

# Battery Swapping Station – Alternative For Charging Station

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**Abstract-** This paper tries to find out challenges with Batteries charging station issue and how Battery Swapping Station (BSS) is better option to match speed of charging.

Under Faster Adoption and Manufacturing of Electrical Vehicles (FAME) program, Government of India is providing incentives for electric vehicles to encourage people to move from ICE. However due to basic infrastructure issues like charging facility and slow charging issue has negative impact on Government's plan.

**Keywords-** C Battery Swapping Station (BSS), Electrical Vehicles, Battery Technology

## I. INTRODUCTION

Government of India is keen on electrification of vehicles (2W, 3W and 4 W) in India to reduce dependency on crude oil. Crude oil price has direct impact on economy. India can save 64% energy demand and reduce the carbon emission by 37% in 2030 due electrification of vehicles. It could help in reducing crude oil bill by 3.9 lakh crore and also improve the health condition of Indian citizens.

India has a unique set of conditions to move from traditional to new way of mobility i.e electric vehicles. However, this will not be going to be easy task as it involves major challenges like building charging infrastructure, battery ownership, charging fee and developing efficient and cost effective batteries. Due to lack of charging infrastructure, consumers are not ready to adapt new of transport even it is having lot of benefits in terms of variable cost. Lack of charging infrastructure and charging of EV ( minimum 2 hours per vehicle). This itself is major challenges to penetrate use of EV across pan India.

At present negligible number of EV charging stations (~220) are present compared to Petrol and Diesel retail stores (~65000). EV's have shorter range compared to Petrol and diesel operated engine thus need a dense charging infrastructure. And existing Battery technology needs further improvement as distance travelled by one charging is very less ~80 Kms.

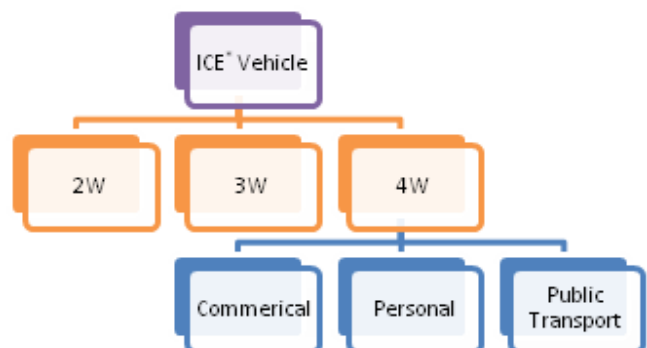
Battery swapping-charging system is more promising compared to charging station in current scenario. Speed of BSS is matching with Diesel/Petrol filling which perfect fit with India market scenario. Building charging station is more capital intensive compared setting up battery swapping station. Business generated by Charging station is around 400 Rs/hr compared to 50,000 Rs/hr by Petrol/Diesel Retail store. So this makes even difficult to convince to retail operators to invest into charging station. BSS is the only answer to charging station which can easily implemented at each retail outlet with minimum investment.

Strategic decisions are required and needs to be implemented for BSS. It is possible to convert existing Petrol/Diesel retails into battery exchange centre.

This paper focused on

- Challenges faced by charging station
- Operations & Service management of Battery Swapping Stations
- Lean Business Canvas for BSS

To optimize business operation, integration between battery charging facility and battery swapping is very important.



IEC\* - Internal Combustion Engine

**Types of vehicle category:**

Internal combustion engines are broadly classified into 3 categories 2W, 3W and 4W. 4W are sub classified based on application of vehicle like commercial, personal and public transport. NITI Aayog and Rocky Mountain Institute worked together to identify the actions items from transitioning from ICE to EV. As per the report published by NITI Aayog, 3 key strategies were identified which includes service strategy, Technology strategy and Manufacturing strategy. In case of 2 & 3 Wheelers, smart, standardized and swappable batteries could reduce cost of vehicle.

### EV Charging Infrastructure (Charging Station Vs Battery Swapping Station):

To increase adoption of EV requires availability of charging infrastructure or stations. This is one of the critical parameter for growth of EV market. EV charging infrastructure is capital intensive and has long payback period. As profitability is still uncertain, Government sub-subsidies are required to encourage for private player to setup charging facility.

There are mainly 2 ways of charging infrastructure which are as below.

- a) Charging Station
- b) Battery Swapping Station

Charging station is sub-classified into 2 types i) On-board charging ii) Off-board charging. Battery swapping is sub-classified into 2 types i) side swapping ii) rear swapping

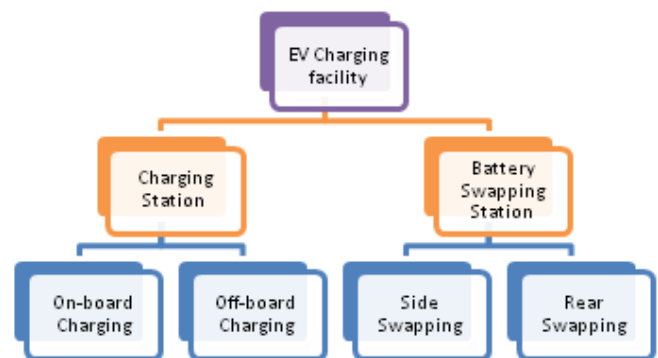
## II. LITERATURE REVIEW

As per the BCG report [1], fully electrical vehicle as convenient as ICE-based cars are unlikely to be available for the mass market by 2020. Also, below are couple of challenges which favors battery swapping option over charging station.

**Charging time** – This is one of the major hurdle for EV's acceptance in consumer market. As on today, minimum charging time of EV is 120 minutes using fast charging option which is still high as compared to gasoline fill time (~2 minutes). For country like India having 2nd largest population, this will create long Ques at charging station. So, there is still scope of improvement in charging and battery technology. In this scenario, battery swapping has advantage where end user must replace depleted batteries with charged one. (~ 2 mins of replacement time )

**Specific Energy** – Energy storing capacity of battery is still 1 % compared to gasoline so frequent charging required [1]. So, charging time for long distance travel will be major inconvenience factor for customer.

Charging station option will only feasible in case charging time come down to ~2 minutes and specific energy equals gasoline. As on today, these two parameters are major hurdle which can be solved by providing battery swapping station. Number of battery swapping station requirement will be high because of low specific energy.



Battery swapping station will be only successful if it would require strong supply chain management charged batteries and battery leasing models should be clearly defined.

### Research Gap:

Based on secondary data analysis, it was found that enough information is not available about Battery Standardization. Also, government's policy about BSS is not clear. Along with this, cost structure model for BSS needs to be developed.

## III. METHODOLOGY

### A. Exploratory Research Methodology

Exploratory Research Methodology was used for this research paper. Secondary data which is available in public domain was used to understand the problem.

## IV. OBSERVATIONS & FINDING

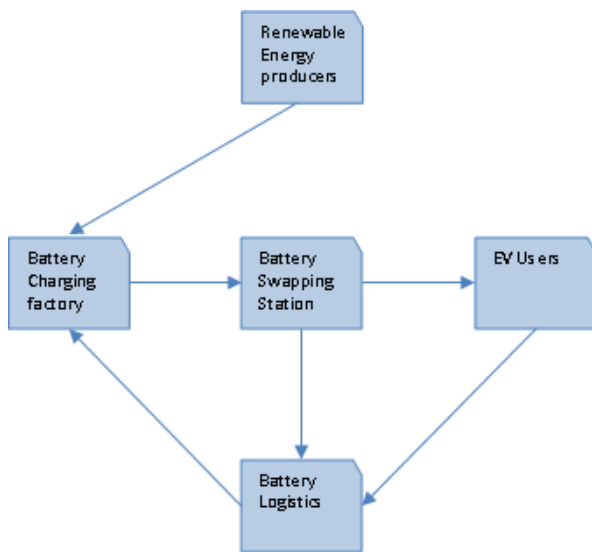
### Supply Chain Management of BSS

Supply and demand management of charged batteries is key parameter for success of BSS. Development of

responsive and efficient supply chain is very important. Primary goal is lowest cost and quick response.

In Supply chain of BSS, battery charging factory may reside at remote location and close to metro city. Main objective of charging factory is to provide charged batteries to different BSS spread across the city.

Milk run logistic model simply allows frequent delivery of discharged batteries and in return collect those discharged batteries. Also Hub and spoke logistic model will also work for BSS.



Supply chain management BSS

### Battery Swapping station

It is possible to convert existing Petrol retailers into BSS with minimum investment and without any major safety concerns. However, same is not true for charging station as it's requires huge capital investment and along with safety standards to be followed. The timing of BSS replenishment is determined by its fully charged battery storage, amount of battery swapping requests and its distance to the battery swapping station.

### Payment options

Using Mobile application, it will be possible for end user to track the current status of battery. Also, it will help end user to see the nearest BSS. Prepaid or post-paid payment options can be making available.

### Battery Leasing model

Battery is core element of EV and it contribute 40% of EV cost. Battery leasing model will help to reduce this EV cost drastically by keeping the ownership with manufacture. This way manufacturer can charge monthly or yearly rent for batteries. This leasing model needs to be studied in details and there is scope to build business model for leasing.

### Supply and Demand model of BSS

Based on secondary data analysis, it's still clear about number of batteries required per car to match the supply and demand. As specific energy of batteries less compared to fossil fuel, dense network of BSS is required compared to petrol/diesel retail outlets.

### v. CONCLUSION

BSS is most suitable option for public transport buses and 2/3 wheelers. Main advantage of battery swapping is speed. As whole operations take equivalent amount of time like petrol/diesel filling. Considering India population and avoid long Ques at station, BSS will be the most prominent option to encourage faster adoption of electrical vehicles. Also, this provides additional benefits of energy utilization like battery charging during off peak hours when load on grid is low. This gives better flexibility and cost optimization over charging station.

However, to make BSS successful, it requires support from local battery manufactures and Government organization. Standardization of Battery is important for success of BSS and it requires collaborations between OEM's and Battery manufacture.

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