EXECUTIVE SUMMARY

Global Energy Storage Market Forecast 2019

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Executive Summary

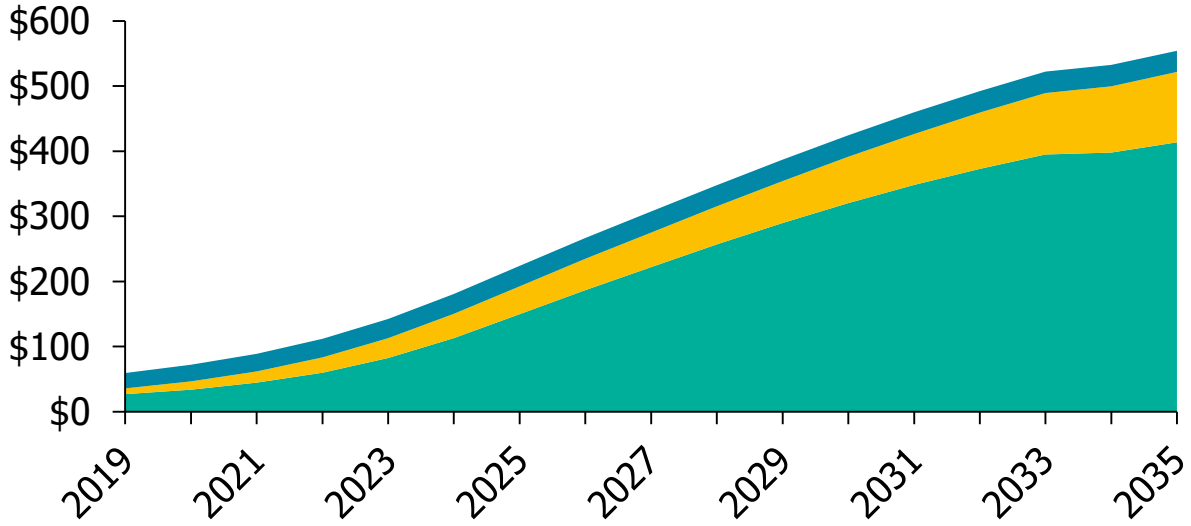
In the 2019 edition of our biennial market forecasting report, we find that by 2035, the total energy storage market will grow to $546 billion in annual revenue and 3,046 GWh in annual deployments.

Mobility remains the long-term driver of energy storage annual revenue and demand, with a 2035 total market share of 74% by annual revenue and 91% by demand. Meanwhile, the stationary storage market will surpass the electronic devices market in 2023, when we project it will become a $30 billion industry of 52 GWh in installations.

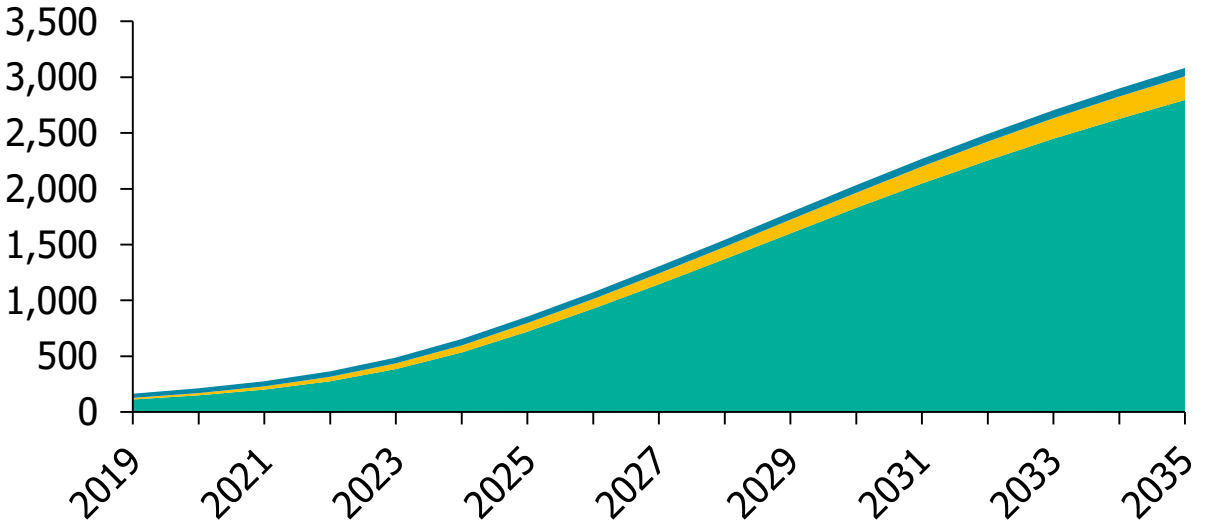
This growth will be driven by the commercialization of several key innovative technologies, including solid-state batteries and flow batteries.

Total market projections

Energy storage annual revenue ($ billions)



Energy storage demand (GWh)



The energy storage industry includes a wide diversity of companies and technologies targeting three main markets

The ability to store energy is still just beginning to impact our energy systems, from disrupting the automotive industry to transforming the way we produce and distribute electricity. It is composed of three principal markets:

- **Electronic devices**, such as laptops, cell phones, and drones, are the most mature markets for energy storage. Annual sales of many of these devices have plateaued, and there are few growth opportunities for battery companies targeting these markets.
- **Mobility** applications, including both battery electric vehicles (BEVs) and fuel cell electric vehicles (FCEVs), are supported all around the world by vehicle emissions regulations. Automakers are now aggressively expanding their BEV offerings to capture greater shares of this growing market.
- **Stationary storage** deployments are also increasing globally to support increasing renewables deployments, meet grid storage mandates, and tap into new revenue streams through application stacking. However, it can still be challenging to make money in this market due to uncertainties in regulation and regional differences.

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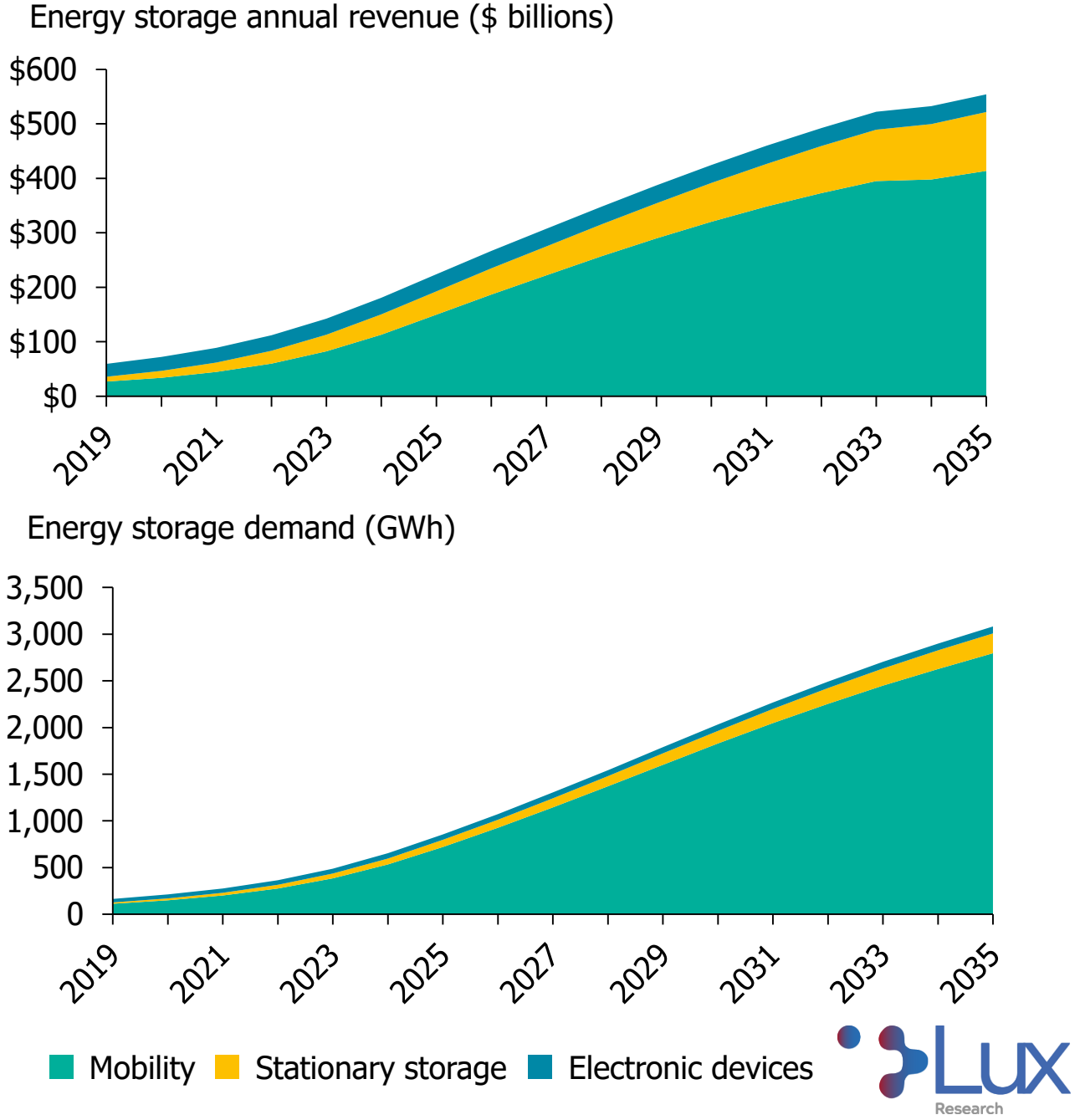
Total market forecast

Total market size, 2019	$59 billion	164 GWh
Total market size, 2035	$546 billion	3,046 GWh
CAGR	14.9%	20.0%

Mobility remains the long-term driver of energy storage annual revenue and demand, with a 2035 total market share of 74% by annual revenue and 91% by demand. It also has the highest compound annual growth rates (CAGRs) through 2035 of 18.6% by annual revenue and 22.3% by demand.

The electronic devices market was the second-largest segment in 2018, more than triple the stationary storage market. Yet this segment is expected to remain relatively flat, with CAGRs of only 1.9% by annual revenue and 4% by demand.

We forecast that the stationary storage market will surpass the electronic devices market in 2023, when we expect it will become a $30.4 billion industry of 52.5 GWh in installations compared to the $29.5 billion/52.1 GWh electronic device market.



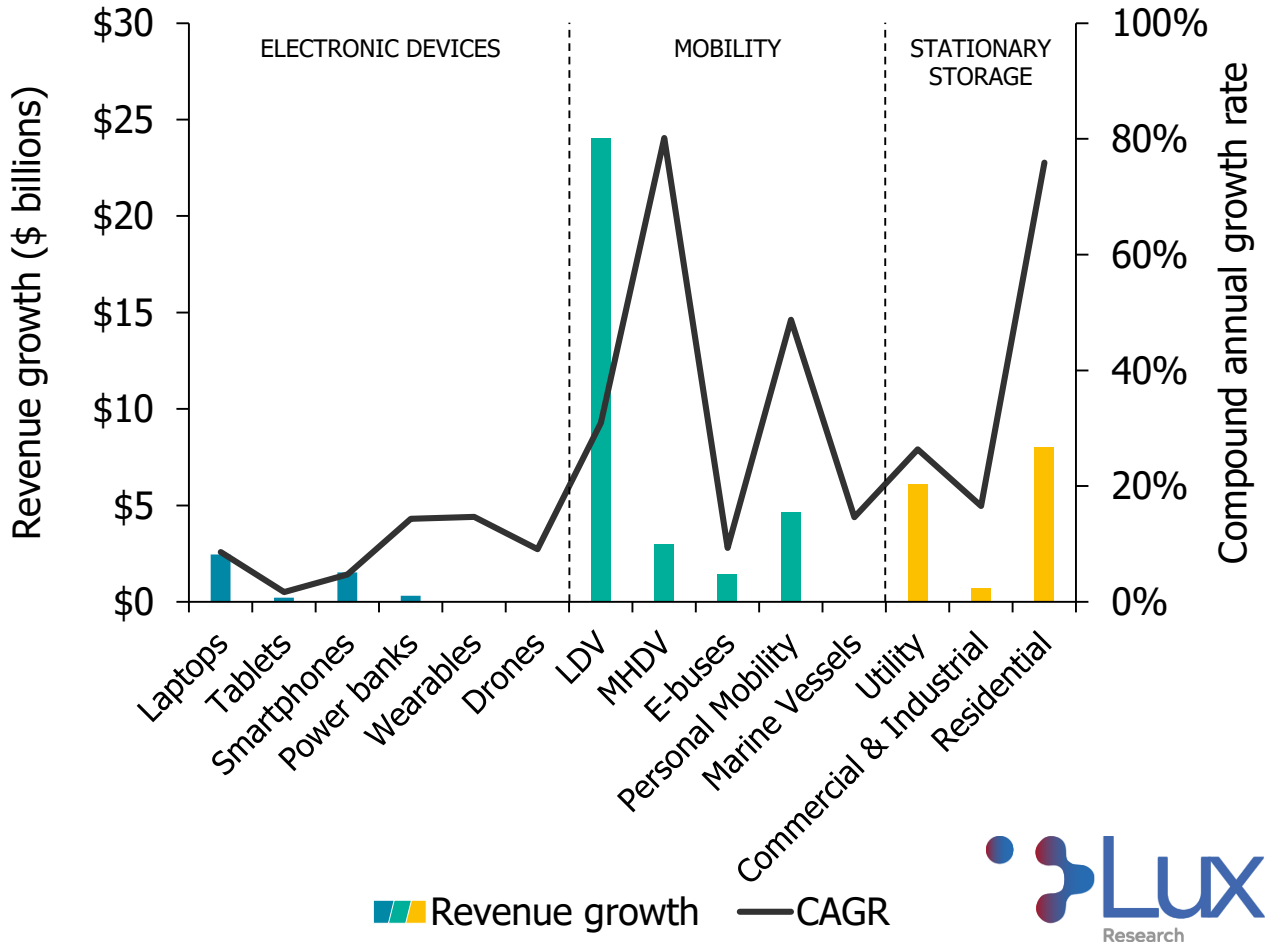
Near-term, MHDVs and residential storage are the fastest-growing applications, while LDVs remain the largest market

Over the next three years, the top three fastest-growing opportunities in the energy storage market include two in mobility and one in stationary storage:

- **Medium- and heavy-duty vehicles (MHDV)** have the highest CAGR by demand (80%), growing from $600 million/year in 2019 to $3.6 billion/year in 2022.
- **Residential storage** takes second place, with a CAGR by demand of 76% and an increase in revenue of $8 billion over the next three years.
- **Personal mobility** is the third-fastest growing market, with a CAGR by demand of 49% and an increase in revenue of $4.6 billion over the next three years.

Despite these applications' high CAGRs, **light-duty vehicles (LDVs)** remain the largest market for energy storage by annual revenue, with an increase in revenue of $24 billion by the end of 2022.

Near-term growth opportunities
2019-2022



Electronic device market forecast

Market size, 2019	$24 billion	39 GWh
Market size, 2035	$32 billion	72 GWh
CAGR	1.9%	4.0%

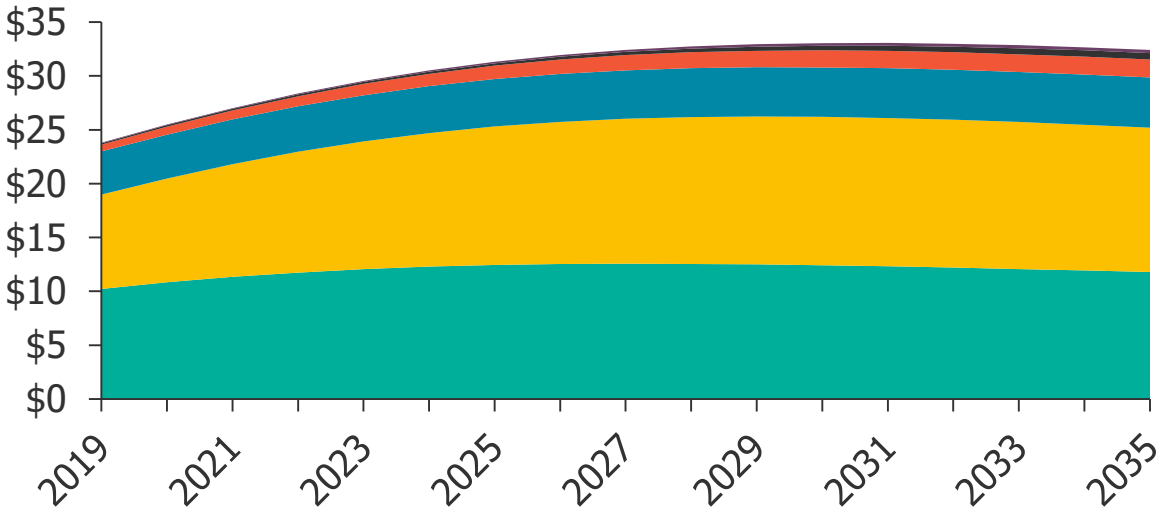
Electronics markets are relatively stable: The markets for smartphones, laptops, tablets, power banks, and consumer drones have all reached critical mass and will only increase with population growth. Additionally, most wearable devices require very small battery capacity and are therefore not strong drivers for the energy storage market; devices that do have greater energy requirements, such as AR/VR headsets, are much more commonly wired than battery-powered.

The most dynamic segment over the next 15 years will be commercial drones. Since our last market sizing report in 2017, the market share of commercial drones powered by batteries rather than fossil fuels increased from 50% to 90%. Implementation is also expected to steadily increase as drone traffic management platforms are deployed and regulations relax to allow for air taxi operators to offer public services by 2030. Yet even in 2035, the total drone market will remain small, as regulations will continue to limit growth.

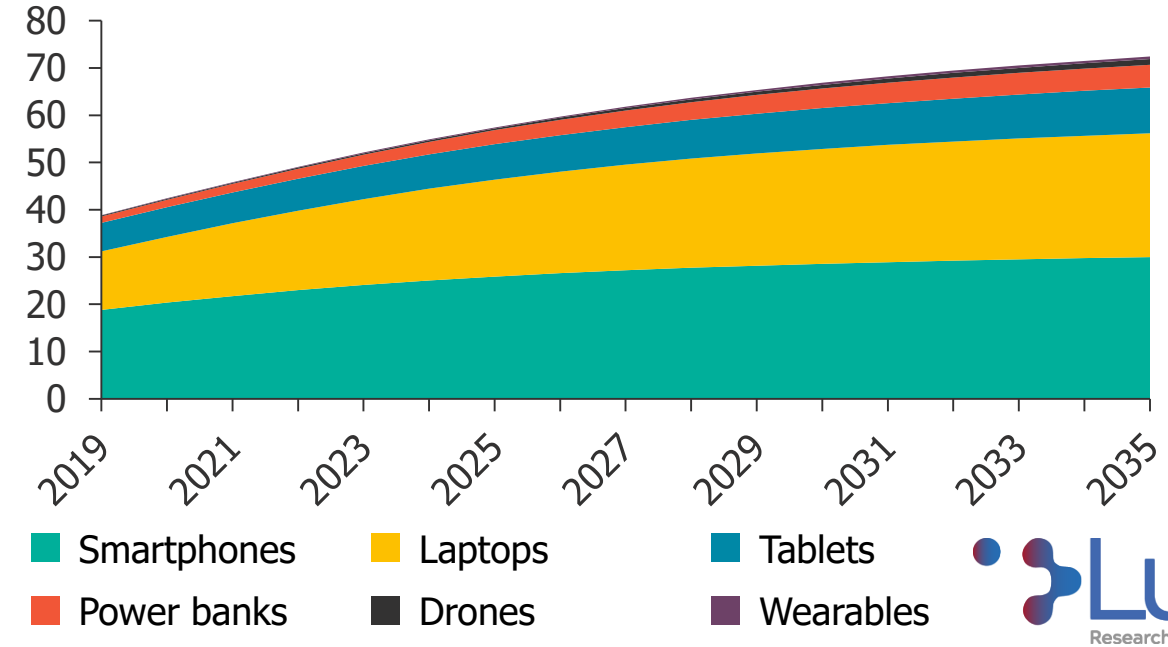
View the report "**The Future of Electric Aviation**."

Electronic device market forecasts

Energy storage annual revenue ($ billions)



Energy storage demand (GWh)



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Personal mobility

Market size, 2019	$2 billion	4.9 GWh
Market size, 2035	$43.7 billion	175.4 GWh
CAGR	21.2%	25.1%

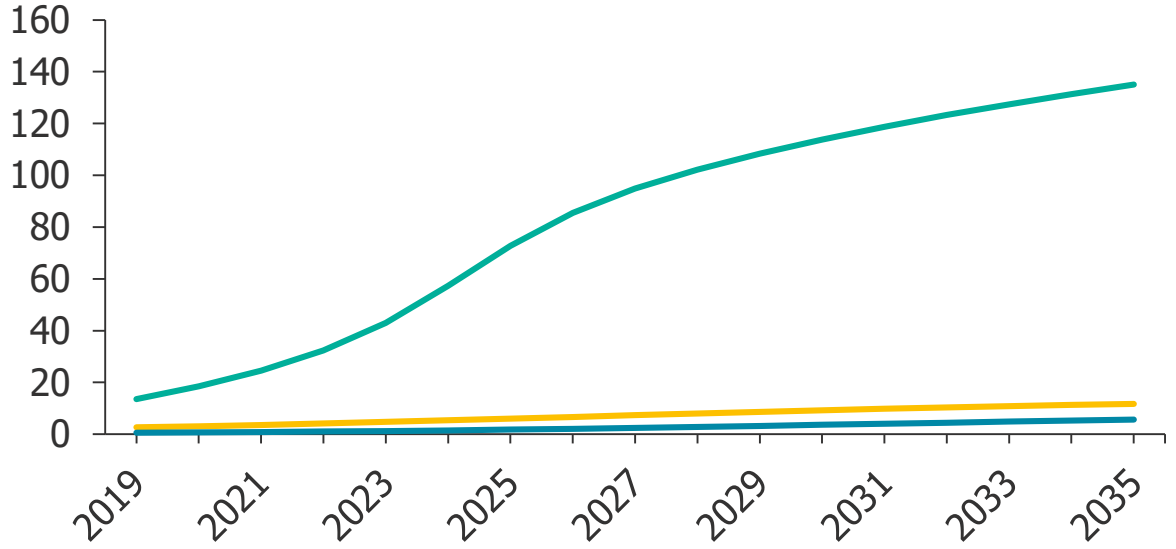
China's electric scooter and bike market already exceeds 30 million units annually, although most of that remains lead-acid-powered today (our forecasts only consider Li-ion-powered units). Growth in China will come from this shift to Li-ion chemistries, which is already underway.

The largest sources of growing demand will be India and Southeast Asia. Limitations in charging infrastructure and a slumping automotive sector will see light-duty electric vehicle sales in India stagnate, but competitive costs for electric bikes, scooters, and motorcycles will drive considerable growth. In India, shared mobility is likely to be powered by swappable Li-ion batteries powering two- and three-wheeled vehicles, such as those from Ola and SmartE.

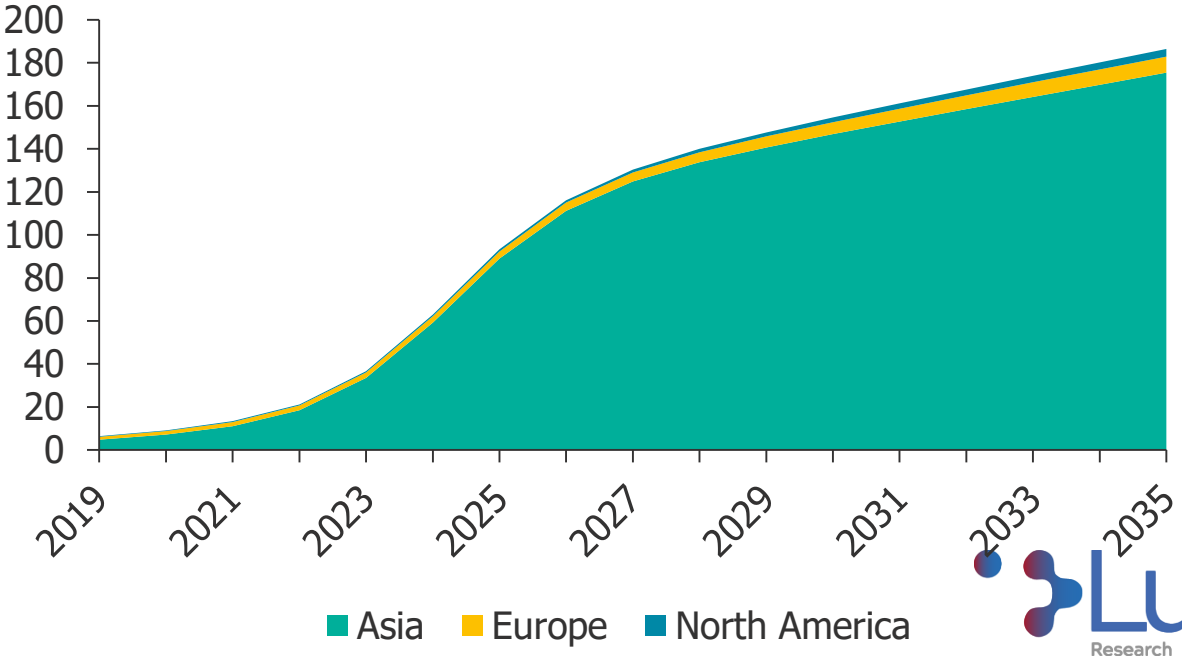
In Europe, some countries like the Netherlands and likely soon Germany are already seeing e-bike sales outpace those of conventional bikes. However, with just 12% of global personal mobility sales, Europe will not result in meaningful demand.

Personal mobility market forecasts

Unit sales (millions)



Energy storage demand (GWh)



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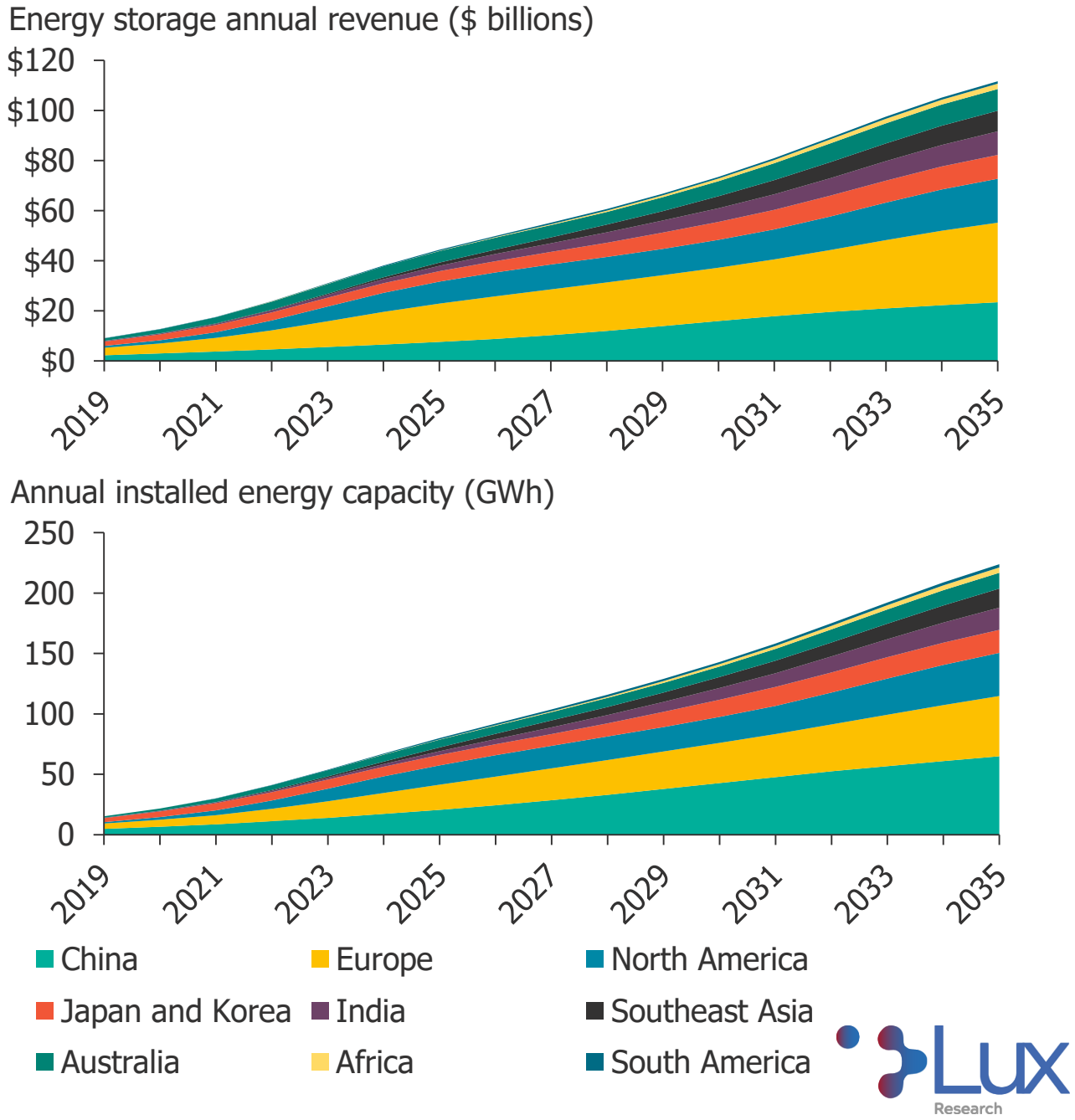
Stationary storage market forecast

Market size, 2019	$9.1 billion	15.2 GWh
Market size, 2035	$111.8 billion	222.7 GWh
CAGR	17.0%	18.3%

The falling cost of stationary storage systems, the rise of renewable energy, and the liberalization of electricity markets around the world will be transformative for energy storage over the next decade and a half. The shift of Li-ion battery manufacturing capacity toward energy-dense chemistries to support the growing electric vehicle industry means that future Li-ion battery cost reductions for stationary storage systems will be modest – 2% to 4% annually – compared to historical trends of more than 10%.

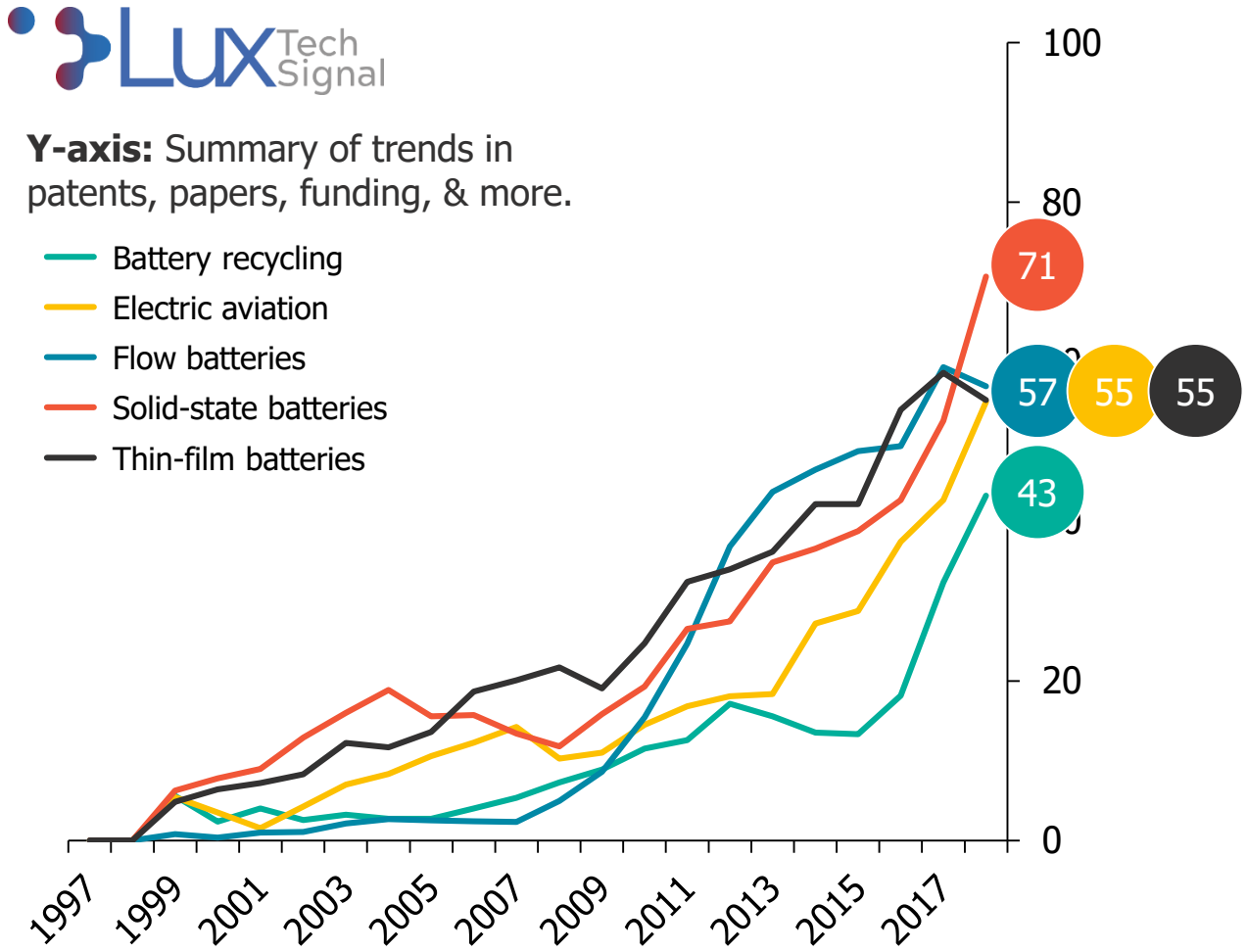
The increased value proposition of energy storage in electricity markets will more than make up for a slowdown in cost reductions. Wind and solar will grow to a third of worldwide generating capacity, building opportunities for stationary storage to balance the growth of nondispatchable renewables. Electricity market reform will enable stationary storage to participate more broadly in more regions: By 2035, more than 40% of annual deployments will take place in evolving grids like China, India, Southeast Asia, and Africa.



Over the next 15 years, the commercialization of key technologies will grow the global energy storage market

These technologies are well-positioned to impact markets both inside and outside the energy industry:

- **Battery recycling** will alleviate the strain on securing key feedstocks like lithium and cobalt.
- **Electric aviation** will reduce the carbon cost of flying, and regional operators are already transitioning to electric powertrains.
- **Flow batteries** will play a critical role in a future grid with a high wind and solar penetrations by providing carbon-free bulk capacity.
- **Solid-state batteries** offer both improved energy density and safety, making them the most likely candidate to displace today's Li-ion batteries.
- **Thin-film batteries** could enable innovations in wearables, medical applications, and IoT devices.



Follow these technologies here: **battery recycling**, **electric aviation**, **flow batteries**, **solid-state batteries**, and **thin-film batteries**.

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Stationary storage outlook

The vast majority of stationary storage that will be deployed over the next decade and a half will be Li-ion batteries, specifically durable chemistries like LFP. Other technologies like flow batteries and sodium-sulfur batteries may see some penetration in longer discharge duration utility applications, but chemistry won't be the key differentiating factor; software that optimizes dispatch or aggregates systems through virtual power plants will be what sets energy storage products apart.

Regions like Europe and Australia will see wind and solar grow to significant penetrations, prompting a discussion about overgeneration and seasonal variability. While a rational approach is to develop ultra-long-duration storage, an alternative approach is to link excess renewable generation to other industries like chemicals or transportation through hydrogen generation. Long-duration storage versus sector coupling will be the next great debate in the power sector, the outcome of which will shape industry and mobility for decades.

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