Draft

CIRCULAR ECONOMY IN ELECTRONICS AND ELECTRICAL SECTOR

Policy Paper

Ministry of Electronics and Information Technology
Government of India
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Executive Summary

Circular economy (CE) is an industrial system, which is an alternative to highly extractive and resource-intensive linear economy principle of take-make-dispose. CE replaces the end-of-life concept with restoration and regeneration, shifts towards usage of superior design of materials, products, systems and business models for waste elimination. CE aims at retaining value of resources, products and materials at their highest by keeping them in use as long as possible, minimizing wastage at each life-cycle stage, and extracting the maximum value through reusing, repairing, recovering, remanufacturing and regenerating products and materials at the end of each service value.

India is the third largest consumers of raw materials produced globally and estimated to consume nearly 15 billion tonnes of material by 2030 with the current economic trends. Electronic and Electrical Equipments (EEE) manufacturing is dependent on high material consumption with metals like Iron, copper, silver, gold, aluminum, manganese, chromium and zinc along with various rare earth elements. Rate of extraction of these abiotic resources for EEE manufacturing is significantly higher than the rate of their formation in nature. CE approach will thus be imperative to fulfill the resource needs for the country.

EEE waste is considered as one of the rich sources of secondary raw materials and can contribute towards resource security and environmental sustainability. India is the third most electronic waste (e-waste) generated country (with 3.2 million tonnes in 2019), however, only 10 per cent of the waste is collected for recycling. The collection and management of EEE waste remain a key challenge. This necessitates the shift to a more circular approach for the sector.

Existing regulations and policy can act as an important tool for CE transition. Extended Producer Responsibility (EPR) under the E-Waste Management Rules, 2016 rests on circularity principles by ensuring producers responsible for cradle to cradle management of the products. Enhancing circularity and resource efficiency make business sense for manufacturers and hence provides incentives for eco-design, modular structures in products to reduce fast obsolescence of products and resources, enhance recycling and recovery of secondary resources can be used in production processes to bring down costs, which makes producers competitive.

India can tackle systemic challenges which can lead to integration of circularity principles in design, manufacturing, consumption and finally end of life management of products wherein it can ensure recovery and utilization of secondary raw materials, circular products with longer use-life, quality assurance for repair and refurbished products, investment in its labor force and advanced recycling technology to mine secondary materials from e-waste, enabling circular growth in electronic production and hence resulting in enriched livelihood, enhanced quality of life and sustainable access to resources.

NITI Aayog thus entrusted the MeitY to formulate action plan for implementation of circular economy principles in the e-waste sector. This will focus on lifecycle of electronics including stages of raw material acquisition, design, manufacturing/production stage, consumption to end of life (e-waste) management, and secondary raw materials utilization.

Contents

1 INTRODUCTION

Circular economy (CE) is an industrial system that is restorative or regenerative by intention and design. It replaces the end-of-life concept with restoration and regeneration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems, and business models. It serves as an alternative to current model of highly extractive and resource-intensive linear economy, and aims at maintaining and retaining value of resources, products and materials at their highest by keeping them in use as long as possible. It also aims at minimizing wastage at each life-cycle stage, and extracting the maximum value through reusing, repairing, recovering, remanufacturing and regenerating products and materials at the end of each service value.

A transition towards CE will serve to reduce dependency on virgin materials and enhance resource productivity. As India recovers from the COVID-19 impacts especially on society and economy, selfreliance or Atmanirbhar Bharat becomes crucial to address these challenges and recover back through sustainable growth models. The Indian recovery strategies need to sustainably promote conditions to rebuild for people, environment, and economy. This would necessitate increased investment in skills, sectors, products, business models, processes, digitalization and technologies that can create long term prosperity for humankind and a healthy planet.

The National Policy on Electronics (NPE) 2019 envisions to position India as a global hub for Electronics System Design and Manufacturing (ESDM) by encouraging and driving capabilities in the country for developing core components, including chipsets, and creating an enabling environment for the industry to compete globally [Ministry of Electronics & Information Technology (MeitY) 2019]. To address this vision of 'Make in India', MeitY launched a 'Product Linked Incentive Scheme (PLI) to boost large scale financial incentives in domestic manufacturing of electronic components and semiconductor packaging. This policy package was launched at a suitable time when countries and companies are strengthening and reengineering the electronics value chain and production.

As per the report from the Ministry of Commerce and Industry[1] mobile manufacturers shortlisted under a production linked incentive scheme invested ₹1,300 crores and produced goods worth around ₹35,000 crore in December 2020 and additional employment generation during this period, stands at around 22,000 jobs. This scheme provides a big push to move towards sustainable product policy for the products developed in India to address the global markets towards sustainability and green manufacturing[1]. The domestic electronics manufacturing sector in India has seen significant growth in the last six years. Production of electronic goods in India increased by 187 percent from Rs 1,90,366 crore in 2014-15 to an estimated Rs 5,46,550 crore in 2019-20, with a compound annual growth rate (CAGR) of about 24 percent, according to the MeitY's annual report 2019-20.

[1] Mobile makers invest ₹1,300 crore under PLI Scheme in 2020 Dec qtr: Govt | HT Tech (hindustantimes.com)

Globally, by 2050, the rate of consumption of resources would be three times higher than the rate at which earth can replenish. Global consumption of materials such as biomass, fossil fuels, metals and minerals are expected to double by 2060, while annual waste generation is projected to increase by 70% by 2050. Notably, the current modes of production, consumption and waste-generation linked to products are responsible for pollution and for around 40% of global greenhouse gas emissions (EU 2020). For instance, manufacture a tonne of laptops, potentially leads to 10 tonnes of CO_2 are emitted. When the carbon dioxide released over a device's lifetime is considered, production stage is the most crucial which makes resource efficient production and inputs at the manufacturing stage (such as use recycled raw materials) and product lifetime, as key determinants of overall environmental impact[2].

Cognisant of the resource and environmental challenges facing the word, in 2015, the United Nations General Assembly set up the Sustainable Development Goals (SDGs) for achieving a better and more sustainable future for all by the year 2030. India is also a signatory to the SDG goals. Some of the SDGs including SDG 12: Responsible Consumption and Production, SDG 11: Sustainable Cities and Communities, and SDG 9: Industry, Innovation and Infrastructure are promoting the circular economy. A large number of businesses, including many electronic manufacturers like Dell, Samsung and HP etc. have announced their specific response plan and strategies for aligning with specific SDGs.

India is the third largest consumers of raw materials produced globally. If current economic trends persist then India's material requirements are projected to be nearly 15 billion tonnes by 2030 and little above 25 billion tonnes by 2050. For India to fulfill its resource needs, it is imperative that we follow circular economy approach rather than the current linear economy principle of take-make-dispose.

Electronic and Electrical Equipments (EEE) manufacturing itself is dependent on high material consumption and uses metals like Iron, Copper, Silver, Gold, Aluminum, Manganese, Chromium and Zinc along with many rare earth elements. The rate of extraction of these abiotic resources for manufacturing in EEE and other sectors is significantly higher than the rate of their formation in nature. Electronic and Electrical waste, collection and management of which remains a key challenge, is one of the rich sources of secondary raw materials and can contribute towards resource security and environmental sustainability. This necessitates the shift to a more circular approach for the sector.

Electronics waste (e-waste) is a global challenge and India is also facing the problem due to rapid use and fast disposal of the electronic gadgets and lack of safe disposal facilities. According to the Global E-Waste Monitor 2020, the world generated a striking 53.6 Mt of e-waste, an average of 7.3 kg per capita in 2019. The growing amount of e-waste is directly linked to higher consumption rates of EEE, short product life-cycles, rapid technological advancement and few repair options. Asia generated the highest quantity of e-waste in 2019 at 24.9 Mt, followed by the Americas (13.1 Mt) and Europe (12 Mt), while Africa and Oceania generated 2.9 Mt and 0.7 Mt, respectively.

As per Global E-Waste Monitor 2020 report, India generated 3.2 million tonnes of e-waste in 2019, ranking third after China (10.1 million tonnes) and the United States (6.9 million tonnes). India collected just 10 per cent of the electronic waste (e-waste) estimated to have been generated in the country 2018-19 and 3.5 per cent of that generated in 2017-18, said a recent report by the Central Pollution

[2]Minter Adam, "How We Think about E-Waste Is in Need of Repair," Anthropocene, October 2016, www.anthropocenemagazine.org/ewaste-repair

Control Board (India collected just 3% e-waste generated in 2018, 10% in 2019: CPCB report[1](downtoearth.org.in). There is a significant gap between e-waste generation and collection for recycling, which needs to be assessed to make resource efficiency effective in India. The reverse logistics supply chain needs to be designed through the value of raw materials in the e-waste, made economically viable through designed economic instruments.

A circular economy approach to management of e-waste will play an important role in resource efficiency, reduction in pollution and waste, longer product-life, recovery of precious and rare materials, minimization of occupational and health hazards as well as in giving an impetus to the evolution of recycling industry, thereby leading to formalization and job creation. To achieve the same, CE approach will also necessitate that changes relating to eco-design (like RoHS) and sustainable manufacturing of EEE, development of CE business models, sustainable consumption through reduction in volume of e-waste generation, resource recovery through mining of precious resources and enhanced use of secondary resources. Lastly, a mix of innovative approaches will be needed to shift towards CE including use of digital tools and platforms for ensuring transparency, urban mining, marketplace for secondary resources and connecting the stakeholders across the value chain.

To expedite the focus on Circular Economy and ensure transition of electronics products in India to sustainable models, as per direction of NITI Aayog, the MeitY is formulating an action plan for implementation of circular economy principles in the sector. This will focus on lifecycle of electronics including stages of raw material acquisition, design, manufacturing/production stage, consumption, to end of life (e-waste) management, and secondary raw materials utilization.

From a resource access and security perspective for the sector, it is instructive to note that while India has abundance of iron ore and bauxite, it remains import dependent on many essential materials for production of EEE products including copper, nickel, cobalt and many other rare earths. Given the green-fencing policies adopted by many electronics producing and material exporting economies, particularly in Asia, a CE approach becomes more significant for the growth of the domestic electronics manufacturing sector. Notably, while India faces considerable challenges in terms of managing e-waste, the resource potential of secondary materials in end-of-life electrical and electronic products holds enormous potential for India. Precious metals, steel, aluminum, copper, and plastics make end of life electronics valuable from the potential of secondary materials. Harnessing these resources in a transition from linear to circular economy will be key to growth for the EEE sector.

India has the benefit of a huge labor force that can be leveraged on the front-end in terms of manual disassembly of e-waste, that could be coupled with investments in advanced recycling technology in line with circularity principles leading to resource efficiency in this sector. Lastly, transition to circular electronics sector would generate better outcomes for the Indian producers, consumers, society and environment at large.

In summary, if India can tackle systemic challenges which can lead to integration of circularity principles in design, manufacturing, consumption and then end of life management of products wherein it can ensure recovery and utilization of secondary raw materials, circular products with longer use-life, quality assurance for repair and refurbished products, investment in its labor force and advanced recycling technology to mine secondary materials from e-waste, enabling circular growth in electronic production and ultimately resulting in enriched livelihood, enhanced quality of life and sustainable access to resources.

There are existing regulations and policy which can act as an important tool for this transition. One such tool is the Extended Producer Responsibility (EPR) which is the cornerstone of the E-Waste Management Rules, 2016 introduced by the Ministry of Environment Forests & Climate Change (MoEFCC) for responsible collection, channelization, recycling and management of e-waste. It also rests on circularity principles which makes producers responsible for cradle-to-cradle management of the products that they put in market, and has the potential to trigger positive upstream changes. Enhancing circularity and resource efficiency makes business sense for manufacturers and hence provides incentives for eco-design, modular structures in products to reduce fast obsolescence of products and resources, enhance recycling and recovery of higher amount of secondary resources can be used in production processes to bring down costs. That makes producers competitive and also leads to financing EPR costs without a significant impact on the bottom-line.

1.1 OBJECTIVES

The objective of this report is to address material and resource security especially to address Atma Nirbhar Bharat (self-reliance) programme of the Government of India and to create a conducive framework for stakeholders to support sustainable transition of the economic, environmental and social paradigms wherein linear models of production and consumption are replaced with circular economy processes and models. This action plan will support creation of a sustainable product policy initiative for India where Indian industry is supported to embrace Circular Economy approaches focussing on material acquisition, design &production, consumption, end-of-life management, recovery and re-utilisation of secondary raw materials. The action plan also supports in enabling a framework to support the draft Resource Efficiency (RE) policy (MoEFCC, 2019) through digitalization, promotion of standards across the value chain, green public procurement, repair, refurbishing and remanufacturing, technology roll out through blended financing, skills and awareness creation, eco-design, technology enabled recycling for maximum resource extraction, etc.

The Action Plan on Circular Economy in EEE Sector aspires to postulate the tenets of 'Make in India' and 'AtmaNirbhar Bharat' that advocate self-reliance by maximizing resource efficiency and minimizing the consumption of finite resources. It will also provide the impetus to the emergence of new business models and entrepreneurial ventures to promote circularity, and open avenues for job creation.

MeitY has earlier as well taken steps in this direction. In 2019, MeitY and NITI Aayog had published the Strategy on Resource Efficiency in the Electronics and Electrical Equipments Sector including an Action Plan[3]. The recommendations of the Strategy on RE for EEE Sector and its Action Plan remain relevant today and may be considered for integration as a part of this strategy and action plan. MeitY has also supported development of recycling technologies, awareness programmes to enhance outreach and advocacy around environmental hazards of e-waste and research on rare earths extraction for secondary uses, etc. It may be noted that the design stage is responsible for determining nearly 80 percent of the products environmental impacts, therefore, by providing necessary vision and guidance, MeitY can play a crucial and important role in promoting a holistic approach on circular economy in the EEE sector.

[3] https://www.eu-rei.com/pdf/publication/NA_MeitY_RE Strategy in EEE Sector_Jan 2019.pdf

1.2 CIRCULAR ECONOMY OPPORTUNITY

'Strategy on Resource Efficiency in Electrical and Electronic Equipment Sector' (NITI Aayog and MeitY, 2019) noted that the ICT sector offers great opportunity for sustainable development, and the secondary materials management through recovery and utilisation in ICT manufacturing. It has the potential for enhancing resource security, abatement of loss of precious and rare minerals, addressing pollution, enhancing livelihood opportunities, and mitigating environmental degradation. Furthermore, adoption of standardised approaches to manufacturing through ecological-friendly and modular design promotes circularity which enhances the ability to extract secondary resources so that they can be channelised back into the production processes.

1.2.1 Economic Opportunity

Circular Economy in the EEE sector has the potential for creating significant economic impact. EEE manufacturing requires varied and complex materials and is resource dependent. In order to ensure that production processes do not get affected due to scarcity of raw material flow, producers have to be continuously on the lookout for sources which they can depend on. Shrinking rate of supply of resources has the potential to disrupt current production processes which can cause chaos in economic systems and value-chains across the world, and affect jobs and livelihoods. Urban mining from e-waste provides that opportunity to producers for ensuring access to materials at a far lower cost and on a continuous basis. The movement towards a circular and resource efficient design than the traditional linear model of produce, use and dispose has the scope of business savings for businesses.

1.2.1.1 Critical Materials for Manufacturing

The FICCI Circular Economy Report, 2017 outlined that the business opportunity for extracting gold from e-waste is to the tune of $0.7 - $1 billion. Furthermore, 1 ton of ore has an extractable reserve of about 1.4 gms of gold while a ton of mobile phone PCBs can produce about 1.5 kgs. Global E-waste Monitor 2020 estimates that in 2019 as only 17.4 % of e-waste was collected and recycled leading to loss of nearly $47 billion in recoverable materials including gold, silver, copper, platinum and other high value materials.

Thus, critical materials including rare earth elements needed for manufacturing of EEE products, solar panels, electric vehicles, and many high-techs defence equipment when mined from the e-waste offers great opportunity for securing availability of these resources in future.

In India, lack of domestic reserves and supply of rare earth elements, makes circular economy even more important for a large and growing country like India, where a CE approach provides an opportunity to enhance resource availability for domestic manufacturing.

1.2.1.2 Jobs

CE approach in EEE Sector has potential to create jobs at each stage of the life-cycle of the product. As CE approach fosters greater security of resources domestically, it can enable greater production leading to provision of skilled jobs in the sector. Furthermore, in order to include CE measures at each stage of the product life-cycle and value chain, CE skilled professionals and experts would be needed. It will also promote innovation and research infrastructure in the sector. While, repair, refurbishment and recycling activities are already undertaken in India, a CE action plan and associated measures towards supporting these activities has the potential to create more jobs.

It must be noted that the currently informal sector in India is the backbone of recycling and resource recovery. However, owing to lack of economic capital and access to technology, the ways and means employed are often archaic in nature leading to low yield of resource recovered and creation of waste. Most of the times, the methods employed are risky, unscientific and hazardous to human health and environment. The problem is further accentuated with lack of capacity development for this sector which leads to lower levels of resource efficiency in the recycling of waste and recovery of secondary raw materials. It is widely seen and researched that access to material for the informal sector is much easier because of the widespread network. Over the years, connections between informal actors in different cities has been established which is well documented in several studies as well (Mehra 1985)[4].

The PROs/ Recyclers may formally engage the informal waste pickers (Kabadiwala) with mutually accepted financial model. The Aadhar number of the person may be used to create unique identify attached with the PROs/ Recyclers. The ULBs should facilitate any assistance required for this integration. The PROs/ Recyclers along with ULBs should undertake capacity building and skill development for the informal waste pickers so that they can operate safe and healthy condition. This will enhance resource efficiency of the collected wastes by the informal waste pickers and better economic benefit[5].

Greater investment in the environment friendly waste-recycling technologies can develop the domestic recycling industry with blended financing options. It will encourage innovation and creation of business models and offer opportunity for integration of informal sector. In this regard, measures towards awareness generation, capacity building, provision of access to safe technology that enhance recovery will be key.

1.2.2 Environmental Benefits

Environmental benefits of longer lasting products will lead to reduced volume of waste generated, and enhanced resource recovery from e-waste will reduce extraction pressures especially for the rare earth elements that are predominantly found in bio-diversity rich areas. Reduced pressures from mining have the potential to provide further opportunities for undertaking landscape restoration and regeneration of degraded mined areas. Environment friendly recycling technologies will prevent pollution emanating from existing crude methods of recycling as well from landfilling of the e-waste. Also, sustainable and circular products would not only lead to reduced waste generation and pollution associated with disposal but also save related costs. Responsible and circular resource use can also contribute towards reduction of GHG emissions and help meet the climate change commitments.

1.2.3 Social Benefits

Reduced extraction pressures due to adoption of CE measures have the potential to reduce conflict and displacement in mining areas, as well as improve health and welfare of local communities. The enhanced job and livelihood opportunities in EEE sector through CE measures will contribute to overall

[4] Mehta, Meera (1985). Urban Informal Sector: Concepts, Indian Evidence and Policy Implications. *Economic and Political Weekly,* Vol. 20:8.

[5] https://www.adelphi.de/en/system/files/mediathek/bilder/giz2018-en-e-waste-partnerships-india.pdf

poverty reduction. Recovery of resources and domestic manufacturing can further enhance access of such products to greater number of people.

CE approaches that tackle 'planned obsolescence', longer-life of products and enhanced reparability also contribute to better consumer experience. Though, the manufacturers may not formally have a policy on 'planned obsolescence', they typically have policies on repair, return, software and hardware upgrades and compatibility etc. This leads to consumers having to necessarily change their electrical and electronic equipments due to short-product life cycles and constant upgrades in software that render devices obsolete. Furthermore, non-availability of spare parts and/or expensive costs associated with repairing forces consumers to spend their disposable income on buying new products. Given the current level of integration and digitalisation of the world, access to better longer-lasting products for all sections of society is important.

The refurbished market will further grow if 'planned obsolescence' can be minimised with CE approach. Informal waste pickers along with repairing technicians can develop more market place in tier II and tier III cities for quality refurbished products. This will help in earning higher wages for informal operators and better livelihoods. The ULBs may formalise the informal waste pickers (Kabadiwala) and independent repairing technicians for promoting such economic activity in the society.

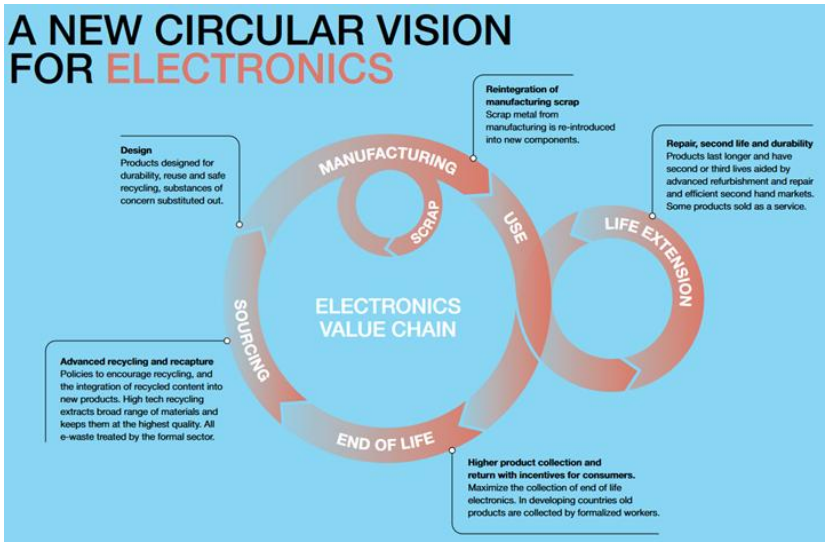
Achieving economic growth and sustainable development requires to reduce the present ecological footprint by changing the production and consumption pattern of goods and resources. Efficient management of shared natural resources, and disposal of toxic waste and pollutants, is important targets to achieve this goal. Encouraging industries, businesses and consumers to recycle and reduce waste is equally important, as is moving towards more sustainable patterns of consumption.

A large global population is still consuming far too little to meet even their basic needs. Reducing the per capita of global waste at manufacturing and consumer levels is also important for creating more efficient production and sustainable supply chains. CE products will be able to tackle such wasteful resource use and consumption patterns. Finally, CE measures can contribute towards preserving resources for future generations.

1.3 What does Circular Economy in Electronics sector entail?

Electronics and Electrical Equipment sector in India and globally is set up in a linear fashion where product related externalities are not internalised due to the take-make-dispose model. The net zero transformation of the sector requires a low carbon footprint designed product with longer-life, higher repairability, reduced toxicants, higher material efficiency, and better recovery.

For a circular business models, government policies and business action need to support circular economy through mobilizing the potential of digitalization of products and value chains through digital product passports, ecodesign, increased product lifespan, tackling planned obsolescence, higher repairability, recycling quotas and achieving higher recycling rates, and better recovery & value of resources. Enabling circular economy in e-waste entails a paradigm shift to focus on a change as a policy package for the electronics and electrical sector.



Raw material security: addressing sustainable product package/ policy wherein material sourcing can look at addressing reducing GHG emissions, foot-print and reduced pollution.

Better product design: The existing e-waste rules focus mainly on the collection and recycling system while a circular economy approach focuses more on better product design, RoHS compliance and raw material security. Both approaches viz. circular economy and EPR framework complement each other, and as such EPR can serve as an important tool for driving upstream changes. The companies will thus need to design products which with longer product life and are easier to recycle. This may mean multiple things e.g limiting use of multiple types of materials for product creation, eliminating toxicity or any materials of concern, enabling ease of dismantling; decreased product obsolescence and restricting single use.

Collection Systems: Creating systems which can result into large scale participation by the people. Systems that bring ease of participation and ensure no leakages of the collected e-waste to the informal sector for recycling.

Recycling Systems: Creating systems that enable recycling/dismantling not far from the source of generation, ensure full traceability of materials, recovery of critical materials; ecosystem of secondary material buyers; harmonized tax structures; strong enforcement and publicly available datasets

Secondary Materials Usage: Setting up norms for use of recycled material for new products; Incentives for procurement of products with high recycled content; mandating traceability on utilization of secondary materials; financial incentives/tax breaks for use of secondary materials.

2 POLICY TOOLS& BEST PRACTICES FOR ENABLING CIRCULAR ECONOMY IN EEE SECTOR

Over time, governments across the world have emphasized the need to adopt the circular economy model for a safe and healthy environment, based on the learnings gained from the implementation of the policies and regulations.

The European Commission's Circular Economy Action Plan includes legislative and non-legislative measures along the entire life cycle of products promoting circular economy processes, fostering sustainable consumption, and ensuring that the resources used are kept in use in the EU economy for as long as possible.

The Government of India has identified the need for, and opportunities offered by, a shift to a circular economy. NITI Aayog has published several strategy papers on broader policy direction that can be implemented by the government to mainstream a resource efficient and circular Indian economy.[6]As mentioned above Ministry of Electronics and Information Technology specifically released a Strategy on Resource Efficiency in Electrical and Electronic Equipment Sector.[7] It has also adopted a

The e-waste in India is regulated through E-Waste (Management) Rules, 2016, notified by Ministry of Environment and Forest & Climate Change (MoEF&CC) on 1st October 2016. These rules have been superseded the earlier version, E-waste (Management and Handling) Rules, 2011, effected since 1st May 2012. The present Rule introduced Producer Responsibility Organisation (PRO), deposit-refund system (DRS), e-waste exchange, etc. for convenience of the manufacturers. The target based Extended Producers Responsibility (EPR) is another important measure introduced in the Rules for streamlining waste collection in formal channel. E-waste (Management and Handling) Rules, 2011(henceforth referred to as 'Rules 2011') and the E-waste (Management) Rules, 2016 (henceforth referred to as 'Rules 2016') there has been a growing change in perception of e-waste in the waste recycling market in India.

The Rules 2016 enacted since 1st October 2016 have considered 21 products under its ambit along with their components and spare parts. This rule recognized stakeholders as manufacturer, producer, dealers, refurbishers, consumers or bulk consumers, dismantlers, and recyclers except informal sectors. A target-based EPR and liability clause with financial penalties has started showing positive results on formalising waste collection in the country. However, dominance of informal sector could not be restrained and formal sector is facing stiff competition from them in terms of economy and facing acute shortage of input feedstock. PRO collected e-waste is also facing the challenge to dispose of the products due to shortage of recycling facility.

However, on record the situation is different. During 2018-2019, the total recycling facilities were 312 with a total capacity of 7.8 lacs MT and the recycling facilities have been enhanced to 407 in 2019-2020 with a capacity of 11.10 lacs MT. Majority of recyclers are not even processing 50% of their licensed

[6]The Strategy Paper on Resource Efficiency outlines the context and relevance of the circular economy in India, its potential to contribute to India's international commitments under the Paris Climate Change Agreement and its congruence with flagship government programmes such as Swachh Bharat, Make in India and Digital India missions.

[7] Resource Efficiency in the Electrical and Electronic Equipment Sector. MeitY

capacities in last few years. There is a major challenge of leakages of the collected waste to formal recycling facilities due to various reasons and, therefore, a significant quantity of the generated e-waste is still being processed by informal sector. The rationalization of pricing of waste is a major issue to be addressed by the stakeholders (especially PROs and recyclers) to support formal recycling facilities. Another major source of leakages is the auction of e-waste by the bulk consumers which needs to be strictly monitored to check the existing infrastructure of the bidding agencies.

2.1 Policy Tools & Incentives

Several kinds of policy tools ranging from information-based strategies to regulatory instruments may be used to drive the adaptation of circular practices in the EEE sector. Many of these tools can be seen in the figure below.

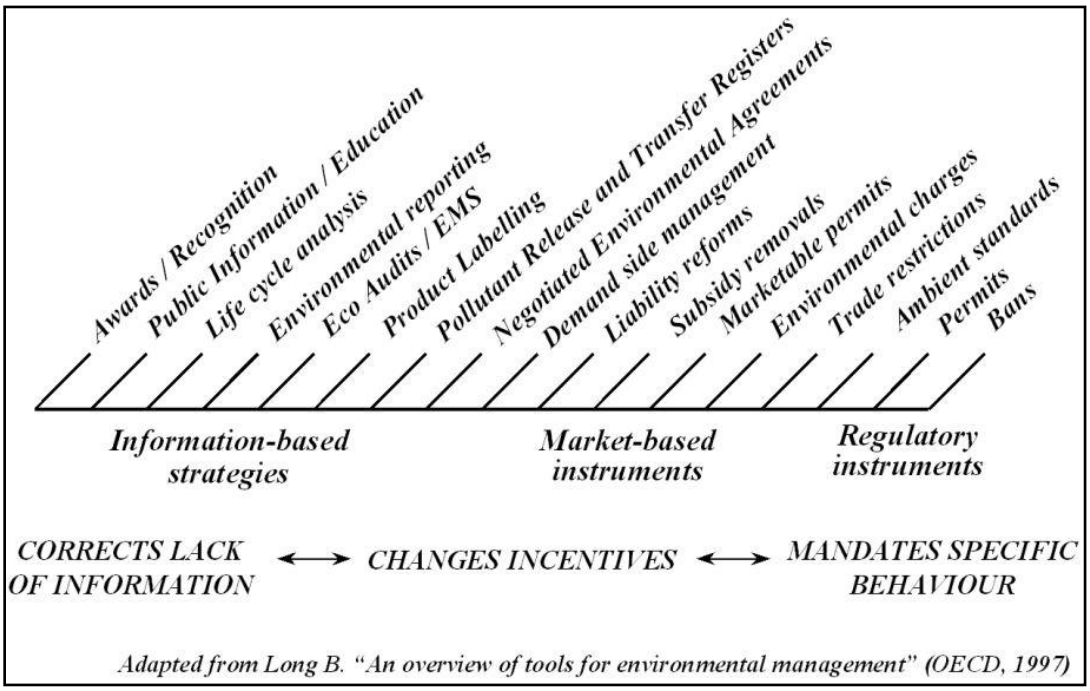


Figure: Tools and Instruments for Environmental Policy

Today there are such a variety of products available and different stakeholders involved that no one policy tool can meet all needs.

2.1.1 Information-based Strategies

(i) Voluntary Environmental Agreements

The voluntary agreements could be used when the industry front-runners are willing to take the lead and drive changes which lead to significant life-cycle environmental benefits.

(ii) Information Based Strategies to influence Stakeholders

Several kinds of information flows are needed between different actors during the life-cycle phases for improving the environmental performance of products. Information flows are needed between the

suppliers and the manufacturers, from the manufacturers to consumers, and between the manufacturers and the recyclers.

The strengthening of information-based instruments is specially supported to create consumer demand for environmentally sound products and steer their behaviour to be more sustainable.

Important elements in changing consumption patterns include awareness raising on environment and providing relevant environmental information on products to the consumers for better purchasing decisions in a way that respects their preferences, and for proper usage and disposal.

A good policy measure for consumer information for example is the BEE Energy Label for house-hold appliances. This measure has effectively shifted the consumer buying behaviour towards the purchase of more energy efficient household appliances. Lesson learnt from this approach suggests that progress can be made if relevant and timely information is provided to the consumers.

Other examples of successful eco-labels that reduce information asymmetry include organic products labeling, Fair Trade, FSC- Forest Stewardship Council etc., which are practiced in India as well. The customers need information on the relevant environmental, health and safety aspects of the product if they are to give their contribution by choosing the products with best environmental performance. This information must be easy to understand, readily available and comparable. Thus, a common and agreed way for providing environmental information is required.

2.1.2 Market based instruments

(i) Incentives for Front-Runners (Producers)

A front-runner approach should be discussed to give incentives to manufacturers for developing green products. This should have the aim to move the market to the sustainable direction. Through this approach, products with the best environmental performance on the market should be identified and their manufacturers recognised. Standards could be established on the basis of the products in market that have the best environment performance.

The manufactures should be assessed based on their CE promotion efforts such as benchmarking, incentives, awards etc. The front-runners could be treated as trusted partners by public authorities and could be invited to participate in the process of setting future policies so that their expertise is utilised. This approach should be focused and targeted on an industry sector or a product group. To initiate the front-runner approach the following actions may be needed:

- Development of transparent criteria for identifying the products with best environmental performance in the focus industry sector or product group.
- Identification/development of public benchmarks, targets and standards based on the products with best environmental performance in cooperation with the front-runners.
- Identification of award schemes/incentives for the front-runners.
- Identification of incentives for other manufacturers whose products reach the benchmarks/targets/standards established on the basis of products with best environmental performance within a certain time-period.

(ii) Green or Sustainable Public Procurement (GPP/SPP)

Preferential procurement by large organisations, public or private, is often used a tool for bolstering the market demand of socially and environmentally responsible goods and services. Governments are among the largest consumers in an economy. The Government spending is nearly 30% of the share of national GDP (https://ourworldindata.org/grapher/historical-gov-spending-gdp?country=~IND) and with further digital push due to COVID 19 pandemic compulsion, the contribution may further increase. The Government procurement policies and measures can provide crucial support towards market transformation and acceptability of circular products and services. The sustainable product procurement will motivate producers to change product design for longer life, thereby, transition to green products will begin for other consumers also.

Green or Sustainable Public Procurement is used as a policy tool to promote various social objectives in different countries including supporting vulnerable small scale industries, protecting human rights in the supply chain, improving energy efficiency, reducing environmental impact etc. GPP could have crucial benefits for the environment by stimulating the demand for greener products.

By establishing a green procurement policy, and communicating the actions taken and their results, the authorities can demonstrate that an action in this area is possible, and it leads to concrete results. Further, by promoting green procurement, public authorities indirectly give incentives to industry to develop products with superior environmental performance.

In general, some priorities for GPP include:

- It must be strongly coherent with the spirit and rules of the regulation concerning public procurement.

- The purchasing organisation must have the right to select and also weight environmental aspects according to its needs.

(iii) Incentivizing Producers/Importers/Brand Owners

A mechanism to incentivize the producer through rebate schemes for using recycled products back in the manufacturing process can be implemented. This will add the value proposition to the e-waste value chain and producers will be more inclined towards buyback schemes as it will directly get them the product, with increased value return from raw material extracted cost from the waste.

2.1.3 Regulatory instruments

(i) Coverage of e-waste categories

EU's definition on EEE products must be adopted to cover all the e-waste categories (products operating upto 1000 V DC to 1500V AC) in order to include entire products under the ambit of the Rules and to ensure recovering valuable the secondary raw materials from end-of-life products.

The categorisation of products and components in Schedule 1 of the E-waste Rules is currently not based on either the toxicity or the resource efficiency potential. For instance, even though servers, routers and switches have similar toxicity potential, only servers are included in targets for collection. Moreover, the solar panel, an important fastest growing waste stream, is not included. The recycling of

end-of-life solar panels will ensure recovery of valuable resources materials. The amendment in Schedule 1 of the E-waste Rules needs to be undertaken.

(ii) Calculation of EPR targets & average weight

EPR plans that are submitted for EPR authorisation to the CPCB require calculation of producer targets in terms of average weight of the product put on the market such that the targets for collection of e-waste can be determined. Since the onus of reporting the average weight of the product is on the producer there are chances of misreporting. For similar products, two producers could potentially report two different weights. Producer 'X' could, for instance, report the average weight for keyboard as 1 kg/piece, whereas, producer 'Y' could report it as 0.25 kg/piece hence making their targets incomparable and disproportionate. This is especially pronounced for importers who import a large variety of models under the same category thus making it very difficult to determine the average weight.

This issue could be solved under the Compulsory Registration Scheme (CRS) for Electronics and IT goods by requiring producers to declare the weight of each product when they apply for registration from Bureau of Indian Standards (BIS) after getting their product tested from BIS recognized labs. The CPCB may obtain CRS data for arriving suitable producer targets.

(iii) Expanding the stakeholders list and responsibilities

Circular economy implementation framework will impact the quantum of e-waste available due to refurbishing, repurposing, extended life etc. This framework will have interdependence between stakeholders and will also bring in new players into the chain. These players (informal collectors, aggregators, dealers, retailers, online market places, auctioning platforms, platforms for trading e-waste) need to be defined with clear responsibilities.

The existing informal sector offers opportunities for capitalizing on existing circular approaches. Policymakers need to consider how best to capture and preserve existing CE expertise and innovation in the informal sector. They will have to consider how to mitigate the risk of large-scale displacement of informal workers and put in place the right policy structures to support domestic CE practitioners and innovators. Hybrid approaches to integrate the informal sector into managed supply chains are one means of promoting basic principles of good practice in workplace safety, but robust labour standards and the promotion of decent work principles will be needed to enshrine appropriate monitoring and accountability frameworks.

The responsibilities of the stakeholders in the Rules, including 'Bulk Consumers', should be re-looked accordingly and legal actions in case of non-compliance should clearly be defined.

Targets for collection by producers need to be realistically recalibrated once the new stakeholders and their responsibilities are mapped.

(iv) Engage informal sector as stakeholder in E-waste Rules

(v) Effective Management and Monitoring of Hazardous Waste

To manage the hazardous fractions and materials of concern, there is a strong need to track the hazardous substance in each of the product categories. Depollution practices should be made a norm

and a monitoring system should be devised to track the hazardous fractions post dismantling of the product. Tracking the hazardous fractions can also be an useful tool to calculate how much e-waste has truly been recycled.

Then a backward calculation and audit should be done to measure the concerned fraction (e.g. *Form 3 and the Form 10 the quantity should be in correlation with the hazardous waste generated and a matching concept needs to be ascertained and accordingly the level of responsibility to the recycler to be mandated*).

(vi) Digital systems for submissions, reporting, analysis, sharing & transparency

- **Tracking& Evaluating the Implementation of Rules**

A centralized digital system for effective end-to-end monitoring of EPR implementation must be developed. Digitising the full process of EPR from submission of EPR application to submission of annual returns and other statutory compliances will bring in accountability and transparency in the entire E-Waste value chain. The digital system should also enable data sharing between all enforcement bodies at both centre and state levels. This will help plug in a lot of information asymmetry that currently exists about producer targets, set-up of collection channels, how collection is being done, awareness mechanisms, and recycling of collected waste. It should introduce measures for identifying paper trading practices and create systems for traceability of secondary materials and mass balancing. This system should be developed such that the following are monitored:

- Submissions: Sales data of Producers is uploaded on a rolling basis: EPR plans covering all states are available for monitoring by SPCBs
- Reporting: Procurement & movement at all nodes is visible, State-wise awareness activities are recorded
- Recycling: Mass-balance of input and output fractions and resource recovery percentages are measured
- Robust SOP for recyclers for tracing and tracking recycling process and efficient compliance operations should be issued for recyclers, PROs, collection centres as well as producers . In the present Rule, no clear reference is mentioned to the importance of downstream management.
- A centralized digital system for effective end-to-end monitoring of EPR implementation must be developed. Digitising the full process of EPR from submission of EPR to recycling will bring in greater transparency
- Developing of a digital marketplace with a tiered structure for taking into account different business models and value chains. Common parameters for linking the value-chains can be determined.

Development of a digital system will be imperative for taking into account different business models and value chains. The above measures are important, however, compelling producers to share sales to shipments data from the company or actual final retail sales and from shops on a centralized platform would be challenging in the present context.

- **Tracking Hazardous Fractions and Materials of Concern**

The digital systems should enable tracking of e-waste material fractions (post dismantling/ recycling) which are hazardous or of concern. These fractions include but are not limited to CFCs, HCFCs, PCBs,

Capacitors, Oils, Leaded glass, Mercury, etc. This system shall allow measuring the effectiveness and efficiency of the circular initiatives and ensure no hazardous material is left unchecked. Such a system will also help understand if the hazardous fractions are being collected or they are being left out during collection.

- **Surveillance for RoHS**

The state of the RoHS clause implementation under the Rules is non-functional currently and only self-certification is considered from the producers. The product wise testing protocol and guidelines for the laboratory and the producers are required without further delay. Authorizing few Government labs (*C-MET, Hyderabad is the only Government laboratory is functioning now*) would also be important to ensure necessary compliances from producers and also initiate tracking toxic products.

The surveillance for RoHS should seriously be implemented as this scheme also like BIS and BEE Star Labelling programme can track toxicity in the products and thereto its hazardous effects at e-waste.

(vii) Producers must have a mechanism to trace E-waste

Traceability is an important factor; all the producers have a database of buyers; while the warranty and services are regularly monitored for most products (esp. in the Printing and Durables space) for 3-5 years since the date of sale, some-how the connect gets lost thereafter. In the E-waste Management Rules 2016 or amended thereof, all producers know the End of Life of Products, and since they have databases, they must initiate push calls to touch base its existing buyers and arrange take back of end-of-life products.

Besides, in telecom with the help of IMEI nos. one can trace the mobile phones and in the printing industry, MFD's can be tracked with their serial nos. and IP addresses. There needs to be a mechanism to track all such WEEE sent for recycling, and the same needs to mandated and should be adopted for traceability such that manufactured products can be identified at the time of disposal.

(viii) EPR Authorisation, Reporting and Documentation

The entire process requires a re-work with better transparency on authorisation procedures. Many of the authorised entities and systems are not existing on-ground, so keeping them on record may invite obvious leakage of the materials to informal channel.

(ix) Circular Economy for Producer

As per Rules 2016 and amendment 2018, EEE producers are mandated to meet EPR compliance through three options viz., PRO, E-Waste Exchange (Digital) and Recyclers. The producers shall thus set up a permanent digital system by neutral organisation (3rd party), duly empanelled by CPCB for EPR compliance and subsequent seamless reporting to SPCB/ CPCB. This will enable EEE producer to reduce their recurring cost including managing varied vendors and material supply chain for EPR compliance. The system will also ease out due diligence, policy compliance, monitoring by CPCB and enable implementation of circular economy for EEE Sector

(xi) National Clearing House

The confidential and complex data, participation of multiple stakeholders in the value chain often leads to inefficiencies, profiteering and moral hazard. To overcome this, most countries have established

independent clearing houses with the responsibility to ensure efficiency, transparency, fairness and impartiality within and among compliance schemes.

CPCB may set up such clearing house on its own or may authorize few Government owned laboratories, based on the infrastructure and capabilities, to act as such purpose. The functions of a clearinghouse should include the following:

a) Monitoring and enforcement: to obtain data from producers and PROs simultaneously, also from PROs separately to know the gaps in data, that can further be used for imposing fines by clearinghouses. The clearinghouses may have some legal set-up and may function as a subordinate authority
b) Central body for formulating improvements in e-waste management
c) Development of standards in coordination with BIS, MeitY

The best-practice case study of the Italian clearinghouse, which manages by Italy's PROs under supervision of the Ministry of Environment, may be seen at https://www.cdcraee.it/GetHome.pub_do and also at pages 19-20 of reference: https://weee-forum.org/wp-content/uploads/2020/11/EPR-and-the-role-of-all-actors_final.pdf.

(xii) Funds for Enforcement

Funds for enforcement need to be enhanced. A dedicated fund should be created which will support SPCBs in rolling out enforcement mechanisms. The enhanced fund will help in increasing contractual personnel of SPCBs to support the enforcement process. If a clearinghouse will be set up and it is tasked with enforcement, the funds should go to the clearinghouse. The contribution from producers may also be explored obligation to fund the operational expenses of the clearinghouse.

(xiii) Standards across e-waste value chain

The adoption of resource efficiency standards and benchmarks and business best practices on circular economy will be imperative.

A 2018 study on Enhancing Resource Efficiency through Extended Producer Responsibility (EPR) (EU-REI 2018) as well as the 2019 Strategy on RE in the EEE Sector 2018 and highlight the importance of standardization, research and development.

The transition of the E-Waste sector from a semi-informal to a formal and regulated economy can be successful only when standards are implemented and adhered to by the entire value chain. India can take a lead in developing standards in this space while ensuring harmonisation with Global standards like WEEE Labex, E-Stewards, R2, CENELEC which can be referred to while developing suitable standards for India. These standards could be developed and contextualised by 'Centres of Excellence/Expertise' and recognised by the Bureau of Indian Standards in collaboration with CPCB, and in consultation with NITI Aayog and MoEFCC. The national standard should aim at:

- Setting recycling and recovery targets and benchmarking
- Creating a transparent level playing field for all stakeholders
- Ensuring compliance with legislation
- Promoting adoption of best available technologies

Standards could be established on the basis of the products in market that have the best environment performance, and can be three-layered:

- Circular Economy Systemic Level Standard/s that take into account different circular measures addressing repurpose, reparability, and transparency for reporting on constituent materials. The weightage of each of these attributes/criteria may be determined.
- CE Standards at product level in order to address different product groups and sub-groups. Such standards may also consider the technology used for development of products.

BIS have initiated a process on evolving a draft standard for e-waste recycling, the above suggestions should also be considered in the draft.

(xiv) Benchmarking of Costs for E-waste (Full Units)

One of the most important aspects of the entire value chain towards best practices for enabling circular economy in the EEE sector is to track and evaluate the implementation of Rules. Producers main focus is to bring down the cost for collection to achieve a zero-cost model. As a consequence, with the limited contribution from Producers or their intent to invest in PROs, the developing infrastructure or investing to create such state-of- the-art infrastructure is challenging. Hence a concerted effort is needed to regulate product-wise pricing.

(xv) Dedicated EPR budget

A dedicated EPR budget may be calculated by using the prescribed costs of compliance, budget to cover consumer awareness, collection (procurement), logistics and recycling should be defined in the Annual Implementation Plan given by Producers to the regulators. All activities to be done at the level of the PROs for producers should be approved by the CPCB/ MoEFCC; and that needs to be agreed in their annual contracts with defined actions and budget-lines in Quantity, Quality and timeframe.

(xvi) Establishing cost of compliance

To make the circular economy sub-ecosystems self-sustainable each of these sub-ecosystems need to be economically and environmentally viable either from the demand for value creation done or by the fees to cover the value creation. Economically viable models can act as benchmarks for each stakeholder and prevent malpractices.

In order to bring fairness to the current system, these economic models and true costs of compliance need to be scientifically/rationally determined and published by a competent body of government on a regular basis. These true costs of compliance can then be referred by enforcement bodies and auditors to assess the compliance and intent of the producers.

Producers are generally concentrating on collection targets but do not support in developing the infrastructure. The process of applying for EPR may further be elaborated to file various documents with precision. The true cost of compliance for producers needs to be identified to include developing the collection network, training the various stakeholders in the value chain and awareness raising.

Auditing guidelines should be developed auditors should be skilled on auditing of material flows and related financial flows across the value chains for each kind of product should also be developed.

A detailed system for analysis of the costs of compliance should be bought in. This must enable deep analyses of the EPR finances spent by companies in the past years to understand what was done to meet the collection targets.

Another important aspect is to determine the price range for each type of e-waste at which an individual or a bulk consumer shall sell it to the collection channels set by the producers or PROs. The price range would depend on the type of product being handed over for recycling. Today, there is no reference point for bulk consumers or individuals at which they should sell their e-waste.

The true cost of compliance once established (and revised year on year) will avoid the ongoing malpractices and will provide a level playing field to all stakeholders. The cost of compliance should consider the fair market value of SRM, in case, it is lower than the cost of procurement for avoiding leakages and malpractices.

To enable a level playing field, transparency in disclosure against obligations and what has been done, by Producers, PROs, Recyclers, Retailers, and Digital platforms must be bought in.

A similar discussion is currently on-going in the EU. Article 8a of the Waste Framework Directive calls for EPR schemes' funding of "necessary costs": https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L0851&rid=5.

(xvii) Benchmarking Price points

A pricing benchmarking mechanism shall be established for each stakeholder so that stakeholders covered in the Rules can sustain their businesses.

(xviii) Periodic revision of the Rules

The E-Waste (Management) Rules 2016 were last revised in 2018. First Rules was notified in 2011, after six years the Rules in 2016 was introduced, whereas, Rules 2018 was an amendment only. Since the last revision many new operational challenges related to the Rules have been observed on the ground. A system for regular review of the rules should be bought in with valuable feedback and representation from major stakeholders including producers, recyclers, PROs, digital platforms and environment focused NGOs and relevant government agencies.

(xix) Graded penalties

Presently, no clarity has been provided on penal provisions for non-compliance by Producers or the other stakeholders in the rules 2016. As a result, the kinds of penalties that have been levied have not been in sync with the errors. Also, the experience of implementation has led to recognition of gaps and the challenges in the system. A penalty structure could be introduced that clearly defines low, medium and high penalties in proportion to the errors that various stakeholders make.

The penalty system under the Rule 2016 needs to be overhauled in favour of a graded financial penalty system that is structured to promote growth of the overall e-waste ecosystem. A clear and explicit graded penal framework for non-compliances under the Rule 2016 must be both easily enforceable and

act as a sufficient deterrent. This is possible by specifically identifying offences/non-compliances by each responsible stakeholder, including producers, PROs and recyclers, digital PROs and bulk consumers, refurbishers, e-tailers and other collectors in the supply chain and the corresponding financial penalties for such non-compliances/violations. Penalties should be more than the compliance cost as the Producers are comfortable in paying lower penalties and thus do not adhere to the right cost of compliance. Stringent check on bulk consumers should also be ensured to know how much of e-waste is generated and quantum of waste.

2.2 National Circular Economy Council (NCEC)

In order to establish normative e-waste recycling and resource efficiency network under a single umbrella, a National Circular Economy Council (NCEC), a multi ministry-level agency in charge of promoting circular economy in India is proposed. It is essential to create a receptive and suitable policy environment for e-waste management to be effective. In this regard, different stakeholders should work together to ensure that there is a concerted effort to promote e-waste management, increase efficient use of resources and reduce the overall waste disposal. To attain this, a roundtable should be established to ensure that all aspects from different stakeholders are equally considered. It also creates an opportunity for them to exchange information and feedback, to obtain financial and personnel support and to negotiate, so that potential conflicts can be avoided. Regarding enforcement issues, the flexibility of short-term policy instruments can offer incremental improvements to enhance the balance between competing interests and thus increase the effectiveness of the legal system.

2.3 Taskforce to enhance the competence of the value chain

To enhance the competence of the entire WEEE management value chain at a national level, a governing council could be set up with expert members for overseeing the PRO, recyclers and digital exchange. The expert members can be chosen from established education institutes, researchers, GoI representatives, industrial associations, delegates/experts from producers and be a part of such a council for neutral assessment of the value chain could contribute to the transition of CE in WEEE sector.

3 RECOMMENDATIONS ACROSS LIFE-CYCLE STAGES

3.1 RAW MATERIAL ACQUISITION

Presently, the raw material acquisition of the EEE sector is predominantly dependent on mining and procurement of virgin resources. In the absence of systematic exploration, there has been no major mineral discovery in India in the last 40 years particularly in the context of technology metals, energy critical metals and rare earths (such as gallium, germanium, selenium and indium-tellurium), which are essential for manufacturing of almost all modern devices and machinery, and those facilitating more efficient energy use (IREP 2017). Also, while India has resources, which are required for large infrastructure support sectors like Steel and Aluminium, as noted earlier it lacks materials which are required for production of electronics and their components.

In this age of fast paced connectivity, electronics plays a key role and India aims at ensuring that companies which have been leaders in this sector invest into setting up manufacturing facilities in India as well. Thus, there are disadvantage of not having access to raw materials can be turned into an advantage through urban mining. In terms of the quantum of secondary materials that can be accessed, many of the materials and metals needed for production of EEE are lying unrecovered in the mounting volumes of e-waste. There is a need to promote research to enhance recovery of materials including rare earths. In order to encourage recovery, it is important to have mandates for utilisation of certain percentage of secondary raw materials for manufacturing.

Recommendations

- **Institutional arrangement to track availability of critical materials for India and how secondary resources can contribute to meeting certain percentage of the demand**

In short-term, a study to understand the potential contribution of secondary raw materials (SRM) to meet the needs of critical materials and its quantum can be undertaken. It will identify the current recovery, recovery potential, measures needed to enhance use of SRM.

In the medium term (3-5 years), a mechanism to digitally track the use of critical materials in India and their supply from mining e-waste can be established. This can also be set up like PROSUM project in the EU to digitally track material specific data from electronics, automobiles, construction, mining waste and solar panels.

- **Support in setting up material sampling labs across the regions to as to assess the material value in the end of life product.**

This may help in bringing trust level among informal sector, PROs and recyclers for seamlessly handing over collected end-of-life products with suitable remunerative cost.

- **Regulation/Guidelines on Materials sourcing**

The Regulation/Guidelines may be introduced to ensure producers mentioning the raw material sourcing details including secondary materials. Suitable incentives for good performance and provision of penalization for poor performance may also be explored under E-waste Rules.

- **Mandatory use of certain percentage of critical materials sources from secondary materials.**

The existing EPR should be modified to introduce the provision with a nominal percentage (~5%) of using secondary raw materials in production stage. The major product categories might be considered in initial years.

- **Promotion of technology for extraction of maximum number of materials through technology development/transfer, innovative finance mechanisms and schemes.**

The Government of India may initiate a financial scheme in MSME sector to support informal sectors availing indigenously developed technologies to recycle EOL EEE and strengthen the recovery of secondary materials.

- **Incentive for producers using critical materials from secondary resources.**

The producers using critical materials from secondary resources will be preferred in government procurement.

- **Incentives to set-up infrastructure for recovery of secondary materials**

In order to retain the precious metals including rare earth elements in India, state-of-art facilities must be established for final extractions under PPP model in India and circularity will truly be ensured when all secondary raw material are retained and utilised in India.

The Government of India may initiate a financial subsidy scheme like Eco-parks in the country to boost the recovery of secondary materials from EOL EEE.

3.2 Product Design, Component Manufacturing, Product Assembly

EEE Sector has undergone rapid changes in the last two decades. However, the technological advancement and innovation in the sector has also contributed greatly to the problem of mounting e-waste. Therefore, manufacturing and design stage of the life-cycle of EEE are key towards also tackling several challenges that present themselves at the end-of-life stage as well. Following CE Measures should be undertaken for enhancing the overall sustainability in the sector:

Recommendations

- **Eco-design**

A global framework is more effective than standalone domestic pieces of legislation for promoting eco-design.The EEE must be designed in a manner that at first ensures a longer-life of the products in order to keep the materials and the value in the use for as long as possible. Secondly, the design should make the products amenable to repair, refurbishment, remanufacturing, recoverability, and recycling. Currently, despite the advancement in the mechanical as well as chemical recycling technologies due to increasing complexity of the electrical and electronic equipment and introduction of novel products in

the market, the recycling and recovery infrastructure is playing constant catch-up. Notably, the environmental impact of a product is already determined by 80% (EU 2012)[8].

Therefore, CE measures should be introduced to ensure that the manufacturers follow the eco-design principles to enhance at first the durability, reparability, upgradeability, and then to design products that can be easily dismantled and disassembled into different components and materials can flow into the streams for repair, refurbishment or recycling. Both at the level of overall product as well as materials, the design should take into account other stages of life-cycle and sustainability criteria. Regions like the EU have drafted laws which aim to enhance resource efficiency and circular economy through better product design and by enabling product and material recycling. In India, design for circularity guideline can be developed to guide the industry in the same direction. Stronger EPR implementation may also result in producer proactively adopting such measures.

Financial incentive structure could be designed to incentivise and reward those manufacturers who ascribe to a more sustainable manufacturing of their products. Labelling and standards should be developed for greater market uptake. In this regard, a compilation of best practices, global standards related to design for recycling and extension of product life can be developed. Furthermore, standards to check forced obsolescence in electronics will be needed to ensure compliance as well as foster trust in circular claims of producers. MeitY may also develop a 'Sustainable Product Policy' for mandatory design for recycling, and extension of product-life. Future promotional scheme for electronics manufacturing (like MeitY's PLI Scheme) may incentivise or mandate the design for recyclability, extension of product—life, standardisation of interfaces of accessories like chargers, headphones, modular structures of product to enable easy replacement of components and parts and allow upgrading and design requirements of ICT/ CE devices to evaluate scope for Indian eco-design programme.

The RoHS clause compliances should be implemented effectively under the Rules to ensure reducing toxic materials in EOL EEE. International best practices on product wise testing protocol and guidelines for the laboratory and the producers should be introduced so that compliance mechanism can be initiated seamlessly.

The important benchmarks for economically successful circular design include: material selection, standardized components, designed-to-last products, design for easy end-of-life sorting, separation or reuse of products and materials, and design-for-manufacturing criteria that take into account possible useful applications of by-products and wastes.

- **Skill Building**

Enhancing Resource Efficiency and Circular Economy in the electronics sector requires an upgradation of skills and capacities across the entire value chain. As a CE approach is also dynamic and transformative, therefore, adaptive skills need to be developed and capacities enhances with stakeholders who practice livelihoods in the end-of-life stage of electronic products. In India, these livelihoods are usually practiced by informal actors who have access to materials and products which are disposed by consumers.

[8] Ecodesign your future - Publications Office of the EU (europa.eu)

Recycling and dismantling processes which are deployed by these stakeholders are usually bereft of environmental and health concerns. Skilling these actors will ensure environmentally sound processes are established and followed which will enhance the productivity of extraction of secondary resources. This will have a positive impact on health, livelihoods, incomes and also enhance resource efficiency and circular economy in the electronics sector in India.

The MeitYalong with Electronic Sector Skill Council of India has initiated programmes for skill development programme on Electronics System Development and Manufacturing (ESDM) at different stages of the lifecycle of electronic products and competent. The content of this skill programme should be augmented to include the green design and CE approach in product design, component manufacturing, product assembly so that skilled manpower is available for the local manufactures. Production processes have been streamlined through skill development and have acquired standards as well. Skilling processes need to be standardized through creation of content and pedagogical methodologies.

3.3 CONSUMPTION STAGE

Consumers are key actors who also have a shared responsibility in charting a path towards more efficient and sustainable resource use. Their awareness towards availability of more circular alternatives of goods, readiness to buy them, and proper segregated disposal of generated waste into separate waste streams to aid recovery of the materials are important steps towards environmental sustainability.

Circular consumption, however, is more than replacement of unsustainable product with a more sustainable one. It entails movement away from acquisition towards reduction, reuse, repair as well as responsible disposal of products. The Globe Scan Survey in 2020 notes that the globally 74 percent people surveyed wanted to reduce their impact on the environment and nature by a large amount. However, there is currently a gap between aspiration and actual behavior. Those surveyed noted shifting to sustainable choices was difficult in an unsupportive system. Accessibility and affordability of sustainable products were identified as important criteria to enable consumption shift.

Circular-Consumer-Electronics-2704.pdf (ellenmacarthurfoundation.org)

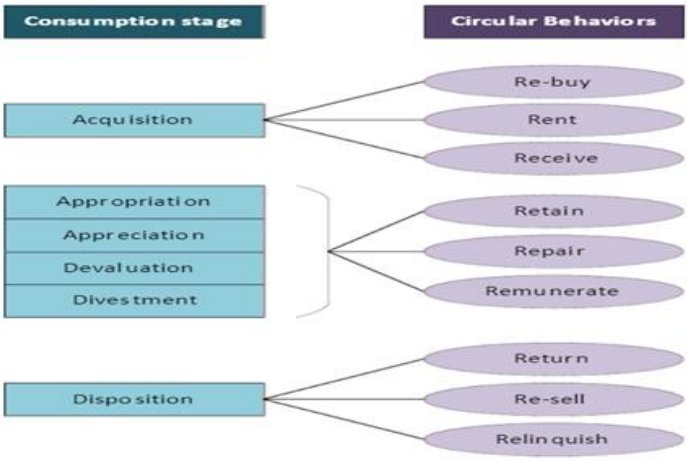


Figure 1 Circular consumption behaviours

Figure Source: Camacho-Otero, Tunn and Chamberlain, 2019[9]

Ellen MacArthur Foundation in its 2017 report titled "Circular Consumer Electronics" describes the vision as one of where consumer electronic products are loved for longer by being kept in use as long as possible, either by the original user, or flowing to new users who will find new value and utility in them. After use, the devices end up in the hands of specialists, who will professionally refurbish products, reuse or remanufacture the valuable components inside, and separate and recycle materials. Thus it highlights the following: The electronics are a gateway to the cloud wherein distributed computing has the potential to increase the product longevity by allowing for more flexibility and adaptability in computing power and memory allocation, with the potential to reduce structural waste; customers get the service that's right for them: products and components are kept in use; circulated between different categories of users for as long as possible; Products and components are cascaded: to get maximum benefit from energy and resources, electronic items move from high-end consumer electronics to lower performance applications; they eventually reach recycling processes, where all materials are recovered and reused in the system.

In India, circular consumption movement can be supported with the help of policy instruments like 'Right to Repair.' India has a thriving culture of reuse and repair has led to creation of jobs and ensured elongation of life of materials and resources. A demand for such services has ensured sustainability of these jobs. However, changing consumer preference coupled with planned obsolescence of EEE has dented the practices that supported the principles of circular economy and resource efficiency.

The complement by nudging systems, National benchmarking framework, Pull effect should be encouraged on consumption stage rather than post-consumption stage. Further, National Benchmarking/Ranking framework can be based on public disclosures of firm and their EPR plans. It will gradually lead to more and better quality of public disclosures, audited reports, and more consumer pressure on companies.

Recommendations

- **Resource Efficiency/Circular Economy labelling:**

A stronger regime of standards, certifications and labels is imperative towards engendering greater trust in the claims of the green products. It will aid consumers to assess the authenticity of claims by manufacturers. Ecolabelling of products for CE criteria with information on recycled content, type, value, weight of different materials used can also inform decision making of consumers. This generates trust in consumers towards claims of producers of products and services. This will encourage the circularity aspects of value addition and waste minimization (6 R principles).

- **Awareness programs on e-waste management, RE/CE labels.**

Information dissemination and awareness generation play a significant part in driving consumer behaviour. Therefore, awareness regarding circular products among consumers is important. MeitY has considerable experience due to its awareness raising programmes in the area of e-waste. Such

[9] (PDF) Consumers in the circular economy (researchgate.net)

awareness generation around circular products can be also developed. Furthermore, capacity building of stakeholders on RE and CE will make consumers responsible towards product usage and disposal.

It is also recommended that eco-labelling on the products w.r.t to % use of recycled materials in the product to be done to create the consumer awareness in recycling aspects of products. The proposed action for this could be creating awareness on the toxicity of the use of various materials within products through labelling.

- **Guidelines for Refurbishment, Repairability, Availability of Spare Parts and Remanufacturing**

Consumer motivation alone may not be enough and other policies that improve the competitiveness of circular products and models are needed. Repairability guidelines with modular designs, availability of spare parts and remanufacturing possibilities

- **Product subscription/ lease models across various product categories**

Circular consumption entails development of practices around wherein ownership of products is not the only means for deriving the value to fulfil a particular need. If consumption is understood as a value-deriving exercise, then subscription and rental of product and services along with other innovative models can also help meet the same demand. It has the advantage of establishing the reverse logistics for collection of e-waste.

- **Supporting Consumption Circular and Sustainable Consumption Practices**

Awareness and demand for circular consumption must be supported by improved availability of such circular products and services in the market. Such products and services must be supported by a larger ecosystem wherein policies and incentives that enable circular products practices.

In this regard, it is important to have regulation that tackles planned obsolescence including regulation to increase EEE warranty from 2 to 6 years, measures against planned obsolescence with right to repair.

Legal warranty of second-hand and refurbished products will help to increase the quality and value of such products and also engender greater trust in the consumers.

- **Promote Green public procurement (GPP) by Government agencies**

Green Public Procurement is a strong tool to ensure bulk consumers alignment to the products and circular complying with the best practices.

Thus, strategic and tactical approaches including, awareness creation on RE&CE practices, skill building for repairing, guidelines on refurbished products, green public procurement by government agencies by adoption circular products and services, promotion of subscription models, support towards circular practices and tackling of planned obsolescence are needed.

- **Innovative R& D in Circular Economy/ Start-ups & Entrepreneurship promotion**

Special funds for promoting Research and Development in the Circular Economy area is needed towards promotion of technologies and products in relation to circular economy, environmentally benign technologies for safe disposal of toxic/hazardous substances and the development of Artificial Intelligence for increase the effectiveness and optimize circular economy business models and streamlining the infrastructure needed to keep products and materials in use.

R&D and innovation should continuously be emphasized to bring out the new cost-effective and locally manageable technologies, which support easy to follow processes and a strict mechanism for risk mitigation. This systemic approach will enhance the scope for budding innovators, start-ups, NGOs to holistically address e-waste management and CE, in India.

3.4 COLLECTION SYSTEMS FOR EOL EEE PRODUCTS/COMPONENTS

E-waste generation is growing at an exponential pace. It is of critical importance that we create a robust collection infrastructure that will allow waste to flow in for responsible recycling. A wide, easily accessible and mature collection network is at the core of a healthy e-waste ecosystem and is essential to achieve the goals. India needs a widely distributed formalised collection network that consumers can readily access at their homes, offices, and public spaces to drop off their e-waste.

Recommendations

- **Create channels and provide clarification for budgets for public awareness**

There is little awareness amongst individual consumers on proper disposal of e-waste. Most consumers keep their e-waste stored and when they do dispose it off look for high returns matching the notional value based on the purchase price. The current e-waste regulations require the producers to provide, on their websites, information on the impacts of e-waste, appropriate disposal practices, and such other issues. They are also required to run awareness campaigns at regular intervals. Many producers have already provided information on their websites but evidence shows that the overall awareness levels, even among bulk consumers, remain low.

At present there are no criteria or guideline on designing awareness plans that lead to real measurable behavioural change in consumers. No direction has been provided on acceptable budgets for such programmes either. This prompts producers to opt for the bare minimum options for compliance that show impressive numbers but cost less instead of impactful and holistic pan-India plans for long-term behavioural change.

If producers are provided guidelines then more programmes with long term behavioural change with pan-India reach will be implemented.

- **Training for State Pollution Control Boards on circular economy and e-waste**

There is a need to conduct a trainings for the officials from the State Pollution Control Boards/PCCs from each states/UTs. Along with professional trainers, recyclers, PROs and dismantlers can also be included to share the best practices and innovative learning for a long term comprehensive growth of the ecosystem.

- **Training and skill development for informal sector**

Recyclers/ PROs may provide adequate training and skill development for the informal sector. Once it will be documented with a proof, the suitable reward, incentives may be awarded to the successful Recyclers/ PROs.

Role of ULBs

ULBs are a very important part of the 'Indian Waste System'. E-waste Rules should ensure that all the e-waste collected by ULBs should be channelised to PROs/ authorised recyclers. If ULBs are not collecting e-waste, they should be encouraged to tie up with PRO, recycler and ensure that e-waste is collected from household and provided to the PRO, recycler with proper documentation.

- **E-Auction**

Online auction is actually an 'offline quote comparison process' taken online. E-auction portals have eased the process for large organisations to dispose of their scrap. It does encourage active bidding but most of these platforms do require the vendor to possess an 'E-waste Authorisation' to procure the e-waste. Even when the platform requires the vendor to have an e-waste authorization, the platform does not follow through and check if the auctioned e-waste has truly been recycled. Outright ban on such portals will not be effective as the traction that they have gained is enormous. E-waste Rules should ensure the traceability of the materials flow of the e-waste collected through E-Auction process with proper documentation.

- **Provide a framework that allows the creation of a granular collection network/ Create Ease of Participation for individuals by developing accessible infrastructure including digital platforms**

From a consumer perspective, lack of easily accessible collection points is a deterrent in ensuring proper channelization of e-waste. Lack of easy mechanism and system for citizens, ULBs, consumer industry &organisations to channelize to correct destination, lead to the situation where citizens, ULBs and other organisations sell their e-waste to kabadiwalas (because of their easy access) or discard it, leading to increase of flow of e-waste to informal players and related pollution.

- The EWM Rules 2016, do not clearly differentiate between collection centre and collection point. The current framework requires that collection centres are following prescribed standards for operation and does not allow flexibility in the way "drop-off points" or "collection bins" can be set-up. Rules 2016 already mandates the need to set a collection network or drop off points by all stakeholders including producers, PROs, and digital platforms. The Rules should further fine-tune the collection network set up that includes such points as a second layer of localized collection that are easy to maintain and operate in a hub and spoke model with the centres for collection. This would enable the creation of a well distributed collection network that is readily available for consumers to access at residential complexes, malls, public offices and locations etc. Even State Pollution Control Boards have expressed the need to have a greater number of such points.
- The number of collection centres required in pan-India basis in every state may be set up by the PROs and the producers to whom it serves and in sync with the allocated targets.
- In a market-based EPR approach with competing PROs, the market pull will be created once monitoring and enforcement is effective.

- The Collection Centres should be allowed to store e-waste till it reaches As per Rules 2016, chapter 4 , heading 15 e-waste can be stored at collection centers or any authorized storage facility upto 180 days which is enough time to collect a truck load of material or an optimum quantity for transportation (one-truck load). For remote locations, these timelines can be relaxed for cost optimization.
- The recyclers, digital platforms and Producer Responsibility Organizations, as the interface between the producers and the rest of the e-waste value chain are best positioned to develop and monitor a mature and professional collection network. Auditing in collection, transportation and storage of all stakeholders must be regularly carried out.
- Through self-auditing processes supplemented by third-party audits, PROs, recyclers and digital platforms can ensure, and be responsible for, compliance of the collection network against clear guidelines regarding compliance requirements. This will also assist in reducing the burden of each producer member of a PRO requiring prior consent of regulators for any changes and updates in the collection network made by the PRO.
- Reward good and voluntary compliance**.** There are examples and experiences from regulators in other countries that have developed a compliance system that rewards and recognizes compliance of producers for going above and beyond mere obligatory compliance by voluntarily subscribing to a widely distributed collection network. A graded system of recognizing a collection network underpinned by producers towards their compliance of EPR obligations should encourage producers to voluntarily influence wider deployment of robust e-waste collection mechanisms.

- **Digital Infrastructure for circular e-waste management, pan India**

Digital infrastructure (eg. e-waste exchange) is globally recognized for sound collection and effective recycling and resource recovery. MoEF&CC may empanel such digital infrastructure for pan India operation. Digital infrastructure will thus enable online disposal, recycling and resource mapping from e-waste and will promote the use of secondary resources in manufacturing. Such infrastructure will help citizens channelizing urban e-waste from societies (~ >43%), enable bulk consumers, producers & ULBs to easily recycle their e-waste. Producers, bulk consumers, ULBs shall use this digital infrastructure voluntarily. Use of digital infrastructure for channelisation of e-waste to recyclers will be made mandatory for government offices, ULBs, producer and consumer companies, from FY 2024.

- **Open up existing public infrastructure for setting up collection channels**

Existing civil infrastructure government must be leveraged to create effective collection infrastructure for e-waste. E-waste collection can be done through post offices, CSCs (Common Service Centres) under MeitY or urban local bodies. Tie-ups with PROs could be done to maintain these collection points which could then further be linked to e-waste collection centres.

- **Make buy back schemes feasible with clear guidelines and a rate card**

Buy-back schemes should be allowed for the same EEE code items instead of restricting it to the same brand as well as product. Currently, there is ambiguity in the rules/guidelines regarding this. This has led to brands only using buy-back for products that are still in working condition and are meant for re-sale. This must be clarified in the guidelines by incorporating the provision of buyback with a rate-clarification must be included for the same. Collection of Most Hazardous Waste Fractions must be ensured.

The most toxic fractions of the waste are not being collected as they are expensive to treat. In the case of an ITEW2 it can mean avoiding pick-up of CRT monitors (which are most toxic due to presence of lead). Therefore, it is important to establish mechanisms for the collection and management of such negative or zero value e-waste fractions.

E-retailers buying back of the pre-owned and used products for disposal or reuse must be regulated under Rules 2016

- **Provide a standard guiding price range for bulk consumers/ individuals**

The consumer in India is conditioned to receive monetary value for its e-waste and therefore is not motivated enough to drop E-waste for free at collection points. The cost of this access to waste by formal collectors is often results in poor outcomes at the stage of dismantling and recycling as it impacts the overall net cost in the value chain. The price of e-waste is also self-determined by each dismantler and collector. Given the lower cost of compliance and use of crude and hazardous technologies and process, informal players are able to pay more, leading to diversion of waste from the consumer organisations / citizens to them.

Publish rate card with maximum amounts defined: Provide a guiding price range for bulk consumers to sell their e-waste depending on the recycling returns that can be generated. The price gap between formal and informal transactions needs to be bridged by external funding, mainly producer funds under EPR. Sound monitoring and enforcement efforts will further narrow down price gaps effectively.

In other countries, such systems have proven successful, may refer e.g. Ghana with pilot incentive scheme:https://www.giz.de/en/downloads/giz2020_en_incentive_based_collection_e_waste%20_ghana.pdf.

- **Ban Auctioning of E-waste**

Industry, Government office and organisations are selling their e-waste at H1. Such bidding system is detrimental to environment. There are large online auctioning platforms like Government owned MSTC, other private tendering agencies like tender tiger, eco-emarket those are dealing with e-waste as scrap material should not be allowed to auction, lot of bulk consumers auction their waste through these agencies. However, they do not find a mention in the Rules or the Guidelines and there are no frameworks in place to regulate them. It is recommended that they are brought under the purview of the E-waste (Management) Rules and systems are put in place such that they are connected to a producer take-back channel via PROs, recyclers and digital platforms who are authorised to collect by the E-waste Rules. The platform like MSTC which is used for selling scrap material including e-waste of public institutions does not allow PROs or other stakeholders to use its platform. Such platforms should also be held responsible if the waste goes in the wrong hands or gets leaked. The auctioning practice increases the cost of e-waste procurement exorbitantly, which leads to malpractices.

- **Define Liabilities for Bulk Consumers who don't file their e-waste returns**

Bulk consumers are largely unaware of their legal liability for E-waste management and filing E-waste returns. To ensure bulk consumers are stringent about who they handover their e-waste to they should also be held responsible partially for any mismanagement done by the recycler that they work with.

The absence of guiding recycling price range for bulk consumers leads to them demand recycling certificates while forcing refurbishment prices e.g. bulk consumers usually expect over INR 2000 for a laptop when the real price that can be offered if the product is recycled is around INR 200.

- **Ensure all formal/informal players of e-waste are registered on the digital platform for all transactions**

A registration system that ensures that e-waste is not handed over to non-registered entities is important for bringing greater accountability. Arrangements should be made to register all those who are collecting any type of -waste in the informal/formal marketon a central platform with digital presence as well to ensure accessibility and ease.

- **Funding Collection Systems / Defining Costs of Compliance to create adequate budgets**

There is need for channellising financial resources generated through EPR mechanisms towards setting up of a collection system. The evaluation of MeitY's GreenE Awareness Programme revealed that even when the consumers are motivated to responsibly dispose their e-waste, lack of collection systems forces them to rely on informal actors. A system is required to be introduced to track the movement of e-waste.

All nodes where waste changes hands must become entry points for data. At all times, e-waste should be traceable for its origin, and its particular coordinates in the transaction.

The cost of compliance should adequately be borne by financial resources generated through EPR mechanisms.

Each producer must refer to the Cost of Compliance (CoC), which can be apportioned in the cost of the product being put to market, and can be later channelized from their books of accounts as CoC. Mandatory action should be on ensured for any deviation of CoC.

- **Policy to monitor budgets committed by producers**

All producers while applying for EPR, commit budgets w.r.t deliverables like Takebacks, E-waste collection and recycling, awareness sessions, collection centre coverage; however, an action plan should be implemented to monitor targeted budgets versus expenses, and the rationale behind the yearly expenses. Audits and Surveillance should be done from time to time.

- **Develop standard TORs/methodologies for inventorisation**

The regulations acknowledged the lack of waste inventories as a limitation and placed the responsibility of developing state-wise e-waste inventories on the respective state pollution control boards (SPCBs). However, there is no inventory data available at state level on e-waste generation rates. Government should define standardized methodology for inventorisation and a standard ToR which can be used by SPCBs to conduct this exercise.

- **Formalising the informal collection network**

The existing collection network, dominated by the informal sector, is not connected to the formal recycling channels. Though informal sector aggregators and pickers form a big source and channel of e-waste, are not even currently mentioned or recognised the Rules 2016.As a large part of the collection

of e-waste is being done through the informal sector, the Rules and Guidelines should also provide a framework for working with them and formalising them.

Formalising will enable the formal actors to also establish legal channels and undertake business transactions. Sampling and testing labs for the e-waste recovered for establishing the value of recovered materials will also help enhance monetary value and make it competitive and plug leakages.

Tapping into the strength of the informal sector through formalization will facilitate larger volumes of e-waste into the formal value chain and enable greater circularity in material flows. It will also enable the informal sector players to engage in their livelihood in compliance with the law. Integration of localized "collection points" and "collection bins" / "drop-off points" connected to larger "collection centers" that aggregate and channelize e-waste towards sound recycling is essential for the collection network to mature and for the informal sector to formalize.

Role of informal sector needs to be acknowledged, and a platform should be created for registration of informal sectors and formalizing them. All the e-waste collected by anyone not registered in the system should lead to penalties. The mainstreaming of the informal sector can be achieved through upgradation of skills, selective authorizations and certifications, interfacing with PRO, recyclers and digital PROs managed collection centres that aggregate e-waste from multiple sources, and through making provision for access to domestically developed e-waste recycling technologies. A roadmap is provided in the 2019 RE Strategy for EEE Sector. This will allow rapid expansion of the collection infrastructure that would create a win-win situation for the informal sector as well as create a sustainable e-waste management system across the country.

- **Redefine the modus operandi of the PROs**

The Rules and the Guidelines mention PROs in passing, providing a very rough framework for the functioning of PROs leading to many unscrupulous entities mushrooming as PROs. There is a need to clearly define the term PRO, its roles and responsibilities in the system. Currently, there is a lot of ambiguity which is leading to malpractices in the sector. A system for regulating and monitoring the work of PROs is of critical importance. A well governed, industry-led and managed PRO with multiple producers may bring convergence, better governance and sharing of global best practices. PROs' responsibilities and penalties must be defined and this purpose global PROs (e.g. in EU countries) must be referred. Specify ways in which recycler, Non-government organisations (NGOs), Waste Management Agencies (WMAs), Informal Sector can become a part of the authorised PROs, recyclers and digital PROs collection and recycling ecosystem rather than becoming their competitors.

The development of third party audit protocols for effective auditing would be important all stake holders.

- **Long term roadmap of evolution of the Rules on Circular Economy adoption**

It is also recommended that the MoEF&CC may create a long-term roadmap that shows the projected evolution of the Rules, within this system. This will be an information-based strategy that will influence both the industry and the consumer to be more e-waste conscious.

3.5 DISMANTLING &RECYCLING INFRASTRUCTURE /RECOVERY STAGE

The large majority of e-waste in India, up to 95% as per various reports[10,11], goes to informal recyclers. End-of-life electronic products change several hands, going from collectors and aggregators to dismantlers, who might scavenge parts for reuse, to specialized dismantlers and recyclers who recover precious and other metals, often using harmful and dangerous processes with few environmental safeguards. Technology development and commercialization should be encouraged in PPP mode for effective rolling out of best suited technology in India.

There are evidences of systemic leakages from many formal authorised recyclers to the informal sector aggregators/recyclers. The CPCB has taken action against many such recyclers and canceled their authorization[12]. However, in the absence of traceability and visibility on material flows channeled through the system, recyclers and dismantlers simply cherry pick the valuable fractions that are profitable, while leaving the more difficult to treat and often hazardous fractions to the informal sector recyclers.

The capacity constraints in formal recycling coupled with the probability of leakages has made it very difficult to ensure sound recycling defeating the objectives of the Rules 2016. Thus, this stage requires measures to increase the recycling capacity and policy frameworks to plug leakage of material to informal sector.

The development of third party audit protocols for effective auditing would be important all stake holders.

Recommendations

- **Plugging leakage of materials from recyclers to informal sector**

Provisions should be put in place for strict monitoring of recyclers. Some recommendations are provided below

- **Introduce standards for dismantling/recycling units including de-pollution practices to ensure removal of toxic fractions:** No directive has been provided for dismantler to follow depollution practices and management of hazardous vs non-hazardous fractions. Detailed instructions should be provided to dismantlers for following depollution practices and systems should be put in place to ensure regular checks such that these practices are followed.
    - Reporting standards for recyclers should be set such that there is transparency and documentation of what happens to e-waste after it reaches recyclers.
    - Recyclers should be provided formats for reporting Certificate of Destruction and Mass Balance (MBR) Reports
    - Producers could be allowed to set audit systems for recyclers
    - Recyclers could be asked to provide live CCTV access to SPCBs/Producers/ Producer linked auditors
    - Disposal reports should include visual proofs like pictures and videos

[10] Tackling informality in e-waste management: The potential of cooperative enterprises. ILO Report. Access here
[11] Building the Link: Leveraging Formal-Informal Partnerships in the Indian E-waste Sector, GIZ, 2017. Access here
[12] Notice by CPCB dated 12.03.2020. Access here

    - Recyclers should not be given license merely on built up area, but on the available infrastructure, plant machineries, technology knowhow for e-waste recycling and secondary raw material recoveries percentage. The classification criterion for licensing recyclers should be amended from area to technology to further ensure best practices in the industry.
- **Recyclers should be required to provide the following as a part of annual report to CPCB (formats could be provided)**
    - List of their secondary material vendors (downstream vendors)/ TSDF and the annual MBR to CPCB
    - Details of the producers/PROs that are in their channel and the amount of waste being recycled on their behalf should be updated whenever a new partner is onboarded
    - Recyclers must provide audited balance sheets and GST returns along annual form 3 to Pollution board to co-relate the working as per the claim of dismantled and recycled quantities.
    - Details of machinery installed and power consumption details
    - Details of manpower engaged
- **Introduce 'Recovery Targets' covering both toxic and non-toxic fractions and connect these targets with collection targets for producers**. Since recyclers have been given no recovery targets, they are left with room to indulge in multiple accounting of E-waste which essentially means that the same waste is counted multiple times for multiple producers.

- **Set-up coherent dismantling and recycling infrastructure frameworks and provisions**

Most authorised recyclers currently are only dismantling products and do not have the technology or the capacity to recycle, Good recycling facilities for consumer electronics are almost non-existent. Provisions should be created to encourage set-up of responsible units for recycling of e-waste.

A collaborative approach is required which would enable learning from world leaders in e-waste recycling and also enhance technology exchange and transfer.

- **Proliferation of Right Technology:** MeitY tech proliferation – Technology and blended financing through SIDBI SME loans to be evaluated for business purpose
- **Leveraging indigenous technology knowhow**: Knowledgebase and low cost technologies are available in academic institutions and research laboratories. Blended financing may be provided to encourage different actors to leverage their knowledgebase to develop small scale recycling facilities and providing training for the informal workers.
- **Creating a repository of all approved solutions:** Development and identification of solutions for different types of e-waste fractions post dismantling
- **Recognition/evaluation of existing solutions for non-toxic fractions**
- **Upgrade skillsets and build capacity to encourage micro-enterprises in dismantling/recycling:** Leverage schemes and incentives from the MSME ministry to develop CFCs for the micro enterprises in this sector and enable technology and infrastructure along with smart financial instruments can develop capacities for formal recycling of e-waste in India.
- **Support initiatives for upgradation of informal sector workers:** Ongoing GIZ DPP initiatives are one such tool to support collaborations across private sector and public sector.

- **Set-up advance stage recycling to recover critical materials, precious metals & handle hazardous fractions post dismantling**

Advanced recycling technology is expensive and makes large investments risky, especially when sourcing of e-waste is a challenge. Most of the formal recycling companies in India limit their role to only pre-processing of e-waste, wherein the crushed e-waste with precious metals is exported to smelting refineries outside India. An end-to-end solution for e-waste recycling needs to be developed available in India.

- **Set-up of Sampling Labs for understanding the material content**

Policy that allows setting up of "sampling labs" - On ground "Common Facility". This is key to informal sector not attempting to refine.

- **Model unit for Dismantling and recycling of e-waste**

Each State Government should be encouraged to start one model unit, which is extremely well managed and transparent on its own or in partnership with authorised recyclers, PRO or digital PROs.

- **Incentives to set-up advanced recycling units/ Eco-parks**

To curb the economic and environmental risks of nation's heavy resource exploitation and to accelerate resource efficiency and circular economy towards self-reliance, secondary raw material use has to be invigorated. At least one eco-park in each State and UT should be created in PPP model. The recycling centres should be linked with proposed eco parks in the country to promote manufacturing activities. Eco parks will organize their enterprises to carry out comprehensive use of resources and promote the development of cyclic economy. Increasing reliance on home-regenerated materials rather than imports will increase the country's resource security.

A financial incentive scheme from Government of India may be created for creating recycling units like Eco-parks in State level can be initiated. The eco-park is a cluster of small and medium industries where informal and formal sector should work hand-in-hand and carry out end-to-end processing towards zero-landfill is envisioned. Activities proposed in eco-park include disassemble through manual process for segregation of materials including structural metals parts, heat sinks, ferrous metal, ferrite & ceramic components, nonferrous metal scrap mainly Cu & Al, glass components etc. for processing at local smelters. Plant machineries for possessing plastic, crushing machine for CFL, fluorescence, stripper for cable, wire, precious metals extraction from chips, IC, connector, printed circuit boards, lithium ion batteries, other materials including rare earth CFL phosphor, hard disk etc. should commonly be utilized in each eco-parks by all the players. The financial support upto 50% of the plant machineries cost may be explored for environmentally sound viable secondary raw materials processing.

- **Recycling unit at EEE industry clusters**

The industry and Investment Trade policy of various States including Punjab, Telangana have mandated the implementation of recycling unit within SEZ / cluster defined for manufacturing of EEE products. This strategy is significantly useful to develop circular industry clusters. At least one recycling unit within each EEE manufacturing cluster/ SEZ should be made mandatory. State Governments shall support

setting up such recycling unit, in /near every EEE manufacturing cluster, by providing the land, and establishing recycling unit in PPP model.

- **Promotion of start-ups and entrepreneurship**

MeitY has established a Centre of Excellence (CoE) on e-waste management at C-MET, Hyderabad with central and state governments and industries financial partnership. This CoE is nurturing Start-up companies/ SMEs with suitable low-cost technologies and locally fabricated machineries to manage e-waste in environmentally friendly manner and viable manner. The CoE has technology knowhow for the processing of PCB, lithium-ion batteries, spent magnets, CFLs, solar PV panels. Continuous R&D augmentation for those technologies is also carried out. This CoE is engaged in empowering informal recyclers, dissemination of knowledge base for human resource development, skill development for prosperous entrepreneurs and nurturing of start-ups etc. Similar arrangement can be promoted to create suitable manpower for future entrepreneurs in recycling sector.

- **Green approach**

E-waste collection and processing involves significant energy consumption. In the spirit of circular economy, we should encourage to use renewable energy sources for operation a progressive manner.

3.6 Post EOL Production/Secondary Material Usage

Benchmarking of existing technologies and recovery of Critical Raw Materials other than precious metals should be a part of the circular economy and resource efficiency

- **Develop Circular economy standards to recognise producers making circular products**

Recognise frontrunners in developing circular products. Producers should be given recognition by government for doing exemplary work in making circular products. Incentives for secondary material usage by producers

- **Development and adoption of supply chain standards for secondary materials**

- **Develop Targets for utilization of secondary materials**

Use EPR to create value chains which can allow secondary resources to compete with virgin ones. The industry will automatically shift to secondary resources.

- **Develop Circular Economy Evaluation Indicators**

Evaluation Indicator Systems viz. Comprehensive Indicators, Work Indicators, and Reference Indicators for Circular Economy Development should be defined to prudently monitor the progress of implementation of CE in the country. The Comprehensive Indicators reflect the core concept that circular economy emphasizes efficient use of resources and their recycling and reuse.

4 ADOPTION OF CIRCULAR ECONOMY-ACTION PLAN & TIMELINES

4.1 ACTION PLAN

To create a Circular Vision for Electronics and Electrical Equipment Sector, the roadmap needs to cover systemic lifecycle thinking towards digital transition of the Indian economy across the extraction, production, consumption and end of life stage. The committee proposes to draft the action plan with key measures (short, medium and long term) across EEE value chain rather than e-waste only so that MeitY can provide an impetus to address sustainable product policy in India. The Action Plan Table is given below:

Life-Cycle Stage	Objective of Action/ Challenge Affected	Affected Stakeholder Group	Recommendation	Action	Implementing Agency/ Actor
Raw Material Acquisition	Security of Critical Materials	Producers Component Manufacturers	**Institutional** - • Institutional arrangement to track availability of critical materials for India and how secondary resources can contribute to meeting certain percentage of the demand. • Support in setting up material sampling labs across the regions to as to assess the material value in the end of life product **Regulation/Guidelines** - • Mandatory use of certain percentage of critical materials sources from secondary materials. (Medium to Long term) • Promotion of technology for extraction of maximum number of materials through technology development/transfer, innovative finance mechanisms and schemes. **Promotional -** • Incentive for producers using critical materials from secondary resources. • Incentives to set-up infrastructure for recovery of secondary materials	**Short Term (1-2 years):** ○ Study on critical materials and potential contribution of secondary raw materials (SRM) if they are recovered. **Medium Term (3-5 years):** ○ Establishing a mechanism to digitally track the use of critical materials in India and their supply from mining e-waste. This can also be set up like PROSUM project in the EU to digitally track material specific data from electronic, automobiles, construction, mining waste and solar panels. **Long Term (5+ years):** ○ Future incentive schemes (like PLI Scheme of MeitY) should mandate for use of critical materials from secondary resources	MeitY, MoEFCC and Ministry of Finance
Design, Component Manufacturing, Product Assembly	Design for Recycling/Disassembly/ Extension of product-life	Producers	**Regulation / Incentives for –** • Future Production Linked Incentive Scheme (PLI) of Government of India to include: o design for recyclability o Standardisation of interfaces of accessories like chargers, headphones o Modular structures of product to enable easy replacement of components and parts and allow upgrading o Design requirements of ICT/ CE devices to evaluate scope for	**Short Term:** Compilation of best practices, global standards related to design for recycling and extension of product life. Standards to check forced obsolescence in electronics. **Medium Term:** Development of standards and guidelines for manufacturing. Developing metrics for linking PLI with design for recycling	MeitY, MoEFCC and Ministry of Finance, Ministry of Skill Development & Entrepreneurship

			Indian eco-design programme. • All Producers to give an integrated Implementation PLAN to the regulators defining geography, in collection, segregation, transportation, dismantling and sustainable disposal product wise and to which recyclers as per laws. o This needs to be given for every year as per the norms already or in the 1st month of operations. o More emphasis and investments by producers through the EPR agreements in investing to widen the entrepreneurs, start-ups to bring more institutions in the E-Waste sector to meet the increasing demands. More new players on capacity building to happen.	and extension of product-life. **Long Term:** Sustainable Product Policy to be developed by MeitY for mandatory design for recycling, and extension of product-life. More systemic focus to be maintained on R&D on a regular basis to bring out the new cost-effective, locally manageable technologies; processes, to encourage innovators, startups, NGOs.	
Consumption Stage	Product obsolescence / Extension of product-life	Consumers	**Promotional** • Resource Efficiency/Circular Economy labeling • Eco-labelling on the products in the % use of recycled materials in the product to create the consumer awareness in recycling aspects of products. • Repairability guidelines with modular designs, availability of spare parts and remanufacturing possibilities • Product subscription/ lease models across various product categories • Regulation to increase EEE warranty from 2 to 6 years, measures against planned obsolescence, • Legal warranty of second hand products • Promote Green public procurement (GPP) by Government agencies	Awareness programs on e-waste management, RE/CE labels. Skill Development for repair centres To ensure bulk consumers alignment to the products complying the best practices Creating awareness on the toxicity of the use of various materials in use within products through labelling	Producers/ MoEFCC/MeitY/ Electronics Skills Council to support and design skill development programmes for repair and refurbishment
End-of-Life Stage **Collection Systems for EOL EEE products/ Components**	Enhancing responsible disposal by consumers at e-o-l • Ease of participation • Financial Transparency across collection and recycling • Auditability of Systems • Formalisation of informal sector into collection;	Consumers/Producers	**Policy instruments for Producers** • Recommended 'Costs of Compliance (CoC) (EPR budget)'on a per kg basis for each type of product put on the market. Costs of compliance to be estimated in a scientific way. • CoC, to always ensure certain actions to be mandatorily done in the domain of waste-pickers-informal sector inclusivity and for the stakeholder's awareness, building clarity in safe use and disposal, across supply chain for Electronic and electrical waste (EEW). • EPR budget to be calculated using the prescribed costs of compliance. Budget to cover consumer awareness, collection	**Short term:** -Detailed analysis to estimate the costs of compliance for each and every product - For the informal sector, including the small aggregators investments to made to strengthen their skills in dismantling, machinery and systems approach to bring materials efficiency. -Analysis of EPR finances spent by companies in the past years to understand what was done to meet collection targets. -Revision of E-waste Rules	CPCB/ MeitY/Private Sector/think tanks/research institute/Bilateral/multilateral agencies.Ministry of Skill Development and Entrepreneurship

	Recognise the role of informal sector		(procurement), logistics and recycling, which should be defined in the Annual Implementation Plan given by PIBOs to the regulators. All activities to be done at the level of the PRO/Waste Management Agency (WMAs) and that needs to be agreed in their annual contracts with defined actions and budget-lines in Quantity, Quality and timeframe. • All PROs and WMAs should always furnish the ULBs and the SPCBs/CPCBs as the case could be on the collections and recycling. • Mandatory and full public disclosure of money spent by producers from the escrow account for EPR compliance. • Guidelines for auditing on material+ financial flows+value chains for each kind of product item • Develop standard TORs/methodologies for inventorisation of state level e-waste generation by SPCBs **Policy instruments for Consumers/Bulk Consumers** • Price range at which Bulk Consumers / Consumers can sell their e-waste for recycling • Ban on Auctioning **Schemes/ Incentives for informal sector** • Schemes linked to Green Skill Development Programme for informal sector to transition to formal economy by becoming collection agents and transition away from informal recycling	-Analysis / calculation of monies that consumer/bulk consumer can demand when they handover/sell an unwanted product/accessory for recycling. The money would depend on the type of product being handed over for recycling. This money would be estimated by calculating the value of materials in a product type. -Amendment of GFR -Develop criteria for identifying the products with best environmental performance in the focus industry sector or product group. -Integration of informal in short term in collection systems **Medium term:** -Conduct material flow and financial flow analysis -Develop a methodology/basis for calculation of EPR calculation cost. Use value chain methods for estimation of costs for ensuring collection, transportation, dismantling and recycling of the product. A service markup fee should be paid to each PRO. - Create skill development schemes to train and register formal collection agents which can be a part of "Green Skill Development Programme" **Long term**: -Development of the guidelines for auditing on material + financial flows	
Recycling/ Recovery Stage	-Strengthening Recycling Systems by focusing strongly on depollution practices - Create pathway for clean transparent recycling systems to	Producers/Recyclers/Dismantlers	Regulations/Incentives • Introduction of recovery targets covering both toxic and non-toxic fractions • Enabling Material Balance • Incentives to set-up advanced recycling units • States to set-up a model dismantling/recycling unit • Standards for dismantling/recycling units including de-pollution practices to ensure removal of toxic fractions	**Short Term** -Skilling of the informal sector so that they can be formalised either with existing recyclers or become entrepreneurs. -Using schemes and incentives from the MSME ministry to develop CFCs for the micro enterprises in this sector and enable technology and infrastructure along with smart financial instruments	Consortium of national and international consultants – Led by MeitY

	come up in multiple states -Enable advance recycling set-ups which can manage toxic fractions and/or can recover critical materials		Promotional • Development and identification of solutions for different types of e-waste fractions post dismantling • Creating a repository of all approved solutions • Recognition/evaluation of existing solutions for non-toxic fractions • Recycling Vs. Refurbishment – Auctioning – Economic analysis of material for recycling • MeitY tech proliferation – Technology and blended financing through SIDBI SME loans to be evaluated for business purpose • EU CEN/CENELAC standards can be adapted for Indian context – EU-REI initiated a scoping study (with MoEFCC) with partners like WEEE forum, Umicore, adelphi etc.	can develop capacities for formal recycling of e-waste in India. **Medium term** Techno-financial analysis providing comparison of recycling/refurbishment techniques and technologies available locally and globally. **Long term** Joint collaboration initiatives supporting upgradation of the informal sector workers in the value chain to be supported. Ongoing GIZ DPP initiatives are one such tool to support collaborations across private sector and public sector	
Secondary Raw materials	Creating a market for secondary materials	SRM Suppliers/Producers	**Regulation/Incentives** • Target for utilization of secondary materials • Incentives for secondary material usage by producers	Use EPR to create value chains which can allow secondary resources to compete with virgin ones. The industry will automatically shift to secondary resources	MoEFCC /MeitY/Make-in- India
Circular Economy Evaluation Indicators	Creating benchmark for CE approaches	Producers/ Recyclers	**Regulation/Incentives** • Effective monitoring of CE implementation and progress	To evaluate the performance, productivity and waste discharges	MeitY/ MoEFCC

ANNEX: CASE STUDIES AND BEST PRACTICES

Brief description of case study/best practice
Clearinghouse/coordination body for WEEE management in EPR competitive schemes, CdCRaee in Italy - The CdC RAEE is managed and governed by Italian PROs under the supervision of the Ministry of the Environment and Protection of the Territory and the Sea and the Ministry of Economic Development. - PROs have the obligation to register to the Coordination Center. It operates to guarantee the collection of WEEE in the collection network. It also manages incentive programmes like the "Premi di Efficienza''. - An advanced reporting system allows for adequate reporting of the tonnages of WEEE sent for treatment and transparent communication to the competent institutions the extent to which the goals have been achieved by the multi-consortium system. - The CdC RAEE also collaborates in defining the methodology for the adequate treatment of WEEE and ensures responses to collection requests from the disposal centres. It also collects and reports data relating to collection and treatment. - The CdC RAEE also stipulates specific agreements with municipalities, collection companies and national trade associations of Producers, Distribution and Treatment Companies, thus ensuring the monitoring of the WEEE flows, divided by grouping and sorted to the PROs. **References** - https://www.cdcraee.it/GetHome.pub_do - https://weee-forum.org/wp-content/uploads/2020/11/EPR-and-the-role-of-all-actors_final.pdf
Modulated EPR fees in the EU - According to Article 8a of the EU Waste Framework Directive, EPR schemes (and hence PROs) need to ensure that their fees are modulated, notably by considering their durability, reparability, re-usability and recyclability and the presence of hazardous substances - The modulated fees serve as incentives for producers to design products that contribute to waste prevention and facilitate recycling **References** - https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L0851&rid=5 - https://erprecycling.b-cdn.net/wp-content/uploads/2018/06/ERP-Background-Paper-Modulated-Fees-June-2018.pdf
Incentive scheme for WEEE recycling scheme in Ghana - In Ghana, e-waste is mainly recycled informally. One key challenge is how existing collection structures can be used while collected e-waste is channelled to sound recycling. One concept to do so is to incentivise collection at the condition that collected e-waste is handed over to sound recycling. - This project made a test of such an incentive and payment system for selected e-waste types in Accra, Ghana. In this test, a temporary handover centre offered monetary incentives for waste cables. These incentives were paid-out to supplying individuals upon delivery. As the default option for the treatment of cables on a scrapyard is burning, the idea was to transform the current cable waste value chain into a sustainable value chain. - The incentive-level was set slightly above the local material value of the cables in order to pay for the service of collection in addition to the material value. The aims of this test were to: a) develop and test implementation, pricing, transaction & documentation modalities; b) test and document market reactions to such incentive-based collection; and c) collect and document lessons-learned from this exercise to facilitate comparable e-waste management models in Ghana and beyond. **References** - https://www.giz.de/en/downloads/giz2020_en_incentive_based_collection_e_waste%20_ghana.pdf

Reduced VAT on repair services, Sweden

- As of January 1st 2017, the Swedish government has introduced a 50% tax break for using repair services on consumer goods. The proposed approach foresees a VAT tax cut from 25% to 12% for various product groups (including e.g. clothes, shoes and bicycles). It would additionally allow people to get income tax deductions for repairs of larger household appliances.
- The measure is considered to create new job opportunities for those lacking formal education, promote conscious consumption behaviour and reduce carbon emissions for imported goods in particular.

References

- https://knowledge-hub.circle-lab.com/article/3624?n=Government-tax-break-program-for-repair
- https://www.weforum.org/agenda/2016/10/sweden-is-tackling-its-throwaway-culture-with-tax-breaks-on-repairs-will-it-work/

Right to repair initiative in the EU

- The EU parliament has introduced a new report in 2020 to promote reuse as well as repairs and tackle premature obsolescence (production practices that shorten the lifespan of products) at EU-level, by making repairs more appealing, systematic, and cost-efficient. This could be achieved by extending guarantees, providing guarantees for replaced parts, or better access to information on repair and maintenance.
- Members of the Parliament suggest to label products according to their durability in the future (e.g. by providing clear information on the estimated lifespan of a product). Harmonized mandatory labelling is considered a necessary prerequisite.

References

- https://www.europarl.europa.eu/news/en/press-room/20201120IPR92118/parliament-wants-to-grant-eu-consumers-a-right-to-repair
- https://repair.eu/about/

WF-RepTool in the EU

- A WEEE expert group, including representatives of the WEEE Forum developed a software application for the reporting of de-pollution and to do the calculation of recycling and recovery rates of WEEE in a uniform way. It aims to promote the development of WF-RepTool reports which is a document (a database entry) of aggregated data about the treatment of WEEE.
- The tool monitors downstream fractions for WEEE in accordance with the requirements of both the WEEELABEX and CENELEC EN 50625 standards.
- It considers the following processes:
    - Recycling
    - Other material recovery
    - Energy recovery
    - Thermal disposal
    - Landfill and other disposal
    - Preparation for re-use
- A Working Group improves the tool annually, based on new developments and expectations for upgrades.

References

- https://www.wf-reptool.org/

I4R Platform in the EU

- Since the introduction of the Article 15 of the Directive 2012/19/EU (WEEE Directive), EU manufacturers are required to collect information about reuse and treatment for each type of EEE according to a harmonized reporting format for each product. To better respond to recyclers' needs, APPLiA and DIGITALEUROPE have created an online platform – the Information for Recyclers Platform (I4R) – where recyclers can access recycling information at product category level.

- The platform informs managers in the recycling sector as well as organizations preparing for reuse and trains workers on safety issues. In addition, I4R helps recyclers to optimize sorting and allows e-waste recyclers as well as preparing for reuse organizations to access information about the presence and location of materials and components that need separate treatment.
- The platform is structured around six EEE categories:
    - Large household appliances
    - Small appliance
    - IT equipment
    - Cooling and freezing appliances
    - Temperature exchange equipment
    - Screens

References

- https://i4r-platform.eu/about/
- https://weee-forum.org/information-4-recyclers/

Urban Mine Platform in the EU

- The Urban Mine platform was developed as part of an EU funded project called PROSUM (Prospecting Secondary raw materials in the Urban mine and Mining wastes). It displays available data on products put on the market, stocks, composition and waste flows for electrical and electronic equipment (EEE), vehicles and batteries for all EU 28 Member States.
- It enables access to an extensive library of more than 800 source documents and databases used to populate this platform.
- The data includes those elements and materials found to be of high abundance in EEE waste products including base metals, precious metals and those listed as Critical Raw Materials.
- The platform allows the end-user to generate charts illustrating the amount of a relevant element, e.g. platinum, in the stock in EEE, vehicles and batteries for any given country from 2000 to 2020, generate waste flows and export the data.

References

- http://www.urbanmineplatform.eu/homepage
- http://prosumproject.eu/sites/default/files/DIGITAL_Final_Report.pdf

WEEE Park Hong Kong, China

- The Hong Kong Government together with ALBA IWS designed and built the Waste Electrical and Electronic Equipment Treatment and Recycling Facility (WEEE·PARK). With equipment from the German company the facility will be operated until 2027. The Park processes refrigerators, TVs, computers, washing machines and air conditioners into valuable secondary raw materials while controlling the management of the hazardous materials that are contained in this equipment.
- The Park is supposed to deliver recycling rates of over 80% and transform up to 30,000 tonnes of regulated e-waste back into raw materials each year.

References

- https://www.weee.com.hk/
- https://www.weee.com.hk/materials/mediace/20180409154239.pdf

Circular economy eco-system in Japan

- Comprehensiveness and collaboration are at the heart of the Japanese circular economy system. The public plays a part by separating out recyclables, paying recycling fees directly and holding companies to account when necessary. Manufacturers do their bit by using more recycled materials, and making longer-lasting products that are easier to repair and recycle. The key features of CE are

Consumer-friendly collection: the system for collecting old appliances for recycling is so comprehensive and easy to use that it is harder not to recycle them. Old appliances are collected by retailers either in store or when delivering a new appliance. For old IT equipment, the manufacturer can be requested to collect it by local authorities from the doorstep, or it can be taken to any post office to be returned to them. This is routine across Japan, making it well understood and widely used.

Consumers pay fees up front: for electronics, the cost of transport and recovery is paid for at the point of purchase, meaning that the customer does not have any disincentive to participate when a product comes to the end of its life. Penalties for fly tipping are also stiff.

Recycling infrastructure is co-owned: the law requires consortia of manufacturers to run disassembly plants, ensuring they directly benefit from recovering materials and parts. Companies therefore invest for the long term in recycling infrastructure. And because they own both manufacturing and recovery facilities, companies send product designers to disassembly factories to experience the frustrations of taking apart a poorly designed product. Some companies even put prototypes through the disassembly process to make sure they are easy to recover.

Japan's system is built on the assumption of collaboration, but the system also incentivises everyone to do the right thing. This model, neatly summarised as 'honesty, with incentives' shows that effective Japanese systems help to reinforce Japanese public spiritedness. The result is that system is highly profitable.

URL: Environmental Scientist, Journal of the institution of Environmental Sciences, D. Benton and J. Hazell, P:55-59, 2015

South Korea

Eco-Assurance system(ECOAS)

The Eco-Assurance System in South Korea is designed to minimize environmental loads through systematic management of entire life cycle of electrical products, electronic devices and vehicles, in order to reduce wastes generation and promote recycling activities thereby promote circular economy. The ECOAS can be classified as preventive regulation and follow-up management regulation. In the preventive regulation, the contents are designed to reduce the hazardous substances in the products, to satisfy the obligation target of recycling, to improve the materials and structures for recycling, and to exchange recycling information. In the follow-up management regulation, the contents are designed for manufactures and importers to deal with the obligation target of recycling, to satisfy the recycling methods properly. The ECOAS tries to encourage the recycling with systematic management of E-waste and vehicle products using life cycle approach. Main objective of the ECOAS is to collect e-waste items as much as possible from producers and local authorities in nationwide. In addition, it makes recycling easier by considering the recycling of waste at the design stage of electronics and restricting the use of hazardous substances in those products. With the introduction of ECOAS, the recycling rate of E-waste was increased gradually with reducing hazardous substances.

URL: S-W-Rhee, Beneficial use practice of e-wastes in Republic of Korea, Procedial Environmental Sciences, 31, 707-714 (2016), https://www.researchgate.net/publication/301745519_Beneficial_Use_Practice_of_e-wastes_in_Republic_of_Korea

China

China implemented circular economy as a new model to make better use of resources and energy. Since then, the model has become an integral part of the national economic strategy, and has been built upon throughout the last three Five Year Plans. The adoption of the Circular Economy Promotion Law in 2008 marked China out as a frontrunner in circular economy legislation. Early efforts to implement the circular economy revolved around the transformation of industrial parks, by creating 'symbiotic relationships' in which the waste from one process is used as input for another. With regards to waste management measures, China adopts reuse, recycling, waste trade markets, and industrial and urban symbiosis, which allows waste products to remain in circulation. The CE concept in China was implemented in three layers: Micro, meso, and macro.

At the state level, the National Development and Reform Commission (NDRC), responsible for the planning and coordination of the circular economy in China, oversees a scheme called 'Trade Old for Remanufactured', along with other ministries. Customers get a 10% discount if the trade on their old equipment for remanufactured items; and the Ministry of Industry and Information Technology (MIIT) support in other ways including administering an official remanufacturing certification scheme and publishing an annual seven-volume catalogue of official certified parts. In China, cleaner production, eco industrial park, and low-carbon cities are implemented to improve the circularity of products at the manufacturing/production stage.

URL: In the name of circularity: Environmental Improvement and Business slowdown in a Chinese Recycling Hub, Y. Schulz and A. Lora-Wainwright, Journal of Interdisciplinary studies, 2(1), 9, 1-13 A.2019.

United States of America

Recovering resources from used smartphones and laptops accelerate adoption of low-carbon energy and create a domestic supply of minerals that the U.S. typically imports from other countries. Policy will play a key role in realizing this potential, but the U.S. lacks comprehensive federal e-waste regulations. Over 20 years ago, the Environmental Protection Agency (EPA) tried to develop federal policy through a multi-year effort involving a broad group of stakeholders, but the effort fell apart due to lack of agreement over financing mechanisms.

Due to federal inaction, states began to pass their own laws to create and fund electronics recycling. To date, 25 states have some type of regulated e-waste program. Each is slightly different, but most use an extended producer responsibility model requiring manufacturers who sell common electronics in that state to help fund their recycling.

State programs are now reporting lower collection volumes year-over-year. This decline is particularly challenging for those states that set collection targets based on pounds recycled. Some of these targets are set as a percentage of new products that manufacturers sell into that state. But as products sold get lighter, this mismatch means it is increasingly difficult for states and the obligated manufacturers to keep collecting at a pace to meet their targets.

Beyond the "patchwork" of state policies and local programs, advancing U.S. e-waste management will require comprehensive action on multiple fronts. Investment in recycling infrastructure to build capability for recovering high value and scarce materials is one of the prime requirement. Another pathway is green design of electronics, whether through electronics purchasing standards or extended producer responsibility that requires product designs be easier to disassemble and repair. Policies that emphasize education and information sharing may spur consumer awareness of and participation in e-waste programs. The greatest benefit, however, can arise from capturing the sustainability benefits of electronics, without paying a high environmental price.

URL: https://thehill.com/opinion/energy-environment/536768-electronic-waste-in-the-us-is-changing

Committee for Circular Economy on Electronics Waste, constituted by NITI Aayog, New Delhi

Shri Ajay Sawhney, Secretary, Ministry of Electronics and Information Technology, Chairman
Shri Naresh Pal Gangwar, Joint Secretary (HSM), Ministry of Environment and Forest, Member
Shri Neeraj Sinha, Adviser(S&T), NITI Aayog, Member
Dr. Sandip Chatterjee*, Director, Ministry of Electronics and Information Technology, Member Convenor
Dr. R Ratheesh, Director, CMET Hyderabad, Member
Shri Binay Kumar Jha, Director, Ministry of Urban & Housing Affairs, Member
Prof. Kalyan Bhaskar*, XLRI, , Member
Prof. Brajesh Dubey, IIT, Kharagpur
Shri Prabhjot Sodhi, Head, Circular Economy, UNDP, Member
Prof. KK Pant, IIT Delhi, Member
Prof Rama Mohan Turaga, IIM Ahmedabad, Member
Shri George Paul*, CEO, MAIT, New Delhi, Member
Dr. Ashish Chaturvedi, Director, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), India,Member
Dr. Rachna Arora*, Team Leader & EU – REI,GIZ, India, Member
Dr. Shalini Sharma, Co-Founder & CEO, Sanshodhan An E-Waste Exchange, Member
Shri Pranshu Sighal*, CEO, Karosambhav, New Delhi, Member
Smt Radhika Kalia, Managing Director, RLG Reverse Logistics Group, India, Member
Dr. P Parthasarthy, Managing Director, M/s E- Parisaraa Pvt. Ltd. Bangalore, Member
Dr. Ashok Kumar, Director, Greenscape Eco Management Pvt. Ltd, Member
Shri Nitin Gupta, Attero, Member
Shri Karan Thakkar, Founder & CEO, The Recycling Company, Member

**MeitY acknowledges the contribution of the above members in drafting the report*