# Visualization Tool for Electric Vehicle Charge and Range Analysis

## PROJECT DESCRIPTION

A vehicle that can be powered by an electric motor that draws electricity from a battery and is capable of being charged from an external source and have an electric motor instead of an internal combustion engine.

The Electric Vehicle (EV) is not new, but it has been receiving significantly more attention in recent years. Advances in both EV analytics and battery technologies have led to increased automotive market share. However, this growth is not attributed to hardware alone. The modern mechatronic vehicle marries electrical storage and propulsion systems with electronic sensors, controls, and actuators, integrated closely with software, secure data transfer, and data analysis, to form a

comprehensive transportation solution. Advances in all these areas have contributed to the overall rise of EV's, but the common thread that runs through all these elements is data analytics. The new EV's are combined Electrical storage and propulsion systems with electronic sensors,controls, and actuators, integrated closely with software, secure data transfer

Template

# Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

**10 minutes** to prepare
**1 hour** to collaborate
**2-8 people** recommended

Share template feedback

## Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes

- **Team gathering**
  Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.
- **Set the goal**
  Think about the problem you'll be focusing on solving in the brainstorming session.
- **Learn how to use the facilitation tools**
  Use the Facilitation Superpowers to run a happy and productive session.

Open article

## 1 Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

PROBLEM
**Visualization Tool For Electrical Vehicle Charge and Range Anxiety**

**Key rules of brainstorming**
To run an smooth and productive session

- Stay in scope.
- Encourage wild ideas.
- Defer judgment.
- Listen to others.
- Go for volume.
- If possible, be visual.

## 2 Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

TIP
You can select a sticky note and hit the pencil [switch] to switch over to start drawing!

Person 1 | Person 2 | Person 3 | Person 4 | Person 5

## 3 Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

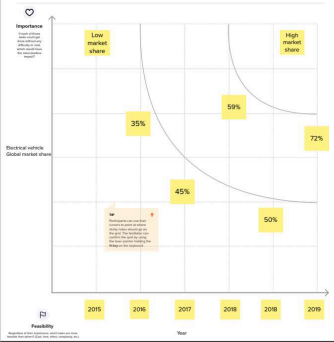
TIP
Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as themes within your mural.

1.A vehicle that can be powered by an electric motor that draws electricity from a battery and is capable of being charged from an external source and have an electric motor instead of an internal combustion engine.
2.However, this growth is not attributed to hardware alone. The modern mechatronic vehicle marries electrical storage and propulsion systems with electronic sensors, controls, and actuators, integrated closely with software, secure data transfer, and data analysis, to form a comprehensive transportation solution

## 4 Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes




## After you collaborate

You can export the mural as an image or pdf to share with members of your company who might find it helpful.

Quick add-ons

- **Share the mural**
  **Share a view link** to the mural with stakeholders to keep them in the loop about the outcomes of the session.
- **Export the mural**
  Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

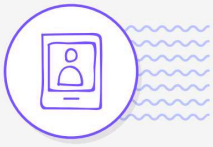
Keep moving forward

- **Strategy blueprint**
  Define the components of a new idea or strategy.
  Open the template
- **Customer experience journey map**
  Understand customer needs, motivations, and obstacles for an experience.
  Open the template
- **Strengths, weaknesses, opportunities & threats**
  Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.
  Open the template

Share template feedback

Need some inspiration?
See a finished version of this template to kickstart your work.
Open example

Template



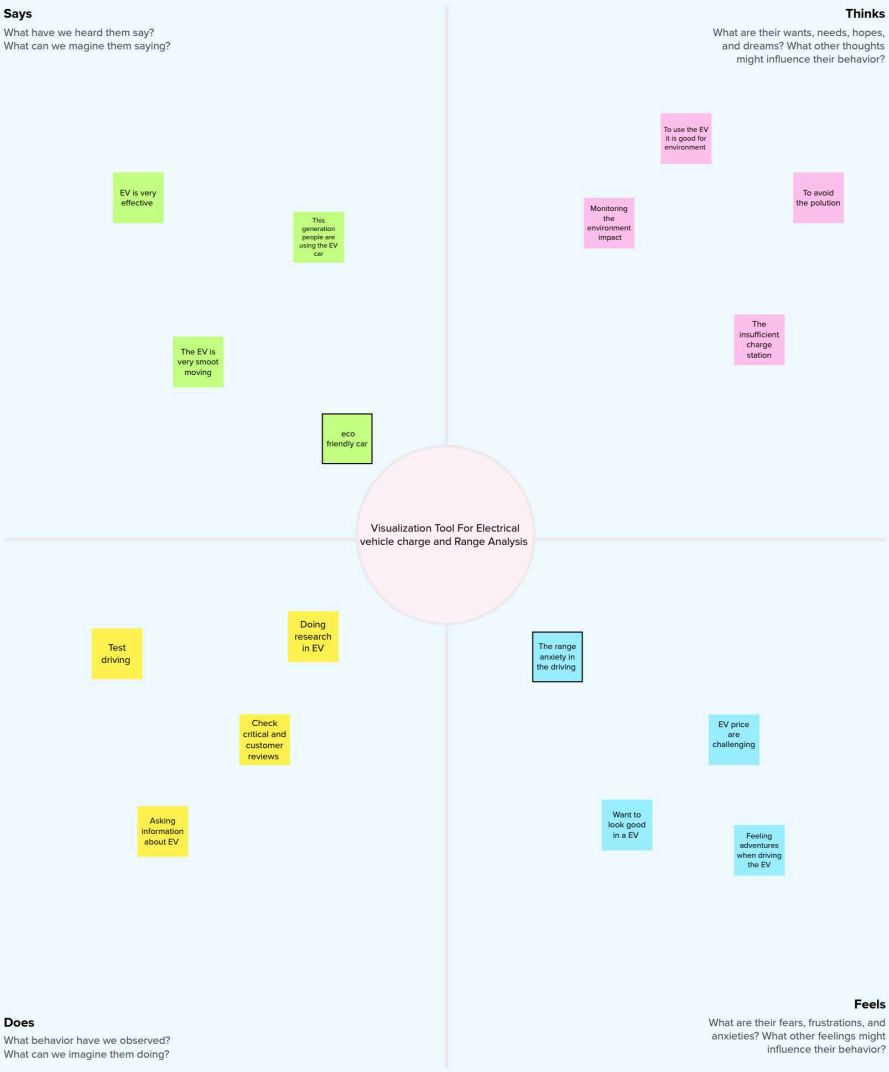
# Empathy map

Use this framework to develop a deep, shared understanding and empathy for other people. An empathy map helps describe the aspects of a user's experience, needs and pain points, to quickly understand your users' experience and mindset.

Share template feedback

## Build empathy

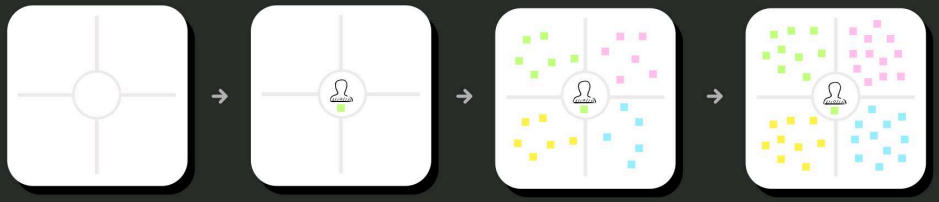
The information you add here should be representative of the observations and research you've done about your users.

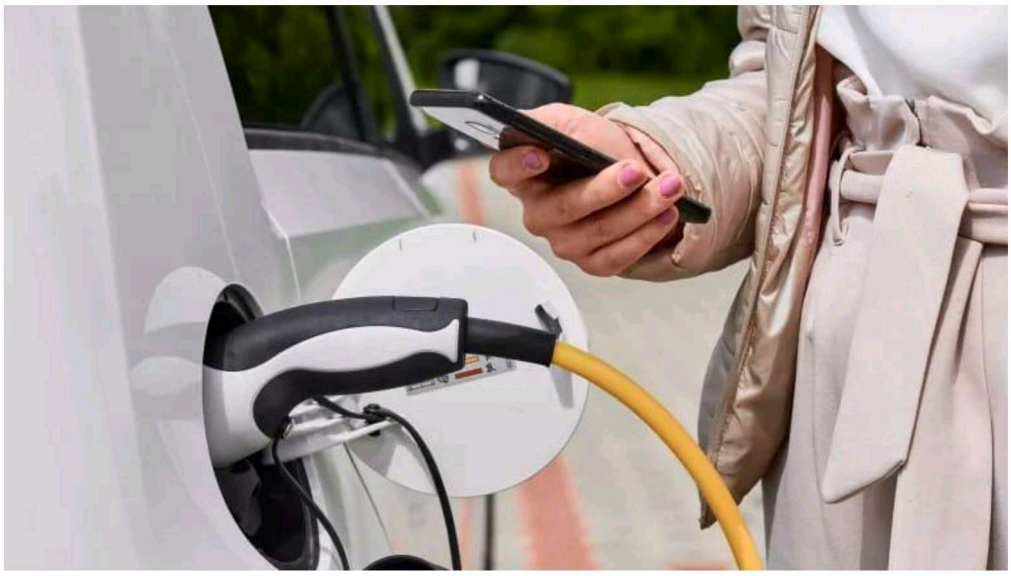



**Need some inspiration?**

See a finished version of this template to kickstart your work.

Open example →





## Key Components of an All-Electric Car

### Battery (all-electric auxiliary):

In an electric drive vehicle, the auxiliary battery provides electricity to power vehicle accessories.

Charge port: The charge port allows the vehicle to connect to an external power supply in order to charge the traction battery pack.

DC/DC converter: This device converts higher-voltage DC power from the traction battery pack to the lower-voltage DC power needed to run vehicle accessories and recharge the auxiliary battery.

Electric traction motor: Using power from the traction battery pack, this motor drives the vehicle's wheels. Some vehicles use motor generators that perform both the drive and regeneration functions.

Onboard charger: Takes the incoming AC electricity supplied via the charge port and converts it to DC power for charging the traction battery. It also communicates with the charging

equipment and monitors battery characteristics such as voltage, current, temperature, and state of charge while charging the pack.

Power electronics controller: This unit manages the flow of electrical energy delivered by the traction battery, controlling the speed of the electric traction motor and the torque it produces.
Thermal system (cooling): This system maintains a proper operating temperature range of the engine, electric motor, power electronics, and other components.
Traction battery pack: Stores electricity for use by the electric traction motor.
Transmission (electric): The transmission transfers mechanical power from the electric traction motor to drive the wheels

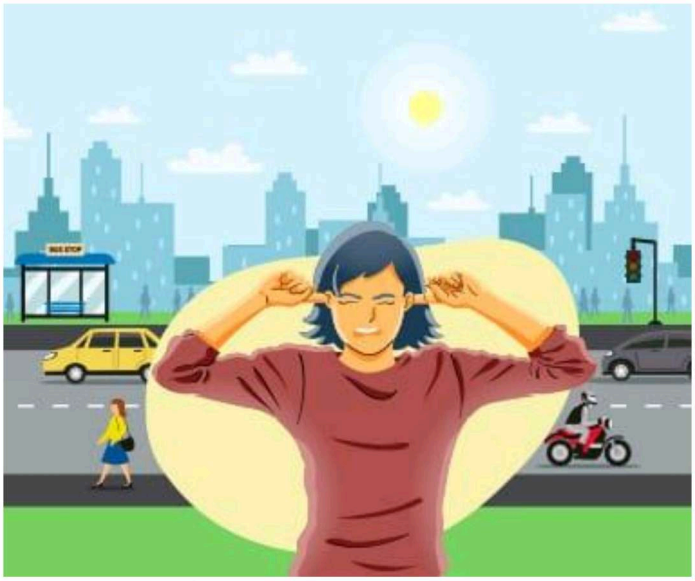
**RESULT**:

### Convenience of charging at home

Imagine being at a busy fuel station during peak hours, and you are getting late to reach your workplace. These problems can easily be overcome with an electric vehicle. Simply plug your vehicle in at your home charger for 4-5 hours before you plan to go. If you are able to get a charger where you park at home, it is very convenient to plan your journeys in advance. What if you forget to plug in your machine someday? Then you can easily take the help of fast chargers or even battery swapping services if you are on a two-wheeler on the road.

### No noise pollution

Electric vehicles have the silent functioning capability as there is no engine under the hood. No engine means no noise. The electric motor functions so silently that you need to peek into



your instrument panel to check if it is ON. Electric vehicles are so silent that manufacturers have to add false sounds in order to make them safe for pedestrians.

Buying an electric vehicle (EV) means being able to skip expensive trips to the pump while protecting our climate and health. But there's still a learning curve when it comes to charging, from how long it takes to how much it costs. Let's break down your most pressing questions about EV charging so that you can drive and refuel confidently.

## How long does it take to charge an electric car?

Charging your EV from empty can take as little as 20 minutes or upwards of 40 hours, depending on everything from the size of your particular car's battery to where and when you decide to charge. First, it's good to know the three levels of charging for EVs.

Level 1: This is EV-speak for plugging the cord set that comes with your EV into a regular 120-volt outlet (the same kind you'd use for, say, a phone charger or a lamp). The gist is that this level of charging is slow—between 40 and 50 hours, if you're charging from empty. Though it's worth noting that, on average, U.S. car owners only drive about 31 miles a day. So Level 1 may be enough for your daily needs or in a pinch to add some mileage.

Level 2: This means you're charging from a 220-volt outlet (the same kind that heavy-duty appliances like washers use) or hardwired equipment. In this scenario, you can charge from empty in about four to ten hours. Public Level 2 charging stations are common at locations where drivers tend to park, like workplaces or commercial parking lots, but most EV owners also get this version installed in their garage so they can charge overnight. A nice bonus: Some incentives could cover the cost of Level 2 equipment.

Level 3: For the fastest charging speeds, you can turn to Level 3 chargers—also known as DCFC chargers or direct current fast chargers—which can charge your EV from empty in as little as 20 minutes. These public charging stations are more expensive to use, but they are particularly great for time-conscious road-trippers or urban drivers who can't easily refuel at home. Plus, they're getting faster. The first generation typically charged vehicles at 50kW, but the ones being installed today are generally at least three times as powerful, with some charging at 350kW.

In 2021 consumers across the world spent an estimated USD 250 billion on EV purchases. The growth in EV sales is driving investment in electrification, which represented more than 65% of overall end-use investment in the transport sector in 2021. Recent analysis by the IEA estimates that this share will increase to more than 74% in 2022. Moving beyond cars, investment is also being directed towards electrification of buses and heavy-duty trucks. In early

2022 India ran a tender for the purchase and deployment of more than 5 000 electric buses across five major cities. The contract was awarded for half the price reached in previous tenders. A public–private joint venture in Chile is also seeking financing to fund an 1 000-strong electric bus fleet in Santiago.

The global production capacity of batteries is set to increase from below 200 GWh in 2019 to over 1 200 GWh in 2024, following massive capital expenditure by listed battery manufacturing companies in 2021, rebounding from a large dip during the pandemic. These companies are now investing three times as much as they did in 2020. In 2021 China led global battery manufacturing capacity by controlling around 75% of the world's total, followed by the United States, Hungary and Germany.

## Electric Vehicles

Abstract

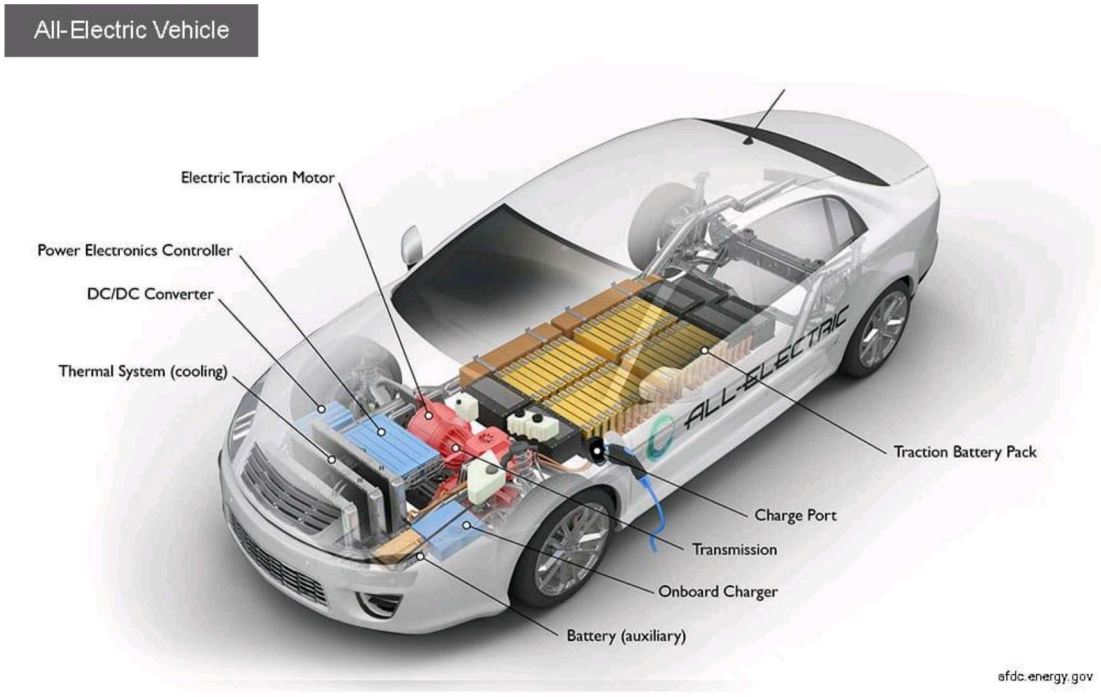
About this report

Electric vehicles are the key technology to decarbonise road transport, a sector that accounts for 16% of global emissions. Recent years have seen exponential growth in the sale of electric vehicles together with improved range, wider model availability and increased performance. Passenger electric cars are surging in popularity – we estimaate that 13% of new car sold in 2022 will be electric; if the growth experienced in the past two years is sustained, CO2 emissions from

cars can be put on a path in line with the Net Zero Emissions by 2050 Scenario. However, electric vehicles are not yet a global phenomenon. Sales in developing and emerging countries have been slow due to higher purchase costs and a lack of charging infrastructure availability.

## Technology deployment

Electric car sales reached a record high in 2021, despite supply chain bottlenecks and the ongoing Covid-19 pandemic. Compared with 2020, sales nearly doubled to 6.6 million (a sales share of nearly 9%), bringing the total number of electric cars on the road to 16.5 million. The sales share of electric cars increased by 4 percentage points in 2021. The Net Zero Emissions by 2050 Scenario sees an electric car fleet of over 300 million in 2030 and electric cars accounting for 60% of new car sales. Getting on track with the Net Zero Scenario requires their sales share to increase by less than 6% percentage points per year.



China continues to maintain its lead in the number of publicly available chargers, accounting for about 85% of fast chargers and 55% of slow chargers worldwide. In 2021, 680 000 slow chargers were installed in China, followed by Europe with over 300 000 installations (up 30% on 2020), and the United States with 92 000 deployed (up 12% on 2020). The number of fast chargers reached almost 470 000 in China in 2021 (up 52% from 2020), while in Europe the number increased to nearly 50 000, followed by the United States at 22 000. By 2030 the Net Zero Scenario sees the installation of 18 million publicly available charging stations.

## Investment

In 2021 consumers across the world spent an estimated USD 250 billion on EV purchases. The growth in EV sales is driving investment in electrification, which represented more than 65% of overall end-use investment in the transport sector in 2021. Recent analysis by the IEA estimates that this share will increase to more than 74% in 2022. Moving beyond cars, investment is also being directed towards electrification of buses and heavy-duty trucks. In early 2022 India ran a tender for the purchase and deployment of more than 5 000 electric buses across five major cities. The contract was awarded for half the price reached in previous tenders. A public–private joint venture in Chile is also seeking financing to fund an 1 000-strong electric bus fleet in Santiago.

The global production capacity of batteries is set to increase from below 200 GWh in 2019 to over 1 200 GWh in 2024, following massive capital expenditure by listed battery manufacturing companies in 2021, rebounding from a large dip during the pandemic. These companies are now investing three times as much as they did in 2020. In 2021 China led global battery manufacturing capacity by controlling around 75% of the world's total, followed by the United States, Hungary and Germany.

Expenditure on EVs and investment in the supply chain are increasing

Policy

New zero-emission vehicle (ZEV) sales targets were announced in several markets and existing targets were intensified as governments demonstrated a strong commitment to incorporating the electrification of cars as a key component of strategies to meet net zero targets and nationally determined contributions. They include:

An executive order In the United States in August 2021, which set a new ambition for EVs to represent 50% of LDV sales in 2030.

In October 2021, an announcement of ambitions to have 100% zero-emission LDV sales by 2035 in Chile.

In Canada a new target to achieve 100% zero-emission LDV sales by 2035 instead of 2040. New interim targets of 20% zero-emission LDV sales by 2026 and 60% by 2030 were also established.

Several governments increased the stringency of vehicle emission standards to further facilitate ZEV deployment. The United States finalised rulings establishing more stringent standards for both corporate average fuel economy and GHG emissions. In the European Union, the European Commission's Fit-for-55 package includes a regulation, recently passed by the European Commission, that requires fleet emission reductions (from a 2021 starting point) of 55% for cars and 50% for vans by 2030, and 100% for both by 2035. This effectively mandates that all new cars and vans sold from 2035 onward would need to emit zero tailpipe emissions.

Overall, government expenditure on electric car subsidies almost doubled in 2021. Major changes include the following:

China extended its NEV subsidy scheme to the end of 2022 (from a previous 2020 expiry date), although it has started reducing base subsidy amounts by 10%, 20% and 30% each year (between 2020 and 2022). It further extended a purchase tax exemption for NEVs through the end of 2023. In Korea, the new subsidy scheme introduced in 2021 limited subsidies to passenger cars priced less than KRW 90 million (USD 78 671), while in 2022 subsidies were limited to cars priced less than KRW 55 million (USD 48 077).

The Build Back Better Act In the United States was drafted in 2021 and proposes a restructuring of EV purchase subsidies to include an additional USD 4 500 for EVs equipped with batteries manufactured with union labour, on top of a USD 7 500 base incentive. More recently, the passage of the Inflation Reduction Act extends tax credits for electric vehicles that meet certain criteria (regarding battery mineral mining and processing and domestic final assembly), and expands credits to used EVs. Finally, California passed a regulation requiring that all cars sold

by 2035 be zero-emission vehicles, a mandate that is likely to be followed by many Section 177 States.

Following a doubling of its subsidies in December 2020, Japan announced a budget allocating JPY 25 billion (USD 228 million) for ZEV subsidies.

In 2021 ZEV deployment was also supported by a sweep of announcements on funding packages to build out supporting infrastructure. Governments also announced industrial strategies that aim to create and expand their prominence within integrated supply chains, so as to futureproof their economies and support domestic production.

Governments announced more ambitious zero-emission vehicle targets and policies in 2021 than ever befor

## ADVANTAGES OF ELECTRIC VEHICLES

Transport is a fundamental requirement of modern life, but the traditional combustion engine is quickly becoming outdated. Petrol or diesel vehicles are highly polluting and are being quickly replaced by fully electric vehicles. Fully electric vehicles (EV) have zero tailpipe emissions and are much better for the environment. The electric vehicle revolution is here, and you can be part of it. Will your next vehicle be an electric one?

## Lower running costs

The running cost of an electric vehicle is much lower than an equivalent petrol or diesel vehicle. Electric vehicles use electricity to charge their batteries instead of using fossil fuels like petrol or diesel. Electric vehicles are more efficient, and that combined with the electricity cost means that charging an electric vehicle is cheaper than filling petrol or diesel for your travel requirements. Using renewable energy sources can make the use of electric vehicles more eco-friendly. The electricity cost can be reduced further if charging is done with the help of renewable energy sources installed at home, such as solar panels.

## Low maintenance cost

Electric vehicles have very low maintenance costs because they don’t have as many moving parts as an internal combustion vehicle. The servicing requirements for electric vehicles are lesser than the conventional petrol or diesel vehicles. Therefore, the yearly cost of running an electric vehicle is significantly low.

## Zero Tailpipe Emissions

Driving an electric vehicle can help you reduce your carbon footprint because there will be zero tailpipe emissions. You can reduce the environmental impact of charging your vehicle further by choosing renewable energy options for home electricity.

Tax and financial benefits

Registration fees and road tax on purchasing electric vehicles are lesser than petrol or diesel vehicles. There are multiple policies and incentives offered by the government depending on which state you are in. To find out more about electric vehicle incentives, click below .

ELECTRIC VEHICLE INCENTIVE

Petrol and diesel use is destroying our planet

The availability of fossil fuels is limited, and their use is destroying our planet. Toxic emissions from petrol and diesel vehicles lead to long-term, adverse effects on public health. The emissions impact of electric vehicles is much lower than petrol or diesel vehicles. From an efficiency perspective, electric vehicles can covert around 60% of the electrical energy from the grid to power the wheels, but petrol or diesel cars can only convert 17%-21% of the energy stored in the fuel to the wheels. That is a waste of around 80%. Fully electric vehicles have zero tailpipe emissions, but even when electricity production is taken into account, petrol or diesel vehicles

emit almost 3 times more carbon dioxide than the average EV. To reduce the impact of charging electric vehicles, India is ambitious to achieve about 40 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by the year 2030. Therefore, electric vehicles are the way forward for Indian transport, and we must switch to them now.

Electric Vehicles are easy to drive and quiet

Electric vehicles don't have gears and are very convenient to drive. There are no complicated controls, just accelerate, brake, and steer. When you want to charge your vehicle, just plug it in to a home or public charger. Electric vehicles are also quiet, so they reduce noise pollution that traditional vehicles contribute to.

## Disadvantages Of Electric Vehicles

1. Higher Purchase Cost

Compared to regular automobiles, electric vehicles are highly pricey. A gasoline vehicle costs between three and four lakh rupees. However, you would be surprised to learn that the beginning price of an electric vehicle is merely ten to twelve lakhs. Due to the high cost of purchasing, not everyone in this position can utilize it.

2. Low Speed and Range

An electric car will not be able to go vast distances. Electric vehicles cannot travel farther at a faster rate of speed than those powered by engines if speed is the issue. The driving range is also very limited in addition to this.

3. Low Price on Selling

Even though fuel-powered cars are expensive to maintain, they sell for a high price. When it comes to electric vehicles, you may acquire them for less than three times the price you paid. After operating an electric car, the relevance of its capacity reduces substantially, resulting in a low selling price.

4. The Inconvenience of Service Station

The utilization of electric vehicles is still in its infancy. As a result, the stations that serve it are similarly built in small numbers. Even after traveling great distances, service locations where cars may be refueled with electricity are few and far between.

5. Low Energy

The most significant disadvantage of electric vehicles is that they must be charged regularly. Aside from that, increasing the weight of these vehicles reduces their capacity. Electric cars with little energy and capacity can sometimes fall behind fuel-powered ones.

6. Battery Expenses

Although electric vehicles do not utilize gasoline, the batteries that power them are quite powerful. Aside from that, if the battery is not changed within a defined time interval, it might cause the vehicle to be damaged.

7. Slow Charging

Electric vehicles require many hours to charge, unlike engine-powered vehicles, which can recharge quickly. The charging of these automobiles is quite sluggish. Why would anyone waste time refilling a vehicle in our fast-paced world

**Electric Vehicle Charging Infrastructure**

**Level 1 and Level 2**
**Residential Charging**

Electric vehicles are charged via an AC power supply at a normal (Level1) or semi fast charging rate:
Voltage
120V 1-Phase AC
Amps
12-16 Amps
Charging Loads
1.4 to 1.9 KW
Charging Time
3-5 Miles of range per hour
Price per Mile
2c-6c mile

**Level 2**
**Work and Public place Charging**

Electric vehicles are charged via an AC power supply at semi fast (Level2) charging rate:
Voltage
208V or 240V 1-Phase AC
Amps
12-80 Amps (Typ 32 Amps)
Charging Loads
2.5 to 19.2KW (Type 7KW)
Charging Time
10-20 Miles of range per hour
Price per Mile
2c-6c mile

**Level 3**
**DC Fast Charging**

Electric vehicles are charged via an DC power supply at a fast (Level3) charging rate:
Voltage
208V or 480V 3-Phase AC
Amps
<125 Amps (Typ 60 Amps)
Charging Loads
<90KW (Type 50KW)
Charging Time
80% Charge in 20-32 minutes
Price per Mile
12c-25c per mile

## APPLICATION:

1. Expensive Recharging Options

If there is any other choice than recharging the electric vehicles at a charging station, it is to charge them with the electrical power supply connected to their houses. If you do this, your electricity bill may surprise you considerably. To recharge these vehicles, a high-voltage electric current is required.

2. Problem For Fuel-Producing Countries

You may already be aware that many nations only have relevance because of the fuel they provide. Fuel sales power the economies of numerous nations, including Iran, Oman, and Saudi Arabia. If the number of diesel fuel cars suddenly declines, these nations may face a financial crisis. As a result, the popularity of fuelless electric cars may prove to be a problem for fuel-producing countries.

3. Fewer Users

Due to the high cost of electric vehicles, it is not accessible to everyone. It is not incorrect to suggest that electric vehicles are exclusively available to the wealthy. One of the main reasons for its high price is that the number of electric vehicles is also limited due to low product availability. The costs of low commodities and excess demands

## CONCLUSION:

So, in conclusion, electric cars have both advantages and disadvantages. They are a great way to minimize environmental pollution but also have certain disadvantages. We all know that nothing is perfect or adequate. Thus, in this article, we made you aware of these things. This article may be helpful when considering choosing an electric vehicle in the future.