

A close-up photograph of a person's hand operating a green industrial machine. The hand is pulling a silver metal handle. The machine has a green base with some orange and white components. In the background, another hand is visible, resting on a surface. The overall scene suggests a manufacturing or industrial setting.

NRI

India's Opening Gambit in Battery as a Service

‘Battery as a Service’ is proposed to be the future of Electric Vehicles in India. The OEMs, the service providers and the government need to synergize their efforts to develop disruptive strategies to address the challenges and capitalize on the opportunities.

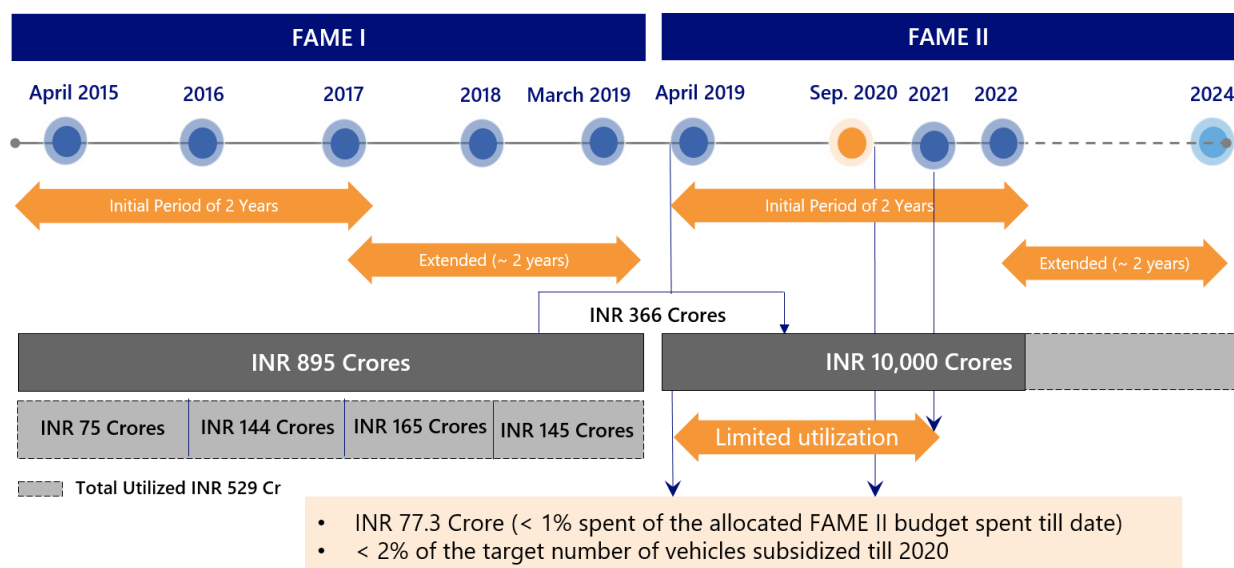
'Battery as a Service' business model based on battery swapping technology is the new talk of the Indian EV Motown. Recent innovations in BESS (Battery Energy Storage System) technology has been a fillip to newer business models in the EV industry. In the recent Union budget, Finance Minister Nirmala Sitharaman expressed the government's aim to establish a policy for battery swapping and specify interoperability standards.

In the light of these developments, we can expect the BaaS business model to attract remarkable participation by the industry players. Industry players expect customer subsidies and a reduction in GST rate to place the battery swapping service on an equal footing when compared with fixed battery EVs. In the initial stages, the government plans to focus on E-2W and E-3W swapping and come up with safety standards. It is also planning to include BaaS under FAME 2. Recently in February '22, Niti Aayog organised a pre-draft consultation on Battery Swapping Policy to discuss potential key barriers, enablers and regulatory measures in the battery swapping policy with key industry players in BaaS segment. Once the draft is finalized and before its implementation, another such meeting is proposed to be held. As the policy unfolds, all eyes are on the government as to how it addresses these challenges.

India's Electric Vehicle conundrum

The budget announcement can be seen in the context of the paradigm shift in fuel technology that the automobile sector in India has seen in the last two decades – from ICE (Internal Combustion Engines) run on petroleum-based fuels to electric motors based EV technology. The transition has been gradual, but we can now slowly see the impact. India's three urgent needs – energy security, import dependency and carbon emission- necessitated this shift.

Current EV penetration in India is a small fraction of total vehicle sales and is predominantly concentrated in 2 and 3 wheelers. The government of India has been launching projects to push sales of EVs since 2010. Initially, support for Alternate Fuels for Surface Transportation Programme was launched by MNRE to promote EV in 2010. Going ahead, need of a comprehensive mission was felt, and the onus was shifted to the Ministry of Heavy Industries in 2012. Under National Electric Mobility Mission Plan 2012, both demand and supply-side incentives were introduced, along with encouraging R&D and promoting setting up of charging infrastructure, which are substantial impediments in boosting EV sales. The flagship scheme under this has been FAME in 2015 (later FAME 2 introduced in 2019) that provides demand-side purchase incentives on fixed battery EV.



Source: NRI Research

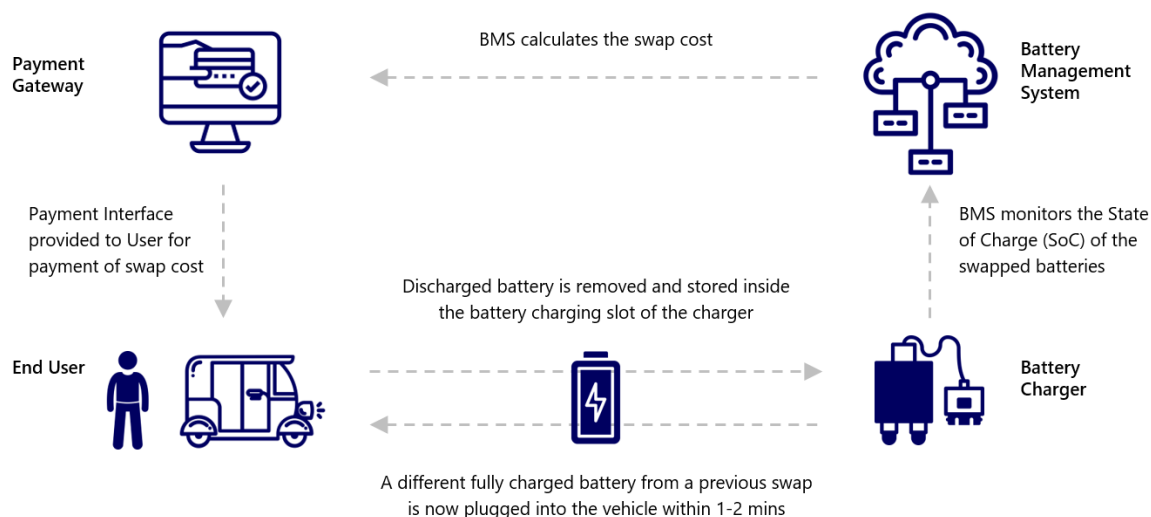
FAME I & II Budget Allocation & Utilization (as of August 2021)

Gradually we also see that the utility of battery as a customer-owned asset is being challenged, and it is being perceived more as a service. The government allowed registration on battery-less EV in 2020, and now the guiding policy is awaited.

No More Battery Ownership

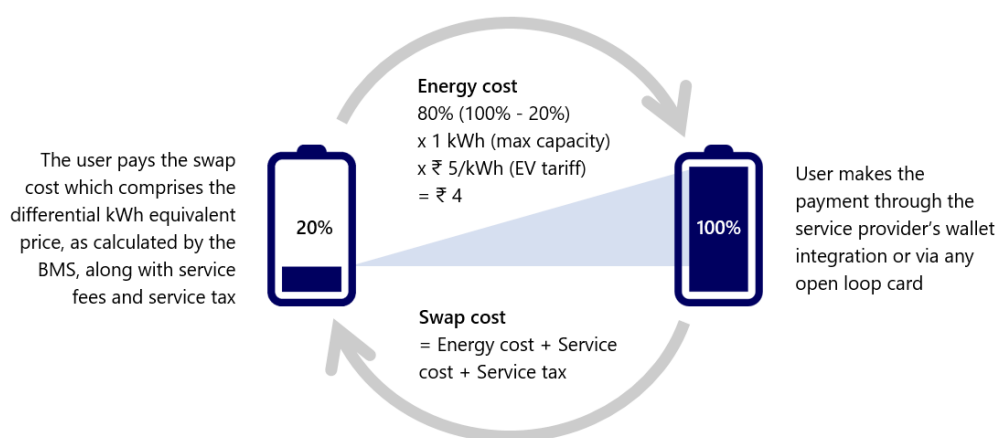
Battery as a Service works on the principle of separating the ownership of the battery from the EV and providing it as a service on-demand or a 'pay as you go' model as we popularly call it. Instead of charging the pre-fitted fixed battery at a public or a home charging station, in the battery swap model, the customer can purchase energy stored in a rentable swappable battery and use it in their vehicle. The swapping which takes just a few minutes, is not very different from a customary refuel, the only difference being that in the case of EVs, the fuel is the battery's stored energy.

In this model, the battery ownership does not lie with the user who has bought the EV; instead, it lies with the battery swap service provider. The user pays for the swap on a pro-rata basis, calculated as per the differential charge present in their current discharged battery against a fully charged battery, which is to be "swapped" at the swap station.



The framework of Battery as a Service

This model resolves several constraints posed by the fixed battery model. To begin with, we may discuss the associated capital expenses of owning a battery. The battery typically comprises 30-40% of the cost of an EV, making it expensive compared to ICE vehicles. Without the battery, the price reduces significantly. So if we assume an E-2W to cost around INR 1.5 lakhs which is the typical cost of the newer models, it can be purchased for around INR 1 lakh while availing the battery service separately. Instead of paying a hefty amount upfront for the battery purchase, the customers can pay the swap fee comprising service fees (entails cost of battery, chargers and labour) and the differential kWh energy fee.



Source: NRI Research

Determining the swap cost

Higher costs make financing the purchase more difficult. It is easier for customers to get a loan for a cheaper battery-less EV and pay the battery service costs on their own, rather than getting a bigger loan for the battery-fitted EV.

In a battery-fitted EV, the responsibility of the battery lies on the owner. The battery quality deteriorates from Day 1, and sooner or later it has to be replaced. The government does not provide an incentive for a new battery (as it does for the first battery under FAME) when the battery has to be changed after a few years, further increasing the cost for the end user. For a battery-less EV, the responsibility of providing a good quality battery and maintaining the battery lies on the battery swap service provider, ensuring a healthy battery after every swap. This also reduces the risk of life threatening accidents which are more often linked to inappropriate charging behaviours by end users.

Another pertinent issue which this model address is the charging time. There are primarily two types of charging available in the market – slow charging, which is claimed to be good for battery life but takes 4-5 hours to charge fully, and fast charging, which can charge fully within an hour. Battery swapping reduces the charging downtime to just a few minutes, making it a better option for drivers whose income is directly proportional to the uptime of the vehicle during the day. So while fixed battery EV restricts drivers' productive hours compared to an ICE driver who gets more time to run his vehicle due to less fuelling downtime, swappable battery neutralizes this disadvantage of EVs.






A battery-less EV is also more customer-friendly as there is no anxiety around how long the battery will last on a single charge. The fixed battery model requires the battery to be charged repeatedly, hindering its use in emergencies. Once adequate swapping infrastructure comes up, getting a newly charged battery would be as easy as getting fuel filled at pumps. In fact, given the existing network of pumps in India, there is a strong case to set up swap stations at these pumps themselves. With this, the drivers would not need to change their existing routes and refuelling behaviour.

Considering the Indian context in particular, there are two challenges with battery-fitted EV that BaaS resolves. Firstly, there is a significant reduction in the upfront cost of an EV. Although the TCO (total cost of ownership) comprising purchase and operating fees does not reduce for the customer, in the battery swapping model, the price has to be paid in small chunks over a long time horizon, which is a friendlier option for the Indian middle class. Secondly, BaaS resolves the challenge of limited availability of space as mentioned by the Finance Minister in the budget speech. Fixed battery EV need 1-5 hours to charge, and the vehicle has to be parked in the station throughout this time. Hence, there is only a limited number of vehicles that can be served in a day as there are parking limitations in urban areas, especially metro cities. By reducing this time significantly, battery swapping allows larger number of vehicles to be served, thereby resolving the space constraint.

From a sustainability point of view, the BaaS business model gives a thrust to the circular economy. Once the life of an EV is over, disposing the battery is a difficult task, comprising of technological challenges and health risks. With battery swapping, the battery can be better reused and recycled compared to fixed battery since the responsibility for battery health monitoring would lie on the swapping service provider and they can track the journey of the battery from manufacture to use and determine its reusability.

Scramble for the Indian Market

EV is a highly competitive industry, and with the introduction of battery swapping, all the stakeholders – OEMs, Battery Management Systems, swapping service, Discoms, and the like. – have started strategizing to adapt to the new technology. For a successful business to come up, there needs to be cooperation between the OEM and Swapping service provider on compatibility of the battery with the vehicle design. Further, Battery Management System has to be refined and tuned to maintain the performance of the battery pack. Electricity regulatory commissions need to be taken on board to get electricity at special competitive rates from Discoms for charging.

Powertrain, Vehicle, Car component OEMs	Energy Production & Distribution	Battery Management & Energy Storage	Charging Infrastructure and Mobility Services	Fleet Services
<ul style="list-style-type: none"> • Mahindra Electric • Tata Motors • Hyundai • Ashok Leyland • Piaggio • Kinetic Green • Bajaj Auto • Revolt Motors • Ola Electric • Tork Motors • Ather • Ultraviolette Automotive 	<ul style="list-style-type: none"> • State DISCOMs • NTPC Limited • Tata BP Solar India • Tata Power • Bharat Heavy Electricals Ltd • Power Grid Corporation Of India • Adani Power • Reliance Power 	<ul style="list-style-type: none"> • Ion Energy • Log 9 Materials • Honda Power Pack Energy India • Greentech • Inverted • Sun Mobility 	<ul style="list-style-type: none"> • Gogoro • Honda Power Pack Energy India • Sun Mobility • Amara Raja • Exicom • Magenta Power • Fortrum • Plugin India • Charzer • Charge Zone+ 	<ul style="list-style-type: none"> • Ola • Euler Motors • Etrio • Gayam Motors • SmartE • ETO Motors • Smart-E • BluSmart 

Battery swap industry players (not exhaustive)

Different industry players have come up with innovative business models. Sun Mobility is one of the major players in the battery swapping business. Taking an early mover advantage, it has set up 65 battery swapping stations in 15 cities. It effectively counters the challenge of non-standard batteries by roping different stakeholders – EV OEMs, battery and EVCS (Electric Vehicle Charging Station) manufacturers and the service providers, to a single battery standard.

Under its Energy as a Service model, Sun Mobility partnered with Piaggio to promote battery-less EV sales. Sun Mobility provides swapping stations and batteries compatible with the Piaggio EV. Piaggio gets access to the swap station network, where its customers can get their batteries exchanged. Both partners collaborate to ensure that the quality of the battery improves the efficiency of the EV.

Under the Mobility as a Service model, Sun Mobility offers vehicle and battery subscriptions together as a bundled offering to corporates and fleet owners. Subscription would be provided for a certain period of time, with features like an unlimited swap plan. This would help fleet owners scale up their business without becoming capital intensive.

Similarly, Japanese automobile giant Honda is in the final stages of introducing its battery swapping service in India. It is taking up the subsidiary model to enter the Indian market by setting up its own

subsidiary Honda Power Pack Energy India and roping in as many OEMs as possible to use its battery standards, starting with battery standards for E-autos and E-Rickshaws. The batteries are to be 'Made in India' with plans to use renewable energy for charging. After the recent pilot in Maharashtra, Honda will set up its swapping stations in Bengaluru.

On the other hand, Ola plans to build upon its existing network of cabs, drivers and passengers and create a whole ecosystem of its own. Currently, Ola has very little market presence in the EV industry. As we advance, Ola plans to horizontally integrate its manufacturing facilities, from EVs to batteries, all by itself and provide swapping service as well.

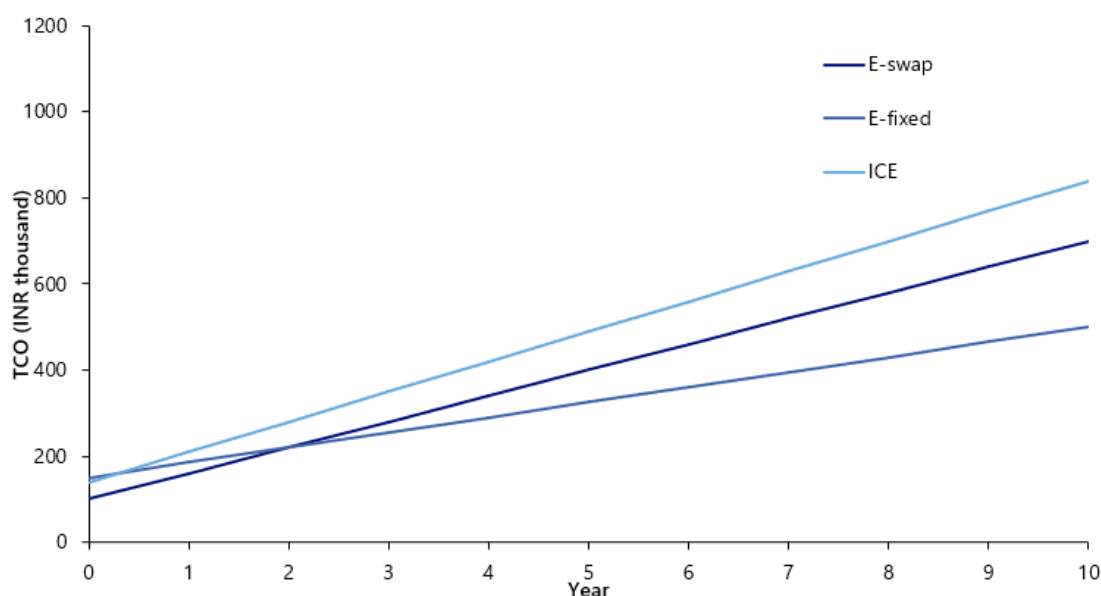
The Hero-Gogoro partnership model also presents a viable option. With Gogoro's expertise in battery swapping with the network of 2000 Super GoStations in Taiwan supporting over 3 lakh swaps a day and Hero's extensive market presence in India, the JV targets to enter Hero-branded two-wheeler section by setting up Gogoro powered battery swapping stations. Hero gets more sale opportunities, while Gogoro gets upfront service fees and subscription revenue. The system is connected by the Gogoro Network cloud service, which monitors the condition of every battery & manages how quickly they are charged.

Challenges and Opportunities

The major challenge faced by OEMs is the batteries are not standardized for use in different EV models. Different models use batteries of different capacity and size, which makes it difficult for OEMs as they have to make significant design modifications in their vehicles to accommodate different batteries. As design is a USP for OEMs, battery standardization by government would compromise possibilities of innovation in a highly competitive market. That's why companies like Sun Mobility are racing to onboard as many OEMs as possible to adopt their battery standards.

Additionally, proper care has to be taken of the quality of batteries in circulation to ensure the smooth functioning of the vehicles. The number of batteries per vehicle used in case of BaaS increases compared to fixed battery, which works on a single battery per vehicle model, as the service provider needs to keep a sufficient inventory of batteries to cater to the swapping concept. This increases capex for the swapping service provider, which is a deterrent to setting up the business.

Battery swapping service currently invites a higher GST rate of 18%, compared to 5% GST on sale of EV. Additionally, the Fame II subsidy is currently applicable only for battery-fitted EVs, making it cheaper. If we compare the cost of a fixed battery EV and a swappable battery EV, taking operating cost per km of ICE vehicles as the benchmark, we can infer that the operating cost per km is higher for swappable batteries compared to fixed batteries (while both being cheaper than ICE). Hence, in the long run, the TCO exceeds for battery-less EV. That might be one of the reasons why state governments also focus more on the fixed battery model.



Source: NRI Research

Typical total cost of ownership pattern: ICE vs E-swap vs E-fixed (indicative)

Only a few states such as Maharashtra and Delhi have made policies targeting swappable battery EVs. Maharashtra provides purchase subsidies to customers, 50% of which is given to OEMs, to be mandatorily passed on to the end customers on purchase of battery-less EV, and rest 50% goes to battery swapping service provider. Going one step further, Delhi provides a direct subsidy to customers on purchase. Some states have rolled out the policy but have not finalized the operational guidelines, making implementation and investment difficult. Ambitious and pioneering states such as Karnataka and Gujarat have the potential to quickly ramp up EV adoption by incorporating provisions for battery swapping in their policies. As the technology advances, the swappable batteries are expected to be smaller in size with lower Lithium composition, making the EV more efficient and reducing the Lithium import burden. Governments may encourage this by introducing additional subsidies on swappable battery technology.

On the plus side, Honda, KTM, Piaggio, and Yamaha formed a partnership to promote the use of swappable batteries for electric bikes and light electric cars in order to overcome the issue of interoperability standards. The Swappable Batteries Motorcycle Consortium (SBMC) intends to increase the usage of light electric vehicles including scooters, mopeds, and motorbikes while also promoting more sustainable battery management.

With IEA predicting 30% EV penetration in India by 2030 and similar targets set by the government, demand for EVs is likely to shoot up in the coming years. The numerous issues of fixed battery charging might impede achieving the expected penetration, making battery swapping a viable alternative. If formulated to comprehensively tackle demand and supply-side challenges, government policy can open up myriad opportunities.

Customer Value Proposition

As governments, companies and individual customers are increasingly moving towards an environmentally conscious approach to purchasing, EV sales are highly likely to shoot up, and battery swapping technology would give that additional push to the customers.

B2B customers can significantly benefit from this model. The gig economy is the upcoming trend in India, and cab services, food deliveries, logistics companies and fleet operators can optimize their costs by using swappable batteries in multiple vehicles. This way, fewer vehicles would have to be purchased as fixed assets, and batteries can be used in 'shifts', similar to how the drivers work in shifts, reducing unnecessary expenditure on batteries that are kept idle at non-operational hours.

This model can enable the Indian middle-class segment, which was hitherto sceptical about replacing ICE vehicles with EVs due to cost constraints, to venture into switching to EV. Similarly, as mentioned for B2B, EV cost can be optimized by using swappable batteries with multiple vehicles, bringing down the upfront cost by 30-40%. This radical increase in affordability comes without any radical change in user behaviour, as the process of charging mimics the process of fuelling an ICE vehicle in terms of time and convenience.

But these benefits come at the cost of loss of accountability for the customer. The quality of batteries used has to be taken care of to ensure the proper functioning of the EV. Currently, for the EV and batteries, the buck stops with the OEM. BaaS exempts the customer from the responsibility of maintaining batteries but places it on the swapping service provider. If they do not provide good quality batteries, it will affect the performance of EV, just as using poor quality fuel would degrade the performance of an ICE vehicle. So the accountability of a substandard performing EV gets divided between the OEM and the service provider. And as it is said, everyone's responsibility is no one's responsibility; the customer does not know whom to hold accountable for it – swapping service provider for poor quality batteries, or OEM for poor quality EV, as a result of which the customer is at a loss.

The Endgame

Battery as a Service is a relatively new concept under Mobility as a Service umbrella. It is yet to take off even in the most advanced economies. Indian society is a potpourri of numerous lifestyles and hence it provides an avenue for multiple business models to try their luck. It can be said that no single business model would cater to the diverse needs of this market, and it is most likely going to be a mix of different models, customized on the basis of multiple factors. With the advent of quick commerce, it won't be a surprise if we are able to get EV battery delivered to our home along with our daily grocery just as we currently order AAA batteries for our TV remotes.

BaaS service works under the principle of mutual collaboration across different stakeholders and often with the users themselves. Success of new business models such as BaaS require cooperation from the Central and State administrative bodies, ensuring the presence of well-defined policy and guidelines and handholding by the government at various levels of the value chain. The industry and all concerned players should not view the service as a zero-sum game wherein a player occupies maximum market share by being a first-mover and try to eliminate their competition by cheerleading

their respective standards. Setting up a network of swap stations across India and standardization of battery charging is highly capital intensive and requires a collaborative effort from the OEMs and the government. We see many players reluctant to jump into BaaS offering as they are still in wait and watch mode. The government has sent a strong message with this year's budget announcement that Battery as a Service is here to stay, and the narrative has shifted from an 'if' to a 'when'. All that remains are for the industry to join forces and figure out the path ahead.

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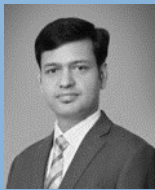
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