ELECTRIC VEHICLE ECOSYSTEM

1.INTRODUCTION

An **electric vehicle**, also called an **EV**, uses one or more [electric motors](https://en.wikipedia.org/wiki/Electric_motor) or [traction motors](https://en.wikipedia.org/wiki/Traction_motor) for propulsion. An electric vehicle may be powered through a collector system by electricity from off-vehicle sources, or may be self-contained with a [battery](https://en.wikipedia.org/wiki/Electric_vehicle_battery), [solar panels](https://en.wikipedia.org/wiki/Solar_panel) or an [electric generator](https://en.wikipedia.org/wiki/Electric_generator) to convert fuel to electricity. EVs include, but are not limited to, road and rail vehicles, surface and underwater vessels, [electric aircraft](https://en.wikipedia.org/wiki/Electric_aircraft) and [electric spacecraft](https://en.wikipedia.org/wiki/Electrically_powered_spacecraft_propulsion).

EVs first came into existence in the mid-19th century, when electricity was among the preferred methods for motor vehicle propulsion, providing a level of comfort and ease of operation that could not be achieved by the gasoline cars of the time. Modern [internal combustion engines](https://en.wikipedia.org/wiki/Internal_combustion_engine) have been the dominant propulsion method for [motor vehicles](https://en.wikipedia.org/wiki/Automobile) for almost 100 years, but electric power has remained commonplace in other vehicle types, such as trains and smaller vehicles of all types.

Why electric vehicles?

The electrification of transportation is part of an over-arching structural change in our transport and energy systems. This change is primarily driven by the well understood impacts of climate change and the significant contribution that transport has on greenhouse gas emission. Along with environmental benefits, they will deliver long term reductions in living expenses, ensure fuel security, and positively impact the gross domestic product .

Electric motors are mechanically very simple and often achieve 90% [energy conversion efficiency](https://en.wikipedia.org/wiki/Energy_conversion_efficiency) over the full range of speeds and power output and can be precisely controlled. They can also be combined with [regenerative braking](https://en.wikipedia.org/wiki/Regenerative_braking) systems that have the ability to convert movement energy back into stored electricity.

2.ECOSYSTEM(INFRASTRUCTURE)

A growing number of manufacturers, consumers, government agencies, investors and urban developers believe that the electric vehicles (EVs) can have better outcomes for the industry and environment. Cleaner, safer and simpler electric vehicles now span categories ranging from two-wheelers and rickshaws to cars and mining vehicles, as well as fleets of buses and vans. The ‘glue’ connecting the mix includes startups in IoT (Internet of Things) and solar energy as well as mobile operators and blockchain players. It will not be individual corporate players who win the game, but whole ecosystems of partners and competitors coming together to define standards and roll out electric charging infrastructure.

  3.  ELECTRIC VEHICLE NETWORK

**electric vehicle network** is an [infrastructure](https://en.wikipedia.org/wiki/Infrastructure) system of [charging stations](https://en.wikipedia.org/wiki/Charging_station) and battery swap station to recharge [electric vehicles](https://en.wikipedia.org/wiki/Electric_vehicle). Many government, car manufacturers, and charging infrastructure providers sought to create networks.

MAPS(go electric stations,plugshare links)

 Go Electric Station is a global station navigation system which provides activation from the tap of a smartphone and real time availability information can be discovered along with a detailed payment option system and navigational routing maps.

PlugShare is a crowdsourced map of public, private and residential charging locations. The site uses Google Maps to provide a map of charging locations and their own database to filter by charging type..

DEMAND ON GRID

IS THE GRID READY?

4. MANUFACTURER

The [Renault–Nissan Alliance](https://en.wikipedia.org/wiki/Renault%E2%80%93Nissan_Alliance) has made agreements to promote emission-free mobility in [France](https://en.wikipedia.org/wiki/France), [Israel](https://en.wikipedia.org/wiki/Israel), [Portugal](https://en.wikipedia.org/wiki/Portugal), [Denmark](https://en.wikipedia.org/wiki/Denmark) and the U.S. state of [Tennessee](https://en.wikipedia.org/wiki/Tennessee). Nissan plans to install 200-volt [level 2](https://en.wikipedia.org/wiki/Level_1,_2,_and_3_charging) charging stations at 2,200 Nissan dealers in Japan, and [level 3](https://en.wikipedia.org/wiki/Level_1,_2,_and_3_charging) fast charging stations at 200 dealers.

[Tesla Motors](https://en.wikipedia.org/wiki/Tesla_Motors), in March 2009, announced that they are "working with a government-affiliated partner to set up battery changing stations at various locations" to service their [Model S](https://en.wikipedia.org/wiki/Tesla_Model_S) platform cars. The first were unveiled September 24, 2012 As of 17 April 2016, Tesla currently operates 3,644 superchargers in 616 [stations](https://en.wikipedia.org/wiki/Tesla_station) worldwide, and Tesla announced on 31 March 2016 plans to double the size of the Supercharger network by 2017. Superchargers are a free service for Tesla Model S and [Model X](https://en.wikipedia.org/wiki/Tesla_Model_X) owners.

STARTUPS

 MotionWerk – Blockchain-Based Wallets For EV Charging Electric vehicle owners can pay charging stations using their Blockchain-enabled electronic wallet. People also can share their charging stations with drivers who pay for usage via blockchain technology. **[MotionWerk](http://www.motionwerk.com/" \t "_blank)**, a German startup, develops **[Share&Charge](https://shareandcharge.com/" \t "_blank)** – an Ethereum-based decentralized protocol for tracking charging transactions and exchange payment between customer and host. This solution allows EV owners to safely pay for charging services on the move and enables charging stations owners to independently set their own tariffs and adapt it at any time.

### eMotorWerks – Vehicle-to-Grid

Platforms control and shift how much electricity EV charging stations draw from the grid and when. This helps utilities and grid operators reduce electricity costs, improve grid reliability, and maximize the use of renewable energy. **[eMotorWerks](https://emotorwerks.com/" \t "_blank)** from San Carlos in the US develops JuiceNet, a patented communication, control, and intelligence platform. This platform dynamically matches drivers’ historical charging patterns, as well as real-time input, and signals from grid operators, allowing utilities to aggregate and to manage a charging station’s demands.

### Ubitricity – Portable Charging Devices

Charging station’s metering and communication technologies are usually installed inside every single charging point. The aim here is to increase the simplicity of use and to reduce the costs of existing charging infrastructures for electric vehicles. German startup **[Ubitricity](https://www.ubitricity.com/en/" \t "_blank)**, for instance, equips EV users with their own portable charging device, in which the electricity is measured and billed. Because of this, charging points are reduced to simple and highly cost-efficient system sockets.

### Roviero – Robot-Charger

The idea of using robots to charge electric vehicles has the potential to transform the entire industry. This way of charging is especially suitable for autonomous vehicles as there are no drivers to charge them. This also means no more waiting time for drivers to wait their turn. Additionally, robot-chargers enable grid balancing because the entire parking time can also be used to obtain energy from the power grid. US-based **[Roviero](https://roviero.com/" \t "_blank)** develops such a robot for electric vehicle charging. Car owners can just park and go, without having to wait in lines, while the robot performs all actions required for charging. Roviero’s robot uses computer vision to determine the car type, its car charger port and even connects the plug autonomously.

### Easelink – Wireless Charging

Wireless charging systems typically consist of hardware components, such as an inverter, rectifier, receiver, and then syncs via cloud software to establish communication between the hardware components. This serves as the sole interface for the user. Austrian startup **[Easelink](http://www.easelink.com/" \t "_blank)** develops and industrializes MATRIX CHARGING® – a connection system to automate electric vehicle charging. Cars equipped with MATRIX CHARGING® Systems charge automatically when parked over their pad. The connector and pad communicate via a secure

5.CONSUMER

Citizens will also have to play a consistent role in switching their driving, commuting and vehicle ownership attitudes. Unfortunately, as disposable income increases in emerging economies, there is also an aspirational rise in demand for self-driven vehicles rather than public transport. Today, 19 out of the 35 most polluted cities in the world are in India, according to BIS Research. More than half the pollution in densely-populated urban areas is vehicular. As of 2016, there were 229 million vehicles on Indian roads. Citizens will need to play a more vocal role in switching to electric vehicles or using more public transport.

GREATER ACCEPTANCE

HOW CAN EV USERS OVERCOME RANGE ANXIETY?

The battery-size, cooling-requirements, weight of the vehicle (including battery and passengers) and energy-efficiency of the vehicle (amount of energy required per km), all goes on to contribute to the range that a vehicle can travel, before it requires recharging or battery-swapping. Addressing range issues is critical to the ecosystem development.  
  
6.GOVERNMENT POLICIES

Some countries have set strict emission targets which will help spur the shift to electric. For example, in Europe, manufacturers must bring down vehicle emissions to 95 grams per km per vehicle by 2020. Sweden plans to have a fossil fuel-free transportation system by 2030. Canada has announced regulatory changes to make it easier for condominium owners to get approval from their condo corporations to install an electric vehicle charging system. Ontario’s Electric Vehicle Charging Incentive Program has provided incentives for the installation of thousands of home charging stations. There are an estimated 18,000 electric vehicles on Ontario’s roads. “The transportation sector contributes the most greenhouse gas pollution in the province, so actions that encourage the use of low-carbon vehicles help move us towards a healthier, cleaner future,” says Chris Ballard, Minister of Government and Consumer Services. Governments need to have clarity in their pronouncements on electric vehicle adoption. For example, in 2017 the Indian Ministry of State for Power and Renewable Energy set 2030 as the phasing-out date for fossil fuel vehicles, but later withdrew the target date. Electric vehicles will not only help reduce carbon dioxide emissions, but also reduce dependence upon oil imports, which raises all kinds of political risk in a volatile world. Other initiatives include Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME), part of the National Electric Mobility Mission (NEMM) to promote fuel-efficient cars. Such schemes will be particularly important for fast-growing or large cities. Incentives will also be needed at industry and consumer level to spur the switch to electric vehicles. The Committee for Standardisation of the Protocol for Charging Infrastructure, set up by the Indian government, has recommended adopting uniform standards for electric vehicle charging stations, as well as options for electronic payment such as via smartphone. A study by the Society of Manufacturers of Electric Vehicles (SMEV) shows Gujarat, Bengal, Uttar Pradesh, Rajasthan and Maharashtra as the top five states in EV sales.

7.INTEROPERABILITY(eg <https://www.digitaltrends.com/cars/electrify-america-evgo-and-chargepoint-interoperability-agreement-for-electric-car-charging/>)

Interoperability is defined as the ability of various systems to work together. For the eMobility market, interoperability leads to non-discriminatory eMobility services, such as charging and navigation, and makes it available through-out a defined territory (in this case the UK) without limitation and with a coherent service quality level at an optimized price.

Although all public authorities refer to interoperability in their regulations or their tenders, there are typically three primary concerns that have to be addressed:

• Establishing a fair business case for all stake-holders, taking into consideration investments and operating costs

• Defining clear interoperability rules

• Ensuring a coherent and equivalent service level, nationally

The typical user or customer would likely have several questions and concerns relating to interoperability:

• "Where are the available charging Points around me?”

• “How can I use this charging Point? Swipe my badge? Where? Push a button? Plug the cable first?”

• “Is my authentication media compatible with the reader?”

• “Am I authorized to access the service on this charging point?”

• “May I use my contract with my recharge services provider to use and pay this charging Point?”

• “Is the socket of the charging Point compliant with the cable I have?”

**Overcoming the Interoperability Challenges**

In overcoming the interoperability challenges, the ecosystem has to provide features that can be divided into four groups:

• Charging point technical features (authentication media, plug and socket compliancy …)

• Charging point functional features (markings, how to use …)

• System (system interconnection, data exchanges …)

• Business & legal features (roaming agreements between operators ...)

Thus, for the eMobility service provider to ensure interoperability it has to make sure its services (search and find, charge, book, etc.) to its customers are compatible with the infrastructure of any charging operator under the umbrella of a B2B relationship at negotiated prices.

A good example of this will soon be seen at Newcastle University where the UK’s first public 175kW electric vehicle chargers will be located. Under the new project with Dutch charging firm Fastned, which won the tender from the North East Combined Authority (NECA), two Go Ultra Low fast-charging ‘filling stations’ will be constructed: The first at the university and the other in the city centre of Sunderland.

Open Access and Payment

Many definitions of interoperability start with consumer facing systems, focusing on how EV drivers pay for and access their charging stations. One definition from Plug In America describes “open access” payment standards as those that have two components making public chargers accessible:

1) access to public chargers must not be restricted behind a gate or wall and

2) one or more method of payment is available to enable charging.

Charger to Network Communication

Charger to cloud network communication would utilize standardized communication between charging stations and the central control system (e.g., a charging network provider or utility) that supports them. Data communication allows network providers and site hosts to better manage chargers and charging activity, ultimately enhancing flexibility and increasing charger utilization. Standardizing this data sharing can also enhance the experience for all EV drivers by enabling databases—like the Alternative Fuels Data Center or charging provider cell phone apps

Open Charge Point Protocol (OCPP) – OCPP is the dominant charger to cloud network open communication protocol in place in the United States, though it has not technically been adopted as a standard. 9 Use of this open protocol, rather than a priority protocol, may provide hosts flexibility in the long run: if a station provider goes out of business or a site host dislikes his or her current provider, it can be replaced by a new network provider as long as the charger is OCPP compliant (not all are), without replacing the entire unit.

Network to Network Communication

Network to network communication enables coordination and data sharing among charging providers, which can facilitate network “roaming”—Charging Network A can make it easy for its members to charge on a different Charging Network B directly through the Charging Network A app, payment system, and membership; the driver would not need to belong Charging Network B. The same is true in reverse for members of Charging Network B, who now could also utilize Charging Network A. This data sharing process can also allow Charging Network A to provide to its customers charger location and availability data for Charging Network B (and visa-versa) and allow these two charging providers to share customer billing and payment data to facilitate settlement of roaming charging sessions. Through roaming, drivers would potentially only need to have one membership but may access a larger network of chargers across a broader geographic area. Below we highlight two models for facilitating network to network communication: bilateral peer-to-peer agreements and a central hub model. These network communication structures are not mutually exclusive; charging providers can pursue both types with different partners.

Open Charge Point Interface (OCPI) – Bilateral or peer-to-peer agreements – OCPI is a network communication standard that has been utilized by charging networks to form bilateral or peer-to-peer agreements to institute network to network communication and allow roaming.

Open InterCharge Protocol (OICP) – Central hub – Instead of bilateral agreements, charging networks can also join a central hub to facilitate network to network communication and allow roaming, billing and settlement. One hub standard is OICP

## Infrastructure providers

* Hubsta- Is a UK-based facility for EV users and claims to facilitate 'connecting to over 55,000 Charge points worldwide' and 'its never been easier to charge your EV or manage your EV charging Network'.
* FullCharger International, founded in 2009, is a French operator of charging stations for electric vehicles with multi-territorial networks. They propose to local authorities and private operators complete solutions[*[buzzword](https://en.wikipedia.org/wiki/Wikipedia:Use_plain_English" \l "Buzzwords" \o "Wikipedia:Use plain English)*] for electric mobility. FullCharger ChargePoint Network is the world's largest network across 23 countries.
* Share&Charge is a Germany-based peer to peer network aimed at the sharing of private charging poles in order to make them accessible to everyone as well as billable. The peer to peer network comes in an App which includes a map of existing charging poles, the possibility to easily register a private charging pole as well as the handling of the payment by Share&Charge. Share&Charge Website
* [Elektromotive](https://en.wikipedia.org/wiki/Elektromotive) is a UK-based company that manufactures and installs charging infrastructure for electric cars and other electric vehicles using their patented Elektrobay stations. The company has partnerships with major corporations including EDF Energy and Mercedes-Benz to supply charging posts and data services.

8.IMPACT

Shifting modes of mobility could launch new business opportunities. These would emerge in areas such as charging and swapping infrastructure, service, or integrated transport.. There are several studies that suggest overall positive impact on GDP on introduction of EVs in fuel importing service dominated economies. One study has estimated that driving the shift to electric vehicles would lead to a 1% increase in EU GDP[6]. In another study, net private and social benefits are estimated between $300 and $400 per EV[7]. Coupled with generation of renewable power, the battery manufacturing industry in India can become bigger than the total amount spent on import of crude oil. This would provide a huge boost to the Indian economy. The revenue loss for governments from the taxes on the oil sector is expected to be replaced by higher tax revenues in other economic sectors.

 IMPACT ON EMPLOYMENT European Climate Foundation has estimated that through reducing oil demand by more efficient electric cars, employment will increase by 5,00,000 to 8,50,000 by 2030. Another report estimates that about 2 million additional jobs will be created by EVs by 2050. The report further adds that oil production and distribution has very low employment intensity of just four jobs per million Euros value added compared to 24 jobs per million Euros in the general economy. Therefore, any shift in expenditure from buying imported oil to other expenditure choices would generate additional employment. Further, as imported oil is replaced by electricity and batteries, large employment is possible in enhancing power-generation and distribution, and in battery manufacturing, including battery-recycling. As far as the automotive sector is concerned, a large part of the supply chain will get transformed in the power train segment. Traditional suppliers will move from supplying parts such as exhaust pipes and ICEs to perhaps battery materials, electric motors, and regenerative braking systems. EVs will create opportunities in durable and lightweight thermoplastics, higher demand for electricity, storage and many others. The net impact on employment would perhaps be balanced out. In addition, EV battery charging and swapping would create a large number of jobs throughout the country.

IMPACT ON ENVIRONMENT AND HEALTH ICEs are one of the main sources of air pollution globally. They negatively affect both human health and ecology. Emissions from ICE powered motor vehicles are responsible for about two-thirds of air pollution in urban areas. The current ban on older fuel cars in some Indian cities already shows a positive influence on air quality, and this can only further improve with the large scale introduction of EVs.