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Reverse Logistics, Green Supply Chain & Carbon trading

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Abstract*— Reverse logistics and Green Supply Chain form an interconnected and interwoven network of parameters that contribute to enhancement and incremental exchange in the triple bottom line in the consistently changing and fragmenting markets of the globalizing markets of today. Reverse Logistics not only contributes to completing the supply chain in a comprehensive and synchronized manner but also contributes to a significant degree in optimizing green supply chains through procedures such as recycling , refurbishing etc. contributing to waste reduction. Carbon trading, owing to its limitations in the global context and being in a nascent stage seeks plethora of research to determine its full application in synergy with reverse logistics and green supply chain.

***Index Terms*—Carbon emissions, Carbon trading, Green supply chain, Reverse logistics.**

I. INTRODUCTION

THE paper deals with researching , determining , interpreting and establishing a relationship between reverse logistics, green supply chain and carbon trading. The reduction in emissions that can be beneficially generated through reverse logistics in green supply chain have the potential to be transformed to cash credits through carbon trading. The paper attempts to envisage and explore the techniques in reverse logistics and there applications in green supply chain.

A. Reverse Logistics

Reverse logistics refers to the movement of a tangible object from the end consumer towards the producer or manufacturer because of rejection by the consumer to retain the product offered to him. It offers a 360 degree loop to the supply chain practices and thus projects a keen opportunity to minimize the loss of resources in the form of inefficient and unoptimised links in the supply chain to cater to rejected products. It may be figuratively represented as in Fig: 1.

Figure 1 projects a broad description of the steps involved in reverse logistics. It is initiated by an unsatisfied customer followed by the incorporation of the product in the supply chain. The grievances or customer care segment play an integral role as the first receptors of products in supply chain as a legal face of the company.

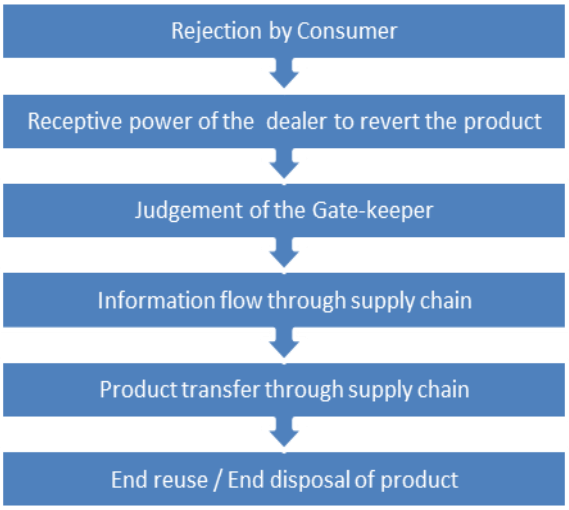

Fig. 1 Overview of reverse logistics

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Figure 1 projects a broad description of the steps involved in reverse logistics. It is initiated by an unsatisfied customer followed by the incorporation of the product in the supply chain. The grievances or customer care segment play an integral role as the first receptors of products in supply chain as a legal face of the company. The customer support center dictates and plays a critical role while determining the products that are the responsibility of the company pertaining to after sales documented rules of the product communicated to the customer by the company. Thus, the product entry through the supply chain is regulated by the gate keeper so as to determine the viability of the product to be propagated through the supply chain and the steps or route via which the product needs to be forwarded in the intricate and complex network of supply chain. Thus, gate keeping prevents excess or unnecessary loss of time or resources because of acceptance of wrong products or because of products reaching the inappropriate or wrong destination for the process of reverse logistics.

Reverse logistic is interpreted as a means to value addition and thus is a form of extrinsic activity in the value chain that originates or is driven by the customer at different and distinct parts and segments of the supply chain. The procedure or orientation of the activity involved in reverse logistics dictates the capitalization and conversion of efficiency and potential to generate the value in quantifiable and measurable terms so as to create a competitive leverage, advantage and pressure over the competitors. Every business model has gaps and niches and thus the ability to generate and integrate a diversified and differentiated process as reverse logistics into the value chain essentially requires mapping of the analytical and qualitative aspects involved.

Cost analysis is a descriptive term and essentially revolves around creating a benchmark to assess the viability and sufficiency of the revenues and thus the profits generated. The efficiency and effectiveness of the cost analysis is based on the aspects and process oriented features which demarcate the operations or segments that are subject to costing and thus are treated as cost centers. An inaccurate assessment of the cost centres and the cost analysis creates imbalance and thus misaligned and misinterpreted information to assess the alignment of the procedures to be carried out. Reverse logistics has undergone a transformation from being exhibited as a cost centre to profit centre. The tricycle of reduction, reuse and recycle creates a profitable and untapped proposition for the firm involved and thus initiates an unmapped and unexplored plethora of opportunities.

B. Green Supply Chain

Green Supply Chain Management is the introduction of variables and aspects in the supply chain processes so as to optimize and improvise the existing framework and simultaneously introduce stimuli to allocate the existing and acquired resources in the most profitable and beneficial manner. Recycling by-products and end-products is an important component of green supply chain as it contributes to not only reduced wastage but enhances the savings created because of better operations practices , thus subsequently influencing the bottom line in a significant and impactful manner. Thus, green supply chain deals with culmination of the operational and business plan of the company with the conceptualization and implementation of the imbibed principles of green supply chain within processes, tasks and operational activities .Thus, it should be analyzed and assessed in an objective, holistic and comprehensive manner so as to assess the feasibility of the introduction of variables of green supply chain into the main-stream operations of the supply chain.

Green supply chain also deals with the prospects of remodeling and redesigning manufacturing processes in the industrial sector so as to alter the lead time and process time in order to enable a reduced span of product under operation to reduce the consumption of resources. The resource used in the process may be physical, technological, human and financial. It should be noted that the consumption of each resource is invariably associated with an indirect or direct cost. Thus, green supply chain substantiates the apportionment of activities in a skillful manner to enable the beneficial residual progressive addition to not just the bottom line but to the triple bottom line to enhance the value of the organization not just in monetary terms but also in the perceived image by the customer, consumer, stake holders and involved subsidiaries and other linked in its framework.

Quality improvement is one of the integral and defined factors of green supply chain management and thus involves a synchronized allocated framework of responsibilities aligned to enhance and create deliverables of standardized and uncompromised quality. Quality has a relationship framework with durability, reliability and the associated

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technology. Thus, it is essential to visualize and align an agile, adaptable and lean supply chain that creates excellence in quality to enhance the value in terms of customer's experience which shall eventually be translated to enhancement of the bottom line. Management of green supply chain additionally involves tracked and calculative reduction of the generated carbon emissions, which has been subsequently explained.

C. Carbon emissions

Carbon emissions has become much debatable topic on public responsibility and action against global climate change. Carbon emissions refers to gaseous emissions directly and indirectly associated with human production and consumption that affects climate change. Carbon pollution causes extreme weather, rising sea levels and higher temperatures. Climate change is a global problem and requires global solution from all the countries. Carbon polluting nations need to take steps to reduce and stabilize their levels of carbon emissions. Carbon emissions is measured in tones of carbon dioxide produced per year.

Carbon emissions are one of the eminent emissions created in the dynamically industrialized and globalized world market of the twentieth century. It is imperatively essential and important to create a synergy between the varying and different pollutants and the means to mitigate the levels of pollutants to acceptable levels. Emissions are dispersive and randomly rapidly impactful in nature. The direct and indirect consequences of accumulation of these emissions has the potential to create irreparable losses in the ecosystem and thus substantiate the urgency in allocation of interest and resources to deal with the issue of carbon emissions.

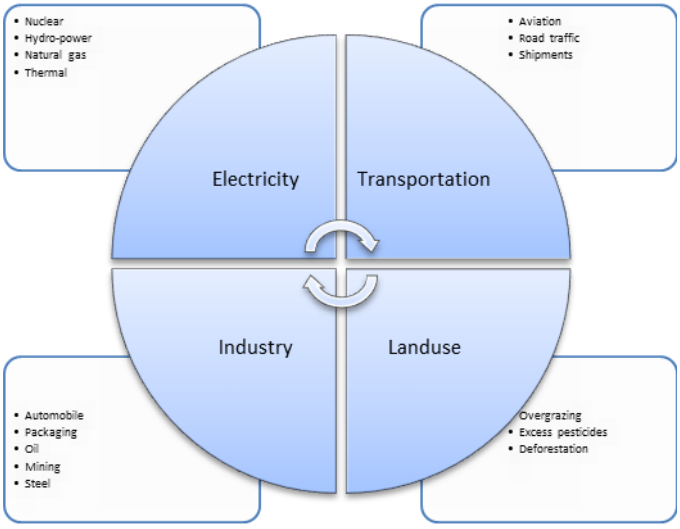

Fig 2: Sources of power generation

The figure represents a broad overview of the major generators of carbon dioxide and thus intends to create a basic classification of the sources of carbon emissions as:

- Electricity
- Transportation
- Industry
- Land-use

Electricity is an essential and important commodity of the modern world in both the developed and developing countries but the nature and resource utilization in the process of electricity generation can have a huge impact on the frequency and magnitude of carbon emissions and thus a strong influence on the global eco-system. Transportation is an integral and vivid necessity for survival in the networked and related lifestyle of today and thus a persistent and exclusive use of the transportation facilities in its diversified and influential format creates a global impact. Heavy industries contribute extensively to carbon emissions owing to the technology limitations and the magnitude of investment needed to create a sustainable environment. Oil and mining industries are one of the major contributors owing to the extent of diversified coverage and resource utilization. Land use has lately been an

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immense contributor to carbon emission owing to reduction in the coverage of are under green mask and thus reducing the extent to which carbon may be extracted from the environment.

The globe is an interconnected and interrelated mesh of influence and activities that creates, allays and explores the possibilities and ventures of uncertainty in the domains ranging from discovery of our ancient past to the innovations of cloning and travel. The synthesis and emergence of these activities deals with the emissions at every segment as a part of concurrent activities that diverge through differentiated process generation. Thus, the globe inevitably needs to create a mapped and feasible approach to deal with the increasing carbon emissions. "A carbon footprint is a measure of the amount of carbon dioxide emitted through the combustion of fossil fuels. In the case of a business organization, it is the amount of CO2 emitted either directly or indirectly as a result of its everyday operations. It also might reflect the fossil energy represented in a product or commodity reaching market." Grub & Ellis (2007) [1]. "… a technique for identifying and measuring the individual greenhouse gas emissions from each activity within a supply chain process step and the framework for attributing these to each output product (we [The Carbon Trust] will refer to this as the product's 'carbon footprint')." (Carbon Trust 2007, p.4) [2]. "A 'carbon footprint' is the total amount of CO2 and other greenhouse gases, emitted over the full life cycle of a process or product. It is expressed as grams of CO2 equivalent per kilowatt hour of generation (gCO2eq/kWh), which accounts for the different global warming effects of other greenhouse gases." Paliamentary Office of Science and Technology (POST 2006) [3]. Carbon foot printing is the quantifying of the carbon emissions into a measurable, gauge able and perceptible format of emission study. It is the means to evaluate, assess and interpret the positioning of the carbon footprints generated and thus offer a better road map to success through value generation. Carbon foot printing is inclusive but not restricted to the computation of carbon emissions generated but it offers insight into the relative distribution, dissemination, propagation and circulation of the basis of generation of emissions and thus enable better insight in dealing and mapping solutions.

D. Carbon trading

Carbon trading is an exchange of credits between nations working on carbon emissions reduction. Countries with higher carbon emissions buy carbon credits from countries with lower carbon emissions to purchase the right to release more carbon dioxide into atmosphere. The carbon trade originated after 1997 Kyoto Protocol and today every developing and developed nations are working on reducing their carbon emissions. Carbon Emissions trading gives the high carbon dioxide polluters an incentive to reduce their emissions [4]. If a country or a company pollutes less than their quota they can sell their spare permits .If they pollute more than their quota they can buy spare permits. The carbon markets are two types : the voluntary market and the regulatory (compliance) market. The carbon credits are generated by projects operating under United Nations Framework Convention on Climate Change (UNFCCC) approved mechanism Clean Development Mechanism (CDM). The credits generated in compliance market are known as Certified Emissions Reductions (CERs). In voluntary market , carbon credits are generated by projects that are accredited to Verified Carbon Standard (VCS) [5].

II. RELATIONSHIP

Thus, an inter-relationship can be successfully established among reverse logistics, green supply chain, carbon emission and carbon trading. The existence of an intricate network among the stated is substantiated as reverse logistics contributes significantly and exorbitantly to the formation of green supply chain, influencing the downward tail of the framework. The efficiency of the aligned network can be quantified through carbon emissions in the form of carbon foot printing. Thus, green supply chain is a form of eliminating or mitigating products generated in the processes and operations involved in the supply chain , that are hazardous to the environment in any form . Reverse logistics as an optimized procedure to carry out the tail end activities and thus caters to reduction in wasteful and unproductive activities, thus indirectly contributing to reduction in resources that may contribute to creation of pollution or products that may be harmful for the environment. Carbon emissions are an important component of the greenhouse gases creating pollution and thus quantifying them is an integral part of estimating the pollution caused because of the concerned activities and carbon footprint serves as a useful tool to measure the same and subsequently connecting the four involved in a complex but predictable pattern.

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Fig: 3 Drivers of sustainable growth

The figure illustrates the drivers of sustainable growth and thus encompasses the critical factors to ensure a holistic, comprehensive and integrated approach to a mapped and continual development. The essence and importance of green supply chain models to be integrated into the global business frameworks is imperative for an ecologically strong environment to sustain and flourish and thus it is essential for the coupling of global awareness and ecological value chains to create long term positive impact on the global existence of the diversified species. The profitability of frameworks encompassing global green initiatives needs to be gauged in a weighted average of qualitative and quantitative terms , thus inclusive of long term trends and alterations in the global scenario of the functioning of industries.

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