21ABC

21st Asian Battery Conference and Exhibition

IMMEDIATE AND LONG-TERM PROSPECTS AND CHALLENGES FOR LEAD

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International Lead and Zinc Study Group (ILZSG)

2-5 September 2025

Kota Kinabalu, Malaysia

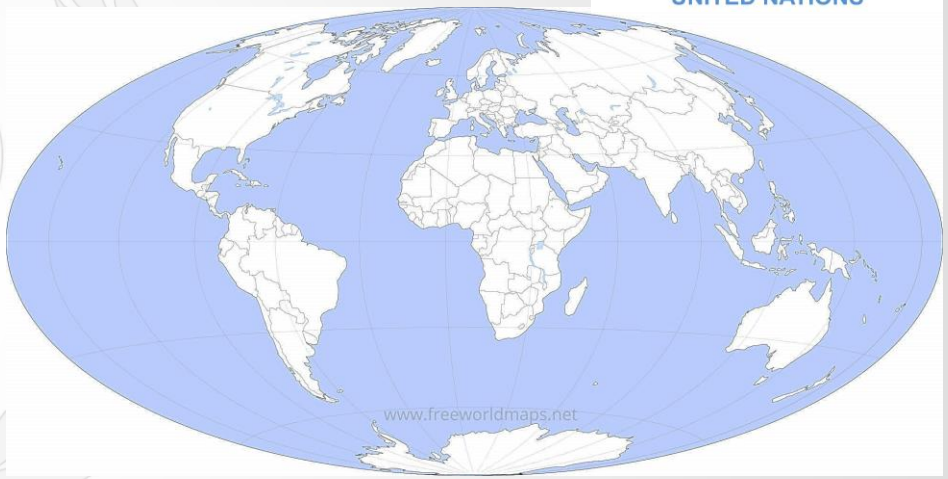
PRESENTATION OUTLINE

- ILZSG Overview
- The Rise of Hybrid and Electric Vehicles
  - Impact on Lead Demand 2024-2030E
- Developments in the E-bike Sector in Asia
  - Implications for Lead Demand 2024-2030E
- Concluding Remarks

ILZSG OVERVIEW

- **Intergovernmental organization set up within the UN system**
- Established by UN in 1959 in New York
- Moved to London in 1977
- From start of 2006 ILZSG, ICSG & INSG co-located in Lisbon, Portugal
- Membership open to any country involved in lead and/or zinc production, usage, or trade
- 26 members **(>85% of global lead/zinc industry)**

UNITED NATIONS



- Australia
- Belgium
- Brazil
- Bulgaria
- China
- Finland
- France
- Germany
- India
- Ireland
- Italy
- Japan
- Korea Rep.
- Mexico
- Morocco
- Namibia
- Norway
- Peru
- Poland
- Portugal
- Russian Fed
- Serbia
- Sweden
- Türkiye
- United States
- European Community

ICSG

ILZSG

INSG

ILZSG – WORK OF THE GROUP

Promote Market Transparency

Closely monitor production, consumption, prices, stocks, trade flows and market balances

- **Monthly Bulletin**
- **Monthly Data Spreadsheet**
- **Online Statistical Database**
- Reports and Directories
- **Twice-yearly Market Forecasts**
  - Detailed **supply and demand short term forecasts** published in April and October
  - Information provided mainly by industry representatives in member countries in response to a global survey
  - Bottom-up forecast starting with country-level estimates that are added together to generate a global forecast
  - Consensus unbiased view providing unique insight into the plans of miners and smelters
  - Results widely covered in global metals press
  - Accuracy carefully monitored and reported on

In-depth Research into Issues of Interest/Concern to Members (Environmental legislation, economic developments, etc)

ILZSG – FACILITATE GOV/INDUSTRY COOPERATION

Study Group six monthly meetings bring together government and industry representatives in Lisbon

- Meetings usually held in April and October
- Up to 150 participants attend in October
- Industry or government delegates from non-members can request participation as observers
- Unique forum where mining ministries can meet their global counterparts and the international metals industry

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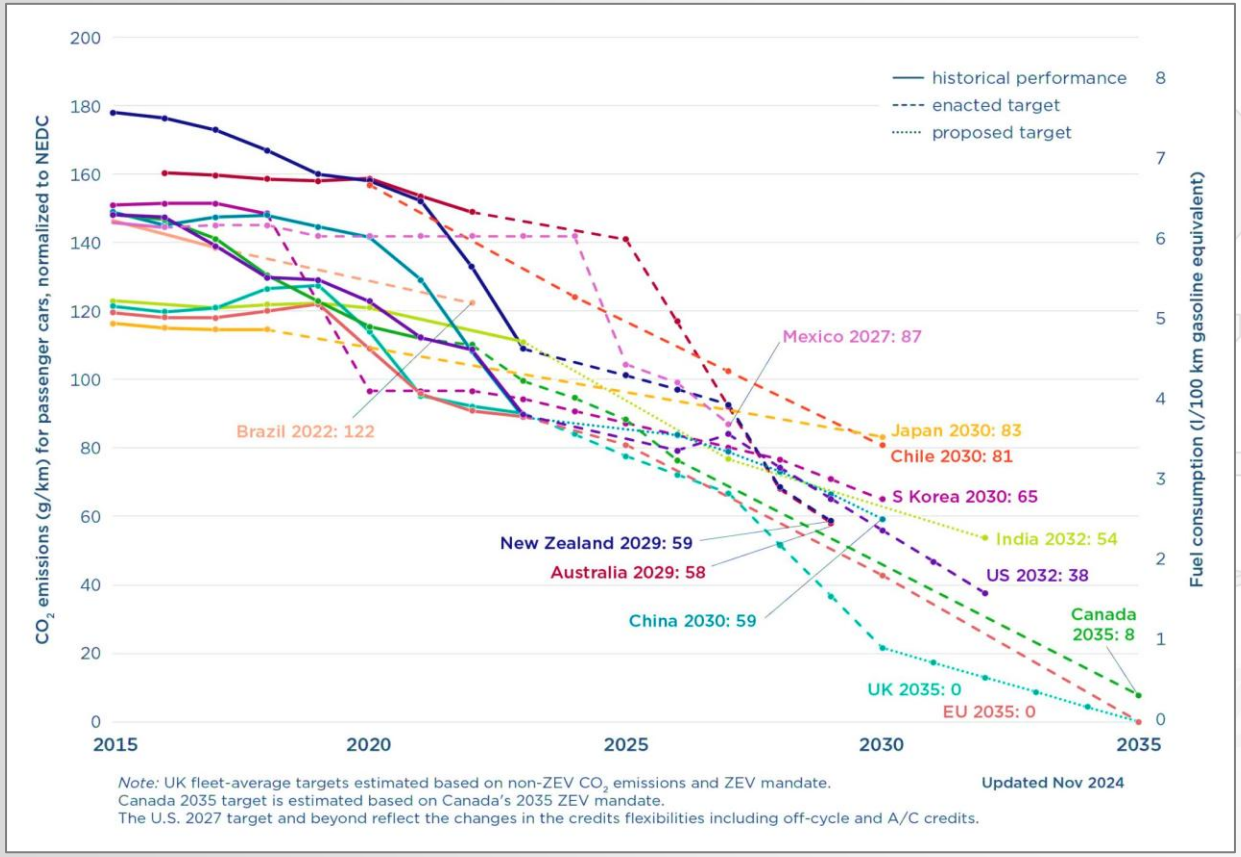
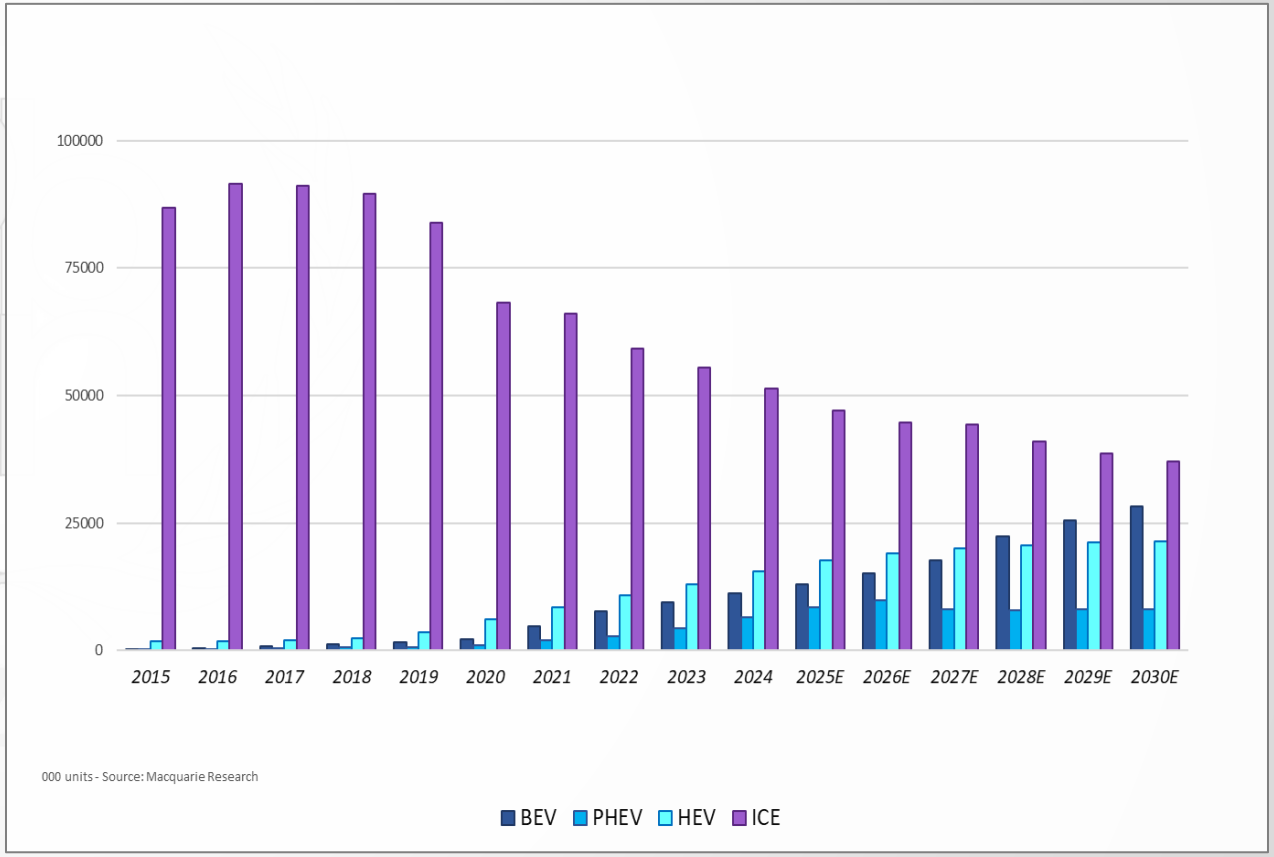
PASSENGER CAR CO2 EMMISSIONS

GLOBAL SALES OF LIGHT DUTY VEHICLES



Source: International Council on Clean Transportation



Source: Macquarie Global EV Tracker v.54

CURRENT TRENDS IN THE AUTOMOTIVE MARKET

- **Sales** of hybrid and electric vehicles **increasing rapidly**
- Global Market share: 2015: 3% / **2024: 39%** / **2030E: 60%**
- Lithium battery technology: **standard** choice for **torque** assistance and **traction** purposes in **HEVs, PHEVs** and **EVs**
- **Lead-acid dominates** the **12V battery** market
- **12V** electrical circuit: **SLI** duties in **ICE** vehicles
- **And Auxiliary** safety & comfort duties in all vehicles

- **Auxiliary 12V batteries: lower lead content => immediate threat to the future of the lead industry?**

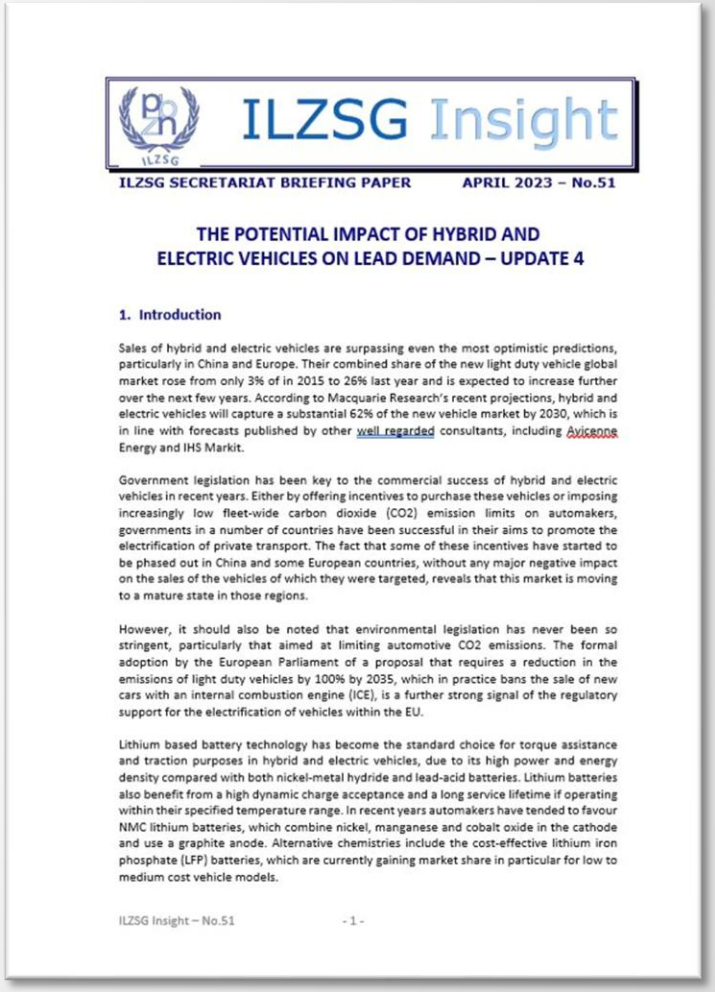
It's not that simple…

Source: ILZSG

Source: Macquarie Global EV Tracker v.54

PREDICTIVE ANALYSIS FOR LEAD USAGE IN LDVs 12V BATTERIES 2024-2030E

- Number **batteries** each **vehicle** will use over its **lifetime**
  - 1 Original Equipment + 3 Replacement
- **Share of Hybrids** using li-ion batteries to start the ICE
  - 10% use higher voltage li-ion batteries to start the ICE + 12V lead battery for auxiliary duties
- **Share of lead-acid** tech in the **12V auxiliary battery** market
  - 85% of 12V auxiliary batteries used in LDVs are lead-based
- The amount of **lead contained** in each **type of battery**
  - SLI: 10kg Pb / Auxiliary: 5kg Pb



ILZSG Insight

ILZSG SECRETARIAT BRIEFING PAPER APRIL 2023 – No.51

THE POTENTIAL IMPACT OF HYBRID AND ELECTRIC VEHICLES ON LEAD DEMAND – UPDATE 4

1. Introduction

Sales of hybrid and electric vehicles are surpassing even the most optimistic predictions, particularly in China and Europe. Their combined share of the new light duty vehicle global market rose from only 3% of in 2015 to 26% last year and is expected to increase further over the next few years. According to Macquarie Research's recent projections, hybrid and electric vehicles will capture a substantial 62% of the new vehicle market by 2030, which is in line with forecasts published by other well regarded consultants, including Avicenne Energy and IHS Markit.

Government legislation has been key to the commercial success of hybrid and electric vehicles in recent years. Either by offering incentives to purchase these vehicles or imposing increasingly low fleet-wide carbon dioxide (CO_2) emission limits on automakers, governments in a number of countries have been successful in their aims to promote the electrification of private transport. The fact that some of these incentives have started to be phased out in China and some European countries, without any major negative impact on the sales of the vehicles of which they were targeted, reveals that this market is moving to a mature state in those regions.

However, it should also be noted that environmental legislation has never been so stringent, particularly that aimed at limiting automotive CO_2 emissions. The formal adoption by the European Parliament of a proposal that requires a reduction in the emissions of light duty vehicles by 100% by 2035, which in practice bans the sale of new cars with an internal combustion engine (ICE), is a further strong signal of the regulatory support for the electrification of vehicles within the EU.

Lithium based battery technology has become the standard choice for torque assistance and traction purposes in hybrid and electric vehicles, due to its high power and energy density compared with both nickel-metal hydride and lead-acid batteries. Lithium batteries also benefit from a high dynamic charge acceptance and a long service lifetime if operating within their specified temperature range. In recent years automakers have tended to favour NMC lithium batteries, which combine nickel, manganese and cobalt oxide in the cathode and use a graphite anode. Alternative chemistries include the cost-effective lithium iron phosphate (LFP) batteries, which are currently gaining market share in particular for low to medium cost vehicle models.

ILZSG Insight – No.51 - 1 -

PREDICTIVE ANALYSIS FOR LEAD USAGE IN LDVs 12V BATTERIES 2024-2030E

OE batteries 2024

1st Repl Batt - 2020

2nd Repl Batt - 2016

3rd Repl Batt - 2012

Lead Usage in LDV SLI/Auxiliary 12V Batteries

	SLI 12V Batteries (10Kg Pb)						Auxilliary 12V Batteries (5Kg Pb)					
	ICE	BEV	PHEV	HEV	TOTAL		ICE	BEV	PHEV	HEV	TOTAL	
2024	2,849	0	71	193	3,113		0	59	3	11	73	
2025E	2,822	0	99	229	3,150	1%	0	79	5	13	96	32%
2026E	2,751	0	120	259	3,130	-1%	0	103	6	14	123	28%
2027E	2,707	0	119	293	3,119	0%	0	124	6	16	146	18%
2028E	2,521	0	143	338	3,001	-4%	0	154	7	19	179	23%
2029E	2,430	0	170	378	2,979	-1%	0	187	8	21	216	20%
2030E	2,305	0	190	409	2,904	-2%	0	222	9	23	254	18%
					CAGR 2024 - 2030E	-1%					CAGR 2024 - 2030E	23%

Source: ILZSG

Source: Macquarie Global EV Tracker v.54

PREDICTIVE ANALYSIS FOR LEAD USAGE IN LDVs 12V BATTERIES 2024-2030E

Lead Usage in LDV 12V Batteries

SLI + Auxiliary 12V Batteries

000 tonnes	ICE	BEV	PHEV	HEV	TOTAL	% Change
2024	2,849	59	75	204	3,186	
2025E	2,822	79	103	242	3,246	1.9%
2026E	2,751	103	125	274	3,254	0.2%
2027E	2,707	124	125	309	3,264	0.3%
2028E	2,521	154	149	357	3,181	-2.6%
2029E	2,430	187	178	399	3,194	0.4%
2030E	2,305	222	199	432	3,159	-1.1%
				CAGR 2024 - 2030E		**-0.1%**

Source: ILZSG

Source: Macquarie Global EV Tracker v.54

PREDICTIVE ANALYSIS FOR LEAD USAGE IN LDVs 12V BATTERIES - CONCLUSIONS 2024-2030E

- Rising penetration of **hybrid and electric vehicles**
- **Lithium**-based battery technology: standard choice for **torque** assistance & **traction**
- **All** current and planned conventional **ICE** vehicles, as well as **most HEVs** and **PHEVs**, use a SLI **lead**-acid **battery**
- Large majority of **EV's** also incorporate **12V auxiliary** lead-acid **batteries**
- **Auxiliary** batteries: up to 50% **less lead - lower intensity** of **lead** per vehicle
- New vehicles including more **complex electronic** that rely on 12V batteries
- **Rising** demand for both larger vehicles and **AGM** lead batteries containing more lead
- By **2030**, **70%** of **new cars** sold will have an **ICE** engine *(according to Macquarie Global EV Tracker v.54)*
- **Replacement** market of SLI Pb batteries in **2024**: **4.5 X larger** than OEM
- **Up until 2030 rising sales of hybrid and electric vehicles unlikely to result in a significant decline in lead demand**

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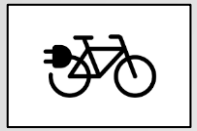
E-BIKE SECTOR PROSPECTS

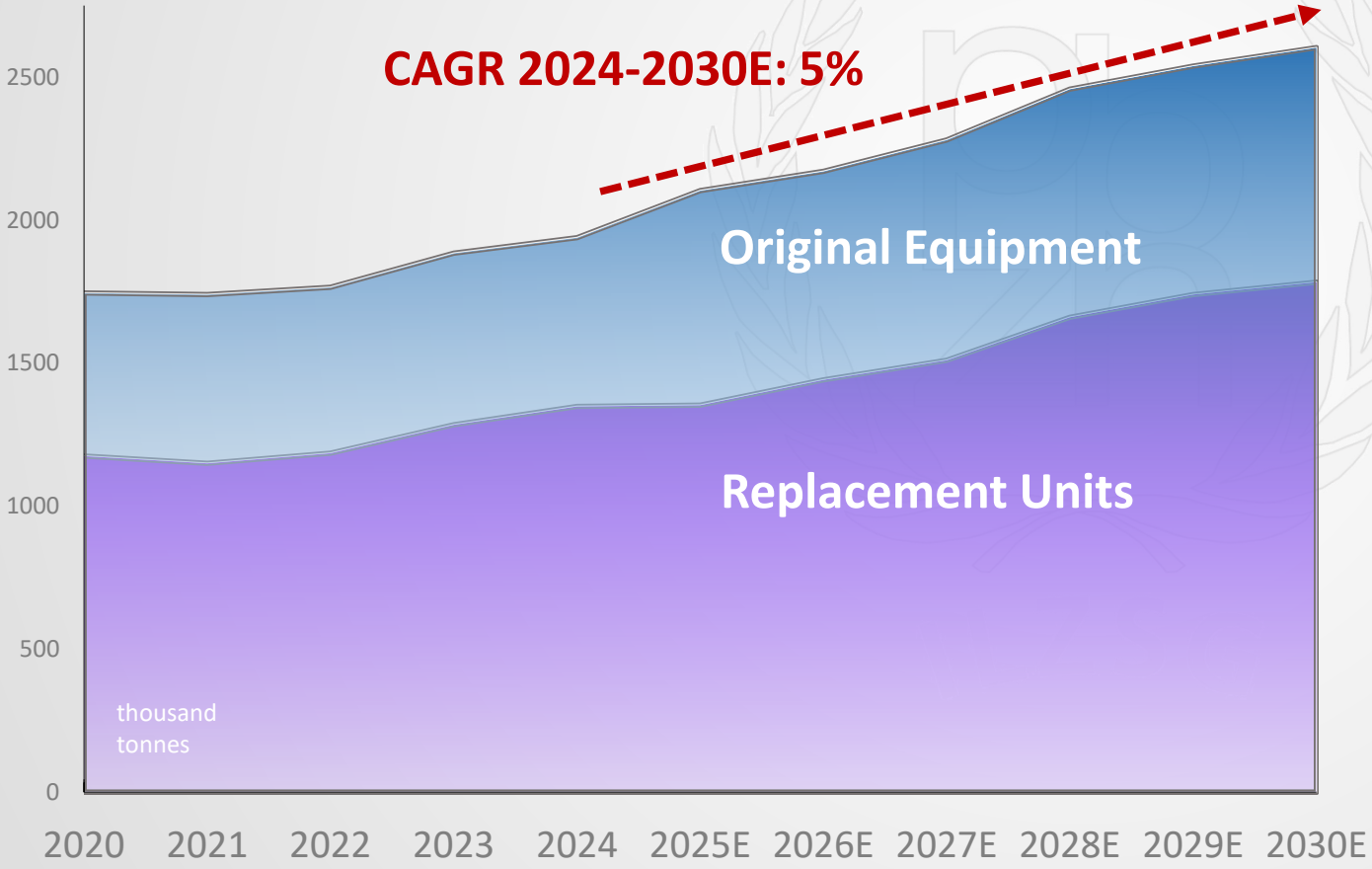


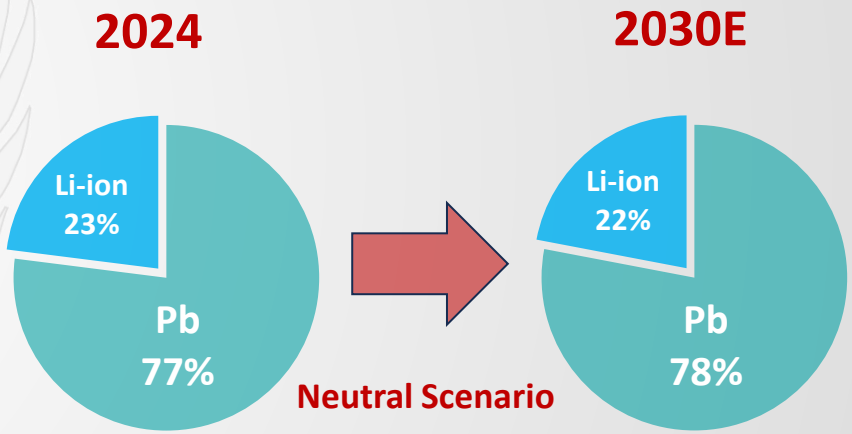
- **Lead based batteries** ➡ **dominate** E-bike industry globally but competition from Li-ion rising
- **China**, **India**, and **Southeast Asia** ➡ lead-acid batteries
- **China: pioneer in e-bike** development, large-scale adoption and production ➡ remains the largest producer
- Europe, India, and certain countries in Southeast Asia, such as Vietnam ➡ significant **e-bike producers**
- **E-bikes** ➡ excellent replacement for private cars/motorbikes in urban commuting
- **Opportunities** ➡ lead smelting and battery recycling industries
- Steady **increase** in **demand for lead** from the e-bike sector in **Asia** over the **next years**

Source: Shanghai Metals Market (SMM)

E-BIKE DEMAND FOR LEAD IN CHINA

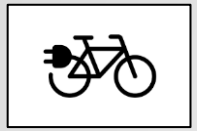
2020 – 2030E

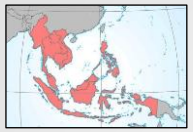




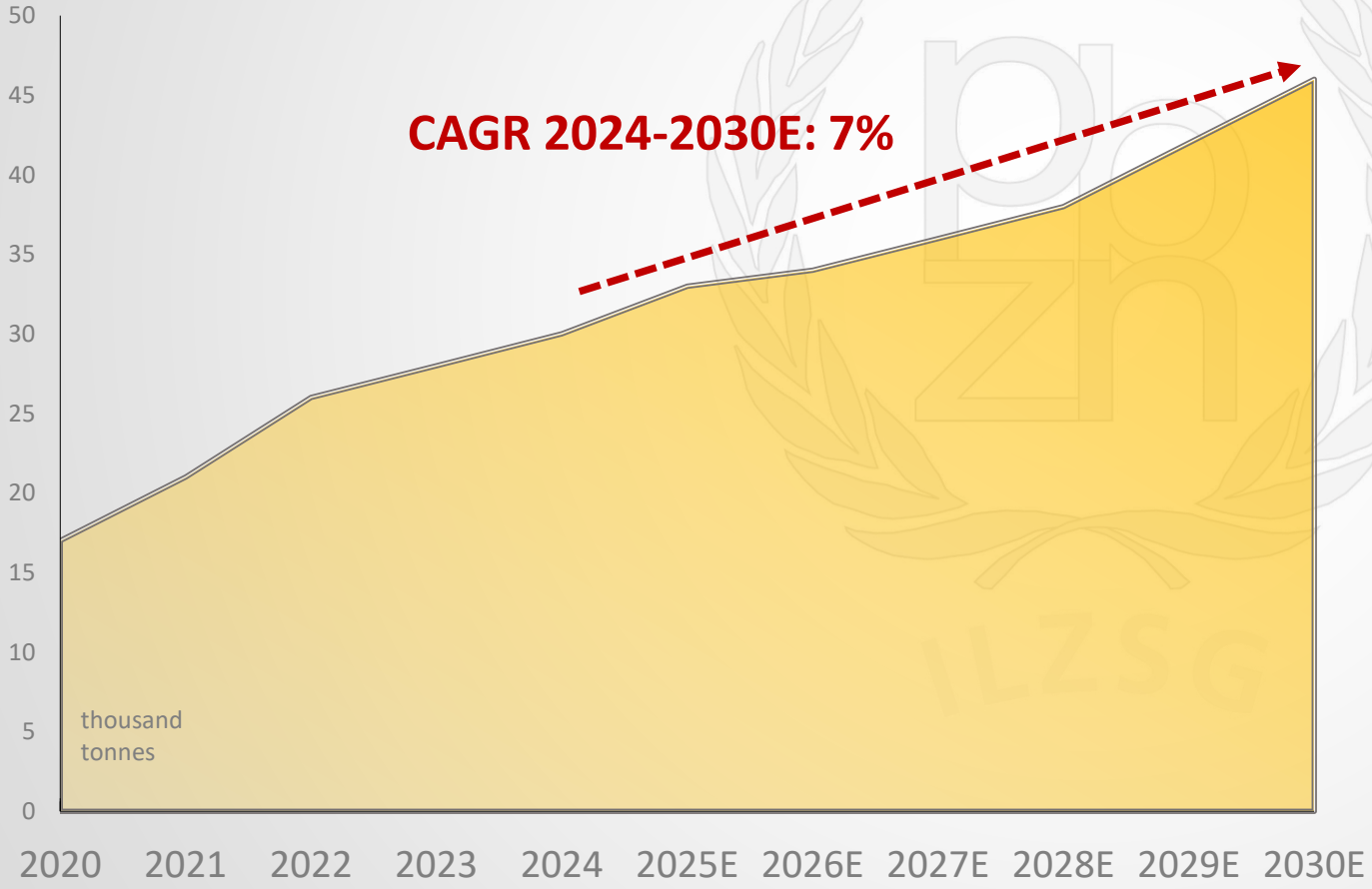
Source: Shanghai Metals Market (SMM)

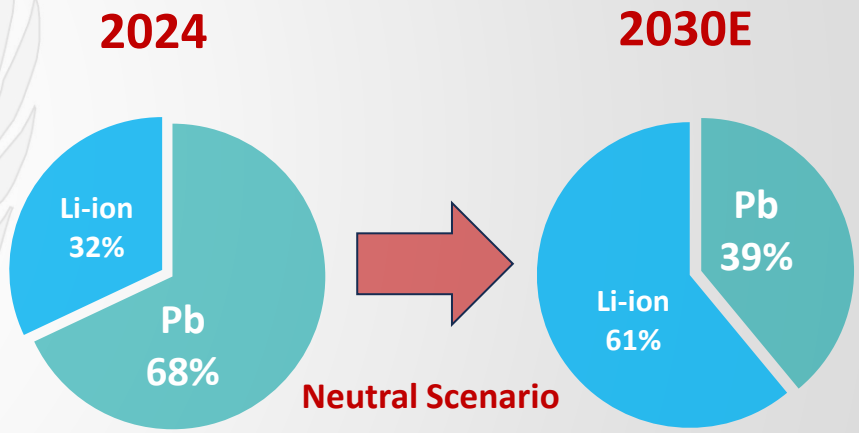
E-BIKE DEMAND FOR LEAD IN SOUTH-EAST ASIA





2020 – 2030E

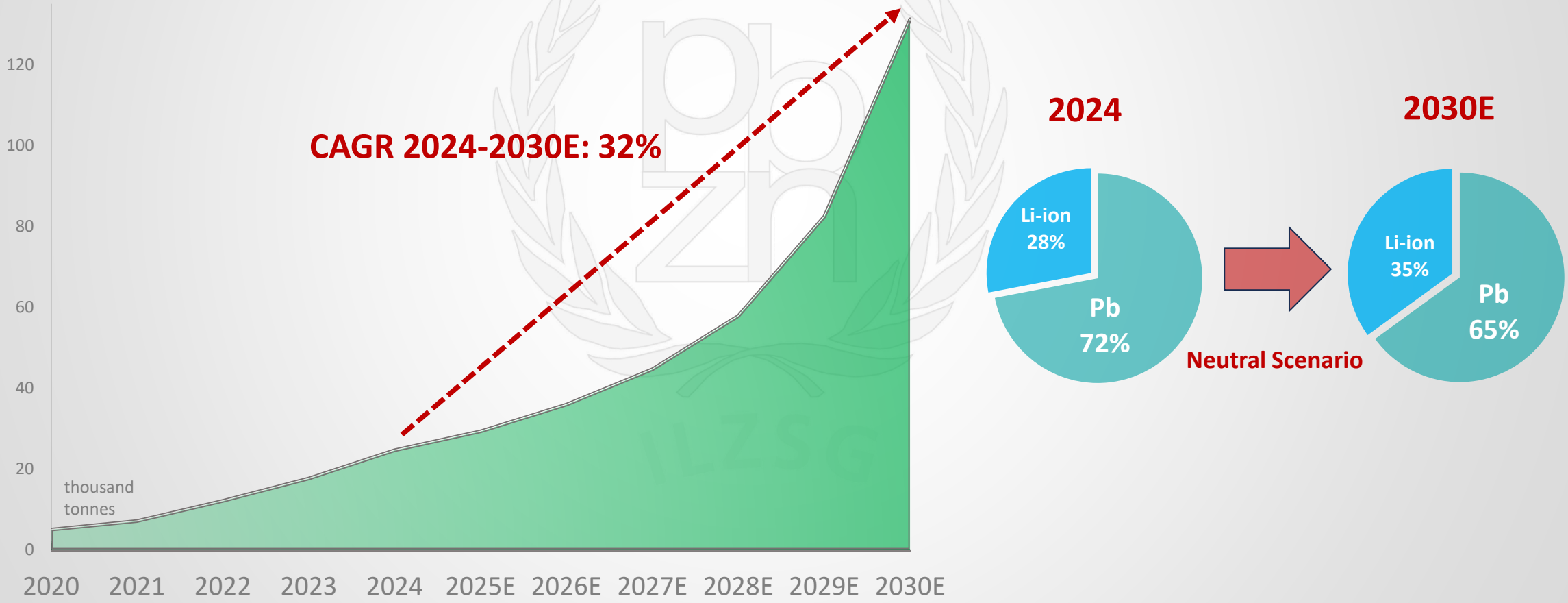




Source: Shanghai Metals Market (SMM)

E-BIKE DEMAND FOR LEAD IN INDIA

2020 – 2030E



Source: Shanghai Metals Market (SMM)

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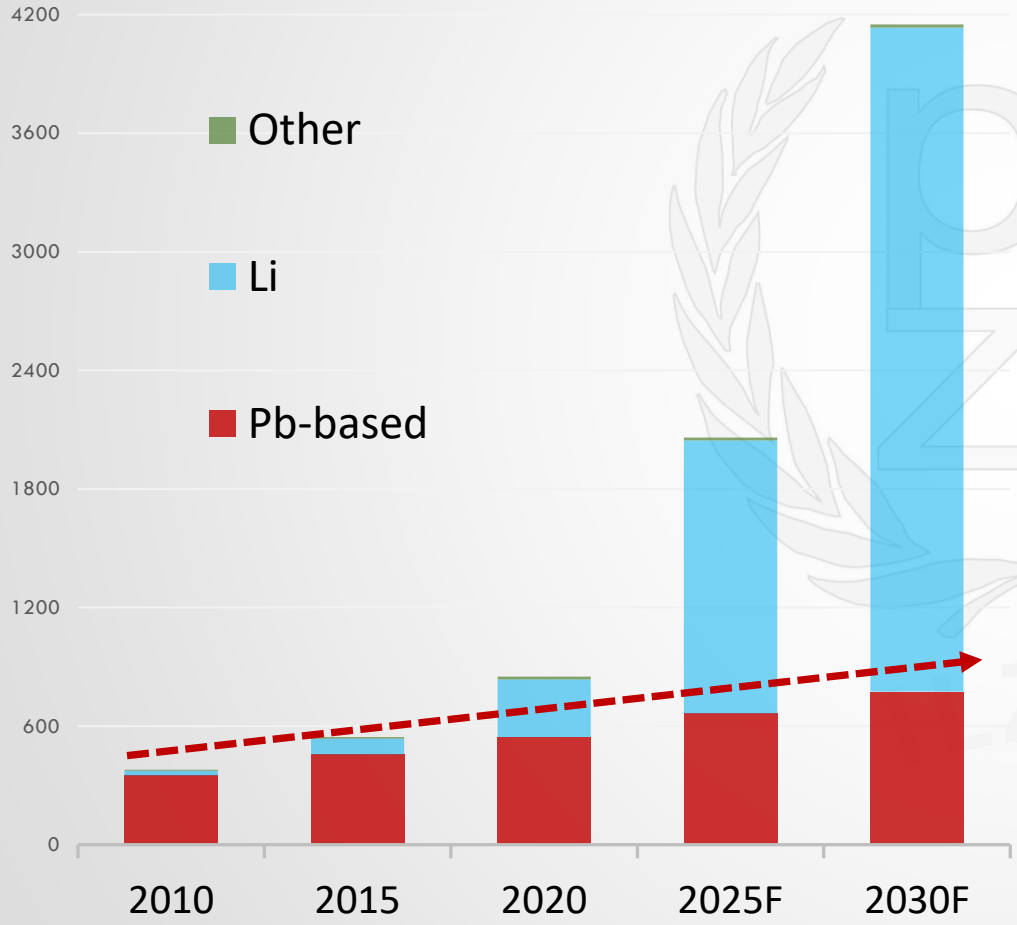
WORLD BATTERY MARKET IN VALUE BY CHEMESTRY

2010-2030F – AVICENNE ENERGY



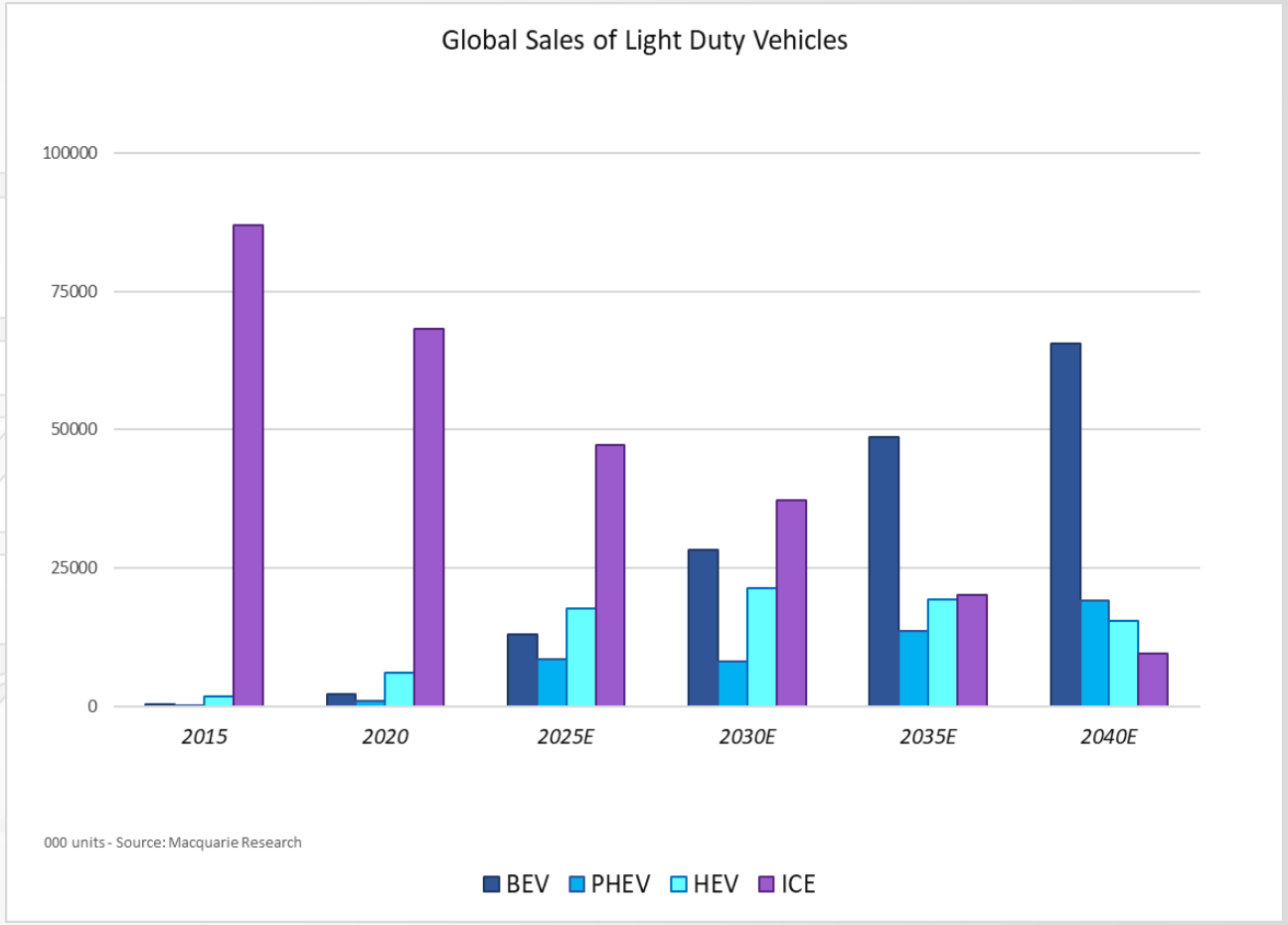
Lead-acid batteries

- Safety
- Reliability
- Cost-efficiency
- Mature raw materials supply market
- Easily and widely recycled
- Perfectly adapted to e-bikes and 12V electrical circuit in cars
- and Energy Storage Stationary systems
- VRLA/AGM batteries: performance improvements

Source: Avicenne Energy, ILZSG

LONGER-TERM CHALLENGES

- Rise of EVs to continue after 2030
- Li-ion penetration in E-bike and 12V automotive battery markets
- Substitution of 12V circuit by higher voltage in hybrids
- Strong competition from Li-ion in ESS
- Li-ion batteries: falling production costs and safety improvements
- Lead has still some reputation issues
- Li-ion based batteries capture larger media attention and investment
- Development of alternative battery tech
- **Upcoming years key for Pb industry to invest, adapt and evolve**



Source: Macquarie Global EV Tracker v.54, ILZSG

INDUSTRY'S RESPONSE
COOPERATION, INVESTMENT IN R&D, PRODUCT DEVELOPMENT

US university to test lead battery's ability to balance renewable integration on the grid

Best Magazine, Apr 2025

Ecobat installs backup gel batteries, supplied by Exide, for Irish power plant

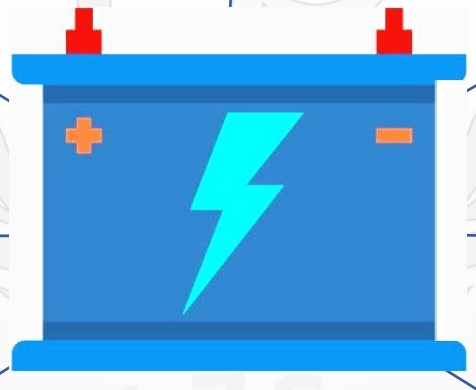
Batteries International, Mar 2025

Coram Energy to deploy 646 MWh EverGreenSeal™ bipolar Advanced Battery Concepts (ABC) batteries in southern California

pv-magazine-usa.com

Clarios supercharges AGM plans in $6bn US investments

Batteries International, Mar 2025



Luminous launches advanced lead plant in India

Batteries International, Feb 2025

Lead batteries poised to compete in BtM storage

Best Battery Briefing, Jul 2025

Exide adds new AGM battery to aftermarket sales,

Best Battery Briefing, Jan 2025

Source: Battery Press

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Thank you!

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