Accounting 2 (2016) 129–136

Contents lists available at GrowingScience

Accounting

homepage: www.GrowingScience.com/ac/ac.html

A state-of-art review on green supply chain management practices

Sunil Dhull[a*] and M.S. Narwal[b]

[a]*Research Scholar Department of Mechanical Engineering, Deenbandhu Chhotu Ram University of Science and Technology, Sonipat, Haryana, India*
[b]*Assistant professor, Department of Mechanical Engineering , Deenbandhu Chhotu Ram University of Science and Technology, Sonipat, Haryana, India*

C H R O N I C L E

Article history:
Received October 5, 2015
Received in revised format
December 16 2015
Accepted February 16 2016
Available online
February 16 2016

Keywords:
GSCM
Green supply chain management
Green practices

A B S T R A C T

There is an emergent need for corporates to incorporate environment friendly practices into supply chain management. Green Supply Chain Management (GSCM) practices are the processes, which reduce the environment hazards from the supply chain. These practices help industries provide the competitive advantage from their core competitors by reducing environmental hazards. The literature gives an idea about a number of evidences of green supply-chain management practices, which are not developed. The study discusses the rules and the regulations made by the environmental authorities to meet social and environmental concerns to help in both developments of economies as well as business units suffering from insufficient GSCM practices. This research helps academicians, practitioners and researchers in incorporating and understanding GSCM practices in a broad manner. The research on the GSCM practices is at a very nascent stage in Indian manufacturing environment despite the fact that sustainability is the foremost worry of Indian industries. Using the rich literature, an attempt is made to bring out the need for GSCM practices and environmental sustainability of organizations. Finally, the findings and interpretations are summarized, and the main research issues and opportunities are highlighted.

1. Introduction

Supply chain management is the management and organization of a complex network of activities involved from the delivering raw materials to the final products. Environmental burden from the supply chain starts from extraction of resources, to manufacturing, use and reuse, final recycling or disposal of product after its useful life. This deterioration in environment has promoted the industries to recognize, understand and handle the environmental sustainability issues. This leads to new paradigms in supply chain management strategies beyond its definition with adding "green" component to the supply chain; it is now a day's known as green supply chain management. It is the addition of green procurement, green manufacturing, green distribution and reverse logistics. Environmental issues under legislations are becoming important subjects in developed and developing countries. These pressures

* Corresponding author.
E-mail address: sunildhull12@gmail.com (S. Dhull)

doi: 10.5267/j.ac.2016.2.002

are not only from the legislations but also from the society, customers and stakeholders. To combat these pressures the industries have started to implement systematic and integrated environment management strategies in the supply chain known as Green Supply Chain Management (GSCM). GSCM practices is associated with the practices that are used for reducing the environmental hazards in the industries. These practices are gaining more and more popularity as these are used to take competitive advantages to their core competitors. According to Dembowski (2001), however in India, as in China, the implementation of written environmental policies, laws, and amendments have proven challenging. Official legislation by the central government is often more symbolic than practical. Table 1 demonstrates some of the GSCM practices.

Table 1
List of various GSCM practices

S. No.	GSCM Practices	Description
1.	Green purchasing/ Green procurement practices	Considering the environment concern while purchasing the goods/services
2.	Green Materials management	Use of material handling which are eco-friendly and do not deteriorate the environment
3.	Green distribution & marketing	The distribution of goods among the various supplier with minimum effect on the environment hazards/wastes as well as marketing
4.	Reverse logistic	Environment friendly reverse logistics while taking back products after their useful/end-life products/services
5.	Internal environmental management	The periodic audit team should access the in-house environment management practices
6.	External GSCM	The periodic audit team should access the external environment management practices
7.	Investment recovery	The investment may be recovered by selling and old and outdated machines or tools
8.	Design of products to avoid or reduce use of hazardous products and/or their manufacturing process	In designing of the products the environment friendly products should be given more weightage.
9.	Establishing a control list of environmentally hazardous substances	Make a list of the environmentally hazardous substances and try to avoid their use in production.
10.	Profiles for raw materials containing no prohibited substances	Make a list of the environmental friendly substances and try to use maximum manufacturing and design.
11.	Assessment tables for the environmental management of suppliers	Periodic environmental management of suppliers can be assessed to monitor their performance and giving them certain rating
12.	Green product approval data	The design, manufacturing, raw material should be approved by the environment agency before putting in actual practice
13.	Green manufacturing practices	While manufacturing of the products green manufacturing practices should be adopted
14.	Green/eco design	While designing of new products or services environmental consideration to be taken into account
15.	Manufacturing of green products	Those products are manufactured that can be recycled and reuse after the end of their useful life
16.	Reduction, recovery and reuse of used products	The emphases should be given to recovery and reuse of used company product/other company waste
17.	Green products standards	Stiff green products standards should be implemented for suppliers as well as in-house manufacturing practices
18.	Supplier ISO 14000 Certification	The supplier should be motivated to have ISO certification or those supplier should be selected who are having ISO 14001 certification
19.	Environmental audit for suppliers to help internal environment management	The periodic audit team may be sent to access the supplier GSCM practices
20.	Green Supplier Selections	The selection of the supplier on the merits of the environment
21.	Eco labeling of products	The products made by the company should be categorized according to their environmental impact
22.	Investment recovery (sale) of excess inventories/materials	The excess material/stock placed in warehouses should be sold for the recovery of the investment
23.	Design of products for reuse, recycle, recovery of material, component parts	The components of the products should be designed in such a manner that they can be easily recovered, recycled and reused again and again
24.	Design of products for reduced consumption of material/energy	Design of products should be made such that consumption of material/energy be minimized

Fig. 1 shows carbon dioxide emissions for the top 50 countries by total emissions in 2014given as totals and per capita. Data from EU Edgar database.

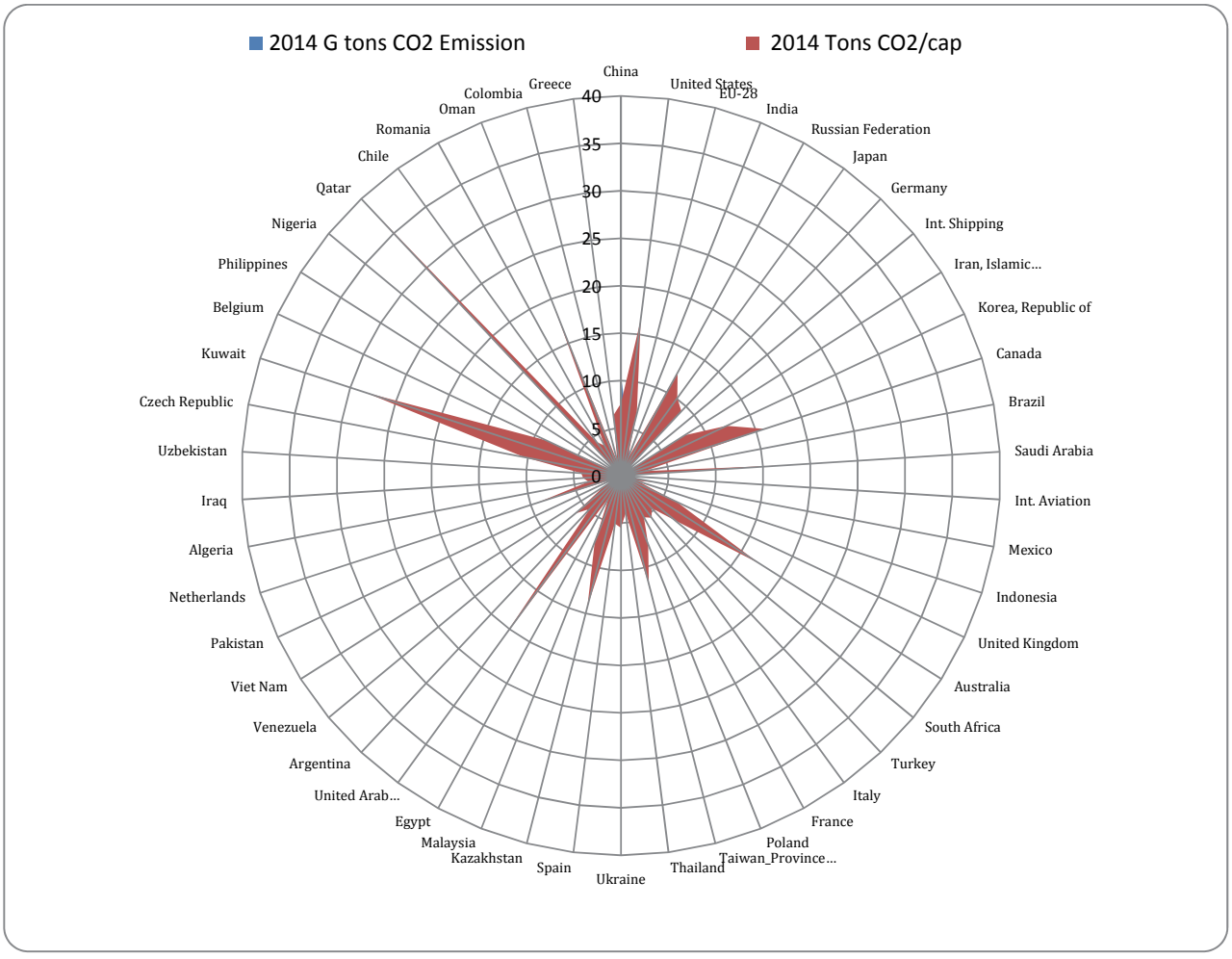

Fig. 1. Carbon dioxide emissions for the top 50 countries by total emissions in 2014given as totals and per capita

According to European Commission EDGAR database, Table 2 and Fig. 1 show the top 50 countries of the world that are emitting CO_2 in 2014, including per capita figure. In this report China is at the most polluting country followed by Unites States of America, European Union and India. Intended Nationally Determined Contributions (INDCs) of the largest greenhouses gas emitters included China, which put a strict target to reduce 60-65% greenhouse gas emissions per unit of GDP by 2030, United State targeted 26-28% reduction by 2025, European Union targeted 40% by 2030.India submitted a target of 33-35% per unit per unit of GDP.

2. Literature review for practices of GSCM

Most of the leading companies have adopted GSCM as a strategy to reduce environment hazards. According the supply chain literature, GSCM practice has closed loop formation; it starts from green purchasing to incorporate supply chains following from suppliers, manufactures, to end users and reverse logistics. In the recent trends, in the quality revolution of the 1980's and supply chain revolution of the 1990's, it is clear that the best practices are integrated in environment management system with ongoing operations. The GSCM practices are gaining attention among the researchers of operations and supply chain management practitioners.

Table 2
Distribution of CO2 emissions

Country	2014 G tons CO2	2014 Tons	Country	2014 G tons CO2	2014 Tons	Country	2014 G tons CO2	2014 Tons
China	10.54	7.6	Italy	0.34	5.5	Kuwait	0.1	28.33
United States	5.33	16.5	France	0.32	5	Belgium	0.1	8.7
EU-28	3.42	6.69	Poland	0.3	7.8	Philippines	0.1	1
India	2.34	1.8	Taiwan_Prov. of China	0.28	11.8	Nigeria	0.09	0.5
Russian Federation	1.77	12.4	Thailand	0.27	4	Qatar	0.09	39.13
Japan	1.28	10.1	Ukraine	0.25	5.5	Chile	0.08	4.4
Germany	0.77	9.3	Spain	0.24	5.1	Romania	0.08	3.6
Int. Shipping	0.62		Kazakhstan	0.24	14.2	Oman	0.07	18.92
Iran	0.62	7.9	Malaysia	0.23	7.5	Colombia	0.07	1.5
Korea, Republic of	0.61	12.3	Egypt	0.23	2.7	Greece	0.07	6.4
Canada	0.57	15.9	United Arab	0.2	21.29			
Brazil	0.5	2.5	Argentina	0.2	4.8			
Saudi Arabia	0.49	16.8	Venezuela	0.2	6.3			
Int. Aviation	0.49		Viet Nam	0.19	2.1			
Mexico	0.46	3.7	Pakistan	0.16	0.9			
Indonesia	0.45	1.8	Netherlands	0.16	9.4			
United Kingdom	0.42	6.5	Algeria	0.14	3.5			
Australia	0.41	17.3	Iraq	0.14	4			
South Africa	0.39	7.4	Uzbekistan	0.12	4.2			
Turkey	0.35	4.7	Czech Republic	0.11	10.4			

The GSCM is gaining importance mainly because of increasing degradation of environment for example diminishing raw material resources and increasing waste. According to Hervani et al. (2005), the aim of the GSCM is to reduce or minimize various types waste along the supply chain (energy, emissions, chemical /hazardous, solid wastes). Carter and Ellram (1998) found that the industries are implementing green manufacturing practices like cleaner production, environment management systems (EMS) and eco-efficiency and green supply chain management (GSCM) play key role in ensuring that all these factors are well addressed.

According to Gupta, 1995, environmental impact occurs at all the stages of product's life cycle that is why GSCM practices have become an important research in the present scenario for the industries to take competitive advantage, profit and market share by reducing the environmental hazards and its impact, while raising their ecological efficiency. According to Shultz and Holbrook, (1999), organizations are facing community and competitive pressures and they have to make a balance between economic, environment, financial and operational performance. Sarkis et al. (2005) defined the GSCM by adding green components to supply chain management, which addresses the environmental issues in the supply chain management starting from the extraction for the raw materials

to the final product and end of useful life. GSCM practices are used to minimize waste environmental impacts without sacrificing the customer's satisfaction and health.

Zhu and Sarkis (2006) found that to improve company's environmental performance, design for environment (DFE) is useful tool by addressing product functionality by reducing lifecycle environmental impacts. This can be achieved by internal cross-functional cooperation within the organization and outside cooperation with other partners throughout the supply chain. Kainuma and Tawara, (2006), in their research, proposed a new metrics of lean and green supply chain management including return on assets (ROA), customers satisfaction, life cycle analysis (LCA) and extended the supply chain to integrate re-use and recycle throughout the life cycle of their products and services. Zhu et al. (2008) identified GSCM practices in power generating, chemical/petroleum, automobile and electrical/electronic industries related to GSCM to close loop supply chain management. They found that adoption of GSCM practices is different for different sectors and varies from one industry to another one. Zhu et al. (2008) studied some Chinese manufacturing industry and reported that GSCM practices had been divided into five major parts including internal environment management, cooperation with customers, green purchasing, eco-design, and investment recovery. These five green practices of GSCM differentiate it from the traditional supply chain management. Hu and Hsu (2010) defined the green supply chain management as the management of the raw materials to components and processes from suppliers to manufactures, customers and taking back the products while considering the environmental impacts throughout its useful life. Liu et al. (2011) reported that, in China the firm environment management capabilities can be enhanced by providing regular training of employees its contribution in GSCM practices. Kenneth et al. (2012) found in their study that the implementation of GSCM practices in the manufacturing industries results in enhanced economic and environmental performance which, in turn, has positive effect on operational performance and thus operational performances enhances firm performance.

Jabbour et al. (2013) analyzed in their research and found that GSCM practices adopted by Brazilian industries are internal environment management, investment recovery and reverse logistics and these are adopted by some high-tech industries. The main drivers for adaptation of these GSCM practices are Brazilian environmental legislation and international policies. Luthra et al. (2014), in their study in Indian automobile industry, found that with the implementation of GSCM practices there is an improvement in environmental, economic, social and operational performances. Diab et al. (2015) studied the impact of green supply chain practices and its elements on the organization performance, like, environmental performance, financial performance and operational performance. This helps in increasing the sales and benefits to the industries.

5. Conclusion

In this paper, an attempt has been made to review the literature on GSCM practices. These practices can reduce the environmental hazards without scarifying quality, cost, reliability, performance. In this state of art literature review, GSCM integrated the whole large range of activities in this area. This literature review have highlighted the ongoing integration of GSCM practices. These identified practices can help the industries and practitioners reduce their environmental impacts. In United Nations Climate Change Conference (UNCCC Submit) held in Paris France in December 2015, it was decided to reduce the carbon. Intended, Nationally Determined Contributions (INDCs) of the largest greenhouses gas emitters included China, which put a strict target to reduce 60-65% greenhouse gas emissions per unit of GDP by 2030, United State targeted 26-28% reduction by 2025, European Union targeted 40% by 2030 and India submitted a target of 33-35% per unit per unit of GDP. These practices can help these countries reduce greenhouse emission and play an important role in achieving their targets.

Table 3

Literature Reviews of Green Practices of Green Supply Chain Management (GSCM)

S. No.	Authors	**1**	2	3	4	5	6	7	8	9	10	11	12	13	14	15	**16**	17	18	19	20	21	22	23	24
1.	Carter, et al. (1998)	√															√								
2.	Sarkis (2003)	√																							
3.	Sarkis (2005)	√	√	√	√																				
4.	Faith-Ell et al. (2006)	√																							
5.	Chien & Shih (2007)	√							√	√	√	√	√	√	√	√	√	√		√					
6.	Tsireme et al. (2012)	√							√								√				√				
7.	Salam (2008)	√																							
8.	Zsidisin & Hendrick (1998)	√						√											√	√					
9.	Zhu et al (2007)	√				√		√							√										
10.	Amemba et al. (2013)	√														√									
11.	Carter and Ellram (1998)	√			√																			√	√
12.	Rashid (2009)			√																					
13.	Hui, et al., (2001		√																						
14.	Tan, et al. (2002)		√																						
15.	Zhu and Sakis, (2006)	√	√			√		√		√	√	√	√	√	√				√				√		
16.	Zhu and Sarkis, (2004)					√	√	√	√																
17.	Walton et al. (1998)									√	√	√	√								√				
18.	Li, et al. (2006)									√	√	√	√												
19.	Zhu et al (2008)	√					√	√							√			√	√	√		√	√	√	√
20.	Salam (2008)	√																							
21.	Ho et al. (2009)		√																						
22.	Beamon, 1999				√														√						
23.	Guide & Srivastava, (1998)				√									√	√	√									
24.	Srivastava, (2007)				√									√	√	√									
25.	Dowlatshahi (2000),				√																				
26.	Rogers and Tibben- Lembke (2001)				√																				
27.	Amemba et al. (2013)				√										√										
28.	Srivastava and Srivastava, (2006)				√																				
29.	Shih, (2001)				√																				
30.	Nagorney and Toyasaki, (2005)				√																				
31.	Min, Ko and Ko, (2006)				√																				
32.	Montabon et al. (2007)														√		√	√		√					
33.	Navin-Chandra's (1991)														√										
34.	Kuo et al. (2010)																				√				
35.	Lee et al. (2009)																				√				
36.	Kannan et al. (2014)																				√				
37.	Kumar et al. (2013)																					√			
38.	Banerjee & Solomon (2003)																					√			
39.	Truffer et al. (2001)																					√			
40.	Walker et al., 2008											√													

Note: The column numbers are associated with row numbers in Table 1

References

Amemba, C. S., Nyaboke, P. G., Osoro, A., & Mburu, N. (2013). Elements of Green Supply Chain Management. *European Journal of Business and Management*, *5*(12), 51-61.

Banerjee, A., & Solomon, B. D. (2003). Eco-labeling for energy efficiency and sustainability: a meta-evaluation of US programs. *Energy Policy*, *31*(2), 109-123.

Beamon, B. M. (1999). Designing the green supply chain. *Logistics information management*, *12*(4), 332-342.

Carter, C. R., & Ellram, L. M. (1998). Reverse logistics: a review of the literature and framework for future investigation. *Journal of business logistics*, *19*(1), 85

Carter, C. R., Ellram, L. M., & Ready, K. J. (1998). Environmental purchasing: benchmarking our German counterparts. *Journal of Supply Chain Management*, *34*(4), 28.

Chien, M. K., & Shih, L. H. (2007). An empirical study of the implementation of green supply chain management practices in the electrical and electronic industry and their relation to organizational performances.

Choon Tan, K., Lyman, S. B., & Wisner, J. D. (2002). Supply chain management: a strategic perspective. *International Journal of Operations & Production Management*, *22*(6), 614-631.

de Sousa Jabbour, A. B. L., de Souza Azevedo, F., Arantes, A. F., & Jabbour, C. J. C. (2013). Green supply chain management in local and multinational high-tech companies located in Brazil. *The International Journal of Advanced Manufacturing Technology*, *68*(1-4), 807-815.

Dembowski, Hans (2001). *Taking the State to Court: Public Interest Litigation and the Public Sphere in Metropolitan India*. online: Asia House. pp. 63–84.

Diab, S. M., AL-Bourini, F. A., & Abu-Rumman, A. H. (2015). The Impact of Green Supply Chain Management Practices on Organizational Performance: A Study of Jordanian Food Industries. *Journal of Management and Sustainability*, *5*(1), p149.

Dowlatshahi, S. (2000). Developing a theory of reverse logistics. *Interfaces*,*30*(3), 143-155.

Faith-Ell, C., Balfors, B., & Folkeson, L. (2006). The application of environmental requirements in Swedish road maintenance contracts. *Journal of Cleaner Production*, *14*(2), 163-171.

Green Jr, K. W., Zelbst, P. J., Meacham, J., & Bhadauria, V. S. (2012). Green supply chain management practices: impact on performance. *Supply Chain Management: An International Journal*, *17*(3), 290-305.

Guide, V. D. R., & Srivastava, R. (1998). Inventory buffers in recoverable manufacturing. *Journal of operations management*, *16*(5), 551-568.

Gupta, M. C. (1995). Environmental management and its impact on the operations function. *International Journal of Operations & Production Management*, *15*(8), 34-51.

Hervani, A. A., Helms, M. M., & Sarkis, J. (2005). Performance measurement for green supply chain management. *Benchmarking: An international journal*, *12*(4), 330-353.

Ho, J. C., Shalishali, M. K., Tseng, T., & Ang, D. S. (2009). Opportunities in green supply chain management. *The Coastal Business Journal*, *8*(1), 18-31.

http://edgar.jrc.ec.europa.eu/overview.php?v=CO2ts1990-2013 (20 December 2015)

Hu, A. H., & Hsu, C. W. (2010). Critical factors for implementing green supply chain management practice: an empirical study of electrical and electronics industries in Taiwan. *Management research review*, *33*(6), 586-608.

Hui, I. K., Chan, A. H., & Pun, K. F. (2001). A study of the environmental management system implementation practices. *Journal of Cleaner Production*, *9*(3), 269-276.

Kainuma, Y., & Tawara, N. (2006). A multiple attribute utility theory approach to lean and green supply chain management. *International Journal of Production Economics*, *101*(1), 99-108.

Kannan, D., de Sousa Jabbour, A. B. L., & Jabbour, C. J. C. (2014). Selecting green suppliers based on GSCM practices: Using fuzzy TOPSIS applied to a Brazilian electronics company. *European Journal of Operational Research*, *233*(2), 432-447.

Kumar, S., Luthra, S., & Haleem, A. (2013). Customer involvement in greening the supply chain: an interpretive structural modeling methodology.*Journal of Industrial Engineering International*, *9*(1), 1-13.

Kuo, R. J., Wang, Y. C., & Tien, F. C. (2010). Integration of artificial neural network and MADA methods for green supplier selection. *Journal of Cleaner Production*, *18*(12), 1161-1170.

Lee, A. H., Kang, H. Y., Hsu, C. F., & Hung, H. C. (2009). A green supplier selection model for high-tech industry. *Expert systems with applications*,*36*(4), 7917-7927.

Li, S., Ragu-Nathan, B., Ragu-Nathan, T. S., & Rao, S. S. (2006). The impact of supply chain management practices on competitive advantage and organizational performance. *Omega*, *34*(2), 107-124.

Liu, X., Yang, J., Qu, S., Wang, L., Shishime, T., & Bao, C. (2012). Sustainable production: practices and determinant factors of green supply chain management of Chinese companies. *Business Strategy and the Environment*, *21*(1), 1-16.

Luthra, S., Garg, D., & Haleem, A. (2014). Empirical analysis of green supply chain management practices in Indian automobile industry. *Journal of The Institution of Engineers (India): Series C*, *95*(2), 119-126.

Montabon, F., Sroufe, R., & Narasimhan, R. (2007). An examination of corporate reporting, environmental management practices and firm performance. *Journal of operations management*, *25*(5), 998-1014.

Nagurney, A., & Toyasaki, F. (2005). Reverse supply chain management and electronic waste recycling: a multitiered network equilibrium framework for e-cycling. *Transportation Research Part E: Logistics and Transportation Review*, *41*(1), 1-28.

Olivier, J.G.J. and Janssens-Maenhout, G. (2014) CO2 Emissions from Fuel Combustion (Part III). In: "CO2 emissions from fuel combustion, 2014 Edition", pp. III.1-III.51. ISBN 978-92-64-21711-9. International Energy Agency, Paris. Internet: http://www.iea.org/W/bookshop/648-CO2_Emissions_from_Fuel_Combustion.

Olivier, J.G.J., Janssens-Maenhout, G., Muntean, M. and Peters, J.A.H.W. (2014) Trends in global CO2 emissions: 2014 Report. PBL Netherlands Environmental Assessment Agency, The Hague; European Commission, Joint Research Centre (JRC), Institute for Environment and Sustainability (IES). JRC93171, PBL1490, ISBN: 978-94-91506-87-1, Internet: http://edgar.jrc.ec.europa.eu/news_docs/pbl-2014-trends-in-global-co2-emissions-2014-report-93171.pdf

Rogers, D. S., & Tibben-Lembke, R. (2001). An examination of reverse logistics practices. *Journal of business logistics*, *22*(2), 129-148.

Salam, M. A. (2008, December). Green procurement adoption in manufacturing supply chain. In *Proceedings of the 9th Asia Pasific Industrial Engineering & Management Systems Conference* (pp. 1253-1260).

Sarkis, J. (2003). A strategic decision framework for green supply chain management. *Journal of cleaner production*, *11*(4), 397-409.

Shih, L. H. (2001). Reverse logistics system planning for recycling electrical appliances and computers in Taiwan. *Resources, conservation and recycling*, *32*(1), 55-72.

Shultz, C. J., & Holbrook, M. B. (1999). Marketing and the tragedy of the commons: A synthesis, commentary, and analysis for action. *Journal of Public Policy & Marketing*, 218-229.

Srivastava, S. K. (2007). Green supply-chain management: a state-of-the-art literature review. *International journal of management reviews*, *9*(1), 53-80.

Srivastava, S. K., & Srivastava, R. K. (2006). Managing product returns for reverse logistics. *International Journal of Physical Distribution & Logistics Management*, *36*(7), 524-546.

Truffer, B., Markard, J., & Wüstenhagen, R. (2001). Eco-labeling of electricity—strategies and tradeoffs in the definition of environmental standards. *Energy Policy*, *29*(11), 885-897.

Tsireme, A. I., Nikolaou, E. I., Georgantzis, N., & Tsagarakis, K. P. (2012). The influence of environmental policy on the decisions of managers to adopt G-SCM practices. *Clean technologies and environmental policy*, *14*(5), 953-964.

Walton, S. V., Handfield, R. B., & Melnyk, S. A. (1998). The green supply chain: integrating suppliers into environmental management processes.*Journal of Supply Chain Management*, *34*(2), 2.

Zhu Q, Sarkis J, Lai KH (2008b) Green supply chain management implications for "closing the loop". Transportation Research Part E 44(1):1–18.

Zhu, Q., & Sarkis, J. (2004). Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. *Journal of operations management*, *22*(3), 265-289.

Zhu, Q., & Sarkis, J. (2006). An inter-sectoral comparison of green supply chain management in China: drivers and practices. *Journal of cleaner production*, *14*(5), 472-486.

Zhu, Q., Sarkis, J., & Lai, K. H. (2007). Green supply chain management: pressures, practices and performance within the Chinese automobile industry. *Journal of Cleaner Production*, *15*(11), 1041-1052.

Zhu, Q., Sarkis, J., & Lai, K. H. (2008). Confirmation of a measurement model for green supply chain management practices implementation.*International journal of production economics*, *111*(2), 261-273.

Zhu, Q., Sarkis, J., & Lai, K. H. (2008). Green supply chain management implications for "closing the loop". *Transportation Research Part E: Logistics and Transportation Review*, *44*(1), 1-18.

Zsidisin, G. A., & Hendrick, T. E. (1998). Purchasing's involvement in environmental issues: a multi-country perspective. *Industrial Management & Data Systems*, *98*(7), 313-320.