



Global two- & three-wheeler electrification



Photo credit: Katumba Badru Sultan / Lubyanza

There are approximately [half a billion motorised two- and three-wheelers](#) (2&3W) in the world, most of them found in Asia, Latin America, and Africa. A significant and increasing number of vehicles worldwide are transitioning to electric power, and 2&3Ws are no exception. Urbanites facing rising and unpredictable fuel prices, constant maintenance needs, and dangerous air pollution are swapping their internal combustion engine (ICE) scooters, motorcycles, and tuk-tuks for electric models.

The existing fleet of electric 2&3W is already displacing [nearly twice](#) as much oil volume than all the four-wheel EVs combined.¹ The transition towards electric 2&3W could significantly reduce up to [500 to 600 million metric tons of CO₂](#) equivalent each year.² Beyond CO₂ emissions reductions, this transition can also contribute to reducing air and noise pollution, supporting global efforts in combating climate change and promoting public health. In China, for instance, motorcycles accounted for [22%](#) of volatile organic compounds (VOCs) emissions, while in Taiwan, they were responsible for around [20%](#) of carbon monoxide emissions. Shifting from internal combustion engines (ICE) to electric models for these vehicles is a crucial step towards sustainable development.

¹ Oil displacement figure from BNEF Electric Vehicle Outlook 2023; four-wheel EVs encompass buses, passenger cars and vans and trucks.

² Based on 2020 average grid emission factors for Africa, Latin America and Asia from EMBER (<https://emberclimate.org/data/data-tools/data-explorer/>). Data without consideration of emissions from battery production.

Key Trends

Three key trends are essential to understanding the growth and future of electric 2&3Ws.

1. Higher affordability and accessibility of electric 2&3Ws

Recent advances in battery technology, along with a nearly [ten-fold decrease](#) in the cost of long-lasting lithium-ion batteries over the past two decades, have made 2&3Ws more affordable. This progress is expected to increase their availability further, thanks to expanding manufacturing capacity and the development of new battery chemistries.

2. Battery-swapping business models

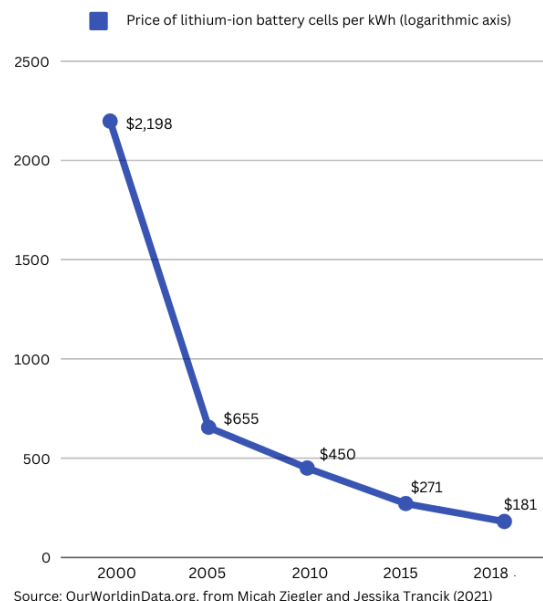
The transition to electric vehicles (EVs) has been hampered in many countries by the sparse electric grid, low-density charging network, and battery prices. This infrastructure gap has fuelled uncertainties about EV adoption, as potential users worry about finding convenient charging options and facing long charging times.

The battery-swapping model offers a promising solution to these challenges. This innovative approach allows EV users to quickly exchange their depleted batteries for fully charged ones at dedicated swapping stations, effectively bypassing the need for a dense charging network and lengthy charging times. It also addresses a significant portion of the upfront cost barrier, as the expense of the battery is absorbed by the swapping company. Battery swapping also mitigates range anxiety, one of the most significant obstacles to EV adoption, by providing an accessible, efficient, and widely available service.

3. Market leadership by Asian countries

Before and parallel to the rise of electric models, governments have often been ambivalent about the presence of 2&3Ws. Governments in Africa, for example, in [Ghana](#) and [Cote D'Ivoire](#), have regarded 2&3Ws as a nuisance, mainly due to air pollution and disrespect of traffic rules, and sought primarily to ban them or restrict them from certain areas. In contrast, [in China](#), the government has recognised the potential of these modes and financially promoted the use of electric 2&3Ws to act against air pollution. This support has significantly contributed to the industry's expansion in China, where over [three-quarters of EV battery cell manufacturing](#) and [purchase over 90% of the world's e2&3W](#) is taking place.

As the market evolves, other Asian nations, including Thailand, India, Vietnam, and the Philippines, have followed China's lead. These countries have acknowledged the benefits of 2&3Ws in alleviating traffic congestion, thereby fuelling market growth, for example, by [Delhi's mandate](#) to switch to electric vehicles by 2030. This trend suggests that Asian countries are poised to continue dominating the production and export of 2&3Ws in the foreseeable future.



Key Challenges

Although the electrification of 2&3W is increasing, some challenges are still impeding the fast uptake of the new technology in certain places around the world. While the industry has grown rapidly over the past decade, there are still technical and economic hurdles to overcome to provide affordable vehicles that can replace the capabilities of their ICE equivalents.

1. Charging infrastructure

While battery swapping stations could reduce the burden of battery cost, there has been insufficient investment in these, as the industry faces a chicken-or-egg situation: customers want to be assured there is sufficient charging infrastructure before buying a vehicle, while charging infrastructure providers (usually private) want to see demand from EV users before investing in charging stations.

2. Vehicles unfit for the market

2&3W operators face many of the usual barriers to the adoption of a new technology. The introduction of vehicles unfit for the market, such as low-powered vehicles with a low ground clearance, which work well in flat coastal Chinese cities but struggle to climb hills and navigate potholes in Kigali or Kathmandu. There is still some way to go before a diversity of vehicles that are adequate for different topographies and road conditions are available in the market.

3. Affordability

Affordability depends on factors such as local fuel and electricity prices, in addition to use. In many markets, e2&3W already have a lower total cost of ownership than ICE 2&3W. However, lower-income consumers, particularly in Africa, can also face a high cost of financing, putting EV purchases further out of reach.



Photo credit: REUTERS/Monicah Mwangi

Policy Recommendations

Several [key actions can be used to speed up the transition towards e2&3W](#), primarily aimed at lowering costs, building out charging infrastructure, and providing strategic direction.

1. Increase the affordable supply of reliable e2&3W vehicles

- Import-dependant countries should reduce import taxes, such as customs duties, value-added tax, and excise duties, to lower the costs of e2&3W vehicles, lithium-ion batteries, and charging infrastructure.
- Local supply chains and industries can be built up by tying benefits such as lower corporate tax rates or direct vehicle subsidies to ensure a significant portion of local sourcing and manufacturing.
- Establish zero emission 2&3W vehicle mandates on manufacturers with 100% zero emission long-term end goals and a reasonable timeline for increasing interim targets.
- Strategic, national-level policy is critical to provide direction and stability for regulators, funders, users, and entrepreneurs, with clear phase-out dates and bans on ICE sales.

2. Support consumer and fleet uptake of e2&3W vehicles

- Offer consumer incentives (e.g., subsidies, tax credits, etc.) for the purchase of new and used e2&3W vehicles.
- Offer fleet and financial institution incentives for purchasing and financing new and used e2&3W vehicles by commercial entities.

3. Invest in local charging infrastructure to support e2&3W uptake, battery swapping, and safe battery value chains

- In all settings, the government must provide clear guidance on charging and swapping stations.
- Support the build-out of e2&3W charging infrastructure.
- Promote industry standardisation and interoperability.
- Ensure and promote high battery safety standards and consumer protections.
- Ensure a reliable supply of renewable, low-carbon electricity
- Phase out subsidies supporting fossil fuels supplying 2&3W ICE vehicles.
- Develop responsible ways of reusing, recycling, or disposing of end-of-life batteries and other equipment.

4. Educate, encourage, and incentivise municipalities to offer preferred access and pricing to e2&3W vehicles to local parking, popular pick-up/drop-off zones, lanes, roads, and neighbourhoods

5. Develop public education campaigns to increase awareness of the viability and benefits of electric motorcycles among stakeholders, including policymakers, motorcycle owners, and riders.

Together, these policies can help to accelerate the transition from ICE to electric 2&3Ws and deliver reduced greenhouse gas emissions, improve local air quality, and save on energy and maintenance costs. 



This explainer was produced by the Global Network for Popular Transportation (GNPT), a project of the Shared-Use Mobility Center (SUMC). Andrea San Gil León was the project and editorial lead and project manager, with assistance from Camila Barquero and Christian Bernstein. Tom Courtright was the research consultant, analyst, and writer. GNPT and SUMC are grateful to Uber, who made the creation of this explainer possible, particularly for the guidance and input of Harrison Peck and Shin-pei Tsay. The written content and conclusions of this report are solely those of GNPT and SUMC.

Additional Resources

Africa E-Mobility Alliance. (2023). EV Importation and Industrialisation. https://africaema.org/resources/AfEMA_policy_paper_2023_Kenya_ii.pdf

Antara (2023, February 7). Jakarta to Proceed with Procurement of Electric-powered Official Cars. TEMPO.CO. <https://en.tempo.co/read/1743705/jakarta-to-proceed-with-procurement-of-electric-powered-official-cars>.

Bishop, T., & Courtright, T. (2022). The Wheels of Change: Safe and Sustainable Motorcycles in Sub-Saharan Africa. FIA Foundation.

BloombergNEF. (2023). Electric Vehicle Outlook 2023. <https://about.bnef.com/electric-vehicle-outlook/>

Doerr, M. (2023, May 3). Indonesia's historic announcement proves the country's transport future is electric. International Council on Clean Transportation. <https://theicct.org/indonesia-mef-may2023/>

Electrum. (n.d.). Indonesia's Leading Electric Vehicle Company. Retrieved November 29, 2023, from <https://electrum.id/en>

Henze, V. (2021, November 30). Battery Pack Prices Fall to an Average of \$132/kWh, But Rising Commodity Prices Start to Bite. BloombergNEF. <https://about.bnef.com/blog/battery-pack-prices-fall-to-an-average-of-132-kwh-but-rising-commodity-prices-start-to-bite/>

Gupta, R., Hertzke, P., Lath, V., & Vig, G. (2023, August 17). The real global EV buzz comes on two wheels. McKinsey & Company. <https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-real-global-ev-buzz-comes-on-two-wheels>

Setiawan, A. et al. (2023, December). Examining the effectiveness of policies for developing battery swapping service industry. Energy Reports. Volume 9, 2023, Pages 4682-4700, ISSN 2352-4847. <https://doi.org/10.1016/j.egy.2023.03.121>. <https://www.sciencedirect.com/science/article/pii/S235248472300358X>

Team, M. C. D. (2023, March 5). Gogoro Motorcycles—2023 Facts, Data, Insights | MotorcyclesData. Motorcycles Data. <https://www.motorcyclesdata.com/2023/03/05/gogoro/>

UNEP. (2023). Electric two-and three-wheelers: Global Emerging Market Overview. https://sustmob.org/EMOB/pdf/Global_EmergingMarketsReport_ElectricTwoThreeWheelers.pdf

Weinert, J., Ma, C., & Cherry, C. (2007). The transition to electric bikes in China: History and key reasons for rapid growth. Transportation, 34(3), 301–318. <https://doi.org/10.1007/s11116-007-9118-8>

World Economic Forum. (2021). How swappable battery tech is keeping India's electric rickshaws on the road. <https://www.weforum.org/agenda/2021/01/sun-mobility-ev-battery-swap-stations/>

Xiaoying, Y. (2023, November 7). The 'new three': How China came to lead solar cell, lithium battery and EV manufacturing. China Dialogue. <https://chinadialogue.net/en/business/new-three-china-solar-cell-lithium-battery-ev/>

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Produced by GNPT with the support of Uber Technologies Inc.

The Global Network for Popular Transportation is a project of The Shared-Use Mobility Center