The Power of 3

Driving the future further

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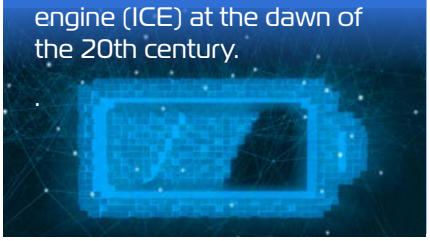
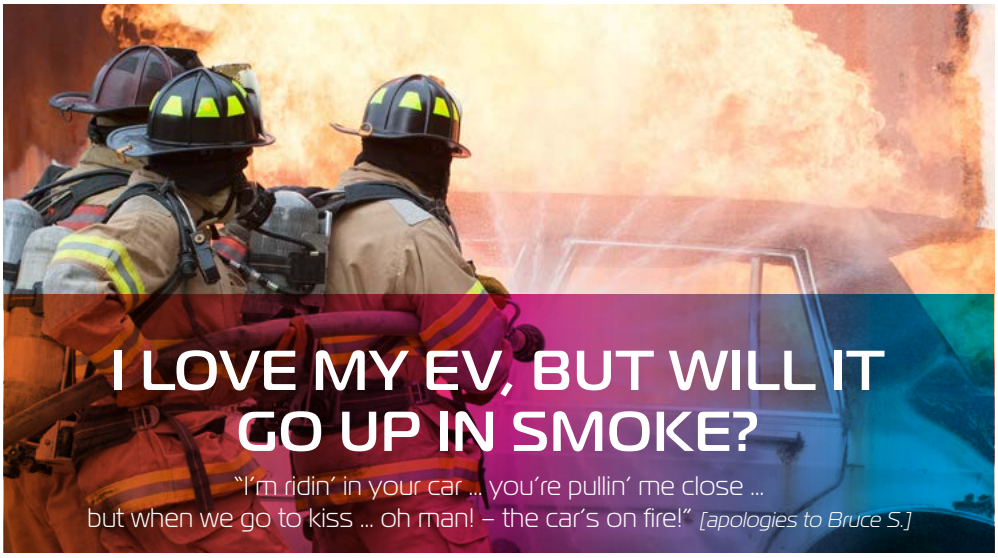
Overview

Recently, fresh attention has been paid to the safety of lithium-ion battery (LIB) technology, not least due to tales of Teslas in flames and the blazing inferno at the big battery project in Victoria in early August 2021, a fire that burned for more than three days before being brought under control.

Although such incidents are rare, it's worth examining the potential fire risks for LIBs, the basis of an energy-storage revolution now intrinsic to modern life worldwide – not just to power portable personal devices but also many forms of transport as fossil fuel use declines. Indeed, LIBs are shaping daily life in a manner akin to that of the internal combustion engine (ICE) at the dawn of the 20th century.





I LOVE MY EV, BUT WILL IT GO UP IN SMOKE?

"I'm ridin' in your car ... you're pullin' me close ...
but when we go to kiss ... oh man! – the car's on fire!" *[apologies to Bruce S.]*

LIBs on fire

LIBs catch fire due to a process called thermal runaway. It's a response within a battery cell that, beginning with some sort of failure, causes the battery's internal temperature to rise until it creates a chemical reaction. That reaction produces even more heat, driving the temperature higher and causing further chemical reactions that spread in a domino effect to adjacent cells, creating, eventually, a fire.

While any fire caused by thermal runaway is cause for concern, it's especially worrisome when packs of LIBs are designed for large stationary battery energy-storage systems (BESS), as with the Victorian fire, or for vehicular transport, personal or otherwise. As **Forbes** noted recently, after a spate of battery fires in Chevrolet Bolt electric vehicles (EVs):

> *Just as automakers step up EV production and try to convince consumers battery-powered vehicles are safe, companies involved in producing and testing cells are digging in to say they're doing everything they can to provide peace of mind among consumers through advance technologies.*

The issue in EVs

Both Chevrolet (see above) and Hyundai have encountered battery problems in their EVs that have proved enormously challenging, wildly expensive and reputationally damaging.

In February of this year, Hyundai announced a substantial EV recall, applying to around 76,000 of its Kona Electric EVs, some Ioniq models and electric buses built between November 2017 and March 2020. At a cost of USD$900 million, this was the most expensive EV recall ever until Chevrolet's announcement trumped it in August of this year.

Chevrolet was forced to declare a full safety recall of all the Bolt EVs ever sold, due to fire safety concerns related to their batteries. That came on top of Chevrolet's previous recall of cars built between 2017 and 2019. In all, the number of EVs expected to be recalled is 142,000, at a cost of USD$1.8 billion to General Motors.

The factor common to all these safety-related recalls is that the same nickel-based NMC battery packs were sourced from a single Chinese manufacturer.

Such glitches have certainly dampened the development plans of many in the auto industry ... but, with those plans now revived by ambitious goals like that of US President Biden's for the States' transition to EVs, and other countries vowing to phase out legacy ICE vehicles by 2030, the need to minimise fire risk in all forms of electrified transport has never been greater.

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There *is* a solution

Currently, the two types of LIBs in widespread use in both EVs and BESS are lithium nickel manganese cobalt oxide (NMC) and, more recently in the West, lithium iron phosphate (LFP). Both have their pros and cons in real-world use but which is safer in terms of fire risk?

After research and testing by multiple scientific and other institutions, the main conclusions were these.

- NMC batteries begin to fail earlier than LFP batteries.
- LFP batteries take longer to initiate thermal runaway than NMC batteries.
- If thermal runaway ***is*** initiated, LFP batteries have a much lower peak temperature than NMC batteries. With the latter, the peak temperature is almost 1000 degrees Celsius, compared to an LFP peak temperature of around 410 degrees Celsius.

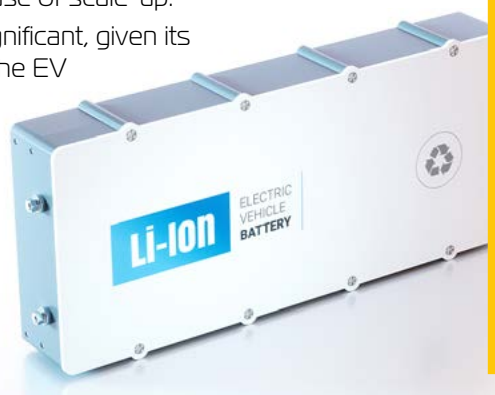
The consensus, then, is that LFP batteries pose much less of a fire risk than NMC batteries, a fact not lost on major automotive/EV manufacturers.

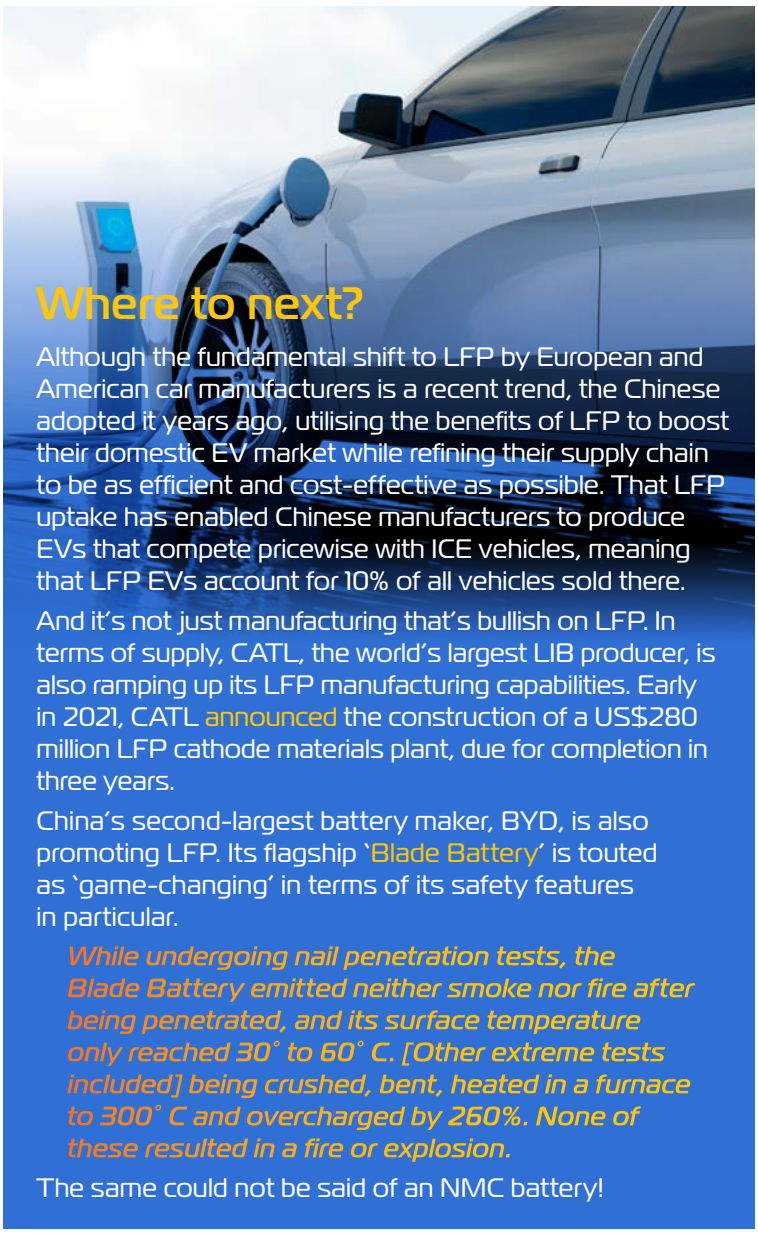
Take Volkswagen, Europe's largest car maker. Owing to LFP's inherent advantages (not just safety but also lower cost and greater longevity) VW, at its **Power Day** earlier this year, underlined the importance of LFP for use in its future ranges. Indeed, VW's technology roadmap to 2030 touted LFP as the backbone of its collection of mass-market, entry-level EVs designed to achieve price parity with ICE vehicles.

Meanwhile Ford, America's largest car manufacturer, in its **Ford+ strategic EV plan**, anticipates that by 2030 40% of global vehicle volume will be fully electric. And of that 40%, all commercial EVs will have LFP batteries.

This follows in the wake of iconic American car company Tesla, which has already initiated its long-term shift to predominantly LFP by switching from NMC to LFP for its Megapack storage batteries. CEO Elon Musk hopes that eventually two-thirds of Tesla EVs will also incorporate LFP batteries. An LFP enthusiast for a while now, he appreciates not only its safety, longevity and lower cost but also its ease of scale-up.

Tesla's intent is significant, given its pioneering role in the EV and clean-energy Industries and the way it sets trends for other manufacturers.





Where to next?

Although the fundamental shift to LFP by European and American car manufacturers is a recent trend, the Chinese adopted it years ago, utilising the benefits of LFP to boost their domestic EV market while refining their supply chain to be as efficient and cost-effective as possible. That LFP uptake has enabled Chinese manufacturers to produce EVs that compete pricewise with ICE vehicles, meaning that LFP EVs account for 10% of all vehicles sold there.

And it's not just manufacturing that's bullish on LFP. In terms of supply, CATL, the world's largest LIB producer, is also ramping up its LFP manufacturing capabilities. Early in 2021, CATL announced the construction of a US$280 million LFP cathode materials plant, due for completion in three years.

China's second-largest battery maker, BYD, is also promoting LFP. Its flagship 'Blade Battery' is touted as 'game-changing' in terms of its safety features in particular.

> *While undergoing nail penetration tests, the Blade Battery emitted neither smoke nor fire after being penetrated, and its surface temperature only reached 30° to 60° C. [Other extreme tests included] being crushed, bent, heated in a furnace to 300° C and overcharged by 260%. None of these resulted in a fire or explosion.*

The same could not be said of an NMC battery!

Conclusion

It's clear that the safest, most efficient way forward for mass adoption of EVs is their propulsion with LFP-type LIBs. Although both NMC and LFP have roles to play, the latter seems ideal in terms of supply chain security, safety, practicality and cost, allowing nations to meet their net-zero emission targets and providing car manufacturers with a logical and economic means of phasing ICE vehicles out of their product ranges. The future of energy storage and transportation, and the best way to transform next-generation energy needs, is LFP.

And finally ... In the unlikely event that your battery-powered ride does go up in smoke, is it wise to keep a fire extinguisher on board? Research suggests otherwise: that water sprayed directly onto the battery housing to slow the combustion within is the remedy of choice. The only problem is, LOTS of water is required, as *Business Insider* reports. So, despite Tesla's claims that its EVs are the "safest in the world," why not wait until they're even safer – with LFP rather than NMC battery packs on board?

Which Perth-based company is contemplating commercial production of LFP?

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