

Battery swapping: ideal deal for EV charging

At the verge of an EV transition India needs to look at building a stable ecosystem to make the changeover seamless, starting with a viable recharging solution.



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India has not made a mark in the world's 'auto-electrification' map as of now, despite the availability of scale and demand potential. This is largely attributed to four main barriers: high acquisition cost, differentiated EV mix, unavailability of in-house low-cost technology and lack of standardizations. All these barriers point to our uniqueness in transportation trends which call for requirement of innovation, R&D, and at the same time newer opportunities for business entities.

The desirable way to ease into the EV transition is to start with the low-hanging fruit - initiate transition with 2W and 3W (together contributing about 80 percent of total vehicles in India). As the country builds the charging infrastructure, industry shall also explore an alternate refueling option that may be more feasible for Indian conditions - battery swapping.

Battery swapping is a process in which a discharged battery is exchanged with a fully charged battery at a swapping station. In this scenario,

the battery is separated from the vehicle and is not owned by the vehicle owner. Instead it will be owned by an 'energy operator' who as a battery aggregator would provide the infrastructure, where several batteries are kept in charging and charged batteries are leased to the EV drivers.

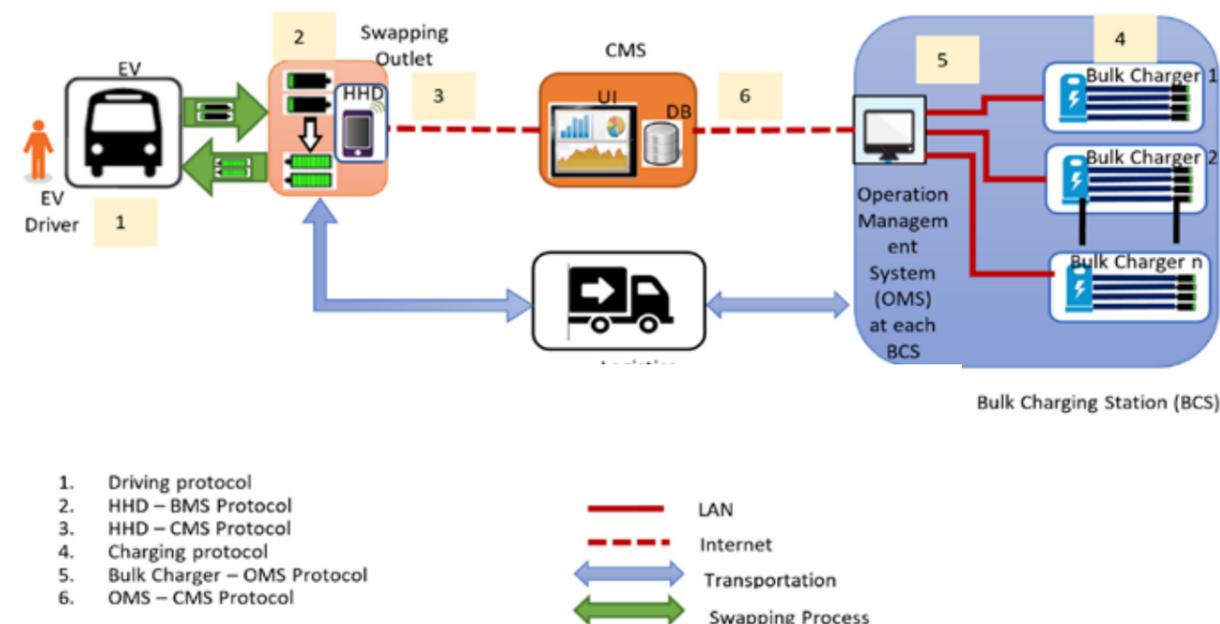
The following are few benefits of battery swapping.

- Reduction in up-front cost - Battery accounts for about 35-50 percent of the total cost of an EV. In case of a swap system, the vehicle does not have a built-in battery and therefore ownership of the battery would lie with the energy operator and not with the vehicle owner. This brings the vehicle cost within the buyer's capacity, which becomes equal or lesser than the cost of its ICE equivalent.
- Elimination of long charging time and elaborate public infrastructure - AC charging and also DC charging times are quite long and require a huge parking area. Battery swapping offers an alternative that may be faster than refueling an ICE vehicle, and also requires limited space to install swapping stations.
- Enhanced battery life - Fast charging and

charging in high ambient temperature may lead to battery degradation in due course. Whereas, swapped batteries can be charged via slow-charging in a controlled environment to prolong the battery life. The connectivity of the charger to an analytical engine can be a huge value-add in extending battery life, and predicting failures and battery end-of-life.

- Improved infrastructure utilization - The assets shall have better utilization leading to lower service turnaround time and better ROIs.
- Grid load management - The schedule for charging batteries can be managed to ensure uniform load demand on the grid. The number of batteries being charged at the same place can act as a good load balancer for the grid. For instance, charging batteries at night time or during off-peak hours, or controlled to bring in balancing during grid fluctuations.

Though swapping brings in huge benefits both for the service provider and for customers, there are some important concerns that need to be addressed. The most important of all is the need to standardize swapping infrastructure,



Battery swapping infrastructure

which largely comprises standardization of battery packs for swapping operations, to avoid interoperability between battery packs.

While protecting the control of OEMs' design strategies for battery packs as their core technology; batteries need to be standardized for minimum performance guarantees, mechanical sizing, connectors and communication protocols. The next important thing is ensuring the performance of the leased battery pack to the customers; this is where management of batteries and chargers becomes very important.

Given the form factor for both 2W and 3W, battery swapping stations can easily pack in 20-30 spare batteries. With this battery density, the swapping station can more closely mirror the utility of an actual petrol bunk compared with a charging station. There can be new and innovative ideas used for implementation of charging infrastructure for battery swapping in India at locations

such as toll stations, highway dhabas (eateries), metro stations, kirana (grocery) shops and other clustered locations.

To bring in standardization, the Centre of Battery Engineering and Electric Vehicle -- IIT Madras, together with some major industry players has worked on defining specifications for swapping architecture and for its components like the vehicle, batteries, chargers and users and also defined the communication protocols to be used for communication amongst all. This is called LS-VBCC (Locked Smart -- Vehicle-Battery-Charger-Cloud Protocol) architecture as shown in the diagram.

To ensure the safety of batteries (such that a service provider does not lose his asset and is ensured of steady business), the swappable batteries would be designed as locked-smart batteries (LS-Batteries) so that these batteries could only be charged by an authorized charger of the energy operator and will not be usable in any vehicle other

than for the one it is swapped-in.

These batteries would be designed to record and relay the exact condition in which they are used and the state of cells in every trip. This information will then be passed on to a Central Management server, to ensure that the batteries are used in a manner that maximizes their life-cycles and gives the users a mileage and safety that they expect. Intelligent internet of things (IoT) riding on data analytics, provides a clear picture of the energy level of the battery and guidance on which battery to select at the swapping station.

A critical characteristic of battery swapping stations is the ability to self-serve conveniently; simple digital authentication combined with seamless digital payment can make the process of battery swapping effortless. When it comes to convenience, cost and scalability for India's rapidly growing micro-mobility EV segment, it's quite clear that battery swapping will be the form factor to look out for in the future. **ETN**