

EXPLOITING UNTAPPED RESOURCES

A cost benefit analysis of recovering reusable paper at Smith College

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Abstract

In this study I investigated the cost effectiveness of retrieving reusable paper from recycling bins and totes at Smith College in Northampton, Massachusetts. I sampled bins and totes on campus to estimate the amount of reusable paper that is recycled each year and the time it takes to retrieve it. I also did a survey of college-sponsored flyers on campus and conducted an experiment comparing printing on new paper with printing on reused paper. I then calculated the profitability of retrieving reusable paper by comparing the costs of a number of retrieval methods with the benefits in terms of money to be saved or earned by using or selling reusable paper. I found that the recovery of reusable paper is cost effective in many of the cases analyzed. These findings support a move to reuse paper on a large scale at Smith College.

Introduction

As a graduating senior, I have had plenty of opportunities to observe Smith's sustainability practices, or lack thereof. Most often what I notice are instances of needless waste. Whether using more of a resource than necessary or disposing of a resource that has yet to be used to its full potential, this institution and the people that make it up do tend towards recklessness. For example, I have always been struck by how much reusable paper is recycled on campus. Whether it is flyers in the post office or photocopies in the library, I have consistently come across such a wealth of paper that has only been printed on one side that I have never needed to buy paper for note-taking or even for printing. Granted, for whatever reason it does not occur to many people that paper that has been used on one side has only realized half of its capacity to serve. However, were this bountiful source of paper to be harnessed and made available for use it could both change peoples' perspective and help Smith embrace practical measures of sustainability.

Despite its ubiquity and deceptively low price, paper is hugely costly in terms of the degradation it causes to the environment at all stages of its production. The manufacture of paper first evidences ecological harm in its sources of fiber for raw

materials. In the mid nineties the majority of the fiber supply came from virgin wood at 55% while 38% came from recycling and 7% came from non-wood sources (Abramovitz and Mattoon, 1999). Of the virgin wood harvested, 55% came from secondary growth forests, 29% came from tree plantations, and 16% came from old growth forests (Abramovitz and Mattoon, 1999). Naturally, the destruction caused by logging old and secondary growth forests varies depending on the method of extraction. However, overexploitation can easily lead to soil erosion, desertification, and disruption of wildlife, especially in third world countries that rely heavily on logging where regulations are not as rigorously enforced. Tree plantations can offer a good alternative to logging in forests for fiber, and indeed, the industry has been pushing to increase plantation numbers (Abramovitz and Mattoon, 1999). Oftentimes though, plantations replace existing forests rather than saving them and these ecologically impoverished, pesticide-dependent monocultures are incapable of supporting the diversity of species that occur in natural forests (Abramovitz and Mattoon, 1999).

Paper production is ecologically harmful as well at the pulping and bleaching stages where a number of deleterious emissions, effluents, and solid wastes are created. The most commonly used form of combination mechanical and chemical pulping, the Kraft process, only converts half of the wood treated into usable fiber (Abramovitz and Mattoon, 1999). The remaining sludge is relegated to landfills, burning, or spreading in the open as a “soil additive” (Abramovitz and Mattoon, 1999). The chemicals involved in pulping and bleaching loose even more noxious products into the environment in the forms of carbon monoxide, sulfur dioxide, nitrogen oxides, reduced sulfur compounds, methanol, dioxins, volatile organics, and particulates (Biermann, 1996). These

compounds are held accountable for significant environmental problems running the gamut from acid rain, to global climate change, to eutrophication, to the spread of bioaccumulative carcinogens (Abramovitz and Mattoon, 1999).

Finally, the paper industry causes significant pollution indirectly through the energy-intensive nature of paper production. By virtue of the fact that huge machines are used to strip bark, chip wood, chemically and mechanically pulp, wash, and bleach wood and fiber to create paper, it stands to reason that abundant power is necessary to run those machines (Biermann, 1996). In fact, paper production is ranked with steel and iron production as one of the most energetically expensive industrial processes in terms of kilowatt-hours per ton of product produced (Abramovitz and Mattoon, 1999). This poses a problem for the environment when one considers that the source of that power comes mainly from electricity. In December of 2003 over half of the electricity generated in the United States came from the burning of coal, representing most of the 70% of electricity being generated from fossil fuels (Energy Information Administration, 2004).

Considering the pollutants released in coal burning and from fossil fuels in general the paper industry's heavy reliance on electricity represents an additional tax on the environment. It bears mentioning here that paper recycling is subject to the same analysis as far as energy use goes. The machinery that transforms used paper into new products is just as large and energetically expensive as that used to create virgin paper (Biermann, 1996). Accordingly, although recycling is vital to a sustainable economy, it does not give us carte blanche to use paper wantonly.

Bearing in mind the slew of environmentally damaging consequences behind the production of paper, it behooves us to use what paper we do buy to its fullest potential if

we mean to champion sustainability. In acknowledging this and having recognized that a lot of reusable paper is recycled on campus, I decided to investigate whether or not it could be economically feasible to reclaim reusable paper that winds up in recycling bins at Smith.

Methodology

Researched information

In order to do a cost benefit analysis for recovering reusable paper at Smith I made a number of inquiries relating to the calculations I intended to do. I started by researching how paper is recycled at Smith to learn how often it is cleared from paper receptacles and whether or not it gets sorted on site. I also sought out information on the wages of custodial staff and student workers for the purpose of later cost calculations. Similarly, I found values for paper at Smith by looking up prices for a case of paper and going to the bookstore to record their prices for notebook paper for later calculations of benefits.

Samples, surveys, and trials

To collect data on how much reusable paper is recycled from high traffic areas around campus, I inventoried the contents of eight bins and toters near steady sources of reusable paper (flyers from the post office, sheets from photocopiers, and sheets from printers). On March 27, 2004¹ I sorted paper in one of the toters in the Post Office, the toter in Haven House, two bins on the first floor of Neilson Library, the toter in the computer lab in Seeyle, a bin in Young Science Library, a bin in Wright Hall, and a bin

¹ Paper recycling is typically emptied twice a week on Fridays and Mondays (Dombkowski, personal communication). I did my sampling on a Sunday to get an idea of how much paper builds up in the biweekly cycle.

in Sabin-Reed. I went through the entire contents of each bin or toter separating reusable paper from non-reusable paper. I defined reusable paper as an 8^{1/2}” x 11” sheet of paper that was blank on at least one side and did not contain any tears or crumpling. I used a stopwatch to time how long I spent sorting at each bin or toter. I then recorded the number of white sheets of reusable paper I found, the number of colored sheets of reusable paper I found, and the total number of items that were in the bin or toter. In addition, I made a note of how many completely blank 8^{1/2}” x 11” sheets of paper I came across out of surprise at finding them.

I also did a survey of some of the larger buildings on campus for departmental flyers and postings in order to estimate how many are likely printed in a year. On April 5, 2004 I counted all the flyers posted in Seeyle, Bass, Wright Hall, and the Campus Center that advertised a lecture or event sponsored by an academic department or college-run organization. I assumed that the life span of such postings advertising events would be two weeks and multiplied the number I counted by fourteen to estimate how many are likely put up in an academic year. Such flyers are paid for directly by the college and represent a potential use for reusable paper were it to be recovered on a large enough scale.

Finally, I carried out a printing trial with new and used sheets of paper to do a cursory evaluation of the likelihood that paper that has been printed on one side will jam printers. On April 19, 2004 I printed the same poster on twenty sheets of new paper and on twenty sheets of used paper that I had collected from a recycling bin in Young Science Library. I used the hp LaserJet printer in Burton 209 for this trial.

Calculations

In doing my cost benefit analyses I made a number of assumptions to extrapolate the data I had collected to cover a year’s worth of operations at the college. I multiplied the reusable paper in each bin or toter by the fifty-six pick-ups that should occur in an academic year of twenty-eight weeks. In the case of the Post Office toter, I multiplied my findings by three also to estimate the reusable paper recycled from the total of three paper toters located next to the mail boxes. In the case of Haven House, I calculated the reusable paper recycled per student in that fifty-two student house in a year, then multiplied it by the twenty-five hundred undergraduates typically enrolled at Smith to project the findings at Haven House to all residential houses. I priced reusable paper as printing/photocopying paper and as notebook paper (Table 1). In pricing reusable paper

Paper type	Price/unit	Sheets/unit	Price/sheet
Printer/copier	\$20.50 ²	5,000	\$0.0041
Notebook	\$1.39 ³	50	\$0.0278

for note-taking I calculated the price per sheet of the most inexpensive notebook paper in the bookstore, then divided the value in half to account for the fact that new notebook paper offers two sides for note-taking whereas reusable paper would only offer one in most cases. Finally, in estimating what proportion of reusable sheets would be placed in a reusable paper bin if that were an option, I divided the number of reusable sheets observed by seven⁴.

² (Schulze, 2003).

³ As observed in the Smith College bookstore in April of 2004.

⁴ There is a box for reusable paper next to the printers in the Seeyle computer lab. I counted fifty-eight sheets of reusable paper in this box, roughly one seventh of the reusable paper in the lab at that time.

I did calculations of costs versus benefits for recovering reusable paper for a number of different scenarios. I calculated how much it would cost for custodians to sort the paper and for student workers to sort the paper (Table 2). I also considered the possibility of collecting the paper by putting out bins expressly for reusable paper or by incorporating reusable paper retrieval into established Circulation Assistant jobs at the libraries. I compared the cost of each of these retrieval methods to the money to be saved or earned by either the college using the paper for printing and photocopying or selling the paper to students for note-taking. My calculations are superficial in scope, ignoring additional costs of wasting paper such as transporting it to Fort Hill and the indirect costs of loss of ecosystem services and human health through buying more paper than is necessary.

Job title	Hourly wage	Wages/minute
Custodian	\$14.63 ⁵	\$0.2438
Student worker	\$7.25 ⁶	\$0.1208

Results

Reusable paper samples

In each of the eight paper bins and totes sampled, I found reusable paper. In the majority of the cases, white reusable paper outnumbered colored reusable paper with the Post Office tote being the only exception. In terms of the percentage of reusable paper each receptacle contained, the values ranged from 6.9% to 83.8% reusable content. The majority of the bins and totes sampled had 50% or greater reusable paper content with only the Post Office and Haven House totes containing less than half reusable items.

⁵ (Sullivan-Crowley, personal communication).

⁶ (Smith College Student Financial Services, 2004).

The time I spent sorting the contents of each receptacle varied most between bins and totes with bins taking under a minute and a half to sort and totes taking between seventeen and thirty-two minutes. In projecting my findings to how much reusable paper is likely to be recycled in one academic year I found receptacle size to be significant as well. The bins were estimated to yield between one hundred and two thousand sheets of reusable paper a year while the totes were estimated to yield between four thousand and twenty thousand sheets per year (Table 3).

Location	White sheets	Colored sheets	Total items	Reusable	Time (min)	Sheets/year
Post Office	29	49	1,129	6.9%	31:16	4,368
Haven House	60	30	443	20.3%	17:26	5,040
Neilson 1	31	0	37	83.8%	0:45	1,736
Neilson 2	36	0	56	64.3%	1:19	2,016
Seeyle	328	18	517	66.9%	19:21	19,376
Young	30	0	52	57.7%	0:57	1,680
Wright	5	0	10	50.0%	0:18	280
Sabin-Reed	2	1	6	50.0%	0:12	168
TOTALS	521	98	2,250			34,664

Departmental flyers survey

Between the five buildings I surveyed, I counted one hundred and sixty-eight flyers put out by academic departments or college-run organizations. Of the twenty-one departments and groups represented, the theater department, psychology department, and environmental science and policy program had the greatest number of postings with the chapel and the coastal and marine science program having higher numbers of flyers as well (Table 4). By estimating that this volume of flyers is put up every other week I estimated that 2,352 sheets of paper are devoted to college-sponsored advertising each academic year.

Table 4. Survey of college-sponsored flyers	
Flyers	Department / Group
39	Environmental Science and Policy
35	Theater
17	Psychology
15	Chapel, Coastal and Marine Science
9	Under-represented Scientists
7	Geology, Physics
6	History
4	Women and Financial Independence
2	Jewish Studies, Museum, Smith Outdoors
1	African Studies, Art, Comp. Lit., E. Asian Studies, Italian, Philosophy, Poetry Center
168	TOTAL FLYERS
2,352	PROJECTED FLYERS / YEAR

Printing trial

I experienced no paper jams for either the new or reused paper out of the twenty trials each type of paper received.

Cost/benefit analyses

The profitability of recovering reusable paper from the bins used in my study varied depending on the method of recovery and on what use that recovered paper would be put to. In pricing the paper according to the cost of buying new paper for printing and photocopying, it was only consistently profitable to recover the paper using new bins or by incorporating the retrieval into Circulation Assistant positions. Profits ranged from under one dollar to over one hundred dollars a year depending on the paper receptacle when using reusable paper bins or the job incorporation strategy. Reusing the paper in college printers or photocopiers would always cost money if custodians recovered it and would only save money at one of the bins in Neilson and the bin in Young if a student worker were paid to recover it. The loss was most significant at the toters ranging from fifty to eight thousand dollars while losses at individual bins were at most ten dollars a year (Table 5).

Location	Custodian	Student worker	Reusables bin	Circulation Assistant
Post Office	-\$1,227.08	-\$580.90	\$7.68	
Houses	-\$7,814.26	-\$3,371.27	\$141.92	
Neilson 1	-\$3.12	\$2.05	\$1.02	\$7.12
Neilson 2	-\$9.71	-\$0.64	\$1.18	\$8.27
Seevle	-\$184.78	-\$51.50	\$11.35	
Young	-\$6.08	\$0.46	\$0.98	\$6.89
Wright	-\$2.95	-\$0.88	\$0.16	
Sabin-Reed	-\$2.04	-\$0.66	\$0.10	
TOTALS	-\$9,250.02	-\$4003.34	\$164.39	\$22.28

When the paper was priced according to what students pay for notebook paper in the bookstore, recovering reusable paper was largely profitable. Again, using reusable bins or incorporating reusable paper reclamation into the existing Circulation Assistant jobs were entirely profitable. Profits were projected to range from under one dollar to over four hundred dollars a year at individual paper receptacles using these strategies. If custodians or students were to be paid to recover reusable paper for sale as notebook paper, it would only consistently lose significant amounts of money in the Post Office or in the student houses. In these locations losses would be between four hundred and six thousand dollars per year. However, at all other locations using custodians or student workers to sort through paper receptacles would either cost less than a dollar or earn between one and over one hundred dollars a year (Table 6).

⁷ Costs and benefits were calculated in terms of wages to be paid and money to be saved on buying new paper respectively, then added together to determine net gain or loss. Wages = (wages/minute)(minutes sorting)(pick-ups/year). Savings = (price/sheet of printer-copier paper)(sheets/year).

Location	Custodian	Student worker	Reusables bin	Circulation Assistant
Post Office	-\$1,098.66	-\$452.56	\$26.02	
Houses	-\$5,439.64	-\$996.65	\$481.15	
Neilson 1	\$13.89	\$19.06	\$3.45	\$24.13
Neilson 2	\$10.04	\$19.11	\$4.00	\$28.02
Seeyle	\$5.11	\$138.39	\$38.48	
Young	\$10.38	\$16.92	\$3.34	\$23.35
Wright	-\$0.21	\$1.86	\$0.56	
Sabin-Reed	-\$0.39	\$0.99	\$0.33	
TOTALS	-\$6499.48	-\$1252.88	\$557.33	\$75.50

Discussion

On the whole, my findings are encouraging. My initial impression that a substantial amount of reusable paper is recycled on campus proved to be right, even given the fact that my sampling of bins and totes was limited. Subsequent investigations into departmental paper usage that lends itself to reusable paper and the notion that previously used paper jams printers only strengthen the assertion that there is a market for reusable paper at Smith. My calculations also show that there are a number of ways reclaiming reusable paper can be profitable at Smith College, making our path to embracing sustainable operations all the more inviting.

The samples of reusable paper I made from bins and totes across campus illustrated a number of relevant trends. Perhaps most importantly, all of the receptacles sampled that were located next to a printer or a photocopier contained at least half reusable paper content. That the untapped resource in question should occur in such high concentrations in predictable locales makes it easy for us to focus our energy on the bins and totes that will have the greatest return for our investment. Secondly, it is notable

⁸ Costs and benefits were calculated as in Table 5. Wages = (wages/minute)(minutes sorting)(pick-ups/year). Savings = (price/sheet of notebook paper)(sheets/year).

that none of the bins sampled from took longer than a minute and a half to sort through. The fact that this class of paper receptacle can be sorted through so quickly implies that to do so would not necessarily be a significant factor in terms of paying people in existing positions more if paper sorting were an added duty. Finally, from the estimations I made of the sheets of reusable paper recycled per year it is apparent that the numbers are not trivial. The thousands of sheets of reusable paper that are recycled on campus each year represent a huge waste. This volume of paper could cover the needs of groups printing flyers and the note-taking needs of many students were it channeled efficiently.

In terms of the feasibility of the college being able to put some of this reusable paper to use, my flyer survey and printing experiment are very telling. Based on the estimated two thousand or so flyers the college pays for directly each year, there is an ample supply of reusable paper on campus that could fill this need. After having printed twenty sheets of reusable paper on a school printer with no problems, I am willing to assert that printer jams are not a sufficiently likely inconvenience to deter the college from using reusable paper for flyers. The stocking of photocopiers with reusable paper is possible too as evidenced by a company in Mountain Valley, California that does so without adverse consequences (Stein, 1997). Furthermore, the visual quality of flyers printed on reusable paper is on par with that of flyers on new paper. I did a paired comparison of two of the flyers I had printed in my trial representing the two types of paper and the fifteen people I showed them to were at a loss to detect a difference between them.

It is in my calculations of the costs and benefits of recovering reusable paper at Smith that the case for instituting a retrieval program is strongest. Naturally putting out

bins for reusable paper or incorporating bin sorting into the jobs of Circulation Assistants are attractive since these options cost the college no money for upkeep. In fact, only the first of these schemes would cost the college anything at the onset when new bins were bought, but this investment could be made back through savings or earnings generated by the paper collected. As these two scenarios entail no regular costs they are also attractive in that the college could use the paper recovered either internally, to sell to students, or even give away to students for free in a publicized effort to foster sustainability depending on the needs at the time. Paying custodians or students to recover reusable paper is more complicated as it would only be profitable if the paper were sold back to students for a price comparable to what they would pay in the bookstore. Since there is no indication of whether or not the student body at Smith would be interested in buying used paper when they could get new sheets, the success of the program would need to be evaluated after implementation. However, the number of sheets of paper that can be retrieved from the profitable locations in a year are low enough that they probably could not supply notebook paper to every student at Smith. This being the case, the subset of students that are most aware of and concerned with sustainability might be market enough to sell all the paper collected. In particular, the paper could be marketed to students on the Environmental Science and Policy e-mail list and those taking courses with environmental content.

Based on my analysis of both the supply of reusable paper available at Smith and the cost effectiveness of recovering it, I believe that the college should address this resource waste in three main ways. First of all, I would recommend that reusable paper bins be placed in high traffic areas on campus, but especially in the Post Office and

in the houses. Even knowing that not all students would bother to sort reusable paper from non-reusable paper, allowing conscientious students to do so makes the endeavor worthwhile. Over one thousand sheets of reusable paper could be reclaimed from the Post Office and over thirty thousand sheets from houses even in the face of limited cooperation from students. This volume of paper represents both money to be earned and saved as well as needless stresses on the environment avoided. This option is also the most attractive in terms of fostering an awareness of sustainability in students. By supplying bins that are marked to receive reusable paper, the cause of reusing will be highly visible, working its way into the consciousness of Smithies, faculty, and staff. As people on campus see this paper being marketed as a valuable resource it has the potential to fundamentally change perceptions regarding the life span of the products we use. Enlightening students in this way would serve the college well in educating them to be ecologically responsible citizens in the future.

Secondly, bin sorting should be incorporated into the Circulation Assistant positions at both Neilson and Young Science Libraries. Neilson Library has four paper bins on the first floor located next to printers or copiers and Young Science Library has two located on the first floor and in the basement. Since it took me under a minute and a half to sort reusable paper from each bin sampled, adding this task to the job description of a Circulation Assistant should not add more than five minutes of work to their shift. Furthermore, I sorted through half a week's worth of paper at each of my bins so logic dictates that were bin sorting to be required at the beginning or end of each shift a Circulation Assistant could complete the task in even less time. Accordingly, I do not believe that requiring the Circulation Assistants to fulfill this role would be an

insufferable hardship and the college could reuse thousands of sheets of paper each year at no added cost.

Finally, I believe that a student worker position should be created to sort through the paper totter in the Seeyle computer lab twice a week before pick-ups. Based on the calculations I made, the creation of such a position could generate over one hundred dollars a year for the college provided the paper was all sold. Given the amount of reusable paper that is recycled from the Seeyle computer lab each year and the potential profitability of recovering that paper, there is no good reason not to try the job out for a year. Of course, I did not look into the costs of packaging this paper in uniform bundles or transporting it to places it could be sold from. This represents a setback to the creation of such a job, but not in my mind an insurmountable one. The volume of paper that would be handled in a biweekly shift is small enough that it should not take long to group into uniform bundles. Stacking the paper and measuring the height of the stack could take the place of counting individual sheets, and these stacks could be placed in a box with scrap cardboard from cereal boxes placed between them. It would then be a simple matter to carry a filled box to the bookstore or some other locale from which the paper would be sold to students from.

As with almost any new product that is manufactured, paper carries with it a burden of severe environmental degradation. Having discovered that Smith College does indeed waste vast quantities of paper that can be economically salvaged into a reusable resource, I believe we have an obligation to reuse that paper. Smith is fortunate to have such a painless way to be a better steward of the environment and to turn out more sustainability-minded graduates. All that remains is to act.

LITERATURE CITED

Abramovitz, J.N.; Mattoon, A.T. 1999. *Paper-cuts: Recovering the Paper Landscape*. Worldwatch Institute, Washington, DC.

Biermann, C.J. 1996. *Handbook of Pulping and Papermaking: Second Edition*. Academic Press, San Diego, CA.

Schulze, B. 2003. *Reducing Paper Usage at Smith College*. Unpublished Report, Northampton, MA.

Smith College Student Financial Services Homepage. Smith College. 29 March 2004 <<http://www.smith.edu/finaid>>.

Stein, K. 1997. *Beyond Recycling: A Reuser's Guide*. Clear Light Publishers, Santa Fe, NM.

United States Energy Information Administration Homepage. 31 March 2004. U.S. Department of Energy. 10 April 2004 <<http://www.eia.doe.gov>>.