

Homework 4

- 1) You are the packaging engineer for a toothpaste company. Your secondary packaging measures 2.5" h x 2.5" d x 6" l. You ship 20,000,000 units of toothpaste per year. The toothpaste is shipped on wooden pallets weighing 75 lbs a piece and you can only get 2 shipments out of a pallet before it has to be scrapped. Each pallet costs \$10 new and the cost of the wood disposal is \$0.50/lb. The pallet dimension is 48" x 48" and the boxes can be stacked 40" high. The transportation costs (trucking, fuel, labor, etc.) are \$25/pallet. The toothpaste has a primary package made of polyethylene and a secondary package made of cardboard. The cost of the cardboard (paper, handling, printing, etc.) is \$0.001 per square inch. After careful analysis, you determine that you can reduce the size of the secondary packaging by ¼-inches in all three dimensions without impacting the marketing and sale of the product. The cost to make these engineering changes is \$100,000. Determine the total amount of money the company will save each year from your design modification.



Things to think about:

- a) Packaging [1 point]

The original box size is 66.25 sq. in. and the volume is 37.5 cu. in. How many sq. in. of paper will you save each year? What will the cost savings be, given the cost of \$0.001/sq. in.? [Hint: the area of the paper is based on the number of sides there are to the box...there's 6 sides to a box.]

- b) Cost of the pallets [1 point]

With the original box size, you can get 2,458 boxes of toothpaste on a single pallet [Pallet volume (40" x 48" x 48") ÷ box volume (37.5 cu. in.)]. That means you'll need 20,342 pallets per year to ship 50M tubes of toothpaste. With the change in box size, how many fewer wooden pallets will you need? What's the cost savings for new pallets? [Hint: remember you can make 2 shipments before you need to replace the pallet.]



- c) Disposal of the scrap pallets [1 point]

With the original box size, you'll need to dispose of those 10,171 pallets (20,342 pallets ÷ 2 shipments/pallet), and the cost to dispose of them is \$0.50/lb x 75 lb./pallet x 10,171 pallets = \$381,408/yr. How much will you save on the disposal costs with the smaller boxes?

- d) Cost of the transportation [1 point]

The cost to transport those 20,342 pallets is \$406,835. How much will you save on transportation costs with the smaller boxes?

- e) What's the total cost savings in the first year? [Hint: don't forget you had to spend \$100,000 on the initial engineering changes.] [1 point]

- 2) Your company produces and sells cathode ray tube (CRT) video display monitors. You produce 1 million units per year. Your company is looking to differentiate itself from the competition and marketing research shows that if your customers are “Greenback Green” and “Sprouts” and that by selling your monitors as environmentally



friendly you may pick up some market share. Your R&D people decide that you should move into production and sale of flat panel display (FPD) monitors because they use less energy and don't contain some of the toxic materials present in CRTs (mercury, lead, etc.). In doing the comparison between the two product lines (assume number of units will remain at 1 million), you determine the following:



- Energy usage by the CRT when it is active is 240 watts
- Energy usage by the FPD when it is active is 65 watts
- Both units have a “sleep” mode (inactive) with power consumption of 3 watts
- Usage for both are: 24 hrs/day, 365 days/year, 25% of the time is active, 75% of the time is in sleep mode
- The use of electricity produces global warming gas emissions, primarily in the form of carbon dioxide (CO<sub>2</sub>). The average generation of electricity in the country is as follows:
  - Natural gas, 30%, produces 0.5 Ton CO<sub>2</sub>/MWhr
  - Coal-fired, 50%, produces 1.1 Ton CO<sub>2</sub>/MWhr
  - All others (hydro, nuke, wind, solar, etc.), 20%, produces 0.1 Ton CO<sub>2</sub>/MWhr
- Average electricity rates are \$0.16 per kW-hr
- The retail sale price for a CRT is \$200 and the price for a FPD will be \$400.

Determine the following:

- a) Total power used by 1 million VDUs for CRTs and FPDs? [2 point]
- b) How much CO<sub>2</sub> produced per 1M VDUs of CRTs and FPDs? [2 point]
- c) How much CO<sub>2</sub> could be reduced? [1 point]
- d) **Extra credit:** how long will it take for a consumer to make up for the additional cost to buy an FPD vs. the CRT just from cost of electricity? [+1 point]

[show your calculations]