

## Supply Chain vs. Green Supply Chain Management

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### Abstract

The concept of green supply chain management (GSCM) appeared at mid '50s, however the studies on this topic grew exponentially only after beginning of XXI century. A modern and competitive business ecosystem is defined by the integration of industrial actions in harmony with environmental policies governed by a green supply chain. Both are hardly influenced by cost drivers and customer drivers, the balance between them leading to company and environmental overall performance. Beside costs there are also stakeholders pressure, including here but not resuming to industry regulators, consumers, NGOs, that are pushing for a greener supply chain even to sub-supplier's level.

The study purpose is to enhance environmental supply literature and to investigate on selected companies practical examples of GSCM implementation. As scientific method we will use descriptive analysis, our paper focusing on environmental policies of top players from various industries as described by themselves on annual reports. The results will show that there is still little emphasis financially speaking on the environmental policies of respective companies compared with their turnovers. Although it might not be a complete novelty, the originality of the study is the authors beliefs that on the long run chasing a green supply chain is becoming a competitive advantage if properly handled, not only from environmental point of view but also as cost of the final product, resilience of the supply chain, capability to overpass turbulent situations and market image. From practical point of view companies will be more interested to invest in a sustainable environmental plot, switching to green supply chain if they will see the rewarding part of this action, subject action being an investment.

### Keywords

Green supply chain, sustainability, competitive advantage, clean industries.

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### Introduction

Over 300 laws, agreements, pacts, rules draw the bindings for handling environmental issues. From Asia-Pacific Partnership on Clean Development and Climate up to Vienna Convention for the Protection of the Ozone Layer partners try to cover all environmental aspects like air and water quality up to waste management and chemical safety. The 2015 United Nations Climate Change Conference showed that all stakeholders have a common interest, including private sector. Participating 196 countries agreed, to a global pact, the Paris Agreement, to reduce emissions as part of the method for reducing greenhouse gas.

The scale of companies implementing environmental management system standard has increased rapidly. For example, a study from 2006 revealed that more than 40,000 companies have implemented ISO14001 (Zhu and Sarkis, 2006). Nowadays, according to International Organization for Standardization there are over 300.000 companies from 171 countries who adopted this standard 14001:2015. According to Zhu and Sarkis (2004) and Zhu et al. (2008a,b,c), green supply chain

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management (GSCM) consists in a set of environmental rules to be followed by logistics management with the aim to include subject environmental rules both into the forward and reverse logistics. In practice this set of environmental rules may include but not limiting to reducing packaging and waste, continuous assessment of suppliers based on their environmental performance, inovating more eco-friendly products, and reducing foot print carbon emissions associated with the transport of goods produced (Walker, et al., 2008). Green Supply Chain Management should be a company goal and focus throughout all company processes not just a set of some green practices to be followed, it should become a scope itself, implemented at all levels from management up to basic production level (Davies and Hochman, 2007).

Having in consideration such abundances of laws, agreements, pacts, rules how can a company fulfil its targets for the benefit of its shareholders? Do companies started to use GSCM and put pressures on all its partners to respect environmental rules just for the sake of common good or did they manage to transform through innovation the rules in a competitive advantage, making the supply chain rotation more efficient? The study aim to enhance environmental supply literature and seeks to answer the research questions proposed. Another objective of this study is to investigate on selected companies practical exemples of GSCM implementation.

By studying several examples of the statements, effective actions and results we will draw a conclusion with the anticipated result that adopting and respecting eco-rules is becoming a competitive advantage and a driver for higher profits, but still not enough funds are funneled on this.

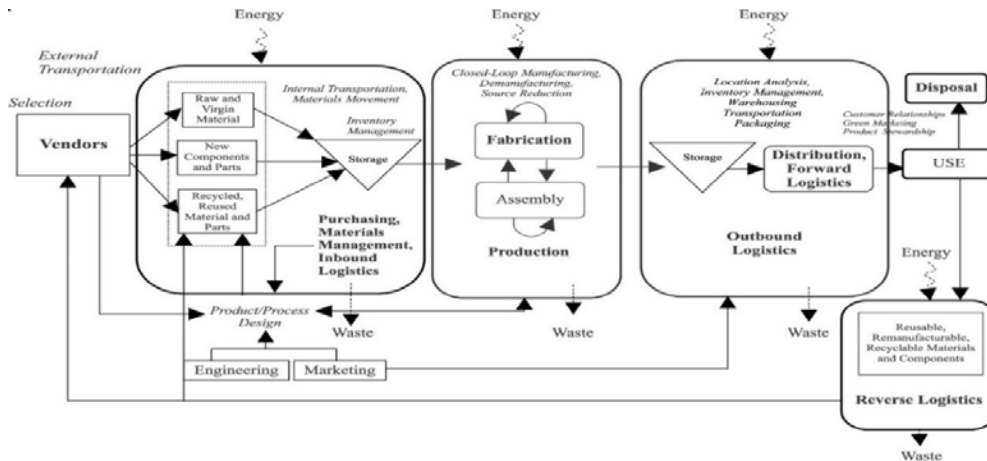
### **Review of the scientific literature**

There are several definitions of GSCM in the specialty literature. According to Asian Productivity Organization ed. (2001), to make a supply chain green presume to incorporate environmental standards or awareness into company purchasing decisions and among relationships with suppliers. Beatrice Kogg, a sound voice from the industry, foster for the “The International Institute for Industrial Environmental Economics” the definition of a GSCM as defined by Zsidisin and Siferd (2001, p.69) “the set of supply chain management policies held, actions taken, and relationships formed in response to concerns related to the natural environment regarding the design, acquisition, production, distribution, use, re-use and disposal of the firm’s goods and services”. According to Zhu et al. (2008, p.262) GSCM “ranges from green purchasing (GP) to integrated life-cycle management supply chains flowing from supplier, through to manufacturer, customer, and closing the loop with reverse logistics”. By compiling work of Walker et al. (2008) later Diabat and Govindan (2011, p.660) gave another dimension of GSCM as “the green supply chain concept covers all phases of a product’s life cycle, from the extraction of raw materials through the design, production, and distribution phases, to the use of the product by consumers and its disposal at the end of the product’s life cycle”.

Green Supply Chain Management involves environmental considerations into all stages of a supply chain no matter upstream or downstream, starting from product design, supplier selection and collaboration (Van Hoof and Thiell, 2014), manufacturing and remanufacturing processes, forward and reverse logistics (Liu, et al., 2020), green development (Li, et al., 2020) and product end-of-life management (Srivastava, 2007). The challenges of the environmental protection combined with the ones of competitive advantages, put focus over supply chains with green supplier management (Zhu et al., 2013; Brandenburg et al., 2014). Traditionally, the focus of green supplier management is on first-tier suppliers (Giunipero, et al., 2012; Walker and Jones, 2012). The increasing pressures from various stakeholders like environmental non-governmental organizations (NGOs) and the media result in going beyond the organizational boundaries into green multi-tier supplier management (GMSM) (Grimm et al., 2014, 2016; Tachizawa and Wong, 2014; Wilhelm, et al., 2016).

**Research methodology**

Hervani, Helms and Sarkis, (2005, pp 335) gave not only an extensive definition to GSCM put also draw a concrete diagram of the various processes that are involved in GSCM:



**Figure no. 1. Process involved in green supply chain management.**

*Source: Hervani, Helms and Sarkis, 2005, p.335*

By studying figure no. 1, it can be identified as in every common supply chain, there are three major pillars of the supply chain respectively: Vendors (of raw, parts or recycled materials), Producers and Distributors. Each one has its own processes that implies consumption of energy and each one is connected through storage module. No matter the layer or level of operation we underline the consumption of energy. Our research questions are:

- What are the major, identifiable steps that companies take to add the green components to their supply chain?
- Do companies take green path just to follow the laws and rules?
- Is the green path a competitive advantage?

We will take several examples of sound companies, involved in every tier of a supply chain, to observe the steps taken in the effort to become greener with the aim to become more competitive.

From research methodology point of view, we will use descriptive analysis, including companies own public statements regarding environmental current and future approach. Examples of companies are from various industries but with heavy impact on environment. A brief introduction in their own history will be given to see how they reach in top of their own industries. Public sources like Carbon Major Database ([www.cdp.net](http://www.cdp.net)) will be used to see current ranking of studied company or industry from greenhouse gasses emission. Also, in our analysis we will take in account companies published environmental policy, statement, vision, money they had invested, or they will spend towards environmental protection. At the end we will compare amount spend to protect environment versus their turnover over a year period.

**Results and discussion**

Following industries and their exponents, with heavy impact on the environment, will be observed from the point of view of pledges and commitments, concrete actions and impact on revenues and profits:

- Primary industry – mining, Rio Tinto, UK/Australia
- Chemical industry – chemicals, BASF, Germany

- Food and beverages industry – food, Nestle, Switzerland
- Manufacturing industry – automotive, Volkswagen, Germany

*Rio Tinto- history, figures, steps taken*

Rio Tinto Plc is acting in the business of finding, mining, and processing of minerals resources. It operates through five product groups: Aluminum, Copper, Diamonds & Minerals, Energy, and Iron Ore. The company as known today was founded on March 30, 1962 and is headquartered in London, the United Kingdom. The roots of the company are back in 1873, on the banks of Rio Tinto river, in Andalusia, Spain. Currently the company has over 46.000 employees, operates in 36 country, using over 37.000 suppliers. It ranks second largest mining company in the world after BHP Billiton.

According Carbon Majors Database, 2017 edition, the distribution of emissions is concentrated: 25 corporate and state producing entities account for 51% of global industrial GHG emissions. All 100 producers account for 71% of global industrial GHG emissions. Rio Tinto held the 24<sup>th</sup> place in this ranking, being responsible for 0.75% of the Global Green House Gases over the studied period of 1988-2015.

As per Rio Tinto “Climate Change” (<https://www.riotinto.com/sustainability/climate-change>) report here are the statements: “We have considered climate change as part of our strategy for two decades and it is fully integrated into our strategic planning, risk and governance processes. Our ambition is to reach net zero emissions by 2050 across our operations. We have set new targets to reduce our emissions intensity by 30% by 2030 and our absolute emissions by 15% over the same timeframe. To help us achieve our ambition and targets, we plan to invest around \$1 billion over five years in emissions reduction projects, research and development. Since 2008 we have reduced the absolute emissions from our managed operations by 46%. Today, 76% of our electricity consumption is from renewable energy, compared with 26% of global electricity production. Most of our operations already have significantly lower carbon intensities than sector averages. We also continue to work on new technology solutions such as our partnership with Alcoa and Apple, to produce aluminum without any direct CO<sub>2</sub> emissions.”

Published results of Rio Tinto show vast fluctuation of the market. Being a primary product market, it is highly dependable on the rest of the world economy. Iron ore stock price is a viable indicator of overall market trends and health. There were years like 2006 when Rio Tinto had 42% operating margin, but also years like 2015 with only 13%. However, taking in consideration the statement made by Rio Tinto in 2019, that they are looking to spend 1 billion USD over the next 5 years, we may conclude that this represents 0.52% from their gross sales revenue from the last 5 years and 2.92% from their net earnings from the last 5 years, without taking in consideration future market movements.

*BASF - history, figures, steps taken*

BASF, is ranking as the biggest chemical manufacturing company in the world. The company is headquartered in Ludwigshafen, Germany and owns various subsidiaries in more than 80 countries around the world. At the end of 2019, the company employed 117,628 people, with over 54,000 in Germany and posted sales of €59.3 billion. BASF was established in 1865 by Fredric Engelhorn. The company also was responsible for setting up gasworks, whose by-product tar was used to produce dye, soda and acids. With a turbulent history, including during World War II a factory at Auschwitz, BASF managed not only to survive the war, but through aggressive acquisition and tough leadership to become the largest chemical company in the world.

By 2008, greenhouse gases released by BASF’s worldwide gone to 27.1 million metric tons (2007: 27.5 million metric tons). In 2019, the emissions reached the value of 20.1 million metric tons of CO<sub>2</sub> equivalents, almost 10% decrease (2018: 21.9 million metric tons of CO<sub>2</sub> equivalents). As per Greenhouse Gas Protocol ([www.ghgprotocol.org](http://www.ghgprotocol.org)) which BASF is part of, goes up to 100 million metric tons of CO<sub>2</sub> in 2019 (2018: 118 million metric tons of CO<sub>2</sub> equivalents). BASF is aiming that by 2030 to achieve the target of carbon neutral growth, to increase their production without increasing their carbon footprint.

“We want to contribute to a world that provides a viable future with enhanced quality of life for everyone. We do so by creating chemistry for our customers and society and by making the best use of available resources. Sustainability is at the core of what we do, a driver for growth as well as an element of our risk management.” (<https://www.basf.com/global/en/who-we-are/sustainability.html>)

By 2017 BASF invested in new and improved environmental protection plants and facilities about 234 mil euro, while in 2018 this expenditure raised to 277 mil euro. However, these amounts are almost 3 times lower than the one allocated for provisions for environmental protection measures and remediation (compulsory expenditure as per local laws), respectively 600 mil euro for 2017 and 639 mil euro for 2018 ([www.basf.com/reports](http://www.basf.com/reports)). We may assume that at the rate of investments shown in the past years, BASF will spend about 1-1.2 bln euro investments in the environment protection for the next 5 years. According financial data published, the amounts to be spend on environmental protection convey to 0.35-0.4 % from their net revenues or 3.5-3.75% from their net income.

*Nestle - history, figures, steps taken*

The history of Nestle began in 1866 when Milkmaid brand is launched by the newly established company Anglo-Swiss Condensed Milk Company. Next year, in 1867, the pharmacist Henri Nestle launch in Vevey, Switzerland, his product consisting of “flour with milk”. In 1905 Anglo-Swiss and Nestle merged in a new company that held the name of Nestle and the HO in Vevey. The company quickly developed in markets like Germany, Spain, United States and Britain. After first World War Nestle put pressure on expending the production on its second-best product, chocolate, war crisis in both World Wars being an opportunity for Nestle. Is good to mention that in 1939 launch a coffee powder extract, what will be known later as Nescafe. After war, Nestle expend massively in pharma and healthcare products, adding continuously brands to its portfolio. In 1985 Nestle launch on of its current success, Nespresso. By 2014 Nestle become the world biggest food company in the world.

According to its own statements, Nestle is concentrating its effort in several directions, naming here: tastier and healthier food, healthier lives, nutrition knowledge and other but also on climate change, caring for water and environment. Nestle aim to take leadership in climate change by setting ambitious goals. 189 factories of Nestle (about one third of all its factories) are consuming in 2019 energy from renewable sources. Also, in 2019 the production of Nestle reduce its gas emissions with 34% compared with 2010, while in 100 warehouses of Nestle emissions has been cut with 35 %. Every tone of product of Nestle produce directly and indirectly 105 kgs of CO<sub>2</sub>. Following is from Nestle report on climate change: “As climate science has developed, so has our ambition to reduce our operational impact. In September 2019, we announced plans to accelerate our commitment to tackle climate change. With the expiration of our 2°C science-based target at the end of 2020, we have committed to achieving zero net GHG emissions by 2050 and aligning our efforts with the ambitious 1.5°C target outlined in the most recent Intergovernmental Panel on Climate Change report. More than 90% of our GHG emissions occur along our value chain. We will address these through a range of product developments and collaborative actions with our suppliers. Read more about how we are developing our climate change mitigation strategy.”

In 2018 Nestle committed that by 2025 all it packaging to be reusable or recyclable. In 2020 Nestle announced that they will invest 2 billion CHF for development of this initiative. 6 million kilograms of CO<sub>2</sub> emissions has been cut by Nestle by adding 28.000 photovoltaic panel to its production sites in Dubai.

There are not specific financial figures published by Nestle in respect of the investments of climate and environmental change, however, Nestle recognize that: “Nestlé’s reputation is based on consumers’ trust. Any major event triggered by a serious food safety or other compliance issue could potentially impact upon Nestlé’s reputation or brand image.” The Nestle business was linear for the last 10 year with a sales results around 100 billion CHF and with a margin of 12-13 %. In 2019 the group reported sales of 92.5 billion CHF and net profit of 12.6 billion CHF. We can estimate from investments announced or committed by Nestle that the amounts spent for climate and environmental change might be around 2.5-3% of their sales in line with other global players.

*Volkswagen - history, figures, steps taken*

Volkswagen is a German automobile manufacturer, established in 1937 to produce a low-price car. Translated Volkswagen means people car. Due to turbulent times over second world war, under British command, mass production of the Volkswagen began later on 1946. In 1949 control of the company has been passed to the West German government and the state of Lower Saxony. Volkswagen production expanded rapidly in the 1950s. One of the most successful cars was Beetle model, while later Golf model being popular. Starting 1960 company went public, 60 percent of the company being on stock market. Company grew exponentially due to organic growth but also through acquisitions. Volkswagen owns several other brands, naming here Audi and Porsche, SEAT, Škoda, Bentley, Lamborghini, and Bugatti. In 2015, for a short period Volkswagen became world's largest car manufacturer. On the same year U.S. Environmental Protection Agency (EPA) found out that the manufacturer's diesel-powered cars contained software that altered the vehicle's performance to pass emissions tests. Over 10 million automobiles worldwide had to be recalled. In the United States alone, the carmaker was fined with over \$4 billion.

According its own environmental policy Volkswagen is committed to: "We intend to become a CO2 neutral company by 2050. By 2025, we plan to reduce our total life cycle Greenhouse Gas Emissions of passenger cars and light duty vehicles by 30% compared to 2015. By 2025, we plan to have reduced the production-related environmental externalities (CO2, energy, water, waste, volatile organic compounds) by 45% per vehicle compared to 2010. By 2025, the share of battery electric vehicles in our model portfolio will be between 20 and 25%. The share of electric vehicles in the Group fleet is to rise to at least 40% by 2030." The four major areas Volkswagen is concentrating is climate change, resources, air quality and environmental compliances.

Volkswagen is describing its own supply chain and steps taken to sustain a GSCM. According to them: "Approximately one third of the gross weight of many Volkswagen brand vehicles is already accounted for by recycled metal and oil-based materials." The example of its Kassel factory is self-explanatory: "All aluminum cuttings produced from alloy Al 226 with a residual moisture level below two percent can now be melted directly on site, producing new raw material. Thanks to the new approach, Volkswagen itself saves some 3,250 MWh of energy per year, representing a reduction of 1,430 tones in CO2 emissions. On the logistics side, this process also reduces the distance traveled by trucks by 800,000 kilometers per year. In addition, nitrogen oxide output is cut by 0.5 tons per year and Volkswagen also reduces the use of many consumables such as melting salts (-1,300 tons p.a.) and calcium hydroxide (-16 tones p.a.), as well as the production of waste such as salt slag (-2,670 tons p.a.) and filter dust (-130 tones p.a.)."

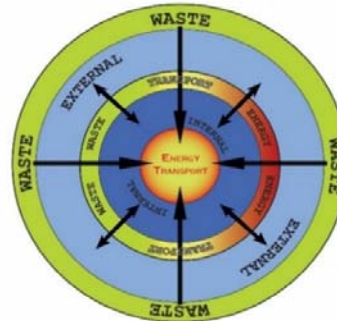
Volkswagen measures its own progress on reducing CO2 emissions using an index called DCI, decarbonification index. The DCI includes the CO2 emissions from the supply chain, our own production, the provision of fuel, emissions from 200,000 km of driving and from recycling. The group noticed that 77% of the emissions generated are from the car produced itself with an average of 124 grams of CO2 per kilometer. The total amount to 382.488 tons of CO2 emissions in 2019. Having in consideration that the biggest footprint carbon is generated by their products, Volkswagen decided to invest massively in the electric car production, investing by 2024 over 33 billion euro with the aim to become world leader to e-mobility by 2028. Subject commitment was done in 2019.

In 2019 sales of Volkswagen group accounts for 252 billion euro, while profit counts for 19 billion. Therefore, we can observe that Volkswagen will invest for R&D, development of new ecofriendly cars about 2.6% of its revenues.

By observing above statements, effective actions and plans from the examples we extrapolate, generalize, and synthesize a set of minimum rules followed by companies for a green supply chain. By following subject rules, which are not exhaustive, we may also answer to the questions of our study.

- What are the major, identifiable steps that companies take or should take to add the green components to their supply chain?

One of the first and common step while introducing the green component in a supply chain is **defining** what green means for the subject organization. Either through internal processes or adding third party standardization algorithm defining and future applying goes together. It has been observed that another step will be to **set up goals** for a GSCM and continuous improvement of these targets through incremental steps. Becoming greener and reaching goals cannot be fulfilled without an objective, measurable audit of the current standpoint and milestones. Continuous **measurements** to observe, detect and correct deviations from the plan is another step. Since a modern, green supply chain goes to every layer and levels of the supply chain itself and organization mixed teams are required to be involved, **commitment** to respect plans to reach the goals. All above are to be achieved only with firm implication and directives from the management, **leadership** being required at all steps. Looking back at the Hervani drawing (figure no. 1) and considering the pillars of the supply chain it has been identified and confirmed that the supply chain acts like physical system: defined by internal and external layer, segregated by storage buffer. Each change between layers is with energy consumption, each process in respective modules is also energy consumer and involves transport. At every stage of the processes waste is generated. It has also been observed that exchanges between layers is bi-directional, with consumption of energy, involves transport and generates waste at every stage.



Figures no. 2. Layers of a supply chain  
Source: authors contribution

Considering statements and figure above we do notice that every process between supply chain pillars producer, vendor, distributor has in common energy consumption, transport and waste production Effective steps done by company to have a GSCM start with usage of a **clean energy** source or by buying **green certificates**. An analysis of the **transport** needs how is do it and by whom with the aim to streamline and to maximize the transport capacity is also compulsory and widely used in a GSCM. In a supply chain, storage is involved therefore an **efficient warehousing** or storage platform using green energy or maximizing storage capacity is required. Sustainability efforts for a GSCM is supported by **technology**, either through high algorithms computers that redesign processes for maximum efficiency and minimum losses, including here IoT or AI. We must underline that in a regular supply chain the circles are closed by waste as per figure 2. In a green supply chain, through **reverse logistics** the waste is re-introduced and re-used in the cycles. There are also other steps identified and reported as effective to create a GSCM. Third party expertise with focus on green may conclude in beneficial **partnerships**, with companies certifying from procurement sources up to compliance audits (Bostan, et al., 2020; Dinu, 2020).

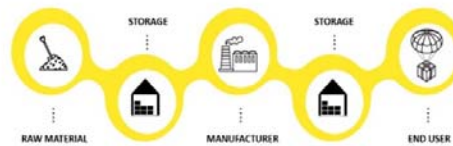


Figure no. 3. Basic chain  
Source: authors contribution

- Do stakeholders of a supply chain take green path just to follow the laws and rules?

If we schematize more a supply chain from raw material producer up to end user, we will observe that each stake holders have its own interest in the green path. It is author observation from practical examples that depending on the layer and level, participants will abide laws and rules from different considerations. A raw material producer will follow the laws, aiming to reduce its financial risk. A producer will obey rules on one hand to reduce its financial risk but also to have and show a corporate responsibility towards its end consumers, to preserve its public image. The end consumer will follow rules to avoid any penalties from responsible bodies controlling proper waste collection for example. Once again, it is author assumption that stakeholders follow laws and rules from their own considerations rather than acting purely from goodwill. There are several reasons to take the green path, not necessarily just to follow the laws and rules like lowering operational costs, increased sales, lower taxes, saving resources, reduce or eliminates wastes, preserving the environment for future generation and many more.

➤ *Is the green path a competitive advantage?*

In the search of a green path, the willingness to have a green supply chain, companies are pushed to innovate and to put pressure to other stakeholders of a supply chain to become greener. It is also noted that while following the green path the stakeholders follow each other participant actions becoming an observer and corrector of effective actions.

There are several products launched by companies to minimize their impact on the environment but at the end they bring additional value, becoming a competitive advantage. Some examples of products initially designed to become more ecofriendly that proved to be also very efficient in terms of energy consumption, transport impact or waste reduction are: AdBlue liquid that reduce gas exhausted but also save fuel, ships scrubber that reduce SOx gases but reduce also corrosion and ships engines life, LED bulb that reduce energy consumption but also increase bulb life, rPET ( 100% recycled PET) reduce waste generated but also save costs to acquire raw material and examples might continue.

## Conclusions

The movement for a green supply chain is a common effort. Beside the ethical and moral obligation for the green component it has been observed that in the search for a greener product companies are pushed to innovate.

Companies should focus on their own processes, suppliers' processes and end users one's with the aim to reduce the impact on the environment by reducing energy consumption or using energy from green or renewable sources, choosing the less environmentally impact transport, doing its best to diminish its waste and to reintroduce its waste in a reverse logistic by recycling it. Compared with a traditional supply chain on a GSCM the main aim (Figure no. 2) will be to reintroduce waste in the ecosystem as a potential energy or transport generator. The GSCM is defined by green exchanges of statute from internal to external layer and vice versa.

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