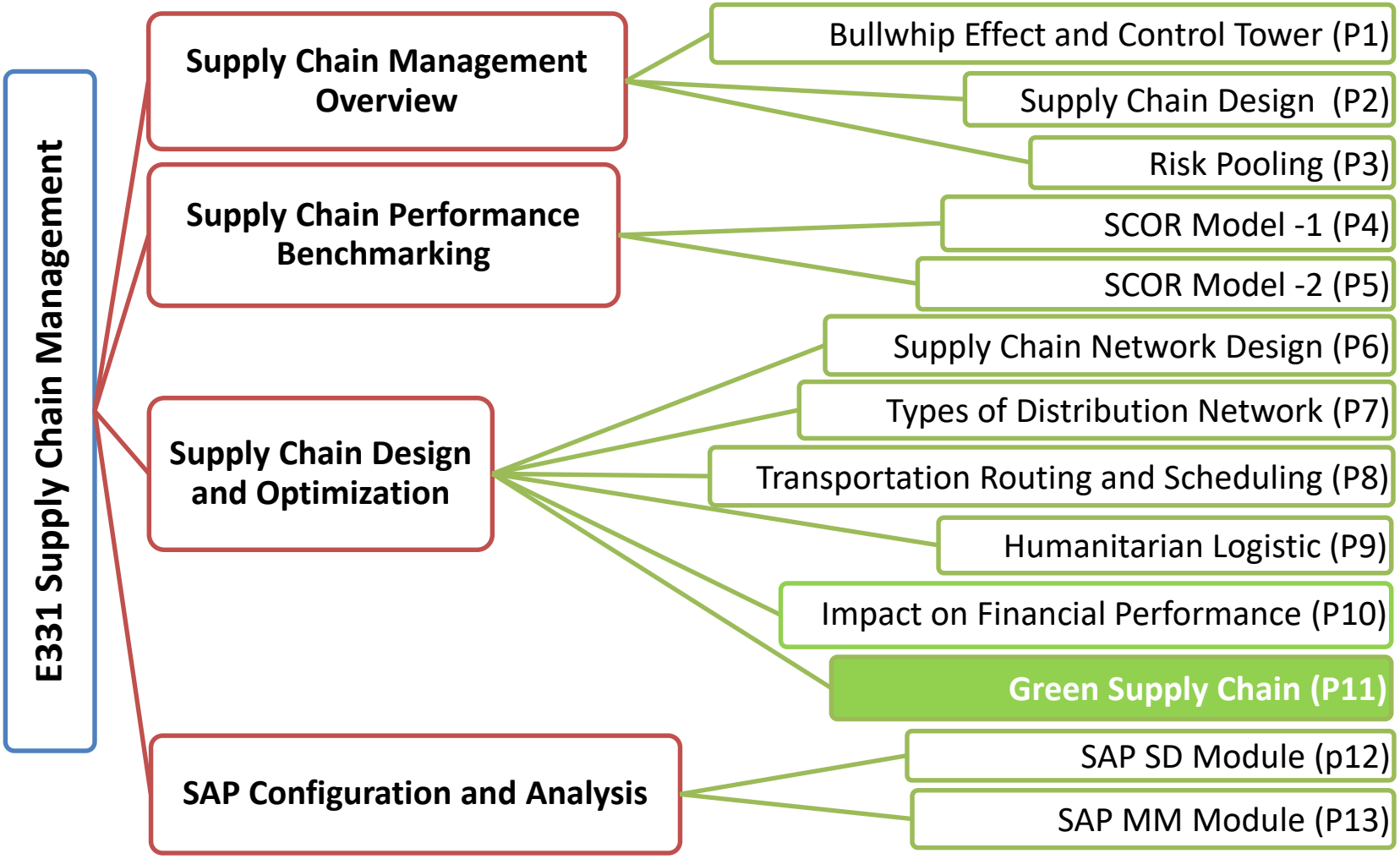
L10
Green Supply Chain

E331 – Supply Chain Management

e-learning

Diploma in Supply Chain Management

E331 Module Overview



Defining "Green"

- Green ≠ Sustainable
- Sustainable is:
  - Environmental (Planet)
  - Social (People)
  - Economic (Profit)

- Sustainable Business Practices address all three above
- Green Supply Chain Management (GSCM):

  An integrating environment thinking into supply chain management, including:
  - Product design
  - Material sourcing and selection
  - Manufacturing processes
  - Delivery of the final product to the consumers
  - End-of-life management of the product after its useful life

(Srivastava, 2007)

Supply Chain Turns Green

- Supply Chain Management has traditionally worked to optimize business solutions among three constraints:

  Cost, Quality and Service

- "Going Green" introduces additional constraints:

  Carbon, waste, water, and social impacts

- All areas of supply chain are interconnected and dependent on one another. An optimized supply chain quantifies both the cost and the carbon impact of various supply chain policies.

Barriers to Green Supply Chains

- Legislation conflicts
- Inadequate or misaligned stakeholder incentives
- Lack of environmental norms and tools
- Lack of resources
- High costs of implementation and technology
- Lack of information about the green supply chain best practices
- Lack of top management level commitment
- Global sourcing makes tracing of carbon footprint difficult

Barriers can be overcome through a properly structured, comprehensive, and phased migration strategy. A “Big-Bang” approach is not recommended.

What Drives GSCM?

- Rising energy costs
- Rising cost of transportation/ Reduce logistics costs
- Global concerns about greenhouse gases
- Chemical Control Legislation (especially for textile industry)
- Pollution Control Legislation (especially for textile industry)
- Regulations like RoHS (Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment), etc.
- Technology innovations
- Increased public awareness of environmental issues
- Achieve regulatory compliance
- Differentiation from competitors
- Corporate social responsibility
- Standard quality certifications like ISO 14001

Benefits of a Green Supply Chain

- Positive impact on financial performance
- Sustainability of resources
- Lowered operational costs/increased efficiency
- Product differentiation and competitive advantage
- Adapting to regulation and reducing risk
- Improved quality and product
- Effective management of suppliers
- Large investment and risks are shared among partners in the supply chain
- Better control of product safety and quality
- Beneficial uses for waste

World Class Examples on Successful Green Initiatives

- **Pepsi-Cola** saved $44m by switching from corrugated to reusable plastic shipping containers
- **GM** reduced its disposal costs by $12 million by establishing a reusable container program with its suppliers
- **Heineken** aims to reduce fuel and electricity costs by 15% for the period between 2002 and 2010
- **Starbucks Coffee** as well as **Ben and Jerry**'s require raw material suppliers to meet guidelines for sustainable farming
- **Amazon** can be seen as a greener option than traditional storefront retailers because it does not need to operate physical locations. Also, Amazon's transportation logistics and distribution center efficiencies could reduce the life-cycle energy use of consumer products.

Quiz 1

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Which of the following statements is true?

- Green supply chain only considers cost, quality and service
- Green supply chain management does not include vendor selection
- Sustainable business practices have a bigger scope than green supply chain
- Inventory policies do not have carbon impact on the supply chain

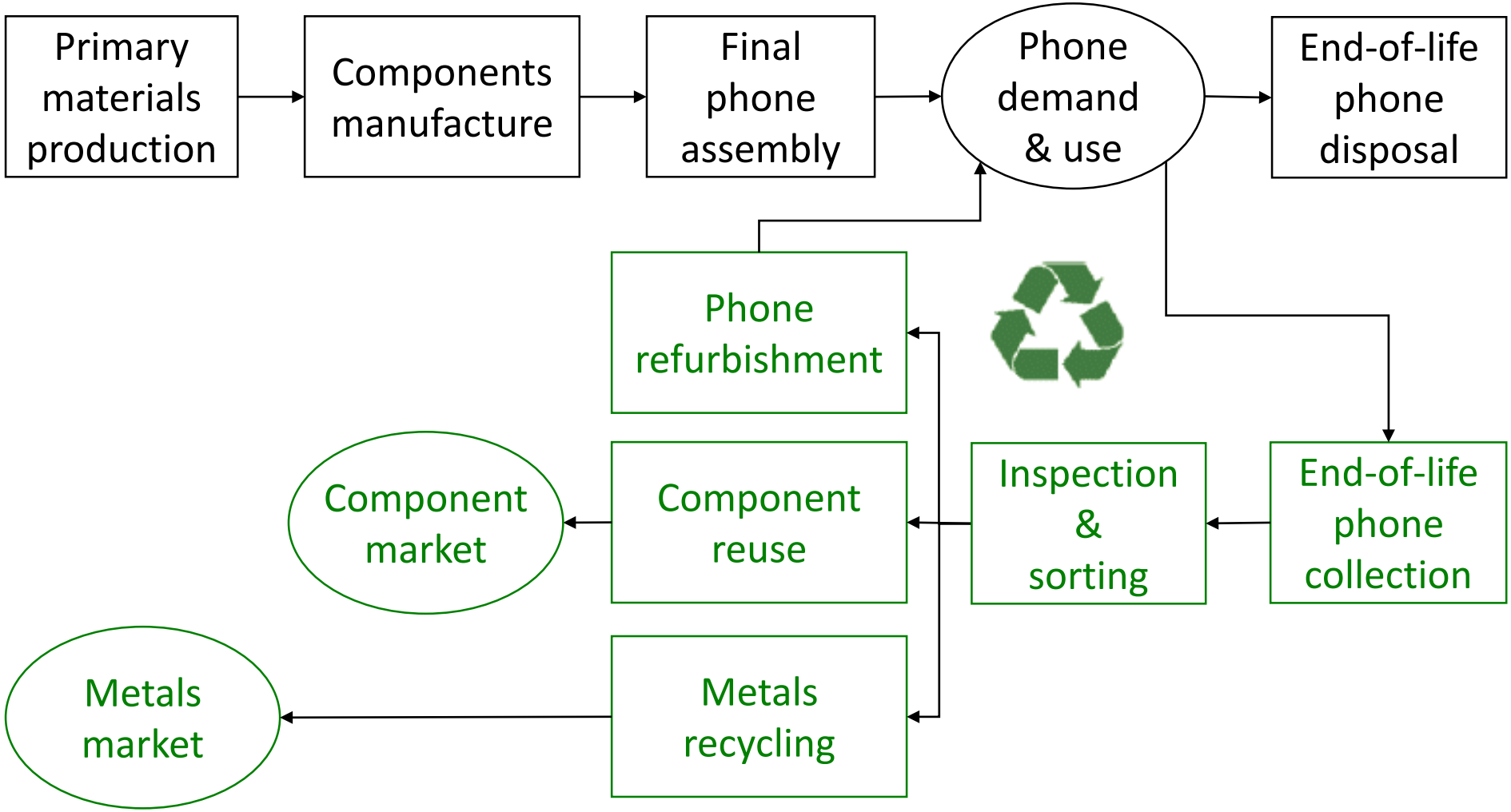
Reduce, Reuse and Recycle (3Rs)

- **Reduce**
  - A technique in which the consumption rate of materials and/or energy is minimized
  - Reducing the amount of waste you produce is the best way to help the environment.
  - For example, we should only buy products that do not have much packaging and that we really need.
- **Reuse** → Reuse items as much as possible before replacing them.
- **Recycle** → Many of the things we use every day, like paper bags, soda cans, and milk cartons, are made out of materials that can be recycled. Recycled items are put through a process that makes it possible to create new products out of the materials from the old ones. Recycling is performed to retrieve the materials content of used or non-functioning products.

Other Green Practices with Rs

- Rs: Rework, Repair, Refurbish, Remanufacture, Reverse logistics, etc.
  - Rework: to re-process again for use or use again in altered form
  - Refurbish: used products that have been cleaned, tested, reconfigured and warranted for future use
  - Remanufacture: the process of disassembly and recovery at the module level and, eventually, at the component level. It requires the repair or replacement of worn out or obsolete components
- Waste management is the management of waste generation and its impacts through activities such as source reduction, pollution prevention and disposal.

Typical Uses of Rs in a Handphone Supply Chain



Quiz 2

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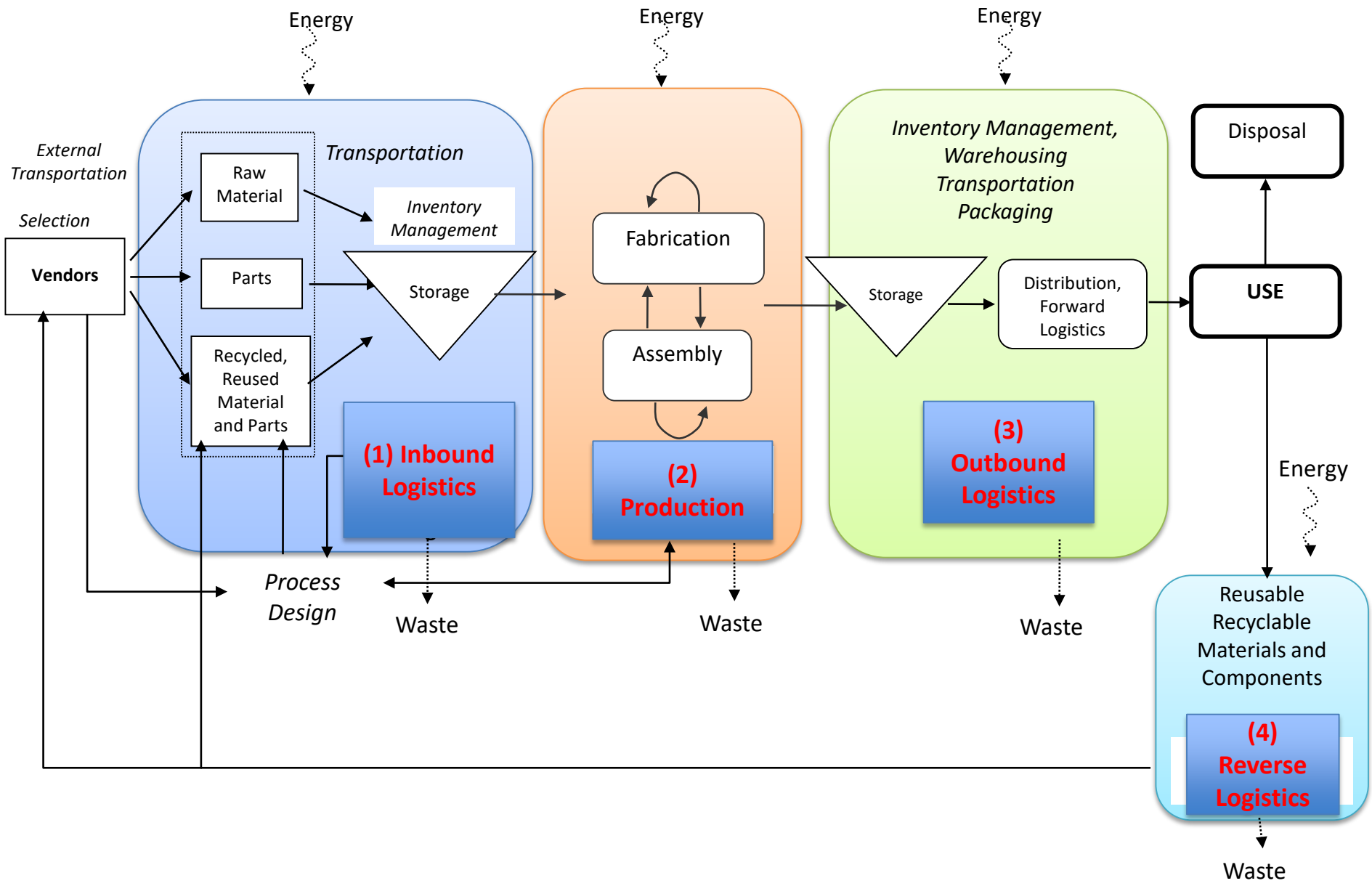
Which of the following practice is considered as “Recycle”?

- Use energy-efficient air-conditioner in the office
- Mineral water bottles are cut into pots for plants growing
- Use the plastic bags from supermarkets as trash bags
- Buy products in bulk with less packaging

Supply Chain Phases in Green Perspective



Greening Inbound Logistics

- Involves the acquisition of materials from suppliers to meet the needs of producing the organizational product or service. Purchasing includes duties such as vendor selection, material selection, outsourcing, negotiation, buying, delivery scheduling, inventory and materials management, and to some extent, involvement in product design.

- Case study
  - GM reduced its disposal costs by $12 million by establishing a reusable container program with its suppliers.

- The green initiatives may include:

  1) Product design in general
  - Use more environmentally friendly materials
  - Design more efficient products
  - Plan in recycling of product at the end of its life
  - Consider environmental impact of products
  - Conduct life cycle analysis in cooperation with suppliers
  - Engage suppliers in design for environment (DFE) product innovation

Greening Inbound Logistics

2) In-bound logistics focuses on managing the vendor-organization relationship. Many companies are beginning to green this phase by working on environmental initiatives with their vendors as well as the supplier selection:

- Screen suppliers for environmental performance
- Build environmental criteria into supplier contract conditions
- Set standards to prevent/reduce use of hazardous materials
- Reduce purchase volumes of materials that are ultimately difficult to dispose of
- Source larger amounts of recyclable materials
- Source materials that promote cleaner production
- Encourage suppliers to use less packaging, more biodegradable materials
- Consider energy-efficient practices (green manufacturing facilities of suppliers, hybrid delivery vehicles from suppliers)
- Localize sourcing for Just In Time (JIT) to cut inventory cost and waste (JIT may raise fuel consumption and traffic congestion due to small batch delivery, hence investigations of trade-off are necessary.)

Greening Production

- Involves fabrication and assembly. The green initiatives in achieving green production include:
  - Improve factory layout
  - Improve production process from straight push to pull, push-pull or postponement strategy
  - Utilize fuel efficient tools and machines
  - Recycle materials and use less materials
  - Use less water or electricity during manufacturing
  - Substitute input materials: non-toxic for toxic, renewable for non-renewable and hazardous substance control
  - Reduce unwanted outputs: cleaner production, industrial symbiosis
  - Convert outputs to inputs: 3Rs and waste minimization

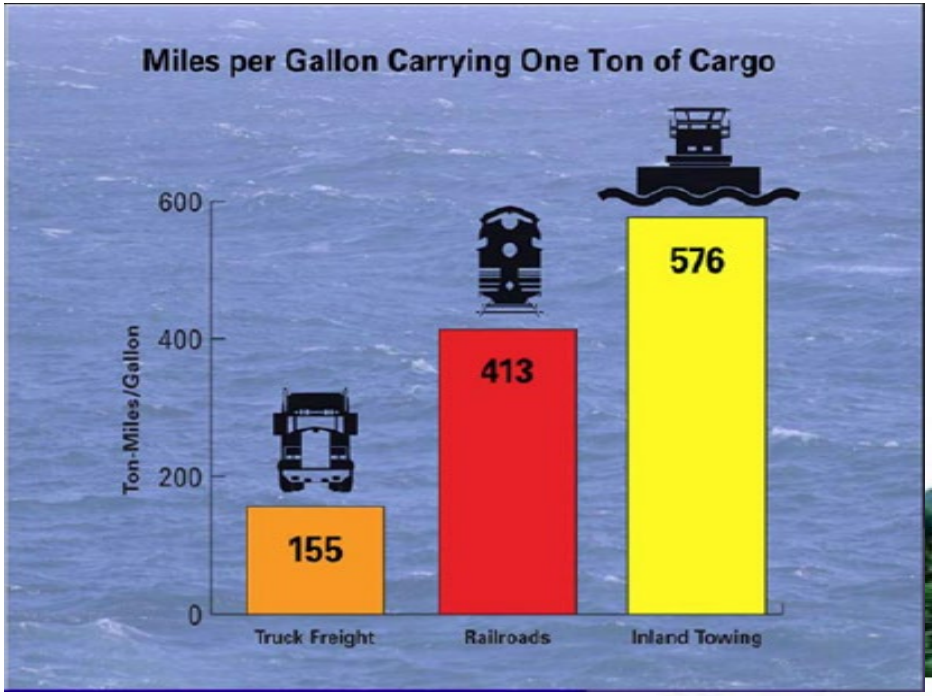
Greening Outbound Logistics

- Includes transportation, packaging design, delivery, warehousing, inventory management, and waste disposal practices.
- The green initiatives may include:
  - Distribution
    - Strategically place warehouse & distribution centre
    - Improve warehouse layout
    - Utilize fuel efficient tools and machines
    - Educate customer on recycle/ reuse policy
  - Transportation
    - Consolidate LTL or milk run for both inbound and outbound
    - Use more environmentally friendly logistics providers
    - Reroute fleet vehicles
    - Optimize truckloads
    - Utilize rail or intermodal

Green Transportation (Examples)

- Transportation mode selection

  Fuel Efficiency: Ship Vs. Truck Vs. Rail



"One train can carry the load of more than 280 trucks."

- Shipping by **ship** is the greenest
- Shipping by **rail** is greener than by **truck**

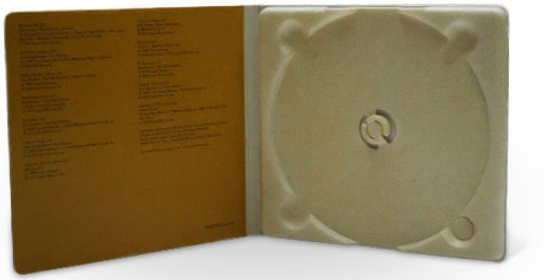
Data Source: Texas Transportation Institute and University of Texas

Greening Outbound Logistics

- Packaging
  - Minimize the amount of packaging used (weight and volume)
  - Minimize the energy used for production and transportation of goods
  - Plan & use packaging that can be reused again, such as bottles and refillable ink cartridges
  - Use recycled and recyclable materials
  - Use biodegradable materials

Green packaging is not just about reducing the amount of packaging but takes package design, processing, disposal conditions and the entire product lifecycle into consideration.

Greening Packaging (Examples)



Eco Tray for CD & DVD

Use potato starch or tapioca starch, that are100% biodegradable and recyclable. It reduces the carbon footprint of the finished product by 85-90%, compared to conventional plastic packaging.

Lipstick

The new design enables easier recycling and has the added benefit of using a renewable polymer (PLA) as the material of construction.

Eco Friendly Shoe Packaging

Contains 65 percent less cardboard by using a bag made of recycled plastic. With the new packaging's lighter weight, Puma expects to cut carbon dioxide emissions by 10,000 tons per year and water, energy and diesel use by 60%.

Greening Reverse Logistics

- This phase deals with the collection and reprocessing of used products, the return of materials, components and parts, and bringing them back to the supply chain, to the extent possible.

- The green initiatives may include:
  - Streamline the returned processes; organize a safe and cost effective transportation
  - Early identify the goods that need repair before being sold again
  - Recycle the packaging material of returned goods
  - Integrate IT systems such as warehouse management system for faster and cost effective process of returns

- Case study
  - McDonald's companies all over Europe use the trucks that deliver new goods to the restaurants to collect cardboard for recycling. The backhaul reduces waste going to landfill, emissions from transport and waste-disposal costs.

Quiz 3

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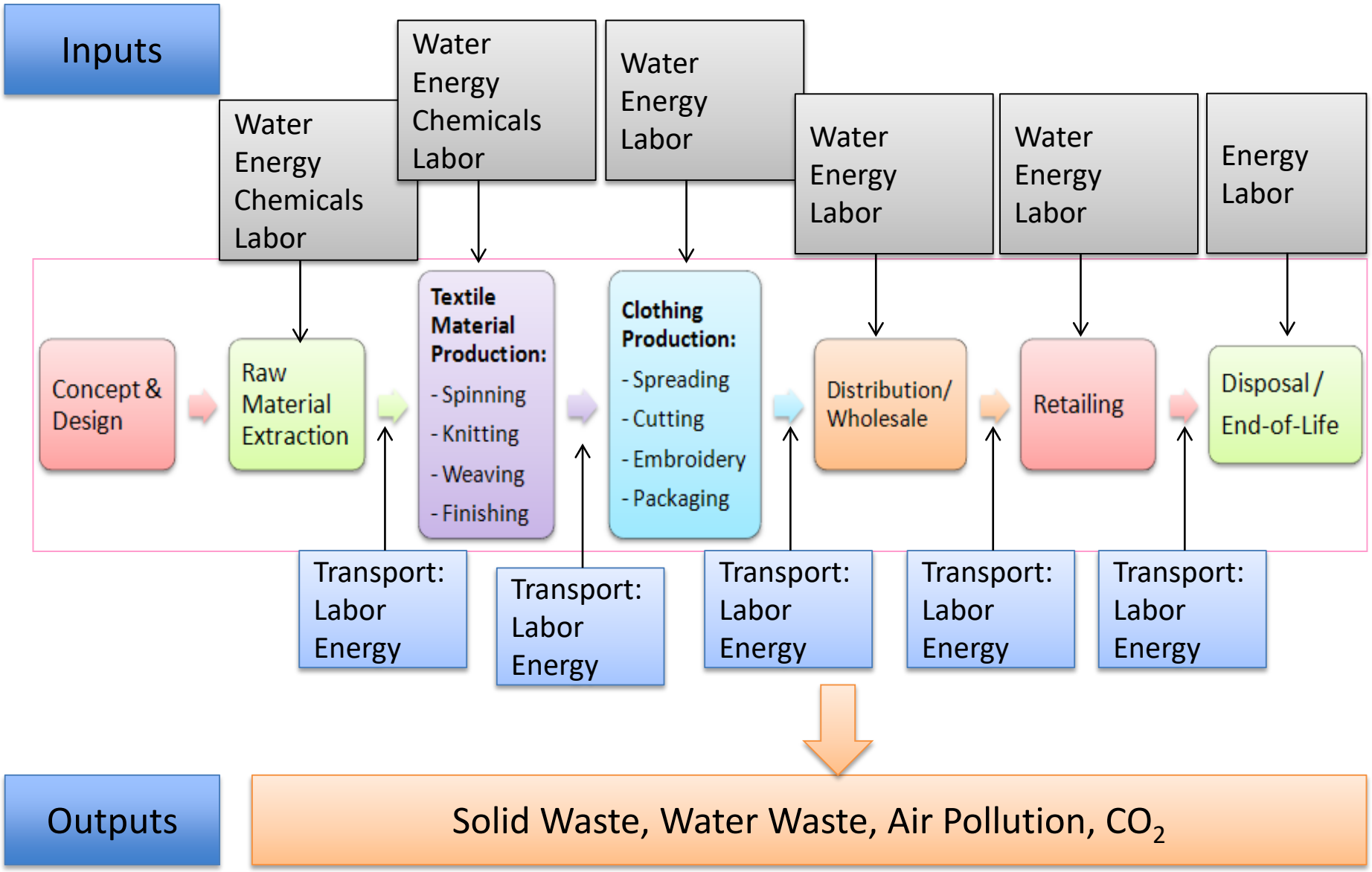
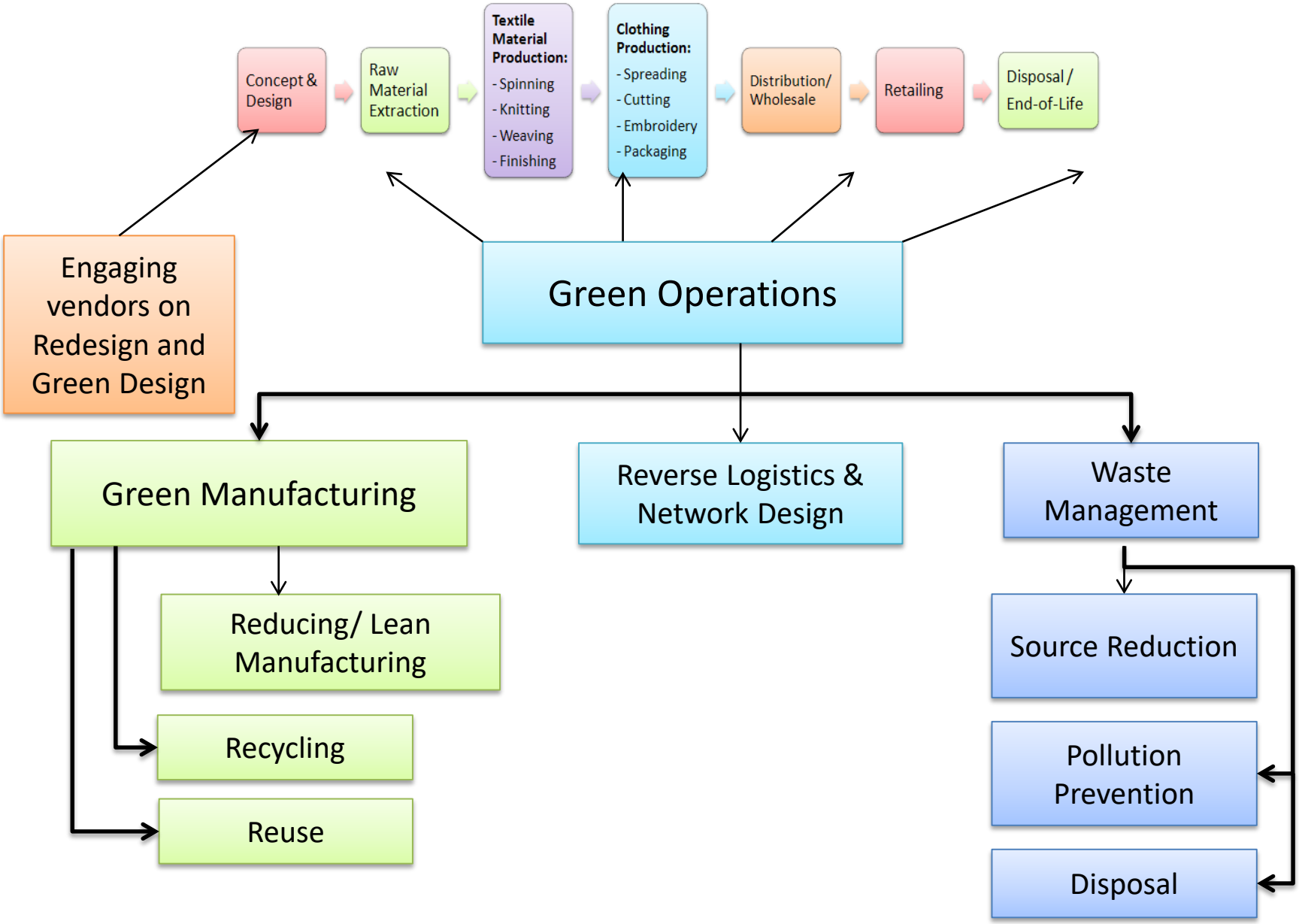
Which of the following is a major phase in a green supply chain, but not a major one in a traditional supply chain?

- Development and Research
- Reverse Logistics
- Purchasing
- Production

Case Study: The Apparel Supply Chain



Opportunities in Greening the Apparel Supply Chain



Green Design/ Eco-design for Apparel Industry (1)

- An environmental-conscious design of a product and its packaging that aims at minimizing negative environmental impacts of the product and its packaging throughout its entire life
- Considerations during product design include reduction or elimination of hazardous items, reuse, recycling, remanufacturing, and resource efficiency (material and energy) during product use.
- Eco-design enables the use of eco-friendly raw materials and fabrics

Green Design/ Eco-design for Apparel Industry (2)

- Life cycle assessment (LCA) or Product Life Cycle Analysis (PLCA) is used to forecast the impacts of different production alternatives of a product, and to choose the most environmentally friendly one.
- Compare different product designs according to energy use, toxicity, acidification, CO2 emissions, resource depletion and others
- The end-of-life of a product is very important because some products emit dangerous chemicals into the air, ground and water after they are disposed of in a landfill, so this should be part of the design consideration.

Green Procurement for Apparel Industry

- An environmentally conscious purchasing practice that aims at reducing or eliminating hazardous items, reducing sources of waste, and promoting recycling and reclamation of purchased materials:
  - Supplier selection: purchase materials or parts only from “Green Partners” who satisfy green partner environmental quality standards
  - 3Rs in procurement process
- One of the largest polluters in the world is the textile industry. At least 8,000 chemicals are used to manufacture raw materials into clothing and linens.
- Key factors of sustainable clothing are the fiber source and renewability without the use of agro-chemicals and pesticides along the entire manufacturing process from raw fiber to textile
- Today many companies offer their customers products made from organic cotton, bamboo or soy fibers

Green Production for Apparel Industry

- The process of textile production & garment production involves the use of further toxic chemicals
- Water is used at every step of the textile and garment process, becoming full of chemicals, which in turn pollutes the environment
- Green manufacturing refers to production processes which use inputs with relatively low environmental impacts and which generate little or no waste or pollution.
  - Hazardous substance control
  - Energy-efficient technology
  - 3Rs and waste minimization

Green Logistics for Apparel Industry

- For industries with lower margins like the clothing industry, green supply chain management can lead to lower supply chain related costs. These cost reductions can be translated into significant competitive advantages and profit.
- It is estimated that freight transport accounts for roughly 8% of energy-related CO2 emission worldwide. The inclusion of warehousing and goods handling is likely to add around 2 - 3 percent to this total.
- Reverse Logistics activities vary form product/industry to product/industry, but common activities are collection, transportation, inspection/sorting, storage, reprocessing (including recycling, reusing, repairing) and/or disposal.

Quiz 4

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For the apparel supply chain, which process impact the environment the least?

- Distribution / Wholesale
- Concept & Design
- Textile Material Production
- Retailing

Green Warehouses in Singapore (Examples)

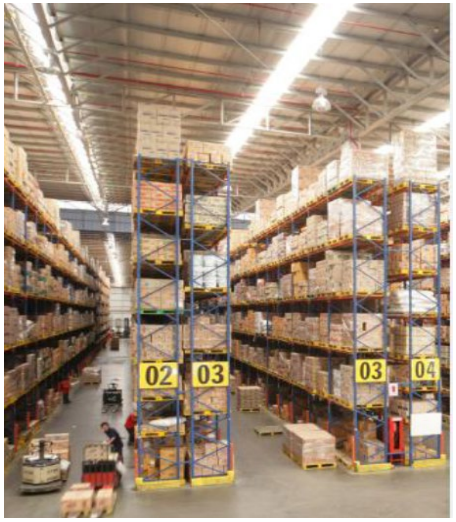
- SDV has a four-storey ramp-up new facility with nine floors of production and office space. It is the first warehouse in Singapore to be Green Mark Platinum certified. It is also the largest logistics centre in Asia to be under LEED (Leadership in Energy and Environmental Design) Gold Certification. A total of SGD55 million was invested into this green warehouse which spans an area of 42,000 sq. m.

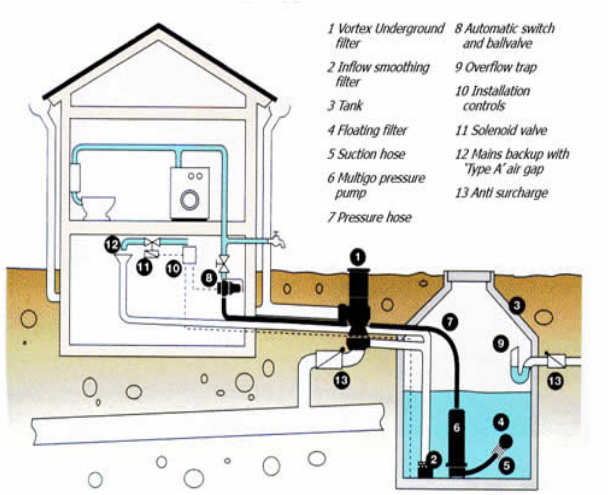
- XPO Logistics unveiled a new US$50 million warehouse and distribution centre in Boon Lay in 2015. It is XPO 's first "green" warehouse in Singapore, and cater to customers seeking more environmentally sustainable supply chain management. It has about 100 staff, and will fulfil about 105,000 shipping orders a year – about one order every five minutes.

Greening a Warehouse

Layout of the warehouse

- Have natural ventilation (E.g. open-air window)
- Consider east/west orientation of locating the warehouse so as to make use of natural lighting from the Sun during daylight.
- Adopt Skylight concept at rooftops to admit natural light into the warehouse
- Warehouse building can be equipped with rain water collection system, and the water collected can be used for flushing of urinals & toilets bowls.
- Implement a solar power system at the rooftop of the building





Greening a Warehouse

Storage & Handling

- Use Channel Storage solutions to provide high density storage for homogenous products
- Use Mobile Pallet Racking for efficient use of warehouse footprint
- Implement energy-saving equipment such as conveyors with auto-sensing adjustable speeds

- Go paperless by using: Voice-recognition systems, Barcodes, Wireless technologies such as Bluetooth and Wi-Fi

Greening a Warehouse

Staging Area

- Install motion detecting energy saving lights.

- Use RFID for better inventory control and reduce the use of resources

- Use Stretch Wrap Machine instead of manual wrapping to reduce usage of plastic film
- Reuse items such as pallets whenever possible

Greening a Warehouse

Loading Bays

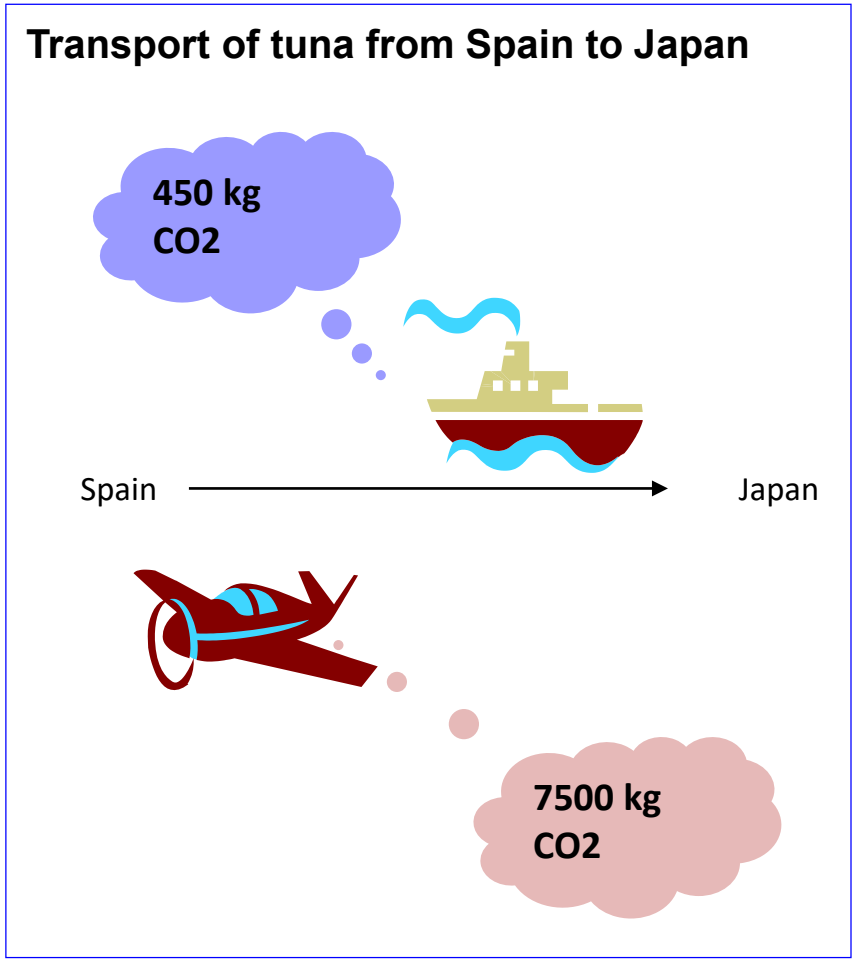
- Design the bay for easy access and manoeuvring of vehicles

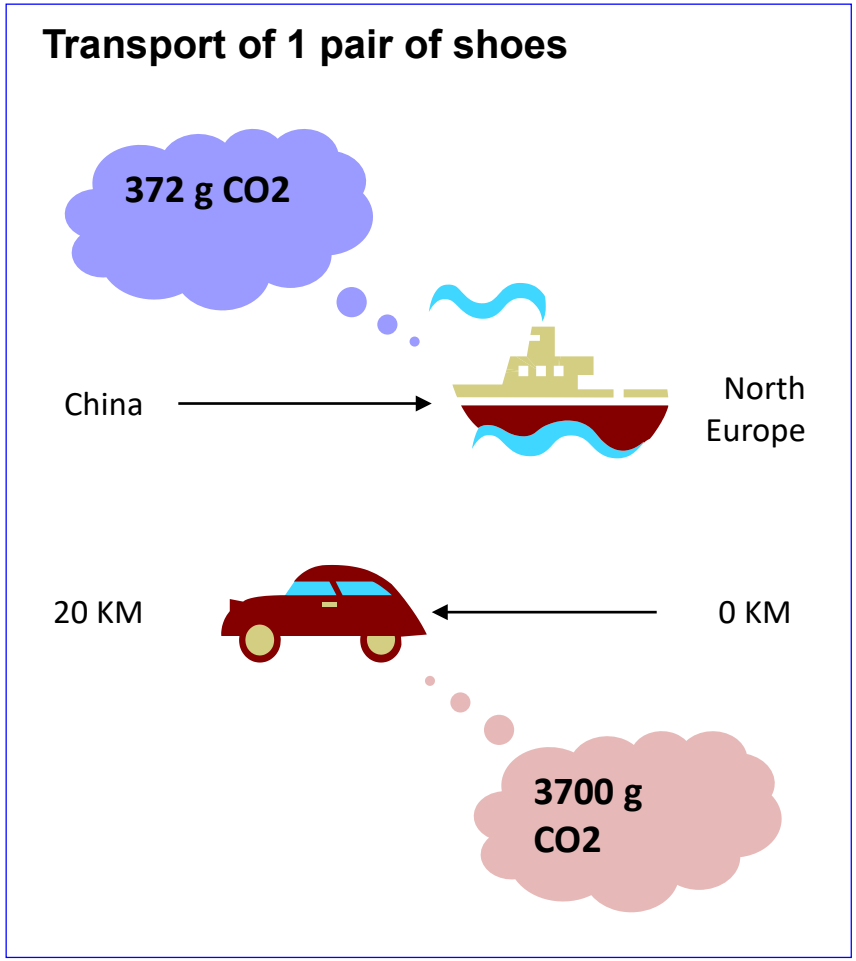
- Switch off engines while loading/ unloading.
- Use energy-efficient Lift Trucks

Carbon Footprint

- A carbon footprint is a measure of the impact of the supply chain activities on the environment and climate change.
- It is commonly used to describe the total amount of CO2 and other greenhouse gas (GHG) emissions for which an individual or organization is responsible.
- For example, the carbon footprint of a can of food is the total amount of carbon emissions from production, transportation, consumption and disposal of the single can of food.
- Types of footprint: Organizational/ Product
  - **Performance Metric**: Total supply chain carbon footprint = sum of emissions from energy and fuel consumption and process related emissions = Plan Carbon Emissions + Source + Make + Deliver + Return

Examples of the Carbon Footprints When Transporting





Environment Management Systems (EMS)

- EMS is a strategic management approach which normally consists of a collection of internal policies, assessments, plans and implementation actions affecting the entire organization and its relationships with the natural environment.

ISO 14000 Series

- ISO 14000 is World's first series of international standards for environmental management.
- It is a guide to Environmental Management Principles, Systems and Supporting techniques.
- It provides voluntary standards that will lead to the common worldwide approach to environmental management systems.
- The first two standards, ISO 14001:2015 and ISO 14004:2004 deal with environmental management systems (EMS).
- ISO 14001:2015 sets out the criteria for an environmental management system and can be certified to. It maps out a framework that a company or organization can follow to set up an effective environmental management system.

ISO 14000 Series

- ISO 14004:2004 gives general EMS guidelines on the establishment, implementation, maintenance and improvement of an environmental management system.
- 14010 series of standards are about auditing.
- 14020 is about environmental labelling.
- 14030 is a standard on environmental performance evaluation.
- 14040 series standards are on environmental life cycle assessment (LCA) and they are the only part of ISO 14000 series that rely on competent engineering and environmental science.

ISO 14000 Series

- An EMS meeting the requirements of ISO 14001:2015 is a management tool enabling an organization of any size or type to:
  - identify and control the **environmental impact** of its activities, products or services, and to
  - **improve** its environmental performance continually, and to
  - implement a **systematic approach** to setting environmental objectives and targets, to achieving these and to demonstrating that they have been achieved.
- Specifically, it brings in benefits of
  - reduced cost of waste management
  - savings in consumption of energy and materials
  - lower distribution costs
  - improved corporate image among regulators, customers and the public
  - providing framework for continual improvement of environmental performance.

ISO 14000

Conclusions (1)

- Aligning green supply chain management program with every business's goals creates strategic value
- Before embarking on green supply chain management program, the company needs to determine the role of the environment in the business:
  - Product Differentiation?
  - Managing Competitors?
  - Cost Reduction?
  - Risk Management?
  - Redefining Markets?
- With Green Supply Chain Continuous Improvements, firms target:
  - Wasted materials
  - Wasted energy or effort
  - Under-utilized resources

Conclusions (2)

- Firms generally take two approaches to greening their supply chains:
- The first looks externally to its various suppliers. Suppliers are asked to provide evidence of their operations meeting relevant environmental requirements and, in some cases, evidence of ISO14001 certification.
- The second approach is an internal examination of how a firm designs, produces, and ships its products. Packaging reduction and the reduction of toxic materials usage have been the key focus area
- Cost Savings to be enjoyed
  - Efficient design saves waste
  - Environmentally friendly sourcing saves disposal costs
  - Pollution/ emissions control saves cleanup costs
  - Compliance with environmental regulations

Conclusions (3)

- Take environmental issues into decision-making process, and add reducing energy needs & CO2 emissions into considerations. This will in turn help to reduce the cost and maintain a sustainable business development.
- Develop Environment Management Systems (EMS) to address internal policies, assessments, plans and implementation actions affecting the entire organization and its relationships with the natural environment.
- Certify its environmental management systems (EMS) to ISO 14001 standards.

Quiz 5

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For a cold warehouse, which of the following will help energy/resource saving the most?

- Have natural ventilation
- Equip rain water collection system
- Implement a solar power system
- Make use of natural lights from the Sun during daytime

Learning Outcomes

- Explain the basics of Green Supply Chain Management
- Describe the driving forces to Greening the Supply Chains
- Explain the concept of carbon footprint
- Identify the various strategies to be used in greening the 4 phases of a typical supply chain
  - Purchasing and inbound logistics
  - Production or internal supply chain
  - Distribution and outbound logistics
  - Reverse Logistics

- Describe the good practices of “greening” a warehouse
- Appreciate the importance of Environment Management Systems (EMS)
- Appreciate the global green standards ISO 14000 series and how it helps companies move toward sustainable development