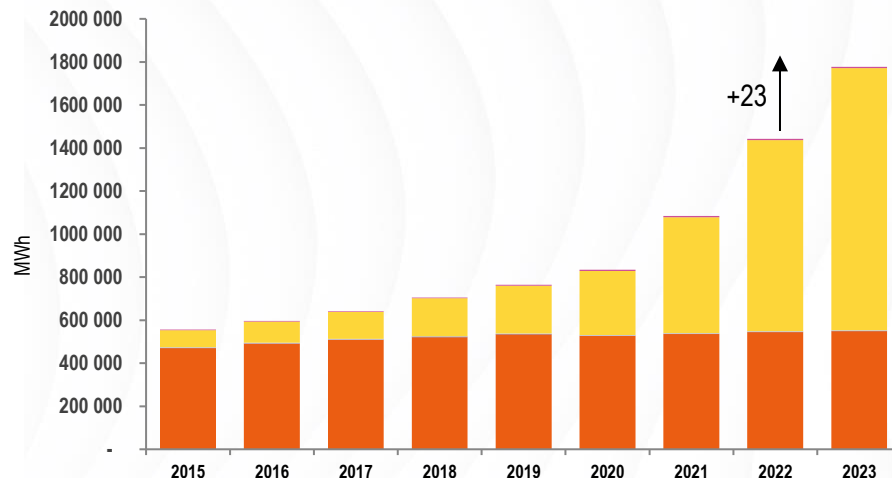
The worldwide battery market

Within the global battery market, the Lithium-Ion battery segment represents the highest growth & the major investment part, while Lead Acid batteries still represents >30% of the market

Worldwide battery market by Chemistry, 2015-2023, MWh



Worldwide battery market by Chemistry, 2015-2023, MWh



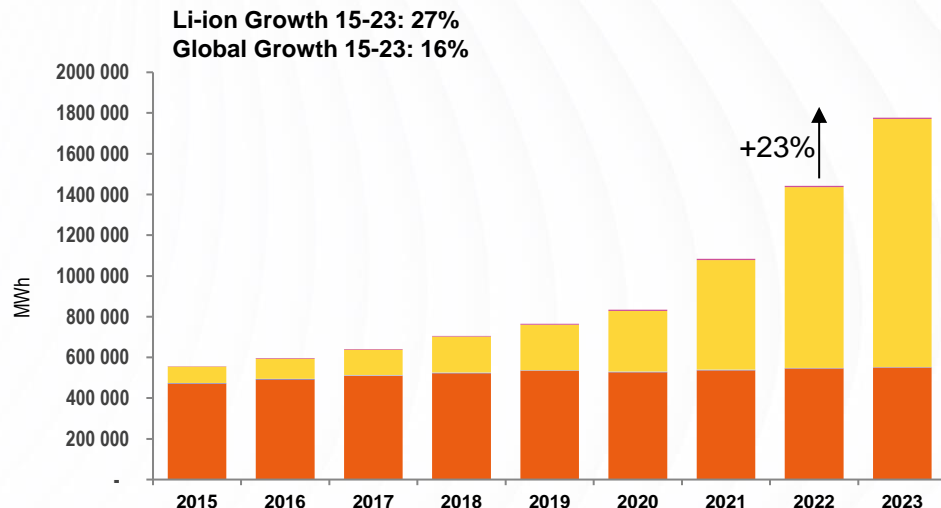
Others (Flow battery, NAS, ...) Li-ion NiMH NiCD Others (Flow battery, NAS, ...) Li-ion NiMH NiCD Lead Acid



The worldwide battery market – Lead Acid

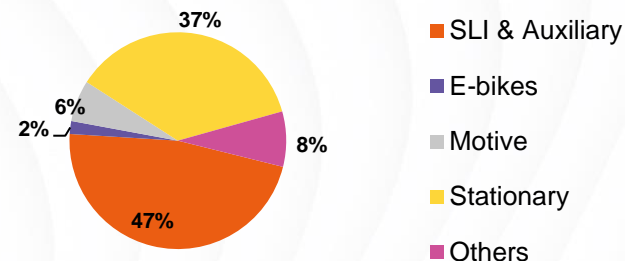
Lead acid batteries : from 526 GWh in 2020 to 550 GWh in 2023

Worldwide battery market by Chemistry, 2015-2023, US\$Bn

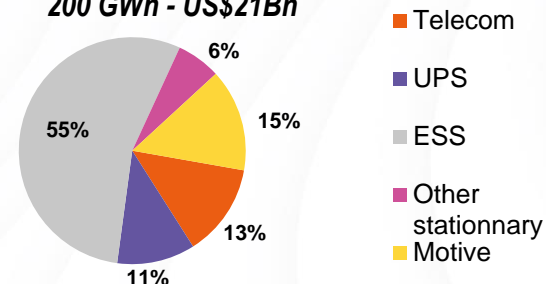


Others (Flow battery, NAS, ...) Li-ion NiMH NiCD Lead Acid

2023 Lead Acid batteries market:
550 GWh - US\$50Bn



2023 Industrial Lead Acid batteries market:
200 GWh - US\$21Bn

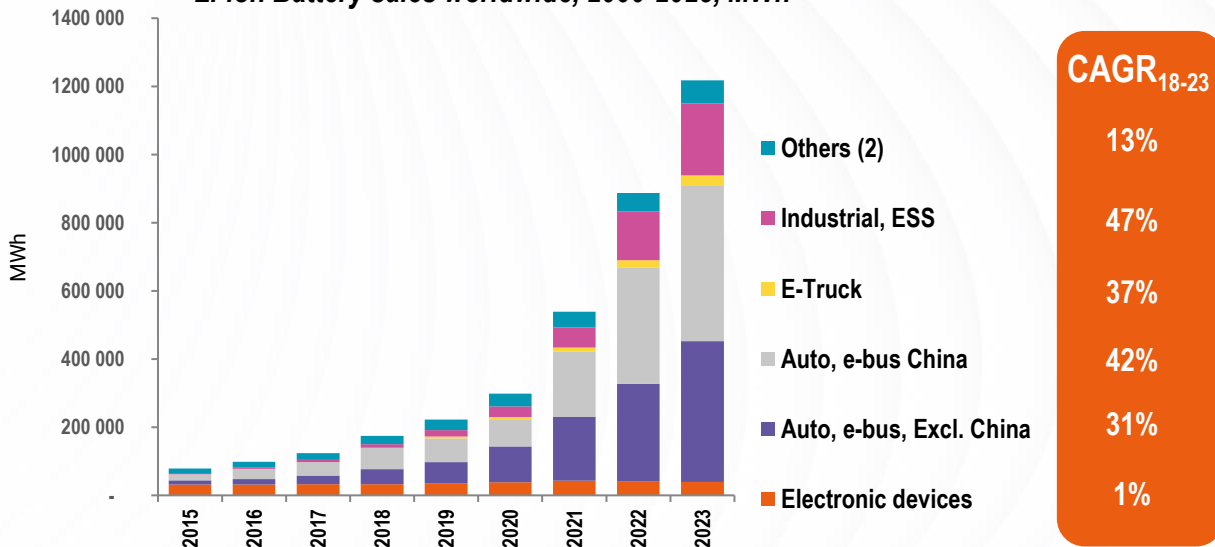




The Lithium-ion battery market 2000 - 2023

In 2023, EV, e-buses & e-trucks account for 75% of the li-ion battery market with a total LIB market of 1 200 000+ MWh

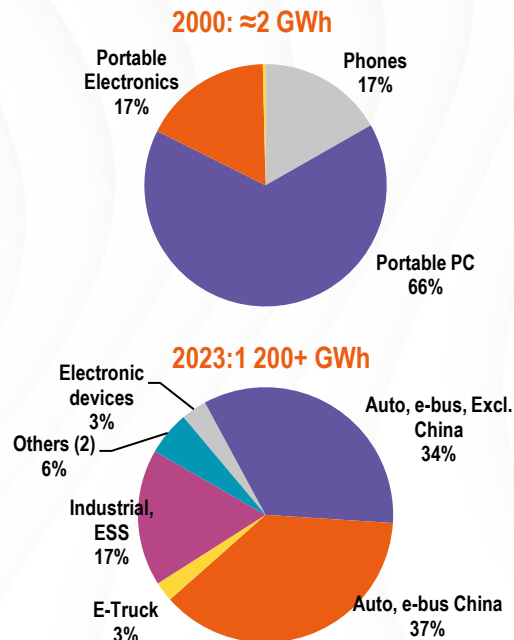
Li-ion Battery sales worldwide, 2000-2023, MWh



(1) Pack level

(2) Others: medical devices, power tools, gardening tools, e-bikes...

CAGR₁₅₋₂₃: 37% per year in volume

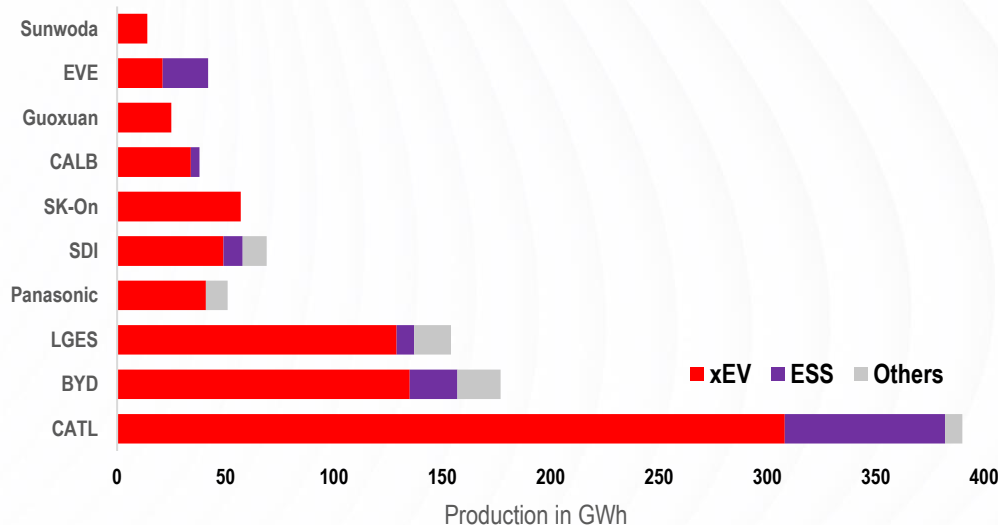




Lithium-ion battery production

In 2023, the Worldwide li-ion battery market represents >1200 GWh, with CATL producing 390 GWh (31%), BYD 177 GWh & LG 155 GWh – ESS account for 185 GWh

Lithium-ion battery production, in 2023, in GWh



(1) xEV including trucks, buses, ESS, industrial, portable, power tools, E-bikes, LSEV, Medical, Space, aviation, train, marine, and many more

In 2023	xEV	ESS
CATL	308	74
LGES	129	8
BYD	135	22
Panasonic	45	
SDI	49	9
SK-On	57	
CALB	34	4
Guoxuan	25	
EVE	21	21
Sunwoda	14	0
Farasis	15	
Svolt	10	
PPES	6	
AESC	5	
REPT		14
HTHIUM		13
GREAT POWER		6
GOTION		6
Other players	50	8
Total	903	185

¹: xEV including all kind of electric passenger cars HEV, PHEV & EV – excluding E-buses, E-trucks, E-vans

²: Other lithium-ion battery market (Excluding xEV)

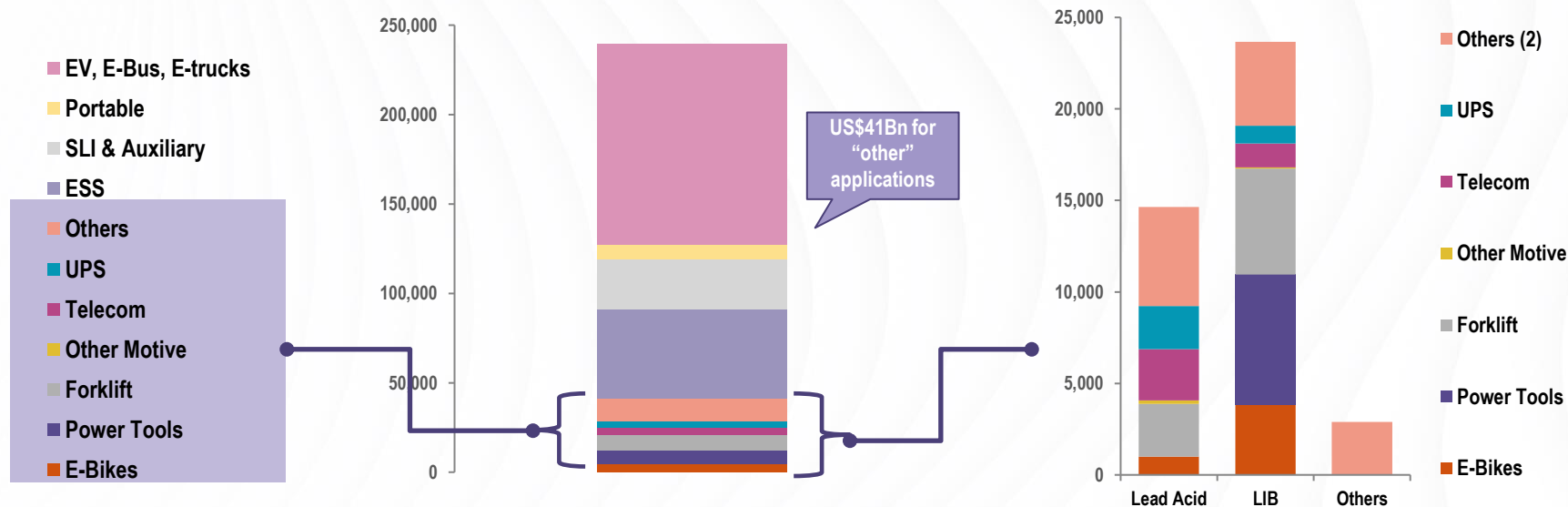


The worldwide battery market in 2023

Beyond EV, Portable, SLI market & ESS, a lot of “other” applications are growing, representing an additional market of US\$ 41Bn¹ in 2023

Worldwide battery Market split in applications, 2022, US\$Mn

Worldwide « other » battery applications split in applications & chemistry, 2022, US\$Mn



1- Pack level: Pack including cells, cells assembly, BMS, connectors – Power electronics (DC DC converters, invertors...) not included

2- Other app: marine, train, aviation, space, medical, caravanning, Low speed electric vehicles, Golf cart...

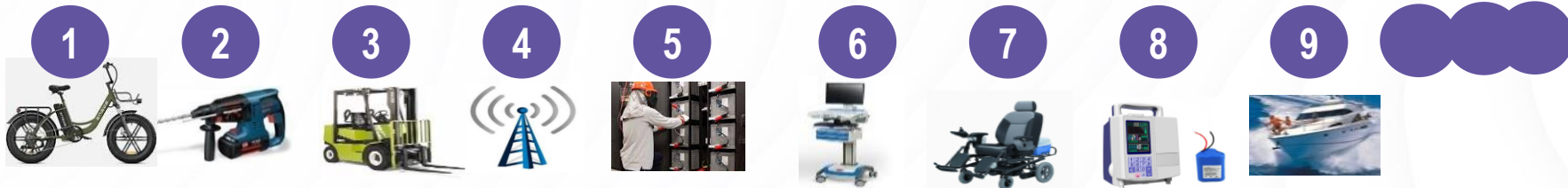
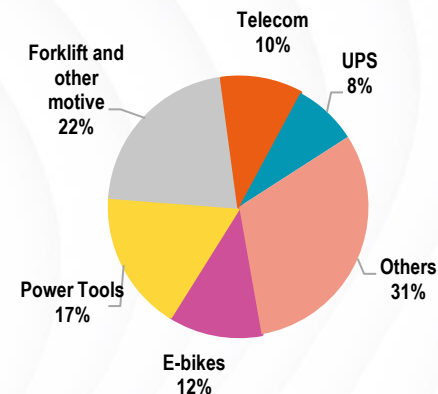


Details on the “OTHERS” applications

In 2023, the so called “other” applications represent a market of US\$41Bn¹ at pack level

- | E-bikes, 3 wheelers
- | Power tools including gardening tools, cordless vacuum cleaner
- | Forklift, Automatic handling equipments, Motive industrials, Automated Guided Vehicles, Scrubber Dryer Machines,
- | Stationary including Telecom, UPS, Back-up
- | Medical
- | Marine
- | Aviation
- | Railways
- | Low Speed Electric Vehicles
- | Others...

Other applications market share in 2023, % of value



¹: Pack level: Pack including cells, cells assembly, BMS, connectors – Power electronics (DC-DC converters, invertors...) not included

Few comments before making forecasts

The Moore's Law we know in electronics do not work in electrochemistry: we do not expect any revolution in the EV battery technology over the next 10 years ; Evolution but no revolution

Long time to market



Safety issue could delay this market



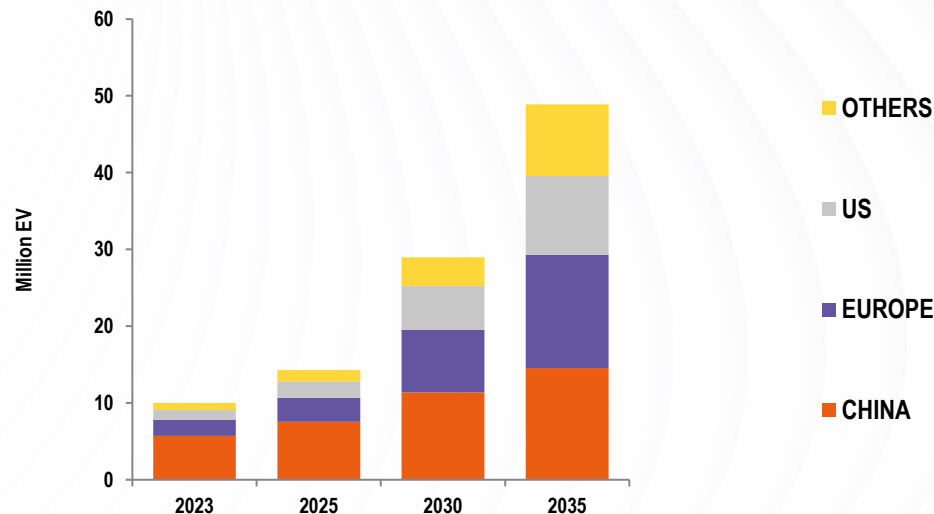


EV & PHEV forecasts worldwide

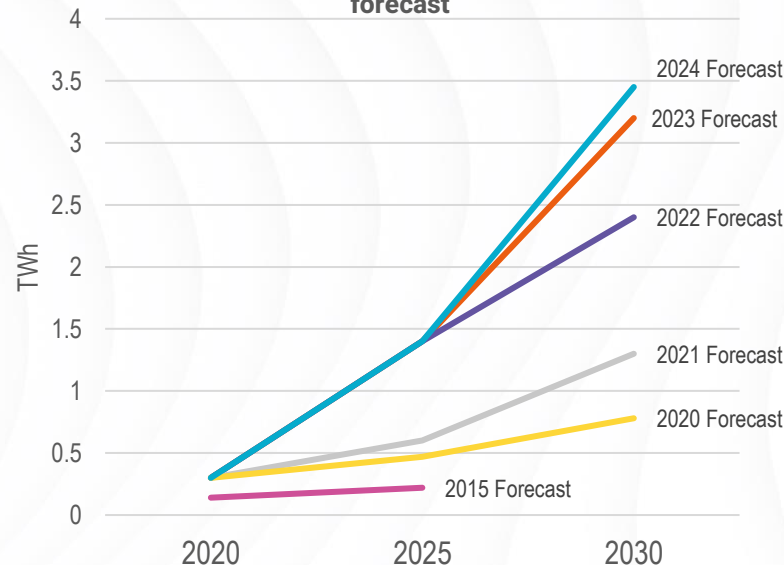
Full EV (Passenger cars & commercial vehicles) market will be ~50M worldwide in 2035

We always underestimate the battery market

EV market Worldwide (Million)



AVICENNE EV, E-buses, E-trucks Battery market forecast



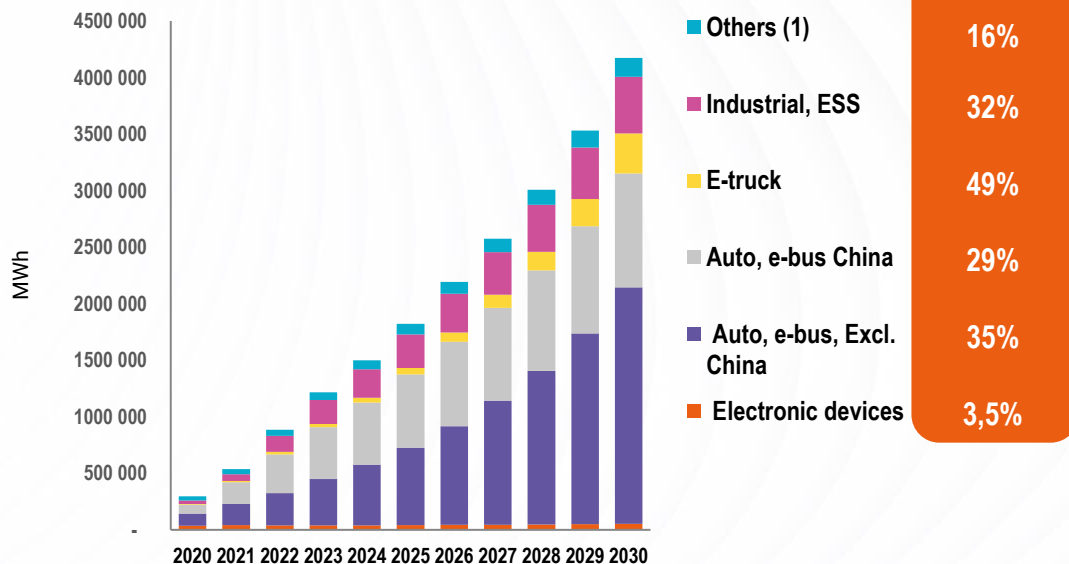
Accurate forecasting is needed in the supply chain to continue to enable growth, avoid costly timing errors and missing the opportunity, Avicenne Energy's approach will be to remain conservative and a trusted partner with our clients on their growth journey



Li-ion battery market forecasts

The Lithium-ion battery market will grow from ≈ 1200 GWh in 2023 to $\approx 4,200$ GWh in 2030, with a $CAGR_{20-30}$ of 30% in volume

Li-ion Battery sales, Worldwide, 2000-2030, MWh



(1): Others: medical devices, power tools, gardening tools, e-bikes...

$CAGR_{20-30}$

16%

32%

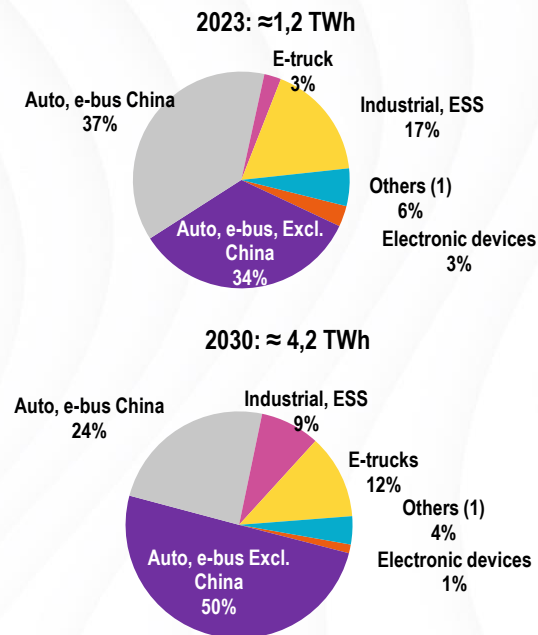
49%

29%

35%

3,5%

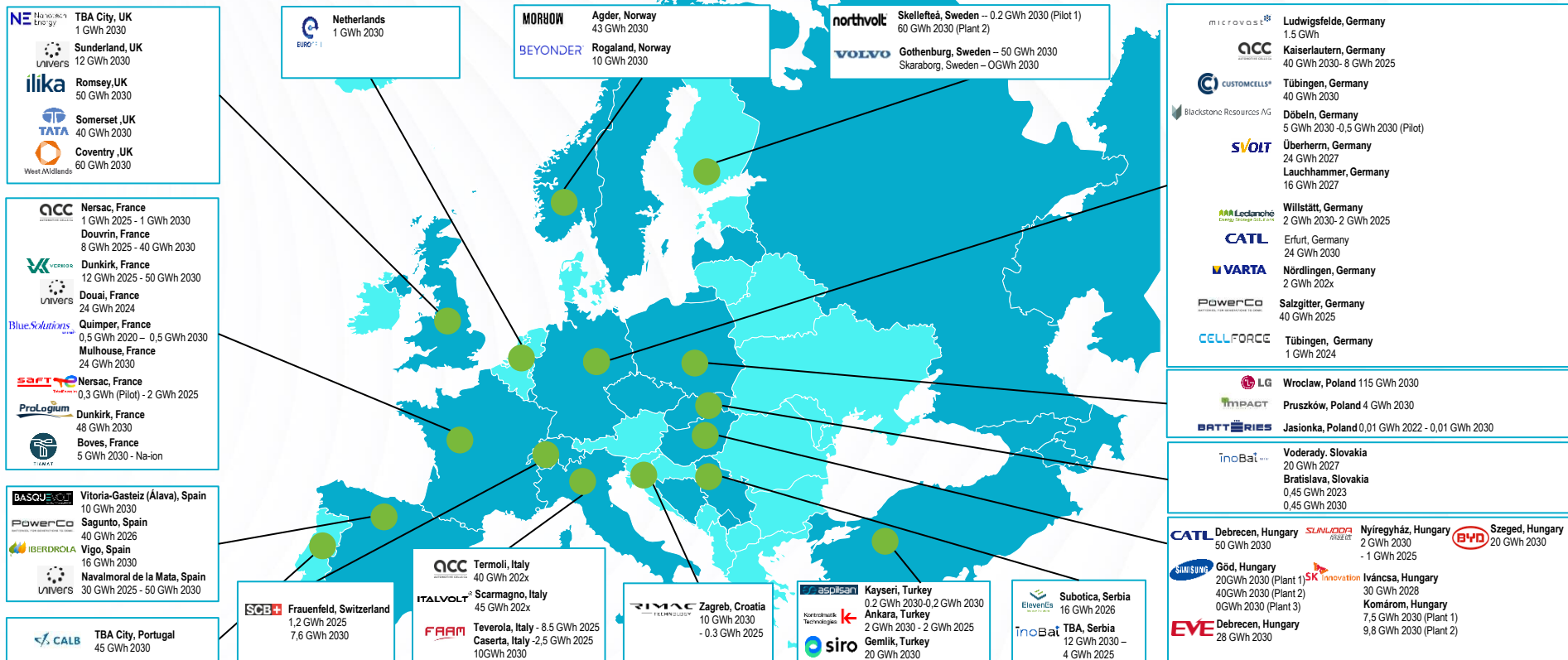
Li-ion Battery sales, Worldwide, per application :





Announced Europe production capacity*

Announced production capacity in 2030: ≈1,700 GWh





Project Annoucement ----> Reality

A huge number of projects are announced (>2000 in our database)

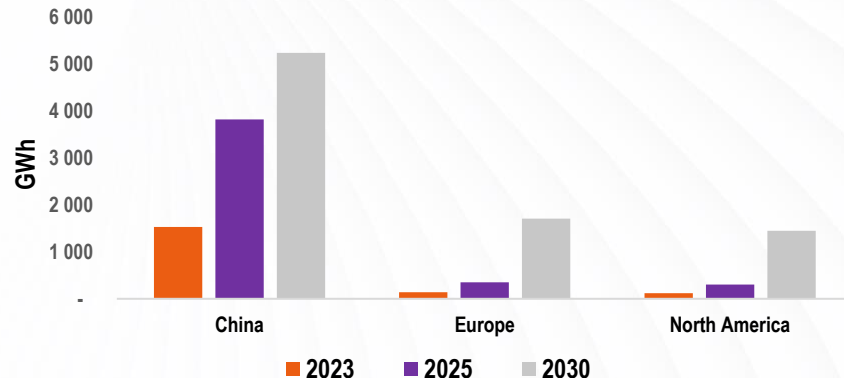
Some will be delay, some will never happen

MAIN CRITERIA :TECHNOLOGY, FOUNDS & CUSTOMERS

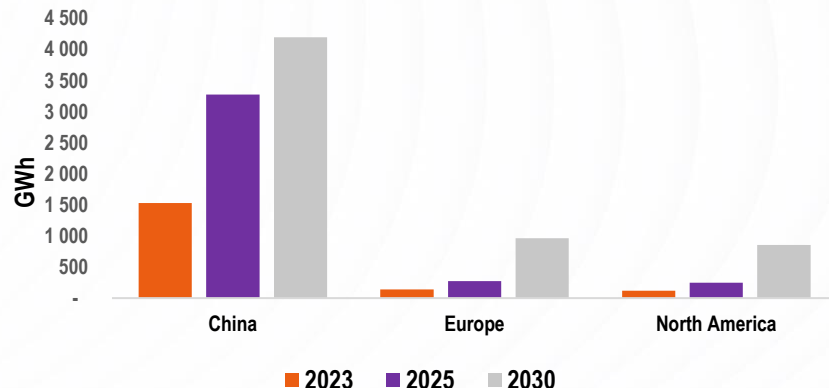
Degrees of Certainty	Probability Levels				
	Existing	High	Medium	Low	Research
Description	<ul style="list-style-type: none"> - Plant in place - Operating level is low capacity - High capacity includes announcements for expansions - SOP set at 2020 	<ul style="list-style-type: none"> - Well funded industry participant - Strong technology base - firm product offering with value proposition - Strong customer base - firm demand - Construction well planned - engineering and construct 	<ul style="list-style-type: none"> - Partially funded - Technology development including target customer sampling, but unclear value proposition - Target customer base, but unknown actual demand - Construction progress - demo plant or pilot, uncertainty on main plant 	<ul style="list-style-type: none"> - Unclear funding - No clear technology established - Target customer base unknown or questionable demand - Site selected - but limited to no progress on approvals or construction 	<ul style="list-style-type: none"> - Established battery lab - Materials, cell and/or system testing/validation - Wet and Dry labs likely - Strong market focus and connections



Announced Capacity by region, 2023-2025-2030 Total: 9 TWh



AVICENNE view for Capacity by region, 2022-2025-2030, GWh



Worldwide production capacity

Europe & US battery industry will have to invest US\$≈120Bn

Production capacity outside Asia will reach +2 TWh in 2030 (33%)

In Europe, capacity should increase from 140 GWh in 2023 to 1 TWh in 2030

Huge overcapacity in China

US\$60Bn investment required from now to 2030 for cell manufacturing in Europe – same in the US

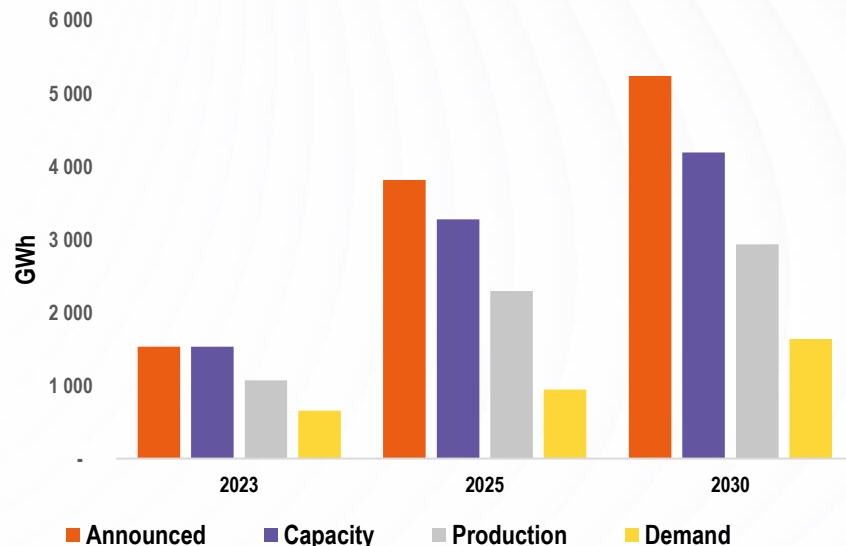
(Capex: ≈ US\$55 - 75/kWh)



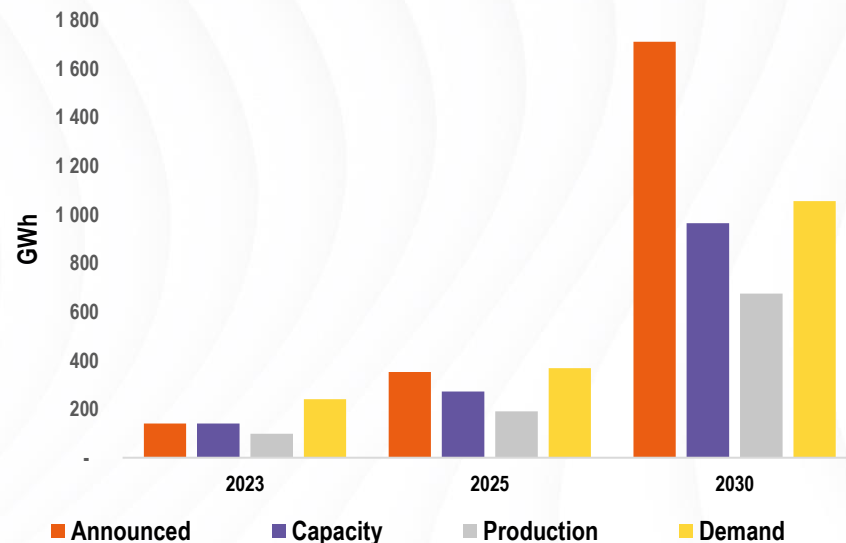
LIB demand & supply by region

In 2030, 5.2 TWh announced in China versus 1.7 TWh in Europe. Until 2030, Europe will face shortages in supply as EU Gigafactories production are not sufficient

LIB demand & supply in China, 2022-2025-2030, GWh



LIB demand & supply in Europe, 2022-2025-2030, GWh

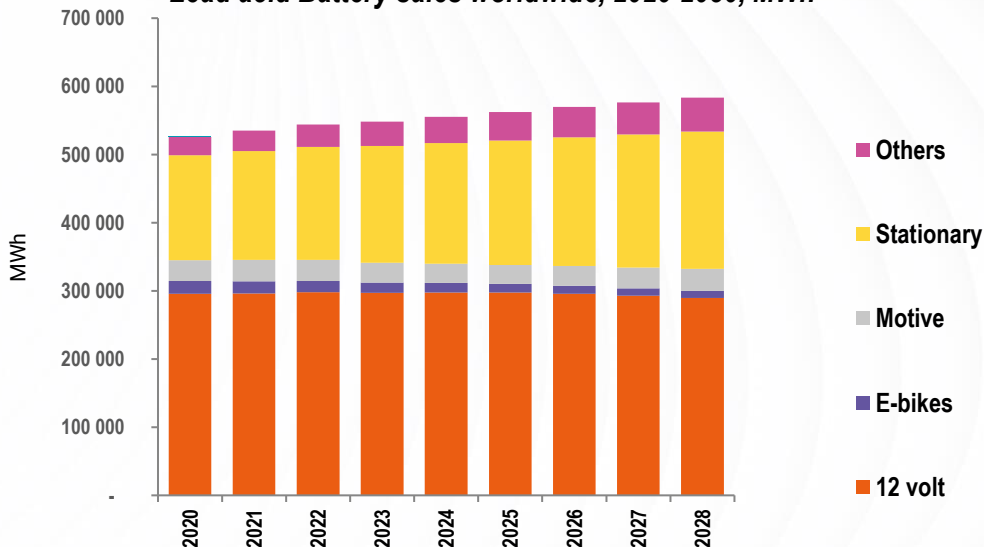




The Lead acid battery market 2023 - 2030

12v batteries & stationary are the main applications

Lead acid Battery sales worldwide, 2020-2030, MWh



(1) Others: LSEV, Golf cart, medical cart, marine, ...

CAGR₂₀₋₃₀

7%

3,4%

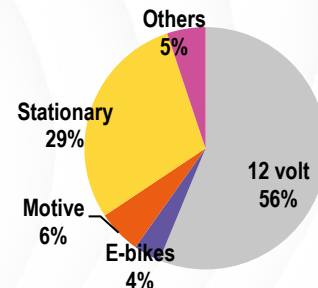
1,8%

- 8%

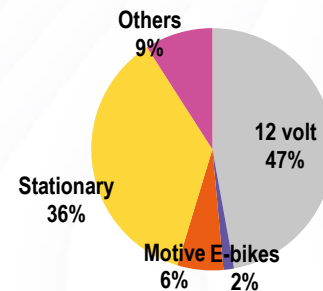
- 0,5%

CAGR₂₀₋₃₀: 1,2% per year in volume

2020: ≈ 527 GWh



2030: 594 GWh



AUTOMOTIVE BATTERIES

	12V Batteries		2030 in GWh		Traction Batteries
	SLI	Auxiliary			
Conventional ICE (SLI batteries) Stable	<p>Li 4% Lead 96%</p>	<p>Li 54% Lead 46%</p>	Current mix of NiMH and Li-ion will move to 100% Li-ion in 2025-30		<p>Li 100%</p>
Hybrid Vehicles Strong growth expected until 2030: +9% Decrease and disappear after 2035					
PHEV Market share to decrease quite fast as a result of high cost and EC Regulation					
EV Strong growth anticipated (+30%)			Chemistry is and will remain exclusively Li-ion		<p>Li 100%</p>



INDUSTRIAL BATTERIES

UPS Batteries

- **Lead-based batteries** will remain dominant in 2030 (70%)
- 7% annual growth in volume to be expected up to 2030

Telecom Batteries

- Almost exclusively **lead-based** today, but Li-ion market share of 27% expected by 2030
- 7% annual growth in volume to be expected up to 2030

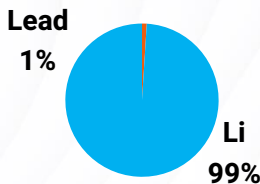
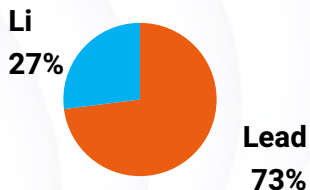
ESS – Grid & Residential (excluding inverter market)

- Today, **mostly Li-ion** batteries
- >30% annual growth in volume expected up to 2030

Motive Batteries

- **Lead-based** batteries (70% market share in 2023) still dominant today
- By 2030, **Li-ion** market share will reach 49%
- 5.1% annual growth in volume anticipated up to 2030

2030 in GWh





Synthesis

Lead-acid battery market share will stay at a high level in 2030, except for ESS

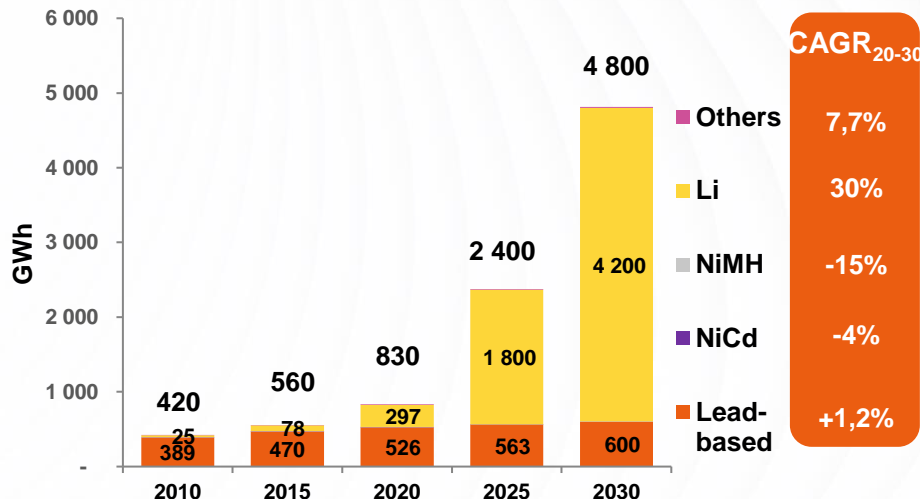
		2023-2030 Market Sales/year	2023-2030 LAB market share	CAGR _{TOTAL} 20-30 CAGR _{LAB} 20-30 (In value) Competitors technology	Rationales
1	Stationary Applications – Telecom	21,3 GWh US\$ 4,1 Bn 31,5 GWh US\$ 5,3 Bn	82% in vol. 68% in value 63% in Vol. 60% in value	TOTAL: 5,1% LAB: 2,7%	In some specific cases (hot, humid and difficult access location), TCO of lithium ion could be lower than lead acid batteries.
2	Stationary Application – UPS	17,5 GWh US\$ 3,3 Bn 25,9 GWh US\$ 4,6 Bn	84% in vol. 61% in value 70% in Vol. 58% in value	TOTAL: 5% LAB: 1,6%	Costs, shipping and safety issues limit the usage of Li-ion to user that are willing to pay the extra costs associated with Li-Ion batteries. Currently this consists of the military and a limited number of scientific markets or few data centers.
3	Motive application	41,4 GWh US\$ 8,7 Bn 68,2 GWh US\$ 11,7 Bn	67% in vol. 33% in value 51% in Vol. 23% in value	TOTAL: 9% LAB: -2%	In the case of intensive use, TCO of Li-ion (taking in account time saving due to multiple shift operation) could be lower than lead acid. But Li-ion faces several issues: cost, safety and high mass energy density (heavy lead-acid battery used as counterbalance)
4	ESS for the Grid	192 GWh US\$ 32,7 Bn 453 GWh US\$ 54 Bn	3% in vol. 3% in value 3% in Vol. 3% in value	TOTAL: 27% LAB: 6%	The market is dominate by LIB (97% of the market). Lead acid only 3% but it means 7,5 GWh in 2023 and 12 GWh in 2030.



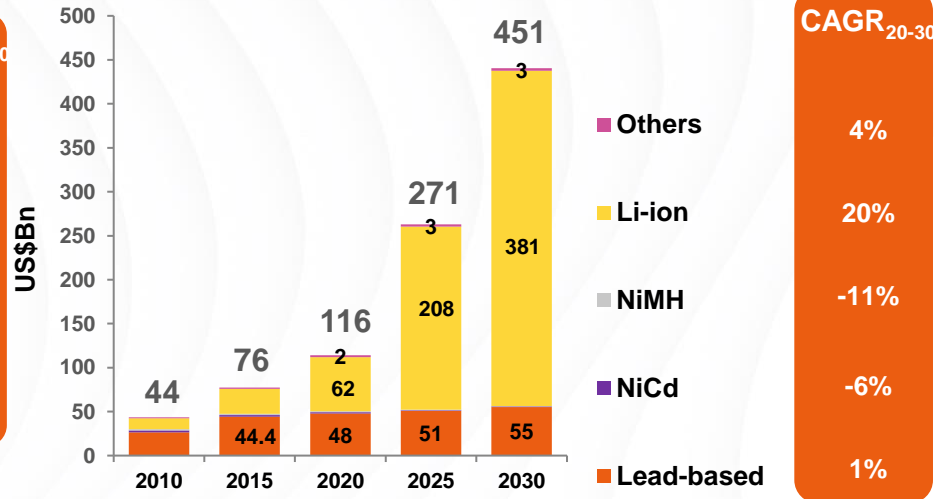
Worldwide battery market

Lead-based and li-ion batteries will remain in 2030, the 2 most important markets
Market will reach 4,8 TWh & US\$≈450Bn in 2030. The CAGR₂₀₋₃₀ in value is 14%

The worldwide battery market in value by chemistry, 2010-2030, GWh



Market value at Pack level¹, 2010-2030, in US\$Bn



(1) Pack level: pack including cells, cell assembly, BMS, connectors – power electronics (DC-DC converters, invertors, etc.) not included

(1): Li for xEV including all kind of electric passenger cars HEV, PHEV & EV, E-buses, E-trucks, E-vans

(2): Others: automatic handling equipment, robots, forklifts, UPS, telecom, medical devices, residential ESS, grid ESS, drones, hoverboards, etc.



Key takeaways

- Lead based battery: 1,2% growth (2020-2030)
- Very slow penetration of lithium-ion battery for 12 V SLI
- LIB will take market share in e-bikes, Auxiliary batteries, forklifts
- Forklift: LAB & LIB will co-exist
- LAB market share will stay high for Telecom or UPS
- No opportunity for LAB on ESS for the Grid
- Lithium-ion batteries: An incredible growth: $\approx 30\%$ in volume and $\approx 20\%$ in value for the next ten years
- Main drivers: EV market thanks to regulation and incentives
- Hundreds of US\$Bn will be invest in US & Europe by 2030
- Accurate forecasting is needed in the supply chain to avoid costly timing errors
- Europe will not be ready to meet all the demand in 2030
- Today, EU & US have a lack of Gigafactories, Raw materials, Equipments & Talents



Batteries Event 2024

3 days congress in France (Lyon)

October 16–18, 2024 – Tutorials October 15th

26th Edition (first edition in 1999)

+1,200 attendees

+130 Booths

Battery makers, raw materials suppliers, IC & BMS suppliers, tests, machining, coating, ...

+175 international speakers:

Researchers, industrial process, marketing, financials



The future of battery Industry



What is happening NOW ? Operational



SAVE THE DATE
1 > 3 APRIL 2025





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