The *Lotus Live* Guide to ***Drink Containers***

In this guide, Lotus Live presents the collective knowledge of our members and of many reliable internet and print sources regarding the eco-effectiveness of the various drink bottling methods on the market currently. The guide is divided into two sections: **known culprits**, which should be avoided, for a variety of environmental, social, or health reasons, and **passive positives**, the materials that are far better choices.

Known Culprits:

- **Aluminum** is the most energy intensive way to store drinks-having 1.5 as much embodied energy per liter of capacity than glass, and 3.7 times more than plastic.[1] Aluminum may also leach into a can's contents, and has been linked to a number of health issues, including Alzheimer's.[2]

- **Plastics:**

  - #1 (Polyethylene Terephthalate[3]) and #2 (High Density Polyethelene[4]) are the least toxic and most widely recycled plastics, so #1 and #2 are the best plastic options. However, although they are better than #3, 6, and 7, better packaging options still exist.

  - #3 (PVC a.k.a. vinyl[5]) is made from the carcinogen vinyl chloride, and releases the most powerful carcinogen known to man (dioxin) during its manufacture, and may leach phthalates and adipates in hot food that comes in contact with PVC, which have been shown to cause birth defects, fetal death, and damage to the liver, kidneys, lungs, and reproductive systems.[6]

  - #4 (Low Density Polyethelene[7]) and #5 (Polypropylene[8]) are also commonly recycled, and are generally considered to be safe.

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[1] 12 oz can weighs 0.014 kg * 218 MJ/kg = 3.09 MJ. 1 L = 2.8 cans = **8.7 MJ per L**

[2] Debra Lynn Dadd Aluminum Q & A

[3] PETE is used for soda bottles, water bottles, vinegar bottles, and medicine containers.

[4] HDPE is used for detergent, bleach, milk, shampoo/conditioner and motor oil containers, and various toys.

[5] PVC is used for pipes, shower curtains, cooking oil bottles, baby bottle nipples, shrink wrap, medical tubing, and vinyl covers.

[6] Living Better With Plastics

[7] LDPE is used for wrappers, grocery bags, sandwich bags.

[8] PP is used for Tupperware®, syrup bottles, yogurt tubs, diapers, outdoor carpets.

- #6 (Polystyrene[9]) is what many everyday soft plastics, and styrofoam are both made of. The soft plastic branch of #6 falls in with #4 and #5-often recyclable, but not 100% safe, while styrofoam is not commonly recycled and often ends up in landfill, where it lasts virtually forever. Styrofoam is known to leach carcinogenic styrene into hot liquids.[10]

- #7 (Polycarbonate[11]) plastics are made of phthalates, estrogenic endocrine disrupters which had been linked to lower sperm counts, decreased sex drive, early puberty, breast cancer, and ovarian cancer, and Bisphenol-A, a carcinogenic estrogen receptor which causes a wide array of horrifying effects including predisposition to breast cancer and damage to the reproductive system.[12] Bisphenol-A has been proven to leach from used polycarbonates at room temperature.[13]

- Although #1, 2, 4, and 5 are generally considered safe, all conventional plastics are made from finite, highly toxic petrochemicals.

Passive Positives:

- **Bioplastics**: In the future, bioplastics may be a viable alternative. Current research is generally inconclusive about the environmental performance of current bioplastics compared to the alternatives. However, as bioplastics could theoretically come from organic renewable resources, and would be recyclable and biodegradable, they definitely deserve a closer look. Preliminary research also indicates that bioplastics could represent up to a 30% reduction in embodied energy compared to traditional plastics.[14]

- **Glass:** Glass containers will not leach anything into their contents, and are very safe to use. The embodied energy is usually higher for a new glass container than for an equivalent plastic one (a one liter glass bottle uses twice the energy of a plastic one liter bottle[15]), but a glass bottle is easier and safer to reuse than a plastic one, and two or more uses of a bottle will negate the difference.[16] The raw material for glass (sand) is extremely abundant, especially compared to the finite fossil fuel inputs required for current plastics.

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[9] PS is used for coffee cups, disposable cutlery and cups, bakery shells, meat trays, packing peanuts, and styrofoam.

[10] Living Better With Plastics

[11] PC is used for hard, clear plastics, most notably in a certain brand of hiking water bottles.

[12] Environmental Working Group: Bisphenol A

[13] Bisphenol A Is Released from Used Polycarbonate Animal Cages into Water at Room Temperature

[14] Novamont processed bioplastic pellets = **59.5 MJ/kg**, compared to **83 MJ/kg** for traditional polyethylene.

[15] Glass 1 L bottle = 0.45 kg * 12.7 MJ/kg = **5.76 MJ** Plastic 1 L bottle = 0.028 kg * 83 MJ/kg = **2.35 MJ**

[16] A shift in the recycling industry which allowed intact bottles to be returned to the manufacturer to be sanitized and reused, instead of melted down and used as raw material would make glass an even more worthwhile choice.

- **Steel:** Steel containers will also not leach toxins into their contents. In addition, a 30 oz stainless steel water bottle has half the embodied energy of an equivalent plastic one[17] and a steel drink can has about a third as much embodied energy as an aluminum can[18]. Steel cans weigh a tiny bit more than aluminum ones, but are safer, and less energy intense. Steel is likely the most readily recyclable material in the world, and experiences no downcycling. Like glass, its inputs (mostly iron) are extremely abundant, and readily available.

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If you have any ideas, suggestions, or corrections you would like to contribute to this guide on Drink Containers, please send us an email at additions@lotuslive.org.

Feel free to make use of any of the information in this guide for any purpose--we simply ask that you credit us and our predecessors, and link to us.

[17] 27 oz steel weighs 0.156 kg * 52 MJ/kg = **8.1 MJ** 32 oz plastic weighs 0.163 kg * 100 MJ/kg = **16.3 MJ**

[18] 12 oz steel can weighs 0.022 kg * 52 MJ/kg = 1.14 MJ *2.8 cans/L = **3.2 MJ/L**, from above, Aluminum = **8.7 MJ/L**
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