



## HP's Closed Loop Plastics Recycling Process

### Overview

HP has developed an unprecedented, closed loop plastic recycling system that incorporates post-consumer recycled plastics – from sources such as water bottles and ink cartridges – into the manufacture of new Original HP inkjet print cartridges. An engineering breakthrough, HP inkjet cartridges made from newly molded recycled plastic resins still meet HP's high-performance standards. It took years of research and development and a team of dedicated engineers, chemists and partners to perfect this complex scientific process, the result of which lessens HP's environmental footprint, while maintaining high standards for design innovation.

### From "Down-cycling" to "Up-cycling"

HP has used plastic in product development for many years and has committed to developing sustainable end-of-life solutions for those products. For example, HP's Planet Partners return and recycling program makes it free and easy to return HP print cartridges, while ensuring that cartridges returned are never refilled, resold or sent to a landfill.

A longstanding challenge for HP and other companies in the technology industry has been to find uses that maximize the benefits of the highly technical materials recovered through electronics recycling programs. The use of recycled plastics from high-tech products in less-demanding applications, such as park benches or decking, is sometimes criticized as "down-cycling" even though such use provides a second life to recovered materials. Always seeking better solutions, HP set out to create a more sustainable, closed loop system, which will enable the highest value usage for these materials, including using recycled plastics to manufacture new HP inkjet cartridges.

HP's considerable investments in recycling resources and infrastructure provided the foundation necessary to improve the plastics recycling process. HP inkjet cartridges returned through Planet Partners are sent to HP's dedicated inkjet supplies recycling facility in Nashville, Tenn., where they begin a multi-phase recycling process.

Most cartridges within HP's inkjet portfolio are composed primarily of glass-filled polyethylene terephthalate (PET), a highly engineered formulation specifically tested for HP's inkjet cartridge performance and manufacturing. Achieving the same reliability with recycled PET (RPET) as with virgin plastics was a critical hurdle, so a team of dedicated engineers, chemists and partners made sure all recycled materials performed on par with virgin materials to meet HP's high performance standards. This is a significant accomplishment because the recycling process diminishes critical material properties.

Here's how the new process overcomes this obstacle:

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- HP combines recycled beverage bottle resin (RBR) and a suite of additives with the PET to offset lower viscosity, as well as thermal and mechanical property changes.
- The additive package also includes chain extenders to create the desired molecular weight, impact modifiers to provide the right amount of resistance for the product drop test, and nucleating agents to restore the crystalline nature of PET.
- HP adds additional glass fiber to account for both the RBR portion of the recycled plastic recipe, which contains no fibers, and fibers damaged in inkjet cartridge plastic recycling.

This highly engineered process creates a “drop-in” RPET resin that is equivalent in performance to virgin materials and can work with existing molds and manufacturing lines. The new RPET formulation – which accounts for 70 to 100 percent of the total plastic weight -- does not contain simply reground or re-melted plastic. HP and its partners have re-compounded and re-engineered the materials in a way no one has done before. They have “up-cycled” common plastic water bottles and recycled material from returned HP cartridges and turned them into Original HP inkjet print cartridges, containing more than 50 percent recycled plastic (95 percent post-consumer) by weight.

#### **Future opportunities and applications**

Since piloting the program, HP has used enough recycled plastic to fill more than 200 tractor trailers<sup>(1)</sup> and create more than 200 million HP inkjet cartridges globally. HP used more than 5 million pounds of RPET in Original HP inkjet cartridges last year alone, and is committed to using twice as much in 2008.

HP’s use of recycled plastic closes the product design loop. The innovative resin formulation is competitive with virgin resins on both price and performance factors. Having such a material will greatly facilitate additional environmental design innovations at HP, such as incorporating recycled content into HP hardware.

<sup>(1)</sup> Based on a nominal payload of 44,000 pounds.

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