GUIDELINES FOR ENVIRONMENTALLY SOUND MANAGEMENT OF END-OF-LIFE VEHICLES (ELVs)

Ministry of Environment Forests and Climate Change

Central Pollution Control Board

Government of India

New Delhi

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List of abbreviations

ACMA	Automotive Component Manufacturers Association of India
AIS	Automotive Industry Standards
AISC	Automotive Industry Standards Committee
ARAI	Automotive Research Association of India
ARN	Auto Recycling Netherlands
ASR	Automobile Shredder Residues
ATF	Authorized Treatment Facility
CoD	Certificate of Destruction
CPCB	Central Pollution Control Board
CPR	Collective Producer Responsibility
ECS	eddy-current separators
ELV	End-of-life vehicle
EH&S	Environmental Health & Safety
EMP	Environmental Management Plan
EPR	Extended Producer Responsibility
ESM	Environmentally Sound Management
EST	Environmentally Sound Technology
HFC	Hydrofluorocarbons
IDIS	International Dismantling Information System
IPR	Individual Producer Responsibility
NATRIP	National Automotive Testing and R&D Infrastructure Project
M&H	Management & Handling
MSW	Municipal Solid Waste
MoRTH	Ministry of Road Transportation and Highways
MoHI	Ministry of Heavy Industry
MVSS	Motor Vehicle Service Station
NATRIP	National Automotive Testing and R&D Infrastructure Project
NEP	National Environmental Policy
NVMSRP	National Vehicle Mercury Switch Recovery Program
OEM	Original Equipment Manufacturer
para.	Paragraph
PPP	Public-Private Partnership
PRO	Producer Responsibility Organisation
RTO	Regional Transport Authority
SIAM	Society for Indian Automobile Association
SOP	Standard Operating Procedures
SPCB	State Pollution Control Boards
SR	Shared Responsibility
SRF	Shredder Residue Fines

Executive Summary

Automobiles have become an integral part of our life and all our movement is now dependent on vehicles. The automotive industry is one of India's fastest growing industries. In 2014-2015, a total of 23.36 million vehicles were produced in the country (SIAM 2015). There has been an increasing demand for two and three wheeler vehicles in the Indian market which provide an affordable means of transportation for a large segment of population in India. There were about 142 million motorised vehicles (incl. two-wheelers, cars, jeeps, taxis, buses, goods vehicles and other vehicles) registered by the end of March 2011 (Offices of State Transport Commissioners/UT Administration 2012). With the annual domestic sales of 17.7 million, 18,4 million and 19,9 million cars in the three consecutive years 2012-2015, the overall amount of registered vehicles adds up to over 200 million in 2015 (SIAM 2015).

With the heavily increasing number of vehicles on India's roads, the proper management, treatment and disposal of vehicles at their end-of-life becomes a pressing problem. Currently, scrap dealers and dismantlers from the semi-formal sector recycle discarded vehicles. The scrapped vehicles are cut out and reused, recycled or disposed. As more than 75% of a vehicle's weight is comprised of metals, these parts are sold to secondary metal processing units for recycling and recovery. The secondary processing of metals requires less energy than the primary production of metal.

Besides the production of metals, there are other secondary materials such as glass, plastic, tyres, oil etc., which are also recovered for reuse and recycling from end-of-life vehicles (ELV). However, the process of material recovery has been a major concern due to environmental and health hazards arising from the same. Recycling automobile scrap is invariably considered as low grade activity being carried out without using proper equipment and tools. This is partly due to a lack of investments in proper operational equipment and a lack of awareness on hazardous waste that emanates from an ELV. It is expected that the current system for ELV management and recycling may not be able to cope up with the growing volumes of automobiles that are likely to reach end-of-life in the near future.

In order to improve the performance of the semi-formal ELV recycling sector and to allow for the development of a formal sector, it is necessary to provide a dedicated regulatory framework that describes the steps of environmentally sound management (ESM) of ELVs. Furthermore, it is necessary to set up a Shared Responsibility (SR) system that mandates the specific roles for the stakeholders in the ELV value chain, including government authorities, manufacturers, recyclers, dealers/intermediaries, insurers and consumers. An important aspect of such an SR System is to clarify the responsibilities of government

agencies concerning the different processes related to environmentally sound ELV management. Another key success factor is to integrate the manufacturers of vehicles into the recycling of ELVs. In this regard, lessons can be drawn from the Extended Producer Responsibility (EPR) approach that many countries have adopted for the management of ELVs. Under this approach the manufacturers or the producers of the vehicles are responsible for the entire life cycle of their products. Responsibility thus extends beyond manufacturing to the post-consumer stage of the product including its take back, recycling and final disposal. It is important to note that producer responsibility does not mean that the existing semi-formal system with all its jobs becomes obsolete. It rather means that manufacturers are held responsible for the recycling of ELVs – this recycling could still be done within the existing system, with the exception that manufacturers would need to cooperate with the current actors and ensure that recycling occurs in an environmentally-friendly manner.

So far there is no comprehensive regulatory framework for the ESM of ELVs in India. While some aspects of ELV recycling are addressed by vehicular policy, environmental policy as well as waste management and handling regulations, other aspects are not yet covered by law. In particular the steps of ELV recycling from deregistration to final disposal remain unclear and unregulated. A first step towards the transformation of the management of ELVs has been taken by organizations of the Indian automotive industry. In 2015, they have published a set of Automotive Industry Standards (AIS 129, AIS Committee 2015) for End-of-life Vehicles that provide guidance for the collection and dismantling of ELVs by authorised centres and describe provisions that manufacturers should take in order to increase the recyclability of vehicles. However, these standards need to be further developed into a regulatory framework in order to ensure compliance by the semi-formal sector and to make vehicle manufacturers responsible for their vehicles throughout their entire life cycle.

The main objective of these guidelines is therefore to provide guidance in handling end-of-life vehicles in an environmentally friendly manner. In order to provide a practical operational system for dealing with the ELVs in India a system for Shared Responsibility is proposed in these guidelines. Furthermore, the guidelines provide building blocks for the development of a legislative framework.

The guidelines comprise seven chapters encompassing background on ELV (Chapter 1), a description of the status of ELV recycling in India (Ch. 2), details on the objectives and scope of these guidelines (Ch. 3) a detailed discussion of environmentally sound management of ELVs (Ch. 4), suggestions on a policy framework for environmentally sound management of ELV (Ch. 5), guidance for stakeholders on how to set up such a system (Ch. 6), and the way forward (Ch. 7).

1. Background

The automobile industry has become an integral part of human history spreading well over a century. After the invention of the automobile by the German engineer Carl Benz in 1886 the automobile conquered the world. In India, production of automobiles took off in the early 1990s and has become one of the country's fastest growing industries. In 2010, the Indian people owned a total amount of more than 110 million automotive, including passenger vehicles, commercial vehicles, three wheelers and two wheelers (Chaturvedi et al. 2012). Since then, motorised vehicle ownership has increased impressively – according to the Society of Indian Automobile Manufacturers (SIAM) an additional number of 10,37,88,457 vehicles were produced in the period from 2010-2015. In 2014-15 alone, the Indian automotive industry produced a total amount of 2,33,66,246 vehicles. This number comprises 32,20,172 passenger vehicles, 6,97,083 commercial vehicles, 9,49,021 three wheelers and 1,84,99,970 two wheelers. Two wheelers account for 80% of vehicles sold by number and for about 40% by weight, thus making them especially important in the Indian context.

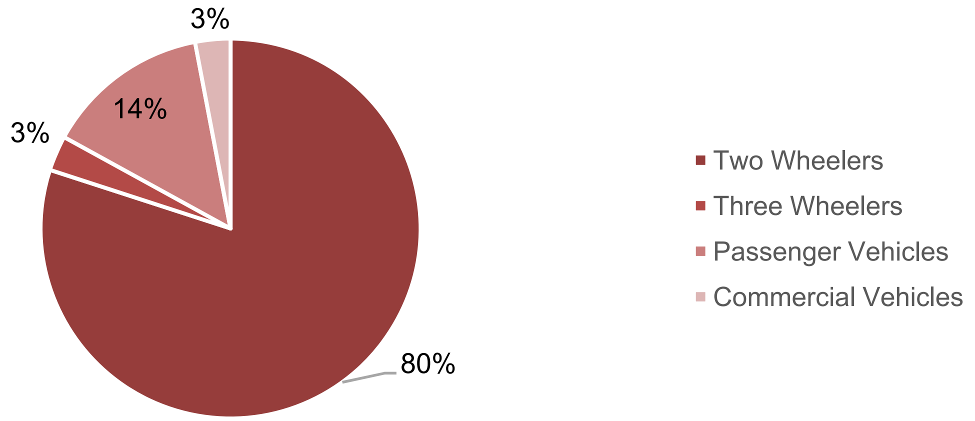

Figure 1: Domestic vehicle market share 2013/2014 (in percent) (SIAM 2015)

In order to satisfy the Indian society's increasing demand for the various types of automobiles, ever more resources have to be used. However, this growing resource use is not sustainable as the overall amount of non-renewable resources is finite. While the extraction rates of many primary materials such as copper are currently still on the rise they will very likely reach their peak and decrease in the future. The consequences of this scarcity will be grave for the industrial sector – competition between countries, sectors and companies for the sourcing of resources will aggravate, resource prices will climb to unknown heights and supply will become increasingly unstable. This will seriously affect the development prospects of resource intensive industries such as the automotive sector. At the same time, excessive extraction of primary materials harms the environment and distracts many of the ecosystem services that are vital for human wellbeing. Thereby, the development of whole societies is jeopardised. In order to avoid these issues it is necessary to find ways how to “create more with less” (European Commission 2015a) and reduce negative environmental and social impacts throughout the life cycle of resources.

The reuse and recycling of vehicles provides an important opportunity for transforming the resource use of societies. A typical passenger car consists of about 70% steel and iron by weight. Recycling one ton of steel conserves 1,134 kg of iron ore, 635 kg of coal and 54.4 kg of limestone (Sakai et al., 2013; Steel Recycling Institute 2014).Similarly, vehicles have much potential for reuse – in India, up to 70% of a vehicle are dismantled and directly reused or sold to other manufacturars (Akolkar et al. 2015). Even though in India, automobile life is usually prolonged through repeated repair and reconditioning, the vehicles ultimately become unusable and have to be scrapped. At this final stage before scrapping, the vehicles are termed “end-of-life vehicles**“** (ELV, see Box 1 for the definition).

Box 1: Defining End-of-Life Vehicles

ELVs are broadly divided into Natural ELVs and Premature ELVs. Natural ELVs refer to those vehicles that have come to the end-of-life due to wear and tear. Premature ELVs refer to those vehicles that have come to end-of-life due to unnatural reasons such as an accident, fire, flood or vandalism damage (ASM 2015). According to the definition provided in European Union Directive, 2000 ‘end-of-life’ means a vehicle which is a 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. In Australia the ELVs are those vehicles that are permanently removed from the national fleet. This can be done through several pathways, namely through damage, un-roadworthiness, vehicle age, or at the owners request. The definition provided in the Automotive Industry Standards (AIS 129, AIS Committee 2015) is ‘End-of-life vehicle means, a vehicle which at the discretion of its last owner is ready to be scrapped.’

Due to the increase in the vehicular population in India it has been estimated that more than 87 Lakh vehicles will reach ELV status by 2015 out of which 83% are likely to be two wheelers. For 2025 it is estimated that the number of vehicles to become ELV will be 2,18,95,439. Two-wheelers will probably make up 80% of this amount (Akolkar et al. 2015).

Type of vehicle	Total ELV count in 2015
Two Wheelers	72,89, 442
Three Wheelers	2,62,439
Private Cars/SUVs	7,21,558
Commercial passenger Vehicles	46,522
Commercial goods vehicles	4,11,230
Total vehicle likely to be ELV in 2015	87,31,185

Table 1: Total ELV count in 2015 (Akolkar et al. 2015)

Type of vehicle	Total ELV count in 2025
Two Wheelers	1,77,23,951
Three Wheelers	7,57,932
Private Cars/SUVs	28,09,966
Commercial passenger Vehicles	94,757
Commercial goods vehicles	11,88,833
Total vehicle likely to be ELV in 2025	2,18,95,439

Table 2: Total ELV count in 2015 (Akolkar et al. 2015)

While they are no longer fit for transportation purposes, the ELVs contain large quantities of metal and other materials that, if salvaged or recycled, can be once again fed into the economy. In turn, the use of primary materials can be reduced and pressure on the environment alleviated. Secondary metals are processed using simple technologies requiring less energy in comparison to the primary processing of metals. This further reduces environmental impacts of resource use.

However, many challenges reduce the efficiency and sustainability of ELV recycling in India. Besides economically valuable materials, ELVs are known to contain hazardous substances including waste oil, lubricants, lead acid batteries, lamps, electronic components, air bags, etc. These materials are problematic in two ways: firstly, their recovery is often harmful to the health of the scrap workers; and secondly, they cause environmental contamination if improperly dismantled or disposed. At present, nearly all of the automobile scrap yards in

India are managed by the semi-formal sector[1]. Semi-formal recyclers use crude methods to recover materials and are poorly organised among each other and with other stakeholders of the ELV value chain.

This situation, i.e. the growing number of vehicles and subsequently ELVs, the resources present in these ELVs as well as the hazards to the environment and the human health require a proper approach for an ‘Environmentally Sound Management’ of ELVs in India. At the moment, the ELV recycling sector is lacking an enabling framework. Existing regulations for the channelling of hazardous materials include the Hazardous Wastes (MH&T) Rules (2008), Batteries (M&H) Rules (2001) or e-waste (M&H) Rules (2011). However, the lack of standard operating procedures, of a licencing system and of responsive concerned authorities regarding the handling of ELV waste remains a major issue (Akolkar et al. 2015). The unique feature of India is the large number of two and three wheelers for which an indigenous recycling model has to be developed as there is no global model available. For four wheeler ELVs recycling systems are already available in other countries but still need to be adapted to the Indian context.

Taking an important step to fill this gap, these “End-of-Life Vehicle Management Guidelines” provide guidance for proper handling of ELVs at every stage, for the setup of a Shared Responsibility scheme and for the development of an enabling policy framework. Whenever applicable the guidelines make reference to the Automotive Industry Standards for End-of-Life Vehicles (AIS 129) that were published by organizations of the Indian automotive industry in 2015 (AIS Committee 2015). These standards provide guidance for the collection and dismantling of ELVs by authorised centres and describe provisions that manufacturers should take in order to increase the recyclability of vehicles. However, these standards need to be further developed into a regulatory framework in order to ensure compliance by the owners, semi-formal sector and develop recycling potential to make vehicle manufacturers responsible for their vehicles throughout their entire life cycle.

Following this introduction, chapter 2 will continue to give an in depth overview of the status of ELV recycling in India. This entails an analysis of the sector’s strengths and opportunities as well as weaknesses and threats. Based on these considerations, chapter 3 will lay out the specific objectives and scope of the guidelines.

In chapter 4, international frameworks for the environmentally sound management of ELVs will be reviewed and used to design a framework that fits the Indian context. The proposed framework for India will treat all relevant steps of ELV recycling, including the declaration,

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[1] Throughout this document the term “semi-formal” will be used for all actors of the recycling chain that do not belong to the formal sector. The semi-formal sector also includes actors of the so-called informal or unorganised sector.

collection, handling, dismantling, recycling and disposing of ELVs. Furthermore, the framework will include considerations on ELV recycling facilities as well as on a Shared Responsibility Scheme. In chapter 5, existing international and Indian policy frameworks related to the recycling of ELVs will be reviewed. Consequently, a policy framework for India will be designed.

Finally, chapters 6 and 7 will give concrete recommendations for the implementation of the proposed frameworks. Specifically, chapter 6 will provide guidance for the most important stakeholders on how they can contribute to the transformation of the sector. Chapter 7 specifies the next steps for making the ELV recycling sector more environmentally friendly and ready for future challenges.

For better overview, the structure of the guidelines is presented below:

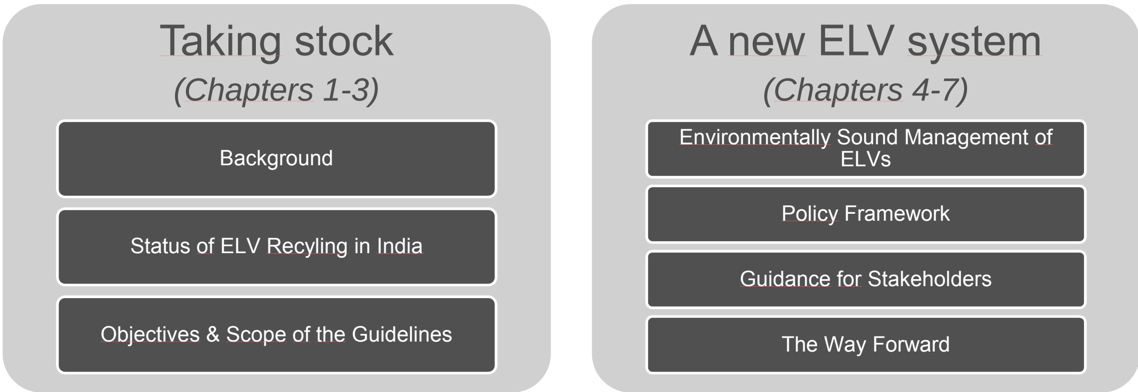

Figure 2: Outline of the Guidelines

2. Status of ELV Recycling in India

In India, ELV recycling has existed ever since automobiles were introduced in the country. In particular the semi-formal sector has a historic role in waste management and recycling in India. Scrap dealers and dismantlers located in major cities carry out the majority of recycling activities. Some of these hubs are well known, for example Mayapuri in Delhi, Pudupet in Chennai, Ukkadam in Coimbatore, Mallick Bazaar in Kolkata and Lohar Chawl in Mumbai.

The semi-formal recycling of ELVs in India is characterised by both strengths and weaknesses. On the one hand, the current system holds benefits that are embodied above all in the creation of employment for thousands of people and in the adding of value to materials that would otherwise be thrown away. On the other hand, several issues related to the inefficient and harmful processing of ELVs generate substantial environmental costs that are generally borne by society. Promoting available strengths and working against weaknesses of the ELV sector will contribute to a greater success of the suggested ELV policy framework.

2.1. Strengths and Opportunities

2.2.1 Employment creation

The semi-formal automobile recycling sector provides jobs to thousands of people. Many of the prevailing family business are led by young, second generation owners who are well aware of the nuances of reuse and trading on the second hand markets (Akolkar et al. 2015). These entrepreneurs have active and widespread networks, good access to materials and considerable manual skills. For many units, this semi-formal but entrepreneurial SME-based ecosystem permits profitable business operations. Virtually every ELV business surveyed by Akolkar et al. was financially sustainable in 2015.

2.2.2 Adding value to secondary materials through recycling and reuse

In view of the increasing material consumption and increasing prices of raw materials such as steel, copper, aluminium and others, ELVs are considered a valuable resource for many different materials. Efficient and effective recycling of ELVs is therefore a key task to recover the maximum amount possible of the resources contained in ELVs.

Most of India’s semi-formal automobile scrap dealers and recyclers are involved in collection, dismantling and segregation of material. Key parts of the vehicles are identified and dismantled to be sold to those who make best use of these parts. Some parts such as engines, gears and some other intact parts have high value while the others like wheel rims and doors etc., have low value. A large second hand market for the automobile spares is a thriving business with low levels of required capital investment. Salvaging parts for reuse conserves natural resources and energy.

Other materials are recycled using specialised treatment technologies and then also sold to specialised traders. The recycling technology for both ferrous and non-ferrous metals, plastics and glass are all well known in Indian recycling hubs. There are adequate industries set up both as primary processing or secondary processing units for processing such wastes from ELV in the country.

The economics of reusing and recycling and the social bondage between recyclers are some of the factors that keep the semi-formal sector going.

2.2. Weaknesses and Threats

2.2.3 Negative environmental & health impacts of ELV recycling

Despite the benefits of recycling and reusing, many of the processes employed in the industry have negative impacts on the environment and on the health of workers and communities. For example, ELVs contain a number of substances in liquid form (waste oil, engine oil, gear oil, transmission fluid, hydraulic fluid, brake fluid, power steering fluid, etc.) as well as solid form (air filter contains foam and ferrous parts , battery & battery terminal contains acid and lead metals, catalyst spent, cables, tires, plastic parts, polyurethane, glass, etc.). While some of these substances are not hazardous in nature per se, if recycled in uncontrolled environments, they can cause damage to both the environment and human health.

Some of these materials need to be disposed of as per the requirements in the prevailing regulations (e.g. Hazardous Wastes (Management, Handling and Transboundary Movement) Rules 2008; Batteries (Management and Handling (M&H)) Rule 2001; Plastic Waste (M&H) Rules 2011; and E-waste (M&H) Rules 2011). Other hazardous materials are not regulated. Due to their low economic value they are often dumped on the ground or along the roads or in landfills. There is also no decontamination procedure followed in most units. As a result the hazardous fluids from the ELVs are spilled and disposed on the ground while handling the ELVs. The whole area in such units is often contaminated with oil, coolants and other fluids from ELVs. Since the recycling hubs located in the urban periphery have gradually become a part of the city, environmental pollution due to uncontrolled management of ELVs can affect the health outcomes of the nearby communities at the same time.

Furthermore, certain dismantling and recycling processes produce toxic gases that directly harm the health of the scrap workers. Overall, ELV recycling hubs are operating without adhering to environmental or work safety standards in their operations. They are operated as low grade industry with minimal investments and marginal revenue generation.

2.2.4 Low recovery efficiency of ELV recycling

Another issue of the Indian ELV sector is its low recovery efficiency that is caused by the lack of a specialised system and technologies for the collection, dismantling, shredding and processing of ELVs.

Although scrap dealers salvage and reuse or recycle ELV parts, there are no automotive recyclers who deal specifically with the recycling of ELVs including automobiles, light and heavy duty trucks, buses, motorcycles, scooters, auto rickshaws etc. Individuals and enterprises that engage in ELV recycling are usually metal scrap dealers and recyclers who treat with various wastes, besides ELVs, to extract metals and other resources.

These recyclers work with very basic technologies that do not allow for the maximum possible recovery and recycling of materials. As a consequence, valuable secondary resources are disposed of and are not fed back into the economy.

The main reason for the lack of appropriate technologies is that the number of vehicles coming in for scrapping does not yet provide a sufficient economic basis to invest in elaborate recycling systems. Overall the Indian recycling sector is characterised by low investments and very rudimentary technologies.

2.2.5 Lack of appropriate infrastructure to deal with future ELVs

The lack of appropriate infrastructure for managing ELVs already leads to inefficiencies today. Considering that the amount of ELVs to be recycled and reused will increase dramatically in the near future, this infrastructure problem will have even graver implications. One particular challenge will be that ELV recycling requires massive infrastructure due to the large size of the vehicles. Consequently, ELV recycling facilities would need to be mechanised to handle such large size and volume. This would require high investments and involvement of the various parties taking part in the Shared Responsibility Scheme, including automobile manufacturers, government agencies and car owners.

Another technological challenge is that the automobile industry is thriving on vehicle models that are more difficult to be dismantled and recycled, particularly by hand. Their handling requires specific equipment.

A model facility (NATRiP) has been set up in Chennai which provides the infrastructure requirements for automobile recycling operations. However, such facilities also need to be integrated with the semi-formal sector in order not to wipe out thousands of jobs. This would be critical for establishing a business case for environment friendly management of ELVs as access to material is a critical constraint for the functioning of formal recycling facilities. Overall, there is urgent need to provide for a specified ELV recycling sector.

2.2.6 Different value chains

Even though the automotive value chain and the ELV value chain could be closely interlinked (see figure 3), there exists no cooperation between automobile manufacturers and stakeholders involved in the management of ELVs in India.

The stakeholders in the automobile value chain include raw material suppliers or components manufacturers, automotive producers as well as other players involved in the distribution and marketing of the automobiles. Furthermore, the service centres provide the interface with the customer. There are no linkages between automobile manufacturers and stakeholders after the sale of the vehicle as there are no regulatory requirements for the manufacturers on the management of end-of-life vehicles.

For the ELV sector it is not completely clear where the value chain begins and where it ends. In India, the recycling of a motorised vehicle begins when the final consumer or auto disposer delivers the vehicle to the collection centre for deregistration or scrap yard for disposal. Afterwards, various actors ranging from storage facilities to transportation companies, dismantlers, used parts traders and recyclers pass on the vehicle.

The effect of this coexistence of different value chains is that ELV recycling is not as efficient as it might be. On the one hand, manufacturers do not know of the capacities and requirements of semi-formal recyclers. Recently, more and more of the modern vehicles are not recyclable using conventional technologies. On the other hand, the semi-formal sector actors do not have the possibility to learn from the more sophisticated technologies of large automobile producers.

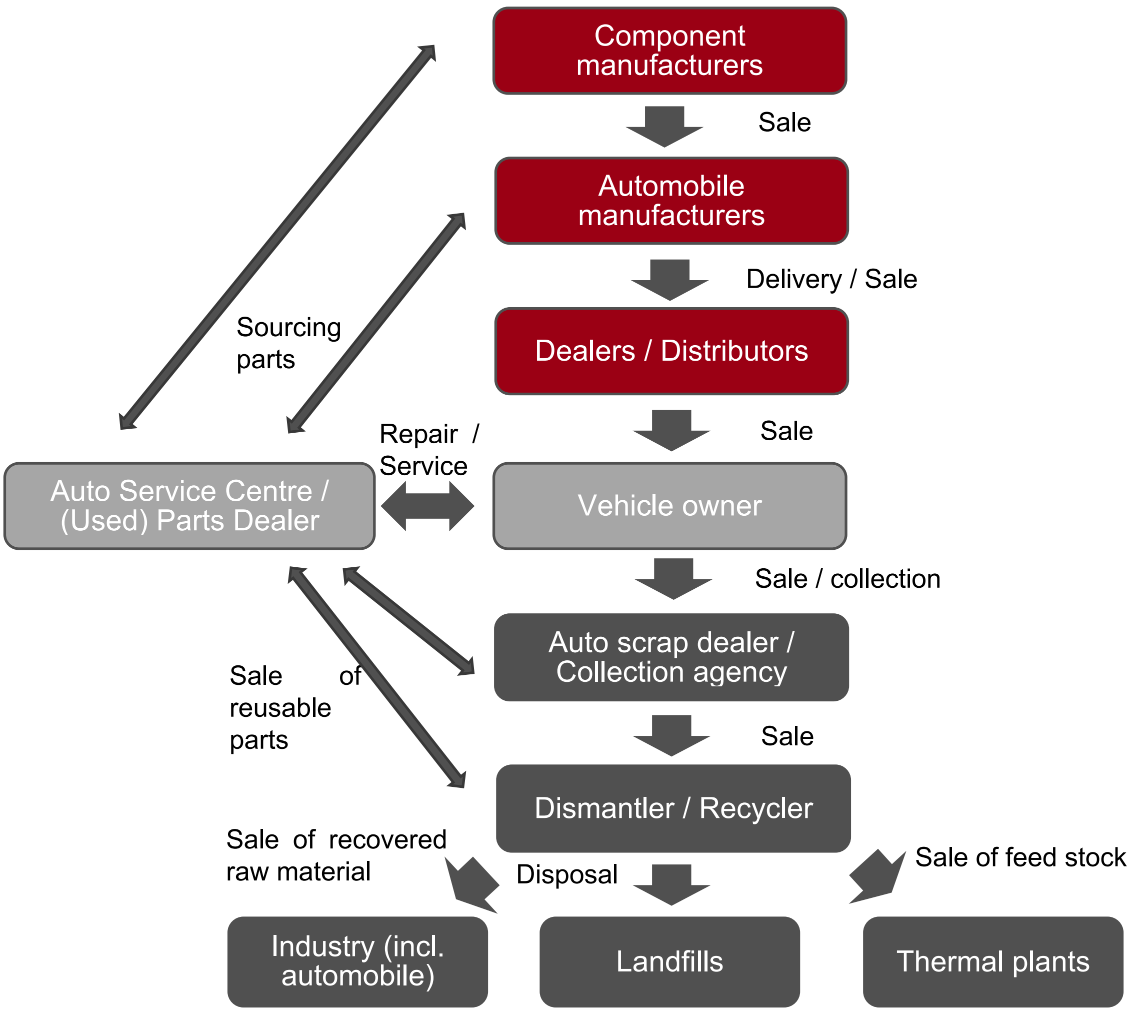

Figure 3: Automotive and ELV value chain

2.2.7 Lack of proper ELV policy framework

At present there exists no comprehensive policy or regulation governing the management of ELVs. Existing regulation is incomplete and is often not fully enforced. For example, the deregistration certificate provided by the Regional Transport Office (RTO) is not carried out for all vehicles as most of the vehicles are sold as auto junk to the scrap dealers and recycled in the semi-formal sector or abandoned on the road side after accidents, fire, etc. Further existing regulation that is relevant for the ESM of ELVs concerns the management and disposal of different types of waste. The existing policy framework will be discussed in more detail in chapter 5.2.

Additionally, the Indian automotive industry has set up voluntary Automotive Industry Standards (AIS 129) for ELVs (AIS Committee 2015). The AIS 129 provide detailed information on various important aspects of the ESM of ELVS. In the first part, they determine the responsibilities of the last owners of ELVs well as of the authorised ELV collection and dismantling centres; describe the procedure for obtaining authorization; and define minimum technical requirements for collection and dismantling centres. In the second part, the AIS 129 address the vehicle manufacturers. More specifically, they provide a list of materials that should not be used in vehicles; specify which type of information vehicle manufacturers should make available to the dismantling centres; set targets for the minimum reuse and recycling or reuse and recovery rates of vehicles; and make provisions for the type approval of vehicles with regard to their reusability, recyclability and recoverability.

These standards are an important contribution to the ESM of ELVs in India. However, important challenges remain to be overcome.

- Even though the automotive industry requires "mandatory compliance" with the AIS 129, no mechanisms exist for ensuring their enforcement. As long as it is not defined what is legally required of ELV recyclers a change in behaviour towards more environmentally friendly management of ELVs cannot be expected.
- The AIS 129 do not include stipulations for an Extended Producer Responsibility scheme. This is due to the fact that, according to the opinion of the automotive industry, an EPR is neither feasible (due to the development status of the Indian automotive industry) nor necessary (due to the fact that the market provides sufficient incentives for recycling). However, experiences from many countries with ELV legislation show that such a system is key for ensuring ESM of ELVs by providing financial, technological and organisational support to the ELV recyclers. This point will be further explained in chapter 4.2.6.

As a consequence of the regulatory vacuum Indian recycling entrepreneurs currently do not take into account the side effects of their activities. Low recovery and recycling rates as well as environmental and health impacts lead to costs that are distributed among the Indian society in the form of negative externalities – while the recyclers make economic gains, surrounding communities, the employed workers and the society in general suffer from increasing resource scarcity, environmental degradation and health hazards. More efficient and environmentally friendly ELV recycling would therefore be desirable from a social as well as from an economic point of view.

2.3. Requirements for a Regulated and Resource Efficient ELV sector

One key requirement on the way towards making the Indian Automotive sector future-proof is to increase the efficiency of material recovery and recycling of ELVs. This would not only reduce pressures on primary resources but also fire up the economic value of the sector. Besides ensuring the maximum recovery of resources from ELV, it should also be the objective of any comprehensive ELV system to reduce the adverse environmental impacts from ELV.

“Environmentally Sound Management” (ESM) can be an approach to improve the performance of the ELV sector. ESM means taking all practical steps to ensure that any industrial process or activity is managed in a manner which will protect human health and the environment against the adverse effects which may result from such activities (Basel Convention 2015). “Environmentally Sound Technologies” (EST) can be a means to implement an ESM system. EST refers to technologies used for any industrial process or recycling technologies that are non-polluting and ensure conservation of resources and energy, thereby reducing the waste destined for disposal. In addition to these technologies it would also be beneficial for the health of many urban residents to move ELV recycling facilities further out of the cities where they have more space.

At the same time, the semi-formal sectors must not be pushed out of ELV processing activities. If a future system does not integrate the semi-formal ELV recycling sector in a convincing way, negative social effects could be the consequence. In addition, a competition for ELVs between the formal and the semiformal sector could threaten the business continuity of both sectors. Semi-formal scrap handlers should be facilitated to attain formalised status to become integral part of the value chain. This involvement and recognition of the semi-formal sector could be a part of the Corporate Social Responsibility of the automobile and the component manufacturers. Labour intensive techniques for dismantling can be developed or upscaled, increasing the recoverable amount of useful materials compared to mechanical recycling mechanisms. This would generate additional employment and keep the semi-formal sector in the ELV value chain.

However, these changes are not likely to be proactively implemented by the semi-formal sector without any guidance or regulation. Therefore, a comprehensive framework for the ESM and formalization of the ELV sector is required to enhance the resource recovery potential in the sector. In the following chapters key procedures of ESM will be described and a draft of such an enabling framework will be elaborated stipulating the responsibilities of various stakeholders for the ESM of vehicles throughout their life cycles.

3. Objective and Scope of the Guidelines

The development and formalization of the Environmentally Sound Management (ESM) of ELVs in India is likely to pose considerable challenges for the various stakeholders included in this process. On the one hand, manufacturers, recyclers, traders, customers and other participants of the value chain will need guidance on how to proceed with recycling in an environmentally friendly manner. On the other hand, policy makers will require inspiration for the development of a policy framework that encourages and guides the transformation of the ELV sector. Around the globe, various countries have already gathered experiences with this process. Their lessons learned can now serve as the basis for the development of guidelines for ELV recycling in India.

These guidelines are intended to provide insights and guidance on the following topics:

Environmentally Sound Management (ESM) of ELVs

- Insight into internationally renowned procedures and technologies for the ESM of ELVs
- Comprehensive framework for the ESM of ELVs in India, including detailed descriptions of the following procedures:
    - Declaration of ELVs, deregistration of vehicles and ownership transfer
    - Collection and channelization of ELVs
    - Repair and refurbishment, dismantling and recycling
    - Identification of residues and processing for safe disposal
    - Setup of ELV recycling facilities
    - Design and implementation of a Shared Responsibility scheme

Policy framework for ESM of ELVs

- An insight into the various regional and national policy frameworks for ELV management
- Recommendations for a policy framework for ESM of ELVs in India, including
    - Definition of ELVs and other related definitions to be covered
    - Responsibilities of various stakeholders
- Compliance requirements under the prevailing legal framework in India in order to ensure safe dismantling and recycling of ELVs until a comprehensive regulatory framework is enforced

The way forward

- Specific guidance for possible contributions by various stakeholders

- Recommendations for the next steps to be taken

All stakeholders in the ELV as well as the automobile industry value chain may use these guidelines: the component manufacturers, automobile manufacturers / original equipment manufacturers (OEMs), consumers, automobile service centres and automobile dismantler and recyclers including the transporters of ELVs.

4. Environmentally Sound Management of ELVs

Environmentally Sound Management (ESM) of ELVs provides important means for safe recycling and efficient recovery of materials from the ELVs. This chapter provides step by step information on ESM of ELVs. The first sub-chapter (4.1) presents how ELV recycling is managed on the international level. Based on these insights, subchapter number two (4.2) will provide suggestions on how to develop the Indian system. Both subchapters will be structured according to the consecutive steps of ELV processing as shown below.

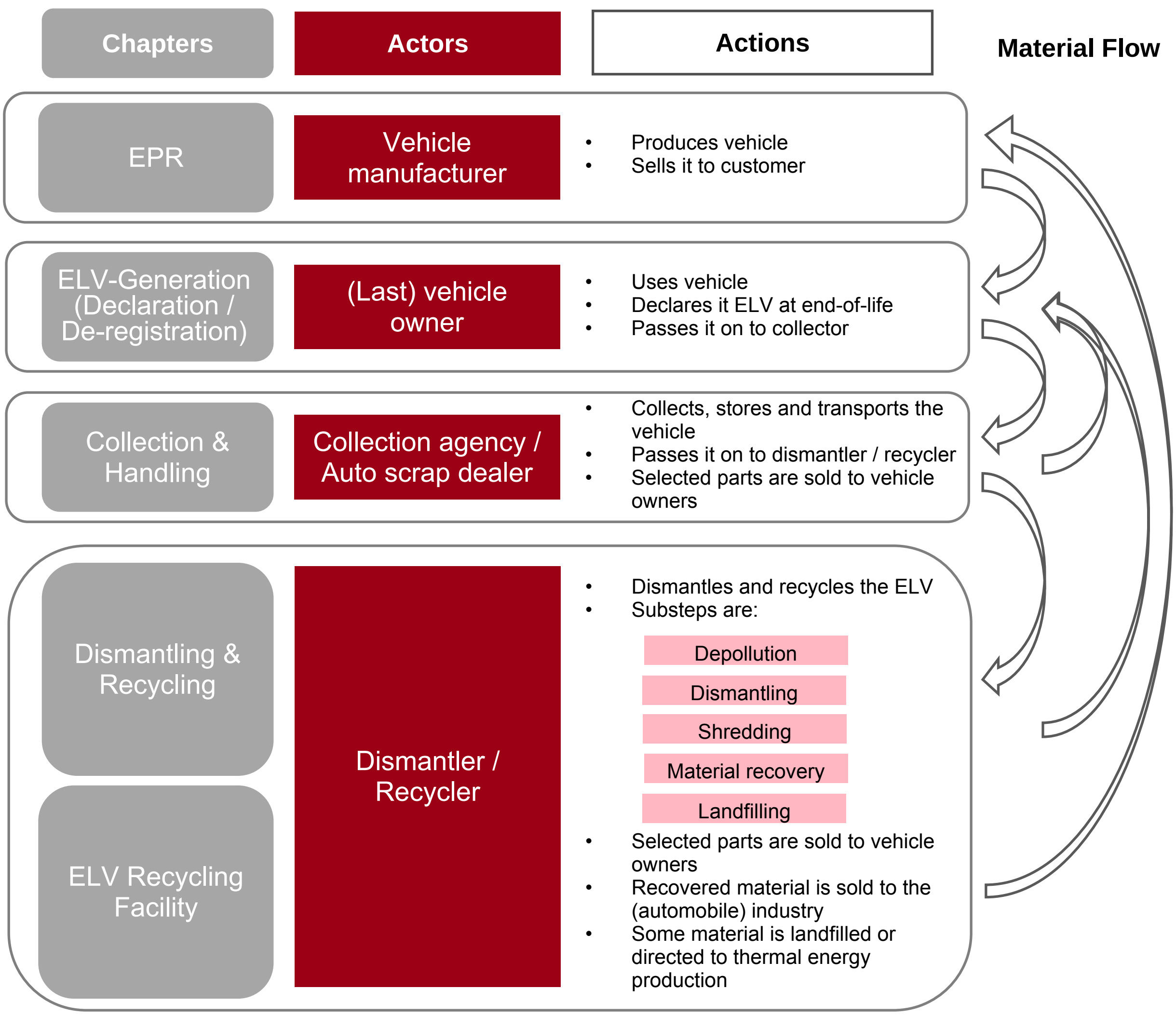

Figure 4: Steps of ELV processing

4.1 International framework

The worldwide automobiles production has increased steadily due to increasing demand for automobiles. In 2000, 41.22 million cars and 17.17 million commercial vehicles were produced globally, which rose to 47.05 million cars and 19.67 commercial vehicles in 2005 while in 2013, 65.44 million cars and 21.86 commercial vehicles were produced. As the automobile production is on the increase there is an increase in the ELV generation. The global ELV generation is estimated to be 40 million ELV/ year; this accounts for 4% of total global automobile ownership. (Sakai et al. 2013)

The European Union (EU) generates approximately 9 million tonnes of ELVs every year (Eurostat 2015) and has made producers responsible for the treatment of ELVs. The treatment of ELVs was identified as a major challenge in Japan as every year approximately 5 million automobiles are taken off the roads. In the US approximately 12-15 million vehicles and in Canada about 1.2 million ELVs (Wordsworth 2011) are generated annually. The global rate of ELV generation is increasing and there is the need to ensure that these ELVs become resources for future automobile manufacturing.

Automobile recycling activity is known to be one of the oldest recycling activities essentially due to the presence of large amount of scrap metals. In the recycling process both ferrous and non-ferrous metals are recovered and directed to reuse. It has been estimated that passenger cars contain about 70% steel and 7-8% aluminium (Sakai et al., 2013). The rest 20-25% is plastic, rubber, glass etc., which are also recyclable. The automobile recycling has attained a professional status and is a proper industry in many countries. The infrastructure for recycling has been developed gradually with the increase in the production of vehicles in Europe, the U.S. and other countries.

Finite resources are unlikely to fulfil the world economy's increasing demand for raw materials – unless production and consumption patterns around the world become more resource efficient and sustainable. An obvious symptom of increasingly scarce raw materials is rising prices. Copper prices for instance have seen a significant increase over the past years. These developments set additional incentives for ELV recycling, as improved ELV recycling can contribute to increasing the amount of renewable substances as well as to reducing the generated waste volumes (Chen et al. 2010).

Against this backdrop many countries have already begun to establish ELV management systems. In general, one can differentiate between two types of ELV management systems: direct management systems based on legislation and indirect management systems based on market mechanisms and environmental regulations. (Sakai et al. 2013) While the EU, Japan, Korea, China and Taiwan have established legislative ELV recycling systems, the

U.S., Canada and Australia are managing ELV recycling under existing laws on environmental protection. Those countries that have a legislative ELV system usually set national targets for ELV recovery rates, many aiming for more than 95% recovery (Sakai et al. 2013).

Country	Year	Legislation
EU	2000	EU Directive 2000/53/EC on ELVs
Japan	2005	Law for the Recycling of ELVs
Korea	2008	Act for Resource Recycling of Electrical and Electronic Equipment and Vehicles
China	2001 2006 2008	ELV Recycling Regulations Automotive Products Recycling Technology Policy Regulations on Pilot Remanufacturing of Automotive Parts
Taiwan	1994	Waste Disposal Act, including ELV Recycling Guidelines

Table 3: International ELV policy overview (Sakai et al. 2013; Chen et al. 2010)

While those pioneering countries can be a good reference for further ELV recycling development, there remain challenges common to all countries dealing with ELV. First, many countries that engage in ELV practices have only insufficient health and safety standards for those working in the respective facilities. The process of depollution and dismantling could be further facilitated by improved labelling policies and provisions for sharing information, especially through the provision of information on the hazardous substance embedded in ELVs. This could make ELV recycling safer, more effective and more efficient. Another entry point is the design stage: further effort in research and development in environmentally friendly and sustainable materials and production processes can bring about innovation. These innovations are especially needed with respect to recent technological developments in the automotive industry. The increasing computerisation of cars as well as the growing fleets of electric and hybrid passenger cars in countries such as Germany for instance pose new challenges to ELV recycling. One of these challenges is the recycling of batteries; another is the increasing demand for so called “critical raw materials.” (Sakai et al. 2013; Kohlmeyer 2012)

In 2013, countries such as Russia, India, Mexico, Turkey and Vietnam were making preparations for introducing legislative management systems for ELV recycling. (Sakai et al. 2013)

4.1.1 Declaration of ELV & Deregistration

The first steps in the ELV processing chain is an automobile's declaration as an ELV, deregistration and issuance of a destruction certificate. The process of deregistration for vehicles that have reached their end-of-life is mandatory in almost all countries. General indicators for when a car is declared include its age, emission conformity, its condition and technical safety. In most countries, the latter two are periodically examined by independent organisations. In the US, Canada and Germany the frequency of the check is around every two years. If a car does not pass the check, the owner may decide whether to upgrade the vehicle to meet the required standards (if possible) or to declare it as ELV.

Once the vehicle is declared as ELV it is to be deregistered. In most countries deregistration of the vehicle is done by the authorities or agencies that register the vehicles for plying on road. The deregistered vehicles are removed from the road and no further road tax is paid. When the deregistered vehicles are accepted as ELVs for recycling, the recycling company carries out the recycling procedures and at the end of it provides a destruction certificate which completes the disposal of the vehicle. In the EU, a destruction certificate is issued by the dismantlers/recyclers.

It should be noted that the number deregistered cars in a country does not necessarily equal the number of ELV as not every deregistered car is declared an ELV. Deregistered automobiles can also include cars prepared for export, cars used within private sites and cars that are illegally dumped as waste. (Sakai et al. 2013)

In the **EU**, the presentation of a certificate of destruction is a condition for the deregistration of an ELV. The certificate is issued to the holder/owner of the car when it is transferred to an authorised treatment facility (ATF). In case a producer, dealer or collector takes responsibility for transferring the ELV to the treatment facility, he may also issue a certificate of destruction on behalf of the ATF. All certificates of destruction issued in the EU are to be mutually recognised in all member states. (European Parliament and Council of the EU 2000)

In practice, there are different approaches to deregistration across the EU member states. While in most countries deregistration takes place when a car owner wishes to dispose of its vehicle, deregistration is compulsory every time the ownership of the car changes (e.g. Austria). (Schneider et al. 2010)

In the **UK**, Certificates of Destruction (CoD) are required for all passenger vehicles and light goods vehicles under 3.5 tonnes, as well as for all 3-wheeled motor vehicles. The CoD are issued by the ATF but generated through an online system operated by the Environment Agency. That way, the national vehicle record is automatically updated with each CoD issued. (UK Environment Agency 2014)

In **Taiwan**, deregistration had traditionally only required the car owner to hand over the car's license plate to a Motor Vehicle Service Station (MVSS). As the ELV was thereafter still considered to be the owner's property, there were no mechanisms in place to monitor the subsequent use of the ELV. This led to low ELV recycling rates. A recent amendment to Taiwan's Waste Act now obliges car owners to hand in their ELV to a legal recycling operator. The recycling operator then issues a certificate that is considered a required document for deregistering a car at the MVSS. (Chen et al. 2010)

In **Japan**, car owners can only deregister their cars after they have been notified by the respective dismantling facility that their car has been successfully dismantled. (Zhao and Chen 2011)

4.1.2 Collection and Handling

The collection and handling of vehicles declared ELV usually comprises the transfer of the car to a designated treatment facility where the actual depollution, dismantling and recycling processes take place. There are different modes of organising this transfer.

In the **Netherlands**, the Dutch automobile industry has established "Auto Recycling Netherland" (ARN) which is responsible for the collection of all scrap cars as well as for overseeing the dismantling and recycling process. The collection is without cost to the last owner. The system is financed through a waste disposal fee that is to be paid in the course of the initial vehicle registration. For the actual collection of the ELVs, ARN enters into contracts with other service provision companies. (U.S. Environmental Protection Agency 2013)

In **Taiwan**, the legal framework provides for two different modes of ELV collection. First, there is a financial reward scheme in place to encourage citizens to voluntarily turn in their ELV after having it deregistered. Secondly, the environmental police authority is entitled to remove deserted ELVs on roadsides. Collection points for ELV are service stations and car dealers. (Chen et al. 2010)

In **China**, the collection of ELVs is organised via around 800 "take back stations" that are spread in bigger cities around China. Car owners usually sell their cars to these take back stations, with the price calculations being based on the car's metallic content and the current scrap metal market price. (Zhao and Chen 2011)

In the **UK**, the transfer of ELVs to the authorised treatment facilities is facilitated via two main free take back service providers, namely "Autogreen" and "Cartakeback". They both operate within a network of ATF throughout the UK. (SEPA and NIEA 2015)

4.1.3 Environmentally sound depollution, dismantling, shredding, material recovery and disposal of ELVs and relevant actors / facilities

The environmentally sound recycling process of ELVs comprises four major stages and is depicted below:

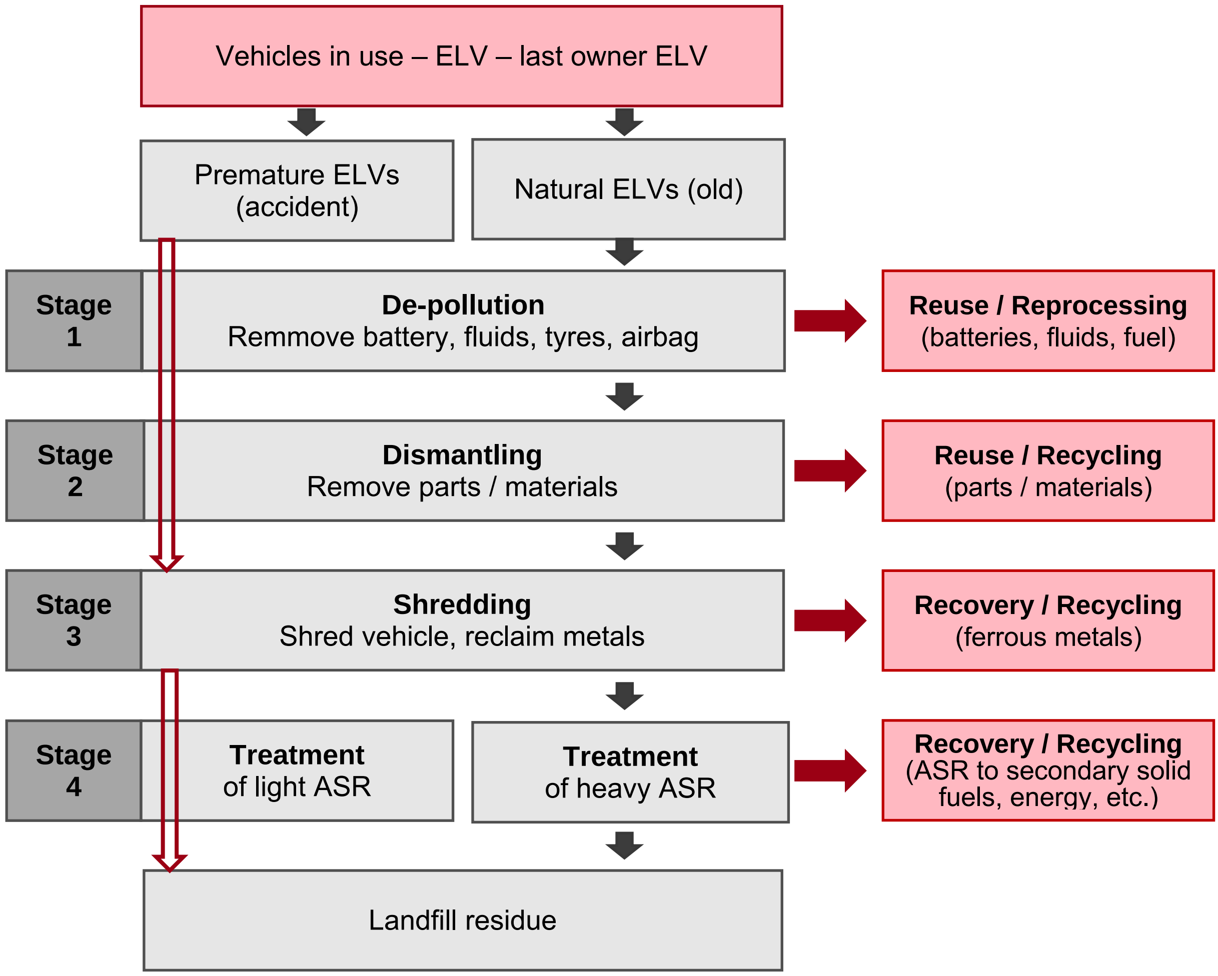

Figure 5: Stages of ESM of ELV

The recycling process of an ELV starts at the dismantling or treatment facility where it is first depolluted and then dismantled (sometimes these two steps are summarised as "dismantling"). Depollution includes removing hazardous components and substances such as the battery, fuel, other fluids, airbags and any parts containing mercury. As the removed materials are either explosive or corrosive depollution must follow strict health and safety rules and contamination of the environment must be prevented. This includes storing hazardous components and materials separately and providing adequate training for employees. (UK DEFRA 2011).

Once the vehicle has been depolluted it needs to be dismantled. This process involves segregating and collecting recyclable and reusable components, including engines, tires, bumpers, and other parts. According to experiences from the EU and Japan the car hulks weigh approximately 55–70% of their original weight after dismantling (Sakai et al. 2014). The degree of mechanization of the dismantling process depends on the costs of labour and availability of large scale technology (Tian and Chen 2014).

The recovered components and fluids are sold for reuse in other vehicles (motor parts, batteries, fuel, etc.) or for further recycling (tires, valuable metals, carpets, etc.). All waste water that is produced during the depollution and dismantling processes must be treated. Resulting waste material is sent to incinerators for energy recovery or to landfills for disposal. (Chen et al. 2010)

The remaining hulk of the vehicle is crushed so that it can be transported in a compact and cost-effective form to the shredder facility. There 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 automotive shredder residue (ASR)) and other materials (light ASR). The separation process is realised by complex machinery such as magnetic separators, air classifiers, infrared systems, etc. (Sakai et al. 2014; ARS et al. n.d.). Processing scrap in smelters usually produces secondary metal.

As several regions or countries now have high targets for the recycling rates of ELVs, the recycling of ASR becomes increasingly important. ASR is a highly heterogeneous mixture of residual ferrous and non-ferrous metals (5–23%), plastics (20–49%), rubber (3–38%), textile and fibre material (4–45%), wood (2–5%), and glass (2–18%). Some of these components can be further processed: heavy ASRs are molten for the 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 use ASR for energy recovery or to send them directly to landfills. Within the overall ELV recycling chain, the management of ASR is one of the most problematic steps and requires further technological advances. (Vermeulen et al. 2011)

The **EU** ELV Directive obliges all member states to ensure that all end-of-life vehicles are transferred to authorised treatment facilities (European Parliament and Council of the EU 2000). In 2006, a total of 8,000 authorised ELV dismantlers operated within the EU-25 territory, complemented by 232 shredding facilities. At the same time, there remained a considerable number of illegal treatment facilities, particularly in those countries that did not have a sound ELV recycling system. Successful countermeasures include a national campaign launched by the UK Environment Agency in April 2008 that reduced the number of illegal ELV and scrap metal sites by 50% within one year. (EU 2010) With regard to ASR recycling the **EU** tries to reduce the amount and hazardousness of ASR by intensive dismantling; another strategy is post-shredder treatment. The ELV Directive determines that by 2015 all member states have to reuse, recycle or recover 95% of an ELV by weight. Out of this, energy recovery must not exceed 10%. The recycling of ELVs is organised under an Extended Producer Responsibility Scheme according to which manufacturers are responsible for increasing recyclability of vehicles, disseminating information on recycling procedures and providing free take-back of ELVs. (Sakai et al. 2013)

In **Germany**, dismantling facilities are responsible for depolluting as well as dismantling of ELVs. In 2014, there existed approximately 1300 registered dismantling facilities (UBA 2014). They are under strict obligations with respect to organising the process. These requirements relate to the dismantler's structure, equipment and operation, as well as to its documentation procedures. Additionally, dismantling facilities need to pass an annual certification by an external expert. Shredding is realised by shredding facilities which have to comply with similar obligations. (Kohlmeyer 2012)

In **Japan**, vehicle manufacturers and importers are required by law to take back and recycle air bags and ASR, and to ensure sound treatment of fluorocarbons. The recycling rates for air bags and ASR are 85% and 70%, respectively. The costs of recycling the mentioned components are borne by vehicle users who, at the moment of buying a new car or handing in an old car, are required to pay a recycling fee. Collection of refrigerant gases is mandatory as well and falls under the responsibility of refrigerant gas processors. However, no recycling rate was determined for these gases. (Sakai et al., 2013; Wang and Chen 2013) The processing of other components or liquids is done voluntarily by dismantling and shredding facilities. In 2007, 5000 dismantling and recycling operators and 140 shredding plants were registered. There exists no recycling rate for the overall weight of the ELV. (Chen et al. 2010)

In **Korea**, ELV recycling is done by the dismantling and shredding facilities. For 2015 and onwards, a material and energy recovery of ELVs of 95% was determined. This includes a maximum energy recovery rate of 10%. (Serona et al. 2010) ASRs are landfilled or incinerated (Sakai et al. 2013).

In **Taiwan**, ELV recycling is realised by dismantling and recycling operators. In 2009, there were 303 recycling operators and five shredding and sorting plants. These operators work along three different business streams: a) trading of scrap metal and reusable parts, b) trading of spare parts after the dismantling process, and c) export of ELVs and used cars. ASRs are disposed of in waste processors, incinerators or landfills. (Chen et al. 2010)

In **China**, ELV recycling is realised by dismantling facilities. The reuse of five major vehicle assemblies (i.e. engines, steering, transmissions, axles and frames) is currently allowed only for selected pilot facilities. (Wang and Chen 2013) By the year 2017 the recycling rate of ELVs should reach at least 85% (Sakai et al. 2013).

In the **U.S.** ELV recycling is voluntary and driven only by the economics of recycling. However, all steps of ELV recycling are subject to monitoring under environmental law (Sakai et al. 2013). While the processing of most components is organised in a decentralised manner by the different actors of the ELV recycling chain, there exist nationwide efforts for the collection and recycling two particular contaminants, namely mercury switches and vehicle tyres. With respect to mercury switches, a broad coalition of federal, state, industry and environmental non-profit partners in 2006 have created the National Vehicle Mercury Switch Recovery Program (NVMSRP). The return of switches under the NVMRSP is rewarded financially, through a fund set up voluntarily by steel and auto manufacturers (U.S. Environmental Protection Agency 2013). ASR that results from ELV processing is landfilled.

4.1.4 Responsibilities throughout the life cycle of vehicles

The above described activities require the cooperation of all stakeholders of the vehicle and ELV value chains. In order to optimize the various processes it is important to clearly define the responsibilities of car owners, government agencies, vehicle service centres, collection and recycling facilities and other stakeholders.

Vehicle manufacturers have to play a key role. Their decisions oftentimes directly affect the recyclability of their products, i.e. through the choice of material, car design, and other aspects. Furthermore, they are often larger, better connected and endowed with more resources than independent recycling facilities, thus allowing them to operate in a highly effective manner. Therefore, many countries around the world now encourage producer responsibility throughout the life cycle of vehicles.

One approach to this is Extended Producer Responsibility (EPR), an environmental strategy that makes the manufacturer or importer of the product responsible for the entire life cycle of the product (Lindhqvist 2000). This responsibility starts at the design stage of the vehicle. Here, manufacturers should reduce the overall environmental footprint of their products by reducing the use of toxic and hazardous substances; increasing the use of recycled constituents; enhancing the ease of disassembly; and so on. Another important responsibility of producers is to provide for the take back, recycling and final disposal of the product (Lindhqvist 2000). The producer’s responsibility for a product is hence extended beyond the ‘manufacturing’ to the ‘post-consumer stage’ of a product’s life cycle (OECD 2001).

EPR can be managed either individually or collectively. ‘Individual producer responsibility’ (IPR) means that the producer (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. ‘Collective Producer Responsibility’ (CPR) is when a number of producers, manufacturers, importers and other stakeholders come together as a consortium or establish an organisation to take collective responsibility for the end-of-life management of products manufactured or imported. Such organisations are often called the ‘Producer Responsibility Organisation (PRO)’. They function on behalf of producers and are responsible for collection and channelization of end-of-life products for environmentally sound recycling (Lindhqvist 2000; OECD 2001).

Besides EPR there exist a number of other approaches (shared responsibility, product stewardship, etc.) that are characterized by varying degrees and nuances of producer responsibility. A country’s approach ultimately depends on the characteristics of the stakeholders in the production, service, recycling and waste industries; on the existing regulatory framework; and on other specifications.

Country examples

At **EU level**, the ELV Directive (2000/53/EC) stipulates the principle of producer responsibility. Material and equipment manufacturers are obliged to use common component and material coding standards. For each new type of vehicle entering the market, the producers are obliged to provide dismantling information within 6 months after the vehicle has entered the market. The information provided shall help treatment facilities to quickly locate all hazardous substances assembled in the car. The use of mercury, lead, cadmium and hexavalent chromium in vehicles is forbidden. (European Parliament and Council of the EU 2000) Further, the ELV Directive mandates that vehicle owners must be allowed to return their ELVs to authorised treatment facilities free of charge. The costs of ELV recycling must be borne by manufacturers. (European Commission 2005)

In **Germany**, the producer responsibility principle obliges car manufacturers and importers to take back ELVs free of charge. (Kohlmeyer 2012)

In the **Netherlands**, a vehicle’s first owner pays a recycling fee to the manufacturer, seller, or importer from whom he purchases the car. (Chen et al. 2010)

In **Korea**, producers and importers are held responsible for the use of hazardous substances, recyclability of materials, ELV collection and information exchange. They are legally required to provide technical support to scrap dealers and ELV recyclers and to pay for costs if they exceed the benefit of recycling. The respective provisions are laid out in Korea’s 2008 Act for Resource Recycling of Electrical and Electronic Equipment and

Vehicles (U.S. Environmental Protection Agency 2013). Before this Act, Korea employed an EPR approach in its waste management policy. With the 2008 Act this EPR approach has been developed into an “Integrated Product Policy” that introduced a so called “eco-assurance system”. This eco-assurance system follows a two sided approach to product responsibility, including both preventive actions (environmentally friendly design and manufacture of products) and follow up management (environmentally sound waste management). (Sakai et al. 2013)

In **Japan**, the 2002 ELV Recycling Law provides for a “shared responsibility principle” that obliges consumers to pay a fee when purchasing a new car or when handing in an old car that was bought before the law was enforced (U.S. Environmental Protection Agency 2013). The fee is deposited into a deposit management entity and operated by an electronic management system that confirms the actual ELV recycling. According to the Law the responsibilities of automotive producers are the following: they should design for recycling; provide dismantling information to the recycling operators; take back and recycle airbags, ASR and fluorocarbons; record waste recycling; specify the charging standard; and mark their name on the vehicle before selling it (Wang and Chen 2013).

In 1994 the **Taiwanese** Environmental Protection Administration established a Recycling Fund Management Board responsible for collecting a recycling fee. This so called “Collection Disposal Treatment Fee” is collected from responsible enterprises (vehicle manufacturers, importers and sellers) and used for recycling activities and related tasks. (Chen et al. 2010)

In **China** the “Technology Policy for Auto Products Recycling” (2006) stipulates the strengthening of automotive producers’ and importers’ responsibility but so far not much progress has been made in that sense, thus the majority of costs for recycling are borne by the recycling operators. In 2008 standards were proposed that make producers responsible for determining and marking the recoverability of different automobile parts. Furthermore, they must not use substances that are listed on the List of Disabled/Restricted Substances for Automotive Products. (Wang and Chen 2013)

In the **Unites States**, there is no federal law governing EPR practices. The term usually used for EPR-related activities is “product stewardship”. The concept of product stewardship addresses producers, manufacturers, retailers, users and disposers alike and holds all these parties responsible for the reduction of a product’s impact on the environment. (U.S. Environmental Protection Agency 2013)

Company examples

Some of the automobile manufacturing companies such as BMW and Volkswagen in Germany as well as Toyota and Nissan in Japan are known to facilitate the recycling and recovery of components and parts from the ELVs of their own brand. Such companies either set up their own recycling plants or support recycling units. They also prescribe procedure for the handling and recycling of their vehicles along with schematic diagrams in the form of brochures.

The **BMW Group** makes a commitment to the environment by manufacturing energy saving vehicles, environmentally sound production process and environmentally friendly recycling. The BMW Group has acknowledged that the used cars are potential sources of secondary raw materials and aims at contributing to the conservation of natural resources through recycling. BMW Group started anchoring environmental protection policy within its organisation in the early 1970s. The Group has started to establish a network of take back centres for the acceptance and recycling of vehicles as far as the early 1990s. Today, all ELVs returned to these centres are processed by authorised treatment facilities. For coordinating and promoting its efforts in ELV recycling, BMW Group has established a “Recycling and Dismantling Centre” in Munich, Germany that does on the one hand serve as an authorised treatment facility itself and is on the other hand engaged in research and development for creating recycling concepts for future vehicles. (BMW Group 2009)

In 2007, the Volkswagen Group has published a strategy on how to achieve the recycling and recovery rates as prescribed in European and German ELV legislation. According to the strategy the Group has various standards in place to ensure environmentally sound product development, including standards for marking product parts, material documentation, material restrictions and others. The company cooperates with material manufacturers and suppliers to reduce hazardous substances in their vehicles and to ensure efficient recovery and dismantling. Volkswagen ELVs can be returned to a large number of take back facilities operated by a Volkswagen subcontractor. All necessary information for dismantling and recycling is made available to the take back facilities via the "International Dismantling Information System" (IDIS, http://www.idis2.com), an online platform that was established together with a large number of international car manufacturers. In order to achieve the 95% ELV recovery target by 2015 Volkswagen provides information and works on technologies for both component dismantling and post-shredder treatment. It runs its own operations for reuse of components after treatment. (Hackenberg and Hildebrandt 2007)

The **Toyota Motor Car Company** started a joint venture with Toyota Metal Company in 1993 to develop ASR recycling technology and built the first automobile recycling plant in 1998 in Japan recycling 15,000 cars per month. This plant has an ELV shredder plant and an ASR recovery plant where they developed the technology to use shredders for ferrous and non-ferrous metal chunks and Shredder Residue Fines (SRF) leaving no residue for disposal after ELV recycling. The resin which is the largest constituent of shredder residue is used as substitute fuel. They also recycle and reuse glass from ELVs. Toyota is continuously investing in R&D on recycling technologies with the objective to achieve zero waste for disposal from ELVs. (Toyota Motor Corporation 2014)

Nissan has addressed the 3R principle of Reduce Reuse and Recycle and has a dedicated Recycling Promotion Department to develop and implement appropriate and efficient methods to handle ELV recycling in the future. Nissan is working on the standardization of recycling technologies to incorporate them in the design stage. ELV management at Nissan is divided in two stages. One stage is the development stage where the use of heavy metals such as lead mercury, cadmium and hexavalent chromium is avoided and the design is adjusted for easy dismantling and recycling. Their approach also considers recycling without down cycling or losing any material quality. Nissan recycles iron, aluminium and lead yet they are often challenged by a mix of materials which is difficult to separate. Research on dismantling continues to harness ways and means to effectively recycle material and reuse parts. (Nissan 2004)

The U.S. automotive industry assumed part of its responsibility for a more sustainable automobile industry by forming the Vehicle Recycling Partnership in 1992. Under this partnership manufacturers such as **Ford, Chrysler and General Motors** coordinate collaborative research programmes to promote sustainable ELV recycling in North America and globally. (U.S. Environmental Protection Agency 2013)

4.2 Building blocks of a framework for India

Based on the considerations taken in chapter 4.1 a potential framework for the ESM of ELVs in India has been elaborated. This chapter will follow the same structure as chapter 4.1.

4.2.1 Declaration of ELV & Deregistration

Some important issues need to be addressed before declaring the ‘end of life’ of a vehicle. They are presented below.

Testing and certification of roadworthiness and identification of ELVs

Testing and certifying the roadworthiness is important to legally assure the roadworthiness of the vehicle by the Regional Transport Office (RTO). The safety, technical performance and emission conformity need to be checked and certified over the vehicle’s life cycle i.e. every two years by an independent organization. Once a vehicle is found to be unfit for the road and the owner is not going to repair or upgrade it, then it has to be deregistered by the RTO where the vehicle is presently located. The final decision about declaring a vehicle as ELV should be taken by the last owner of the vehicle.

Handing in of the ELV by its last owner

According to **AIS PART-1 para. 4.1** the last owner of an ELV has the following responsibilities:

- 4.1.1 The last owner, when he/she considers disposition of vehicle, shall hand over the end-of-life vehicle only to the Authorised Collection and Dismantling centre or his authorised agent.
- 4.1.2 The last owner shall ensure that the ELV does not contain any other waste other than an ELV.
- 4.1.3 Except as provided for in clause 4.2.2 (c), the last owner shall ensure that the ELV contains the following vehicle aggregates while submitting ELV to the Collection and Dismantling Centre:
    - 4.1.3.1 In the case of M1 category vehicles: i) Body shell / Chassis ii) Engine iii) Transmission iv) Front and rear axles with wheels and tyres v) Battery vi) Catalytic convertor (if fitted)
    - 4.1.3.2 In the case of L1 and L2 category vehicles: i) Engine ii) Transmission iii) Front and rear axles with wheels and tyres
- 4.1.4 The last owner shall make an application in Form 3 prescribed in Annex B while submitting the vehicle as an ELV to the concerned authorised collection and dismantling centre.

Acceptance by the collection or dismantling facility

According to **AIS PART-1 para. 4.2**: any person(s) operating Collection Centre(s) and Dismantling Centre(s):-

- 4.2.2 a) shall offer the last owner a price, as stipulated by the Government of India from time to time or in absence of such stipulation shall offer the last owner a mutually agreed price based on the evaluation of ELV. In any case collection and dismantling centre shall not charge any money from the last owner.
- b) shall accept vehicle even when some of the parts fitted are not OE parts, but are from replacement market.
- c) shall accept vehicles retrofitted with CNG/LPG/Hybrid kits, provided the same is endorsed in the registering certificate. AIS-129 3/48
- d) shall accept the accident vehicles irrespective of the state of vehicle, provided that such vehicle is in continued legal possession of the last owner.

- e) shall accept prototype/ research vehicle/ unregistered vehicles.

Issuing the Certificate of Destruction

According to **AIS PART-1 para. 4.2** any person(s) operating Collection Centre(s) and Dismantling Centre(s) shall issue "Certificate of Destruction" of ELV in Form 4 as per Annex B to the last owner, on receipt of the ELV. Maintain records of the same and the records should be available for scrutiny by the appropriate authority.

Deregistration

According to **AIS PART-1 para. 4.2.10** any person(s) operating Collection Centre(s) and Dismantling Centre(s) shall apply for deregistration of the ELV in Form 20a as per rule 47a of CMVR, 1989 to the registration authority within a period of 1 month of issue of Certificate of Destruction to the last owner.

The first step towards the declaration of a vehicle as ELV is to cancel the registration and provide a destruction certificate to the vehicle owner. According to Section 55 of the Motor Vehicles Rules 1989 the registration of the motor vehicle is cancelled if the vehicle has been destroyed or has been rendered permanently incapable for use or in a condition that would cause danger to the public or beyond reasonable repair. ELVs may be declared on the basis of age of the vehicle, its condition and roadworthiness which should be periodically examined (usually 2 years) by an independent organisation once the vehicle is more than two years old or has been driven over 50,000 km. The declaration of ELV should be on scientific basis to include the technical safety of the vehicle and conformity to the emission standards.

Classification

In order to manage the ELV in an environmentally sound manner the type of vehicle that will be scrapped needs to be known. Automobiles or vehicles can be classified on the basis of: (The Indian Engineers Technology Blog 2013)

Load

- Heavy transport vehicle (HTV) – trucks, trailers etc.
- Heavy motor vehicle (HMV) – buses.
- Light transport vehicle (LTV) – pickup, station wagon, etc.
- Light motor vehicle (LMV) – cars, jeeps, etc.

Number of wheels

- Two wheeler vehicle – Scooter, motorcycle, scooty, etc.

- Three wheeler vehicle – Auto rickshaw, three wheeler scooter for handicapped persons, speed, etc.
- Four wheeler vehicle – Car, jeep, trucks, buses, etc.
- Six wheeler vehicle – Big trucks with two gear axles.

Fuel used

- Petrol vehicle – motorcycle, scooter, cars, etc.
- Diesel vehicle – cars, trucks, buses, etc.
- Electric vehicle – which uses battery and electric motor to drive.
- Steam vehicle – engine which uses steam engine (now obsolete).
- Gas vehicle – LPG (liquefied petroleum gas and CNG (compressed natural gas)).

Body (size)

- Sedan with two doors
- Sedan with four doors
- Station wagon
- Convertible, jeep, etc.
- Van
- Special purpose vehicle – ambulance, milk van, water van, petrol/HSD vehicle.

Source of the vehicle

- **Individual Owner –** ELVs are generated by individual owners/users who are generally motivated to sell their ELVs to scrap dealers or hawkers or their agents who provide money in exchange for the vehicle.
- **Commercial ELVs or the fleet owners –** The bulk or fleet owners, both the government and private sector, generate bulk ELVs comprising large volumes; these are usually disposed through auctions.
- **Manufacturing defects –** Original automobile Manufacturers (OEMs) sometimes produce defective vehicles that do not pass through the Quality Control checks. Some other times the defects are detected after sales and certain batches of vehicles are called back that may be defective. In both cases the manufacturer takes the responsibility and these are either rectified and returned to the customer or sold at discounted rates or scrapped to salvage the useful parts and components.
- **Manufacturing rejects –** Huge quantities of rejects arise from the automobile manufacturing which may be whole or in parts. Such parts may sometimes enter the secondary market. At other times they are treated as waste to be scrapped. Both scrap and rejects comprising defective parts or components from the

manufacture of automobiles may also be put back into the manufacturing process or channelled for recycling or reuse in an authorised or registered recycling unit.

- **Second Hand Market –** Large number of ELVs are sold to the second hand market where the parts are salvaged and sold to the repair shops and further rejects from these markets are sold as scrap to scrap dealers or recyclers.
- **Imports –** The vehicles imported by consumers for their use, upon reaching the end of life are also major source of spares that are often sold to repair shops or dealers. However, no imports of ELVs are to be allowed for scrapping or recycling.

Condition of the vehicle (ASM Auto Recycling 2015)

- **Natural ELVs** are vehicles that have come to the end of their life due to natural wear and tear. Natural ELVs are usually more than ten years old. Natural ELVs are mostly depolluted and then dismantled and recycled for scrap metal.
- **Premature ELVs** are vehicles that have come to the end of their life for unnatural reasons (e.g. accident, fire, flood or vandalism damage). They are subject to the assessment by the insurance companies and approved to be sold complete as damaged-repairable salvage, or for parts dismantling only.

4.2.2 Collection and handling

There is the need to develop a collection and channelisation mechanism for ELVs from the source of its generation for recycling and recovery in an environmentally sound manner. The ELV collection system needs to be established to facilitate the movement of ELV in a regulated manner from its origin to the final destination for recycling, treatment and disposal. The stages involved in the process include establishing collection channels, setting up ELV collection & deposition facilities, providing financial mechanisms for collection, and organising handling and storage.

Collection channels

There exist different collection channels for ELVs. Bulk generators or fleet owners such as public transport and tourist agencies (government and private) or offices (government and private) adopt different modes of disposal of ELVs depending upon the number of vehicles and their conditions. Bulk amounts of ELVs are usually auctioned off by public agencies. The buyer is the highest bidder and could either be a scrap dealer, auto dismantler or a recycler involved in recycling or resale of automobile parts. The other mechanism that prevails is the replacement of old and used vehicles by new ones through dealers or the manufacturers.

Many automobile companies and bulk generators of ELVs carry out regular sales of used vehicles which are conducted by private agencies. The buyers may be individuals who intend to further use the vehicle or auto scrap dealers or dismantlers. The Original Equipment Manufacturers (OEM) also sell their manufacturing defects (parts) to auto scrap dealers or dismantlers in the semi-formal sector. Sometimes OEMs recall the vehicles with manufacturing defects and rectify the same themselves or may also put the defective components and equipment back into their own system by rectifying these. Individual owners channel ELVs through sale or exchange of old vehicles while buying new ones. In case of accidents and fire there are also cases of vehicles abandoned on the road sides from which parts and components are stolen.

Below a figure on the different channels of ELV generation is provided:

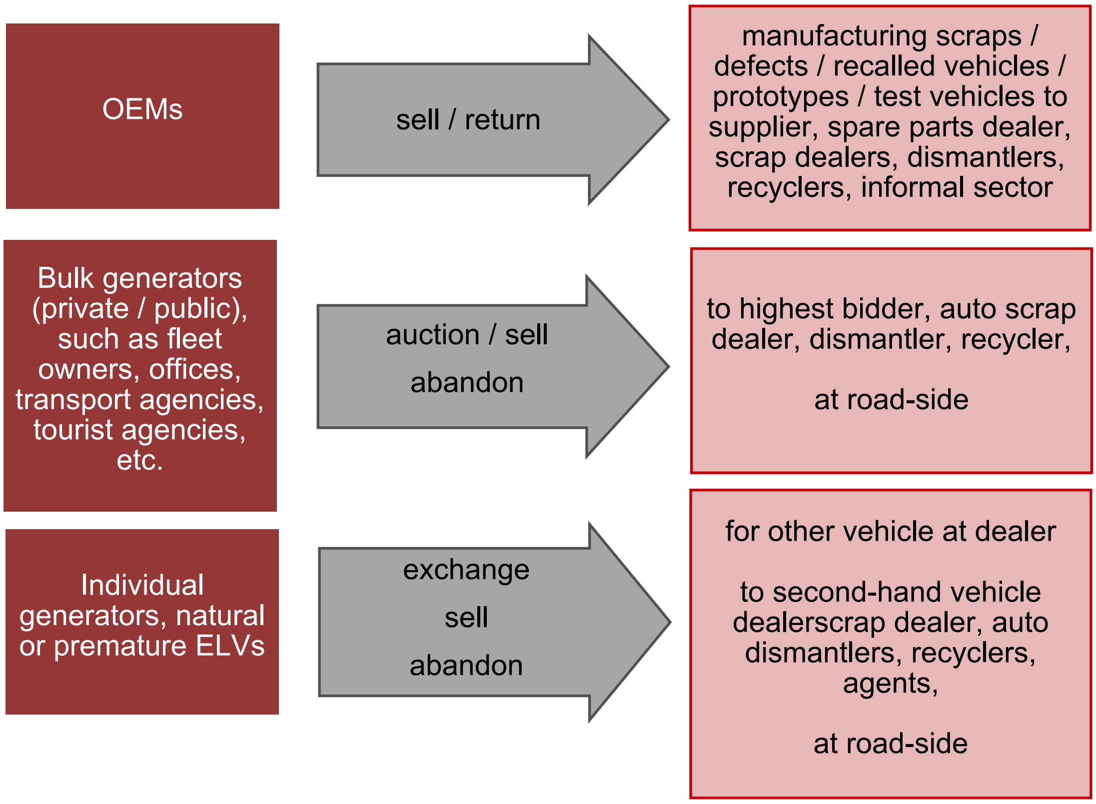

Figure 6: Channelisation options for ELVs

Based on these common practices the ELV collection channels should close the gaps in the recycling loop and prevent the loss of potentially valuable material. In order to provide efficient collection systems for ELVs, the actors in the collection channels are to assess the materials for reuse and recycling in order to prevent improper recycling practices in the backyard recycling units. Effective collection channels would further enhance the availability of material for recycling and make the tracking of material and material components possible.

ELV collection & dismantling centres

In view of the large size and volume of automobile scrap the collection facility needs to be set up in large areas where the various types of ELVs could be handled. As mentioned before, ELVs in India would include the small two and three wheelers, cars, large buses, trucks and trailers. Depending upon the area available, different locations should be assigned for different types of ELVs. At present there is no mandatory requirement for collection of ELVs but voluntary systems are present which would need to be better organised in the process of setting up a nationwide ELV recycling system. Possibilities for take back should be provided by Collection and Dismantling Centres. These could be created by upgrading existing vehicle service centres, scrap yards or recycling workshops in cooperation with vehicle producers. In a collective system, producers would setup joint collection centres or collectively sign contracts with existing recyclers to organise the collection on their behalf. In an individual collection each producer would have to set up his or her own collection facility or sign individual contracts with collectors.

Generally, the collection system needs to fulfil the criteria of an adequate area of coverage for collection. It is advisable to consider a 50 km radius around a take back facility. Collection points or centres can be established in designated places where ELVs are collected. Such collection points could also be linked to a centralised collection centre where these could be stored and later sent to dismantling/recycling plants.

Roadside dumped vehicles shall be impounded by Municipality after a notice period. No action by the owner will lead to transfer of vehicle by ULB to collection/dismantling facility and also attract a penalty.

Financial mechanisms for collection

As it was mentioned before, **AIS PART-1 para. 4.2.2** suggests that Collection and Dismantling Centres shall take back ELVs for free or pay the last owner a price. An exception to this might be that if vehicles lack essential components or contain only waste the facility that takes the vehicle back could be allowed to charge the last holder.

In the case that recycling costs generally exceed the financial gains even though the ELVs contain all essential parts, producers could be made responsible to pay for the recycling.

Collective systems often go hand in hand with a deposit that the first owner of a vehicle provides as collateral when he or she purchases a car. This money is paid out when the vehicle is returned to a certified treatment facility at the end of its use life. The other alternative is a fund system that requires either the first owner or producer to pay a certain amount to a fund. The money is not necessarily committed to vehicle return, but could also be used to finance other recycling projects or is sunk in government budgets without any direct environmental designation.

Handling, storage and transportation

ELVs are often large in size (for example trucks and busses) and require machines to handle them. Any vehicle that reaches end-of-life needs to be lifted using cranes and towed to the destination. At the Collection and Dismantling Centres facilities cranes / lifting equipment would be required to move ELVs within the unit. Adequate handling equipment should be required for any ELV collection, treatment and recycling facility.

In accordance with **AIS PART-1 para. 4.2.5** any person(s) operating Collection Centre(s) and Dismantling Centre(s) shall store the ELV (even temporarily) and treat in accordance with Annex A without endangering human health and without using processes or methods which could harm environment. ELVs should be stored in a way that protects their value and protects the surrounding environment. ELVs contain hazardous fluids and other components that can pollute the soil, water, and air. For example, when leaking fluids soak into the ground they contaminate the upper soil layers as well as the underlying groundwater. Likewise, storm water runoff from rainfall and snowmelt can be contaminated if it comes in contact with greasy, oily parts, or flows over contaminated soils or through puddles of vehicle fluids. Contaminated storm water runoff can spread pollution on one's property and onto neighbours' property. If refrigerants (such as Freon) are allowed to escape from air conditioning units in ELVs, they can spread to the upper atmosphere and destroy parts of the earth's protective ozone layer. In addition to storing ELVs in an environmentally protective manner, there are good reasons to also store these vehicles in an orderly, tidy manner. Organising the vehicle storage area helps to keep track of one's inventory and thus to find a desired vehicle faster. Moreover, leaks and other potential problems can be detected and dealt with more rapidly. (N.H. Green Yards BMP 2008).

What should be considered for storing the materials is:

- ELVs shall not be stored until the fuel, oil, antifreeze, and other fluids are completely drained, and the fuel tank, radiator, and other fluid containing parts have been removed. (Ensure that fluids do not leak or drip onto the ground.)
- A written record shall be kept of the vehicles stored.
- In order to prepare vehicles for storage a routine shall be established; this helps in knowing the condition of every vehicle stored.
- An ELV shall not be stored without removing the battery.

- ELVs shall be stored in dry areas where there is no water logging or water will not be flowing under the vehicle during rain or snow melt periods.
- ELVs shall be stored on impermeable surfaces, such as concrete or other feasible ground sealing.
- Storage areas shall be provided for spillage collection, decanting and degreasing;
- Storage facilities shall be provided for dismantled spare parts, including impermeable storage for oil contaminated spare parts;
- Appropriate containers shall be provided for storage of batteries (irrespective of whether electrolyte neutralisation is conducted on site or elsewhere), filters and PCB / PCT-containing condensers;
- Storage tanks shall be provided for the segregated storage of ELV fluids;
- Equipment shall be provided for the treatment of water, including rainwater in compliance with health and environmental regulations;
- Used tyres shall be stored appropriately, including the prevention of fire hazards and excessive stockpiling.
- If engines or greasy parts are exposed, they shall be covered with a tarpaulin or other covering to prevent rain.
- ELVs shall not be stored in the flood hazard zone or in wetlands.
- ELVs shall not be stored along or over property boundaries, public rights-of-way, or easements.
- Authorisation needs to be obtained from the concerned authorities for the storage of junk vehicles
- The boundaries of the vehicle storage area shall be demarcated with a site drawing.
- Vandals and other unauthorised persons shall be kept from entering the vehicle storage area. If necessary, a fence shall be erected and “no trespassing” signs shall be posted.
- ELVS shall be parked in rows, with enough aisle space between the rows to allow individual vehicles to be inspected and removed as needed.
- ELVs shall be stored in an upright position and shall not be stacked or piled on top of each other.

- An inventory of the ELVs shall be stored with detailed record of the make, model, and year of each vehicle, the date the vehicle arrived. The record shall be maintained on date of inspection for leaks, and any other relevant information needed to control the flow of the inventory.
- ELVs that no longer have parts of value shall not be accumulated. They shall be crushed and sent to a scrap processor for material recovery as soon as possible.
- The storage area shall be inspected regularly to ensure that there are no problems; a record shall be kept of the inspections.

Transportation of ELVs need specialised vehicles with a provision to lift and load the ELVs. If there are large numbers of ELVs it becomes economical to have dedicated vehicles for transportation. In case of small numbers it may be feasible to use public carriers. Large vehicles and lifts are also required for the onsite movement of ELVs.

4.2.3 Environmentally sound depollution, dismantling, shredding, material recovery and disposal of ELVs

The actual recycling is the most important step in the ELV value chain facilitating the recovery of useful materials from the ELVs thereby reducing the waste destined for disposal and conserving the natural resources. The recycling activity needs to be regulated and monitored in order to ensure that such recycling is carried out in an environmentally sound manner. In India, a state of the art recycling facility using the Best Available Technology (BAT) is yet to be set up.

A demonstration automobile recycling unit has been set up by National Automotive Testing and R&D Infrastructure Project (NATRIP) under the Ministry of Heavy Industry, Government of India in Chennai which provides the basic requirements for ELV recycling infrastructure but a large scale commercially viable unit that can deal with all kinds of ELVs from two and three wheelers to large commercial vehicles like buses and trucks still needs to be set up.

Once deregistered and declared an ELV, such vehicles go through the different stages of treatment, which involve depollution by removing or draining all hazardous components and liquids; dismantling of reusable and recyclable parts; shredding of car hulks and recycling of ferrous metal parts; as well as separation and recycling or disposal of automotive shredder residue. The manufacturers' service centres can directly use the salvaged materials or sometimes these find their way to the second hand market. The recycled and recovered material may go back to manufacturing units.

The four recycling stages also shown in the figure in Chapter 4.1.3 are presented in more detail in the following sections.

Depollution

According to **AIS PART-1 para. 4.2.6** any person(s) operating Collection Centre(s) and Dismantling Centre(s) shall carry out operations for depollution of end-of-life vehicles as mentioned in Annex A as soon as possible.

The processes involved in depollution of the vehicle are important as the ELV is made free from the liquid and hazardous substances and the further processing becomes safe. Depollution activities should be carried out using appropriate equipment that is specifically designed for carrying out the required depollution operations. Most of it is used in automobile service centres and workshops and is commercially available. Such equipment is usually pneumatically operated. The use of such equipment ensures that a high level of depollution (removal, as far as reasonably practicable, of most fluids contained in the ELV) can be achieved in a relatively short timeframe (20-30 minutes per ELV). In case that a depollution in a completely mechanised system is not possible alternative methods of manual operations could be used, ensuring the same levels of depollution without compromising on health and safety requirements. Since the Indian semi-formal sector is based in manual operations an assessment of the risks involved in using such methods of depollution must be carried out. Based on this assessment adequate measures, necessary to comply with relevant health and safety legislation/regulation, must be put in place. If alternative methods are used it should ensure the same level of depollution.

The sites for ELV treatment and storage shall be designated and need to be prepared both for storage and treatment. These areas shall be provided with the following:

- Impermeable surfaces for designated areas;
- Spillage collection facilities;
- Decanters and cleanser degreasers;
- Equipment for the treatment of water, including rainwater;
- Designated storage areas for dismantled spare parts;
- Impermeable storage areas for oil contaminated spare parts.
- Tanks/containers for segregated storage of fluids – such as fuel, motor oil, gearbox oil, transmission oil, Hydraulic fluid, cooling liquids, antifreeze, brake fluids, air conditioning fluids and other fluids.

- Equipment and tanks/cylinders for safe de-gassing and storage of gases and safe storage for pyrotechnics from air bags, ACs etc.
- Appropriate areas/containers for storage of solids – batteries, oil filters unless crushed, PCB/PCT containing condensers, other hazardous components used tyres (prevent fire hazard due to excessive stockpiling)

The depollution or decontamination operations comprise a number of steps according to which the ELV should be treated (see figure 7). The steps are based on the materials contained in the ELV. There are certain minimum standard practices that need to be followed. Additionally, vehicle specific requirements are given by the automobile manufacturers.

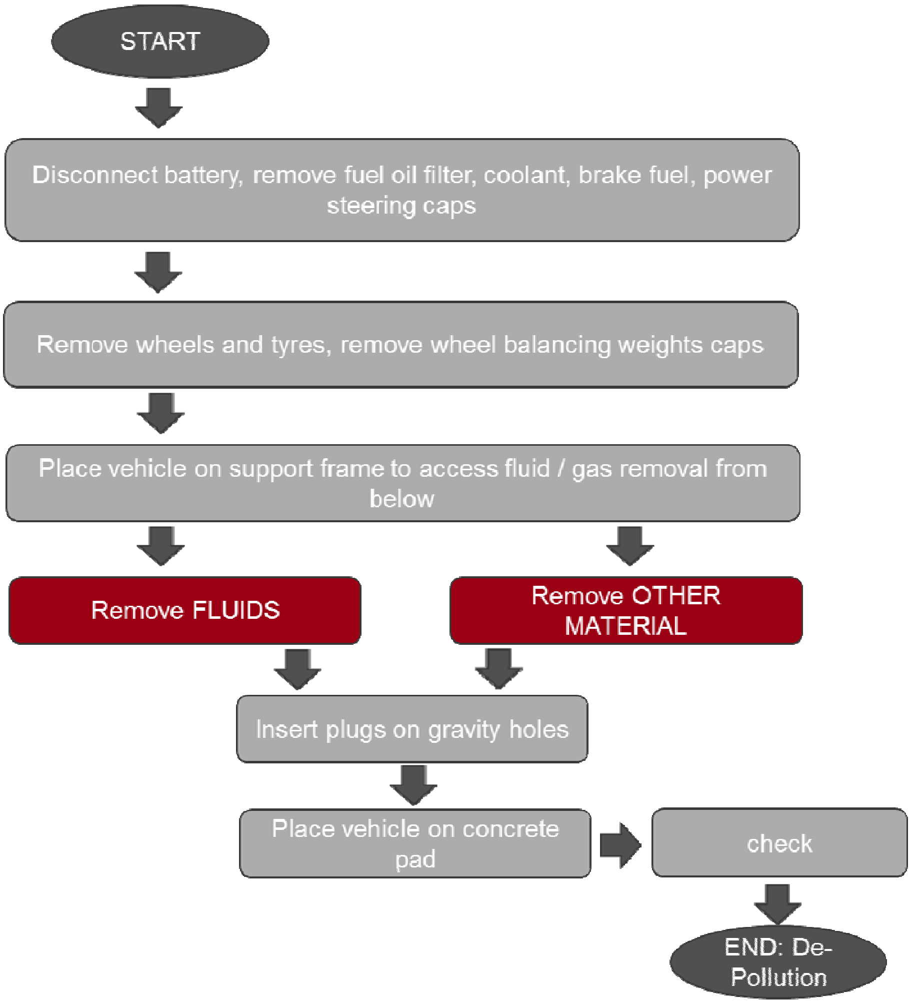

Figure 7: Depollution process

The sequence of the operations is given in the table below where it is also indicated whether an individual operation is best conducted from above (A) or below (B) the ELV. The specific sequence of operations, however, may be evolved as per the requirement of the ELV and equipment available at the treatment facility. The objective should be to completely depollute/

decontaminate the ELV before it can be passed on to further treatment, i.e. shredding and material recovery. At least 20 minutes should be given for gravity draining of the engine oil.

Operation	Depollution Sequence Above / Below (A/B) vehicle
Before Lifting the vehicle	
Remove Battery	A
Remove fuel filter cap & oil filler	A
Set heater to maximum	A
Remove wheels and tyres and separate balance weights	A
Remove any parts identified as containing mercury	A
Lift the vehicle on depollution frame or lifting device	
Degas air conditioning unit (if fitted)	A
Drain engine oil and remove oil filter for crushing or disposal	B
Drain transmission oil, including rear differential	B
Drain coolant	B
Drain brake fluid	B
Remove catalyst (if fitted)	B
Drain washer bottle	A
Drain brake/clutch reservoir(s)	A
Drain power steering reservoir (if fitted)	A
Drain fuel tank	B
Drain shock absorbers or remove suspension fluid	B
Replace drain plugs/fit plastic stoppers	B
Remove vehicle from depollution frame or lifting device	
Deploy airbags and other pyrotechnics in-situ (if fitted and able to conduct this operation)	A
Remove air bags and other pyrotechnics (if fitted, and cannot be deployed in-situ)	A

Table 4: Depollution sequence (UK DEFRA 2011)

For the removal of hazardous substances certain rules have to be complied with. Some of the basic steps have been given below based on the common hazardous materials that are likely to be present in all vehicles

Hazardous substances (fluids) such as engine oil, gear oil, transmission fluid, hydraulic fluid, brake fluid, power steering fluid, coolant fluid, present automobiles need to be decontaminated while processing ELVs as per the norms prescribed in the relevant regulations and guidelines.

- **Waste oils**
  - Used and waste oils shall be sent to registered recycling or re-refining unit.
  - If uncontaminated, these shall be sent for burning for energy recovery.
- **Transmission oil**
  - Transmission oil contained in gearboxes can be gravity drained through the drain plug. Drilling a hole in the bottom of the gearbox shall drain those without drain plug.
  - In rear axle differentials of rear wheel drive vehicles the drain plug shall be drilled or differential flange shall be loosened to allow the oil to drain.
  - Oil shall be collected in a container and stored and then sent for disposal.
  - The power steering fluid has to be extracted from both reservoir and connecting hose using similar equipment for reservoir and by piercing the hose and sucking out the fluid or cutting.
  - Transmission oil/fluids shall be managed like used oil by direct reuse or re-refining in registered recycling units, or by burning it for energy recovery.
  - Transmission fluid must not be disposed in a storm drain, septic tank, on the ground, the sewer system or dumpster.
- **Brake fluids & cleaners**
  - Brake fluid is typically contaminated with chlorinated solvents from brake cleaners.
  - Brake fluid shall be collected in a separate container marked, "Hazardous Waste – Brake Fluid".
  - Brake fluid must not be burned for energy recovery.
  - Brake fluid must not be disposed of in a storm drain, septic tank, on the ground, sewer system or dumpster.
  - Brake and carburettor cleaner shall be closed when not in use.
  - Brake/carburettor cleaners must not be mixed with other solvents, like solvents from parts washers.
  - Spent cleaners and solvents shall be disposed of as hazardous waste.
- **Fuel and fuel filters**
  - Fuel shall be removed from fuel tanks by siphoning or suction as soon as the vehicle enters the facility.
  - Fuel reusability shall be determined – it shall be labelled "Reusable Gas (or Fuel)" if reusable; if the fuel is not reusable it shall be labelled as "Hazardous Waste – Gas (or Fuel)"

- All fuel shall be stored in closed, leak proof containers.
- Reusable fuel shall be used at the facility or given away.
- Fuel must not be mixed with any other waste streams.
- Excess fuel shall be drained from filters into a proper fuel container.
- Used fuel filters shall be kept in a separate fireproof container marked "Hazardous Waste Fuel Filters Only". Fuel filters shall be treated as hazardous waste and disposed of as required. (Florida Department of Environmental Protection 1999)

- **Coolant (Antifreeze)**
  - Coolant can be gravity drained removing the bottom hose from the radiator or using suction and a minimum of 10 litres is collected and reused.

Hazardous substances (solids)

- **Lead acid batteries** present in the automobiles are one of the major sources of toxic and hazardous substances. They contain sulphuric acid that is corrosive and lead plates that are highly toxic.
  - Lead-acid Batteries shall be removed and tested for reusability.
  - Leaking batteries shall be drained and acid stored in containers safely.
  - Intact or drained batteries shall be stored indoors avoiding heat and rain.
  - Batteries shall be sent for recycling in registered recycling units.
  - Battery terminal metal parts sold as scrap for recycling shall contain acid which causes pollution
- **Air filter** contains foam and ferrous parts that pose a potential hazard if burnt in case that it cannot be directly used.
- **Oil filter** contains filter paper and residual oil which is toxic when burnt, it also contains metallic parts which is sold by scrap dealers
- **Hot tank solutions** and sludge from cleaning ELVs (and ELV parts) in auto recycling units could be a major issue as it shall be contaminated with the process effluents and residues. These need to be treated as hazardous wastes.
- **Mercury switch** shall contain mercury, copper and brass that makes it attractive to recycle.
- **Brake shoe clutch plates/discs** contain asbestos that is carcinogenic and hazardous to human health. Asbestos are crushed with the vehicle and are not removed for reuse in vehicle recycling. If brake shoes and clutches are not removed, asbestos particles shall become airborne while shredding. Sometimes these are

stripped and dumped on ground The best way is to limit exposure and health damage by providing proper controls to contain brake dust and prevent its release in the air:

- o Brakes or clutches must not be cleaned with air hoses, dry brushes, wet brushes, rags, garden hose, liquid squirt bottles, solvent spray or ordinary shop vacuums.
- o Brake shoes or clutches shall be removed using specially designed low pressure spray equipment that wets down brake or clutch dust and properly catches the runoff to help prevent asbestos from being released.
- o It is not recommended to eat in asbestos work areas. It is recommended to wash hands before eating.
- o Before going home clean clothes shall be put on. Asbestos particles can become embedded in clothing and carried into the house. (Wyoming Department of Environmental Quality n.d.)

- **Rubber** parts are usually sent for recycling in furnaces as they have the potential to emit toxic fumes.
- **Glass** parts, essentially the windshield and other glasses fitted in the doors, are toughened glass with a PVC sheet pressed between the two layers of glass. If the glass is intact it can be reused. Recycling options are limited and it can only be recycled into construction aggregate. If the PVC is removed then it can be recycled like normal glass. If recycling automotive glass is not an option, it shall be handled as solid waste.
- **Electronic parts** are fitted in modern cars. Such electronic waste shall be disposed of in accordance with the E-waste (M&H) Rules.
- **Refrigerant gases** present in ELVs need to be removed before processing ELVs as these have the potential to cause adverse effects on environment and health. The two types of refrigerant that are used in vehicle air conditioning systems are R12 and R134a. The type of refrigerant is marked on the vehicle. The refrigerant must be removed using specialist equipment which allows airtight operations in order to avoid any gas leakage, and two collection cylinders are required; one for R12 (a CFC) and one for R134a (an HFC).
- **Airbags** contained in most of the modern vehicles contain explosives and shall be handled in accordance with the handling and deployment procedure prescribed by the manufacturer.
- **Catalyst**: All modern vehicles contain catalytic converters in the exhaust for both diesel and petrol vehicles. These catalysts contain precious and rare metals which are valuable for recycling.

Dismantling and segregation

In the next step, the depolluted and decontaminated ELVs are dismantled to separate different parts of the vehicle into their components so that these could be segregated for further processing. Dismantling is one of the important steps in the processing of ELVs. The dismantling process could be manual or mechanical depending upon the type and size of the vehicle. Small vehicles can be easily dismantled and manual dismantling is preferred. The larger vehicles that are not easy to handle manually can be dismantled using machines or are subject to mechanical dismantling. Manual dismantling helps to identify and remove parts that can be reused.

Some common components of automobiles during recycling are: (Automotive Recyclers Association 2014)

- Engines and transmission systems removed from vehicles can often be directly reused; they shall be stored under a permanent roof on an impervious surface, or in an outdoor covered, weather-proof container.
- Engines and transmissions that can be re-manufactured and/or recycled shall be stored under a permanent roof on an impervious surface, or in an outdoor covered, weatherproof container or on an impervious surface that drains to an oil water separator or equivalent treatment device.

In line with **AIS PART-1 para. 4.2.8** any person(s) operating Collection Centre(s) and Dismantling Centre(s) shall not sell the components mentioned in clause 4.2.8.1 and 4.2.8.2 below to any person(s) for reuse in the after sales market and shall dispose of in an environmentally friendly manner.

- 4.2.8.1 In the case of M1 category vehicles: i) all airbags including cushions, pyrotechnic actuators, electronic control units and sensors ii) automatic or non-automatic seat belt assemblies, including webbings, buckles, retractors, pyrotechnic actuators iii) seats (only in case where safety belt anchorage and / or airbags are incorporated in the seat) iv) steering lock assemblies acting on the steering column v) immobilisers, including transponders and electronic control units vi) emission after treatment systems (e.g. catalytic converters, particulate filters) vii) keys and lock components viii) sections of bodywork bearing the vehicle identification number ix) electronic brake components. AIS-129 4/48
- 4.2.8.2 In the case of L1 and L2 category vehicles: i) Steering lock assemblies acting on the steering column ii) Immobilisers, including transponders and electronic control units iii) Emission after treatment systems (e.g. catalytic convertor, particulate filters) iv) Keys and lock components v) Sections of bodywork bearing the vehicle

identification number vi) Engine parts bearing the engine number vii) Electronic brake components viii) Suspension system ix) Any item other than those recommended for reuse by the vehicle manufacturer in the dismantling information

Shredding & Processing Residues

After dismantling and recovering parts from the ELV, the remaining part is known as car hulk. This hulk is compressed and flattened and sent to a shredder for scrap metal recovery. The shredder essentially pulverises the vehicle into fine sized pieces of materials, which are then sent by conveyors for separation using magnetic separation, eddy current, laser and infrared systems (depending on the availability of the systems). Shredding and separation plants are capital intensive and technically complex. The metal recovered from these plants becomes raw material feedstock for steel mills, electric arc furnaces, aluminium and other non-ferrous metal smelters to manufacture a variety of products, including new vehicles (Recycleguide 2014). The automobile recycling rate is almost 100% and is the most recycled commodity.

Along with ELVs, shredders may also process other metal rich scrap, such as construction scrap and waste, large end-of-life appliances such as white goods. During the shredding process, the vehicle is broken down into much smaller pieces, and the metals are extracted. Both ferrous metals – iron and steel – and non-ferrous metals, such as copper, zinc and aluminium, are recovered. Ferrous metals make up about 70% of a vehicle, while non-ferrous metals make up about 6%. These are separated using magnetic separators. The amount of recyclable material that is removed from an ELV via shredding is generally calculated to be about 75% by weight. By far the greatest share (by weight) of recycled material is the scrap metal.

When an ELV is shredded, the residue is usually separated into four fractions: ferrous metals (using magnetic separation), non-ferrous metals (using mechanical separation), heavy shredder residue and the light fraction, which is separated by air suction. Ferrous metals are not being processed further, and are considered ready.

Treatment of automobile shredder residue (ASR)

The final processing of ELV by shredding generates many fractions and a residue also known as automobile shredder residue (ASR) containing a variety of materials that could not be recovered by any of the processes employed. This residue has been a major concern in many countries and a lot of research has been going on to assess how this residue could be used. The two fractions identified in ASR are the light fraction representing 10-24% of the weight of the original vehicle and the heavy fraction representing 2-8% of previous vehicle weight. A gross estimate of ASR generated from ELV recycling in relation to the original vehicle weight is 15-17%. Initially ASR was being land filled. Recent findings show that the light fraction of ASR could be used for energy production while only the heavy fraction needs to be land filled. In Japan mixed ASR is used for thermal energy production. Today it is still being debated whether some amount of ASR needs disposal.

The schematic diagram shown below has been presented in an international comparative study on ELV recycling systems (Sakai et al. 2013). It depicts the steps required for a systematic recycling process but also indicates the percentage recovery rates of resources at different stages in the ELV recycling process.

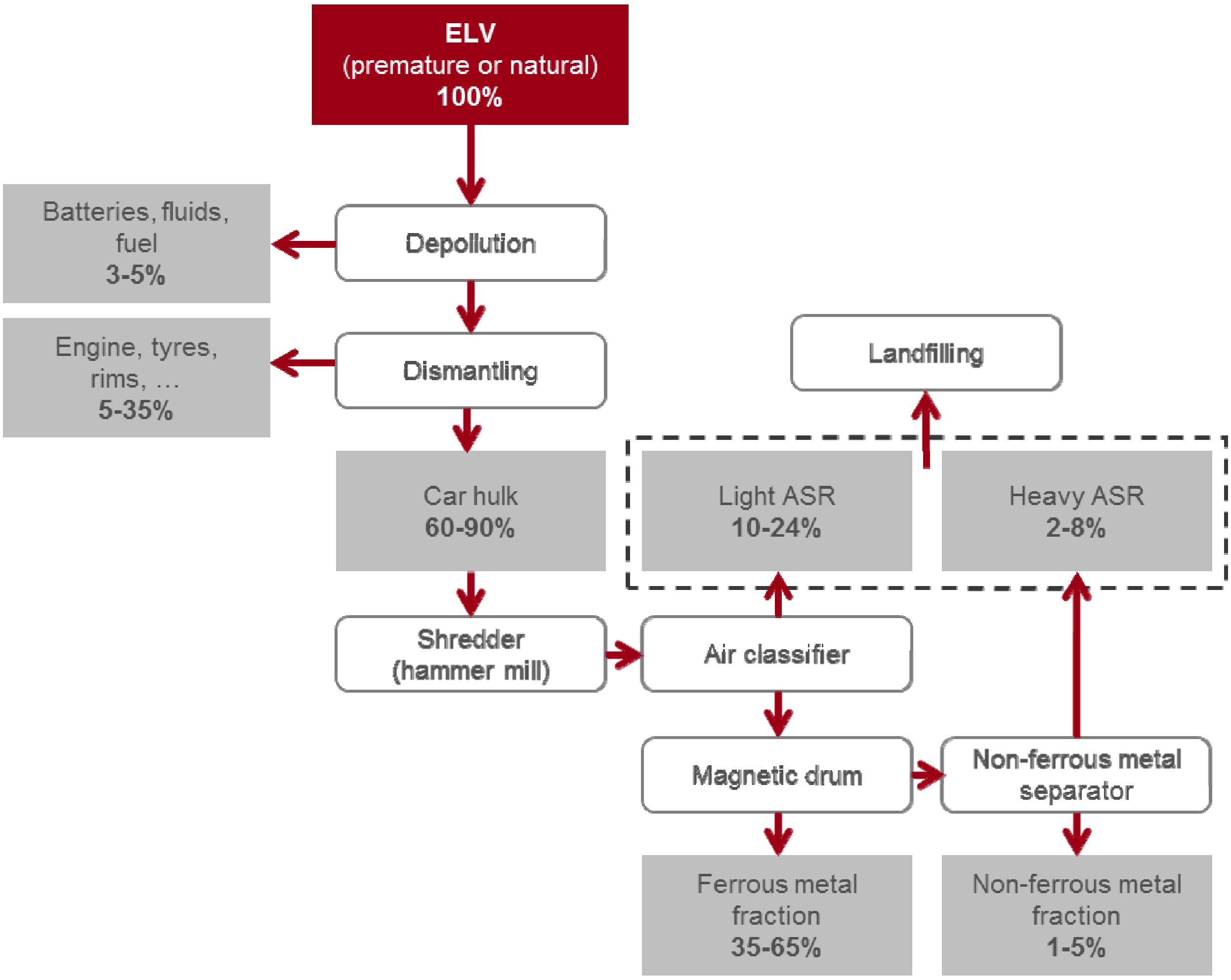

Figure 8: Typical ELV processing in the EU (Sakai et al. 2013)

The depollution removes 3-5% of weight, dismantling 5-35% of weight, and remaining car hulk is about 60-90% of the previous car weight. The ferrous metal share after shredding is 35-65% while the non-ferrous share is 1-5%. Substantial amounts of non-ferrous parts enter into heavy ASR fraction (2-8%) while the light fraction of ASR is around 10-24%.

4.2.4 ELV recycling facility

The establishment of an ELV recycling facility shall be based on the guidelines published, best practices adopted and regulatory requirements in India for establishing and operating “Recycling and Disposal Facilities”. Such facilities shall only be set up by the formal, formalised or organised sector.

The activities presently taking place in the semi-formal sector need to be reorganised. They shall provide a support and channelization system for the integrated facilities that are to be established. With the increasing vehicular population a suitable infrastructure for largescale operations is needed to deal with a large number of vehicles. This would allow bringing the semi-formal sector in the main stream of the ELV management activities and facilitate environmental compliance of all actors. The proposed mechanism for the ELV recycling facility is only an illustrative model and details have to be worked out to develop such facilities.

Facility and operation requirements

In order to provide an infrastructure for recycling ELVs there is a need to identify large areas of land where adequate space is available for storage, handling, and recycling ELVs. ELVs requiring treatment range from small two wheelers to large trucks and trailers. It may be possible to have different facilities for different types of vehicles but one major facility in every region catering to a number of States would be ideal. However, the interstate movement would need to be streamlined.

Procedures for Setting up & Management of ELV recycling facilities

Steps required for setting up ELV recycling facility are the following: (U.S. Environmental Protection Agency n.d.)

1. A license shall be obtained to set up the ELV recycling industry from the appropriate authorities.
2. Land shall be produced in an Industrial Estate to set up the facility. Requisite layout and design approvals shall be obtained

3. In accordance with **AIS PART-1 para. 4.2.4** any person(s) operating Collection Centre(s) and Dismantling Centre(s) shall fulfil the minimum requirements in accordance with Annex A.
4. Environmental Clearances (EC) shall be obtained based on the scale of operations as prescribed in the Environmental Clearance notification dated 14 September 2006.
5. An Environmental Management Plan (EMP) shall be prepared and put in place.
6. Facility shall have obtained consents under the Water Pollution (Control & Prevention) Act, 1974 and Air Pollution (Control & Prevention) Act, 1981.
7. Facility shall be registered as a Recycler under the Hazardous Wastes (Management, Handling and Transboundary) Rules 2008 with the concerned State Pollution Control Board.
8. Facility shall have a written plan describing the facility's risk management objectives for environmental performance and compliance and its plans for attaining these objectives based on a "plan-do-check-act" continual improvement model.
9. Regular evaluation of Environment, Health and Safety (EH&S) objectives and monitoring of progress toward achievement of these objectives shall be conducted and documented in the facility.
10. Facilities shall take sufficient measures to safeguard occupational and environmental health and safety. Such measures may be indicated by local, state, national and international regulations, agreements, principles and standards, as well as by industry standards and guidelines.
11. Training & Capacity Building for employees at different levels.
12. EH&S.
    - An up-to-date, written hazardous materials identification and management plan to address the specific hazardous materials that would be handled.
    - Where materials are shredded or heated, appropriate measures to protect workers, the general public and the environment from hazardous dusts and emissions.
    - An up-to-date, written plan for reporting and responding to exceptional pollutant releases, including emergencies such as accidents, spills, fires, and explosions.
    - Liability insurance for pollutant releases, accidents and other emergencies.
    - Completion of an EH&S audit, preferably by a recognised independent auditor, on an annual basis.
13. Facility to have a regularly implemented and documented monitoring and recordkeeping program that tracks key process parameters, compliance with relevant

safety procedures, effluents and emissions, and incoming, stored and outgoing materials and wastes.

14. Facility to have an adequate plan for closure and shall be updated periodically and financial guarantees shall ensure that the necessary measures are undertaken upon definite cessation of activities to prevent any environmental damage and return the site of operation to a satisfactory state, as required by the applicable laws and regulations.
15. Finally, as laid out in **AIS PART-1 para. 4.2.12** any person(s) operating Collection Centre(s) and Dismantling Centre(s) may accredit their centres/ units as per ISO 14001 (Environmental Management System)

Registration and authorization of Recyclers processing ELV

In order to grant recyclers of ELVs a proper legal status they need to become registered according to various regulatory regimes for the recycling of wastes such as non-hazardous and hazardous wastes, lead acid batteries and E-waste. In the beginning of the establishment of an ELV system, registration of recyclers could be introduced in the guidelines as a voluntary measure. After a certain period, registration requirements could be included in the emerging policy framework. Finally after the acceptance of the principle behind the registration by all stakeholders these registration requirements could be mandated through a regulatory framework. Basic requirements to be eligible for recycling ELVs are as follows:

- The **ELV** recyclers and their facilities shall be registered with the Central Pollution Control Board and/or the respective State Pollution Control Board
- In Accordance with **AIS PART-1 para. 4.2.1** any person(s) operating Collection Centre(s) and Dismantling Centre(s) shall obtain an authorization in accordance with the procedures prescribed in **AIS PART-1 para. 5 "**Procedure for authorisation by Government certifying agency" from the concerned Government Certifying Agency (see Annex B).
- Only registered and authorised recyclers shall be allowed to recycle **ELV**
- Recycling shall be carried out using environmentally sound technologies
- The subsequent residue disposal is to be conducted as per the Hazardous Waste Rules
- Recycling is to be carried out as per the '**Guidelines for Environmentally Sound Management of ELV**'

4.2.5 Technologies for the ELV recycling process

In the following, the technologies required for the recycling process are presented in detail.

Technologies for depollution, dismantling and segregation

- For the lifting of vehicles during the depollution process the recycling facility needs a depollution frame or lifting device.
- Pneumatic tools and electrical screwdrivers are required for detaching the parts to be recycled from the ELV

Technologies for shredding & processing residues

Shredding

- **Dry / moist shredding**:

  Vehicle hulks are fed to the shredder/hammer mill with varying amounts of water. In case of dry shredding, extensive dust is sucked from the shredder by suction air streams. For moist shredding a small amount of water is sprayed into the shredder to eliminate airborne dust emissions from the shredder and from the product transfer points (Gesing 2006). Most shredders worldwide process ELVs alongside other consumer products including white goods, light iron and metallic manufacturing and construction waste (Forton et al. 2005)

Segregation of light ASR

- **Air classifiers, cyclone separators**

  After shredding, all material is injected into a chamber which normally contains a column of rising air. Light ASR, fluff and dust is lifted up by the air drag and removed by cyclone separators. There exist various types of classifiers that can separate particles of different sizes and weight classes. Air classification can be repeated until material is sorted to a satisfactory degree (Christensen 2011).

Segregation of ferrous metal fractions:

- **Magnetic separators**:

  Once light material has been separated, the remaining residue is transported to magnet separators / drum magnets for segregation of ferrous metals. Magnetic separation can be repeated until material is sorted to a satisfactory degree. This could be beneficial if, for example, small ferrous particles were covered and held back by other non-ferrous materials during the first magnetic separation process (Forton et al. 2005).

Segregation of non-ferrous metal fractions:

- **Eddy-current separators**:

  In the next step, non-ferrous metals (aluminium, copper, zinc, etc.) are separated from non-metal materials using eddy-current separators (ECS). The ECS is installed at the end of a conveyer belt and creates a magnetic field to throw conducting metals forward from the belt into a product bin, while non-metals simply fall off the belt (Mastermag, n.d.). Modern ECS can also eliminate small arts of ferrous metals left from the sorting with magnetic separators (Cogelme, n.d.). The separation process can be repeated until material is sorted to a satisfactory degree.

- **Heavy media separation / sink-and-float separation**

  Another technology for segregation of non-ferrous metals is by heavy media separation, also called sink-and-float separation. Material is introduced into a heavy medium (mixture of water and very fine and dense powder). Denser particles will sink, while lighter particles will float on top of the medium (Encyclopædia Britannica Online).

  Compared to ECS, wet separation methods have the major disadvantage of having long wait times for settling and drying. Furthermore, they produce large amounts of waste water (Lee 2012).

- **Other technologies**

  There exist other technologies for separating metals from specific non-metal materials. For example, polymers can be removed using electrostatic separators (Lee 2012).

Sorting of non-ferrous metal fractions:

- **Sensor-based / manual colour sorting**:

  Non-ferrous metals are then sorted by colour. Sensors based on colour recognition can be applied to differentiate copper and brass (red/yellow particles) from aluminium/magnesium (white/grey particles). Colour sorting of different non-ferrous metals can also be done by hand (Margarido et al. 2014).

Sorting of ASR

- **Air classifiers, cycle separators**

Non-metal residues (glass, fibre, rubber, plastics, dirt, etc) can again be separated into light and heavy fractions using air classifiers.

Technologies for treatment of segregated materials

After the shredding and separation process, there are the ferrous metal, non-ferrous metal, and light and heavy ASR fraction. The ferrous and non-ferrous metal fractions are commonly treated in metal smelters. There are different options for treating the ASR fractions.

Thermal treatment

- ASR has a calorific value of 14 – 30 MJ/kg rendering it a valuable energy source. However, high chlorine content, brominated flame retardants, ash content and high heavy metal concentrations make it difficult to actually use it as fuel (UNIDO et al. 2012). In addition, it has varying moisture content (Jody et al. 2010). To limit the amount of hazardous substances released from burning ASR, it may be co-incinerated in Municipal Solid Waste (MSW) incineration plants not exceeding a certain share in the fuel (in Switzerland the ASR fraction may not exceed 5 %, in Sweden up to 20 % were co-incinerated in MSW incinerators). Testing the flue gas emissions showed that the flue gas emission composition did not change significantly. However, concentrations of heavy metals increased in boiler and fly ash (UNIDO et al. 2012).

  Another option is to improve the quality of the ASR. By removing the finest fraction of the ASR through screens, shaker tables, rotary drums or float/sink separation techniques the ASR fuel quality can be improved. Removing PVC from the ASR can lower the chlorine concentration of ASR. Density separation with a bath density of 1,100 – 1,200 kg/m^3 can remove up to two-thirds of chlorinated plastics from the ASR (UNIDO et al. 2012).

  Although ASR could be used as a fuel for cement kilns, tests using 50 % of ASR as fuel in the kilns had a negative effect on clinker as the concentrations of heavy metals in the material increased significantly. In addition, more ash is formed, clogging of the fuel injection zone happens and increased concentrations of hazardous elements is found in the kiln dust (UNIDO et al. 2012).

Metal recovery

- For recovering metals from the recycling process, the obtained materials can be treated in different smelters. Ferrous metal junks can be fed into electric arc or blast furnaces (Kumar and Sutherland, 2008). The different metal fractions can be treated in copper or integrated smelters. As integrated smelters are high-tech installations only 5 – 10 smelters fit to adequately and environmentally-sound treat the ELV fractions exist, among them smelters in Belgium, Canada, Germany, Japan and Sweden (UNIDO et al. 2012). Light residues from a car shredder can be treated in secondary aluminium smelters (UNIDO et al. 2012).

Chemical recycling

- There is the option of converting the organic content of ASR to liquid and gaseous fuels via pyrolysis or gasification (Jody et al. 2010)

  Through chemical recycling processes, materials such as monomers, lighty hydrocarbons, liquid and gaseous fuels could be extracted from the hydrocarbon-based fraction. The main sources of such products will be plastics and rubber. Processes that may be employed for chemical recycling include most prominently pyrolysis and gasification. Other processes are hydrolysis, selective dissolution, hydrogenation, and de-polymerization (Jody et al. 2010). Pyrolysis is the thermal decomposition of organic materials (such as wood, coal, plastics, tires) to produce fuels and chemicals (Jody et al. 2010). Gasification is a process that converts the organic component of a material in a gaseaous mixture of CO, H_2 and CO_2 and reduced metals. Gasification reactors commonly used are moving bed, fluidized bed and entrained flow reactors (Jody et al. 2010).

Plastics recovery

- Technologies that could be used to separate plastics from the ASR are heavy media separation, froth flotation, jigging, cryogenic grinding, use of magnets, air knives and vibrating tables (Forton et al. 2006). Plastics would have to be separated in different types to be reused (Forton et al. 2006).

  As the thermoplastics content in the plastics fraction in ASR is rather high (70 – 80 %) it can be recovered, heated and remolded in products such as park benches, lamp posts, road side furniture, etc. Separation technologies that could be used for this task include water elutriators and gravity separators (Jody et al. 2010). Conventional MSW recycling separators could be adjusted for the application to ASR (Jody et al. 2010).

Incorporation into other materials

- ASR can also be recycled or stored by including it in composite, concrete or asphalt (UNIDO et al. 2012).

Landfilling

- Landfilling of the ASR is still the most common treatment approach for this fraction as the other technologies described above are either too expensive or have significant negative environmental impacts.

4.2.6 Responsibilities throughout the life cycle of vehicles

Implementing the above-described arrangements will require concerted efforts by Indian government agencies, vehicle manufacturers, the recycling sector as well as vehicle owners.

An important stepping stone on the way towards formalizing the recycling sector and triggering more effective ELV management is to involve vehicle manufacturers in the whole life cycle of their products. In India, the automotive industry is making considerable efforts to facilitate ELV recycling at various stages of the lifecycle of vehicles.

In 2015 the AIS Committee (AIS Committee 2015) published a detailed set of voluntary Automotive Industry Standards (AIS 129). The AIS 129 suggest that vehicle manufacturers support ELV recycling through improved product design and information dissemination:

- **PART-2A, para. 3.1**: Vehicle manufacturers shall strive to ensure that the vehicles type approved after the mandated date shall not contain lead, mercury, cadmium or hexavalent chromium. Vehicles shall be so constructed as to be: reusable and / or recyclable to a minimum of 80 % by mass, and reusable and / or recoverable to a minimum of 85 % by mass.
- **PART-2A, para. 4.2**: The vehicle manufacturer shall make available the “Dismantling Information” in the form of manuals or by means of electronic media (e.g. CD ROM, online services, etc.) to the authorised dismantling centres.
- **PART-2B, para. 4.2.1** Vehicles shall be so constructed as to be (4.2.1.1) reusable and / or recyclable to a minimum of 80 % by mass, and (4.2.1.2) reusable and / or recoverable to a minimum of 85 % by mass

Furthermore, the automotive industry has provided comprehensive support to the Indian Ministry of Heavy Industry for setting up an ELV demonstration centre at the Global Automotive Research Centre in Chennai (AIS Committee 2015). The centre seeks to develop recycling processes which employ manual labour to the greatest extent, and particularly procedures for dealing with two-wheelers.

Despite these efforts there remain short falls. Even though the AIS 129 define extensive responsibilities for vehicle manufacturers, these standards are limited to the product design stage as well as information dissemination. Concerning the actual recycling process of ELVs, the AIS 129 lay out mandatory compliance rules for vehicle owners and dismantling facilities. It does not, however, become clear how the automotive industry is meant to help these actors comply with the rules. Particularly collection and dismantling centres will be faced with substantial additional costs for obtaining authorization; paying the last ELV owner a salvaging price according to the value of the ELV; recycling various types of ELVs in an environmentally friendly manner; and disposing of vehicle parts that are deemed non-reusable (AIS 129: § 4.2).

The key question remains how to make ELV regulations and the voluntary standards of the automobile industry converge towards guaranteeing an environmentally sound management of the ELVs.

As it was shown in chapter 4.1.4 in most countries with ELV legislation this is achieved by legally establishing Extended Producer Responsibility (EPR) or by defining other approaches to producer responsibility. In India, EPR is now a part of most waste legislations (e-waste, plastic, batteries and to a certain extent, municipal solid waste). The setting up of a legal EPR scheme has been discussed by organizations of the Indian Automotive Industry. Based on consultations with stakeholders they have come to the conclusion that the setup of an Indian EPR scheme is not feasible due to the fact that “the industry is not developed to that maturity level” (AIS Committee 2015). Consequently, the principle of EPR was not included in the AIS 129. Instead it is believed that “the market economy must take care of the final ELV value offered to the customer” (AIS Committee 2015).

However, the vast challenges faced by the recycling sector (e.g. more complex vehicle design, new materials and parts, lack of space, etc.) strongly reduce the incentives for small-scale entrepreneurs to invest in ESM of ELVs. In order to allow for the uptake of efficient technologies and better coordination among different facilities, close cooperation with vehicle manufacturers remains a crucial aspect**.** A holistic approach to ELV recycling would therefore be to set up a ‘Shared Responsibility’ model (Akolkar et al. 2015) that distributes responsibilities among a number of actors – “from producers, recyclers and dismantlers (both formal and informal), to government authorities, and consumers (both private and commercial), dealers/ intermediaries and insurers”. In particular the public sectors has the potential to contribute to ELV recycling by providing an adequate policy framework, creating awareness and outreach programmes and generating incentives moving all actors towards the implementation of a comprehensive ELV system. According to this model the responsibilities of the vehicle manufacturers would look as follows:

- Extended Producer Responsibility ought to give producers the leeway needed to innovate by choosing materials and structures that aim to make also the dismantling and recycling easier and safer (Lindhqvist 2000). **This point is already covered by the AIS 129.**

- The producers will also have to play a major role in strengthening the capacities of the semi-formal sector in regard to dismantling and recycling. **This point is partly covered by the setup of the dismantling centre in Chennai**. However, this effort is not enough to reach the majority of the semi-formal sector as it is large and spread over various regions of India. Furthermore, the automobile manufacturers could frame the Standard Operating Procedures (SOPs) for dismantling every model and type of vehicle. The SOPs could be shared with the semi-formal sector in vernacular languages.
- Finally, producers also need to set up mechanisms for product take back, with infrastructural and financial responsibility for its effective implementation nationwide. Such a take back system would ensure that all ELVs can be returned for recycling and that the recycling facilities are adequately equipped. The automotive industry has the economic strength to establish and maintain such a system and can thus contribute considerably to ensuring ESM of ELVs. By requiring vehicle producers to take care of the recycling of their products the incentive for building “green” vehicles would be increased. **So far, the AIS 129 do not provide for a take back system.**

These considerations are based on consultations with informal ELV recyclers and regulators which were held by Akolkar et al (2015) in order to identify approaches for improving the performance of the sector.

5. Policy Frameworks for Environmentally Sound Management of ELVs

In the previous chapter, the steps of Environmentally Sound Management (ESM) of ELVs were described. In order to transform the current ELV sector in India, these procedures should be realised to the greatest extend possible. However, as long as there do not exist any regulations or incentives, this transformation is not likely to be initiated by the semi-formal sector. Therefore, a comprehensive framework for the ESM and formalization of the ELV sector is required.

Chapter 5 will provide important inputs for such a framework. In the first subchapter (5.1), it will be assessed on how the ELV recycling sector is regulated in other countries. The second subchapter (5.2) will give an overview of the existing policy framework in India in order to identify possible synergies and avoid inconsistencies. Finally, subchapter number three (5.3) will propose a policy framework that fits the Indian context.

5.1. International framework

There are two distinct approaches with regard to policy frameworks for ELV prevailing in most countries: Under the first approach a legislative/regulatory framework is in place that mandates the activities pertaining to ELV recycling and disposal; under the second approach no dedicated ELV law is in place and stakeholders follow guidelines provided by authorities or the automobile manufacturing companies or their associations; this guidance is not mandatory. Below it is listed which approaches different countries belong to.

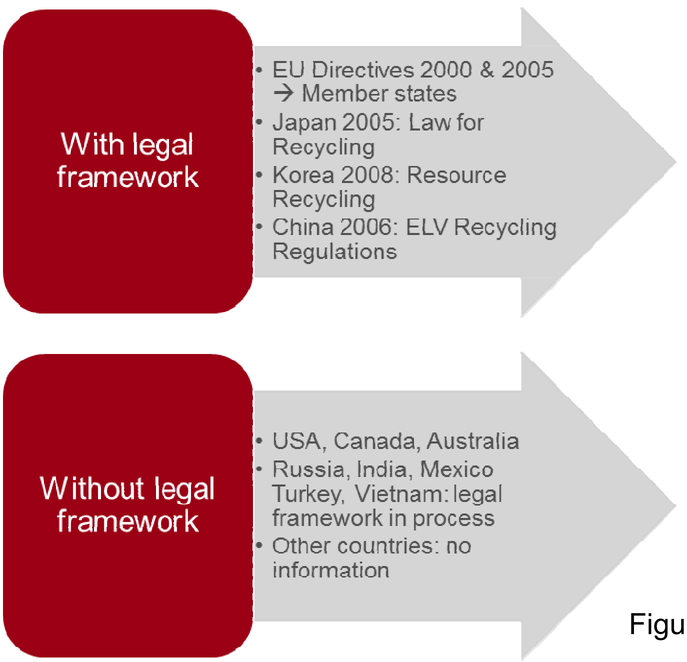

Figure 9: ELV policy frameworks

In the United States ELV recycling is managed under the existing environmental protection laws and guidelines for recycling efficiently. In the EU, Japan, Korea, and China ELVs are regulated under a specific ELV legislation that mandates the activities pertaining to ELV collection, recycling and recovery of resources. A comparative account of the global policies, responsibilities and targets is presented in the table below:

	EU	Japan	Korea	China	USA	India
Background	Abandoned Automobile ASR disposal, Auto Dismantling and recycling activity	Illegal dumping of ASR, lack of disposal sites and Maximise use of resource recovered	Effective use of ELVs as resources	Illegal assembly effective use of resource recycling economy	ELV Recycling for resource recovery	Informal Sector Activities
Policies & Regulations	ELV LAW EU Directive 2000/53/EC on ELV Sep 2000 Revised I 2005LAW	ELV LAW ELV Recycling Rules 2002 enforced 2005	ELV LAW Resource Recycling of EEE & ELV 2005 in enforce form 2008	ELV LAW ELV Recycling Regulation 2001 ELV Recycling Technology Policy, 2006	NO ELV LAW Environment Laws RCRA Clean Air Act, etc. & Market Mechanisms	NO ELV LAW Environmental Laws Hazardous Waste Rules 2008, Batteries Rules 2001, E-waste Rules 2011
Recycling Responsibility	**EPR** Producer responsible for free take back & to incur recycling cost	Sustainable Recycling Society under 3R Shared responsibility owner, manufacturer Collector & recycler	**EPR** Automobile Manu-facturers & importers respon-sible for recycling incur cost	Traded as valuable secondary resource	No regulations traded as valuable secondary resource Market driven	No regulation Economics of recycling & employment in informal sector for urban poor

Recycling Target & Achievement	reuse+ recovery Target (achieved) 2006 - 85% (80%) 2015 –95% (85%)	No recycling Target Airbag recovery 85% ASR use 70% 2015 50% 2010 30% 2009	Material +energy recovery : Until 2014 85% After 2015 95%	Possibility of recycling: 2010 ~ 85% 2012 ~ 90% 2017 ~ 95%	No specific goals 95% of ELV for recycling 80% material recycled	No specific targets market driven activity
System Characteristics	EPR based Principle Regulation to prohibit use of Heavy metals Enforcement of Domestic Laws	Automobile Manufacturer & importer responsible for recycling No recycling Targets Thermal recovery of ASR	EPR based Planning as per ELV prices Operations under Eco-assurance system	ELV Recycling Regulation to prevent accidents. No recycling of axle, engine, steering, frame and transmission Remanufacturing Regulation 2008	No regulatory System Motor Vehicle Information system Automotive Recycling Association	No assessment for ELV deregistration procedures not followed Recycling mostly in the informal / unorganised sector

Table 5: International comparison of ELV systems (Sakai et al. 2014)

5.2. Existing policy framework for India

In India, the existing national policies and regulations for ELVs include those that deal with the declaration of vehicles as ELV and some steps or elements of the recycling process of such vehicles. At present there is no comprehensive policy or regulation governing the management of ELV with a cradle-to-cradle approach. Some of the regulations applicable to ELVs are discussed in this chapter with suggestions on how to develop a new policy framework for ELVs.

5.2.1 Vehicular policy

The Central Motor Vehicles Act 1988, the rules published thereunder, and the notifications issued provide the regulatory regime for the registration of vehicles. The cancellation of the registration or deregistration of vehicles is the only legal procedure to take the vehicle off the road. This certification is provided by the Regional Transport Office (RTO) that is responsible to register the vehicles that are put on road, and to ‘deregister’ vehicles that are unfit to ply on road. However, if the ELV is located at within the jurisdiction of an RTO where it is not registered, the ELV would have to be transported back for deregistration. This will cause undue delay and complications for the businesses that are responsible for ELV management. To rectify this situation, a system must be established empowering the RTOs where the ELV is found so that they can deregister the vehicle and inform the RTO where the vehicle was originally deregistered. This amendment would improve the vehicle deregistration process which is currently not very effective in India as the scrap dealers accept ELVs without any legal documentation.

5.2.2 Environmental policy

The 2006 National Environmental Policy (NEP) focuses on sustainable development and the need to facilitate the reuse/recovery/recycling of useful materials from waste, thereby contributing to the conservation of natural resources and the reduction of wastes destined for final disposal; eventually environmentally sound management of all wastes is to be ensured. Moreover, the NEP encourages legal recognition and strengthening of the informal waste sectors to be integrated into the mainstream waste management activities. (Raghupathy 2009) Considering the large recycle potential of ELVs, these should be recycled properly to recover valuable natural resources in an environmentally sound manner. At present there is no separate policy or law or regulation governing the management of ELVs. However, the environmental compliances for recycling activities could be in accordance with the prevailing laws such as The Water (Prevention & Control of Pollution) Act, 1974, (The Water Act), The Air (Prevention and Control of Pollution) Act, 1981 (Air Act) and The Environment (Protection) Act, 1986 (EP Act) and the rules made thereunder.

5.2.3 Other relevant regulatory framework applicable for ELVs

The Ministry of Environment and Forests has the power to make rules under the Environment (Protection) Act, 1986 which are central regulations implemented through the State Government and State Pollution Control Boards or the Pollution Control Committees of the Union Territories. The following waste regulations notified by the Ministry are applicable for the management and recycling of ELVs:

- The Hazardous Wastes (Management and Handling) Rules 1989 amended 2008.
- The Municipal Solid Waste (Management and Handling) Rules, 2000.
- The Ozone Depleting Substances (Regulation and Control) Rules, 2000.
- The Batteries (Management and Handling) Rules, 2001.

- The e-waste (Management and Handling) Rules 2011.
- The Plastic Waste (Management and Handling) Rules, 2011.

All the above rules address environmental issues concerning waste management (recycling or disposal). The different rules cover industrial wastes, urban waste as well as post-consumer waste. These rules have been notified under the Environment (Protection) Act, 1986 by the Ministry of Environment Forests and Climate Change in order to provide statutory provisions for regulating the handling and management of wastes without causing any adverse effects on environment and human health. The concept of recyclability of wastes and regulating recycling activity has been introduced in some of these rules with the goal to increase the recovery of resources thereby reducing the waste destined for disposal. Some of these rules include provision for the registration of recyclers who have the capability to recycle wastes using environmentally sound technologies.

The **Hazardous Wastes (Management and Handling) Rules 1989** were the first set of rules that were notified for regulating the hazardous wastes generated from industries. These have been amended in the past and became the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008. The hazardous substances and hazardous fluids present in ELVs such as waste oil, transmission fluid, coolant fluid, brake fluid, power steering fluid, hydraulic fluid, gear oil and other materials arising from de-pollution shall be recycled or disposed of in accordance with these rules. In addition to these substances, the hazardous solid wastes such as air filter, oil filter, brake shoe, asbestos in clutch discs are required to be disposed of in accordance with the hazardous waste rules. Any recycling of these hazardous wastes recovered from the ELVs shall be carried out only by the registered recyclers notified under these rules. The residues containing hazardous substances arising from both manufacturing and recycling activities have to be disposed of in an environmentally sound manner and the disposal procedures shall be decided on the basis of the constituents present in the waste. All hazardous wastes generated from the ELVs shall be disposed of in accordance with the requirements under the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008.

In compliance with the requirements under the Montreal Protocol the **Ozone Depleting Substances (Regulation and Control) Rules, 2000** have been notified. These rules provide a control on the production, consumption, export and import of the 95 Ozone Depleting Substances listed in the Schedule 1 of these rules. All refrigerants containing ODS recovered from ELVs should be disposed of in accordance with these rules.

The lead acid batteries recovered from the ELVs shall be recycled by the registered recyclers in accordance with the **Batteries (Management and Handling) Rules, 2001**. Similarly all electronic gadgets are to be treated and disposed of in accordance with the **E-waste**

(Management and Handling) Rules in 2011 to channel e-waste for recycling to registered recyclers. However there are no specific rules for the management and recycling or disposal of some of the parts such as tires, air bags, glass, polyurethane and plastic parts that may be recycled and disposed as is being practiced in other countries.

Regulation on ELVs, being a post-consumer waste, needs to be framed along the lines of the E-waste (Management and Handling) Rules 2011.

5.2.4 Industry standards

The Automotive Research Association of India (ARAI) along with the Society for Indian Automobile Association (SIAM) and the Automotive Industry Standards Committee (AISC) under the Ministry of Road Transport & Highways has developed 'Automotive Industry Standards for End-of-Life Vehicles' (AIS 129) which have been notified in July 2015. The main objective was to enable automobile recycling to become an organised sector activity and to prescribe minimal operational standards for automobile recycling in-line with the European Directives of 2000 and 2005. In due course of time when large infrastructures are set up for ELV recycling the legal provisions could be developed based on these standards (yet going beyond them especially in terms of establishing a Shared Responsibility system and providing clear guidance for ESM).

5.3. Building blocks of a policy framework for India

Once the vehicle is declared as ELV there is the need to regulate the handling and processing of ELVs. For this reason a policy framework for ELV management and handling needs to be promulgated in India. In order to accelerate the policy development process, the development of these Guidelines on the Management and Handling of ELV (this document) is a first step towards this goal and can be considered as a precursor to a proper regulatory framework.

The policy and regulatory framework for ELVs should essentially provide for the declaration, collection, handling, dismantling, recycling and disposal of ELVs as a 'Shared Responsibility' involving the key stakeholders such as manufacturers, dealers, consumers and recyclers.

The main objective of the policy should be to address the requirements for ELV management and to put in place an effective control and monitoring mechanism on the declaration, collection, handling, dismantling, recycling and disposal of ELVs. In this regard the consultations with stakeholders in the ELV value chain should lead to a consensus for a regulatory framework to include regulations and procedures for environmentally sound management of ELV.

The environmentally sound management of ELVs needs to be the regulated by the Ministry of Environment Forests and Climate Change along the lines of other post-consumer waste streams. The policy process would comprise different stages in the decision making process with a logical sequence for problem solving involving all stakeholders.

In the policy framework to be developed, ELV generators should include consumers such as bulk consumers (transport agencies, institutions, banks, public and private undertaking etc.) as well as individuals. It should regulate wastes in the form of rejects, scraps etc., from manufacturing of vehicles as well the fines generated while scrapping. The various types of vehicles should be classified and within each category the components from each vehicle should be listed. Some aspects of the recycling process are already covered under existing rules. New rules on ELV recycling would need to take account of this. The Hazardous Waste Rules cover some of the hazardous constituents from ELV such as the lube and waste oils, cooling fluids, cables, etc.; the lead acid automotive batteries are covered under the Batteries Rules and the e-waste in the electronic gadgets provided in the automobiles is covered under the E-waste Rules.

The policy should address the following:

- Shared Responsibility involving all stakeholders
- Mechanism for ELV Declaration, Deregistration, Destruction Certification and Transportation to Authorized Recyclers
- Authorization & Registration of Recyclers processing ELV

5.3.1 Goals of a Policy on ELV

The policy goals for the proposed ELV management system are:

1. **Decrease** open dumping of ELVs
2. **Encourage** re-use, recycling and other forms of recovery of ELVs
3. **Reduce** the uncontrolled disposal of ELVs by the semi-formal sector
4. **Control** the usage of Hazardous Substances in new vehicles
5. **Contribute** to the efficient use of resources and the retrieval of valuable secondary raw materials
6. **Improve** the environmental performance of all operators involved in the life cycle of ELVs (e.g., manufacturers, importers, distributors, consumers, collectors, dismantlers, recyclers, and exporters).
7. **Set up** a “Shared Responsibility” scheme

8. **Engage** consumers and businesses (Business-to-business (B2B) and Business-to-consumer (B2C))

5.3.2 Shared Responsibility Scheme

A key building block of the proposed framework, not covered under the AIS 129, is the introduction of Extended Producer Responsibility. As documented above, EPR is now being used globally as a policy instrument in waste management legislations. In India, EPR is now embedded in several waste management laws. However, the concept of EPR would need to be adapted to the Indian conditions to make it viable. Given the vast presence of the semi-formal sector in ELV management, introduction of EPR along the lines of the European experience would not be viable in the Indian context. **Extended Producer Responsibility would have to be embedded within a Shared Responsibility Framework** with clear roles envisaged for the public sector as well. Such a shared responsibility model would enable the development of appropriate infrastructure through the modality of PPPs. Also, the bridging of formal and semi-formal markets for the handling of ELVs would need active intervention and convening power of the public sector. It is critical that the roles and responsibilities of the different stakeholders in such a shared responsibility model are clearly defined and supported through a legal instrument. This would enable the development of controlled channels for the flow of materials as well as infrastructure to handle the ELVs.

5.3.3 Regulations

From a regulatory perspective the following success factors are critical for the successful management of ELVs:

1. Generally, the regulation adopted for ELVs shall comply with Rule of Law standards, i.e. be precise, coherent, practical and proportionate.

 Precise means that clear legal terminology is used and that especially all rules that impose responsibilities and obligations on private or legal persons or confess rights must be fully understandable

 Coherent means that all rules are shaped in a way that they fit with already existing rules in other legal acts without contradictions or unnecessary redundancies

 Practical means that the legal provisions adopted can realistically be applied and enforced, either directly after the entry into force of the Regulations or later, as indicated in transition clauses. The most ambitious and advanced legislation is not worth anything if it cannot be implemented due to high demands, complexity, unrealistic targets or low institutional capacity etc.

 Proportionate means that obligations, restrictions, fines, are always in proportion to the goal to be achieved and can be realistically complied with by the addressee of a rule.

2. Command and control mechanisms and instruments such has authorization, registration, record forms, prohibitions, inspections should only be used to the extent necessary from an environmental perspective. However, as regards the future success of an ELV management system to be established that proper awareness raising, information distribution and voluntary participation are at least as important – and they do not need much legislation. This goes even more in a largely self-organized system led by the private sector.

3. The environmental safe treatment of ELV can only be ensured through adequate treatment standards and the authorization or registration of stakeholders involved in any kind of ELV treatment activities.

5.3.4 Financing

ELV management principles

To create a system that encourages participation of all the relevant stakeholders and to create a level playing field, the fund management should be based on the following critical principles:

 Cost recovery: The ELV management system should be based on a not-for-profit basis and finances should be allocated to recover costs. There should be an annual financial audit of the system that presents the total costs of organizing and implementing the ELV management system. The recycling costs should be suitably adjusted if there is either a build-up or running down of the funds as compared to the costs.

 Visibility: If the burden of the finances required to set up the ELV management system is passed on to the consumers, the exact fee should also be reflected at the point of sale to the consumer. This would enable greater public participation in the management system.

Transparency: Reputed third party auditors should conduct the annual audits of the ELV management system. As the government would be a key stakeholder and would provide the mandate to the setting up of the system, additional oversight instruments, which are applicable to the government schemes as envisaged by the Comptroller and Auditor General may be applicable to the ELV management system as well.

 Enabling the Development of a Business Case for Environmentally Sound Management of ELVs: Appropriate fiscal instruments or incentives could be developed to support the development of a controlled and regulated ELV recycling system in the country. These incentives could be provided by the relevant Ministries that are responsible for the development of the Automobile Industry or for the protection of the environment and natural resources.

Multi-stakeholder governance: The ELV management system should be open to scrutiny by a high-level multi-stakeholder group representing the diversity of interests of the manufacturers, consumers as well as the government. This would ensure that the concerns of the consumer groups as well as the regulatory authorities are suitably represented in a private sector implemented system. However, it should be made clear that this structure cannot be held liable for any malpractices, as it will not be involved in the day to day running of any system set up by the private sector.

6. Guidance for Stakeholders

6.1. Ministry of Road Transport and Highways

The Ministry of Road Transport and Highways is the nodal ministry responsible for the implementation of the Motor Vehicles Act, 1988. Within the purview of the act, the Regional Transport Offices (RTOs) are responsible for registering of vehicles that will ply on roads and ensure that all safety guidelines as prescribed within the act are adhered to by vehicles.

Existing regulation around ELVs is incomplete and is often not fully enforced. For example, the deregistration process to be accomplished by the Regional Transport Office (RTO) is not carried out for all vehicles as most of the vehicles are sold as auto junk to the scrap dealers and recycled in the semi-formal sector or abandoned on the road side after accidents, fire, etc. An online central registry is already in place for all vehicles that are registered. A similar registry needs to be prepared for those that have been declared ELV either natural or pre-mature at the location of the ELV and not at the location of registration. The RTOs may work in partnership with the local municipalities especially for the deregistration of abandoned vehicles within municipal areas.

Testing and roadworthiness standards should be strengthened to balance the environmental concerns with the economic incentives of the producers. While, vintage based vehicle retirement initiatives might be attractive to the industry, they are likely to impose increasing demands on the environment through the use of ever-more raw materials. At present, the registration certificate for a heavy vehicle is issued for 10 years while that of a four-wheeler or two-wheeler is issued for 15 years. The duration of these certificates should be reviewed so that vehicle owners are not inconvenienced unduly and at the same time the environment is not harmed by the continued use of polluting vehicles.

The ministry should appoint a nodal authority that will be responsible for monitoring of standards employed at the production stage of vehicles. The recyclability and recoverability rates as specified should be adhered to and guidance on dismantling should be provided to all formal dismantlers within 6 months of launch of a new vehicle. Design conformity should be set and monitored through standards such that recyclability and recoverability rates are met.

Guidance should also be offered to municipalities in the form of awareness and outreach programmes that can be designed by the ministry such that they are able to educate and spread awareness on the environmental hazards posed by vehicles which attain ELV status.

The municipalities may be asked to report on an annual basis on the quantum of ELVs impounded within their jurisdiction.

6.2. Ministry of Heavy Industries and Public Enterprises

The Ministry of Heavy Industries and Public Enterprises is the nodal Ministry governing the automotive industry in India. As a first step the Automotive Industry Standards 129 have been published in 2015 providing guidance on collection and dismantling of ELVs by authorised centres as well as describing provisions that manufacturers should take in order to increase the recyclability of vehicles. However, these standards need to be further developed into a regulatory framework in order to ensure compliance by the semi-formal sector and to make vehicle manufacturers responsible for their vehicles throughout their entire life cycle.

The AIS 129 must be integrated with a shared responsibility model combining producer responsibility with consumers and disposer responsibility. While the main objective of the standards is to provide guidance in handling end-of-life vehicles and to describe procedures for ESM of ELVs, in order to provide a practical operational system for dealing with the ELVs in India a system for shared responsibility is being proposed in these guidelines. It is important to note that the automotive industry requires mandatory compliance with AIS 129 but a mechanism needs to be put in place for ensuring its enforcement.

The AIS 129 provide for standard operating procedures for dismantling of ELVs for its environmentally sound management. The ministry should increase its outreach with key stakeholders like Municipalities such that the semi-formal sector which is present in almost each Municipal area of the country is made aware of the same and are conscious about environmental issues related to vehicle repair, dismantling and recycling.

6.3. State Pollution Control Boards

The State Pollution Control Boards have a critical role in ensuring that the different actors involved in the ELV value chain are made aware of these guidelines. The SPCBs may conduct outreach and awareness activities to enhance the awareness of the stakeholders on the environmental impacts of ELVs.

The SPCB would be responsible for the registration of dismantlers and recyclers of ELVs in partnership with the MoRTH. They may also be involved in the quantification of ELVs as well as in identifying the hot-spots of ELV recycling within a state. This would enable the development of appropriate infrastructure and the mapping of material flows within the state boundaries.

Also, the SPCBs would be responsible for providing clearances for the inter-state transfer of ELVs for dismantling and recycling

With the rising amount of electronics and plastics in ELVs, there would be a challenge of e-waste and plastic waste emanating from ELVs. As SPCBs are currently involved in monitoring the implementation of the e-waste and plastic waste rules, integrated infrastructure development at the state level should take into account the synergies across these different waste streams. Forward-looking businesses that wish to develop infrastructure and that combines several waste streams should not be discouraged by the SPCBs.

There needs to be specific guidelines in place for ASR. As infrastructure for handling ELVs develops, the SPCBs would have to face the challenges due to open dumping of ASR. The concerned private operator should arrive at landfilling costs of ASR and the quantum of ASR for disposal should be guided by recyclability and recoverability potential as identified in AIS 129. Reporting guidelines on ASR management need to be put in place for the formal sector dismantlers and the same should be slowly disseminated to the semi-formal sector as well.

6.4. Manufacturers

Manufacturers should ensure that voluntary standards of AIS 129 are adopted and designs of vehicles conform to the standards set for material recoverability and recyclability. It is also important to ensure that self-enforcement of these guidelines takes place and a shared responsibility framework is developed including viable business models for cooperation with the semi-formal sector.

Manufacturers would be the key actor responsible for the functioning of a ‘Shared Responsibility’ model outlined in sections above. By taking up their key function in the shared responsibility model, the manufacturers would not only fulfil their environmental responsibility but would also be able to take advantage of the business opportunities and recovery potential emerging from the handling of ELVs.

7. Way forward

ELVs are fast emerging as an environmental challenge in India. Taking cognizance of the evolving dynamics of the Indian market conditions and drawing lessons from international experiences, these guidelines examine the key issues in relation to setting up an Environmentally Sound Management (ESM) System of ELV in India. In this chapter, we outline the critical elements of a way forward (depicted in the figure below).

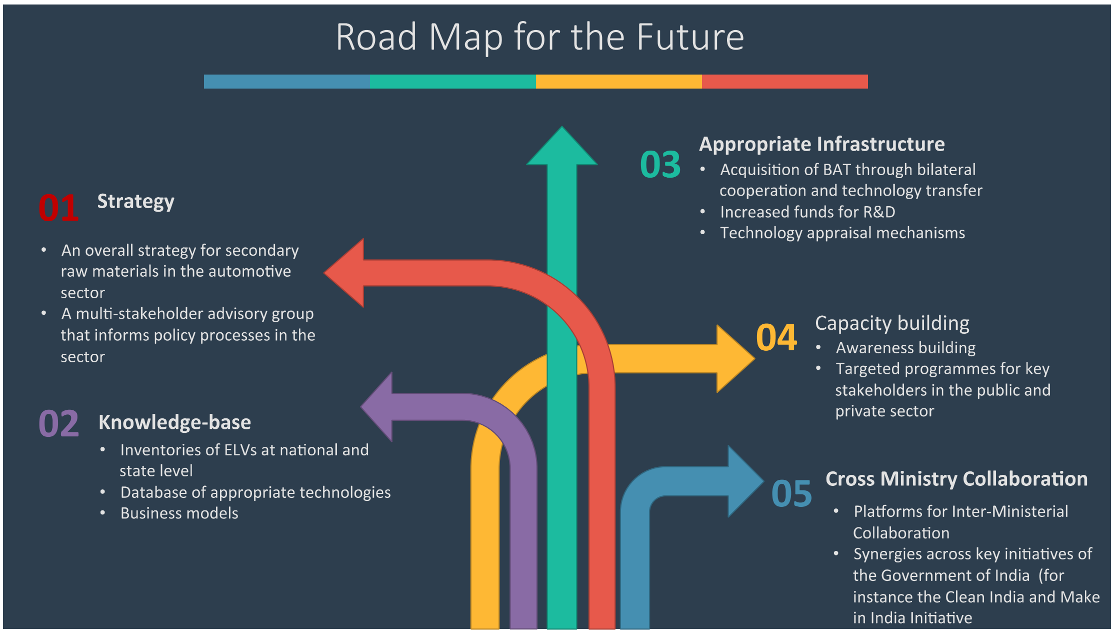

Figure 10: Elements of a ELV Roadmap for India

7.1. Strategy

The first crucial element of the way forward is developing an overarching strategic framework for the environmentally sound management of ELVs in India. Although, several Ministries as well as the automobile Industry are undertaking initiatives in this sector, an overarching strategy for the management of secondary raw materials in the automotive sector is still not available. Given the rapidly expanding nature of this sector and the increasing obsolescence rates, it is critical to develop a strategy that promotes closed loop manufacturing processes that makes maximal use of resources embedded in ELVs in an environmentally sound manner. Such a strategic framework would provide orientation to both industry and policymakers about the impact of raw material demand on the environment. Further, such a framework would propose options for minimizing this impact on the environment including the potential use of resources embedded in ELVs. The Ministry of Environment, Forests and Climate Change may develop this framework in consultation with all the other concerned Ministries.

A key contributor to developing such strategic orientation would be through the constitution of a multi-stakeholder advisory group that informs policy processes in the sector. Such a multi-stakeholder advisory group would bring together the diverse perspectives that influence and, in turn, are affected by policy decisions. The key role of such a multi-stakeholder group would be to provide evidence-based support to the policy formulation process. Further, this group would also provide a platform for the convergence of the diverse perspectives that, in the absence of such a platform, have the potential to drive policy processes in several directions. The Central Pollution Control Board (CPCB) may establish this multi-stakeholder advisory group with representation from the concerned Ministries as well as relevant stakeholder groups.

7.2. Knowledge-base

The development of an environmentally sound management system on ELVs would depend on regular information flows as well as an updated knowledge base that provides information to all the concerned stakeholders. For instance, the development of appropriate infrastructure would depend on the availability of data on the quantity of ELVs being generated in India. Similarly, industries desirous of setting up infrastructure for the management of ELVs would benefit from the availability of information on appropriate technologies. Further, given the complex nature of ELV management in the country, with a significant proportion being managed in the semi-formal sector, it is critical to document and propose innovative business models on to ensure controlled and regulated material flows.

To develop an overview of the quantities of secondary resource available, quantification of ELVs should be done on a regional as well as national basis. The CPCB, along with GIZ, and SIAM have developed preliminary figures independently on the amount of waste due to ELVs. These numbers should be updated in an on-going manner. The CPCB (in collaboration with the SPCBs), Ministry of Heavy Industries and the Ministry of Road Transport and Highways, in collaboration with industry associations like SIAM, ACMA should develop a process through which the quantifications studies of ELVs can be accomplished on an annual basis.

A compendium of best available technologies in the ELV recycling sector should be prepared regularly in order to guide the development of appropriate infrastructure for the environmentally sound management of ELVs. Such a compendium may be prepared by CPCB every five years to document the evolution of the technologies in this sector.

As noted above, a majority of ELVs are currently handled by the semi-formal sector in India. In order to channelize the ELVs to a regulated channel, innovative business models would have to be developed bridging the divide between the semi-formal and formal sector. Such business models would be based on international as well as national experiences on ELVs as well as other sectors. Consultants commissioned by the Government or the private sector, under the guidance of the multi-stakeholder advisory group proposed above, could prepare such a compendium of business models.

7.3. Appropriate Infrastructure

With the rising quantities of ELVs, appropriate infrastructure would have to be developed to ensure that there are sufficient capacities to handle them in an environmentally sound manner. The infrastructure may be developed by the private sector or through a Public-Private Partnership (PPP) mode. Given the experiences of setting up an ELV recycling plant, the Ministry of Heavy Industries and Public Enterprises should take the lead in promoting the development of such infrastructure in partnership with the private sector.

There should be an increased allocation of resources for Research and Development (R&D) in this sector with funds allocated by all the concerned Ministries. The Ministry of Heavy Industries and Public Enterprises may support R&D in infrastructure. The Ministry of Environment, Forests and Climate Change may support R&D in resource efficient and climate friendly technologies for secondary material utilisation. The Ministry of Road Transport and Highways may support R&D in developing technologically advanced roadworthiness testing infrastructure.

The CPCB and Ministry of Heavy Industries and Public Enterprises should also set up of a technology appraisal mechanism to evaluate the proposals of the prospective dismantlers and recyclers. Most of the infrastructure set up would be subject to the oversight of the State Pollution Control Boards. In order to strengthen the evaluation of these proposals, a technology appraisal mechanism should be established so that the setting up of infrastructure is not delayed due to the constrained capacities of the SPCBs.

7.4. Capacity Building

A capacity building strategy should be developed for the environmentally sound management of ELVs in India. Such a strategy should be developed by analysing the critical capacity gaps and would involve cooperation across the different Ministries. The Training Institutes and Centres of Excellence associated with the line Ministries could develop the capacity building strategy.

In line with the developed capacity development strategy, training and awareness programmes should be conducted to enhance the understanding of the involved stakeholders on the challenges and opportunities presented by ELVs. The trainings should be developed on both technical and non-technical topics depending on the needs of the target groups. The line Ministries should allocate funds and certain programmes may be conducted in partnership with the private sector.

The OEMs and producers, through the Industry Associations like SIAM and ACMA, should generate awareness amongst consumers on the need for environmentally sound management of ELVs.

7.5. Cross-Ministry Collaboration

The challenges posed by the rising quantities of ELVs cannot be solved through the efforts of any single Ministry. It would require collaboration amongst the concerned Ministries. These guidelines have on several occasions referred to the role played by the different Ministries to ensure environmentally sound management of ELVs.

An Inter-Ministerial Working Group should be constituted to ensure that such collaboration between the concerned Ministries is institutionalised. This working group would also be able to contribute to all the different elements of the way forward outlined above; namely Strategy, Knowledgebase, Appropriate Infrastructure as well as Capacity Building. The Working Group would also provide a platform for discussions on synergising resource allocations by the different Ministries for the environmentally sound management of ELVs. [2]

[2] The MoEF&CC has already conducted one such Inter-Ministerial meeting inviting the relevant Ministries to deliberate on the policy framework for India with a decision to develop appropriate legal and policy instruments for India.

8. Glossary

“**acceptance facility”** means any business or business division accepting end-of-life vehicles for the purpose of making them available or forwarding them to dismantling facilities, without being a dismantling facility themselves; (BMUB 2002)

“collection facility” means any acceptance facility through which the manufacturer, or a third party contracted by the manufacturer, take end-of-life vehicles back; (BMUB 2002)

“compacting” means any measure aimed at reducing volume, through which the properties of the stripped vehicle are changed, e.g. by crashing the vehicle’s roof, crushing the vehicle or cutting it up; (BMUB 2002)

“decontamination” means the process removal of any contaminants or cleansing an object or substance to remove contaminants such as hazardous substances, microorganisms, including chemicals from equipments, tools or sites to the extent necessary to prevent any adverse effects on environment and health (Wikipedia 2015)

“drainage” means the removal of any operating fluids; (BMUB 2002)

“disposal” means any of the applicable processes set forth in Annex II A of the German Recycling and Waste Management Act; (BMUB 2002)

"end-of-life vehicle” means vehicles which are waste according to the German Recycling and Waste Management Act; (BMUB 2002)

“hazardous substance” means any substance which is considered dangerous under § 3a of the German Chemicals Act; (BMUB 2002)

“hazardous waste” means a waste gas, liquid, or solid as defined by the Hazardous Waste Regulation. Tires and windshield washer fluid are wastes as listed above but are not classified as hazardous wastes in accordance with the HWR. Vehicle dismantlers must take special attention to hazardous wastes as there are additional registration, storage and transportation requirements; (British Columbia Ministry of Environment 2008)

“hulk” means a wet vehicle that has been deregistered (Vehicle Identification Number has been submitted to the Motor Vehicle Branch) and the wastes have been removed in accordance with the requirements of the Environmental Management Act; (British Columbia Ministry of Environment 2008)

“manufacturer” means the manufacturer of vehicles according to the registration book, or the commercial importer of a vehicle and the manufacturer or the commercial importer of vehicle parts and materials, as well as their successors; (BMUB 2002)

“prevention” means any measure aimed at reducing the amount and the environmental harmfulness of end-of-life vehicles, their materials and substances; (BMUB 2002)

“pre-treatment” means to remove and to render harmless any hazardous components as well as to drain any fluids; (BMUB 2002)

‘**recovery**’ means any of the applicable operations provided for in Annex IIB to Directive 75/442/EEC (European Parliament and Council of the EU 2000)

“**reuse**” means any operation by which components of end-of life vehicles are used for the same purpose for which they were conceived (European Parliament and Council of the EU 2000)

“**recycling**” means the reprocessing in a production process of the waste materials for the original purpose or for other purposes but excluding energy recovery (European Parliament and Council of the EU 2000)

“treatment” means any activity performed after the transfer of the end-of-life vehicle to a dismantling facility or of the stripped vehicle to a shredding facility or another facility for the purpose of depollution, dismantling, shredding, recycling or preparation for disposal of the shredder wastes, and any other activities carried out in connection with the recycling and/or disposal of end-of-life vehicles and their components. (BMUB 2002)

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10. Annex A

11. Annex B