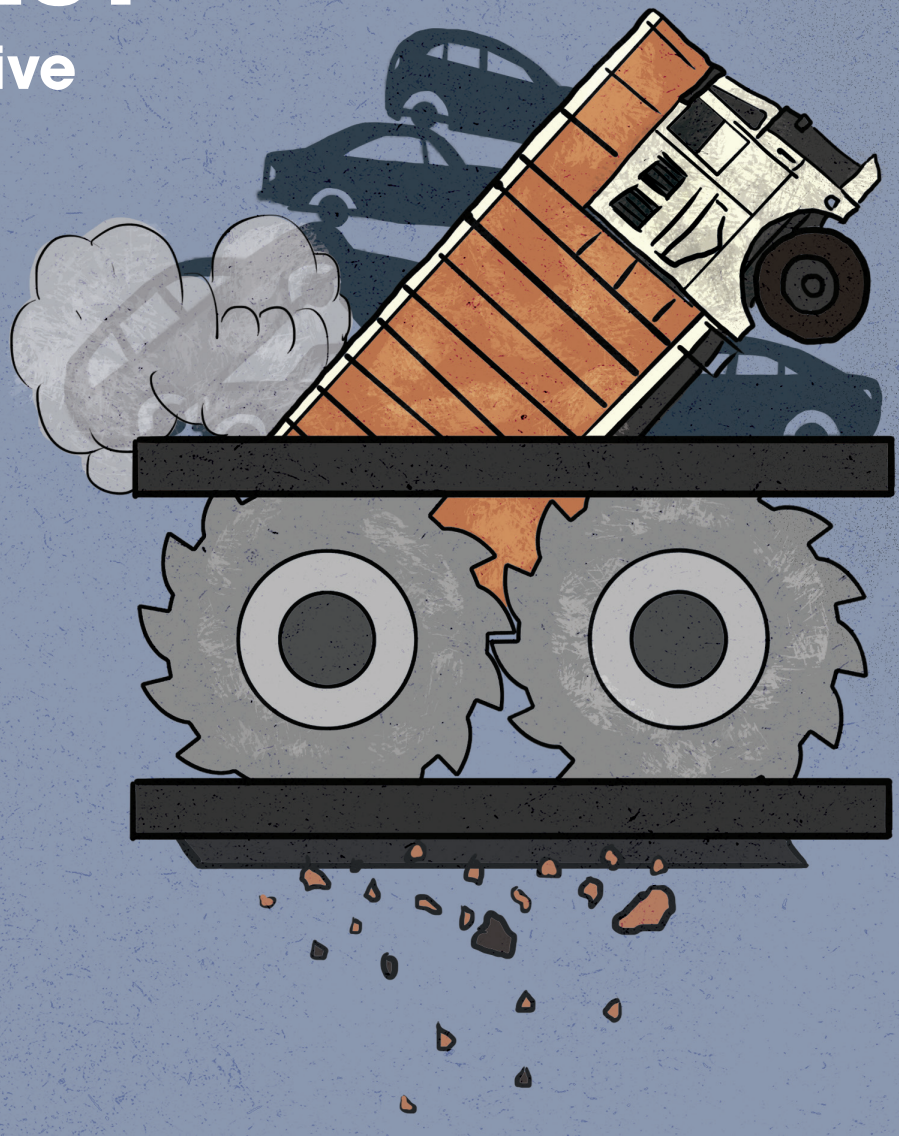
WHAT TO DO WITH OLD VEHICLES?

Towards effective scrappage policy and infrastructure



WHAT TO DO WITH OLD VEHICLES?

Towards effective scrappage policy and infrastructure

Centre for Science and Environment

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WHY THIS STUDY?

India leapfrogged directly from Bharat Stage (BS) IV emissions standards to BS VI in April 2020. This has reduced emissions from the new vehicle fleet by nearly 60–90 per cent, depending on the pollutant and vehicle segment. Gradual fleet renewal based on these standards can help to reduce on-road emissions substantially over time. The magnitude of this impact will also depend on the speed of fleet renewal—how quickly the grossly polluting vehicles are replaced with vehicles meeting the new standards.

This puts a spotlight on the old or legacy vehicle fleet meeting different generations of emissions standards across all regions. Old vehicles are used extensively in India. Accurate quantification of the legacy fleet is a challenge in India as the vehicle registration database is cumulative and is not corrected for retirement and scrappage over time. In 2016, a joint study by Central Pollution Control Board (CPCB) and GIZ had estimated that more than 87 lakh vehicles reached end-of-life (ELV) status by 2015. By 2025 the ELV numbers would be nearly 2.18 crore (two-wheelers account for about 80 per cent of the total ELVs).[1]

The scenario in India is no different from the rest of the world. Globally, on an average, two billion new vehicles are added annually that spew noxious pollutants and heat-trapping gases. At the same time, huge numbers are also becoming old and obsolete. In 2013, about 40 million vehicles a year were estimated to be approaching their end-of-life, representing four per cent of total global automobile ownership that needed to be scrapped.[2] This number will increase further with the growing economy and increasing aspirations of people.According to the International Energy Agency, the global four-wheeler fleet is expected to double by 2050. Also, as the latent demand for cars gets stimulated across the developing world, many old, used, and close-to-being-scrapped vehicles from the developed world will find a market there, with serious public health consequences.

India has been able to withstand the pressure of global trade in old used vehicles largely because of its own domestic policy that does not permit registrations of vehicles that are below the applicable national emissions standards. India also has a strong manufacturing base. However, vehicles change several hands within the domestic market. Growing obsolescence is making cities and towns the dumping ground of old vehicles in India.

There are several complex dimensions associated with old vehicles that require immediate policy attention in India.

Clean air imperative of old vehicles: Air pollution from older vehicles requires urgent attention in India. A quick review of the emissions factors for different generation of vehicle technologies shows that there is a significant difference in emissions rates between old and new vehicles. For instance, old heavy-duty diesel trucks meeting BS I norms can spew 36 times more particulate matter (PM) compared to BS VI compliant trucks. Estimates by the International Council on Clean Transportation (ICCT) for India show that pre-2003

vehicles were less than 23 per cent of the fleet but accounted for nearly half of the vehicular PM and a third of nitrogen oxide (NO_X) emissions in 2011. The accumulating fleet of old and used vehicles thus results in an enormous lock-in of pollution and is responsible for high level of on-road exposure in cities.

Currently, a large number of cities that do not meet the National Ambient Air Quality Standards (NAAQS) are required to implement clean air action plans under the National Clean Air Programme (NCAP) of the Government of India to meet the target of 20–30 per cent reduction in particulate pollution by 2024. Most of them have included phase out strategies for old vehicles as a pollution mitigation strategy. This requires larger policy guidance and legislative backing. Only those few cities where the judiciary is directing action on air pollution—Supreme Court in Delhi and the National Capital Region, High Court in Kolkata, National Green Tribunal (NGT) in these and other cities—have issued specific directions to cap the age of the old vehicles for a phase out. Delhi has capped the age of diesel vehicles at 10 years and petrol vehicles at 15 years. In Kolkata, the High Court has capped the age of commercial vehicles at 15 years. Earlier, under the Supreme Court's direction during 2003–04, several cities, including Kanpur and Lucknow, had initiated phase out of older vehicles. A tighter age cap was also adopted for public transport buses in several cities. In addition, some state governments like Maharashtra and Karnataka have implemented a green tax that increases with the age of vehicles in order to disincentivize old vehicles.

These city-based approaches to phasing out old vehicles can also create a perverse and iniquitous situation when older vehicles phased out from targeted cities move to cleaner regions and cause an increase in pollution there. In fact, the NGT had even issued a directive to identify cleaner areas in the country where these polluting vehicles could be exported. This defeats the purpose of air pollution mitigation to protect public health across the country. A different strategy is clearly required.

Currently, there is no composite national strategy that can help to comprehensively address ELVs based on well-defined criteria, or set the target for rolling out infrastructure for scrapping and recycling material with enforceable environmental safeguards across regions.

Climate imperative of old vehicles: Even though it is sometimes stated that vehicles may become more fuel efficient with age, old, ill-maintained, and malfunctioning vehicles can become energy guzzlers and emit high amounts of heat-trapping carbon dioxide (CO_2) that causes global warming. Moreover, short-lived climate forcers like diesel black carbon from older fleet can trap heat as well. These pollutants have a short life in the atmosphere compared to CO_2 but are bigger heat trappers. The International Panel on Climate Change (IPCC) considers black carbon emissions as short-lived climate forcers. The Working Group I contribution to the IPCC's Fifth Assessment Report (AR5 WGI) has for the first time led to the inclusion of estimates of global warming potential of black carbon which is 900 times higher than CO_2 in a comparable timeframe of 100 years. Therefore, removing high emitters of black carbon can provide climate co-benefits.

Environmental imperative of waste and circularity: Huge accumulation of old vehicles—that are past their useful on-road life—create heaps of waste that burdens the environment.

Yet, a great part of this waste, including metal, plastics, etc., can be recovered and brought back to production. This circularity will have to be built into the old vehicle policy. According to one estimate of the Federation of Indian Chambers of Commerce (FICCI), ELVs have the potential to generate over eight million tonnes of steel that can be extracted in India in 2025; this represents an opportunity to create approximately USD 2.7 billion. This is significant if we keep in view that consumption of steel in India during 2015–16 was approximately 81.5 million tonnes and ten per cent of this steel was used in the automobile sector.[3] This strategy of recycle and reuse can also contribute towards import substitution and improve the country's balance of payments.

Moreover, scrappage of vehicles is also expected to feed into the market for spare parts to meet the demand for appropriate spare parts in on-road fleet. The used-vehicle market has its own demand for appropriate spare parts for the makes and models that are not made by the industry any more. Renewal of on-road fleet makes older spare parts obsolete. This trade will have to be organized more efficiently to service the entire chain. Manufacturers and dealers will have to maintain a critical mass of service components and spare parts in these markets. This market becomes more complex and volatile when emission regulations speed up renewal of the on-road fleet. With growing sophistication in the original equipment manufacturers' (OEM) production process, the scope of reusing parts from the older fleet gets limited and reduced. As a result, a large part of used spare parts that could be reused become scrap and waste and that reduces overall material efficiency.

Economic imperative and green recovery: Global experience shows that targeted scrappage policies are announced from time to time as a fiscal stimulus package for the automobile industry. Such initiatives are taken largely during economic downturns like the 2008–09 recession or for targeted fleet renewal to reduce emissions. The economic imperative has become very significant now as the economy has taken a bad hit from the ongoing COVID-19 pandemic and the automobile industry is seeking stimulus support. The Ministry of Road Transport and Highways (MoRTH) is expected to announce a scrappage policy as a fiscal stimulus measure. It is necessary to link these stimulus policies with green recovery that allows maximum reduction in emissions from the heavy-duty sector and mandates that fleet renewal in any other segment is explicitly linked with targeted electric vehicle roll out to enable India to meet its target of 30–40 per cent electrification by 2030.

Policy imperative: It has now become necessary to define a composite framework for identification of ELVs and grossly polluting vehicles and plan their phase out to control toxic pollution and energy consumption. This will require adequate infrastructure for safe dismantling and recovery of maximum material for reuse and recycling to minimize environmental impact. Increasingly, air pollution regulations will push old vehicles out of the market. Measures that disincentivize older fleet reduce economic life of vehicles. As is evident in Delhi, fixing the age of diesel vehicles at 10 years has substantially reduced resale value of these vehicles. More junk will be created. Even globally, several measures implemented to disincentivize old vehicles—low emissions zones that do not allow entry of older and polluting vehicles inside targeted zones inside cities, expensive and rigorous emissions inspection requirement, higher taxes on older vehicles, and occasional scrappage schemes for targeted fleet renewal—are accelerating fleet retirement. This will require strong preparedness.

JUNK VEHICLE POLICIES IN INDIA

The economic shock during the pandemic has rekindled the conversation on scrappage policy in India. The Ministry of Road Transport and Highways has announced that such a policy as a stimulus strategy is awaiting Cabinet approval and will be announced soon.[4] However, this pandemic is not the origin of this policy. This policy—Voluntary Vehicle Fleet Modernisation Programme (Scrapping Policy)—has pre-pandemic roots. This draft has been in the making since 2016 and it was circulated as a consultation note way back in November 2018. The target was to replace old heavy-duty vehicles.[5] It was expected to come into effect on 01 April 2020.

The current draft policy that is awaiting Cabinet approval is not in the public domain yet. The scope and design elements of this latest proposal are not known. However, the original proposal had targeted to scrap 2.8 lakh old vehicles by giving monetary incentives to the vehicle owners to replace the old vehicle with a new vehicle while earning from the scrap value of old vehicles. Special discount from automobile manufacturers and partial excise duty exemption was also envisaged. These benefits were expected to add up to about 8–12 per cent of total vehicle cost. In fact, according to media reports, the total incentive package had the potential to reduce the cost of a new vehicle by 15 per cent on average.[6] According to reports, starting 2020, all pre-2000 registered commercial vehicles were proposed to go off the road and the life of new commercial vehicles was to be fixed at 20 years.

The draft note has also provided a rationale for targeting the commercial vehicle segment.According to this draft, even though commercial vehicles such as trucks, buses, taxis, and three-wheelers constitute only about five per cent of the total fleet, they contribute nearly 65–70 per cent of total vehicular pollution. The older fleet, typically manufactured before 2000—even before the emission norms were implemented—constitutes less than one per cent of the total fleet but contributes about 15 per cent of the total vehicular pollution. These older vehicles pollute 10–25 times more than a modern vehicle.[7] Therefore, a targeted scrappage scheme for these vehicles can provide considerable emissions benefits.

However, it is not clear if the new policy that is expected now will be confined to this segment alone or will be broadened to include other vehicle categories to provide stimulus for market recovery. According to media reports, the scope is likely to be extended to include other vehicle segments, including two-wheelers.[8] This is also likely to be combined with additional disincentives for very old vehicles including increasing re-registration fees of old vehicles for renewal of licenses after 15 years. However, the details about the full range of expected incentives in terms of monetary support and other fiscal measures from the Government are not known yet.

This scheme is expected to be a combination of fiscal incentives from the Government of India as well as a range of voluntary incentives from the industry. A ministerial statement in 2015 reportedly said that for replacement of small and medium duty vehicles the discount could be between Rs 30,000–50,000 and for heavy duty vehicles it could be upto Rs 1.5 lakh.[9]

But, according to reports, there seems to be a deadlock between the government and the industry over the nature and quantum of incentives and this is delaying the announcement of the scheme. The government wants the industry to volunteer to offer more incentives.[10] The industry is reluctant to increase its share of incentives on the grounds of economic slowdown and the investments made to meet the newly introduced BS VI emissions standards. Industry incentives will be important, especially if personal vehicles are also involved. While the automobile industry is otherwise known for giving voluntary discounts and adopting buy back schemes, etc., the nature of the expected voluntary incentives from the industry is not known at this moment.

However, this initiative has catalyzed interest in linking this scheme to green recovery, especially during this unprecedented crisis caused by the pandemic. While stimulating the market, the scheme should also deliver on the air quality and environmental goals. From that perspective, the scheme should stay on course of the original plan to target and replace old heavy-duty vehicles with BS VI compliant vehicles for maximum emissions gains. At the same time, for other segments, the scheme should link replacement of old vehicles with electric vehicles to accelerate transition towards zero emissions.

Globally, the scrappage policy for fleet renewal is now linked explicitly with air quality objectives for verifiable reduction in local air pollutants and green house gas emissions. The focus is steadily shifting towards green recovery from the pandemic which requires the linking of fiscal stimulus with the electric vehicle programme. Italy, France, Germany, and Spain, among others, have already come forward to provide support for the purchase of electric vehicles. This is needed in India also to ensure that the country, despite the economic slowdown, stays on track to meet the 30–40 per cent electrification target by 2030. Therefore, a lot will depend on the design of the scheme.

There are, however, concerns about the effectiveness of this scheme in meeting both environmental and economic objectives. For instance, the 'Cash for Clunkers scheme' in the US a decade ago was discontinued as it was felt that it had not adequately stimulated the economy. However, the available evidence in the US has also shown that other schemes related to heavy-duty diesel vehicles like the Carl Moyer programme and National Clean Diesel Campaign, that included vehicle replacement along with repowering and retrofitment strategies, have given considerable emissions benefits. This, therefore, points towards the need for designing the scrappage programme in India to ensure verifiable reduction in emissions and accelerate ambitious zero emission pathways.

This will help to address the concern that the scrappage scheme may only end up driving vehicle sales for the auto industry. NITI Aayog is reported to have stated that the scheme should be based on merits of fitness, maintenance, and emissions performance of vehicles and only an age-based approach may not be adequate. It may only result in an economic loss for vehicle owners.It is therefore important to integrate additional criteria of linking scrappage and accelerating fleet renewal with more advanced emissions trajectory. Incentive design for scrappage, especially of two-wheelers, cars, and three-wheelers, needs to be linked with BS VI vehicles and a mandatory share of electric vehicles for zero emissions pathways.

TOWARDS SCRAPPAGE INFRASTRUCTURE

The stimulus package and the ongoing clean air action to phase out and disincentivize older vehicles in cities are expected to inflate the number of junk vehicles. This will require an unprecedented scale of scrapping and dismantling infrastructure in cities for safe disposal and material recovery with minimal environmental damages.

Currently, Section 59 of the Motor Vehicle Act (MVA) 1988 and the amended Act of 2019 has a provision 'to fix the age limit of motor vehicle'. The central government can restrict plying of vehicles considering public safety and can specify the life of a motor vehicle. For the protection of the environment, the government can also make rules prescribing the manner of recycling of motor vehicles that have exceeded their useful life.[11] While this section does not define old vehicles or ELVs explicitly, various state and national permit conditions for commercial vehicles are governed by age, fuel, taxation regime, etc.

More clarity is expected in the scope of the definition of ELVs when the 'Draft guidelines for setting up, authorization and operation of authorized vehicle scrapping facility (AVSF) and the Automotive Industry Standard (AIS)-129 on End-of-Life Vehicles, prepared by the Automotive Industry Standards Committee of MoRTH in 2015, come into effect. These combined with the Guidelines of the Central Pollution Control Board for environmentally sound management of ELV are expected to set important criteria to define the scope of action.

The MoRTH's draft guidelines define end-of-life vehicles as those vehicles which are no longer validly registered, or whose registrations have been cancelled under chapter IV of the Motor Vehicle Act, 1988, or due to an order of a court of law, or which are self declared by the legitimate registered owner as a waste vehicle due to fire, damage, natural disaster, riots, accidents, etc. The government has proposed a few amendments to allow the scrapping of vehicles that are older than 15 years.[12] It has set out detailed criteria and guidelines for setting up of scrappagge facilities across the country for safe disposal and recycling of scrapped vehicles. Moreover, CPCB's Guidelines for Environmentally Sound Facilities for Handling, Processing and Recycling of End-of-Life Vehicles (released in January 2019) define ELV as a motor vehicle that has been abandoned, or is intended to be abandoned, and needs to be managed for the purposes of resource recovery.

However, these drafts are awaiting notification to make them enforceable. The National Green Tribunal has already directed notification of 'Draft guidelines for setting up, authorization and operation of authorized vehicle scrapping facility' and has granted two months time in view of the conditions created by the pandemic.

Currently, an extensive network of informal recyclers carries out dismantling and material recovery. While these are efficient systems for recovery of spare parts and materials, there are concerns that these operations are not well equipped to minimize environmental and occupational hazards and to contain contamination of soil, water, and air. In fact, the informal recycling hubs, like that in Mayapuri in Delhi, have drawn considerable local ire and judicial strictures. But, keeping in view that this informal sector plays a crucial role that cannot be easily substituted by the capital intensive formal sector, and

that this sector has strong potential for livelihood generation and support of the spare part market, it is necessary to design policies to support common pollution control efforts and infrastructure based on collective action to meet the CPCB guideline. A well-enforced siting policy, along with a strong monitoring strategy, is needed to minimize risk to the larger population.

Meanwhile, the Government of National Capital Territory of Delhi issued 'Guidelines for scrappage motor vehicle in Delhi' in August 2018. This includes provisions for licensing, inspection of scrappage centres and facilities, and safe disposal and recovery of scrapped materials and waste. All licensed scrap yards will have to follow the detailed guidelines including those framed by CPCB.

The new rules are also expected to provide an impetus for expansion of the formal scrappage sector with private players including the automobile industry coming forward to set up scrappage facilities. Mahindra Group, Tata Group, Toyota, etc. have already started to set up such facilities, in several cases as a joint venture with the government. They are better equipped to meet the environmental guidelines and can also formalize the process of deregistration of scrapped vehicles. But the existing facilities are still not being able to attract the critical business volumes and the reason is attributed to competition from the informal market. This is likely to change when environmental action on old vehicles accelerates and rules and guidelines are uniformly enforced and the informal sector also gets support for their implementation.

END-OF-LIFE REGULATIONS AND MATERIAL RECOVERY

The ultimate purpose of the scrappage policy is to minimize the environmental footprint of junk vehicles and clunkers. This requires maximum recovery of the material for reuse from the waste, increase in the share of recyclable material, and a reduction in the usage of environmentally harmful materials. This therefore requires not only a strong waste recycling and recovery system but also cooperation from manufacturers to ensure harmful materials are not used or minimized and a target maximum material recovery is met. This requires a regulatory mandate for the automobile industry to reduce usage of heavy metals, plastic, and rubbers; which when used are marked adequately for recycling.

India has already moved in that direction but the rules need to get firmer and more enforceable. AIS-129 was published by Automotive Research Institute of India (ARAI) in March 2015 on behalf of Automotive Industry Standards Committee under Central Motor Vehicle Rules (CMVR)[13]. Based on the review of the existing ELV recycling practices in the countries of Europe, Japan and China, AIS-129 is designed to minimize the impact of ELVs on the environment and was prepared after several consultations with International Automobile Recycling Congress (IARC) and International Congress & Marketing (ICM AG).

Part-2B of AIS-129, as published on the MoRTH and ARAI website, refers to the type approval of vehicles with regard to their reusability, recyclability, and recoverability. Accordingly, vehicles need to be reusable and/or recyclable to a minimum of 80 per cent by mass; and reusable and/or recoverable to a minimum of 85 per cent by mass.This document lays down the requirements for both collection and dismantling centres for the

vehicle manufacturers to comply with the Reduce, Reuse, Recycle calculations, to restrict usage of heavy metals in vehicles, and to suitably code the plastic components and provide dismantling information to the authorized collection and dismantling centres.

Part-2A of AIS-129 refers to the heavy metal restriction and dismantling information. It states that the vehicle manufacturers need to ensure that the vehicles type approved after the mandated date shall not contain lead, mercury, cadmium, or hexavalent chromium other than the specified cases and conditions in the regulation. The status of its implementation is still uncertain. While market watchers claim that the industry has started voluntary implementation, without the formal notification of the scrappage policy along with the AIS-129 and its formal inclusion in the Central Motor Vehicle Act, this cannot become legally enforceable. It is therefore necessary to notify these rules.

However, while doing so it is also necessary to assess the current gaps between India's AIS-129 regulations for recycling and recovery components and similar rules in Europe to further strengthen the Indian rules. There are critical departures from the European regulation (2000/53, 2005/64) that weaken the system. For instance, India's AIS-129 has included within its scope passenger vehicles (M1 category) and also two-wheelers but has excluded goods carriers (N1 category with mass not exceeding 3.5 tonnes). The document mentions that a decision on inclusion of N1 category vehicles will be taken after reviewing the experience with the other specified categories. European directive covers both M1 and N1 categories.

The most important gap in the current AIS-129 is the exclusion of extended producer responsibility (EPR) that provides the legal backing to the process in which vehicle manufacturers take the responsibility of taking back their respective ELVs for safe disposal. EPR is included in the European Directive. Similarly, the AIS-129 document has the provision for marking of the recyclable parts but it is limited to only plastic components. European rules require marking of rubber components as well. Moreover, regulation for controlling of aftermarket spare parts must also be included in AIS-129.

It is evident that detailed laws have been crafted globally for end-of-life regulations, scrappage requirements, and requisite infrastructure for dismantling and material recovery. EPR is in place to make the vehicle manufacturers responsible for safe disposal of vehicles. Countries are increasingly focussing on the policy for circularity to recover material from the waste heaps of used vehicles for reuse and recycling. Infrastructure is being set up to enable this. In fact, the European Union is expected to face an explosion in junk vehicles as most of its cities are now planning to phase out diesel engines and are also setting target dates to phase out internal combustion engines.

THE WAY FORWARD

India has the opportunity to accelerate fleet renewal based on BS VI emissions standards and achieve zero emissions requirement based on electric vehicles through a robust policy for maximizing public health gains and material recovery. If designed well, it can also ensure green recovery from the pandemic. The opportunity for maximizing these co-benefits lies in early implementation of the regulations and guidelines in the pipeline, legal enforceability, and time bound infrastructure creation. It is necessary that these policies and guidelines

are amended as required and notified for implementation quickly. While doing so, India needs to take note of the global learning curve and also leverage the local imperatives for appropriate policy design to achieve effective impact and delivery on environmental objectives.

Implement robust scrappage scheme to reduce emissions from heavy duty vehicles: The Government of India is expected to announce the scrappage scheme soon. The automobile industry has shown interest in this scheme for fleet renewal as this can stimulate the market at the time of economic slowdown. It is important to design this scheme effectively to provide strong emissions benefits. The focus of the incentive programme should be retained on replacement of old commercial vehicles, particularly old heavy-duty vehicles like trucks and buses, with vehicles meeting the BS VI emissions standards. This will provide substantial emissions benefits. The policy may also outline the performance criteria for identifying vehicles for scrappage. In fact, the centralized vehicle inspection centres that are being set up across the country under the aegis of the Ministry of Road Transport and Highways should have the facility to identify vehicles that are unfit for driving and operations. Such vehicles can belong to any age group. However, performance criteria will help to maximize the emissions gains.

Leverage scrappage stimulus to accelerate zero emissions pathways for the new normal: If the scope of this programme is being extended to personal vehicles, including two-wheelers and cars, linking the incentives with targeted electrification of the vehicle segment will be critical to enable India to accelerate the pathways to the target of 30–40 per cent electrification of fleet by 2030. Scrappage stimulus is an immediate policy pathway to accelerate this change. This needs to be extended to buses for city service as well. Globally, the scrappage stimulus is being linked with electric vehicles for green recovery from the economic shock of the pandemic. In India, the recently notified electric vehicle policy of Delhi government has provided for vehicle segment-wise monetary incentive for scrappage and replacement with electric vehicles as one of the instruments for meeting the target of 25 per cent electrification by 2024. This scrappage incentive will be provided after scrapping of old vehicles powered with internal combustion engines is confirmed. The policy has further provided for vehicle dealers' contribution to the scrappage incentive. The automobile industry's participation in this incentive programme and other national programmes will be critical to build support for this programme.

Notify the draft guidelines for authorized vehicle scrapping facility for safe dismantling and material recovery: Given the fact that vehicle retirement is expected to accelerate with enforcement of clean air policies, cities and regions will have to scale up infrastructure for scrappage. This will require immediate notification of the Draft Guidelines for setting up, authorization, and operation of Authorised Vehicle Scrapping Facilities. This is needed for protection of the environment and promotion of a legally compliant vehicle dismantling and scrapping industry.[14] Based on this, state governments would need to develop the details for implementation.

Integrate the informal sector: The informal sector plays an important role in the collection, dismantling, and recycling of ELVs. The spare part recovery business generates livelihood and also serves the market for in-use vehicles. It is important to create a system of monitoring

of these units based on MoRTH/CPCB guidelines. A cooperative or association of small units can be formed for collective environmental management. This may also require government support for setting up of common infrastructure for pollution control so that the informal businesses can become cleaner. Implementing a licensing system for roadside garages or workshops or repair shops can help. CPCB has already proposed a siting policy to have these centres in industrial areas. Enforcement is needed to protect residential and densely populated areas.

Amend and notify India Automotive Industry Standard for End-of-Life Vehicles (AIS-129) to establish manufacturers' responsibility: While AIS-129, already put up on the websites of MoRTH and ARAI, has established the requirement of 85 per cent recyclability and recoverability of material in vehicles, this needs further strengthening. The scope of the rule should be expanded to include the goods/commercial vehicles or N1 category and also the critical provision of extended producer responsibility to make the manufacturers responsible for recycling ELVs. AIS-129 will have to be notified under Central Motor Vehicle Act along with the scrappage policy to make it widely enforceable.

Notify and mandate the CPCB Guidelines for Environmentally Sound Facilities for Handling, Processing and Recycling of End-of- Life Vehicles to minimize environmental damage: 'Guidelines for the Environmentally Sound Management of ELVs in India' were initially framed in 2016 and further strengthened in 2019 to regulate handling, storage, and transportation of ELVs and provide the provision for environmentally sound de-pollution, dismantling, segregation, and disposal. This also has guidance on recycling facilities and technologies for the ELV recycling process.[15] This needs to be notified to become legally binding.

State governments to adopt state level scrappage policy: State governments need to adopt their respective state level scrappage policies to assess the magnitude of junk vehicles to build and license scrapping infrastructure accordingly. Further, enforcement of all guidelines related to safe disposal and material recovery need to be ensured. Local rules for scrapping will have to be established. Delhi has already adopted Guidelines for Scrapping Motor Vehicles in 2018.

Adopt broad based criteria for establishing targets of the scrappage programme and adopt complementary measures to disincentivize old vehicles: The proposed scrappage scheme has to establish verifiable emissions saving goals of the programme. This will require an upgrade of on-road emissions inspection systems to identify the malfunctioning grossly polluting vehicles, unfit vehicles, and also a segment of older generation vehicles that are high emitters. In addition to age caps, other strategies need to be adopted to disincentivize old and highly polluting vehicles in polluted cities/regions. This may include increasing annual road taxes linked with age like the green tax in Maharasthra and Karnataka. But this will require effective tracking to ensure that old vehicles are not abandoned in public spaces to avoid payment of tax dues and to prevent scrappage. Polluted cities may also consider introducing low emissions zones where old and polluting vehicles are barred from entering. This is widely practiced in Europe. In fact, the Supreme Court directive that bars entry of pre-2006 goods carriers and trucks into Delhi or the ban on old vehicles inside Delhi is a first step towards delineating an area as low emissions zone. Delhi has set a precedent.

This idea needs to be built on to do more city specific zoning to clean up local exposures in city centres. Moreover, on-road emissions monitoring needs to be upgraded for efficient fleet screening. Remote sensing or centralized inspection centres need to be leveraged for identification of unfit gross polluters for fleet renewal. It is also possible to consider such strategies as repowering of selected old heavy duty models with new engines to extend their useful economic life. This will require proper certification and quality control systems.

Clean up vehicle database for more credible estimation of ELVs: Scrappage policy will require cleaning up of the vehicle database to estimate accurately the quantum of legacy vehicles across all regions. MoRTH's initiative to create an online VAHAN database for active vehicle permits and registration is an important step. This needs to be taken forward to ensure that all road transport organizations (RTOs) in the country are connected with the updated database which is corrected based on obsolescence, deregistration or scrappage. Without accurate data it will be inefficient to quantify the monetary incentive package and the capacity of the srappage infrastructure to be created.

Need harmonized action: Several laws and rules at the central and state levels apply or have bearing on the dismantling and disposal of old vehicles. This will require coordinated action particularly between MoRTH, Ministry of Environment, Forests and Climate Change (MoEFCC), and CPCB to harmonize the regulatory framework and coordinate implementation. This will have to be aligned with state level action or any advanced measure needed in pollution hotspots.

SECTION 1

CHALLENGE OF LEGACY VEHICLES IN INDIA

MAGNITUDE OF OLD VEHICLES IN INDIA

It is not possible to estimate the precise number of old legacy vehicles by age in India as vehicle registration data is cumulative and is not corrected for scrappage, phase out, and transfers. Deregistration is not accounted for. This has inflated the number of total registered stock. It is therefore debatable how many of the registered vehicles are actually plying on the road.

With the advent of VAHAN database that the Ministry of Road Transport and Highways administers now, there is an opportunity to clean up the database if all RTOs connect and update the live permits for all commercial vehicles and active registration of all vehicles. In fact, the database on commercial vehicles has been cleaned up considerably as it is easier to track live annual permits. Moreover, all new registrations for the past few years are more accurately recorded. Further, with the ongoing implementation of high security non-temperable number plates, it is relatively easier to know the vintage of vehicles, their level of compliance to regulatory provisions, taxation requirements, etc. Deeper effort is needed to correct the entire national database, particularly for legacy vehicles. There is certainly potential for cleaning up the data set with increased digitization.

In the absence of reliable estimates of active vehicles on-road and their composition, studies on emission source inventory have often relied on parking lot surveys (by questionnaire method or by checking registration certificates of a sample), and fuel pump surveys (when vehicles visit for refuelling). Other methods that can be deployed to update and clean up the database are insurance details of vehicles and permits given to commercial vehicles. But these studies specific to cities are limited in scope.

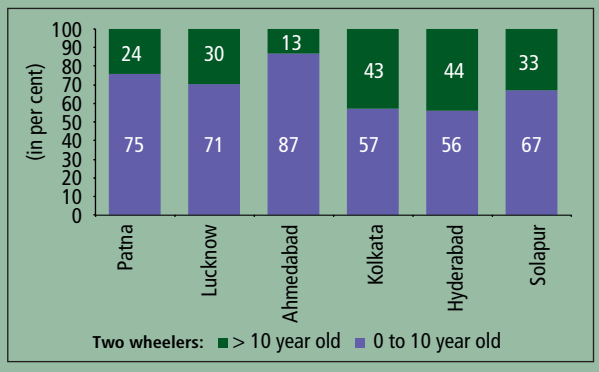
In 2015, CPCB commissioned a study to ascertain emission loads in six cities—Hyderabad, Kolkata, Ahmedabad, Patna, Lucknow, and Solapur, to know the 'status of pollution generated from road transport sector'. For this study CPCB ascertained the vintage of the vehicles based on parking lot surveys of about 4000 participants in each city owning different categories of vehicles. The surveys were random for each category of vehicle without any bias to fuel, age, model or any other factor. This vintage survey revealed that more than 90 per cent of three-wheelers in Ahmedabad and Lucknow, 45 per cent of three-wheelers in Kolkata, and more than 60 per cent of two-wheelers and 70 per cent of cars in all cities were post-2005.

Box 1: Vintage-wise distribution of vehicle categories in different cities, CPCB

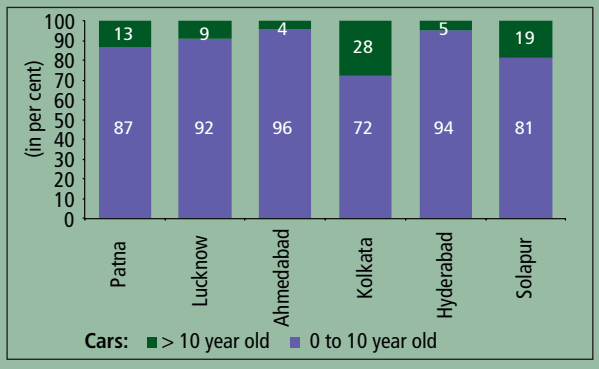
A summary analysis of vehicle vintage in different cities indicates that passenger cars in most cities are new compared to two-wheelers while buses and trucks in many cities are more than 10 years old.

Graph: Vintage-wise distribution of vehicle categories in different cities

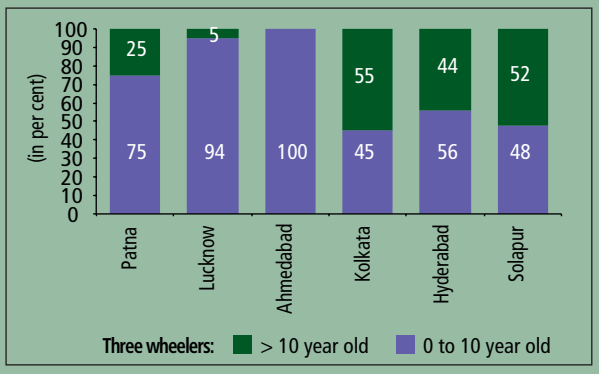
a.) Two-wheelers: Except Ahmedabad all cities have a high share of vehicles which are more than 10 years old (in the range of 24% to 44%)



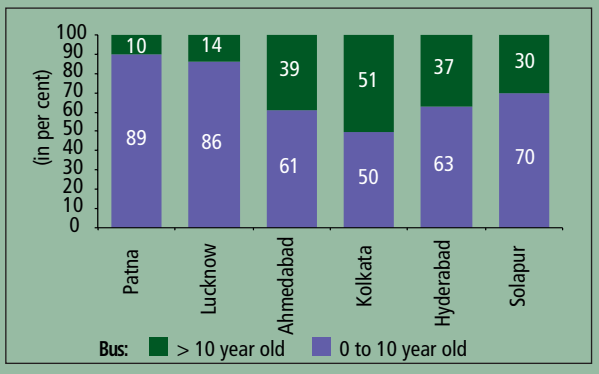
b.) Cars: passenger cars are not that old. In most cities except Kolkata (72%) and Solapur (81%), 87% to 96% of the cars are in the range of 0 to 10 year old



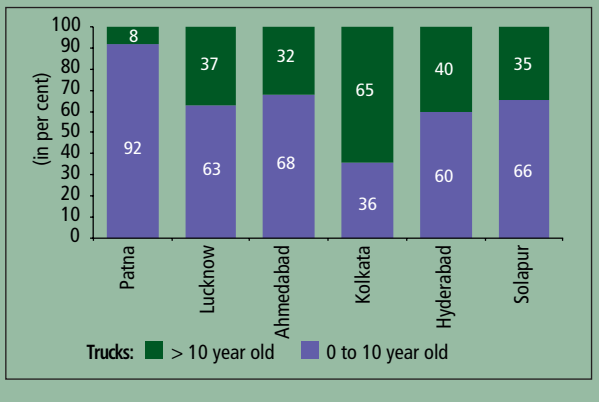
c.) Three-wheelers: Surprisingly, a high share of three-wheelers are more than 10 years old in Kolkata, Hyderabad and Solapur (in the range of 44% to 55%)



d.) Buses: Except Pune and Lucknow, all other cities such as Ahemdabad, Kolkata, Hyderabad, Solapur have a fleet that contains a high number of buses more than 10 years old (in the range of 30% to 51%)



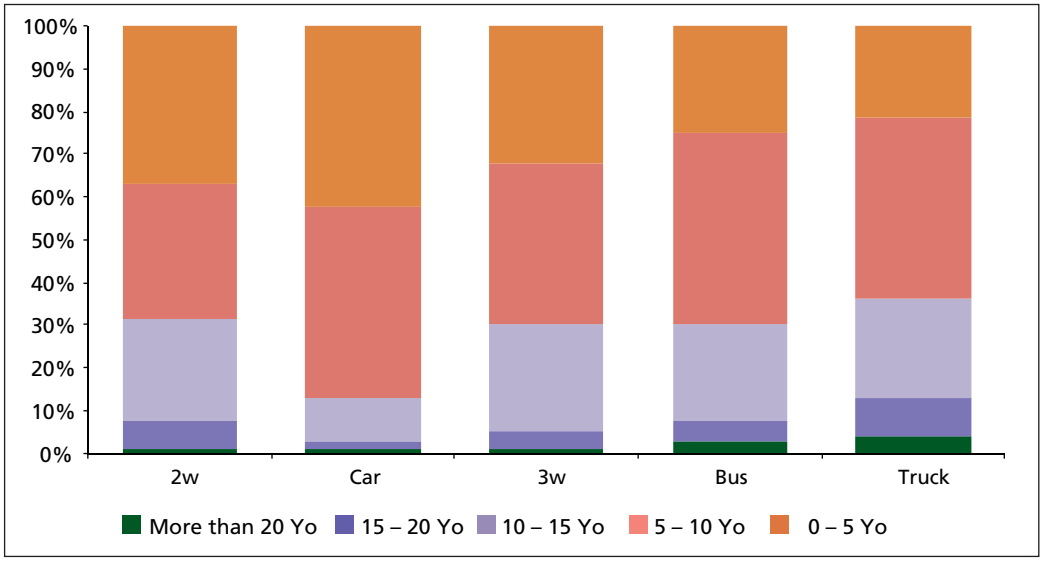
e.) Trucks: Kolkata has an exceptionally old fleet with 65% of the buses being more than 10 years old. Patna fares much better as only 8% of the buses are more than 10 years old. Rest of the cities have old buses in the range of 32% to 40%



Source: Data compiled and computed based on CPCB study conducted with MoEFCC in March 2015: Status of Pollution Generated from Road Transport in Six Mega Cities.

A summary analysis of vehicle categories reported by age reveals that vehicles above the age of 15 and 20 years vary across vehicle segments. About 13 per cent of trucks, eight per cent of buses, five per cent of three-wheelers, three per cent of cars, and seven per cent of two-wheelers are above 15 years. The age group of 10 to 15 years also sees substantial variation from 10 per cent for cars to 23 per cent for trucks *(see Graph 1: Average vintage-wise distribution of vehicle categories in different cities).*

Graph 1: Average vintage-wise distribution of vehicle categories in different cities (average of Patna, Lucknow, Ahmedabad, Kolkata, Hyderabad and Solapur)



Source: Data compiled and computed based on CPCB study conducted with MoEFCC in March 2015: Status of Pollution Generated from Road Transport in Six Mega Cities.

In 2016, CPCB along with GIZ carried out another assessment of the quantum of old vehicles while developing Guidelines for Environmentally Sound Management of End-of-Life Vehicles. This estimated that more than 87 lakh vehicles had reached ELV status by 2015. By 2025, the number of ELVs is estimated to be nearly 2.18 crore (in both cases two-wheelers are about 80 per cent of the total ELVs).[16] This study does not clearly spell out the method applied for estimating and projecting the number of ELVs. However, this indicative trend can inform policy at the central and state level *(see Table 1: CPCB-GIZ study estimate of ELVs for 2015 and projected for 2025).*

Table 1: CPCB-GIZ estimate of ELVs for 2015 and projected for 2025

Type of vehicle	Total ELV count in 2015	Total ELV count in 2025
Two-wheelers	7,289,442	17,723,951
Three-wheelers	262,439	757,932
Private cars/SUVs	721,558	2,809,966
Commercial passenger vehicles	46,522	94,757
Commercial goods vehicles	411.230	1,188,833
Total vehicles likely to be ELV	8,731,185	21,895,439

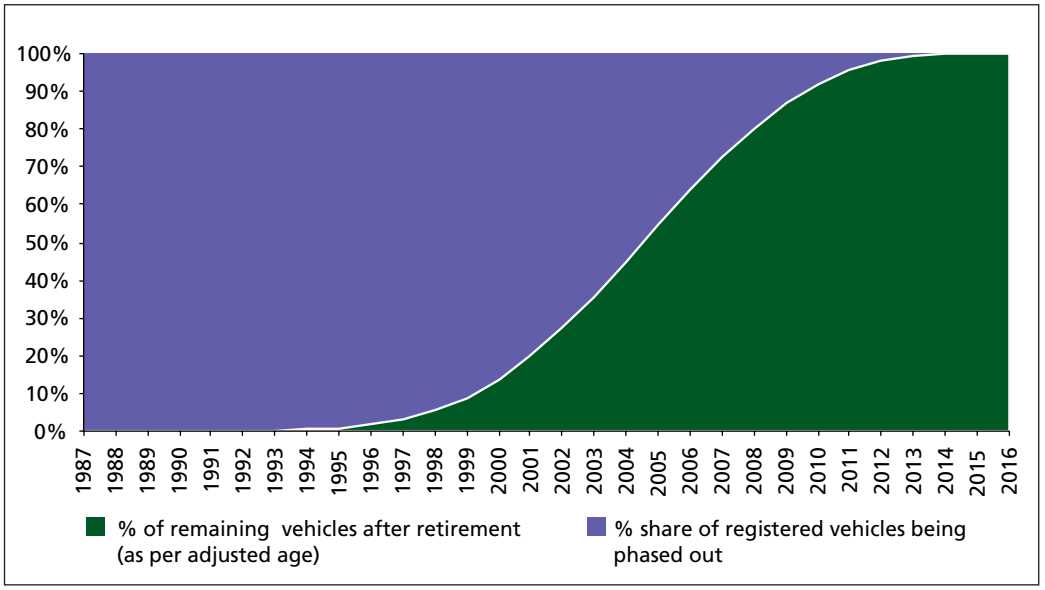
Source: CPCB, GIZ 2016 report on Guidelines For Environmentally Sound Management Of End-Of-Life Vehicles

Making national level estimates is still challenging. However, internationally, certain thumb rules are applied to develop retirement curves. It is possible to broadly ascertain the total number of vehicles that might have retired and those that have survived based on the vehicle retirement curves that are internationally accepted. Global surveys have shown that on an average about 80 per cent of vehicles are between 0 to 10 years of age. There may be variation across countries. These retirement curves have emerged from the Winfrey method.[17] After applying this method on MoRTH's vehicle registration database for the period 1951–2016, it is possible to estimate how many old vehicles may have survived—considering the average age of retirement at 20 years, only 50 per cent of the original fleet of vehicles are in use. Based on this, it is estimated that the total number of active vehicles in 2016 were 152 million.

For the period 1951–2016, total registered vehicles were 230 million. However, after applying 20-year vehicle retirement function the total vehicle population in 2016 was expected to be about 152 million. This means only 66 per cent of total registered vehicles have survived. Of the total vehicle stock that survived in 2016, age-wise distribution of these vehicles is likely to be—86 per cent less than 10 years old, 12 per cent between 10 and 20 years old, and the rest over 20 years old *(see Graph 2: Estimation of vehicle vintage in India based on retirement curve).*

But this can be an underestimation of old vehicles. Greater accuracy is possible if widely conducted field-based surveys or parking lots and fuel pump surveys are conducted to correct the registration database. As seen earlier, CPCB survey in selected cities has shown that two per cent of the fleet is more than 20 years old. Different result may be obtained on the age profile if the data from different source inventory studies and their surveys are applied and compared.

Graph 2: Estimation of vehicle vintage in India based on retirement curve



Source: CSE estimation based on all India vehicle registration during 1951–2016, as data provided in MoRTH Road Transport Year Book 2015–16, https://morth.nic.in/sites/default/files/other_files/Road_Transport_Year_Book_2015_16.pdf

WHY OLD VEHICLES ARE A CONCERN?

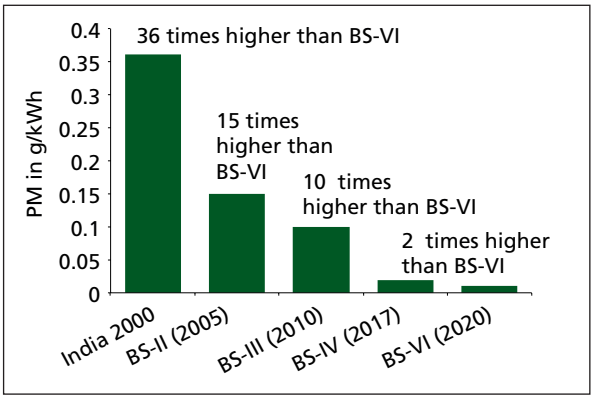
The older generation of vehicles meeting the early stage of mass emissions standards were designed to emit several times more pollutants than the current generation. India implemented BS VI emissions standards nation-wide in April 2020. In most parts of India, barring 13 big cities that had introduced BS IV standards in 2010, BS IV standards were only introduced nationwide in 2017. Currently, BS III and BS IV vehicles largely dominate the vehicle fleet across India with BS I and BS II vehicles continuing in varied proportion. The challenge is to accelerate fleet renewal based on the current BS VI standards in the coming decade.

A review of the emissions factors—representative value of emissions from vehicles in use—developed by the ARAI for different generation of vehicles meeting different emissions standards shows that compared to a BS IV car a 15-year-old diesel car emits 7.6 times higher PM and 3.4 times higher NO_X. Thus, emissions from one old diesel car are equal to four to seven new cars. A 10-year-old diesel car emits 2.4 times higher PM compared to a BS IV car. Toxic emissions too are higher from older vehicles. The difference in emissions of different genre of commercial vehicles is also substantial. CSE's estimate shows that the emission load from diesel vehicles that are 11 to 15 years old is a lot more on a per vehicle basis than those that are between 1 to 10 years old.

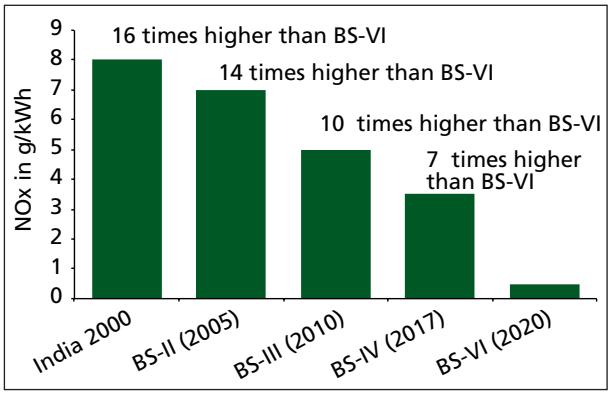
Removing old vehicles, particularly old diesel vehicles, from the fleet will substantially reduce direct exposure on road. This benefit can be maximized if the old heavy duty diesel trucks are removed. For example, a diesel truck certified to BS I standards emits 36 times higher PM compared to a BS VI truck. Similarly, trucks meeting BS II emission norm emit at least 14–15 times higher PM and NO_X compared BS VI trucks. This is not even accounting for deterioration over the years, which increases the emissions gap. Therefore, taking off one BS II truck is equal to taking off 14 to 15 BS VI trucks from the road. This is the basic premise of designing a fleet renewal programme *(see Graph 3: Trend in particulate matter and nitrogen oxide standards for heavy duty vehicles).*

Graph 3: Trend in particulate matter and nitrogen oxide standards for heavy duty vehicles (India 2000 to BS VI)

PM emission standards for heavy-duty engines (trucks/buses)



NO_X emission standards for heavy-duty engines (trucks/buses)



Source: Compiled from notifications, ARAI emission norm booklet

HIGH EMISSIONS LOAD FROM OLD VEHICLES

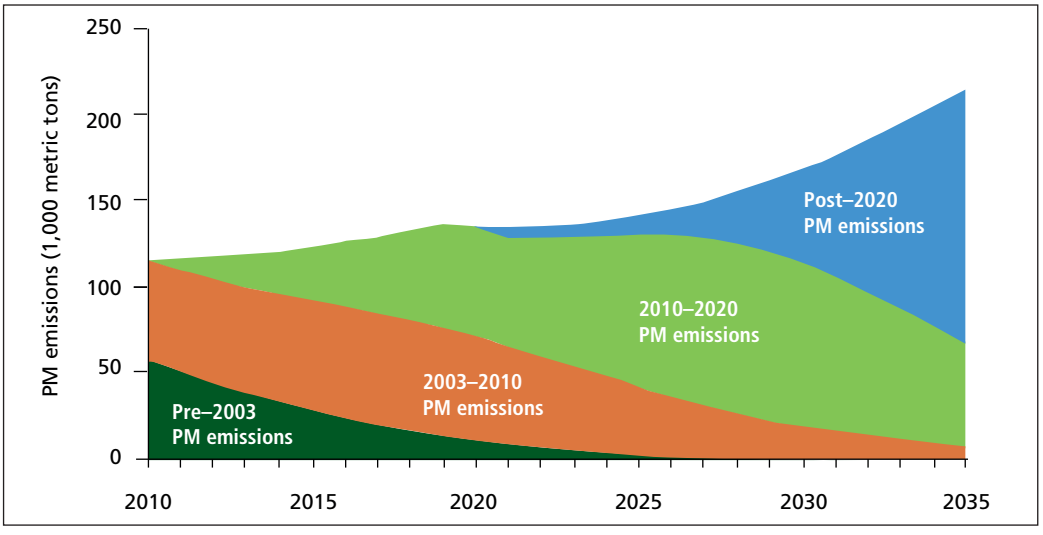
Several studies are available that estimate the contribution of older vehicles to pollution and the emissions benefits from fleet renewal. Of course, environmental benefits of fleet renewal and scrappage programmes depend on the design of the programme. As new vehicles begin to meet substantially tighter emissions standards the older fleet becomes disproportionately responsible for much higher emissions.

ICCT's estimate for India shows that pre-2003 vehicles were less than 23 per cent of the fleet but accounted for nearly half of the vehicular particulate matter and a third of NO_X emissions in 2011. Similarly, their global review of vehicle replacement programmes shows, as per the estimation of the Chinese Ministry of Environment Protection in 2011, vehicles older than ten years (Euro 0 or Euro 1 equivalent) constituted just 15 per cent of the total vehicle fleet in Beijing but caused 61 per cent of the NO_X and 76 per cent of the PM emissions. Around 50 per cent of the particulate matter and black carbon emissions came from high-emitting vehicles.

According to the ICCT, about half of India's vehicular emissions today come from vehicles more than 10 years old. The near-term benefits of BS VI standards can be increased dramatically by scrapping older vehicles, especially commercial vehicles.

Moreover, the rapid expansion of the vehicle market that is expected in the coming decades means that BS VI standards can slow down the rate of emissions increase but cannot stop the trend in the long-term. ICCT has illustrated the expected growth in PM emissions till 2035. A vehicle scrappage programme combined with BS VI standards could achieve substantial emissions reduction *(see Graph 4: Particulate matter emissions by vehicle age in India)*. But the numbers will keep increasing leading to re-bound, unless emission norms are improved again.

Graph 4: Particulate matter emissions by vehicle age in India



Source: Zhenying Shao 2020, Bharat Stage VI emission standards: Mission NOT impossible, https://theicct.org/blog/staff/bharat-stage-vi-mission-not-impossible

CPCB's 2015 assessment 'Status of Pollution Generated from Road Transport in Six Mega Cities' found that vehicle vintage, and configuration of fuel type and quality have bearing on emissions load. In fact, cities with comparatively lesser number of vehicles may have higher pollution load from vehicles if older vehicles dominate the stock. Therefore, according to this study, Hyderabad has the highest particulate emissions from vehicles followed by Ahmedabad. Kolkata, despite having lesser number of vehicles on road, showed significant PM emissions due to the presence of older fleet. Lucknow and Patna also show comparable PM emissions despite the differences in number of vehicles. Lucknow has higher number of vehicles but because of its cleaner CNG fleet, its overall emissions are comparatively cleaner. Patna at that time was dominated by BS III and lower emission norms. This CPCB study has recommended a ban on old commercial vehicles, restriction on old truck entry, gradual phase out of old vehicles, cost-benefit analysis of banning old vehicles, etc.

Scientists from IIT Mumbai have also conducted a multi-city study 'Estimating emissions from the Indian transport sector with on-road fleet composition and traffic volume' published in 2014. According to this study the share of vehicles aged 0–4 and 5–9 years varied between 41–65 per cent and 9–40 per cent, respectively. The population-weighted average ages have been estimated at seven years for two and three-wheelers, 8.5 years for four-wheelers, six years for light duty diesel vehicles (LDDVs), and 6.5 years for heavy duty diesel vehicles (HDDVs). The lower average age of HDDVs suggests that they retire earlier than other vehicle types. This may be a result of higher annual utilization and prevalent overloading.[18] Older HDDVs had higher particulate emissions *(see Graph 5: Age-distributed on-road and registered vehicle populations).*

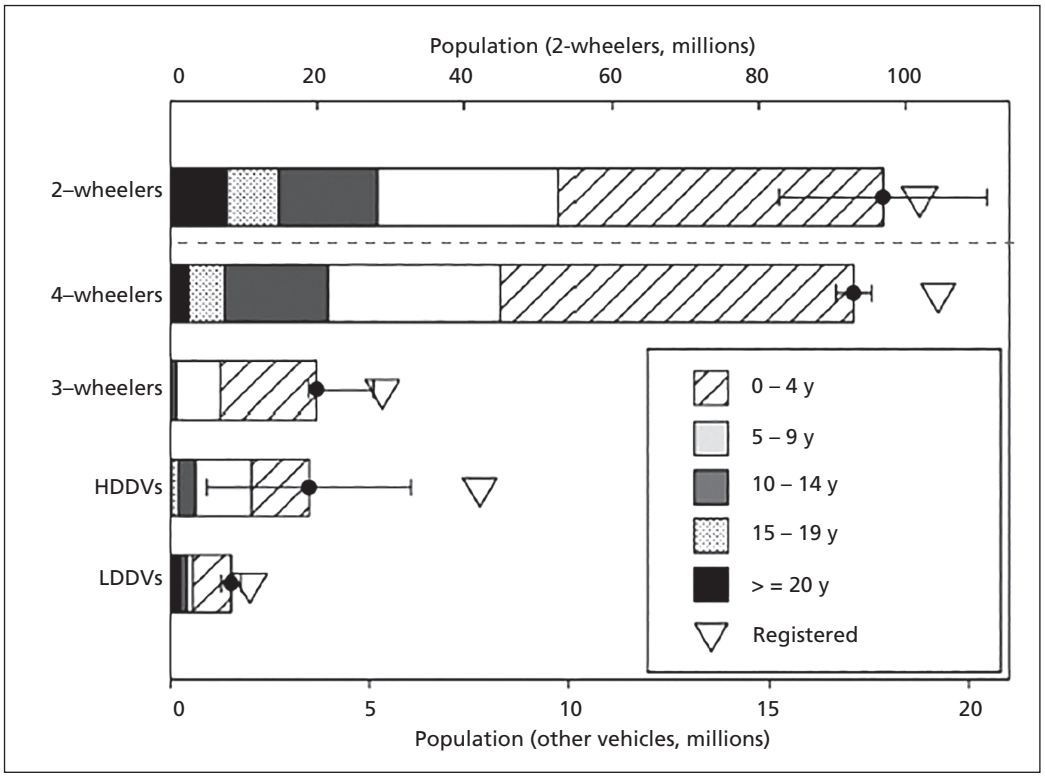
According to this study, pre-2005 vehicles and super emitters comprise about 46 per cent of the on-road population. Their contribution to $PM_{2.5}$ emissions is estimated at 70 per cent of the total pollution load from vehicles.There is also a difference in trend between large cities (NCR-Delhi, Mumbai, Chennai, Hyderabad, Bangalore, Kolkata, Ahmedabad, and Pune with population greater than 5 million) and smaller and medium towns. PM emissions from HDDVs were more significant in small and medium cities (15–49 per cent) than in larger ones (5–29 per cent), due to higher share of HDDVs in those cities. Also, several mega cities have age cap for HDDVs (including New Delhi, Mumbai, and Kolkata).

The contribution of old diesel four-wheelers (cars, jeeps, and taxis) was higher in large cities (8–24 per cent), where car ownership is higher, than in small and medium cities (2–13 per cent). Old petrol two-wheelers, a very polluting technology on a per-kg fuel basis, contributed significantly to $PM_{2.5}$ emissions in all cities (8–23 per cent), except in those with hilly terrain (Shimla, Gangtok: < 1 per cent). Three-wheeler auto-rickshaws (passenger transport) contribute 1–18 per cent of $PM_{2.5}$ emissions, with a significant share coming from vehicles with two-stroke engines.[19]

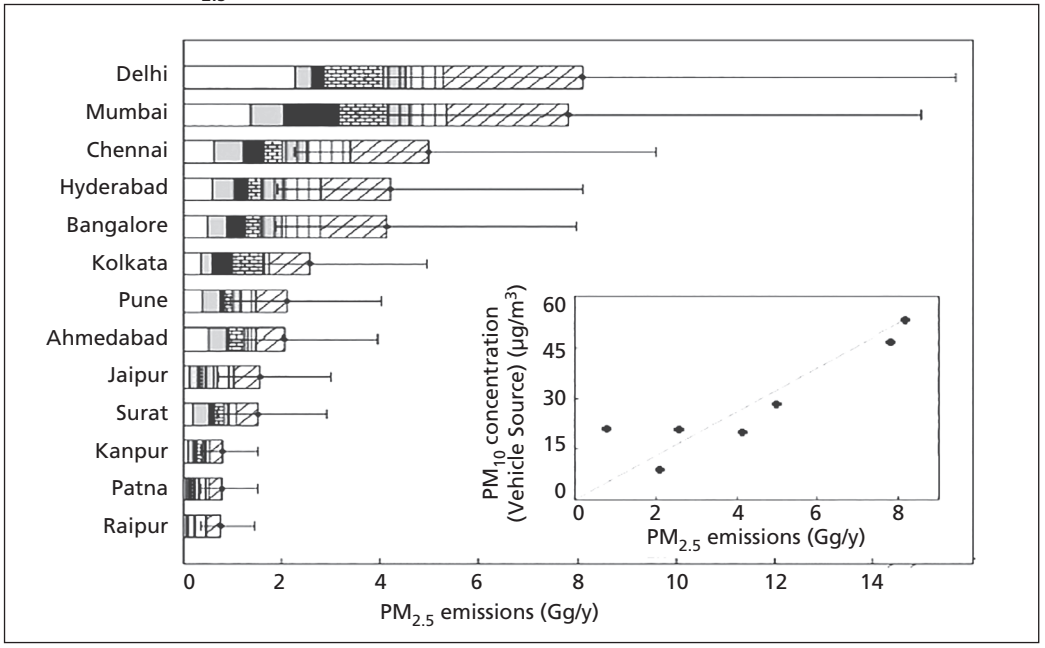
All studies do indicate that even though the relative number of very old vehicles is small in India, their overall contribution to the pollution concentration and total load from vehicles is high and needs mitigation.

Graph 5: Age-distributed on–road and registered vehicle populations

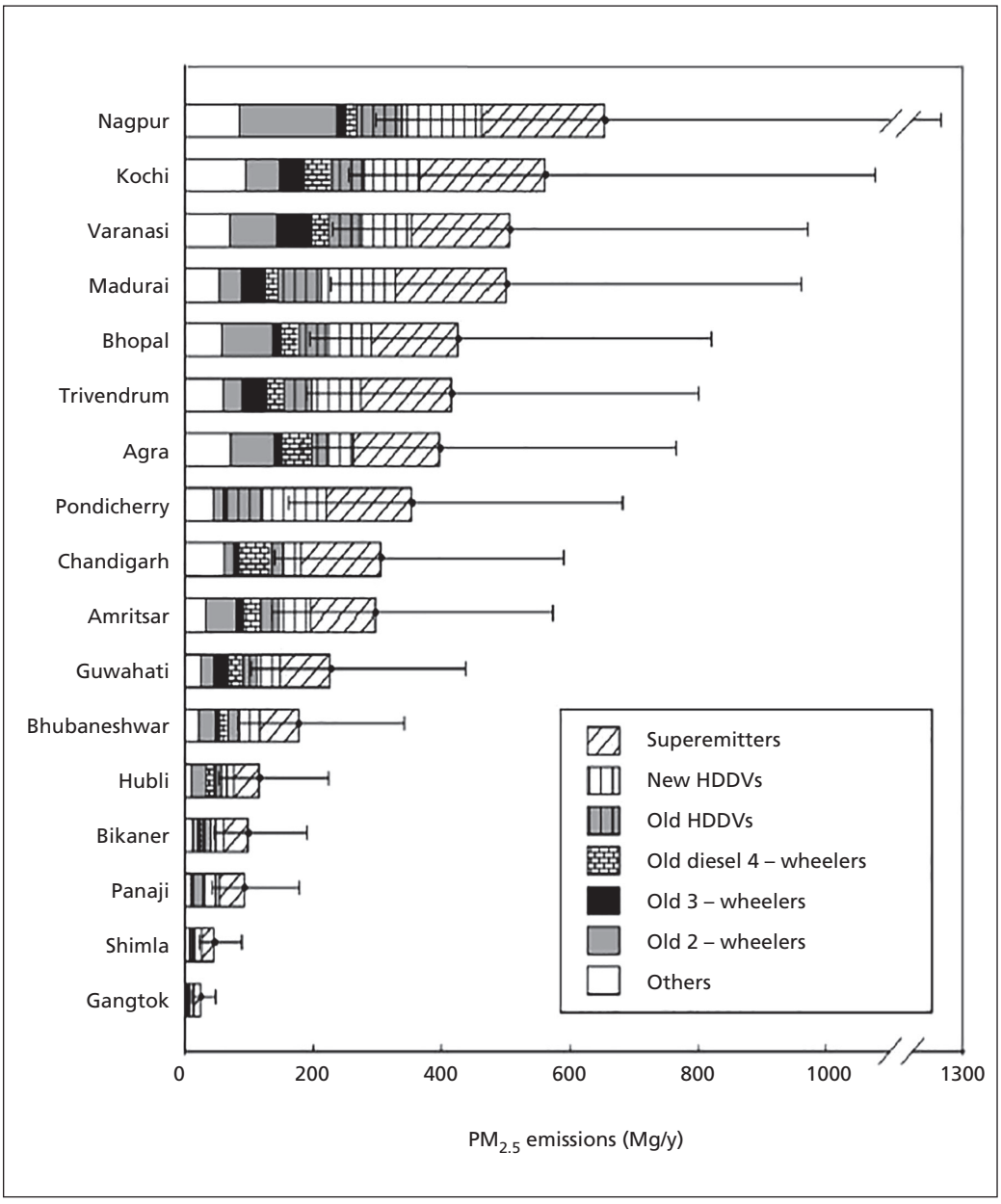
A: Vehicle populations in India (on-road and registered vehicles)
(i) Two-wheelers (ii) Four-wheelers (iii) LDDVs (iv) HDDVs



B1: Estimated $PM_{2.5}$ emissions for thirty major cities in India



B2: Estimated $PM_{2.5}$ emissions for small and medium towns



Source: Apoorva Pandey and Chandra Venkataraman, Estimating emissions from the Indian transport sector with on-road fleet composition and traffic volume, Atmospheric Environment: November 2014, IIT Bombay

OLD VEHICLES AND CLEAN AIR ACTION

The number of junk vehicles is expected to inflate as cities come under pressure to phase out very old vehicles to control air pollution. Most of the clean air action plans in 122 non-attainment cities under the NCAP have included phase out plans for older vehicles. If vehicles are pushed out before their useful economic life is exhausted, they change several hands and move to other geographies. But this only transfers pollution. Those that are beyond their useful economic life get junked.

Many state pollution control departments and transport departments have begun to take action on old vehicles. Most cities where air pollution is high have taken action on 10 or 15-year-old commercial vehicles. Many state governments have considered 15-year-old vehicles as 'old' vehicles, particularly if they are commercial vehicles (buses, trucks, autos, taxis, other goods carriers, etc.), due to their high emissions. The Supreme Court has prohibited plying of 15-year-old petrol and 10-year-old diesel vehicles in the NCR; such vehicles are meant to be impounded if found plying. Further, pre-2006 goods carriers and trucks are not allowed to enter Delhi. In Delhi only authorized scrapping centres can issue a certificate of destruction.

Revised action plan for control of air pollution in non-attainment cities of Maharashtra, prepared by Maharashtra Pollution Control Board, released on 18 September 2019, explains the power of the state government to fix the age limit of vehicles and the fact that the city is implementing a scrappage policy for old vehicles. It mentions that as per Section 59 of the Motor Vehicle Act the Central Government is empowered to fix the age limit of Motor Vehicles, (having regard to public safety and convenience, after the expiry of which the registration is required to be cancelled). The State Transport Authority (vide its resolution no 7/2013) has taken decision to restrict the age of taxis plying in the Mumbai Metropolitan Region (MMR) to 20 years and 16 years for auto-rickshaws. Also, BS II and BS III bus scrapping policy has been developed and Mumbai plans to scrap 425 BS II vehicles by 2021. Further, the city discourages plying of old vehicles by imposing green tax on public and private vehicles over eight and 15 years old, which they are required to pay every year.

Cities like Kolkata, Mumbai, Bangalore, Kanpur, Hyderabad, etc. have taken the decision to phase out old diesel buses and three-wheelers. Kolkata has also taken action on old commercial vehicles. Kolkata Transport Department has issued an order restricting plying of 15-year-old commercial vehicles like buses, mini buses, meter taxis, and other commercial/transport vehicles in Kolkata Metropolitan Area vide its order dated 2012. From August 2012 to October 2018 a total of 113,890 commercial vehicles have been phased out. Further, in 2018 the transport department banned entry of commercial vehicles which are more than 15 years old into Kolkata, Howrah, Bidhannagar, and Barrackpore. The prosecution of such vehicles is taken under u/s 192 of the Motor Vehicles Act, 1988.

In Hyderabad the government has banned plying of 15-year-old three-wheelers. The government also issued an order in 1999 stating that fitness certificates of 15-year-old vehicles should not be renewed in Hyderabad unless scientifically tested and certified by a competent authority. Bangalore, in its action plan to control air pollution, has set a goal to phase out BS III vehicles and to increase the BS IV fleet size of BMTC gradually. BMTC practices scrapping of old buses which have covered 8.5 lakh km or completed 11 years of operation, whichever is earlier.

Most cities do not restrict vehicles based on age limit and allow vehicles older than 15 years to ply. They are re-registered for a span of another five years. Under the current rules, these vehicles require roadworthiness and fitness tests for re-registration. There is no information on the effectiveness of these tests.

Age-wise vehicle phase out policies are easier to implement but often states do not know which vehicles (by registration certificate/date of manufacturing) are plying in the state. Therefore, all states need to clean up their VAHAN databases to identify vehicles operating in the state on the basis of their age and fuel used. Vehicle insurance should be linked withthe Pollution Under Control (PUC) certificate programme to get an actively updated database. This will also help to know emission performance and roadworthiness of commercial vehicles. In fact, following the recommendations from the Environment Pollution (Prevention and Control) Authority, the Supreme Court had taken on board the suggestion of linking annual vehicle insurance with valid PUC certificate. According to the recent reports, the Insurance Regulatory and Development Authority (IRDAI) has issued a circular on 20 August 2020 to advise all insurers to ask for a valid PUC certificate of the vehicle from the policyholder at the time of renewal of motor insurance policy.[20]

Some states like Maharashtra have imposed green tax on old vehicles. But there are complaints that often the total green tax on a junk vehicle is much higher than its scrap value. Often these vehicles are abandoned in public places as owners avoid paying the arrears of green tax. Any sale or re-registration of such vehicles will require clearing of all old dues. Therefore, door-to-door identification of very old vehicles and having an online system for ascertaining the status of green tax payment needs to be put in place to help get rid of very old vehicles occupying public spaces. Such vehicles should be confiscated and scrapped. Clean air action is expected to be a catalyst in accelerating old vehicle phase out.

SECTION 2

CLUNKERS AND MATERIAL RECOVERY

Currently, the factors that determine the final dismantling of vehicles include damage caused due due to accident, seizure of vehicles by police, voluntary decision of the vehicle owners to scrap, policy decision to phase out old vehicles, and ageing and abandonment of vehicles beyond the useful economic life.

The waste heap that gets created has serious environmental consequences. ELV dismantling generates a range of hazardous substances that include waste oil, lubricants, lead acid batteries, lamps, electronic components, air bags, etc. The recovery of these materials is of concern as these not only pose a serious occupational health risk to the scrap recovery workers but can also cause serious environmental contamination if supportive infrastructure for safe disposal of the generated waste is not available.

In the automobile recycling process a large amount of scrap metals are generated which include both ferrous and non-ferrous metals. These are recovered and directed to reuse. Generally, scrapped metal items such as sheet metals, aluminium, and plastics are retrieved and reused. Unusable items such as rubber parts (excluding tires), insulation materials, glasses, etc., are discarded to municipal garbage. Batteries are sold to spare shops, although there are formal regulations concerning disposal of used batteries. Regulations exist for return and recycling of batteries but these are not strictly enforced. Treatment of hazardous materials is very limited. This leads to air, water, and soil pollution in recycling facilities.[21]

The common materials or components that are recovered include the vehicle body frame, windows, tyres, batteries, wires, etc. Material recovery also includes elements like zinc, magnesium, tin, platinum, and cobalt. Most metallic components such as steel and iron are recycled. The present trend of light-weighting of vehicles by using light metals such as aluminium will help. But non-metallic materials such as polymers are not fully recyclable and their use is increasing in vehicles for light-weighting and for comfort and design purposes.

In general the ELVs contain large quantities of metal and other materials. This needs recycling and sustainable and environmentally sound method of recovery and disposal so that they can be effectively brought back into the economy. This substitution can reduce the environmental impacts of mining of primary materials. Also, primary processing of metals requires more energy compared to secondary processing.

According to CPCB, up to 70 per cent of a vehicle is dismantled and directly reused or sold to other manufacturers. The CPCB guidelines have estimated that passenger cars contain about 70 per cent steel and 7–8 per cent aluminium. The rest 20–25 per cent is plastic, rubber, glass, etc., which are also recyclable.[22] Recovery of this material is important as the data shows that India is heavily dependent on imports of most of these materials and therefore recycling and reuse strategy can reduce import dependence *(see Table 2: Contribution of automobile sector to the national income (GDP), consumption base of raw materials, and import dependency).*

Table 2: Contribution of automobile sector to the national income (GDP), consumption base of raw materials, and import dependency

Economic sector	Selected raw materials (vehicle propulsion-wise)	Import dependency (in percentage)
Automobile sector (inclusive of electric vehicles) Share in national income (7.1%)	Internal combustion engine vehicles: Steel, copper, aluminium, zinc, nickel, lead, glass, rubber, various plastics/synthetics	• Copper (50–60%) • Lithium (100%) • Cobalt (100%) • Aluminium scrap (90%) • Steel scrap (20–25%) • Lead (75%) • Rare earths (100%)
	Electric vehicles: Lithium, cobalt, nickel, rare earths, various plastics/ synthetics, steel, copper; aluminium	

Source: Economic Survey 2018–19, Volume II, Chapter Sustainable Development and Climate Change, https://www.indiabudget.gov.in/budget2019-20/economicsurvey/doc/vol2chapter/echap05_vol2.pdf

According to FICCI's estimates, over eight million tonnes of steel can potentially be extracted from end-of-life vehicles in India in 2025, representing an opportunity of approximately USD 2.7 billion. This is as per its publication named 'Accelerating India's Circular Economy Shift: A half trillion USD opportunity, future-proofing growth in a resource-scarce world' which was published in 2018. According to this study, consumption of steel in India during 2015–16 was approximately 81.5 million tonnes. Ten per cent of steel was used in the automobile sector.[23] Hence, urban mining to recover steel and iron from end of life products has huge value.[24]

According to FICCI, automotive components are most attractive for recycling initiatives as these have a finite lifespan, thereby becoming recyclable quickly. Tapping this would be to establish robust circular models to aggregate the vehicles reaching end-of-life at scale and to leverage right technologies to dismantle the vehicles and recover metals (see *Table 3: Recycling of steel from automobiles—a significant circular economy opportunity in India).*[25] Material composition of vehicles is changing over time and needs to be mapped well for material recovery and recycling *(see Box 2: How material composition is changing in automobiles?).*

Table 3: Recycling of steel from automobiles—a significant circular economy opportunity in India

Vehicle type	Number of vehicles reaching obsolescence in 2025	Average weight (in tonnes)	Average steel content (in per cent)	Embedded steel weight (in tonnes)
Two-wheelers	17,723,951	0.10	65	1,186,619
Three-wheelers	757,932	0.37	65	182,775
Private cars	2,809,996	1.04	70	2,039,776
Commercial passenger vehicles	94,757	5.05	65	311,040
Commercial goods vehicles	1,188,833	6.98	65	5,393,735

Note: Estimation based on data from CPCB, Metal Recycling Association of India, National Steel Policy of India 2017, and Accenture Analysis and Research

Source: FICCI 2018, Accelerating India's Circular Economy Shift: A half trillion USD opportunity, future-proofing growth in a resource-scarce world, FICCI Circular Economy Symposium 2018, Accenture Energy, http://www.ficcices.in/pdf/FICCI-Accenture_Circular%20Economy%20Report_OptVer.pdf

Box 2: How material composition is changing in automobiles?

Automotive manufacturers use a large number of materials. The material development and innovations in vehicles are now largely driven by weight reduction of the vehicles to improve fuel efficiency; this is balanced with safety requirements. Specific assessment of change in material composition for the Indian automobile industry is not available. But overall global overview brings out some broad trends over time. The types of materials vary from the smallest parts such as screws and clips to the larger components such as engine and transmission. Available studies show that steel was largely used during late 1980s for the body and frame to produce vehicles that were strong, but that also made them heavy. The gross vehicle weight was not much of a concern earlier as fuel consumption was not the key policy focus.[28] At a generic level, the percentage composition by weight of the major materials includes high strength steel at about six per cent, other kinds of steel at 50 per cent, iron at 15 per cent, plastics at seven per cent, aluminium at four per cent, and others (such as rubber, glass, textile) at about 18 per cent.

Increasingly over time, aluminium has started to replace steel and iron components to reduce the weight of the vehicle. This has led to significant improvement in fuel economy performance. A 2018 study by Mekonnen Asmare Fentahun et al of Mizan-Tepi University, Ethiopia has attempted to characterize the change in material composition from 1970 to 2020. There is special interest in this matter in the African region that is the hub of the used vehicle trade.According to this study the percent of plastics by mass in an average vehicle has gone from 6 per cent in 1970 up to 16 per cent in 2010 and is expected to reach 18 per cent in 2020. It shows that the composition of major materials during the nineties was as follows: high strength steel at 10 per cent, other kinds of steel at 43 per cent, iron at 12 per cent, plastics at seven per cent, aluminium at eight per cent, and others at about 20 per cent. But the efforts to reduce the weight and cost of modern cars in the late 2000s changed this composition, increasing use of plastic materials while reducing iron-made components. Overall, the composition of major materials changed to: high strength steel at 13 per cent, other kinds of steel at 42 per cent, iron at seven per cent, plastics at nine per cent, aluminium at eight per cent, and others at 21 per cent.[29]

According to the same study, the weight of a modern vehicle is centred on the body, including frame and panels that are attached to it. According to current estimation, the body constitutes 40 per cent of the vehicle weight. Interior components contribute some 15 per cent, while chassis and powertrain make up 24 per cent and 16 per cent of the vehicle weight respectively.[30]

In India, the material composition is expected to change further with the AIS-129 automotive standards. MoRTH and ARAI have already put up these standards on their website. These refer to the type approval of vehicles with regard to their reusability, recyclability and recoverability. According to these standards, vehicles can be constructed to have a minimum of 80 per cent reusable and/or recyclable material by mass, and 85 per cent reusable and/or recoverable material by mass. It also asks for suitably coded plastic components and to provide dismantling information to the authorized collection and dismantling centres. However, Part-2A of AIS-129 restricts use of heavy metals. It states that the vehicle manufacturers need to ensure that the vehicles type approved after the mandated date shall not contain lead, mercury, cadmium, or hexavalent chromium other than specified cases and conditions in the regulation.

Environmental safeguards are essential as an estimated 100,000 recycling workers face severe health threats in the informal dismantling facilities. Unscientific dumping also causes environmental hazards. An estimated 410,700 tonnes of scraps (metals, aluminium, and plastics) are sent to scrap dealers. Seven thousand and eight hundred tonnes of rubbers and plastics that cannot be recycled is dumped in open garbage areas. Currently, there is no shredder to crush the remaining unrecyclable parts. The small volumes do not make a shredder economically viable to operate. The Ministry of Steel is proposing to install shredders where high ELV volumes are guaranteed.[26]

However, it may also be noted that the business of dismantling plays an important role in generating reusable parts for the used vehicles in domestic markets as imports of used motor vehicle parts and components are not allowed in India.[27] Therefore, used parts are recovered, refurbished, and sold by dismantlers to second-hand spare outlets located in the same scrap yards. Parts such as bumpers, head-lamps, bonnets, steering wheels, batteries, and others are re-used.

INFORMAL SCRAPPING

An extensive informal network of dismantlers and recyclers collect and dismantle old vehicles to recover material across India. Nearly all of the automobile scrap yards in India are managed by the informal and semi-formal sector. Informal scrap yards exist in different cities and towns. A large number of vehicles are scrapped and stripped in informal, unregulated clusters that have also become hubs for scrap metal and all sorts of recovered and refurbished automobile parts. This is common in big cities including Delhi NCR, Kolkata, Pune, Jamshedpur, Indore, Chennai, and several other places.[31] There are numerous roadside mechanics in India who deal with vehicle repair when the vehicles generally go beyond warranty conditions provided by the automobile company. Informality of the service sector and scrapping, recycling, reuse, sale of parts, etc. is well established.

The vehicles that are not used anymore or are old or damaged are generally traded for scrap and are treated by a large, unaccounted informal sector. Recyclers generally purchase old vehicles. According to a 2012 report of Automotive Recycler's Association's on ELVs, India has

over 100,000 family-run units that are involved in dismantling of old cars and motorcycles, and are recovering parts for sale. There are several informal, unregulated clusters across India which strip end-of-life vehicles. These are hubs for scrap metal and all sorts of recovered and refurbished automobile parts. This is often contrasted with the global practice as noticed in Europe, US, and Japan that have set up robust processes for de-registering of ELVs and have dismantling units that work in tandem with industry and government.

Chintan, a non-government organization working for the welfare and rights of people engaged in informal recycling, conducted a fact-finding study in 2011 and reported that more than 3000 such units operate within Delhi. The report titled 'Analysis of ELV in India', jointly drafted by GIZ, CPCB, and Chintan Environmental Research and Action Group in 2015, provides an overview of the current ELV market in India. The informal sector primarily consists of traders, dismantlers, scrap dealers and recyclers. The report points out that this sector despite being informal in nature is highly specialized. For instance, there are traders who deal only in engines or steel rims or tyres. Parts sold as scrap have their dedicated markets. Some of the key challenges that the informal ELV market currently faces is related to space crunch. Shortage of space is a significant impediment towards business expansion. This sector also gets limited access to financial and technical assistance.

Though there is a thriving market for recycled components in countries where Indian vehicles are exported, the link between these markets and the dismantling business in India is weak. Even though the government has started policy formulation on formal scrappage systems, authorized systems are very few. Details of regulatory provisions regarding scrappage, end-of-life, enforcement and reporting mechanisms, and other related aspects are still awaited.

It's largely small low-technology units with low yield and capacity that carry out vehicle dismantling. This sector is efficient in recovering the usable material but not well equipped to control the non-usable components and the contamination of soil, air, and water while dismantling. They employ labour intensive and low automation methods to recover different streams of waste materials that can be recycled. A 2018 study Vehicle Recycling in the ASEAN and other Asian Countries done by Economic Research Institute for ASEAN and East Asia reports that the working condition is quite poor for the estimated 100,000 recycling workers who face severe health threat. There is not enough space for facilities and the facilities are located in residential areas/city centres.[32] An estimated 410,700 tonnes of scrap (metal, aluminium, and plastic) are sent to scrap dealers, while around 7,800 tonnes of rubber and plastics that cannot be recycled are dumped in open dumping sites.[33]

Currently, there are barely any or very negligible number of shredders in operation in India for ELVs. The small volumes do not make a shredder economically viable to operate. The Ministry of Steel is proposing to install shredders where ELV volumes are guaranteed.[34] Presently, treatment of hazardous materials is extremely inadequate and that contaminates soil, water, and air.

There are concerns that even though the informal market carries out dismantling efficiently, the process of dismantling pollutes air and soil—spent vehicle liquids are drained into storm water drains thus furthering environmental pollution. Although the CPCB has prepared guidelines and standard operating procedure for processing of old and defunct vehicles,

they are not followed on the ground. It has been observed that the informal scrappers bypass an important step of 'depolluting' a vehicle as part of recycling process. Also, the parts that contain harmful chemicals like air bags, seat belts, plastic material, air conditioning units, etc. are not properly handled.

This has stirred local protests in neighbourhoods. One such notable case is the big scrap yard in Mayapuri in Delhi. In May 2015, NGT ordered that all 'illegally and unauthorized operating scrap industries in Mayapuri generating chemicals, oils and poisonous fumes resulting in air pollution, deaths and diseases at large scale' be shut. The NGT has issued four orders in the last four years—May 2015, October 2018, 29 January 2019, and 11 April 2019. Sealing operations have been undertaken on orders from NGT and Supreme Court's Monitoring Committee. Amid reports of non-compliance in 2018, the NGT had directed that a seven-member Special Task Force (STF) comprising representatives from CPCB, DDA, DPCC, DSIIDC, SDMC, District Magistrate, and DCP be formed to stop illegal activities.[35]

However, the informal sector will continue to remain an important channel of dismantling and recovery of material. This will be an important source of livelihood in cities. It is therefore important to find ways of integrating them with the formal sector with adequate support to help establish common treatment facilities for pollution control and disposal of non-usable components. The state governments also need to adopt proper siting policies to keep them away from congested habitation. In fact, it is necessary to develop selected areas with common infrastructure for environmental safeguards for their operations.

TOWARDS ORGANIZED SCRAPPING

Formal scrapping facilities with adequate environmental safeguards in the organized sector are still at a nascent stage in India. Formal repair, service, dismantling, and disposing centres have developed in high-income countries as the auto industry has progressed.

Formal organized units are taking shape very slowly in India. Very few formal scrapping centres have been setup so far. Ministry of Heavy Industries and Public Enterprises (MoHIPE) has set up the Global Automotive Research Centre (GARC) under National Automotive Testing and R&D Infrastructure Project (NATRiP) as a demonstration centre at Oragadam near Chennai. CERO-Mahindra MSTC Recycling Pvt. Ltd is another automobile dismantling and recycling unit in Delhi-NCR (Greater Noida). This is a joint venture between Mahindra Accelo an Metal Scrap Trade Corporation Limited, with each party having a 50 per cent stake.Tata and Toyota are also joining the fray.

These plants are expected to obtain consent to operate from the State Pollution Control Boards and follow the scrapping guidelines set by CPCB. Once the MoRTH's draft policy circular is notified all centres will be expected to follow these guidelines related to all aspects of disposal, recovery, and level of safeguards. Moreover, Delhi Transport Department had issued guidelines for scrapping of ELVs in the National Capital Territory (NCT) of Delhi in August 2018. The Guidelines for Scrapping of Motor Vehicles in Delhi, 2018 apply to all petrol vehicles older than 15 years, all diesel vehicles older than 10 years, and any vehicle damaged in accidents or otherwise. These guidelines enable enforcement agencies, including the Delhi Traffic Police, Municipal Corporations, New Delhi Municipal

Council, Cantonment Board, and the Transport Department, to confiscate any ELV found operational, or parked in a public place or discarded as junk. Scrapping of an ELV requires dismantling, safe disposal of its non-reusable components, and issuance of a scrapping certificate to the registered owner of the ELV. The guidelienes also allow certification of scrapping yards in non-residential, commercial, and industrial areas.

Along with online transfer of real-time information on scrapping, Delhi guidelines require the submission of CCTV footage of each scrapping, record of scrapped parts, and record of all scrapping certificates to the Department of Transport. Scrapping will have to be carried out according to the CPCB guidelines. The scrap yards should have a minimum of 1000 square yards and be equipped to remove batteries and liquid gas tanks, to neutralize potential explosive components like air bags, and to remove and separately collect fluids, oils, anti-freeze, coolants, brake fluids, etc. Further, they should be able to remove catalytic converters and extract noble metals and dispose of non-reusable material without damaging the environment. Currently, the volume of dismantling in these centres is reported to be low. The organized sector has a concern regarding the competition from the informal sector that has lower cost curves. In fact, it is said that even when the government departments want to scrap their vehicles, in their tender process informal sector has an advantage as they can quote higher prices. For example, in the informal set up such as in Mayapuri, a vehicle owner can be paid Rs 15,000 for an old Maruti 800. In contrast, CERO will give Rs 8000 for the same. But the formal sector will also provide scrapping certificate after which the RTO deregisters the vehicle and the old vehicles cannot be misused and defective parts cannot be sold (see *Box 3: Towards organized sector)*.

Available information from formal recyclers shows that the actual cost of scrapping to the company can be high, depending on the type of unit and recycling done. At the current level of business volume, the balance sheets remain negative. However, this is expected to change when volumes of recycling increase and help attain economy of scale.

Box 3: Towards the organized sector

Several initiatives are now in place to set up organized scrapping facilities for ELVs. Here are some of the illustrative cases.

Global Automotive Research Centre (GARC): GARC is a state-of-the-art test centre established by MoHIPE (under NATRiP) at Oragadam near Chennai. GARC has been authorized as a testing agency under CMVR 126 by MoRTH. GARC also has an ELV project and its recycling unit is a step towards developing a modern auto recycling industry, as per NATRiP. The code of practice for handling ELVs has been formalized and is followed by the unit. The bailing machine is available for making bales of the sheet metal. GARC's recycling unit expertise includes value evaluation of scrap vehicle, parts-material classification, and proper disposal of materials generated from scrapping of ELV's. This recycling ELV centre was established in 2011.

In its certification system it is possible to find out the total amount of material recovered from different types of vehicles. It also states the recovery price of the material. The scrap value of a moped is Rs 1,650, of a bike is Rs 3,350, and of a scooter is Rs 3,800. Cost incurred at GARC's recycling demo unit for dismantling a two-wheeler considering manpower, infrastructure, and other expenses is Rs 450.[36]

Figure 1: Certificate of destruction (COD) involves a report on parts recovered.

Source: Responsibilities of Collection and Dismantling centre, Automotive Recycling Demo Unit, SIAM and NATRIP 2012, https://www.siamonline.in/International-Seminar-on-Environmentally-Friendly-and-Viable-ELV-Infrastructure-July-20-2012-NewDelhi-India/Session-3/Session3-M-Praveen-GARC-India.pdf

Table 1: Amount of material recovered (in kg) from 60 two-wheelers (2012 estimates)

Type of vehicle	Ferrous scrap	Non-ferrous scrap	Plastic	Rubber
Moped	32.09	1.65	14.84	8
Bike	68.26	2.8	7	10
Scooter	84.84	1.56	6.72	8.2

Table 2: Market rate for two-wheeler scrap (2012 estimates)

Ferrous	Non-ferrous	Plastic	Rubber
Rs 30/kg	Al—RS 100/kg Cu—Rs 300/kg	Rs 10/kg	Re 1/kg

Source: Responsibilities of Collection and Dismantling centre, Automotive Recycling Demo Unit, SIAM and NATRIP 2012, https://www.siamonline.in/International-Seminar-on-Environmentally-Friendly-and-Viable-ELV-Infrastructure-July-20-2012-NewDelhi-India/Session-3/Session3-M-Praveen-GARC-India.pdf

CERO (Mahindra MSTC Recycling Pvt. Ltd) automobile dismantling and recycling unit: It is a joint venture between Mahindra and the Ministry of Steel (Metal Scrap Trade Corporation Limited), with each party having a 50 per cent stake. This plant has been operational for the past 2.5 years and is an initiative of the Mahindra group.The company has received accreditation from the Delhi Government.

CERO Chennai is already operational and CERO Bangalore will be operational by April 2020. Mahindra is investing in developing an automated shredder plant for ELVs. Shredding is a capital intensive and energy intensive venture that requires lots of space. However, a shredder can shred up to 150 vehicles per day. Dismantling is done manually. As in the case of manual dismantling, shredding also involves removal of hazardous wastes such as fluids, oils, and batteries from the vehicles. Since a shredding plant requires a bigger area to operate, there is only one shredding plant in Punjab as of now.

Nature of operation of plants in organized sector

This is an illustrative case to demonstrate how formalization of the sector works. It is evident from the case study assessment of the CERO plant in Noida. This practice is expected to be different for other plants.

This plant gets 200–300 vehicles per month and their total capacity is for 600 vehicles. Of the total ready-to-scrap vehicles received here, 70 per cent are cars and the rest are two-wheelers. Commercial vehicles are negligible. CERO gets more petrol vehicles than diesel vehicles. There are a total of 35 people working in the plant. The scrapped vehicles are provided with a Certificate of Destruction. CERO claims that 98–99 per cent of the vehicle is reused or recycled after dismantling. As of now, their output is low and they are losing money, mainly due to lack of demand. The company runs outreach programmes to attract customers. The plant managers feel that EPR is required in this sector.

CERO gives fiscal incentives for scrapping of the vehicles. Itsells the components and the good parts are reused, sold to sellers, etc. The batteries are not sold and generally, once the fluid is extracted, are sent to Exide for recycling. CERO has obtained a license from the Delhi Government. They have plans to set up a CERO plant in Pune or Mumbai. This plant also operates according to CPCB's guidelines and they have a Consent to Operate from their SPCB.

Procedure

A vehicle undergoes different processes at the CERO plant. These include:

1) De-pollution station — This is the first step where all the hazardous material, such as oil, coolant, and batteries are removed from the vehicle. Oils, etc., are then stored at the back in the storage tank.
2) Dismantling station — The second step involves manually removing various parts of the vehicles. The engine and parts below the car are removed after turning the vehicle upside down. Then parts such as wire, plastic, motors, etc. are separated from the vehicle. Vehicle parts which are in good condition are segregated and kept for reuse.

3) Removing glasses — Glasses are then removed and sent to agencies like Bharat Oil where they follow CPCB guidelines to dispose of them.
4) Shearing and bailer — When just the skeletal frame is left, the body is compressed and compacted, and then transported for recycling of steel.

Other initiatives: TATA is also setting up a similar plant in Rohtak and Toyota group (JV with Maruti Udyog) has invested in a plant in Noida. Draft authorized vehicle scrapping guidelines by MoRTH have recommended procedures and other details to set up such centres in India.

This sector is expected to grow when the environmental safeguards as enshrined in the CPCB 2019 Guidelines and MoRTH draft notification become enforceable. This will require extensive infrastructure for ELV recycling, including systems for environmentally sound de-pollution, dismantling, shredding, material recovery, and disposal of ELVs[37] (see *Box 4: CPCB guidelines on dismantling of ELVs).*

Box 4: CPCB guidelines on dismantling of ELVs

The CPCB 2019 Guidelines for Environmentally Sound Facilities for Handling, Processing and Recycling of End-of-Life Vehicles has outlined the key elements of processing and dismantling of ELVs.

De-pollution: The recycling of ELVs starts at the dismantling or treatment facility where it is first de-polluted and then dismantled (sometimes these two steps are summarized as 'dismantling'). De-pollution includes removing hazardous components and substances such as the battery, fuel, other fluids, airbags, and any parts containing mercury. As these materials are hazardous (explosive, corrosive, etc.), de-pollution must follow strict health and safety rules. Contamination of the environment must be prevented. This needs safe and separate storage of hazardous components and materials and adequate training of employees.[38]

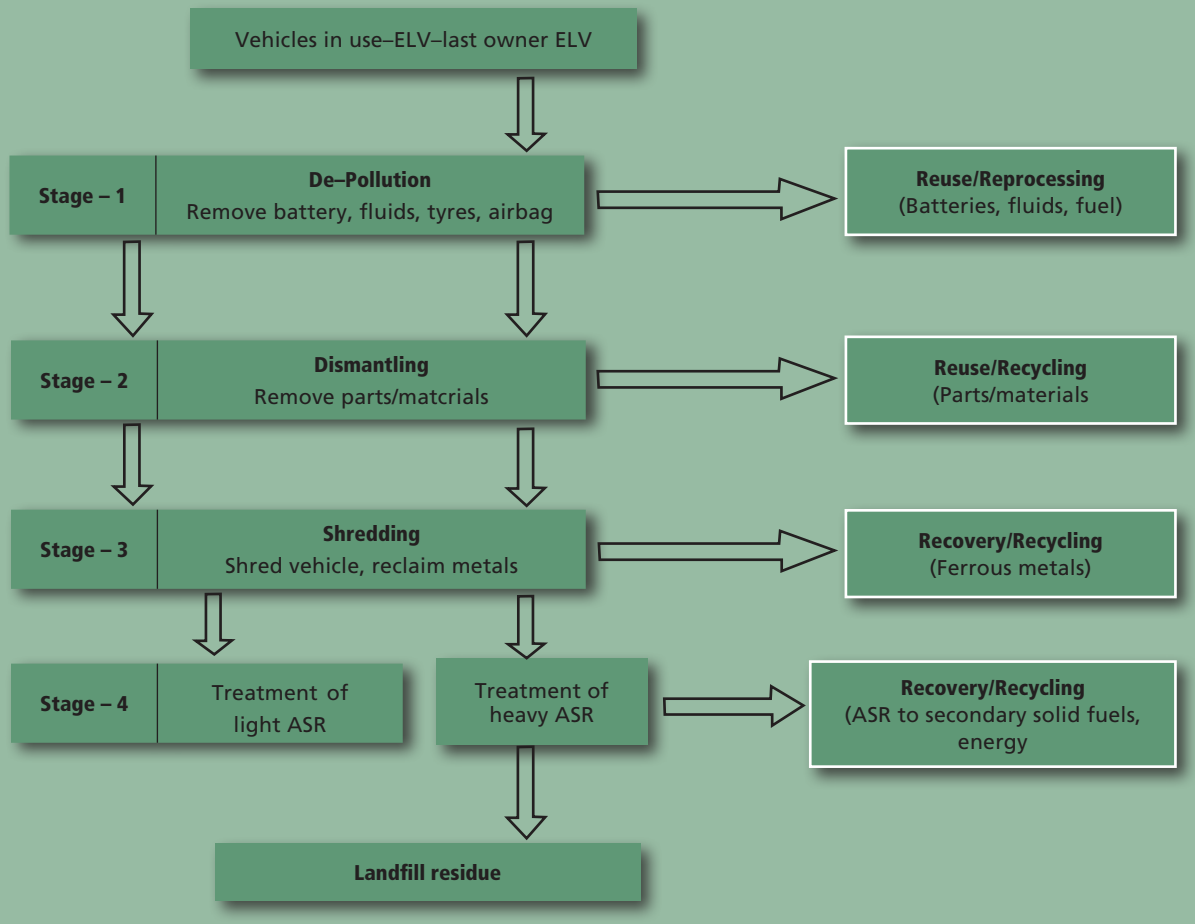
Dismantling: Dismantling of vehicles begin after de-pollution.This process involves segregating and collecting recyclable and reusable components, including engines, tyres, bumpers, and other parts. The degree of mechanization of the dismantling process depends on the costs of labour and availability of technology. The recovered components and fluids are sold for reuse in other vehicles (motor parts, batteries, fuel, etc.) or for further recycling (tyres, valuable metals, carpets, etc.).[39]

All waste water that is produced during the de-pollution and dismantling processes must be treated. Waste material is sent to incinerators for energy recovery or to landfills for disposal.[40]

Shredding / automotive shredder residue (ASR): ASR is a highly heterogeneous mixture of residual ferrous and non-ferrous metals (5–23 per cent), plastics (20–49 per cent), rubber (3–38 per cent), textile and fibre material (4–45 per cent), wood (2–5 per cent), and glass (2–18 per cent). Some of these components can be further processed: heavy ASRs are melted for recovery of valuable non-ferrous metals such as aluminium and copper, combustible materials are used to make fuel substitutes, etc. However, these components are difficult to separate from other materials such as ash and heavy metals. Therefore, it is more common to either use ASR for energy recovery or to send them directly to landfills.[41]

According to experiences from the European Union and Japan, the car hulks weigh approximately 55–70 per cent of their original weight after dismantling. The remaining hulk of the vehicle is crushed so that it can be transported in a compact and cost-effective form to the shredding facility. Thereafter, it is broken up into fist-sized pieces by large shredders. The shredded material is then separated into ferrous metals, for material recovery, as well as non-ferrous metals (heavy ASR) and other materials (light ASR). The separation process is realized by complex machinery such as magnetic separators, air classifiers, infrared systems, etc. Processing scrap in smelters usually produces secondary metal.[42]

Environmentally Sound Management of ELV recycling process comprises four major stages[43]



Source: CPCB 2019 Guidelines for Environmentally Sound Facilities for Handling, Processing and recycling of End-of- Life Vehicles

SECTION 3

LEGAL FRAMEWORK FOR DISPOSING OF OLD VEHICLES

The technical definition of what constitutes end-of-life vehicles and what requires scrapping is still not well laid out and is open to interpretation. Section 59 of the Motor Vehicle Act, 1988 has a provision of 'power to fix the age limit of motor vehicle'. The central government is empowered to restrict plying of vehicles considering public safety and can specify the life of a motor vehicle. For the protection of environment, the government can also make rules prescribing the manner of recycling of motor vehicles that have exceeded their useful life.[44]

After the amendment of Motor Vehicle Act in 2019, Section 59 has continued to provide that 'The Central Government may, having regard to the public safety, convenience, protection of the environment and the objects of this Act, make rules prescribing the manner of recycling of motor vehicles and parts thereof which have exceeded their life.'[45] The Government can specify the life of a motor vehicle from the date of its manufacture, after the expiry of which the motor vehicle shall not be deemed to comply with the requirements of this Act and the rules made there-under, provided that the Central Government may specify different ages for different classes or different types of motor vehicles.[46]

However, vehicles or parts that exceed their life remain undefined in Motor Vehicles (Amendment) Act, 2019. MoRTH has not defined old vehicles or end-of-life vehicles in CMVR in explicit terms. There is no set of specific criteria. But various permit conditions for the commercial vehicle segment relate to age, fuel, taxation regime, etc. This can vary across states.

However, the several guidelines on scrapping, dismantling, and recovery that are in the pipeline are expected to define the scope of ELVs more clearly. These include MoRTH's' 'Draft guidelines for setting up, authorization and operation of authorized vehicle scrapping facility', and AIS-129 on End-of-Life Vehicles prepared by the Automotive Industry Standards Committee of MoRTH, under the Central Motor Vehicle Rules, in 2015.[47] To this is added the CPCB Guidelines for Environmentally Sound Management of End-of-Life Vehicles, 2019. All of them include important criteria that can define the scope of action.

MoRTH's Draft guidelines for setting up, authorization and operation of authorized vehicle scrapping facility state that 'end-of-life vehicles' means all vehicles which are no longer validly registered, or whose registrations have been cancelled under chapter IV of the Motor Vehicle Act, 1988, or due to an order of a court of law, or are self-declared by the legitimate registered owner as a waste vehicle due to any circumstances that may arise

from fire, damage, natural disaster, riots, accidents, etc. Therefore, all these criteria can be applied to legally define ELVs as soon as the draft is notified. The government has proposed a few amendments to certain motor vehicle regulations in order to allow the scrapping of vehicles that are older than 15 years. The aim behind these proposed changes is to promote the adoption of electric vehicles for various uses.[48]

Moreover, CPCB's Guidelines for Environmentally Sound Facilities for Handling, Processing and Recycling of End-of-Life Vehicles (released in January 2019), defines ELV as a motor vehicle that has been abandoned, or is intended to be managed for the purposes of resource recovery. The criteria have been identified as follows: vehicles which are no longer validly registered under Section 41 of the Motor Vehicles Act, 1988; or where the owners are desirous of scrapping their vehicles, or the enforcement authorities in exercise of their statutory powers have to scrap the vehicles impounded or seized by them; or in accordance with the directions of any court of law. In the 'Guidelines for Environmentally Sound Management of End-Of-Life Vehicles' prepared with GIZ in 2016, CPCB defined ELVs as:

- When an automobile's life is prolonged through repeated repair and re-conditioning, the vehicles ultimately become unusable and have to be scrapped. At this stage before scrapping, the vehicles are termed 'end-of-life vehicles'.
- According to the definition provided in European Union Directive, 2000 an 'end-of-life' vehicle is equivalent to waste. The last owner usually designates a given vehicle as an ELV once it is no longer safe to drive or does not comply with emission standards. In certain cases, a vehicle is considered end-of-life simply due to its age. According to the EU Waste Shipment Regulations, such vehicles are not allowed to ply on the road or to be exported outside of the European Union.

It may also be noted that the MoRTH has issued a draft notification tightening the rules of vehicle fitness and increasing test frequency and fee for older vehicles. In the Draft Notification on 24 July 2019 (G.S.R. 523(E)) which amended the CMVR, the government has proposed renewal of fitness certificates for vehicles older than 15 years every six months instead of the current timeframe of one year.[49] While this makes fitness requirements for old commercial vehicles more exacting, it is only a strategy to prolong the useful life of the vehicle. This strategy is not supported by other complementary measures of repowering old vehicles with new engines or retrofitment of emissions control systems in not-so-old vehicles to improve the overall performance of the fleet.

When looked at from the standpoint of the recovery and recycling of material, other ministries are also getting involved. Ministry of Mines has framed a Draft National Non-Ferrous Metals (Aluminium and Copper) Scrap Recycling Policy, No.Met 4-13/5/2020, and Steel Scrap Recycling Policy 2019. Ministry of Environment, Forests and Climate Change has also framed the Draft National Resource Efficiency Policy 2019that will have bearing on old vehicles.

Moreover, from the standpoint of environmental safeguards, several regulations and legislations can be leveraged to contain pollution in this sector. The scrap traders and recycling units should adhere to all the existing and relevant guidelines issued by the government from time to time to contain environmental hazard. Authorization of agency

may be cancelled in case of violations. The range of policies and regulations that have a bearing on this sector include Environment (Protection) Act, 1986, amended 1991; Water (Prevention and Control of Pollution) Act, 1974, amended 1988; The Air (Prevention and Control of Pollution) Act, 1981, amended 1987; Hazardous and Other Wastes (Management and Transboundary Movement) Rules 2016; Guidelines for environmentally sound management of ELVs, November 2016, laid down by CPCB—AIS-129; Waste regulations notified by MoEFCC as applicable for the management and recycling of ELVs; Atomic energy (radiation protection) Rules, 2004; Solid Wastes Management Rules, 2016; The Ozone Depleting Substances (Regulation and Control) Rules, 2000; The Batteries (Management and Handling) Rules, 2001; The E-waste (Management) Rules, 2016; The Plastic Waste Management (Amendment) Rules, 2018; Factory Act, 1948 along with amendments in 1987 and rules made therein and any other rules notified by Ministry of Mines or any other Ministry or the State Governments from time to time. All these will have to inform the rule making process and set the terms of action in states.

It may also be noted that while defining the scope of what requires scrapping, explicit criteria are also needed to include emissions and fuel efficiency performance of the fleet. This can help to improve the screening method and also maximize emissions and energy gains. This can be conjoined with advancement on emissions inspection of on-road fleet either at the centralized inspection centres for commercial vehicles or by introducing remote sensing measurements for on-road fleet screening.

SCRAPPAGE SCHEME FOR FLEET RENEWAL AND STIMULUS

The immediate interest in scrappage policy and fleet renewal is its potential to be a fiscal stimulus for the industry. One time scrappage of targeted vehicle segment with government support and industry participation is expected to stimulate the market for fleet renewal and revive the market.

Under the current conditions of pandemic and economic slowdown, there is a renewed interest in scrappage scheme for market recovery. This policy conversation on scrappage schemes had already started in 2016, just before the BS IV emissions standards were scheduled for nation-wide implementation in 2017. That was the time when MoRTH had announced its intent to propose vehicle scrappage policy as a fleet renewal and stimulus strategy with support from the government. Various official and ministerial statements were issued about the imminent policy. At that time, there was also strong public interest in not linking fleet replacement with the BS IV emissions standards but wait for the nation-wide introduction of much cleaner BS VI vehicles in 2020 to maximize the emissions gains from this initiative.

However, MoRTH has continued to work towards finalization of the Voluntary Vehicle Fleet Modernisation Programme (Scrapping Policy). The original 2016 draft on 'voluntary vehicle fleet modernisation programme (V-VMP)' had proposed scrapping of 2.8 lakh old commercial vehicles. It stated that 'The vehicle owners shredding their old vehicle will get monetary incentives to buy a new vehicle in three forms to aid adoption of this programme: (1) scrap value from old vehicle, (2) automobile manufacturers' special discount and (3) partial excise duty exemption. In summary, we expect customers to receive three benefits amounting to 8–12 per cent of total vehicle cost.'[50]

This Draft Concept Note on Vehicle Fleet Modernisation Programme was circulated on 26 May 2016 to seek comments from the concerned stakeholders and the general public. Based on the comments received from stakeholder discussions held with the Finance Ministry on 24 August 2016, it was decided that the proposal would be placed before the Committee of Secretaries (CoS).[51]

This discussion continued in 2017. Comments and suggestions were incorporated in the final version of the policy. In 2018 it was reported that vehicle scrap policy has got the go ahead at the meeting in Prime Minister's Office (PMO) and that 'Starting 2020, all pre-2000 registered commercial vehicles would be off the road. And vehicles that are registered after the government approves this policy will have a lifetime of 20 years.' This draft policy had proposed incentives for scrapping of commercial vehicles. According to reports, these incentives were likely to reduce the cost of a new vehicle for a buyer by 15 per cent on average.[52] The note on Scrappage Policy is with the Cabinet for approval.[53]

In May 2020, when the pandemic hit and the economy slowed down, the Union Minister Nitin Gadkari further reiterated that the vehicle scrappage policy was likely to be finalized soon to boost the automobile sector. Even the Finance Minister Nirmala Sitharaman in February 2020 said that a policy for scrapping of old vehicles 'is in the works' and will be announced after concerned ministries 'fine tune' it.[54] It was reported in the media that the vehicle scrappage policy was awaiting the final clearance from the Union Cabinet.

The latest draft of the policy is not yet in the public domain. Therefore, the details of the scope of the scheme are not known. It has been reported that while the original plan was to focus only on the old heavy-duty vehicles, the new plan may include all vehicle segments, including two and three-wheelers. This cannot be verified. It has also been reported that the draft policy may be sent for a fresh round of consultation with stakeholders following the direction of the PMO.[55]

According to the latest media reports in July 2020, the much-awaited scrappage policy has got further delayed because of a deadlock over incentive design for the scheme. There is a point of difference with the auto industry, which reportedly is not in favour of offering more than one per cent incentive on scrappage. The government, on the other hand, would like the industry to do more. The auto industry claims that profit margin per vehicle is only about 3–9 per cent per vehicle across segments, so it's not economically feasible for the industry to offer more incentives. The industry also says that they have absorbed most of the price hike of BS VI as well.[56] The incentive design will have to be worked out.

However, industry participation, as global experience shows, will be critical for effective impact of the programme. Automobile industry generally offers discounts from time to time to boost sales, and also offers zero down payment finance schemes, etc. Companies also buy pre-owned cars and sell them back to the market after refurbishing them. The buyback scheme is also used by the industry to boost sales. Discounts on buying back an old vehicle for scrappage and on new models need to be promoted. This will incentivize the owners of old vehicles to replace with newer vehicles.

Currently, in India, the buyback option is more popular in the luxury segment. Automakers themselves have resorted to the buyback option to tackle slowdown and to increase sales. According to reports, Mahindra Alturas priced at Rs 35 lakh had buyback offer of 57 per cent after three years. Honda offered a 52 per cent buyback option for its two diesel versions of Civic (price Rs 22.34 lakh has a buyback value of Rs 11.62 lakh after three years) and CR-V (price Rs 32 lakh, buyback option of Rs 17 lakh after three years); similar offers were launched by Skoda, MG Motor, etc.[57] Toyota recently offered assured buyback for few models. Automobile companies also offer buy and sell platforms for pre-owned vehicles, such as Maruti Suzuki's True Value channel.[58]

However, an effectively designed incentive scheme with industry as a partner is needed especially if the personal vehicles including two-wheelers and cars are involved. The commercial vehicle segment, trucks and buses, will require state support for maximizing gains. But this will require more precise estimation of ready to scrap vehicles for implementation and fiscal support.

There are concerns that the scheme may not provide the intended economic and emissions benefit. Such global programmes as the 'Cash for Clunkers scheme' in the US have been cited as examples. This US scheme had provided financial incentives to car owners about a decade ago. But this was abruptly stopped after the US government spent about USD 3 billion towards it. This apparently did not actively stimulate the US economy to the extent desired.[59] NITI Aayog has also raised concerns regarding age-based approach. It would prefer a system based on merits of fitness, maintenance, and emissions performance of vehicles. It is therefore important to integrate additional criteria of fleet renewal like emissions and fuel economy performance. Incentive design for scrappage especially for two-wheelers, cars, and three-wheelers also needs to be linked with a mandatory share of electric vehicles for zero emissions trajectory. This is now the global trend.

END-OF-LIFE REGULATIONS FOR THE MANUFACTURERS

Yet another critical aspect of the legal framework for the phase out and disposal of ELVs is the responsibility of the automobile industry to ensure that they adopt conscious policies to maximize use of recyclable material at the time of manufacturing. Taking a well-to-wheels approach will allow maximum material recovery at the time of recycling of the vehicles. This requires regulatory targets for the vehicle industry. Globally, such regulations have helped in improving material recovery.

In India, AIS-129 on ELVs has been prepared by the Automotive Industry Standards Committee of MoRTH, under the Central Motor Vehicle Rules.[60] This was published by ARAI (in March 2015) on behalf of Automotive Industry Standards Committee under CMVR–Technical Standing Committee set-up by MoRTH. This is designed to minimize the impact of ELVs on the environment. This was prepared based on several consultations with International Automobile Recycling Congress and International Congress & Marketing. Existing ELV recycling practices in Europe, Japan, and China were also reviewed to prepare this document.

Part-2B of ELV regulation AIS-129 as put up on the MoRTH's website refers to the type approval of vehicles with regard to their reusability, recyclability, and recoverability.

This requires vehicles to be: a) reusable and/or recyclable to a minimum of 80 per cent by mass; b) reusable and/or recoverable to a minimum of 85 per cent by mass. This document also lays down the requirements for both collection and dismantling centres to comply with the Reduce, Reuse, Recycle calculations and for the vehicle manufacturers to restrict the use of heavy metals in vehicles. It also asks for suitable coding of the plastic components and to provide dismantling information to the authorized collection and dismantling centres.

Part-2A of AIS-129 provides for heavy metal restriction and dismantling information. It states that the vehicle manufacturers need to ensure that the vehicles type approved after the mandated date shall not contain lead, mercury, cadmium, or hexavalent chromium other than specified cases and conditions in the regulation.

While some market watchers hold that the industry might be following some of these requirements voluntarily already, there is also a concern that the notification of AIS-129 is necessary under the Central Motor Vehicle Act to make it legally binding. According to information available in the market domain, Indian ELV regulation implementation date is not fixed yet and the government and the industry are still discussing implementation conditions. According to Society for Indian Automobile Manufacturers (SIAM), 'Recycle Infrastructure', 'End-of-Life Vehicle System' and 'Vehicle Inspection System' are needed before implementation. Industry is expected to voluntarily implement ELV regulations.[61] The roadmap for the provisions of AIS-129 related to material recyclability and recoverability targets and restrictions of heavy metals is not yet clear.

There is an additional concern that AIS-129's recycling and recovery mandate is not as robust as the global best practice and there are gaps that need to be addressed immediately. Comparison of the provisions in AIS-129 with the European regulation (2000/53, 2005/64) shows that there are critical gaps in India's approach that weaken the process.

For instance, AIS-129 standards have not yet included all categories of vehicles. Currently, only passenger vehicles (M1 category) and two-wheelers are included. But goods carriers (N1 category—mass not exceeding 3.5 tonnes) are excluded from the scope of the Indian regulation. The document mentions that based on the experience of implementation with the targeted vehicles segments currently, a decision will be taken for inclusion of N1 category vehicles. The European directive already covers both M1 and N1 categories.

The most critical gap in the AIS-129 is the exclusion of the provision of extended producer responsibility. This is necessary to establish the role and create the mandate for the industry to dispose and recycle its own waste. If this provision is brought in, the industry's investment in organized scrap centres will also increase and this will increase the volume of the recycling market in the organised sector. AIS-129 needs to be further amended to include EPR to close the loop of circularity and establish manufacturers' responsibility.

Similarly, the requirement of marking of the parts to indicate the need for recycling is limited to only plastic components in AIS-129. But European rules require marking of rubber components as well. There is no provision for controlling the aftermarket spare parts. But the EU directive covers spare parts also.

Thus, this policy conversation has become necessary to understand the different dimensions of policymaking and implementation strategy for old vehicles and ELVs for a robust circular economy. If done well, this will not only reduce pollution, environmental hazard, and ill health but also improve material recovery and reuse of spare parts.

It is evident that emissions and fuel guzzling that add to the cost of operations can increase with ageing, poor maintenance, and malfunctioning. Fleet renewals allow these savings. In fact, it is notable that there is a growing interest in voluntary fleet renewal programmes in the industry. One of the biggest truck operating companies, VRL Logistics Ltd, which owns the largest fleet of commercial vehicles in India, is reported to have said that they would not buy new trucks and would get rid of old ones to control repair costs and for recovery. They operate about 5,000 vehicles, including tankers, cranes and buses. It is reported that they have identified about 700 low capacity trucks for scrappage. The market forecasts show that it may take at least three years for truck sales to recover in India.[62]

According to recent reports, there is also growing interest in the industry in up-cycling recycled material from across sectors for automotive application in the industry. For example, it has been recently reported that Jaguar Land Rover has shown how innovative recycling process can up-cycle aluminium waste from drinks cans, bottle tops, and end-of-life vehicles into premium cars and reduce CO_2 emissions by up to 26 percent.[63] Aluminium is one of the most widely recycled materials. Post-consumer recycled aluminium can be used for high-end applications such as automotive manufacturing. By recovering the high-quality automotive-grade aluminium used to manufacture vehicles, Jaguar Land Rover can re-use the premium properties as part of a blend, reducing the need for virgin aluminium in vehicle production. Currently, end-of-life vehicle scraps are re-used for low-end applications. High-end use in automotive process is possible. Jaguar Land Rover will start its aluminium closed loop and recycling initiatives for its Destination Zero programme.[64]

It is however necessary to review the global best practices to identify the gaps and key elements that need to inform and strengthen the policy framing in India.

REGULATORY FRAMEWORK FOR SCRAP YARDS

Once the central level policies and guidelines and state level action to control pollution from old vehicles begin to scale up there will be enormous demand for adequate infrastructure for dismantling and recycling of vehicles.

The NGT has already demanded action on scrappage infrastructure. On 24 July 2020, the NGT observed that a proper mechanism be set up and authorized recycling centres be put in place to be compliant with the environmental norms. The MoRTH has informed the NGT that the draft guidelines for setting up, authorization and operation of vehicle scrapping centres have been uploaded on MoRTH website vide letter dated 14.10.2019 for public comments. After addressing the public comments/inputs, formal notification will be issued with approval of the Cabinet.[65] The NGT however feels that there is no tangible explanation for the long delay in issuing of the necessary notification. In view

of the pandemic, two more months have been granted for the issue of the notification.[66] As mentioned earlier, MoRTH issued the draft guidelines for setting up, authorization and operation of automated vehicle scrapping facility in the country on 14 October 2019.[67] This aims to promote legal compliance with the guidelines for safe and regulated disposal of vehicles. The draft rules have specified the criteria for scrapping vehicles. These include vehicles which are no longer validly registered under section 41 of the Motor Vehicle Act, 1988; or vehicles which the owners want to scrap; or when the enforcement authorities scrap vehicles after impounding and seizing them; or if there is any direction from a court of law.[68]

The draft guidelines specify technical requirements and other criteria for setting up a vehicle scrappage facility. These include the minimum area needed for such a facility and several other operational and structural requirements. Scrapping license for an authorized vehicle scrapping facility will need a valid tenure of ten years, after which it will need to re-apply. All AVSFs will need to be in compliance with labour laws, minimum wages act, employees provident fund, etc. Once notified these guidelines will apply to all vehicles and their last registered owners, Automobile Collection Centres, AVSFs, and recyclers of all types of automotive waste products. These guidelines shall come into force with effect from the date of its notification.[69]

The AVSFs need to apply for Consent to Establish from the competent authority of the State/UT and meet the minimum technical requirement for collection and dismantling centres specified in the CPCB Guidelines.[70] MoRTH guidelines specify in detail i) conditions of eligibility to set up AVSF; ii) authorization procedure; iii) validity and renewal of authorization; iv) criteria for scrapping vehicles; v) right to inspection; vi) scrapping procedure; vii) certificate of vehicle scrapping; viii) requirements for scrapping yard; ix) applicable act and rules; and x) audits and certification.[71]

The agencies or entities interested in setting up and running such centres will have to follow the guidelines from the date of the notification. All scrappers will also have to follow the CPCB guidelines for removal, recycle, and disposal of hazardous parts of the scrapped vehicle.[72] Once a vehicle owner submits vehicles for scrapping, the owner will get a 'certificate of deposit'. According to the guideline, this document will be sufficient for the owner to avail incentives and benefits for purchase of a new vehicle as may be promulgated from time to time. Once the benefit is received, the certificate will be cancelled by the agency providing the benefits to the holder of the said certificate. [73] The authorized scrapper would need to issue digital certificates after processing. The scrapper would need to keep safe custody of cut piece of the chassis number for a period of six months from the date of issue of 'certificate of vehicle scrapping'[74] *(*see *Box 5: CPCB's minimum technical requirements for collection and dismantling centres).*

As per these draft guidelines, scrapping centres will be allowed only in industrial areas and not in residential areas. Permission from the state transport department will be required for the scrapping centres and the owners will need to furnish earnest money deposit, proposed to be between Rs 10 lakh to Rs 1 crore, to state governments. OEMs having their own scrapping centres might offer incentives to those using their scrapping services or buying their vehicles in the future.[75]

This policy initiative has to promote legally compliant vehicle dismantling and scrapping industry so that compliance with safe disposal requirements and environmental safeguards can be enforced.

Box 5: CPCB's minimum technical requirements for collection and dismantling centres[76]

A.1 Sites for storage (including temporary storage) of ELVs prior to their dismantling

The collection and dismantling centres shall have:

A.1.1 impermeable surfaces like concrete flooring, etc. for appropriate areas (including areas where vehicles are stored prior to de-pollution as necessary) with the provision of spillage collection facilities, decanters, and cleanser-degreasers.

A.2 Sites for dismantling

The collection and dismantling centres shall have:

A.2.1 impermeable surfaces like concrete, etc. for appropriate areas with the provision of spillage collection facilities, decanters, and cleanser-degreasers,

A.2.2 appropriate storage for dismantled spare parts, including impermeable storage for oil-contaminated spare parts,

A.2.3 appropriate containers for storage of batteries (with electrolyte neutralization on site or elsewhere), and filters/PCB/PCT-containing condensers (if applicable),

A.2.4 appropriate storage tanks for the segregated storage of ELV fluids: fuel, motor oil, gearbox oil, transmission oil, hydraulic oil, cooling liquids, antifreeze, brake fluids, air-conditioning system fluids, and any other fluid contained in the ELV,

A.2.5 appropriate storage for used tyres, including the prevention of fire hazards and excessive stockpiling.

A.3 Dismantling operations for de-pollution of ELVs:

The collection and dismantling centres shall possess the equipment and facilities required for:

A.3.1 removal of batteries,

A.3.2 removal of liquefied gas tanks,

A.3.3 neutralization of potential explosive components (e.g. air bags),

A.3.4 removal and separate collection and storage of fuel, motor oil, transmission oil, gearbox oil, hydraulic oil, cooling liquids, antifreeze, brake fluids, air-conditioning system fluids and any other fluid contained in the end-of-life vehicle, unless they are necessary for the re-use of the parts concerned,

A.3.5 removal, as far as feasible, of all components identified as containing heavy metals as identified in Annex A of AIS-129: Part-2 A.

A.4 Dismantling operations in order to promote recycling:

The collection and dismantling centres shall possess the equipment and facilities required for:

A.4.1 removal of catalysts, to facilitate further extraction of noble metals by recyclers,

A.4.2 removal of metal components containing copper, aluminium, and magnesium in such a way that they can be effectively recycled as materials if the ELV is not going to be treated in a shredder,

A.4.3 removal of tyres and large plastic components (bumpers, dashboard, fluid containers, etc.) in such a way that they can be effectively recycled as materials,

Note: removal of large plastic components is recommended only if they can be dismantled and recycled in an economical and profitable manner.

A.4.4 removal of glass in such a way that it can be effectively recycled.

Note: removal of glass is recommended only if the glass can be dismantled and recycled in an economical and profitable manner.

A.5 Storage operations shall be carried out to avoid damage to components containing fluids or to recoverable components and reusable parts.

A.6 Recommended tools and equipment for pre-treatments (draining and dismantling):

- Shredder, bailing press or any suitable device for compacting
- AC gas recovery unit
- Vehicle lift
- Auto shear machine for cutting catalytic converter
- Air bag deployment unit
- Filter wrench/oil filter removal tool
- Wheel popper
- Piercing equipment for damper oil
- Suction equipment for fluid
- Bleeding system for brake fluid
- Dedicated fluid collection container
- Hydraulic tube cutter
- Pneumatic saw
- Portable power tool
- Draining tray
- Pry bar/spanner/ratchet/mallet
- Screwdriver/slot screwdriver/impact screwdriver
- Cutter/cutting plier/special plier
- Centre punch and bag (for glass breakage & collection)
- Windshield removal tool
- Pneumatic air gun water supply

SECTION 4
GLOBAL LEARNING CURVE

Strong environmental safeguards and high disposable income in high-income countries leads to vehicles retiring more rapidly. As emissions regulations get tougher, larger numbers of used vehicles are expected to retire even before their useful economic life is exhausted.

A CSE publication 'Clunkered'[77] that investigated the international trade in used vehicles brought out the challenge of influx of discarded vehicles from high-income countries to poorer markets of Africa and Asia. Consulting firm Ricardo-AEAT estimated in 2015, based on vehicle scrappage rates, that in the European Union, 94 per cent of the cars have a second life, 87 per cent have a third life, and about 27 per cent have a fourth life. A fourth life is not so common because of the scrappage rate.[78]

Several countries have introduced regulations to retire old vehicles. Complementary policies are designed to support vehicle retirement and discourage use of high emitting vehicles to encourage owners to replace their vehicles. These include vehicle scrappage schemes for fleet renewal and market stimulus, low-emission zones that do not allow vehicles of older vintage, age limits for vehicles, early action subsidies for retrofitment and repowering schemes for older vehicles to prolong their useful life, life, and expensive periodic inspection requirements for older vehicles.

Often, vehicle retirement programmes are adopted to stimulate sales of new vehicles. This happened in the US and Europe following the 2008 economic recession. The 2009 Car Allowance Rebate System or the Cash for Clunkers programme in the US are examples of stimulus programmes. Mexico implemented a vehicle renewal programme in 2009. It is evident that in 2009 the Cash for Clunkers programme that provides incentives for scrapping old vehicles resulted in over three times the normal amount of cars being scrapped—more than dismantling companies could handle over the course of that year. Similar scrappage schemes have been implemented in European countries like Germany.

There is however no clear definition for classifying high-emitting vehicles; it varies across regions and depends on fleet characteristics, age and mileage, and original emission standards. Stringency will depend on the target set by the governments to control emissions and fuel guzzling. Vehicle retirement programmes have been more widely implemented for light-duty vehicles; there are very few for heavy-duty vehicles. These measures together generate a large pool of old and used vehicles not wanted in the domestic market.

Typically, in all advanced markets, legislative framework has emerged to scrap old vehicles and recycle ELVs. This has happened mainly for light-duty vehicles. Once a vehicle is identified as ELV, it is de-registered, scrapped, and recycled through appropriate processes.

Currently, ELV recycling systems exist in EU, Japan, Korea, China, and Taiwan. The European Union, Japan, and Korea have also adopted the extended producer responsibility principle, designed to recover used-car parts, scrap metal, batteries, etc. These countries have adopted explicit regulations related to emission standards and labelling of vehicles, scrappage, end-of-life regulations, and extended manufacturers' responsibility. In the US, ELV recycling is managed under existing laws on environmental protection.

In EU member states, Japan, and Korea, reporting on the number of ELVs is mandatory under their legislative ELV recycling systems. But in other countries, the number of ELVs is usually reported by the recycling industry that processes and recycles the ELVs. Vehicle retirement programmes vary in nature and structure.

There are limited elaborate end-of-life regulations for the heavy-duty industries. Heavy-duty vehicles use more re-manufactured components, and components are four to five times more expensive. Heavy-duty spare parts handling and processing are very heterogeneous. Some components qualify for profitable re-manufacturing, including tyres, alternators, and starters, which account for nearly 70 per cent of the re-manufactured market. There is supposed to be a substantial trade in refurbished used vehicles and components.

Moreover, fleet renewal policies are expected to change dramatically in the European Union now as a large number of cities are planning to phase out diesel engines and are even setting target dates for phasing out internal combustion engines to accelerate electric mobility in the time horizon of 2030–50. Europe will require an elaborate local dismantling system for material recovery from the older fleet and also to prevent dumping in low-income countries. Already several pollution control policies are accelerating fleet renewal. For instance, in Europe, fees for entering low-emissions zones are differentiated based on emissions—charges are higher for high emitters. Stringent and expensive periodic vehicle inspection programme, requirements of repowering of heavy-duty fleet with new engines, and retrofitting older vehicles with emission-control systems add to the challenge. Beijing, while offering subsidies for vehicle replacement, also restricts old vehicles from operating in low emission zones.

As the policies on circular economy take root, explicit rules are being laid out on end-of-life regulations including extended producer responsibility to make the manufacturers of vehicles responsible for the entire life cycle of the products. Scrappage policy is a subset of these strategies. End-of-life disposal is designed to recover valuable material that would otherwise get lost. Increasingly, policies on circular economy in Europe will aim to recover material from this segment.

Manufacturers are required to reduce the overall environmental footprint of their products by reducing use of toxic and hazardous substances, increasing the use of recycled constituents, enhancing ease of disassembly, etc. The producers also have to provide for take back, recycling, and final disposal of the product within the domestic economy. There is 'Individual Producer Responsibility' in which manufacturer or importer takes responsibility individually for its own products throughout the entire life cycle, including the collection and 'end-of-life management' through 'take back' or any other system. In 'Collective Producer Responsibility,' a number of producers, manufacturers, importers,

and other stakeholders come together as a consortium or establish an organization to take collective responsibility for end-of-life management of products manufactured or imported. The nature of these interventions depends on the regulatory framework. This prescribes that the costs of managing post-consumer resources should be built into the cost of the product itself.

EUROPEAN UNION

The European commission's end-of-life Directive 2000/53/EC mandates producer responsibility in which material and equipment manufacturers are obliged to use common component and material coding standards. In EU, automobile recycling targets are established under the ELV Directive 2000/53/EC that lays down the reuse rates for scrap cars: 80 per cent for reuse and recycling; 85 per cent for reuse as a whole. These rates increased to 85 and 95 per cent respectively as of 2015. Moreover, the European Union member states adopted Correspondents' Guidelines No. 9 on Shipments of Waste Vehicles to monitor ELVs. Improper vehicle dismantling and scrapping have adverse environmental impacts and valuable raw materials are lost instead of being recycled.

European automotive manufacturers and importers are responsible for recycling costs based on the principle of EPR. Producers have the responsibility for the collection, treatment, and recycling of waste from their products at the end-of-life. Producers have to take-back (free of charge) the end-of-life vehicles and provide information about the proper dismantling of such vehicles. EPR has already moved the entire automotive industry in the EU towards a more circular economy, as opposed to a more limited company-by-company approach.[79]

In Europe, every year, end-of-life vehicles generate between seven and eight million tonnes of waste. Accordingly, the Directive 2000/53/EC aims to make dismantling and recycling of ELVs more environmentally friendly. It sets clear quantified targets for reuse, recycling, and recovery of the ELVs and their components. [80]

It also pushes producers to manufacture new vehicles with minimum to negligible hazardous substances, in particular lead, mercury, cadmium, and hexavalent chromium (see also Directive 2005/64/EC on the type-approval of motor vehicles with regard to their reusability, recyclability, and recoverability). The list of prohibited hazardous substances is listed in Annex II of the ELV Directive. This is subject to regular reviews. ELV Directive is subject to an ex-post evaluation.[81]

GERMANY

Germany has consistently exceeded EU recovery rates with an 89.2 per cent reuse/recycling rate and a 92.9 per cent recovery rate in 2008. In 2010, more scrap cars were recovered than were handed over to dismantling companies, owing to back inventory from the Cash for Clunkers programme. The Germany bonus programme announced in 2009 was originally supported with €1.5 billion subsidizing the purchase of 600,000 cars.

The ELV Directive (2000/53/EC) requires 85 per cent reuse and 95 per cent recycling respectively. They are based on waste statistics that the Federal Statistical Office (Statistisches Bundesamt) as well as regional-state statistics agencies collected from the relevant companies, in accordance with the Environmental Statistics Act (Umweltstatistikgesetz).

Based on this the UBA determines the scrap-car recovery rate for Germany and submits the German report in this regard to the European Commission.

Under the programme, the German government pays individuals to buy a new car meeting the then current emission standards. Scrapped cars are recycled in two stages. First, the cars are dismantled at one of around 1,300 certified dismantling centres, which drain all motor oil, antifreeze, and other fluids from the cars and remove parts that contain pollutants such as lead batteries, spare parts, and recyclable elements such as tyres and catalytic converters. The bodies are then shredded mechanically, with iron, aluminium, and other metal scrap that is sold to scrap dealers, in some cases after undergoing additional processing. Scrap dealers melt down the scrap into recyclable metal.[97] This also generates shredding residues that need to be disposed of. These are composed of plastic, rubber, glass, residual metals, and other materials, including pollutants.

This process is governed by Directive 2000/53/EC. This law applies to cars, light-utility vehicles, and three-wheelers (excluding motor tricycles). The ELV regulation requires automakers to take back scrap cars free of charge via a comprehensive network; places restrictions on the use of mercury, cadmium, lead, and hexavalent chrome in cars; sets recovery rates; and lays down technical requirements for scrap car reuse and recovery. Hence, such cars may only be dismantled and scrapped by companies that have ELV regulation certification.

There is an added concern that used and scrapped cars can get exported from Germany in high numbers to East Europe and Africa. Over a million used cars are still exported from Germany each year, mostly to other EU countries. It is often difficult to determine whether a given vehicle is usable or meant for the scrap heap. To address this issue, EU member states have adopted Correspondents' Guidelines No. 9 on Shipments of Waste Vehicles, which though not legally binding help officials monitor export (particularly outside the EU) and improper disposing of cars which should be scrapped. Preventing the export of these vehicles will require much tighter export rules and stronger proof of scrapping. For instance, in the US, the Cash for Clunkers programme required dealers to destroy old engines by draining the motor oil and injecting sodium silicate. But the German programme largely required the scrapped vehicles to only be sent to junkyards. This can also become a loophole for leakages and illegal exports.

Scrappage as fiscal stimulus in Germany

Germany's Umweltprämie ('Environmental Bonus' a.k.a Abwrackprämie, 'Scrappage Bonus' or Cash for Clunkers programme) was implemented in 2009 to provide economic stimulus for the auto industry following the 2008 world economic crisis. According to an ICCT review, this also aimed at reducing emissions of all air pollutants. The Umweltprämie was the model for the United States' Cash for Clunkers programme and similar scrappage programmes in other European countries.[82]

Under the Umweltprämie, light-duty vehicle owners were eligible for a one-time bonus of €2,500 (USD 3,500) for the purchase of a new vehicle to replace an old one. To qualify for the bonus, the old vehicle had to be at least nine years old old since the time of its first registration, and the replacement vehicle had to be less than a year old and meet at

least Euro 4 emission standards that were allowed inside Germany's low emission zones. This temporary scheme was expected to last till December 2009. Its entire budget of €5 billion (USD 7 billion) was exhausted by September 2009, as this subsidized two million vehicles.

There are, however, doubts if this truly contributed to long-term economic recovery. At least one study concluded that the vast majority of bonuses went to people who would have bought new vehicles even without them.

There were however air quality benefits. A late 2009 study found that, on average, replacement vehicles emitted 99 per cent less PM, 87 per cent less NO_X, and 74 per cent less CO than old vehicles. Replacement vehicles were about 20 per cent more fuel efficient, but a lot of this gain was offset by the fact that many replacement vehicles were heavier and more powerful than the vehicles they replaced. Overall, the Umweltprämie met emissions reduction objectives. This programme could not take the benefit of Euro 5 standards that were introduced later in September 2009.

Although the programme required old vehicles to be delivered to scrapyards, regulations requiring and verifying actual scrappage were either unclear or loosely enforced. As a result, many old vehicles were simply resold to Africa or Eastern Europe. In a few instances, the vehicles even returned to Germany.

Studies show that despite its environmental benefits, the programme was very expensive. The bonuses issued under the programme were set at a constant €2,500 (USD 3,500) for all replacement vehicle purchases, regardless of their impacts relative to old vehicles. This did not incentivize vehicle owners to replace their old vehicles with the least polluting and most fuel-efficient vehicles. The programme was carried out entirely by Germany's Federal Office of Economics and Export Control. There was no inclusion of state or local authorities in implementing the programme.

UNITED STATES

The US has implemented multiple programmes including Carl Moyer programme for on-road and off-road vehicles in California; Consumer Assistance to Recycle and Save or cash for clunkers for light duty vehicles in the US; and National Clean Diesel Campaign Cash for heavy duty vehicles.

The dual objective of the cash for clunkers was to provide temporary stimulus during the economic recession and provide financial incentives to car owners to replace old, less fuel-efficient vehicles with more fuel-efficient vehicles. This was administered by the National Highway Transportation Safety Administration (NHTSA) that allowed consumers to trade in older, less fuel-efficient vehicles for a voucher to be applied toward the purchase of newer, more fuel-efficient vehicles.

The U.S. government sponsored cash for clunkers from 27 July through 24 August 2009. The programme gave buyers a rebate when they replaced old vehicles with a new one. The rebate was either USD 3,500 or USD 4,500, depending on the difference between the fuel economy of the new and the trade-in vehicles. Overall, about 690,000 vehicles

were purchased and traded in under the program. Funding available for the scheme was increased to USD 3 billion.[83]

The stated purpose of the scheme was to reduce air pollution, stimulate consumer spending, and initiate market recovery. The program did allow purchase of foreign vehicles. Car dealers were required to crush or shred the trade-in vehicles. The U.S. has 274 shredder installations.[84]

Nearly 700,000 clunkers were traded in between 01 July 2009 and 24 August 2009 as part of the programme. After the 'clunker' was traded in at the dealership, its engine was destroyed, ensuring its permanent removal from the US vehicle fleet.

The U.S. however does not have specific national regulations related to extended producer responsibility, or quantitative recycling targets for the disposal of light or heavy-duty vehicles. The recycling of ELVs is only managed under existing and cross-sector regulations on environmental protection. There is also no uniformity in the age of ELVs. While the American and European vehicle fleets and associated recycling industries have common elements, the respective fleet are quite different. The average ELV in France weighs 1,040 kg and is 17.5 years old, while the average ELV in California is 1,700 kg and 15.6 years old.[85]

An evaluation of this programme shows that the programme led to slight improvement in fuel economy, and some reduction in carbon emissions. The cost per tonne of carbon dioxide reduced from the programme was very high. But the programme was more cost effective than other environmental policies of that time like the tax subsidy for electric vehicles or the tax credit for ethanol.

Studies also show that about USD 2.85 billion in vouchers provided by the programme had a small and short-lived impact on gross domestic product. These programmes are not likely to be continuous as there are doubts about the real economic and environmental gains. Economists have argued that the programme cost taxpayers USD 3 billion and that it did little to stimulate the US economy—even in the short run. It is also said that it helped foreign auto manufacturers at the expense of domestic manufacturers. Environmental gains were also small.

The end-of-life management and processing of light-duty vehicles in authorized treatment facilities is handled properly for efficient decontamination (i.e. de-pollution), dismantling, and shredding processes. According to State of California Auto Dismantlers Association (SCADA), the vehicle fluids and other regulated materials are extracted and properly recycled. Recovered parts are then sold to repair other cars at savings of up to 80 per cent over the cost of new parts. Recyclable materials are sent to a processor and manufactured into new products.[86]

In the US it is the discretion of the individual states to adopt regulations, or even forego the option.[87] There is no federal law governing EPR so that individual states have developed and implemented their own policies, reflecting local conditions. Between 1991 and 2011, US states have enacted more than 70 EPR laws, which generally require manufacturers

to implement EPR programmes, though without specifying recycling targets. In parallel, producers have themselves implemented voluntary programmes to organize the collection and recycling of their products.[88]

A number of states have taken specific actions to prevent pollution associated with mercury in scrap tires and lead-acid batteries.[89] Specifically in 2006, a coalition of federal, state, industry, and environmental non-profit partners created the National Vehicle Mercury Switch Recovery Program (NVMSRP), a voluntary effort to promote safe removal of mercury switches from ELVs before they are shredded for recycling. Steel and auto manufacturers have established a voluntary USD 4 million fund to provide incentives for switches returned through the NVMSRP.[90] Tyre recycling and reuse has also been supported. There are comprehensive procurement guidelines at the national level for recycled products (ex. retread tires) and environmentally-preferable purchasing practices.[91]

As on 2008, less emphasis has been placed by government on sustainable vehicle design and production than on recycling. Life cycle analysis is becoming important for the US manufacturers to develop vehicles.[92]

Addressing heavy duty pollution in the US

The oldest running programme to address pollution from on-road heavy-duty vehicles is the Carl Moyer Program, a voluntary grant programme targeting the replacement of older, heavy-duty diesel vehicles and equipment to accelerate commercialization of the cleanest technologies available. This includes replacement of an older, high polluting vehicle/equipment with a newer one; repowering or replacement of an in-use engine with a new cleaner engine; and retrofitment or installation of CARB-verified emission control devices for an in-use engine, vehicle, or piece of equipment.[93]

This was designed to reduce NO_X, PM, and reactive organic gases from heavy-duty vehicles and other equipment operating in California in a cost-effective manner. The programme provided financial incentives.[94] Since 1998, the Carl Moyer Program is said to have significantly reduced emissions and improved air quality. This targeted on-road equipment including heavy-duty trucks (with gross vehicle weight rating (GVWR) > 14,000 lbs), transit and other buses, solid waste collection vehicles, public agency and utility vehicles, and emergency vehicles.[95]

In the US, the National Clean Diesel Campaign (NCDC) was initiated in 2007 under the directive of the Diesel Emissions Reduction Act (DERA), which is a part of the Energy Policy Act of 2005. The program is geared toward HDVs and non-road vehicles and equipment and is somewhat similar to the Carl Moyer Program. But it's a national programme. According to the ICCT, this programme got the maximum allocation from the US Congress but the actual fiscal incentives issued were considerably lower. This grant is tied to projects that aim to reduce PM and NO_X from in-use diesel vehicles.[96] The NCDC is not purely a vehicle replacement programme but also includes retrofits, engine rebuilding and repowering, operational changes, and cleaner fuels. In 2009 and 2010, vehicle replacement programmes accounted for only 10 per cent of NCDC funding grants.[97] The programme has to ensure emissions reduction and prevent increase in real-world emissions.[98]

Bills have been introduced in the Congress to reauthorize the DERA program through 2024.[99] There are talks about an ambitious USD 2 trillion clean energy plan in the US election campaign of 2020, including a cash for clunkers type programme intended to encourage people to trade their internal combustion engine vehicles (ICEs) for EV models.

CHINA

China has a compulsory retirement age requirement and this regulation has evolved over time. China's official age limit of service life is prescribed in 'Automobile Scrapping Standard'. The mandatory scrapping standard of passenger vehicles was 10 years (or a service distance of over 100 thousand kilometres). However, with the rapid development of the automobile industry in China, the restriction was extended to 15 years in 2000.[100]

In the latest 'standard for compulsory scrapping of motor vehicles' announced in 2013, the mandatory retiring age of small and medium-sized non-operating passenger vehicles was cancelled. Instead, the service distance limitation is set at 600,000 kilometres. If the passenger vehicles travel an average of 20,000 kilometres per year, the service time can be 25–30 years.[101] China allows vehicles to operate as per service life. However, it is not clear what service life is considered for end-of-life now.

Table 4: Permitted vehicle service lives in China as of 2006

Sr. no.	Type	Number of years
1	Trailer, trucks, mining operation SPVs, mini trucks, and all kinds of taxicabs	8
2	No more than nine seats (incuding nine seats) non-operating cars (including cars, cross country vehicles)	15
3	Trucks, tourism passenger cars, and over nine seats non-operating passenger cars	10
4	Buses	10
5	Motorcycles	10
6	Operating vehicles to non-operating vehicles and non-operating vehicles into operating vehicles	8

Source: Jinhui Li et al 2014, Recycling and pollution control of the End of Life Vehicles in China, January 2014, Journal of Material Cycles and Waste Management 16(1), DOI: 10.1007/s10163-013-0226-6. Lead author is from Tsinghua University China

Before 2006, each type of vehicle was permitted to be in service for a regulated number of years, and individual private car owners had to apply to postpone the deadline if they wanted to continue to utilize their cars after the permitted service life (15 years). In 2006, the compulsory policy was revised, and private cars were allowed to remain on the road, but were required to have either two or four inspections annually if their service lives exceeded either 15 or 20 years, respectively. In May 2013, The Regulations on Mandatory Standard of Scrapping Vehicles were published. The biggest change in the new regulations is their applicability to private cars, as their service life is now based on mileage rather than vehicle age, with a limit of 600,000 km of useful life.[102]

These new regulations have resulted in the rapid development of the ELV recycling industry, and it has been estimated that auto recycling provides more than two million tonnes of scrap steel, 50,000 tonnes of non-ferrous metals, and a large amount of waste rubber and plastic each year. In China, vehicle manufacturers play a very important role in the vehicle recycling system.[103] It is also estimated that in China, with rapid motorization, the ELV generation is expected to be 99.5 million in 2020. Exporting used vehicles is not legal in China.

Regarding the standard of material recycling efficiency in China, the Automotive Product Recycling Technology Policy of 2006 has been issued by the National Development and Reform Commission, the Ministry of Science and Technology, and the State Environmental Protection Administration in order to clarify the standard of ELV recycling. The target recovery rate of all materials from end-of-life passenger vehicles in China was set at over 95 per cent, with a target recycling rate ofover 85 per cent by 2017. A 2019 report from auto recycling statistics shows that about 80 per cent of a vehicle (by weight) can be recycled.[104]

Moreover, legislation directives in China encourage whole vehicle and component manufacturers to design products with re-use and recycling in focus. The legislation also restricts the use of specific substances including lead, mercury, cadmium, chromium (VI) and, in certain cases, also bromated flame retardants such as polybrominated diphenyl ethers (PBDE) and polybrominated biphenyl (PBB).

Certain parts/systems in vehicles are considered important in vehicle recycling laws. These are called 'five assemblies' which include engines, steering gears, transmission, front and rear axle assembly as well as frame. Under the Old ELV Measures in China, the 'Five Assemblies' dismantled from the ELVs had to be disposed off as scrap metal and delivered to smelters. This requirement, which originally aimed at wiping out illegal vehicle-assembly activities, became a major deterrent to the growth of auto parts remanufacturing industry in China. According to Article 12 and 13 of the New ELV Measures, the 'Five Assemblies' dismantled may be sold to capable remanufacturing enterprises. The ELV operators need to maintain a record of the dismantled 'Five Assemblies' (including quantity, model, and goods flow) and feed the information to an ELV recycling information database to be established and maintained by the Ministry of Commerce.[105]

China has also implemented yellow-label vehicle scrappage subsidy policy to control air pollution. Yellow-label vehicles are light duty vehicles not meeting China I emission standards and heavy duty vehicles not meeting China III emissions standards. The Green-label vehicles meet these or more advanced standards. China's first national scrappage subsidy programme began in mid-2009. This year-long programme offered subsides ranging from 3,000 to 6,000 RMB (USD 490 to USD 980) per scrapped vehicle. Subsidies varied by vehicle type and targeted both LDVs and HDVs.

According to the available studies, the costs and benefits of the policy have been estimated for the Beijing-Tianjin-Hebei (BTH) region based on 1.362 million Yellow-label vehicles from 2008 to 2015. It is estimated that because of the implementation of the policy, the $PM_{2.5}$, PM_{10}, NO_x, CO, and HC emissions in this region have decreased during 2008–

2015.[106] These vehicles have enormous impact on air quality. In 2010, it was estimated that the CO, hydrocarbon (HC), NO_x, and particulate matter emissions from Yellow-label vehicles accounted for 46.1 per cent, 47.9 per cent, 63.1 per cent and 86.1 per cent of the total emissions from on-road vehicles.[107]

The costs, benefits, and net benefits of the policy were 13.69, 34.03, and 20.34 billion yuan respectively. Of the 13 cities in the BTH region, Beijing had the highest net benefits, amounting to 16.43 billion yuan. According to scientists, the results may provide scientific support for the promotion of older vehicle and diesel vehicle scrappage subsidy policies, the development of cost-benefit analysis, and effective environmental decision-making in China.[108]

Over the course of 2010, the government spent a total of 6.41 billion RMB (USD 1.04 billion) on subsidies for 459,000 vehicles—equivalent to an average subsidy of about 14,000 RMB/vehicle (USD 2,270). Most subsidies were given to passenger cars (46.4 per cent), then large/medium buses (20.7 per cent) and small/micro trucks (17.2 per cent). The national programme closed at the end of 2010. Although no national-level scrappage subsidy programme has been run since then, the Chinese national government has repeatedly mentioned wide-scale scrappage of Yellow-label vehicles as an important near-term goal.[109]

During 2019, new regulations to manage vehicle recycling came into force. The new automotive scrapping regulation aims to eliminate illegal recycling and dismantling activities and promote an open scrap market. Under the new rule, only state-approved automotive scrapping firms that meet a pre-established environmental standard will be permitted to operate, China's commerce ministry said on May 2019. Recycling and automotive scrapping firms will need to apply for operating licences online and get those approved by a central authority before they can continue to trade. Firms operating without licences will be fined and their assets will be confiscated by the government.[110]

Scientists from Tsinghua University recommend that governmental management and supervision should be strengthened to deal with the expected rapid increase of ELVs in the near future—particularly with regard to the second-hand car resale enterprises, and the enforcement of deregistration procedures and standards.[111] Recycling networks for ELVs need to be standardized and haphazard collection needs to be prevented. Stronger action is needed on illegal dismantlers. A national recycling network and standardized collection logistics for universal collection system are needed.[112]

Moreover, ELV recycling industry needs technology and pollution control upgrades. Five hundred and twenty authorized recycling and dismantling enterprises were set up in China by 2012. Recycling technologies should be upgraded, and the recycling and disposal of shredded residue from de-pollution and dismantling, and crushing needs more attention. It has been recommended that more incentives and regulations, and stricter environmental protection and regulatory requirements, should continue for circular economy to address both hazardous and non-hazardous wastes during recycling operations. The government needs to support development of key enterprises so that waste steel, plastics, and non-ferrous metals are recycled under better management and with a higher level of environmental accountability.[113]

In China, studies show that the actual recycling ratio is decreasing annually as most of the authorized recycling and dismantling enterprises are not able to collect and process enough ELVs from the legitimate market.[114]

It is reported that the implementation of EPR is still not that effective because of weak relationship between the automotive producers and the recycling enterprises.[115] Although the vehicle manufacturers are encouraged to use less hazardous substances and to avoid prohibited toxic substances, including lead, mercury, cadmium, chromium VI, polybrominated biphenyls, and polybrominated diphenyl ethers, the scientists of Tsinghua University recommend that industrial design should follow the eco-design rules for easier recycling. All the information from the manufacturers, owners, collectors, and dismantlers should be retained by the automotive recycling information centre in order to compile and store the life management history of the vehicles.[116]

JAPAN

The law for recycling and ELVs was enforced in 2005 to address the shortage of landfill sites for disposal of discarded vehicle waste. This also led to a hike in vehicle recycling fees. The law systematically defines vehicle recycling through specifications for car manufacturers and importers as well as customers and government requirements. Recycling is mandatory for all citizens and corporate entities and is governed by various laws. The Japan Automotive Recycling System is designed to minimize illegal dumping possibilities by adopting a prior fee payment arrangement whereby the purchaser of a new vehicle must pay the recycling fee at the time of purchase, while the owner of an in-use vehicle must pay it at the time of the first periodic inspection.

Moreover, ELVs are important for Japan as sources for recycled resources. According to the Ministry of the Environment, the number of unlawful ELVs in Japan sharply declined from 126,000 units in August 2001 to only 35,064 in March 2007. The Shaken programme contributed to the decline. In Asia, both Japan and China have come up with end-of-life regulations. But they have different levels of stringency. A thriving trade has emerged in spare parts and components mined from scrapping and become an important export business in Japan. The used parts, removed from ELVs, are exported worldwide to wherever there are used-vehicle markets of Japanese vehicles. This is also needed to serve the overseas markets where used vehicles have been traded.

LEVERAGE SCRAPPAGE SCHEME FOR ELECTRIC VEHICLE PROGRAMME

In the pandemic hit economies there is considerable thrust on green recovery. Several countries are designing bailout packages for industries and linking them explicitly with environmental objectives. Scrappage and incentive schemes are being designed to accelerate electric vehicle programmes to decarbonize transport and reduce local air pollution. Italy, France, Germany, and Spain are some countries that have taken this initiative *(see Box 6: Countries leveraging scrappage policy to accelerate electric vehicle programme).*

Box 6: Countries leveraging scrappage policy to accelerate electric vehicle programme

To prepare for the new normal post pandemic, several countries are designing scrappage and incentive programmes to accelerate transition towards zero emissions and scale up penetration of electric vehicles. ICCT has reviewed the incentive packages that have emerged during the pandemic in Europe. Some of the highlights are as follow.

Italy: Italy has announced a recovery plan in which bonus for the purchase of a battery BEV increases from €4,000 to €6,000, including a car manufacturer's share of €1,000. If a car is scrapped that is at least ten years of age, the maximum support can increase from €6,000 to €10,000, including €2,000 provided by car manufacturers. The maximum amount for PHEVs is €3,500 without scrappage (previously €1,500) and €6,500 with scrappage (previously €2,500). Also, buyers of a Euro 6 standard petrol or diesel car with CO_2 emissions between 61 and 110 g/km (as measured in the NEDC) can receive a bonus of €1,750. If an older car is scrapped, the amount doubles to €3,500.[117]

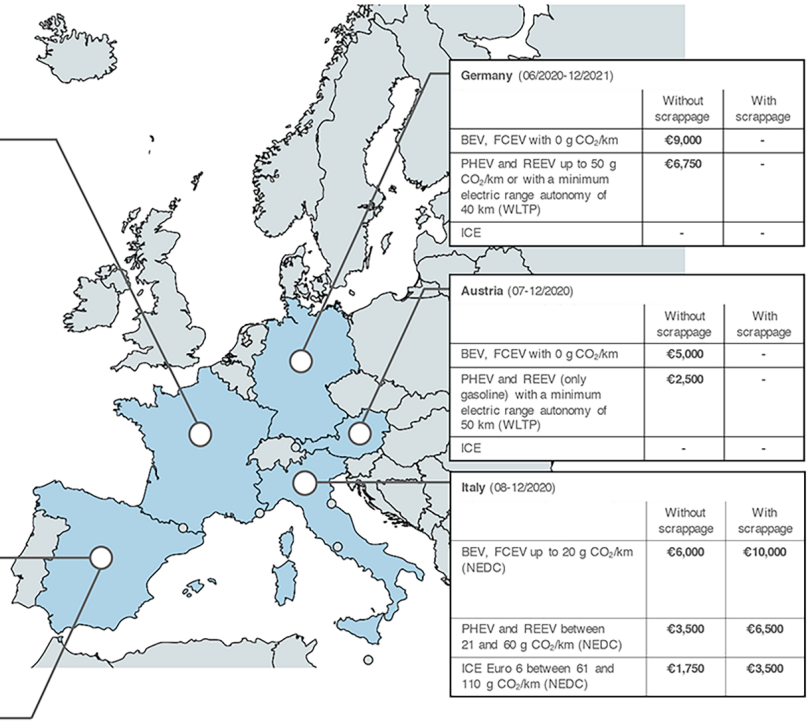
France: In May 2020, the government increased its contribution towards new electric cars to €7,000 from the old €6,000. The existing scrappage scheme has also been temporarily revised, maintaining the maximum aid amounts but loosening the income limits between June and July 2020. The maximum scrappage aid is €5,000 for purchasers of a BEV or a PHEV with an electric range of more than 50 km.[118] Under the scheme, companies buying electric fleet cars would be eligible for €5,000. Electric cars remain considerably more costly than equivalent models powered by internal combustion, often weighing in at around twice the price. People buying new diesel or petrol cars may also qualify for up to €3,000 if they can demonstrate their new vehicle is cleaner than their old one. France expects the stimulus to boost sales of unsold cars in French showrooms. Under the stimulus plan, France aims to produce over one million clean energy cars by 2025.[119]

Germany: The German government doubled the incentives for BEVs and PHEVs as part of its recovery package to €6,000 and €4,500, respectively. The financial aids are complemented by incentives offered by the car industry of €3,000 for a BEV and €2,250 for a PHEV, totalling up to a maximum of €9,000 for a BEV (previously €6,000) and €6,750 for a PHEV (previously €4,500). The German recovery package does not include any subsidies for the purchase of a new gasoline or diesel car.[120]

Spain: In Spain, two aid plans were adopted in June and July 2020 in response to the COVID-19 pandemic. As per the first plan, the financial aid is up to €4,000 for a BEV and PHEV with a minimum electric range of 90 km. Scrapping a car which is more than seven years old in favour of a BEV or PHEV results in a government incentive of up to €5,500. BEVs and PHEVs with a smaller range of between 30 km and 89 km can receive up to €1,900 without and €2,600 with scrappage. The financial aids are complemented with a €1,000 discount offered by the car manufacturers. The second scheme includes financial support for the purchase of electric as well as conventional cars with the obligation to scrap a vehicle older than ten years. Buyers of a BEV can receive up to €5,500, including a €4,000 governmental incentive and a €1,000 discount by the car manufacturers. An additional €500 is added for scrapping a car older than 20 years, for beneficiaries with reduced mobility, or households with income less than €1,500.[121]

Green cars can avail more incentives with scrappage of an old car in many countries: ICCT review

Maximum aid for private passenger car purchases from select European government recovery packages (status: August 2020)



France (06-12/2020, with scrappage 06-07/2020)

	Without scrappage	With scrappage
BEV, FCEV up to 20 g CO_2/km (WLTP)	€7,000	€12,000
PHEV between 21 and 50 g CO_2/km and with a minimum electric range autonomy greater than 50 km (WLTP)	€2,000	€7,000
PHEV, LPG, CNG/LNG, ICE Euro 4, 5 and 6 (gasoline), ICE Euro 5 and 6 (diesel), between 51 and 137 g CO_2/km (WLTP)	-	€3,000

Spain (MOVES II Program, 06-12/2020)

	Without scrappage	With scrappage
FCEV and BEV, PHEV and REEV with a minimum electric range autonomy of 90 km (NEDC)	€5,000	€6,500
BEV, PHEV and REEV with an electric range autonomy between 30 km and less than 90 km (NEDC)	€2,900	€3,600
ICE	-	-

Spain (RENOVE 2020 Program, 07-12/2020)

	Without scrappage	With scrappage
BEV, FCEV, REEV	-	€5,500
PHEV with a minimum electric range autonomy of 40 km (NEDC)	-	€4,100
PHEV with an electric range autonomy of less than 40 km, HEV, LPG, CNG/LNG up to 120 g CO_2/km (NEDC)	-	€2,500
ICE Euro 4, 5 and 6 (gasoline), ICE Euro 6 (diesel) up to 120 g CO_2/km (NEDC)	-	€2,100

Germany (06/2020-12/2021)

	Without scrappage	With scrappage
BEV, FCEV with 0 g CO_2/km	€9,000	-
PHEV and REEV up to 50 g CO_2/km or with a minimum electric range autonomy of 40 km (WLTP)	€6,750	-
ICE	-	-

Austria (07-12/2020)

	Without scrappage	With scrappage
BEV, FCEV with 0 g CO_2/km	€5,000	-
PHEV and REEV (only gasoline) with a minimum electric range autonomy of 50 km (WLTP)	€2,500	-
ICE	-	-

Italy (08-12/2020)

	Without scrappage	With scrappage
BEV, FCEV up to 20 g CO_2/km (NEDC)	€6,000	€10,000
PHEV and REEV between 21 and 60 g CO_2/km (NEDC)	€3,500	€6,500
ICE Euro 6 between 61 and 110 g CO_2/km (NEDC)	€1,750	€3,500

BEV = Battery Electric Vehicle, FCEV = Fuel Cell Electric Vehicle, PHEV = Plug-In Hybrid Electric Vehicle, REEV = Range Extender Electric Vehicle, ICE = Internal Combustion Engine vehicle, HEV = Hybrid Electric Vehicle, LPG = Liquefied Petroleum Gas vehicle, CNG = Compressed Natural Gas vehicle, LNG = Liquefied Natural Gas vehicle
NEDC = New European Driving Cycle, WLTP = Worldwide Harmonized Light-Duty Vehicles Test Procedure

Start dates reflect the times when the program came into effect. Ending dates refer partially to the maximum aid time and might end earlier in case funds are exhausted (e.g., Austria, France, Spain).

Amounts listed include governmental share as well as share by car manufacturers and show maximum aid amounts. They are partially tied to certain preconditions, e.g. purchase price of the vehicle, household income, or mobility restrictions of beneficiaries. Local incentives and additional incentives (e.g., France when living in a Low Emission Zone) are excluded.

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Source: Sandra Wappelhorst 2020, Economic recovery packages in response to COVID-19: Another push for electric vehicles in Europe?, 3 August 2020, The ICCT.

THE WAY FORWARD

Rapid motorization and steady ageing and obsolescence of vehicles will continue to inflate the number of grossly polluting old vehicles and super emitters, thus increasing toxic exposure to air pollution. This obsolescence will contribute hugely to the waste heap posing serious threats to the environment. As these vehicles get junked, a large quantity of materials that can be recovered for recycling will be lost at an enormous economic cost.

India now has the opportunity to accelerate fleet renewal based on BS VI emissions standards and zero emissions electric vehicle programme to minimize emissions and maximize public health gains. With economic slowdown during the pandemic there is renewed interest in the scrappage scheme as a stimulus package for market recovery. This needs to be designed well for maximum benefits.

This matter also requires urgent policy attention to have effective and enforceable end-of-life regulations to maximize recycling potential of the material and establish infrastructure for material recovery. This requires detailed regulations and guidelines for scrappage and dismantling with requisite environmental safeguards for the scrap-yards.

The opportunity for these co-benefits lies in the on-going policy initiative to frame several pieces of regulations and guidelines. It is important to inform this process based on the global learning curve to get appropriate policy design and strategy for effective impact.

Implement robust scrappage scheme to reduce emissions from heavy duty vehicles: The Government of India is expected to announce the scrappage scheme soon. The automobile industry has shown interest in this scheme for fleet renewal as this can stimulate the market at the time of economic slowdown. It is important to design this scheme effectively to provide strong emissions benefits. The focus of the incentive programme should be retained on replacement of old commercial vehicles, particularly the old heavy-duty vehicles like trucks and buses, with vehicles meeting the BS VI emissions standards. This will provide substantial emissions benefits. This policy may also outline the performance criteria for identifying vehicles for scrappage. In fact, the centralized vehicle inspection centres that are being set up across the country under the aegis of the Ministry of Road Transport and Highways should have the facility to identify vehicles that are unfit for driving and operations. Such vehicles can belong to any age group. However, performance criteria will help to maximize the emissions gains.

Leverage scrappage stimulus to accelerate zero emissions pathways for the new normal: If the scope of this programme is being extended to personal vehicles, including two-wheelers and cars, linking the incentives with targeted electrification of the vehicle segment will be critical to enable India to accelerate the pathways to the target of 30–40 per cent electrification of fleet by 2030. Scrappage stimulus is an immediate policy pathway to accelerate this change. This needs to be extended to buses for city service as well. Globally,

the scrappage stimulus is being linked with electric vehicles for green recovery from the economic shock of the pandemic. In India, the recently notified electric vehicle policy of the Delhi government has provided for vehicle segment-wise monetary incentive for scrappage and replacement with electric vehicles as one of the instruments for meeting the target of 25 per cent electrification by 2024. This scrappage incentive will be provided after the scrapping of old vehicles powered with internal combustion engines is confirmed. The policy has further provided for vehicle dealers' contribution to the scrappage incentive. The automobile industry's participation in this incentive programme and other national programmes will be critical to build support for this programme.

Notify the draft guidelines for authorized vehicle scrapping facility for safe dismantling and material recovery: Given the fact that vehicle retirement is expected to accelerate with enforcement of clean air policies, cities and regions will have to scale up infrastructure for scrappage. This will require immediate notification of the Draft Guidelines for setting up, authorization, and operation of Authorised Vehicle Scrapping Facilities. This is needed for protection of the environment and promotion of a legally compliant vehicle dismantling and scrapping industry.[122] Based on this, state governments would need to develop the details for implementation.

Integrate the informal sector: The informal sector plays an important role in the collection, dismantling, and recycling of ELVs. The spare part recovery business generates livelihood and also serves the market for in-use vehicles. It is important to create a system of monitoring of these units based on MoRTH/CPCB guidelines. A cooperative or association of small units can be formed for collective environmental management. This may also require government support for setting up of common infrastructure for pollution control so that the informal businesses can become cleaner. Implementing a licensing system for roadside arages, workshops, and repair shops can help. CPCB has already proposed a siting policy to have these centres in industrial areas. Enforcement is needed to protect residential and densely populated areas.

Amend and notify India Automotive Industry Standard for End-of-Life Vehicles (AIS-129) to establish manufacturers' responsibility: While AIS-129, already put up on the websites of MoRTH and ARAI, has established the requirement of 85 per cent recyclability and recoverability of material in vehicles, this needs further strengthening. The scope of the rule should be expanded to include the goods/commercial vehicles or N1 category and also the critical provision of extended producer responsibility to make the manufacturers responsible for recycling ELVs. AIS-129 will have to be notified under Central Motor Vehicle Act along with the scrappage policy to make it widely enforceable.

Notify and mandate the CPCB Guidelines for Environmentally Sound Facilities for Handling, Processing and Recycling of End-of- Life Vehicles to minimize environmental damage: 'Guidelines for the Environmentally Sound Management of ELVs in India' were initially framed in 2016 and further strengthened in 2019 to regulate handling, storage, and transportation of ELVs and to provide a provision for environmentally sound de-pollution, dismantling, segregation, and disposal. This also has guidance on recycling facilities and technologies for the ELV recycling process.[123] This needs to be notified to become legally binding.

State governments to adopt state level scrappage policy: State governments need to adopt their respective state level scrappage policies to assess the magnitude of junk vehicles to build and license scrapping infrastructure accordingly. Further, enforcement of all guidelines related to safe disposal and material recovery need to be ensured. Local rules for scrapping will have to be established. Delhi has already adopted Guidelines for Scrapping Motor Vehicles in 2018.

Adopt broad based criteria for establishing targets of the scrappage programme and adopt complementary measures to disincentivize old vehicles: The proposed scrappage scheme has to establish verifiable emissions saving goals of the programme. This will require an upgrade of on-road emissions inspection systems to identify the malfunctioning grossly polluting vehicles, unfit vehicles, and also a segment of older generation vehicles that are high emitters. In addition to age caps, other strategies need to be adopted to disincentivize old and highly polluting vehicles in polluted cities/regions. This may include increasing annual road taxes linked with age like the green tax in Maharasthra and Karnataka. But this will require effective tracking to ensure that old vehicles are not abandoned in public spaces to avoid payment of tax dues and to prevent scrappage. Polluted cities may also consider introducing low emissions zones where old and polluting vehicles are barred from entering This is widely practiced in Europe. In fact, the Supreme Court directive that bars entry of pre-2006 goods carriers and trucks into Delhi or the ban on old vehicles inside Delhi is a first step towards delineating an area as low emissions zone. Delhi has set a precedent. This idea needs to be built on to do more city specific zoning to clean up local exposures in city centres. Moreover, on-road emissions monitoring needs to be upgraded for efficient fleet screening. Remote sensing or centralized inspection centres need to be leveraged for identification of unfit gross polluters for fleet renewal. It is also possible to consider such strategies as repowering of selected old heavy duty models with new engines to extend their useful economic life. This will require proper certification and quality control systems.

Clean up vehicle database for more credible estimation of ELVs: Scrappage policy will require cleaning up of the vehicle database to estimate accurately the quantum of legacy vehicles across all regions. MoRTH's initiative to create an online VAHAN database for active vehicle permits and registration is an important step. This needs to be taken forward to ensure that all road transport organizations in the country are connected with the updated database which is corrected based on obsolescence, deregistration or scrappage. Without accurate data it will be inefficient to quantify the monetary incentive package and the capacity of the srappage infrastructure to be created.

Need harmonized action: Several laws and rules at the central and state levels apply or have bearing on the dismantling and disposal of old vehicles. This will require coordinated action particularly between MoRTH, MoEFCC, and CPCB to harmonize the regulatory framework and coordinate implementation. This will have to be aligned with state level action or any advanced measure needed in pollution hotspots.

REFERENCES AND ENDNOTES

1. *CPCB 2016, Guidelines For Environmentally Sound Management Of End- Of-Life Vehicles (ELVs), Central Pollution Control Board, Delhi*
2. *Roychowdhury, A. 2018, Clunkered: A roadmap for Africa and South Asia, Combating dumping of used vehicles, Centre for Science and Environment.*
3. *FICCI 2018, Accelerating India's Circular Economy Shift: A half trillion USD opportunity, future-proofing growth in a resource-scarce world, FICCI Circular Economy Symposium 2018, Accenture Energy. Accessed at http://www.ficcices.in/pdf/FICCI-Accenture_Circular%20Economy%20Report_OptVer.pdf*
4. *Approved cabinet note for scrapping old vehicles, policy out soon: Nitin Gadkari, 19 September 2019. Accessed at https://economictimes.indiatimes.com/news/economy/policy/approved-cabinet-note-for-scrapping-old-vehicles-policy-out-soon-nitin-gadkari/articleshow/71206673.cms*
5. *Ministry of Road Transport and Highways (MVL Section), 19 November 2018, Consultation note on Scrapping of Commercial Vehicles. Accessed at http://jhtransport.gov.in/pdf/Morth_Scrapping%20of%20Older%20Vehicle.pdf*
6. *Vehicle scrap policy gets go ahead at PMO meet; over 20-yr old CVs to face axe, March 2018. Accessed at https://economictimes.indiatimes.com/news/politics-and-nation/vehicle-scrap-policy-gets-go-ahead-at-pmo-meet-over-20-yr-old-cvs-to-face-axe/articleshow/63336713.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst*
7. *Ministry of Road Transport and Highways (MVL Section), 19 November 2018, Consultation note on Scrapping of Commercial Vehicles. Accessed at http://jhtransport.gov.in/pdf/Morth_Scrapping%20 of%20Older%20Vehicle.pdf*
8. *Policy on vehicle scrapping soon, says Gadkari, 07 May 2020. Accessed at https://www.tribuneindia.com/news/nation/policy-on-vehicle-scrapping-soon-says-gadkari-81704*
9. *Cash for clunkers in India too? Soon you may be able to turn in your old car and get up to Rs 1.5 lakh. The Modi government could soon come out with a policy offering financial incentives of up to Rs 1.5 lakh on surrender of vehicles that are over 10 years old, FP Staff, 14 August 2015. Accessed at https://www.firstpost.com/business/cash-clunkers-india-soon-may-able-turn-old-car-get-rs-1-5-lakh-2392412.html*
10. *Vehicle Scrappage Policy delayed as deadlock over incentives between government & Motown continues, 30 July 2020. Accessed at https://www.timesnownews.com/videos/et-now/news/vehicle-scrappage-policy-delayed-as-deadlock-over-incentives-between-government-motown-continues/69238*
11. *India Code, Digital Repository of All Central and State Acts. Accessed at https://www.indiacode.nic.in/show-data?actid=AC_CEN_30_42_00009_198859_1517807326286&orderno=58*
12. *MoRTH 2019, Public circulation of Draft Guidelines for setting up, authorization and operation of Automated Vehicle Scrapping Facility (AVSF), New Delhi. Accessed at https://morth.gov.in/sites/default/files/circulars_document/Draft%20Guidelines%20for%20Vehicle%20Scrapping%20(1).pdf*
13. *ARAI 2015, Automotive Industry Standard for End-of-Life Vehicles (AIS-129). Accessed at https://morth.gov.in/sites/default/files/ASI/352015506 54PMAIS-129_F.pdf*

14. *MoRTH 2019, Public circulation of Draft Guidelines for setting up, authorization and operation of Automated Vehicle Scrapping Facility (AVSF), Ministry of Road Transport and Highways, New Delhi. Accessed at https://morth.gov.in/sites/default/files/circulars_document/Draft%20Guidelines%20for%20Vehicle%20Scrapping%20(1).pdf*
15. *CPCB, January 2019, Guidelines for Environmentally Sound Facilities for Handling, Processing and Recycling of End-of- Life Vehicles (ELV), New Delhi.*
16. *CPCB 2016, Guidelines For Environmentally Sound Management Of End- Of-Life Vehicles (ELVs), New Delhi.*
17. *This is based on Winfrey S3 Survival Curves. Statistically, it has been considered that about 80% of vehicles are between 0 to 10 yrs. This method of 'vehicle retirement' is sourced from John A. Rogers, Mexico-Traflagar (also used by Sarath Guttikunda). Winfrey curves are named after Robley Winfrey, with Iowa Engineering Experimentation Station during the 1930s. Winfrey collected information on dates of installation and retirement of 176 groups of industrial assets and calculated 18 'type' curves that gave good approximations to their observed retirement patterns. Winfrey considered many of the major companies of the time and he examined Iowa State vehicle registration records covering a wide range of 'motor trucks' and 'motor cars' to assess the service life and retirement*
18. *Apoorva Pandey and Chandra Venkataraman 2014, Estimating emissions from the Indian transport sector with on-road fleet composition and traffic volume, article in Atmospheric Environment, November 2014 (DOI: 10.1016/j.atmosenv.2014.08.039), IIT Bombay.*
19. *Ibid.*
20. *ET Auto, 2020, You need to have a valid pollution under control certificate to renew your motor insurance: IRDAI, 21 August. Accessed at https://auto.economictimes.indiatimes.com/news/policy/you-need-to-have-a-valid-pollution-under-control-certificate-to-renew-your-motor-insurance-irdai/77669202*
21. *Vehicle Recycling in the ASEAN and other Asian Countries, Economic Research Institute for ASEAN and East Asia, November 2018. Accessed at https://www.eria.org/uploads/media/ERIA_RPR_FY2017_16.pdf*
22. *CPCB 2016, Guidelines For Environmentally Sound Management Of End- Of-Life Vehicles (ELVs), New Delhi.*
23. *Accelerating India's Circular Economy Shift: A half trillion USD opportunity, future-proofing growth in a resource-scarce world, FICCI Circular Economy Symposium 2018, Accenture Energy. Accessed at http://www.ficcices.in/pdf/FICCI-Accenture_Circular%20Economy%20Report_OptVer.pdf*
24. *Ibid.*
25. *Ibid.*
26. *Vehicle Recycling in the ASEAN and other Asian Countries, Economic Research Institute for ASEAN and East Asia, November 2018. Accessed at https://www.eria.org/uploads/media/ERIA_RPR_FY2017_16.pdf*
27. *Ibid.*
28. *Mekonnen Asmare Fentahun and Mahmut Ahsen Sava, 2018 Materials Used in Automotive Manufacture and Material Selection Using Ashby Charts, International Journal of Materials Engineering. Accessed at http://article.sapub.org/10.5923.j.ijme.20180803.02.html*
29. *Material composition in a vehicle, 26 November 2014, New Straits Times. Accessed at https://www.nst.com.my/news/2015/09/material-composition-vehicle#:~:text=Steel%20was%20largely%20used%20by,compared%20with%20the%20vehicles%20today.&text=According%20to%20current%20estimation%2C%20the,cent%20of%20the%20vehicle%20weigh*
30. *Ibid.*

31. *Why old vehicles need to be given a clean and timely burial, and how, 26 May 2016. Accessed at https://economictimes.indiatimes.com/why-old-vehicles-need-to-be-given-a-clean-and-timely-burial-and-how/articleshow/52442076.cms?utm_source=contentofinterest&utm_medium=-text&utm_campaign=cppst*
32. *Vehicle Recycling in the ASEAN and other Asian Countries, Economic Research Institute for ASEAN and East Asia, November 2018. Accessed at https://www.eria.org/uploads/media/ERIA_RPR_FY2017_16.pdf*
33. *Ibid.*
34. *Ibid.*
35. *Behind Mayapuri sealing drive, a 2015 NGT order yet to be implemented, 14 April 2019. Accessed at https://indianexpress.com/article/delhi/delhi-mayapuri-sealing-drive-2015-ngt-order-5674462/*
36. *Responsibilities of Collection and Dismantling centre, Automotive Recycling Demo Unit, SIAM and NATRIP 2012, https://www.siamonline.in/International-Seminar-on-Environmentally-Friendly-and-Viable-ELV-Infrastructure-July-20-2012-NewDelhi-India/Session-3/Session3-M-Praveen-GARC-India.pdf*
37. *CPCB, January 2019, Guidelines for Environmentally Sound Facilities for Handling, Processing and Recycling of End-of- Life Vehicles (ELV), New Delhi.*
38. *Ibid.*
39. *Ibid.*
40. *Ibid.*
41. *Ibid.*
42. *Ibid.*
43. *Ibid.*
44. *India Code, Digital Repository of All Central and State Acts. Accessed at https://www.indiacode.nic.in/show-data?actid=AC_CEN_30_42_00009_198859_1517807326286&orderno=58*
45. *TheMotorVehicles(Amendment)Act,2019,MinistryOfLawAndJustice(LegislativeDepartment), New Delhi, 09 August, 2019. Accessed at http://egazette.nic.in/WriteReadData/2019/210413.pdf*
46. *Ibid.*
47. *AIS-129, End-of-Life Vehicles, Ministry of Road Transport and Highways. Accessed at https://morth.gov.in/sites/default/files/ASI/352015506 54PMAIS-129_F.pdf*
48. *MoRTH 2019, Public circulation of Draft Guidelines for setting up, authorization and operation of Automated Vehicle Scrapping Facility (AVSF), New Delhi. Accessed at https://morth.gov.in/sites/default/files/circulars_document/Draft%20Guidelines%20for%20Vehicle%20Scrapping%20(1).pdf*
49. *Ministry of Road Transport and Highways, Draft Notification, 24 July, 2019 (G.S.R. 523(E)). Acceessed at https://morth.gov.in/sites/default/files/notifications_document/Notification_no._G.S.R_523%28E%29_dated_24.07.2019_regarding_registration_fee_for_vehicles%C2%A0%28353KB%2C%C2%A0.pdf*
50. *MoRTH 2016, Concept Note: Voluntary Vehicle Fleet Modernization Programme. Accessed at https://morth.nic.in/sites/default/files/Concept_Note_on_Voluntary_Vehicle_Fleet_Modernization_Programme.pdf*
51. *Record of discussion of the meeting in connection with the Scrapping Policy for Old Vehicles, 06 December 2016. Accessed at https://dhi.nic.in/writereaddata/UploadFile/RoDmeetingScrappPoliVehci061220160001.pdf*
52. *Vehicle scrap policy gets go ahead at PMO meet; over 20-yr-old CVs to face axe, March 2018. Accessed at https://economictimes.indiatimes.com/news/politics-and-nation/vehicle-scrap-policy-gets-go-ahead-at-pmo-meet-over-20-yr-old-cvs-to-face-axe/articleshow/63336713.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst*

53. *Approved cabinet note for scrapping old vehicles, policy out soon: NitinGadkari. Accessed at https://economictimes.indiatimes.com/news/economy/policy/approved-cabinet-note-for-scrapping-old-vehicles-policy-out-soon-nitin-gadkari/articleshow/71206673.cms*
54. *Vehicle scrappage policy to be announced after fine-tuning by ministries: FM. Accessed at https://auto.hindustantimes.com/auto/news/vehicle-scrappage-policy-to-be-announced-after-fine-tuning-by-ministries-fm-41580699421876.html*
55. *Policy on vehicle scrapping soon, says Gadkari, 07 May 2020. Accessed at https://www.tribuneindia.com/news/nation/policy-on-vehicle-scrapping-soon-says-gadkari-81704*
56. *Vehicle Scrappage Policy delayed as deadlock over incentives between government & Motown continues, 30 July 2020. Accessed at https://www.timesnownews.com/videos/et-now/news/vehicle-scrappage-policy-delayed-as-deadlock-over-incentives-between-government-motown-continues/69238*
57. *Automakers bank on buyback option to tackle slowdown, 31 Aug 2019. Accessed at https://economictimes.indiatimes.com/industry/auto/automakers-bank-on-buyback-option-to-tackle-slowdown/articleshow/70918909.cms?utm_source=contentofinterest&utm_medium=-text&utm_campaign=cppst*
58. *True Value, Maruti Suzuki. Accessed at www.marutisuzukitruevalue.com*
59. *Scrappage policy hits another roadblock after NITI Aayog flags issues. Accessed at https://www.livemint.com/news/india/scrappage-policy-hits-another-roadblock-after-niti-aayog-flags-issues-11574189306752.html*
60. *AIS-129, End-of-Life Vehicles, Ministry of Road Transport and Highways. Accessed at https://morth.gov.in/sites/default/files/ASI/352015506654PMAIS-129_F.pdf*
61. *DENSO, JAPIA Presentation to CLEPA (European automotive suppliers). Accesed at https://clepa.eu/wp-content/uploads/2018/04/7.-Y.-Shimizu-CLEPA-Material-Regulation-EventELV-in-Asia6NEW.pdf and https://clepa.eu/wp-content/uploads/2015/08/9._ELV_in_Asia.ppt*
62. *Biggest trucker in India to scrap 15% of fleet in 'lost year', Bloomberg, 18 August 2020. Accessed at https://auto.economictimes.indiatimes.com/news/industry/biggest-trucker-in-india-to-scrap-15-of-fleet-in-lost-year/77604794*
63. *AutoCar Professional, 23 August 2020, Jaguar Land Rover to upcycle aluminium waste into future cars, slash carbon emissions by 26%. Accessed at https://www.autocarpro.in/news-international/volta-zero-electric-freight-truck-launch-on-september-3-57063*
64. *Ibid.*
65. *The National Green Tribunal, Principal Bench, New Delhi, Original Application No. 807/2018 and Original Application No. 996/2018, Date of hearing: 24.07.2020. Accessed at https://greentribunal.gov.in/gen_pdf_test.php?filepath=L25ndF9kb2N1bWVudHMvbmd0L2Nhc2V-kb2Mvb3JkZXJzL0RFTEhJLzIwMjAtMDctMjQvY291cnRzLzEvZGFpbHkvMTU5NTY3MD-M4ODE5MDU3MTQ3NDM1ZjFiZmY3NDRjN2RiLnBkZg==*
66. *Ibid.*
67. *MoRTH 2019, Public circulation of Draft Guidelines for setting up, authorization and operation of Automated Vehicle Scrapping Facility (AVSF), New Delhi. Accessed at https://morth.gov.in/sites/default/files/circulars_document/Draft%20Guidelines%20for%20Vehicle%20Scrapping%20(1).pdf*
68. *Ibid.*
69. *Ibid.*
70. *Ibid.*
71. *Ibid.*
72. *Ibid.*
73. *Ibid.*
74. *Ibid.*

75. *ET Auto Originals: Scrappage Policy—A panacea for Indian auto industry, Accessed at https://auto.economictimes.indiatimes.com/news/industry/etauto-originals-scrappage-policy-a-panache-for-indian-auto-industry/75338661*
76. *CPCB, Guidelines for Environmentally Sound Facilities for Handling, Processing and Recycling of End-of- Life Vehicles (ELV), January, 2019, New Delhi*
77. *Roychowdhury, A. 2018, Clunkered: A roadmap for Africa and South Asia, Combating dumping of used vehicles, Centre for Science and Environment.*
78. *Ibid.*
79. *Saidani, M., Kendall, A., Yannou, B. et al. Management of the end-of-life of light and heavy vehicles in the U.S.: comparison with the European union in a circular economy perspective. J Mater Cycles Waste Manag (2019). Accessed at https://doi.org/10.1007/s10163-019-00897-3*
80. *European Commission 2020, End of Life Vehicles, https://ec.europa.eu/environment/waste/elv/index.htm*
81. *Ibid.*
82. *Francisco Posada 2015, Survey Of Best Practices In Reducing Emissions Through Vehicle Replacement Programs, ICCT*
83. *Accelerated Vehicle Retirement for Fuel Economy: "Cash for Clunkers", 10 August 2009–03 March 2010. Accessed at https://www.everycrsreport.com/reports/R40654.html*
84. *Study Finds Cash for Clunkers Program Boosted Average Fuel Economy of All Vehicles Purchased by 0.6 mpg in July and 0.7 mpg in August, 12 September 2009. Accessed at https://www.greencarcongress.com/2009/09/umtri-c4c-20090912.html*
85. *Saidani, M., Kendall, A., Yannou, B. et al. Management of the end-of-life of light and heavy vehicles in the U.S.: comparison with the European union in a circular economy perspective. J Mater Cycles Waste Manag (2019). Accessed at https://hal.archives-ouvertes.fr/hal-02190787/document*
86. *Ibid.*
87. *Konz, Raymod J., "The End-of-Life Vehicle (ELV) Directive: The Road to Responsible Disposal" (2009). Minnesota Journal of International Law, 85. Accessed at https://scholarship.law.umn.edu/mjil/85*
88. *The State of Play on Extended Producer Responsibility (EPR): Opportunities and Challenges, Global Forum on Environment: Promoting Sustainable Materials Management through Extended Producer Responsibility (EPR), 17–19 June 2014, Tokyo, Japan. Accessed at https://www.oecd.org/environment/waste/Global%20Forum%20Tokyo%20Issues%20Paper%2030-5-2014.pdf*
89. *Recycling and Reuse: End-of-Life Vehicles and Producer Responsibility. Accessed at https://archive.epa.gov/oswer/international/web/html/200811_elv_directive.html#US*
90. *Ibid.*
91. *Ibid.*
92. *Ibid.*
93. *Carl Moyer Program Overview, South Coast Air Quality Management District, 2020. Accessed at https://www.aqmd.gov/docs/default-source/aqmd-forms/moyer/moyer_overview_pps.pdf?sfvrsn=38*
94. *Carl Moyer Program (Heavy-Duty Engines). Accessed at https://www.aqmd.gov/home/programs/business/business-detail?title=heavy-duty-engines&parent=vehicle-engine-upgrades*
95. *South Coast Air Quality Management District, 2020 Carl Moyer Program, Financial Incentives for Purchasing Zero and Low-Emission Heavy-Duty Vehicles, Engines and Equipment. Accessed at https://www.aqmd.gov/docs/default-source/aqmd-forms/moyer/carl-moyer-brochure.pdf?sfvrsn=48*

96. *Posada, F. et al 2015, Survey Of Best Practices In Reducing Emissions Through Vehicle Replacement Programs, The International Council on Clean Transportation. Accessed at https://theicct.org/publications/survey-best-practices-reducing-emissions-through-vehicle-replacement-programs*
97. *Ibid.*
98. *Ibid.*
99. *Anon 2019, The Diesel Emissions Reduction Act (DERA) Program, Congressional Research Service, In Focus. Accessed at https://fas.org/sgp/crs/misc/IF11331.pdf*
100. *Li, Y. et al 2020, The Potential and Trend of End-Of-Life Passenger Vehicles Recycling in China, Sustainability 12(4):1455, Accessed at https://www.researchgate.net/publication/339422163_The_Potential_and_Trend_of_End-Of-Life_Passenger_Vehicles_Recycling_in_China*
101. *Ibid.*
102. *Recycling and pollution control of the End of Life Vehicles in China, https://www.researchgate.net/publication/260522599_Recycling_and_pollution_control_of_the_End_of_Life_Vehicles_in_China*
103. *Li, J. et al, Recycling and pollution control of the End of Life Vehicles in China, January 2014, Journal of Material Cycles and Waste Management 16(1).*
104. *Li, Y. et al 2020, The Potential and Trend of End-Of-Life Passenger Vehicles Recycling in China, Sustainability 12(4):1455, Accessed at https://www.researchgate.net/publication/339422163_The_Potential_and_Trend_of_End-Of-Life_Passenger_Vehicles_Recycling_in_China*
105. *New regulations on end-of-life vehicles, Good news for auto parts remanufacture in China, (21 May 2019), https://www.taylorwessing.com/en/insights-and-events/insights/2019/05/new-regulations-on-end-of-life-vehicles*
106. *Zhou, J. et al 2019. Cost-benefit analysis of yellow-label vehicles scrappage subsidy policy: A case study of Beijing-Tianjin-Hebei region of China, Journal of Cleaner Production, Volume 232, 20 September 2019, Pages 94-103. Accessed at https://www.sciencedirect.com/science/article/abs/pii/S0959652619318487?via%3Dihub*
107. *Ibid.*
108. *Ibid.*
109. *Posada, F., White Paper March 2015, Survey Of Best Practices In Reducing Emissions Through Vehicle Replacement Programs, ICCT. Accessed at https://theicct.org/sites/default/files/publications/ICCT_HDVreplacement_bestprac_20150302.pdf*
110. *China sets new regulation on automotive scrapping, 09 May 2019. Accessed at https://www.argusmedia.com/en/news/1899877-china-sets-new-regulation-on-automotive-scrapping*
111. *Li, J. et al, Recycling and pollution control of the End of Life Vehicles in China, January 2014, Journal of Material Cycles and Waste Management 16(1).*
112. *Ibid.*
113. *Ibid.*
114. *Ibid.*
115. *Ibid.*
116. *Ibid.*
117. *Wappelhorst, S. 03 August 2020,Economic recovery packages in response to COVID-19: Another push for electric vehicles in Europe? ICCT. Accessedat https://theicct.org/blog/staff/economic-recovery-covid-19-ev-europe-aug2020#:~:text=The%20maximum%20scrappage%20aid%20is,of%20more%20than%2050%20km.&text=The%20German%20government%20doubled%20the,6%2C000%20and%20%E2%82%AC4%2C500%2C%20respectively.*
118. *Ibid.*

119. *Anon 2020, France unveils stimulus plan worth €8 billion for car industry, 27 May 2020. Accessed at https://www.dw.com/en/france-unveils-stimulus-plan-worth-8-billion-for-car-industry/a-53578294*
120. *Wappelhorst, S. 03 August 2020,Economic recovery packages in response to COVID-19: Another push for electric vehicles in Europe? ICCT. Accessedat https://theicct.org/blog/staff/economic-recovery-covid-19-ev-europe-aug2020#:~:text=The%20maximum%20scrappage%20aid%20is,of%20more%20than%2050%20km.&text=The%20German%20government%20doubled%20the,6%2C000%20and%20%E2%82%AC4%2C500%2C%20respectively.*
121. *Ibid.*
122. *Ministry of Road Transport & Highways, 14 October 2019, Draft Guidelines for setting up, authorization and operation of Authorized Vehicle Scrapping Facility (AVSF) in the country*
123. *CPCB, Guidelines for Environmentally Sound Facilities for Handling, Processing and Recycling of End-of- Life Vehicles (ELV), January 2019, New Delhi.*

India adopted the BS VI emission standards in April 2020. While it is mandatory for new vehicles to meet these emission standards, old vehicles are still being used extensively and are a major cause of on-road pollution. For the new emission standards to have the maximum impact, it is imperative that older vehicles, especially diesel trucks and buses, be replaced as quickly as possible. Further, in order that the replacement itself does not lead to environmental problems, proper scrappage policies for junk vehicles have to be adopted and implemented. Thus, this report by CSE aims to address the complex dimensions associated with old vehicles that require immediate policy attention in India.

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