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Recharging India's electric vehicle ambition by electrifying public transport

Plugging the gaps through business models

For private circulation only

February 2019

Future of Mobility Solution Centre

Contents

Background

Rapid urbanisation stimulates mobility needs and augments travel demand, creating a surge in the demand for vehicles. Rising number of vehicles impacts air quality and increases the country's dependence on crude oil leading to higher import bills. However, economic development often involves judicious trade-offs and thus arises a need for green mobility solutions. Given that, India has pledged to reduce carbon emission intensity by 33-35% by 2030 (compared to 2005 levels)[1], the emerging automotive technologies and alternative fuel seem to be the way forward.

While this may appear as an appropriate strategic move, introduction of Electric Vehicles (EVs) in India currently lies at the core of sustainable mobility solutions. This is likely to require robust ecosystem and conducive environment and there is, thus, a potential need to develop appropriate business models for government and private sector stakeholders to facilitate and optimise the interplay amongst various actors in EV ecosystem.

Development of a robust ecosystem key to EV adoption

India is leapfrogging in electric mobility and each stakeholder has been seen spearheading the initiatives to promote EV adoption in the country. The interplay of these stakeholders is essential for streamlining EVs in transport systems and in creating a favorable EV ecosystem. Elements comprising the ecosystem include demand as well as supply-side factors, and enablers that bind these factors together. These are briefly discussed as follows:

- **Demand-side factors** involves well-designed incentives (fiscal and non-fiscal) to kick-start EV programmes by motivating to acquire EVs by reduction in costs and increased returns on investments.
- **Supply-side factors include** strengthening the manufacturing base through a host of interventions and promote research and development activities by encouraging Original Equipment Manufacturers (OEMs) and ancillary industries like spares and component vendors.
- **Enablers** are expected to bridge the gap between the demand and supply factors and help develop a cohesive environment.

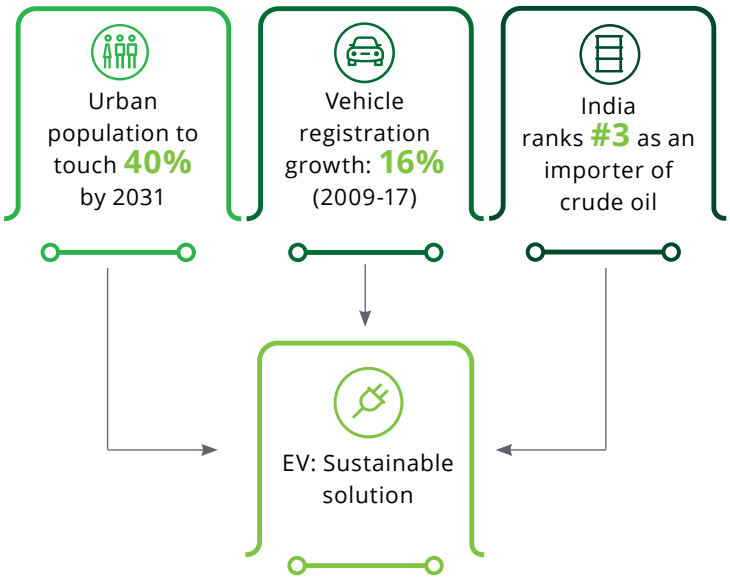


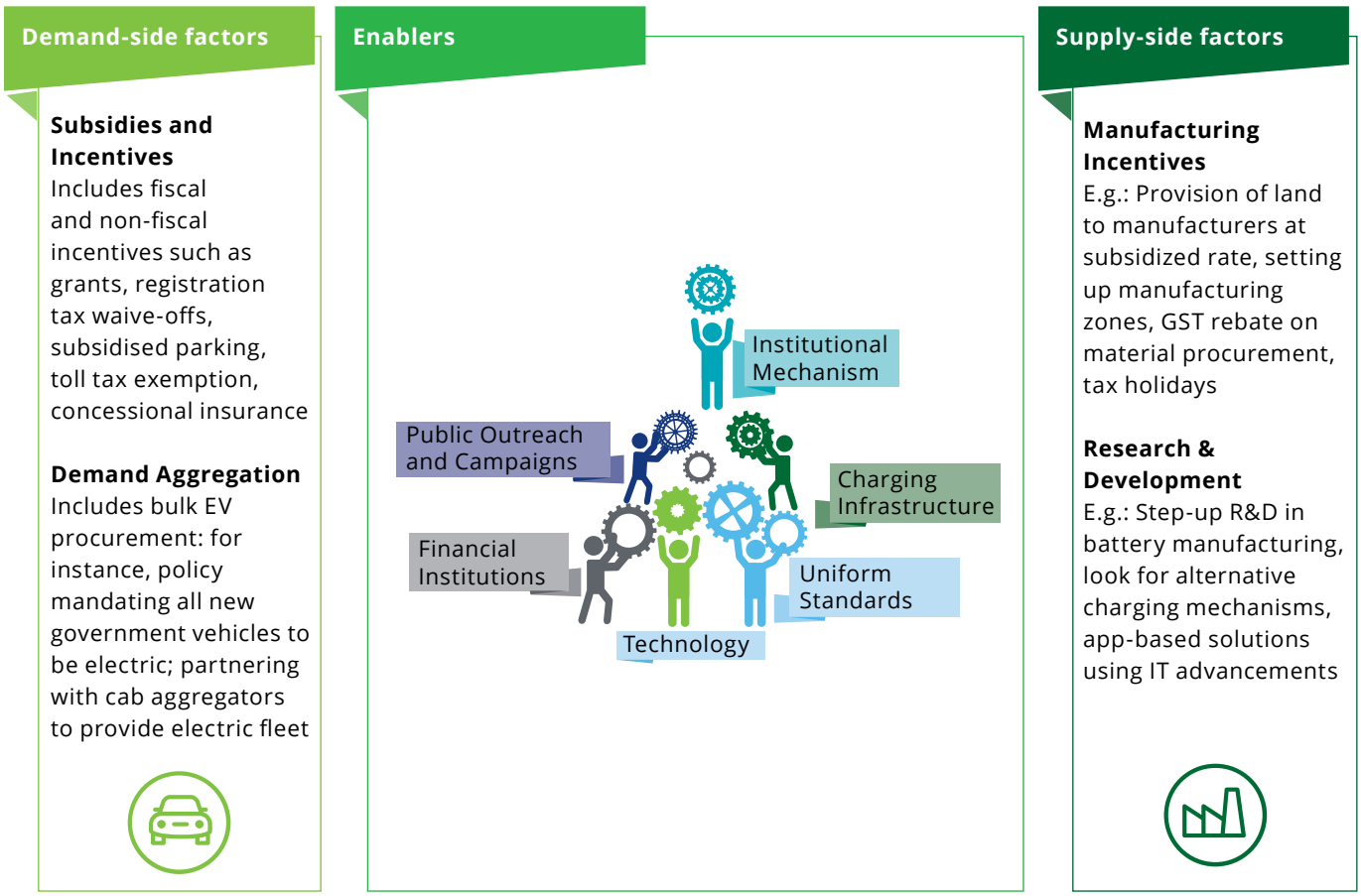
Figure 1: Components of EV Ecosystem

Demand side factors	**Subsidies and incentives** including fiscal and non-fiscal incentives like registration tax, grants, tax waive-offs, buy back of old vehicles, free parking etc. **Demand Aggregation** like bulk procurement
Supply side factors	**Manufacturing incentives** like provision of land at subsidised rates, tax holiday, special zones **Accelerated research & development promoted industry partnerships**
Enablers	**Charging Infrastructure,** Institutional Mechanisms, Technology, Financial Mechanisms, **Policy** framework

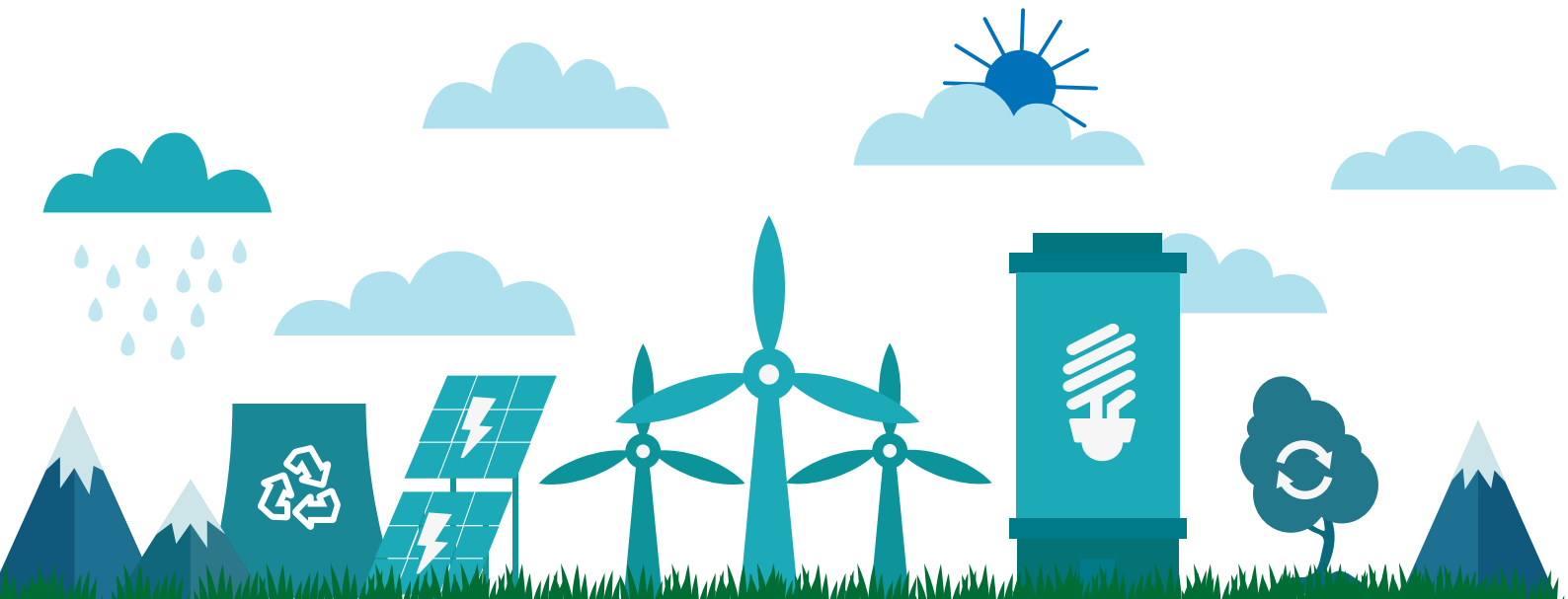
[1] COP21 Commitment, Ministry of Environment, Forest and Climate Change

Mainstreaming EVs is thus expected to require interplay of policy, regulatory and institutional framework, demand and supply, charging infrastructure, incentives, research and development and technological improvements. Since every component is likely to have varying degree of stakeholder involvement, integrated efforts become more important for development of sustainable and smart electric mobility solutions. This interplay among stakeholders may be enhanced by government through designing rationalised and sustainable business models to foster the transition to EVs.

Figure 2: EV Ecosystem



Source: Deloitte Analysis



Identifying roles and expectations of the actors for interplay in the ecosystem

In order to facilitate smooth EV adoption, multiple stakeholders involved in the EV ecosystem would need to develop guiding rules of interplay with well-defined roles, responsibilities, and expectations. All stakeholders would need to be mapped to try to make sure that they play the role in synergy. The **government** at all three levels i.e., central, state and municipal level is expected to play a crucial role in supporting EV adoption and developing a supportive ecosystem. The government would need to act as a regulator and develops standards, specifications, performance benchmarks, institutional framework and conduct promotional campaign to sensitize people for EV adoption. **Manufacturers** would have to build the supply of EVs at minimum cost with use of latest technology. **Battery providers** are expected to play a key role in providing technology to improve battery density and battery performance to support the ecosystem through improved driving range, energy density, power, life, charging system and reduced cost of batteries. **Power utilities'** expected role would include defining the technical framework for easy charging of vehicles from the grid and reducing impact of EV deployment on the grid through innovation in distribution of power. **Energy supplier's** may need to act as service providers relieving the vehicle operator from responsibility of battery acquisition and charging. **Vehicle aggregators** may have to act towards accelerating adoption of EVs by bringing in economies of scale through bulk procurement and operation of EVs. In view of high acquisition cost of EVs as compared to conventional vehicles, large amount of funds are likely to be required for their acquisition, which could be facilitated by **financial institutions.** Government may also support acquisition of EVs and infrastructure by way of grants or interest free loans for accelerating adoption of EVs. **Commuters and the citizen groups** complete the value chain of the EV ecosystem. Their perception about usage and sense of association with EVs is likely to play a key role in sustainable mobility in the EV ecosystem.

An indicative role for each actor is identified as follows:

Figure 3: Interaction among various stakeholders

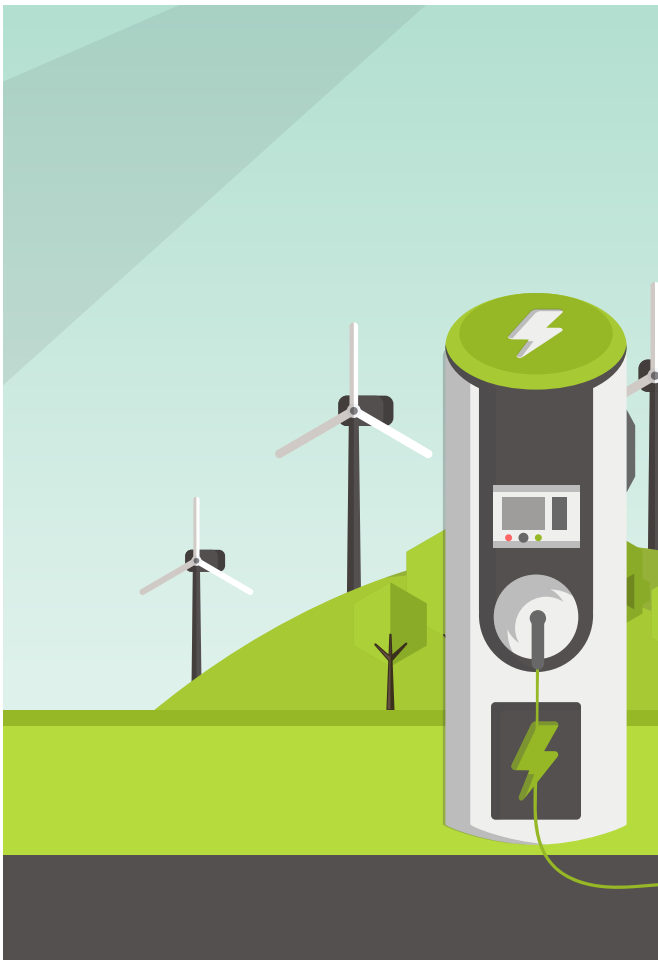
Source: Deloitte Analysis

Business Models can facilitate synchronisation among stakeholders

Responsibilities of each actor are expected to vary depending upon the role played across different phases for deploying vehicles depending on vehicle category (electric two-wheeler, three-wheeler, cars or buses) and related charging infrastructure. There are various activities to be performed at different stages of planning, implementation and subsequent operations and maintenance of EVs. An activity or set of activities may be undertaken by a particular actor depending on the choice of the model.

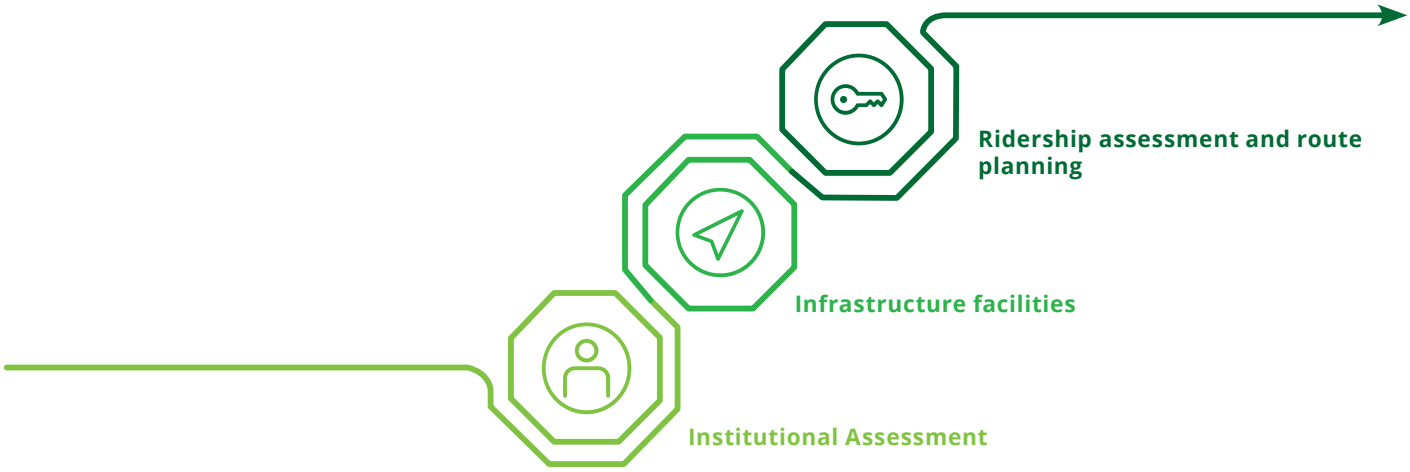
There can be number of business models depending on the possible combination and may be driven by an individual player or by collaborating with each other. However, the government would need to lay emphasis on business models that will play an important role in achieving financial, economic and operational sustainability. While action on various fronts is ongoing, appropriate business models would help create synergy amongst stakeholders and leverage their competence and expertise towards a common outcome. Some of the objectives of these business models would be:

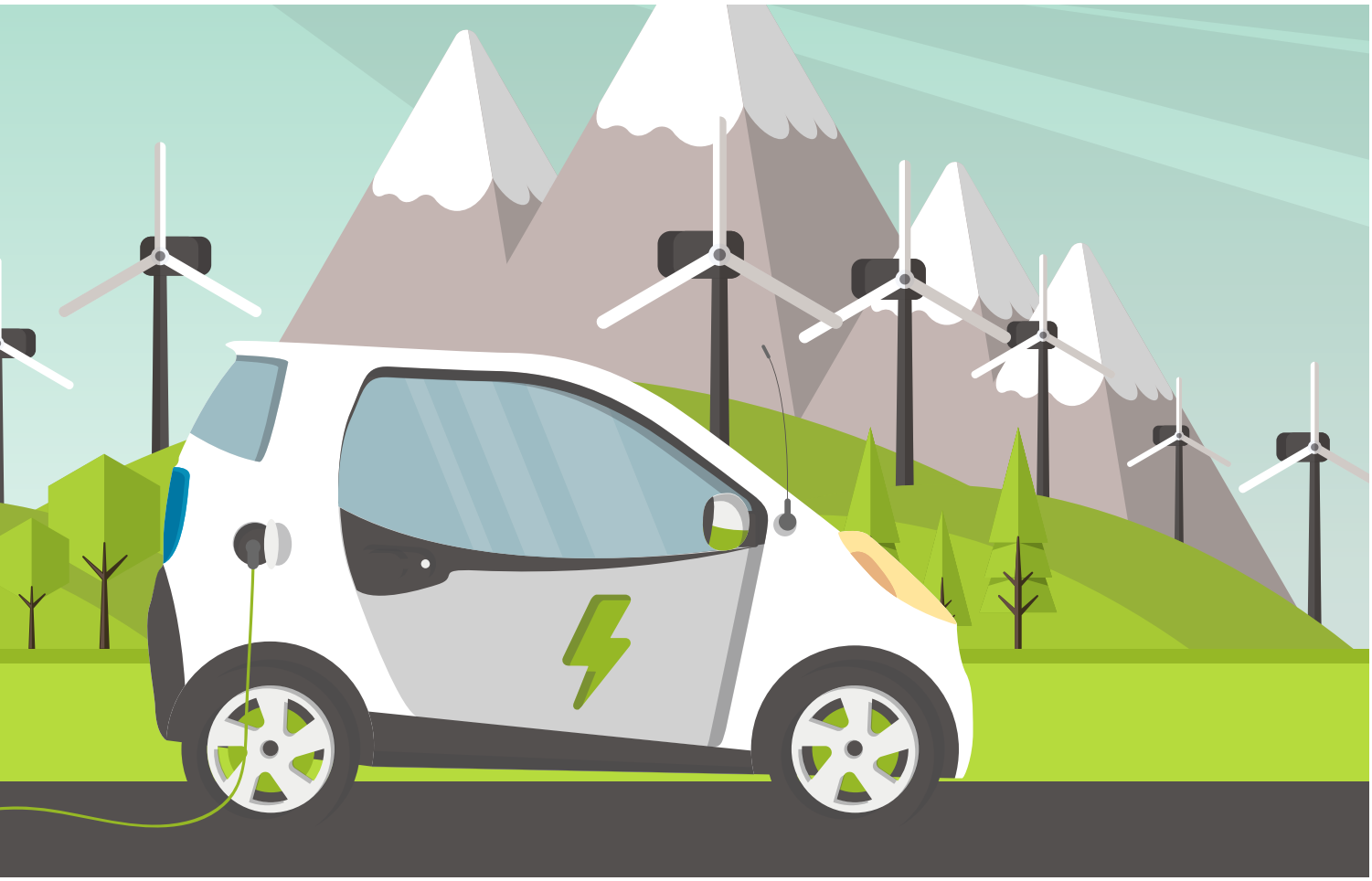
- **Bring synergy** amongst players involved in electric mobility
- Ensure **economic sustainability**
- Achieve **customer orientation**
- Encourage **innovation**



Prerequisites for setting a business model

There are certain activities which need to be undertaken in advance for initiating transportation services to public. These form the premises for any business model that is applicable and are listed as follows:



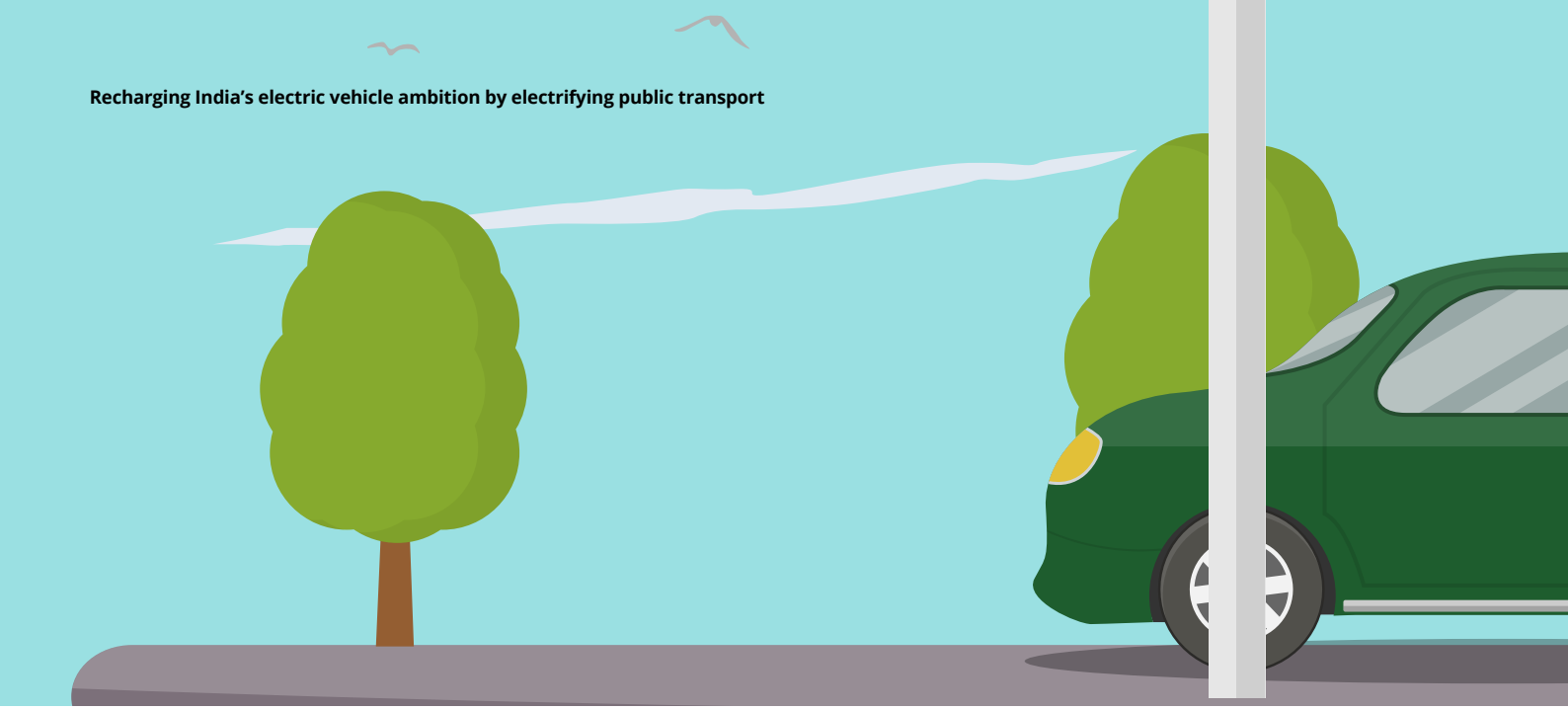


- **Ridership assessment and route planning:** The transport system would need to be sufficient to serve the spatial and temporal travel needs. Considering the high upfront cost in case of electric buses, it is imperative to identify high-density routes to estimate revenue from the ridership to cover the cost. Similarly, locations for charging stations need to be assessed to reduce range anxiety among commuters.
- **Infrastructure facilities:** The infrastructure facilities would include parking facilities integrated with charging facilities, bus depots and stops, integrated facilities including improved ticketing systems, etc. The authorities would need to focus on establishing Intelligent Transport Systems (ITS) that help them obtain real-time operating data and communication across devices specially charging infrastructure.
- **Institutional assessment:** The government should aim to implement sustainable transport system by improving governance, enhancing institutional capacity, accountability and transparency. Since additional regulatory bodies will now be involved like Ministry of Power etc., it becomes important to foster institutional strengthening and facilitating coordination of activities.

Fundamental characteristics of business models

There are certain key elements that would need to be common across all the business models. These are inherent fundamental characteristics irrespective of the choice of the model. The key pillars for the success of the model shall include:

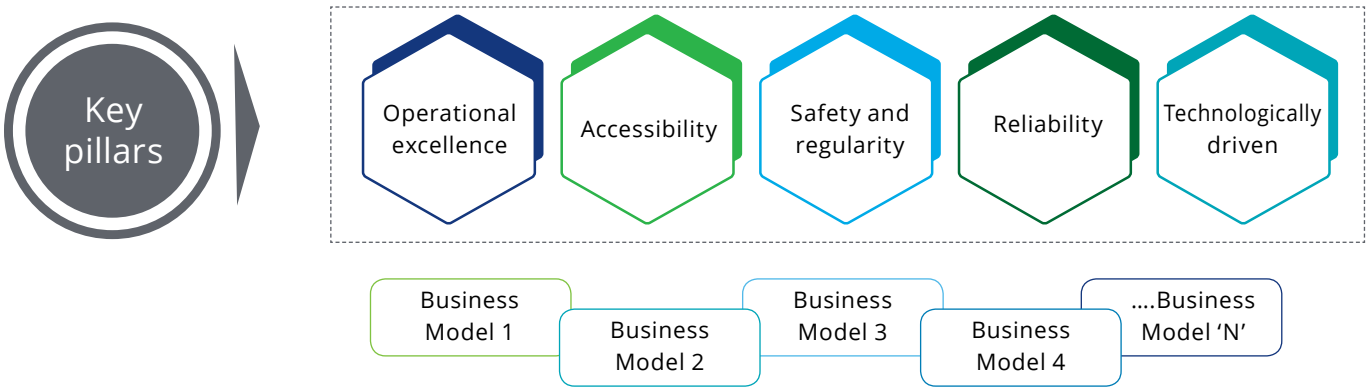
- **Operational excellence:** The business model should enhance the operational efficiencies and drive down the cost. There should be optimum utilisation of available resources.
- **Accessibility:** The business models should stimulate accessibility. Accessibility is defined as easy access to the services (ease of access to electric buses, electric rickshaws, and charging stations). Thus, any business model would need to work towards a large percentage of population being able to consume the services.
- **Safety and Reliability:** Safety is a key concern for every commuter. The business model, irrespective of the stakeholders involved, would need to focus on safety of the travellers and other road users. There should be a measurable benchmark for accidents and be watchful of the seriousness of accidents. This is likely to also promote reliability of services.



- **Technology:** Every business model would need to factor in intervention of advanced technology in order to optimise cost and provide enhanced quality services. For instance, GPS tracking can provide operational data in real time for management to address any charging time issues; IOT enabled platforms to identify the charging locations.

Some of the key pillars and key deciding factors of a business model are illustrated in the diagram.

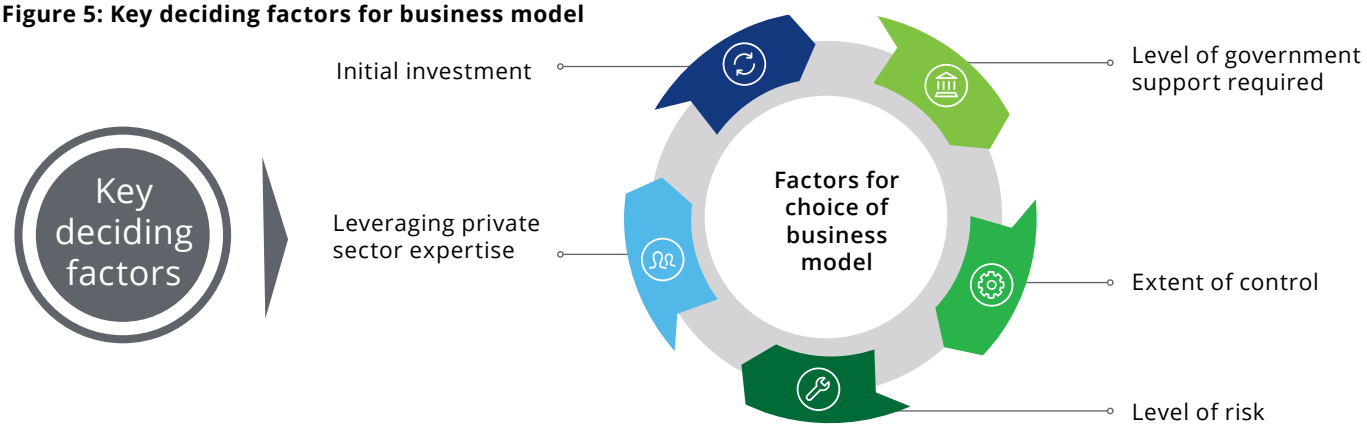
Figure 4: Fundamental characteristics of business model



Factors affecting the choice of a business model

Every business model is unique and has its own pros and cons. Government would need to judiciously choose the model for actual implementation and rollout of EVs and supporting infrastructure. Some of the key factors that are expected to affect the choice of model and are considered to be important in evaluation by the government are listed as follows:

Figure 5: Key deciding factors for business model



Source: Deloitte Analysis

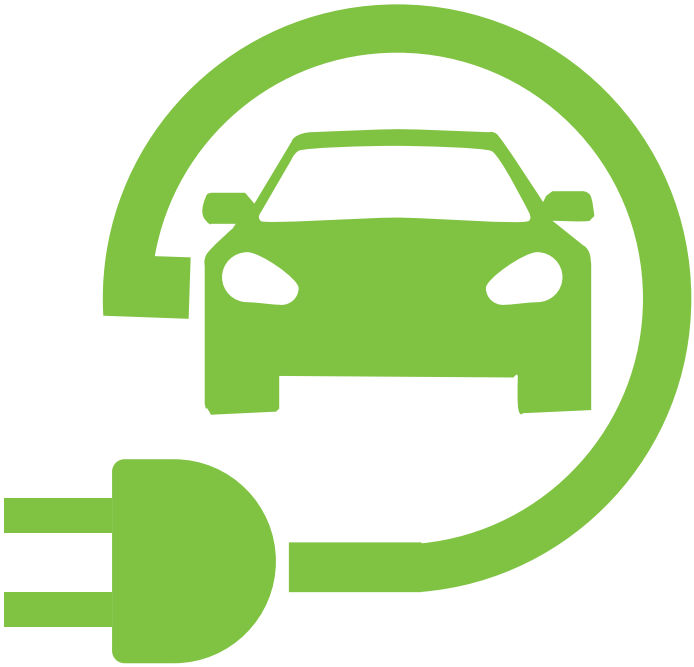
Extent of Control is the degree of ownership desired by the government. More the number of players involved in operating and managing, lesser will be the control by the government and higher would be the division of responsibilities among involved stakeholders. Since the electric mobility domain is evolving, government may encourage third– party participation. However, if the government wants the command over the entire value chain, the degree of control given out would be significantly less. The decision on degree of control is likely to be primarily influenced by existing competence, financial capacity and availability of required resources within government agency.

Level of government subsidy/support required is another important influential factor. Business models should be self-sustainable wherever possible and the government would need to provide capital funding for creating infrastructural assets like depots, terminals, charging stations where life of asset is much higher than that of the operational contracts with the private sector partner. However, some costs may be distributed among stakeholders according to their investment capacity in a way to rationalize risk and optimize return for each. There may be further gaps between operational costs and revenues of EVs particularly for ensuring affordability of services to users. Such gaps may need to be bridged by the government. An optimal operating model would need to focus on minimizing the need for subsidy support.

Level of risk is important determining factor as risk appetite of players involved in EV value chain is different. The risk would need to be distributed based on the appetite and the risk-bearing capacity of each stakeholder. The model should aim at distribution of risk amongst stakeholders and reduce the impact of uncertainties on any single player. Higher risk for some partners signals risk concentration for limited number of players whereas if more players are collaborating to perform the operations, then risk is likely to be more evenly distributed.

Leveraging private sector expertise becomes important to improve the operational efficiency and increasing the penetration of EVs. The involvement of private sector allows minimizing bottlenecks by pioneering in advanced technology, efficient operations and improved service delivery. Since electric mobility is still evolving, capability of government may not be adequate and hence, it becomes important to bring innovative mechanisms through involvement of suitable private sector players.

Initial investment determines the willingness/capacity of parties to decide upon the choice of business model. If the upfront cost is too high, stakeholders might be reluctant to invest in the business. Business model should be such that it enables to spread this high cost to encourage more participation and is no longer a deterrent factor for growth of EVs.



Potential models for adoption of EVs in public transport

The need of public transport with a focus on electric bus

Public transportation has the potential to influence the development of any city. A good public transport is accessible to all and has the power to bridge the gap in mobility. There can be different modes of public transport like passenger trains, buses, trams, rapid transit (metro, subway), and electric rickshaws (for promoting last mile connectivity). But buses are the dominant form of public transport in India However, this share is declining and is expected to reduce further. The energy consumption per passenger/km in a bus is one-third[2] of that of a car and the CO2 emissions per passenger kilometer for a diesel bus at 20% capacity is one-third[3] of that of equivalent number of cars required. Moreover, public transport addresses the issue of congestion on roads by promoting shared mobility.

The transition to electric buses is expected to not only help reduce carbon footprint but also save fuel. The enhancement of electric public transport seems to be the need of the hour in every city. The advantages of electric buses have been recognized globally and different cities have taken initiatives to deploy electric buses in their fleets. For example, the city of London has pledged that no new diesel buses shall be added to the city's fleet from 2018[4]. Even in India, the Department of Heavy Industries, Government of India, has sanctioned USD 67 million for the procurement of electric buses, e-taxis and e-autos[5].

Actors in electric bus ecosystem

Among the actors highlighted earlier, the electric bus ecosystem has the following actors playing an important role:

- Government authorities responsible for provision of Public Transport services (also termed as "authority")
- Bus Manufacturers (with or without batteries)
- Battery Manufacturers
- Electric Utility provider
- Private Operators and
- Financial Institutions

The high capital cost of electric buses require changes to conventional business models rather than focusing on subsidies whose aim is to reduce the capital cost to make it comparable to conventional buses. A business model should aim at achieving operational and financial sustainability by bringing in technological innovation, effective grid management, and improving efficiency. As can be seen from the following diagram, there is decline in total cost of ownership for electric buses on transition from conventional buses to electric buses.

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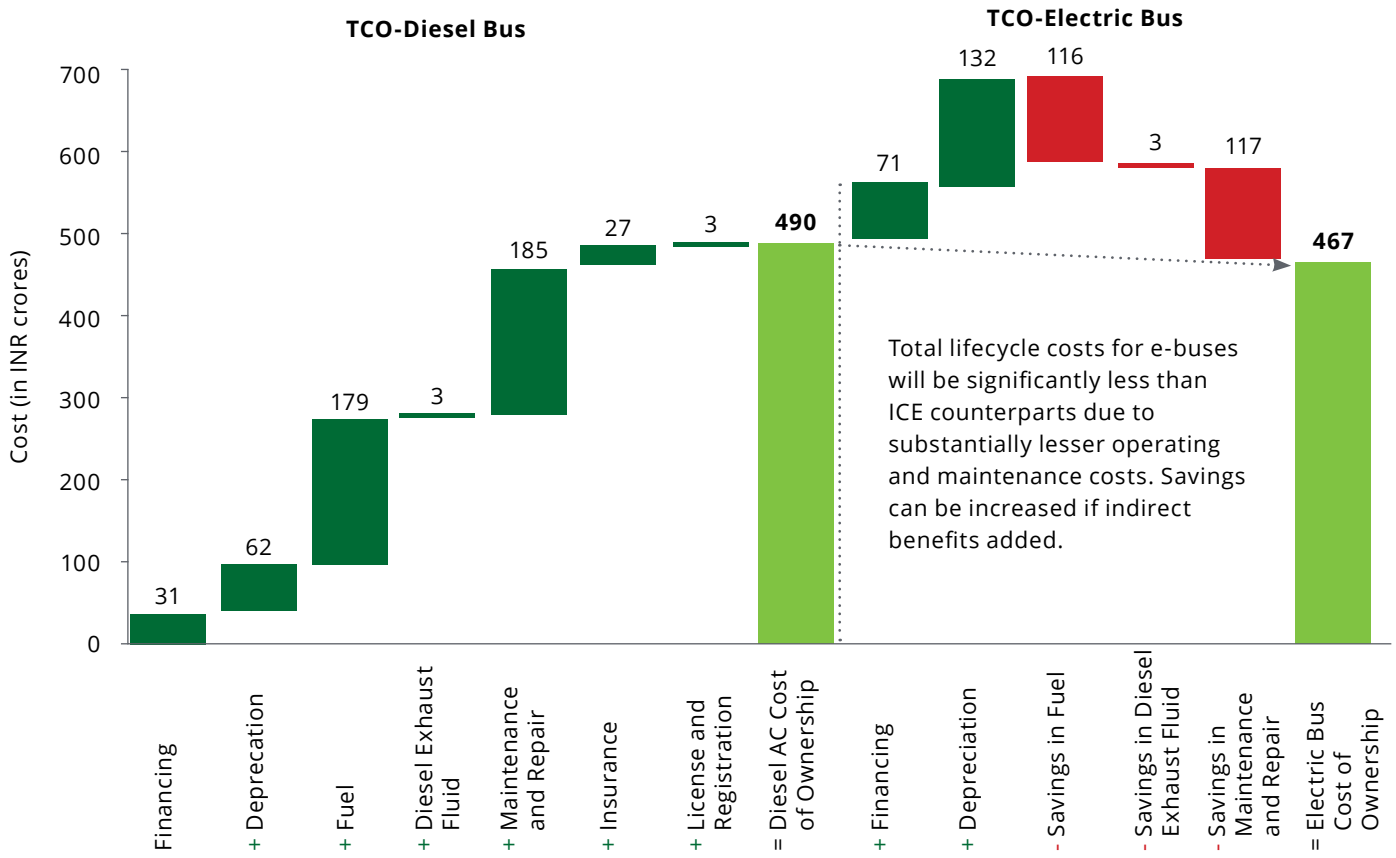
2 Buses today and tomorrow, International Association of Public Transport (2012)

3 Buses today and tomorrow, International Association of Public Transport (2012)

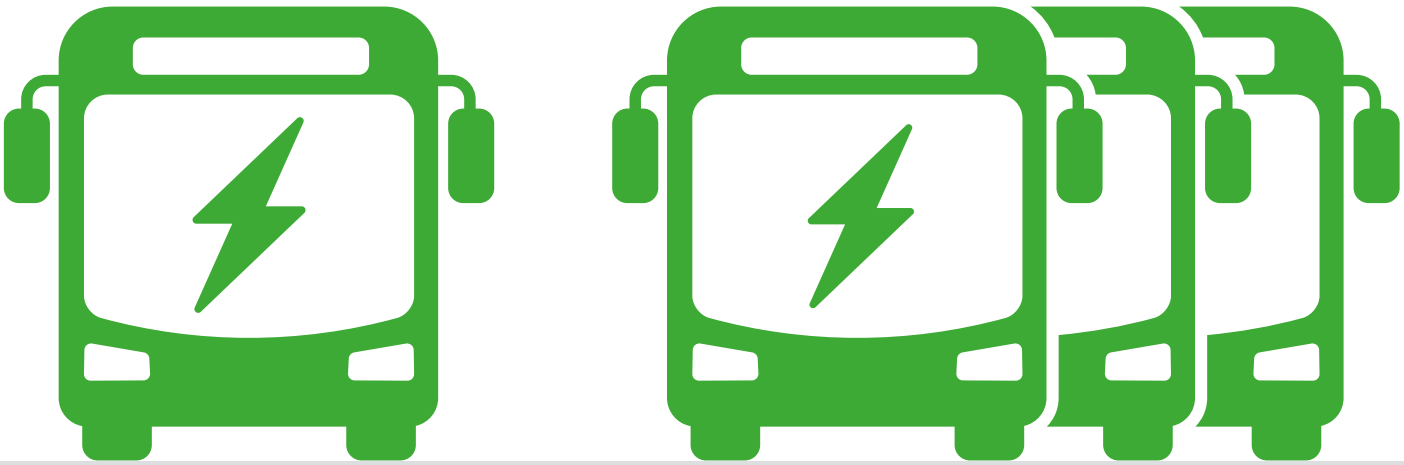
4 http://www.bbc.com/news/uk-england-london-38157860

5 FAME scheme, Government of India

Figure 6: Total Cost of Ownership Analysis (TCO) for electric buses (without including subsidies)



Source: Deloitte Analysis



Exploring business models for electric bus operations

Based on the roles an individual actor can play, the following business models can be implemented by any city depending on their suitability and city characteristics:

Business Model 1: Government driven

This model is based on the premise that because of high requirement of capital investment, getting enough private players would be a challenge, hence government agency involved in operation of buses will assume entire responsibility including procurement (through leasing[1] or outright purchase), provisioning and maintenance of infrastructure facilities and revenue collection.

The advantages under this model are that the government retains full flexibility to modify or restructure routes and schedules, fares, etc. The viability gap funding if any will be easier to access in this case. However, this model will have a huge impact on the budgets of the government and there might be low overall efficiency due to limited expertise or prior experience of government in electric mobility and operations.

Case: Indore, Lucknow, Kolkata, Jammu and Guwahati has done outright purchase of electric buses. O&M of buses will be done by authority and private player will provide AMC for 7-10 years with replacement of battery.

Business Model 2: Collaboration between government and energy supplier

The government joins hands with utility or energy suppliers to provide more specialized services related to power and energy supply-a limited but major area of intervention for the government. In this model, government will be responsible for all activities including procurement (through leasing or outright purchase), provisioning, maintenance of infrastructure facilities and bus fleet, revenue collection. However, energy supplier will acquire, own, operate and maintain battery-charging systems including the provision of battery.

The authority in this case harnesses expertise of the energy supplier, with reduced requirement of initial investment as battery cost is assumed to form a significant proportion of total cost. Energy supplier will play the role of existing fuel stations who stores the fuel. Energy supplier will be able to achieve economies of scale by promoting wider use of facilities. However, the energy supplier might be at risk of low utilisation in initial stages when volumes are low. The bidding parameter can be "Rate per bus km" and/or Rate per battery pack per month.

Business Model 3: Government partnering with private operators

In this model, the government may join hands with private player for implementation of electric bus on Public-Private Partnership basis. This enhances the role played by each individual by leveraging the expertise of players. In this case, private operator procures (on lease or outright purchase) buses complete with batteries and battery charging system, operates and maintains buses and authority makes provision of land, infrastructure and other supporting activities. Revenue collection is arranged by the authority either in-house or through a private agency.

This model envisages reduced quantum of upfront investment by the authority in bus fleet and charging infrastructure. It also reduces staff requirement by the authority. Operational efficiency of the system tends to improve because of higher and focused competence of each stakeholder. The partnership clearly outlines the roles and responsibilities of each partner. However, non–compliance to SLA may lead to penalties. The bidding parameter could be Operations and Maintenance (O&M) fee per km.

Case: Bangalore, Ahmedabad, Mumbai, Hyderabad and Jaipur have procured buses under gross cost contract. The buses would be operated and maintained by the supplier at a fixed cost per km under GCC. Under the FAME Scheme, the city expects to receive subsidy of upto 60% of the capital cost of Electric Bus over a period 3 years in three instalments of 20% each in each fiscal starting from the current fiscal year of 2017-18.

Business Model 4: Partnership among government, energy supplier and private operator (acquires buses with or without batteries)

In this model a partnership amongst the government, the operator and the energy supplier is envisaged for distribution of investment needs and the risks, and to harness expertise of each partner for improved operational efficiency and service delivery. Private operator in this model has an option to procure buses with batteries or without batteries and subsequently operate and maintain these buses. In the former case, the energy supplier acquires, owns, operates and maintains battery-charging systems. In the latter case, battery manufacturer provides battery charging system and maintenance service and buses are procured (on either lease or outright purchase),

1. Leasing as a mode of procurement for buses significantly reduces the CAPEX required for buses. Moreover, during the lease period, warranty is given and thus, maintenance is taken care of by lessor.

supplied, charged and maintained by the energy supplier utilising its captive battery charging system. Energy suppliers have the choice of selection and use of any of the available charging systems depending on the availability of power. Authority takes care of revenue collection function besides planning related aspects like demand assessment, tariff fixation, route network planning, infrastructure provisioning, setting performance standards and specifications, monitoring and control of operations, etc.

This model is conducive to improve operational efficiency of activities related to operation and maintenance of electric buses and supporting infrastructure. This also enables efficient inventory management and focused application of expertise. However, management and coordination of multiple players may pose a challenge for the government. The bidding parameter could be O&M fee per km for private operator and Rate per bus km and/or Rate per battery pack per month for Energy supplier.

Partnering with utilities: The case of Shenzhen, China[6]

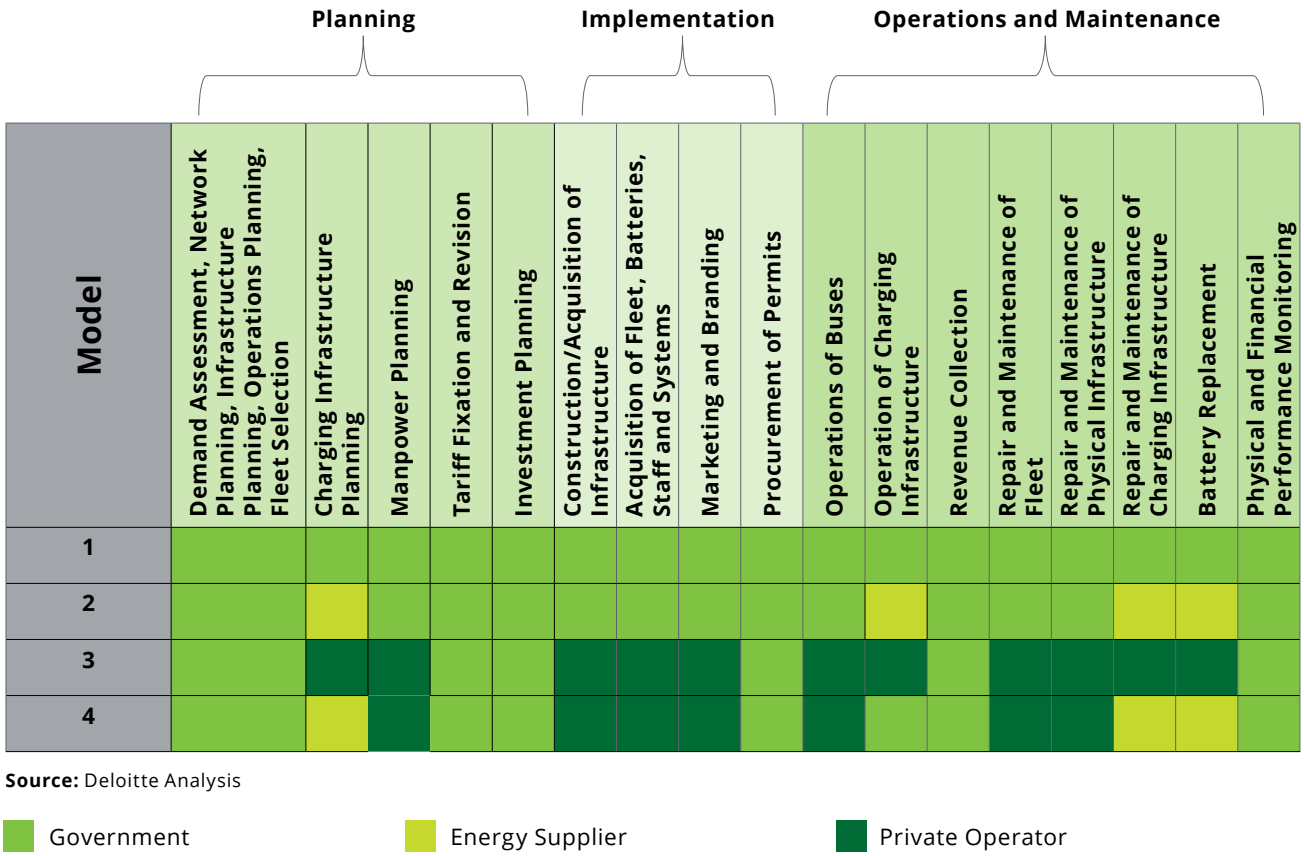
The Shenzhen government fostered a financial leasing model by partnering with state-owned enterprises Potevio New Energy and China Southern Power Grid. Under this model, Shenzhen Bus Company, the public transport company purchases the bus without the battery (cutting the cost by ~ USD 56,000). Potevio retains the ownership of the battery and leases it to the bus company. While vehicle manufacturers provides sales and service for the vehicles, the battery manufacturers provides battery charging, replacement, and maintenance services.

A typical EV bus costs USD 320,000 (compared to USD 80,000 for a conventional bus). The Shenzhen Bus Company receives USD 160,000 as subsidies from the government, and is offered loan guarantees from Potevio on the remaining capital costs of USD 104,000, thus alleviating much of its capital burden. The China Southern Power Grid, on the other hand, has been laying down charging stations in the city, covering the city's main roads, communities, and parking lots.

6. Developing New Business Model in case of Pure Electric Bus (PEB) in China, Oulu Business School

The variation in activities across models are captured as follows:

Figure 7: Activities involved in electric bus operations



Source: Deloitte Analysis

Choosing the appropriate business model

As discussed earlier, there are several factors that influence the choice of a particular business model for operating electric buses. Each parameter has its relevance. The business models are qualitatively evaluated against those parameters as follows:

Parameters (as related to the authority)/ Business Models	I Government driven	II Govt. and energy supplier	III Govt. with private operators	IV Partnership (with/ without batteries)
Extent of control	High	High	Medium	Medium
Level of government support required	High	Medium+	Low	Low
Level of risk	High	Medium+	Low	Low
Leveraging private sector expertise	Low	Medium-	High	High
Initial investment	High	Medium+	Low	Low
Suitability	*Suitable if the govt. wants to retain the control, has sufficient funds, can leverage its own past experience and assume high risk*	*Able to leverage capabilities of energy supplier and has sufficient funds and experience in the domain*	*If the government has limited funds, minimal experience and willingness to share responsibility*	*When it is important to involve multiple parties to leverage individual experience and drive down cost and share risk*

Potential business models for electrifying first and last mile connectivity

The need of electric rickshaws

Urban transport systems generally end up servicing the major route networks leaving First/Last mile connectivity unattended. In some cities, Intermediate Public Transport (IPTs)/Non-Motorized Public Transport (NMT)/Auto partially play the role of public transport in such uncovered areas. While NMTs involve human effort and take long time to complete the journey, fossil-fueled internal combustion driven auto-rickshaws are highly polluting. Provision of public transport services for these cities or areas by electrification of auto-rickshaws appears to be one of the optimal solution. These electric three wheelers are expected to complete the value chain for public transportation by providing first/last mile connectivity or urban public transport services to the commuters. The electric three wheelers also termed as e-rickshaws could, thus, be the low hanging fruits in EV adoption due to lower lifecycle cost.

Actors in electrification of rickshaws

Among the actors aforementioned, e-rickshaw ecosystem involves the following actors:

- Government (also termed as authority),
- E-rickshaw manufacturers,
- Battery manufacturers, and
- Private operators

The relevance of e-rickshaws in providing First/Last mile connectivity and/or public transport services in some urban areas is unparalleled. The business models thus, should aim at promoting acquisition, deployment, usage, and monitoring and control of these vehicles effectively. Additionally, it should aim at managing the risk among the involved parties, allowing to operate them to attain cost efficiency.

Exploring business models for e-rickshaws

The business models for e-rickshaws ideally should be such that they help in furthering adoption of electric vehicles in the cities by ensuring better connectivity of services. These business models would need to promote accessibility, adequacy, affordability, safety and reliability of passenger services and facilitate efficient last mile connectivity. Based on the principles outlined earlier, the following models can be adopted for promoting e-rickshaws in the city:

Business Model 1: Manufacturer driven

The rationale of setting this model is that the value chain for electric mobility is undergoing development. While manufacturer understands the technology and functioning of the e-rickshaws, the OEM industry is at nascent stage. It is the government who identifies the routes or operational areas and manufacturer(s) operates e-rickshaws on the dedicated routes and areas. Manufacturer also brings his technical expertise and designs the vehicle with updated technology. Manufacturers who also make provision of charging infrastructure get into a separate contract with drivers for operation of e-rickshaws. Government may assist the manufacturer in acquiring requisite land parcels for above purpose. A System Management Fees (SMF) can be paid by manufacturer to the government.

In this model, government hardly needs to invest in infrastructure and the vehicles but maintains adequate control/flexibility on their deployment and performance monitoring. Manufacturer(s) bear the investment risk and gets an opportunity for improved penetration of vehicles. The economies of scale can be achieved as there could be large-scale deployment of e-rickshaws by the manufacturer. Revenue risk is born by the manufacturer. The advantage of the model is the reduced cost for the government and fixed returns in form of fee. However, the selection of the manufacturer for a certain route/area will also pose a challenge for the government in addition to addressing the problem of existing unorganized players in the market. Government would also need to address the issue of monopoly situation by a single manufacturer. The bidding parameter could be the SMF.

Business Model 2: Operator driven

The rationale for setting this model is to leverage the expertise of the operator. In this model, authority lays downs specifications and standards for vehicles and the operations, and fixes user tariffs and monitors and controls service quality performance. A System Management Fees (SMF) is paid by the operator to the government. Operator acquires, deploys, operates and maintains e-rickshaws on the dedicated/pre-identified routes or areas at his cost and collects user tariff based revenue. This will help achieve efficiency in the operations.

The operator could be any business entity or an aggregator or a service provider. This model transfers the investment and the revenue risk to the operator. Operator brings in advanced technology to improve first/last mile connectivity. There would be fair distribution of investment risk and responsibilities between the business entity and the individual operator. Although there would be minimal interventions in operations, government retains operational flexibility and full control over tariff fixation as also on performance monitoring and control. The bidding parameter could be the SMF.

Business Model 3: Government driving the procurement by creating a dedicated association/society

The existing operations of first/last mile connectivity are fragmented and managed by multiple operators/individuals. This leads to difficulty in imposing uniform standard and accountability. Hence, the rationale of this model is to allow government drive the model in association with the users in a coordinated fashion. In this model, the government encourages to set up dedicated forums or associations or cooperative societies of drivers to promote e-rickshaw adoption. This is set up as a legal entity.

Authority allocates operational routes or areas to various forums. Drivers register with a forum, obtain permits, licenses, and the registration number for the vehicle. This forum trains drivers and ensures all the compliances are met with no compromise on user service quality, safety and reliability. The forum gets financial support from the government and pool of funds from the drivers. The collective forum facilitates quantitative ease and lower acquisition price by procurement of large number of vehicles. The forum distributes costs, revenues and profits amongst the members. However, the involvement of drivers needs to be taken into consideration in advance and there should be readiness to bear the revenue risk.

Here, investment and revenue risks are shared amongst a large number of drivers. Monitoring and control of operations by the authority is easy and efficient in view of small number of entities. Authority charges certain SMF from the forums. SMF would be the bidding parameter if number of participating forums are more than those specified.

Business Model 4: Public Transport Authority driven

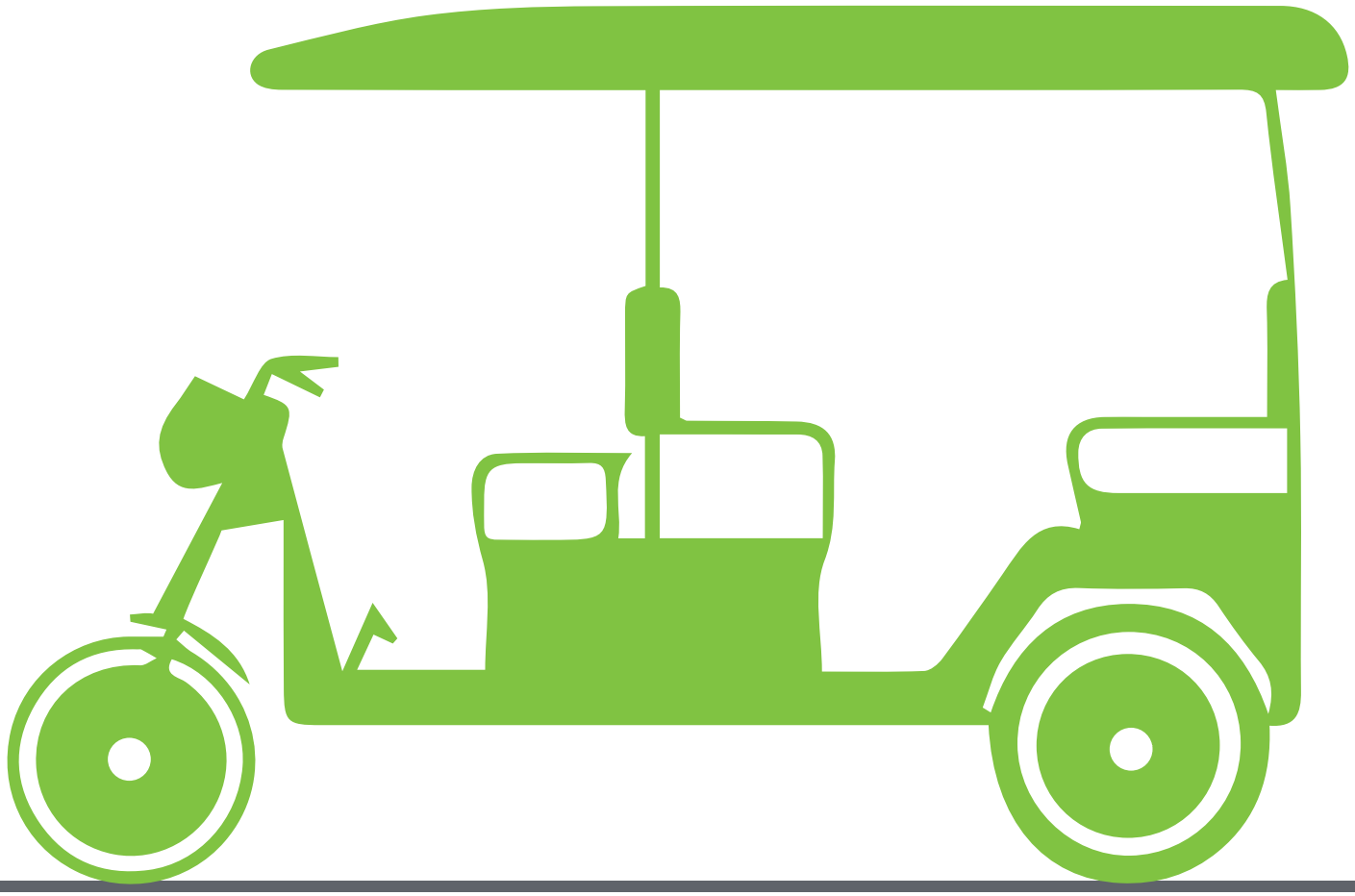
E-rickshaws may be optimally used for servicing last mile connectivity needs in the cities. In this model, the Public transport agency collaborates with e-rickshaw manufacturer for deployment, operation and maintenance of e-rickshaws for providing First/Last mile connectivity on pre-defined routes/areas charging user fare as applicable in the operational area. Revenue may be collected either by the manufacturer-operator or by the authority. In the latter case, integration of user tariffs with that of the mass transport system becomes easier motivating commuters to use e-rickshaws. The user charges may be in-built in the fare structure to provide uninterrupted travel solutions.

Depending upon the selected operational model, authority may pay to the service provider on basis of assured kms operation over a period and retain the user tariff revenue in the gross cost system or charges certain SMF from operator and allows him to retain user tariff in the net cost system. The bidding parameter could be per kms charge or the SMF depending upon the selected operational model. SMF may be positive or negative. In this system investment risk for the authority is minimal.

Choosing the appropriate business model

As discussed earlier, several factors affect the choice of a particular business model for operating electric rickshaws. The business models are qualitatively evaluated against each of those parameters as follows:

Parameters (as related to the authority)/ Business Models	I Manufacturer driven	II Operator driven	III Government creating a dedicated association	IV Public Transport Authority driven
Extent of Control	Medium	Medium	Medium	Medium
Level of Government Support required	Medium	Low	Medium	Medium--
Level of Risk	Low	Low	Medium	Medium--
Leveraging Private sector expertise	High	High	Medium++	High
Initial Investment	Low	Low	Low	Low
Suitability	*When Manufacturers are able to build the supply side, bring technical expertise and rationalise routes easily*	*When fair distribution of investment cost and risk has to be done, using advanced technology and minimize bureaucratic inefficiencies*	*When there is availability of surplus funds with govt., drivers are willing to be part of association, high govt. involvement can be there*	*When the existing developed mechanisms and routes are to be utilized in collaboration with public transport authorities and for a unified payment mechanisms*



Potential business models for setting-up charging stations

The need of EV Charging Station

EVs carry limited on-board energy in the battery packs of smaller sizes. These sizes are generally guided by the operational range of vehicles and the storage capacity of batteries. Hence, batteries need to be charged time to time depending upon the battery pack, size and capacity, their charging levels and the charging mechanism.

EV charging system for supply of energy to on-board energy storage system of vehicles, in a way, serves the same function as a fossil fuel dispensing station supplying fuel for Internal Combustion Engine propelled vehicles. Operational viability of a charging system depends on quantum of vehicles charged daily. Charging systems are thus essential requirement for sustainable operation of EVs. They are essential for giving a kick-start to EV adoption in the country and hence suitable models will have to be designed.

Actors in charging infrastructure ecosystem

Among the actors of EV ecosystem, as highlighted in the earlier sections, following actors play a dominant role in the charging infrastructure for electric vehicles:

- Government (also termed as Authority)
- Electrical Vehicle Manufacturers,
- Battery Manufacturers,
- Electricity generator or distributors,
- Financial Institutions,
- Charging infrastructure provider/operators, and
- Other commercial agencies such as Retailing Malls, parking system management, etc.

During initial stages of EV adoption, penetration of various types and sizes of EVs is expected to be low till adequate confidence level is achieved amongst potential vehicle buyers. Further, different types of EVs are expected to have varying charging needs besides the charging system and its components. Such low penetration of EVs becomes a challenge for starting a charging system. However, uptake of EVs essentially depends on comprehensive availability of public charging stations. Business models will thus play a vital role in setting charging stations. The proposed models would need to develop a strategy for energy sale and provision of demand response based ancillary services, uninterrupted charging and frequency control.

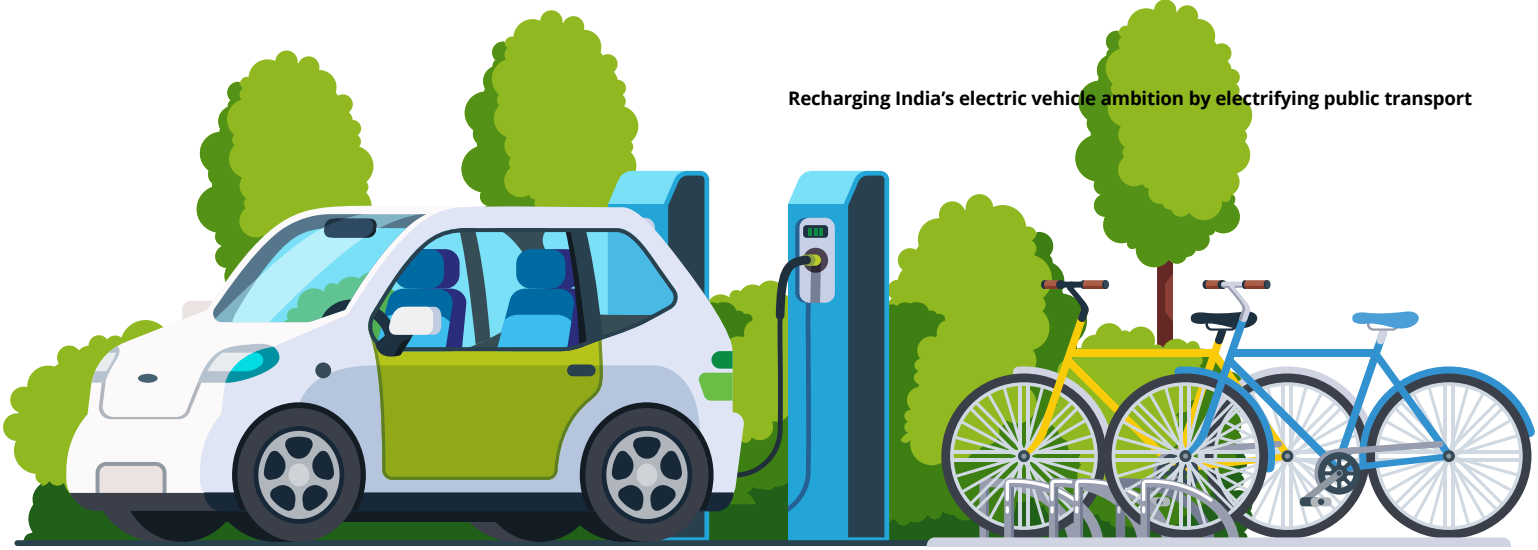
Identifying Business Models for Setting Charging Infrastructure

An appropriate business model for identified players for charging infrastructure may not be based solely on direct revenues from EV charging services but could include indirect revenues from EV charging services including increased EV sales, increased retail sales for site host, etc. Thus, some of the potential business models of charging infrastructure that could be pursued for early and sustained adoption include the following:

Business Model 1: Urban Local bodies (ULBs) operating charging infrastructure-

In most cases, ULB is the nodal agency playing a significant role in the development of the city. Their role in transportation is already pervasive and the impact created by them reaches a larger audience. The transition to EVs can, thus, be accelerated with the support from ULBs. In this business model, the ULBs would set up the infrastructure on its own land, acquire and install the equipment and operate the charging station with its own resources. Everything would be under the umbrella of the ULB which includes Municipal Corporations, Development Authorities, etc. The ULB charges a predetermined per unit price for delivery of measured services.

This model will help in achieving gradual scale in demand for the public and will assist in making sure that the costs are optimum and no exploitation of the resources occurs. This also enables better utilisation of existing municipal facilities since ULBs have land parcels across the city which are used to provide various services to the citizens. The surplus land



in these facilities can be optimally utilised. The government has the higher capacity to bear losses as against other stakeholders involved. Moreover, since there is centralised control, it facilitates coordination of operations. However, this model limits the private sector expertise and potential for innovation in addition to operational inefficiencies owing to limited precedence and technology upgradation. All investment and revenue risks are born by the ULB. The investments could be a challenge for ULBs since most of the ULBs are dependent on government grant for sustenance.

Business Model 2: Public Private Partnerships driving the charging stations-

Public private partnership (PPP) is one of the effective ways of implementation as it adds productivity to the overall system. Under this model, ULBs provide land for the charging stations and private operator undertakes acquisition, installation and operation and maintenance of the charging system. Private operator collects revenue from users at rates fixed through a competitive and transparent process.

Figure 8: Charge Point setting charging stations on PPP basis

Business Model of charging service provider

Charge Point in the US and the New Motion in Europe

Problem experienced

For charging service providers, it is difficult to generate sufficient revenue solely form the power sales to EV drivers that charge their vehicles in order to retrieve the investment in the infrastructure.

Business Model

Operators provide both the hardware (i.e., actual charging stations) and back-office services (such as payment and billing services) as a turnkey solution for customers who want to have charging station installed, such as retailers, municipalities and businesses with parking lost for their guests and employees.

Municipalities and businesses are paying for hardware and installation of charge points. Some retailers might want to attract extra additional customers by offering two hours of free charging and then charging a high premium for any additional charging time. Businesses might want to offer completely free charging to their employees.

Land Location	Government/ Third party
Charging infrastructure & installation	Third Party/ Government Owned
Operations & Maintenance	Operator
Revenue Risk	Operator/ Third Party

Key Learning

- The actual infrastructure is funded by the government or third party like retail outlets and commercial complexed
- Parties like municipalities, retail outlets, business houses have the freedom to set their own pricing scheme for the charging stations that are installed
- For the charging services provider, revenues are generated by the subscription fees from EV drivers, as well as the fee for the back-office services delivered to customers

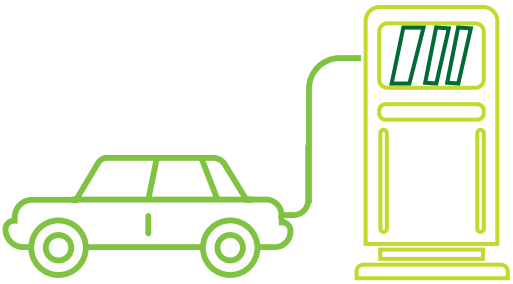
What's in it for drivers/commuters?

EV drivers pay for a subscription with the service provider and – with the use of an RFID identification card – can get access to the network of all publicity accessible stations connected to the network

Source: Deloitte Analysis

This model ensures operational efficiency by leveraging the expertise of the private operator. The investment and revenue risks are born by the private operator. Private operator's prior experience enables driving the cost efficiencies in the system. However, duplication of efforts should be avoided and accountability should be fixed in advance. This system normally becomes suitable in a near mature market driving large volumes of EVs same way as the fossil fuel dispensing stations. The bidding parameter for selection of private operator is the fee charge per unit of energy supplied including the service component.

The figure 8 mentions the successful story of setting charging stations on PPP[7] basis.

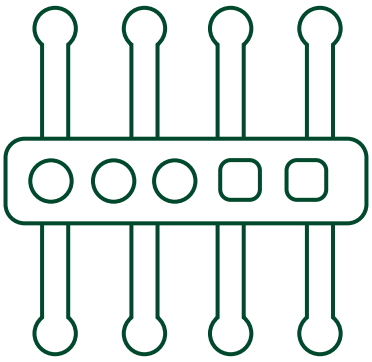


Electric Vehicle and EV Charging Station

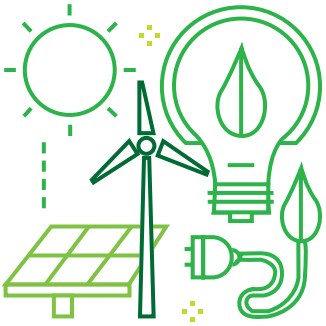
Business Model 3: Electric Utilities and power generators managing charging stations

In this model electric utilities and power companies, who are equipped with understanding of the grid and grid load management including the dynamics of charging a vehicle during peak and off-peak hours, will be expected to acquire, install, operate and maintain charging infrastructure in the EVs operational areas. In this model the charging infrastructure is set up by the electric utilities or power generators (service provider) on government or privately owned land. Service provider owns and operates the charging infrastructure and collects revenue from users at predetermined rates.

Case: Enel recently acquired eMotorWerks, an advanced energy and e-mobility solutions company and leading supplier of EV charging stations. The acquisition is expected to enrich Enel's e-mobility offering and integrate a highly sophisticated smart EV charging solution within a portfolio of grid-flexibility services, which includes a demand-response network, distributed energy management systems, and battery storage solutions.

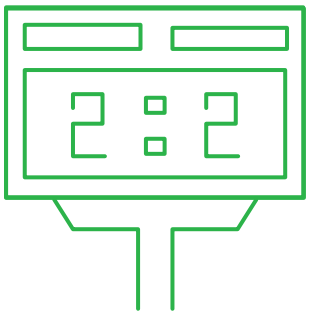


Remote User Monitoring



Energy Generation

This model leverages the domain knowledge and expertise of utilities for improving operational efficiency and service delivery. Managing a charging infrastructure will be a new service line for the utilities relating to vehicles and their energy sources. The balance of the grid can be better monitored and demand can be effectively managed. However, the service provider deprived of domain knowledge of batteries may face challenges in bringing in innovations in battery efficiency, charge density and operational range.



Grid Monitoring

Business Model 4: Public Transport Corporations/ Aggregators facilitating EV public charging

In this model, public transport corporations and cab aggregators set up charging infrastructure for their own

7. Greater Toronto Airports Authority (GTAA) Partners in Project Green on Up Ontario

vehicles. This infrastructure can also be utilized by other vehicles if required to gainfully use spare capacity. In Public Transport Corporation,for example, buses are normally available for charging during night shift generally leaving the charging infrastructure poorly utilised during day time. PT corporations may improve utilization of their system by offering charging services to private vehicles.
PT corporations may provide their services at market rates. Similarly, cab aggregators help in aggregating the demand by deploying electric vehicles in bulk in their fleet which will end up utilising charging stations.

Case: Ola has set up charging infrastructure for 200 vehicles in Nagpur.

This model brings in demand for the vehicles charging stations thus, enables PT Corporations and aggregators to generate additional revenue from vehicle charging. However, there is limited financial and risk bearing capacity of PT corporations or aggregators for large deployments. Lack of expertise and experience is a potential drawback of the model. As system operation and maintenance cost by PT corporations are significantly higher than those of private operators, revenue margins at market rates may be a challenge.

Business Model 5: Vehicle/Equipment manufacturer setting own charging infrastructure

Manufacturers are familiar with the vehicle design, and compatibility of the vehicle battery and the chargers.

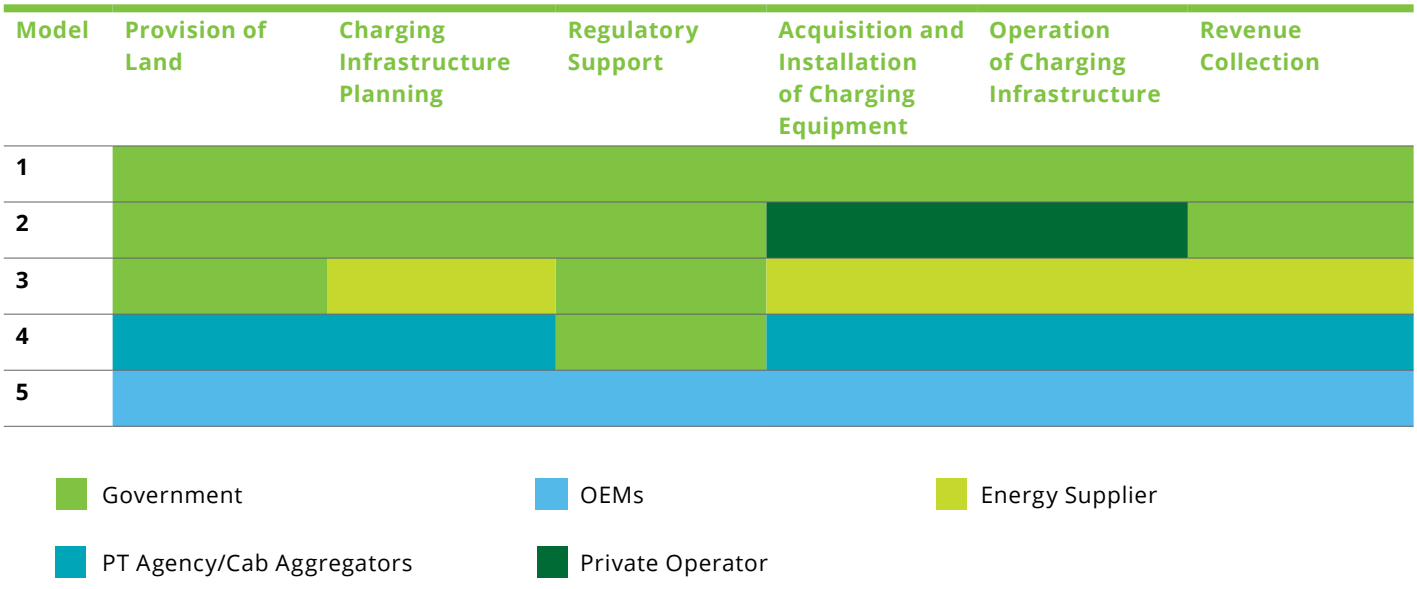
Thus, in this model vehicle/equipment manufacturers set up and operate their own charging infrastructure on privately acquired land. Vehicle/equipment manufacturers could set up charging infrastructure at their own expense and include these costs as part of "marketing costs" to encourage uptake of sale of their own brands and improve electric mobility. They may collect service charges at market rates.

Case: Tesla sets its own charging stations compatible with its cars. Additionally BMW, Daimler, Ford and Volkswagen has teamed up to build and operate 400 charging stations across Europe by 2020.

Manufacturers will be able to build confidence among users of their vehicles. However, each manufacturer may install proprietary charging infrastructure limiting interoperability. Government would hence need to make sure that no manufacturer creates a monopoly. This model may help promote standardisation of charger across the vehicles.

The activities across various phases for establishing a charging station under the different models discussed above can be broadly mapped as follows:

Figure 9: Activities involved in Setting Charging Infrastructure



Source: Deloitte Analysis

Choice of business model is dependent on several factors

The evaluation of business models is done against the predetermined criteria. Every model has its pros and cons vis-à-vis the other model. The business models are qualitatively evaluated against select criteria as follows:

Parameters (as related to the authority)/ Business Models	I ULB Operated	II PPP	III Electric Utilities	IV Public Trans. Corp/	V Vehicle Manufacturers/ OEM
Extent of control	High	Medium	Low	Low	Low
Level of government support required	High	Medium	High	High	High
Level of risk	High	Low	Medium	Low	Medium
Leveraging private sector expertise	Low	High	Medium	Low	High
Initial investment	High	Low	Medium	Low	Low
Suitability	*When ULBs have excess availability of funds, self-sufficient in managing the setup, during initial phases of EV adoption*	*When owned resources are limited, leveraging private sector investments, efficiency and expertise*	*To leverage the domain knowledge and expertise in grid management and power distribution and to balance power utilization based on surplus after meeting other demands*	*When large scale deployment is to be achieved in a short time period, Utilize surplus capacity particularly when system is unutilized*	*To build compatibility in chargers and stations, promote adoption of their EVs*

The Road Ahead: Redesigning electric mobility landscape for the cities

In the initial phases of EV penetration, the aim should be to reduce dependence on fuel based private vehicles by developing e-public transport system supplemented by electric last mile connectivity. To facilitate and optimize the interplay amongst various actors in the suggested ecosystem, various business models could be adopted. The primary focus is to divide responsibilities based on existing capabilities, diversify the risk based on risk appetite, leverage private sector expertise and promote self-sufficiency.

Mobility plays a central role in a city's economic prosperity. This is why it is important for cities to reap the benefits of electrifying and providing smart solutions to the city. Cities should look for out-of-the-box solutions to solve their problems, lead future of mobility in their cities by demonstrating usage of EVs in multiple areas. Their success tends to stem from integration and innovation rather than sheer investment.

Given the speed of change and technological trends, all cities have the opportunity to radically remake its mobility landscape over the next few years. Cities that rank poorly today could leapfrog to become leaders in the future of mobility by deploying advanced solutions that solve some of transportation's perennial problems.

As India embarks on the journey to shift towards EVs, government support in terms of regulatory framework, reduction in battery cost, and widespread availability of charging infrastructure are expected to be the key pillars for mass adoption. Collaboration with a range of ecosystem players (government ministries, utilities, manufacturers, financiers) as partners in the e-value chain is considered paramount to succeed, as will be crafting of new business models suited for the value-conscious Indian consumer, including battery swapping, battery leasing or rental. The Government of India has encouraged Electric Vehicle adoption through incentives provided on both the demand and supply sides of the EV value chain.

Backward/forward integration among manufacturers, battery OEMs, financial institutions, discoms, cab aggregators, commercial establishments, and start-ups, will be necessary for a robust and dynamic ecosystem to mainstream Electric Vehicle adoption. However, the precise role of every stakeholder needs to be defined upfront.

Initially, it is important to leverage the global experience as the mobility space is evolving. This can be done by engaging private players who have rich experience and expertise in this domain. Government should initially not consider taking all the risk and should rather be more of facilitator in developing the conducive environment for growth of players and electric mobility by providing funds, subsidies, developing policy framework, etc. The private players are expected to be able to bring innovation in the era when technology is evolving. It is essential for the government at this juncture to develop insights on the functioning of the overall ecosystem for electric mobility. Government can play active role in developing policy and regulatory framework; setting standards, specification and performance benchmarks; operations planning, monitoring and controlling; research and development in EVs and its subsystems; and skill development for manufacturing, operation, maintenance, and management of EVs and their sub-systems. Thus, government will play an indispensable role in creating conducive environment for larger participation of private operators at all stages of EVs adoption such as manufacture, operation, charging systems, etc. for a total shift to EVs progressively.

In January 2019, on the supply side, the import duties on Electric Vehicles and its components had been reduced to a range of 10%-15% from the earlier 15%-30% by the Government of India. Further, import duty exemptions on EV battery packs have been removed and in fact increased to 5% to encourage domestic manufacturing of the same. As of February, 2019, on the demand side, the Central Government has provided tax rebates, as well as lowered interest rates on loans for EV purchases.

Source: https://auto.economictimes.indiatimes.com/news/policy/govt-lowers-import-duty-on-components-for-electric-vehicles/67750620
https://www.ibtimes.co.in/central-govt-may-give-rs-50000-rebate-boost-electric-vehicle-adoption-792021

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