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THE ROLE OF LOGISTICS AND TRANSPORT IN REDUCING SUPPLY CHAIN CARBON EMISSIONS

Öğr.Gör. Veysel TATAR
Artvin Çoruh Üniversitesi, Hopa Meslek Yüksekokulu, Artvin/Türkiye

Doktora Öğrencisi Meriç Burçin ÖZER
Avrasya Üniversitesi, Sosyal Bilimler Enstitüsü, İşletme Anabilim Dalı
Trabzon/Türkiye

ABSTRACT

To date, logistics and transport companies have mostly taken a tactical and internal view of supply chain decarbonization. This has resulted in important, but nevertheless small scale, responses to climate change.. More than three quarters of the greenhouse gas (GHG) emissions associated with many industry sectors come from their supply chains. For that reason, a growing number of leading companies are engaging their suppliers about managing GHG emissions. Over the past few years, these companies have incorporated systems for reducing GHG emissions into their own business practices and are now seeking ways to drive down emissions beyond their own operations. This paper examines the current methodologies and approaches developed to estimate carbon emissions in supply chains.

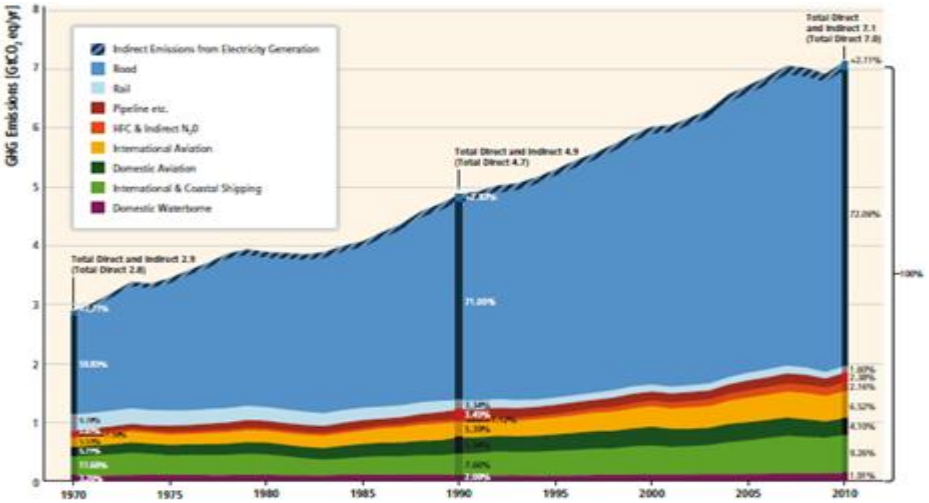
Keywords: Carbon Emissions, Logistics, Supply Chain

1. INTRODUCTION

The freight sector is a large contributor to emissions of greenhouse gas (GHG), to mitigate its negative impact on the environment is therefore essential in strives for a sustainable development. Globally the transport-sector currently represents 23% of CO2 emissions from fossil fuel combustion and approximately 15% of overall GHG emissions (ITF, 2010). The share of transport emissions is continuously increasing and could reach more than 30% of total EU emissions by 2020 if no action is taken. Emissions from freight transport account for approximately one third of total transport GHG emissions. 93-95% of GHG emissions from transport operations is accounted for by CO2 emissions.

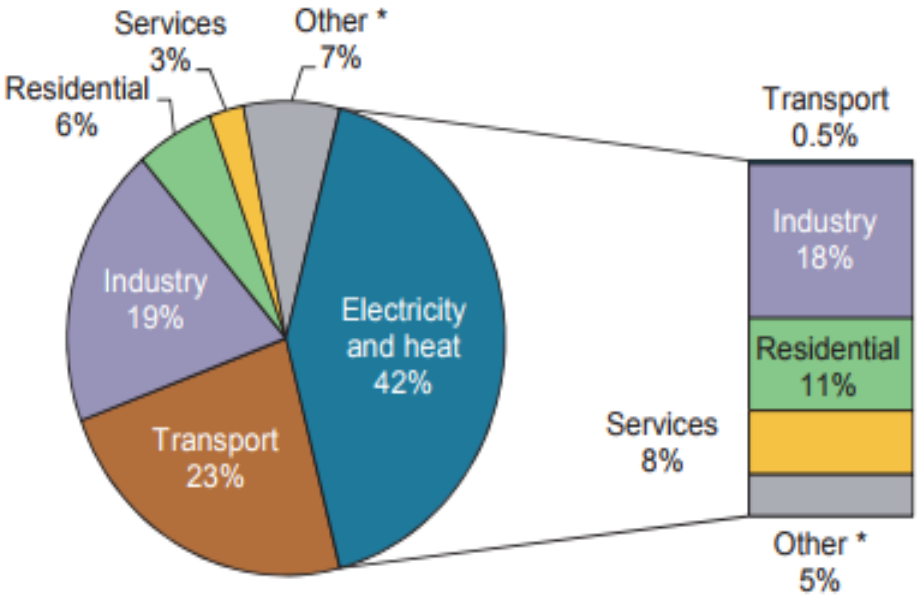
Without aggressive and sustained mitigation policies being implemented, transport emissions could increase at a faster rate than emissions from the other energy end-use sectors and reach around 12 Gt CO2eq / yr by 2050. Transport demand per capita in developing and emerging economies is far lower than in Organisation for Economic Co-operation and Development (OECD) countries but is expected to increase at a much faster rate in the next decades due to rising incomes and development of infrastructure. Greenhouse gas (GHG) emissions from the transport sector have more than doubled since 1970, and have increased at a faster rate than any other energy end-use sector to reach 7.0 Gt CO2eq in 2010 (IEA, 2012a). Around 80 % of this increase has come from road vehicles (Figure 1). The final energy consumption for transport reached 28 % of total end-use energy in 2010 (IEA, 2012b), of which around 40 % was used in urban transport (IEA, 2013). The global transport industry (including the manufacturers of vehicles, providers of transport services, and constructors of infrastructure) undertakes research and development (R&D) activities to become more carbon and energy efficient. Reducing transport emissions will be a daunting task given the inevitable increases in demand and the slow turnover and sunk costs of stock (particularly aircraft, trains, and large ships) and infrastructure. In spite of a lack of progress to date, the transition required to reduce GHG emissions could arise from new technologies, implementation of stringent policies, and behavioural change.

Figure 1. Direct GHG emissions of the transport sector (shown here by transport mode) rose 250 % from 2.8 Gt CO2eq worldwide in 1970 to 7.0 Gt CO2eq in 2010 (IEA, 2012a; JRC / PBL, 2013; see Annex II.8) (IPCC, 2014)



Transport is an important contributor to overall GHG emissions and the second largest sector after electricity production. In 2009 transport represented approximately 24% of the CO2 emissions from fossil fuel combustion (IEA, 2010), CO2 accounts for 93%-95% of the total GHG emissions from transport operations, the remaining 5%-7% consist of other gases such as nitrogen oxides (NOX), and different sulfur compounds (Cefic-ECTA. (2011). Emissions from transport have grown globally by 45% from 1990 to 2007, and in contrast to other sectors the emissions are still growing. Within EU, emissions of CO2 from freight transport grew by 24% between 1990 and 2001 (Åkerman and Höjer, 2006). Globally, the yearly growth rate of transport emissions between 1990 and 2000 was 2,11%, but the rate is increasing and from 2000-2006 it was 2,26% annually. This is mainly driven by developing countries, many in Asia, since the annual growth rate in the western world has actually fallen in the last years (ITF, 2009). With a business as usual approach, the global emissions are projected to grow by 38% from 2006 to 2030 (ITF, 2010). The challenge is to reduce the dependence on oil without sacrificing the efficiency and mobility of the transport sector (EC, 2011). Transportation activity normally increases with economic development and increasing gross domestic product (GDP). This has been seen earlier in the western economics and is now seen in emerging markets, of which many in Asia. A growing transportation activity leads to increasing emissions from transport, hence to reach a sustainable future, the increase must slow down and ultimately be reversed (Asian Development Bank, 2009). Two sectors produced nearly two-thirds of global CO2 emissions from fuel combustion in 2014: electricity and heat generation, by far the largest, which accounted for 42%, while transport accounted for 23% (Figure 2).

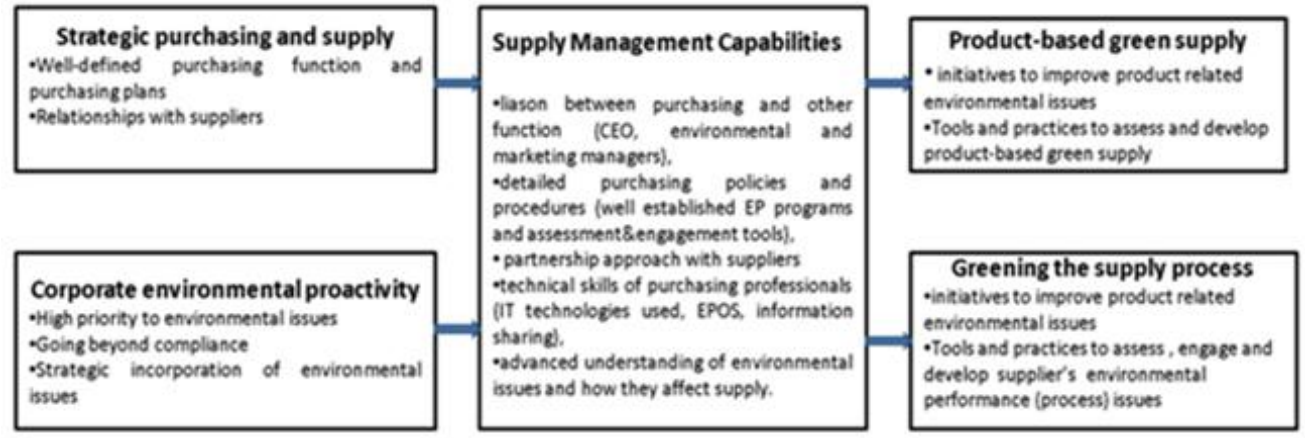
Figure 2. World CO2 emissions from fuel combustion by sector in 2014 (IEA, 2016)



2. SUPPLY CHAIN MANAGEMENT

Supply chain management (SCM) is the oversight of materials, information, and finances as they move in aprocess from supplier to manufacturer to wholesaler toretailer to consumer. The definition of "supply chain" seems to be more common across authors than the definition of "supply chain management" (Cooper and Ellram 1993; La Londe and Masters 1994; Lambert, Stock, and Ellram 1998). La Londe and Masters proposed that a supply chain is a set of firms that pass materials forward. Normally, several independent firms are involved in manufacturing a product and placing it in the hands of the end user in a supply chain—raw material and component producers, product assemblers, wholesalers, retailer merchants and transportation companies are all members of a supply chain (La Londe and Masters 1994). By the same token, Lambert, Stock, and Ellram define a supply chain as the alignment of firms that brings products or services to market. Note that these concepts of supply chain include the final consumer as part of the supply chain. It has been noted that discussions of SCM often use complicated terminology, thus limiting management's understanding of the concept and its effectiveness for practical application (Mentezer et al.. 2001). Given the growing environmental concerns during the past decade, a consensus is emerging that environmental pollution issues accompanying industrial development should be addressed together with supply chain management, thus contributing to green supply chain management (GSCM) (Sheu et al., 2005). Strategic purchasing and corporate environmental pro-activity positively contributes to development of supply management capabilities, which in turn are prerequisites for successful greening of supply (Fig. 3).

Figure 3. The role of supply management capabilities in green supply (Bowen and Cousins, et al., 2001)



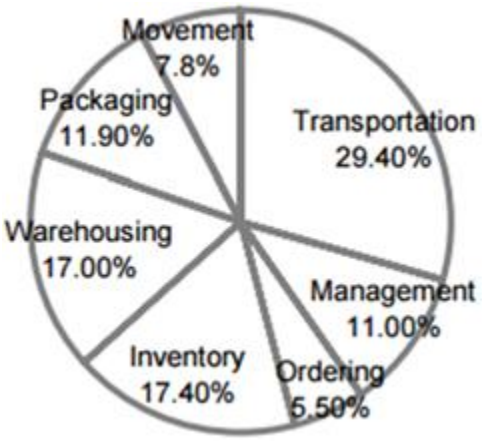
Supply chain management (SCM) has been examined through the conceptual lenses provided by a number of academic fields, including marketing (Mentzer et al., 2001) operations management (Mabert and Venkataramanan, 1998), management science (Aviv, 2001), purchasing (Giunipero and Brand, 1996), and logistics (Ellinger et al., 2002). This multidisciplinary approach is appropriate and necessary given that supply chains involve many functional areas of an organization.

3. GREEN SUPPLY CHAIN MANAGEMENT

Green supply chain management (GSCM), which integrates environmental concerns into supply chains, has been widely implemented by companies to improve performance (Zhu et al., 2016). Some studies showed that GSCM can bring both environmental and economic performance (Chiou et al., 2011). Supply chain management is a hierarchical and strategic approach to planning supply and demand, sourcing raw materials and components, making products and parts, tracking inventory and order fulfillment, and delivering to the customer and end user (Chow et al., 2008).

Transport system makes goods and products movable and provides timely and regional efficacy to promote value-added under the least cost principle. Transport affects the results of logistics activities and, of course, it influences production and sale. In the logistics system, transportation cost could be regarded as a restriction of the objective market. The ratio is almost one-third of the total logistics costs. The transportation cost here includes the means of transportation, corridors, containers, pallets, terminals, labours, and time. Figure signifies not only the cost structure of logistics systems but also the importance order in improvement processing.

Figure 4. Cost ratio of logistics items (Chang, 1998)



Green supply chain management (GSCM) has emerged as an approach to balance these competitive requirements (Narasimhan and Carter, 1998). Green supply chain management (GSCM) is gaining increasing interest among researchers and practitioners of operations and supplychain management. The growing importance of GSCM is driven mainly by the escalating deterioration of the environment, e.g. diminishing raw material resources, overflowing waste sites and increasing levels of pollution (Kumar and Chandrakar, 2012). Figure 4 shows what we regard as a tension between use of natural resources, such as fossil fuels and the eco-system, and relates this to emerging research agendas within logistics and supply chain management. GSCM covers activities such as 'green design', 'green sourcing/procurement', 'green operations' or 'green manufacturing', 'green distribution, logistics'/marketing' and 'reverse logistics' (Diabat and Govindan, 2011). GSCM practices encompass a set of green activities in procurement, manufacturing, distribution and reverse logistics (Ninlawan et al., 2010).

4. GREENHOUSE GAS EMISSIONS AND GLOBAL CLIMATE CHANGE

Transportation, as a component of supply chain has a significant impact on the environment [Cioca et al., 2015; Coyle et al., 2010). Transportation is a complex contributor to national greenhouse gas emissions, and can be part of the Nation's solution to the climate change challenge.

The Intergovernmental Panel and Climate Change (IPCC) estimates that in the absence of adopting some policies and solutions to reduce GHG, emissions will increase to 110% between the years 2000 and 2030. The IPCC projects that global temperatures will rise between 2°F to 11.5°F by 2100, and global sea level will rise between 7 to 23 inches. More recent estimates that include the effects of polar ice sheet melting suggest a possible 3 to 4 foot sea level rise. IPCC said that, global GHG emissions must be reduced to 50 to 85 percent below year 2000 levels by 2050 to limit warming to 2.0°C to 2.4°C (3.6°F to 4.3°F). To reach this target, GHG emissions from all sectors must be reduced through a multi-generational effort (U.S. Department of Transportation, 2010). By analysing the quantity of carbon dioxide emissions at European Union level, it was found that the largest quantity has resulted from producing electric and thermic energy within each individual country. For example, producing energy based on coal within EU states has generated around 950 million tonnes of CO2 emissions in the year 2005, which represents 24% of the total CO2 emissions in the EU.

5. CONCLUSIONS

Supply chain management is the coordination and management of a complex network of activities involved in delivering a finished product to the end user or customer. Adding the "green" component to supply chain management involves addressing the influence and relationships of supply chain management to the natural environment. In response to environmental problems and quest for efficiency in consumption of natural resources green initiatives become vital practices. GSCM practices emerge as a new approach that involves supply chain partners and relationships in the greening process. GSCM can reduce the ecological impact of industrial activity without sacrificing quality, cost, reliability, performance or energy utilization efficiency. Therefore, in order to have a balanced demand-supply relationship, the environmental consciousness must be understood by every party in the supply chain – including the end consumers – and must be managed carefully in order not to over-promise when starting to implement green processes.

Economic expansion, rising per capita income, positive demographic trends and the rapid pace of urbanization have been the main drivers of energy demand, which is estimated to increase by around 6 percent per annum

until 2023. If the small and medium enterprises are interested in making their processes more ecological, at the beginning it is important to focus on implementation of initiatives of green logistics into such corporate strategies which will enable their implementation in the whole enterprise, and will have a positive impact on the offer of products and services (Bektas et al., 2015). Green logistics is therefore defined as efforts to examine ways of reducing these externalities and achieving a more sustainable balance between environmental, economic and social objectives, (Figure 5) (Iwan et al., 2014). GSCM alone is not enough to improve financial performance but the manufacturers will need to extend their focus beyond organisational boundaries to their customers (Laari et al., 2016).

Figure 5. Green logistics as an element of sustainable development (Iwan et al., 2014)

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