



Project funded by European Union

**switchasia**  
POLICY SUPPORT



## Green supply chain in auto-part sector

ห่วงโซ่อุปทานสีเขียวในอุตสาหกรรมยานยนต์

วันที่ 4 มิถุนายน 2556 ณ โรงแรมโนโวเทลสยาม กรุงเทพฯ

ดร. เจตวิทย์ ภัคศรีพันธุ์

ผู้เชี่ยวชาญอาวุโสอุตสาหกรรมชิ้นส่วนยานยนต์

ภาควิชาวิศวกรรมเครื่องกล คณะวิศวกรรมศาสตร์ ม.เกษตรศาสตร์

ภายใต้โครงการส่งเสริมการผลิตและการบริโภคอย่างยั่งยืน ด้านนโยบายสนับสนุน ประเทศไทย

หน่วยงานดำเนินการ:



คณะที่ปรึกษา:



1



Project funded by European Union

**switchasia**  
POLICY SUPPORT



## Contents

- What is Green Supply Chain Management (GSCM)
- Green Supply Chain Management Principles
- Green Supply Chain Management Best Practices
- Implementing Best Practices
- Successful Case



2



Project funded by European Union



## Introduction

- Green supply chain management (GSCM) is gaining interest among practitioners of SCM
- Driven by the **escalating deterioration of the environment, diminishing raw material resources and overflowing waste sites.**
- The applications are beneficial to the organization's **environmental and financial performance**
- The GSCM initiatives are implemented through various Re's (Reduce, Re-use, Rework, Refurbish, Reclaim, Recycle, Remanufacture, Reverse logistics, etc.)



3



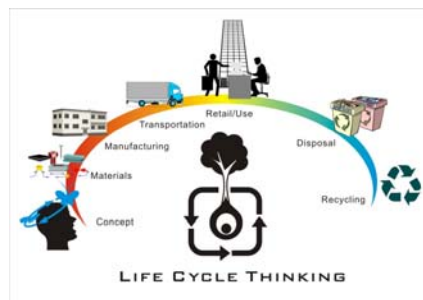
Project funded by European Union



## Green Supply Chain Management

An **integrating environment thinking into supply chain management**, including produce design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers, and end-of-life management of the product after its useful life.

(Srivastava, 2007)



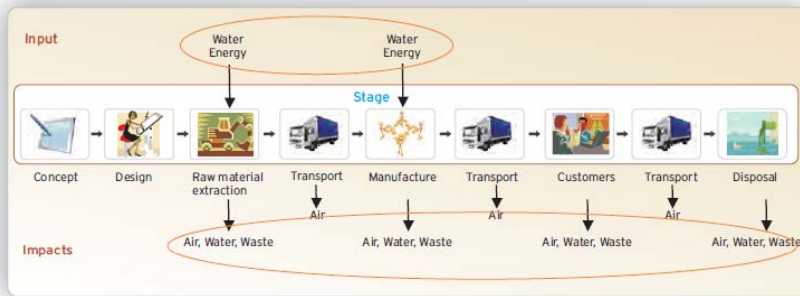
4



Project funded by European Union



## Product Life Cycle is the basis of GSCM



Creating a Green Supply Chain, Cognizant ([www.cognizant.com](http://www.cognizant.com))



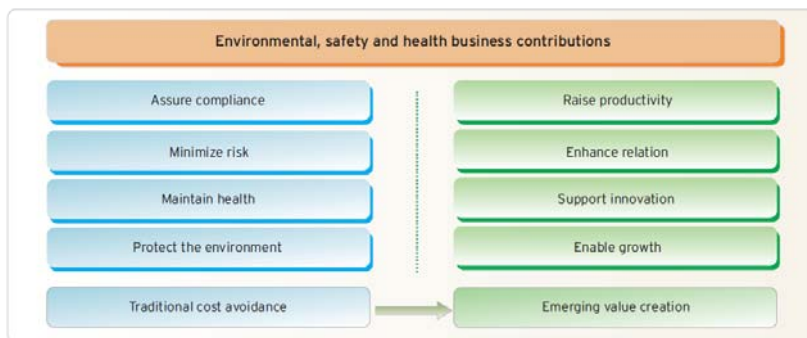
5



Project funded by European Union



## From compliance to value creation



Creating a Green Supply Chain, Cognizant ([www.cognizant.com](http://www.cognizant.com))



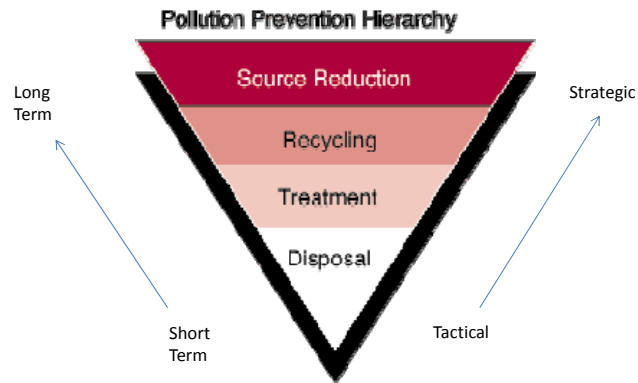
6



Project funded by European Union



## GSCM is a strategic analysis tool



Pollution Prevention Work Practices, EPA ([www.epa.gov](http://www.epa.gov))



7



Project funded by European Union



## Drivers of GSCM

- External Drivers: Pressures from outsiders to the company (government, NGOs, consumers)
- Internal Drivers: Company's motives (efficient SCM, attract green consumers)



8



Project funded by European Union



## Green Supply Chain Practices

- Two practices of GSCM:
  1. **Green Design:** systematic environmental consideration in the product design
  2. **Green Operation:** relate to all aspects related to the SCM operations



9

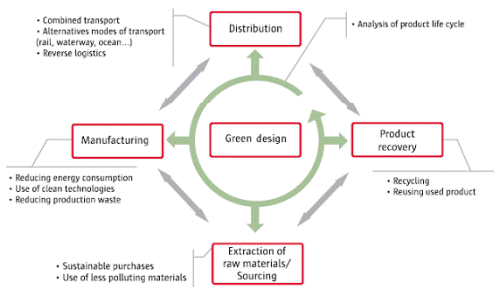


Project funded by European Union



## Green Design

- Environmentally conscious design (ECD) is aim to develop and understanding of **how design decisions affect** a product's **environmental** compatibility
- Life-cycle assessment/analysis (LCA) is a process for assessing and **evaluating** the **environmental, occupational health and resource-related consequences** of a product **through all phases of its life**



Supply Chain Monitor "How mature is the Green Supply Chain?"



10



Project funded by European Union



## Green Operation

Three types of green operations:

1. Manufacturing and re-manufacturing
2. Reverse logistics
3. Waste management



11



Project funded by European Union



## Green Operation: Manufacturing and re-manufacturing

- **Green manufacturing** is about reducing the ecological burden by using appropriate material and technologies
- **Remanufacturing** is recycling-integrated manufacturing
- **Recycling** is performed to retrieve the material content of used and non-functioning products



12



Project funded by European Union



## Green Operation: Reverse Logistics

- Reverse logistics (RL) is the process of **planning, implementing,** and **controlling** the efficient, cost-effective flow of raw materials, in-process inventory, finished goods and related information *from the point of consumption to the point of origin* for the purpose of recapturing value of proper disposal
- Redesigning logistics networks to accommodate product returns and remanufacturing and re-use is important to minimize the operation cost



13



Project funded by European Union



## Green Operation: Waste Management

- Waste Management is the **reduction of hazardous waste** which is generated (during production and operations) or subsequently **treated, store or disposed**
- The operation aims to **prevent the creation of waste** rather than managing it after it is generated



14

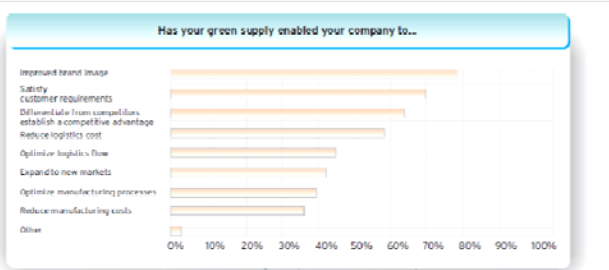


Project funded by European Union



## GSCM Benefits

- Economic benefits from increase efficiency
- Competitive advantage through innovation
- Improved product quality
- Consistent corporate environmental goals
- Improved public image



15  
Creating a Green Supply Chain, Cognizant ([www.cognizant.com](http://www.cognizant.com))



Project funded by European Union



## Steps to a greener supply chain

1. Redesign the product
2. Reconfigure manufacturing
3. Shift to green suppliers
4. Shorten distances
5. Alter service level agreements
6. Shrink packaging
7. Plan for reverse supply chain activity
8. Consolidate shipments
9. Plan shorter routes
10. Coordinate with partners
11. Take a lifecycle view
12. Start now



16





Project funded by European Union



## GSCM Successful Case: General Motors

- Waste Reduction
  - Landfill-Free Facilities
  - Reducing waste
  - Reusing
  - Recycling
- Energy Efficiency
  - Reducing Energy Use
  - Green Building
  - Renewable Energy
- Resource Preservation
  - Reducing Water Use
  - Watershed Education
  - Habitat Enhancement
- Greener Vehicles
- Green Suppliers



17



Project funded by European Union



## GM Waste Reduction: Landfill-Free Facilities

- Landfill-Free Facilities
  - GM has a total of **105 landfill-free facilities worldwide** the re-use, recycle, or convert to energy all waste from daily operations



- ▶ 85 landfill-free manufacturing sites on average **recycle** approximately **97% of their waste** from daily operations and **convert 3% to energy**
- ▶ 20 landfill-free sites are non-manufacturing facilities



18



Project funded by European Union



## GM Waste Reduction: Reducing

- Reducing
  - From 2005-2010, GM **reduced non-recycled waste by 40%** and total waste generated per vehicle by 28%
  - Gm **works with its supplier** on designing for the environment and rethinking product design to avoid scrap



### GM Awards Supplier for Environmental Excellence

FTS Technologies enables paint to stick to plastic vehicle parts without chemicals  
2012-04-13

DETROIT – FTS Technologies, a surface treatment company based in Whitmore Lake, Mich., received the General Motors Environmental Excellence Award for introducing an energy-efficient technology that lets paint stick to plastic vehicle parts without using traditional chemical adhesion systems. It helps GM's supply base reduce waste and emissions.

By using the new process on the Cruze, for example, GM suppliers:

- Reduced solid and liquid waste (filters, cleaners, solvents and coatings) from 48 tons a year to less than 1 ton.
- Decreased air pollutants from 810 tons a year to 80 tons a year.
- Eliminated landfill waste like paint sludge and painted scrap material from 25 tons to nearly zero.



19



Project funded by European Union



## GM Waste Reduction: Reusing

- Reusing
  - GM frequently **turns material byproducts** from routine manufacturing operations **into new-vehicle components.**
- Recycling cardboard packaging into Buick Verano and Lacrosse headliners to provide acoustic padding.
- Recycling test tires into the manufacturing of air baffles for a variety of GM vehicles.
- Mixing plastic caps that protect vehicle parts during shipment with other post-consumer plastics to make air deflectors for Chevrolet Silverado and GMC Sierra pickup trucks.



20



Project funded by European Union



## GM Waste Reduction: Recycling

- Recycling
  - Today, all of GM's worldwide manufacturing facilities combined **recycle or reuse more than 90% of the waste** they generate
  - Some materials recycled include 1.8M metric tons of metal, 115,000 metric tons of wood, 104,000 metric tons of cardboard, 19,000 metric tons of plastic, and 1.8M gallons of oil
  - GM recycling and reuse efforts in 2011 **avoided 10 million metric tons of CO2-equivalent emissions**
  - GM **use recycled and bio-based materials** (e.g., plastic bottles, cardboard, denim fibers, carpet, tires, fibers, balsa wood and soy) **in a variety of vehicle components**. Each material we use meets or exceeds quality and cost requirements.



21



Project funded by European Union



## GM Waste Reduction: Vehicle Recyclability

- Vehicle Recyclability
  - GM **design vehicles** to be as **recyclable and recoverable** as is feasible, following ISO standards and developing internal standards to gain common benefits across global regions
  - On average, GM vehicles are approximately **85% recyclable and 95% recoverable** by weight
  - GM **works with the vehicle dismantling industry** to help ensure the majority of material is salvaged and can be recycled or reused in new vehicles or other consumer products



22



Project funded by European Union



## GM Waste Reduction: Financial Impact

GM has generated **\$2.5B in revenue** through various recycling activities **from 2007 to 2010** and now count about **\$1B** in byproduct reuse and recycling revenue **annually**



23



Project funded by European Union



## GM Energy Efficiency: Reducing Use

- Reducing Energy Use
  - GM **reduced energy** use at our **global facilities by 28%** on a per-vehicle-produced basis between 2005 and 2010. These savings reduced greenhouse gas emissions by 3.34M metric tons during that timeframe
  - Efficiency tactics include **automating shut-down** of equipment when it is not needed, using **energy-efficient lighting**, tracking hourly consumption with **energy management systems**, and **upgrading our heating and cooling systems**. For example:
    - GM saves \$3M per year in energy costs across 10 plants by using sophisticated software that syncs up all energy-using systems to plant conveyors, automating the shutdown and restart of equipment as needed
    - GM saves \$2M in the United States through real-time management of our HVAC equipment
    - GM invested \$400,000 in a heat recovery project at our Gliwice, Poland plant's paint shop; energy savings provided a payback within five months
    - GM's Kaiserslautern, Germany plant saved energy worth \$750,000 per year with a compressor project that also helps us better meet compressed air demand.



24



Project funded by European Union



## GM Energy Efficiency: Green Building

- Green Building
  - When constructing a new facility or upgrading existing ones, GM follows LEED (Leadership in Energy and Environmental Design) green design and construction practices
  - GM new Joinville, Brazil engine plant is expected to generate electricity from sunlight, heat water using solar power, and reuse water through reverse osmosis
  - GM's Warren, Mich. tech center will consolidate company IT infrastructure, reduce operating costs and cut energy use by about 40%



25



Project funded by European Union



## GM Energy Efficiency: Renewable Energy

- Renewable Energy
  - Solar: 17MW in Germany, 1MW in California, 516kW in Michigan, 1.8MW in Ohio, 1.2MW in Maryland
  - 9 solar EV charging station
  - Landfill Gas: Fort Wayne, Toledo and Orion Plants
  - Biomass from sugar cane in Brazil



26



Project funded by European Union



## GM Resource Preservation: Water

- Reducing Water Use
  - Between 2005 and 2010, we **reduced water use by 32%** on a per-vehicle-produced basis at our facilities worldwide
    - Construction of lagoon to store treated water
    - Wastewater treatment
    - Storm water collection
    - Water filtering process
    - Water recycling plant



27



Project funded by European Union



## GM Resource Preservation: Education

- Watershed Education
  - GM GREEN program (Global Rivers Environmental Education Network) helps students understand their impact on local watersheds. The program matches approximately **8,500 students** each year with GM mentors to **retrieve water samples, test and analyze them, identify an issue of concern, and develop a community project addressing it**. GREEN is designed to sharpen problem-solving skills, improve knowledge of science and the environment, and encourage community involvement through hands-on learning experiences



28



Project funded by European Union



## GM Resource Preservation: Wildlife Habitat

- Habitat Enhancement
  - GM actively manages **2,635 acres of wildlife habitat** throughout our facilities around the world
  - GM works with local schools, NGOs, nonprofits and environmental preservation groups to enhance our habitats and increase community awareness about wildlife preservation



29



Project funded by European Union



## GM Greener Vehicles

- GM believes the keys to developing sustainable transportation are energy alternatives and advanced technologies that help reduce dependency on petroleum, improve fuel economy and reduce emissions
 

<ul style="list-style-type: none"> <li>▪ Active Fuel Management</li> <li>▪ Gasoline Direct Injection</li> <li>▪ Aerodynamics</li> <li>▪ Lightweight Materials</li> <li>▪ Tire Construction</li> <li>▪ Variable Valve Timing</li> <li>▪ Flex Fuel</li> <li>▪ Bio-diesel</li> <li>▪ CNG bi-fuel</li> </ul>	<ul style="list-style-type: none"> <li>▪ Hybrid Vehicle</li> <li>▪ eAssist Start-Stop</li> <li>▪ Electric Extended Range</li> <li>▪ All Electric Vehicle</li> <li>▪ Batteries &amp; Electric Motors</li> <li>▪ Fuel Cell</li> </ul>
--	---



30



Project funded by European Union



## GM Green Suppliers

- North America
  - GM involves through the **Supplier Partnership (SP) for the environment** which is an innovative partnership between US automobile manufacturers, their suppliers and the US Environment Protection Agency (EPA)
  - SP has **work groups** concentrating on specific tools to **help suppliers** improve their environmental performance
- Australia
  - GM Holden is working through an Australian **government program** to **assist supplier** business development. This competitive **grant-based** program will provide **A\$20 million over four years** to Australian automotive manufacturers, suppliers and auto industry research and development organizations to enable local automotive suppliers to compete more effectively in global and domestic markets



31



Project funded by European Union



## GM Green Suppliers

- China
  - Shanghai General Motors (SGM) promotes the **Green Supply Chain Initiative** which is aimed at improving the performance of its joint ventures' suppliers in support of the Chinese government's goals of promoting energy efficiency and sustainable development
  - GM plants **hire resource managers** – experts in waste elimination and reduction – to assist suppliers
  - In 2011, the Green Supply Chain Initiative involved 70 Tier 1 SGM suppliers, who implemented 257 projects at a cost of 90,686,000 RMB (US\$ 21M) and resulted in an annual benefit of 72,482,350 RMB (US\$ 19M). Reductions in energy, water use and waste generation include:
 

▶ 205,600 metric tons/year of water use	▶ 3,840,000 metric tons of coal gas
▶ 26 million kW hours/year of energy use	▶ 9,730 metric tons of wastewater
▶ 212,000 cubic meters of natural gas use	▶ 31,000 metric tons of GHG emissions
▶ 2,000+ metric tons of coal use	▶ 1,570 metric tons of solid waste
▶ 217 metric tons of diesel fuel use	



32





Project funded by European Union

**switchasia**  
POLICY SUPPORT



## Question/Answer



33