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Achieving Environmental Impact: Sectoral Study of Application of Circular Economy in India

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Abstract: This paper provides framework for achieving resource efficiency, environmental efficiency through the application of circular economy in business models in India. The paper also addresses the lesson from India on the Principles of Circular Economy: REDUCE, REUSE and RECYCLE to achieve environmental benefits along with social and economic benefits. The focus will be on reviewing the application of circularity principle for the sectors: Construction, Electronics and Electrical Equipment and Agriculture. The rationale for selection of sector is that – Construction is the major job creators, Construction, automobile, and electronics have the largest growth potential; Majority of household expenditure is on these sectors. India is experiencing digital revolution and is the second largest market for smartphones apart from US. This sector will provide the maximum advantage through the application of circular economy and enablers like- tracking, leasing, and sharing.

Keywords: Economics, Environmental Impact, Environmental Sustainability, resource efficiency, reduce, recycle, and reuse.

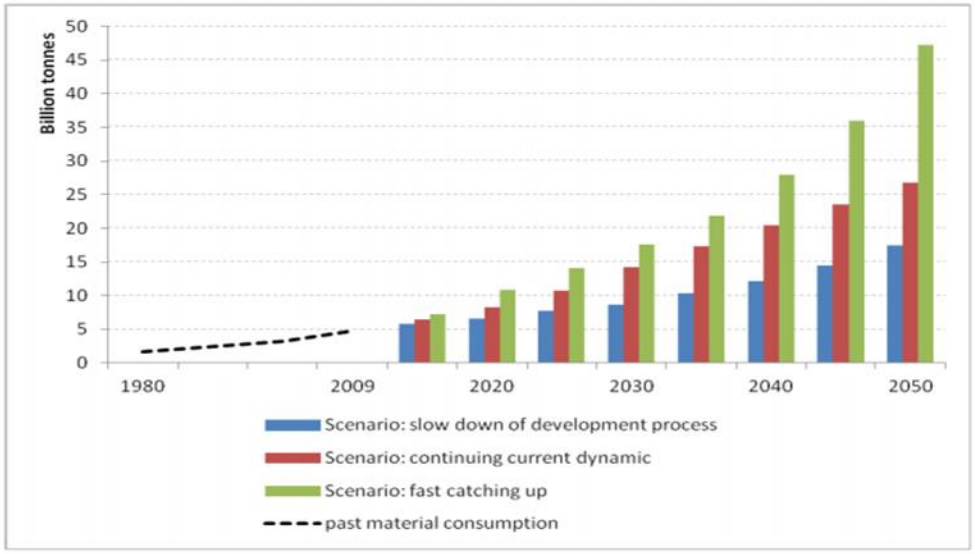
Introduction

India's population and economy is growing at a fast pace. It has become a destination of innovative business entrepreneurial experience. New businesses are joining in, and the old ones are coming up with various upgradation to be in the race. It is high time that the government intervein with policies supporting circular economy models so that businesses come up with ways of producing goods and services that can be reused by sharing, leasing, recycling to achieve resource efficiency and environmental efficiency. Today's leaders should

encourage the youth by talking and promoting circular economy practices. Governments should draught buyback legislation that specifies how the goods will be collected, refurbished, remanufactured, recycled, and disposed off. This may push firms to collaborate with the government on the development of technology that can aim to promote resource efficiency and achieve environmental efficiency (Srivastava, & Bagga, 2014; Bagga, 2016; Anirudh, et.al., 2017; Vishnoi,2020).

Not only India but the world is on. the edge of making a very important decision for the future. The selection of an incorrect option, the impact on the ecosystems globally can be very drastic (Larsson et al., 2011). In the present scenario there exists a combination of crisis in different areas of industries across the world. To effectively tackle these crises, one must try and look at the bigger picture. To analyses the crisis and develop a solution for the same a holistic perspective would be beneficial. One of the fastest growing sectors in India is the Electronic and Electrical Equipment Sector in India. Therefore, it becomes imperative to study the principle of circularity in this sector.

Figure 1: India's past material demand and future projections until 2050.



(Source: IGEP, 2013)

To move in the direction of circular economy, the way things are produced and consumed requires a paradigm shift. Industries must attempt to incorporate a closed loop thinking at the heart of their current business models which will have a significant implication on our society, since the current methods of how we develop things not only decides how we work but also what we buy as well. (Womack, 1990). Circularity concept is not just recycling it is basically a system which is restorative in the industrial processes which treats the waste as a resource. It implies that once a in the product life cycle the product's life ends attempts should be made to utilize them by creating a value of it (Ellen Mc Arthur 2015). The transition from tradition to circular requires the changes in the functioning of organizations and reshaping of the supply chain process by infusing the mindset of sustainability in product designers.

The concept of circular economy provides sustainability approach to business practices through reversing the depletion of resources and waste generation. The World Economic Forum, Governments and business leaders have championed the circular economy movement. Unfortunately, the skepticism remains as to whether the required changes to business models and consumption patterns are feasible. Transition to a circular economy requires co-operation and co-ordination across multiple spheres of influence.

The policies in India are still focusing on the themes relating to individual areas and the approach followed in not well structured and systematic. The policy focus is majorly on extraction and mining rather than resource efficiency or SRM (NITI AAYOG, 2017). The National Design Policy of 2007 directly relate with resource efficiency and secondary resource management but is related to value the strategic content of material in the product, which is crucial for resource recovery. The goals of sustainability and inclusiveness can be achieved through emphasizing the need for RE and SRM by integrating innovation with the developments in science and technology. The businesses willing to adopt the principle of circularity finds this integration challenging. Business involving circularity approaches viz, substituting the scarce and hazardous material/ resources with the restorative, cleaner and more regenerative ones involve huge financial resources which they lack. There is an urgent required for not only technological but financial eco system also that can help India to adopt circular economy. For sustainable growth along with the creation of job opportunities manufacturing sector is gaining. Enhancement in resource efficiency and promoting SRM usage has vast potential in creation of not only environmental benefits but also creating economic opportunities in the production processes. The policies in India have failed to promotion of resource efficiency and SRM in the manufacturing sector inspite of such promising environmental and economic benefits.

Electronic and Electrical Equipment

Consumers in India are looking forward to improving the lifestyle and their standard of living including their homes as the composition of middle-class population and the youth aged below 35 years or less has been increased. This radical transformation in demographics along with the fall in prices of consumer electronics has brought about a transformation in the white goods market in India. According to the National Electronics Policy 2019, the global electronics production is estimated to be US$1,740 billion in 2017 and has registered a growth rate of 5%. The India electronic hardware production in the year 2017-18 has been around US$59 billion with the growth of 26.7%. In the global hardware electronics production, the share of India is 3.4%. In the India's GDP the share of domestic electronics is 2.3%. For the year 2017-18 the imports of electronic goods were of about US $ 53 billion in 2017-18. It is expected that the demand for electronic hardware will increase to US$400 billion by the year 2023-24. This is not in favor of India and hence the promotion of domestic electronic hardware manufacturing becomes very crucial. The Domestic production has increased considerably over the past few years and the production of LED products, LCD/LED Televisions and mobile handsets have increased significantly. In the last few years, the PMP (Phased Manufacturing Programme) for mobile handsets and related subassemblies components manufacturing has created robust manufacturing eco system in India.

Several schemes have been launched to promote electronics manufacturing in India. For the development of the ESDM sector, the National Policy on Electronics aims to provide and ecosystem through hosting a few policies to reduce the dependence on Imports and development of infrastructure for the growth of the sector.

The e waste in India is currently growing per annually is increasing at a growth rate of 30% (Pandit,2018). In India the unorganized sector manages more than 95% of e –waste, who down cycle the end of the life product (burning or dumping in water bodies of useless materials) and does not recycle it, while only around 2% is being recycled. Table 1 clearly indicates the value of extracted raw materials in the e waste. The opportunities in the extraction of materials are huge in the e waste which implies the potential benefits from the reverse logistics.

Table 1: Potential Value of raw Materials in e waste in 2016

Material	kilotons (kt)	Million €
Fe	16,283	3,582
Cu	2,164	9,524
Al	2,472	3,585
Ag	1.6	884
Au	0.5	18,840
Pd	0.2	3,369
Plastics	12,230	15,043

Source: NITI Aayog, 2019.

Value Chain the Electrical and electric equipment's sector incudes' extraction and supply raw materials supply, sub-components production, product designing and manufacturing, distribution of product and retailing, use phase of product, waste management and recycling of waste.

The potential to energy saving is huge in the input stage itself if recycled material is used in place of extracted virgin material. Disposing off the hazardous material continues to be a major concern. It is also essential to design the consumer appliances which can be easily repaired, and its life can be prolonged easily. Thus, the call of the hour is to develop an effective and efficient infrastructure for reverse logistic network and recycling because of the toxic nature of e waste and its potential environmental and health hazards.

In the first phase of value chain: resource extraction the composition of the material used has changed significantly due to technological advancements which includes not only usage of miniature components but also understanding the impacts of hazardous components. Like, replacing the metal components with plastic has decreased the weight pf the product and banning of hazardous materials in the production along with the use of new rare materials. The is more use, although in smaller quantity of exotic metals which has a very low recovery value (NEW, INNONET, 2016). There is demand more use of recycled material as compared to virgin material. Very few companies like Apple and Google have made their products free form the PVC and BFR as committed. Dell is also in process of making their commitment to go 100% green.

Design Stage:

In today's consumerism world companies are producing single use short life span products as they are facing market saturation accelerating the replacement cycle, however the need is to provide and design products which extends the usage life. The material resource can only be saved through extended use life along with

the spread of carbon print over many years. It is also desired that the product should be repairable and can be easily upgraded.

Best Practices during the input stage

Dell uses the recycled plastics derived from water bottles and old computers that they generate through their 'take back' system. It is one of the companies to get certification from Underwriters Laboratories Environment Practicing closed loop recycling. Dell's OptiPlex 3030 All-in-one computers are verified to contain a minimum of 10%recycled content. By reducing plastics already in circulation, Dell is cutting down e-waste, saving resources and reducing carbon emission by 11% as compared with virgin plastic.

End of Life Stage

The formal recycling system can only work if the proper infrastructure to the reverse logistics is in proper shape. The system of recycling should be cost effective, and the quality of recycling process is should also be efficient. It is the mandate under the E- waste management Rules'2016 and amendment 2018 that it is the producer's responsibility to make arrangement for getting the products back under the effective and efficient waste management mechanism. Deposit Refund Scheme (DRS) is being recommended (through implementation through dealers and retailers) to be provided to the customers from the producer so that customer returns the end-of-life equipment. The task to channelization of e waste for recycling and dismantling is assigned to the Urban Local Bodies.

Bhopal e -waste Clinic

India's first e waste clinic to enable segregation of waste, its waste and disposal of waste from both household and commercial is being set up by Bhopal Municipal Corporation and Central Pollution Control Board.

Electronic waste is being collected from door to door or can also be deposited directly at the clinic in exchange for a fee. The technical assistance is provided by the Central Pollution Control Board. This clinic has been created in accordance with the Solid Waste Management Rules, 2016

Envirocare, India

E waste Management and Handling services are provided by Envirocare in the entire India Subcontinent. The details of the company are mentioned in Table 2. They deal in the e waste which may be of any type and any stage – final disposed after the life, not continued in use broken, outdated etc. are being collected by the company for safe segregation, transport, dismantling and disposing. The company is authorized and has license from SPCB and CPCB. The main goal of the organization is conservation resources and environmental protection. The company offers recycling of e waste, implements EPR for products and acts as a PRO (Producer responsibility Organization) for them.

Table2: Practicing Circular Economy: End of Life stage, ENVIROCARE

Company	Envirocare
Year of foundation	2009
Founded	Hafiz Ansari
Reach	PAN Indian
Contribution to circular economy	• Provision of value addition innovation in e waste recycling services • Focusing on provision of environmental safety, security and healthy and creating green and clear earth
Process	RECYCLING, Envirocare's e-waste disposal process is a complete recycling process starts from collection, Sorting, dismantling, disassembly, Physical and mechanical separation of complex materials, and disposal of hazardous waste material
Positives	• Envirocare has presence in PAN India: Dealing comprehensively in Management and services e waste sector. • Collection of all types of e waste including desktops, laptops, mobile handsets, and all other types of electrical and electronic equipment. and at all stages of disposal: end of life, working, non - working, distorted. • SPCB and CPCB authorisation for collection, Sorting, dismantling, disassembly, Physical and mechanical separation of complex materials, and disposal of hazardous waste material • The organization focusses on conservation resources and environmental protection • Services spectrum ranges from Recycling of E-waste to Implementing EPR (Extended Producer Responsibility) for produces and acting as a PRO (Producer responsibility Organization) for them. • Supporting the Customer for CSR Activities like Channelizing of E-waste, setting up Collection Point and Providing E-Bin.
challenges	The major concern is DATA Protection; they offer On Site Data Sanitizing and Degaussing. They also provide physical Destruction of Disk and Media.

Source: https://envirocareindia.co.in/

Consumers are being encouraged to correctly dispose off their e waste, with the increment in the re usage and recycling rates there has been a link between the initiatives like Extended Producer Responsibility (ERP), Design for Environment (DfM); 3RS with the market so that the consumers also adapt sustainable consumption habits. The success of Extended Producer Responsibility (EPR) requires proper infrastructure, policies especially designed for e- waste, technology, and skilled labor along with the financial backing, which unfortunately India lacks in. Moreover, the e waste policy 2016 is not able to clearly define the responsibility and the role of various stake holders and organizations in the field of waste management. Although the promotion of Circular Economy cannot be solely done by the Government only but an approach involving the partnership of consumers, retailers and investors jointly is required. With the improvements in technologies and innovations like-Cloud, the electronic sector can easily dematerialize and creation of a sustained economy from millions of e-waste disposed of every year has create has a huge demand and potential. The change in consumerism is only expected to boost up the circular economy. To prepare the new future, it is expected that companies need to be more responsible for the waste generated by them the e waste management companies have even a bigger role in managing this waste.

Construction

There has been tremendous growth in the construction sector majorly because of urbanization, rise in per capita income population growth and the government schemes like housing for all. India likely to become the 3rd largest construction market with residential and commercial sectors having a major market share. The current contribution of constructions sector India's GDP is around 8% and after agriculture it is the major sector providing employment. It means resources majorly, material resources in the construction sector includes stone, stone sand and soil. These resources which are used in construction are limited and it requires long time to replenish. It was estimated that over 70% construction is yet to be done and it implies that the demand pressure on these limited resources is expected to increase sharply.

Value Chain in Construction

The three lifecycle stages important for assessment and adoption of various strategies include

a. Material and component production

b. Designing and planning

c. End of life

It is necessary to integrate the design phase during the construction such that the materials can be recovered at the end-of-life stage.

The principle of circularity can bring about energy efficiency by more than 30% (WEF,2016) and the emission rates also becomes cost effective. The strategies adopted in the construction sector aims to extend the use of the life of products through repairing, refurbishment or remanufacturing and then close the material flows through recycling once the end of life is achieved. The use and maintenance of quality resources ensures that they are being used beyond single life and decrease the amount of resource extraction and limit the waste going to the land fill. The total construction in demolition waste generated is more than 700 16,000,000 tons

mean streaming of use of the raw material requires strict regulations along with appropriate technology market system. Table 3 explains the opportunities of using the secondary material in the construction sector.

Table: 3 Opportunities of using the secondary raw materials in the construction sector

Primary Resource	Secondary Raw Material	Source	Application
Soil	Fly ash Industrial Waste like marble Sludge	Thermal Power Plant Industry	Fly Ash Alternatives/ Waste based bricks
Stone	Demolition Waste	C&D waste	Recycled aggregate, Replacement in ashait mixtures, Portland Cement concrete
Sand	Demolition waste Natural Stone	Construction Sites Quarry	M-sand
Limestone	Crushed Limestone Calcinated Clay	Lower Quality Limestone, overburden clay mines, Thermal Power Plants, Sponge iron Industries	Blended Cement

Source: TERI, GIZ and DA 2016

Favorable Developments in Construction sector:

Indian government taken several steps for increasing use of fly ash, red mud and slag concrete in place of other binders. To reduce the use of carbon-based resources there has been increase in by-product and substitutes from other industry and manufacturing processes. Share of blended cement has increased substantially since 2010 2011. Due to lack of awareness, there has been struggle in the construction industry and various measures have been adopted by Bureau of Indian standards for using C& D Waste.

Agriculture Sector

About 8% total global agriculture output is the second largest producer of agricultural products. agriculture account for about 17% of India about 60% of the Indian rural household agriculture as their main source of livelihood .in the last few decades India has witnessed rapid transformation specially after the economic reforms of 1991.food sector in India has not yet reached its full potential. The production of most crops is much below the global average. India also lacks in processing facilities majorly for many crops .in India only 4% of the crops are being processed in comparison to China 23% ,Indonesia 50% and Brazil 70% .India loses 40% due to inadequate processing infrastructure . To achieve food security, it is essential that the shelf life reduce should be extended which is going to benefit the farmers income as well (Kumar and Sharma 2016 and ASSOCHAM)

Opportunities across the Value chain in Agriculture

If we examine the agricultural food system, it will be evident that opportunities in all stages off the value chain starting from primary production to use of food waste in the eco system nexus of bio economy and retail Consumer.

Input supply stage

1. 80% of the India's fresh water out of available 4% of world water is used for agricultural activities

2. There has been searches extending from years to years for water use efficiency in agriculture.

3. Sprinkler irrigations system, Drip irrigation, Utilization of treated water, use of micro free plans some of the initiatives are regarded feasible source of irrigation water.

India produces more than 5 lakh tons of biomass annually because in India agriculture possesses dominant position a large portion of these crop residues are burned in fields every year to clear the straw stables which causes air pollution major reasons behind burning of crop residue is shift from manual to mechanical harvesting burning causes not only air pollution, but the soil loses the organic matter as well. the options available for management of crop residues include livestock feed, preparation of compost, Cultivation of mushroom, Conversion into biofuel, crop residues as biochar, crop residues incorporation and power generation. rice husk power plant. Husk Power Systems, de -centralized power generation and distribution company started its operation in 2007 with the objective to provide affordable, Reliable environmentally sustainable energy who rural India by using husk as a fuel.

Extending shelf life of food

Development of food processing such as cold chain connectivity, Improvements in packages packaging, edible coating, carbon dioxide emitting patches has helped in Roots changing consumer references across countries. This type of infrastructure has also enabled distribute not only the domestic market but also export but in India current exports only 1% of the total produce.

Conclusion

Consumers are the only one that can provide effective management of e waste and they are being encouraged to correctly dispose-off their e-waste. With the increment in the re usage and recycling rates there has been a link between the initiatives like Extended Producer Responsibility (ERP), Design for Environment (DfM); 3RS with the market so that the consumers also adapt sustainable consumption habits. The success of Extended Producer Responsibility (EPR) requires proper infrastructure, policies especially designed for e-waste, technology, and skilled labor along with the financial backing, which unfortunately India lacks in. Moreover, the e waste policy 2016 is not able to clearly define the responsibility and the role of various stake holders and organizations in the field of waste management. Although the promotion of Circular Economy cannot be solely done by the Government only but an approach involving the partnership of consumers, retailers and investors jointly is required. With the improvements in technologies and innovations like-Cloud, the electronic sector can easily dematerialize and creation of a sustained economy from millions of e-

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