

Introduction:

This document was created to synthesize the environmental policies and practices implemented by Princeton University in the past ten years and mainly focuses on the information provided in the three environmental audits that were performed in the years 1995, 2000, and 2002. The 1995 audit was completed by a former organization, the Princeton Environmental Reform Committee (PERC). The other two audits were executed by undergraduate students in Environmental Studies 201. Policy transformations that have occurred since 2002 were gathered through online research, the meeting minutes of the Princeton Environmental Oversight Committee (PEOC), and interviews with representatives in departments such as Engineering, Building Services, and Environmental Health and Safety. The audits, combined with research, have yielded information on the changes that have resulted on campus throughout the past ten years.

The University: Committees, Policies, Academic, and Student Organizations:

In 1990, an unofficial Ad Hoc Environmental committee comprised of students, faculty, and administrators was formed. The committee functioned as a discussion group allowing for the formation of the undergraduate Environmental Studies program in 1991 and the founding of the Princeton Environmental Institute in 1994 to bring environmental teaching and research together under one umbrella. Moreover, the group spearheaded small environmental research projects and supported the beginnings of a university-wide recycling program. In 1991, Princeton received the New Jersey Department of Environmental Protection's (NJDEP) Outstanding Achievement award for recycling more than sixty percent of its waste. However, the committee was never formally recognized as a university advisory committee and consequently lost momentum in pushing for environmentally sustainable practices. An

environmental chair was provided in 1992, as a position on the student college council, and by 1995 four of the five residential colleges maintained the post. The Princeton Environmental Reform Committee (PERC) was created following the Campus Earth Summit held in 1994. Similarly, this coalition included staff, faculty, students, and administrators working together to improve campus environmental issues. The 1995 environmental audit of Princeton University was conducted by PERC beginning in the spring of 1994 in order to gather evidence and demonstrate the need for University improvement.

In the same year, the University signed on to the Voluntary Green Lights Program and became a Green Lights Partner implying that Princeton was seeking to increase lighting efficiency and hence energy conservation. As a partner, the University was requested to perform lighting surveys and upgrades to buildings, where it was profitable, within five years time. All new construction projects would also require energy-efficient lighting. Simultaneously, the Employer Trip Reduction Program (ETRP) began implementation as a way to comply with federal regulations to reduce emissions mandated in the 1990 Clean Air Act Amendments for institutions with more than one hundred employees. A compliance plan was formed that included, but was not limited to: the Princeton University Ride Share program, a voluntary program to help employees form carpools, and a payment of \$720.00 to any employee who switched from gasoline to natural gas as his/her fuel source. However, shortly after the PERC audit was completed, the New Jersey Department of Transportation announced that reductions from vehicles would become voluntary as New Jersey would instead concern itself with lowering factory and plant emissions to comply with the regulations. Therefore, the Princeton program was largely disbanded. The Undergraduate Student Government appropriated the Ride Share

Program in 1995 and the program is still in use. The service, known as Rideline, helps students find rides home during breaks from the University.

The second and third environmental audits of Princeton were conducted in 2000 and 2002, respectively, and continued the analysis that began with the 1995 audit. In 2001, Princeton University signed the Sustainability Greenhouse Gas Action Plan promoted by the New Jersey Department of Environmental Protection, which demanded a decrease in emissions to 3.5% of 1990 levels by the year 2005. On April 16, 2002 the first meeting of the Princeton Oversight Committee (PEOC) was held. PEOC was created based on the recommendations of the 2000 audit and was formed with the authorization of the President. The committee is a coalition of undergraduate students, graduate students, faculty, staff, and administrators. Since its conception, PEOC has played an instrumental role in altering university policy with regard to the Princeton environment.

Facilities - Dining Services:

Numerous, environmentally sound changes occurred in the department of Dining Services within the past ten years. Since the early 1990s, recycled napkins replaced virgin paper napkins in all the dining halls and a mug discount along with reusable silverware was provided in the student center. In 1994, the student center also recycled black plastic plates and had initiated a program to recycle polystyrene cups. However, following the opening of the Frist Campus Center in October of 2000 many of these operations were halted. Initially, the Frist Center provided reusable plates and bowls, but the practice was discontinued due to theft. However, the Frist Center currently continues to offer reusable silverware.

Furthermore, since 1993 the amount of food waste in the dining halls has substantially declined. A food waste reclamation program was established with pig farmers through a local

company called Neil McIntyre: Recyclers of Food Waste. All of the dining halls are currently encompassed in the food recycling program and leftover food is transported from Princeton, sanitized, and fed to pigs. Prior to 1995, Dining Services utilized many vendors in food delivery, but they have since reduced the amount of vendors from which they acquire goods to two and have encouraged bulk buying, which decreases the amount of waste associated with food production. Furthermore, the implementation of FoodPro, software that keeps track of food use and waste in the dining halls, also helped decrease the amount of materials discarded by Dining Services. In 2001, a program was implemented to close certain dining halls during slow periods of the school year reducing the need for beverage machines and dishwashers to be in service. Moreover, a new soap and detergent vendor selling a more concentrated product was contracted. Both of these policies were introduced to reduce the amount of water used in the department. A biweekly donation to the Trenton Soup Kitchen of food that had been prepared, but not served to students, was also instituted to help decrease the amount of solid waste discarded in food production.

Within the past two years, Dining Services, with the help of a student group called Greening Princeton, has emphasized environmental sustainability in the food industry. Reusable mugs and information about their benefits were distributed to undergraduate students in January and September of 2003, and a discount was once again provided to students from 2002-2004 when they used a reusable mug in Café Vivian and the Frist cafeteria instead of receiving a paper cup. In 2003, environmentally-friendly food was introduced in the dining halls on a trial basis and included: organic and local produce, sustainable seafood, and antibiotic free meat. Moreover, in February a labeling system was instituted with colored dots reflecting the sustainability of the seafood being served. Organic, fair-trade coffee was also made available in

Café Vivian as well as the dining halls. The measures Dining Services has pursued in the past ten years has helped to create a smaller ecological footprint for Princeton University and foster a more sustainable way of living.

Facilities - Engineering:

Facilities Engineering has also been involved in many projects ranging from helping the University become more energy efficient to reducing emissions to the environment. Many of the policies implemented by the Engineering department have been ongoing projects. Since 1990, Facilities Engineering has concentrated on upgrading old lighting systems, phasing out incandescent bulbs in favor of fluorescent lighting, adding motion and daylight sensors to newly constructed buildings as well as to some departments, replacing old lights in exit signs with light emitting diodes (LEDs) for greater energy efficiency, and replacing chlorofluorocarbons (CFCs) in the older chillers of the Chilled Water Plant with hydrofluorocarbons (HFCs). In 1991, the first Environmental Engineer was hired to the staff of Facilities Engineering to coordinate environmental projects. One such project has been the removal of 170 underground oil and gasoline tanks, which has occurred since 1992. The majority of tanks on campus are now stored above ground and were converted to natural gas, and tanks that were not converted to natural gas were replaced with double wall tanks eliminating the possibility for underground leaks.

The department has also specifically concentrated on making changes that effect energy management and production. Beginning in 1994, a plan was formulated to add all dormitories and academic buildings to the Central Supervisory Control System (CSCS), a central computer located in the MacMillan building. Remote microprocessor data multiplexers (RMDM) are installed in the buildings and allow temperature readings, status of mechanical equipment, steam, chilled water, and electrical meter readings to be transmitted. The CSCS system controls the

heating and air conditioning of most buildings on campus. By 2004, there were 101 buildings added to the computer system and by 2020 all buildings should be online. The program allows the temperature of the building to be computer controlled and regulated at a specific, set temperature. Moreover, the system can be coded to run automatically allowing the system to shut down at the end of the day and to heat a building when people arrive. The system provides greater efficiency in energy management and control. The Heating, Ventilation, and Air-Conditioning (HVAC) system is run by a central computer adjusting heating and cooling as needed. The HVAC system utilizes variable frequency drives and motors, which replaced older, less efficient models in the pumps and fans of the system. Moreover, fume hoods, standard equipment in many laboratories and the biggest energy consumers on campus, also contain controls, which manage the air flow in order to minimize energy expenditure. Heating recovery coils transfer excess heat from the hoods' exhaust to incoming air allowing energy to be saved through preheating the outside air.

Perhaps the greatest environmental accomplishment, in terms of energy management and production, was the construction and implementation of the cogeneration plant in October of 1996. The cogeneration plant uses natural gas and diesel as fuel in a gas turbine-driven electric generator and utilizes waste heat to provide heating and cooling for the University. The natural gas and diesel are considerably cleaner than the #6 grade oil previously used. Production of energy by the cogeneration facility has decreased the carbon emissions of the University substantially, well within the limits outlined in the Kyoto Protocol. Furthermore, the following year, highly inefficient Halogen lamps were banned from dormitories in favor of incandescent light bulbs significantly decreasing dorm electrical use thereby allowing energy demand to be reduced further.

In the past five years, Facilities Engineering has been committed to making buildings and dorms more energy efficient. Following the construction and renovation in 2000 of Scully Hall and Buyers, respectively, the dorms were fitted with independently-controlled thermostats to minimize overheating and provide better comfort for the students. The standard for all future dorm renovations and new buildings is now to incorporate individual thermostats in every room. Additionally, several energy and water conservation upgrades occurred on campus in 2002. Soda machines were fitted with motion sensors allowing only the next few sodas in the tray to be cooled minimizing electrical use. Four large heat recovery systems were also installed in the Lewis Thomas laboratory, so less energy is needed to heat the incoming air, and a reverse osmosis system was installed in the cogeneration plant providing better management of the waste water. In 2003, new chilled water control valves and cooling coils were installed in the chill Water Plant minimizing water usage and saving pumping and chiller energy.

Projects preserving the quality and quantity of waterways and the atmosphere were also implemented by Facilities Engineering. In 1996, Facilities began installing low-flow bathroom fixtures in toilet and shower facilities. Newly installed shower heads now have a 2.5 gallon/minute rate as opposed to the previous 3.9 gallon/minute. Additionally, in 1998 West and East end detention ponds were constructed on campus to help filter and contain the run-off water on campus. These two policies have helped to maintain the water quality on campus. Moreover, the department also pursued measures to reduce harmful emissions to the natural environment. In 1994, silver recovery units were employed in photographic operations with a vendor contracted in northern New Jersey to monitor and manage the effluent. Beginning in 1999, passive radon systems were placed in newly renovated building, such as Little and Blair (Buyers). In 2001, a Toyota Prius was purchased as an alternative to the traditional cars bought

by Facilities, and the department hopes to continue acquiring vehicles that generate lower emissions. Finally, a significant change in University policy transpired when Facilities took the initiative to begin purchasing Global Electric Motorcars (GEM) to replace gasoline powered golf carts in 2004. These cars release zero emissions from the tailpipe and will reduce noise pollution providing students and faculty with a cleaner campus environment.

Facilities – Building Services

Since 1987 when recycling regulations became mandatory in the state of New Jersey, the department of Building Services has sought to improve the amount of waste the University recycles. In 1995, the department of Building Services began recycling magazines and envelopes in addition to the paper products already being recycled thereby allowing a smaller amount of waste to be landfilled yearly. Following the completion of the Frist Campus Center in 2000, standardized recycling bins were placed in all newly constructed buildings in an effort to increase recycling on campus through greater accessibility and uniformity. Three other initiatives instituted by Building Services in the past ten years have involved student move-out. In 2004, hand carts were provided during the move-out process in order to limit the amount of cars driven on University grass and the destruction of vegetation. Finally, two recycling schemes were created to reduce the amount of waste thrown out by students. A carpet recycling program was implemented with a company called CarpetCycle and a cinder block recycling program began with Habitat for Humanity. In conjunction with these two programs the University also collected seventeen boxes of leftover food for delivery to the Crisis Center and twenty-five bags of clothing, which was sent to the Rescue Mission. These programs decreased the amount of waste landfilled by the University and allowed for the creation of new materials out of old products.

Facilities - Construction:

In the past fifteen years, a great amount of construction and renovation projects have occurred on the Princeton campus providing the University with ample opportunity to become a leader in “green” design and construct buildings with greater environmental sustainability. Scully Hall, completed in 1998, contains some features that are energy efficient, such as individual thermostats in dorm rooms and a highly effective ventilation system that captures heat from exhaust air before it is expelled from the building and transfers the warmth to the incoming air. The 1999 renovation of Wright and Patton utilized double pane windows to replace the single pane glass to provide for better insulation while simultaneously maintaining the gothic style architecture and providing greater personal comfort. In 1999, the single pane glass in the New South building was also replaced with thermopane, as was the glass on the fourth floor of Robertson Hall in 2001. These changes minimized heat loss and were accompanied by improvements in both buildings’ HVAC systems.

The Frist Campus Center, completed in 2000, was equipped with variable speed motors and motion sensors in many of the classrooms allowing lights to be shut-off when not in use. In 2001, Princeton University developed a Design Standards manual, which noted the need for “green” design to achieve energy management and Leadership in Energy and Environmental Design (LEED) standards. These standards are articulated by the U.S. Green Building Council and promote environmental sustainability in construction by emphasizing energy efficiency, appropriate materials selection, water conservation, and indoor environmental quality. Coupled with the Design Standards manual, a project utility assessment was introduced, which encouraged the use of energy saving techniques in buildings to minimize peak loads.

The Icahn laboratory, completed in 2002, also included a heat recovery system, similar to the one functioning in Scully, variable fume hoods and variable speed motor controls, as well as solar sensing panels, which move to shade the building and minimize heat gain. Moreover, the planning stages for the expansion of the Lawrence graduate student apartments in 2002 proposed the use of geothermal energy for indoor climate control. The renovations were completed in 2003-2004 and the geothermal system allows a heat exchange process to occur with the ground thereby reducing the University's reliance on fossil fuels. The new undergraduate dormitory, the Ellipse, is scheduled to open in the fall semester of 2004 and could qualify for silver certification under LEED standards. The building includes: bamboo flooring, variable frequency motors, a roof constructed from white material, a heat recovery system, and triple glazed windows to provide insulation during the fall and winter and exterior sun shading against the summer heat.

Facilities - Grounds and Maintenance:

In the past ten years, the department of Grounds and Maintenance has largely concentrated on reducing negative impacts to vegetation on Princeton's campus. After 1995, no more than five percent of the same plant species could be planted in a single area in order to discourage pest infestation and the spread of disease. Moreover, in 1993, with the help of Bartlett Tree Company consultants, the department began utilizing a system of Integrated Pest Management (IPM), and in 2000 a position was created within the department to oversee the implementation of IPM. IPM is centered on natural solutions to control insects and blights rather than the use of herbicides and pesticides and eliminates the use of general spraying. Consequently, they switched to the use of a biological treatment to control Dutch Elm disease rather than relying on a fungicide. A policy was also developed to replant with American elms, which are more resistant to the disease. A test block is located near lot 23A. The use of

biologicals has also become more widespread as a treatment method. In 1992 and 1993, a policy was created to switch from grass to another form of ground cover in areas that could not support lawn growth. Planting has been done with such foliage as ivy, pachysandra, and euonymus. These plants facilitate water filtration and reduce erosion and sedimentation. Furthermore, following a harsh winter of ice storms a different salt mix was procured, as excess sodium chloride can harm vegetation, corrode metal and pollute surface waters in extreme cases. Grounds and Maintenance switched to a Pennsylvania road mix containing fifty percent sodium chloride and fifty percent cinders to salt roadways.

In 1994, the expansion of the campus caused the Grounds and Maintenance department to concentrate on areas under construction. Construction fabric and crushed stones were placed on the ground to protect the roots of trees from the tires of trucks and construction equipment. Moreover, wood barriers were placed around trees to prevent vehicles from backing into the trunk and to stop people from leaning objects against the bark.

Reunions and move-out were two areas that the Grounds and Maintenance department concentrated on as well. In order to lessen the impact on the grass during reunions, the staff implemented three initiatives in 2000. The first was based on using troughs equipped with pumps to siphon run-off water from ice chests into storm drains to disallow melted ice from leaking onto grassy areas and causing greater soil compaction. The next initiative consisted of placing the tables and bars used in reunions next to paved walkways in order to allow people to form lines on the pavement instead of on the grass and hence, reduce damage to the lawn. The last method consisted of including a sixteenth reunion site in the festivities so that an individual site could recover while the other fifteen were rotated.

Besides the management of vegetation, Grounds and Maintenance has also focused on conservation of energy and water. From the period 1995-1999 the department phased out the use of chlorofluorocarbons (CFCs) in air conditioning units, but not walk in coolers, in favor of hydrofluorocarbons (HFCs) and hydrochlorofluorocarbons (HCFCs), which contain little or no chlorine respectively. CFCs are quite destructive to the ozone layer, and therefore the change has reduced the University's participation in damaging the ozone layer as well as its energy consumption. During the drought in the summer of 1999, Carnegie Lake was used for irrigation purposes thereby lessening the amount of clean, fresh water used for the purpose of watering University foliage. In 2000, tree islands were planted in the parking lot below the cogeneration power plant to cool the area and the department placed hay on top of grass seed to provide for better water retention and reduce watering of the lawn. Three years later a sod/garden roof was installed on Marquand library allowing for greater water retention in the natural system.

Office of Information Technology (OIT):

The changes in this department have been limited but significant. Since 1995, used toner cartridges have been employed in printers, toner cartridges are recycled, and in 1997, computer and printer recycling began. A silver recovery unit was added to photoservices in the microfilm department in 2000/2001 thereby allowing the silver to be recycled. The year 2001 also saw the establishment of the Pharos Uniprint system in computer clusters throughout the Princeton campus and the University Print Shop phasing out oil-based inks in favor of more environmentally friendly soy-based inks. This Pharos uniprint system provides for printing and paper-use accountability by allowing students to view the amount of pages they have printed. Moreover, instead of the document simply printing immediately, users must now release their

print operation from Print Release stations located in the cluster. These modifications have helped reduce paper use on campus.

Environmental Health and Safety:

The Office of Environmental Health and Safety has instituted numerous environmental changes in the past ten years. The University paint shop phased out oil-based paints in favor of latex paints in 1991, which release less volatile organic compounds (VOCs). In 1993, a fifty-five gallon solvent drum was removed from the Chemistry stock room and now small containers are used in its place. The amount of harmful chemicals on campus and the percentage of waste sent to landfills were reduced in 1995. That year, mercury waste was sold to recycler Bethlehem Apparatus, one hundred mercury thermometers were swapped for alcohol thermometers, the use of a chromium based glass cleaner was discontinued in laboratories, and the university began recycling laboratory solvent bottles that were triple-rinsed and aired out. Furthermore, laboratories were made safer in 1997 after agar was substituted for acrylamide in lab experiments. Agar is a natural substance that is far less dangerous than acrylamide, which is believed to be carcinogenic. In 1998, regular fluorescent bulbs were replaced with reduced-mercury fluorescent bulbs in the lighting systems, and vegetable-based oil was used in elevator lubrication rather than hydraulic fluid, a more environmentally-safe option. Moreover, in the cooling systems of buildings the chemical ethylene glycol was replaced with propylene glycol, a less toxic substance. However, one exception to this policy exists. Upon completion in 2002, the Icahn laboratory used ethylene glycol in the cooling system rather than propylene glycol. It is hoped that as new buildings are constructed in the future, they too will utilize propylene glycol instead of ethylene glycol.

In 1999, carbon monoxide detectors were installed in the Graduate College and certain dormitories located adjacent to natural gas systems, such as boilers or dryers. Additionally, propylene glycol replaced formaldehyde as a preserving agent in laboratories. Both of these measures have protected the health and well-being of students on campus. Carbon monoxide is a deadly gas that is odorless and cannot be detected, and formaldehyde is thought to have carcinogenic properties. The control of both these substances on campus has created a safer housing and laboratory environment. In continuation of the practice to remove mercury from the campus, University Health Services replaced all mercury-containing equipment in 2000 with mercury free alternatives, and another mercury thermometer swap occurred in 2001 with one thousand thermometers replaced. The University Environmental Safety and Risk Management Committee adopted an Environmental Health and Safety Policy on October 17th of that same year in order to set environmental health and safety standards on campus.

Two initiatives centering on conservation of energy and water occurred in 2002 and 2003. Thermal stills, which require heating mantels, continuous water cooling, and use sodium as a drying agent were replaced in laboratories with column base stills that do not need heating mantels, continuous cooling, or sodium. Therefore, fume hoods are not utilized and both energy and water are conserved. Water aspirator pumps were also replaced with diaphragm pumps in laboratories which do not need to utilize water in the process, instead a mechanical motion is used. Both of these measures have reduced the energy and water consumption in laboratories.

Purchasing:

The Purchasing Department has made a number of changes that benefit the environment affecting many aspects of the campus, from the students to the staff. Tracking changes within the Purchasing Department can be difficult, though, because purchasing is not centralized within

the University and most departments make individual acquisitions. However, the Purchasing Department is the central office for procurement of departmental supplies. Since 1994, the University has created a policy of purchasing Energy Star-compliant computers, which is indicative of an industry-wide change. These computers power down to 30 watts or lower when idle allowing the University to decrease its energy use. In 1994, the University also established a contract with Boise Cascade, an office supply company offering more recycled products than the previous provider.

An environmentally-preferable purchasing policy was created in 2001 implying that the University would consider the environmental implications of its purchasing decisions and procure more “green” products. Accordingly, the first PEI environmental intern in 2002, while working with purchasing staff, produced a “green” purchasing catalog of recycled content items, which made it possible to purchase these environmentally-friendly items in the PeopleSoft system. However, the most significant change in the purchasing department occurred in April 2004. Following months of paper testing, by Purchasing and an official request to the Provost from the PEOC, all departments were required to purchase 100% post consumer waste (pcw) office paper, specifically Aspen 100 from Boise Cascade. The substitution of 100% pcw paper for the previously used 30% pcw or virgin paper illustrated a substantial change in Princeton policy with the University assuming a greater role in ecologically-sound purchasing.

Transportation:

The Parking Office has sought to reduce the amount of cars parked on campus as well as preventing the construction of more parking lots. Therefore, the University has focused on developing a shuttle system to decrease the amount of faculty/staff parking on campus. The Tiger tram began operation in 2001 as a way to facilitate the movement of faculty/staff from

parking garages to Nassau Hall, West College, and Stanhope. Following the construction of Lawrence apartments, a pilot shuttle system was tested in order to reduce congestion.

For this endeavor, Ford Motor Company provided two natural gas shuttles for Princeton to use in their system, and BP donated several years' supply of natural gas. Natural gas vehicles are less environmentally harmful because they release less carbon than gasoline powered automobiles, and the fuel contains no benzene. Furthermore, manufacturing the fuel is much safer and cleaner than producing either gasoline or diesel. Prior to the donation, Princeton had taken the initiative to install a natural gas fueling facility on campus in order to facilitate the expansion of a fleet of vehicles that utilize natural gas in the transportation sector of the University.

In February of 2003 the first shuttle loop called the Green Line was initiated and consisted of two buses running from 8 am to 8 pm. The pilot was continued in the fall of 2003 following positive response and demand. At the same time, a new rule was established stipulating that graduate students living in the apartments could no longer drive to campus but would be provided with a certain number of day passes to be used in emergency situations. Additionally, in the fall of 2003, the company Zipcar initiated a program to allow individuals twenty-one years of age and older to rent a car for few hours or a few days in order to deter students and employees from driving and parking cars on campus. These forms of transportation demand management has helped Princeton become a less congested campus.

Conclusion:

In the past ten years, Princeton University has made significant progress in promoting environmental standards on campus. Individual Facilities departments, such as Grounds and Maintenance, Building Services, and Engineering have all implemented polices that are

environmentally-friendly, and they continue to seek ways to establish more “green” initiatives. As improvements in environmental performance often also mean a reduction in costs, the University should persist in using its economic resources to raise its environmental standards. The creation of the PEOC has ensured that the University will have an organization to serve as a liaison between the administration and the rest of campus to request and encourage sustainable practices to be utilized when possible. More progress can be achieved through the PEOC’s mandate of identifying and establishing methods to put new “best practices” into place thereby creating a more environmentally sustainable campus for the benefit of future generations.