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Innovating financial solutions

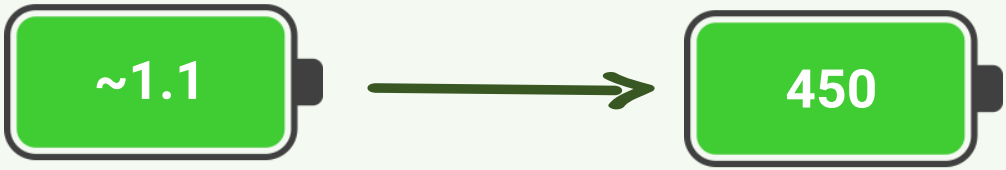
Battery Swapping v/s Battery Charging Stations

What will power the future of EV in India?

India Market Opportunity

Battery Swapping Stations

In '000



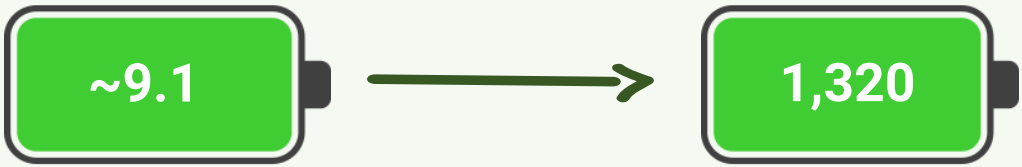
No. of Battery Swapping stations (Aug '23)

No. of Battery swapping stations required by 2030

Source: Moneycontrol Report

EV Charging Stations

In '000



No. of EV Charging stations (Aug '23)

No. of EV Charging stations required by 2030

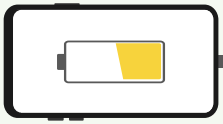
Source: Inc42 Report, Confederation of Indian Industry (CII) Report

History of Batteries

1

Use of Non-Rechargeable Batteries

In early 1900s, Non-rechargeable lead-acid batteries were in use, necessitating battery replacement when charge was depleted



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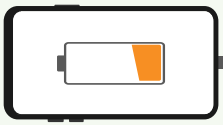
Advent of Rechargeable Batteries

With the advent of rechargeable batteries during last decades of 20th century, charging became the preferred option as it helped in saving cost of constant replacement and extended the life of batteries



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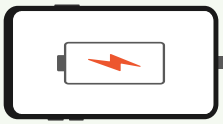
Advancements in Battery Chemistry

Advancements in batteries of various chemistries, like Li-ion and Na-ion, with greater cycle life and longer battery life. Long charging time was still a major bottleneck for EV adoption



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Emergence of Battery Swapping

In 2000s, Battery swapping emerged as a solution to counter the bottleneck of high charging times and it gained popularity in applications which warranted lower downtimes

Let’s Understand Battery Swapping

Electric vehicles exchange depleted batteries for fully charged ones at swapping stations to keep running efficiently

Advantages of Battery Swapping

1	**Minimal Downtime**	Rapid replacement reduces charging wait time
2	**Addressing Range Anxiety**	Provides an immediate solution for range concerns
3	**Enhanced Battery Life**	Due to maintenance in optimal condition
4	**Lowers Cost of EVs**	Delinking battery cost from EV ownership cost

Challenges of Battery Swapping

With fast and continuous innovation in battery related technology and high infra and capital intensiveness, it faces several challenges

1	**Capital Intensive**	Expensive infrastructure setup
2	**Compatibility Issues**	High inventory due to multiple battery types
3	**Ownership Perception**	Requires shift in consumer mentality of owning batteries
4	**User Adoption**	Changing consumer behavior and charging routines

Let's Understand EV Charging Stations

- Battery Charging has been around since introduction of rechargeable batteries during last decades of 20th century
- Currently, there are 2 types of EV chargers are in use

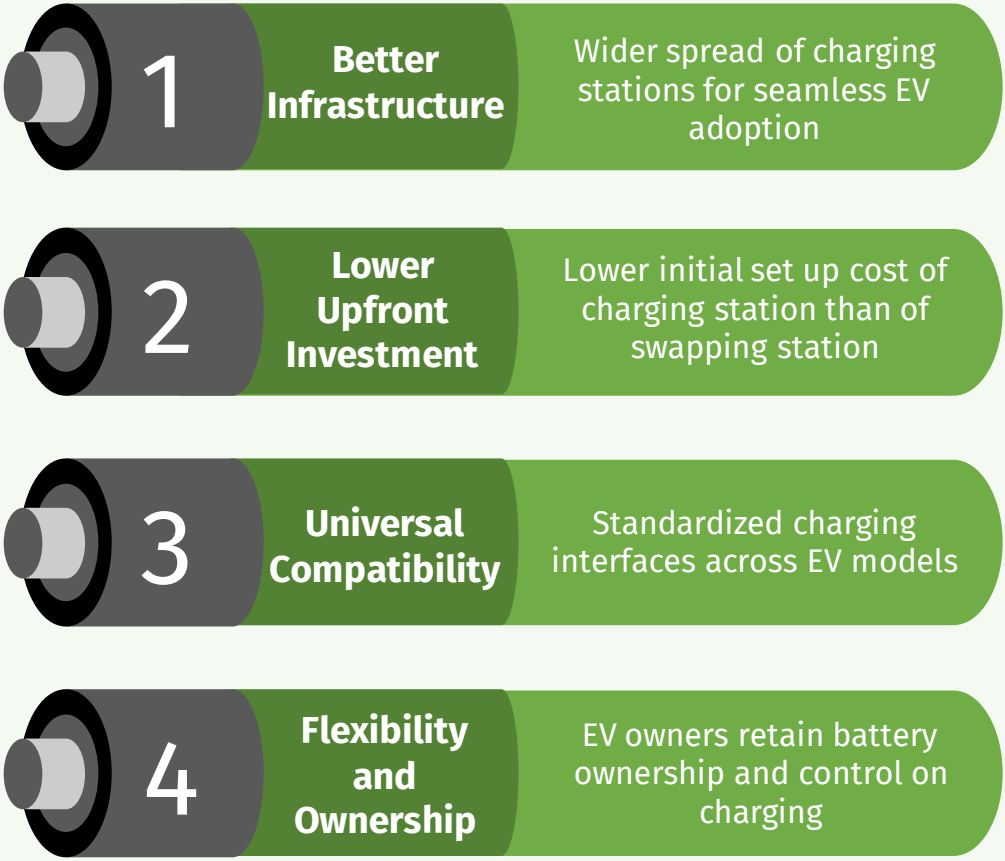
AC Chargers		DC Chargers
Level 1 Chargers 120-volt	Level 2 Chargers 208 to 240-volt	Level 3 Chargers 400 to 900-volt

Use Cases of Different Levels		
Overnight charging at home And low-range EVs	Public charging stations, workplaces, and at home charging setups	Highways, commercial areas for rapid charging in a matter of minutes

- Due to the high cost of DC chargers, level 2 AC chargers are more commonly used in charging stations
- GoI has recently set up various incentives to encourage the adoption of DC chargers in India
- As charging stations has a major role in development of the EV infrastructure and the GoI is planning to develop a robust charging station infrastructure

Advantages of EV Charging Stations

Electric vehicle charging stations offer numerous benefits, making it a cornerstone of the EV ecosystem. Here are the advantages of EV charging stations



Challenges of EV Charging Stations

With a classic “chicken or egg” situation in retail consumer adoption of EVs and required infra needs, the charging infrastructure is encountering low usage. Let's delve further into the obstacles faced

1	**Charging Time**	Longer charging times compared to swapping
2	**Range Anxiety**	Potential delays due to crowded charging stations
3	**Battery Degradation**	Frequent fast charging impacts battery life
4	**Infrastructure Gaps**	Lacks sufficient infrastructure spread for seamless long-distance travel

Comparison: Charging Stations and Battery Swapping

Parameters	Battery Charging	Battery Swapping
Downtime	High	Low
Infrastructure Availability	Wider spread	Early stage
Compatibility	Universal	Limited
Cost Effectiveness	Lower Initial Cost	High Infrastructure Investment
User Adaptation	Minimal Behaviour Change	Habit Adjustment
Range Anxiety	Present due to Infrastructure gaps	Somewhat Solves
Battery Degradation	High Impact by Fast charging	Controlled Maintenance & charging
Ownership	Retained by Owners increasing initial cost	None

Global Infrastructure of Both Technologies

Countries	EV Charging Stations	Battery Swapping	Status Check
China	1.8 Mn Charging stations (As of 2022)	2000 Swapping stations (As of 2022)	Charging holds a dominant position, but government initiatives promote battery swapping through policy measures
US	51K Charging Stations (As of 2023)	Started by a few startups in some locations	Charging Dominates EV Infrastructure, Swapping Emerging for Fleet Efficiency
Europe	535K Charging Stations (As of 2022)	Early adoption in Norway, Germany, Sweden and Netherlands at a small scale	Charging dominates Europe's EV infrastructure, with swapping stations emerging in select nations

Source: IEA Report, Statista, CNET

Favorable EV Charging Stations Policy Making

GOI's initiative to promote charging station

- Capital subsidies for charging stations
- Higher incentives for fast charging stations
- Public parking lots and fuel stations with an area of more than 5K sq mts to install EV chargers

Goals for charging station Setup

- Every 3 km in cities
- Every 25 km on highways
- Within every 3 X 3 km grid
- Every 100 km non-highway roads

Incentives for charging stations adpotion

- License-free setup
- Relaxation on Property Tax
- Fixed subsidized electricity tariff for EV charging

Battery Swapping Policy in India

GOI permits battery-less EV sales, reducing upfront costs and promoting innovative, cost-effective battery swapping

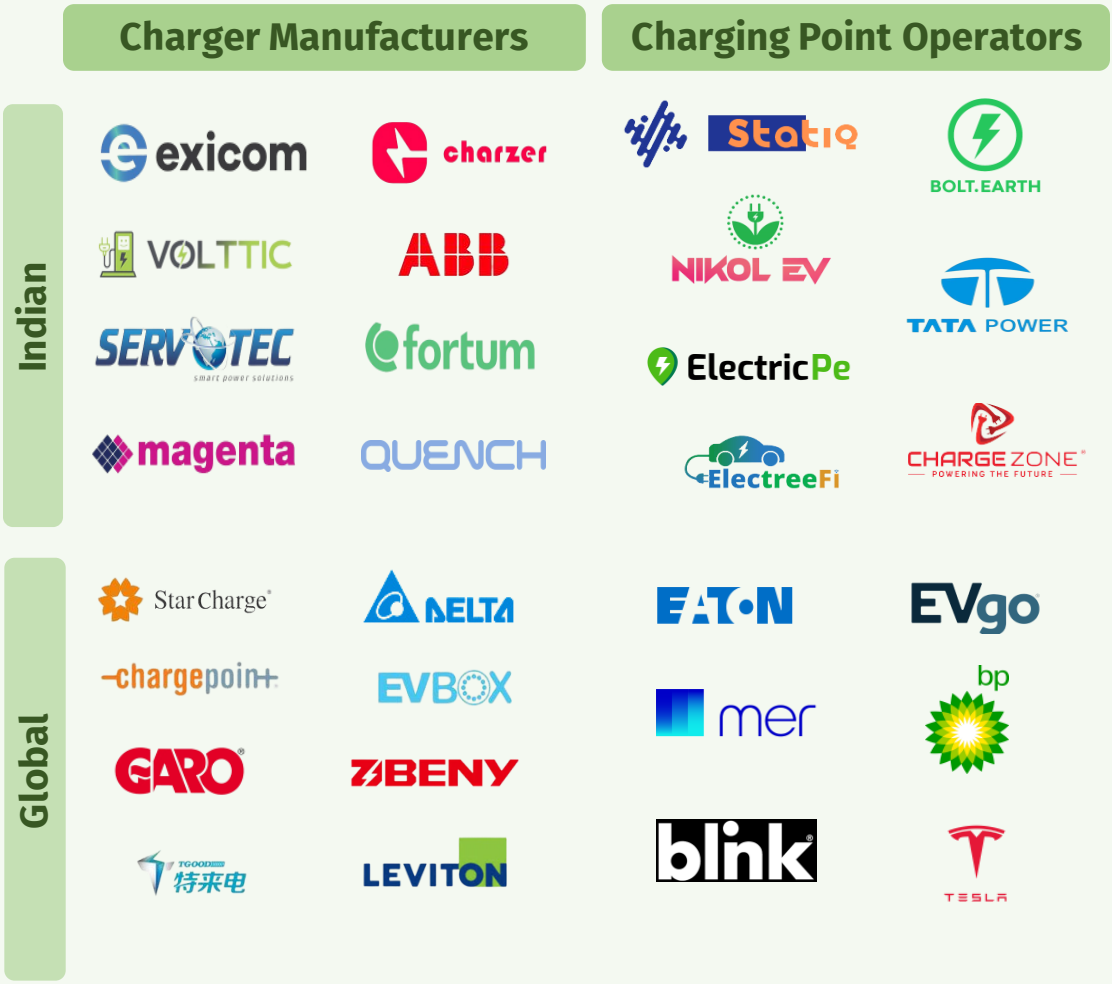
India's Battery Swapping Policy

- Mandatory BMS & IoT for Safety & Monitoring
- Unique ID for Battery & Stations
- Certification for Safety & Interoperability
- One station must serve EVs of min 2 OEMs
- Open Data Sharing for Transparency among players
- Subsidized rates for non-peak hour battery charging
- Land at subsidized rates
- Priority to metro cities in rollout plans
- Setup of nodal agencies (BEE) for implementation
- Reduction in GST differential b/w batteries and EVSE components

State Initiatives

Telangana, Delhi, and Maharashtra, have already started setting up battery swapping stations

Leading Players in EV Charging in India



Leading Players in Battery Swapping in India

Battery Swapping Stations

Indian

Battery Smart

VOLTUP SMART SWAPPING

SUN MOBILITY

OLA ELECTRIC

esmito

BOUNCE

BatteryPool

AMARA RAJA

LITHION

RACE

DRONE POWER

OKAYA NEVER STOP INDIA

charge up

Global

gogoro

OYIKA the way to go

Swobbee we share batteries

KYMCO

奥动 ulton

IMMOTOR

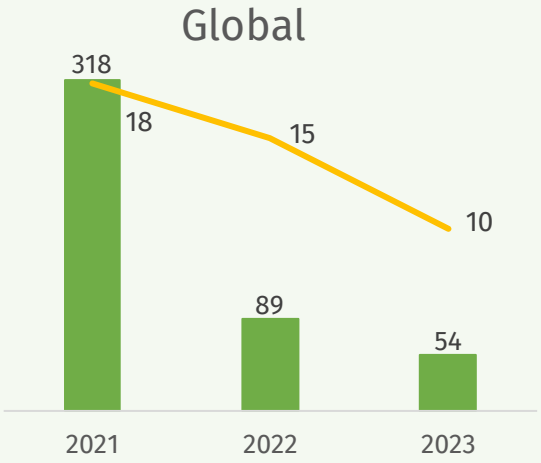
BYD

NIO

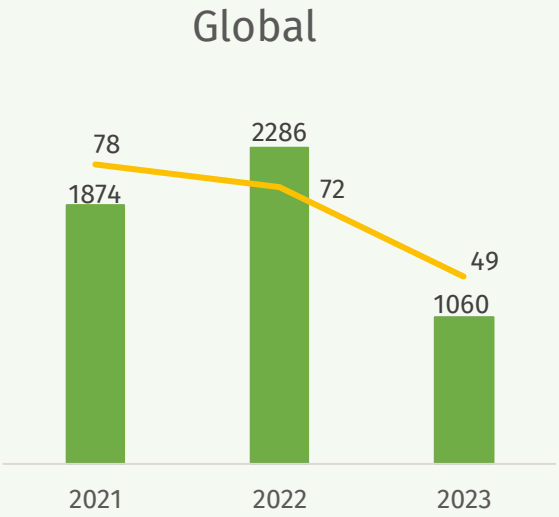
Numocity

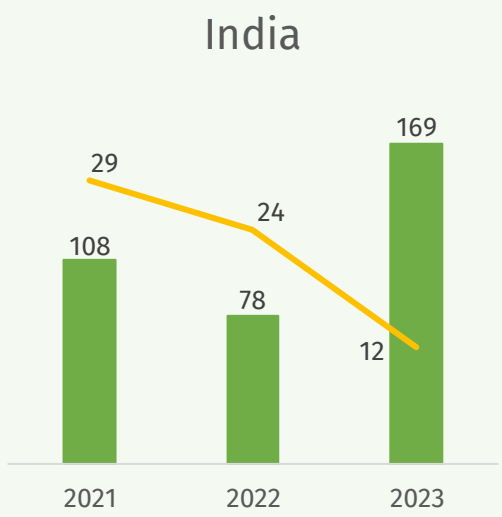
Battswap

Investment Trends in Battery Swapping



Investment Trends in Charging Stations





Total Funding (in $ Mn) Number of Funding Rounds

Source: Tracxn
**Data of 2023 is till October*

Major Fundings in Battery Swapping in India

Battery Smart	SUN MOBILITY	esmito	BOUNCE
Series A	Unattributed	Seed	Series E
$33 Mn	$50 Mn	$1.2 Mn	$20 Mn
Jul ‘23	Oct ‘21	Sep ‘22	Jan ‘23

Major Fundings in EV Charging Stations in India

BOLT.EARTH	CHARGE ZONE POWERING THE FUTURE	Statiq	magenta
Series B	Series A	Series A	Series A
$20 Mn	$54 Mn	$25.7 Mn	$22 Mn
Oct ‘23	Mar ‘23	Jun ‘22	Feb ‘23

Upcoming Innovations in Battery Charging Technology

Ultra Fast Charging

It is a "turbo boost“ for 4W EVs which can significantly reduce charging time. This will enhance customer convenience, making 4W EVs more appealing to wider audience.

Wireless Charging Technologies

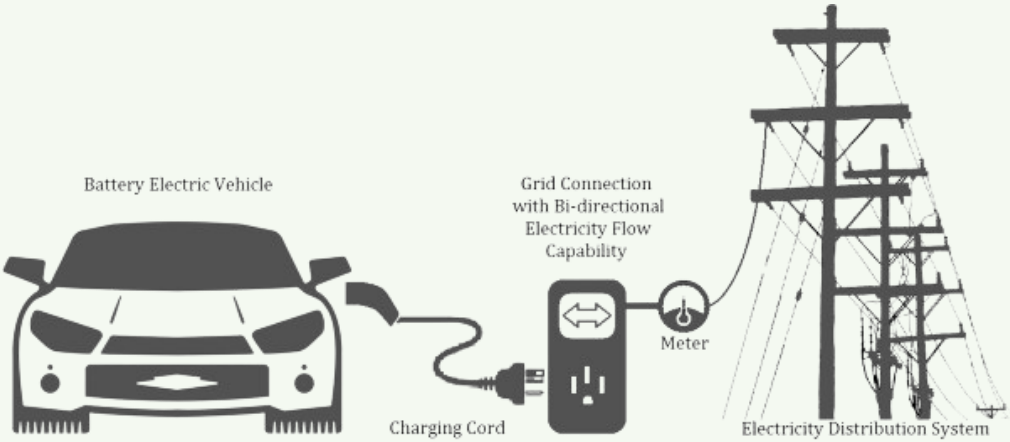
Wireless charging offers a cord-free future for EVs, simplifying the charging process and enhancing user-friendliness, making electric cars even more accessible and convenient

Net Zero ESS Charging Stations

Net Zero Energy Storage System (ESS) Charging Stations are green hubs that not only charge EVs but also generate and store energy from renewable sources, reducing grid dependency and carbon footprint.

Upcoming Innovations in Battery Swapping Technology

Grid Integration using Vehicle to Grid (V2G) Technology



- Enables two-way electricity exchange for EVs, supporting both charging and supplying excess power to the grid
- Such versatility will enhance battery swapping technology, making EV batteries more adaptable
- Idle EV batteries will help in balancing energy supply and demand and support grid stability

Integration of V2G with battery swapping will improve efficiency and cost-effectiveness

Which Technology will have an edge going forward?

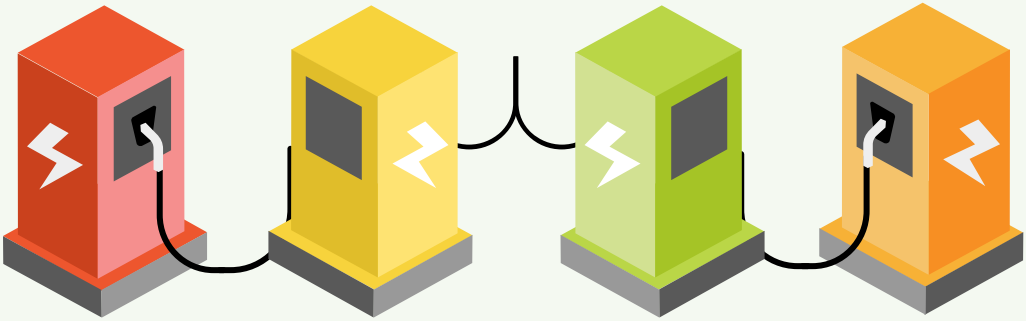
Audience	Battery Swapping	Battery Charging
Fleet Owners	Ideal (due to max utilization)	Less efficient (due to higher downtime)
Retail Consumers	Less likely to dominate	More likely to dominate
Vehicles Category	2W and 3W (due to ease of swapping)	4W (as the battery cannot be swapped easily)
Key Reasons	- Reduced downtime -Assists in the policy of fleet electrification	- Adaptable to personal usage - Caters to the ownership mentality of consumers
Conclusion	Has potential for **high adoption across fleets**	Has potential to cater **more towards retail consumer need**

As we venture further, a here is a thing to look out for:

Which of these Technologies will emerge and how will policy making evolve for setting up best industry standard going forward?

Get ready to discover the game-changing insights in our upcoming posts.

Don't miss out – stay tuned and join the conversation!



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