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A Critical and Prescriptive Approach to Analyzing Green Waste Management for Regis University (Denver, Colorado)

Tamsin Connell
Regis University

A CRITICAL AND PRESCRIPTIVE APPROACH TO ANALYZING GREEN WASTE MANAGEMENT FOR REGIS UNIVERSITY (DENVER, COLORADO)

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Tamsin Connell

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Thesis written by

Tamsin Connell

Approved by

Thesis Advisor

Thesis Reader or Co-Advisor

Accepted by

Director, University Honors Program

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1. Green Waste Management: The Basics

Imagine a single sheet of paper, one used to print directions to a doctor's appointment or to write a quick note to a partner. Once disposed, the single sheet of paper tends to disappear into a waste oblivion, floating around in a "cyberspace" of landfill, incineration or garbage bins. However, the cycle of paper production and waste disposal follows a particular "life cycle" in which energy is utilized and energy is released. A basic life cycle of any material product follows a flow as seen in Figure 1.1:

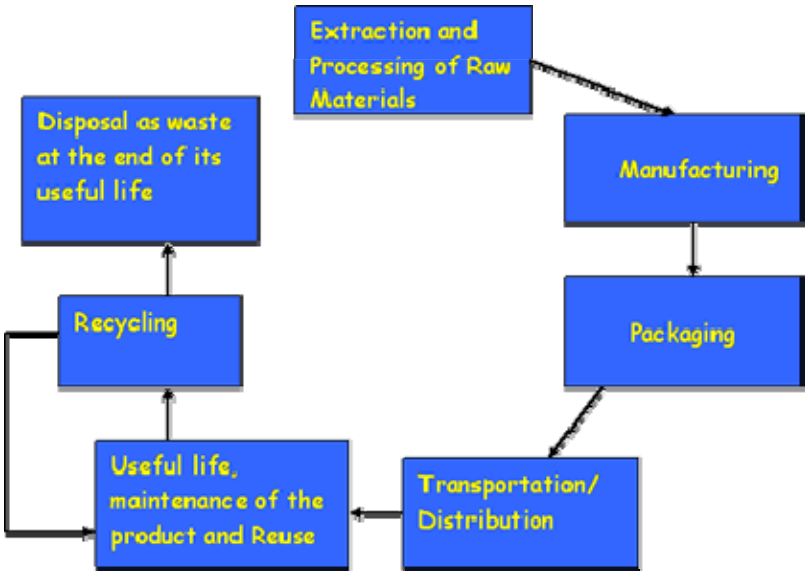

Figure 1.1. Shows the life cycle of a product from the extraction of resources to the end disposal (Garcilaso 2009).

For a single sheet of paper, this life cycle assessment is assigned particular values of energy, materials, transportation, and disposal that reach far beyond basic raw material demand. Although generally unacknowledged, paper produces a large carbon footprint that can be detrimental to the global ecosystem. In the United States, "estimations of office paper consumption per employee are at approximately 10,000-20,000 sheets a year… and at 500 sheets per ream, an average employee consumes 30 reams each year. A ton of paper consists of about 400 reams, therefore, 10 to 15 employees use up to one ton of paper. It takes 12-24 trees to manufacture one ton of paper, resulting in an average of 18 trees cut down for every 10 employees per year" (Ortar 2009). Universities can use these statistics as a template for an administrative operation. The student, faculty, and staff populations are comparable to an office environment in terms of printing and paper usage statistics and may even exceed the numbers listed above. The extraction and processing of raw materials for paper not only includes the energy stripped from raw materials but the energy expended to process, manufacture, package, transport, and distribute the paper to various locations nationally or internationally.

In terms of kilowatts extracted, logging in order to harvest the raw material "pulp" for paper accounts for "over 42% of tree cut down per year"

(Ortar 2009), removing vital trees from the ecosystem that can convert carbon dioxide into oxygen and work to reduce carbon dioxide in the atmosphere (carbon dioxide scrubbing). However, when these trees are removed, the potential to sequester carbon dioxide is simultaneously removed, and aids the rise of carbon dioxide globally, leading to increases in global warming and climate change.

The manufacturing of raw materials for paper additionally raises issues of concern. Aside from the energy exerted into logging and the transportation of the raw materials, the "extraction of pulp itself is extremely energy consuming… Phosphorous emissions from pulp production stages and nitrous oxide emitted during transport are accountable for toxic emissions into the natural environment as well" (Ortar 2009). Paper, after usage and disposal into garbage bins, ultimately ends up in landfills, decomposing and emitting large amounts of methane that is 23 times more potent to global warming than carbon dioxide (Ortar 2009). With the energy expended and the amount of toxic gases released into the natural ecosystem through its life cycle, each ton of regular office paper emits the equivalent of "6.3 tons of carbon dioxide in greenhouse gases" (Ortar 2009). This large carbon footprint leads to increases in global warming and other toxic gaseous and liquid emissions from the production, manufacturing, and disposal of paper that can be detrimental to the natural environment. With the increase in paper usage globally and the threats to forests as well as the global

ecosystem, universities and corporations must take action to decrease the ecological footprint of not only paper but other waste materials.

Electronic waste, similarly, follows the same product lifecycle, from the initial resource extraction to usage and finally, to disposal as waste. The costs of the electronic "footprint" lie in the disposal stage of the waste that, when not conducted in a sustainable manner, holds implications for health risks to the human population and ecosystem (Nnorom et al. 2008). A responsibility to address electronic waste in an environmentally sustainable fashion falls within the realm of the university because it is a direct player within this environmental health risk and ecological footprint. Within the direct irresponsible disposal of electronic waste, local and global communities feel this impact, and thus, the university must take action to create standards of disposal in order to reduce or prevent a large environmental impact. This urgent action can be addressed through the implementation of waste management in order to recover energy and resources from solid waste such as paper and electronic waste through re-use or recycling and to reduce the amount of waste produced.

What is "Green" Waste Management?

"Green" waste management consists of a constructed system of collection, transportation, processing, environmentally friendly recycling/disposal, and monitoring of waste materials. In particular, this term relates specifically to waste

generated by humans, rather than taking into consideration waste generated by organisms or ecosystems. This aspect of waste is especially of concern in today's environment because human waste has significant impacts on international human health as well as the health of the global natural environment. In 2007, 254.1 millions of tons of waste were produced in the United States, with a per capita per individual of 4.6 lbs of waste produced each day. Of this amount of waste produced, 32.7% is paper, 12.8% yard trimmings, 12.1% plastics, 8.2% metals,5.3% glass, 5.6% wood, 4.7% textiles, 2.9% rubber and leather, 1.5% miscellaneous organic waste, and 1.7% other (Arsova et al.. 2006). Developing a holistic system for the collection, processing, and recycling/disposal of this waste generated is essential in addressing concerns regarding waste management. Within this holistic system, infrastructure on a larger level rather than the individual is essential in order for the system to work effectively. Costs of personal time and energy create inefficiency and unaccountability in personal responsibility within addressing waste issues on the individual level, creating a demand for higher infrastructure. Within waste management, bio-physical and socio-economic factors necessitates a system that "includes reduction, reuse, recycling, composting, incineration, and transfer of waste emphasizing a regional approach in order to achieve economies of scale" (Hostovsky 2005). This larger scale approach can satisfy the economic goals of waste management because cost and benefit can potentially equalize on larger scales.

Within a green waste management plan, implementers must outline specific goals. To begin, a waste management model must fulfill a basic equity between economic factors (costs v. benefits) as well as address environmental concerns, “The [policy] must be first of all the element of balance between economy and social development aims with the goals of environmental protection” (Grzesik 2005). Environmental aspects in waste management must be implemented into all policies of waste management, but economic and social development strategies must equally be considered within an effective plan outline. The plan outline requires both qualitative and quantitative aspects including statistics on costs and benefits, audits of waste stream to determine waste percentages annually, identification of social and economic goals, and plan review.

Goal identification and future plan evaluation can be further identified in two different spheres: conventional and post-rational. The first approach of plan evaluation, conventional, focuses on a quantitative approach “based on mean/ends, plan conformity and implementation, leading to ‘performance’ criteria” (Hostovsky 2005). Waste management is constructed around a strategy of goal identification (ends) and action planning (means). The construction of a goal base creates an effective path for future plan implementation, performance review, and critique. It is within this conventional approach that environmental goals are identified in terms of the 3 R’s: Reduce, Re-use, and Recycle. These 3

R's can only be evaluated quantitatively through gathering statistics on waste production and as well as waste reduction. Furthermore, goals in waste management are constructed on an environmental basis of waste reduction and recovery in order to sustain environmental protection.

However, it remains that the social and economic concerns of waste management must be addressed in unison with environmental concerns. Unlike the conventional approach, the second approach of plan evaluation addresses socio-economic concerns; the post-rational camp focuses on the nature of the policy itself within a social and economic context. Within the post-rational camp, a qualitative approach uses "process communication, mutual understanding, reflective practice, social learning, and social justice, leading to 'communicative criteria'" (Hostovsky 2005). This qualitative approach identifies questions of equitable communication, the implications of cost/benefit analysis, promotion of democratic values, education/awareness, and stakeholder rights. These foci allow for an evaluation of waste management implementation in terms of the community and an effective method of implementation through the incorporation of social factors. Definitions of "success" in waste management plans can also be properly defined within a more qualitative approach in which cost-benefit analyses as well as "what stakeholders consider a successful outcome" (Hostovsky 2005) can create more popular bases of garnering support for waste management proposals. Before determining success, however, management goals

must also incorporate these qualitative questions of cost/benefit analysis, communication, education, and rights to insure future success.

Waste management focuses on the following elements: reduction, recovery, and environmentally safe final treatment of waste. Reduction goals must be centered on the ideas of increasing efficiency and benefits while reducing costs (monetary, time, energy, etc.). Reducing per capita waste production proves to be difficult particularly in a time period when increasing per capita production of waste materials is inherently characteristic of the global capitalistic market system. However, source reduction holds implications for economic benefits as well and environmental alleviation. According to the United States Environmental Protection Agency (EPA), source reduction is essential because it reduces the overall need for feedstocks, ultimately lowering the energy demand for production and leading to less burning of fossil fuels and carbon dioxide emissions into the atmosphere (EPA 1989). Not only can reduction of source material lower the need to acquire and process the materials needed, but reduction can also effectively cut costs of acquiring the finished product, opening funds that can be spent in areas of greater need. Recovery of waste can be classified under the last two functions of the waste management model: Re-use and Recycling. This recovery requires the "setting up of comprehensive user-friendly and convenient waste recycling programs, including reuse and drop-off centers for old goods as wells as [creating and] modeling proper recycling practices" (Zotos et

al.. 2009). These programs ensure the creation of public recycling education and awareness and insure environmentally safe final treatment of waste produced.

The University's Role in Waste Management

A university campus provides an ideal microcosm for the implementation of waste management infrastructure and the incorporation of such qualitative concerns such as education and communication. The adoption of sustainable waste management is popular and widely utilized on larger levels of communities such as cities and municipalities and beginning in 1990 with creation of the first waste management plan for Tufts University in Massachusetts (Creighton et al. 2006), waste management has become a mainstream endeavor for universities nationally. Although higher level education is the "seedbed of the sustainability movement", (Shi 2008) in terms of environmental and biological research, university infrastructure offers new pressures in a community that are not generally seen on larger levels of infrastructure. The majority of research in the field of waste management is conducted on the level of the city or state, leaving a small fraction of research pertaining to the level of the university setting. Although national waste management can be utilized as a foundation to approaching waste management issues in the university setting, limits to this foundation must be identified. First of all, large-scale and longer-range implementation for universities and cities/states must be approached in an

incremental scale. Zotos et al. (2009) identify current waste management problems, particularly in the Western world, as increasing production of waste, the need for high levels of investment in physical infrastructure, institutional barriers, and a wide range of stakeholders. Long-term investment is essential in order to meet the requirements of high levels of investment and a dynamic policy area. Building a waste management infrastructure as well as affecting change within the current system is only possible through a long-term investment.

The primary issue of waste management is the effectiveness of incremental planning versus comprehensive planning. In his evaluation of an integrated waste management, Hostovsky (2005) identifies the "triumph of incrementalism over the rational comprehensive model of planning". Incrementalist approaches to waste management planning allow for a slower, but more effective means of creating effective and efficient infrastructure as well as adequately educating the public on issues of waste management. Furman University in South Carolina adopted a longer-range incremental plan in 2004 to address waste management with the ultimate goal of "weaving sustainability into the very fabric of institutional life, not just campus operations and construction practices, but the curriculum, co-curriculum, and community outreach" (Shi 2008). This longer-range incremental plan has allowed the university to institute waste management infrastructure within the construction of the university as well as increase awareness in the student body of issues, allowing for a more extensive

effort within the application of the waste management infrastructure. Within the smaller level of the university, administration must propose and establish incremental changes in order to build a strong foundation of waste management. Thus, universities must address large-scale issues such as electronic (e-waste) and paper waste at the forefront of the infrastructure before issues such as green purchasing can be solved. Particularly on the university level, the issues of paper waste and e-waste present the biggest concerns in terms of waste management. Furman University identified these particular needs at the forefront of an emerging effort for waste management in the form of "an aggressive recycling effort not only for paper and cardboard products, but also for… computers and batteries" (Shi 2008). On a university levels, the main streams of waste management have been identified as "paper, plastic, glass, metals, organic waste, and batteries" (Zotos et al.. 2009). Of this list, paper, metal, and batteries are the focus of the following proposed case study waste management plan for Regis University.

A Waste Management Case Study: Regis University (Denver, Colorado)

Regis University in Denver, Colorado is a case study for the implementation of waste management in a university setting. With a student population of 1,734 undergraduates (enrolled in the Regis College) and

approximately 560 Rueckert-Hartman College for Health Professions students that are active on campus daily as well as additional faculty and staff members (269 faculty, 1,742 affiliate faculty, and 632 additional staff members), this community has an increasing need for waste management. Regis University as an institution “believes that it is their responsibility to ensure that every effort is made to conserve and properly manage energy and natural resources, as well as to exercise sound financial judgments. Implementation of this policy is the joint responsibility of Regis University administration, faculty, students, support personnel, and its success is based on cooperation at all levels” (Regis website). With current initiatives in recycling, base level foundations in this policy have been laid. However, under the current infrastructure, initiative and action is left on the individual level with limited outlined infrastructure on an administrative level. Needs in terms of cost/benefit analyses as well as student and department requirements and specific goals in sustainability with regard to waste management must be clearly specified in order to create a viable waste management plan for the university. Given the current situation on the campus, there is a need for a restructuring of electronic waste management, a formation a sustainable system of printing and paper usage, re-use, and recycling. Finally, the plan must focus on increasing university community education and involvement in waste planning initiatives on campus.

2. Electronic Waste Management for Regis University

What is Electronic Waste?

Electronic waste is specifically defined as discarded, surplus, obsolete, or broken electrical or electronic devices. These electronic devices can be defined further as any secondary computers, entertainment devices, mobile phones, televisions, refrigerators, toasters, stoves, etc. that are sold, donated, or discarded by the owner. This waste is often misunderstood as only consisting of computers or equipment used only by an Information Technology (IT) department. However, Regis University's waste management plan requires a broader, more encompassing definition for electronic waste. In particular, Khetriwal et al.. (2005) define electronic waste or waste electric and electronic equipment (WEEE) as "any appliance using an electric power supply that has reached its end-of-life". However, WEEE also includes those electric or electronic appliances that no longer satisfy the current owner for its original purpose. Widmer et al.. (2005) give an additional definition of electronic waste that identifies not only the need to dispose of these devices but the demand to reutilize the devices for profit, "E-waste refers to the reverse supply chain which collects products no longer desired by a given consumer and refurbishes for other consumers, recycles, or otherwise

processes wastes". This particular definition identifies the presence of an infrastructure of processing electronic waste beyond basic disposal, but an organized effort to re-address this waste as a viable product in itself. Annual increases in electronic waste (e.g. a 0.5% increase of electronic waste generated in the U.S. between 2006 and 2007 (EPA 2008)) necessitate analysis, evaluation, and prescription of fulfilling electronic waste management.

Electronic waste, or e-waste, has become a major player in waste produced in today's global system. With an expanding increase in the digitalization of medical records, market transactions, academic and business affairs, etc., e-waste is quickly becoming a growing concern in regards to proper waste disposal, materials for fabrication, and electronic turnover. Today, electronic and electrical equipment has become globalized, crossing trans-national boundaries and information exchange and technological development is occurring at an exponentially increasing rate. Technological obsolescence occurs at a rapid rate in the current global system (e.g.55% of all portable computers, computer monitors, and keyboards become obsolete or reach the end of their lifespan within 5 years of purchase (EPA 2008)) due to changing technological advances, development, trends, and conversion. Similarly, the increase of technological development creates a greater field of technological waste because current electronics are no longer used or desired within the projected course of this development. Thus, "the planned or perceived equipment obsolescence from rapid

technological advancements or trends and pervasive computing… contribute to e-waste's growing contribution to the US's municipal solid waste stream" (Wagner 2008). In 2005, 1.9-2.2 million tons of electronic devices became obsolete, whereas 1.5-1.8 million tons of these products were disposed. However, within this particular statistic of disposal, only 345,000-379,000 tons or 21- 23% of these devices were recycled, presenting a need to re-address electronic waste management (EPA 2005).

Environmental and Human Health Risks for E-Waste

Electronic waste is not only a concern in terms of increasing percentages of waste but also presents a number of environmental and human health threats. Although toxins and pollutants comprise "approximately 2.70% of the total weight" (Widmer et al. 2005) of the total amount of materials used in electronics, these toxins can be dangerous to human and environmental health. Nnorom et al.. (2008) identify that the disposal of electronics "creates a large waste stream of obsolete electronic equipment that, due to their hazardous material contents, may cause environmental problems during the waste management phase if it is not properly pre-treated". These toxins include lead, mercury, cadmium, beryllium, mercury, and brominated flame retardants. According to Allen Hershkowitz, senior scientist at the Natural Resources Defense Council electronic waste contains "Lead, cadmium, mercury, chromium, polyvinyl chlorides. All of these

materials have known toxicological effects that range from brain damage to kidney disease to mutations and cancers" (Granatstein 2009). These human health risks are additionally linked often to localized contamination due to toxins that leach out into local water and food sources. Individuals directly exposed to these contaminants (such as workers in landfills) often suffer direct negative health effects through skin contact and inhalation, while the wider communities are exposed through smoke, dust, drinking water and food (Robinson 2009).

Environmentally, electronic waste poses major threats to ecosystems and organisms that thrive on those ecosystems. Metals that comprise E-waste including copper, aluminum, and iron as well as plastics and ceramics, when improperly disposed of, become toxins that enter the environment through landfill leaching. Additionally, "A discarded personal computer… typically consists of metal (43.7%), plastics (23.3%), electronic components (17.3%) and glass (15%) … and contain high concentrations of flame retardants and heavy metals" (Berkhout and Hertin 2004). These materials can be highly toxic to aquatic and terrestrial environments via "leaching from dumpsites where processed or unprocessed E-waste may have been deposited. Similarly, the disposal of acid following hydrometallurgical processes into waters or onto soils, as well as the dissolution or settling of airborne contaminants, can also result in the contamination of ecosystems" (Hoffman 1992). Contamination in ecosystems due to electronic waste leaching can ultimately lead to decreases in animal and plant

populations, threats to biodiversity, air/water pollution, and other environmental issues.

According to the Regis University Mission, “Consistent with Judeo-Christian principles, we apply knowledge to human needs and seek to preserve the best of the human heritage. We encourage the continual search for truth, values, and a just existence. Throughout this process, we examine and attempt to answer the question: “How ought we to live?” (Regis website). As a Jesuit University, Regis has a responsibility, according to their mission, to work for justice and preserve human needs, including human health universally and through all facets of the university. The human health and environmental risks associated with electronic waste require responsibility for Regis to effectively address issues and provide solutions to electronic waste. Asking the question “How ought we to live?” must be asked throughout the university infrastructure, including the impact of electronic consumption and waste.

Electronic Waste Management: Goals for Regis University

To create an efficient, viable electronic waste management plan for Regis University, the plan must outline and identify goals. According to Khetriwal et al.. (2007) in a review of e-waste management in Switzerland, “Conventional waste management policies more suited to handle traditional waste types cannot be applied in the case of the e-waste stream”. This is due to two factors: the

environmental and health risks associated with e-waste as noted previously and the amount of valuable raw materials that can be recovered from e-waste. Thus, independent goals as well as infrastructure must be outlined specifically for e-waste. Firstly, a review of the current e-waste management plan must seek to reduce costs and increase efficiency for an organization while holding sensitivity for the environmental impact of e-waste generated on campus. In the current economic system, cost and profit often fuel the actions of a corporation or company and changes within infrastructure must be based on low costs in order to remain as a viable part of infrastructure. Electronic waste management follows the same lines within the infrastructure of the university setting in that budgets must cut costs as much as possible.

The second section of the Waste Electrical and Electronic Equipment (WEEE) plan must include a factor of efficiency. More specifically, the plan must not come at the cost of the efficiency of the university as a whole as well as the individual departments of faculty and administration. This efficiency can be determined through a survey of assets, in particular an inventory of electronic equipment, details of the equipment, and status of the equipment. According to the asset management plan for the University of Richmond, an accurate survey of assets as well as "an accurate estimate of the campus community's varying needs for technology, can determine the most efficient distribution of your inventory among users across campus" (Burchar 2008). Thus, before efficiency is best

quantified within the university campus of Regis, the IT department must conduct a survey of assets as well as an overview of electronic needs for students, faculty, and administration. When these quantitative data are obtained, further quantitative and qualitative goals of efficiency can be identified. In a general sense, this efficiency includes the following: providing better service to students and faculty, increasing speed of communication between departments, increasing reliability of data software and electronic equipment, increasing electronic usage life, increasing security of data, and ultimately reducing costs. This efficiency is important for Regis University in order to provide students and faculty alike with the same or higher level of service as well as reducing outside factors such as wasted time or lost data that can slow down service time.

Simultaneously, however, environmental sustainability and an awareness of impact should be kept in mind. This awareness of impact fits under the goal of electronic waste management for reducing costs. Within this infrastructure, costs must be expanded beyond monetary concerns. The current capitalistic system of consumption has had a great impact on the environment in the past and continues to leave a lasting footprint in the natural ecosystem. The costs of these footprints not only include the health risks to the human population as noted previously but a risk to environmental health as well (Nnorom et al. 2008). A responsibility to address electronic waste in an environmentally sustainable fashion falls within the

realm of the university because it is a direct player within this environmental health risk.

This impact is produced within the direct irresponsible disposal of electronic waste and thus, the university must create standards of disposal in order to reduce or prevent a large environmental impact. Specifically in regards to computer disposal, these standards must be outlined on the following, as identified by Burchar for the University of Richmond (2008): “Reuse computer that still have a useful life, recycle computers using the most environmentally responsible process, and manage data security in a cost-effective manner”. A focus on computers must be, for Regis University, the focal point of the electronic waste management plan because it is the most used electronic device on the campus. Reusing computers can provide an area of budget saving within the fiscal year in that new computers are not purchased, but the IT department rotates and re-services computers already present on campus annually. Additionally, computers that can no longer service the university community must be recycled responsibly as to avoid the impacts on environmental and human health as well as to benefit from a harvesting of valuable materials within the machines. Finally, Burchar reinforces the idea that within this reuse and recycling plan, users must maintain data security and efficiency as well as cost efficiency.

For Regis University, recycling rates of computers should be 100% recycling rate for all computers on campus after usage. Recycling in the terms of

electronic waste includes donation to charities, reuse after refurbishment each year, and use of a certified electronic waste recycling company to guarantee environmentally friendly disposal. On the Regis Lowell Campus, there are a total of 1230 computers, in various locations and campus areas (Table 2.1).

Table 2.1. Shows the total number of computers for each building located on the Regis University Lowell campus.

LOCATION	NUMBER OF COMPUTERS
Carroll Hall	235
Dayton Memorial Library	62
DeSmett Hall	26
Fine Arts Building	1
Field House	29
Information Technology Services	58
Jesuit Residence	5
Life Directions Center	34
Loyola Hall	40
Mobile Conference Center	3
Main Hall	284
O'Connell Hall	47
Residence Hall	2
Pomponio Science Building	45
Student Center	67
West Hall	14
Xavier House (Retired Jesuits)	2

Total: 1208

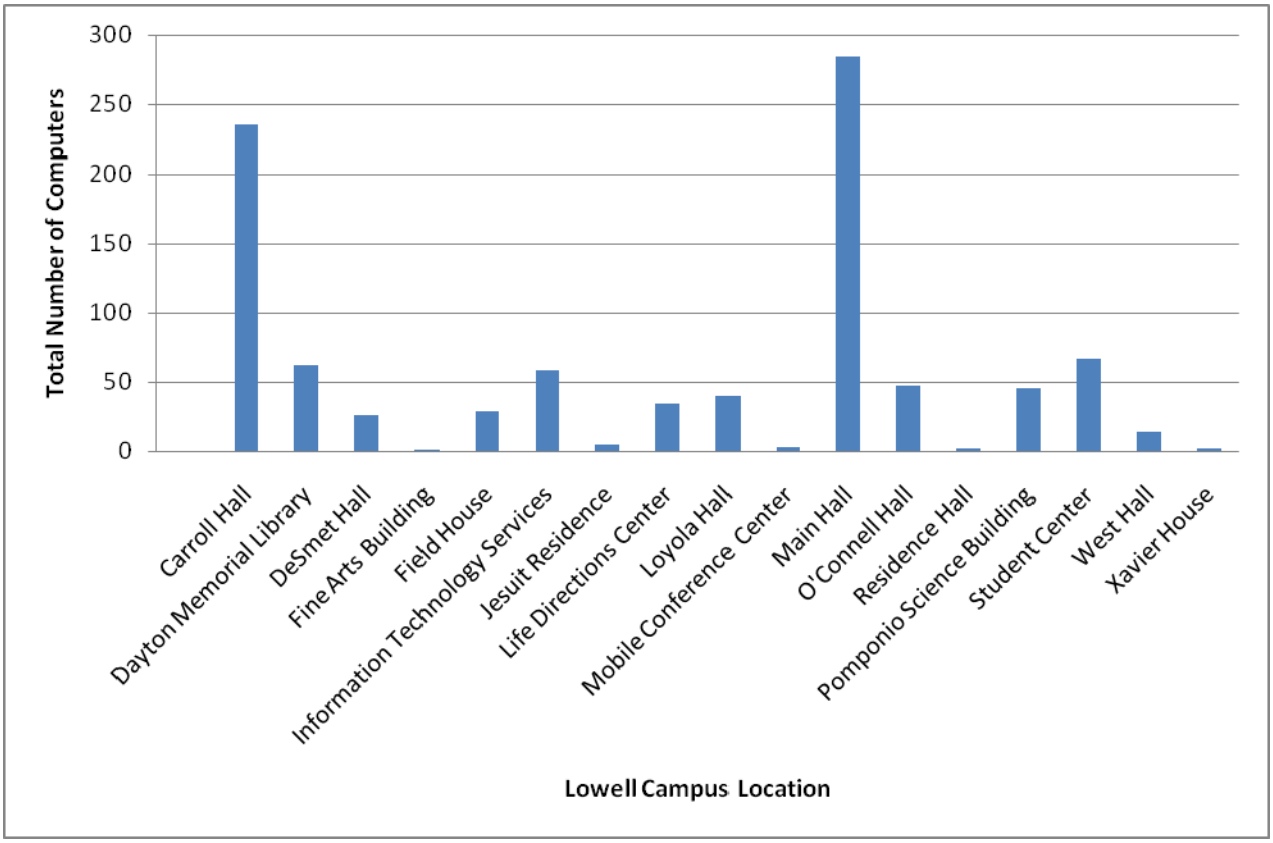

Figure 2.1. Shows the concentration of computers on Regis campus by location.

The three areas of the most concentrated computer locations are Carroll Hall and Main Hall (Figure 2.1). Main Hall comprises a majority of administrative computers with the focus on administrative framework such as finances, admissions, and additional confidential documentation. Carroll Hall's computer total comprises mostly of student-used computers as well as faculty computers. These computers function as research sites for students and faculty in addition to internet communication and databases. Areas of student residences such as the Residence Village, O'Connell Hall, and DeSmet Hall are among the least computer concentrated areas due to a concentration of personal student

computer use. According to the above statistics, Carroll Hall, Main Hall, and the Student Center are the highest concentrated areas and most used areas for computers and should be the main focal points for electronic waste management due to higher turnover of computer usage.

Another aspect of electronic waste management that must be addressed for Regis University is the field of proper battery disposal and recycling. Batteries have a considerable impact on environmental health when not properly disposed. The importance of proper battery disposal is evident within the Battery Directive passed by the EU in 2006 which identified that, "The primary objective of this Directive is to minimize the negative impact of batteries and accumulators and waste batteries and accumulators on the environment, thus contributing to the protection, preservation and improvement of the quality of the environment" (EU Directive 2006). Batteries contain heavy metals such as lead, mercury, cadmium, and nickel, that, according to the EPA, can contaminate the environment through either leakage of toxins or if the batteries are incinerated, the metals may be transferred to the atmosphere through the concentration of ash produced by the combustion process (EPA 2005). Additionally, according to the EPA, Americans purchase nearly "3 billion dry-cell batteries every year to power radios, toys, cellular phones, watches, laptop computers, and portable power tools" (EPA 2005). With the addition of 3 billion dry-cell batteries into the waste stream annually, the environmental risk of improper battery disposal increases at a large

scale each year. This environmental impact has lead to many states creating regulations for proper battery recycling. The Mercury-Containing and Rechargeable Battery Act of 1996 took action on a federal level when the U.S. Congress made it easier for rechargeable battery manufacturers to collect and recycle batteries and certain small lead-acid batteries.

However, no further action has been taken on the state or the federal level to regulate battery disposal. In particular, the State of Colorado has no law in place currently in terms of battery disposal and recycling. However, the effects that batteries have on the environmental health require action, if not on the state level, then on the institutional level. Additionally, Thomas Lindhqvist on his "Policies for Waste Batteries" points out that the development of the EU Battery Directive merits a look at current battery disposal legislation in the United States and requires a change in legislation to more regulation (Lindhqvist 2010).

Although the state of Colorado has no current legislation on battery disposal, Lindhqvist's remarks on the importance of regulating disposal should be considered on a university level. The university, as an instrument and center of learning that aims to create future leaders, has a responsibility to act on what it teaches, that is to say, create a center of environmental awareness in addition to teaching environmental awareness in the classroom setting. Thus, Regis University has a responsibility to implement requirements on battery disposal on an administrative level. This infrastructure requires the following goals: to create

an infrastructure of battery recycling stations, to raise awareness on environmental impacts of improper battery disposal, and create an example on the level of faculty and administration in properly disposing of batteries in each department. A future goal of battery disposal at Regis University could be, as suggested by Lindhqvist, “avoiding/reducing the use of batteries and shifting to more reuse of batteries, that is, to use more rechargeable batteries” (Lindqvist 2010). Not only can this shift in battery disposal infrastructure help reduce the toxins released into the environment by batteries, it also aims “for resource conservation of other materials, in particular, metals” (Lindqvist 2010). This conservation fits within the larger goal of conservation and sustainability of the general waste management plan for Regis University.

Battery Disposal System on Campus

In our society, and particularly on Regis University’s campus, portable electronic equipment has become essential in everyday activities such as the use of mobile phones, laptops, music devices, etc. Batteries identified for primary individual use include zinc-carbon, alkaline-manganese, zinc-air, zinc-silver oxide, and lithium batteries that comprise of “the majority of batteries consumed, accounting for about 90% of the portable battery market” (Smith et al. 2010). Presumably, it is this battery group that is largely utilized throughout the university setting, however, knowledge of battery production and improper

disposal remains largely nonexistent throughout the student, faculty, and administrative populations. Currently, proper battery disposal infrastructure does not exist on campus despite the dire effects unrecycled batteries have on the natural environment. This group of commercial batteries is comprised of both active and inactive components such as cadmium, lead, and mercury that after shelf life ends, can be toxic to ecosystems if leached out of the steel casings. These components are the primary concern for environmental issues due to improper battery disposal such as “human health risks such as liver and kidney damage associated with lead and cadmium, permeation of these materials into soil resulting in risks for plants and animals, and the release of potential greenhouse gases from landfills” (Lindvquist 2010). In order to prevent the release of these toxic substances in disposal facilities such as landfills, infrastructural programs should be made available to all members of Regis University.

The battery program centers on the collection and organized recycling of end-of-life batteries. Collection needs are high for Regis University and a simple, comprehensible system can provide an effective solution to meet this need, “Collected batteries should also be recycled, which is in line with an approach of not only addressing the most toxic components in the batteries but also aiming for resource conservation of other materials, in particular, metals” (Lindvquist 2010). Efficient collection of batteries on campus depends on the availability of disposal locations as well as the willingness of the student and faculty populations to

participate in the program. Simple disposal locations in each university department as well as areas of student activity and residence are essential in the form of battery recycle bins placed in close proximity to existent recycle disposal receptacles. Monthly, a member of the faculty or a work-study student should collect all batteries at these stations and drop them off at a certified battery recycling location close to campus on a monthly basis.

In addition to the implementation of battery disposal sites across the campus, public awareness of these receptacles must be increased. A battery recycling program implemented in Belgium in the early 2000s identified that "it was necessary to invest in an intense and continuous public-awareness campaign to inform the population about national laws, to motivate participation in collection programs, and to change battery disposal habits" (Smith et al. 2010). Public awareness campaigns include information on battery production and materials, as well as battery disposal and subsequent environmental impact of improper disposal. Posters should be placed around campus (near receptacles and additional locations) of battery issues in order to promote the program as well as faculty should become aware through lectures and presentations given by members actively involved in this program.

Finally, the most effective means of combating improper battery disposal is reducing battery use and promoting the use of rechargeable batteries on campus, "In battery disposal programs, complementary approaches, such as

avoiding (reducing) the use of batteries and shifting to a more reuse of batteries, that is to using more rechargeable batteries should be considered as well" (Lindvquist 2010). Incentives for rechargeable battery use could be utilized to encourage increases in use such as student/faculty/staff battery handout programs, monetary rewards for departmental battery reduction initiatives, and the possibility of redirecting budget savings to particular departments in response to reducing costs of battery purchasing and usage across campus.

Re-using Computers and Annual Rotation System

The first goal for computer management must be the re-use of current computers on campus. Approaching the idea of computer reuse must begin with an analysis of department and campus area needs based on computer usage and dependency per department. This particular demand must be determined by annual meetings with administration and faculty done by the Information Technology (IT) services in order to quantify need per department, resolve electronic issues, and determine the number of new computers needed for the following year. These meetings must also include laboratory areas and student areas in which student input (through tracking computer usage data) is taken as well as focusing on need in library areas on campus. After need has been identified, administration and the IT department can make decisions based on available budget for the purchase of new equipment as well as refurbishing old

machines. The refurbishment of old computers must be based upon Regis' current model of an annual system rotation in which present computers are placed on replacement cycles. After the end of each academic year, computers are taken in by the IT department, hard drives stripped, and computers updated with newer systems. Each refurbished computer is rotated to a different location at the start of each academic year after having been refurbished in order to switch out old computers in major departments and allow for the replacement of older computers that need the attention of the ITS department. The refurbishing of these systems is completed during the summer months when student population is diminished and faculty use is at a minimum. The refurbishment stage of the cycle also provides an opportunity for the university to employ students during the summer months on an internship program in order to complete the updating of the systems in all computers annually.

Under this system, however, the computers after refurbishment are not returned back to the original locations, but typically are repurposed for work-study use, kiosk computers around campus, and other non-mission critical uses in order to create space for the addition of new systems into the computer pool. Thus, annually, Regis University purchases new computers for these original departments, with approximately 1/3 of all lab computers replaced (approximately 130-140 new computers) and in a fully funded fiscal year, about 400 computers per year. Annually, the cost of computer replacement totals approximately

$130,000.000 for lab/classrooms ($400,000.00 during full funding) (IT Department, email correspondence 2010). However, this system is not adequately comprehensive to fulfill the goals of the above outlined computer recycling program.

First of all, the system does not return refurbished computers to original departments but relocates them to different locations in order to place new computers in original locations, requiring the purchase of these computers. This process should be re-evaluated and consider the re-allocation of refurbished computers to original departments. The Regis University IT department should seek to reduce computer purchase to approximately $100,000.00 for lab/classroom computers per year through increasing refurbishing efforts, using refurbished or upgraded machines in original departments, and increasing available labor resources. Refurbishment techniques and methods currently used by the IT department are effective and should remain within the system, but rates of refurbishment and subsequent re-use must increase. If annual computer purchase can be incrementally reduced in a period of 6 year to the goal of $100,000 and use of refurbished computers can be increased by approximately 25% to satisfy demand on campus, costs can be reduced by 5.4% after 6 years. This percentage is based upon both computer cost reduction but additionally considers increases in labor and additional equipment and servicing for old computers. Table 2.2 shows that labor needs require the addition of a part-time IT

staff member (with a salary of approximately $20,500/year) as well as a work study student (with a pay rate of $7.15/hr and a maximum of 9 hours/week for 38 weeks). Figure 2.2 outlines costs over the next 6 years with the addition of labor (a part-time faculty member in 2012 and the addition of a work-study student in 2013 if needed) as well as the reduction of computer costs (with a reduction of approximately 4% of new computers purchased (i.e. 5 computers annually)).

Table 2.2. Shows annual projected costs in dollar amount of computers without reduction, costs of computers with reduction, costs of additional labor and services (i.e. a part-time faculty and work study student), and total costs for the period of 2010-2017for Regis University.

Year	Cost of Computers without reduction	Cost of Computers with reduction	Cost of Additional Labor and Services	Total Costs
2010	$130,000.00	$130,000.00	$0.00	$130,000.00
2011	$130,000.00	$130,000.00	$0.00	$130,000.00
2012	$130,000.00	$125,000.00	$20,500.00	$145,500.00
2013	$130,000.00	$120,000.00	$22,900.00	$142,900.00
2014	$130,000.00	$115,000.00	$22,900.00	$137,900.00
2015	$130,000.00	$110,000.00	$22,900.00	$132,900.00
2016	$130,000.00	$105,000.00	$22,900.00	$127,900.00
2017	$130,000.00	$100,000.00	$22,900.00	$122,900.00

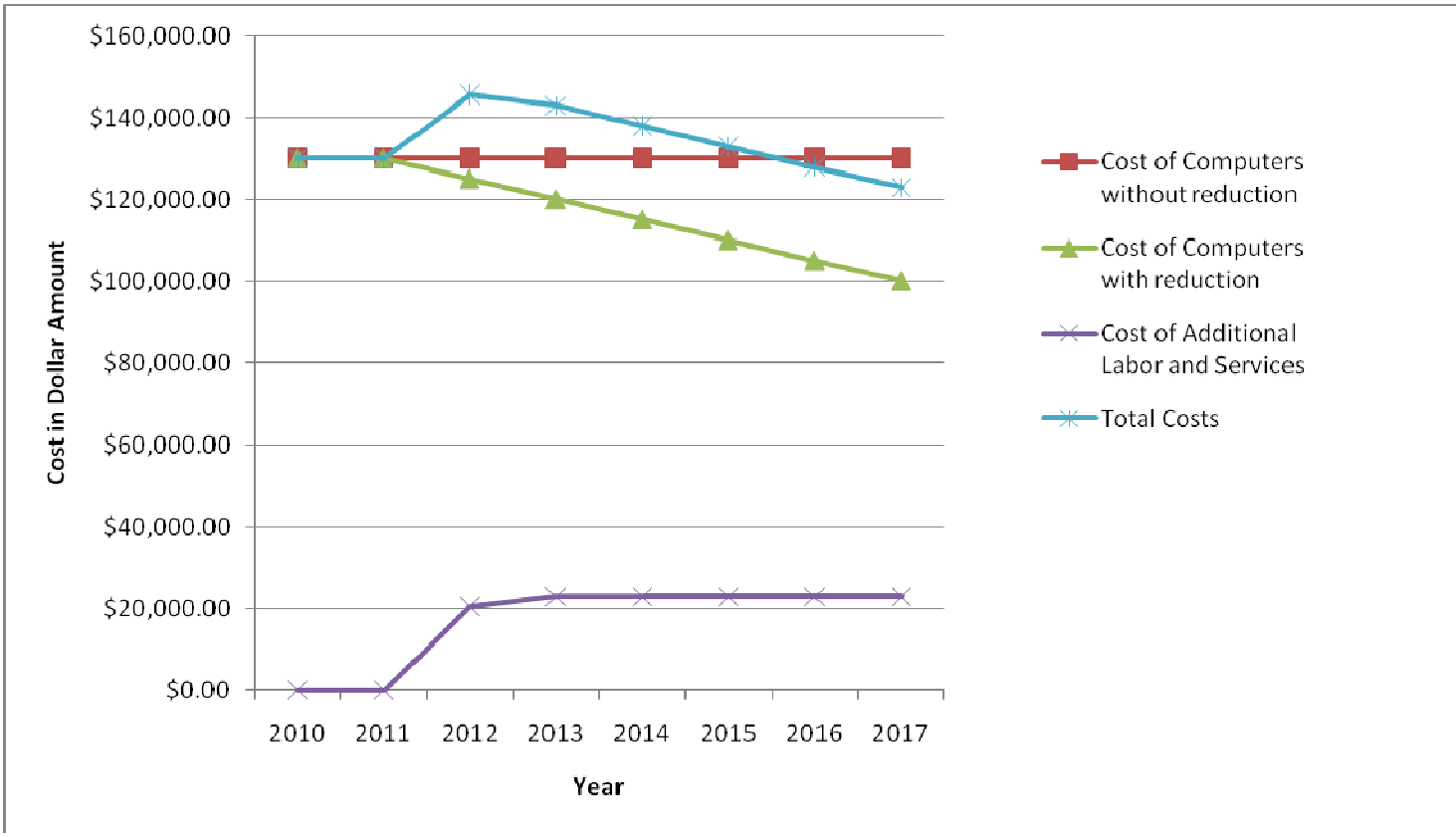

Figure 2.2. Shows the projected cost trends (in dollar amount) of computers without reduction, costs of computers with reduction, costs of additional labor and services (i.e. a part-time faculty and work study student), and total costs for the period of 2010-2017 for Regis University.

In the initial year of implementing these goals, a peak in costs is expected as the part-time staff member is hired with a salary of approximately $20,500/year and an initial reduction of computer costs of $5,000.00. However, after the initial year of implementation, total costs reduce and after the fifth year of implementation, costs are lower than projected costs of the current computer purchasing amounts. After 6 years of implementation, the projected plan saves the university $7,100.00/year. These savings can, in the future, be channeled into

other areas of sustainability on campus (e.g. green purchasing) and the increase in reuse rates for computers on campus will be a beginning of a more comprehensive sustainability initiative for Regis University.

This system can also be considered within the needs of part-time faculty and travel needs for present faculty. Currently, part-time faculty have minimal computer facilities for work need at Regis University. This electronic waste management plan invites the implementation of allowing part time faculty the use of secondary computers within the system that have been refurbished and updated and new computers be used for full-time faculty. Additionally, at present, Regis University has no travel need computers available for full time faculty, forcing faculty to purchase computers for work travel needs out of their own budgets. The university should purchase a pool of laptop computers and these laptops should be included annually within the system rotation of all the computers on the campus in order to fulfill travel needs. Although the purchase of these new computers will factor initially into the computer budget for the university, the system rotation allows for the computers to be used for an extended period of time that will ultimately avoid future costs to purchase new computers annually.

There are, however, potential costs to this particular system. The first issue is that the ITS department will have to manage and support more systems than before as well as have added responsibility within and outside of the academic year to continue this support. This increase in work load could be supplemented

with the addition of resources and personnel to the department which will incur additional monetary costs to the university's budget. Currently, the annual rotation and refurbishment service for the ITS department entails the cost of the labor of the staff and no equipment costs as the computer parts are covered under the warranty of the computer. Although there are no available monetary figures for annual computer refurbishment from Regis University, it can be assumed that outside the costs of labor, no additional finance is currently needed. With the increase in labor, accessibility and efficiency for all computer needs for departments will increase, specifically in terms of labor needs as represented above.

Additional issues with the potential program include the existence that the system may not meet user's needs or that the equipment is not available for later periods in the academic year as the equipment inventory drops. In terms of user's needs, the refurbished systems may not be powerful enough to support all requirements for all departments on campus. However, these cases may prove to be very few and a certain amount of the budget al.lotted to this system of annual rotation should be kept solely for these cases (i.e. for the purchase of more powerful systems). Additionally, with the drop of inventory as the school year progresses, a certain percentage of the refurbished systems should be set aside to address this particular problem so that systems remain available year-round.

Finally, it is only after a test run of 2 to 3 years that these needs can be identified and properly corrected as this program progresses.

Environmentally Friendly Computer Disposal: Choosing an E-Waste Partner

The second area of concern for the proposed electronic waste management plan lies in the proper disposal of computers that after having served their use within the system of rotation have completed their product life. Because of the environmental risks previously noted, the need for proper computer disposal on campus is clearly evident. However, the university is not legally equipped to handle proper disposal of this equipment and a need for outside action is apparent. Thus, a company unaffiliated with the university should be utilized in overseeing the proper disposal of the systems. The e-waste partner should be chosen with a critical analysis into post-pick up procedures, that is to say, what occurs with the waste after it is picked up from the campus. The company should fulfill the following needs, as outlined by Wendy Burchar of the University of Richmond (2009), in order to be environmentally sustainable:

- Securely pick up and drop off the equipment
- Provide an audit trail
- Take ownership of the equipment
- Assume liability for the assets under their control
- Dispose of the equipment in the most environmentally friendly way
- Make sure that the data is completely removed from all hard drives

Currently, Regis University does have a partner for the recycling of unserviceable computers. However, this company does not cover the costs for the pick-up and proper disposal of electronic equipment, particularly computers. Therefore, it is essential that the administration re-examine needs for computer disposal and determine a proper disposal partner that fits the above listed criteria. In addition to these criteria, it would be beneficial to select a partner that returns a percentage of the profits to the university when remarketing and selling the used computers. This profit return can aid to offset the cost of environmentally responsible disposal of the systems as well as promote proper disposal procedures for electronic equipment for the whole campus and the local community. Burchar also makes further recommendations when a partner is chosen:

- Visit their recycling plant, making scheduled and unscheduled visits
- Make sure they don't ship overseas
- Have them provide an audit trail
- Verify that they are covered by a liability policy that will insure against data loss of environmental damage
- IT department verify that the company is an approved e-waste vendor

These steps, if followed, will ensure that the university is complying with an environmentally friendly computer disposal plan and insure against any legal ramifications or liability. When selecting a vendor, it is also important to not

select vendors based on costs, expect that all equipment will be sold and profits returned, and select a vendor that simply relays waste into a landfill.

A second option for disposing systems can be donation to outside sources. This donation, however, should be made to approved charity organizations that agree to recycle the systems in an environmental manner. Furthermore, careful steps must be taken in order to verify complete clearance of data on the systems before donation as well as transfer of ownership must be completed legally. This option provides several benefits in that it fits within the university's mission "to make a positive impact on a changing society" (Regis website) as well as allows the university to ensure environmentally sustainable computer disposal practices. A combination of an e-waste partner and a donation program may be the best option for Regis University in that it satisfies the focus of the university's mission of making a positive impact on the community as well as incorporates the responsibility of the institution to address and prevent negative environmental impacts due to electronic waste disposal.

3. Re-addressing Paper Needs: Paper Waste for Regis University

In today's society, universities have become larger than their elementary purpose, expanding their once educational status into a commercial operation. The university campus is not merely a conglomeration of intellect and education, but a thriving economic enterprise with commercial concerns and needs. Because the university has now morphed into a business, economic, social, and environmental concerns should be addressed at every level of the institution. In regards to environmental concerns, waste and material consumption should be addressed on a larger scale and within an administrative infrastructure, "The waste and material consumption could be reduced considerably by the systematic implementation of environmental management principles and systems, and the majority of waste produced by tertiary education institutions is recyclable" (Amutenya et al. 2009). The fact that the majority of produced waste is recyclable is identified as a primary goal for waste management plans on a university level.

Quantifying Paper Usage on the Regis University Campus

For purposes of waste management for Regis University, main focus is paper usage and recycling. Paper products constitute a large portion of solid waste

generated on university campuses through both academic and administrative factions. Lia Ortar presents the following estimations for office paper consumption in the United States annually: “Estimations of office paper consumption per employee are at approximately 10,000-20,000 sheets a year, and can even go as high as 40,000 in the banking sector. At 500 sheets per ream, an average employee consumes 30 reams each year. A ton of paper consists of about 400 reams, therefore, 10 to 15 employees use up to one ton of paper per year. It takes 12-24 trees to manufacture one ton of paper, resulting in an average of 18 trees cut down for every 10 employees per year. Office paper usage is in fact cutting down millions of acres of forests every year” (Ortar 2009). As a university campus, the university institution can be compared to commercial endeavors, as suggested previously. Thus, if calculations were to be adopted from Ortar’s analysis to the undergraduate student population the statistics would be as following:

- Average paper consumption per student per year: 30 reams (i.e. 15,000 sheets per year)
- Undergraduate student population for Regis University: 1,670
- Average paper consumption for total undergraduate student population: 50,100 reams (751,500,000 sheets per year)
- Average number of trees cut down for total student population per year: 2,130 trees

However, due to the vast amounts of paper consumed on these campuses, “Generally, paper and paper products are regarded as cheap products and are

often undervalued as waste products. Because of this, much paper is wasted with minimal re-use" (Amutenya et al. 2009). This wasted paper, in addition, holds not only environmental implications but financial implications as well. Monetary costs associated with paper waste must additionally be indentified and remedied in order to cut costs and increase budgetary funds for all departments. Thus, paper needs must be identified and considered on the campus.

Goals for Paper Waste Management

The impact of paper waste extends beyond the emission of CO2 into the atmosphere, leading to changes in global climate, into concerns of deforestation, resource depletion, and land destruction. Additionally, the demand for wood pulp in order to make paper creates the demand for energy biomass supply (i.e. a double demand for wood for energy burning as well as paper resource supply). This demand has a widespread impact on the above environmental impacts and creates a need to focus not only on the emission of CO2 over the paper life-cycle, but "resource efficiency of paper production as well… Increased demand of wood for energy use may affect the price and availability of pulp wood. This could be overcome by increasing biomass supply or by improving the efficiency with which we use biomass for energy and materials. Recycling of paper could be a key part of such a strategy" (Laurijssen et al. 2010). Lowering demand of wood biomass supply by increasing the efficiency of paper usage can have a major environmental influence and work towards a greater sustainability effort on

campus. This paper usage efficiency takes the form of the three environmental R's: Reduce, Re-use, and Recycle.

These goals (the 3 R's) must be developed in a concrete mission statement as well as adopted in the infrastructure of the university through implemented policies for staff and administration. Environmental and sustainability goals must become an integral part of Regis' mission through a sustainable waste management plan, "A goal of sustainable waste management is the recovery of more valuable products from waste with the use of less energy and a more positive environmental impact… For example, an outgoing gradually expanding paper recycling system in Aristotle University of Thessaloniki in Greece (AUTh) was expected to recover more than 160 tons of paper annually (approximately 45% of annual paper usage) according to its application study, a prediction that was validated by its latest reported results" (Tchobanoglous et al. 2005). Regis paper waste management must set the example set forth by the University of Thessaloniki by aiming to recover 50% of paper used annually as well as increasing paper usage awareness in faculty, student, and administrative populations.

Paper Reduction and Recycling: Prescriptive Measures

A more sustainable paper waste management can be fulfilled through several programs and methods. The first step in the paper waste management plan should be change of all computers on campus to default double-sided printing

which will lead to a reduction in paper use. For example, in 2009, the University of Toronto switched two printers in the library to default double-sided printing and by "Simply changing the default setting on two printers to duplexing resulted in a reduction of 26,000 sheets of paper in two months within one library at the University of Toronto… We could also deduce that in October and November 2009, the rates of duplexing jumped to 80%, reducing the quantity of sheets used by almost one-third relative to the previous year at the same time" (Cunningham et al. 2010). This paper reduction suggested a cost savings of approximately $1,000 annually for paper in the library and the researchers have suggested that this financial savings budget be channeled toward green purchasing of more sustainable paper products with higher recycled content and certification that the fibers are sustainably sourced and processed. This green purchasing choice would "substantially increase the environmental benefits of the paper initiative, saving up to 45 trees annually while reducing energy use, greenhouse gas emissions, and pollution" (Cunningham et al. 2010). Smyth et al. identify that for the University of Northern British Columbia, "Developing an institutional duplex policy would remove several barriers to reducing paper waste while setting the norm for campus-wide participation. Coupling a formal policy with source reduction education and awareness measures will be instrumental in moving UNBC beyond recycling" (2010).

Regis University needs to make the same leap beyond recycling into a paper waste management plan that is active, comprehensive, and a model for campus-wide and local community participation. This infrastructure on an institutional level will create a base foundation for campus participation by removing the barrier of self preference. For example, double-sided printing would no longer be a preferential choice, but required under this new infrastructure. This institutional duplex policy is essential for the implementation of the waste management plan for Regis University in order to remove barriers to paper reduction, particularly the barrier of personal preference. With the requirement of all printed documents to be printed on double-sided paper, paper usage will be able to be effectively reduced throughout the campus. Currently, Regis University does not require duplex printing and the majority of printers on campus have single-sided printing defaults. Personal preference is currently the only motivation for Regis students, faculty, and administration to consciously choose duplex printing. This option is not sufficient enough to promote paper reduction on campus due to perceptions of inefficiency and lack of knowledge of duplex printing options.

The primary goal for Regis University paper waste management is the reduction of paper usage. This plan suggests an initial reduction of 33% of paper usage by 2013 and a final reduction of 50% by 2014. However, this reduction is not possible unless access to duplex printer facilities increase for students, faculty

and administration. The university should purchase 25 new duplex printers each year (beginning in 2012) at approximately $400.00 per printer (www.hp.com), with the purchase of 50 new printers in 2013 to begin the phasing into a required duplex printing policy for all students, faculty, and administration in order to successfully reach the goal of 50% paper usage reduction. Table 3.1 outlines the following costs of the system as well as the future cost reductions in paper usage due to duplex printing capacity and administrative policy:

Table 3.1. Shows the projected annual cost (in dollar amount) of cost of paper without reduction, cost of paper with reduction (33% from 2012-2013 and 50% from 2013-2016) cost of duplex printer purchase (25 new printers annually and 50 new printers for 2013 at $400.00 per printer),and total costs for the period of 2010-2016 for Regis University.

Year	Cost of Paper without reduction	Cost of Paper with reduction	Cost of Duplex Printer Purchase	Total Costs
2009	$50,400.00	$50,400.00	$0.00	$50,400.00
2010	$53,353.12	$53,353.12	$0.00	$53,353.12
2011	$51,640.00	$51,640.00	$0.00	$51,640.00
2012	$51,640.00	$51,640.00	$10,000.00	$61,640.00
2013	$51,640.00	$34,857.00	$20,000.00	$54,857.00
2014	$51,640.00	$25,820.00	$10,000.00	$35,820.00
2015	$51,640.00	$25,820.00	$10,000.00	$35,820.00
2016	$51,640.00	$25,820.00	$10,000.00	$35,820.00

*(Layton, personal email correspondence, 2011)

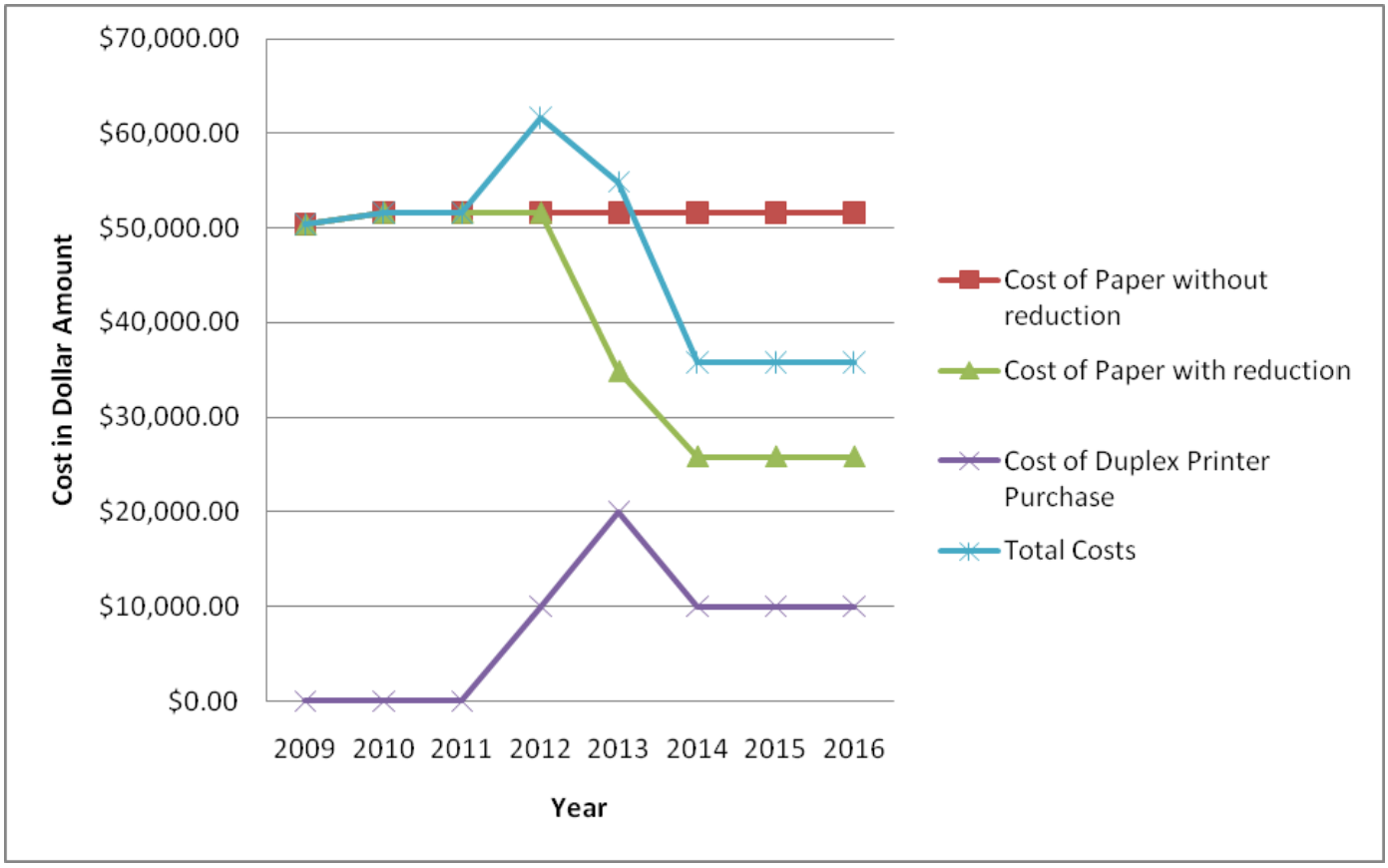

Figure 3.1. Shows the projected cost trends (in dollar amount) of cost of paper without reduction, cost of paper with reduction (33% from 2012-2013 and 50% from 2013-2016) cost of duplex printer purchase (25 new printers annually and 50 new printers for 2013 at $400.00 per printer),and total costs for the period of 2010-2016 for Regis University.

In the initial year of implementing these goals (2012), a peak in costs is expected with the initial purchase of 25 new duplex printers to be placed as needed per department. It is only after this initial purchase that paper reduction is feasible as the university should aim to reduce paper usage by 33% for the following year (2013). Beginning in 2013, paper costs are reduced by 1/3 and an additional 50 duplex printers are purchased, reducing costs compared to the

previous year, yet still exceeding costs at the initial stages of the plan. However, after increasing duplex printers by 75, the university can begin phasing into a reduction of paper usage by 50% into 2014. Beginning in 2014 with an increase in paper usage reduction and the purchase of 25 more printers, costs are significantly lowered and begin to offset the initial startup costs of the program. After the first two years of initial implementation (reduction of 50% and purchase of a total of 100 new duplex printers), total costs are lowered by $15,820.00 per year including the purchase of 25 duplex printers per year and paper reduction by 50%. After 5 years of implementation, the projected plan saves the university an estimated $15,820.00/year in paper purchase. These savings can, in the future, be channeled into other areas of sustainability on campus (e.g. purchasing recycled printer paper throughout the campus) and the reduction of paper waste will be a beginning of a more comprehensive sustainability initiative for Regis University.

A study done at the library at Gerstein University in Toronto identified the three “R’s” as the primary focus of the paper usage initiative and asserted that “simply providing recycling bins within the library is not sufficient to minimize impacts of paper usage” (Cunningham et al. 2010). Although recycle bins do have a slight impact on campus paper re-cycling on the Regis campus, it cannot be left as the only option on paper waste management on campus. Reduction of paper usage must complement recycling efforts in paper waste management.

Furthermore, reduction of paper will benefit the university as a whole due to cost reduction of not only paper purchasing but recycling resources as well.

In addition to paper reduction, the university should increase paper recycling capacity. Currently on campus, a lack of recycling stations for every printer does not satisfy the needs for the community. In a survey of all student areas for printing on Regis University's campus, the following areas were identified as the major areas of student printing activity: Carroll Hall, Dayton Memorial Library, DeSmet Hall, O'Connell Hall, and the ALC. Table 3.1 outlines computer locations, recycling bin availability in all locations, and double sided printing defaults for all computers. In the key areas of student activity (i.e. ALC, Carroll Hall, and Dayton Memorial Library), a mere 7 recycling bins are located near computers with a total computer count of 162. With approximately 1 recycling bin per 23 computers, recycling rates for students are extremely low due to a lack of adequate recycling receptacles. Efficiency is identified as the primary focus for students particularly in regards to printing on campus. The current low percentage of recycling locations available to students in key areas of printing on campus is a large cost of inefficiency for recycling rates for the university. An increase in recycling bins near computers will be extremely beneficial in offsetting the cost of inefficiency for recycling printed papers.

Table 3.2. Shows the number of computers, recycling bins, trash bins, and duplex printing capacity for different locations around the Lowell Regis University Campus (Note *all printers had duplex printing capacity).

Location	**No. of Computers**	**Recycling Bins**	**Trash Bins**	**Double Sided default***
ALC Hall 1st floor	6	0	1	No
ALC Lab room 06	24	1	1	No
Sci Chemistry Suite	12	2	2	Yes
Student Center Grill	4	1	1	Yes
Caroll Hall lab room 19	24	1	1	No
Caroll Hall lab room 17	16	0	1	Yes
Caroll Hall lab room 16	14	0	1	No
Caroll Hall lab room 15	12	1	1	No
Library 2nd Floor (A&B)	25	2	2	No
Library 1st Floor	11	1	2	No
Library 3rd Floor	6	1	2	Yes
Library 4th Floor	24	0	2	No

The central theme for the campus initiative should be to reduce. In a study done by Smyth et al. of the University of Northern British Columbia (UNBC), it was identified that "In moving towards sustainable waste management, UNBC focus on reducing waste at the source, re-using materials when possible and recycling what remains… A potential paper reduction strategy for UNBC would be to institute a policy requiring all university documents be paperless when possible or printed on both sides where hard copies are required. (2010). A main goal for a paper waste management plan for Regis University must be an evaluation of costs and benefits for paper reduction for students, faculty, and administration. Incentives for reducing paper usage are the most efficient and effective means of ensuring a successful paper reduction goal. Financial incentives should be implemented on the faculty and administrative levels to

encourage paper usage awareness. These incentives should be focused on a shift in budget use, providing financial increases to budget for departments that seek to actively reduce paper usage per month. Paper usage should be monitored per department by work study students in each department and compiled monthly by a designated faculty member to be evaluated and awarded according to ranking of paper reduction. At present, there is no financial incentive for students to choose duplex printing or copying option.

Quantifying Waste Streams on Campus: Faculty, Staff, and Students

Additionally, Regis University should conduct waste stream studies per year to quantify the amount of waste produced on campus annually. These studies will be extremely beneficial in determining annually goals for the Regis paper initiative as well as to determine potential areas for budgetary cuts in order to decrease waste (particularly paper waste) costs. Smyth et al. (2010) in a study assessing steps to reduce solid waste in higher education determines that, "Effective solid waste management programs require a complete understanding of the composition of a waste stream as well as the activities that determine its generation in the first place". In addition to infrastructural changes in activities on campus, an annual review committee must be created in order to accurately determine and understand the composition of the Regis solid waste stream annually. Direct waste analysis studies will allow for the most direct and effective methods in examining the types of waste generated on campus and the

opportunities to fulfill the three R's of the paper saving initiative: reduce, re-use, and recycle. This step to the paper initiative is identified by Smyth et al. (2010) as an essential step towards greening the university campus.

A 5 day paper survey was conducted on Regis University campus in order to analyze typical paper usage on campus among students, faculty, and administrators. A test survey population of 15 individuals (5 students, 5 faculty/professors, 5 administrators) was asked to track paper printing usage over the course of 5 working days in the following categories:

1. Student Test Group
    a. Printing Email, etc.
    b. Printing Research
    c. Printing Class Handouts and Notes
    d. Printing Administrative Forms
    e. Printing Papers
2. Faculty Test Group
    a. Printing Emails
    b. Printing Class Handouts and Exams
    c. Printing Administrative Forms and Paperwork
    d. Printing Memos
    e. Printing Notes/Research
    f. Other
3. Administration Test Group
    a. Printing Emails
    b. Printing Memos
    c. Printing Administrative Forms and Paperwork
    d. Printing Research
    e. Printing Notes
    f. Printing Other

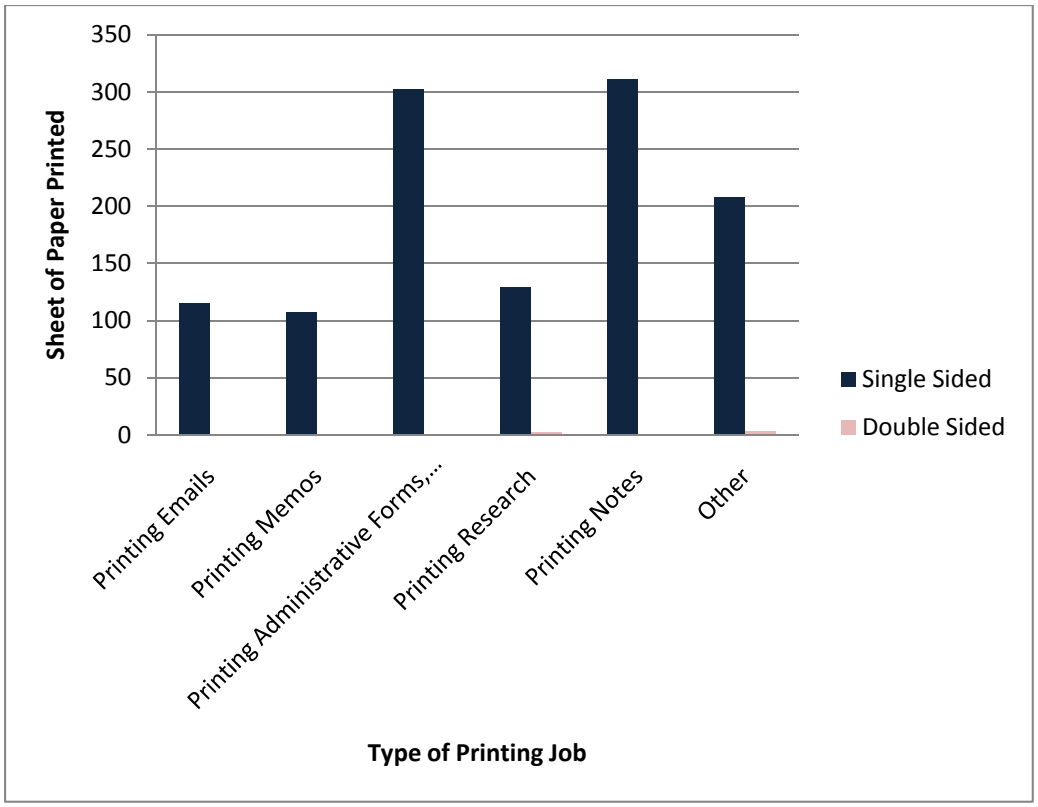

Figure 3.2. Shows administrative paper usage of a test group of 5 people for 6 groups of printing needs over a 5-day study period.

According to Figure 3.2, the administrative test group had the largest total paper usage over the 5 day test period with a total printed page number of 1174 pages. The departments that were surveyed were Student Disabilities, Career Services and Financial Services. The data show that the majority of pages printed included administrative forms, paperwork, agendas, and notes. A total of 613 pages were printed within the aforementioned categories during the test period, all of which were printed on single-sided sheets. Paper reduction must be identified as the primary goal for administration, particularly through the strategy of

requiring double-sided printed or the implementation of an online system for all administrative forms and paperwork. Implementing a double-sided printing requirement could reduce paper usage by a potential 50%, decreasing paper budgets for each department. However, double sided printers are either not available for these departments or default duplex printing settings have not been changed. Thus, these departments must be equipped with double-sided printers and all default settings for department computers should be changed to duplex printing. Training should additionally be provided for departments as to the function of the printers and the duplex printing options for each computer. With the purchase of double-sided printers, budget costs for paper purchasing will decrease over time and potentially earn back the initial costs of the printers as projected in Table 3.1. Budget reductions for paper purchasing could be additionally channeled into green purchasing (i.e. purchasing recycled printing paper) or additional potential green sustainability areas.

For the three departments, of the total of 1174 pages printed during the test period, only 5 pages were printed double-sided (approximately 0.04%). This percentage is illustrative of the necessity for the university to implement different printing requirements for all facets of the university infrastructure. Additionally, the category of “Printing Notes” for administration requires an increase in paper re-use. This category consisted of personal and professional notes that were disposed of within a period of 2 days, i.e. not used for permanent records. With

the re-use of “scrap” paper, paper consumption can be dramatically reduced in this category as well as insuring that all notes be duplex printed. Furthermore, all figures of printing emails and research are single-sided and not printed on re-used paper, contributing to unnecessary paper consumption. Promotion and awareness of duplex printing and paper use is essential in the form of administrative programs. For example, one tray of each department printer could be designated for re-usable sheets of paper for an option for printing emails, research, and notes. Slogans such as “Take a Sheet, Leave a Sheet” could be utilized to encourage administrative members to print on re-used paper and to promote sustainable printing practices in all areas of the university.

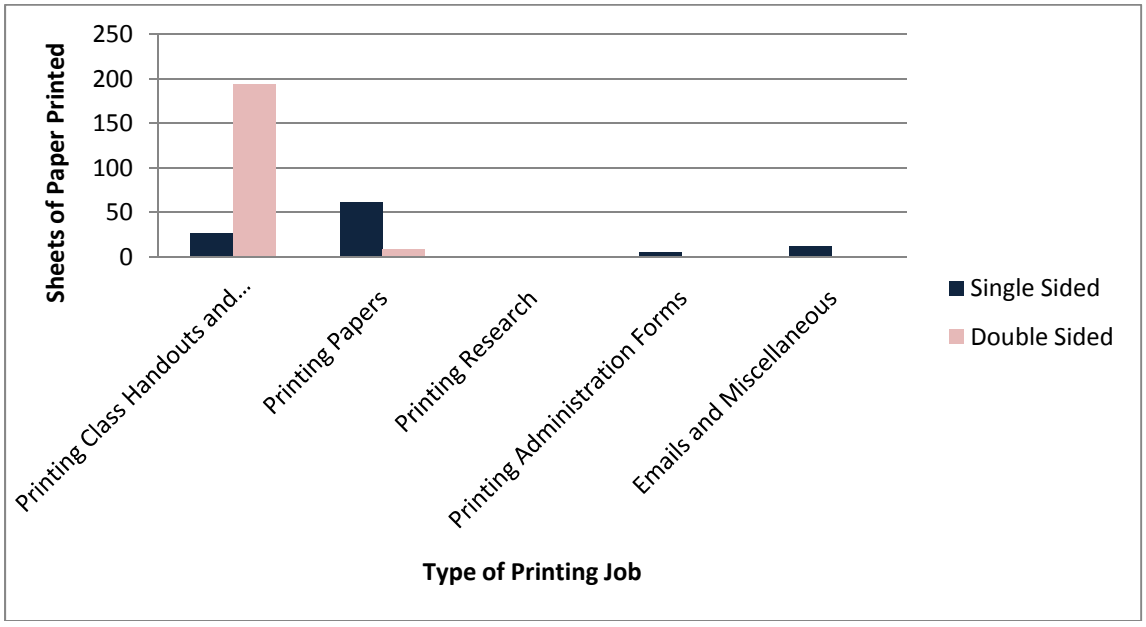

Figure 3.3. Shows student paper usage of a test group of 5 people for 5 groups of printing needs over a 5-day study period.

Within the student test population, printed page totals were greatest in printing class handouts and notes. Of the total of 308 sheet printed over the test period, 221 sheets (71.7%) were class lectures notes and handouts. Of these, 194 sheets (or 87.7%) were printed using duplex printing. Therefore, for the student population, a focus should not be placed on increasing awareness of duplex printing, but a focus on reducing paper usage as well as increasing recycling after paper usage.

In terms of focusing on paper reduction, programs such as the aforementioned "Take a Sheet, Leave a Sheet" administrative program should be implemented on a student level as well. Promotion for the re-use of paper must include large percentages of student participation in order for paper re-use programs to be successful. Programs should be complemented by utilizing posters on program initiatives, encouraging participations through slogans, and implementing possible incentive for participation. Possible incentives may include changing printing cost numbers for page counts to take into account duplex printing, for example, charging 1.5 sheets for every 2 sheets of double-sided printing, encouraging students to duplex print in order to cut printing costs. Another possible incentive may include monitoring printing patterns in Residence Halls on campus and rewarding areas for effectively reducing printing totals monthly. In regards to academic printing purpose (i.e. printing essays/papers), 61 of the 70 sheets (87%) were printed on single sided sheets of paper. This

particular figure is attributed to a lack of faculty and administrative implementation of duplex printing for all papers written by students. The lack of double sided printing for this category can be remedied by a creation of a requirement for all faculty members to necessitate duplex printing for all papers.

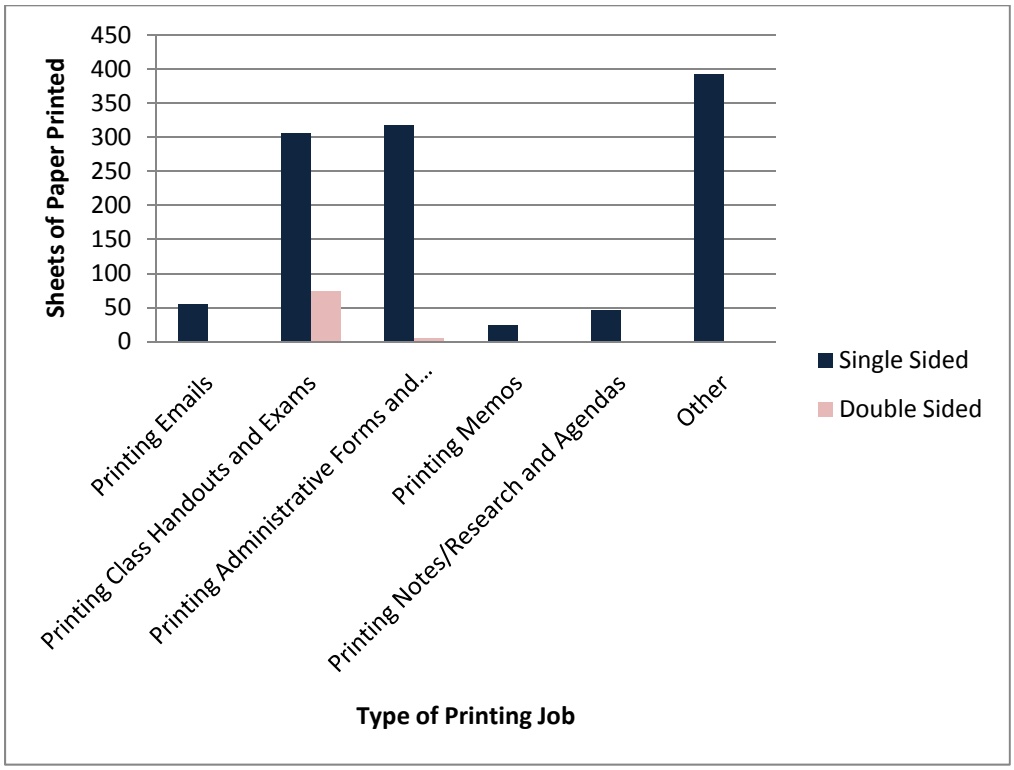

Figure 3.4. Shows faculty paper usage of a test group of 5 people for 6 groups of printing needs over a 5-day study period.

In terms of faculty printing statistics, within the test population, the majority of printing is single-sided. Out a total of 1221 sheets printed, 1142 sheets were single sided (93.5% of total printed pages). Of these 1142 sheets, 393 sheets were printed single-sided under the category of “other”, 318 single-sided sheets were printed for administrative forms and paperwork, and 306 single-sided sheets

were printed for exams and class handouts. Faculty printing waste management should center on an increase in duplex printing percentage and a decrease in pages printed in general. The majority of faculty on campus does not have direct access to duplex printers or knowledge of how to use duplex defaults, thus, access to duplex printers as well as duplex printing awareness must increase among faculty in all departments. For departments that do have direct access to duplex printers, double-sided defaults should be installed in all faculty and staff computers and awareness must be raised among faculty/staff for proper usage of duplex printing. Administrative regulations should additionally be implemented that require all class handouts to be posted online rather than printed and all exams to be duplex printed. An increase in re-usable sheets of paper for printing purposes (i.e. "Take and Sheet, Leave a Sheet" program) could potentially reduce paper needs in the "Other" category for faculty members, creating a comprehensive paper reduction program for all printing paper uses for faculty.

Goals for Future Paper Initiatives

The goals of Reduce, Re-use and Recycle should be addressed in particular regards to paper waste management on Regis University campus in order to have the greatest ecological and economic impact. The first step in the implementation of this new paper waste management plan must be a characterization of the paper-saving initiative with specific goals and plans for all

facets of the campus. The current outline is a suggestive template of goals for the future paper initiative:

- Reduce paper usage by 50% by 2015
- Increase paper reuse by providing paper reuse bins, etc.
- Increase paper recycling locations on campus as well as increase awareness of these locations
- Develop a description of Regis University's paper-saving initiatives as well as a slogan to promote this initiatives
- Develop a handbook of paper-conservation tips and strategies for use by students, faculty, staff, and administration on campus
- Develop a concrete explanation of paper reduction and reuse impetus

The data, figures, and table given in this chapter can be used as the template for implementing this future paper initiative. The administration and faculty must provide support in the form of infrastructure, policy, and action and the students should be informed and involved in the initiative to ensure the future success of the program for Regis University. The fusion of infrastructure, policy, and student involvement encourages an environment of intellectual debate and development in addressing the improvement and transformation of the paper initiative on campus and can aid in the evolution of the university into an environmentally conscious and sustainable institution.

4. Citizen Participation at Regis University

The Role of the Individual: Personal Empowerment

At Regis University, the students, staff, and faculty determine the success of the institution as a whole through the active participation of all communities in every facet of the university. The institution cannot function and develop without the efforts of student, staff, and faculty and this effort requires motivation that pushes the population to make great effort in determining the success of the university. Thus, the institution should foster this motivation in order to create an environment of empowerment and solidarity, "Empowerment conveys both a psychological sense of personal control or influence and individual determination over one's own life" (Maeda et al. 2009). In a large institution (particularly in a university setting), the individual often struggles to see the end results of this active participation, leading to a lack of motivation and direct action. However, when individuals are given the opportunity to control or influence a part of the institution's procedures, personal empowerment is possible because participants experience the outcomes and effects on a larger, more personal level.

Personal empowerment with regards to waste management must include a sense of personal control over the workings of a newly implemented system. The

system should contain outlets for both administration and student involvement directly in the implementation, development, and analysis of the waste management plan through all stages. These outlets provide a foundation for personal empowerment and solidarity and provide a means for a growth in physical and mental abilities and the process of thinking about critical problems. The ability to think critically about present social, economic, political, and environmental problems not only requires a general knowledge of history and background information but also requires an active participation in finding and implementing solutions to such problems. Direct social effects within these possible solutions manifest by providing those actively involved in the solutions with a sense of solidarity, self-efficacy, and empowerment. This is evident in the words of Maeda et al.. (2009) in conducting after-study interviews with volunteers directly involved in environmental groups, “Ando conducted interviews with members of environmental groups and found that volunteers gained skills, self-efficacy, and a sense of solidarity from their participation. In the context of this study, self-efficacy meant the growth and development of one’s abilities and way of thinking, and a sense of solidarity meant expanding networks and sharing similar interests with a group”. The development of self-efficacy, solidarity, and networking will create an expansive and complete system in which communication is fostered and is essential in addressing future problems and finding solutions.

The Problem of Efficiency and the Promise of Citizen Involvement

Although personal involvement in identifying and solving environmental problems offers less evident benefits such as self-efficacy, the direct personal costs of time and money are a major obstacle in reality. These personal costs are an indicator of efficiency in future and current systems and the university administration should take into consideration an analysis of personal costs to efficiency as well as potential benefits to the individual and the in the construction and implementation of these systems. In addition, “To reduce personal costs, efforts are required to minimize time costs associated with participation and to offset the burdens associated with human relations during citizen participation” (Maeda et al. 2009). In order to minimize time costs, efficiency must be a large focus for waste management systems, particularly in large corporate arenas and university campuses. This focus on efficiency requires an administrative role in the form of a sustainability coordinator. A sustainability coordinator would be responsible for not only developing methods of sustainability on campus but insuring that those methods guarantee efficiency in terms of time and money. An administrator would oversee efficiency logistics for sustainability on campus in order to incorporate not only environmental issues but economic and social issues as well. While economic factors incorporate monetary and time costs, social issues incorporate the offset of burdens associated with human relations by increasing social and mental benefits reaped by those participating directly in the

system (i.e. personal empowerment and self-efficacy). The combination of efficiency and social/mental benefits furthermore creates a system that extends throughout several disciplines and requires the input of individuals of all specialties that work and/or live on campus. This sustainability coordinator would work to improve efficiency and social benefits on campus by creating a program of volunteer participation in all facets of sustainability on campus.

This volunteer participation in the waste management system would expand networks as well as a share and increase the acquisition of skills (both mental and physical). Specifically within the Regis university vicinity, an expansion of networks would extend far beyond the drawn boundaries of the campus, but ultimately flow into the local community. By creating a sustainable example of waste management within the university infrastructure and community, the influence of the university is able to extend as an example for local communities in regards to waste management. In addition, the system would encourage not only the participation of those located directly on campus, but those that live and work in the surrounding areas. This active involvement of the community requires the participation of not only those who specialize within the system, but individuals and ordinary citizens who have no experience in volunteer activities. In order to ensure this general citizen participation, “conventional methods such as efforts in building a positive evaluation of citizen participation through highlighting the social benefits expected from citizen participation would

not be sufficient. Advocacy efforts must be made emphasizing that participation provides empowerment through a sense of self-efficacy and solidarity" (Maeda et al. 2009). This advocacy effort requires a large faction of support not only from volunteers and citizens but from top administrative infrastructure and a sustainability coordinator as well.

Regis University should implement a system a strong, centralized regulation and top support for bottom-up initiatives. This notion creates a system in which all level of infrastructure and participation lie on the same plane, the idea of "democratic pragmatism", "The notion of democratic pragmatism seeks to bring citizens and stakeholders into equal positions of power in environmental management issues, especially with its emphasis on local control" (Maeda et al. 2009). This equalization of top and bottom levels in the system promotes and encourages the participation of all persons involved in the waste management system because direct social and environmental effects are visible to all levels in the same time frame. Additionally, a conceptualization of environmental effects of unsustainable consumption patterns is necessary for a mobilization of the local community for the waste management program. This conceptualization also creates the potentiality of cooperation between all individuals and groups involved in the waste management chain because it creates a base foundation of knowledge and awareness that is equally distributed throughout the chain and the

message that waste management is the responsibility of all individuals involved on campus.

The foundation of student and faculty participation on Regis University's campus must be a change in attitude about the problem of waste management itself, "Citizens needs to see themselves not only as part of the problem, but also part of the solution if the transition seeks to create more sustainable lifestyles" (Agger 2010). By directly involving the local population in not only an awareness of the problem but as an active voice in searching for a solution, the waste management plan extends beyond a paper infrastructure into a system that is implemented and lived actively and consciously. The population's role is transformed into a vital role in the education, mobilization, and response to waste management problems on campus. This evolution of the role of students and faculty will create not only immediate success for the system, but a sustainable implementation for the future. Furthermore, the incorporation of student and faculty within the direct implementation of the waste management plan transforms the role of the university itself.

A Transformative Role of the University

This new perspective of the role of the university in providing solutions to waste management issues can be explained by the theory of "Reflexive Ecological Modernization". Within the framework of REM, the "state's" role in

environmental issues is defined and expanding with indentifying problems and discovering possible solution, “According to the Danish sociologist Holm (2007), we are now witnessing a new and more deliberative form of reflexive ecological modernization. With this approach, the state plays a more interactive and facilitating role. It uses communicative tools to mobilize citizens as co-producers of public steering in ecological transition processes” (Agger 2010). This approach moves beyond a basic scientific method in addressing environmental problems but views environmental problems as challenges for social, economic, and technical reform rather than a consequence of industrialization and development. The transformation of environmental problems, thus, incorporates not only science, but the infrastructure of politics, social affairs, economics (i.e. the market), and the consumer. Additionally, this theory alters the role of the state to incorporate a greater combination of top-down support and bottom-up grassroots initiative and participation. When adopted at a university level, the role of administration in waste management issues transforms along similar lines to those outlined under REM for the state. This theory requires the university to incorporate the views and suggestions of the “consumer”, that is to say, the students as well as faculty.

To begin, this transformation of the role of the university in addressing environmental problems requires a method for insights, concerns, and considerations to be heard on an administrative level. In a study conducted to

analyze the success of a waste management plan implemented in Tehran, Iran in 2008, Nasarabadi et al.. conducted door-to-door surveys to evaluate citizen's attitudes and beliefs about participation in local waste management programs such as the source separation program. By conducting the survey, areas of concerns and possible improvement were solidly indentified and addressed in respect to specific areas of the waste management program. For Regis University, a channel of participant and local community response to the waste management program must be created by administration. The feedback of the individuals that experience the success and failure of different areas of the program will allow the administration to strengthen or change areas of the program that require improvement. Thus, Regis should conduct similar surveys annually among the local population. The statistical results of the survey should be analyzed and used to improve the program annually.

Citizen Education, Awareness, and Participation in WEEE

The involvement of a greater percentage of the student population on Regis University's campus requires action on both the top and bottom levels. The first goal in increasing active participation in the proposed waste management plan in student and faculty communities must be awareness and education. Basic efforts to increase awareness and education should be focused on the placement of informational posters and brochures around campus on paper recycling initiatives

as well as electronic waste policies. Identifying areas of highest student and faculty concentration identifies the most effective areas to promote waste management awareness and education via posters and brochures. Furthermore, the promotion of the waste management plan through visible marks throughout campus publicizes the sustainability efforts on the university to prospective students and faculty. This method also provides a quick and efficient means of increasing environmental awareness without requiring significant changes in infrastructure as well as budgetary resources.

Initially in the waste management process, there is a need to transform the student's and the faculty's unwillingness to participate in waste management practices on campus. A major player in this willingness is the lack of knowledge of students, faculty, and staff of local solid waste facilities on campus. This lack of awareness must be changed and this change is possible through a number of simple possible solutions. Firstly, physical maps of available recycling facilities and solid waste receptacles must be available throughout the campus in form of posters or signs that indicate locations. All receptacles should be placed in convenient locations around the campus, including all printers and by all trash receptacles and be labeled clearly for proper disposal usage.

Additionally, an awareness of the local and global effects of unsustainable behavior such as not recycling is imperative in order to ensure waste management success because, "Many people find it difficult to relate to debates about climate

and sustainable development because the consequences of their consumption patterns are often invisible or they affect people, other places or future generations" (Agger 2010). In order that consumption patterns become visible to students and faculty on campus, education must be incorporated not only in the global environmental awareness curriculum, but as a general display on campus (posters, informational brochures, etc.) and in general residence life orientation for students. An awareness of the consequences of action fosters concern and a desire to prevent those consequences. Thus, this consciousness should become a core goal for campus sustainability through the increase of public awareness events such as documentary showings, guest lecturers, and student/faculty forums. Incorporating the student body during periods of student involvement and activities such as Ranger Week on campus for Regis University in issues of sustainability (particularly waste management) will be highly effective in promoting the success of the program. For example, a display of recycled art on campus during Ranger Week or organizing competitions between student residences in creating art out of recycled materials on campus may provide an opportunity to educate the student body of the waste management programs on campus and provide an initiative for students to become actively involved in the program.

Academically, the current implementation of a required environmental core course provides an ideal setting for the increase of awareness of

sustainability issues for the student population and should be developed through the increase of available courses. The newly developed environmental core requirement should be focused not only around a purely academic framework, but incorporate an active participation requirement to promote active volunteering in environmental programs on the campus. This core requirement must be a fusion of the liberal arts university mission to “encourage the development of the skills and leadership abilities necessary for distinguished professional work and contributions to the improvement and transformation of society” (www.regis.edu). The core requirement provides an opportunity for the university to manifest the synthesis of intellectual enterprise with the development of professional skills and action in order to work to solve environmental issues such as waste management on the university campus. A successful waste management plan requires not only an infrastructural outline, but the injection of intellect, motivation, skill, and individual input. With the involvement of students under a constructed syllabus, awareness and volunteer participation in waste management will increase. In this context, “ It is important to emphasize that environmental education is not just recycling information provided in booklets. Essentially, environmental education is a long-term effort that must be a commitment between present and future governments, with the objective to create a strong environmental consciousness among citizens, the private and the public sectors” (Bortoleto et al. 2007).

The fusion of a student/staff/faculty run committee such as the Sustainability Committee on campus with a sustainability coordinator that is involved not only in sustainability on campus but approaches sustainability problems on campus with an awareness of the economic, social, and political infrastructure of the university as an institution creates a versatile and highly adaptive organization that will be able to address sustainability issues successfully and efficiently. This organization additionally bridges the gap between the administrative infrastructure and the every-day experiences of students and faculty by creating a successful outlet of creativity within the system for students and faculty that are directly affected by programs such as campus waste management. The position of the university as an inter-disciplinary liberal-arts institution allows the infusion of creativity in addressing sustainability issues within the university through a highly varied pool of interests and disciplines. This encourages an environment of intellectual debate and development in addressing the improvement and transformation of the campus as an environmentally conscious and sustainable institution.

Epilogue

I began this thesis with a vision: to explore the extent of Regis University's environmental impact through daily product use of paper and electronics and to educate those of us who come into contact with these issues on a daily basis often unaware of the past and future implications of our actions. My research opened up an extensive area of complex social, economic, and environmental issues that work together to create a comprehensive infrastructure for waste management on campus. Goals became evident in each area of my study: reduce paper waste, increase paper recycling and duplex printing capacity, re-evaluate the electronic waste system on campus, create battery recycling infrastructure, and increase faculty, staff, and administrative participation in waste management on campus. However, one goal stood as the greatest challenge to the campus throughout my research: to change the way the university approaches the 3 R's (Reduce, Reuse, and Recycle). According to Marc Fournier in the book "The Green Campus, "Colleges and universities, in general, concentrate their resources on recycling first; reuse second; source reduction, and buying recycled, and disposal third" (Simpson 2008). Regis University is no exception. I found through my research that the majority of sustainability efforts in regards to paper and electronic waste management were focused largely on recycling throughout

the campus. Although recycling is an essential player in a sustainable and environmentally aware institution, it should not be the primary focus. Rather, a shift in sustainability in waste production is necessary on campus from the priority of recycling over reduction and re-use to a priority of reduction followed by increased re-use rates and finally, recycling. Primary reduction of consumption on campus reduces the amount of raw materials needed to manufacture those products and reduces the amount of waste generated and funneled into landfills across the country and world.

Reducing consumption ultimately implies living a “simpler” life defined by consuming and utilizing fewer material goods, a life highly valued by the Jesuit tradition. This simple life is not only defined by a reduction in consumption, but a shift in focus of how we consume, what we consume, and why we consume. In order to truly create an impact on the environment, Regis University, through the collaborative efforts of faculty, staff, and students, must create a community define by a common sustainable lifestyle centered on sustainable consumption, conscious efforts to re-use and recycle products, and an awareness of the environmental impact of the actions of each individual and the university as a whole. A change in viewing consumption patterns will allow the university and those active in the community to affect a change on a larger level by beginning on a personal level. Living the sustainability messages creates contemplatives in action, individuals who engage in an informed conversation of

environmental issues and take that conversation outside the walls of the university into everyday life and the outside community.

Finally, this thesis not only offers an economic and environmental analysis of waste management for Regis University, but encourages this institution to re-evaluate the meaning of sustainability and weave this new definition into the thread of the university mission, infrastructure, and community. The following figure represents the encompassing and comprehensive character of sustainability:

(Holbrook 2010)

Sustainable solutions require an integrative dialogue between economic, environmental, and social issues and this dialogue must encompass all players in this system through a top-down, bottom-up collaboration. The fusion student, faculty, and staff participation in not only waste management issues on campus but all sustainability efforts and environmental issues will allow for the versatility and adaptability of Regis University to address current environmental issues that threaten our global ecosystem through education and action. Sustainability in this sense requires an integration of all departments, curriculums, and disciplines across campus and calls upon a weaving of sustainability into the core of the university and its mission to move into the future as a local and national leader in sustainability and environmental awareness in higher education.

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