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Information Technology
Government of India

CIRCULAR ECONOMY IN ELECTRONICS AND ELECTRICAL SECTOR

ACTION PLAN

Ministry of Electronics and Information Technology
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New Delhi

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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 consumer of raw materials produced globally, and with the current economic trend, estimated to consume nearly 15 billion tonnes of material by 2030. 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 (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 one of the elements of circularity principles (end-of-life management). Enhancing circularity and resource efficiency make business sense for manufacturers to design the products to last longer, enhance recycling and recovery of secondary resources 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 that are built to last longer , quality assurance for repair and refurbished products, investment in its labor force and advanced recycling technology to extract 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 MeitY to formulate an action plan for implementation of circular economy principles in the e-waste sector. Before finalizing the report, comments of stakeholders and public opinion were obtained, wherein diverse views of manufacturers emerged. A task force was thus constituted for a balanced view and graded approach for phased transition to CE. This action plan is a concerted effort, based on the recommendations, for seamless implementation across the country. It recommends adoption of CE principles in EEE sector considering whole life cycle stages of products while focusing on end of life management, recycling and secondary raw materials utilization so as to lay strong foundation for expansive adoption of CE principles in the sector. The action plan also recommends material acquisition, design and other circular economy principles for electronics sector at large, which may be considered in the long- term by way of a "Sustainable Product Policy" in-line with global frameworks and best practices.

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, self reliance 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, commenced in August 2020, invested ₹2,336 crores and produced goods worth around ₹54,357 crore in March 2021 and additional employment generation during this period, stands at around 12,350 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[1]. The domestic electronics manufacturing sector in India has seen significant growth in the last six years. Production of electronic goods in India

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

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.

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[2].

Taking cognisant of the resource and environmental challenges faced by the world, the United Nations General Assembly, in 2015, had 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, such as, 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 EEE manufacturers have announced their specific response plan and strategies for aligning with specific SDGs.

India is the third largest consumer of raw materials produced globally. If current economic trends persist, then India's material requirement could be nearly 15 billion tonnes by 2030, and little above 25 billion tonnes by 2050. In order to fulfil the resource need, it is imperative that India should also follow circular economy approach rather than the current linear economy principle of take-make-dispose.

Electronic and Electrical Equipment (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 is a key challenge, is one of the rich source 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[3]. The growing

[2]Minter Adam, "How We Think about E-Waste Is in Need of Repair," Anthropocene, October 2016, www.anthropocenemagazine.org/ewaste-repair
[3]http://ewastemonitor.info/wp-content/uploads/2020/12/GEM_2020_def_dec_2020-1.pdf

amount of e-waste is directly linked to higher consumption rates of EEE, due to rapid technological advancement and changing consumer preferences. Asia generated the highest quantity of e-waste in 2019 at 24.9 Mt, followed by the America (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 e-waste estimated to have been generated in the country during 2018-19 and 3.5 per cent of that generated in 2017-18, said a recent report by the Central Pollution Control Board (India collected just 3% e-waste generated in 2018, 10% in 2019: CPCB report[4].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 giving 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 design (like RoHS) and sustainable manufacturing of EEE, development of circular 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 so as to lay a strong foundation for expansive adoption of CE principles in the sector.

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

[4]https://www.downtoearth.org.in/news/waste/india-collected-just-3-e-waste-generated-in-2018-10-in-2019-cpcb-report-75072

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 important for the growth of 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, which 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 principles in electronics and electrical sector would generate better outcomes for the society and environment at large.

In short, if India can tackle systemic challenges which can lead to integration of circularity principles across the life cycle stage of products wherein it can ensure recovery and utilization of secondary raw materials, circular products that are built to last longer, quality assurance for repair and refurbished products, investment in its labour force and advanced recycling technology to mine secondary materials from e-waste, enabling circular growth in electronics sector and ultimately resulting in enriched livelihood, enhanced quality of life and sustainable access to resources.

The existing regulations and policy could 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 notified by the Ministry of Environment Forests & Climate Change (MoEFCC) for responsible collection, channelization, recycling and management of e-waste. Enhancing circularity and resource efficiency makes business viable for manufacturers and hence provides incentives for circular products that are built to last longer, reduce demand for resources, enhance recycling and recover higher amount of secondary resources in production processes to bring down costs. That makes producers competitive and also leads to minimize EPR costs without a significant impact on the bottom-line.

Moreover, the initiatives of circular economy can leverage the existing programmes and schemes of Government of India like Swachh Bharat Abhiyan, Smart Cities Mission, Atmanirbhar Bharat, Digital India and others for better outreach and normalisation.

1.1 Objectives

The objective of this report is to address material and resource security under 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 the whole life cycle of the products will embrace Circular Economy approaches so that resource materials will be consumed in judicial manner. The action plan also supports in enabling a framework of the draft Resource Efficiency (RE) policy

(MoEFCC, 2019) [5] through digitalization, promotion of standards across e-waste value chain, technology roll out through blended financing, skills and awareness creation, 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.

In this direction, MeitY has taken various steps earlier as well. In 2019, MeitY and NITI Aayog had published the 'Strategy on Resource Efficiency in the Electronics and Electrical Equipments Sector' encompassing an Action Plan[6]. Besides, MeitY has also supported development of cost-effective environment friendly 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 plays an important role on the environmental impact of a product. MeitY, responsible for promoting electronics manufacturing in the country, can, thus, play a crucial role in enabling a holistic approach on circular economy in the EEE sector by providing necessary vision and guidance.

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 approaches to manufacture through environment-friendly methods that promote circularity enhances the ability to extract secondary resources that could 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 may provide opportunity to producers for ensuring access to secondary materials on a continuous basis.

[5] http://moef.gov.in/wp-content/uploads/2019/07/Draft-National-Resourc.pdf
[6] https://www.eu-rei.com/pdf/publication/NA_MeitY_RE Strategy in EEE Sector_Jan 2019.pdf

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 only 17.4 % of e-waste was collected and recycled in 2019 leading to loss of nearly $47 billion 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-tech defence equipments, when mined from the e-waste, offers great opportunity for ensuring availability of these resources in future.

In India, lack of domestic reserves and supply of rare earth elements, makes circular economy even more important, since 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, in India, currently informal sector 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 and wastage of resource material. Besides, the methods used for extraction are risky, unscientific and hazardous to human health and environment. The problem has further accentuated due to lack of capacity development for this sector, leading to lower resource efficiency in recycling of e-waste and recovery of secondary raw materials. It has been observed that access to material is much easier for the informal sector because of the widespread network. Over the years, connections between informal actors in different cities has been established, which has also been documented in several studies (Mehra 1985)[7].

The PROs/ Recyclers may formally engage the informal waste pickers (Kabadiwala) with mutually accepted financial model. The Urban Local Bodies (ULBs) should facilitate the required assistance for this integration. The PROs/ Recyclers along with ULBs should undertake capacity building and skill development for the informal waste

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

pickers, so that they can operate in safe and healthy condition. This will enhance resource efficiency of the collected wastes by the informal waste pickers and better economic benefit[8].

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

1.2.2 Environmental Benefits

The sustainable and circular products will lead to reduction in waste generation and enhanced resource recovery from e-waste, which in turn will reduce extraction pressure, especially for the rare earth elements that are predominantly found in bio-diversity rich areas, besides save related costs. Reduced mining would further provide opportunities for landscape restoration and regeneration of degraded mined areas. Environment friendly e-waste recycling technologies will also prevent pollution emanating from existing crude methods, as also, the landfilling. Responsible and circular resource use can also contribute towards reduction of Greenhouse Gas (GHG) emission 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 poverty reduction. Recovery of resources and domestic manufacturing can further enhance access of such products to greater number of people.

CE approaches can contribute to provide circular products that are built to last longer and better consumer experience. Given the current level of integration and digitalisation of the world, access to end of life options for all sections of society is important.

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 and better livelihoods to the informal operators. 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 reduced ecological footprint by changing the production and consumption pattern of goods and resources. Efficient management of shared natural resources, and scientific disposal of toxic waste and pollutants, is important targets to achieve this goal. Encouraging

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

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. Circular 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 product, built to last longer and is repairable with reduced toxicity, higher material efficiency, and better recovery.

For a circular business model, government policies and business action need to support circular economy through mobilizing the potential of digitalization of products and whole life cycle of the products including recycling quotas, achieving higher recycling rates, better recovery and value of resources. Enabling circular economy entails a paradigm shift to focus on a change as a policy package for the electronics and electrical sector.

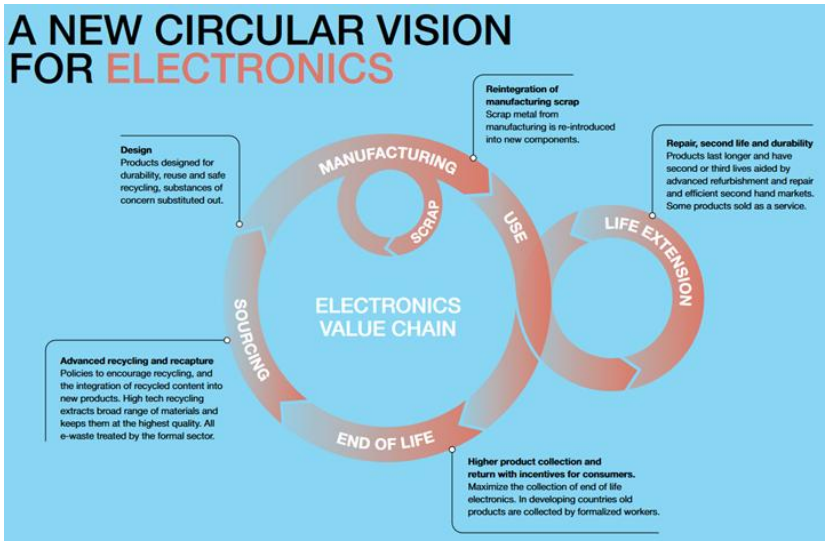

Figure1: Schematics of Circular Economy in Electronics sector

Raw material security: addressing sustainable product package/ policy wherein material sourcing can look at reduction in 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 that are built to last longer, less toxic and easy to dismantle and recycle.

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, 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 products with high recycled content; encourage traceability of secondary materials; financial incentives/tax breaks for use of secondary materials.

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

Governments across the world have been emphasizing 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 released several strategy papers on broader policy direction that can be implemented by the government to mainstream a resource efficient and circular Indian economy.[9] One such report entitled, "Strategy on Resource Efficiency in Electrical and Electronic Equipment Sector" has been prepared by NITI Aayog along with Ministry of Electronics and Information Technology.[10]

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. 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') were instrumental in 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 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 and acute shortage of input feedstock (e-waste). Collected e-waste is also facing the disposal challenges due to inadequate 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, which were increased to 407 with a capacity of 11.10 lacs MT in 2019-2020. Majority of recyclers could not even

[9]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.
[10] Resource Efficiency in the Electrical and Electronic Equipment Sector. MeitY

processed 50% of their licensed capacities. There is a major challenge of leakages of the collected waste to informal recycling facilities due to various reasons and, therefore, a significant quantity of the generated e-waste is still being processed by informal sector. 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 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 following figure:

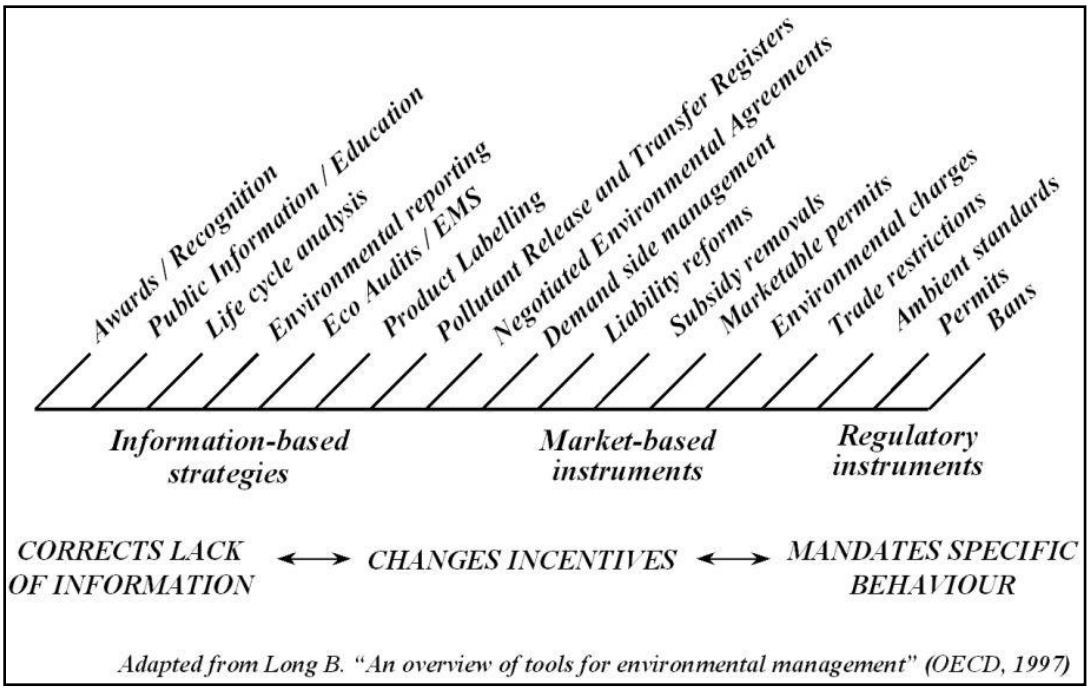

Figure2: Tools and Instruments for Environmental Policy

Today, a variety of products are available and different stakeholders are involved. Therefore, a single policy tool would not be able to meet the requirement.

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 pattern include creating awareness for environment protection and providing relevant environmental information about product to the consumers for better purchasing decisions as per their preferences, as also, for proper usage and disposal.

The customers need information on the relevant environmental, health and safety aspects of the product so as to choose the products with best environmental performance. This information must be easy to understand, readily available and comparable.

2.1.2 Market based instruments

(i) Incentives for Front-Runners (Producers)

A front-runner approach may help in incentivising manufacturers for developing green products. This would aim to move the market to the sustainable direction. Through this approach, products with the best environmental performance in the market and its manufacturers should be identified for recognition. Standards could be established on the basis of the products in market with 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 as 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[11] and with further digital push due to COVID 19 pandemic compulsion, the contribution might have increased further. The Government procurement policies and measures could provide crucial support for market transformation and acceptability of circular products/ services. The sustainable product procurement will motivate producers to design circular products that are built to last longer and less toxic, thus, beneficial for consumers.

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 should coherent with the spirit of rules and regulation concerning public procurement.

- The purchasing organisation could select the products as per its needs keeping in view the environmental aspects.

(iii) Incentivizing Producers/Importers/Brand Owners

A mechanism to incentivize the producer through rebate schemes for using secondary raw materials back in the manufacturing process and innovative business models can be envisaged. This will add the value proposition to the e-waste value chain with optimized value return from raw material extracted from the waste.

(iv) Infrastructure to promote CE adoption in the country

Adoption of CE principles in the country is an ongoing effort and journey. It would be crucial to ensure that the requisite infrastructure and capacity building measures should be available for the successful adoption.

(v) Due consideration for Micro, Small and Medium Enterprises (MSME)/SME manufacturers

The policy measures may consider extended implementation timelines and/or other flexible measures as may be necessary for MSME/SME sector to ensure their

[11] https://ourworldindata.org/grapher/historical-gov-spending-gdp?country=~IND

readiness, capacity and capabilities to adopt the suggested circular economy principles.

2.1.3 Regulatory instruments

(i) Coverage of e-waste categories

The categorisation of products and components in Schedule 1 of the E-waste Rules needs amendment based on either the toxicity or the resource efficiency potential. Such amendment might be based on the EU's definition on EEE products (i.e. products operating upto 1000 V DC to 1500V AC) in a phased manner through adequate research, feasibility study and stakeholder consultations across the industry and its sub-segments to ensure recovery of valuable secondary raw materials from end-of-life products. While considering EU definition to expand the scope of the E-waste Rules, it would be important to consider the relevant exemptions (especially industrial, medical, research and development) as well.

(ii) Inventory of e-waste

The proper inventory of e-waste is very important for planning/ creating requisite collection and recycling infrastructure. UNEP has indicated five methods for estimation of an inventory of electronic waste, based on the 'materials flow'[12]. Each method has its own applicability and strength. While, the Time Step Method and Market Supply method use data from producers to estimate e-waste at the end of a time period, Approximation Method uses consumer sales data for estimation. The Carnegie Mellon Method (CMM), one of the complex method, visualize situations arising due to practice and attitude of users towards product disposal to arrive at the quantum of e-waste, and reflect the true number of products that is likely to be disposed of by the users.

The CMM is best suited to India, as per one market study carried out by MeitY. The sales data along with combined average lifetime of new and second hand item is considered for the calculation in CM formula, which is also described in CPCB guidelines for implementation of e-waste Rules. CPCB obtains sales data from the producers through EPR registration and filing returns, which was mandatory. The study also suggested that inventory assessment value should be validated with various reports, such as, Census data, Annual Report of TRAI, Annual Reports of DoT & MeitY, E-Readiness of States, MeitY & MoSPI, NSSO, National Family Health Survey by MoHFW, MAIT's ITOPS, ACE Dialogues by CEAMA, EPR Plan & Returns of CPCB.

The sales data at State Level is presently not available, thus, the State Level inventory would not be feasible. At present, inventory of e-waste can only be assessed in central level. In future, GST data along with sales data may be explored for assessing state wise e-waste inventory.

8 https://wedocs.unep.org/bitstream/handle/20.500.11822/7857/EWasteManual_Vol1.pdf?sequence=3&isAllowed=y

(iii) 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 in the market so 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, an audit mechanism may be evolved in consultation with the producers to resolve any inconsistencies.

(iv) 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 among 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, mitigate the risk of their large-scale displacement and put in place the right policy structures to support domestic CE practitioners and innovators. Integrating 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. Keeping in mind shared responsibility among stakeholders, targets for collection by the producers need to be realistically recalibrated once the new stakeholders and their responsibilities are mapped so that the entire e-waste streams are accounted. Holistic targets for collection and recycling should be considered and allocated to various stakeholders in the ecosystem.

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

Informal sector must be included as a stakeholder in the e-waste rules and mechanisms to be developed to enable them report the volumes that they recycle so as to support the holistic collection and recycling of all e-waste streams. NGO and civil societies can play a vital role in capacity building of informal sectors.

(vi) 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 a 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*).

(vii) 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 to prohibit 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
- MIS : Procurement & movement at all nodes is visible, awareness activities are recorded
- Recycling: Mass-balance of input and output fractions and resource recovery percentages are measured
- Robust SOP for tracing and tracking recycling process and efficient compliance operations should be issued for recyclers, PROs, collection centres and producers . In the present Rule, no clear reference is mentioned to the importance of downstream management.
- 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**

RoHS implementation under the Rules is a self- declaration from the producers which is harmonized with the global practices. CPCB may conduct post-market surveillance to verify compliance of the self- declaration by the producers. The product wise testing protocol and guidelines for the laboratory harmonized with global standards are required without further delay. Authorizing few Government labs (C- MET, Hyderabad is the only Government laboratory *operational* now) would also be important to ensure necessary compliances from producers and also initiate tracking toxic products.

The surveillance for RoHS should stringently be implemented, like BIS and BEE Star Labeling programme, to track toxicity in the products and e-waste.

(vii) Mechanism to trace E-waste

As per the definition of e-waste in the Rules, 2016, 'e-waste' means electrical and electronic equipment, whole or in part discarded as waste by the consumer or bulk consumer as well as rejects from manufacturing, refurbishment and repair processes. A system must be developed to trace e-waste after it has originated or arisen from the consumer until its final disposal is ensured.

(viii) EPR Authorisation, Reporting and Documentation

The process of authorisation requires further improvement and strengthening to ensure better transparency in authorisation procedures and eliminate any possible leakages of the materials to informal channel. The many authorised Producers, PROs, Dismantlers, Recyclers are non-functional on-ground, so keeping them on record may invite obvious leakage of the materials to informal channel.

(ix) 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. The functions of a clearinghouse should include the following:

a) Monitoring and enforcement: to obtain data from all stakeholders simultaneously, to know the gaps in data, that can further be used to report their findings to CPCB. The clearing houses shall ensure co-ordination and share information among stakeholders in the e-waste ecosystem. The clearing houses will minimize the administrative process for states and the regulators to create a centralized location for receipt and processing of registration and reports
b) Central body for recommending improvements in e-waste management to CPCB & MOEF&CC

The best-practice case study of the Italian clearinghouse, which is managed 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.

(x) 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.

(xi) Standards across e-waste value chain

The adoption of resource efficiency standards, benchmarks and best business practices in 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 had highlighted 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, ISO 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

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

(xii) 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 evaluate, and track the cost structures for the entire e-waste value chain.

The cost structures include but are not limited to – raising awareness amongst masses, collecting e-waste from various sources, including making payments to individuals, bulk consumers, waste pickers, aggregators, etc., setting up collection

channels catering to various consumers across the country, social costs of formalizing the informal collectors, logistics of aggregating and moving the collected e-waste to recyclers, dismantling the e-waste, recycling the dismantled fractions, responsible disposal of fractions which cannot be recycled, conversion of recycled material to homogenous/high grade secondary raw material which is suitable for use in manufacturing, etc. Optimizing and monitoring these cost structures by attributing responsibilities to stakeholders across the value chain is critical.

(xiii) 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 e-waste management need to be scientifically/rationally determined and published by a competent body of government on a regular basis. These true costs of e-waste management and compliance can then be referred by enforcement bodies and auditors to assess the compliance of all stakeholders.

EPR guidelines should be seen beyond collection of e-waste, such as, support in developing the infrastructure. The process of applying for EPR may further be elaborated to file various documents with precision. Developing the collection network, training the various stakeholders in the value chain and awareness raising should also be considered as important elements.

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

A detailed system for analysis of the costs of e-waste management should be bought in. This must enable deep analyses of cost of e-waste collection and recycling in the past years to understand the optimum cost for EPR planning and economic viability of e-waste management in the country.

Moreover, an important aspect is to study the price range for each category of e-waste at which an individual or a bulk consumer is selling it. The price range depends on the type and condition of product being handed over for recycling.

The true cost of e-waste management 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 e-waste management 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.

(xv) Benchmarking Price points

A price benchmarking mechanism shall be established for each stakeholder so as to ensure shared responsibility of stakeholders covered in the Rules.

(xvi) Periodic revision of the Rules

The legislations should have ample provision of revision. Flexible and evolving legislations would be helpful to overcome the challenges related to rapidly changing e-waste scenario. The complex socio-economic structures of the emerging economies, necessitates the review and re-review of policy constantly. Reconsiderations at regular intervals will help to identify possible gaps in implementation. The policy or legislations should be in coherence with other major cross cutting policies like Industrial policy, Trade/ import policy, Science and Technology Policy etc.

A system for regular review of the rules should be brought in with valuable feedback and representation from major stakeholders including producers, recyclers, PROs, digital platforms and environment focused NGOs and relevant government agencies.

(xvii) Graded penalties

The Rule 2016 has adequate provision of penalty. However, in order to make the system more effective and seamless enforceability, a graded financial penalty system with sufficient deter may be devised for non-compliances under the Rule 2016. This may be assessed by 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 might be more than the compliance cost. Stringent check on bulk consumers should also be ensured for generation of quantum of waste.

A penalty structure could be introduced in consultation with stakeholders to clearly define low, medium and high penalties in proportion to the severity of non-compliance.

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 and all stakeholders including producers, PROs, recyclers etc. 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 committee should be constituted 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 work of all stakeholders. 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, who 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 sectors, like Steel and Aluminium, 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, the 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 meet 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 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.

- **Guidelines on Materials sourcing**

The guidelines may be introduced to encourage and incentivise producers to disclose the use of secondary raw materials in products.

- **Use of critical materials sources from secondary materials.**

Secondary raw materials must be able to compete with virgin material on quality, supply, and price. Therefore, the manufacturers of secondary raw materials should be incentivised to produce quality and quantity comparable to virgin materials. This will make producers of EEE confident that new products with recycled material content are able to comply with quality thresholds and chemicals legislation (RoHS etc.). Measures to promote recycled or secondary raw material content can be considered when the supply of recycled material is deemed sufficient in terms of quality and quantity.

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

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 could 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 secondary raw material are extracted and utilised.

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 product is crucial in tackling several challenges at the end-of-life stage as well. Following CE Measures could be undertaken for enhancing the overall sustainability in the e-waste 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 reuse, repair, refurbishment, 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)[13].

Therefore, CE measures can be considered to ensure that the manufacturers follow the eco-design principles to enhance at first the durability, reparability, and then to design products that can be 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 are considering laws which aim to enhance resource efficiency and circular economy through better product design and by enabling product and material recycling. India can similarly consider globally harmonized design for circularity guidelines.

Financial incentive structure could be designed to incentivise and reward those manufacturers who ascribe to a more sustainable manufacturing of their products. In this regard, a compilation of best practices, global standards related to design for recycling and extension of product life can be developed. MeitY may also develop a 'Sustainable Product Policy' to encourage design for recycling, and designed- to-last products. Future promotional scheme for electronics manufacturing (like MeitY's PLI Scheme) may incentivise design for recyclability and built to last design principles.

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 should be introduced so that compliance mechanism can be initiated seamlessly.

The important benchmarks for economically successful circular design include: ROHS, designed-to-last products, design for easy end-of-life sorting, separation or reuse of products and materials that take into account possible use in products.

- **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 of stakeholders, who are engaged in the end-of-life stage of electronic products, are enhanced. In India, informal actors have access to materials and products which are disposed by consumers. Recycling and dismantling processes which are deployed by the informal actors are usually bereft of environmental and health concerns. Skilling these actors will ensure adoption of environmentally sound process and enhance the productivity of extracted secondary resources. This will have a positive impact on health, livelihoods, income and also enhance resource efficiency and circular economy in the electronics sector in India.

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

The MeitY along with Electronic Sector Skill Council of India has initiated a skill development programme on Electronics System Development and Manufacturing (ESDM) for different stages of the lifecycle of electronic products and components. The content of this skill programme could be augmented to include the green design and CE approach in product design, component manufacturing and product assembly so that skilled manpower is available for the local manufactures. Production processes have been streamlined through this initiative as well as acquired requisite standards. Skilling processes need to be standardized further 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 74 percent of the people surveyed globally, wanted to reduce the products impact on the environment and nature. 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. Figure 3 shows the typical consumer behavior (Source: Camacho-Otero, Tunn and Chamberlain, 2019[14])

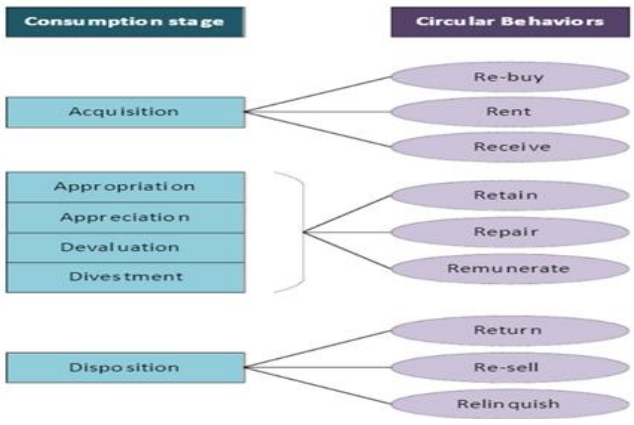

Figure3: Circular Consumer Behavior

Ellen MacArthur Foundation in its 2017 report titled "Circular Consumer Electronics"[15] describes the vision, where consumer electronic products are loved for

[14]https://www.researchgate.net/publication/337085214_Consumers_in_the_circular_economy
[15]https://www.ellenmacarthurfoundation.org/assets/downloads/Circular-Consumer-Electronics-2704.pdf

longer 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, 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 can be supported with policy instruments like 'Right to Repair', which should ensure access to high quality, safe and secure repair options, instead of consumer-led repair. India already has a thriving culture of reuse and repair, which has led to creation of jobs and ensured sustainable useful life of product. Policy should ensure reliable and safe repair service by qualified technicians, using genuine/ recommended parts for long working life of the product as originally designed. A demand for such services will ensure the sustainability of the jobs. Policy measure should consider skill development programmes to ensure that India has sufficient trained/qualified personnel to support the repair and refurbishment industry. Such skill development measures may duly consider opportunities for inclusion of rural and remote locations.

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

- **<u>Resource Efficiency/Circular Economy labelling:</u>**

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. Internationally harmonized labeling requirements may be considered that can provide appropriate, useful information to consumers in a simplified manner. Ecolabelling of products for CE criteria with information on recycled content 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). Policy measures may consider technological advancements to allow use of e-label / online provision of information.

- **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. Similar awareness generation programme around circular products may also be initiated, where producers may take the lead. The Rules, 2016, mandating producers to create awareness on e-waste management, may now extend for RE and CE. The capacity building of stakeholders on RE and CE will make consumers responsible towards product usage and disposal. It is also recommended to create consumer awareness on eco-labelling of the products including their recycling aspects, the toxicity of the use of various materials within products.

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

Circular consumption entails development of practices 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. Policy should encourage incentive models to support innovative product service models.

- **Supporting 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 enable circular products practices.

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

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

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

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

Allocation of special funds for Research and Development initiatives to promote technologies and products in relation to circular economy, environmentally benign technologies for safe disposal of toxic/hazardous substances, development of Artificial

Intelligence to increase effective and optimized circular economy business models, and streamlining the infrastructure to keep products and materials in use is needed.

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 circular economy in EEE sector 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 a robust e-waste collection infrastructure for responsible recycling is created. A wide, easily accessible and compact collection network is essential to achieve the goal of a healthy e-waste ecosystem. Thus, India needs a widely distributed formalised e-waste collection network that could be readily available at their homes, offices or the public spaces.

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 store their e-waste for high returns for disposal, 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.

Study and stakeholder consultation to measure and improve the effectiveness of awareness programmes can be considered for long term behavioural change with pan-India reach. Government initiatives like 'Jago Grahak Jago' can also be considered to improve outreach and effectiveness.

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

There is a need to conduct a trainings for the officials of State Pollution Control Boards/PCCs from each states/UTs. Besides professional trainers, recyclers, PROs and dismantlers might be engaged 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. The knowledge available in educational institutions may also be utilised to create dismantling and segregation facilities and to train the informal workers.

- **Role of ULBs**

ULBs are a very important part of the waste management system. E-waste Rules should ensure that all the e-waste collected by ULBs should be channelised to authorised channels. At present the collection and processing of e-waste at ULBs is considered. It is recommended to develop capabilities and capacities of the ULBs through PPP model not only to collect and segregate e-waste, but also to evolve system and process to integrate with formalized EPR systems and recycling channels.

- **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. E-waste Rules should ensure the traceability of the materials flow of the e-waste collected through E-Auction process with proper documentation and e-waste collections from bulk consumers are only channelised through producer take back systems.

- **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 channelise 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 increased flow of e-waste to informal players and related pollution.

- The Rules, 2016 do not clearly differentiate between Collection Centres and Collection Points. As per the said rules, Collection Centres & Collection Points are same. We may introduce the word 'Drop Off Point' in the said rules for ease of operation. The current framework should ensure that collection centres are following prescribed standards for operation and does not allow flexibility by way of "drop-off points" or "collection bins" set- up.
- The Rules may further re-look to streamline 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.

- The public infrastructure such as ULBs, post offices, and others such places may be allowed to the stakeholders including producers, recyclers, PROs, ULBs etc. to use as collection network points. Even State Pollution Control Boards have expressed the need to have a greater number of such points. E-waste Rules may be suitably amended to allow a widely held collection mechanism.
- In a market-based EPR approach with competing PROs, the market pull will be created once monitoring and enforcement is effective.
- The Rules, 2016 may suitably be amended to accommodate storing of e-waste in the Collection Centres till it reaches an optimum quantity (one-truck load) for reduced cost of transportation.
- The recyclers, digital platforms and Producer Responsibility Organizations, the interface between the producers and the rest of the e-waste value chain, are best positioned to develop and monitor a fully operational professional collection network. Auditing of collection, transportation and storage of all stakeholders must also be carried out regularly.
- 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, where a compliance system have been developed 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 pan India circular e-waste management**

Digital infrastructure is globally recognized for sound collection and effective recycling and resource recovery. In this regard, an on-line E-Waste Management System has been developed by C-DAC for CPCB and the system will be operational and channelisation of e-waste will be monitored shortly. The functionalities will include verifications of collection targets of e-waste, collection centres/ points, activities of authorized dismantlers, recyclers in general and also verification of quantity of e- waste collected, dismantled & recycled to prevent leakage of E-Waste from the authorized channels to informal sector or to any other un-authorized channel in line with the E-Waste (Management) Rules, 2016 and the guidelines of CPCB. This will improve monitoring of implementation of EPR

- **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 voluntary**

Buy-back schemes are allowed in the Rules 2016 and guidelines for the same EEE code items, not restricting it to the same brand as well as product, which are restricting the brand owners to only buy-back products that are still in working condition and are meant for re-sale. Further clarification in the guidelines may be needed to incorporate the provision of buyback with a rate-clarification.

- **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. Collection of Most Hazardous Waste Fractions must be ensured. In the case of an ITEW2 it can mean avoiding pick-up of CRT monitors (which are most toxic due to presence of lead). 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 accessing waste by formal collectors 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 e-waste from formal take back channels. It is important to formalize the informal sector and E-waste Rules should accordingly be amended.

In other countries, Publish rate card with maximum defined amounts 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**

The e-waste is being sold at H1 by industry, Government office and organisations. Such bidding system is detrimental to environment. There are large online auctioning platforms like Government owned MSTC, other private tendering agencies that deal with e-waste as scrap material. A large number of bulk consumers auction their waste through these agencies. However, these auctioning platforms do not find a mention in the Rules or the Guidelines and there are no frameworks in place to prohibit them. It is recommended that a framework may be made, under the E-waste (Management) Rules, to channelize the e- waste from bulk consumers through producer take-back system. 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 prevent any mismanagement, it may be ensured that bulk consumers handover their e-waste to producer take back system only.

- **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 the collectors of any type of waste (in informal/formal market) on a central platform with digital presence to ensure accessibility and ease.

- **EPR Collection Systems**

EPR budget is arrived by considering the cost of compliance such as, consumer awareness programmes, collection (procurement), logistics and recycling as per the ERP Implementation Plan submitted by Producers to CPCB. Producers need to retain flexibility on this matter and the financing can be extended with adequate controls and limits.

- **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. 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 regulators have 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. The standardized methodology for inventorisation and a standard ToR should be defined for seamless utilization for SPCBs to conduct this exercise. Inventorisation may be conducted using available data sources such as GST, industry reports and others.

- **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, they are not recognised in 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 informal actors to also establish legal channels and undertake business transactions. Sampling and testing labs for establishing the value of recovered materials will help in enhancing monetary benefit, thereby making the business 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 players to engage in their livelihood in consonance with the law. Integration of localized "collection points" and "collection bins" / "drop-off points" with large "collection centers" would not only aggregate and channelize the e-waste towards sound recycling, but also essential for strengthening the collection network and formalization of informal sector.

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 be penalized. The mainstreaming of the informal sector can be achieved through upgradation of skills, selective authorizations and certifications, interfacing with PRO and recycler managed collection centres that aggregate e-waste from multiple sources, and by providing domestically developed e-waste recycling technologies. The roadmap provided in the 2019 RE Strategy for EEE Sector will allow rapid expansion of the collection infrastructure and would create a win-win situation for the informal sector, as also, create a sustainable e-waste management system across the country.

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

The Rules, 2016 defines PRO and PRO Guidelines defines role and responsibility of PRO, which are inclusive. Though all the PROs are registered, a system for regulating and monitoring the activities of PROs is, however, critical for effective e-waste management. The present framework is leading to many entities working as PROs. The PROs are conduits between various sources of e-waste and disposal channels, thereby playing a crucial role in ensuring clean and proper implementation/ execution of EPR system. Today, PROs merely act as a third party service provider/formal aggregators with no specific responsibilities and accountabilities assigned to them. The guidelines need to be strengthened further so as to ensure a well governed, industry-led and managed PRO with multiple producers, which may bring convergence, better governance and sharing of global best practices. Thus, there is a need to re-define the term PRO, its role, responsibilities and accountability. The responsibilities of PRO, Producer and other stakeholders should be fairly distributed to drive accountability.

In this direction, the best practices of PROs functioning around the world (e.g. in EU countries) could be referred. The guidelines may further specify the 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 third party audit protocols could be introduced for effective auditing for all stakeholders. The guidelines should also provide PROs' accountabilities, as also, the penalties.

Regulators may strengthen the audit mechanisms of PROs through periodic audits (at least annually) to ensure compliance with the regulations, standards and other requirements. Successful completion of audit of PROs should be a pre-condition for issue or renewal of authorization. PROs may be monitored through the digital monitoring system to ensure that they do not engage in any malpractices. PROs should be integrated with the centralized digital system for effective end-to-end monitoring of EPR implementation. Remote inspection of PRO systems could also be considered for monitoring.

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

It is also recommended that the MoEF&CC may create a long-term roadmap for evolution of circular economy in EEE sector. 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[16,17], 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. Specialized dismantlers and recyclers 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[18]. However, in the absence of traceability and visibility of 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 of all stake holders would be important.

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

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:** Introduce standards for dismantling/recycling units including de-pollution practices to ensure removal of toxic fractions. Provide directions and detailed instructions to dismantlers to follow depollution practices and responsible management of both hazardous and non-hazardous fractions vis-à-vis regular checks to ensure compliance. Some suggestions are given below:
    - 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
    - Regulators should carry out periodic mandatory site audits (at least annually) to ensure compliance of regulations, standards and other requirements by the recyclers/ dismantlers. Successful completion of audit of recyclers should be a pre-condition for issue or renewal of authorization
    - 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
    - The capacity determination criterion for licensing recyclers should be well defined and may consider the built up area as well as technology deployed.
- **Recyclers/dismantlers should submit the following as a part of annual report to CPCB in addition to SPCB (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 on boarded
    - Recyclers must provide audited balance sheets and GST returns along with annual form-3 to Pollution board to corroborate the claim of dismantled and recycled quantities
    - Details of machinery installed and power consumption
    - Details of manpower engaged
- **Introduce 'Recovery Targets' covering both toxic and non-toxic fractions and connect these targets with collection targets for producers**. Since there is no recovery target for recyclers, there is a room to indulge in multiple

accounting of E-waste, i.e. the same waste could be counted multiple times for multiple producers.

- **Monitoring of capacity utilization.** Recyclers may be monitored by CPCB/SPCBs/PCCs through the suggested digital monitoring system to ensure that recyclers operate within their authorized capacity to avoid any malpractices. Remote inspection systems can also be considered for the said monitoring.

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

Currently, most of the authorised recyclers are engaged in only dismantling and do not have the technology or the capacity to recycle. Good recycling facilities for consumer electronics are almost non-existent. Provisions should be made to encourage them to set-up the 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 best available recycling 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 skill sets 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 to 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.

Thus, an end-to-end solution for e-waste recycling needs to be developed available in India.

- **Set-up 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 on its own or in partnership with authorised recyclers, dismantlers, PROs or digital PROs, which should be extremely well managed and transparent.

- **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 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. Activities in the eco-park should include end-to-end process of e-waste such as disassembling, segregation, recycling till the precious metals extraction.

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 may be initiated for setting up of recycling units like Eco-parks in State level.

Moreover, the recycling units may be considered as industry, and a suitable PLI schemes can be evolved to promote such industries for the recovery of SRMs and generate employments.

- **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 financial partnership of central government, state governments and industries. This CoE is nurturing Start-up companies/ SMEs with suitable low-cost

technologies and locally fabricated machineries to manage e-waste in environment friendly and viable manner. The CoE has technology know-how 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 use of renewable energy sources for operations in progressive manner.

3.6 Post EOL Production/Secondary Material Usage

- **Benchmarking**

Benchmarking of existing technologies and recovery of secondary 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**

The frontrunner manufacturers should be recognized for developing circular products. Manufacturers of EEE products should be given recognition by government for doing exemplary work in making circular products. Incentives for secondary material usage by producers, such as proportionate reduction of EPR target equal to secondary raw material usage may be considered.

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

Secondary raw materials from recycling must be able to compete with virgin material on quality, supply, and price to help ensure its wide adoption by the industry. Producers will consider adoption of secondary raw materials when their usage in manufacturing of EEE products does not put product compliance or product performance at risk. For the purpose, it is essential that secondary materials, comply with related quality standards in force across the world. Manufacturers of secondary raw materials need to be incentivized to provide higher quality and quantity of those materials. The standards should ensure that new products with recycled material content are able to comply with quality, performance and compliance with chemicals legislation. Policy measures to encourage usage of recycled content may be considered for adoption after quality and quantity for secondary raw materials is ensured through the above suggested control measures.

- **Encourage utilization of secondary materials**

Government may consider financial incentives to create value chains which can promote production of quality secondary raw material resources to compete with the virgin ones. This will facilitate industry to automatically shift to secondary raw material resources.

- **Develop Circular Economy Evaluation Indicators**

The stakeholders may consider adoption of CE Evaluation Indicator Systems viz. comprehensive indicators, work indicators, and reference indicators for circular economy development. The evaluation indicators may reflect the concept of circular economy that emphasizes efficient use of resources and resource recovery.

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 transition of the Indian economy across the extraction, production, consumption and end of life management, besides recycling and secondary material usage. The committee proposes the following action plan with key measures (short, medium and long term) across EEE value chain value so that MeitY can provide an impetus for adoption of circular economy principles in India. The policy measures with extended implementation timelines and/or other flexible measures as may be necessary for MSME/SME sector to ensure their readiness, capacity and capabilities to adopt the suggested circular economy principles.

Life-Cycle Stage	Objective of Action	Stakeholder involved	Recommendation(s)	Action(s) proposed	Implementing Agency/ Actor
Raw Material Acquisition	Security of Critical Materials	Recyclers, Manufacturers and Suppliers of secondary raw materials and Producers	**Institutional** - • Institutional arrangement to track availability of critical materials for India and how secondary resources can contribute in meeting certain percentage of the demand. • Support in setting up material sampling labs across the regions to assess the material value in the end of life product **Guidelines** - • Encourage use of secondary raw materials sources post evaluation of their quality and quantity.(Medium to Longterm) • Promotion of technology to ensure extraction of quality and sufficient quantity of materials through technology development/transfer, innovative finance mechanisms and schemes. **Promotional -** • Incentive for producers to use secondary raw materials. • Incentivise the manufacturers of secondary raw materials to set-up infrastructure and production which can compete with virgin material on quality, supply, and price	**Short Term (1-2 years):** ○ Study on critical raw materials (CRMs) and potential contribution of secondary raw materials (SRM) if they are recovered. ○ Identify best available technologies to promote recycling and recovery of secondary raw materials **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 be done in line with PROSUM project in the EU, to digitally track material specific data from electronic, automobiles, construction, mining waste and solar panels ○ To form incentive plans for promotion of best available technology for extraction of suitable quality and quantity of secondary raw materials **Long Term (5+ years):** ○ Future incentive schemes to promote technology and competitiveness (like PLI Scheme of MeitY) to encourage use of secondary raw materials. Feasibility, impact	MeitY, MoEFCC/ CPCB and Ministry of Finance

				assessment studies and stakeholder consultations be held to evaluate availability of quality and quantity of secondary raw materials to ensure that any such incentive schemes are successful and implementable.	
Design, Component, Manufacturing, Product, Assembly	Recyclable/ Disassembly/ longer lasting Products	Producers	**Regulation / Incentives for –** • Future Production Linked Incentive Scheme (PLI) of Government of India to include: o Design of products that are recyclable o Design guidelines for ICT/ CE devices to promote scope for eco-design • To promote adaptive skills and capacity of informal sector workers to help them transition to sustainable practices while protecting livelihoods at the end-of-life stage of electronic products	**Medium Term:** o Compilation of global best practices, o Guidelines to adopt design for recyclable and longer lasting products o Promote adaptive skills and capacity of informal sector workers. **Long Term:** o Development of guidelines in-line with global best practices to promote eco-design o Developing metrics for linking future PLI with design for recyclable and longer lasting products o Sustainable Product Policy to be developed by MeitY to promote design for recyclable , and longer lasting Products o Develop criteria for identifying the products with best environmental performance in the focus industry sector or product group o 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.	MeitY, MoEFCC and Ministry of Finance, Ministry of Skill Development & Entrepreneurship
Consumption Stage	Labeling / Awareness	Consumers	**Promotional** • Internationally harmonized resource efficiency/circular economy to provide appropriate, useful information to consumers in a simplified manner. • To assist producers in driving awareness of proper disposal options and promote awareness of current and pending legislation as well as available producer recycling programs. • Product subscription/ lease models across various product categories • Promote Green public procurement (GPP) by Government agencies	o MoEF&CC, MeitY, ULBs, Producers and other stakeholders to conduct awareness programmes on e- waste management, RE/CE label to make consumers responsible towards product usage and safe disposal o Adopt internationally harmonized RE/CE labels/ online dissemination of information. o To promote consumer awareness onlegislation o Skill Development for repair centres o Government and line ministries to ensure bulk consumers alignment to	Producers/ MoEFCC/ MeitY/ Electronics Skills Council to support and design skill development programmes for repair & refurbishment

				the products complying the best practices ○ Promote adoption of product subscription/ lease models.	
End-of-Life Stage **Collection Systems for EOL EEE products / Components**	Enhancing responsible disposal by consumers at End-of-Life • Ease of participation • Financial Transparency across collection and recycling • Auditability of Systems • Collection through formalised informal sector	Consumers/ Producers/PROs	**Policy instruments for Producers** • Develop framework that allows the creation of a granular collection network. Open up existing public infrastructure for setting up collection channels. • Costs of compliance for management of e-waste value chain in order to ensure fairness in current system and economic models. EPR systems should be encouraged to actively engage 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). • To monitor EPR budget to ensure that committed budgets have been met through the deliverables, such as, consumer Awareness, take back, logistics and recycling, as submitted by producers in the EPR Plan. All activities to be done at the level of the PRO needs to be agreed in their annual contracts with defined actions and budget-lines in Quantity, Quality and timeframe. • Develop standard TORs/methodologies for inventorisation of state level e-waste generation by SPCBs • More emphasis and investments by producers through the CSR social enterprises in the E- Waste sector to ensure realization of environmental, social and economic benefits. **Policy instruments for Consumers/Bulk Consumers** • Ban on Auctioning • E-waste from bulk consumers should be channelized through producer take-back system to ensure the traceability of the e-waste collected. **Schemes/ Incentives for informal sector** • Schemes linked to Green Skill Development Programme for informal sector for transition to formal economy by becoming collection agents and transition away from informal recycling **Policy instruments for PROs** • A well governed PRO is crucial to bring convergence in effective,	**Short term:** ○ Detailed analysis to estimate the costs of compliance across e-waste value chain to ensure fairness to the current system, economic models. ○ 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 and material flow through the e-waste collection and recycling value chain in the past years to understand fairness of the current system. ○ Revision of E-waste Rules to allow flexibility in collection channels, graded penalties, assignment of shared responsibilities with clear accountability among all stakeholders, recognition of informal sector and other changes as may be necessary. ○ Amendment of GFR ○ E-waste Rules should be amended to enforce prohibition on e-auction by bulk consumers. ○ Ensure mandatory registration and enforcement actions against bulk consumers. ○ Integration of informal sector into formal collection systems. ○ To develop inventorisation methodologies using available data sources such as GST, industry reports and others. ○ Develop standards and practices for all stakeholders including PROs, in-line with global governance system. ○ To amend E-waste Rules to provide accountability and penalty for all stakeholders including	CPCB/MOEF&CC/ULB/SPCB/PCC/Min of Housing and Urban Affairs MeitY/ Private Sector/ think tanks /research institute/ Bilateral/ multilateral agencies. Ministry of Skill Development and Entrepreneurship

			efficient and compliant EPR systems. • PROs' accountabilities and penalties must be defined. • Comprehensive audit protocols for effective monitoring and controls. Regulator should carry out periodic audits of PROs to ensure compliance. • PROs should be monitored through centralized digital systems for effective end-to-end EPR implementation. **Policy instrument for regulators** • Training and capacity building of CPCB, SPCB personnel on circular economy, waste management, audit protocols etc for a long-term comprehensive growth of the ecosystem. **Policy instrument for ULBs** • Capabilities and capacities of the ULBs need to be developed to not only collect and segregate e-waste, but also evolve systems and processes which can support them to integrate with formalized EPR systems and recycling channels.	PROs o Develop audit protocols and enforcement strategies for all stakeholders including PROs. o Conduct training sessions to develop capacities of the ULBs. o MoEF&CC /Ministry of Housing and Urban Affairs to develop necessary system and process at ULBs to aid integration with EPR systems. **Medium term:** o Create skill development schemes to train and register informal collection agents which can be a part of "Green Skill Development Programme" o Integrate all stakeholders including PROs with the centralized digital system. o Conduct training and capacity building of CPCB, SPCB personnel for long term comprehensive growth of the ecosystem. o -ULBs to set up e-waste collection, segregation and disposal systems (example- smart city program KPI). **Long term**: o Development of monitoring guidelines for material and financial flows across the e- waste value system to measure and improve e-waste ecosystem.	
Recycling/ Recovery Stage	Strengthening Recycling Systems by focusing strongly on depollution practices - Create pathway for clean transparent recycling systems which can also manage toxic fractions and/or recover	Producers/ Recyclers/ Dismantlers	**Regulations/Incentives** • Capacity expansion of recycling industry to ensure adequate quantity and quality of secondary raw materials. • Capability to handle various categories of products should be improved to ensure that scope of e- waste rules expansion can be considered in a phased manner. • Introduction of material recovery targets • Enable Material Balance Reporting from recyclers • SPCBs/PCCs should carry out periodic (with minimum annual periodicity) mandatory site audits to ensure recyclers/dismantlers	**Short Term** o Skilling of the informal sector so that they can be formalised either with existing recyclers or become entrepreneurs. o Transfer of indigenous technologies and holding to the local recyclers till commercialization o Provide technology and machineries at affordable cost o Using schemes and incentives from the MSME ministry to develop CFCs for the micro enterprises in this	MeitY, DST, CSIR & MOEF&CC, CPCB/SPCB/PCC Consortium of national and internation

	critical materials		compliance with the regulations, standards and other compliance requirements. • Monitoring of capacity utilization to ensure that recyclers operate within their authorized capacity to avoid any malpractices. • 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 **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 adopted for Indian context – EU-REI initiated a scoping study (with MoEFCC) with partners like WEEE forum, Umicore, adelphi etc.	sector and enable technology and infrastructure along with smart financial instruments ○ Conduct studies to understand recycler capabilities to recover material fractions from each product category. ○ Develop audit protocols and enforcement strategies for recyclers. ○ CPCB/SPCBs/PCCs to monitor capacity utilization through the suggested digital monitoring system and site inspection scan ○ Develop capacities for formal recycling of e-waste in India. **Medium term** ○ Develop and implement product-wise material recovery targets for recyclers ○ 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. **Long term** ○ Joint collaboration initiatives supporting upgradation of the informal sector workers in the value. GIZ DPP initiatives are such tool may be availed to support collaborations across private sector and public sector	al consultants – Led by MeitY & CPCB
Secondary Raw materials	Creating a market for secondary materials	SRM Suppliers/Producers	**Incentives** • Incentives for secondary material usage by producers • To address compatibility of secondary raw materials with virgin material in quality, quantity and price for wide adoption of SRM	○ Create value chains which allow secondary resources to compete with virgin ones. ○ Develop and adopt supply chain standards for secondary materials ○ Formulate incentives for manufacturers of secondary raw material to develop higher quality and quantity. ○ Promote trading of secondary raw materials in commodity markets and exchanges ○ Encourage integration of	MoEFCC/ MeitY/ SEBI/CPCB

				secondary raw materials with global supply chains.	
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/ CPCB

IMPLEMENTATION PRINICPLES

The suggested implementation measures from the above action plan could be applied in a proportionate manner while keeping pace with the evolving societal, technological and global developments in Electronics and Electrical Equipment Sector. This is a key to ensure that the measures also support growth and job creation – allowing India to ensure its competitiveness in the global economy - while maintaining social and environmental sustainability. The implementation actions must lead to a simple, clear, stable and predictable regulatory framework for businesses, workers and citizens.

Periodic revision of the recommendations and the policy may be considered through proper studies, impact assessments, and wide stakeholder consultations. This will ensure that the recommended action plan are relevant at the time of implementation and able to deliver the policy objectives with optimal cost and maximum benefits to citizens.

Principles for effective implementation will include:

- Research and studies for existing developments, landscape and best practices
- Evaluation and fitness checks of existing regulations
- Impact assessments: to assess economic/environmental/social impact of new solutions
- Stakeholder consultations

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.

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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.

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- 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.

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- 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

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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.

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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.

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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.

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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.

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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.

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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.

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