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NITI Aayog

INDIA'S ELECTRIC MOBILITY TRANSFORMATION

PROGRESS TO DATE AND FUTURE OPPORTUNITIES

NITI AAYOG & ROCKY MOUNTAIN INSTITUTE

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EXECUTIVE SUMMARY

EXEC

The Government of India has signaled the beginning of a new era of mobility for India. Global technology trends and India's rapidly growing economy have led to focus on electrification of transportation as the primary technology pathway to achieve this transformation. This intersection presents India with a powerful but perishable opportunity to emerge as a global leader in new mobility solutions and battery manufacturing, positioning India for durable economic growth and global competitiveness. India is uniquely positioned to deploy electric vehicles (EVs) at scale, leapfrogging traditional mobility models that perpetuate congestion, air pollution and oil import dependence while driving down the costs of batteries through economies of scale even faster than the rate at which current projections anticipate.

At the central level, several ministries and departments have been involved in supporting the electric mobility transition, including the Ministry of Road Transport and Highways, Department of Heavy Industry, Department of Industrial Policy and Promotion, Ministry of Finance, Ministry of Housing and Urban Affairs, Ministry of Power, Ministry of New and Renewable Energy, Department of Science and Technology and NITI Aayog. Additionally, 27 states have formulated strategies for transforming their mobility systems and several states have formulated or are in the process of formulating their EV policies.

The release of the second phase of the Faster Adoption and Manufacturing of Electric Vehicles (FAME) Scheme provides an opportunity to reflect on India's recent progress and the required next steps for moving towards an electric mobility future. FAME II's intended impact and reach is far greater than the vehicles it directly incentivizes. Beyond providing support for a number of vehicles over a three-year period, it aims at catalyzing the market, enabling the development of a supportive ecosystem for EVs, and crossing thresholds of economic viability that can initiate mass adoption of e-mobility solutions. The scheme is bolstered by global trends and a suite of additional policies at the central, state and city levels.

Based on expert interviews and projected cost competitiveness, FAME II will directly create significant energy and emissions

savings. But the market that it could catalyze will save far more of both. For example, vehicles eligible under FAME II scheme will cumulatively save 5.4 Mtoe of oil demand over their lifetime. This will result in net reduction of 170 Petajoules of energy and 7.4 Mtons of CO_2 emissions over the deployed vehicle's lifetime. The electric buses subsidized under FAME II will account for nearly 3.8 billion vehicle kilometers travelled over their lifetime.

If FAME II and other measures are successful, India could realize EV sales penetration of 30% of private cars, 70% of commercial cars, 40% of buses and 80% of two and three-wheelers by 2030. If realized, the lifetime cumulative oil, net energy and net carbon savings of all electric vehicles deployed through 2030 could be many fold and larger than savings from FAME II. For example, achieving these levels of market share by 2030 could generate cumulative savings of 846 Mtons of CO_2 over the total deployed vehicles' lifetime.

Capturing the benefits of FAME II and its intended ripple effect on the electric mobility ecosystem will require the participation of multiple stakeholders in the ecosystem. Realizing scaled adoption beyond the time period of FAME II necessitates continuous coordination and collaboration between government and industry and increasing customer awareness and acceptability of EVs. In particular, governments at all levels —central, state, city—have a key role to play in enabling the electric mobility transition. While several recent policy initiatives, including the launch of FAME II, have served a vital role in kick-starting India's shift towards an electric mobility future, additional actions by policy makers and implementing agencies would provide an effective and irreversible momentum in this direction. Such a transformation will not just enable the clean movement of people and goods, it will create enormous economic, social and environmental benefits.

ABOUT THIS DOCUMENT

This document has three primary objectives:

» *Provide a summary of key policy and industry initiatives to support rapid adoption of electric mobility*

» *Analyze the impacts of FAME II with respect to emissions, oil consumption, and overall EV adoption trends*

» *Propose possible actions that industry and government can take in continued support of the faster deployment of EVs*

While the ideas put forth in this report are not exhaustive, they are intended to support continued conversation and action towards India's accelerated transition to electric mobility.

CHAPTER 01

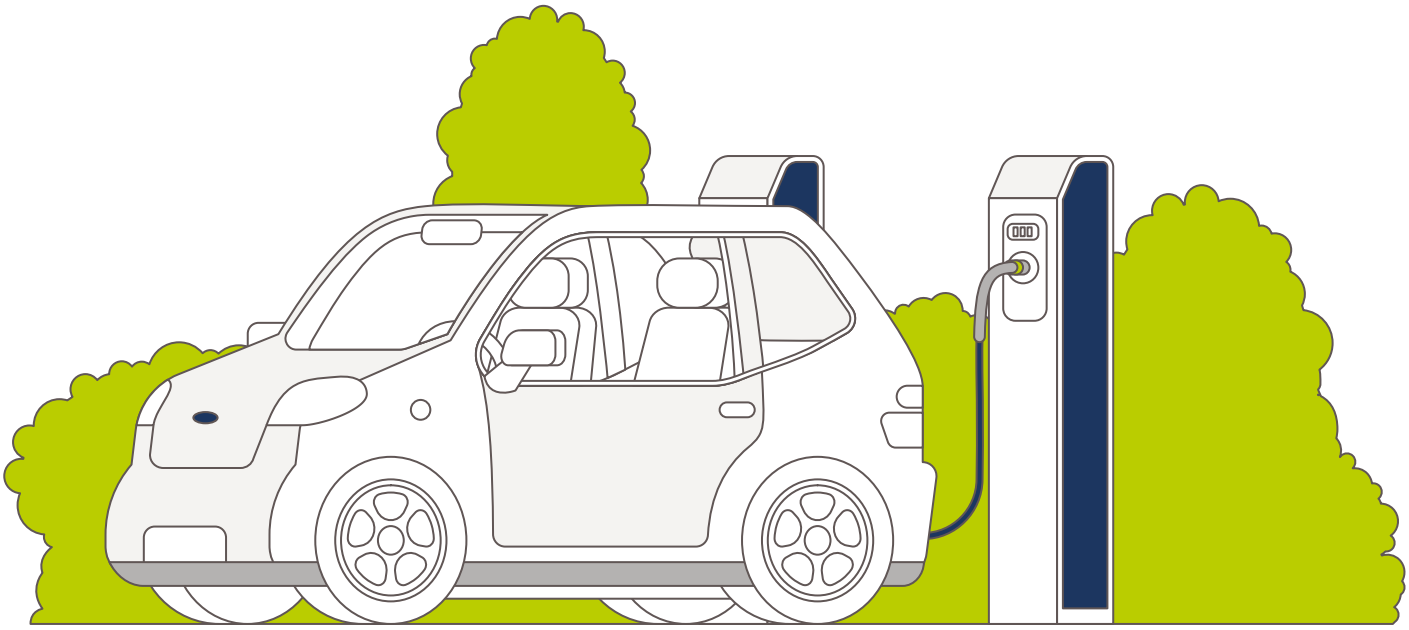
INITIATIVES TO SUPPORT ELECTRIC MOBILITY IN INDIA

1.1 RECENT POLICY INITIATIVES TO SUPPORT ELECTRIC MOBILITY

A suite of fiscal and non-fiscal measures have recently been put in place to support the adoption of electric mobility.

At the central level, several ministries and departments have been involved in supporting the electric mobility transition, including the Ministry of Road Transport and Highways, Department of Heavy Industry, Department of Industrial Policy and Promotion, Ministry of Finance, Ministry of Housing and Urban Affairs, Ministry of Power, Ministry of New and Renewable Energy, Department of Science and Technology and NITI Aayog.

As part of creating coherent policy on transformative mobility in the country, 27 states have formulated strategies for transforming their mobility systems and several states have formulated or are in the process of formulating their EV policies. This section summarizes these recent policy initiatives at the central and state levels that support the early adoption of electric mobility solutions.



1.2 POLICY INITIATIVES

» MINISTRY OF POWER (MoP)

MoP issued a clarification stating that charging EVs is considered a service, not a sale of electricity, meaning that no license is required to operate EV charging stations.

» MINISTRY OF ROAD TRANSPORT AND HIGHWAYS (MoRTH)

MoRTH announced that battery-operated vehicles, both private and commercial, will be given green license plates (GSR 749 (E)).

» MINISTRY OF ROAD TRANSPORT AND HIGHWAYS (MoRTH)

MoRTH announced that it will facilitate the import of 2,500 electric vehicles compliant with international standards without the need for homologation (GSR 870 (E)).

» DEPARTMENT OF SCIENCE AND TECHNOLOGY (DST)

DST launched a Grand Challenge for developing the Indian Standards for Electric Vehicle Charging Infrastructure. Additionally, Bureau of Indian Standards (BIS) has notified general requirements for EV charging based on CCS & Chademo charging standards.

» MINISTRY OF ROAD TRANSPORT AND HIGHWAYS (MoRTH)

MoRTH announced that all battery-operated, ethanol-powered and methanol-powered transport vehicles will be exempted from the requirement of permits (S.O. 5333(E)).

» INDIAN SPACE RESEARCH ORGANISATION (ISRO)

Indian Space Research Organisation (ISRO) issued a request for quotation (RFQ) document for commercialisation of indigenously developed lithium-ion battery technology. Thus far, ten firms have been shortlisted for the transfer of technology.

» MINISTRY OF HOUSING AND URBAN AFFAIRS (MoHUA)

MoHUA released an amendment of building code and town planning rules for provisioning of EV charging stations in private and commercial buildings.

» MINISTRY OF POWER (MoP)

MoP issued a policy on charging infrastructure to enable faster adoption of EVs. The policy permits private charging at residences and offices where tariff for supply of electricity to EV charging station shall not be more than the average cost of supply plus 15 percent.

» MINISTRY OF ROAD TRANSPORT AND HIGHWAYS (MoRTH)

MoRTH amended Central Motor Vehicles Rules (CMVR), 1989 to allow driving licenses to be given for age group 16–18 years to drive gearless electric scooters and bikes up to 4 kWh battery size (GSR 1225 (E)).

» NITI AAYOG

NITI Aayog released a concessionaire Agreement for public private partnership in operation and maintenance of electric buses in cities through Operating Expenditure (OPEX) model. This would reduce the requirement of upfront capital as the lease would be signed on a per-kilometer basis.

» MINISTRY OF FINANCE (MoF)

MoF rationalized the customs duty for all categories of vehicles, battery packs and cells to support Make in India and incentivize uptake of electric vehicles (Notification no. 03/2019-Customs).

» DEPARTMENT OF HEAVY INDUSTRY (DHI)

The Cabinet approved FAME II, the second phase of the scheme for Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India. The scheme has a total outlay of Rs. 10,000 crores, to be used for upfront incentives on the purchase of EVs as well as supporting the development of charging infrastructure. The program will be implemented over a period of three years, effective from 1 April 2019.

» NITI AAYOG

The Cabinet approved the National Mission on Transformative Mobility and Battery Storage, which will drive clean, connected, shared, sustainable and holistic mobility initiatives. The Mission aims at creation of a Phased Manufacturing Programme (PMP) for five years, to support setting up of large-scale, export-competitive integrated batteries and cell-manufacturing giga plants in India, as well as localizing production across the entire electric vehicle value chain.

1.3 STATE/UNION TERRITORIES MOBILITY STRATEGIES

Twenty seven states/UTs have developed strategy plans for transforming mobility to support their citizens with safe, inclusive, economic, and clean transport options. Many of these strategies were developed or updated in preparation for the MOVE Summit, hosted by NITI Aayog in September 2018. The deliberations at the Summit focussed on the following themes:

- Maximum asset utilization
- Comprehensive electrification
- Alternative fuels
- Re-inventing public transport
- Logistics and goods transport
- Data analytics and mobility

These plans address a wide range of mobility challenges and cover all modes of transport, including air, water and road. More details on each of these plans can be found in the compendium published by NITI Aayog for the MOVE Summit (September 2018).[1,2]

[1] www.niti.gov.in/writereaddata/files/document_publication/State-Summary-Final.pdf

[2] www.niti.gov.in/writereaddata/files/document_publication/Complete-State-Compendium_Final.pdf

1.4 STATE-LEVEL EV POLICIES

STATE	KEY POLICY ELEMENTS/TARGETS
Andhra Pradesh — Electric Mobility Policy 2018–2023	» Goal of 10 lakh EVs by 2024 » Goal of 1 lakh slow and fast EV charging stations by 2024 » Government plans to stop registration of petrol and diesel cars by 2024 in the upcoming capital city of Amaravati » All government vehicles, including corporations, boards and government ambulances to be electric by 2024
NCT of Delhi — Draft Electric Vehicle Policy 2018	» Aims at 25% of new vehicle registrations to be electric by 2023 » 50% of entire public transport targeted to be electric by 2023 » Proposes a feebate to fund a high proportion of the incentives » Encourages the reuse and recycling of EV batteries that have reached the end of their lives

STATE	KEY POLICY ELEMENTS/TARGETS
Karnataka — Electric Vehicles Manufacturing Policy 2018	» 100% of three and four-wheelers moving goods will be encouraged to transition to electric by 2030 » Incentives for first 100 fast chargers » Encourages startups to develop business models focused on supporting economic applications for EVs
Kerala — Electric Vehicle Policy 2018	» Target of bringing 1 million EVs to the state by 2022 » By 2022, the state aims to pilot a fleet of 200,000 two-wheelers, 50,000 three-wheelers, 1,000 goods carriers, 3,000 buses and 100 ferry boats
Maharashtra — Electric Vehicle & Related Infrastructure Policy 2018	» Target to increase number of EV registrations in Maharashtra to 5 lakhs » Generate an investment of Rs. 25,000 crores for the manufacturing of EVs » Create jobs for 1 lakh people
Telangana — Electric Vehicle Policy Draft 2017	» Telangana State Transport Corporation to set a target of 100% electric buses by 2030 for intracity, intercity and interstate transport » Telangana Government will set up first 100 fast charging stations in GHMC and other cities in a phased manner

STATE	KEY POLICY ELEMENTS/TARGETS
Uttar Pradesh — Electric Vehicles Manufacturing Policy 2018	» Goal of 1,000 electric buses deployed in the state by 2030 » Target of achieving 100% electrification of autorick-shaws, cabs, school buses/vans, etc., by 2030 in five cities: GB Nagar, Lucknow, Kanpur, Varanasi and Ghaziabad
Uttarakhand — EV Manufacturing, EV Usage Promotion & Related Services Infrastructure Policy 2018	» Aimed at making Uttarakhand a preferred destination for investment in EV manufacturing capacity » Special focus on developing green highways in Dehradun, Haridwar, Rishikesh, Haldwani, Rudrapur and Kashipur » Term loans in the range of Rs.100 million to Rs.500 million will be provided to micro, small and medium enterprises interested in manufacturing EVs

» *Many more states are in the process of drafting electric vehicle policies.*

1.5 INDUSTRY INITIATIVES

An increasing government focus on EVs as the primary technology pathway for future mobility has been bolstered by industry initiatives. Established and new industry players in automotive, charging infrastructure, batteries and mobility services have been making investments and forging partnerships to develop and test new products and business models. Following section highlights some of the key trends related to industry initiatives in the EV space.

» VEHICLE MANUFACTURING AND SALES

According to market estimates, in financial year 2018 electric two-wheeler sales almost doubled to 54,800 compared to the previous financial year. Electric two-wheelers have been leading the EV market; estimates suggest they account for 98% of the country's EV sales. Manufacturers, established and new, continue to/are starting to invest in the Indian EV market through fund infusion, investments in start-ups and expansion plans. Companies are designing and testing products suitable for the Indian market with a key focus on electric two-wheelers and three-wheelers. OEMs have been forging partnerships with state and city governments such as Delhi, Pune, Ahmedabad and Bengaluru to augment the public transport system to bolster shared mobility. As recently as March 2019, over 100 companies showcased electric vehicles of all types at the India E-Vehicle Show.

» COMPONENTS AND BATTERY MANUFACTURING

The Indian government reduced tariffs on imported parts of EVs in January 2019 to boost assembly in India. The automobile industry has indicated that this will trigger investments in critical components. Battery manufacturers have announced major joint venture investments to produce both battery cells and packs in India with an aim to contribute to the 'Make in India' drive. Several manufacturers, energy solution providers and start-ups have announced their plans to make lithium-ion batteries in India through R&D centres and lithium-ion battery manufacturing plants. India is likely to see a surge in new cell manufacturing units in India with key players lining up their long-term

plans. Ten companies have come forward to adopt Indian Space Research Organisation's (ISRO) cell chemistry for commercial applications.

» CHARGING INFRASTRUCTURE AND BATTERY SWAPPING

Significant investment is being mobilised by the private sector to manufacture and install electric vehicle supply equipment (EVSE) infrastructure across India. This includes charging and battery swapping technologies. Both charging and swapping solutions are supported by business model innovation that enables high utilisation of infrastructure. Plans are underway to fuel EVs with clean power, with industry players exploring solar-plus-EV technology in Mumbai and beyond. Moreover, the Indian Railways has announced its intention to allocate space for electric vehicle charging stations at their station parking lots. Railways authorities aim to invite private sector participation by issuing tenders to create this infrastructure. Public sector units in India have signed several Memorandums of Understanding (MoUs) with aggregators to develop dedicated EV charging stations across Indian cities.

» MOBILITY SERVICES

Mobility service providers around the world and in India are testing EV solutions in anticipation of wider-scale deployment. Compelling economics are encouraging aggregators and drivers to act on EVs' low operating costs, which can offset their capital cost premium. Despite competitive economics, persistent challenges exist including the operational mandates of service vehicles, risk aversion from drivers and fleet operators, and the first cost difference between ICEs and EVs. In order to address some of these challenges and capture the economic advantages of EVs, taxi aggregators and car rental platforms have formed partnerships with original equipment manufacturers (OEMs) to manufacture and test fit to purpose vehicles that are successful in Indian road and weather conditions, meet the needs of customers and make a strong business case for drivers and service providers.

1.6 LEARNINGS FROM FAME I

India has seen increasing policy and industry momentum towards accelerating EV adoption. The implementation of the FAME I Scheme provides useful insights for the design of future interventions. This section discusses key learnings that can inform the future actions.

TAKEAWAY	FAME I CONTEXT AND SUBSEQUENT DEVELOPMENTS
For a fiscal purchase incentive to be effective, consumers need to have a range of product options in the market	When FAME I was initiated in April 2015, there were few EV models available in India. The years since have seen the launch of a variety of new EV models, in all vehicle segments, for the Indian market. The 2018 Auto Expo in Delhi alone saw over 50 new electric vehicles being showcased by OEMs such as Tata, Mahindra, Hero Electric, Maruti Suzuki and several other new players. This wide range of product options for electric vehicles offers more choice to customers and better positions FAME II incentives for greater effectiveness.
The development of a charging network is essential to the adoption of electric mobility	While FAME I provided support for the development of charging infrastructure, the adoption of EVs has faced the challenge of limited charging infrastructure availability. Moving into the second phase of FAME, the central and state governments have bolstered support for the development of charging infrastructure throughout the country that is expected to enable easier adoption of EVs.

TAKEAWAY	FAME I CONTEXT AND SUBSEQUENT DEVELOPMENTS
Promoting awareness of electric vehicles is critical to stimulating demand	In 2015, electric vehicles were being discussed primarily by niche audiences and less by the general public. Since then, EVs have gained much attention in the media, especially as the central and state governments have taken measures to promote their adoption. This increasing general awareness of EVs as an option for mobility is a critical step in creating demand.
Focusing on shared and public transport has a higher overall impact than focusing on private vehicles	By targeting incentives towards shared and public transport, there is a potential to achieve better out comes (in terms of a larger share of passenger kms traveled by electric modes) by using the same pool of public money. FAME II puts emphasis on moving people rather than vehicles through clean means of transport and prioritizes public and shared transport. This meets multiple objectives including reducing traffic congestion, improving urban quality and reducing carbon emissions.
Batteries/vehicles should be incentivized in proportion to their efficiency and range	FAME I determined incentives based on vehicle segment (i.e., two-wheeler, four-wheeler, etc.). While this helped promote cleaner technologies, it did not incentivize manufacturers to produce or customers to buy increasingly more efficient vehicles. Linking FAME II incentives to battery capacity provides motivation to customers and manufacturers to shift to

Continued >

TAKEAWAY	FAME I CONTEXT AND SUBSEQUENT DEVELOPMENTS
	wards long-range vehicles. An even stronger policy signal would entail linking incentives to vehicle range, battery life and other performance criteria, and not just battery capacity to ensure that large but low-quality batteries do not become the largest beneficiary of FAME II funding.
Emphasizing domestic manufacturing of batteries, EV components (including electronics), and charging infrastructure is critical to India's electric mobility transition	Lack of emphasis on domestic manufacturing of EV components, batteries and charging infrastructure previously meant that India had to rely on expensive imports that may not have been best suited to Indian conditions. The need to localize manufacturing has hence emerged as a critical area from the perspective of having products that are suited to Indian conditions, can be produced at scale and are affordable. The National Mission on Transformative Mobility and Battery Storage, as well as Make in India, are aimed at promoting domestic manufacturing and localization of the entire value chain for EVs.
New business models need to be developed for procuring and deploying e-buses	FAME I provided direct subsidies and incentives for purchase of e-buses on an upfront cost basis. However, this limited the efficacy of the programme, as very few buses could be procured through the limited available funding. NITI Aayog's newly proposed concessionaire model that bases procurement of e-buses on

Continued >

TAKEAWAY	FAME I CONTEXT AND SUBSEQUENT DEVELOPMENTS
	a Gross Costs Contracting (GCC) basis allows STUs to finance e-buses based on their lower total cost of ownership (TCO) relative to their diesel counterparts.

The developments since the implementation of FAME I—greater options for EVs, increased public awareness and a developing charging infrastructure network—coupled with an emphasis on public transport and vehicle efficiency could make it possible to drive significantly greater adoption of EVs with FAME II. Chapter three suggests a few interventions that could help realize this accelerated adoption.

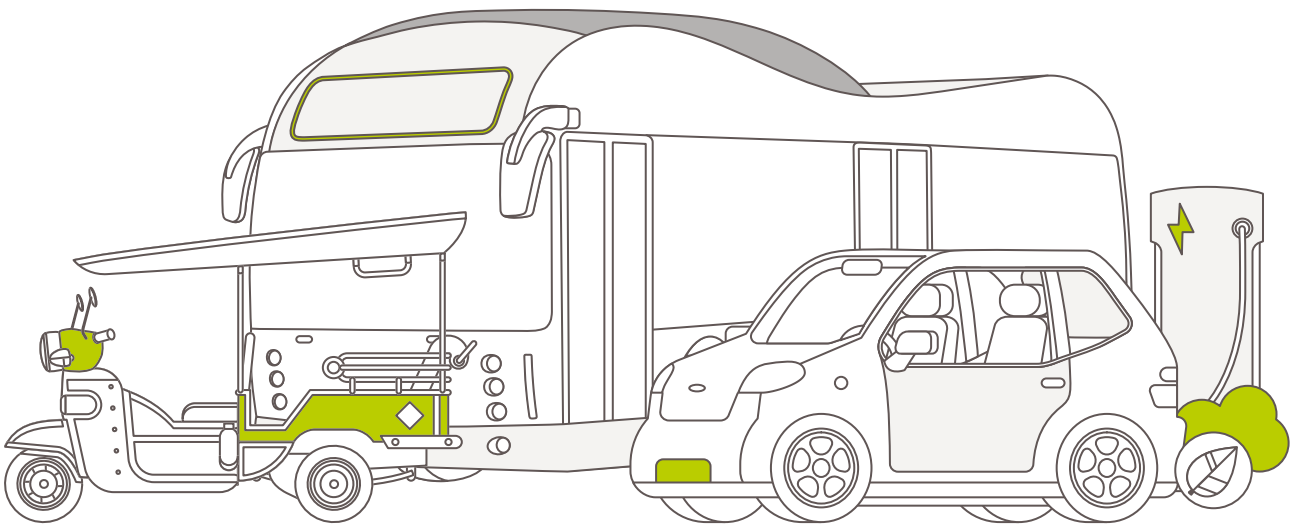
CHAPTER 02

SIZE OF THE OPPORTUNITY: POTENTIAL IMPACT OF IMPLEMENTING FAME II

2.1 THE ROLE OF FAME II IN INDIA'S MOBILITY TRANSFORMATION

The following chapter quantifies the effects of FAME II with respect to oil demand reduction, net energy savings and CO_2 emissions. It also assesses the potential impact of FAME and other supportive policies on overall EV adoption rates. The modeling calculations assume that all the vehicles eligible for FAME II (10 lakh two-wheelers, 5 lakh three-wheelers, 55,000 four-wheelers and 7,000 buses i.e., 3.8 billion vehicle kilometers over their lifetime) are deployed by 2022.

While the results are significant, it is critical to note that the effects of FAME II will go beyond just the vehicles that are eligible under this scheme. FAME II is intended to catalyze a market and establish the supportive ecosystem for it to develop. Thus this chapter also makes assumptions about market share for electric vehicles across segments, in 2030 to demonstrate the potential cumulative opportunity for energy and carbon savings across the vehicles' lifetime, should FAME II and other measures have a catalytic effect on the market. FAME II and India do not stand on their own in realizing the accelerated deployment of EVs—they are supported by global trends that are quickly making electric mobility an economic choice.



2.2 MODELING METHODOLOGY AND ASSUMPTIONS

To quantify the effect of FAME II and other supportive policies on the current vehicle market in India as well as implications on oil consumption, NITI Aayog and Rocky Mountain Institute have analyzed oil, net energy and net CO2 emissions savings associated with the two, three, and four-wheeled vehicles and buses covered by FAME II over their lifetime, as well as the potential savings associated with greater adoption levels by 2030. To quantify the magnitude of savings associated with increased EV adoption levels by 2030, the analysis covers the oil, net energy and CO2 emissions savings of all vehicles sold through 2030 over their lifetime.

Some of the key assumptions in the analysis include:

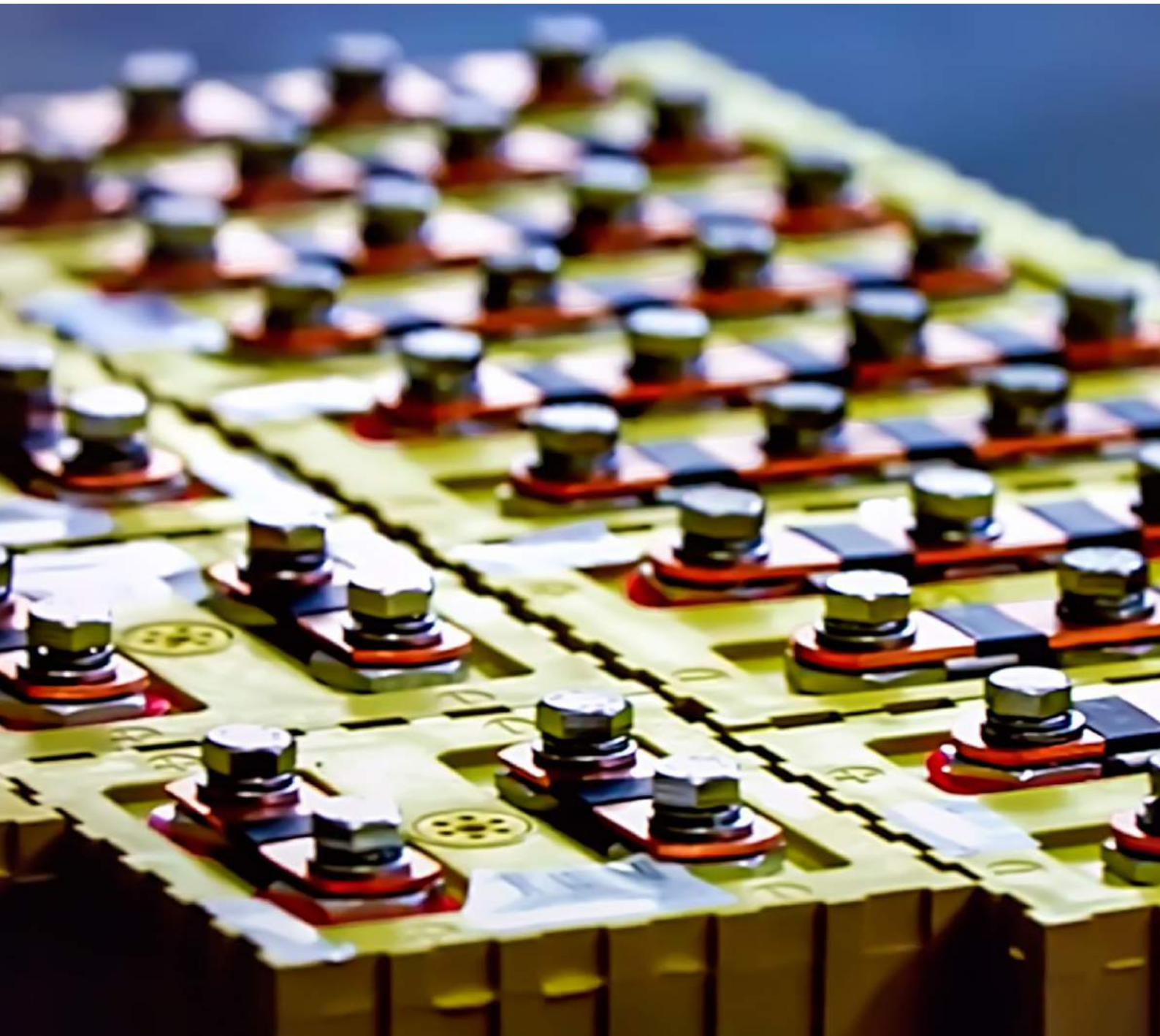
- Cars under FAME II are commercially owned
- ICE two-wheelers run on petrol; ICE three-wheelers run on petrol, diesel and CNG; ICE buses run on diesel; and ICE commercial cars run on diesel and petrol
- FAME II and other policies supporting electric mobility push EV sales penetration to 70% for commercial cars, 30% for private cars, 40% for buses and 80% for two and three-wheelers by 2030
- Well to wheel emissions are analyzed for ICEs and EVs. For estimating EV emissions, NDC[3] grid emission factors are used.
- Vehicle kilometers for buses is a function of utilization, e-buses stock and vehicle lifetime. Assumptions for calculating vehicle kilometres:
  - Utilization: 150km/day
  - Days of operation/year: 365
  - Vehicle lifetime: 10 years
- Crude oil price: USD 67/barrel
- USD to INR conversion rate: 70

[3] NDC: India's Intended Nationally Determined Contribution

2.3 ELECTRIC VEHICLES ELIGIBLE UNDER FAME II CAN SAVE 5.4 MTOE OF OIL DEMAND AND 7.4 MTONS OF NET CO_2 EMISSIONS OVER THEIR LIFETIME

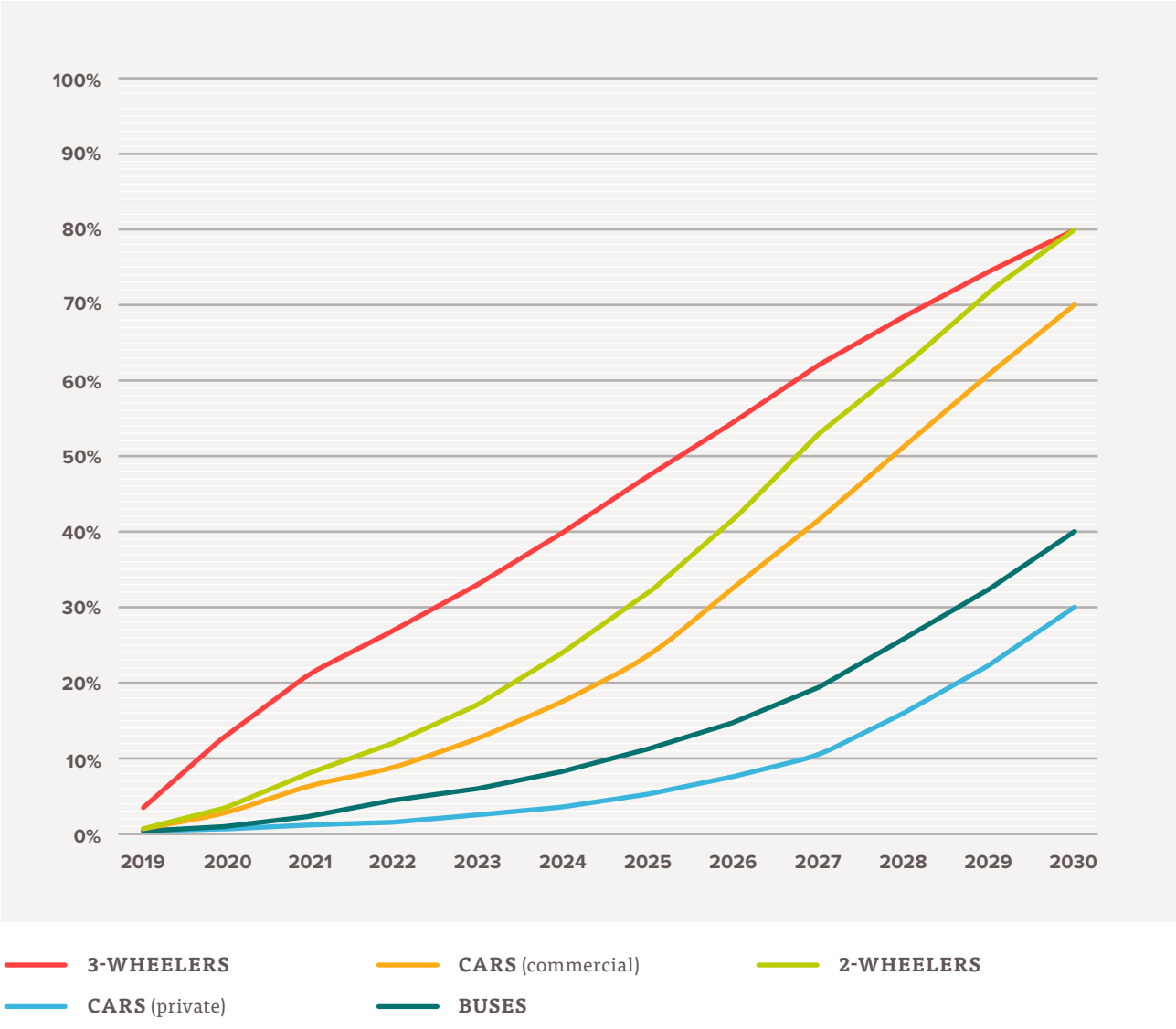
VEHICLE CATEGORY	TWO WHEELERS	THREE WHEELERS	FOUR WHEELERS	BUSES	TOTAL
NO. OF VEHICLES INCENTIVIZED	10,00,000	5,00,000	55,000	7,000	15,62,000
OIL SAVINGS (MTOE)	0.9	2.3	0.8	1.4	5.4
OIL SAVINGS (1000 CRORE INR)	3.0	7.2	2.5	4.5	17.2
NET ENERGY SAVINGS (PETAJOULES)	35.7	73	19.4	41.7	169.9
NET CO_2 EMISSIONS SAVINGS (MILLION TONS)	2.6	3.2	0.1	1.5	7.4

- Vehicles eligible under FAME II scheme can cumulatively save 5.4 million tons of oil equivalent over their lifetime, worth INR 17.2 thousand crores
- This would result in net reduction of 170 Petajoules of energy and 7.4 million tons of CO_2 emissions over the deployed vehicles' lifetime
- Electric buses covered under FAME II will account for 3.8 billion vehicle kilometers travelled (e-vkt) over their lifetime



2.4 FAME II AND OTHER SUPPORTIVE POLICIES CAN HELP JUMPSTART THE ELECTRIC VEHICLE MARKET

FIGURE 01 EV SALES PENETRATION



» FAME II and other electric mobility supporting policies are intended to have a catalytic effect on the market

» Based on interviews with experts and projected cost competitiveness, EV sales penetration of 70% for commercial cars, 30% for private cars, 40% for buses, and 80% for 2 and 3 wheelers by 2030 could be attainable (Figure 01)

2.5 ELECTRIC VEHICLES SOLD THROUGH 2030 CAN SAVE 474 MTOE OF OIL DEMAND AND 846 MTONS OF NET CO_2 EMISSIONS OVER THEIR LIFETIME

If India were to reach EV sales penetration of 30% for private cars, 70% for commercial cars, 40% for buses, and 80% for 2 and 3 wheelers by 2030, potential energy and CO2 savings over sold vehicle's lifetime will be as below:

VEHICLE CATEGORY	TWO WHEELERS	THREE WHEELERS	FOUR WHEELERS	BUSES	TOTAL
NO. OF EVS SOLD (THOUSANDS OF VEHICLES	56,594	12,319	10,587	542	80,042
OIL SAVINGS (MTOE)	103.6	92.8	185.1	92.5	474.0
OIL SAVINGS (1000 CRORE INR)	332.5	297.9	594.1	296.9	1,521.4
NET ENERGY SAVINGS (EXAJOULES)	4.0	2.8	4.6	2.6	14
NET CO_2 EMISSIONS SAVINGS (MILLION TONS)	312.4	195.2	179.8	158.9	846.3

» Electric vehicles sold until 2030 can cumulatively save 474 million tonnes of oil equivalent over their lifetime, worth INR 1521 thousand crores

» This would result in net reduction of 14 Exajoules of energy and 846 million tonnes of CO2 emissions over the deployed vehicles' lifetime

» Electric buses deployed through 2030 would account for 334 billion vehicle kilometers travelled over their lifetime

CHAPTER 03

THE WAY FORWARD

3.0 THE WAY FORWARD

Much has changed since FAME I Scheme was operationalized in 2015. The global transition towards electric mobility has accelerated; more products exist in the market; charging networks are starting to be developed; prices are beginning to fall; and there is, in general, an increasing understanding and there is growing interest and awareness about EVs among consumers. In India, an EV ecosystem has been developing, including the formulation and implementation of policies and measures that can support early adoption of e-mobility solutions. FAME II is one such policy that is built on the learnings of its predecessor and is well-positioned for success in its goal of driving the faster adoption and manufacturing of electric vehicles.

Yet there is still work to be done to realize an electric mobility future for India. Capturing the benefits of FAME II and its intended ripple effect on the electric mobility ecosystem will require the participation of many stakeholders—from government to industry. This section suggests some potential interventions that governments and industry could take to continue supporting the realization of this electric mobility future.

3.1 POTENTIAL INITIATIVES BY INDUSTRY

The ease and speed of the electric mobility transition will require active participation from industry.

While private sector actions may mostly be driven by competitive and commercial interests, early growth of the e-mobility sector may require collaborative industry action. The industry may benefit by working together to build a supportive ecosystem for electric mobility including a robust supply chain and an accessible charging infrastructure. This "coopetition" approach that stresses on cooperation where possible while maintaining some areas of competition will benefit all players as the market develops in its early stages.

Some actions that industry could take include:

- OEMs and dealers could collaborate to increase customer awareness and access to EV variety
- Conduct EV research and development specific to Indian conditions and increase domestic manufacturing
- Consider new business models that promote the uptake of EVs

OEMS AND DEALERS COULD COLLABORATE TO INCREASE CUSTOMER AWARENESS AND ACCESS TO EV VARIETY

» CONTEXT

Globally, a lack of variety in EV models has been linked to weak EV adoption because consumer preferences vary significantly. Further, auto-dealers are often poorly trained to sell EVs or may even discourage sales of EVs in favor of ICEs as the latter are linked to higher maintenance and spare parts revenues.

» PROPOSED ACTIONS

- Educate salespersons and dealerships on the merits of EVs vis-à-vis ICEs
- Feature EVs prominently at dealerships and ensure that test-rides can be readily offered
- Provide information to potential EV customers on where public charging infrastructure is available in their region
- OEMs could provide higher sales-linked incentives to dealerships and salespersons for sales of EVs relative to ICEs
- Dealers may stock and sell vehicle-compatible EV charging infrastructure at the dealership to ease customer experience

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» CASE STUDY

Based on a study of dealerships in Greece and the U.S., sales of EVs at specific outlets were directly correlated with customer experience.[4, 5]

Shanghai has established EV demonstration zones for potential users to understand and experience the EV technology better. Under an agreement with LEV manufacturers, up to 160 vehicles of different types are available for test-drives at the Zone, along with educational programming, one-on-one interviews and outreach.[6]

CONDUCT R&D FOR EVs AND COMPONENTS CUSTOMISED TO INDIAN CONDITIONS AND INCREASE DOMESTIC MANUFACTURING

» CONTEXT

Electric vehicles can be sensitive to weather and humidity conditions due to battery and electrical systems. Current EVs in the market have been designed predominantly by American, Japanese, European and Chinese firms, with those geographies in mind. An opportunity exists to encourage "Make in India" for battery cells and packs, develop EV models with India-specific conditions in mind and build a domestic manufacturing ecosystem for EVs and EV components.

Continued >

[4] www.sciencedirect.com/science/article/pii/S235214651730399X
[5] www.greentechmedia.com/articles/read/us-auto-dealerships-are-bad-at-selling-electric-vehicles-study-finds#gs.0or1s1
[6] www.c40.org/case_studies/c40-good-practice-guides-shanghai-international-electric-vehicle-demonstration-zone

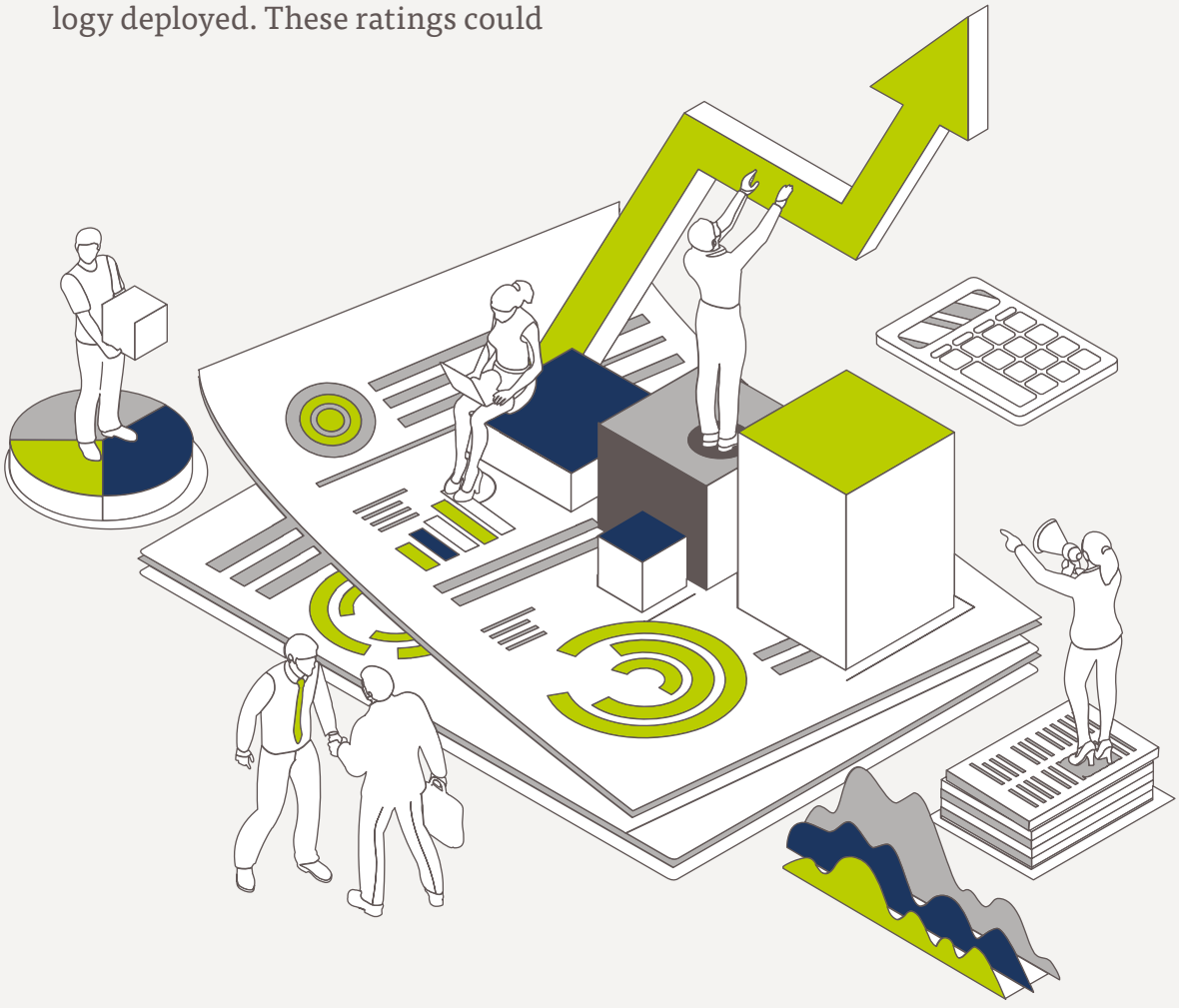
» PROPOSED ACTIONS

» Establish an alliance between auto and battery manufacturers to research Indian climate and use conditions and establish a series of recommendations for electric vehicles in India

» Develop a set of recommendations for rating EVs in India based on performance metrics and technology deployed. These ratings could be used in determining performance-based incentives

» Promote "Make in India" and localize manufacturing of the entire value system of EVs, including electronic component manufacturing and EV charging infrastructure

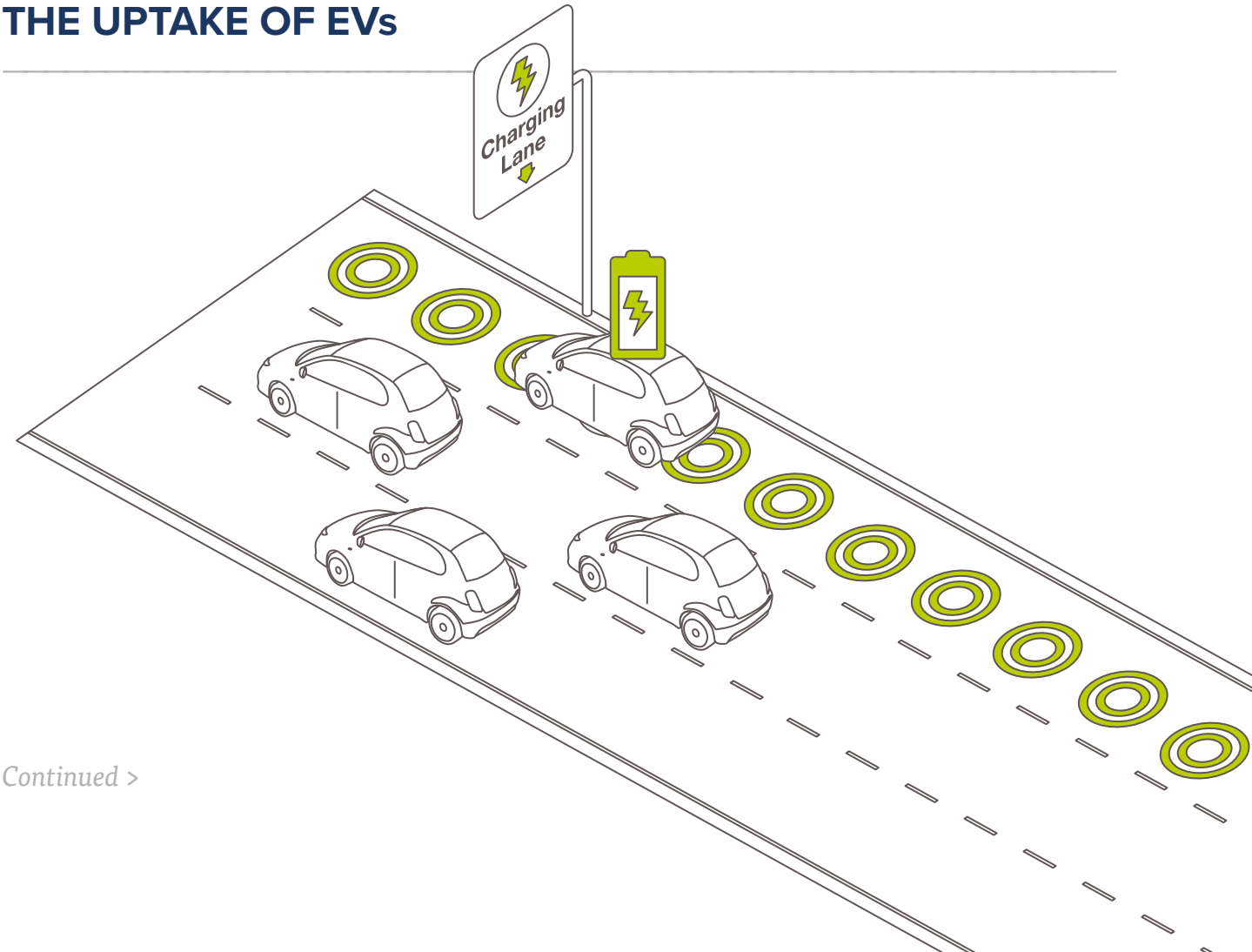
» Conduct R&D to reduce, nullify or recycle—the need for battery materials that are not readily available in India



» CASE STUDY

Researchers at the Technical University of Munich have worked with stakeholders in Sub-Saharan Africa to co-design a vehicle to better meet African transport needs and operate in the climate and use conditions of the market. Similarly, Project "RekkEVidde" in Finland was created to better understand how EVs could be redesigned for better performance in the cold Scandinavian weather. Researchers at IIT Madras are currently conducting research on multiple aspects of EV batteries, including lifecycle testing, pack design, thermal management systems, etc.

CONSIDER NEW BUSINESS MODELS THAT PROMOTE THE UPTAKE OF EVs



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» CONTEXT

EVs are particularly suited to certain vehicle segments and use cases—for example, fleets and commercial high-mileage vehicles can capitalize on EVs' low operating costs. By analyzing the techno-economics, there is an opportunity to build new business models around these use cases. For example, a ride-hailing service that invests in EVs or a battery-swapping station that allows commercial vehicles to quickly swap out a battery rather than charging.

» PROPOSED ACTIONS

» Determine high-impact use cases for electric vehicles and consider what innovative business models can be developed to capitalize on those opportunities

» Consider both charging and battery swapping as options for particular use cases

» CASE STUDY

Gogoro, a Taiwan-based company, manufactures scooters with a swapping capacity. The company offers a range of scooters for personal use, and additionally operates a fleet of shared scooters in Paris and Berlin. Additionally, the company owns, operates and maintains a large number of swapping stations in its regions of operation.

3.2 SUGGESTED INTERVENTIONS BY GOVERNMENT

Governments at all levels—central, state and city—have a role to play in the electric mobility transition. FAME II itself is a strong policy but additional actions by government must be taken to ensure the broader adoption and scaling of electric mobility.

Some actions that government could take include:

- Ensure deployment of high-quality advanced batteries
- Use incentives as a tool for directing or promoting industry
- Competitively allocate incentives to ensure most efficient use of funds
- Ensure finance availability, particularly for commercial EVs
- Launch information, education, and communication (IEC) on electric vehicles
- Provide fiscal and non-fiscal incentives for phased manufacturing for electric vehicles and batteries
- Focus on creation of Phased Manufacturing Plan

ENSURE DEPLOYMENT OF HIGH-QUALITY ADVANCED BATTERIES

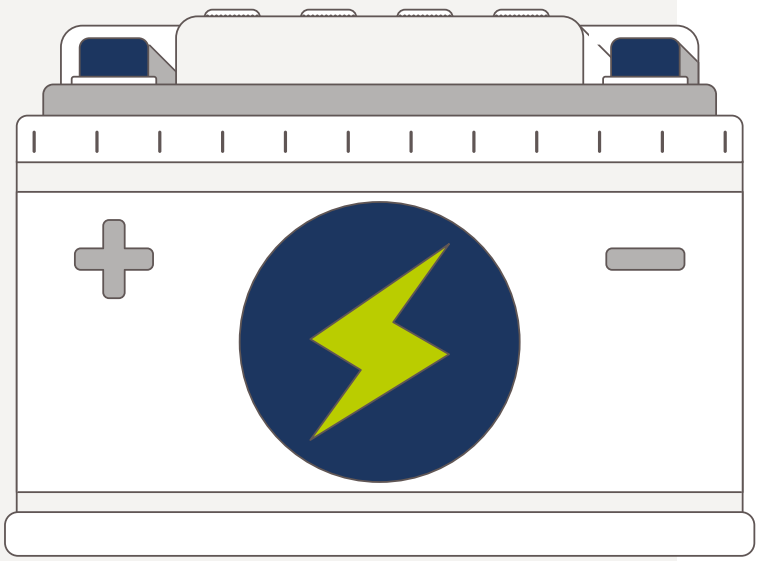
» CONTEXT

FAME II discusses the need to link demand incentives with battery sizes. It also mentions that incentives will only be available to vehicles with "advanced batteries." Given that batteries are core to an EV's lifecycle performance and safety, ensuring that high-quality batteries are deployed in India will be key to the long-term growth of the EV market in India. Safety hazards or underperforming EVs because of inclusion of poor-quality batteries could be a setback to the industry. Further, FAME II and other government policies must also take cognizance of breakthrough changes in battery technologies that could have significant implications on battery costs and performance.

» PROPOSED ACTIONS

» Appropriate regulatory bodies may consider creating regulations and standards that benchmark battery quality based on multiple criteria such as battery cycle life, energy density, safety and recyclability or reusability.

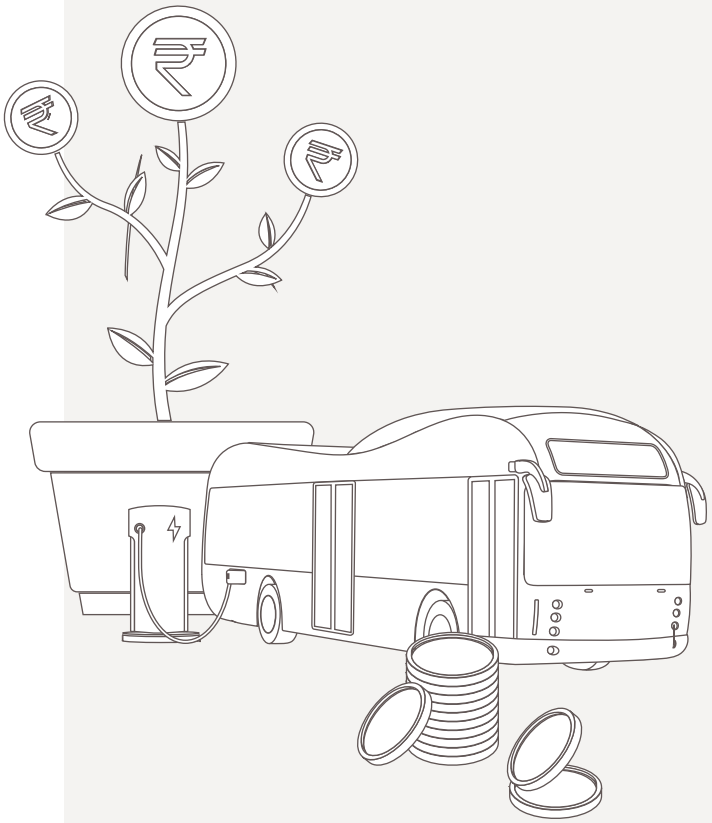
» Such regulations and standards may be designed to accommodate and be amenable to emerging battery technologies and should ideally be revised periodically as information about new battery technologies emerges.



USE OF INCENTIVES AS A TOOL FOR DIRECTING OR PROMOTING THE INDUSTRY

» CONTEXT

Currently, electric vehicles command a price premium over conventional vehicles. This has meant that many governments (including India have offered incentives such as tax incentives and discounts to incentivize buyers). It is essential to ensure consumers are purchasing high-quality vehicles and that government subsidies are not being granted for sub-performance vehicles entering the market.



» PROPOSED ACTIONS

» FAME could offer different levels of incentives depending on the technology and efficiency of the vehicle being deployed, and this could likely be tied into how incentives are changed over time. These "performance-based incentives" will lead to introduction of high-quality vehicles in India.

» Such performance-based incentives could be tied to different vehicle attributes such as vehicle range, battery energy density and battery cycle-life. Increasing level of incentives tied to such metrics could facilitate a healthy competition between vehicle OEMs to produce high-quality, low-cost vehicles in a "race to the top".

» Incentives may be reduced or eliminated over time as EVs attain price parity with their ICE counterparts, and the EV industry gains momentum.

» CASE STUDY

China's incentive program granted roughly INR 650,000 per vehicle no matter the type, but as of June 12, 2018 this has shifted to a performance-based system wherein electric vehicles with a range greater than 90 miles will receive subsidies between INR 153,000 and INR 626,000 depending on their range and battery density, and vehicles with ranges under 90 miles will receive no incentive at all.

COMPETITIVELY ALLOCATE INCENTIVES TO ENSURE MOST EFFICIENT USE OF FUNDS

» CONTEXT

As a relatively new technology, the EV and battery markets are changing rapidly, necessitating a dynamic incentive process—rather than a fixed incentive value—to keep pace with changing technologies and prices. Additionally, the total incentive pool is relatively limited relative to the potential size of the EV market; therefore, it is critical to use these funds as efficiently as possible. One way of doing this is to competitively auction incentive amounts, to enthuse competition among auto OEMs and set incentive amounts based on the minimum needed to support the OEM in producing a specific vehicle type.

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» PROPOSED ACTIONS

» Implement an incentive auction in which auto OEMs bid on the incentive amount per vehicle they need in order to produce that vehicle. The auction should be segmented by vehicle type (e.g., vehicle segment, range, battery size, etc.), grouping vehicles within a certain range of specifications. The lowest bidder sets the price for that vehicle type and has first priority for incentive allocation

» CASE STUDY

In 2015, the Ministry of Power ran several reverse auctions to allocate incentive support for power producers to buy imported LNG for restarting their stranded electricity generating stations. Power producers had to meet a set of technical specifications to enter the auction. Qualifying producers were then required to quote the incentive, in rupees per unit, they need to generate power. The value of the total pool was set and a maximum bidding price per unit was determined. In the May auction, 14 plants technically qualified to participate in the first round of reverse auction; the bidding round concluded with three participants submitting the lowest bid price.

ENSURE FINANCE AVAILABILITY FOR COMMERCIAL EVs

» CONTEXT

Currently, electric vehicles command a 30–50% price premium over similar internal combustion engine vehicles. Though this differential is reducing, EVs are expected to hold an initial cost premium in the near future. Availability of finance will be critical for adoption of EVs given the higher upfront costs. The early adoption experience for EVs (particularly commercial EVs) in India shows finance availability as a key barrier that needs to be addressed.

» PROPOSED ACTIONS

» Engage with financial institutions to ensure easy availability of finance for purchase of EVs, particularly commercial EVs like auto rickshaws and taxis.

» Additionally, government policy initiatives could target providing low-interest finance to commercial EV segments that are deployed for public and shared transport.

» CASE STUDY

As China shifted towards greater use of finance (from 5% using financing to 30%) to market private vehicles, the market shifted to average 20% growth rate. India has the opportunity to pioneer an electric vehicle-specific financing program.

LAUNCH AN INFORMATION, EDUCATION AND COMMUNICATION (IEC) CAMPAIGN ON ELECTRIC VEHICLES

» CONTEXT

Electric vehicles typically have a higher upfront cost than a conventional ICE vehicle. EVs are also often seen as having significant logistical challenges around charging, particularly for those living in apartments without easy personal charging access. Shifting public mindset around EVs and publicizing incentives is critical to driving greater consumer demand.

» PROPOSED ACTIONS

» Improve public perception of electric vehicles through outreach and media campaigns. These campaigns can be combined efforts between government and industry.

» Government agencies can coordinate with media companies to promote environmental benefits of EVs, their lower lifecycle costs, as well as the incentive structures at national and state levels.

» CASE STUDY

Many campaigns in the US and Europe have been collaborations between auto manufacturers and government agencies. Examples of EV publicity campaigns around the world include:

» UK's "Road to Zero" campaign, which provided online tools for customers to estimate costs with different vehicle classes and led to a 19% increase in customers planning to purchase EVs

- City of Denver's Electric Vehicle Awareness Campaign, which led to more than 3 million ad views
- The Chinese government's joint partnerships with Ford, Volkswagen and Daimler for the co-marketing of EVs
- EV demonstration zones in Shanghai that provide potential customers an opportunity to understand and experience EV technology

CONNECT INCENTIVES WITH EMISSION STANDARDS

» CONTEXT

Implementing numerous policies can be cumbersome and can add extra administrative burden. Designing a suite of interrelated EV policies, rather than developing policies in isolation, can ensure that policies are aligned rather than contradictory and provide automakers additional flexibility in meeting policy requirements. This will better support manufacturers in making the transition to electric vehicles.

» PROPOSED ACTIONS

» Allow automakers to use demand incentive credits to offset corporate average fuel consumption (CAFE) credit deficits. A system would need to be developed to convert an incentive value to an equivalent CAFC credit amount

» CASE STUDY

China's New Energy Vehicle (NEV) mandate policy combines a Zero Emissions Vehicle (ZEV) credit with pre-existing fuel consumption regulation for passenger cars. This combining of policies allows OEMs more flexibility in meeting the policy requirements. Program design and features include:

» Annual mandatory requirements are set for auto manufacturers on NEV credits, which need to be achieved by producing or importing enough new energy passenger cars

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- Manufacturers are allowed to use surplus NEV credits to offset corporate average fuel consumption (CAFC) credit deficits, adding compliance flexibility to the existing fuel efficiency regulation for passenger cars

- Manufacturers with annual production or import volume of at least 30,000 conventional passenger cars need to hit targets for both CAFC and NEV credits; small-volume manufacturers need to only to meet CAFC targets

- Surplus NEV credits can be sold to other companies; to offset a NEV credit deficit, an automaker can purchase NEV credits from a company with a surplus of credits

- Surplus CAFC credits can be banked and carried forward to help with CAFC compliance in future years or transferred to affiliated companies to help offset a CAFC credit deficit

- To offset a CAFC deficit, in addition to the options of using banked CAFC credits or transferring CAFC credits from affiliated companies, a company can use NEV credits (either self-generated or purchased from another company)

CONSIDER ADDITIONAL POLICY MECHANISMS TO BRING EVs AND ICEs CLOSER TO PRICE PARITY ON TOTAL COST OF OWNERSHIP

» CONTEXT

Developing a policy ecosystem to support the adoption of EVs should take into account all vehicles in the system. In addition to supporting the uptake of EVs, policies should be developed to incentivize the transition away from more polluting vehicles. A suite of policies simultaneously incentivizing EVs and disincentivizing polluting vehicles can speed up the transition to cleaner options by bringing EVs closer to price parity with their ICE counterparts.

» PROPOSED ACTIONS

» Consider a suite of potential policies, such as congestion pricing, ZEV credits, low emission/exclusion zones, parking policies, etc. to drive adoption of EVs.

» Introduce a system of fees on internal combustion engine vehicles, ideally proportional to the level of pollution produced or fuel efficiency, in addition to the incentives provided by FAME II. While it may help drive adoption of EVs, it would also help to finance the incentives provided to electric vehicles.

» CASE STUDY

» London has a low-emission zone policy, with certain zones limiting free access only to all-electric cars, some plug-in hybrids and any vehicle under a certain CO_2 emission threshold.

» Some Chinese cities, such as Beijing, limit the number of license plates for ICEs and require ICE owners to enter a lottery with a low probability of being granted vehicle registration, for which they must pay a relatively high price. For example, Beijing's June 2016 lottery received 2.7 million applications and granted only 725 license plates, a 0.03% probability. EVs, by contrast, receive immediate registration and exemption from registration fees.

» France introduced rebates for lower-emitting vehicles in December 2007. In January 2008, it introduced fees on higher-emitting vehicles, rounding out France's bonus-malus or feebate-style program. Vehicles are either charged a fee or awarded a rebate on the basis of emissions intensity (using the metric of gCO_2/km). The bonus-malus scheme helped reduce the sales-weighted average CO_2 emissions per kilometer of France's new vehicles by 6% in its first year of implementation.

FISCAL AND NON-FISCAL INCENTIVES FOR PHASED MANUFACTURING FOR ELECTRIC VEHICLES AND BATTERIES

» CONTEXT

India accounts for approximately 5% of the global production (in units) in the cars and commercial vehicles segment. Auto industry contributes 49% to the overall share from manufacturing sector to the national Gross Domestic Product (GDP) and it employs as many as 30 million people, both directly and indirectly. It accounts for more than 7% of India's GDP, expected to increase to more than 10%, acts as a growth catalyst towards the creation of additional employment opportunities. Looking at the high potential growth of this sector, ICE-based mobility to zero emissions mobility is a necessary and inevitable shift that ensures operations at a larger size and scale than the existing magnitude to maintain the trend of upward growth.

Currently, there is limited domestic manufacturing of EVs and EV systems. There is a need for India to develop a pathway for reconciling its vehicle electrification goals with its "Make in India" objective of increasing manufacturing.

» PROPOSED ACTIONS

» Grand Challenge among states to set up Gigafactories for battery storage in India

» To drive initial growth of manufacturing, tax incentives and land grants can be offered to firms to develop new factories for EV and battery component manufacturing

» A three to four-year phased custom duty rationalization regime for components across all vehicle segments and battery components to incentivize localisation.

Continued >

» CASE STUDY

The approval for creation of a Phased Manufacturing Programme (PMP) for EV components and batteries under the National Mission on Transformative Mobility and Battery Storage by the Union Cabinet in March 2019 is a step in the right direction. The PMP aims at having initial pack assembly plants ready by 2020 and integrated cell manufacturing by 2022.

India aims at pursuing a plan similar to the one adopted for cellular telephone manufacturing, which has already led to 70 new manufacturing facilities and 100,000 new jobs.

3.3 AN ELECTRIC MOBILITY FUTURE IS WITHIN REACH

With the support of government and industry, India can realize a shared, electric and connected mobility system. When FAME I was first announced in 2015, this future seemed to be a futuristic goal. Now, with the launch of multiple policies that provide fiscal and non-fiscal incentives, the vision of a transformed mobility system for India appears within reach. This transformation will potentially benefit the country by improving air quality, reducing oil imports, and creating jobs among other benefits.

Certainly EVs do not exist in isolation. EVs are just one component of a new mobility paradigm in which transportation is shifting from an ownership to a usership model. Thought will need to be given to the system as a whole, taking into account the implications of new mobility models that will come along with this transition and supporting infrastructure which will enable India's shift to a shared, clean and connected mobility system. Increasing adoption of electric mobility is one key component of this larger transition.

While FAME II and other recent policy developments are an important step in motivating this transition, they are not an end, they are a beginning. The potential benefits are larger than their direct impact.

In order to capture the potential opportunity in 2030, batteries must remain a key focal point today. Batteries will continue to be the key cost driver of EVs. This highlights the critical importance of India's commitment to transformative mobility solutions and the market opportunity associated with domestic battery manufacturing. Growing India's battery manufacturing ecosystem will create huge competitive advantages in mobility, consumer electronics, and support a stable and resilient electricity grid that can absorb increasing shares of renewable energy. In this way, batteries have leverage over several of the most dynamic and growing sectors of India's economy. Such a transformation will do more than enable the clean movement of people and goods. It will create benefits that will reach to almost every corner of India's economy and geography. ■


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