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THE ROAD TO ELECTRIFICATION: EV DEVELOPMENT IN EMERGING MARKETS



Electric Vehicles in
Emerging Markets



BNP PARIBAS
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Emerging markets are at an interesting crossroads when it comes to the issue of climate change. As they continue to grow at an accelerating pace, their greenhouse gas (GHG) emissions are rising precipitously, with transport the second biggest contributor. Electric vehicle (EV) development in these markets is critical to tackling these daunting challenges. So far, China is playing a key role in global EVs. We examine where major markets like India stand in their evolution, and also explore the scope for EV to develop in other global emerging markets.

To view the long version of this whitepaper, please click [here](#).



WHY IS EV SO RELEVANT FOR EMERGING MARKETS?

As EM countries rapidly develop, they are contributing disproportionately to GHG emissions, with China and India among the top three emitters globally (accounting for ~27% and 7% of global emissions respectively, with the US at 13%)¹. As these markets continue to develop, their carbon emissions are likely to skyrocket. The transport sector is of particular interest, generating ~24% of emissions², with road vehicles – including cars, trucks, buses and two- and three-wheelers – comprising the largest share. How emerging economies harness clean energy technologies has far reaching ramifications not only for the global system, but also locally, for each developing economy, as these large emitters are also among those most vulnerable to its effects.

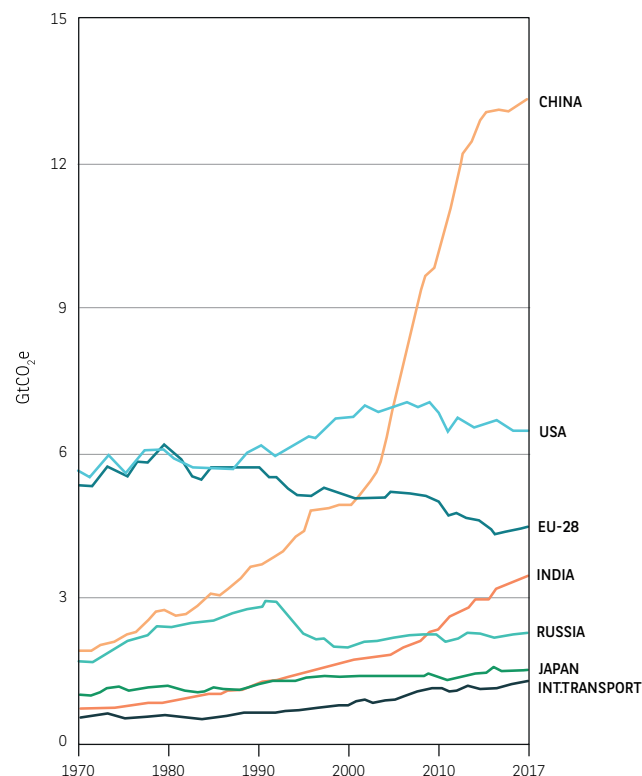
ECONOMIC AND HEALTH IMPACT OF RISING EMISSIONS

Studies show that growing transport emissions have led to severe pollution and elevated mortality, with East and South Asia the most acutely and disproportionately impacted from high levels of ozone and fine particulate matter (PM2.5). In these regions, reducing emissions is about preserving the environment and also attenuating rapidly mounting social and economic costs. The World Bank estimates that welfare losses from air pollution have impacted GDP by ~7.5% in parts of Asia³. According to the Asian Development Bank, Southeast Asia could suffer disproportionately from climate change vs. most regions, including ~11% GDP impact by 2100.

REDUCING ENERGY DEPENDENCE

From an economic perspective, many emerging economies, particularly in Asia, depend on imported oil for their energy requirements. India imports 84% of its crude oil needs⁴, while China's crude oil import dependence is ~72%. As these economies grow, their energy needs will rise exponentially. Transport energy demand has been increasing the fastest of any sector and transport-led energy consumption is expected to grow mainly in non-OECD countries, led by Asia. Despite an ongoing shift to renewable energy, dependence on fossil fuel imports remains heavy. Therefore, EV adoption may hold greater significance for EM than anywhere else in the world.

Top greenhouse gas emitters excluding land-use change emissions



Source: United Nations Environment Programme, "Emissions Gap Report 2018", 27 November, 2018.

HOW CAN EVS CHANGE THE EQUATION?

Adopting electric vehicles can help mitigate emissions related to unhealthy air quality in EM, while also reducing foreign oil import dependence, thereby driving overall health and economic returns. Despite the critical nature of these issues for EM, apart from China, there has been little attention devoted to the EV industry evolution across these regions.

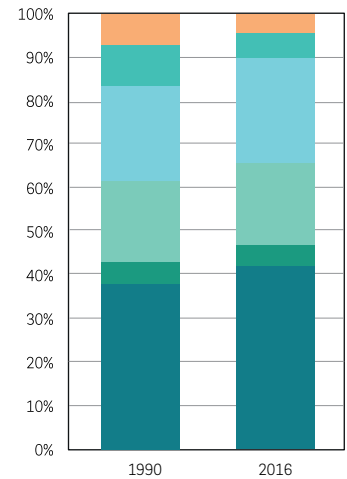
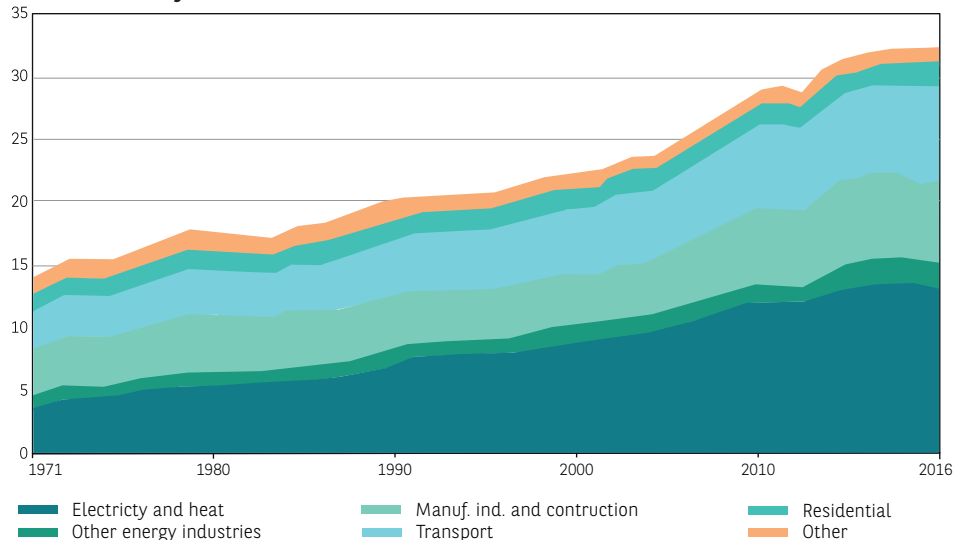
1. Source: UN Environment Programme, "Emissions Gap Report 2018", 2018.

2. Source: International Energy Agency, "CO2 emissions from Fuel Combustion 2018 Highlights", 26 October 2018.

3. Source: World Bank and Institute for Health Metrics and Evaluation, "The Cost of Air Pollution: Strengthening the Economic Case for Action", 2016.

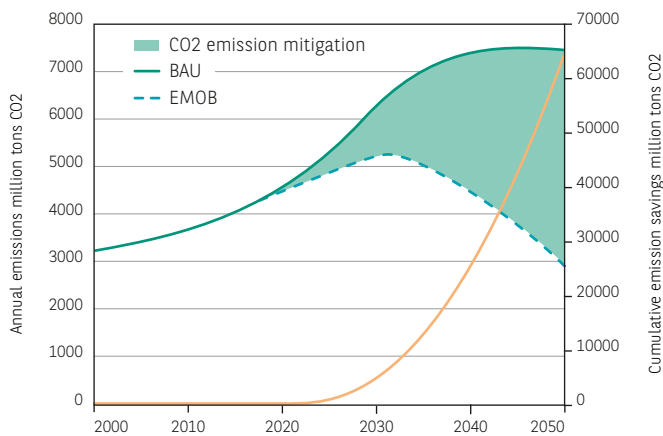
4. Source: Indian Oil Ministry – Petroleum Planning and Analysis Cell, as of 31 March 2019.

CO2 emissions by sector



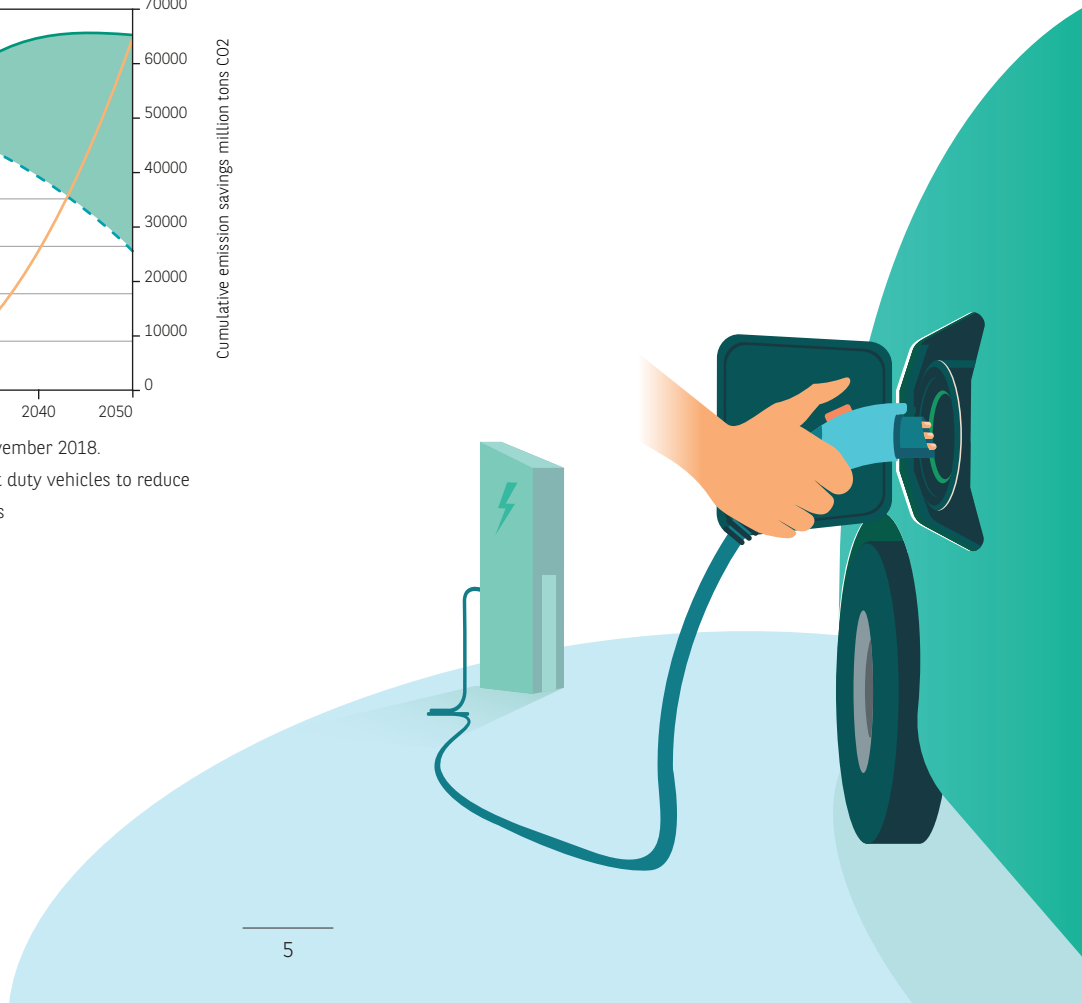
Source: International Energy Agency, "CO2 Emissions from Fuel Combustion Highlights", 2018.

Carbon emission savings in a business as usual (BAU) and eMobility* (eMob) scenario



Source: United Nations Environment Programme, November 2018.

*UN Environment estimated potential of electric light duty vehicles to reduce energy use, CO2 and air pollutant emissions and costs



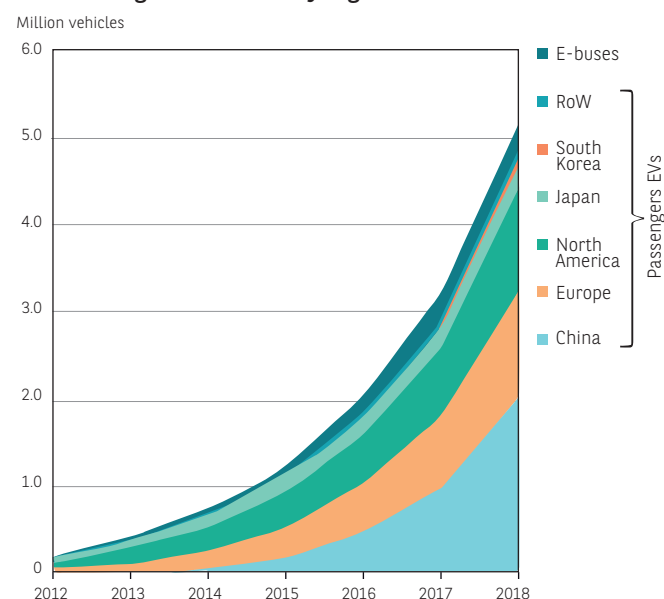
EMERGENCE OF CHINA AS A KEY PLAYER IN THE GLOBAL EV MARKET

Perhaps no global economy has risen to the challenge of adopting EV as quickly and forcefully as China, which now accounts for >50% of global EV sales and also dominates the global charging infrastructure market. China is the most rapidly developing EV market globally, having achieved a 9-fold increase in EV penetration in just the last few years.

IMPACT OF GOVERNMENT STRUCTURE AND CLEAR POLICY FRAMEWORK

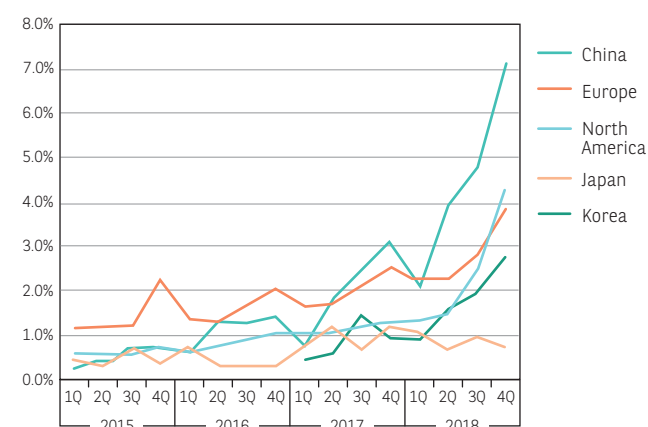
China's rapid ascent in its EV development in a relatively short span of time is remarkable, driven by an ambitious policy framework and a centralized government structure. Motivated by multiple objectives of reducing emissions, energy independence and economic goals, China in 2015 made EV one of the 10 pillars of its Made in China 2025 Plan⁵, with an aggressive annual sales goal of seven million EVs by 2025, ~20% of total vehicle sales. Incentives included subsidies, tax breaks and rebates to generate supply and demand, and sharp restrictions on internal combustion engine (ICE) vehicles, which have brought cost of EV ownership closer to parity in many cities. Leveraging its already well developed electronic supply chain, China has also become a top global producer of lithium ion batteries (LiB) – among the most critical components in the EV supply chain. China is now home to 73% of global-LiB production capacity⁶, led by Contemporary Amperex Technology Co. (CATL) and BYD. China's drive to develop its EV industry extends further down the supply chain, to securing of raw materials, as well as further downstream with build-out of robust charging infrastructure. Not only has China successfully developed domestic brand EVs, but global automakers are also looking to tap this attractive market given favorable subsidies and demographics of a rising middle class consumer whose demand looks destined to rival, if not exceed that of the US.

Cumulative global EV sales by region



Source: Bloomberg New Energy Finance, May 2019.

EV share in new car sales



Source: Bloomberg New Energy Finance, March 2019.

The above-mentioned securities are for illustrative purpose only, are not intended as solicitation of the purchase of such securities, and does not constitute any investment advice or recommendation.

5. Source: Financial Times, "Electric cars: China's Highly Charged Power Play", 12 October 2017.

6. Source: Bloomberg New Energy Finance, "Long-Term Electric Vehicle Outlook 2019", 15 May 2019.

WHAT ARE THE OPPORTUNITIES AND CHALLENGES FOR EV TO DEVELOP IN INDIA?

THE INDIAN GOVERNMENT'S AMBITION FOR GREENER FUELS IS LED BY TWO APPROACHES:

- Catching up to global emission standards - India shifted from BS3 to BS4 in 2015.
 - a. India will shift to BS6 in April - 2020; this is equivalent to Euro 6, the current highest global standard for conventional fuels.
 - b. CAFE norms in April 2022. This will lead to lower sales of diesel vehicles and also escalate the adoption of hybrids/ EVs depending on cost economics.
- The government's second approach is towards long-term EV policy initiatives (FAME 1 & 2).

FAME (FASTER ADOPTION AND MANUFACTURING OF (HYBRID &) ELECTRIC VEHICLES) OVERVIEW:

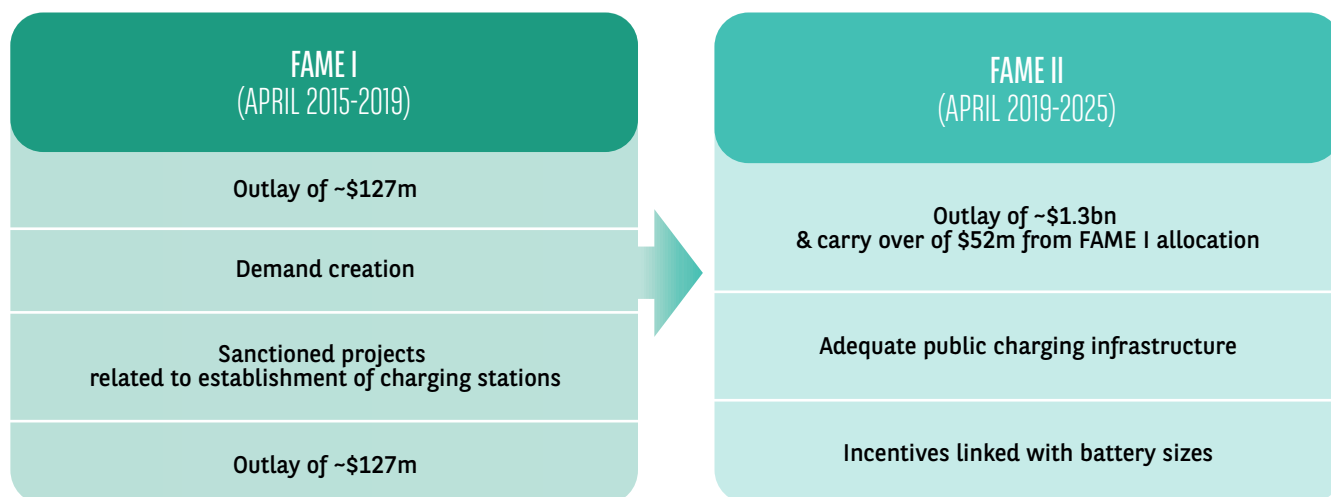
FAME 1:

India's first official policy on EV was established in 2015. The government provided a **budget of US\$127 million** towards initial charging stations infrastructure establishment and towards providing subsidies for EV sales.

FAME 2:

In April 2019, the government launched FAME 2. This has a far larger and serious **outlay of US\$1.3 billion**. FAME 2 is directed towards public as well as private EV charging infrastructure building. **FAME 2 further widens the scope of subsidies to more intermediate solutions for India, i.e. "Hybrids"**.

FAME 1 & 2



Source: Ministry of Heavy Industries & Public Enterprises, PIB, from April 2015 to 2025.

THE BRIDGE TO EV FOR INDIA IS CNG/HYBRID:

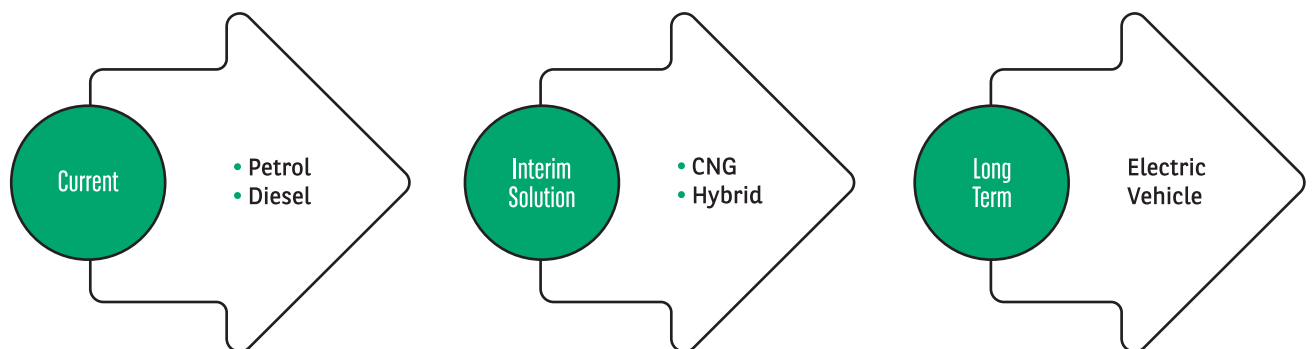
India has laid a roadmap called Vision 2030 which calls for 30% of the vehicle population to transition to EV by 2030. A Goldman Sachs report in 2017 estimated India can be the second largest EV market by 2030 compared to negligible numbers currently.

CNG/Hybrid can be an interim solution to reduce carbon emissions:

CNG as a fuel is at least 25%-30% cheaper than petrol/diesel currently. Coupled with this, the government has set a target to install 10,000 CNG stations in the next 10 years.

The quest to reduce carbon emissions by auto fuels will ensure that the share of conventional ICE vehicles is gradually reduced. A progressive decline **in share will likely be replaced by CNG/hybrids and then EVs.**

Collaboration between the government and OEMs will play a critical role in achieving the Vision 2030 targets. While EV pick-up has been slow, CNG penetration is increasing rapidly. **The dual push of CNG+EV will eventually help India to significantly reduce auto fuel emissions.**



Source: BNPP AM, July 2019.



WHAT IS THE SCOPE FOR EV DEVELOPMENT IN THE REST OF EM?

SOUTH KOREA ROLE IN BATTERY SUPPLY CHAIN

South Korea figures as prominently as China in terms of its role in developing the global EV industry, particularly given its position in the EV battery supply chain. It has fostered a supply chain ecosystem around national champions like automakers Hyundai and Kia, and LiB giants LG Chem and Samsung SDI. In contrast, the rest of developing Asia's EV experience more closely resembles that of India.

REST OF EM

Based on my research, India presents a more relatable base case for EV adoption among other EM than does China, with emerging Asia and Latin America sharing the attributes of a growing middle class, demand driven by value proposition to the consumer, and a still-developing manufacturing base. While China's EV path has been dictated by policy directives, economic motivations have been a more compelling driver for EV development in the rest of the emerging markets.

PROSPECTS FOR SOUTHEAST ASIA

Asia's pollution problems are extremely sobering, underscoring the dire need for EVs. According to AirVisual, 99 of the 100 most polluted cities in the world are in Asia, with the majority of cities in South, Southeast, and East Asia exceeding the World Health Organization's (WHO) annual exposure guidelines for fine particulate matter (PM2.5). Southeast Asia (SEA) combines elements of both the India and the China EV journeys in two key respects. First, two-wheelers and three-wheelers dominate due to convenience and affordability. Second, growing urbanization and limited affordability in these markets lends itself to shared mobility solutions.

THE 2-WHEELER (2W)/3-WHEELER (3W) MARKET IN SOUTHEAST ASIA

Beginning with 2Ws, Asia dominates the global motorcycle market, comprising 69% of global demand in 2018; led by India (#1) and China (#2) and with Indonesia, Vietnam and Thailand making up ~20% of global demand, and where motorcycles account for the bulk (52%-94%) of registered vehicle fleets⁷. 2Ws provide an affordable and convenient option given underdeveloped public transportation systems, rising consumer demand and elevated congestion. With many of these operating on ICE technology, their age and inefficiency translates into substantially higher harmful emissions, implying that electrification can significantly improve air quality. UN analysis suggests that a shift to 90% battery electric motorcycle sales by 2030 could reduce CO2 emissions by 11 billion tons through 2050. Lower fuel and maintenance costs, even accounting for higher up-front costs for electric motorcycles, could yield savings of US\$350 billion by 2050⁸, further underscoring the case for 2W electrification in EM. However, most regional EV policies have focused on 4Ws with most SEA governments slow to adopt EV, with some notable exceptions.

THAILAND'S GREEN HUB ASPIRATIONS

For example, Thailand holds the most promise, given its status as one of the region's largest automotive manufacturing hubs, with its auto industry generating 12% of GDP. The Thai government has mobilized to defend this leadership position and attract green auto manufacturing investment, while also seeking to combat worsening air pollution, and has passed some of the most aggressive EV policies regionally. As a result, several global OEMs, including Japanese automakers, are establishing EV production in Thailand.

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7. Source: Bloomberg New Energy Finance, "Southeast Asia's EV Push Needs More Focus on Two-Wheelers", 4 March 2019.

8. Source: Rubia, D., UN Environment Programme, "Promoting Electric Mobility in Low and Middle Income Countries", 1 September 2016.

9. Source: Bloomberg New Energy Finance, "Southeast Asia's EV Push Needs More Focus on Two-Wheelers", 4 March 2019.

10. Source: UN Environment "Air Pollution is Choking Bangkok, But a Solution is in Reach", 1 February 2019.

INDONESIA'S PLAN TO LEVERAGE OFF NICKEL

Like India, Indonesia boasts a younger, higher growth population¹¹, vs. Asia's ageing demographics in China, Japan and Thailand. The newly elected government targets local EV development, with a focus on 2Ws. It's no coincidence that capital city Jakarta ranks worst in terms of SEA air pollution, with levels well above (4.5x) the WHO's targets. The government is keen to leverage its abundant nickel reserves to drive local battery manufacturing capabilities and its own domestic EV ecosystem.

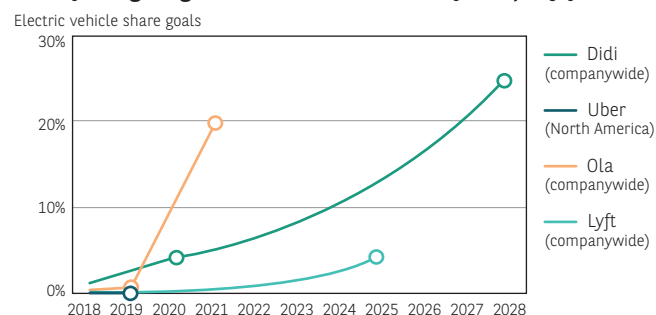
RAPID URBANIZATION AND SHARED MOBILITY SOLUTIONS

The massive urban shift expected across EM over the next few decades represents a fascinating planning and investment puzzle for public and private industry alike. While 55% of the world's population lives in urban areas today, this is expected to rise to 68% by 2050¹². As migration shifts to cities, they hold the key to future mobility. The need for shared mobility in EM is evident given heightened congestion and air pollution. Increased urban formation plus limited per capita incomes may ultimately cap passenger vehicle penetration, instead accelerating development of shared mobility solutions.

RISING SCOPE FOR EV ADOPTION THROUGH RIDE HAILING AND RIDE SHARING IN EM

Ride hailing and ride sharing are emerging as the most exciting shared mobility solutions for emerging markets, with Asia now the largest ride hailing market in the world with ~70% share. The biggest regional players are Didi with 90% share in China, Ola in India, and fierce competitors Grab and Go-Jek in SEA. So far, Didi and Ola have made far reaching commitments to electrifying their fleets: 25% by 2028 and 20% by 2021, respectively. While EVs account for 1.8% of the shared (and autonomous) mobility fleet today, this is expected to rise to 80% by 2040¹³, underscoring the drive towards greater EV adoption. Investor interest in ride hailing is exploding, with private equity, regional auto OEM and tech industry players competing to invest in the space.

Ride-hailing EV companywide or major region goals estimated as share of company fleet

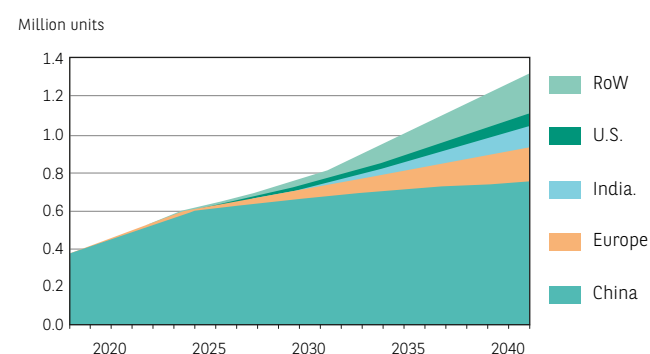


Source: International Council on Clean Transportation, February 2019.

PUBLIC TRANSPORTATION SOLUTIONS AND THE RISE OF E-BUSES IN EMERGING MARKETS

Electrification of public transportation is another fascinating shared mobility trend developing across EM. Since many developing countries still lack infrastructure and scalable, clean energy transportation solutions, there's a unique opportunity to leapfrog technology and go straight to electric buses. Since cities currently contribute over 70% of the world's GHG emissions¹⁴, and the majority of the global bus fleet utilizes highly polluting diesel engines, this is an even more pressing area to focus on. Electric buses also offer tremendous cost savings vs. diesel engines, with much lower estimated operating costs. Bloomberg NEF research includes a scenario in which e-buses could reach cost parity with ICE buses by the mid-2020s¹⁵. China controls 99% of the global e-bus fleet with an estimated 421k e-buses on the road¹⁶ with Shenzhen the first major city to fully electrify its fleet of 16K buses in 2017¹⁷.

Global municipal e-bus fleet



Source: Bloomberg New Energy Finance, May 2019.

Note: RoW includes Australia, Brazil, Japan, Mexico and Thailand.

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11. 4th largest in the world, with 59% of the population between ages 15-54.

12. Source: United Nations, World Urbanization Prospects, 2018.

13. Source: Bloomberg New Energy Finance, "Long-Term Electric Vehicle Outlook 2019", 15 May 2019.

14. Source: World Bank, Urban Development Overview, 1 April 2019.

15. Source: Bloomberg New Energy Finance, 2018.

16. Source: Bloomberg New Energy Finance, "Long-Term Electric Vehicle Outlook 2019", 15 May 2019.

17. Source: International Council on Clean Transportation, "International Evaluation of Electromobility", 17 April 2019.

EV PROSPECTS IN LATIN AMERICA

A number of Latin American cities have joined the e-bus bandwagon, including Santiago, Chile which recently imported e-buses from China's BYD. The Chilean government plans to electrify its public transport networks fully by 2050, leading the region in electrifying its bus fleet. Besides e-buses, Latin America's EV journey has lagged, despite similar motivations as Asia around cleaner air given rapid urbanization. This is primarily due to the lack of clear government support and poor charging infrastructure; this is despite an energy mix that is particularly conducive to benefiting from EV as Latin America has the highest mix (~50%) of renewable energy in the world.

BIGGEST CHALLENGES TO EV DEVELOPMENT

Emerging markets share common ground with developed market counterparts when it comes to the challenges that arise in the road to electrification. While the hurdles to EV adoption are universally shared - including charging infrastructure (which poses a chicken-and-egg conundrum), key component and raw material access, as well as overall affordability, the imperatives of pollution, health and sustainable growth are not universally prioritized, nor neatly split by stage of economic development. This is evidenced by the shared experiences of China, Norway and the state of California, all pursuing net zero emissions policies and supported by clear government frameworks, which in turn are bolstered by strong incentive structures.

RESOURCE ANGLE

A critical piece of the puzzle in developing an effective EV ecosystem is having secure access to the raw materials - such as lithium, nickel, copper and cobalt - that are integral to the LiB supply chain. Beyond this critical aspect, certain materials also play a role in other parts of the EV equation, namely the vehicles themselves and the power grid. While many of the key metals that figure in EVs are heavily sourced across EM countries in Latin America, Africa and Asia, many of these markets have yet to fully capitalize on their rich supply source as they venture down the EV path. In sharp contrast, China has been strategically leveraging these countries' rich mineral sources. China-based Jiangxi Ganfeng recently bought a stake in a lithium project in Argentina, while Tianqi acquired a 24% stake in Chile's Sociedad Química y Minera (SQM), in order to secure its lithium access. Beyond Latin America, Chinese companies have snapped up control of just over half the cobalt output from the DRC, home to ~70% of the world's supply of this low-resourced material¹⁸. By securing access to these materials, China is effectively ensuring control over a key element of the EV supply chain.

CONCLUSIONS: THE ROAD AHEAD

Clearly, the road to electrification has evolved in unique ways across emerging markets, shaped by government policies, existing economic structures and consumer affordability. As investors in emerging markets, this topic has focused us on two of the 3Es that are top sustainability priorities at BNP Paribas Asset Management¹⁹, namely energy transition and environmental sustainability. Growing projections for increased urbanization, coupled with limited affordability and low vehicle penetration suggest a shift towards shared mobility. This trend, in tandem with growing demand for clean power generation, could yield interesting investment opportunities in electric mobility and clean energy. If adopting EVs is accompanied by a shift to more renewable energy sources, this would more efficiently address the urgent issues of climate change, energy independence and economic well-being for EM economies.

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18. Source: Bloomberg New Energy Finance, 2019.

19. BNP Paribas Asset Management Sustainability Goals include 3Es - energy transition, environmental sustainability, and equality.

BIOGRAPHIES



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SENIOR ANALYST,
GLOBAL EMERGING MARKET EQUITIES

Rina is a Senior Analyst for the Global Emerging Markets Equity team at BNP Paribas Asset Management. She focuses on Financials and Consumer. She joined the team in 2017 and is based in Boston.

Prior to her current position, Rina was an Institutional Portfolio Manager at MFS Investment Management covering Global and International Equity Strategies. Before that, she worked as a Senior Equity Analyst at several investment firms including Fidelity Management & Research, Putnam Investments and State Street Global Advisors. Rina started her buy side career at Allianz Global Investors as an Equity Analyst and co-sector Portfolio Manager. Over her career, Rina has focused on financial services stocks and she has also been a generalist equity analyst. She started her career focused on Emerging Market stocks at ING Barings.

Rina has over 18 years of investment experience. She holds a BS in Economics from the Wharton School at the University of Pennsylvania and an MBA from the University of Chicago Booth School of Business. Rina is also a native Hindi speaker.



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Brijesh joined BNP Paribas Asset Management in January 2015. In his position as a Head of Equities – PMS & Offshore Advisory, he is responsible for managing equity portfolios for international investors and PMS portfolios, investment strategy and working alongside the team in the process of equity research.

In his previous role, he held the position of Executive Director - Fund Manager at Enam Asset Management Co. Pvt. Ltd. (August 2004 - January 2015). Prior to that, he worked with a Technology start-up company based in Singapore in 2000-2001, where he was heading the M&A team. Brijesh worked at KPMG India between 2002-2004 covering the information, communication and entertainment sectors.

Brijesh has 17 years of professional work experience, of which he has spent the last 12 years in the asset management industry. He holds an MBA in Finance from Monash Mt. Eliza Business School, Australia and a Bachelor of Commerce from the University of Mumbai.



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Miten Vora joined BNP Paribas Asset Management in October 2013 as Research Analyst. He currently tracks Oil and Gas, Automobile, Auto Ancillary and Consumer Durables sectors.

Miten was formerly at IDBI Asset Management's equity research team as research analyst and has also worked in the equity research team at Antique Stock Broking.

Overall he has over 9 years of experience in the equity research domain. Miten has a Masters degree in Business Administration from Foundation of Liberal & Management Education (FLAME), Pune and a CFA Charter from ICFAI, Hyderabad.



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