What's the Environmental Footprint of a Greenopolis Recycling Kiosk?

By Joe Laur, Senior Manager – Community Engagement and Development for Greenopolis

What is the energy invested in building, shipping and running the Greenopolis Recycling Kiosks?

We all know that the Greenopolis Recycling Kiosks save energy. Every can that is recycled in one of our Kiosks or a PepsiCo Dream Machine represents 2000 watts of savings; every plastic bottle represents 360 watts saved.

But what is the energy invested in building, shipping and running the kiosks? Do they return more energy than they expend over their lifetime? These are good and important questions. Here are some facts and figures on the environmental footprint of our kiosks. I've broken it down into two broad categories: The "upfront" environmental costs of manufacturing and shipping the kiosks, and the "ongoing" environmental costs of operating them.

We'll take a look at the average capture of the kiosks currently in operation and see how long the "upfront" payback time is, and what the "ongoing" payback is afterward. Then we'll give our best estimate of the energy and CO2 savings of the 3000 kiosks we expect to be deployed as Greenopolis Recycling Kiosks and PepsiCo Dream Machines by the end of this year.

This is the kind of transparency and honest assessment we want you to expect from Greenopolis in everything we do. It's our philosophy that most of us, customers, companies, activists, will do the right thing if we have good information. We'll track two metrics below, the energy in kilowatts it takes to make and run the machines, and the pounds of CO2 waste that it represents.

Our kiosks are made in Denver. They have two main components: A laptop computer and a steel housing along with some electronics.

Energy and Carbon Cost to Make a Kiosk

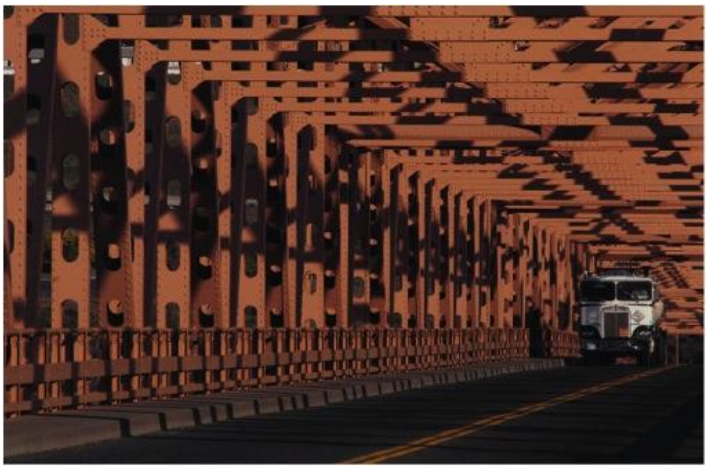
The production line at the Denver based plant for the Greenopolis Recycling Kiosks is better described as integration, rather than manufacturing. The main manufactured element of the kiosks is the cabinet metals, which are sourced from another Denver firm, who have eliminated all solvent-borne paints and powder coatings, achieved a 100-percent recycle rate of scrap metal, paper, and cardboard, switched to biodiesel, and instituted reusable packaging. The computer manufacturer is also a leader in green energy and waste elimination in their manufacturing processes.

The rest of the materials represent finished electronics and hardware goods. Once the materials are in-house, the rest of the activity is integration, software loading, Q/A, testing, and packaging. Measureable resources consumed in the creation of the kiosks, comes down to utilities (gas / electricity) used to acquire components and operate the facility. Utility costs run between $8K and $11K per month. In Denver, energy costs average 8.24 cents per kilowatt- so this represents roughly 133,495 KW of energy per month to run all the operations of the plant. To be conservative, we'll figure the total energy of the plant operations as going into the kiosks.

The US average energy mix generates 2.42 pounds of CO2 per kilowatt, (we found sources as low as 1.37 pounds per KW but went with the higher number to be "conservative"), and so at full tilt the plant would generate about 323,058 pounds of CO2 per month. The manufacturing rate at the plant is 667 kiosks a month, so that translates into 484 pounds of CO2 per machine. The carbon footprint of manufacturing and shipping a typical laptop computer is roughly 485 pounds, which is less than the CO2 footprint of pint of orange juice. Add the computer CO2, and you are up to 969 pounds of CO2 and 400 KW of energy per machine, on the dock ready for shipping.

Environmental Cost to Ship

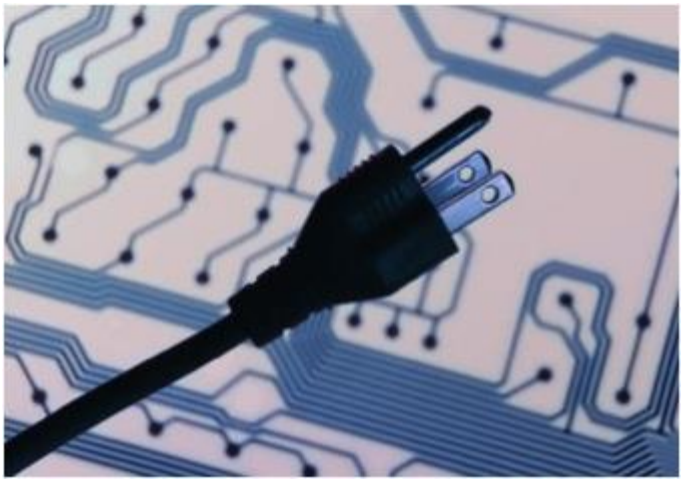
Average shipping distance from Denver to locations across North America is distance 1230 miles. 20 kiosks ship at a time on a 52' trailer that uses 223 gallons of fuels. At an EPA average of 19.4 Pounds of CO2 per gallon, this trip emits 4326.2 total pounds of CO2. Per kiosk, that's 216.3 pounds of CO2. So we are up to 1185.3 pounds of CO2 per kiosk to make and ship. At 2.42 pounds of CO2 per kilowatt, the "embedded energy equivalent" in each machine from manufacturing and shipping is about 490 Kilowatts of electricity, before the machine has grabbed a single can.



Energy and Carbon Cost to Operate a Kiosk

Now here's where it gets interesting. The kiosk operation energy consumption as measured by Underwriters Laboratories (verified at the manufacturer by a UL Agent on 4-30-2010) is as follows:

Normal Operation Consumption



- Draws 150 watts per hour – 3,600 watts per day, per machine
- Draws 1,314,000 watts per machine, per year

Average Operation (with AC unit cycling on about 20% of the time)

- Draws 214 watts per hour – 5,136 watts per day, per machine
- Draws 1,874,640 watts per machine, per year

Maximum Operation Condition (with AC on 100% of the time)

- Draws 470 watts per hour - 11,280 watts per day, per machine
- Draws 4,117,200 watts per machine, per year

Best case scenarios rarely happen, so let's throw out the lowest figure. The average operation of a kiosk represents 1,874KW/4535 pounds CO2 per year. Worst case, with the AC on all the time: 4117 KW/9963 per year of operation. The lifetime of the machines is estimated at 7 years. That brings us up to 13,118 KW/31,745 pounds CO2 for average operations; 28,819 KW/69,742 pounds CO2 in the worst case. Add the 490KW/1185 pounds CO2 embedded in the kiosk from manufacturing and shipping to both figures, and you've got a total lifetime range of energy and CO2 of between 13,608-29,309 KW and 32,930-70,927 pounds CO2.

Now we have a pretty good idea of a kiosk's lifetime costs in terms of energy and CO2. But what does it save us in recycling operations over its lifetime?

The two major items that the kiosks collect are PET bottles and aluminum cans. They also collect glass and HDPE plastic containers, but their energy saving values are similar to PET and aluminum, so we'll focus on those two.

As we noted above, recycling a single plastic PET bottle conserves enough energy to light a 60 watt light bulb for up to six hours. That's 360 watts total saved per bottle. Recycling a single aluminum can conserves the equivalent energy required to light a 100 watt light bulb for up to 20 hours, or 2000 watts total saved per can.

Our average recycling rates per kiosk, based on actual averages from existing kiosks deployed so far in California, New York and Texas are:

Plastic Bottles Reclaimed:

- 285 Bottles per day per kiosk = 102 kilowatts/247 pounds CO2 saved per day per kiosk
- 104,025 Bottles per year per kiosk = 37,449 kilowatts/90,626 pounds of CO2 saved per year per kiosk
- 728,175 Bottles over lifetime of kiosk =262,143 kilowatts/634,382 pounds CO2 saved over lifetime of kiosk

Aluminum Cans Reclaimed:

- 185 cans per day per kiosk = 370 kilowatts/895 pounds CO2 saved per day per kiosk
- 67,525 cans per year per kiosk = 135,050 kilowatts/326,821 pounds CO2 saved per year per kiosk
- 472,675 cans over lifetime of kiosk = 945,350 kilowatts/2,287,747 pounds CO2 saved over lifetime of kiosk

Combined Cans and Bottles – Kilowatts/CO2 Saved per day/year/lifetime

- 472 kilowatts/1142 pounds CO2 per day (each kiosk offsets its “embedded energy cost” of 490 KW/1185 pounds CO2 in a little more than one day of operation)
- 172,499 kilowatts/417,448 pounds CO2 per year
- 1,207,493 kilowatts/2,922,136 pounds CO2 over lifetime of kiosk

Greenopolis Recycling Kiosk average watt consumption per day/year/lifetime

- 5 kilowatts, worst case-11 kilowatts per day
- 1825 to 4015 KW per year
- 12775 to 28105 KW over lifetime of kiosk

The Bottom Line

After paying back its embedded energy and carbon footprint in the first day or two, each kiosk contributes an average net energy/CO2 savings of:

- 467 kilowatts/1130 pounds CO2 per day (worst case, 461 kilowatts/1115 CO2)
- 170,624 kilowatts/412910 pounds CO2 per year (worst case, 168,265 kilowatts/407,201 pounds of CO2)

- That's enough energy saved on average to power more than 15 average homes for a year. From one Greenopolis Recycling Kiosk.
- With over 3000 Greenopolis Recycling Kiosks and PepsiCo Dream machines slated to be deployed by 2011, we could be saving enough net energy to power 46,365 homes each year.
- That's the equivalent of a small city. We could call it Greenopolis!
- All while avoiding 1.24 billion pounds of waste CO2.

Even if the kiosks perform at one half or one third of our current trends, that's enough energy and carbon saved to represent tens of thousands of homes off the grid. The polar bears can thank us later. This is the power of recycling. This is the power of a single person putting a single can into a single kiosk every day, repeated millions of times across the land.

Do you doubt anymore that you can make all the difference? What's your next step?