

ILZSG INSIGHT

THE POTENTIAL IMPACT OF HYBRID AND ELECTRIC VEHICLES ON LEAD DEMAND

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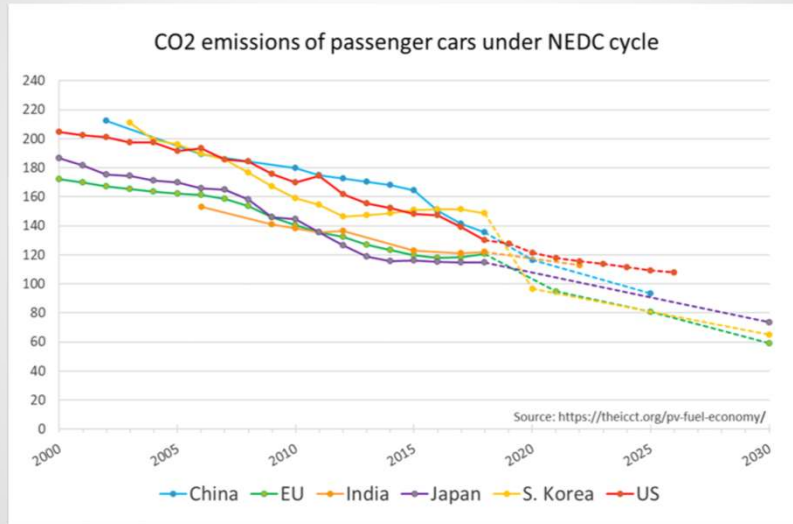
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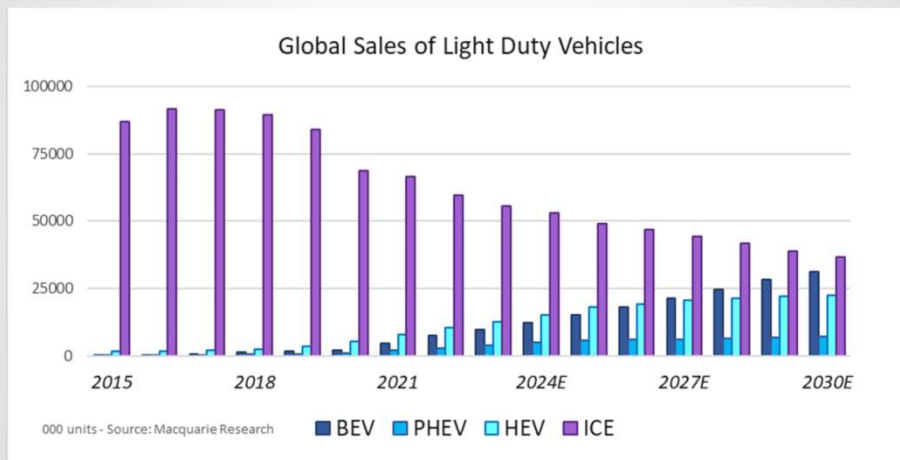
REPORT OUTLINE

- Introduction
- Regional Environmental Regulation Framework and Governmental Incentives Towards Vehicle Electrification
- Types of Vehicle: Micro-Hybrid / Hybrid Electric (HEV) / Plug-in Hybrid Vehicle (PHEV) / Pure Electric Vehicle or Battery Electric Vehicle (BEV)
- Types of Battery: Lead-Acid / Lithium-Ion / Nickel-Metal Hydride
- **Current and Likely Future Trends in the Automotive Market**
- **Empirical Predictive Analysis for Lead Usage in 12V Batteries used in Light Duty Vehicles over the period 2023-2030**
- **Potential Impact on Lead Demand**

REGIONAL ENVIRONMENTAL REGULATION FRAMEWORK AND GOVERNMENTAL INCENTIVES TOWARDS VEHICLE LEGISLATION



CURRENT AND LIKELY FUTURE TRENDS IN THE AUTOMOTIVE MARKET



CURRENT AND LIKELY FUTURE TRENDS IN THE AUTOMOTIVE MARKET



- Sales of hybrid and electric vehicles **increasing rapidly**
- Market share: 2015: 3% / **2022: 26%** / **2030E: +60%**
- Lithium battery technology: **standard** choice for **torque** assistance and **traction** purposes in **HEVs** and **EVs**
- **Pb batteries** continue to be the **standard** choice for **SLI** duties in vehicles using an **ICE**
- And for **Auxiliary** safety & comfort duties in **EVs** and **some HEVs**
- **Auxiliary 12V batteries: smaller amount of lead => imminent threat to the future of the lead industry?**



It's not that simple...

EMPIRICAL PREDICTIVE ANALYSIS FOR LEAD USAGE IN 12V BATTERIES USED IN LIGHT DUTY VEHICLES OVER THE PERIOD 2023-2030

- Number **batteries** each **vehicle** will use over its **life cycle**
 - **1 Original Equipment + 3 Replacement Batteries**
- **Share of HEVs and PHEVs** that use smaller sized 12V lead acid batteries
 - **20% of HEV+PHEV use 12V lead batteries for auxiliary duties only**
- The amount of lead contained in each **type of battery** – **larger SLI** and **smaller auxiliary**
 - **SLI Batteries: 10kg Pb / Auxiliary Batteries: 5kg Pb**

EMPIRICAL PREDICTIVE ANALYSIS FOR LEAD USAGE IN 12V BATTERIES USED IN LIGHT DUTY VEHICLES OVER THE PERIOD 2023-2030

Lead Usage in LDV SLI/Auxiliary 12V Batteries

000 tonnes	SLI Full Sized (10Kg Pb) 12V Batteries					% Change	Aux Smaller Sized (5Kg Pb) 12V Batteries					% Change
	ICE	BEV	PHEV	HEV	TOTAL		ICE	BEV	PHEV	HEV	TOTAL	
2022	2,993	0	28	124	3,146	Change	0	45	4	16	64	Change
2023E	2,979	0	39	152	3,170	1%	0	58	5	19	82	28%
2024E	2,871	0	51	195	3,117	-2%	0	75	6	24	106	29%
2025E	2,847	0	66	238	3,152	1%	0	103	8	30	141	33%
2026E	2,780	0	77	271	3,128	-1%	0	136	10	34	180	27%
2027E	2,708	0	89	310	3,107	-1%	0	165	11	39	215	19%
2028E	2,552	0	102	352	3,006	-3%	0	199	13	44	256	19%
2029E	2,458	0	120	402	2,979	-1%	0	243	15	50	309	21%
2030E	2,329	0	133	438	2,899	-3%	0	291	17	55	363	17%

EMPIRICAL PREDICTIVE ANALYSIS FOR LEAD USAGE IN 12V BATTERIES USED IN LIGHT DUTY VEHICLES OVER THE PERIOD 2023-2030

Lead Usage in LDV 12V Batteries

SLI Full Sized + Auxiliary Smaller Sized Batteries

000 tonnes	ICE	BEV	PHEV	HEV	TOTAL	% Change
2022	2,993	45	32	140	3,210	Change
2023E	2,979	58	43	171	3,252	1.3%
2024E	2,871	75	57	219	3,223	-0.9%
2025E	2,847	103	74	268	3,293	2.2%
2026E	2,780	136	86	305	3,308	0.5%
2027E	2,708	165	100	348	3,322	0.4%
2028E	2,552	199	115	396	3,262	-1.8%
2029E	2,458	243	135	452	3,288	0.8%
2030E	2,329	291	149	492	3,262	-0.8%

Average Annual Change 2023E - 2030E **0.2%**
Overall Change 2022 - 2030E **1.6%**

POTENTIAL IMPACT ON LEAD DEMAND

- **All** current and planned micro-hybrid and conventional **ICE** vehicles, as well as **most HEVs** and **PHEVs**, use a SLI **lead-acid battery**
- **Lithium** based battery technology: the standard choice for **torque** assistance & **traction** in hybrid & electric vehicles
- Virtually **all** these **vehicles** also incorporate **12V** lead-acid **batteries** for **auxiliary** features
- New vehicles: more complex electronic devices + **back up** high voltage circuit in critical **safety** functions + **monitoring** the lithium battery
- **Lead acid batteries**: the only technology **capable** of meeting all major 12V requirements
- **AGM** technology: weight saving & enhanced reliability, durability and stability
- Ultrabattery / carbon additives / EverGreenSeal bi-polar technology

POTENTIAL IMPACT ON LEAD DEMAND

- **Auxiliary** batteries: up to 50% **less lead**
- **Lower intensity** of **lead** per vehicle in BEVs and some hybrids
- Rising penetration of **hybrid and electric vehicles**
- Up until **2030** rising sales of EVs **unlikely** to result in a **decline in lead demand**
- E-bikes/ telecom backup / stationary e-storage / **renewables** / **EV charging stations**
- **Lithium-based batteries**: **high cost** / performance at **low temperatures** / **overheating**
- **Lithium-based batteries**: issues in **supply chains** / product-life **circularity** / environmental sustainability / **recycling**

POTENTIAL IMPACT ON LEAD DEMAND

- **Lead-acid batteries:**
 - **cost effectiveness**
 - cold cranking
 - **safety**
 - **stability**
- Lead-acid batteries: **easily and widely recycled**



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