



**China Council for International
Cooperation on
Environment and Development (CCICED)**

**Practices and Innovation of Green supply chain
CCICED Special Policy Study Report**

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Abstracts

Under the backdrop of globalization, green supply chain management is recognized as a direct and effective mechanism to address environmental problems along the global value chain. Using the purchasing power and consumption behaviors of governments, large enterprises and the public, green supply chain management is a market mechanism for reducing pollution and improving energy and resource efficiency. When combined with effective enforcement of national and regional environmental laws and policies, it can result in the green transformation of entire industry sectors. Green supply chain management can be an innovative tool for environmental management. This works through the incentive-based market system to encourage enterprises to take actions. Therefore, green supply chain management is closely related to the green transformation in China.

CCICED has set up this Special Policy Study (SPS) to provide a systematic examination of green supply chain development and management in the Chinese context. The hope is that through the analysis of international experience as well as research and case studies concerning domestic experience, operable policy recommendations can be identified. It is hoped that the research also can push forward green industry supply chain management by Chinese enterprises, influence China's industrial restructuring, and contribute to sustainable economic development.

The Green Supply Chain SPS focuses on the following elements:

- Examining linkages of green supply chain management, green transformation and the driving forces;
- Analyzing international green supply chain management experience and its implications for China;
- Sorting out the status and issues of the green supply chain management in China's development;
- From the perspective of strengthening the operability of implementation policies and environmental assessment, researching the existing government green procurement system and its implementation results;
- Identifying and sorting out the corporate case for good practice pertaining to green supply chain management, offering guidance to Chinese enterprises, so as to improve their ability of comprehensive environmental management.

The goal of the SPS is to put forward policy recommendations and operational measures that reinforce domestic policies and measures associated with government procurement, greening supply chain with enterprises, environment and sustainable development.

The SPS has adopted the following methods for the research:

- Literature review. The research team summarizes the best practices of enterprise greening supply chain and the experience of government procurement in European countries and the United States through literature review to conclude the implications to China's green supply chain management.

- Field research. The team visits some enterprises, government procurement centers and industrial associations in Shanghai, Shenzhen, Tianjin, analyzes the practices and experience and mostly importantly the feedbacks on status quo and challenges.
- Questionnaires. The research team selects some suppliers and brand companies to investigate the effectiveness, the development bottlenecks, problems and challenges of the implementation of green supply chain through the survey of questionnaire, and put forward policy recommendations.
- Case study. The research team conducts the case studies on Wal-Mart and Shanghai General Motors and Tianjin government procurement center, compared with the experiences and best practices in developed countries.

Greening supply chains is important for China's green transformation. Although there are some beneficial conditions in place for developing green supply chain development in China, the lack of government policies, absence of industrial guidance and corporate strategy on green supply chain, the situation of an immature market of green consumption and public awareness, and long-way-to-go green trade transformation greatly challenges the development of green supply chains in China.

China's green supply chain has just been initiated. The government and enterprises are gradually accepting the idea that enterprises should be guided by "green" concept systems in an integrated way so as to achieve a green transformation of the market. Green supply chain, which serves as a tool to address environmental problems through a market mechanism, will not only complement and complete China's current environmental management system, but also effectively intensify environmental management by enterprises. Policy recommendations for the Chinese government are put forward from the four perspectives of government, enterprises, the market and public to improve and reinforce green supply chain management in China:

- The guiding and regulating role of government should be emphasized to establish and complete China's laws and regulations and standards concerning green supply chain.
- Practice in enterprises should be promoted to establish China's economic system of green supply chain.
- Market forces should be activated to reinforce the service and regulation of the market.
- Engagement of the public should be emphasized to create an enabling environment for China's green supply chain.

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1. BACKGROUND AND RESEARCH OBJECTIVES¹

1.1 Background

On February 15th, 2011, Apple Inc. issued its Supplier Responsibility Report 2010 and reported that 137 workers at a supplier factory in China suffered adverse health effects following exposure to a chemical cleaning agent. On August 31st, 2011, a group of Chinese NGOs issued a report accusing more than a dozen suspected China-based Apple suppliers of making unlawful discharges and polluting the ambient environment. These reports aroused extensive attention both in China and the international community. In 2008, a number of Chinese enterprises and transnational companies including Mengniu, Yili, Nestle, Cadbury and Starbucks were affected by supplier factories that were producing Melamine-tainted Milk Powder. These events, and others like them, have spotlighted the risks of supply chain management. In these cases, not only has public health been endangered, but the supplier companies and their multinational clients have suffered economic and reputational losses.

Under the backdrop of globalization, green supply chain management is recognized as a direct and effective mechanism to address environmental problems along the global value chain. Using the purchasing power and consumption behaviors of governments, large enterprises and the public, green supply chain management is a market mechanism for reducing pollution and improving energy and resource efficiency. When combined with effective enforcement of national and regional environmental laws and policies, it can result in the green transformation of entire industry sectors. Green supply chain management can be an innovative tool for environmental management. This works through the incentive-based market system to encourage enterprises to take actions. Therefore, green supply chain management is closely related to the green transformation in China.

(1) Green supply chain management is an innovative mechanism to facilitate China's green transformation

According to the 12th Five-year Plan, which covers a key period in China's overall transformation, economic policies should focus on changing the economic development mode and structure to promote green transformation and green growth.

Green supply chain management can serve as a significant tool to realize China's "green transformation". In the long run, green supply chain management – which takes environmental protection and energy conservation into account during the life cycle of production from design, to resource extraction to manufacturing, marketing and recycling or end-of-life management – will not only reduce environmental impact but also optimize resource allocation in China, making it an innovative system to foster the country's green transformation.

¹ Authors for Chapter 1: Zhou Guomei, Li Xia.

(2) A green supply chain management system is vital to achieve the goals of energy saving and emission reduction set by the state

During the 11th Five-Year Plan period, China focused on energy conservation and emission reduction as an engine to adjust its economic structure, change its development mode, address climate change and promote scientific advances, and set a target of reducing energy consumption per unit of GDP by 20% and major pollutant emissions by 10%. By 2010, the targets set for 11th Five-Year Plan had mostly been realized, with national energy consumption per unit of GDP falling by 19.1%, total national emissions of sulfur dioxide reduced by 14.29% and national emissions of chemical oxygen demand reduced by 14.25%.

In the 12th Five-Year Plan, emissions reduction targets have been further upgraded by the Chinese Government. The “Double Ten” (10% reduction of SO₂ and COD) was extended to the “Double Ten and Double Eight”, that is, emissions of four major pollutants, Chemical Oxygen Demand (COD), sulfur dioxide, ammonia nitrogen and oxynitride should be reduced by 8%, 8%, 10% and 10% compared to 2010. However, as China’s economy continues to grow, it is facing huge pressures in the area of energy conservation and emission reduction. Simply continuing the emission and energy reduction measures instituted under the 11th Five-Year Plan may lead to huge investment with limited achievements. A system of green supply chain management, which uses market forces to promote lower lifecycle environmental impacts and energy usage, will provide a new avenue for meeting the ambitious goals of the 12th Five-Year Plan.

(3) A green supply chain management system is necessary to promote “made in China” products going global

As the global financial crisis goes deeper, a growing number of international trade disputes are arising, with trade barriers based on environmental issues being more frequently applied. In general, China’s environmental standards are lower than those of developed countries due to the differences of development stage, but the international community tends to mistake the products of “Made in China” as high-carbon and heavy-polluting products. Today, significant changes have taken place in the international market, and China, as a major exporter, is directly or indirectly forced to address environmental issues that could become barriers to international trade. A fully realized green supply chain management program would be beneficial not only for China to reduce environmental impacts and energy consumption domestically, but also to avoid the economic risks arising from green barriers to international trade.

(4) The development of a robust green supply chain program relies on improving governments’ and enterprises’ green procurement and the public viewpoint on green consumption

With the growing public awareness of environmental protection, consumers in particular are increasingly demanding environmentally-friendly products. Their viewpoint on green consumption and actions to protect the environment will promote the development and production of environmentally-friendly products, with associated benefits in resource saving and environmental protection. Consumers are regarded as the end users, their green consumption patterns will urge Chinese enterprises to implement green supply chain programs and increase their green competitiveness.

Furthermore, the public's increasing recognition of green products will promote a change from the traditional procurement mode to green procurement for governments and enterprises. With huge buying power represented by government and large enterprises, green procurement can quickly promote changes in production throughout the industrial supply chain.

1.2 Research objectives

CCICED has set up this Special Policy Study (SPS) to provide a systematic examination of green supply chain development and management in the Chinese context. The hope is that through the analysis of international experience as well as research and case studies concerning domestic experience, operable policy recommendations can be identified. It is hoped that the research also can push forward green industry supply chain management by Chinese enterprises, influence China's industrial restructuring, and contribute to sustainable economic development.

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1.3 Research methodology

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2. THE CONCEPT OF GREEN SUPPLY CHAIN AND THE INFLUENCING FACTORS²

2.1 The concept of green supply chain

2.1.1 Supply chain management

Green supply chain is derived from supply chain management (SCM). SCM is the planning and management for procurement, logistics, and manufacturing of raw materials, work in progress, and inventory management across interconnected businesses that are combined to produce goods or services. SCM in nature is to integrate the supply and demand inter-and between-enterprises. (Council of Supply Chain Management Professionals, 2004)

In general, traditional SCM includes elements of upstream supply, production, logistics & delivery, marketing & retail and consumption (see Figure 2.1), but it hasn't taken environmental impact into account. As environmental protection draws growing attention from the governments, the public and some enterprises, it is necessary to take the impact of products and processes in the supply chain on environment into account, which gives rise to the green supply chain.

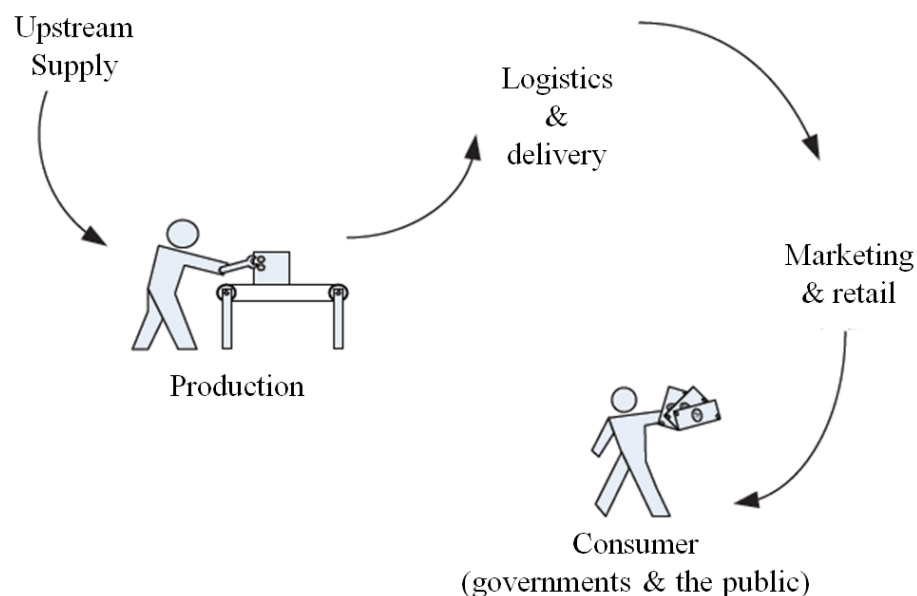


Figure 2.1 Pattern of traditional supply chain

² Authors for Chapter 2: Zhou Guomei, Li Xia.

2.1.2 Green supply chain

The complete concept of “green supply chain” (GSC) was first proposed by the Manufacturing Research Consortium (MRC) of Michigan State University in the U.S. in 1996, for comprehensively considering environmental impacts and resources optimization of manufacturing supply chains. That is to say, it aims to minimize the environmental impacts of the products end-of-use by tracking and controlling the raw material procurement, in order to ensure compliance with environmental rules and regulations starting from the stage of product R&D.

There is no existing standard definition for green supply chain, and many definitions are available. For the purpose of this report, the concept of green supply chain can be put in this way: when considering the impact of its products on the environment, the enterprise should not only take its own processes into account, but also the sourcing of raw materials, the consumption of the products, as well as the recycling of the wastes, i.e., the whole process of the product life cycle (see Figure 2.2). To ensure enterprises in supply chain comply with the unified environmental requirements is the way to improve their environmental performances and reduce environmental impact so that green and low-carbon development can be realized.

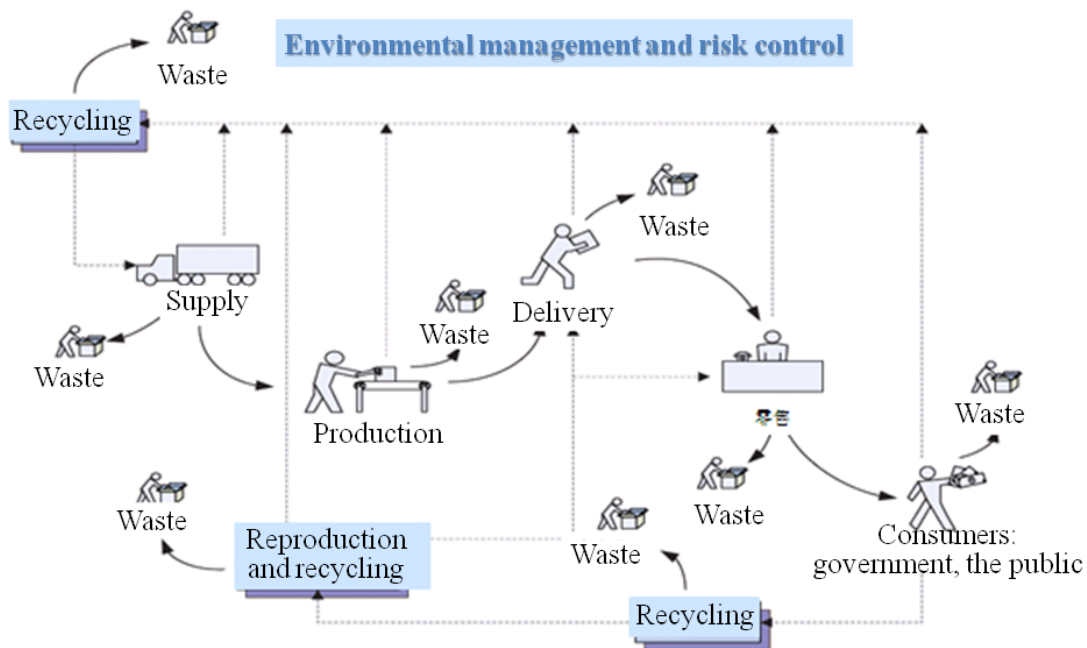


Figure 2.2 Management system of green supply chain

Green supply chains differ from traditional ones in that green supply chain management is integrated into the entire process including planning, procurement, production, consumption, and reverse logistics. The entire supply chain is managed as a green system and every process focuses on environmental management and risk

control, specifically:

Planning, green concept should be introduced starting from the process of planning, and the environmental impacts should also be taken into consideration in each stage of the processes.

Procurement, the management and supervision of suppliers are emphasized during the process of procurement. Environmental elements should also be included in the evaluation beyond the commonly evaluated items like quality and prices and a priority policy on green procurement should be determined.

Production, it refers to several elements including manufacturing, processing, green design and cleaner production. **Cleaner production** requires a preventive and environmentally friendly production process. It intends to increase biological benefits and minimize the damage and risks to human being and environment³, focusing on minimizing the impacts of product on human being and environment during the entire production process.

Consumption, it includes government green procurement and public consumption. **Government Green Procurement** refers to deliberate selection of products and services that conform to the national certified environmental standards and are beneficial to public health and environment. The implementation of government green procurement is beneficial for industrial restructuring and helps promote green consumption.

Reverse logistics, it will help achieve a closed-loop of green supply chain and therefore minimize the environmental impacts.

2.2 Differences between green supply chain and traditional supply chain

The green supply chain focuses on changes in the following five aspects compared to traditional types of supply chain:

- (1) **The goal.** The traditional supply chain aims to lower the cost and improve the efficiency of supply chain enterprise so as to maximize the economic benefits. Green supply chains also seek to maximize economic benefits, to decrease the consumption of resources and energy and to reduce the emissions of pollutants – all in an effort to create a socially responsible enterprise, and to balance the economic benefits, social effects and environmental effects.
- (2) **Management structure of supply chain.** For green supply chain management, environmental performance is included in the enterprise's internal and external management, which is lacking in traditional supply chains.
- (3) **Business model.** A green supply chain means a more complete business model.

³ Definition by United Nations Environment Program, 2007

Elements including low carbon and environmental protection must be included in the entire logistics and supply chain to realize a complete green and low carbon supply chain system through the whole life cycle, from raw material sourcing and industrial design to production and delivery.

(4) Business process. The traditional supply chain starts with suppliers and ends with users, and the products flow is one-way and irreversible, known as “Cradle-to-Grave”. The green supply chain changes this management mode and hopefully realizes “Cradle-to-Reincarnation”. In green supply chain thinking, product flow is circular and reversible and all products must be managed throughout the entire life cycle, and beyond so that “waste” finds a second life or becomes raw material available for new production or other purposes.

(5) Consumption pattern. The consumption pattern of the traditional supply chains is a voluntary initiative governed by consumer interests and business activities. Green supply chains can be promoted through green government procurement, corporate social responsibility, and sustainable consumption education and practices.

2.3 Drivers and barriers of green supply chain development

Drivers and barriers of green supply chain development are listed as below. (See Table 2.1)

Table 2.1 Drivers and barriers of green supply chain development

Drivers	<ul style="list-style-type: none"> • Improve the competitiveness and promote the economic benefits. The strategy of greening supply chain is implemented by stakeholders in the most challenging market, and mutual benefits of efficiency and effectiveness could achieve among upstream & downstream enterprises in supply chains. • Increased client value. Green products will not only bring the benefits to the environment, but also bring green benefits to customers, which will in return earn consumer’s trust in a long term. • Build up enterprises’ image. Enterprises carrying out green supply chain measures can provide safe products and show their social responsibilities so as to earn trust from consumers. • Eliminate the technical barriers to green trade. Many countries especially developed countries attach much importance to environmental elements for trade. Enterprise seeking long-term sustainable development must comply with green standards on products and implement green supply chain measure to facilitate trade.
Barriers	<ul style="list-style-type: none"> • Laws, regulations, and policies concerning green supply chain are needed to facilitate and promote green supply chain management. • Although taking measures of greening green supply chain, to some extent, can improve the efficiency and reduce the costs, it often has a

	<p>negative economic payback.</p> <ul style="list-style-type: none">• Trusts should be built up between enterprises for partnerships on greening supply chains.• Expertise and technical support on green supply chain need to be developed.• Corporate culture integrated with environmentally friendly product and services need to be promoted to help facilitate corporate partnerships on greening supply chains.
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3. INTERNATIONAL EXPERIENCES OF GREEN SUPPLY CHAIN⁴

3.1 The U.S. government and enterprises – sponsor and promoter of green supply chains

The U.S. government has issued vigorous, flexible and scientific laws and regulations to guide policy development of green supply chains. Policies and regulations concerning pollution control, traffic control, food contamination prevention, and interests to safeguard consumers' health have already been issued, and corresponding monitoring systems also have been established.

3.1.1 Market incentives are developed to guide enterprise's environmental behaviors

Incentive-based market tools like taxes are developed by the U.S. government to change the financial decisions of enterprises to help promote greater efficiency or take environmental actions such as renewable energy.

Market incentives for reducing aggregate supply chain energy use can also include the implementation of subsidies to support renewable energy initiatives in companies along the supply chain. These include low-interest loans, loan guarantees, and subsidies for green technology that can create incentives for investment in new equipment (i.e. low emission vehicles or manufacturing equipment) or new energy sources (i.e. local scale wind or solar projects).

Box 1. DOE Loan Guarantees

For example, the U.S. Department of Energy (DOE) provides loan guarantees to finance renewable energy projects (and select startup renewable energy companies). These loans are specifically intended to mitigate the financial risk associated with new energy projects, especially those that are tied to the development of less proven technologies such as new types of solar panels.

The DOE's Loan Programs Office works with banks and companies that seek to implement renewable or clean energy projects and as of April 2011 had committed up to \$26 Billion in loan guarantee support to 21 projects around the U.S. Municipalities such as San Francisco have offered similar loan guarantee programs to help spur investment in local renewable energy installations. These types of financing assistance help speed the adoption of new technologies by allowing banks to more easily provide loans to finance the investments. Such adoption can occur at any place with a company's supply chain.

⁴ Authors for Chapter 3: Andrew J. Hoffman, Alan McClay, Nicholas A. Shufro.

3.1.2 Enterprises are required and encouraged to report on supply chain-related environmental impacts by laws and regulations

The U.S. government requires enterprises to disclose information about the environmental impacts of areas of their operations including their supply chain. The Toxics Release Inventory requirement from the EPA, which requires companies to report on their toxic chemical releases, including location, is an example of such a program⁵. Reporting and transparency are particularly impactful on supply chain performance because supply chains tend to be opaque. For example, regulation under both the *Resource Conservation and Recovery Act* (RCRA) as well as *Superfund* requires companies that produce, handle or dispose of hazardous waste to maintain strict chain of custody documentation to closer monitor the movement of such materials through the supply chain.

In addition, the Government also makes efforts to carry out reporting system on environmental information. American companies, along with many companies doing business in the United States, are required to report on a wide variety of financial and corporate governance issues. This reporting is highly regulated, takes place regularly, and includes exhaustive amounts of information about the companies and their operations. Most corporate reporting is overseen and published through the Securities and Exchange Commission (SEC). The SEC can mandate that companies report on a variety of issues if they deem the information to be important to the company's finances and therefore its shareholders⁶. Congress has the authority to mandate that the SEC begin requiring reporting on new types of information, including environmental impact of operations and supply chain delivery of goods and services. To date, most public reporting on environmental issues has been done voluntarily, such as through the Global Reporting Initiative, the Carbon Disclosure Project or through each company's corporate sustainability report.

In January 2010, the SEC issued guidance for publicly traded companies to publicly report on their risk from climate change legislation or environmental impacts⁷. Although the SEC only issued guidance on the issue, large companies see this as an eventually binding decision⁸. The SEC has the ability to recommend and to enforce which issues public companies report on and how well they actually report. Although this recommendation from the SEC is unenforceable and does not cover the lifecycle

⁵ <http://www.epa.gov/tri/>, E.P.A. (2011 19-April). *TRI Home*. Retrieved 2011 20-April from Toxics Release Inventory Program: <http://www.epa.gov/tri/>

⁶ S.E.C. (2010, 2 8). *United States Securities and Exchange Commission*. Retrieved 4 10, 2011, from Commission Guidance Regarding Disclosure Related to Climate Change: <http://www.sec.gov/rules/interp/2010/33-9106.pdf>

⁷S.E.C. (2010, 2 8). *United States Securities and Exchange Commission*. Retrieved 4 10, 2011, from Commission Guidance Regarding Disclosure Related to Climate Change: <http://www.sec.gov/rules/interp/2010/33-9106.pdf>

⁸Kirkland, J. (2010, 1 28). SEC Issues Climate-Risk Guidance Despite Tough Political Environment. *The New York Times* , pp. <http://www.nytimes.com/cwire/2010/01/28/28climatewire-sec-issues-climate-risk-guidance-despite-tou-27171.html?pagewanted=1>.

of emissions from a company, it still benefits supply chain sustainability because it introduces many companies to the idea of reporting on direct GHG emissions, and because Original Equipment Manufacturers (OEM) may use it as an opportunity to engage with their suppliers regarding GHG emissions.

3.1.3 Enterprises are encouraged by the government to launch voluntary programs to reduce environmental impact of supply chain

The U.S. government has sponsored voluntary programs to encourage enterprises to participate in green supply chain for helping them work towards more sustainable operations. For the purpose of incentives, the government-sponsored programs are not only guidance-based, but also tend to be collaborative and provide incentive. Voluntary programs can also provide a forum for companies to share best practices, which can have significant cascading benefits in an industry. SmartWay program is one of the examples. Initiated by the EPA in 2004, the SmartWay program is a partnership between government and industry that provides logistics companies with strategies for reducing fuel use through efficiency measures⁹. The program is essentially a certification that companies can achieve by becoming members in the program and meeting certain efficiency requirements. The incentive for companies to participate is the recognition of being part of the program, along with the financial savings associated with the required efficiency measures. Additionally, logistics companies are able to use SmartWay membership as a means of demonstrating their environmental leadership to their customers, including large shippers like retailers and consumer products companies. Some companies, in turn, encourage or require SmartWay participation among suppliers. For example, Menlo Worldwide Logistics encourages Smartway compliance among its existing carriers. Similarly, EA Logistics gives preference to high- performing SmartWay Partners (57 percent of EA's 2008 LTL tonnage was hauled by SmartWay Partners).

3.1.4 Promotions on government green procurement

The U.S. government has a complete green procurement system that plays an incentive role in the healthy development of green supply chain. It mainly adopts federal acts and presidential executive orders as the legal basis for promoting green procurement. These acts and orders include: Executive Order No. 12873 *Federal Acquisition, Recycling and Waste Prevention*, No. 13101 *Greening the Government through Waste Prevention, Recycling and Federal Acquisition*, No. 13148, *Greening the Government through Leadership in Environmental Management* presidential executive order and Executive Order 13514, Section 13, that requires the U.S. federal government agencies to address various sustainability issues such as water, waste and greenhouse gas emissions. The federal Environmental Protection Agency issued in

⁹ US EPA. (2011 1-April). *Smart Way*. Retrieved 2011 7-April from U.S. Environmental Protection Agency: <http://www.epa.gov/smartwaylogistics/>

2001 a series of guidelines related to food equipment, electronic equipment, washing machines, photocopiers, carpets, and so on.

Government Procurement Act has detailed provisions on green procurement including: how to purchase eco-friendly products and services (which mainly refer to products made from renewable materials); for recycled materials, if the purchases are more than 10,000 U.S. dollars, then only the types of product specified by the EPA can be procured, by following relevant procedures, and the EPA also stipulated such product catalogs. And it is the government's procurement policy to purchase products and services that minimize impacts on people's health and environment.

The U.S. government has developed several green procurement methods based on green procurement practice, such as the "lowest price method" that gives priority to the products' compliance with environmental standards, the "life cycle cost method" that takes procurement cost and treatment cost into account; "price subsidy method" that gives subsidy to high-cost green products by government; "the most valuable method" that includes both price and performance.

3.1.5 Corporate Prudence in partnerships for a win-win result

Leading American enterprises have many concerns with establishing partnerships with suppliers and often giving priority to environmental performance in their evaluation of suppliers. Final suppliers are selected based on their compliance with environmental laws and regulations as well as the strength of the enterprise's own indicator systems, the data and information provided by suppliers through questionnaires, and the results of quantitative and qualitative analysis. Once the suppliers actually become partners, the leading enterprises won't rely only on monitoring and evaluation, but will establish a win-win partnership with them by providing guidance, support and help. For example, meetings and environmental forums will be held with suppliers, and training will be provided for them.

Box 2. Assumptions on benefits of Packaging Improvement by Dell and similar measures introduced by China's IT industry

Dell is aggressively working to improve packaging with a strategy it calls "the three C's":

The first C is for cube or the volume of the packaging. This initiative reduces the size of boxes as much as possible. The second C is for content or material that the packaging is made of. Dell is innovating with alternative packaging materials that have less environmental impact. The third C is for curb or what is the recyclability of the packaging material. Dell is striving to use sustainable materials that are also able

to be recycled.

With a focus on the three core aspects of Dell's packaging program, the company set a goal in 2008 to reduce packaging by 20 million pounds by 2012. Dell has already reduced packaging by 8.7 million pounds. Using the impact to revenue comparison and comparing Dell to the IT industry in China, we can estimate that if China were to implement a similar program in the IT sector alone it could result in a reduction of 193 billion pounds of packaging (based on 2010 Dell revenues of \$52.9 million).

From 2008 to 2012 Dell anticipates saving an average of \$2 million dollars per year in packaging eliminations. Given Dell's sales revenue of \$52.9 million dollars in 2010, the ratio of packaging savings per dollar of revenue at Dell multiplied against the 2010 sales revenue for China's IT sector gives a rough approximation of potential packaging savings in this sector of \$44.5 billion USD annually. Actual savings would differ for a number of reasons, but the general scope of impact will remain in this general magnitude.

3.2 EU – Expanding global impacts of green supply chains by green products specifications

The EU promotes the spread of green supply chains globally through specification and designation of green products. They hope to take the lead in the environment-friendly development of the manufacturing industry based on the massive business market within the EU and beyond. Major EU measures include those noted below.

3.2.1 Environmental laws promoting a green supply chain revolution

EU approved Waste Electrical and Electronic Equipment (WEEE) and Restriction of the use of certain Hazardous Substances in electrical and electronic equipment (RoHS) in November 2002, and officially issued recycling standards on ten electrical and electronic devices on February 2003, and the said devices shall not contain substances including Lead, Cadmium, Mercury, Hexavalent chromium, Polybrominated biphenyls, PBB, Polybrominated diphenyl ethers, and PBDE by July 1, 2006.

The implementation of WEEE and RoHS plays an active role in increasing the efficiency of recycling and reusing rejected electric items in EU, decreasing the number of electric waste with final treatment, and effectively reducing the impact of electrical items on local environment.

These two decrees have far-reaching influence on the electric appliance manufacturers worldwide and the entire electronics industry supply chain consisting of electric items manufacturer, distributor, as well as contractor. Electric appliance manufacturers seeking market share in EU have to in one hand sustain higher cost arising from

“green barriers”, and on the other hand advance their production technologies which include the extension of product life, the reduction of high energy-consuming products, the application of friendly-assembly and easy-disassembly design, the alternatives of hazardous substances and the continuous greening of production line. In this sense, the WEEE and RoHS help establish green supply chain of global electronic industry and provide experience on electronics waste management for other countries in the world.

3.2.2 Eco-label

As early as 1992 the European Ecolabel¹⁰ was launched as a voluntary scheme to encourage the private sector in its development and marketing of environmentally-friendly products and services. Products and services which have earned the label carry a simple flower logo, which allows for easy recognition across the 27 member states (plus Norway, Iceland and Liechtenstein). Full Life Cycle Assessment (from pre-production through to disposal) is applied in conferring the label. Presently the scheme has been integrated into the Commission’s action plan on sustainability: the Sustainable Consumption and Production and Sustainable Industrial Policies (2008)¹¹. The EU is steadily expanding categories across which the label can be earned. Categories currently include cleaning products, appliances, paper products, textile, home and garden products, lubricants and some services. All mainstream retailers integrate the eco-label ranges in their sustainability practices and reporting.

3.2.3 Green Public Procurement (GPP)

Central to the EU’s policies is GPP¹², or Green Public Procurement, seen both as a spur and model for the private sector to emulate, and a significant weight in its own right as a portion of GDP. GPP has been defined since 2008 as "a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured."

Europe-wide, public authorities account for approximately €2 trillion, or 17% of EU GDP, and constitute therefore a major lever in shifting markets towards sustainable development. GPP provides an incentive for industries to develop green technologies and products and represents sufficient volume to help industries reach critical mass for making the sustainable production of goods and services viable.

¹⁰ http://ec.europa.eu/environment/ecolabel/about_ecolabel/what_is_ecolabel_en.htm

¹¹ EU Information (COM(2008)400)—Brussels, July 16, 2008, European Commission, European Council, European Economic and Social Committee and local Committee.

¹² Public Procurement in A Better Environment,
http://ec.europa.eu/environment/gpp/action_plan_en.htm

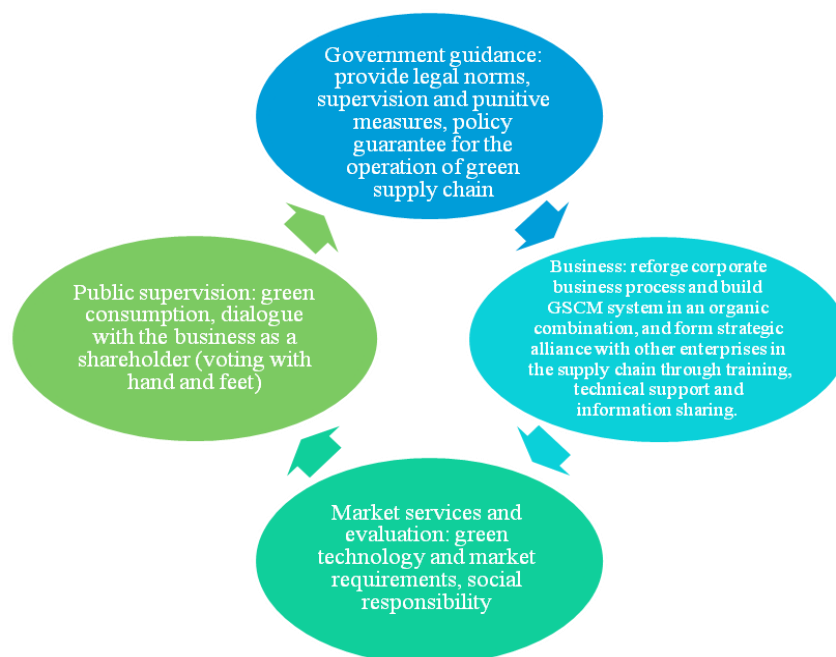
4. STATUS QUO AND CHALLENGES OF GREEN SUPPLY CHAIN IN CHINA¹³

4.1 Status quo of green supply chain development in China

The Chinese Government and businesses lag behind in understanding the concept of green supply chain. As a result, green development of the entire supply chain has started late by comparison to some other countries, and the theoretic studies and practices are still in the infancy. In light of the high consistency between green supply chain and green transformation in terms of the target and actions, green supply chain could evolve to be a vital environmental and economic tool at the micro level to achieve the green development and green transformation.

The Government increasingly has recognized the importance of green supply chain development, and therefore has continuously sought to create a favorable environment for market-based approaches through laws, policies and other means. Meanwhile, some domestic multinationals and large enterprises in China also have realized the strategic role of environment and resources in building competitive advantage during their operation and management, and therefore have initiated preliminary exploration of green supply chains. Some suppliers with long-term perspectives and capabilities have begun to break the barriers to green exports and embarked on the green supply chain development.

Government, business, the market and the public shoulder different responsibilities in green supply chain development, as shown in Figure 4.1.



¹³ Authors for chapter 4: Zhang Xiaodan, Cao Fuguo and Xing Houyuan.

Figure 4.1 Relations among government, business, the market and the public

The government serves as a regulator, promoter and supervisor and is responsible for setting up legal norms, punitive measures, policy guarantee and incentives for the operation of green supply chain, creating a favorable market environment for green supply chain development at the macro level.

Business, the main micro body to implement green actions, reformulate business process and builds up green supply chain system in an organic combination, and forms strategic alliance with other enterprises in the supply chains through training, technical support and information sharing.

The market mainly offers services and 3rd party verification to facilitate fair competition and help promote a green market.

The public is a significant driver for green supply chain development. Being stakeholders, the green choices of the public will help change the way enterprises operate.

4.1.1 Government guidance on green supply chain

From an overall perspective, as the green supply chain is still new, the Chinese Government has not yet positively functioned as a regulator, promoter and supervisor in green supply chain development. Nevertheless, the production system in the green supply chain is closely related to environmental management and cleaner production. Moreover, the recycling system of green supply chain fits with Chinese regulations and policies on waste disposal and government procurement and public green consumption. Therefore, the government still plays a guiding role in the initial stage of green supply chain development.

(1) Government as the regulator in the initial stage of green supply chain development

The legal institutional framework for environment and resource protection has been in place in China and progressively improved after years of efforts, such as energy saving system, environmental standards, environmental monitoring and reporting system, environmental resource planning system, target responsibility system for environmental protection, quantitative examination system for comprehensive urban environmental improvement, environmental impact assessment system, the "three simultaneous" system (design, implementation and production), sewage discharge declaration and registration system, natural resources ownership system, the permit system in the field of environmental resources, paid use of natural resources, and the charging system for sewage discharge. Chinese laws and other guidance concerning green supply chains and their significance are listed as below (see table 4.1).

Table 4.1.Environmental laws, regulations and policies concerning green supply chain

Role	Law	Enacting body	Effective Date	Content
Regulator	Law of the People's Republic of China on Energy Conservation	Standing Committee of National People's Congress (NPC)	01/01/1998	Provides a legal basis for energy conservation and pollution reduction from the perspective of energy production and consumption, which leaves a legal basis for energy saving through the supply chain.
Regulator	Law of the People's Republic of China on Renewable Energy (Amendment)	NPC Standing Committee	Promulgated in 2005 and amended in 2009	Provides legal basis and incentives for renewable energy development.
	Law of the People's Republic of China on Promotion of Cleaner Production	NPC Standing Committee	01/01/2003	Provides a legal fundamentals and technical guidance for green production in the supply chain.
	Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Wastes	NPC Standing Committee	Promulgated in 1995, amended in 2004	Emphasizes the concept of recycling and safe disposal of solid waste.
	Law of the People's Republic of China on Environmental Impact	NPC Standing Committee	01/09/2003	Emphasizes the importance of environmental pollution prevention from the source and requires all new projects obtain the

	Assessment			approval of environmental impact assessment report prior to construction.
	Law on Circular Economy Promotion	NPC Standing Committee	01/01/2009	Targets on economic restructuring and transformation with the principle of 3Rs (reduce, reuse and recycle).
Supervisor	Directory of Listed Companies Subjective to Environmental Inspection by Sector	Ministry of Environmental Protection (MEP)	July, 2008	Provides specific requirements on the sector classification of listed companies subjective to verification.
Supervisor	Opinions on the Implementation of Environmental Policies and Regulations to Prevent Credit Risk	MEP, People's Bank of China, China Banking Regulatory Commission	12/07/2007	Provides principle opinions on minimizing credit risks of projects due to environmental problems.
	Guideline for the Preparation of Corporate Environmental Reports	MEP	01/10/ 2011	Provides standardized corporate environmental information disclosure system.

(2) Promote macro-policy environment conducive to green supply chain development

During the 11th Five-Year Plan period, China has for the first time set the reduction of energy consumption intensity and major pollutant emissions as the binding target of economic and social development, and carried out a series of actions in the hope of energy-saving technological progress, such as shutting down small high-polluting and energy-consuming enterprises. As of 2010, energy consumption per unit of Gross Domestic Product (GDP), as well as sulfur dioxide (SO₂) and chemical oxygen demand (COD) emissions have decreased by 19.1%, 14.29% and 12.45% respectively. Not only has the binding target provided in the *Outline of the Eleventh Five-Year Plan* been accomplished, but also the obvious rising trend of energy consumption per unit

of GDP and major pollutant emissions has been reversed.

Energy saving and emission reduction seems even more arduous in the 12th FYP period. In terms of energy saving, by 2015, energy consumption per 10,000 *Yuan* of GDP is targeted to decline by 16% over the 2010 level. In terms of emission reduction, COD and SO₂ emissions nationwide shall not exceed 23.476 and 20.864 million metric tons respectively, a drop of 8% compared with the 2010 levels; national ammonia and nitrogen oxides emissions shall be limited within 2.38 and 20.462 million metric tons respectively, 10% down 2010 levels.

Although the emission reduction target during the 12th FYP period is slightly lower than that in the previous period, it is not easy to make it happen, and the pressure is even greater because the marginal effect gradually diminishes with the decline of the baseline of emission reduction. In light of the mandatory targets, emission reductions should be deemed as sourced not only from projects, structure and management, but also should incorporate voluntary market emission reduction arising from green supply chain actions.

(3) Government green procurement---- interpreting government’s role as a green supply chain program promoter

Government green procurement as an important instrument to promote green supply chain has attracted increasing attention from the Chinese Government. Its main legal basis listed in Table 4.2 also forms the foundation of the Chinese government green procurement system.

Table 4.2 Legal basis for government green procurement

Year	Name of the law	Connotation	Specific provisions
2002	Law of the People’s Republic of China on Cleaner Production Promotion	It stipulates that the government should give priority to green products in the procurement, marking the first step made by the Chinese government to incorporate green procurement into the law.	Article 16: Government at all levels should give priority to energy-saving products, water saving products, products with waste recycling, and other products beneficial to environmental and resource protection in the procurement.
2003	Law of the People’s Republic of	It sets forth requirements on the support of government	Article 9: Government procurement should contribute to the objectives of national

	China on Government Procurement	procurement for environmental protection.	economic and social policy, including protecting the environment, supporting underdeveloped regions and ethnic minority areas, promoting SME development.
2004	Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Wastes	It encourages the purchase of recycled products and reusable products.	Article 7: The State encourages departments and individuals to purchase and use recycled products and reusable products.
2008	Law of the People's Republic of China on the Promotion of Circular Economy passed by the NPC Standing Committee	Government procurement should give priority to environmentally friendly products.	Article 47: The country implements government procurement policy conducive to the development of circular economy. Procurement with fiscal budgets should give priority to energy saving, water saving, materials saving products, products conducive to environmental protection and renewable products.

The State Council issued the *Decisions on Implementing the Scientific Outlook of Development and Enhancing Environmental Protection* in 2005 and further stressed the need to establish a government green procurement system¹⁴. In the same year, it released *Opinions on Accelerating the Development of Circular Economy* to clarify the policy orientation for government agencies to implement green procurement¹⁵.

In order to implement the documents issued by the CPC Central Committee and State Council, Ministry of Finance (MOF) and MEP jointly issued the *Implementation Opinions on Government Procurement of Environmental Labeling of Products* and publicized the first batch of 14 categories of environmental labeling products for

¹⁴ The document stipulates “vigorously develop the circular economy...in the consumer sector, greatly advocate environmentally friendly consumption patterns, implement environmental labeling, environmental certification and government green procurement system, and improve the renewable resource recycling system.”

¹⁵ The document calls for “vigorously advocate consumption patterns conducive to environmental protection and resource conservation, encourage the use of energy-efficiency labeling products, energy-saving and water-saving certified products, as well as environmental labeling products, food with green label and organic label, reduce excessive packaging and the use of disposable supplies. Government agencies implement green procurement.”

government procurement in October 2006. It shows that environmental criteria have been formally incorporated into the Chinese government procurement model. The document requires “state organs, public institutions and organizations at all levels shall give priority to environmental labeling products in the procurement with financial fund and not purchase products harmful to the environment and human health.” Such a system is an important breakthrough in China’s government procurement policy and system and marks the official kickoff of Chinese government green procurement.

In the years of government green procurement implementation, MOF and MEP have jointly announced 8 batches of the lists of environmental labeling products for government procurement, expanding the product scope from the original 14 categories to the current 24, enterprises from 81 to 550, and product models from 800 to over 18,000. These products include IT equipment, such as automobiles, personal computers, copiers and printers, building materials, such as paint, furniture and plates, and also solar products, as shown in Figure 4.2.

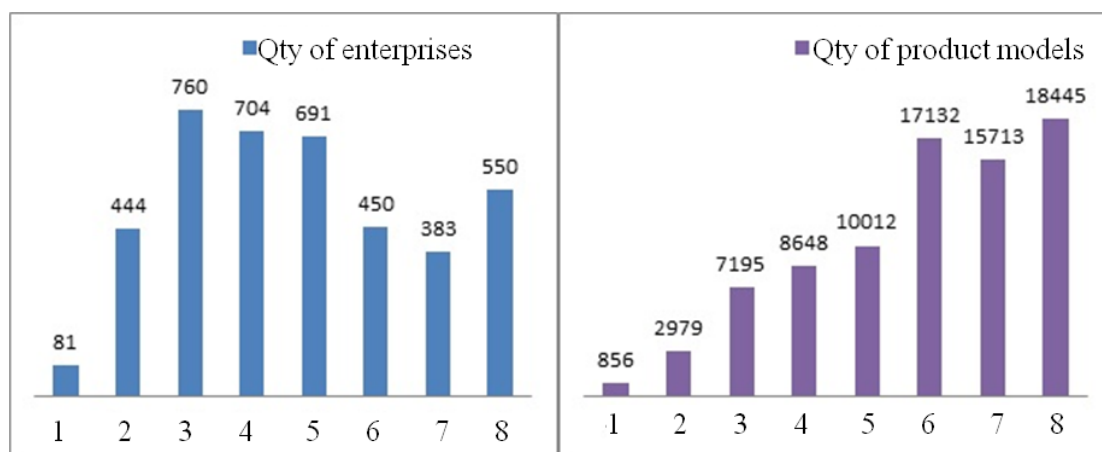


Figure 4.2 Numbers of enterprises and product types in the lists of Chinese government green procurement

Government procurement of environmental labeling products has played an active role in guiding and promoting green production and consumption and building a resource saving and environmentally friendly society, and won strong support and popularity among the various manufacturers of green products. Data show that in 2009, the national procurement of green products was valued at 14.49 billion *Yuan*, accounting for 74% of the government procurement of products in the same category, while the number of government green procurement amounted to 272.6 billion *Yuan* during the 11th FYP period, accounting for about 65% of the government procurement of products in the same category.

Procurement ratio of environmental labeling products

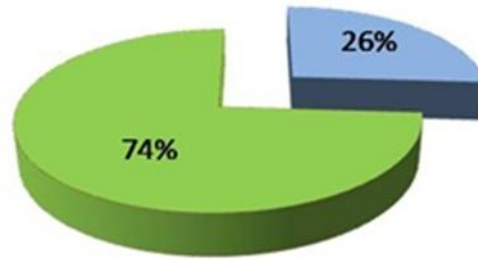


Figure 4.3 Government procurement ratios of green products in 2009

Government green procurement was officially incorporated into the 12th FYP in 2011, making an innovative move in the new era of environmental protection. Its implementation positively advances the building of a resource saving and environmentally friendly society and thus enjoys great support and welcome from the majority of manufacturers of green products, and moreover, guides sustainable consumption in the whole society.

Box 3. Case study -- green practice in Tianjin municipal government procurement center

Following the release of *Implementation Opinions on Government Procurement of Environmental Labeling Products* in 2006, Tianjin Municipal Government issued the *Implementation Opinions on Tianjin Municipal Government Procurement to Support Energy Saving and Eco-friendly Construction and Promote Independent Innovation*. Measures introduced include: appropriately increasing the weights of energy conservation and environmental protection in the evaluation process to enhance the competitiveness of environmentally friendly products in the bid; creating a sound environment for government green procurement with the conscious learning and publicity of green procurement policy, actively directing the market and the community to expand green procurement and green consumption, and also giving full play to the guiding role of government centralized procurement agencies.

Tianjin municipal government procurement center adopts following measures to put government green procurement into practice:

- 1) Linkage of contract procurement with green procurement. Eco-friendly energy efficient products, innovative products, national industrial products and products of SMEs are given priority in the procurement process. Extra points are given to

these four categories of products to fully highlight their advantages in procurement, so that government procurement could be more beneficial to environmental protection and the development of an environment-friendly society.

- 2) Tighten access conditions. Tianjin municipal government procurement center explicitly states that it is only allowed to purchase products included in the government procurement list of environmental labeling products and the government procurement list of energy efficient products. Furthermore, the renewal cycle of vendor products is shortened to a week to facilitate the procurement of latest and most eco-friendly products and ensure the performance of green products. In 2010, Tianjin municipal government procurement center completed a total procurement budget of 9.32 billion *Yuan* (including 5.64 billion *Yuan* of drug procurement). With pharmaceutical factors excluded, the actual purchase valued 3.23 billion *Yuan* in 2010, of which green procurement account for 23.40% and environmental labeling products in the government procurement list contribute 20.16%.

According to the statistics of Tianjin government procurement of printers, copiers and computers in 2010, it has saved 194,700kWh of electricity annually by purchasing these green electric and electronic products. China's energy production and consumption are mostly from coal and other fossil fuel. Taking a power plant for example, every saved kWh of electricity means that 0.4Kg standard coal is saved, and meanwhile the emissions of 0.272kg of dust, 0.997kg CO₂, 0.03kg SO₂, and 0.015kg NO_x are reduced¹⁶. Accordingly, in 2010, 778.8 tons of standard coal was saved, 529,584kg dust, 1,941,159kg CO₂, 58,410kg SO₂, and 29,205kg NO_x were reduced in Tianjin by the procurement of environmental-friendly printer, copiers and computers.

(4) Green trade transformation supports green supply chain development in China

International trade and green supply chains are closely connected. International trade not only promotes the transnational spread of green supply chains, but also drives the sustainable trade. In consideration of China's actual situation, there are three main influencing factors.

First, China frequently encounters friction in its international trade. China may have more acute confrontations with trading partners as its share of products in the international market increases. For purposes including environmental protection and trade protectionism, other countries engaged in international competition sometimes have used environmental standards higher than those of China as a means to restrict the exports of Chinese products. With movement up the value chain of China's export structure, direct competition with the developed countries will become more intense, which will require raising the environmental requirements on China's exports.

¹⁶ China Environment News, December 8th, 2009.

Secondly, the issue of climate change has brought new challenges to China's economic and trade development. New tariff measures like border tax adjustments would directly affect China's export competitiveness. The Chinese Government has to develop actions in response to strengthen green supply chain and thereby help improve the international competitiveness of Chinese enterprises.

Thirdly, building a green supply chain network should serve not only as a measure in response to green trade barriers, but also as a tool to limit contaminated products and wastes from developed countries, and to stimulate development of domestic market standards. Developed countries should conform to such green market standards when exporting products or investing in China and setting up factories, otherwise, the products should not be allowed to enter any link in the supply chain. Such market constraints sometimes are more effective than policy constraints.

The Chinese Government has already implemented a series of “green trade policies” and thus played a positive role in promoting green supply chain development in China, mainly reflected in:

1) Development of environmental certification standards in accordance with international standards to build a green line of defense

It is inevitable to transform traditional manufacturing into green manufacturing. As green trade barriers increase around the world, a number of countries prevent the access of foreign products into the domestic market through legislative and other measures under the pretext of environmental protection, in the hope of protecting domestic enterprises. It is in essence trade protectionism dressed in “environmental protection and low-carbon development”. To this end, China further enhances its environmental standards and develops low carbon certification standards, and initially sets up its own green line of defense through mutual recognition with developed countries.

2) Imposition of export tariffs on high-polluting industries

China began to impose export tariffs on 142 kinds of high-polluting, high-energy-consuming and resource-dependent products as of June 1, 2007 and abolished export tax rebate on 553 kinds of high-polluting, high-energy-consuming and resource-dependent products on July 1, 2007.

At present, China imposes export tariffs and export tax rebate on high-polluting, high-energy-consuming and resource-dependent products, including some energy products such as coal, coke, crude oil and refined oil, steel products like crude steel and iron alloy, non-ferrous metals and rare earth metals like aluminum and copper. Implementation of such policies has achieved initial results in reducing exports of these products, adjusting the domestic industrial structure and cutting down resource

and energy consumption. However, a number of high-polluting products have not yet been covered. In addition, China adjusted its export policy in the second half of 2008 with the outbreak and spread of international financial crisis. It raised export tax rebate rate for consecutive 7 times, lowered down the premium rate of export credit insurance, and adjusted the directory of commodities prohibited from processing trade. These policies not only effectively relieve China's international trade friction, but also turn green supply chain development to be an important option for enterprises to enhance competitiveness.

4.1.2 Corporate green supply chain practices

(1) Multinationals play a promoting role in the initial development of green supply chain in China

Multinationals play a positive role in guiding the implementation of the green supply chain system in China. To meet the parent company's requirements or respond to the needs of business globalization, such companies take the lead in green supply chain practice in China and gradually extend it to the upstream suppliers. A number of foreign invested enterprises or joint ventures have set green requirements for their suppliers, such as IBM, Dell, HP, Sharp, Sony, Samsung, Motorola, Ricoh, Shanghai GM and Wal-Mart (see table 4.3).

Table 4.3 Practices of green supply chain in some foreign invested enterprises and joint ventures

No.	Company Name	Green supply chain Practices
1	IBM	1) Obtain the certification of ISO 140001 system; 2) Pay attention to the hazardous substances in products; 3) Batteries and plastic products meet the relevant requirements of the WEEE Directive
2	DELL	1) Obtain the certification of ISO 14001 system and EPEAT; 2) Control hazardous substances in the products; 3) Seek to comply with the green regulations around the world, such as that of China and the states in the U.S.
3	HP	1) Obtain the certification of ISO 14001 system; 2) Control hazardous substances in the products; 3) Provide supplier CSR (corporate social responsibility) and environmental regulations; 4) Provide environmental reports in accordance with European Recycling Platform (ERP).
4	SHARP	1) Obtain the certification of ISO 14001 system; 2) Control hazardous substances in accordance with RoHS.
5	SONY	1) Obtain the certification of ISO 14001 system;

		<p>2) Provide the medium and long-term plan for annual Green Management;</p> <p>3) Control hazardous substances in accordance with RoHS.</p>
6	SAMSUNG	<p>1) Obtain the certification of ISO 14001 system;</p> <p>2) Provide environmental reports to support the “Samsung Eco-Partner”;</p> <p>3) Control hazardous substances in accordance with environmental management operating standards OQA-2049.</p>
7	MOTOROLA	<p>1) Obtain the certification of ISO 14001 system;</p> <p>2) Control hazardous substances in accordance with 12G02897W18 Motorola Specification <i>Controlled and Reportable Materials Disclosure</i>.</p>
8	RICOH	<p>1) Obtain the certification of ISO 14001 system;</p> <p>2) Provide test report or related statement on controlled materials;</p> <p>3) Provide environmental design criteria.</p>
9	Shanghai GM	<p>Green suppliers should improve by 5-10% in each of the 5 aspects: 1) energy consumption; 2) water consumption; 3) waste emissions; 4) greenhouse gases; 5) non-greenhouse gas pollution, or make an overall improvement of 5-10%.</p>
10	Wal-Mart	<p>Wal-Mart's global procurement center promotes green supply chain, but still at a preliminary experimental stage.</p> <p>1) Pay attention to the hazardous substances of products, but also the operation of environmental management system in suppliers;</p> <p>2) Develop encouraging policies targeted at energy use and management of suppliers;</p> <p>3) Pay attention to suppliers’ waste management, discharge of waste water, waste gas and waste residues, and hazardous materials management;</p> <p>4) Pay attention to energy consumption and GHG emissions;</p> <p>5) Pay attention to water consumption and monitoring.</p>

At present, most multinationals implementing green supply chain in China raise requirements on suppliers’ environmental compliance. For example, suppliers are required to pass the certification of ISO14001 environmental management system. According to the characteristics of their own products, as well as product-related requirements in international laws and regulations, some manufacturers also put forward requirements on the hazardous substances in raw materials and components, design and recycling. In general, different types of enterprises have different priorities in green supply chain implementation. For example, manufacturing enterprises pay more attention to green design, green production and green logistics, while retail

enterprises are more likely to consider green logistics and green supply.

It can be said that, green supply chains cannot take root and sprout in China without the contribution of excellent multinationals. Such enterprises promote green transformation in accordance with the actual situation in China in the initial phase of supply chain development.

Box 4. Case study -- Shanghai General Motors and Wal-Mart

To further understand the status quo of green supply chain practice among multinationals in China, the research team conducts an investigation to Shanghai General Motors (Shanghai GM) and Wal-Mart Global Sourcing.

1. Shanghai GM: Shanghai GM launched the green supply chain program in 2005. Only 8 suppliers participated at first and up to now hundreds of its suppliers have joined in. In 2008, Shanghai GM confirmed a total of 131 green projects by its suppliers. It helps save a total of more than 17 million kWh of power, more than 550,000 metric tons of water conservation, and cut natural gas consumption and waste gas emissions by nearly 1.4 million m³ and 4.34 million metric tons respectively. In this way, the total benefits generated from energy saving and emission reduction amount to 45.76 million *Yuan*. Shanghai GM announced its “Green Future” strategy (2011-2015) in 2010 to support green supply chain development in the aspect of green product, green system and corporate responsibility.
2. Wal-Mart: Wal-Mart Global Sourcing Office located in Shenzhen has promoted the green supply chain program with Chinese suppliers since 2008. The program specifically focuses on the operation of environmental management system in its suppliers, encourages them to save energy and operate energy-saving management system. Also, the program covers solid waste management and hazardous waste management of the suppliers, energy consumption and GHG emissions, and monitors the water consumption. Currently, hundreds of Wal-Mart suppliers have participated in the program, mainly from the angle of energy efficiency, and the evaluation of results is undertaken by third-party energy assessment agencies. According to the reports of 125 factories involved in green supply chain program, measures taken have improved the environmental performance by 20% by the end of the first quarter of 2011, in a comparison of that in 2007, 2008 and 2009. Specifically, a total of 4.04 million kWh of electricity has been saved, equivalent to a reduction of 347,000 metric tons of carbon dioxide. To encourage more suppliers to take actions, Wal-Mart also organizes outstanding green supplier appraisal periodically.

(2) The practices of China-invested companies

In the face of rising green consumption trends, increasing numbers of domestic enterprises in China are beginning to attach importance to green competitiveness. In terms of the implementation of green supply chains, domestic enterprises are evidently polarized in their performance. On the one hand, large and medium-sized enterprises, especially state-owned enterprises, promote green supply chain practices in China, whether actively or passively. However, the other pole is represented by many SMEs, which often are unable to carry out professional transformation, or technology R&D. Due to their thin profit margins and limited financial resources, it is impossible for them to implement green supply chains. This reflects the reality of China's industrial development at present.

Box 5. Initial results of green supply chain implementation among Chinese enterprises

- Haier Group has long been committed to the R&D of eco-friendly energy-saving products and active in the introduction of green supply chain. Its subsidiary Haier Refrigerator Co., Ltd. is the first Chinese company to pass ISO14001 system when it obtained the certification on May 30, 1996.
- Guangdong Donglin Kitchen Group Co. Ltd. called for its suppliers to actively participate in UL toxic and hazardous substances control solutions in May 2005 so as to meet the EU RoHS Directive to establish a green supply chain mechanism, making its products meet the requirements of EU Directive.
- Skyworth Group convened more than 500 suppliers in Shenzhen in August 2005 in response to two EU environmental directives, i.e. WEEE and RoHS (Waste Electrical and Electronic Equipment and Restriction of the Use of Certain Hazardous Substance in EEE). They signed the green supply chain agreement to gradually implement the "zero lead" project, marking a step to "green production" of Skyworth products.

(3) The dilemma of current environmental regulations and corporate supply chain management

Corporate green supply chain management has just started in China, so the corresponding domestic legislation is not perfect now. As there is no explicit specification and regulations on corporate green supply chain, enterprises are not subject to clear regulatory constraints of green supply chain management. Green issues of whether multinationals in China or China-invested enterprises stay more at

the level of market practice, and are not elevated to a strategic level of enterprise-wide operations.

Generally speaking, China's green supply chain policies has not yet been in place and the supervision and regulation of the supply chain system is also absent, causing frequent pollution problems in the supply chain in recent years. For instance, “Sanlu poisonous milk powder” incident seems to be an issue of food quality inspection, but it is the opaque supply chain operation that gives rise to many fatal flaws undermining the safety, such as quality inspection technologies and management, the threshold to become an supply chain member, credit monitoring and quality operation standards of members. If green supply chain is fully implemented in the entire dairy industry, such tragedy will not happen. In the following case, we will better explain the dilemma facing Chinese enterprises in green supply chain implementation.

Box 6. Social Focus -- Dilemma of green supply chain in China with the Apple case

A series of heavy metal pollution incidents have broke out in China since 2009, with thousands of residents poisoned. A detailed investigation reveals that all these pollution incidents are directly related to the supply chain management of IT enterprises¹⁷.

A number of environmental organizations jointly publicized a report on August 31, 2011, accusing the Apple Inc. for ignoring the environmental pollution caused by its suppliers and reaping super-normal profits at the expense of local environment and local residents' interests. Entitled *The Other Side of Apple Inc. (II)*, the report includes the results of field investigations conducted by its authors at over a dozen of suppliers of Apple Inc. such as Meiko Electronics and Kaida Electronics. According to the report, the production procedures of Apple's suppliers in China generate various pollutants, such as wastewater containing heavy metals and cyanide, tin smoke and lead smoke. Currently, a number of suspected Apple suppliers have become the target of complaints in local communities, with over a dozen of cases of environmental pollution being investigated¹⁸.

February 15, 2011, Apple Inc. released the 2010 report on supplier responsibility and publicly acknowledged that 137 employees of its Chinese suppliers had adverse health effects due to improper use of chemicals.

Apple Inc. communicated with the research team of this CCICED report and states that less than 50% of the listed suppliers in the NGO's report are actual Apple

¹⁷ The report of heavy metal pollution investigation in IT industry (the 3rd edition), Retrieved at <http://www.ipe.org.cn/about/report.aspx>

¹⁸ www.people.com.cn, Escalation of the Apple Pollution Incident, August 31, 2011.

suppliers. Apple Inc. reports that Apple has a robust supplier responsibility program that all of its suppliers are contractually required to adhere to and Apple requires facilities to identify and manage substances that pose a hazard to the environment and comply with applicable laws and regulations. According to Apple, Apple is in communication with those NGOs and is using expert third party auditors to audit those Apple suppliers identified in the report and intend to work intensively with those suppliers to ensure compliance and the highest standards of environmental protections.

From a simple point of view, Apple itself has not violated Chinese environmental laws and regulations and thus it is impossible to hold the company accountable for any harm done. However, these allegations of poor worker safety and environmental pollution in Apples' supply chain have severely tarnished the company's image in China.

To avoid reputational risks and to allow for appropriate accountability throughout the international supply chain, a green supply chain program in China that includes legal accountability as well as systems for supervision and management of environmental and occupational safety laws should be developed as soon as possible.

(4) Green trade forces Chinese enterprises to gradually attach importance to green supply chain management and promote trade transformation and upgrading

As the productivity level and the stage of development vary in different countries, environmental standards also differ from country to country, which leads to cost differences in the internalization of environmental costs and thus imposes a direct impact on production costs directly related to the international competitiveness of products.

American and European countries have higher efficiency of social productivity and environmental management capacity than China after long-term economic development. In these countries, the development and implementation of strict environmental standards play a positive role in enhancing the competitiveness of their products in the market. However, most Chinese enterprises regard environmental costs as "burden". With the further development of global economic integration, especially with the extensive integration of economic and environmental issues, environmental concerns are often used by developed countries as an international trade "barrier" which continues to impact on China's export.

Trade barriers in terms of environmental protection, force to raise environmental standards and improve environmental policies in developing countries like China and make their enterprises accept green requirements and comply with higher

environmental standards. It can be said that, international trade-related environmental standards compel Chinese exporting companies to implement green supply chain management, driver the transformation from the demand side and take actions to technological innovation, and further to promote China's trade transformation and upgrading.

Box 7. Case Study -- Green supply chain management elevates the international competitiveness of Chinese apparel enterprises

China is a large apparel manufacturer and exporter in the world. Chinese export-oriented apparel companies are the first to involve in the green supply chain and start the international journey of green trade.

1. Green bans block the Chinese clothing in the EU

Ever since the promulgation and implementation of new EU environmental standards in the apparel industry, especially *Commission Decision Establishing the Ecological Criteria for the Award of the Community Eco-Label to Textile Products and Amending Decision 1999/178/EC-Text with EEA Relevance* and *European Ban on Certain Azo Dyes* issued in May and July of 2002, China's apparel industry exports have been blocked. According to the United Nations Conference on Trade Development statistics, clothing exports from China to the EU valuing 7.4 billion dollars have been blocked in 2001 and 2002 each because they failed to meet environmental requirements.

2. Green supply chain management is kicked off under pressure

In response to the green trade challenges from major export markets, Guangdong Esquel Textile Co., Ltd., a Hong Kong-invested enterprise located in Foshan of Guangdong and one of the leading enterprises in China's textile industry, is forced to adopt green supply chain management and lead relevant upstream enterprises, and has achieved significant results.

3. Green standards transfer demand to upstream enterprises

Nantong YiYi Group, as a supplier of Esquel, was identified as a “red enterprise (bad)” by Nantong environmental protection department in 2007. Its downstream customer Guangdong Esquel Textile Co., Ltd. discovered this gig and immediately called for its rectification.

4. New products are developed to achieve green production

Recognizing it is not economically viable to expand the expensive end-treatment

facilities for products with heavy pollution and low added value, under the pressure of environmental compliance requirements of the Esquel Group, Nantong YiYi Group decided to adopt the suggestions of auditing companies and metering departments and began to develop less water consuming and polluting products to replace old heavy-polluting products. After the production of such new products, YiYi introduced water recycling in the process to reduction energy consumption and costs. Upgrading coupled with water recycling has increased the unit water efficiency by more than one third and drastically cut down COD emissions. In this way, the company made to achieve the COD reduction target stipulated by the government and consequently obtained the ISO14000 certification.

Nantong YiYi Group has also accomplished impressive results in environmental benefits. It reduces the emissions of COD in wastewater and discharges emissions in accordance with regulations. It also cuts down the average water consumption per 10,000 meters fabric production by one third through technical transformation and thus effectively reduces the water consumption. Thanks to water recycling, it can save about 400 metric tons of coal, greatly reducing energy consumption.

5. Environmental governance improves overall economic efficiency

Despite a rise of 1.40 million *Yuan* in environmental transformation investment, Nantong YiYi Group was rewarded 430,000 *Yuan* by Nantong Government and the Hong Kong Government in recognition of its improvements in environmental protection to realize substantial energy savings and obtain the ISO14000 certification. (Nantong government provided an emission reduction bonus of 400,000 *Yuan* while the Hong Kong Government granted a special incentive of 30,000 *Yuan* for the industrial upgrading of companies in Mainland China.) Such an incentive partially offsets the investment in pollution control. Meanwhile, the company has estimated that, it can save annually 120,000 *Yuan* in water fee and 300,000 *Yuan* in energy costs through technological innovation, and thus recover the full pollution control costs in three years. Moreover, new eco-friendly products also help consolidate the relationship between businesses and customers, and keep the status as a supplier.

Guangdong Esquel Textile Co., Ltd. implements green supply chain management to the suppliers on the one hand, and makes efforts to save energy and reduce emission on the other, such as introducing energy saving equipment, improving technologies, reducing consumption, recycling. As a result, it can reduce 600 metric tons of sulfur dioxide emissions and save water, steam and electricity for up to 80% or 600,000 m³, 12,000 tons and 70% respectively. More importantly, through green supply chain, Guangdong Esquel Textile Co., Ltd. improves the international competitiveness of its products in the world market.

4.1.3 China's green consumer market and green supply chain management development

The observation that “China has limited capacity of green consumption and the Chinese consumers do not know green products” is the biggest misunderstanding of the Chinese market. TÜV SÜD Asia Pacific Limited conducted a green market research initiative in China, India and Singapore in 2010. The company compared the attitude towards green products, services, policies and certification of consumers and businesses. Several sectors (appliances, food and beverage, footwear and apparel) were examined. Its official survey report released in January 2011 shows that, compared with India and Singapore, China has paid the most attention to and demand of “green” products.

94% of the Chinese urban consumers surveyed are willing to pay additional costs for clearly proven “green” products and services. However, only 60% of the Chinese companies think that consumers would like to spend more for “green” products. In the survey, 59% of the enterprises in the three major sectors have already produced or sell “green” products in the international trade, but they still fail to properly assess the urgency of the green demand among urban consumers. Appropriate rules or guidelines to minimize the environmental impacts are still lack in most companies.

To sum up, the green consumer market has taken its initial shape in China, with tremendous progress in market consumer desire and spending power. The green consumer market has become the basis for green supply chain development. Traditional supply chains have had difficulties in meeting “the desire for green” in the consumer market. Many Chinese enterprises have not yet realized the point, and squander away opportunities by comparison with transnational corporations.

Box 8. Awareness of “green” certification: Chinese enterprises lag behind consumers

A TÜV SÜD Asia Pacific Ltd. survey finds that, 94% of the Chinese urban consumers believe that a “green” certification issued by an independent body is "important" in their decision to buy which product. Such standard is even more important than price in their purchasing decisions. However, what is surprising is that, only one third of enterprises recognize such standard, despite that the proportion exceeds 50% among Chinese urban consumers.

4.1.4 Enhanced public environmental awareness pushes ahead green supply chain development in China

The consumer is one of the significant driving forces determining whether green products thrive or not, and to what extent. Increasing public attention to environmental issues will press the government and industry to improve green standards and norms. After a series of environmental and human health hazard events, such as “heavy metal pollution, soil pollution, water pollution”, the public environmental awareness of the Chinese consumers has been significantly enhanced.

According to the TÜV SÜD Asia Pacific Ltd. survey, about 50% of urban consumers think actions should be taken at the individual level but rely on the collective public power for a final solution, while 75% of the businesses said the government should introduce explicit initiatives to promote sustainable development and corporate social responsibility. The majority of businesses pointed out that industrial and government regulations are the main reasons behind their enforcement of social responsibility and sustainable development criteria.

As the mainstay of the market and the endpoint and target of industrial supply chains, the consumer determines the “survival” of the market and individual businesses. With the awakening of consumers’ green consumption awareness, green supply chain management has been endowed with the fertile soil for rapid development.

4.2 Problems and challenges in China’s green supply chain management development

Greening supply chain is important for China’s green transformation. Although there are some beneficial conditions in place for developing green supply chain in China, the lack of government policies, absence of industrial guidance and corporate strategy on green supply chain, pre-mature market of green consumption and public awareness, and long-way-to-go green trade transformation greatly challenges the development of green supply chain in China.

4.2.1 Lack of government guidance and the absence of a clear green supply chain management system

(1) Incomplete play to the role of policy regulator, supervisor and promoter hinders market-oriented green development in China

Although a variety of laws and regulations incorporating green supply chain have been rolled out in China, such as *Energy Conservation Law*, *Renewable Energy Law (Amendment)*, *Cleaner Production Promotion Law*, *Environmental Impact Assessment Law* and *Circular Economy Promotion Law*, as well as *Directory of Listed Companies*

Subjective to Environmental Inspection by Sector, Opinions on the Implementation of Environmental Policies and Regulations to Prevent Credit Risk and Guideline for the Preparation of Corporate Environmental Reports, green supply chain development faces great difficulties due to the absence of targeted laws, regulations, policies and specific industry certification standards. In a comparison with developed countries, not only did economic incentives and innovative mechanisms relate to green supply chain development, but also appropriate monitoring and punishment mechanisms have not in place in China to give full play the role of policy regulator, supervisor and promoter.

(2) Lack of continuity and enforceability in government green procurement to fully play the leading role of the consumption power by government

China's government green procurement policies lack continuity and the goals need to be further clarified. *Government Procurement Law* currently implemented stipulates that, government procurement should contribute to the accomplishment of the objectives in national economic and social policies, including environmental protection. In October 2006, MOF and MEP jointly issued *Implementation Opinions on Government Procurement of Environmental Labeling Products* and require that "state organs, public institutions and organizations at all levels give priority to environmental labeling products in the procurement with financial fund and not purchase products harmful to the environment and human health." In comparison, developed countries such as the U.S. and EU have the explicitly legislations on government procurement of ecological, environment-friendly products and services. In particular, the U.S. even adopts the regulation that products designated by U.S. Environmental Protection Agency should be prioritized in accordance with procedures when the purchases exceed 10,000 dollars. Comparatively speaking, the role of the Chinese Government in leading terminal green consumption is rather weak, and the mandatory feature of government procurement of environment friendly products is not highlighted.

4.2.2 Lack of industry guidance and corporate strategy in green supply chain development

In general, the concept of green supply chain is still very new to many Chinese enterprises, especially the SMEs, and green supply chain management is still in its infancy in China. Due to the absence of explicit government regulations and policies, a number of enterprises have encountered obstacles in technical and financial support in the early stage of green supply chain management. Challenges facing corporate green supply chain management are specified as follows:

- **How to make enterprises take voluntary actions on green supply chain management?** Although some Chinese brand companies with significant market share and economic strategic vision have started green supply chain management

and achieved market success, most SMEs have financial difficulties in taking similar actions. Usually, enterprises pay far less costs for pollution behaviors than taking voluntary actions on green supply chain management when environmental standards are not strictly enforced. Therefore, enterprises, regarding maximizing profits as the highest goal, only take actions on pollution reduction when laws and regulations are strictly enforced. To this end, it is urgent to address the issue of how to further strengthen government guidance and market participation and better enable enterprises to voluntarily participate in the green supply chain management through incentive-based policy tools.

- Corporate partnerships on environmental protection between the upstream and downstream enterprises need to be improved. When taking actions on green supply chain management, most Chinese enterprises only focus on their internal environmental management system instead of working with their suppliers, let alone providing market incentives for suppliers to cooperate on environmental protection.

4.2.3 Great divergence in the understanding of the maturity of China's green consumer market between businesses and the public

A well-developed green supply chain management system needs a well-developed market of green consumption. Generally, the government and enterprises consider that green consumption market does not exist in China. However, in fact, due to the influences of environmental problems and social evolution, China has ushered in an era of rapid development of green consumption market and witnessed a growing public awareness of environmental protection.

Due to different judgments of green consumption market, the government, businesses and the public have enforced diverse consumption policies, which are partly contributed to the tardy development of green consumption market and sluggish green supply chain management development in China.

4.2.4 Green consumption needs to be fully developed

At present, the ordinary consumers in China have not yet fully understood the concept of green consumption, and the concept of environmental right-to-know is far from being popular. Most consumers are only satisfied with the pursuit of "green" and "safe" products, and do not pay enough attention to the environmental impacts of the products through the life cycle such as transportation in the supply chain system. As a result, it is difficult to put enough consumption pressure from the public on enterprises to take the change on environmental protection in their supply chains.

4.2.5 Trade transition’s impetus to green supply chain management development remains to be seen

Environmental trade barriers impose a significant motivation for Chinese enterprises to take actions on the green supply chain management. Such enterprises are forced to improve their environmental standards and implement green supply chain management so that they can achieve green production, green processing, green storage, green transportation, green sale and recycling, with a complete pollution-free environment management system. In order to meet the environmental standards of importing countries, environmental inspection and certification have to be conducted in the various links of the supply chain to satisfy international trade requirements.

However, most Chinese SMEs are at the low end of supply chain and are lack of independent innovation together with the problem of unaffordable costs for technical upgrades; therefore it is difficult for them to achieve green transformation in the short term. How to achieve a win-win development in domestic industrial upgrading and international trade transformation through the adoption of green supply chain management is worthy serious attention.

Achievements in green supply chain development and problems facing China are as shown in Table 4.4.

Table 4.4 Status quo and challenges of green supply chain development in China

Elements	Effectiveness	Challenges
Government guidance	<ul style="list-style-type: none"> • Relevant environmental laws, regulations and policies provide a legal and policy basis for green supply chain development. • Actions such as energy saving, emission reduction, and shutting down small polluting and energy-consuming businesses create a good social environment for green supply chain. • Government green procurement achieves some success 	<ul style="list-style-type: none"> • Lack of laws, regulations, policies and industry certification standards directed at green supply chain • Lack of environmental economic instruments to guide green supply chain development, such as supplier environmental audit and full environmental cost calculation module. • Lack of social awareness and government guidance in terminal green consumption. Green procurement in government procurement needs to be strengthened. • Lack of economic incentives and institutional innovation mechanism for green supply chain development

Corporate practice	<ul style="list-style-type: none"> Practice and promotion of multinational corporations in China (Wal-Mart and GM) New understanding and attempts of Chinese large and medium enterprises 	<ul style="list-style-type: none"> Corporate environmental awareness needs enhancement and the favorable situation for scale development and rapid advance has not yet taken shape Global statistical standards for international business needs enhancement (consistency of corporate social responsibility at home and abroad) How to promote the major transition of Chinese enterprises, especially SMEs (passive participation and natural selection)
Market services and evaluation	<ul style="list-style-type: none"> Market phase-out of some polluting enterprises Voting of environmentally unfriendly companies by foot Gradual formation of market service function (consulting service organizations) 	<ul style="list-style-type: none"> Lack of market services (third-party certification, consulting services of related organizations) Lack of basic data investigation and support Green consumer market requires long-term nurture
Public oversight	<ul style="list-style-type: none"> Enhanced public environmental awareness Direct effects of green consumption 	<ul style="list-style-type: none"> Public environmental awareness has yet to be improved and environmental right-to-know implemented How to upgrade the capacity of public green consumption in consideration of economic and cost factors

5. THE BASIC PRINCIPLES FOR CHINA TO SET UP THE GREEN SUPPLY CHAIN POLICIES¹⁹

5.1 China's green supply chain system should be designed in line with the goal of green transformation

At present, China lies in a critical transition period of economic growth. During the period of the 12th Five-Year Plan, China is expected to achieve economic restructuring, stimulating domestic consumption, further implementation of the development of low-carbon economy, and to take the innovative path of green transformation. Most Chinese enterprises will confront more stringent emissions reduction requirements. As an advanced enterprise management concept, green supply chain is a beneficial strategy for sustainable socio-economic development. As the microscopic main body implementing green supply chain management, enterprises will no doubt play a key role in boosting green economic transformation in China.

Therefore, the system must be designed in consistent with the goal of China's current green transformation. Only in this way, can a variety of supporting policies be put in practice, the strategic values of green transition at microscopic level be realized through green supply chain.

5.2 Importance should be attached to the balance between environment and economic interests when designing green supply chain system

Although green supply chain differs from traditional supply chain, amid its management system design, it should give full play to the role of market tools, improving management efficiency as much as possible through technical upgrading; it should unceasingly pursue green supply chain through macro-control policies, strengthen coordination between the links and other means; and it should avoid blind emphasis on environmental protection and ignoring corporate environmental costs. The management system must be ultimately designed for the green industry chain, achieving environmental objectives while ensuring corporate healthy, profitable and stable development.

5.3 A combination of top-down and bottom-up approaches should be adopted as a design principle for green supply chain system

The design approach consists of top-down and bottom-up methods. Top-down approach goes from the global and local, while bottom-up approach actually quite the opposite; the former is a process of system decomposition, while the latter is a process of integration. When building up the green supply chain system, the top-down and bottom-up integration and the role of government and enterprises are needed.

¹⁹ Authors for chapter 5: Zhou Guomei, Li Xia.

Green supply chain should be a corporate behavior under governmental supervision. Explicit green policies can help minimize the uncertainty of corporate strategic transformation, so that enterprises are willing to make changes with lowest policy risks.

5.4 Performance appraisal system of green supply chain system should be designed in line with the “MRV” principle

The fundamentals of green supply chain management are partnerships and information sharing between companies, improve product quality, lower production costs, curtail production cycle, improve supply chain responsiveness and flexibility, raise responsiveness to customer needs, and ultimately enhancing market competitiveness of the entire supply chain, while promoting improved environmental performance. To achieve above goals of green supply chain management and evaluate the effectiveness, a performance appraisal system is necessary and urgent. In course of establishing the evaluation system, it is necessary to adhere to the principle of “measurable, reportable and verifiable” (MRV). And the information could be disclosed to stakeholders. If necessary, the performance can be verified, and enterprises should ensure that the performance report is true and effective.

5.5 The design green supply chain management system should be exercisable

Given that green supply chain is a complicated systematic project, operability should be considered during the process of green supply chain system design taking into consideration of different situations of industries and regions. A “one size fit all” approach will discourage enterprises take actions on green supply chain management. Therefore, the design should follow the guiding principle of distinguishing between different sectors and regions, adequately considering the development situation of different sectors and regions. While coordinating with implementation of energy-saving and emissions reduction targets, aiming to cut down on costs, improve environmental effectiveness and increase profits, it is necessary to design a scientific and rational corporate green supply chain system.

The developed countries have an early start in green supply chain management. Many multinational enterprises have integrated international green supply chain concepts with their business management concepts, made great achievements, and accumulated rich experience, which is worthy of the in-depth research in the process of green supply chain management system design in China.

5.6 Principle of gradual improvement should be adopted in green supply chain system design

To launch green supply chain in a massive manner with sufficient evaluation may lead to policy failure. Therefore, the combination efforts of government, enterprise, market

and the public are necessary and a gradual improvement model should be followed to provide guidance and training for governments at all levels, enterprise and the public. Specifically, planning should be all-inclusive, demonstration should be included, and phase-based benefits should be evaluated.

6. MAIN CONCLUSIONS AND POLICY RECOMMENDATIONS²⁰

Greening supply chains is important for China's green transformation. Although there are some beneficial conditions in place for developing green supply chain development in China, the lack of government policies, absence of industrial guidance and corporate strategy on green supply chain, the situation of an immature market of green consumption and public awareness, and long-way-to-go green trade transformation greatly challenges the development of green supply chains in China. Below are the main conclusions arising from the study and key policy recommendations.

6.1 Main conclusions

- (1) Pressure from the international market and monitoring of domestic environment pressures will support Chinese enterprises to participate in green supply chain management.** As China is facing growing pressures from its economic transformation and international trade, the establishment of a green supply chain program would be consistent with the goals of green economic development and sustainable development of China's economy in the future.
- (2) Though China's green supply chain is in an initial stage, the policy and market will provide support for its establishment.** Most of China's laws and regulations on environment and resources overlap with those concerning green supply chain, and governments have the ability to play roles as regulator, driver and monitor. Meanwhile, as green consumption patterns grow, they will also provide support for the establishment of green supply chain.
- (3) Practices of green supply chain for enterprises tend to be spontaneous and voluntary in light of the lack of guidance by laws and regulations and policies.** Though China has no specific laws and regulations and policies relevant to green supply chain, both transnational enterprises and leading Chinese enterprises have a strong interest in China's green supply chain implementation. At present, some transnational enterprises have introduced green supply chain concepts to China while Chinese state-owned enterprises and private sectors are likely to participate in this initiative. However, these are individual instances, and pollution and resource over-use are still occurring in practice due to the inconsistent application and environment of environmental standards.
- (4) The government, enterprise, the market and the public all interact with one another in an integrated green supply chain program.**
The government can develop policies and programs that mandate and reward green supply chain management; enterprises will carry out the green supply chain management practices; market forces will monitor implementation of green supply chain by bringing more business and reputational benefits to those

²⁰ Authors for chapter 5: Zhou Guomei, Li Xia.

enterprises that participate, and the general public will reinforce green supply chain success through consumer loyalty to those enterprises and products that reflect green supply chain management.

6.2 Policy recommendations

China's green supply chain has just been initiated. The government and enterprises are gradually accepting the idea that enterprises should be guided by "green" concept systems in an integrated way so as to achieve a green transformation of the market. Green supply chain, which serves as a tool to address environmental problems through a market mechanism, will not only complement and complete China's current environmental management system, but also effectively intensify environmental management by enterprises.

6.2.1 The guiding and regulating role of government should be emphasized to establish and complete China's laws and regulations and standards concerning green supply chain.

The full implementation of green supply chain requires the government's decision-making; only when the government's policies for encouragement, coordination and investment are matched can green supply chain be promoted.

(1) The government should play a leading role in the green supply chain system, and develop *Green supply chain Management Regulation and Industry Evaluation Standard on Green supply chain*. It also should develop its green supply chain certification in combination with the existing environmental certification system.

It is recommended that the Ministry of Environmental Protection should take the leading role, while Ministry of Finance, Ministry of Commerce, National Development and Reform Commission, China Banking Regulatory Commission, China Securities Regulatory Commission and other government departments offer collaboration. In this way, a *Policy Guideline for Green supply chains in China* should be introduced, helping enterprises realize the goals of sustainable operation and green supply chain starting from complying with regulations, reducing commissions to carrying out low-carbon and green development. Additionally, in adapting to the policy guideline, *Industry Standards and Procedures for Green supply chains* for different industries should be developed. Meanwhile, combining with the existing environmental certification system, green supply chain certification also should be developed so as to ensure the green supply chain can be standardized, operational, monitored, legitimate, and evidence-based.

The government should adopt product stewardship programs for key consumer and industrial products. These programs should be designed to minimize the end-of-life

impacts of key products and to encourage reuse and recycling by requiring manufacturers to take back, recycle or properly dispose of those products. Product categories to be addressed in the stewardship programs should include: consumer electronics, batteries, paint, tires, carpet, mercury-containing products (like thermostats and fluorescent lights), bottles and Cans.

The programs would be designed to share responsibility among government, manufacturers and consumers of products as follows:

- Government will establish goals and timelines for recovery and recycling of each product category, and will launch programs to educate consumers and manufacturers on the aims and requirements of the stewardship programs.
- Manufacturers will be individually responsible for meeting their market share of specified recovery and recycling goals, but will be allowed flexibility for how the goals are met. For example, manufacturers may join a collective system for managing end-of-life products, or may establish a third party organization to meet the program requirements.
- Consumers will participate by bringing appropriate products to designated collections sites at their end of life. Consumers will not be expected to pay for product collection (although compliance costs can be passed along through product pricing).

Each product stewardship program would have enforcement provisions that allow for daily monetary penalties should any manufacturer not have a plan in place to meet program goals within a set period after program commencement, and should any manufacturer not meet the performance goals and timeline outlined in their own compliance plan.

The government should consider adopting a joint Extended Producer Liability law under which all links in the supply chain could be considered liable for violations of environmental and health laws, contamination or misuse of property, or damages to health and public resources. Consistent with Chinese practices for environmental enforcement and for civil liability, an Extended Producer Liability law would extend responsibility to all of the following:

- The current owner or operator of the facility immediately responsible for the violation or damage;
- The owner or operator of the facility at the time the violation occurred or the damage was first initiated; and the purchaser of the products or services whose production contributed to the violation or damage incurred.

(2) The economic policy should be combined with green supply chain, thus effectively changing the market behaviors of suppliers from market-oriented to green-based.

- 1) Provide enterprise participating in green supply chain with favorable taxation measures and green loan support. Support the green supply chain market through guidance of economic means. Through the introduction of green tax incentives,

green subsidies and other policies, the enterprises should be guided with regards to production and operation, and be encouraged to improve efficiency and increase investment in environmental improvement, thereby contributing to the sustainable development of the supply chain.

- 2) Establish voluntary projects of green supply chain to encourage enterprises to participate in such projects. The government can sign voluntary agreements of green supply chain with enterprises, and effectively realize the implementation of green supply chain.
- 3) Require listed enterprises to disclose information about the environmental impacts from all aspects of their supply chain operations through verification measures on listed enterprises. The government should develop a list of the most harmful toxic substances and require enterprises to report publicly on their annual emissions of those substances. Enterprises should be encouraged to publish, on a regular basis, sustainability development reports and corporate social responsibility reports for the production chain.
- 4) Carry out demonstration projects by building green supply chain system in Eco-industrial zone. At present, the construction of China's Eco-industrial zone coincides with green supply chain, thus it can be the location for demonstration practice.
- 5) Improve performance standards and industry technical standards to meet international level. Enterprises should be encouraged to promote technological innovation, stimulate green transformation, and gradually establish performance standards and industry technical standards. In this way, the green supply chain in enterprises can be strengthened to provide support for the successful completion of emissions reduction targets during the Twelfth Five-Year Plan.

(3) The government should play leading and exemplary roles, and intensify green public procurement policies.

Government should focus on the integration of green public procurement plan with the existing procurement policy, consider how to reduce the environmental impact of supply chains and reduce procurement costs. Specifically, the government can carry out green procurement policy through the following aspects, so as to enhance the effectiveness and impact of green supply chain in China:

- 1) Complete *Government Procurement Law* that requires all central and provincial procurement officials to assess and give preference to those products and services that are environmentally preferable.
- 2) Through the platform of government public procurement and giving priority to labeling product standard, the green product procurement indicators should be implemented and general principles and guidelines for government green procurement should be developed. On the platform of government public procurement and by the way of certification, green product procurement indicators should be set, so as to compulsorily promote enterprises entering into the public procurement platform to adopt green supply chain. Industries and products

exerting significant impacts on environment should take the lead in indicators and compulsory government procurement so as to give full play to the government procurement measures and enable the government procurement to play an important role in pollutants emission reduction, environment monitoring and green economic development.

- 3) Develop *General Principles on Government Green Procurement*, which should integrate government green procurement requirements and enterprises carrying green supply chain requirement, and specific requirements on initiators, management, procurement standard, evaluation and monitoring, and performance report. Green procurement guidelines should require that government goods and services are procured only from enterprises able to demonstrate current and consistent compliance with all relevant central and provincial environmental rules and guidelines, including policies and regulations to promote clean production, circular economy, and environmental labeling.
- 4) Establish standard database of government green procurement to provide a platform for information exchange on green products, offering green products information and technical services for suppliers, manufacturers, purchasers, and consumers.

(4) Green trade should be promoted with the supply of public services and research on performance evaluation of green trade.

The existing public service platform for foreign trade should be supplemented with contents of green trade, introducing the technical standards, laws and policies of major countries with regards to environmental protection and low-carbon development, and advanced experience of advanced green trade enterprises. The platform can also provide enterprises with technical training and management personnel for green trade.

In order to enhance the transparency of green trade, and make an objective evaluation on the economic and social benefits of green trade policies, a green trade policy performance evaluation system should be gradually established: to monitor the carbon dioxide emissions of import and export of goods in the whole process of production, from raw materials, manufacturing, contracting, transportation, storage, marketing, to waste recycling; to evaluate the positive results of enterprises which have adopted low-carbon technologies and management practices; and to assess the performance of China's government policies for trade green.

(5) Pilots should be considered to promoted green supply chain nation-wide

One effective way to promote green supply chain management system is to conduct pilots in certain regions first and then extend to the whole nation. The pilots should include the policy innovation and strengthened supervision from the government, activated market forces of certification and other public services, educating

consumers for green consumption and so on. With regard to the locations for conducting the pilots, regions like Tianjin Binhai New Area, Yangtze River Delta and Pearl River Delta with sound economic infrastructure and motivations for green transformation are recommended.

6.2.2 Practice in enterprises should be promoted to establish China's economic system of green supply chain.

(1) Through the model effect of green supply chain, “Star Enterprises for Green supply chain in China” should be cultivated, which can drive the overall development of green supply chain.

Further enthusiasm of enterprises for environmental protection can be created through honorary recognition awards, publicity and other forms, and enable enterprises to realize that the development of green supply chain can improve their core competitiveness. “Star Enterprises for Green supply chain in China” can be fostered through competition and industry consolidation, and these star enterprises can gain further market acceptance and public awareness through the “Green supply chain Certification System in China”.

(2) A “Green supply chain Network Platform” should be constructed to strengthen the cooperation among industries, enterprises, government, NGOs and other external institutions.

Through the establishment of “Green supply chain Network Platform”, Chinese enterprises on the green supply chain can further expand market reach, play the active role of the network platform, integrate market resources, promote the integration of upstream and downstream enterprises on green supply chain, and play the role of intensification and integration of the platform.

Establish standard database of government green procurement to provide a platform for information exchange on green products, offering green products information and technical services for suppliers, manufacturers, purchasers, and consumers.

(3) Green supply chain pilot programs should be carried out within enterprises to verify regulations and policies in practice. Green supply chain pilot programs are suggested among enterprises and follow MRV (measure, reportable and verifiable) principles. A third party is responsible for evaluating the initiatives in green supply chain.

6.2.3 Market forces should be activated to reinforce the service and regulation of the market.

(1) Industry associations should take the lead to establish a “Promotion Center for Green supply chain”, and undertake the functions of regulation for the Fund,

green certification, and advocacy organizations.

Cooperation among enterprises, governments, non-governmental organizations and industry should be promoted by giving full play to the functions of Promotion Center for Green supply chain. Such organizations can be firstly started in areas and locations with green supply chain basis like Tianjin Binhai New Area, Yangtze Delta and Pearl River Delta, so as to intensify the sustainable promotion of green supply chain.

(2) A Fund for the Development of Green supply chain by Enterprises should be set up in combination with Promotion Center for Green supply chain to provide economic incentives for enterprises carrying out green supply chain measures.

It is proposed that the government should take the lead to establish Foundation for the Development of Green supply chain, whose funding should come from government, enterprises, and social institutions. The Foundation can fully mobilize the enthusiasm of enterprises, especially SMEs, which can be encouraged to use more advanced environmental technologies and environmental management concepts, so as to promote a more comprehensive and balanced development for green supply chain in China.

6.2.4 Engagement of the public should be emphasized to create an enabling environment for China's green supply chain.

Consumer demand for responsibly produced products can provide a strong market incentive for enterprises to move toward green supply chain management, as can consumer anger toward those enterprises it believes have not acted responsibly.

(1) The concept of green supply chain should be continuously promoted, thus increasing public awareness.

Through the competition and recognition awards of “Star Enterprises for Green supply chain”, propaganda of green government procurement, green consumption into the community, and other social activities, the importance and urgency of environmental protection should be promoted in the whole society to awaken green philosophy and green consumption awareness among social organizations, so as to create a favorable public opinion and social environment for the implementation of green supply chain, to develop public awareness of green supply chain, and to foster “green consumption thinking” among the Chinese population.

(2) The public should be aware of the environmental performance of local enterprises.

Emissions reports, compliance records and information on specific enterprise and government procurement performance relative to GSCM policies and guidelines should be made easily accessible to the public through online publishing or local

dissemination. Through educational programs and community outreach, the public should be encouraged to review enterprise emissions data and CSR reports, as well as local government green procurement performance, and to engage local enterprise managers and government officials in improving GSCM practices.

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