Environmental Sustainability and Libraries

Eileen McElrath
Ph.D., MSLS. MA in English
Assistant Professor
School of Library and Information Studies
304 Administration Drive
Texas Woman's University
Denton. Texas 76204 USA

Susan Sutherland
MLS, MA in Art History
Lecturer
Department of Visualization
College of Architecture
401 Joe Routt Blvd.
Texas A & M University
College Station, Texas, 77843 USA

Abstract

Shrinking glaciers, melting ice caps, and wide ranges in temperature provide evidence that global warming is occurring although politicians and some scientists disagree about the reality. Libraries probably do not come into mind when one thinks of global warming and climate change. Libraries, however, consume large amounts of energy that contribute to the problem and many library buildings were built before knowledge about global warming and climate change was widely recognized. Considering the seriousness of global warming and climate change and its impact around the globe, there is a need for green libraries that apply environmentally friendly policies and practices. This research reviews literature to establish the current view of global warming and climate change, describes environmentally safe policies and practices for library buildings, describe environmentally safe policies and practices for information technology, describe environmentally safe policies/practices for library services, and offers suggestions for libraries to implement.

Keywords: Green libraries, Sustainability and libraries, Environmental sustainability and libraries, Information technology and sustainability, sustainability and library power consumption.

1. Introduction

Hurricane Sandy's destruction in New Jersey and New York, shrinking glaciers and melting ice caps, and wide ranges in temperature provide evidence that something is happening with our climate. Politicians and even scientists may disagree about the reality of global warming and climate change. However, according to the U.S. Environmental Protection Agency (EPA), "Our earth is warming. Earth's average temperature has risen by 1.4 degrees Fahrenheit over the past century, and is projected to rise another 2 to 11.5 degrees Fahrenheit over the next hundred years" (EPA, 2012). Small changes in the average temperature of the planet can translate to large and potentially dangerous shifts in climate and weather. Other nations recognize the potential of catastrophic climate change. In a meeting of the United Nations in Copenhagen in December 2009, "world leaders and policy makers recognized the need to limit global temperatures rising no more than 2 degrees Celsius (3.6 degrees Fahrenheit) by 2020" (Chowdhury Carbon, 2012).

1.1. Importance of the Issue

Libraries probably do not come into mind when one thinks of global warming and climate change. It is easy to dismiss libraries if one thinks they house only books and some computes. Libraries, however, consume large amounts of energy that contribute to the problem. Library buildings, for the most part, were built before knowledge about global warming and climate change was widely recognized. "Libraries have a variety of computer printers, faxes, network printers and photocopiers. All these machines have an environmental impact using ink, paper, and electricity (Kruse, 2011). The need for libraries and archives to provide adequate climate control is essential to maintain collections. Environmental conditions such as temperature, relative humidity, light, and pests affect the lifespan of a cultural object, such as a book (Morris, 2007). Libraries are data centers that maintain large databases for library users' information needs. Neil Rasumussen states, "Power consumption is one of the most important challenges facing datacenters today. By the EPA's estimates, "power-hungry data centers consume the annual output of 15 average-sized power plants" (Sharavanan, 2010).

While much information is available digitally, books continue to be a significant portion of information availability. The pulp and paper industry is the third largest industrial greenhouse gas emitter. "71% of the world's paper supply comes from natural forests. 125 million trees in 2008 were harvested for the U.S. book and newspaper industry (Callicott, 2010). According to Research Information, 24 trees are required to make 1,000 kilograms of paper (Chowdhury, 2012). The cost of photocopying in the library is sizable. "A medium-sized photocopier working on a capacity of 100,000 pages per year will produce 1,757 lb. CO2" (Chowdhury, 2012). Photocopying contributes quite a bit to the CO2 emissions, thus making it hostile to the environment. Not only this, it is expensive. "The cost of printing 100,000 pages in a month would be $107.88 per year, but the cost of electricity use in idle and sleep mode would be $382.50" (Chowdbury, 2010).

Considering the seriousness of global warming and climate change impact around the globe, there is a need for green libraries. Green libraries are those that apply environmentally friendly policies and practices. Currently libraries use too many resources to be environmentally friendly. They need to consume fewer resources and emit less waste. Libraries can serve the 21st century user by being sustainable by applying environmentally safe policies and practices. This paper reviews some literature about global warming and climate change, challenges facing libraries, and environmentally safe policies and practices for libraries that have been identified in recent library literature. A review of literature reveals three categories of articles about the challenge of global warming for libraries. First, there are articles and information that establish the current view of global warming and climate change. Second, are articles that describe environmentally safe policies and practices for library buildings? Third, are articles that describe environmentally safe policies and practices for information technology, and, finally, articles that describe environmentally safe policies and practices for library services? Additionally, this paper offers suggestions for the future.

2.1 Global Warming and Climate Change

Environmental impact is measured in terms of greenhouse gas (GHG) emissions These gases include "carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4), sulfur dioxide (SO2), hydro fluorocarbons (HFC's), Per fluorocarbons (PFC's), sulphur hexafluoride (SF6), ozone, and other nitrogen oxides (NOX)" (Chowdhury, 2012). The United Nations Environment Programme (UNEP) report states that "current emissions are increasing and the projected 2 degrees is not being realized. It is estimated that 44 GtCo2e (Gigatonne Carbon Dioxide Equivalent) emission level meets the 2 degree target in 2020, however, current global greenhouse gas emissions are estimated at 50.1 GtCO2e, which is 14% higher" (UNEP, 2012). A report published by the World Bank in 2012 estimates that "global temperatures would rise above 3 degrees Celsius by 2020" (World Bank, xiii). There is a 40% chance the following will happen at the current rate of emission. The report projects that "with a 4 degrees C increase we would see:

- heat waves, drought, and floods
- Increases of 6 degrees C (42.8 degrees F) or more in average monthly summer temperatures in areas like the Mediterranean, North Africa, the Middle East, and the U. S.
- increase in aridity, drought, and extreme temperatures in many regions, including Africa, southern Europe and the Middle East, most of the Americas, Australia, and Southeast Asia
- increase of about 150 percent in acidity of the ocean threatening marine species and the entire ecosystems
- Sea-level rise of 0.5 to 1 meters.

- Rise in seas by the rapid loss of ice from Greenland and the West Antarctic Ice Sheet by 2100." (World Bank, 2012).

2.2 Environmentally Safe Policies and Practices for Library Buildings

As mentioned earlier, most libraries were built before global warming and climate change were critical issues. Many libraries are already using environmentally sound practices and developing more so we know successful practices for the buildings. Constructing green libraries are part of a larger environmental building movement. LEED is an acronym for Leadership in Energy and Environmental Design Green Building Rating System, an organization encouraging global adoption of sustainable green building. LEED provides rating systems for design and construction of buildings. International in scope, these ratings are the most commonly accepted standards for eco friendly buildings (Rodney, 2010). LEED offers certification for new construction, renovations, and existing buildings. A green building is, for example, "a building that generates its own electricity through renewable resources, and purifies wastewater and makes a wildlife habitat on its site is regenerative" (Mulford, 2010). LEED even has rankings for neighborhoods. Libraries can become an important and central part of establishing a green neighborhood. The library functions as a mixed-use building that offers meetings and activities for the community. "A green library becomes more efficient and adds greater value to the neighborhood and ecosystem" (Mulford, 2010).

An example of a LEED library is the West Irving Library in Irving, Texas. Opened in April 2012, it is Texas' first LEED certified, net zero energy library. This means that the building generates as much electricity as it consumes. It offers geothermal technology for heating and cooling and solar power for energy. 144 geothermal wells for heating and cooling and 1,444 solar power panels. This geothermal system offers an estimated $60,000 in savings annually. Recycled materials were used for construction. This mixed use example provides an outdoor sitting area and new resources such as a Microsoft Surface Table and SMART boards. A mixed-use facility offers traditional collections and services as well as future technology and spaces. The facility is "Wi-Fi accessible, 55 public computers, interactive touch monitors, business center, meeting room, children's story time and craft area, and young adult zone. It offers drought tolerant landscaping; electric car charging stations, and over 75% of the construction waste was recycled. It has large north facing windows for maximum light exposure, and a kiosk shows amount of electricity being generated through the solar panels" (City Irving, 2012).

The 2011 Gold Level LEED Certification Award and the American Institute of Architecture Houston Design Award in the Renovation and Restoration category was awarded to the Oak Forest Neighborhood Library for its sustainable renovation project. The remodeled 1960's building includes an outside reading area, glass on the south façade for natural light, adult and teen wings on the east, and the use of recycled and reclaimed materials in construction (Oak Forest, 2011). Prairie Creek Branch Library of Dallas Public Libraries, built in 2010, is also an example of new construction built with LEED standards. It sits on a 100-year flood plain. The 50 tons of steel that made up the frame of the building used 80% recycled material, the exterior was overfed in regional brick and stone, and the concrete was poured using a "dry-kiln" technique to improve the air-quality on site. "There is a geothermal /heat pump system, grey water recapture and reuse, 7.7kW PV Array for solar energy, raised floor air distribution, integrated daylight and artificial light system, high efficiency plumbing system, and a retention pond and bios wale. Long prairie grass offers low environmental impact providing wildlife sanctuary (for birds). This native landscaping requires minimal irrigation, thus saving water" (Celsius, 2012).

Libraries do not have to construct new buildings; they can implement environmental practices by looking at their existing buildings. Libraries can control their interior climate by what Patricia Morris refers to as the "microclimate approach." One of the ways to do this is through air handling units for rooms and using data loggers (Morris, 2009). Data loggers show readings of temperature and humidity data in a graph. They are important to a cultural collection and particularly an area with a mold problem. "Data loggers with electronic sensors and digital memories require little maintenance. They need recalibration every 2-3 years and a change of batteries" (Morris, 2009). Another method to achieve energy savings and a healthier microclimate is through HVAC (heating, ventilation, and air conditioning) equipment shutdowns. These systems are set up to run continuously and therefore, consume lots of energy and money. The current best practices for collections are to maintain consistent temperature and relative humidity levels (Linden, 2012). Linden, Reilly, and Herzog conducted a study to show that HVAC shutdowns can occur without harming the environment of an object. They propose this as a sustainable way to combine preservation of collections with minimal consumption of energy (Linden, 2012). Studies are still underway to determine if shutdowns will produce the desired effect.

Patricia Morris also advocates for a wider tolerance of humidity than the National Information Standards Organization (NISO) 1995 guidelines. Libraries can store fragile materials in containers or arrange in smaller, closed stacks to create a microclimate. The "containers create stable microclimates that slow chemical reactions and resist mold growth" (Morris, 2009) May Cassar also recommends adapting the standards for your collection (Cassar, 2011). The Smithsonian Institution found that "museum objects can safely tolerate as much as 15% fluctuation in RH and 10 C differences in temperature" (Cassar, 2011). A new European standard on environmental criteria for collection objects will be completed by 2013/2014.

3. Environmentally Safe Policies and Practices for Information Technology

The Information Technology (IT) industry accounts for "approximately 2% of global CO2 emissions" (Rahman, 2010). This industry includes data centers, servers, personal computers (PC's), telecoms networks and devices, and printers (Rahman, 2010). Both traditional and digital libraries use much of this equipment by providing computers, printers, scanners, copiers, and electronic resources to their patrons. There are some alarming statistics regarding IT use. "IT carbon emission is estimated to grow at 6% each year until 2020. IT represents approximately 3% of the energy consumption in the United States and half of that energy is used by data centers" (Jagusztyn, 2011). This means that data centers use 1.5% of the total electricity used on the planet (Sharavanan, 2010). A data center is a facility that holds electronic equipment used for data storage, data processing, and communication networking (FEC 2).These data centers have lots of equipment such as servers, storage devices, routers, pc's, transformers, and cooling devices. Electricity generation contributes to greenhouse gas emissions.

According to the EPA, "one of the 5 major fuel consuming sectors of the economy that contributes to the CO2 emissions from fossil fuel combustion is electricity" (EPA 8). Electricity generation in 2010 was "the largest producer of greenhouse emissions at 34% in the US." According to the EPA, "data centers used 61 billion kWh of electricity in 2006, accounted for 1.5% of all U.S. electricity consumption, and cost $4.5 billion" (FEC 6).A more alarming statistic is that data centers are "projected to grow by 12% each year" (FEC 6). "Data centers will consume 5% of the world's electricity supply in 10 years" (How much, EBSCO). There are several ways for the IT industry to use computer resources efficiently. They can "adopt efficient technologies, processors and virtualize equipment, eliminate unnecessary IT equipment and remove redundant data. Consolidate the number of redundant databases and eliminate unused systems and services" (Rahman). The EPA estimates that providing computers with a sleep mode "reduces their energy use of 60-70%" (Rahman, 2010). Computers can be programmed to automatically power down to an energy-saving state when they are not in use.

Libraries can follow many of these recommendations. The EPA suggests "extending the life of the equipment by maintaining it and having a plan for acquisition and disposal. Implement best practices. Acquire Electronic Product Environmental Assessment Tool (EPEAT)-registered electronic and Energy Star products" (Inventory, EPA, 2012). The volume of electricity used at data centers need to be decreased. "Virtualization allows data centers to connect and use idle servers at remote data centers and thereby maximize existing server capacity." This reduces the number of servers needed. Consolidation of data centers allow for the same performance with less power consumption (Rahman, 2010). Library users' need for information is inexhaustible. Thanks to large databases containing massive amounts of information; those information needs are being met. Information retrieval (IR) has become a common activity in libraries. Searching the web, library catalogs, databases, e-journals, and e-books for information has become a daily practice.

IR systems provide this information and since libraries grant access to these IR systems, they are important to the energy consumption of the library. IR systems use "ICT (Information and Communication Technologies) which create GHG." Since IR relies on information and communication technologies (ICT), becoming sustainable in the IT arena is important. Green IR refers to improving the access to information. Gobinda Chowdhury "recommends the lifecycle analysis approach to identify the contribution of IR to the GHG emissions, the measures needed to be taken to reduce those emissions, and how the use of ICT can be optimized to reduce the GHG emissions and build a greener IR" (An Agenda, 2012). The "Life Cycle Assessment (LCA) calculates the GHG emissions of a product or service comparing energy inputs and emissions outputs" (Agenda, 2012). Green IT refers to the initiatives of environment, thereby reducing energy costs and achieving a better sustainability for IR systems. We can develop a Green IR by making IR systems more efficient. We can do this by "creating efficient IR systems that reduce the time to access and process digital content, access information using low energy consumption, and reduce the energy consumption of the end-user devices" (Agenda, 2012).

Accessing information using cloud technology is green. We can do this by "applying the four enablers of Green IR: Standardize, Share, Re-use and Green Behavior (SSRGb). Standardize refers to standardizing terms of content creation, organization and processing. This also includes "establishing a Digital Copyright Exchange to facilitate the access and use of digital content" (Chowdhury, 2012). Sharing IR resources includes the Digital Copyright Exchange and crowd sourcing IR. Sharing resources and expertise will reduce the amount of GHG over local usage of data centers. Re-use refers to the tools and content. Cloud computing will help this as research data can be stored in the cloud. Green behavior refers to educating the user, easy access through the cloud and the advances in user devise such as e-book readers and IPads. Users cutting back on printing and photocopying will also help. Cloud refers to the transition of local data from an onsite location behind the firewall to the network space. It is a type of Internet computing that shares resources. Cloud computing may increase the use of energy so it is contributing to the CO2 emissions and GHG problems.

Because cloud computing is becoming a reality, libraries will need to know how to manage their cloud technology more efficiently. "Virtualization and migration are two components of cloud computing that are important. Virtualization allows for the use of machines that are not in use in a networked environment and migration removes the concept of locality. Data migration is the process of moving data from one place to another" (Lefevre, 2010). Lefevre compared the "energy of virtualized environments and determined that the green scenario was the least consuming of power and had the lowest power consumption per node. Green Open Cloud (GOC) architecture has several components. Aspects of "Green Open Cloud are aggregating some reservations to avoid too frequent On/Off cycles, predicting usage in order to switch ON the nodes, and allowing users to specify requests in terms of energy targets" (Lefevre, 2010). By applying these policies at a data center, operating in the cloud can save energy. Libraries can switch off unused computing, networking and storage resources because a lot of energy is used in idle. The IT industry can save on the amount of storage space. Currently, digital information is represented using binary digits of 0 and 1.

There are many methods to storing this information "including photolithography, magneto resistance (MR) and giant magneto resistance (GMR), compact disc (CD), digital versatile disc (DVD), blue-ray disc (BD), and holographic media. New ways to store larger amounts of data are being investigated. Vamsi Talla reports on a "new method of storing information based on color-coding instead of binary digits. The four colors of red, green, blue and black provide higher density of storage and more colors than traditional storage methods" (Talla, 2012). This is a promising way to provide more storage capacity. With the challenge facing the publishing industry, collaboration among libraries, publishers, and other generators of scholarly content is important. The online environment promises beneficial collaboration. Since 2011, UC Press has provided their content through JSTOR (Fritsch, 2011). JSTOR offers "Portico, a digital preservation service that hosts thousands of scholarly e-journals and books in a digital dark archive. Over 750 libraries worldwide partner with Portico, with 374 in the US to preserve scholarly content. JSTOR hosts content for publishers, help bring publishers print-only journals online. Using JSTOR increases the visibility, discoverability, and usage of the publisher" (Fritsch, 2011). The Current Scholarship Program allows "publishers to retain control over their pricing and branding. Libraries already use JSTOR and many subscribe to Current Scholarship titles.

They would not have to negotiate licenses with each individual publisher of the serial" (Fritch, 2011). JSTOR extends digital preservation of scholarly journals by mandating participation in Portico and archiving the content. This collaboration between UC Press and JSTOR would contribute to cutting down on both print resources by moving to the digital environment. It would reduce the duplication of resources for storage and digitization requirements. SHERPA is an "open access institutional repository developed by research universities in the United Kingdom that now has 34 institutions within its consortium" (SHERPA, 2015). The open access movement is valuable in offering content availability, but also sharing of resources and thereby cutting back on the costs of generating the data. The Blue Ribbon Task Force on Sustainable Digital Preservation and Access (2012) made recommendations in 2010 for digital scholarship. They recommend that "libraries, scholars, and professional societies collaborate on policies for emerging scholarly discourse "Blue, (2012). Libraries and archives should "connect with publishers to undertake long-term preservation" (Blue, 2012). Scholars should grant non-exclusive right to publish and preserve (53). Libraries should create a mechanism for monographs and emerging discourse similar to the e-journals (52). Lastly, "libraries need a preservation copy of the digital asset that archiving services like Portico and LOCKSS provide" (Blue, 2012). Rice University and the University of North Texas participate in the Digital Federal Depository Library Program which partners with the U.S. Government Printing Office to preserve born-digital government documents published through that office.

The University of Texas in El Paso, University of North Texas Health Science Center, Texas Medical Center Library, and Southern Methodist University participate in the Digital Commons of LOCKSS to digitally preserve their collections (LOCKSS, 2012). Many libraries are adapting to the digital scholarship movement and have incorporated this as a priority in their strategic plan. For example, Texas A & M University Libraries use Texas Digital Library services for digital repositories and management. The University lists in Strategic Direction #2 the "desired outcome of promoting digital resources" (A & M 4). At Texas Tech University, Priority 3 of the strategic plan is to "expand research and scholarship with the first theme of society and economy – energy, water, agriculture, and the built environment" (LOCKSS, 2012 TTU 60).

In 2000, the Library of Congress started the National Digital Information and Infrastructure Preservation Program (NDIIPP), allowing for future availability and accessibility of information (Howard 2008). This archival program was developed as a "national effort to digital information. The cloud is under-utilized for digital preservation and progress can be made. Dura Cloud, an open source service developed by Dura Space for storage and access to digital content was released in 2011." The website states that it is "the only service that makes it easy to move copies of your content in to the cloud and store them with several different providers" (Duracloud, 2012). The crucial issues for preservation remain in finding long-term solutions and durable media for storing information. TexShare is a consortium of Texas libraries that "share print and electronic materials, purchase online resources, and combine staff expertise" (TexShare, 2014). Storage considerations will need to be *met.*

4. Environmentally Safe Policies and Practices for Library Activities and Services

"The worldwide journal publishing industry is estimated to produce 12 billion kg of CO2. The cost of digital knowledge products is much less compared to the production and distribution of printed knowledge products" (Chowdhury, 2012). With a digital system, there will be less paper, less ink, less production and transportation and thus a reduction in carbon emissions. Evidence suggests that digital would be more environmentally sustainable. "The average book has a carbon footprint of 7.46 kilograms of CO2 over its lifetime" (Chowdbury, 2012). "Reading the New York Times on a Kindle rather than on newsprint compares to saving 50 gallons of gas and 78 gallons of CO2" (Callicott, 2010). Even though it takes a small amount of power to operate e-readers, the vendors of e-content have huge computer servers that use lots of power (Callicott, 2010).

It seems that right now, we do not have a complete picture of the environmental cost of digital products. College Sustainability Report Cards of 2011 reports how and what universities in Texas are doing to reduce their carbon emissions and energy use. This Report Card evaluates the colleges in the areas of sustainability and gives varying grades ranging from B+ to D. The University of Texas-Austin, University of Houston, Rice University, and Southwestern University all received B+ grades. At the University of Texas-Austin, the university achieved a "32 percent reduction in greenhouse gas emissions from 1986 levels" (College, 2012). They installed lighting sensors and metering across campus and employ green IT policies and energy awareness campaigns. They received A grades in the areas of Food & Recycling, Student Involvement, Transportation, and Endowment Transparency. The university recycles some electronics and traditional materials. In the dining halls, no trays are used and there are discounts for reusable to-go containers. They offer free access to public transportation, carpool incentives, a bike-sharing program, and shuttles to high-population residential areas. The majority of vehicles in the campus fleet use alternative fuels. Students participate in Recycle Mania and groups like Net Impact and Engineers for a Sustainable World.

The University of Houston gets an A in the areas of Climate Change & Energy, Green Building, Transportation, and Endowment Transparency. They "aim to reduce greenhouse gas emissions 80 percent below 2005 levels by 2030. They have reduced energy consumption in buildings to 16 percent below 2005 levels. They use T5 and T8 lighting in all campus buildings, temperature setbacks, energy metering, and condensate recovery for the conservation of energy" (College, 2012). They have a formal building policy, and 600,000 square feet of building space meets LEED silver criteria. During the 2009-2010 academic year, "25% of construction and demolition waste was diverted from landfills. They also reduced water use per capita by 20 percent below 2005 levels. They offer a 50 percent discount to students for local public transportation and have a free shuttle service on campus. Students can rent bikes for $5a day and cars for $8 a day. 15% of the vehicle fleet is electric" (Collage, 2012). Rice University receives an A grade in Food & Recycling, Green Building, Transportation, Investment Priorities, and Shareholder Engagement. At Rice, the dining halls are tray less and 30 percent of their food budget is spent on local products. New construction must meet at least LEED Silver standards.

The university meters water use and implements dual-flush toilets, low-flow faucets and showerheads, and waterless urinals. They also use living roofs and porous pavement to manage storm water. Students are provided with campus shuttle and free local transit passes. Over 60 percent of vehicles in the fleet are electric. Southwestern University receives an A in Administration, Green Building, and Investment Priorities. All new construction must be LEED certified. They have dual-flush toilets and for storm water management, use vegetated swales and retention ponds. The university has a formal green purchasing policy, uses Energy Star appliances, environmentally friendly paper products, and green cleaning products. Southern Methodist University and Baylor received B's and The University of North Texas, Texas A&M University, and Texas Christian University received a grade of B- on the College Sustainability Report Card (2011). Southern Methodist University has reduced greenhouse gas emissions over 6 percent since 2005 and a "demonstration photovoltaic array generates renewable energy" (Campus). This was accomplished by purchasing some electricity from renewable sources, establishing and on-campus garden, and buying organic fruits and vegetables. "Cooking oil is recycled for biodiesel production and eight buildings on campus are LEED Gold certified" (Campus, 2012).

Baylor University has three sustainability committees that have implemented purchasing guidelines and environmental control policies (Campus). The university has "installed lighting sensors, LED lighting and energy efficient lighting on campus. They have purchased energy renewable credits. The university spends 20 percent of its food budget on locally grown foods" (Campus, 2012). University of North Texas received an A in Administration has a sustainability office. The university purchases "100 percent postconsumer recycled paper products and Energy Star appliances" (College). The dining facilities "spends 30 percent of its budget on local and organic food products" (College). The campus serves fair trade coffee and students receive discounts for using reusable mugs. Another interesting feature at UNT is that there is a "student green fee used to support on-campus sustainability projects" (Campus, 2012). At Texas A&M University, the greenhouse gas emissions were reduced 20 percent from 2004 to 2009 (Campus) One interesting feature is that "used cooking oil is recycled for biodiesel production" (Campus, 2012). The university also offers donation locations during move-in and out times. For green building, they use meters, high-efficiency laundry machines, living roofs, and retention ponds. In investments, "the endowment is currently invested in renewable energy funds" (Campus, 2012). Texas Christian University has a sustainability plan, three advisory committees on sustainability, and is invested in renewable energy funds (Campus). The university offers an "Eco-Frog camp as their orientation program for new students where sustainability practices are covered" (Campus, 2012). The TCU Frog Shuttle runs on compressed natural gas (Campus). An interesting feature is the Green House Living and Learning Community that houses 42 students (Campus, 2012).

Transportation activities accounted for "32 percent of CO2 emissions from fossil fuel combustion in 2010 (Inventory ES-8). Nearly all of the energy consumed came from petroleum products. Almost 65 percent of the emissions were for personal vehicle use" (ES-8). The number of vehicle miles traveled by light-duty motor vehicles increased 34 percent from 1990-2010 (ES-8). In light of these statistics, it would make sense to think about how patrons arrive and depart from your library. Sustainable activities include walking, biking, taking the bus, and carpooling. By incorporating sidewalks and walking paths around the library, easy access is encouraged for walking. Many campuses offer free campus shuttles. At the University of Texas and Rice University, students have free access to public transportation and at the University of Houston; students receive a 50% discount (College, 2012). The University of Texas also offers carpool incentives (College, 2012). Encouraging employees to take the bus or carpool by offering incentives seems smart, especially when parking is tight. Texas A&M has a ride-share board and discounted permits for carpoolers (Collage, 2012s). Offer bike racks so patrons and employees can ride their bikes.

At the University of Houston, students can rent bikes for $5 a day. Some communities have a bike-sharing program. It that fits the needs of your community, the library might consider starting one. Making IT green can save money and make our world a better place to live. Here ae a few suggestions to the library to reduce its carbon footprint. In 1992, the U.S. Environmental Protection Agency (EPA) launched Energy Star, a labeling program for energy efficiency in products (Appasami, 2011). Libraries can purchase and use devices with Energy Star logo on it. "Keep your computer well-maintained and optimized. If your computer is slow or has lots of errors, it consumes more energy. Add more RAM to your computer if it needs it, disable unnecessary programs launching on startup and optimize Windows services that run in the background" (Appasami, 2011). The "construction of products accounts for more than 70% of the ecological footprint a product leaves behind it its lifetime.

If we increase the lifetime of the product, the footprint is spread across many years, so it makes sense to upkeep our existing equipment" (Appasami, 2012). To achieve greener IT, one can switch off their computers at night so it runs only eight hours a day and this will "reduce energy use by 810 kWh per year and net a sixty-seven percent annual savings" (Appasami, 2011). Turn your computer off on the weekends as this will also save energy. Plug your computer into a "surge protector with a master control outlet. That will sense when the computer is not in use and cuts power to it and all the peripherals. Purchase flat-screen monitors as they use less energy that CRTs" (Appasami, 2011). "Consider a smaller monitor because a 14-inch display uses 40% less energy than a 17-inch one. Enable the standby/sleep mode and power management settings. Do not use the screensaver as it doesn't save energy" (Appasami, 2011). "Choose dark backgrounds for your screen display and reduce the light level in your room when you are on the computer. Consider an ink-jet printer as they use 80-90 percent less energy. Buy vegetable or non-petroleum based inks because they are made from renewable resources" (Appasami, 2011).

There is even a soy-based ink option (Kruse 94). Libraries can set the default on printer to "draft." network and share printers, and print on recycled paper. Also, use the double-sided printing function to save paper. Use email, fax documents, and review documents on screen instead of printing them out (Appasami, 2011). Before "sending large amounts of data, compress and encrypt it so the size is reduced and network traffic is reduced. Computer cooling keeps components within safe operating temperature limits. CPUs, chipset and graphic cards, hard drives all produce heat. PC manufacturing process accounts for 70% of the natural resources used in the life of a PC; therefore, it makes sense to prolong the life of the computer" (Appasami, 20112). You can reduce heat to your laptops by purchasing fans. Reducing the amount of printing both on a personal level and in industry allows us to reduce the use of trees. Libraries can conserve paper by printing on both sides of the paper, reading documents online, use of email and faxes, and employing recycled paper. Encourage downloading of searches and articles rather than printing. Libraries are moving to electronic reserves instead of placing journal articles on reserve (Kruse 192). In this way, the library is not photocopying articles. Many articles are already in the library databases. Students may choose to read this online, email, or save to flash drive rather than print (Kruse, 2011). Libraries can also stop printing paper receipts and direct the patron to their online account or actually stamp the item (Walker, 2012).

"Methane (CH4) is more than 20 times as effective as carbon dioxide at trapping heat in the atmosphere" (Inventory. Over the "last 250 years, the concentration of methane in the atmosphere increased by 158 percent. In the United States, landfills are the third largest anthropogenic source of methane emissions with 16.2 percent of total methane emissions in 2010" (ES-9). "Landfills are also the largest source of anthropogenic greenhouse gas emission from waste management activities" (Inventory, 2012). Recycling is to use old materials to create new ones. It is valuable to reduce the amount of garbage in landfills. Libraries can recycle many items including ink cartridges, batteries, paper, and magazines. Empty ink cartridges can be returned to office supply stores for credit. The US Postal office offers free postage-paid mailing envelops for ink cartridges, cell phones, and other small electronic items (Kruse, 2011). Libraries can recycle non-decomposing CD's by using a CD recycling center. Libraries can set up recycling bins for that so patrons can drop old materials off. The "CD recycling Center of America takes CD's, DVD's, HD's, Blue-ray discs and most of the packaging. In addition to recycling paper, packaging such as tissue and cardboard can be recycled" (Kruse, 2011). The library can hold a "paper drive for old newspapers" (Walker, 2012). Recycling bins both inside for paper and CD recycling and outside for glass, plastic, aluminum, and newspapers can also be available. Other items can be "recycled for charity such as stamps, phones and milk-bottle tops" (Payne 57). The library can "utilize volunteers to assist with the recycling. They can take the materials to public recycling bins" (Payne, 2007).

Even the purchasing department can be effectively green the library. Some universities have already been considering green purchases. Southern Methodist University has a formal green university policy in place (Campus, 2012). Buying recycled products such as paper and ink is environmentally friendly. Purchasing "energy star products, fluorescent light bulbs, and many other products can help the environment. Selecting some online magazines and newspapers instead of the print versions and having kindles or other e-readers available will encourage users to adapt to the digital environment. Buying energy efficient laptops instead of PC's saves energy. Buy remanufactured toner cartridges" (Kruse, 2011). Encourage suppliers to avoid unnecessary packaging (Payne, 2007). There are many ways to save on energy. Turn of the lights when you leave your office. Libraries can install motion detector lights for public areas such as bathrooms, staff areas, and outside exits. Use energy-saving bulbs in lamps. At the University of Texas –Austin, lighting sensors and meters are employed (Campus, 2012). At the University of Houston, "T5 and T8 lighting and meters are used" (Payne, 2007).

Turn the temperature down in the library by one degree to save on electricity. Install ceiling fans for use in the summer and save on the air conditioning bill. Re-insulate your library if it needs it (Walker, 2012). Focus on the roof, windows and doors. Libraries may want to consider alternate energy sources. "Installing solar panels and using rain water in toilets for example" (Payne, 2007). Rice university meters water and both Rice and Southwestern University use dual flush toilets (Campus, 2012). Land-use activities can help cut the "emissions of methane (CH4), nitrous oxide (N20) and carbon monoxide (CO2). By investing in landscaping and recycling, libraries can help cut these emissions. Select native plants that are conducive to the climate and do not need much water. Plant native grasses, ground cover, and drought perennials instead of lawn to cut down on both water and mowing. Planting a community garden pertains to the environmental initiative of the library. Using plants like catnip and citronella grass are natural mosquito repellent" (Walker, 2012).

The library can select plants that would be appropriate for their community whether it be plants for wildlife, birds, or butterflies. Planting trees in urban areas and using yard trimmings and food scraps for land filling are good practices. The library can invest in the community by planting trees nearby. Community gardens may be a way to promote the library's environmental efforts and offer a service to the community. Food grown in the library garden may be eaten by the staff and distributed to the community. It is also a great way to recycle and compost. Of course, the garden should be organic and can provide awareness on sustainability.

"Gases that do not directly impact global warming, but affect terrestrial or solar radiation absorption include carbon monoxide (CO), oxides of nitrogen (NOX), non-CH4 volatile organic compounds (NMVOCs), and sulfur dioxide (SO2)" (Inventory ES-2, 2012). These have been regulated under the Clean Air Act since 1970. Significant sources of these "include fuel combustion, industrial processes, uses of industrial solvents, and incineration of waste "Inventory (ES-17, 2012). Libraries can use environmentally safe cleaning products to cut down on the use of chemicals. Choosing to incorporate plants into the interior of the library can help the quality of air inside the library. Plants create a healthy environment. If the "library gives out plastic bags, consider replacing those with canvas or jute bags that can be purchased" (Payne, 2007. Libraries may not be thinking about food service as their responsibility, but as more libraries feature café's within, greening the dining hall applies to them as well. Also, "think about the lounges, and kitchenettes that the library has for staff. For staff area, a compost bin can be supplied" (Payne, 2007). If your library has a café, then food can be features from local farmers and from the community garden (Walker, 2012).

4. Conclusion- Developing a Green Agenda

Global warming and climate change threaten the quality of our environment. Libraries want to be good social institutions and developing a green agenda allows libraries to do so. It is vital for libraries to begin using green practices or to develop more green practices if they have already begun. There are many ways the library can become more sustainable. Libraries can review environmental sustainability practices like the ones discussed in this article. The emphasis of existing literature seems to focus on doing what is feasible for the local library. Focusing on that, the first step is coming up with a plan incorporating green policies and activities. Eventually, this plan could be included in the mission, vision, or strategic plans of the library. Encourage participation from staff and patrons in developing a green initiative. Brainstorming ideas and accepting volunteers initiate great results. A marketing program would bring awareness to the library's initiative. The library could present a display or presentation about environmental issues (Walker, 2012). The library could raise awareness of staff by imposing volunteering initiatives on conservation projects (Payne, 2007). The library can also start a blog about being green. Library blogs that "exist that librarians should be aware of are The Green Library Blog, Going Green @ Your Library, and Green Libraries" (Walker, 2012). Additionally, libraries can routinely access their progress as they begin and/or develop policies and practices for a green library.

References

Appasami, G. and Suresh, Joseph. K. (2011). Optimization of operating systems towards green computing. EPA. Best practices for data centers. Using your FEC experience to take the next step. FE Webinar. Retrieved July 12, 2012 from: http://www.epa.gov/fec/resources/datacenters.pdf Blue Ribbon Task Force on Sustainable Digital Preservation and Access. (2010). "Sustainable economics for a digital planet: Ensuring long-term access to digital information. Accessed on April 1, 2012 from: http://blueribbontaskforce.sdsc.edu/.

Callicott, Burton B. (June 2010). E.V.T.: A comparison of the relative environmental impact of electronic and traditional methods of publication. Against the Grain, 22(3) 81-83.

Cassar, May.(2011). Energy reduction and the conservation of cultural heritage: a review of past, present and forthcoming initiatives. International Preservation News,55, Dec. 2011.

Chowdhury, Gobinda. (2012). Anagenda for green information retrieval research. Information Processing and Management. 2012. Nov, 2012 http://www.elsevier.com/locateinfoproman.

Chowdhury, Gobinda. (2012). Carbon footprint of the knowledge sector: what's the future Journal of Documentation, 66(6) 934-946. City of Irving. West Irving Library. Accessed on November 23, 2012 from

Celsus: A library architecture resource. Prairiecreek branch library, Dallas Public Library. Accessed on January 25,2013 from: http://libraryarchitecture.wikispaces.com/Prairie+Creek+Branch+Library,+Dallas+Public+Library,+Dallas,+Texas+%28building%29

College sustainability report card.(2011). Sustainable Endowments Institute. Accessed on November 9, 2012 fromhttp://www.greenreportcard.org.

DuraCloud. DuraSpace. Accessed on November 28, 2012. http://www.duracloud.org/overview. Fritsch, David R. and Rachel Lee. (2011) It's time to join forces: New approaches and models that support sustainable scholarship. The Serials Librarian, 60.75-82.

Howard, Rachel. (2008). Preservation perspectives: preserving digital information. Kentucky Libraries. 72(3), Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2010. (2012). U.S. Environmental Protection Agency. Washington, DC. Accessed on April 15, 2012 from http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2012 ES.pdf Janlowska, Maria A. (2011). Going beyond environmental programs and green practices at the American library association. Electronic Green Journal, 1, 32.

Kruse, Ted. (2011). Greener library printing and copying. The Bottom Line: Managing Library Finances, 24(3), 192-196.

Lefevre, Laurent and Anne-Cecile Orgerie. (2010). Designing and evaluating an energy efficient cloud. Journal of Supercomputing, 51, 352-373.

Linden, Jeremy, James Reilly, and Peter Herzog. (2012). Research on energy savings opportunities in university libraries. Library Hi Tech, 30(3) 384-396.

Linden, Jeremy. (2011). Research on energy savings opportunities in libraries." International Preservation News,55, 10-14. LOCKSS. Accessed on November 28, 2012 from http://www.lockss.org/

Maria-Toledo, R. and Pranshu Gupta. (2012) Green data center: how green can we perform? Journal of Technology Research 1-8.

Morris, Patricia. (2009). Achieving a preservation environment with data logging technology and microclimates. College & Undergraduate Libraries, 16, 83-104.

Morris, Patricia. (2007) Interpreting published environmental guidelines for preservation in libraries. Libraries and the Academy, 7(1) 111-122.

Mulford, Sam McBane, and Ned A. Himmel. (2010). How Green is My Library. Libraries Unlimited: Santa Barbars, CA. *Oak Forest Library / Natalye Appel + Associates Architects with Architect Works, Inc. and James Ray Architects.(10 Aug 2011). Arch Daily. Accessed on 25 Nov 2012 from* http://www.archdaily.com/156651.

Payne, Phillip, Emma Blakey, Jo Horsfall, and Ian Young.(2007). "Promoting green issues and sustainability in UK higher education libraries. SCONUL focus, 42, 57-60. Rahman, Nayen and Shameem Akhter. (2010). Incorporating sustainability into information

technology management. International Journal of Technology Management & Sustainable Development, 9(2).

Rodney, AL and Sara House. Going green in north American public libraries: a critical snapshot of policy and practice.

SHERPA. (2015) Accessed October 2015 at http://www.sherpa.ac.uk/.

Sharavanan, S., Poongadim, D., and Ramesh Kunar, A.(2010). Toward green computing: energy efficient data centers. Journal of Mathematics and Technology, 1, 131.

Talla, Vamsi, Rahul Sangwane, and Arun Chattopadhyay. (2008). A new way of information storage using red, green, blue and black color imprints. Micro Systems Technology, 15(4), 553-558.

Texshare. (2015). Accessed on October 2015 from https://www.tsl.texas.gov/texshare/index.html.

Turn down the heat: why a 4 C warmer world must be avoided.(November 2012). A Report for the World Bank by the Potsdam Institute for Climate Impact Research and Climate Analytics. Accessed on November 15 2012 from http://documents.worldbank.org/curated/en/2012/11/17097815/turn-down-heat-4%C2%B0c warmer-world-must-avoided

UNEP (2012). The emissions gap report 2012. United Nations Environment Programme. UNEP), Nairobi. Accessed on November 26, 2012 fromhttp://www.unep.org/pdf/2012gapreport.pdf

Walker, Meredith. (2012). 100 ways to make your library a little greener. Accessed on December 5, 2012. http://www.bachelorsdegreeonline.com/blog/2009/100-ways-to-make-your- library-a-little-greener/.