Automotive Technology Outlook – the future for lead-based batteries

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ELBC SEPT 2024

STUDY: Understand how changes in on-highway light duty applications will impact LV systems and lead-based batteries

Key objectives

Assess market evolution to 2035 for new vehicles and vehicle parc

Understand current and future vehicle architecture requirements

Understand strengths and weaknesses of key battery technologies in relation to vehicle requirements for low voltage systems

International Lead Association

EUROBAT
ASSOCIATION OF EUROPEAN AUTOMOTIVE AND INDUSTRIAL BATTERY MANUFACTURERS

acea
DRIVING MOBILITY FOR EUROPE

jama

MARKET EVOLUTION: New Vehicles

By 2035 <50% of new Light Duty (LD) vehicles in Europe are expected to have an ICE – for all forecast scenarios

12V auxiliary battery applications will become more important than SLI

2035

Based on 2035 European Commission targets for 100% ZEVs to achieve 0 g CO_2/km

Powertrain Mix Breakdown %			
FCEV	8	100	ZLEV
BEV	92		
PHEV	0		
HEV	0	0	Non Plug-In
MHEV	0		
ICE S/S	0		
ICE	0		

Alternative Scenario for 2035

Ricardo Consumer Driven Europe LD Powertrain Forecast

Powertrain Mix Breakdown %			
FCEV	0	80	ZLEV
BEV	50		
PHEV	30		
HEV	9	20	Non Plug-In
MHEV	9		
ICE S/S	2		
ICE	0		

FCEV – Fuel Cell Electric Vehicle BEV – Battery Electric Vehicle PHEV – Plug-in Hybrid Electric Vehicle HEV – Full Hybrid Electric Vehicle MHEV – Mild Hybrid Electric Vehicle
ICE S/S – Internal Combustion Engine with Stop/Start ICE – Internal Combustion Engine ZEV – Zero Emissions Vehicle ZLEV – Zero / Low Emission Vehicle

MARKET EVOLUTION: Light Duty Vehicle Parc

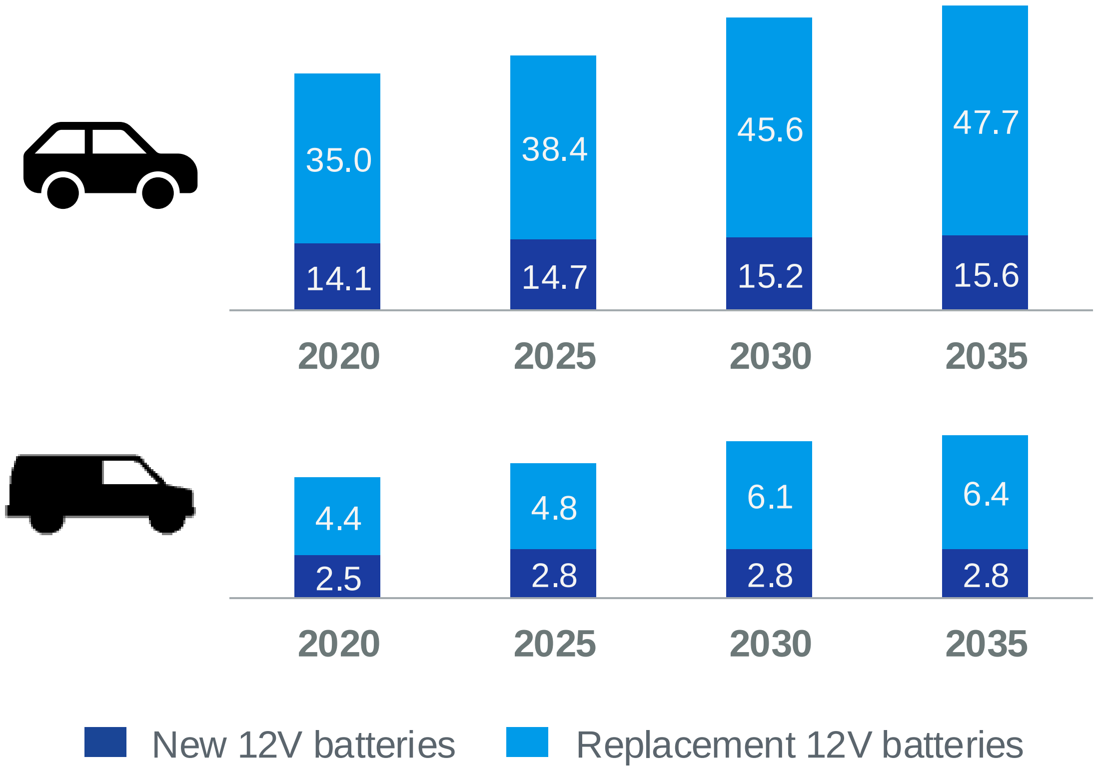
Replacement 12V battery volumes in the European fleet expected to continue to be strong to at least 2035

2035 Estimates

18.4 million – batteries for new vehicles

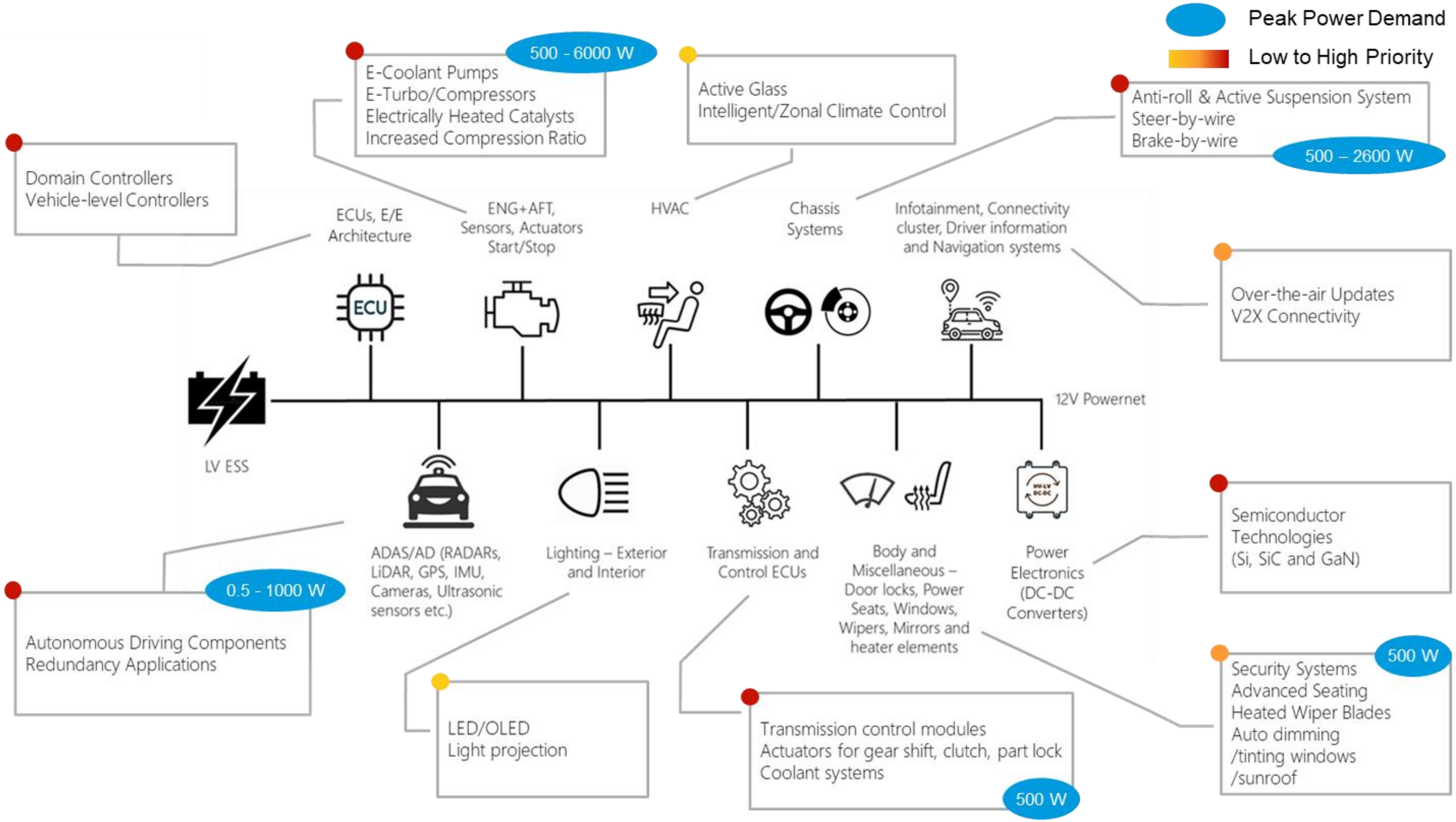
54.1 million – replacement batteries

Estimated New and Replacement Battery Volumes to 2035 (millions)



Parc Model Assumptions
1 12V battery per vehicle
Replacement every 6 years
Vehicle life 12 years

TECHNOLOGY TREND: Non-powertrain power demands are expected to continue to increase in the future



Source: Ricardo Analysis, Vicor, Infac

TECHNOLOGY TREND: Low Voltage system options

Retain 12V Board Net and 12V Batter(y/-ies)

- ✓ Mature technology
- ✓ Compatibility with components

- ✗ Limited power capacity

Transition from 12V to 48V battery and systems

- ✓ Reduced weight
- ✓ Lower power & heat losses, lower cost (for wiring harness)

- ✗ No / limited 48V components on market

Step down from HV supply

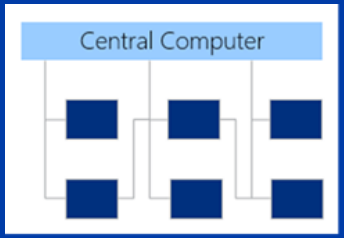
- ✓ Dual / Multiple DC/DC converters can accommodate for increased power loads

- ✗ Unlikely to use technology alone, 12V battery likely to be essential for vehicle functional safety

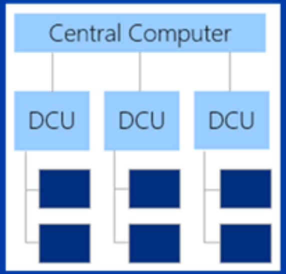
Integrated LV and HV batteries

- ✓ Simplification of vehicle architecture
- ✓ Can share BMS / thermal mgmt with HV battery

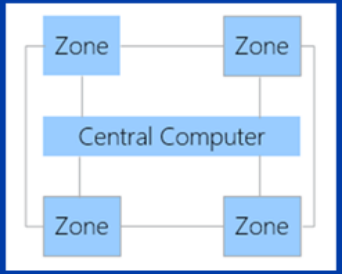
- ✗ Potential for cascading battery failure



Distributed Architecture



Domain-based Architecture



Zone-based Architecture

TECHNOLOGY TREND: Transition to Zonal E/E architecture

Zonal Electrical/Electronic architecture

Shift toward a cross-domain centralised E/E architecture that uses only a few very powerful control units instead of a great many control units

Systems are logically and physically grouped into zones that can be efficiently organised

Advantages	Requirements
Lower complexity	New partnerships
Facilitation of secure over-the-air updates (OTA)	Software-driven development
Reduced weight and cost	Standardisation and modularisation
Greater flexibility	Higher voltage power systems

BATTERY TECHNOLOGY: Lead-based vs Li-Ion

Lead-based and Li-Ion batteries are both utilised for 12V SLI, Auxiliary and back-up battery applications

12V Li-ion batteries have been adopted in a limited number of models at present

Advantages of Lead-based over Li-Ion for 12V auxiliary applications

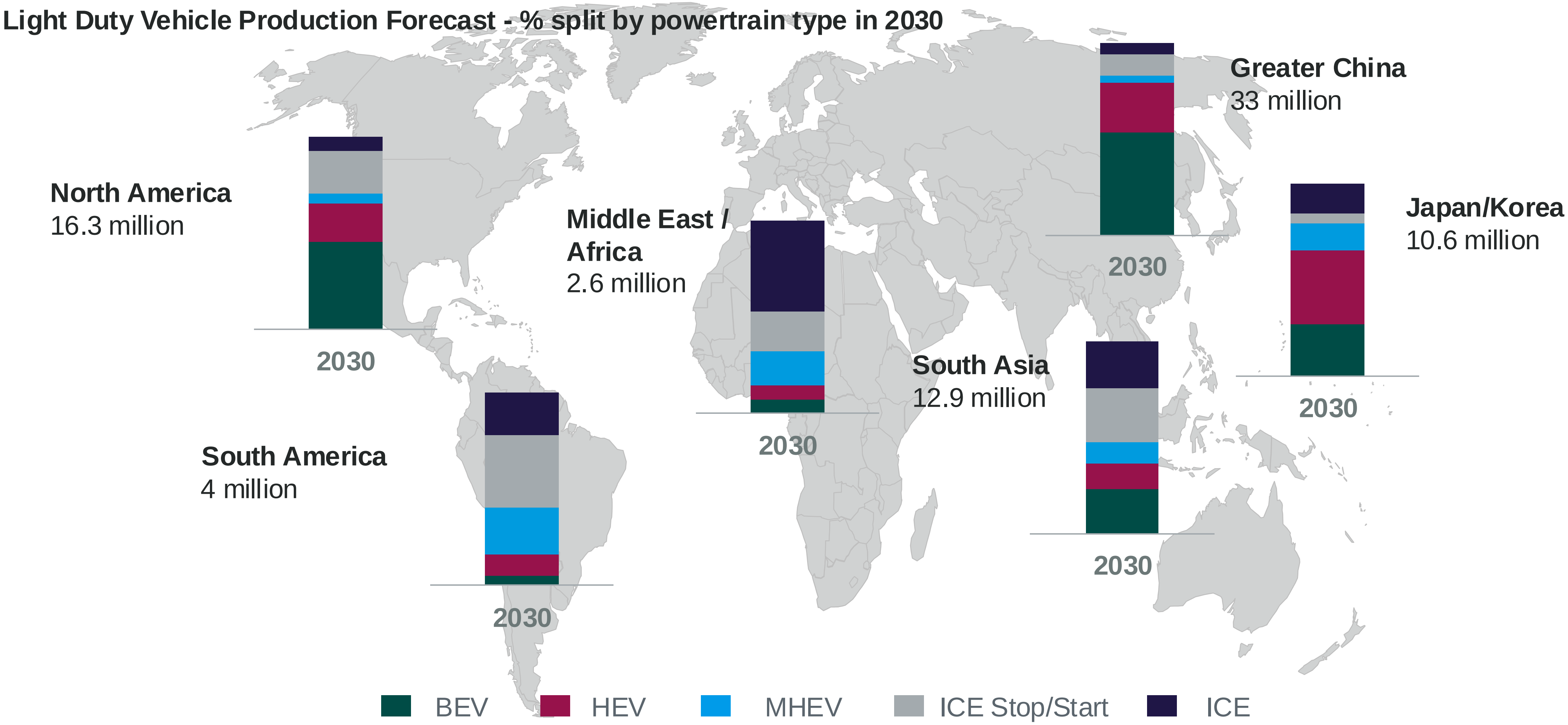
- Cost
- Battery voltage range
- Maximum battery temperature
- Standardisation
- Established supply base

Example

Vehicle Type	High electrification; B-E Segment; 2024 to 2035
Application	12V auxiliary
Share of Market	Anticipated 30% in 2030 (and 50% in 2035)

Performance	Attribute (unit)		Ref.	Battery Technology: EFB	AGM	LFP	Na-ion
What are the maximum capabilities for each battery chemistry? (important factors in **bold**)	Battery Range	*(V)*	*7*	10.8 - 16	10.8 - 14.8	10.8 - 14.5	-
	Useable Battery Range	*(V)*	*7*	13.5 - 15	13.5 - 15	12 - 12.5	-
	Nominal Battery Voltage	*(V)*	*1,2,3*	12	12	13.2	-
	Nominal capacity	*(Ah)*	*1,2,3*	70	70	60	-
	Low Temperature Performance at -29°C	*(A)*	*7*	Expect to be defined by Pulse Power Characterisation (PPC) tests under IEC60095-8 (under development)			-
	Low Temperature Performance at -18°C	*(A)*	*7*				-
	Max Battery Temperature possible (NOTE Typical max = 60°C; some standards specify 75°C)	*(°C use)*	*1,2,3*	70	70	60	-
		(°C storage)	*1,2,3*	70	70	60	-
	Charge Recovery (CR) (max)	*(A)*	*7*	Expect to be defined by Charge Recovery (CR) tests under IEC60095-8 (under development)			-
	Charge Recovery (CR) (min)	*(A)*	*7*				-
	Energy throughput	*(capacity turns)*	*5,6*	800	1200	1200	-
	Weight (without crash protection)	*(kg min)*	*1,2,3,6*	18	19	14	-
		(kg max)	*1,2,3,6*	20	21	16	-
	Weight of additional structures (e.g. crash protection)	*(kg)*	*5*	0	0	3	-
	Battery Price	*(2022 €)*	*8*	85	85	316	-
	Lifetime	*(years min)*	*5,6*	5	5	8	-
		(years max)	*5,6*	7	7	10	-

GLOBAL OUTLOOK



Source: IHS Markit

SUMMARY

- ***Auxiliary and back-up battery applications increasing in importance vs SLI in Europe***

- ***Continues to be a strong market for replacement lead-based batteries in Europe to at least 2035***

- ***Light Duty Vehicle architectures are evolving***
  - *Driven by increased non-powertrain system power demands, need to reduce costs, weight and improve efficiency to meet CO_2 targets*
  - *No clear, single industry direction yet*
  - *A move to zonal architectures may support a transition to 48V*

- ***OEMs have different electrification and vehicle architecture strategies to meet legislative and consumer requirements***
  - *12V board nets likely to remain in some form until at least 2035*
  - *Lead-based batteries will continue to play a role in light duty vehicles until at least 2035*

Thank you