

# Environment Sustainability within Supply Chain of Automobiles

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**Abstract:** Climate change is one of the serious issues confronting humankind. The environmental agency wants to reduce the carbon emissions to two thirds from the current status. The strategy to reduce the carbon emissions while transporting the cars from the place of manufacture to the market place is by using the rail transportation instead of road.

**Keywords:** Carbon Emissions, Rail Transportation, Road Transportation, Carbon Foot print.

## INTRODUCTION

Climate change is one of the most serious issues confronting humankind. It has been estimated by the Environmental Protection Agency that the movement of cargo by rail rather than by road reduces carbon emissions by two thirds. The agency also proposed to the logistics industry to reduce the greenhouse gases emission by changing their mode of transport from road to rail to start with 5% cargo. The direct benefit which we derive out of this reduction in traffic and a low maintenance of roads by our highways department.

## OBJECTIVE

To analyse the carbon emission reduction for two mode of logistics namely the road and rail.

## REVIEW OF LITERATURE

### Carbon Emission

Various literatures identify carbon footprint as emissions of carbon-dioxide gases. This term deals with how much of carbon dioxide emissions can be attributed to a certain product, company or organization. The carbon emission depends on many factors. The carbon emission is actually a carbon weight of kilograms or tonnes per person or activity (GEOFFREY HAMMOND (2007). GRUB & ELLIS (2007) the carbon emission is also called as ecological footprint, is a measure of the amount of carbon dioxide emitted through the burning of fossil fuels. The amount of CO<sub>2</sub> emitted either directly or indirectly as a result of the everyday operations of any business organisation. HAVEN (2007) found that the carbon footprint analysis as "life-cycle assessment took materials, manufacture, transport, use and disposal at every stage of development." ECKEL (2007) found that PA-LCAs (Life cycle assessment) are used for deriving carbon footprint estimates, PA-based LCAs run into further difficulties once carbon footprints for larger entities such as government, households or particular industrial sectors have to be established.

WIEDMANN AND MINX 2008 inquires whether carbon emissions should include methane.

"The carbon footprint is a measure of the exclusive total amount of carbon dioxide emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product". Wiedmann and Minx 2008 says that carbon emissions can be calculated by two methods Process Analysis (PA), and Environmental Input-Output analysis (EIO). DAVID MARTIN HEROLD (2017) the logistics sector has identified 5 key areas where carbon emissions can be managed. They are carbon strategy, carbon risk assessments, carbon target setting, carbon reduction initiatives, and carbon performance and reporting. The research has shown that the Logistics sector has is using carbon management practices. NOUSSAIR and SOEST (2014) The carbon emission control can be attained through carbon tax approach. The carbon elimination cost will be add on to the cost if it adopts cheap methods and the net

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result on the environment is nil. The R&D is supported for innovation of carbon saving technology in Europe (Bye & Jacobsen, 2011).

### **Global Warming**

Global warming is a comparative method to study the carbon emissions. It is calculated for definite period of 20, 50 or 100 years. The value is generally stated as percentage of Carbon dioxide. Global warming is dependent on the absorption of infrared radiation, the location, atmospheric lifetime.

### **Carbon Emissions based on Transport Mode**

The organisations are paying more attention towards carbon emissions which is the result of their day to day activities. The decisions on logistics are generally taken based on inventory and transportation costs. Nowadays the decision is made on in addition to above the carbon emission costs. The inventory model of any company is based on transport mode in addition to stocks and lead time.

(RAVI K JAIN, ANUPAM JAIN & VINITA JAIN, 2013) Carbon accounting is a social activity undertaken to keep a check of amount of carbon dioxide equivalents which will not be released into atmosphere as a result of variability projects under Kyoto Protocol mechanism. Emission trading system is often called as cap and trade. The main motto of this principle is to reduce pollution and fight against global climate change. (CHRISTOPH BOHRINGER & HEINZ WELSCH, 2010) Sovereignty versus egalitarianism has been highlighted to provide a pragmatic answer to the equity debate. When mixed with international emissions trading; the constructive approach stands out for offering the developed countries huge amount of emoluments for participation in the lowering of greenhouse gas effect. (BENJAMIN J RICHARDSON, 2009)

Global warming has been the foremost and front runner theme which paves more insights to have climate finance in the agenda. Present scenario is more pertains to financial selected professionals to leverage capital for emission free trading and clean energy. A significant additional change in economy through the crawling of socially responsible investment has been inadequately looked upon. In a other way around we are constructing more opportunity to control the release of greenhouse gases which indeed proliferates a business case to move towards climate change with feasible solutions. At the same time, there has been less number of SRI due to the lack of public governance framework and postponement of its regulated agenda.

ON THE BASIS OF KYOTO PROTOCOL: (DEEPANSHI CHAUDHARY, 2007) Disorderly anthropogenic process and their impersonation in decreasing, altering the ecosystem, environment has been a matter of worry. In advent to the discovery of Kyoto Protocol which staggers its ability to control in climate change. Presently carbon market is future prospect of estimated worth of \$750 million, trading volumes soaring up to 79 million tonnes of carbon dioxide with growth rate of almost 290 % in just one year. (HEGE WESTSKOG, 2000)

A different means of letting the portability mechanisms as an alternate to get national commitments under the treaty to lower the emission of carbon dioxide gases has been talk of the century; all through the Kyoto Protocol steps. A number of conversations either in support of or not favor of have been put forward. The main characteristic aim is to transcend horizons into number of sayings which will gallop towards reducing emission of greenhouse gases effect.

ON THE BASIS OF CARBON TRADING: (MANISH SACHDER, 1999) Every manufacturing and industrial process releases carbon dioxide. In order to control them, a new technology developed called carbon emission reduction. These are mere certificates given for the purpose of lowering emissions of carbon dioxide. It has been seen that developing countries have been refrained from this kind of phenomena where as there is a room for an element of opportunity from firms within India, Brazil, China. Additional cash flows from sales of credits result in an internal rate of return by 27%. (EVA LOVBRAND & JOHANNES STRIPPLE, 2006) Mathematical notations and analysis point of view states that it is more of stocks and carbon which comes to governance part. Carbon credit accounting is a statutory allowance that controls the carbon dioxide emissions in which content of carbon can be architecture, structured, synchronized. A triumvirate type of carbon account trading has been shown. They are 'national carbon sink', the carbon credit and the personal carbon budget. These are depicted as stocks and flow of carbons to be built as block of administration which seeds to social, political and economic coherence.

ON THE BASIS OF CREDITS: (ALLWARDT & JENNIFER, 2008) Agroforestry projects are the catalyst from which carbon offset credits have been developed which are useful for farmers in the areas of growth. Plethora have been using Kyoto Protocol, but sundry are having the zeal and potential to use (CDM) to diminish carbon dioxide flow; which is also regarded as an impoverished tool. This will leave no stone

unturned especially for farmers; they would receive emoluments for taking care of plantations of carbon offset credits done by the organization.

(BHANAWAT AND VARDIA,2015)The style of carbon credit revenue generation literally took a downward toll from industries of sugarcane, jute, cotton, cement, paper, etc.

(KENNETH M CHOMITZ & FRANCK LECOCQ,2012)Credits which have been derived from carbon storage and is of short duration acts as a decisive technique which filters the emission reduction obligations by lingering it over a high amount of time period. This technique absolutely lays the foundation of environment integrity of a carbon credit project. Since credits which hare of shorter duration needs attention and renewal, it is impossible to compare it with the permanent one.ON THE BASIS OF EMISSION TRADING:(REID & TOEL, 2007).

An organization credibility is increased if it reduces some tonnes of carbon emissions by either trading or by using a new technology. A conceptual difference has been cited between carbon and environment accounting. So as to support decision making process and public disclosure.

(RICHARD BENWELL,2001)Quick growth of emissions trading markets would act as a cushion to pervert cost benefit analysis for American sectors. Tenacity of International trading emissions largely owe to European Market. Two factors hover over it i.e. –firstly ownership of the emerging markets gives the bargaining tenacity to go for fruitful climate changes and secondly, unproportionate benefits seems to be frontline runner in the countries which are fully developed.(DHAVAL SHARMA,1994)A mechanism was used to control and reduce the flow of greenhouse gases is called Kyoto Protocol. Responses are very niggard in nature in categorical to carbon emissions limit. Foundation of markets has to be there for the exchange of carbon allowances. An agreement was signed in the years 2002 where India is 3rd rank category of signatories of UNFCC and world leader of Clean Development Mechanism (CDM).

ON THE BASIS OF CLEAN DEVELOPMENT MECHANISM (CDM)(MICHAEL DUTSCHKE, BERNHARD SCHLAMADINGER, 2015)Forestation and Reforestation are the two types of emissions which have been highlighted under the scheme of CDM (Clean Development Mechanism). The credits get expiry date as result of which buyers have to purchase once again for the ephemeral texture of carbon buffer

## RESEARCH METHODOLOGY

### Data Analysis

#### DISTANCE TRAVELLED BY FINISHED VEHICLES

1. Evaluation of consumption of fuel for road and rail mode

Total distance between Chennai to Delhi

Road - 2181 Km

Rail - 2183 Km

2. Utilization of diesel per Km by two modes of transportation

Train requires 4 Litre of diesel to cover 1 km

Truck requires 0.36 Litre of diesel to cover 1 km

Truck mileage per Litre diesel = 2.75 km

a. Total diesel utilisation by 1 Trailer is calculated with the average mileage

per km 2.75 so, for the distance of 2181 Km =  $2181 \div 2.75 = 793$  L.

b. Total diesel utilisationby Train for the distance 2183 Km =  $4 \times 2183 = 8732$  L.

#### CAPACITY OF CARS TRANSPORTED BY EACH MODE

Train moves = 270+ cars.(Total wagons = 27, each wagon occupies 10 cars so, total  $27 \times 10 = 270$ ).

1 car carrier trailer moves = 7 cars

The number of trailers needed to carry 270+ cars =  $7 \times 39 = 273$ .

#### RAILROAD

Alternative mode (rail)

On an average shipment for one year – 120 trains

One train consumes 8732 litres of diesel

For one month, 10 trains consumes 87320 litres of diesel

In a year the total shipment made is  $10 \times 12 = 120$  trains (10 trains per month)

For 120 trains  $120 \times 87320 = 10478400$  Litres of diesel

Calculation of carbon emission per annum

Alternative mode (rail)

Total Litres of diesel consumed for 120 trains = 10478400 Litres

$10478400 \times 2.64 = 27662976$  kgs (27662.976 Tons)

### CALCULATION OF CARBON EMISSION PER ANNUM THROUGHROAD

Conventional mode (road)

One trailer consumes 793 Litres of diesel

Total trailers used for one shipment 39 and diesel consumed – 30927 Litres

Total trailers used in a month for shipment – 390

Total trailers used in a year – 4680

Diesel required for 4680 trailers – 144738360 Litres

Calculation of carbon emission per annum

Conventional mode (road)

Total Litres of diesel consumed for 4680 ( $4680 \times 30927$ ) = 144738360 Litres

Total Co<sub>2</sub> emitted -  $144738360 \times 2.64 = 382109270$  kgs (382109.27 Tons)

### FUEL REQUIREMENT FOR ROAD OF TRANSPORT :

Total fuel consumption by 39 Trucks is -  $39 \times 793 = 30927$  Litres.

### FUEL REQUIREMENTFOR TRAIN

Fuel consumption = 8732 Litres.

Difference between two modes of transport,

Truck 30927 Litres-Train 8732Litres= 22195 Litres

### COMPUTATION OF CO<sub>2</sub> EMISSION

Diesel:

1 litre of diesel = 835 g.

Diesel contains 86.2% of carbon, which consists 720 grams of carbon per litre.

In order to combust this carbon to Co<sub>2</sub>, 1920 grams of O<sub>2</sub> is required.

(720 + 1920) g = 2640 Grams of Co<sub>2</sub> is emitted for per litre diesel.

Converting into Kg (2640grams = 2.64 Kg of Co<sub>2</sub>).

Burning a litre of diesel produces around 2.64 Kgs of carbon dioxide.

Calculation: 5 litre  $\times$  2.64kgs = 13.2 kgs.

Train carries 270 tonnes on an average.

Empty wagons (27) weight – 970 tonnes

Average weight loaded of automobile products – 250 tonnes

Total tonnes carried through rail – 1220 tonnes (1220000 kgs)

1 Truck transports 7 tonnes on an average.

39 Truck transports 273 tonnes on an average.

Truck weights 24 tonnes (24000 kgs)

39 truck weights 936 tonnes (936000 kgs)

Total tonnes carried through road for one shipment = 1209 tonnes (1209000 kgs)

### THE CALCULATION OF CARBON EMITTED THROUGH

#### CONVENTIONAL MODE (ROAD)

Diesel consumed by one trailer = 793

Co<sub>2</sub> emission by 1 trailer = 2093 Kgs of Co<sub>2</sub>

### COMPUTATION OF CARBON EMISSION FOR FUEL USED FOR ONE TRIP

Trailer» 2181 Km » 30927 litres

Train» 2183 Km » 8732 litres

Trailer 30927 lit  $\times$  2.64 = 81647.28 kgs (81.64728 Ton)

Train 8732 lit  $\times$  2.64 = 23052 kgs (23.05248 Ton)

### COMPARISON OF SHIPMENT FOR A MONTH

On an average shipment for one month through alternative mode – 10 trains

Total 2700 cars are transported

Comparing the alternate mode of transport which needs 386 trailers to carry 2700 cars.

### CALCULATION OF CARBON EMISSION PER MONTH

Alternative mode (rail)

Total litres of diesel consumed for 10 trains = 87320 litres

$87320 \times 2.64 = 230524.8$  kgs (230.5248 Tons)

Conventional mode (road)

Total litres consumed by 386 trailers = 306098 litres

$306098 \times 2.64 = 808098.72$  kgs (808.09872 Tons)

### CALCULATION OF CARBON EMISSION PER ANNUM THROUGH RAILROAD

Alternative mode (rail)

On an average shipment for one year – 120 trains

One train consumes 8732 litres of diesel

For one month, 10 trains consumes 87320 litres of diesel

In a year the total shipment made is  $10 \times 12 = 120$  trains (10 trains per month)

For 120 trains  $120 \times 87320 = 10478400$  litres of diesel

Calculation of carbon emission per annum

Alternative mode (rail)

Total litres of diesel consumed for 120 trains = 10478400 litres

$10478400 \times 2.64 = 27662976$  kgs (27662.976 Tons)

### CALCULATION OF CARBON EMISSION PER ANNUM THROUGH ROAD

Conventional mode (road)

One trailer consumes 793 litres of diesel

Total trailers used for one shipment 39 and diesel consumed – 30927 litres

Total trailers used in a month for shipment – 390

Total trailers used in a year – 4680

Diesel required for 4680 trailers – 144738360 litres

Calculation of carbon emission per annum

Conventional mode (road)

Total litres of diesel consumed for 4680 ( $4680 \times 30927$ ) = 144738360 litres

Total Co<sub>2</sub> emitted -  $144738360 \times 2.64 = 382109270$  kgs (382109.27 Tons)

### CALCULATIONS OF CARBON CREDITS:

The total difference between two modes of transportation

Pricing for carbon credits in dollars as on 2017 is 5.53USD

$382109.27 - 27662.976 \div 5.53 = 64095.1707$  USD.

USD 64095.1707 is equal to Indian rupee - 4319514.56

## CONCLUSIONS

The effectiveness of carbon emission reduction through alternative mode of logistics has been derived with the comparison of conventional mode which gives a clear channel that train movement of transportation produces less emission comparing to road. Carbon emission footprint between road and rail will reduce up to 50% and it is determined through calculation of CO<sub>2</sub> emitted per trip, month, and year of shipments. climate change being a big threat in current era, this kind of carbon reduction is necessary which could promising in future.

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