essential energy everyday

Powered by Sustainable Lead Batteries

INFORMATION BRIEF

Electric Vehicles and Autonomous Vehicles

We are witnessing a transportation revolution and unprecedented growth in demand for batteries to support new concepts of mobility. This shift is driven by three trends: Vehicle connectivity, autonomous driving and electrification. Each of these trends requires additional onboard power. Continued investment in advanced batteries will allow us to meet demand and enable the transition underway.

Introduction

The automotive industry is making tremendous capital investments to expand beyond traditional internal combustion engines (ICE) to include a range of vehicles, from mild- to full-electric vehicles (EVs).

Propelling these changes are government mandates and increasing environmental regulations, with a focus on reducing greenhouse gas emissions. In addition, the investor community is rewarding publicly traded companies who are moving quickly to support the shift from ICE to electrified vehicles.

As change accelerates, advanced lead batteries are poised to be an essential part of the synergistic chemistries needed to electrify the global car parc.

FACT: Twenty years ago, a new car had 20 individual electronic functions. Today, there are more than 150, from park-assist cameras to complex dashboard data screens.[1]

Every Vehicle Electrification Platform Requires a 12V Lead Battery

There are five types of vehicle electrification platforms. Each requires a 12V low-voltage battery (typically a lead battery). As electrification increases, the 12V lead battery provides the critical auxiliary power necessary for nonmotive functions, such as safety, comfort and infotainment features. This is also true for autonomous vehicles (AVs are almost always electric.)

Micro Hybrid

Low degree of electrification. Engine shuts down under braking and rest.

Mild Hybrid

Low to medium electrification. Start/Stop with regenerative braking.

Full Hybrid

Medium degree of electrification. Same as mild hybrid BUT stored energy in battery used for certain range of electric driving.

Plug-In Hybrid

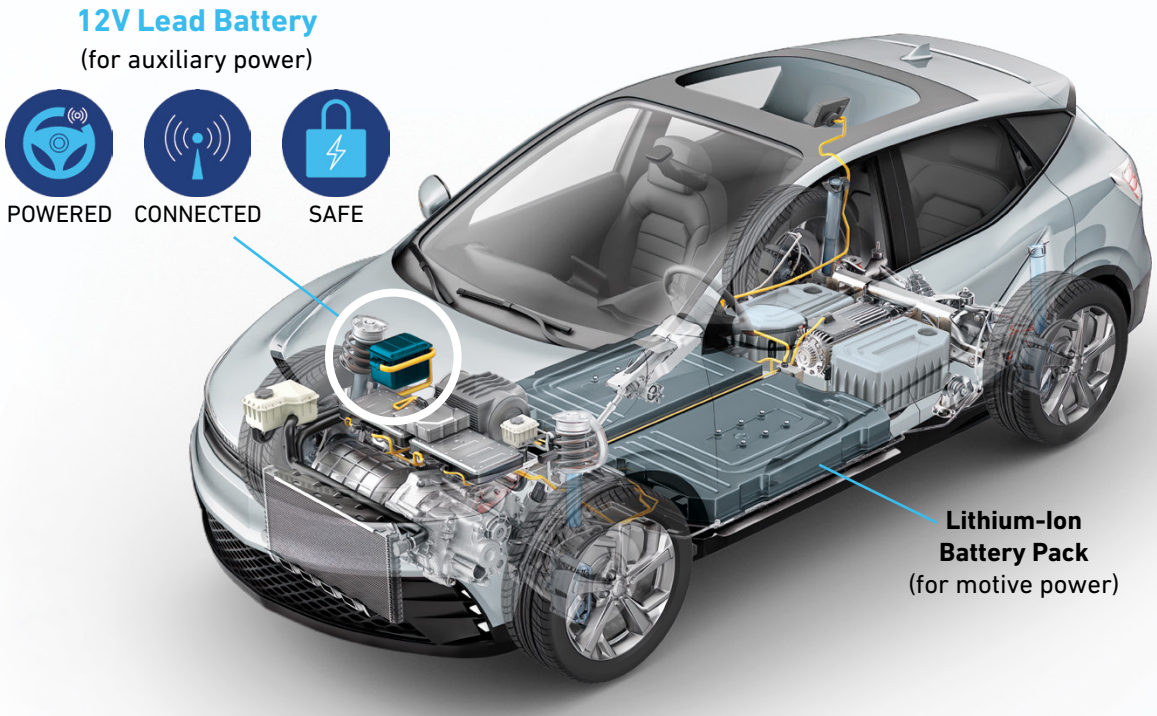
High degree of electrification. Battery used as main energy. Can run in hybrid mode. Charged with off-board electric energy and regenerative braking.

Electric Vehicle

Full electrification. Battery only source of energy. Battery charged with off-board electric energy and regenerative braking.

Lead Batteries Work in Tandem with Lithium-Ion

Most of today's (P)HEVs and EVs use a high-voltage lithium-ion battery pack to power the electric motor that provides vehicle traction. A 12V low-voltage lead battery provides the critical auxiliary power for virtually all other nonmotive electrical functions.



Lead Batteries Enable Critical Functions in (P)HEVs and EVs

A low-voltage lead battery provides the auxiliary power for virtually all plug-in hybrids and fully electric vehicles. A high-voltage battery pack (lithium-ion) provides most or all of the motive power.

When the Vehicle is Off: Stay Connected

+ Starts the car by engaging connectors for the high-voltage battery
+ Keeps electronics operating (remote fobs, entertainment, theft-protection, etc.)
+ Powers connected-vehicle technologies (connects with over-the-air updates, etc.)
+ Manages process to safely charge the vehicle

When Driving: Stay Powered

+ Supports low-voltage power needs for accessory loads
+ Powers loads beyond DC/DC capability (power steering, etc.)
+ Provides peak shaving off primary motor during heavy use, so high-voltage main battery can focus solely on motive power

In an Emergency: Stay Safe

+ Supplies low-voltage systems if high-voltage battery fails, overheats or disconnects
+ Powers steering and braking systems to ensure safe operation
+ Powers emergency connected/accident reporting systems

Lead Batteries Power EV and Hybrid Charging Stations

Reducing drive-range anxiety with a vast charging-station network is key to drivers adopting EVs and hybrids. Lead batteries reliably provide efficient energy storage at charging sites. That supports the deployment of fast-charge-enabled charging points in more locations and at lower cost using existing grid infrastructure.

Appealing Benefits

Charging station developers, automakers and government are rolling out more lead-battery-supported EV charging stations to provide safe, convenient power. Lead batteries offer appealing benefits:

+ Provide a domestically sourced energy storage solution for cleaner and greener EV charging
+ Regulate and ensure power at EV charging stations, even during peak demand and extreme weather
+ Store energy from various electrical sources (grid power, fuel cell, wind or solar)
+ Maintain a nearly 100% recycling rate

GreenCore EV Services, developers of EV charging stations, chose lead batteries to power thousands of solar EV charging stations being installed across the U.S.

> *"They [lead batteries] enable us to harness solar electricity generated on site to minimize our impact on the world with a game-changing, 100-percent recyclable battery."*
>
> — Frank Baumann, CEO, GreenCore

Designed to Meet Automaker Needs

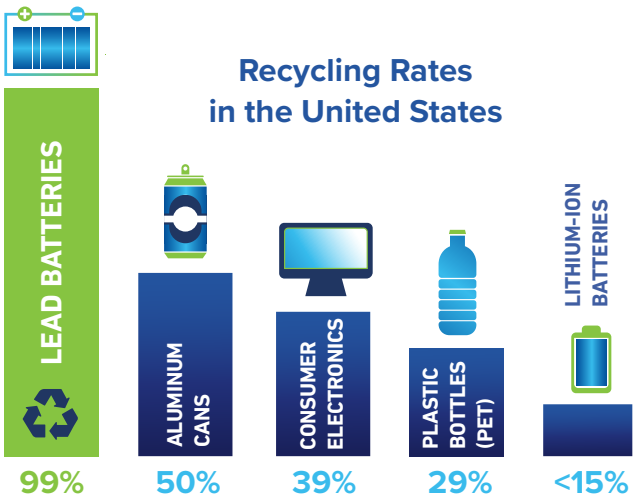
Lead battery manufacturers work closely with automakers (Original Equipment Manufacturers, known as OEMs) to design 12V batteries to help ensure top vehicle performance and to deliver constant power and safety functionality. These batteries are optimized for extended energy throughput and powerful support, and they are sized to meet OEM needs.

Sustainable Lead Batteries Support Sustainable Technologies

Nearly 100% Recycling Rate

Achieving sustainable transportation requires a much closer look at the sustainability of the batteries used in vehicle electrification. Lead batteries reign as the most sustainable battery choice today, which further supports the green profile of EVs and hybrids.

+ Lead batteries have a 99% recycling rate in the U.S.
+ The lead in lead batteries can be infinitely recycled without loss of performance.
+ Lead batteries are the most recycled consumer product in the U.S.



Circular Economy Ensures Domestic Supply

The U.S. lead battery industry is the gold standard for a successful closed-loop manufacturing – and environmentally responsible – system. An established collection and recycling network prevents 130 million lead batteries from going to landfills annually and ensures battery makers have domestically sourced raw materials for new lead batteries.

+ The recycling rate of lead batteries far surpasses any other battery technology.
+ 130 million used lead batteries are recycled annually, rather than going to landfills.
+ A new lead battery typically consists of more than 80% recycled material.

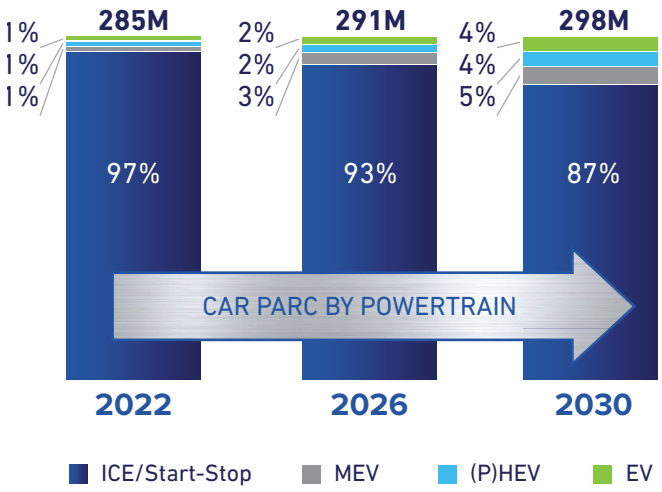
FACT: A lead battery is made to be remade. It has minimal componentry (lead, plastic, acid) with a design that streamlines recycling.

Lead Batteries Bridge Transition from ICE to EVs

Although the transition to electric vehicles in the U.S. is slow, the demand for all types of vehicle batteries is enormous. Lead batteries are a trusted chemistry to power a traditional internal combustion engine (ICE), as well as new hybrid, EV and AV technology.

Despite the ambitious goals for EV adoption in the U.S., it will likely be an evolution, rather than a revolution. Today, full EVs comprise roughly 1% of the U.S. vehicle population, and industry projections show growth over the next 10 years to reach only about 4%.[2]

2020-2030F U.S. Car Parc Penetration by Powertrain
[Percent of Total Car Parc]



Source: IHS Markit / AASA

Starting, Lighting and Ignition Functions

Lead batteries will remain the predominant battery chemistry for the foreseeable future. Nearly every new car and truck, regardless of how powered, includes a 12V lead battery for starting, lighting and ignition (SLI) functions.

Start-Stop Technology Reduces Emissions

Lead batteries can enable significant greenhouse gas savings for ICE vehicles by allowing engines to turn off when the vehicle is on, but not moving. Automakers have long favored lead batteries for this energy efficient feature. Hybrid vehicles have always had start-stop technology, and its integration into the car parc is rapidly growing.

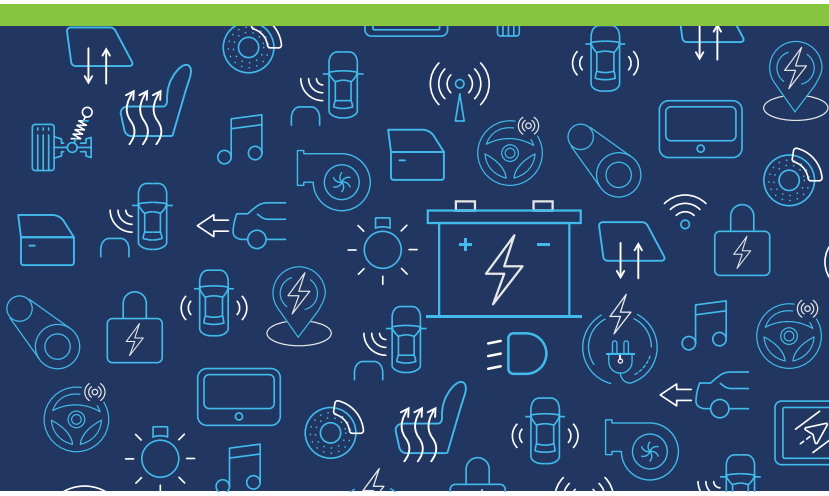
FACT: Start-stop technology lowers fuel consumption by up to 10% and eliminates nearly 6.7 million tons of GHG emissions annually in the U.S.[3]

New Cars and Replacement Batteries

Lead battery manufacturers will continue to provide new and replacement batteries for millions of ICE vehicles already on the road. In fact, 80% of the battery market is aftermarket.[4] That's a strong incentive for manufacturers to continue making lead batteries using robust, domestic manufacturing and recycling infrastructure.

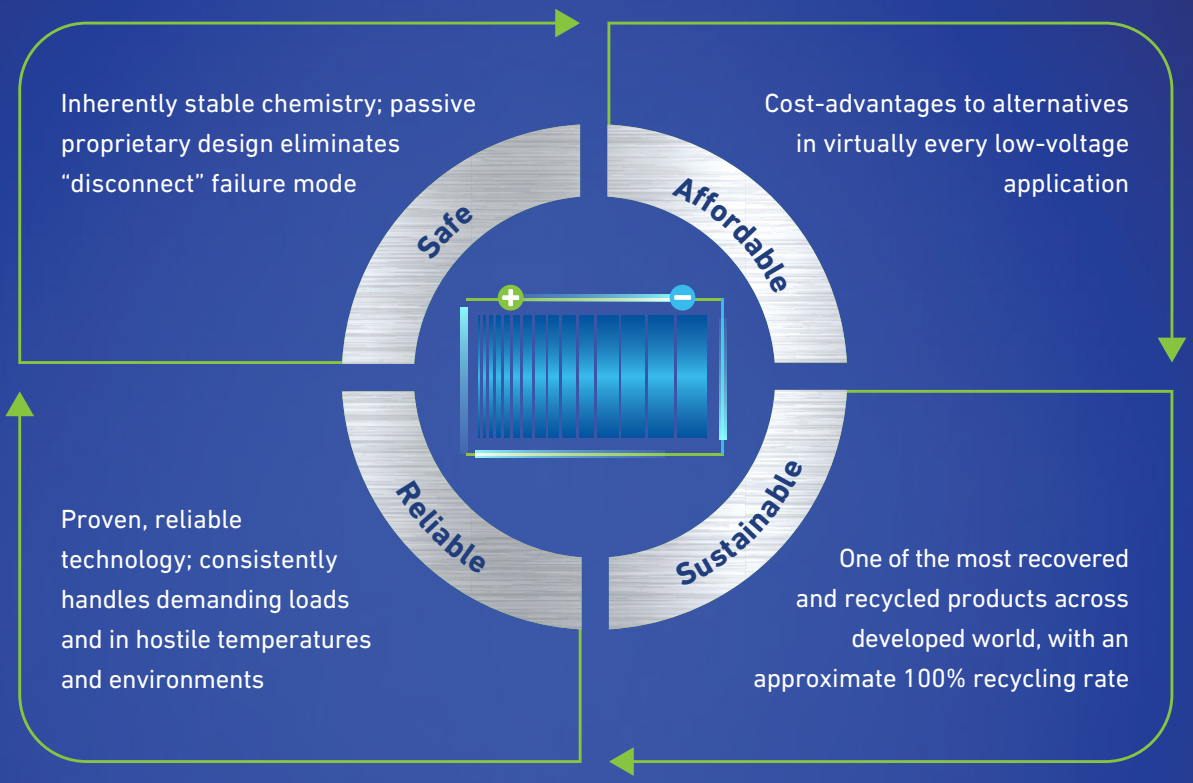
Today's Vehicles Demand More On-Board Power

+ Between 2009 and 2025, the number of electrical devices in vehicles is expected to triple.[1]
+ Over the past 10 years, the peak power needs of a vehicle have increased about 50%.[1]



Lead Batteries are Critical for Vehicle Electrification

The Advantages of Advanced Lead Batteries



Lead Batteries are Essential to Mix of Chemistries Required

As the electrification of transportation accelerates, so will the need for batteries. And, car manufacturers will surely increase the number of electric functions in vehicles, requiring even more on-board power. As we move more toward plug-in hybrids and fully electric vehicles, each of these will require a mix of battery chemistries, including a 12V lead battery.

The convincing benefits of proven, sustainable lead batteries make them worthy of continued investment to unlock their full potential and meet demand.

1. Clarios proprietary data 2021 comparing maximum devices in 2021 to minimum devices in 2009
2. Experian Automotive VIO as of March 31, 2021
3. Consortium for Battery Innovation
4. Avicenne Energy, 2021

Learn more at EssentialEnergyEveryday.com

Visit EssentialEnergyEveryday.com/about/sources to view source information.

Battery Council INTERNATIONAL

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