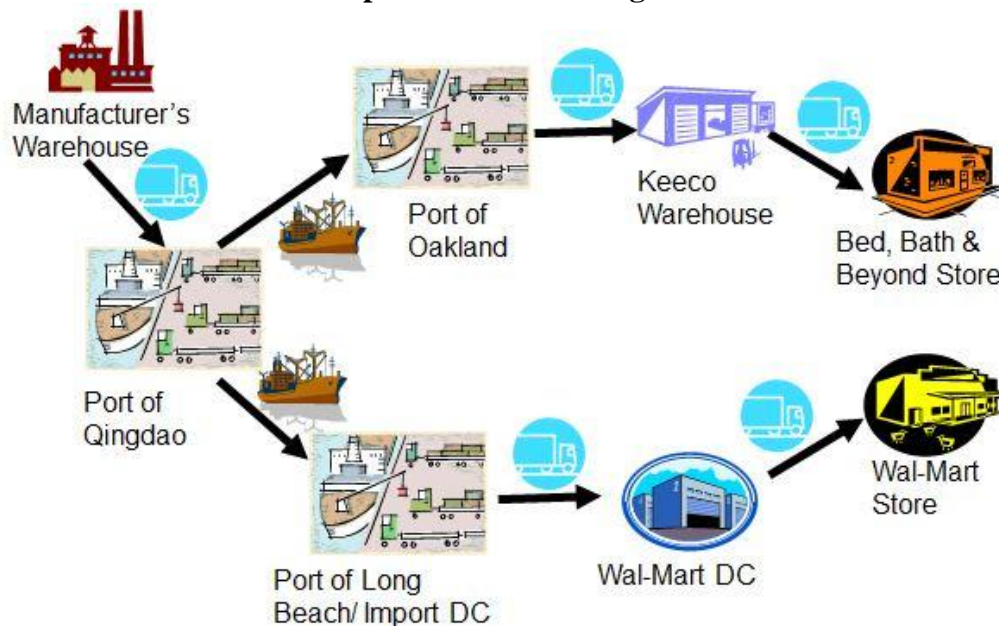


Case: Analyzing Energy and CO₂ Emissions from Importing and Distributing Home Furnishings

Introduction: We shall use CargoScope to model the distribution of a down comforter sold through a retail store in San Jose, California. We will trace the journey back to the manufacturer's warehouse in China, calculating the energy usage and emissions along the way.

Keeco, Inc. is the US-based trading partner of Keeco-China, which in turn has relationships with several contract manufacturers near both Shanghai and Qingdao. Although most consumers are not familiar with the name, Keeco is a major supplier of home furnishings found in many retail stores under a variety of brands.¹ Distribution to these stores varies. For instance, Wal-Mart maintains 40 huge distribution centers within the US including one near Mira Loma², which will be used as the representative DC. Yet another Keeco customer, Bed, Bath & Beyond, does not maintain traditional DCs and requires its vendors to ship items directly to stores. Keeco often fulfills these types of orders through their warehouse adjacent to Keeco's headquarters in Hayward, California. This warehouse receives product solely from Keeco-China, which typically arrives to the US through the Port of Oakland. These products can then be directly distributed from the warehouse to customers by Truckload, LTL (Less-than-Truckload) and even parcel delivery. Both of these supply chain configurations are depicted below.

Figure 1: Push View of Two Options for Delivering Comforters to San Jose Retailers



Although supply chains are often depicted as above with the consumer or retail store as the last step, we can also view this network of relationships starting from the consumer or retailer and look back towards the supplier, effectively a *pull* view of the supply chain. In building our scenarios in CargoScope, we will use a retail store as our root (starting) node and then define nodes further *upstream*. We do not repeat the directions on how to use CargoScope, as many students may have used these interactive directions to build the Wii/Best-Buy supply chain. Some readers may benefit from reviewing and (re)working that prior case.

¹ See <http://www.lkeeco.com/> for more examples.

² While facilities that do not receive customers directly are not as easy to locate as stores, looking at corporate websites for logistics jobs is often a helpful way to find distribution centers: <http://walmartstores.com/Careers/7741.aspx>

After logging into CargoScope, we first define both the shipping weight and dimensions of the product. Most down comforters are packaged in rectangular boxes; a 20x24x12 inch box, with a shipping weight of 8 pounds is typical for a queen-sized comforter.³ The product is assumed to keep dimensions thorough out the supply chain. Indeed, many home furnishing products are already packed within store-ready packaging, with only shrink wrapping or minimal other such bulk packaging needed. A spreadsheet will be handy to convert to SI (metric), showing we need to allot **.094** cubic meters and **3.629** kilograms for an item.



Table 1: Product Measurements

Down Comforter		inches	metric	
dimensions	in->m conversion	20	0.508	
		24	0.610	
		12	0.305	
			0.094	cu-m
weight	lbs->kg conversion	pounds		
	0.454	8	3.629	kg

It should be noted that we do not need to estimate dwell times at any of the nodes. Home furnishings do not typically require climate control interventions; long term product storage at a warehouse is unlikely to result in any significant increase in energy usage. Likewise all transit is assumed to be without any climate control.

Supply Chain Scenario #1: Via Wal-Mart

Although Figure 1 illustrates the supply chain from a *push* perspective, we will detail it from a *pull* perspective. Our first node will be Wal-Mart Store #5435, in San Jose. While other distribution schemes are possible, we assume that our comforter arrives there from the next node, the Wal-Mart distribution center (DC) Mira Loma, via one of the heavy duty diesel trucks within Wal-Mart's fleet, 610 km away⁴. We posit will be fully utilized on the way to the store and carry returned merchandise, allowing for some (10%) backhaul. Wal-Marts are typically large-format stores stocked with many imported items, and there are 2 other Wal-Marts within 20 kilometers of Store #5435, so it would be plausible that regional sales volumes would merit use of larger vehicles. While it is likely the truck is carrying a variety of merchandise from the DC, we will assume the truck is filled with the same or similar products. Unlike the Wii and many other products, comforters are bulky compared to their weight, so a truck filled with comforters would “cube out” (fill by volume) before the truck's weight limit is reached, or “weigh out.”

While Wal-Mart has several DCs in California, the Mira Loma DC is the one closest to the Port of Long Beach, our third node. The Port of Long Beach (USLGB) is the second busiest port in the US, with 90% of trade with East Asia, and with China being the top trading partner.⁵ This seems a natural place for Wal-Mart to receive Chinese-made merchandise. We assume a similar heavy duty truck makes the 100 km trip fully loaded, but returns to the port empty (0% backhaul.)

³ One way to find shipping weights and dimensions for products is to look at online retailers such as www.amazon.com.

⁴ All trucking routes are calculated via www.maps.google.com

⁵ More Port information can be found at <http://www.polb.com/about/facts.asp>

The shipment arrives into USLGB from Qingdao (CNTAO), 9250 km away.⁶ While Keeco-China also exports through the Port of Shanghai (CNSHA) for export, the difference in distance is negligible. We assume a Large Bulk Carrier is used, and we use the CargoScope defaults of 100% utilization and backhaul. Remember these defaults cannot be reset for ocean, air or rail transport modes- it appears that CargoScope lets these be reset, but this part of the interface is misleading- they cannot be changed.

Our last upstream node will be the manufacturer's warehouse. Although Keeco-China sources product from many different contract manufacturers, most are approximately 100 km from either Shanghai or Qingdao. We assume a mid-sized truck is fully utilized to transport the goods to the appropriate port and that it returns empty.

Supply Chain Scenario #2: Via Bed, Bath & Beyond

We consider an alternate supply chain network to service the San Jose clients seeking down comforters. As previously mentioned, Bed, Bath & Beyond does not maintain its own DCs and expects vendors to be able to provide store-ready product directly to each of the stores. Keeco often accommodates such terms through an alternative distribution model that we depict below. It should be noted that even stores like Wal-Mart that have their own DCs occasionally utilize this method of distribution.

First, we consider one of the many Bed, Bath & Beyond stores in San Jose. Although there are 5 nearby stores, we select the Blossom Hill store.⁷ We assume Keeco arranges for transport to this store via a mid-sized truck from its warehouse in Hayward, 50 km away. Neither Keeco nor Bed Bath & Beyond maintains a company fleet of vehicles; a third party logistics provider (3PL) will be used. For full truckload deliveries we would have 100% utilization, but for Less-than-Truckload, we either need to send the truck partially empty or allow the carrier to make multiple stops or visit a terminal for load consolidation, increasing distance travelled for the overall trip and delaying the delivery time. We can capture the LTL effect through CargoScope by showing a lower utilization, 50%. However, use of a 3PL means that the truck is free to take another job such as returning back to Hayward with cargo or perhaps taking cargo from San Jose to another place, so we set the backhaul rate at 100%.

Further upstream, we assume that the Hayward warehouse receives goods from the Port of Oakland, 35 km away. While a smaller port, Oakland (USOAK) is slightly closer to the Chinese ports of interest, at 8740 km distance. Again, we assume that we arrange for transit via a 3PL's mid-sized truck, and we will assume 50% utilization and 100% backhaul (as that truck may have transported goods to the port for another client). From this point onward we will use the same assumptions as in the first scenario.

Your team will provide an executive overview summarizing the situation and any recommendations, as well as an additional document that addressed each of these Questions and Discussion Points as follow. Although you should present each of these points below in "worksheet format," (specifically addressing each question and discussion point in order) be professional, clear and concise. If needed, you may embed graphics with your document(s).

Questions

⁶ Port to port distances and port abbreviations can be found at <http://www.searates.com/reference/portdistance/>

⁷ Store locations and other information are retrieved from <http://www.bedbathandbeyond.com/>

- 1) Which of the two supply chains appears to be more energy and emissions efficient? Can you think of circumstances where the other supply chain is likely to be superior?
- 2) What is the most energy-intensive link of each supply chain? Does distance appear to be the dominant factor in determining emissions?
- 3) As described, what are some of the advantages that the logistical design of Scenario 1 has over Scenario 2? And what are the comparative disadvantages?
- 4) What would happen if we air-freight comforters instead of sending them by ocean freight? (You may ignore the minor model inaccuracies that occur because airports and ports are not located exactly in the same place). Despite the increased expense and energy usage, when might companies opt to use air-freight instead of sending cargo by ship?
- 5) When deliveries to customers are sufficiently small Keeco will arrange for such loads to go to the individual store via a parcel carrier such as FedEx. This scenario can be represented as follows. We alter Scenario 2 to replace the route between the retail store and the Keeco warehouse. Instead, a FedEx delivery truck transports the comforter to the store from the FedEx sorting center in South San Francisco. This would be a new node⁸, which in turn receives the package from another delivery truck that stops by Keeco's Hayward warehouse. Although delivery routes for parcel delivery trucks vary, we will assume a conservative figure of 160 km, with 100% backhaul (as the daily route is circular, there is no issue with a return trip) and 100% utilization.⁹ While FedEx has some electric and alternative fuel vehicles in their fleet, the standard parcel delivery vehicle is closest to a light diesel truck in CargoScope.
 - a) How are energy and emissions affected? What is the likely cause?
 - b) For scenario 2, how much would the utilization on the truck going between the store and the Hayward warehouse have to decrease for energy and emissions to be comparable to that from parcel post delivery?

Discussion Points

- A. Do there seem to be any straightforward ways to reduce transportation energy usage and emissions in the different supply chain scenarios presented? If so, which party or parties should be responsible?
- B. Notice that the supply chain has a limited frame. What stages and links are we leaving out of the frame, and should we have included these? What are the difficulties we might face if we did?
- C. What are some other considerations besides energy and emissions usage do companies may face when determining which supply chain option to use for delivery?
- D. As seen at <http://walmartstores.com/Sustainability/> Wal-Mart is concerned with improving sustainability. What lessons could Wal-Mart take from a carbon footprinting exercise such as this? What are some other considerations for their home furnishings merchandise?

⁸ Inserting a new node in CargoScope is less time consuming thought use of the cut and paste feature. First, cut all nodes below where you want to place a new node. Next, add the new node in, and once it is added, use the paste feature. You will need to define the transit links both between the new node and the parent and the new node and its child.

⁹ This figure is based on the 100 miles per day estimate for parcel delivery vehicles as found in: http://www.allcarselectric.com/blog/1043872_fedex-launches-all-electric-trucks-for-urban-parcel-delivery