

# Carbon Management in Managing Sustainable Supply Chain of Indian Industry

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**Abstract**—This framework development explored the status of GSCM in manufacturing SMEs & concluded that there was a significant gap w.r.t carbon emissions measurement in the supply chain activities. The measurement of carbon emissions within supply chains are important green initiative toward its reduction. Majority of the SMEs were facing the problem to quantify green house gas emissions in its supply chain & to make it a low carbon supply chain or GSCM. Thus, the carbon management initiatives were amalgamated with the supply chain activities in order to measure & reduce the carbon emissions, confirming the GHG protocol scopes. Henceforth, it covers the development of carbon management software (CMS) tool to quantify carbon emissions for effective carbon management. This tool is cheap and easy to use for the industries for management of their carbon emissions within supply chain.

**Keywords**— Carbon Management, Sustainable Supply Chain, Indian Industry.

## I. LITERATURE REVIEW

REICH-Weiser1, et.al. (2010) have segregated the various GSCM frameworks developed into two broad categories: life-cycle assessment methodologies and life-cycle assessment standards. In their paper, the differences between various frameworks were analysed, and their situational employability was also defined. The paper sought to find answers to questions like what are appropriate LCA methodologies for different scales of manufacturing and how do existing standards apply across various levels of manufacturing? Federico Caniato et.al (2012) presents the results of exploratory case-based research aimed at identifying three factors: the drivers that push companies to adopt “green” practices, the different practices that can be used to improve environmental sustainability and its measurement in fashion companies. Results include a comparison of two approaches pursued by established international companies with green-positioned brands with an effort of small firms that have adopted alternative supply chain models. Ian W.H. Parry (1997) emphasized that Reducing the amount of carbon dioxide Americans pump into the atmosphere will involve economic costs. These costs are larger than previously thought because emissions reduction policies are likely to aggravate

economic distortions created by the tax system. But most of this added cost can be avoided if the policy chosen to reduce emissions raises revenues for the government and these revenues are used to cut other taxes. David Simchi-Levi, (2008) emphasised that the supply chain creates one of the biggest carbon footprints through the production, storage and transportation of goods. The ability to determine the carbon footprint for the entire supply chain and make strategic decisions based on ecology but not only on cost is an important consideration. There Richard Lester and Ashley Finan, (2009) reported in MIT paper series that the U.S. is considering seriously to adopt ambitious targets for GHG emissions that requires a reduction in energy-related carbon dioxide releases of 80% or more by the year 2050. Achieving such a goal will reduce the reliance on petroleum for transportation and high carbon fuels for electricity generation towards alternative transportation fuels and low-carbon electrical generating technologies, including solar, wind, geothermal, nuclear, and coal with carbon capture and storage in order to achieve the carbon emission targets. Inas Abdella, (2010) clearly explained in survey study that the good news is that almost 50% of executive respondents claim that their company is able to measure CO<sub>2</sub> emission levels and there is a program in place to reduce carbon emission levels. Only around 14% of respondents did not know whether their company was able to measure CO<sub>2</sub> or had a plan so this is also relatively good news. The challenge lies with the remaining 50% of executives and companies in how and when they will start a program to actively measure and reduce carbon emission levels in their supply chain. Bert Bong (2009), stated while receiving the green supply chain award in transportation for Ford Europe that its actions to reduce the carbon footprint of its vehicle transportation logistics operation have been recognised. Its unparalleled performance in environmental supply chain planning and execution, includes compliance with environmental regulations, minimising waste from the supply chain process and the overall adoption of “green” practices across the supply chain and continuously improve its CO<sub>2</sub> footprints over the entire life-cycle of its products. CDP supply chain Report by Accenture (2012-13) indicates that carbon disclosure project was conducted for its 54 member companies and their 6000 suppliers. Companies responded that they are more aware about the risk the climate change poses to their global supply chains. Growing percentage of companies and suppliers has started investments to reduce

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carbon emissions. Moreover, companies are aware that brand value can be created through more sustainable supply chains. Dale W. Jorgenson et al (1993) presents several important findings that in the United States the effects of a carbon tax will be very similar to the effects of a tax placed solely on coal. Outside the coal sector, the principal effect of carbon tax will be to raise the cost of electricity and to shift base load electric generating capacity toward fuels other than coal. At the aggregate level, higher energy prices will cause gross national product to fall unless the revenue from tax is used to reduce high marginal tax rates elsewhere in the economy.

## II. METHODOLOGY ADOPTED IN CARBON MANAGEMENT SOFTWARE DEVELOPMENT

A user driven program was developed for calculating emissions in various operational activities of SCM in Industries which can be benchmark for low carbon supply chain. The software program is being developed by using the following two languages (i) C++ and (ii) HTML. The baseline data was collected from the latest European emission standards and factors provided by the Department of Energy and Climate Change (DECC) and the Department for Environment affairs, (DEFRA), U.K. The emissions are calculated in the form of "kgCO<sub>2</sub> equivalents" and the values for CH<sub>4</sub> and N<sub>2</sub>O are presented as CO<sub>2</sub> equivalents (CO<sub>2</sub>e) using Global Warming Potential (GWP) factors, consistent with reporting under the Kyoto Protocol and the second assessment report of the Intergovernmental Panel on Climate Change (IPCC). The factor for each case was calculated considering above mentioned method of finding CO<sub>2</sub> equivalents.

## III. DEVELOPMENT OF NUMERICAL SOFTWARE TOOL FOR CARBON MEASUREMENT & ITS MANAGEMENT IN SCM OF AN INDUSTRY

The Software covers the calculation of emissions of CO<sub>2</sub> of three GSCM options or activities, Fuel consumption, energy consumption and transportation costs in supply chain which are the grey areas in terms of cost and plays havoc in generation of emissions for an industry. These areas /factors of SCM are taken into consideration for qualitative measurement and implementing cost effectiveness into the SCM in order to make it carbon neutral. The main measurement components w.r.t the scopes defined in GHG protocol were taken into consideration while developing of this software are as follows:

**Scope1.** Emissions through direct consumption of fuels.

**Scope2.** Emissions through various Transportation modes adopted.

**Scope3.** Emissions caused by units of electricity consumed

## IV. FRAMEWORK DEVELOPMENT FOR CARBON MANAGEMENT MODEL

Figure 1.1 shows the various steps to be followed in development of the Carbon management software tool for carbon measurement. It defines the step wise procedure for the firms to start inculcating the carbon management programs

into their GSCM. Firstly, measurement the carbon emission to know the carbon foot prints. Secondly, when the emissions are measured than go for carbon emission cuts in various operational activities of GSCM. Thirdly, earning carbon credits from the emission cuts & involve the firm in carbon trading and hence making the green profits. This framework can be benchmark for adoption of the carbon management system in manufacturing firms.

## V. CONCLUSION

The software tool which is developed for calculating carbon emissions has various tangible and intangible benefits for the manufacturing organizations. The software tool is an essential asset for any industrial sector including small and medium sector enterprises and tracks the environmental impact of the supply chain activities of the organization. The various benefits that software aims to provide are:

Carbon calculations and reduction promotes positive and environmentally responsible and conscious image of company and boosts its brand image and helps in marketing of its various products and helps in design and planning of Environmental Management System (EMS) of an organization for its continuous environmental improvements and policy implementation. It provides an essential baseline data to the organization to set realistic targets and track progress in of GSCM. & helps to or analyze the effectiveness of the steps taken for carbon management by the organization. Carbon emission reduction program and carbon management leads to essential cost savings of its supply chain activities and the analysis of current emission statistics help in estimation of carbon-credits and other carbon emission trading schemes. It paves the way for use of alternative sources of energy and gives direction for energy saving and waste minimization. It is a guideline for analyzing the Environment impact of their supply chains and motivate towards green initiatives. It is also a guide to choose the transport mode in a supply chain of an industrial/service sector.

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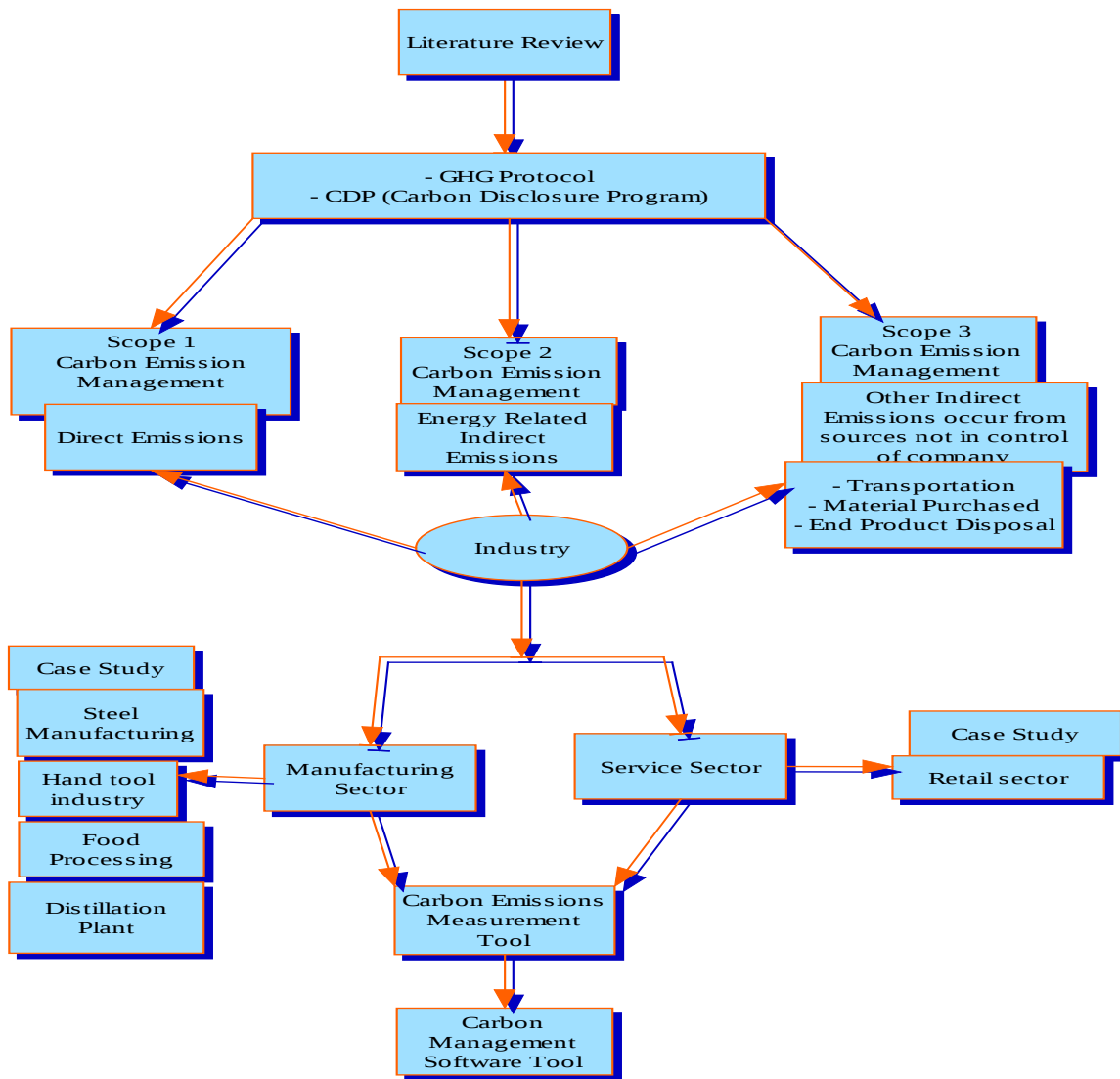


Fig. 1.1 Framework development of Carbon management software tool for carbon emission measurements in supply chains of various industries