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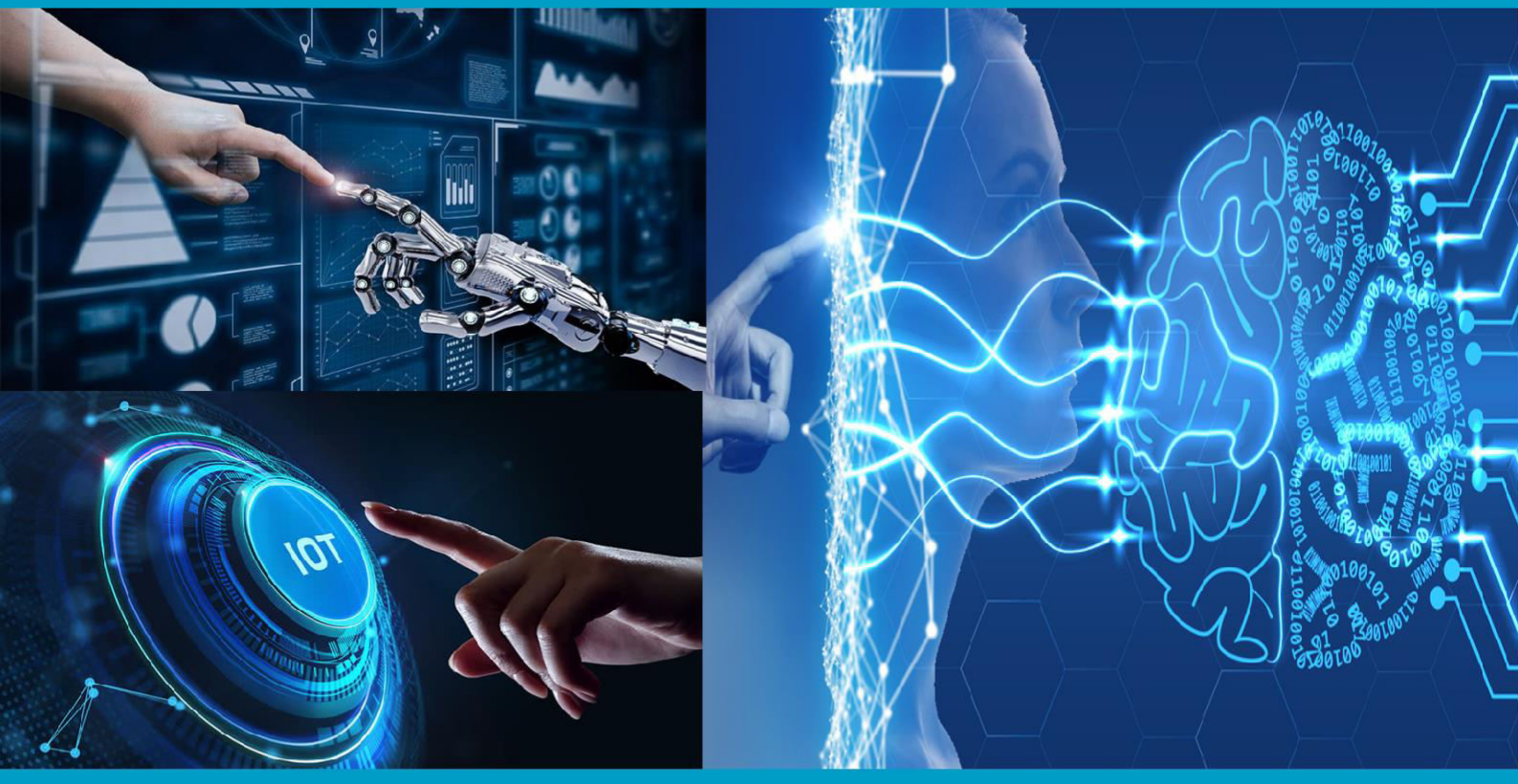

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Growth of Automobile Industry and Its Impact on air Pollution in India

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ABSTRACT

The automotive industry in India is the third-largest by production in the world as per 2022 statistics.[1][2][3]As of 2022, India is the 3rd largest automobile market in the world in terms of sales.[4] In 2022, India became the fourth largest country in the world by the valuation of its automotive industry.

As of April 2022, India's auto industry is worth more than US$100 billion and accounts for 8% of the country's total exports and 7.1% of India's GDP.[5] According to the 2021 National Family Health Survey, barely 8% of Indian households own an automobile.[6][7] According to government statistics, India has barely 22 automobiles per 1,000 people.[8][9]

India's major automobile manufacturing companies includes Maruti Suzuki, Hyundai Motor India, Tata Motors, Ashok Leyland, Mahindra & Mahindra, Force Motors, Tractors and Farm Equipment Limited, Eicher Motors, Royal Enfield, Sonalika Tractors, Hindustan Motors, Hradyesh, ICML, Kerala Automobiles Limited, Reva, Pravaig Dynamics, Premier, Tara International and Vehicle Factory Jabalpur.

KEYWORDS-Automobile,Production,Industry,Pollution,Air,India

I. INTRODUCTION

Automobiles are a 'necessary evil', while they have made living easy and convenient, they have also made human life more complicated and vulnerable to both toxic emissions and an increased risk of accidents. Urban people are most affected and amongst the worst sufferers are traffic policemen who are particularly close to the fumes of automobile exhaust. Studies made in Jaipur, India, indicate that there is high rate of occurrence of respiratory, digestive, ocular and skin problems amongst the traffic policemen and a significant number of them become victims of lung disorders in the very first few months of their posting to a traffic department. Traffic policement everywhere should wear 'pollution masks' for their own safety and to arouse public awareness of the risk of automobile pollution.[1,2,3]

The emissions of pollutants from vehicles are generally low but the numbers of vehicles increasing on the road therefore the environmental pollutions are also increases. About 35% of CO, 30% of HC and 25% percent of NOx produced into the atmosphere is from the transportation sector. These pollutants have adverse effects on the environment and human health. The emissions from vehicles are generally depends upon the air–fuel ratio. The control techniques for exhaust gas emissions are engine modifications, fuel pretreatment, fuel additives, exhaust gas recirculation (EGR), positive crankcase ventilation (PCV) and an application of catalytic converters. A catalytic converter is a device that converts more toxic exhaust gas pollutants into less toxic pollutants. There are different types of catalysts used in the automobile exhaust gas treatment like noble metal and base metals catalysts etc. The catalytic converter was effective and consistent for reducing the noxious tailpipe emissions so that it was developed for use in the trucks, buses, cars, motorcycles and other construction equipped.

India is the fifth-largest global car manufacturer with one of the highest compound annual growth rates (10 per cent) of vehicle registration as of 2019.

Due to economic growth, and continued aspiration of vehicle ownership, the annual car sales in India are projected to increase from the current 3.5 million to about 10.5 million — a three times increase — by 2030. Cars and two-wheelers will dominate the fleet with a share of about 87 per cent.

This will increase exposure to vehicular exhaust emissions. This requires not only improvement in emissions standards but also improvement in measurement procedures for emissions testing of vehicles to keep them low-emitting on roads. In 2022, some major reforms in testing procedures are expected. This needs to be informed well.

In India, vehicle technology is changing rapidly with changes in fuel quality, exhaust treatment systems of the internal combustion engines (ICE), electrification of vehicle segments and steps towards hydrogen-powered vehicles.

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But the current and future batches of ICE vehicles are likely to have a substantial share in on-road fleet till 2040, if not beyond. This not only requires substantial tightening of the emissions standards but also modification of technical parameters for testing of vehicles to reduce the emissions in the real world.

Already, vehicular emission is a major cause of air pollution in urban areas. Typically, vehicular emission contributes 20-30 per cent of particulate matter 2.5 (particles of size less than or equal to 2.5 micrometres) at the breathing level of air quality. This is considered more toxic because of the toxic constituents of its PM2.5 emissions.

According to studies, vehicles annually contribute about 290 gigagrams (Gg) of PM2.5. At the same time, around eight per cent of total greenhouse gas (GHG) emissions in India are from the transport sector, and in Delhi, it exceeds 30 per cent. [4,5,6]

India has taken a major decision to abate vehicular emission by leapfrogging to BS-VI emissions standards for new vehicles. But the vehicles will have to remain low-emitting in the real world when they are being driven. This demands improvement in emissions measurement procedures in the laboratory as well as on roads.

Why emissions testing methods matter

Most countries have formulated regulations for testing vehicles at the manufacturing end and when in use. The vehicle certification procedures consist of testing engine performance and emission compliance on the engine chassis dynamometer in the laboratory.

A drive cycle (a series of continuous data points of speed and time that approximates driving pattern in terms of acceleration, deceleration and idling) is followed to achieve acceptable test results. This is expected to simulate realistic driving intended for the vehicle type that has a bearing on emissions.

The Indian Drive Cycle (IDC) was the first driving cycle formulated for vehicle testing and certification in India based on extensive road tests. The IDC was a short cycle comprising six driving cycle modes of 108 seconds (reflecting a pattern of acceleration, deceleration and idling).

But the IDC did not cover all the complex driving conditions that are normally observed on Indian roads. The average speed of IDC was 21.9 kilometres per hour (covering 3.94 km), which was high for congested cities and low for rural roads or highways.

The IDC considered only gentle accelerations (<0.65 metres per second square) and relatively low engine loads. IDC allowed preconditioning of idling time (other than diesel vehicles) of 40 seconds that warmed up the engine before testing on the chassis dynamometer and ignored the cold start stage when the emissions is maximum. Because of these limitations, IDC does not represent real-world driving and is likely to underestimate the emissions.

Subsequently, as an improvement over IDC, the Modified Indian Drive Cycle (MIDC) was adopted, which is equivalent to the New European Driving Cycle (NEDC). MIDC accounts for wider speed profiles and is a better-suited cycle than the IDC.

MIDC is also significantly close to the idling conditions observed in real-world driving. The maximum speed in the MIDC cycle is set to 90 km/h.

Despite the improvements, MIDC may still represent vehicular emissions during on-road conditions adequately because of variations in traffic density, land-use patterns, road infrastructure and poor traffic management.

Also, the acceleration profiles in cities vary significantly from the prescribed acceleration in MIDC. The realistic speed-acceleration profiles are considerably higher than that mandated in MIDC.

Accelerations and decelerations are not well-reflected in the MIDC in high power requirement zones. In such conditions, vehicles emit high nitrogen oxides (NOx) and other pollutants.

It has therefore become necessary to adopt the Worldwide Harmonized Light Vehicle Test Procedures (WLTP), which is a global harmonised standard for determining the levels of pollutants from ICE and hybrid cars.

It is prudent that India adopts WLTP and suitable cycle or equivalent procedure to include wider range of driving conditions, more representative of on-road driving conditions as being prescribed by other countries.[7,8,9]

Measure emissions in real world

World is now moving towards measuring emissions in the real world when vehicles are driven. For the real driving emissions (RDE) tests, the European Commission, the United States and China suggest that the driving cycles and

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laboratory tests do not reflect the likely emissions during real driving conditions, which are more complex than laboratory driving cycles.

RDE is an independent test to overcome the limitations of WLTP and equivalent laboratory tests. A car is driven on public roads over a wide range of conditions.

Portable Emission Measurement System (PEMS) Equipment is installed on the vehicle that collects data to verify legislative caps for pollutants such as NOx, PN, etc. RDE tests are slowly becoming mandatory.

International Centre for Automotive Technology in India is currently developing RDE procedures that are likely to come into force in 2022.

The RDE cycle must account for conditions prevailing in the country, such as low and high altitudes, year-round temperatures, additional vehicle payload, up and downhill driving, urban and rural roads and highways.

The critical issue in the RDE test is the appropriate Conformity Factors (CF) to account for measurement uncertainty of on-board equipment when compared to laboratory tests.

The CF is 'not to exceed limit' that considers a margin for error present simply because the PEMS equipment does not deliver precisely the same results for each test.

The results of the RDE emissions for the entire RDE trip should remain below the 'not to exceed' emissions limits.[10,11,12]

Next steps

To make the testing parameters more effective for ICE vehicles by 2022, the Indian RDE program needs to pay attention to key technical parameters, but in accordance with Indian conditions. The RDE tests need to be made more robust. Here are some suggestions:

- The Indian RDE testing should consider extending altitude limits up to 2400m mean sea level (MSL). The motorable altitude is in the range of upto MSL to 3500 m. Most vehicles' common range of altitude is expected to be MSL to 1,300 m, excluding the hilly areas.
- India has a large area with significant periods of near- and sub-zero temperature zones in the winter months. The lower temperature limits should preferably be extended to 0 degree Celsius.
- India is using MIDC for type approval, which is no longer aligned with international laboratory testing cycles. India should shift to WLTP.
- The Indian market has highly efficient multi-point fuel injection diesel vehicles and such vehicles can achieve lower particle number / particulate matter emissions with tailpipe emission control devices. Therefore, the PM / PN limits can be further tightened in heavy-duty diesel vehicles.
- India needs to define CFs for RDE testing aligned with international best practice while meeting Indian requirements. EU has implemented CF at 1.5 (NOx and PN) level for EURO-6b. In due course of time, the emission limits during RDE should become fuel-neutral — to be same for vehicles on different fuels.
- Road maintenance and marking, smart traffic signaling, encroachments, standard speed breaker design, speed warnings and traffic discipline are important contributors to RDE. These should be optimally considered in RDE for urban, rural roads and highways.
- Poor quality lubricants and their inappropriate recycling are important causes of RDE. The quality of lubricants should be improved and recycled unorganized sales of the lubricants should be stopped.

II. DISCUSSION

Vehicular pollution is the introduction of harmful material into the environment by motor vehicles. These materials, known as pollutants, have several bad effects on human health and the ecosystem. Transportation is a major source of air pollution in many countries around the world due to the high number of vehicles that are available on the roads today. An increase in purchasing power means that more people can now afford cars and this is bad for the environment. Vehicular pollution has grown at an alarming rate due to growing urbanisation in India. The air pollution from vehicles in urban areas, particularly in big cities, has become a serious problem. The pollution from vehicles has begun to tell through symptoms like cough, headache, nausea, irritation of eyes, various bronchial and visibility problems.

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Ingredients of Vehicular Pollution

The following are the major pollutants associated with motor vehicles:

- Ozone- The primary ingredient in urban smog, ozone is created when hydrocarbons and nitrogen oxides—both of which are chemicals released by automobile fuel combustion—react with sunlight. Though beneficial in the upper atmosphere, at the ground level ozone can irritate the respiratory system, causing coughing, choking, and reduced lung capacity.
- Particulate matter- These particles of soot, metals, and pollen give smog its murky color. Among vehicular pollution, fine particles pose the most serious threat to human health by penetrating deep into lungs.
- Nitrogen oxides- These vehicular pollutants can cause lung irritation and weaken the body's defenses against respiratory infections such as pneumonia and influenza. In addition, they assist in the formation of ozone and particulate matter.
- Carbon monoxide- This odorless, colorless gas is formed by the combustion of fossil fuels such as gasoline. Cars and trucks are the source of nearly two-thirds of this pollutant. When inhaled, CO blocks the transport of oxygen to the brain, heart, and other vital organs in the human body. Newborn children and people with chronic illnesses are especially susceptible to the effects of CO.
- Sulfur dioxide- Motor vehicles create this pollutant by burning sulfur-containing fuels, especially diesel. It can react in the atmosphere to form fine particles and can pose a health risk to young children and asthmatics.
- Hazardous air pollutants- These chemical compounds, which are emitted by cars, trucks, refineries, gas pumps, and related sources.[13,14]

Causes of Vehicular Pollution

The main cause of vehicular pollution is the rapidly growing number of vehicles. The other factors of vehicular pollution in the urban areas are 2-stroke engines, poor fuel quality, old vehicles, inadequate maintenance, congested traffic, poor road condition and old automotive technologies and traffic management system.

Effects of Vehicular Pollution

These are some of the consequences of pollution:

(i) Global warming

Emission of greenhouse gases into the atmosphere leads to depletion of the ozone layer and this causes global warming. The result of this is adverse weather that more often than not results in loss of life and property. Global warming is a concern for many major world governments and deliberate efforts have been made to reduce it. With the ozone layer depleted, the harmful ultraviolet rays of the sun can reach the lower surface of the earth and harm humans and other living organisms on the planet.

(ii) Poor quality of air

There are countries where the quality of air is so poor that people wear masks to reduce the amounts of harmful substances inhaled. This is not something to smile about because aside from the fact that you have to walk around with a mask all day, which is not comfortable, there is also the possibility of health complications. Countries that have a high number of old vehicles generally have a problem when it comes to this. It’s the reason why many governments have also banned the importation of vehicles older than a certain number of years.

(iii) International reputation

Cleaning up the atmosphere is a serious concern globally. This is the reason why so many climate summits are held annually to make agreements on the responsibility of each nation in cutting down greenhouse emissions. A country that has a high level of vehicle pollution risks damaging its reputation and standing on the world stage.

(iv) Health

These pollutants can lead to lung infection and cancer. As we know, hydrocarbons are not very good for human health. They can cause heart disease, aggravate asthma, damage the central nervous system and make breathing difficult. Fuel spillage can also affect the health of plants and marine life. When left unchecked, these health conditions can cause death. Treating diseases such as cancer requires a lot of money. When the population of a country is mostly unwell, the economy stalls because growth is usually pegged on the ability of people to work and earn income.

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(v) Tourism

Most people would not willingly go to visit countries that they know are bad for their health. This will, in turn, result in a reduction in the number of tourists to those countries and subsequently loss of foreign exchange income.

(vi) Smog and acidic rain

Nitrogen oxides contribute to the formation of highly corrosive smog that speeds up rusting of vehicles. When nitrogen oxide dissolves in rain, acidic rain is formed. Water harvested from this type of rain cannot be fit for human, plant or animal consumption. These bad effects of vehicle pollution are the reasons why it should be every person's responsibility to reduce or eliminate environmental pollution. The actions of a small group can put a bigger demographic in harms way.

Reduction of Vehicular Pollution

Even if vehicle pollution cannot be completely eliminated, it can still be reduced to manageable levels. What are some of the things that individuals, governments, and organizations can engage in to reduce the effects of pollution caused by transportation? Here are some actionable pointers:

(i) Civic education

Ignorance is not bliss and education is definitely the key to success. Many people do not care about the effects of pollution because they are not aware of them. One cannot fight to protect what he or she values without knowing that there is an impending danger. Carrying out civic education by government departments and non-governmental organizations can play a great role in awakening the society to the realities of pollution and how reducing it can make the world a much better place to live in. This can be done through community organizers or by having it taught in schools as part of the curriculum. It would be counter-productive to keep on talking about the need to reduce vehicle pollution without making people understand why that is necessary. A sense of responsibility should be cultivated in everyone so that there is a desire and willingness to do what is right.

(ii) Progressive policies

Creating good regulations that anticipate the challenges of the modern world when it comes to reducing vehicle pollution can be very helpful in mitigating it. Lawmakers should draft legislations that will make people do the necessary as far as bringing down the levels of vehicle pollution is concerned. Such laws can include placing a cap on the age of vehicles that can be imported, setting out guidelines on the conditions of roadworthy vehicles, and creating agencies that will look into alternative fuels such as green energy. On the global front, world leaders should come together and agree on standard practices for eliminating or reducing pollution. These should be adopted so that every nation does its part in achieving the desired results. Citizens should also hold their leaders to account and push them to have strategies to reduce environmental pollution in their campaign manifestos.

(iii) Vehicle maintenance

This is more of a personal responsibility than it is universal. One should ensure that his or her car is in good condition and does not release a lot of harmful substances into the atmosphere. Regular car maintenance can help in repairing or replacing worn out parts. When this is done, the vehicle performs optimally and less amount of pollutants are released into the air. Things like replacing oil filters, changing the engine oil and greasing the moving parts should be done on a regular basis. Carelessness is the reason why some vehicles release dark harmful smoke while they are moving on the roads. This is especially harmful to those outside because they inhale the smoke and the dangerous matter.[15]

(iv) Discard old vehicles

Old vehicles should be discarded or returned to the manufacturing company so that new ones can be acquired. They contribute highly to environmental pollution and can also cause accidents on the roads. Getting rid of them would be a double win. Unfortunately many people attach sentimental value to such cars without knowing what that does to the ecosystem. A change in thinking would lead to better practices.

(v) Carpooling

People from the same neighborhood and who work in the same area should consider carpooling. This would reduce traffic jams, save money used on car fuel and maintenance and contribute towards having a clean earth. That is what would really make sense. On the flip side, neighbors would also have more time to bond. This enhances unity and harmony within the society.

(vi) Alternative means of transport

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It wouldn't hurt to use alternative means of transport even if you have a car. One can ride a bike, train or bus to work. Walking is also an option when your workplace is not that far off from your place of residence. Riding bikes, as well as walking, provide great exercising and fitness regimen options. Many people leave work when they are already tired and don't have time for fitness routines so this would make a fun option for staying healthy. It's also cheaper as compared to using your car which would still need fuelling, maintenance and set you back a couple of bucks in parking fees. Using these alternative means of transport is the smart choice.

(vii) Protective wear

In order to reduce the amount of pollutant inhaled, a person can consider putting on pollution masks. In countries where pollution is high and the quality of air is very poor, this is a common practice. Since you can't reduce or eliminate pollution and its effects all by yourself, it would be wise to protect your health. Pollution masks help in filtering the air you breathe so that you don't inhale a lot of impurities. The responsibility for your health starts with you.

It's often been said that we only have one earth and we should do everything to protect it. One cannot afford to sit on the sidelines and watch because when it comes to pollution, everyone is affected, even the ones that did not contribute to it. Vehicle transportation is one of the leading causes of air pollution the world over. The good thing is that something can actually be done about it. It begins with individual responsibility in having a cleaner planet. When people change their mindsets and become more proactive, a lot of good things can be achieved. In the same manner, vehicle pollution can also be reduced and managed.

III. RESULTS AND CONCLUSIONS

India's plan to remove millions of older polluting cars from its roads in an effort to clear some of the world's most toxic air looks set to face several challenges with a new survey showing the majority of vehicle owners aren't interested in trading in their automobile based on age.

Some 57% of 10,543 vehicle owners surveyed by LocalCircles say whether a car should be removed from service or not should depend on miles on the odometer rather than age. The government last year mandated that personal vehicles more than 20 years old and commercial vehicles more than 15 years old will need to undergo fitness tests in order to remain on the road.

In addition, just over half of consumers surveyed said they're planning to reduce the number of cars they own because they believe India's cash-for-clunkers policy will make it more expensive to keep an old vehicle. Authorities have made auto fitness tests more expensive since April, with owners of cars that are older than 15 years now having to spend eight times more to renew their registration.

The public's lack of interest in getting rid of polluting vehicles is a potential setback for India's ambitions to turn net carbon zero by 2070. Recycling old cars is crucial for India to cut emissions considering the take up of electric vehicles is lagging due to sparse charging networks and the high price of battery-powered transport. The nation's Centre for Science and Environment forecasts that by 2025, India will have as many as 20 million old vehicles nearing the end of their lives, causing huge environmental damage.[16,17]

Prime Minister Narendra Modi's administration has said it expects the program to attract fresh investment of more than 100 billion rupees ($1.3 billion) and curb the nation's dependency on other countries for metals. Modi has said scrapping end-of-life vehicles in India is currently not productive because precious metals aren't recycled and the energy recovery is close to nothing.

"Age is not a good criteria for scrapping a vehicle," Maruti Suzuki India Ltd. Chairman R.C. Bhargava said in an interview. "The logic has to be the car's ability to ply roads safely so it doesn't put other road users in danger. A vehicle gets scrapped when the user finds it isn't economical to repair it to get a fitness certificate."

Personal vehicles should undergo fitness tests every three years at least, Bhargava said. In India, when a car goes on the road there's typically no further inspection to check whether safety standards that were prescribed at the time of sale are being met. A large number of accidents happen because of defects in vehicles that aren't periodically certified as fit, he said.

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India also needs more large scrapping centers with recycling currently dominated by informal small-scale units. Maruti Suzuki and Toyota Tsusho Corp. have jointly set up a facility with an investment of 440 million rupees to scrap and recycle over 24,000 end-of-life vehicles annually. Mahindra MSTC Recycling Pvt., which has a recycling facility in Pune, is building four more scrapping units in the western state of Maharashtra with a capacity of 40,000 vehicles annually.[18]

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