

## Current trends in China's e-bike market

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- CHR Metals
- Recap on China's e-bike industry
- New standards for e-bikes in April 2019
- E-bike batteries – how big is annual lead demand
- The e-bike market today – lead and lithium batteries
- Closing comments

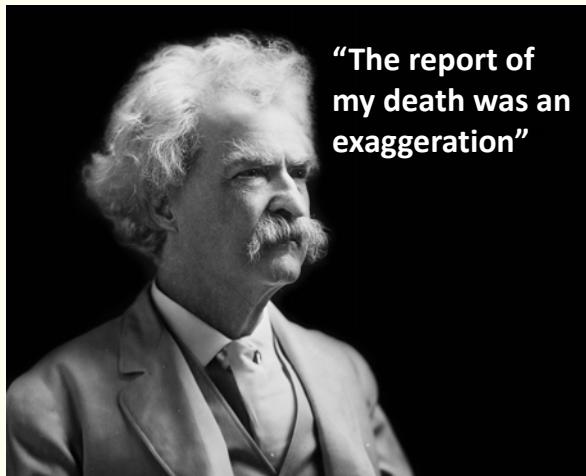


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- Covering all aspects of mine and smelter supply and end-use consumption
- Data from original sources wherever possible
- A particular focus on Chinese market
- Providing detailed data and market reports
- Offices in the UK and Xi'an
- Clients include producers, consumers, traders and hedge funds

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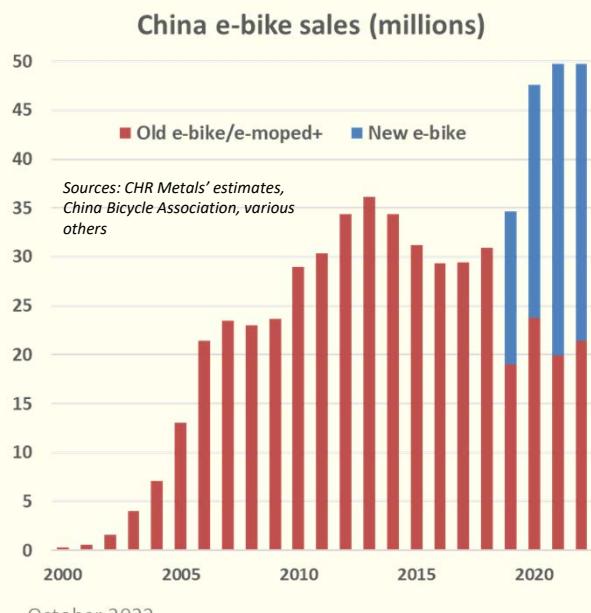


- New standard for e-bikes introduced in April 2019
- Weight limit of 55kgs, including batteries, seen by some as the death knell for lead batteries
- Assumed that only lithium batteries could possibly meet this limit on overall weight
- Many also assumed that all lead battery powered e-bikes would disappear off the roads, and in very short order
- These predictions have been proved to be wrong
- Failure to appreciate the differentiated nature of China's e-bike market
- Chinese pragmatism has, in general, permitted a lengthy transition period for the replacement of e-bikes not meeting the new standard
- Innovation by e-bike and lead battery manufacturers has seen development of products capable of meeting the new standard while still using lead batteries
- High cost and other issues with lithium batteries

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- Lead battery powered, two-wheel electric bicycles appeared on the roads of China in great numbers beginning in the early 2000s
- Sales growth of 200% per annum between 2000 and 2006, to exceed 20 million, with further increases to initial peak of 36 million in 2013
- Number of e-bikes on the road (fleet) grew rapidly and estimated to be 121 million by 2010 before stabilising at around 180 million between 2015 and 2019
- Some data show fleet numbers of 250 to 300 million before 2020 but must assume working lives for e-bikes far longer than our observation and anecdotal evidence suggests
- New technical standards for e-bikes released in 2018, with introduction in April 2019
- Many considered new models able to meet the standard for small e-bikes as unsuitable replacements for commonly-used older style e-bikes

	E-bike	E-moped	E-motorbike
Standard	GB-17761-2018	GB/T-24158-2018	GB/T-24158-2018
Top speed	≤25Km/h	≤50Km/h	>50Km/h
Motor power	≤400W	400W-4KW (Optional)	>4KW (Optional)
Entire weight	≤55kg	Permitted ≥55kg	Permitted ≥55kg
Battery voltage	≤48V	No restriction	No restriction
Passengers	Child under 12 in some provinces	No	1 adult + rider
Legal status	Non-motor vehicle	Motor vehicle	Motor vehicle
Driving license	No	Yes	Yes
License plate	E-bike plate (Varies by province)	Motor vehicle plate (Blue)	Motor vehicle plate (Yellow)

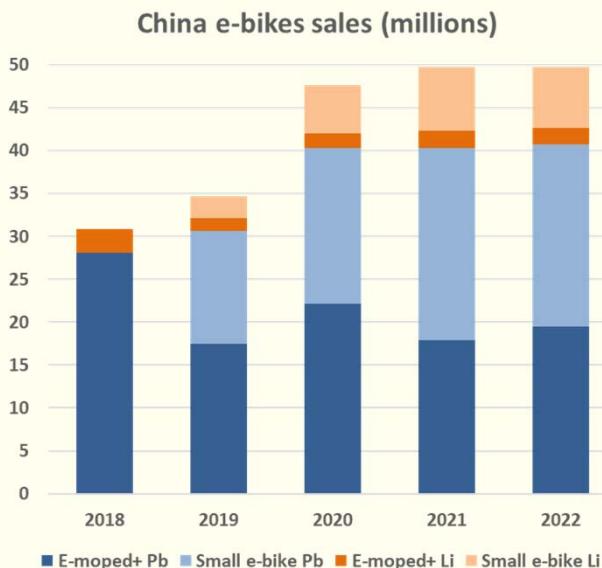


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- Aims of the new e-bikes' standard to regulate the industry and improve safety for both riders and other road users
- E-bike manufacturers must now be certified (3C), a process involving factory audits and product testing to improve quality
- Most smaller manufacturers have been eliminated from the market
- Main difference between classes of electric two-wheelers is where they can be used and if a driving licence and insurance is required
- Only the smaller, lighter e-bikes now permitted to use traditional cycle lanes
- Many older e-bikes made before April 2019 are still legally on the road under various transition schemes
- In some places, older e-bikes will be permitted until 2025 provided they have a temporary licence

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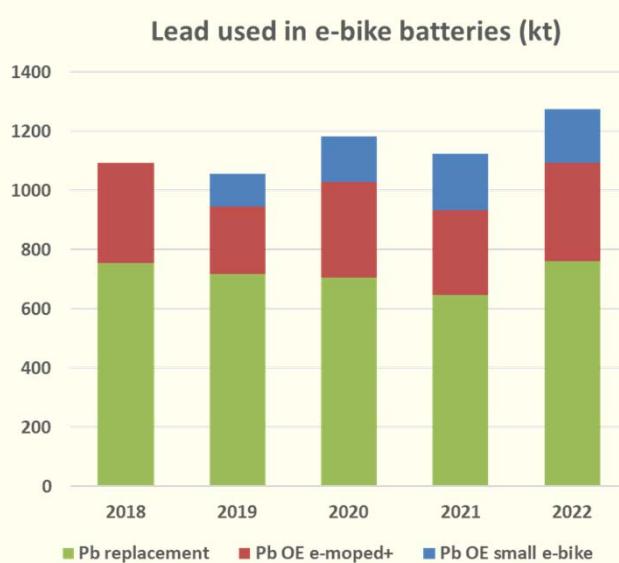


- New standard has transformed the market
- Transition period for elimination of older, non-standard e-bikes varies across the country
- Greater availability of e-bikes meeting new standards in 2020 pushed sales higher
- Other factors include Covid and, more recently, high fuel costs and traffic congestion
- Lead batteries continue to hold onto a large share of the market for both small and larger e-bikes

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- In years before the new e-bike standard introduced almost all e-bikes used lead batteries
- Typically battery packs comprised 3 or 4 12V batteries rated at either 12Ah or 20Ah
- Some larger e-bikes had 5 batteries (60V) or even 6 (72V)
- The lead content of each battery pack fitted in an e-bike was typically between 7.5kg and 15kg
- Roughly 1.75Mt of lead was in e-bikes on China's roads in 2019
- Annual lead consumption for OE and replacement batteries was around 1Mt...
- ...and these numbers have increased since 2019



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## China's e-bike market today



- There has been a sharp increase in sales since 2019
- More than half of sales meet the new standard for small e-bikes
- Weight limit (max 55kgs) favours use of lithium batteries...
- ...but share of small e-bike market captured by lithium batteries is currently no more than 25%
- Small lead battery packs (36V12Ah) are light enough to be used in e-bikes with innovation improving power density, cycle life and low temperature performance
- Small e-bikes are cheap, less than US\$400 each, and choosing lithium battery pack can add 20% to the overall cost compared with a lead battery

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## More reasons for choosing lead batteries



- The cost of lithium batteries compared with lead is one key factor in limiting use in e-bikes
- Safety is also perceived as an issue with lithium batteries after a sharp increase in the number of fires and deaths
- Regulations now prohibit the charging of lithium batteries inside apartments
- E-bike batteries must only be charged in designated charging sheds or official charging points in cities
- Restricting where batteries may be charged removes an advantage of lithium batteries – light enough to carry into an apartment for charging
- A viable, economic recycling infrastructure for lithium batteries is still being developed in China
- Retailers are reluctant to offer a discount when buyers return old lithium batteries for replacement as there is little net value in recycling lithium batteries, especially LFP chemistries
- Some authorities bar or restrict the movement of lithium battery scrap across provincial boundaries, increasing logistical difficulties and costs

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- The e-bike/e-moped/e-motorbike market is still adjusting following the introduction of new standards in 2019
- Many places still allow use of non-standard e-bikes provided they are registered – this dispensation may last until 2025
- The need for licence and insurance to ride an e-moped or e-motorbike continues to push those replacing older, large e-bikes towards small e-bikes which can still be used in the same way as a pedal cycle
- A rising share of smaller e-bikes will not necessarily mean a greater share for lithium batteries at the expense of lead due to the rising cost of lithium batteries
- Sales of e-bikes in 2021 and 2022 have exceeded expectations
- E-trikes remain another very large market for lead batteries in China each year requiring as much, or more, lead than e-bikes

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