EBOOK

Seven Ways to Design a Green Supply Chain

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Why "Green" Business is Smart Business

A decade ago, many forward-looking companies began thinking about the impact their operations were having on climate change and the emission of greenhouse gases.[1] When the financial crisis hit in 2008, these efforts were de-prioritized in favor of corporate survivability considerations.

Today, as the economic recovery has gained strength, enterprises are again evaluating sustainability and environmental improvement initiatives, with the presumption they can now "afford" to make their operations greener. What those organizations are discovering, however, is that changes designed to benefit the environment *are also good for the bottom line*. By making operational changes like using recycled materials, utilizing renewable energy sources and optimizing their routes to decrease empty miles, organizations are able to correlate improvements in sustainability with an increase in savings.

The opportunity is considerable. Research from the Massachusetts Institute of Technology (MIT) has found 63 percent of companies that have fully embraced green and sustainability initiatives have added profits[2] from the efforts, versus 22 percent of other companies that have done so. MIT defines an "embracer" as a company that has a business case for sustainability, views it as necessary for competitiveness, and has made sustainability a permanent consideration on the management agenda.

MIT distinguishes "green" initiatives (primarily focused on the environment) from a broader sustainability (environmental plus social) agenda. A green supply chain plays a vital role in supporting company-wide sustainability objectives.

Given the multiple benefits of pursuing sustainability, focusing on green efforts offers benefits on many fronts, to your individual organization and stakeholders, to the community and society at-large.

Benefits of a Green Supply Chain

1 "Commentary: Five Ways to Ramp Up Supply Chain Sustainability," Tony Brzoznowski, Supply Chain Quarterly http://www.supplychainquarterly.com/news/20170906-five-ways-to-ramp-up-supply-chain-sustainability

2 "Green Supply Chain Management," MIT https://ocw.mit.edu/courses/engineering-systems-division/esd-s43-green-supply-chain-management-spring-2014/lecture-notes-and-videos/MITESD_S43S14_Lecture1.pdf

The Environmental Impact of Industrial Supply Chains

According to research firm Gartner,[3] "more than two-thirds of global carbon dioxide (CO_2) emissions are concentrated in transportation, and the generation of electricity and heat." Industrial processes plus the heat and electricity consumed in industry accounts for 37 percent of all greenhouse gas (GHG) emissions. Transport accounts for another 24 percent. Supply chain sustainability initiatives therefore hold significant potential for reducing emissions.

Among the biggest levers for reducing the environmental impact of industry per Gartner are:

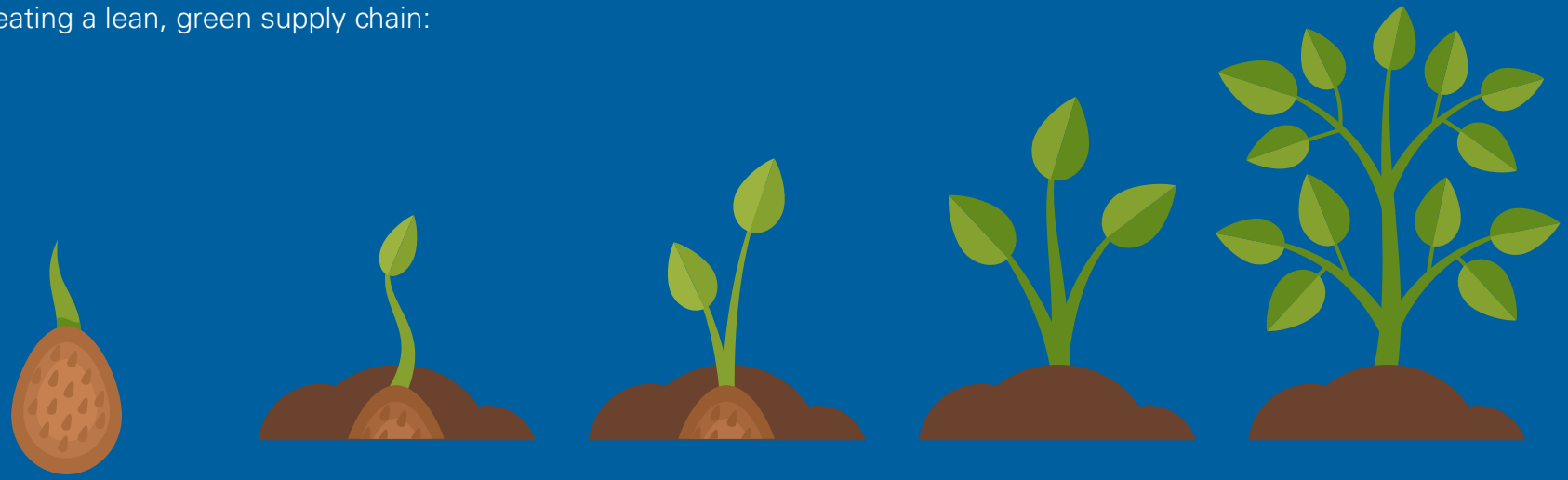
- Factory location
- Internal energy use (conservation plus energy source)
- Fleet vehicle types
- Route optimization
- Supply chain network design

3 "Designing an Environmentally Sustainable Supply Chain Network," Kamala Raman and Pam Fitzpatrick, Gartner https://www.gartner.com/doc/3621326/designing-environmentally-sustainable-supply-chain

How to Start Down the Green Path

Given the multiple and compelling benefits, it may be tempting to jump right into green supply chain design. However, long-term success depends on laying the proper groundwork first.

Karen M. Kroll, writing in Inbound Logistics,[4] recommended five preliminary steps to prepare for creating a lean, green supply chain:



Engage Leadership

Assemble a Diverse Group

Establish a Baseline and Measurement

Set Goals

Focus on Total Lifecycle Costs

4 "19 Steps to Creating a Lean and Green Supply Chain," Karen M. Kroll, Inbound Logistics http://www.inboundlogistics.com/cms/article/19-steps-for-creating-a-lean-and-sustainable-supply-chain/

1. Engage Leadership

Sustainability is a strategic objective, and as such, "commitment from the top is critical."[5] Once leadership understands the business case, top executives will help achieve green supply goals by dedicating personnel and resources to the transition.

2. Assemble a Diverse Group

Bringing experts from different disciplines to the team helps assure no opportunities are overlooked, and that initiatives don't conflict with one another. It also "creates champions of sustainability initiatives across the organization."[6]

3. Establish a Baseline and Measurement Processes

Knowing where you are starting from is the first step in getting to where you want to go. Gartner[7] advises creating "a strong baseline assessment of the existing network so you can select the right metrics" to both identify the starting point for all measures as well as to track progress as initiatives are adopted.

4. Set Goals

Establishing goals is a challenging, but important, step. Ideally, goals should be attainable but ambitious, requiring creative thinking and resourcefulness to achieve. If team members know exactly how to meet a goal right out of the gate, the objective probably isn't aggressive enough.

5. Focus on Total Lifecycle Costs

As the analysis progresses, it's essential to look at costs within the overall supply chain framework rather than in isolation. This is where having a diverse team and modeling technology can help. For example, wood crates cost more than cardboard, but may be worthwhile if they are reusable—unless return shipping costs wipe out those savings. A holistic view of the supply chain gives an accurate picture of areas of opportunity and risk.

5 "19 Steps to Creating a Lean and Green Supply Chain," Karen M. Kroll, Inbound Logistics http://www.inboundlogistics.com/cms/article/19-steps-for-creating-a-lean-and-sustainable-supply-chain/

6 "19 Steps to Creating a Lean and Green Supply Chain," Karen M. Kroll, Inbound Logistics http://www.inboundlogistics.com/cms/article/19-steps-for-creating-a-lean-and-sustainable-supply-chain/

7 Gartner, "Designing an Environmentally Sustainable Supply Chain Network"

Green thinking can be applied across the supply chain from end to end:

1. Procurement
2. Product Design
3. Production
4. Packaging
5. Shipping
6. Network Design
7. Reverse Logistics

Let's take a look at each area in more detail.

1. Green Supply and Procurement

To fully realize the benefits of a green supply chain, it's essential to consider the parts of it you can influence as well as those you directly control. When purchasing raw materials or components, there are a number of steps you can evaluate to reduce the environmental impact, including:

- Use local suppliers whenever possible, to minimize shipping distances.
- In addition to cost, consider environmental performance when evaluating suppliers. Ask if they have programs in place to reduce waste and energy use, and if they recycle products and materials.[8]
- Work with suppliers to transport their products to you in an environmentally friendly manner—for example, by using fuel-efficient vehicles or utilizing bulk shipments.[9]
- Include sub-tier vendors (the suppliers of your suppliers) in your discussions. Communicate your expectations and work with these suppliers to set measurable goals that will help achieve your objectives.[10]

8 Kroll, "19 Steps"

9 "3 Steps to Building a Green Supply Chain," Hazardous Waste Experts http://www.hazardouswasteexperts.com/3-steps-to-building-a-green-supply-chain/

10 Ibid.

Shift in Perception of Sustainability Initiatives

Over the past 10 years there has been an evolution of perception of sustainability initiatives in the boardrooms of global businesses. In the past these initiatives were viewed as separate from other corporate priorities. This shift may be in part due to the United Nations' Sustainable Development Goals, as a related Accenture study showed that 87% of global chief executives said the goals triggered a rethink on approaches to sustainability. Other factors include pressure from investors, increased governmental regulations, and attention from employees and consumers and partners who increasingly consider environmental responsibility as a factor in business decisions.

Sources:

http://boardagenda.com/2017/11/01/sense-sustainability-rewards-responsible-business/

https://www.accenture.com/gb-en/insight-un-global-compact-ceo-study

2. Product Design

Designing products for sustainability can in some cases add to product cost. But the difference is often more than compensated for in terms of commanding a higher price and margin. Certifications, such the ENERGY STAR® label on electronic devices, are appealing to consumers, helping to mitigate any cost increase. And products designed for sustainability often last longer as well. Ideas for reducing environmental impact through product design include:

- Redesign products to eliminate or minimize use of hazardous or rare materials when possible.[11]
- Design products to be reusable or reprocessed (for example, refillable inkjet printer toner cartridges) rather than disposable.[12]
- Design products to be refurbished / repaired, giving them a longer life, and ultimately recycled rather than added to the waste stream.
- Design products using recycled materials where feasible.
- Where possible, design products using fewer or less materials.
- Collaborate with suppliers or contract manufacturers to jointly drive design changes that reduce the environmental impact of the product itself or the manufacturing process.[13]
- Where possible, produce concentrated products (e.g., concentrated cleaning products designed to be diluted in water) for a reduction in packaging costs and inventory space requirements.[14]

11 Murray, "Introduction to the Green Supply Chain"
12 Kroll, "19 Steps"
13 Gartner, "Designing an Environmentally Sustainable Supply Chain Network"
14 Ibid.

3. Manufacturing and Assembly

The location of manufacturing facilities (relative to suppliers/markets as well as sources of renewable energy), plant design (equipment, HVAC systems, power co-generation), and manufacturing processes all provide opportunities for minimizing the environmental impacts of production. Specific ideas for eco-friendly manufacturing include:

- Redesign production processes to eliminate or minimize use of hazardous materials.
- Analyze production facilities and processes for opportunities to reduce energy use as well as switch to renewable sources[15] (e.g., rooftop solar installations).
- Evaluate systems for filtration and recirculation to reduce water use.
- Capture scrap material and return it to vendors for recycling / reprocessing to reduce waste.
- Use building management systems to reduce energy use in non-production facilities.
- Products, processes, and materials constantly change. Always be cognizant of looking for opportunities to recycle, rework, and/or re-use materials and parts.[16]

15 MIT, "Green Supply Chain Management"
16 Brzoznowski, "Commentary: Five Ways"

Corporate Responsibility

The corporate world is recognizing the importance of emissions. Apple, Coca-Cola, Walmart and PepsiCo are among 13 of the largest companies in the US that have signed the American Business Act on Climate Pledge with some ambitious company-specific goals of reducing carbon emissions and heightening focus on environmental sustainability. The pledge acknowledges that increased focus on sustainability, "will produce multiple benefits with regard to sustainable economic growth, public health, resilience to natural disasters, and the health of the global environment."

Source:

The White House, 2015, https://obamawhitehouse.archives.gov/the-press-office/2015/12/01/white-house-announces-additional-commitments-american-business-act

4. Packaging Design

Packaging offers multiple opportunities for reducing environmental impact. But it's a challenging area considering all the purposes packaging must achieve and balance:

- Clear identification (prevent mistakes)
- Protection (breakage, spoiling)
- Theft prevention
- Marketing/branding
- Cost minimization

While balancing those attributes, ideas for improving sustainability in the area of product packaging and containerization include:

- Minimize materials usage (particularly plastics).
- Use recycled materials where feasible.
- Minimize empty space (to avoid "shipping air")
- Maximize stackability and packability to fit more products on a palette and in each shipment (e.g., square or rectangular packaging rather than round or oval shaped).
- Develop re-usable packaging for shipping.
- Re-use outbound shipping containers for product returns.
- Consolidate (ship multiple products packed together) when possible.

5. Shipping and Transport

By happy coincidence, the least expensive shipping modes also have the lowest environmental impact. However, it's important to balance the economic and ecologic advantages of bulk shipping with the impacts of larger order sizes and carrying more inventory. What considerations should you take into account when deciding the right mode for your objectives?

Mode	Average Kg of CO per Ton-Mile[15]	Average Cost per Ton-Mile[16]
Air Freight	0.8063	$1.3567[17]
Truck	0.1693	$0.0662
Rail	0.1048	$0.0366
Sea Freight	0.0403	$0.0061

- Analyze trucking practices carefully. Consolidating shipments often makes economic and ecologic sense, but in some cases, using less-than-truckload (LTL) shipments may make more sense, if it eliminates multiple trips between warehouses.[20]
- Conduct a backhaul analysis. Take a big-picture view to avoid trucks returning empty, looking first for internal product moves or reverse logistics. If there are no good internal options, work with a broker to find potential backhaul partners.[21]
- In addition to modal and truckload (TL) versus LTL analyses, compare third-party shipping options to your internal fleet on all routes.[22]
- Analyze the best points at which to break bulk and opportunities to mix products in shipments.[23]
- With an optimized supply chain network design (see the next section), route optimization offers the greatest potential for savings. Optimizing transport routes reduces:
  - Driver hours
  - Vehicle wear
  - Fuel consumption
  - Emissions
  - Overall shipping costs
- Revisit route optimization frequently. Changes in market conditions, fuel costs, traffic patterns, and road construction can impact delivery times, costs, and emissions. As Toby Brzoznowski noted in Supply Chain Quarterly, "Route-optimization software often identifies a 20 percent or more reduction in miles and can help identify opportunities for backhauls and better asset utilization, which leads to a more sustainable transportation network."[24]
- As fleet vehicles age, evaluate replacing them with more fuel-efficient or alternative-fuel vehicles.

17 "Environmental impact of transport," Wikipedia https://en.wikipedia.org/wiki/Environmental_impact_of_transport
18 "Characteristics and Changes in Freight Transportation Demand," U.S. Department of Transportation https://ntl.bts.gov/lib/4000/4300/4318/ccf_apxF.pdf
19 "Average Freight Revenue Per Ton-mile," Bureau of Transportation Statistics https://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_03_21.html
20 Kroll, "19 Steps"
21 Ibid.
22 MIT, "Green Supply Chain Management"
23 Ibid.
24 Brzoznowski, "Commentary: Five Ways"

6. Supply Chain Network Design

While initiatives in areas like energy conservation and waste reduction are becoming more common, network design presents largely untapped potential for improvement in environmental performance. According to Gartner, " Very few companies are utilizing network design capabilities to track, analyze and optimize emissions reductions. Hence, when sustainability goals require investment, they may seem at odds with traditional financial objectives such as cost reduction."[25]

Choosing the most impactful changes for benefiting both the environment and the bottom line requires both taking a big picture view and utilizing modeling software to evaluate alternative supply chain network design scenarios.

- Analyze your transportation network to avoid "double shipping," where products are moved more than once or backtrack.[26]
- Optimize your warehouse design to minimize space used, the number of times each item is handled, and the travel distance within the facility. [27]
- Inventory control isn't just about minimizing it, but also how much you are stocking and in what location. You may be able to improve both service levels and environmental performance by storing more finished goods closer to sources of demand based on your analysis.
- Revisit network design periodically, particularly if your company is growing through mergers and acquisitions. These activities can lead to redundant facilities or opportunities to rebalance inventory storage.
- Use supply chain modeling software, like LLamasoft® Supply Chain Guru® to evaluate future network design optimization scenarios. While it's unlikely you'd move a production facility purely for environmental reasons, if compelling reasons arise for a move (e.g., labor costs, tax incentives, obsolescence, changes in supply sources or demand patterns)—or if building a new factory is needed to meet growing sales—take sustainability into account. "For example," writes Brzoznowski, "if you consider the source of energy powering a facility, you may find significant opportunities to reduce GHG emissions, often within only a few miles and within similar cost constraints."[28]

25 Gartner, "Designing an Environmentally Sustainable Supply Chain Network"
26 Kroll, "19 Steps"
27 Ibid.
28 Brzoznowski, "Commentary: Five Ways"

7. Reverse Logistics

Gartner places companies with closed-loop supply chains at its highest stage of sustainable supply chain maturity. Yet even short of a fully closed-loop system, producers can find ways to reduce their environmental impact in reverse logistics flows. Among ideas for improving sustainability through returns, recycling, and refurbishment processes:

- Analyze product return processes. If consumer product returns are routed to multiple warehouses, determine if a centralized returns location is more efficient.[29]
- Develop programs and methods to recover raw materials from products already in the field.[30]
- Develop and offer options for refurbishing or remanufacturing products in the field.[31]
- Develop a closed-loop supply chain (return / refurbish / recycle everything).[32]

29 Kroll, "19 Steps"
30 Gartner, "Designing an Environmentally Sustainable Supply Chain Network"
31 Ibid.
32 Ibid.

Conclusion

Use Technology to Save the Environment (and Money)

There are dozens of steps any company can take to reduce GHG emissions, many of which benefit the bottom line as well as the environment. But while some of these tactics may seem obvious, determining the best alternatives often isn't easy.

Moving freight by ship has the lowest cost and environmental impact among transport modes. But choosing an on-shore supplier may be an even better option. Substituting a more expensive material for a less costly alternative may ultimately be the better choice for both the environment and the bottom line—if that material is easier to re-use or recycle. While shipping empty space is generally wasteful, there may be times when LTL deliveries make more economic and ecologic sense—if doing so reduces the overall number of trips or miles driven. There is no one size fits all approach, so entering with a solid view of your organization's objectives is key to making the best choice for your organization.

To make the best decisions taking all constraints and tradeoffs into account, companies need to involve a diverse group of professionals from across different organizational functions in the planning process, and use technology to model the impacts of different scenarios. Software platforms which can assist in choosing the best alternatives across the supply chain, from sourcing through reverse logistics, include but are not limited to:

- Partner relationship management (PRM)
- Product design and lifecycle management
- Enterprise resource planning (ERP)
- Packaging design
- Supply chain management/planning (to optimize loading and routing)
- Online training and support systems (to reduce the need for travel)[33]
- Supply chain network design
- Demand planning and modeling

33 Kroll, "19 Steps"

Using LLamasoft® Supply Chain Guru®, companies can set up models of their supply chains to identify major sources of emissions and model different scenarios, quantifying the financial benefit or costs of achieving sustainability goals. They can build multi-year models to develop and phase GHG reduction programs, and to monitor and report on progress during implementation. If there are major changes to the costs of particular transport modes or operating sites, alternative supply chains can be assessed and implemented.

Per Gartner,[34] "Commercially available network design software, such as LLamasoft's Supply Chain Guru, can make such calculations (balancing economic and environmental impacts) easier by including standardized variables for different types of carbon inputs... in a network model, as well as by including access to greenhouse gas emissions benchmark data within the tool for major transportation modes, per-unit weight and distance shipped."

The LLamasoft transportation optimization solution can help lower carbon emissions by minimizing empty miles through backhaul and interleaved consolidation opportunities. Additionally, zone skipping and consolidation of shipments through cross-docking/ hubs can improve vehicle utilization, ultimately leading to lowered route costs and GHG emissions. These approaches allow for informed decision-making as well as providing the means to demonstrate corporate responsibility. To learn more, email sales@llamasoft.com or call 866-598-9831.

34 Gartner, "Designing an Environmentally Sustainable Supply Chain Network"

About LLamasoft

We love helping our customers design thriving supply chains. LLamasoft enables organizations around the world to model and optimize their supply chain operations for major improvements in cost, service, sustainability and risk mitigation. We're driven to make supply chain optimization easier, better and faster, so you can make the world a better place. We continue to innovate with an aggressive development roadmap including new solutions for supply chain visibility, planning, and predictive analytics.

- Named to the Deloitte Fast 500 for five consecutive years
- Nearly all of Gartner's Supply Chain Top 25 have designed with LLamasoft
- 50% of Fortune 100 companies have designed their supply chains with LLamasoft
- LLamasoft has supported over 2,000 supply chain design projects

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