Dear reader,

Interact Analysis’s recent market report, *Lithium-ion battery production and supply - 2019*, gives an in-depth analysis of the industrial and automotive lithium-ion battery (LIB) market. Our LIB report covers all aspects of the LIB market, from both the demand side and the supply side; and examines the market by application, and by region, as well as taking a look at LIB battery manufacturing equipment.

This whitepaper draws extensively on that report, as well as a series of external sources, to give insights into one specific area affecting the LIB market: electric vehicle production. The LIB market is predicted to see considerable growth up to 2023 and beyond. Electric vehicle production will be a key driver behind this growth.

Markets in batteries for electric buses and private passenger electric vehicles will see the most significant growth, whilst the off-highway vehicle sector will lag behind, but will still offer considerable investment potential. LIB production in Europe is poised for massive growth, with Chinese companies taking the lead. Meanwhile, the nature and use of different vehicles has an important bearing on the type of battery used.

If you enjoy the read and want to carry on the conversation on LIBs with me, please get in touch on the details below. And for more information on the report, [click here](#).

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1. Key Points

- Globally, the predicted trend for private cars favours smaller batteries, as issues around range and charging infrastructure push the hybrid vehicle into the picture.

- As a response to drivers’ concerns over vehicle range, the installed capacity of NCA/NCM batteries almost doubled in the year 2017-2018.

- There is a limited outlook for electrification of trucks, but electric buses will occupy 24% of the global market by 2025.

- **Prismatic batteries** accounted for nearly 80% of the electric bus market in 2018.

- Electric two-wheelers/trikes: there are major marketing opportunities for battery manufacturers in this sector.

- Significant variation exists from region to region in battery type and power requirements.

2. Introduction

Vehicle electrification has huge advantages on a number of fronts, the most prominent being energy security, safety, efficiency, and environmental benefits. Vehicle electrification also faces major challenges, not the least of these being the continued development of the efficiency of the Internal Combustion Engine. But the electric vehicle, or at the very least, the hybrid vehicle, will in time become the norm. In the meantime, challenges have to be met. These challenges centre around charging infrastructure, economic viability, and, most importantly, battery technology, where issues of weight, power density, charge-time and range are paramount.

In this paper, we will take a brief tour of the issues, focusing on the vehicles and their battery requirements,
3. Passenger electric vehicles

The global market for batteries for electric private cars is predicted to show clear growth where smaller batteries are concerned, as more manufacturers produce hybrid cars. The exceptions are China, where there is a clear policy stimulus for full electric vehicles, and Europe, where the decrease in battery size will be relatively small, and where most models will be equipped with upgraded batteries. The hybrid market will continue to grow in Europe, however.

In 2018, global sales of Li-ion batteries used in passenger electric vehicles reached 65.1GWh showing a year-on-year increase of 81.0%. Half of the top 10 LIB cell makers were in China, with Panasonic in first position. However, the competitive landscape is forecast to change, as LIB cell production establishes itself in Europe. The Chinese company CATL, for example, is looking at increasing production capacity in Germany.

A major challenge is the short supply of high-end batteries, and the concentration of market share in the hands of a few manufacturers. Since 2015, the top 10 companies have always occupied over 70% of market share. But it is forecast that the number of battery suppliers will increase, and that requirements of specific vehicles will be reflected in a wider range of battery types.

A major concern for private consumers is vehicle range. This is the reason the installed capacity of NCA/NCM batteries almost doubled between 2017 and 2018. The proportion of pouch/polymer batteries in private passenger vehicles is forecast to increase significantly in the period up to 2023, but cylindrical and prismatic batteries will continue to occupy a significant market share.
LIB Used in Passenger Electric Vehicle by Package Type (2013 - 2023E)

The proportion of pouch/polymer batteries in private passenger vehicles will increase significantly by 2023

Source: Interact Analysis ©2019 Interact Analysis
4. Electric buses & trucks

Despite strong growth, Interact Analysis forecasts that electric trucks will only achieve a penetration rate of 5% of the global truck market in 2025. Trucks can be classed as light-duty, medium-duty and heavy-duty vehicles. Whereas the efficiency of electrification of light-duty trucks has already been proven, the TCO of medium- and heavy-duty electric trucks remains a barrier. By comparison, electric buses are electrifying much more rapidly, and are predicted to occupy 24% of the overall bus market in 2025.

Policy decisions in China are the main reason for this difference. Through aggressive subsidies, and legally enforcing electrification, the Chinese government has almost completely electrified its bus fleet in cities, and the inter-city bus fleet is expected to follow on quickly from this.

The Chinese government has not applied the same policies and subsidies to trucks, however, as a result of which, the penetration rate for electrified trucks is much more modest. There is no technological barrier to significant growth in this sector though, if policies were to be revised in favour of electrification.

China accounts for a huge segment where global electrified bus deliveries are concerned. However, leaving aside China, on a much smaller, but increasing scale, the global market is relatively evenly distributed. There is a large demand for electric buses in Africa and South America, but similar growth is not expected where electric trucks are concerned.

Global Electric Bus Market Split By Region (2017 - 2023E)

China accounts for a huge segment where global electrified bus deliveries are concerned

Source: Interact Analysis ©2019 Interact Analysis
**Prismatic batteries** accounted for nearly 80% of the electric bus market in 2018, and this is expected to be maintained within the forecast period. Pouch and cylindrical batteries are predicted to maintain a market share of around 10% each, and 95% of batteries contained **LFP cathodes** in 2018. This figure is expected to drop marginally by 2023, but will still be over 90%. It is forecast that NCA/NCM cathode material will see small, but significant increases.

The technical route of electric trucks is far more diversified than it is in buses. Here it is important to bear in mind that the electric truck is still largely in its developmental stages. NCA/NCM cathode material is predicted to make slight advances on LFP, but both occupy a similar, major share of the market. Prismatic batteries are predicted to occupy slightly over 50% of the market by 2023, with pouch and cylindrical batteries both occupying much smaller, but significant shares.

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The technical route of electric trucks is more diversified than it is in buses

Source: Interact Analysis ©2019 Interact Analysis
5. Electric two-wheelers/trikes

The electrification of two-wheeled vehicles is seen as key to the fight against pollution in cities, and is also often seen as the solution to a nation’s fuel import dependency. Countries such as India have recognised this, with policies in the offing which could have major ramifications for its motorised two-wheeler industry\(^1\).

LIBS have been used in two-wheelers/trikes for nearly 10 years. However, their relatively immature development and their high price have meant that their market penetration, at 10%, has been far lower than that of lead-acid batteries. Furthermore, the lack of standardisation of battery packs, and the depreciation rate of two-wheeled vehicles under 150cc, especially in APAC, notably the Chinese market, is so great that consumers rarely replace a battery, choosing instead to purchase a whole new machine. However, it is anticipated that with greater standardisation in the LIB production industry, and a proliferation of terminal service providers, more consumers will resort to battery replacement, thereby increasing that market. Furthermore, developments in the portability and durability of electric two-wheelers, coupled with policy decisions such as China’s environmental protection tax for lead-acid enterprises (2018) which will likely limit the use of lead-acid batteries, are creating favourable conditions for future LIB market penetration. **NCM batteries** are the most widely used LIB in the electric two-wheeler/trike market.

![LIB Used in Two-Wheeler/Trike by Cathode Material (2013 - 2023E)](image)

**LIB Used in Two-Wheeler/Trike by Cathode Material (2013 - 2023E)**

NCM batteries are the most widely used LIB in the two-wheeler/trike market market.

Source: Interact Analysis ©2019 Interact Analysis

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6. Electric off-highway vehicles

Progress in the electrification of off-highway vehicles (OHVs) is relatively slow. Economic viability is the main challenge. Size, vehicle type, and application are the prime considerations where electrification viability is concerned. Small machines, and equipment used indoors tends to occupy the lion’s share of the electrification market. Lift trucks are currently the best established OHV type in terms of electrification.

Large machines, such as excavators, working in an isolated environment, away from the grid, such as in road-building, would require high energy density batteries which can last for a minimum of 8 hours. Current battery technology has not yet matched this requirement. However, progress has been made with hybrid systems involving electrification of ancillary equipment, such as hydraulic lifting gear, while the ICE remains the main vehicle motor. It is possible to make significant reductions in fuel consumption with hybrid equipment. Such equipment is much more in line with market demand.

Whilst the LIB is unlikely to be able to be used in full electrification of large off-highway machines, serious research is happening in the field of hydrogen fuel cells, which could have the potential to power large machinery.

China is the largest market for OHVs, and will continue to be so until at least 2028. India will be close behind. The potential for electrification in these markets is considerable.

The trend for electrification of off-highway vehicles varies greatly depending on the application.

Source: China Construction Machinery Association, National Bureau of Statistics, Interact Analysis
7. Battery chemistry – examples of regional differences.

**China:** In 2018, the largest market for lithium-ion batteries in China was the electric passenger car, where issues such as energy density are key. The Chinese government has made major policy decisions regarding battery production. For instance, by 2025 their energy density target of automotive power lithium-ion batteries will be 400Wh/kg. The material system should consist of a lithium-rich manganese-based positive electrode plus a high specific energy silicon-carbon negative electrode. By 2030, the energy density target will be 500Wh/kg.

Conversely, the pressure to raise the energy density of batteries in electric cars is not applied where China’s buses are concerned. Electric buses are the norm in China, which accounted for 98% of buses delivered in 2018. They primarily use lithium-ion phosphate (LFP) batteries, which are cheaper to produce than, for example lithium-ion cobalt batteries, but have a lower energy density. This is not an issue, however, as buses in highly populated Chinese cities tend to operate on a short duty cycle, with congestion meaning they often travel at no more than 10mph².

Japan sees its lithium-ion battery sales mainly concentrated in the consumer 3C products. The consumer market accounted for 84.6% of total LIB sales in 2018. Markets in transportation are limited, and most LIBS for electric vehicles produced in Japan are exported. Research and development of the lithium-ion battery has concentrated mainly in the field of household energy storage systems, where the country is one of the top consumers in the world. While china puts the emphasis on the energy density of LIB cells, Japan concentrates on increasing the energy density of battery packs. For automotive power batteries, Japan has proposed that the energy density of the battery pack (not the cell) should reach 500Wh/Kg by 2030.

**EMEA:** The LIB market has been heavily dependent on imports, but by 2020 production will grow exponentially, with 50% of new capacity coming from Chinese manufacturers. Europe has the most stringent emissions standards, which have resulted in a drive to electrification of off-highway vehicles and large trucks.

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Notwithstanding these high emissions standards, the technical aspirations of countries such as Germany are not as high as other countries. The German goal for energy density of a LIB cell, for example, is 400Wh/Kg by 2030. Significantly lower than China’s.

Where powering electric buses is concerned, however, in Europe, unlike in China, the drive is to use higher density batteries. Like China’s buses, electric buses in European cities have relatively short duty cycles, but depot-only charging strategies mean more powerful batteries are needed. Solaris, for example, announced earlier this year that it will be increasing the energy density of batteries in its articulated buses from 300kWh to 550kWh³.

**The Americas:** The production of Tesla’s pure electric vehicle with its large size battery has meant that the average battery size of the electric car increased by nearly 40% between 2016 and 2018, giving 41.62KWh, much higher than the 30KWh in other parts of the world.

The LIB has had relatively little success at penetrating the market where small OHVs, such as lift trucks are concerned. The exception, perhaps, being AWPs. There is room for considerable growth where electrification is concerned in the huge OHV market.

LIB sales in the transport area are dominated by the **cylindrical NCA battery**, as used by Tesla, but this will change around 2020 with the introduction of new cars produced by other automotive companies.

The U.S. Department of Energy’s specific goal is to achieve a significant reduction in the cost of a battery pack. The aim is to achieve this by reducing the dependence of batteries on imported materials, such as cobalt. This could be at least partly achieved through recycling.

### 8. Conclusion

On a global basis, vehicle electrification is forecast to continue apace. The opportunities for the battery manufacturer are considerable, whether it is in regard to developing new technologies, enabling more rapid charging, increased portability, or greater vehicle range, or to penetrating new markets. From the largest off-highway vehicle through to the electric bike, the opportunities are there to be seized.

To download a brochure and sample pages for Interact Analysis’s market report Lithium-ion battery production and supply – 2019, click here.

To carry on the conversation with Maya Xiao, Interact Analysis’s Research Analyst for LIBs, get in touch with her directly: maya.xiao@interactanalysis.com | +86 21 3893 2558
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