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Q15

The adoption of electric vehicles is rapidly growing worldwide. How do electric vehicles contribute to reducing carbon emissions and what are the key benefits they offer compared to traditional combustion engine vehicles?

UPSC Civil Services Mains 2023 · GS III · 15 marks · Environment and Conservation

Conservation, environmental pollution and degradation, environmental impact assessment.

Core demand of the question

- Explain how electric vehicles reduce India's carbon footprint
- Compare key benefits of EVs over internal combustion engine vehicles
- Name Faster Adoption and Manufacturing of Electric Vehicles (**FAME II**) and related industrial policy

Revision summary

EVs have no tailpipe carbon; life-cycle carbon depends on a still coal-heavy but greening Indian grid.

They are usually cleaner than petrol cars because power plants beat small engines, especially as renewables grow.

Two- and three-wheelers matter most for India's kilometres and oil bill.

Versus ICE, EVs win on efficiency, running cost, noise, and local air; they lag on price, range, and charging.

FAME II and Advanced Chemistry Cell PLI are the Union levers; recycling and clean charging complete the carbon claim.

Introduction

An **electric vehicle (EV)** replaces tank petrol or diesel with a **battery and a motor**. Tailpipe carbon at the street falls to zero. National carbon falls only if the **grid** that charges the battery is cleaner, and if the **battery** is made and recycled without a new mess. India is pushing that shift with **Faster Adoption and Manufacturing of Electric Vehicles (FAME II)** and industrial incentives.

Body**Reducing the carbon footprint**

- **No tailpipe CO₂ or NO_x** in the city; that is immediate air-quality gain even before the grid is green.
- Over the vehicle's life, carbon depends on **kWh of electricity** and how those kWh are made. India's grid is still **coal-heavy**, so a charged EV is not a zero-carbon machine today. It is usually **lower carbon than a petrol car** because a power plant is more efficient than a small engine, and because renewables on the grid keep rising.

- **Two- and three-wheelers** dominate Indian kilometres. Electrifying them cuts a large share of urban fuel use with smaller batteries than cars.
- **Less oil import is a carbon and a current-account gain:** transport is a large slice of diesel and petrol demand.
- Gains shrink if users charge on **diesel generators**, if batteries are dumped, or if extra coal plants are built only for peak charging. Pair EVs with **renewable power, time-of-day tariffs, and recycling**.

Benefits versus internal combustion engine (ICE)

- **Energy efficiency:** more of the energy in the battery becomes motion; an ICE wastes most of the fuel as heat.
- **Running cost:** electricity per kilometre is typically lower than petrol or diesel at Indian retail prices.
- **Local air and noise:** no exhaust; quieter streets.
- **Maintenance:** no oil change, simpler drivetrain; brake wear falls with regenerative braking.
- **Torque and drivability** in city start-stop traffic.
- **Offsets: higher purchase price** (falling with scale), **range and charge time, charging access**, and **battery minerals**. ICE still wins on long-haul heavy trucks until chemistry and trucks catch up.

Policy

- **FAME II** subsidises eligible e-buses, two- and three-wheelers and some cars, and supports charging points.
- **Production Linked Incentive** for **Advanced Chemistry Cell** batteries and for auto champions aims to make cells in India.
- State EV policies add road-tax waivers. The carbon story succeeds if these raise **utilisation of clean kWh**, not only showroom numbers.

Flow diagram

Electric vehicle -> Zero tailpipe
 Electric vehicle -> Grid kWh
 Grid kWh -> Carbon footprint
 Zero tailpipe -> City air
 FAME II PLI ACC -> Electric vehicle
 ICE petrol diesel petrol diesel -> Heat waste oil import

Conclusion

EVs cut street carbon and usually cut life-cycle carbon versus ICE as the grid adds renewables. They win on efficiency, running cost, and city air. **FAME II** and battery PLI are the adoption tools. They fail the climate test if charging stays coal-only and batteries stay unrecycled.

Facts & figures

FAME II

Faster Adoption and Manufacturing of Electric Vehicles Phase II: demand incentive for eligible EVs and support for charging.

PLI-ACC

Production Linked Incentive for Advanced Chemistry Cell battery storage, to localise cells.

Grid mix

Coal still supplies a majority of Indian electricity; EV climate gains grow as the renewable share rises.

Two-wheeler weight

Most Indian passenger kilometres are on two-wheelers; electrifying them moves more carbon than a few luxury cars.

Oil import

Road fuel is a large part of India's crude-product demand; EVs cut that bill if they replace ICE kilometres, not add to them.

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