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Analyzing the Environmental and Public Health Impacts of Increased Petrol and Diesel consumption and its emissions in relation to Alternate Fuels

Mohamed Rizwan[1], K.Karthikeyan[2]*
[1]Research Scholar, Karunya School of Management , Karunya Institute of Technology and Sciences, Coimbatore.
[2]Assistant Professor, HOD Skill Development, Karunya School of Management , Karunya Institute of Technology and Sciences, Coimbatore.
***Corresponding author:** K.Karthikeyan, Assistant Professor, HOD Skill Development, Karunya School of Management , Karunya Institute of Technology and Sciences, Coimbatore, Email:karthikeyan@karunya.edu

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ABSTRACT

India is one of the largest consumers of petrol and diesel. Increased petrol and diesel consumption and emissions have significant environmental and public health impacts. Petrol and diesel are fossil fuels that emit pollutants such as carbon monoxide, nitrogen oxides, and particulate matter when burned in engines. These pollutants contribute to air pollution, which can lead to respiratory problems, cardiovascular disease, and other health issues. In addition to their harmful effects on public health, petrol and diesel emissions also contribute to climate change by releasing greenhouse gases into the atmosphere. The increase in global temperatures caused by greenhouse gas emissions is linked to rising sea levels, more frequent extreme weather events, and other environmental disruptions.To mitigate these impacts, efforts are being made to transition towards alternative fuels that emit fewer pollutants and greenhouse gases. This study analyses fuel efficiency, emissions, and cost-effectiveness of traditional petrol and diesel vehicles compared to alternate fuel vehicles such as Electric Vehicles (EVs), Auto Liquefied Petroleum Gas (LPG), Compressed Natural Gas (CNG), Biodiesel, and Hydrogen fuel. The analysis also done on the growth of petrol and diesel with respect to the sales of two and four wheeler vehicles. To secure a sustainable and healthy future, it is necessary to shift towards the alternate fuels to reduce the environmental and public health impacts resulting from the increased consumption of petrol and diesel and the associated emissions.

Keywords: *Fuel consumption, traditional petrol and diesel vehicles, alternate fuel vehicles, Electric Vehicles (EVs), Auto Liquefied Petroleum Gas (LPG), Compressed Natural Gas (CNG), Biodiesel, Hydrogen fuel cells, fuel efficiency, emissions, pollutants, public health, cost-effectiveness*

INTRODUCTION

Transportation is a vital aspect of modern life, with millions of people commuting to work, traveling, and engaging in various activities that require the use of vehicles. The paper highlights the issue of increased petrol and diesel consumption and emissions in India, and the resulting negative impacts on the environment and public health. It highlights the various pollutants that are emitted by fossil fuels and how they contribute to air pollution, which in turn

causes respiratory problems, cardiovascular disease, and other health issues. The paper also draws attention to the fact that petrol and diesel emissions contribute to climate change by releasing greenhouse gases into the atmosphere, which can cause environmental disruptions such as rising sea levels and extreme weather events.

To address these issues, alternate fuel vehicles have been developed, which aim to reduce fuel consumption, emissions, and dependence on fossil fuels. The most notable alternate fuel vehicles include EVs, auto LPG, CNG, Biodiesel, and Hydrogen fuel cells. However, these alternate fuel vehicles differ significantly in terms of their fuel efficiency, emissions, and cost-effectiveness, making it challenging to determine the most viable options for a sustainable transportation system.

The analysis also examines the growth of petrol and diesel consumption with respect to the sales of two and four-wheeler vehicles in India, thereby it shows there will be a standard growth in petrol and diesel consumption in India prospectively in future.

The analysis highlights the potential benefits of alternative fuels in mitigating the environmental and public health impacts of increased petrol and diesel consumption and emissions. The successful transition towards alternative fuels requires a concerted effort from governments, businesses, and individuals to promote a sustainable and healthy future.

LITERATURE SURVEY

Jia et al [2] compares the environmental and economic impacts of conventional fuels such as gasoline and diesel with alternate fuels such as biodiesel and CNG in the transportation sector. The study highlights the need for supportive government policies and increased infrastructure for the widespread adoption of alternate fuels. The study does not provide a detailed analysis of the technical feasibility of using alternate fuels.

Liu et al[3] presents a lifecycle assessment of the greenhouse gas emissions from EVs and Hydrogen Fuel Cell Vehicles (HFCVs) in China [2]. The study provides insights into the environmental impact of EVs and HFCVs and highlights the need for clean energy sources for hydrogen production. The study does not compare the technical feasibility and economic viability of EVs and HFCVs.

Singh et al [4] presents an optimization model for the design and operation of a Hybrid Renewable Energy System (HRES) for EV charging stations. The study provides insights into the potential of HRES for reducing the environmental impact and cost of operating EV charging stations. The study does not provide a detailed analysis of the technical feasibility and economic viability of implementing HRES in real-world scenarios.

Zhang et al.[5] provides a review of the development and deployment of EV charging infrastructure in China, including the current status and challenges faced [4]. The study provides insights into the progress and challenges of EV charging infrastructure development in one of the world's largest EV markets. The study focuses only on China and does not provide a comparative analysis with other countries or regions.

Gutiérrez et al. [6] presents an environmental and economic analysis of different electric bus charging infrastructure designs, including overhead charging, plug-in charging, and wireless charging. The study provides insights into the environmental and economic feasibility of different electric bus charging infrastructure designs. The study focuses only on electric bus charging infrastructure and does not provide a comparative analysis with other types of EV charging infrastructure.

Bhardwaj et al. [7] presents a review of the potential of biogas as an alternate fuel for transportation in India, including its production, properties, and potential for reducing greenhouse gas emissions. The study provides insights into the potential of biogas as an alternate fuel for transportation in India, a country with significant energy and environmental challenges. The study does not provide a detailed analysis of the technical and economic feasibility of using biogas for transportation in India.

J. Liu et al.[8] reviews the environmental and health impacts of emissions from road

transportation, including petrol and diesel emissions. The authors discuss the various pollutants emitted by vehicles and their effects on air quality, human health, and the environment. The paper provides a comprehensive review of the topic, highlighting the major pollutants emitted by road transportation and their impacts. The paper does not provide a detailed analysis of potential solutions or mitigation strategies.

R. M. Sinha et.al [9] reviews the health and environmental impacts of air pollution in India, with a focus on the sources of pollution, including petrol and diesel emissions. The authors discuss the major pollutants emitted by vehicles and their effects on air quality, human health, and the environment. The paper provides a detailed analysis of the impacts of air pollution in India, with a specific focus on the sources of pollution. The paper does not provide a detailed analysis of potential solutions or mitigation strategies.

P. M. Sudhakar et.al. [10] provides an environmental impact assessment of petrol and diesel use in India, including their effects on air quality, water quality, and land use. The authors discuss the major pollutants emitted by vehicles and their impacts on the environment. The paper provides a detailed analysis of the environmental impacts of petrol and diesel use in India. The paper does not provide a detailed analysis of potential solutions or mitigation strategies.

PROPOSED SYSTEM

This study analyses the fuel consumption of traditional petrol and diesel vehicles compared to alternate fuel vehicles such as EVs, auto LPG, CNG, Biodiesel, and Hydrogen fuel cells. The analysis considers various factors such as fuel efficiency, emissions, and cost-effectiveness, to determine the most viable alternate fuel options for a sustainable transportation system. The paper consists of three sections:

Study on fuel efficiency and emissions of alternate fuels.
Analysis on the growth of petrol and diesel consumption in India with respect to the sales of all kinds of passenger and commercial vehicles.
Environmental and public health impact due to petrol and diesel emissions.

Discussion on the study where it deals about the necessary initiatives to be taken in order to shift India to the alternate fuels.

Study on alternate fuels and its advantages

As the world's population grows and the demand for energy increases, it has become imperative to find alternate sources of fuel that are sustainable, renewable, and environmentally friendly.

TABLE I: Comparison Of Fuel Efficiency, Emissions And Cost-Effectiveness For Different Types Of Fuels

Fuel Type	Fuel Efficiency Emissions	Emissions	Cost-effectiveness
Petrol	Less efficient than diesel engines	Emissions contain harmful pollutants	Widely available and cost-effective
Diesel	More efficient than petrol engines	Emit more harmful pollutants than petrol	Diesel fuel is less expensive than petrol
Electric Vehicles (EVs)	Highly efficient	Emit zero tailpipe emissions	Higher upfront cost, but lower operating
Auto LPG	Higher fuel efficiency than petrol and diesel	Cleaner-burning fuel than petrol and diesel	Generally more cost-effective than petrol
CNG	Higher fuel efficiency than petrol and diesel	Cleaner-burning fuel than petrol and diesel	Generally more cost-effective than petrol
Biodiesel	Lower fuel efficiency than petrol and diesel	Emit fewer greenhouse gases than traditional fuels	Can be more expensive than

Hydrogen Fuel	Require a lot of energy to produce and store	Emit only water vapour	Currently high cost due to energy required

Alternate fuels are those that are not derived from traditional sources such as oil, coal, and natural gas, and include sources such as biofuels, hydrogen, and electricity.

The study of alternate fuels and their advantages has become an important area of research and development in recent years, as the world seeks to reduce its dependence on non-renewable resources and move towards a more sustainable future.

Petrol

Petrol, also known as gasoline, is a fossil fuel derived from crude oil. It has been the dominant fuel for transportation for over a century due to its high energy density and availability. However, petrol combustion releases harmful pollutants into the atmosphere, including carbon dioxide, nitrogen oxides, and particulate matter. These emissions contribute to air pollution and climate change. In addition, the production of petrol involves significant environmental impacts, including oil spills, land use changes, and water pollution. The finite nature of crude oil reserves also raises concerns about energy security and dependence on fossil fuels. As a result, alternate fuels, such as biodiesel and electric vehicles, have gained attention as more sustainable and environmentally friendly options.

Diesel

Diesel is a fossil fuel similar to petrol, also derived from crude oil. It is commonly used in heavy-duty vehicles and machinery due to its high energy density and efficiency. However, diesel combustion also releases harmful pollutants into the atmosphere, including particulate matter, nitrogen oxides, and sulphur dioxide. These emissions contribute to air pollution and health problems, particularly in urban areas. In addition, the production of diesel involves significant environmental impacts, including oil spills, deforestation, and water pollution. The finite nature of crude oil reserves also raises concerns about energy security and dependence on fossil fuels. As a result, alternate fuels, such as biodiesel, compressed natural gas, and electric vehicles, have gained attention as more sustainable and environmentally friendly options.

Electric Vehicles (EVs)

Electric vehicles are powered by rechargeable batteries and electric motors, making them a zero-emissions option. EVs are the most fuel-efficient and environmentally friendly option among alternate fuel vehicles, producing zero emissions and requiring only the cost of electricity.

TABLE 2: Fuel Efficiency For Alternate Fuels

Vehicle Type	Fuel Required	Fuel Efficiency
Petrol Vehicle	4 gallons	25 miles per gallon
Diesel Vehicle	3.4 gallons	30 miles per gallon
Electric Vehicle	30 kilowatt-hours	0.3 kilowatt-hours per mile
Auto LPG Vehicle	5 gallons	20 miles per gallon
CNG Vehicle	3.4 gasoline gallon	30 miles per gasoline gallon
Biodiesel Vehicle	5 gallons	20 miles per gallon
Hydrogen Fuel Cell Vehicle	1.7 kilograms	60 miles per kilogram of hydrogen

TABLE 3: Emission Comparison For Alternate Fuels

Vehicle Type	CO2 Emissions compared to petrol (%)	NOx Emissions compared to petrol (%)
Petrol Vehicle	100%	100%
Diesel Vehicle	85%	377%
Electric Vehicle (EV)	0%	0%
Auto LPG Vehicle	66%	3%
CNG Vehicle	85%	5%
Biodiesel Vehicle	31%	184%
Hydrogen Fuel Cell Vehicle	Depends on hydrogen source	Negligible

Additionally, EVs require lower maintenance costs than traditional petrol and diesel vehicles, making them a more cost-effective option in the long run.

Auto LPG and CNG

Auto LPG and CNG are also cost-effective options with lower emissions than traditional petrol and diesel vehicles. Auto LPG is a blend of propane and butane, while CNG is compressed natural gas. Both fuels are cheaper than petrol and diesel, making them a more cost-effective option. Additionally, they produce lower emissions than traditional petrol and diesel vehicles, making them a cleaner option for the environment.

Biodiesel

Biodiesel is a renewable and environmentally friendly fuel made from vegetable oils, animal fats, or recycled cooking oils. Biodiesel has the potential to reduce emissions, but its cost-effectiveness is debatable, as it requires higher production costs than traditional diesel. Additionally, the production of biodiesel can have negative environmental impacts, such as deforestation and land use changes, which must be considered.

Hydrogen Fuel Cells

Hydrogen fuel cells convert hydrogen into electricity, making them a clean and efficient option. However, hydrogen fuel cells have the potential to be costly and require significant infrastructure development to become a viable option. The lack of infrastructure, coupled with high costs, makes hydrogen fuel cells less feasible in the current market.

The Table I shows the comparison of fuel efficiency, emissions, and cost-effectiveness for petrol, diesel, EVs, auto LPG, CNG, Biodiesel, and Hydrogen fuel:

The formula to calculate fuel efficiency is given below and fuel efficiency is calculated for alternate fuels:

Fuel Efficiency (in miles per kilogram of x fuel) = Distance Travelled (in miles) / x fuel Consumption (in gallons/kilowatt/kilograms)

Table II shows the comparison of fuel required and fuel efficiency for each type of vehicle to travel a distance of 100 miles. In Table II, we can see that the fuel required and fuel efficiency vary significantly between different types of vehicles. Electric vehicles require the most energy to travel a distance of 100 miles, while diesel and hydrogen fuel cell vehicles require the least amount of fuel.

TABLE 4: Cost Effectiveness For Alternate Fuels

Vehicle Type	Initial Cost	Fuel Prices	Maintenance Cost	Resale Value
Petrol Vehicle	Low	Medium	Low	Medium
Diesel Vehicle	High	Low	Medium	High
EV	High	Low/Medium	Low/Medium	High
Auto LPG Vehicle	Medium	Medium	Medium	Low
CNG Vehicle	Medium	Low/Medium	Medium	Low
Biodiesel Vehicle	High	Medium	Medium/High	Medium
Hydrogen Fuel Cell Vehicle	High	High	High	Low

TABLE 5: Passenger Vehicle Growth In February 2023

Vehicle Segment	February		
	2021-22	2022-23	Growth %age
Passenger Cars	1,33,572	1,42,201	6.5
Utility Vehicles	1,20,122	1,38,238	15.1
Vans	9,290	11,489	23.7
Total PV	2,62,984	2,91,928	11

However, it is important to note that the cost of fuel and energy sources may also vary, as well as the availability and accessibility of refueling or recharging infrastructure. Additionally, factors such as driving habits and conditions can also affect the fuel efficiency of a vehicle.

Assuming that the baseline for comparison is the emissions of a petrol vehicle, the following Table III shows the percentage of emissions for each vehicle type compared to a petrol vehicle:

The above percentages are based on real-time data and are subject to change based on various factors such as vehicle model, driving conditions, and fuel quality.

Table IV comparing the cost-effectiveness factors for each type of vehicle. The cost-effectiveness factors listed above are based on general trends and real-time data, and may vary based on factors such as vehicle model, location, and individual driving habits.

Analysis on the growth of petrol and diesel consumption in India with respect to the sales of all kinds of passenger and commercial vehicles

The study on the alternate fuels derives that the diesel is the cheapest and most efficient form of fuel in India. But the pollutant emissions are comparatively higher with respect to auto LPG, CNG, EV and Petrol. Most of the passenger vehicle manufacturing companies like Maruti, Hyundai and Toyota have reduced the production of diesel vehicles with reference to the pollutant emissions from diesel engine. But still there is a growth in passenger as well as commercial vehicle segments. The higher demand of the Indian Automobile Industry can be met only through Petrol and Diesel as per present scenario and it is easily available. Further we study the

growth of Petrol, diesel, Auto LPG as well as Indian Automobile Industry.

Table V shows the Sale of Passenger Vehicles in February 2023 at 2.9 lakhs recorded growth of 11% Year over Year (YoY) over sale of 2.6 lakhs in the month of February 2022. 'Passenger vehicle' sales have been driven by 'utility vehicles.' Passenger cars, utility vehicles and vans recorded a growth of 6.5%, 15.1% & 23.7% respectively during the current month as compared to the same period previous year. However, the data comparison is without BMW, Mercedes, and Tata Motors and Volvo Auto sales data.

Two wheeler and three wheeler sales

Two-wheeler sales in February 2023 with a volume of 11.3 lakhs recorded a growth of 7.6% on a month-on-month basis over volume of 10.5 lakhs during February 2022. Scooters/ Scooterettee & Motorcycle sales were impacted by the shortage in semiconductors and other special elements in the market [1]. Three-wheeler domestic sales in February 2023 with a volume of 0.5 lakhs recorded a growth of 86.1% on a month-on-month basis over volume of 0.27 lakhs during February 2022 as shown in Table VI.

High Speed Diesel (HSD)

The diesel which is used in the diesel engines is termed as High speed Diesel. HSD consumption during the month of February 2023 with a volume of 6.997 MMT recorded a growth of 7.5%, 6.5% & 3.9% over a volume of 6.511MMT, 6.569 MMT & 6.737 MMT in the month of February 2022, 2021& 2019 respectively.

TABLE 6: two & three wheeler vehicle sales in the month of february 2022 & 2023

Vehicle Segment	February 2021-22 (in units)	February 2022-23 (in units)	Growth %
Scooters	356,222	391,054	9.8
Motor Cycle	658,009	703,261	6.9
Mopeds	35848	35346	-1.4
Two Wheelers- Total Estimate	1050079	1129661	7.6
Passenger Carrier- 3 Wheeler	18144	38777	113.7
Goods Carrier- 3 Wheeler	7535	8711	15.6
E-rickshaw	1249	2615	109.4
E-cart	146	279	91.1
3 Wheelers- Total Estimate	27074	50382	86.1

TABLE 7: Month-Wise Hsd Consumption Million Metrics Ton (Mmt) From 2020-21

Month	HSD consumption (MMT)		
	2020-21	2021-22	2022-23
April	3.3	6.7	6.5
May	5.5	5.5	7.3
June	6.3	6.2	7.2
July	5.5	6.1	6.3
August	4.8	5.6	6.6
September	5.5	5.5	7.7
October	7.0	6.6	7.8
November	7.0	6.5	7.0
December	7.2	7.3	7.8
January	6.8	6.4	7.2
February	6.6	6.5	7.0
March	7.2	7.7	7.8

However, it recovered 97.7% over the volume of 7.162 MMT in February-2020. The HSD consumption for the month has crossed 6.9MMT band for the eighth time in FY-2022-23 so far.

Factors affecting diesel consumption during February 2023 are as follows:

Less rain fall & nearing harvesting season of rabi crop ramped up diesel consumption in irrigation, pumps etc.

Marriage season influenced personal mobility and gave push to diesel consumption.

Full-fledged industrial and mining activities in various parts of India increased diesel consumption. Less rainfall during the month ramped up mining activities.

Election in some states of the country ramped up vehicular movement and usage of Diesel Generator etc. attributing increased HSD consumption.

Pan India based domestic HSD consumption since April-2020 to till date is shown in the Table VII.

Table VII shows that there is a constant increase in the consumption of HSD Since 2021, and may still grow further due to the growth in population and Industrial development.

Environmental and public health impact due to petrol and diesel emissions

Petrol and diesel emissions are a significant source of air pollution, which has a negative impact on the environment and public health. When petrol and diesel are burned in engines, they release a range of harmful pollutants, including carbon monoxide, nitrogen oxides, and particulate matter. These pollutants can cause a range of health problems, including respiratory issues, cardiovascular disease, and cancer. In addition, petrol and diesel emissions are a major contributor to climate change, which can cause a range of environmental disruptions, including rising sea levels and more frequent extreme weather events.

To better understand the environmental and public health impacts of petrol and diesel emissions, let's take a closer look at some of the key pollutants and their effects:

Particulate matter (PM): Particulate matter is a mixture of tiny particles that can be inhaled into the lungs, causing respiratory problems and other health issues. PM is classified by size, with smaller particles (PM2.5) being more harmful than larger particles (PM10). According to a study by the Health Effects Institute, outdoor PM2.5 pollution was responsible for 4.2 million premature deaths worldwide in 2015.

Nitrogen oxides (NOx): NOx is a group of gases that can cause respiratory problems and contribute to the formation of ground-level ozone, which is harmful to human health and vegetation. NOx also contributes to acid rain and eutrophication, which can harm aquatic ecosystems. According to the European Environment Agency, NOx emissions from road transport are a major contributor to air pollution in Europe.

In India, the rapid increase in the number of vehicles on the roads has led to a significant increase in NOx emissions. According to a study conducted by the Centre for Science and Environment (CSE), in 2020, transport contributed to 15% of NOx emissions in India.

Carbon monoxide (CO): CO is a poisonous gas that can cause headaches, dizziness, and other health problems. High levels of CO can be fatal. According to the World Health Organization (WHO), exposure to high levels of CO can lead to neurological and cardiovascular effects.

In addition to these pollutants, petrol and diesel emissions also contribute to the formation of greenhouse gases, such as carbon dioxide (CO2), which are responsible for climate change. According to the Intergovernmental Panel on Climate Change (IPCC), human activities, including the burning of fossil fuels, are the primary cause of climate change.

Petrol and diesel emissions have significant environmental and public health impacts, including respiratory problems, cardiovascular disease, and climate change. It is essential to take action to reduce these emissions and transition

towards cleaner, alternative fuels to secure a sustainable and healthy future.

Discussion on the study where it deals about the necessary initiatives to be taken in order to shift India to the alternate fuels.

The study and analysis of the petrol and diesel in comparative with the alternate fuels with respect to their emission, cost effectiveness and growth derives that the traditional petrol and diesel fuels cannot be replaced by any of their alternates like auto LPG, CNG, EV and Hydrogen cells whereas due to the growing demand of industrialization we have to shift slowly to theses alternate fuels. There are many disadvantages in the consumption and usage of alternate fuel vehicle segments like source availability, service availability, storage capacity, safety parameters.

CNG as alternate fuel is much cleaner and cost efficient fuel compared to diesel but there is still a safety threat in the public mind due to the CNG tankage which comes outside the vehicles body and availability of CNG stations are very less. The price fluctuation of CNG has also made it unstable and is costlier in present market conditions.

Like CNG, auto LPG is also a cleaner fuel with propane and butane as the base. The disadvantages of auto LPG are similar like that of CNG where the initial pick up of the vehicle is slow and the cylinder is not inbuilt. And hence becomes a safety concern for the public. There is no standard quality of product and the quality varies from companies to companies for auto LPG which causes repair or makes the engine of the vehicle inefficient.

EV in a cost effective and zero emission alternate fuel whereas there are many practical difficulties in Electric Vehicles. The major concern is lithium battery which needs to be replaced in a short period of time like one to two years. The availability of charging station is also a major concern. The storage capacity of an EV battery is 30 to 50 kilowatt. Hence is not advisable for a long journey of more than 400 miles. Likewise, the speed in an EV and the loading capacity consumes the energy of the battery. Thereby giving a lower mileage. The manufacturing companies of EV vehicles are still in a trial and error method which makes the EV cars and bikes costlier. There are also many other safety issues in EV cars and bikes in case if the vehicles are not properly parked and maintained.

Hydrogen fuel cells are still in a testing stage and have not come for a 100% real time implementation in India. Yet to hit the Indian market.

These above disadvantages of alternate fuels make the public to depend on the traditional fuels like petrol and diesel. The Government of India has taken necessary steps and requested many manufacturing companies to stop production of diesel vehicles due to their emissions and ethanol has been blended in petrol up to 10% thereby reducing the emissions from the petrol.

In order to increase the EV vehicles and reduce the diesel vehicles Government of India has to take make other key initiatives like , offering organizations a huge discounts and monetary benefits on a bulk purchase for their employees , build more charging infrastructure in public places , Increase research and development in EV , Governments and private companies can invest more in research and development area to improve the technology to reduce the cost of electric vehicles and for the recycling of the E-waste involved in manufacturing and scrapping of the EV's.

By implementing these strategies, we can increase the number of electric vehicles on the road and move towards a more sustainable and environmentally friendly future.

CONCLUSION

The study on alternate fuels and its advantages reveals that the need for a shift from traditional fossil fuels to cleaner and sustainable options has become more pressing than ever. India has seen a significant rise in the consumption of petrol and diesel due to the increasing sales of passenger and commercial vehicles. This poses a threat to the environment and public health, which calls for urgent action to be taken. The study suggests necessary initiatives to encourage the adoption of alternate fuels such as electric, hybrid, and

hydrogen-powered vehicles, along with the implementation of policies and incentives to support this transition. The shift to alternate fuels not only helps in reducing emissions but also has economic benefits in terms of savings on fuel costs. Therefore, it is crucial for India to prioritize the shift to alternate fuels and take necessary actions to accelerate this transition.

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