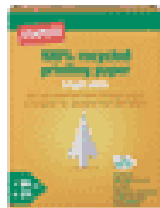


# Recycled Paper vs. Virgin Paper

ENVS 664 Sustainable Design Dr. R. Berman

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This document is printed on 50% recycled paper. Acid free. Recycled wood or fiber from FSC forests.

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**Introduction.** Recycled paper products can be purchased directly although the bulk of the recycled paper waste is made into cardboard and corrugated packaging. Printing paper and paper towels, napkins, etc. are available directly to the consumer. Recycled paper products and paper products from virgin pulp are related and their paths intertwined. The question of which to use, comes down to whether to recycle or not. It may sound like heresy not to select the recycled product every time but there are circumstances where other alternatives should be considered. Studies on this question were neither totally comprehensive nor definitive since they did not consider land usage impact and the issue of biodiversity. It seems wise on balance to continue to recycle and purchase recycled products.

**History of Paper.** Paper was invented in China by Ts'ai Lun almost 2,000 years ago (Paper Industry Association Council, 2008). In the 8<sup>th</sup> century Muslims Arabs learned about paper when they captured a paper plant in China. They later brought paper-making to Europe starting with a paper mill in Spain. In 1690, the first United States paper mill was built in Pennsylvania.

**How paper is made and where does recycling fit in?** The basic recipe is wood, water, and energy (Paper University-b, 2008). First, trees are harvested and transported to the paper mill. Logs are cleaned and the wood is turned into small chips. The chips are then put into water and turned into pulp using either a chemical or mechanical process or a combination of the two. Finished pulp is a mushy, watery solution that is 99% water. The wet end of papermaking starts with spraying this solution onto a long, wide screen called a wire. Water starts to drain out. The water is recycled over and over again (the original use for grey-water). The fiber mat which remains on the wire is squeezed by felt rollers until the pulpy stuff is about 60% water. At the dry end metal cylinders are heated by filling them with steam. The wet pulp passes through these cylinders (like wringers on vintage washing machines) many times as the pulp gradually turn to paper. The paper is given a uniform thickness by big heavy cast iron rollers called a calender. At the end of the line is a big roll of paper as wide as thirty feet.

In recycling (Paper University-a, 2008) as much as 20% of recovered paper is made up of ingredients which are not paper fibers that can be used. Trash such as staples, paper clips, wire, and plastic are screened out and sent to a landfill. The inks, coating and adhesives must be removed before recycled paper can be produced. Some fibers may have been recycled many times before and are now too short to produce paper. These will simply stay in the wastewater. Fibers of wood get shorter and shorter with each recycle and can only be used five to seven

times. Producing pulp from wastepaper requires more energy than with pulp from virgin wood because of the need for the mechanical breakdown of the fibers is required.

**Life Cycle Assessment.** Life Cycle Assessment (LCA) studies have been published for the European Pulp and Paper Industry. Most studies focused on whether recycling or incineration with energy recovery is the environmentally better option for wastepaper management (Finnveden, 1998). The conclusions reached by most could be stated as “it depends”. Conclusions differ with different assumptions in the life cycle inventory (LCI) analysis. Key factors include what energy is replaced (fossil fuel or renewable), what material is replaced by recycled fibers during incineration, how fast forest savings are used, and how efficient is the incineration carrier of the energy produced.

A life cycle optimization model (Bloemhof-Ruwaard, 1996) was developed for the European pulp and paper industry. Recycling offers a reduction in environmental impact in regions with a large population and a high production of paper products. However, regions with a high production of graphic products should focus on cleaner virgin pulp production with energy recovery from the incineration of waste paper. The methodology used a combined linear programming model of the European pulp and paper sector with an environmental index for each process. The configuration entails production, consumption, waste management and transportation. Processes upstream of pulp production – forestry, wood transport, etc. – are subsumed within the process of virgin pulp production. Four virgin pulp process types are assessed: bleached sulphate, unbleached sulphate, bleached sulphite, and bleached thermo-mechanical pulp (TMP). The manufacturing of paper itself is essentially the same regardless of fiber source. Seven emission categories are relevant to the pulp and paper industry: global warming, human toxicity, photo-oxidation, acidification, nitrification, and solid waste.

LCA as a decision-support tool was examined using seven studies on paper recycling versus incineration in Europe, primarily in Sweden (Finnveden, 1998). The studies included 12 cases and 27 scenarios. These cases show energy use to be consistently lower when paper packing material are recycled rather than incinerated. Studies which addressed the issue of transportation consistently concluded that as long as it is reasonably efficient, transportation will not have any effect on the conclusions. None of the studies addressed all relevant environmental impacts.

Assumptions on alternative energy used if paper is not available for incineration is a critical issue which could alter the conclusion and needs further study.

A study in Denmark was completed recently to validate the waste hierarchy (Schmidt, 2007). Denmark and the EU currently prioritize recycling over incineration and then again both over landfilling. Using LCA studies the authors conclude that the priorities are valid except if coal is substituted for the energy lost by not incinerating the waste paper. Europe uses much more incineration of waste than the US which uses more landfills.

A study from Australia turns the analysis further into the “it depends” mode by a LCA on paper waste with a focus on greenhouse gases (GHGs) in production of container board packaging (Ross, 2002). The Australian study has only two processes, landfill and recycling. Recycling is better environmentally unless methane gas can be captured from the landfill. If the methane gas can be captured and used for energy then landfill produces less GHGs than recycling for corrugated containerboard packaging. A weakness of this study was that it failed to examine the land use impacts. If only virgin pulp is used then more forest lands will have to be dedicated for this end use and more land will also have to be set aside for landfills. Forests can be sustainably managed but alternative uses for the land, e.g. biodiversity, would be lost. All impacts need to be studied.

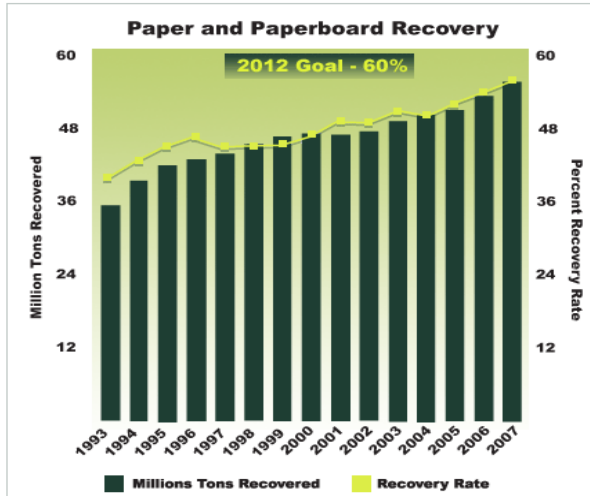
**The U.S. situation.** How many tons of paper is used each year in the U.S. and what is recycled?

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*Approximately 100 tons of paper and paperboard have been used in the U.S. each year for the last 15 years. In 2007 there was a drop of 4% to 96.7 million tons. This is 640 pounds per person per year.*

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*The recycling rate for 2007 was 56.1%. This rate has grown steadily from 38.7% in 1993. The target for 2012 is to reach 60 (Paper Industry Association Council, 2008).*



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Recycling one ton of paper would: Save enough energy to power the average American home for six months, save 7,000 gallons of water, save 3.3 cubic yards of landfill space, and reduce GHG emissions by one metric ton of carbon equivalent (MTCE) (EPA-a, 2008).

The EPA tracks paper recycling rate by some categories of paper end products and sources for papermaking:

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*In 2007, thirty-five percent of recovered paper was exported to overseas markets. Much of this went to China to return as boxes for our toys and other consumer goods.*

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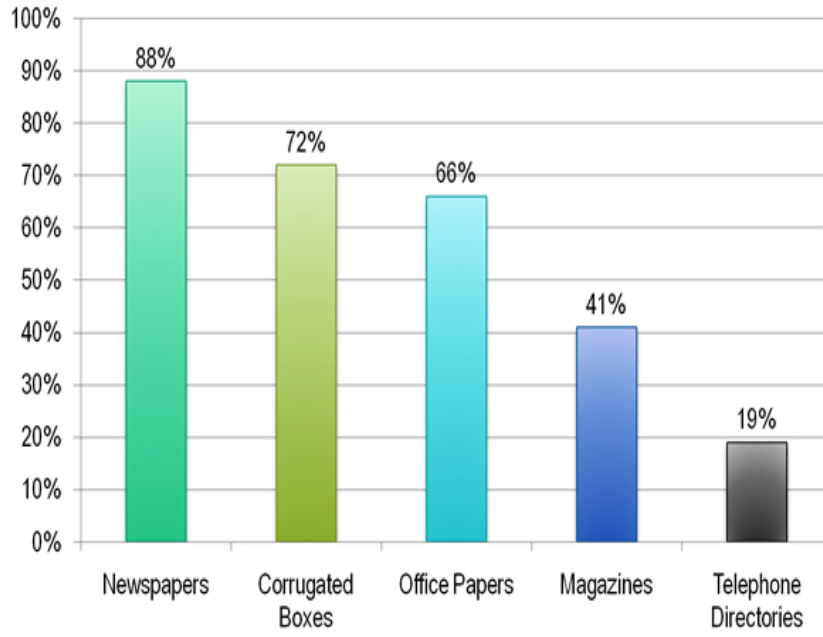
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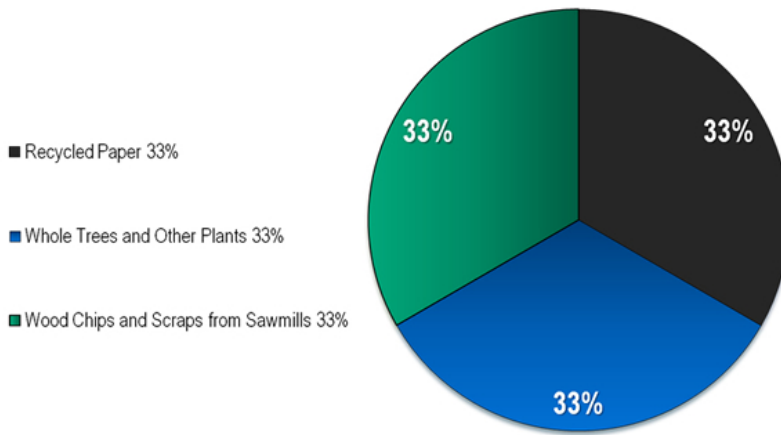
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*In 2007, sixty-two percent of recycled paper stayed in the U.S. to be recycled into paper and paperboard products. Only three percent was used to make other non-paper products (EPA-b, 2008).*

**Paper Recycling Rates 2006**



**Source of Papermaking Materials**



### **How to improve sustainability?**

1) Increase demand to use recycled paper products in the U.S. The domestic paper mills use of recycled paper waste has peaked at 33 to 36 million tons per year over the last 10 years. Is this because of stalled demand for recycled products? With the increase in recycled paper waste going overseas, now at about 20 million tons a year, this is not sustainable. Are we in balance between imports and exports? No records are kept because the imports, which are not paper products but are packing for end products such as toys, electronic, etc. If demand in the U.S. can be kept high the export market, which is less environmentally efficient due to added transportation, would diminish.

2) Target recycling in those states which currently provide less than 90% curbside availability. The national average in 2007 was 62% of the population has access to curbside pick-up of at least one type of paper for recycling (Paper Industry Association Council, 2008). Pennsylvania is at 70%, Delaware is at 61%, New Jersey is at 98%, Maryland is at 90%, New York is at 94%, West Virginia is at 38%, and Ohio is only at 35%. It is not only the environmentally wise to do but economically wise to boot. In these tough economic times, those who cry for help but fail to help themselves will continue to suffer.

3) Urge the U.S. Post Office to charge rates based upon total costs not just incremental costs. “Junk” mail and catalogs are big contributors to this enormous volume of paper consumed by each American.

4) Phone books have a very low recycle rate (only 19%). Require phone companies and other to collect one phone book for each new one they distribute. This is a start in a cradle-to-cradle program. These books will start to diminish in volume naturally as more cell phones and voice-over-internet become the choice of more and more households.

In conclusion, the long-term environment can best be served by recycling. Therefore, recycle as much as possible and use recycled paper products to kept a balance between input and output. More demand in the U.S. will keep the recycled waste used locally.



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