Green Footwear Manufacturing in China for Deckers Outdoor Corporation:

An Internal Business Plan to Reduce the Environmental Impact of Manufacturing Facilities

Donald Bren School of Environmental Science & Management
University of California, Santa Barbara

A Group Project submitted in partial satisfaction of the requirements for the degree of Master of Environmental Science and Management at the Donald Bren School of Environmental Science and Management

March 2009

Prepared By:
Danielle Côté-Schiff, Clancy Donnelly, Lauren Flinn, and Brian Fulmer

Faculty Advisor:
Gary Libecap

deckers
OUTDOOR CORPORATION

Green Footwear Manufacturing in China for Deckers Outdoor Corporation: An Internal Business Plan to Reduce the Environmental Impact of Manufacturing Facilities

March 2009

As authors of this Group Project report, we are proud to archive this report on the Bren School's website such that the results of our research are available for all to read. Our signatures on the document signify our joint responsibility to fulfill the archiving standards set by the Bren School of Environmental Science & Management.

_____
Danielle Côté-Schiff

_____
Clancy Donnelly

_____
Lauren Flinn

_____
Brian Fulmer

The mission of the Bren School of Environmental Science & Management is to produce professionals with unrivaled training in environmental science and management who will devote their unique skills to the diagnosis, assessment, mitigation, prevention, and remedy of the environmental problems of today and the future. A guiding principal of the School is that the analysis of environmental problems requires quantitative training in more than one discipline and an awareness of the physical, biological, social, political, and economic consequences that arise from scientific or technological decisions.

The Group Project is required of all students in the Master's of Environmental Science and Management (MESM) Program. It is a four-quarter activity in which small groups of students conduct focused, interdisciplinary research on the scientific, management, and policy dimensions of a specific environmental issue. This Final Group Project Report is authored by MESM students and has been reviewed and approved by:

_____
Gary D. Libecap, Ph.D.

Abstract

Deckers Outdoor Corporation is interested in improving its environmental performance by promoting the greening of the facilities in China where its products are assembled. This study presents an internal business plan to analyze the financial benefits to Deckers for an initiative to improve the environmental performance of the manufacturing facilities. Deckers' costs for this initiative include staff salary and overhead, communications, and membership fees. The two main sources of benefits to Deckers are risk reduction and positive consumer response. The opportunities for risk reduction can be classified as preempting regulations, increasing the certainty of resource availability, and avoiding negative public perception of Deckers. Positive consumer response can be seen if consumers are more likely to buy, recommend, or pay more for Deckers' products due to greener manufacturing facilities in China. Among the benefits, we quantified the avoided losses Deckers can see from decreasing risk of a loss in profit resulting from negative consumer response to an environmental problem. Over five years, an investment in the initiative will return $3.46 to $20 in avoided losses for every $1 spent. To facilitate Deckers' implementation of this initiative, we created a Facility Audit and a Green Facility Recommendations Handbook, which includes new construction renderings to illustrate an ideal green manufacturing facility. We applied these tools to a specific facility in Hebei, China. Based on the results of the case study, we developed suggestions for the facility to improve its environmental performance.

Acknowledgements

We would like to thank the following people for their guidance, expertise, time, and energy throughout this project. From our client, Deckers Outdoor Corporation: Mark Fegley for his technical expertise and gracious availability, and Dick Ambrocio and Jessica Min, our contacts at the China office. Pat Devaney helped to get the project off the ground while at Deckers and has continued to help us at his new workplace, Stella International Holdings.

We would also like to thank the following people from the Donald Bren School of Environmental Science and Management at the University of California, Santa Barbara for their assistance: Sarah Anderson, Amy Burgard, Natalija Glusac, James Badham, and Chien-Ju Lin, and from the University of California, Santa Barbara, Kathy Graham.

Outside of the Bren School and Deckers Outdoor, many individuals provided us with invaluable knowledge and guidance, among these are: Perrin Pellegrin, a consultant on sustainable building, Lisa Li and Eugenia Hsu from Pou Chen, and Margot McDonald. Margot connected us with Alexis Austin and Julia Metz, who produced the incredible architectural renderings to showcase our green building suggestions.

We would like to extend a special thanks to our faculty advisor Professor Gary Libecap for his guiding support during this project. Finally, we are extremely grateful for the help, time, and patience of Aretha Donnelly, Ryan Kolp, and Jan Côté.

Vision and Mission

Our vision is to help Deckers Outdoor Corporation achieve a leadership position among its competitors by improving the environmental practices of the facilities that manufacture its products.

Our mission is to improve the environmental practices of the facilities that manufacture Deckers' products by investigating conditions and practices, identifying risks, and making recommendations based on knowledge of sustainable practices.

Table of Contents

1. Executive Summary

1.1. Motivation

Deckers Outdoor Corporation, founded in Goleta, CA in 1973, is interested in improving its environmental performance. Thus far, Deckers has focused its environmental sustainability efforts on its Simple Shoes brand through the innovative use of sustainable materials and implementation of recycling and take-back programs. However, Deckers as a whole, which currently owns five other niche brands—Teva, Ugg, Tsubo, Ahnu, and Deckers—does not aspire to be a company that only sells products made of green materials (Derby 2008).

By their nature, many of Deckers footwear lines require the use of materials, such as leather and sheepskin, which will always have some environmental impacts. However, Deckers is committed to promoting environmental sustainability wherever it can and ensuring that its products are made as cleanly as possible (Derby 2008). The company does not see its environmental efforts as stand-alone initiatives that will bring about competitive advantages. Rather, Deckers believes that companies with sound, mature business processes will naturally develop strong environmental sustainability initiatives simply because it makes good business sense to do so. This largely arises out of the Japanese idea of *kaizen*, which focuses on continuous improvement and the elimination of waste. These are the key tenets of many environmental sustainability initiatives and thus are part of broader assumptions about how a good company should be run. Through developing a corporate culture that is driven by continuous improvement, Deckers plans to become more environmentally and socially responsible. To this end, Deckers has developed and implemented Ethical Supply Chain Guidelines to guide its corporate social responsibility efforts, which include the following environmental expectations:

> We require a continuous effort to improve environmental performance along a defined path towards clean production. We expect our business partners to: 1) adopt environmental management systems that address key business impacts and advance sustainable environmental practices; 2) disclose environmental impacts and activities through regular reporting; 3) reduce or eliminate toxic and hazardous substances from operations and products, in accordance with the Deckers Restricted Substances Policy; 4) increase efficiency and thereby minimize pollution and waste; 5) reduce the use of natural resources including raw materials, energy and water; and 6) take responsibility for proper waste management. (Deckers 2008b)

Currently, some Deckers' employees are interested in promoting the greening of the manufacturing facilities where Deckers' products are assembled. This will help ensure that the expectations of the Ethical Supply Chain Guidelines are met during the manufacturing process in China. To further this interest, our project delivers two products:

1. An **internal business plan** to present to Deckers' executive management that identifies the costs and benefits and calculates the rate of return on an investment in an initiative to reduce the environmental impacts of the footwear manufacturing facilities in China where Deckers' products are assembled.
2. A **toolbox** consisting of an audit and a recommendations handbook to help Deckers launch an initiative to reduce the environmental impacts of the footwear manufacturing facilities in China where Deckers' products are assembled.

1.2. The Problem and Opportunity

U.S. footwear consumption has increased by almost 200 percent since 1978 (AAFA 2006, AAFA 2007a), and footwear manufacture has moved to China due to decreased regulations, low-cost labor, and expertise. The vast amount of footwear consumed every year and the less stringent environmental regulations in China mean that the impacts incurred during the life cycle (including materials production and assembly, packaging, transportation, and end-of-life) of each shoe combine to have significant environmental impacts. According to a life-cycle assessment conducted recently for Deckers, materials production and assembly caused around 90 percent of all environmental impacts associated with the life cycle of the four shoes assessed.

Specifically, the facilities where footwear are assembled generate environmental impacts (including water and energy use, waste production, and materials consumption). Depending on the materials used to make the shoes, the impacts of the manufacturing facilities may not be as extensive as those impacts generated through production of the footwear materials (such as leather, plastic, and cotton). However, Deckers is already taking steps to reduce the impacts of the materials used, and reducing the impacts of the manufacturing facilities can further reduce the overall impacts of Deckers footwear. Additionally, Deckers has an excellent opportunity to effect change at the manufacturing facilities because they have already forged strong relationships with these companies. Additionally, because of the direct connection between Deckers and the manufacturing companies, the activities that occur at these facilities create the most risk for Deckers if they are perceived negatively by customers. These risks can create problems for Deckers business, but with these problems come an opportunity for Deckers to avert the risks to its business and possibly stimulate increased brand visibility and sales, both of which can translate to increased profits.

1.3. The Solution

In order to avert the aforementioned risk posed by outsourcing product manufacturing to developing countries, we propose that Deckers begin an initiative to reduce the

environmental impacts of the footwear manufacturing facilities in China where its products are assembled. This initiative targets facilities that:

- produce Deckers' products;
- do not already have robust sustainability initiatives in place; and
- have the potential to improve their facilities in a sustainable manner.

The initiative would involve the creation of a division within Deckers, under the auspices of a Corporate Social Responsibility (CSR) department, to research, facilitate, and monitor the implementation of environmental-sustainability-focused policies, programs, retrofits, and upgrades to the manufacturing facilities in China. There is currently no such dedicated set of persons employed by Deckers. We do not intend for this initiative to focus on any specific part of the production process. Rather, it should focus on the overall environmental and social sustainability of the physical production facilities and their corresponding campuses. This may require anything from minor factory upgrades (new fixtures, lighting and landscaping) to major factory overhauls (photovoltaic systems, grey water recycling systems, bioswales, passive ventilation systems).

1.4. Value Proposition

Through this sustainability initiative, Deckers can realize significant financial benefits. As outlined in Section 5, an investment in this initiative can result in a significant return on investment (ROI) due to one type of reduced risk—preventing negative public perception of Deckers—and the associated avoided losses. When calculated as a percent difference between the costs and avoided losses, this ROI can range from 246 to 1,900 percent. Additional benefits from other types of reduced risk (preempting regulations and increasing the certainty of resource availability) and positive consumer response to the initiative can result in even greater ROI.

1.5. Industry Analysis

Deckers' message is currently similar to that of Timberland and Nike. It shows an awareness of social and environmental issues associated with working with factories located in China. Further, Deckers' CSR message shows a willingness to work only with suppliers who meet their criteria for environmental and social performance, based on audits, reviews, and improvements. However, where Deckers lags behind Timberland and Nike is in the transparency of its efforts. Timberland and Nike take this process a step further by providing links to reports, audit metrics, and the names of companies who produce their products.

1.6. Costs, Benefits, and Return

Table ES.1 below breaks down the estimated annual costs for the implementation team

Table ES.1: Deckers' Annual Costs for the Initiative

Item	Estimated Annual Cost	Assumption
Director – CSR	$125,000	50% of time spent on initiative
Manager – Factory Audits (China)	$50,000	100% of time spent on initiative
Manager – Materials Testing (China)	$50,000	100% of time spent on initiative
Other Mgmt. Time	$200,000	Partial time for several people
Professional Group Fees	$5,000	Membership Fees
Communication	$10,000	Partial FTE + Expenses
Total	**$440,000**	

The benefits Deckers can see by implementing the initiative can be numerous, but the two main sources include risk reduction and positive consumer response. The opportunities for risk reduction can be classified as preempting regulations, increasing the certainty of resource availability, and avoiding negative public perception of Deckers. Positive consumer response can be seen if consumers are more likely to buy, recommend, or pay more for Deckers' products due to greener manufacturing facilities in China. Of all these opportunities for benefit, we have quantified the benefits from reducing the risk of a negative public relations event occurring, as this is more likely to affect Deckers' bottom line directly.

Assuming a 10 to 40 percent probability of a 10 percent loss in revenue without the proposed initiative and five percent probability of a 10 percent loss in revenue with the initiative in place, a five year projection (using a 5 percent discount rate) of the performance of the initiative is illustrated in Table ES.2.

Table ES.2: Discounted Avoided Losses and Costs Over Five-Year Period

Year	Costs	Avoided Losses	
		10% Probability	40% Probability
1	$440,000	$0	$0
2	$438,900	$1,551,825	$10,016,325
3	$437,803	$1,769,081	$10,614,483
4	$436,708	$2,002,747	$11,246,192
5	$435,616	$2,253,860	$11,913,261
Total Present Value	**$2,189,027**	**$7,577,512**	**$43,790,261**

Based on the present values of the costs and avoided losses, we calculated the ROI in two forms. By dividing the avoided losses by the costs, we can see that every dollar spent on the initiative will return $3.46 to $20.00. When looking at the percent difference between the costs and the avoided losses, we can see that the initiative will result in a 246 to 1,900 percent return on the investment.

1.7. Toolbox and Case Study

To facilitate Deckers' implementation of this initiative, we created a Facility Audit and a Green Facility Recommendations Handbook, which includes new construction renderings to illustrate an ideal green manufacturing facility. We applied these tools to a specific facility in Hebei, China. Based on the results of the case study, we developed suggestions for the facility to improve its environmental performance.

2.Project Motivation

Deckers Outdoor Corporation, founded in Goleta, CA in 1973, is interested in improving its environmental performance. Thus far, Deckers has focused its environmental sustainability efforts on its Simple Shoes brand. Through the innovative use of sustainable materials and implementation of recycling and take-back programs, Deckers has promoted the Simple brand as "a nice little shoe company" that produces "shoes for a happy planet." However, Deckers as a whole, which currently owns five other niche brands—Teva, Ugg, Tsubo, Ahnu, and Deckers—does not aspire to be a company that only sells products made of green materials (Derby 2008). Deckers' mission statement is as follows:

> Deckers builds niche products into global lifestyle brands by designing and marketing innovative, functional and fashion-oriented footwear, developed for both high performance outdoor activities and everyday casual lifestyle use (Deckers 2008a).

By their nature, many of Deckers footwear lines require the use of materials, such as leather and sheepskin, which will always have some environmental impacts. However, Deckers is committed to promoting environmental sustainability wherever it can and ensuring that its products are made as cleanly as possible (Derby 2008). The company does not see its environmental efforts as stand-alone initiatives that will bring about competitive advantages. Rather, Deckers believes that companies with sound, mature business processes will naturally develop strong environmental sustainability initiatives simply because it makes good business sense to do so. This largely arises out of the Japanese idea of *kaizen*, which focuses on continuous improvement and the elimination of waste. These are the key tenets of many environmental sustainability initiatives and thus are part of broader assumptions about how a good company should be run. Through developing a corporate culture that is driven by continuous improvement, Deckers plans to become more environmentally and socially responsible. To this end, Deckers has developed and implemented Ethical Supply Chain Guidelines to guide its corporate social responsibility efforts, which include the following environmental expectations:

> We require a continuous effort to improve environmental performance along a defined path towards clean production. We expect our business partners to: 1) adopt environmental management systems that address key business impacts and advance sustainable environmental practices; 2) disclose environmental impacts and activities through regular reporting; 3) reduce or eliminate toxic and hazardous substances from operations and products, in accordance with the Deckers Restricted Substances Policy; 4) increase efficiency and thereby minimize pollution and waste; 5) reduce the use of natural resources including raw materials, energy and water; and 6) take responsibility for proper waste management. (Deckers 2008b)

Currently, some Deckers' employees are interested in promoting the greening of the manufacturing facilities where Deckers' products are assembled. This will help ensure that the expectations of the Ethical Supply Chain Guidelines are met during the manufacturing process in China. To further this interest, our project delivers two products:

1. An **internal business plan** to present to Deckers' executive management that identifies the costs and benefits and calculates the rate of return on an investment in an initiative to reduce the environmental impacts of the footwear manufacturing facilities in China where Deckers' products are assembled.
2. A **toolbox** consisting of an audit and a recommendations handbook to help Deckers launch an initiative to reduce the environmental impacts of the footwear manufacturing facilities in China where Deckers' products are assembled.

3.The Problem and Opportunity

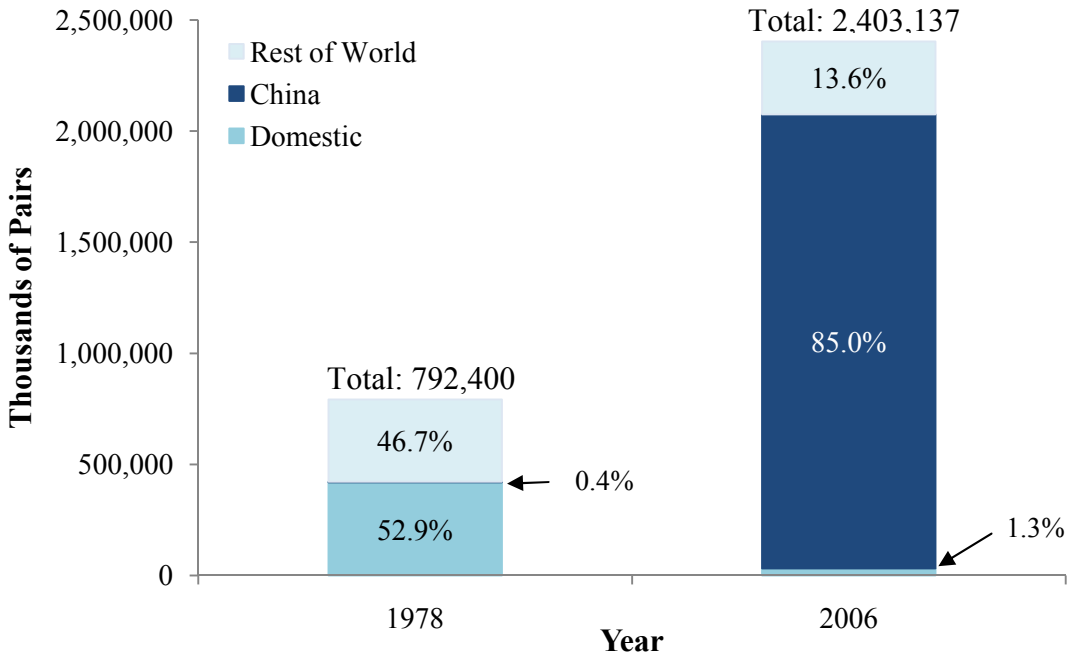
Footwear is not generally considered a product whose manufacture and use have significant environmental impacts, unlike cars or electricity. However, the immense amount of footwear consumed every year, as described in Section 3.1, means that the environmental impacts incurred during the life cycle of each shoe, as described in Section 3.2, combine to have significant effects on the environment. These combined effects can create problems for footwear companies that are not working to decrease their environmental impacts. But with these problems come opportunities for companies to avert risks to their business and possibly stimulate increased brand visibility and sales, both of which can translate to increased profits.

3.1. Footwear Industry Background

Since 1978, consumption of footwear in the U.S. has increased by almost 200 percent, from almost 800 million to around 2.5 billion pairs, as shown in Figure 1 (AAFA 2006, AAFA 2007a). This is an increase in an average of 3.6 to eight pairs of shoes purchased per person per year in the U.S. (AAFA 2007a, U.S. Bureau of the Census 1980). As our appetite for footwear has increased, the footwear manufacturing industry has transformed. In 1978, about 50 percent of footwear consumed in the US was made domestically and about 50 percent was imported, with less than one percent coming from China (AAFA 2006). In 2006, 85 percent of footwear consumed in the U.S. came from China alone, and domestic production made up only 1.3 percent of all footwear consumption in the U.S. (AAFA 2007a). Keeping with this trend, all of Deckers' footwear lines are manufactured in China by independent manufacturing companies.

Prior to the 1990s, shoe manufacturing was centered in Taiwan and Korea. However, in the last 20 years, the Taiwanese and Korean firms transitioned their businesses to China, Indonesia, Thailand and Vietnam, while retaining ownership of the companies (Frenkel 2001). The transition of footwear manufacture to developing countries has been motivated by the availability of low-cost labor and limited regulations (AAFA 2006, Frenkel 2001, Lowder 1999). China has become the world's leader in footwear manufacture for these reasons, as well as their significant expertise in footwear manufacture (RNCOS 2008). In China alone, there are over 20,000 companies manufacturing footwear (China Daily 2006).

Figure 1: Footwear Consumption in the United States in 1978 and 2006



3.2. Environmental Impacts of Footwear Manufacture

As with other manufacturing sectors, footwear manufacture has environmental impacts. According to life-cycle assessment work conducted recently for Simple Shoes, materials production and assembly caused around 90 percent of all environmental impacts associated with the life cycle of the four Simple Shoes that were assessed. Transportation and end-of-life, followed by packaging, were responsible for the remainder of these impacts. When looking at the specific impacts, the majority were related to toxicity potential for terrestrial, freshwater, and marine ecosystems as well as humans. (Albers et al. 2008)

Additional impacts realized through materials production and assembly include the following:

Acidification Potential (AP): represents contribution to acid rain, which is mostly caused by the burning of fossil fuels and damages ecosystems, building materials, and paints and can affect human health (Albers et al. 2008, U.S. EPA 2007).

Global Warming Potential (GWP): represents radiative forcing of greenhouse gas emissions, which contribute to global climate change and have worldwide environmental effect (Albers et al. 2008).

Photochemical Ozone Creation Potential (POCP): represents production of volatile organic compounds (VOCs) and nitrogen oxides (NOx), which are emitted though various activities including industrial processes, motor vehicle use, and chemical solvent use and contribute to the formation of ground-level ozone (i.e., the main component of smog), which has implications for human health and the environment (Albers et al. 2008, U.S. EPA 2009).

These impacts were mainly incurred through the production of the materials used to make the shoes. It should be noted however that the relative impact of the production of the materials to the production of the shoes themselves varies significantly based on the type of materials the shoes are composed of. When looking at the carbon footprint of a leather boot, Timberland found that seven percent of the carbon emitted was due to electricity used to manufacture the boot, while the remaining 93 percent could be attributed to the production of the raw materials (Ball 2008). But when comparing a leather boot to a flip flop for instance, the carbon footprints can vary by a factor of ten (Ball 2008).

No matter the materials that the shoes are made of, the actual assembly of these materials during the manufacturing stage does "contribute somewhat to the overall environmental impact of the shoes." This assembly typically involves the following main steps: cutting, stitching, gluing, finishing and packaging. These stages involve some use of machines and equipment, such as dye cutting machines, industrial sewing machines, lasting machines, mold pressing machines, EDI machines, conveyor belts, rubber rollers, and vulcanizing ovens. However, footwear manufacture is labor intensive, with the machines requiring human operation and other activities, such as the application of adhesives, which are typically completed by hand. (Albers et al. 2008)

Due to the labor-intensive process, footwear manufacturing requires a large number of employees, many of whom live and work at the manufacturing facilities. Therefore, not only do the facilities create environmental impacts typically associated with manufacturing buildings, but they also generate environmental impacts associated with residential buildings. These environmental impacts can include the following:

- Energy use from lighting, machine operation, and office equipment
- Water use by employees and for manufacture processes
- VOC emissions from glues, solvents, and cleaning agents
- Generation of solid waste and wastewater

While these impacts may not be as extensive as those produced further back in the supply chain, Deckers is already taking steps to reduce the impacts incurred during

materials production by sourcing sustainable materials for some shoes and sourcing from responsible companies for other shoes that cannot be made from sustainable materials. Reducing the environmental impact of the buildings where Deckers' products are made can further reduce the overall impact of Deckers' footwear.

Deckers has an excellent opportunity to effect change at the manufacturing facilities because they have already forged strong relationships with these companies. For example, in order to sell shoes to universities, Deckers worked with several facilities to assure compliance with standards set by the Fair Labor Association (FLA). Also, Deckers' Ethical Supply Chain Group has already begun work with facilities to ensure compliance with Deckers' Ethical Supply Chain Guidelines. Additionally, because of the direct connection between Deckers and the manufacturing companies, the activities that occur at these facilities create the most risk for Deckers if they are perceived negatively by customers.

3.3. Risks and Opportunity

As discussed in Section 3.1, the transition of footwear manufacture to China has occurred mainly due to the presence of decreased labor costs and less stringent regulations. The lack of rigorous environmental regulations in China means that footwear manufacturing facilities there will potentially have higher environmental impacts than their counterparts would have in the U.S. As concern about environmental degradation around the world increases, economic and social risks are created for companies, particularly for those that are not taking actions to reduce their environmental footprints (WRI and A.T. Kearney 2008, JP Morgan 2008, Ernst & Young 2008). Although Deckers does not own the facilities that manufacture their shoes, the environmental impacts of these facilities can still weaken Deckers' business through these risks, which can include increased regulations, lack of certainty in resource availability, and negative public perception of Deckers. However, this problem of increased risks also creates an opportunity for Deckers to avert the risks to its business by reducing the environmental impacts of the facilities. These opportunities for reduced risks are discussed further in Section 5.2.

4. The Solution

4.1. Our Initiative

In order to avert the aforementioned risk posed by outsourcing product manufacturing to developing countries, we propose that Deckers begin an initiative to reduce the environmental impacts of the footwear manufacturing facilities in China where its products are assembled. This initiative would involve the creation of a division within Deckers, under the auspices of a Corporate Social Responsibility (CSR) department, to research, facilitate, and monitor the implementation of environmental-sustainability-focused policies, programs, retrofits, and upgrades to the manufacturing facilities in China. There is currently no such dedicated set of persons employed by Deckers. We do not intend for this initiative to focus on any specific part of the production process. Rather, it should focus on the overall environmental and social sustainability of the physical production facilities and their corresponding campuses. This may require anything from minor factory upgrades (new fixtures, lighting and landscaping) to major factory overhauls (photovoltaic systems, grey water recycling systems, bioswales, passive ventilation systems). The quantification and explanation of the costs and benefits of this initiative are discussed in the section below.

4.2. Value Proposition

This sustainability initiative is in line with ideas of *kaizen* or continuous improvement and waste elimination. We believe there is a correlation between sustainability, success, and companies with mature business processes that emphasize an ethic driven by *kaizen*. In keeping with this principle, this sustainability initiative can be seen as simply a cost of doing business.

However, with these costs can come significant financial benefits for Deckers. As outlined in Section 5, an investment in this initiative can result in a significant return on investment (ROI) due to one type of reduced risk—preventing negative public perception of Deckers—and the associated avoided losses. When calculated as a percent difference between the costs and avoided losses, this ROI can range from 246 to 1,900 percent. Additional benefits from other types of reduced risk (preempting regulations and increasing the certainty of resource availability) and positive consumer response to the initiative can result in an even greater ROI.

5.Costs, Benefits, and Return

When analyzing the opportunities for Deckers to benefit from greener manufacturing facilities, it is important to consider the costs of implementing such a program, as described in Section 5.1, as well as the opportunities for benefit. These benefits can be numerous, but the two main sources include risk reduction, as described in Section 5.2, and positive consumer response, as described in Section 5.3. The opportunities for risk reduction can be classified as preempting regulations, increasing the certainty of resource availability, and avoiding negative public perception of Deckers. The specific return on investment (ROI) that Deckers can obtain by taking action to prevent negative public perception is discussed in Section 5.2.3. Positive consumer response can be seen if consumers are more likely to buy, recommend, or pay more for Deckers' products due to greener manufacturing facilities in China.

5.1. Costs

Though the primary cost to update and retrofit the Chinese manufacturing facilities will fall on the manufacturing companies themselves, Deckers will incur internal costs to fund a team to implement the initiative. These costs cover staff salary and overhead, communications, and membership fees. Table 1 below breaks down the estimated annual costs for the implementation team. The total costs are $440,000 for the first year. After the program is implemented, we assume that these costs will increase by five percent each year.

Table 1: Deckers' Annual Costs for the Initiative

Item	Estimated Annual Cost	Assumption
Director – CSR	$125,000	50% of time spent on initiative
Manager – Factory Audits (China)	$50,000	100% of time spent on initiative
Manager – Materials Testing (China)	$50,000	100% of time spent on initiative
Other Mgmt. Time	$200,000	Partial time for several people
Professional Group Fees	$5,000	Membership Fees
Communication	$10,000	Partial FTE + Expenses
Total	**$440,000**	

5.2. Risk Reduction

Despite the costs of the initiative, Deckers will see benefits from greening the manufacturing facilities in China where its products are assembled. These benefits are largely in the form of reductions in the risks to Deckers' business. A recent report published by the World Resources Institute and A.T. Kearney estimated the fiscal

impact to companies not actively engaged in corporate and environmental sustainability is a reduction of 13 to 31 percent in earnings before interest and taxes (EBIT) by 2013 and 19 to 47 percent by 2018 (WRI and A.T. Kearney 2008). By taking action to improve their environmental performance on all levels, Deckers can mitigate these potential risks to their earnings. The proposed initiative to green the manufacturing facilities is an aggressive step towards risk reduction.

Furthermore, a 2009 A.T. Kearney study showed that "companies committed to corporate sustainability practices are achieving above-average performance" in the current economic meltdown (A.T. Kearney 2009). This research supports the notion that successful companies are those companies with good environmental practices. It is therefore in Deckers' best interest to pursue sound environmental policies to safeguard against risk while increasing competitive advantage.

As discussed, there are three main areas of risk reduction that Deckers can achieve through the initiative to green manufacturing facilities: preempting government regulations, increasing the certainty of resource availability, and avoiding a negative public relations event. These sources of risk reduction are described in the following sections.

5.2.1. Preempting Regulations

As China begins to improve their environmental regulatory system, companies will have to quickly respond to meet new standards. According to the China Business Council for Sustainable Development, the Chinese government is passing legislation mandating greater energy efficiency in buildings (CBCSD 2004). Manufacturing facilities that have already reduced their environmental impact may avoid steep fines and potential delays in production due to lack of compliance. Because Deckers operates on a tight seasonal timeline, delayed production can result in a significant loss of profit. We have estimated that a stop in production for only one day at one of Deckers' manufacturing partners can cost Deckers around $200,000 in lost profit (Fegley 2009). Many days or weeks of non-compliance could prove extremely costly to Deckers' bottom line. Therefore attempting to preempt environmental standards in the facilities could spare Deckers the risk of lost manufacturing.

5.2.2. Increasing the Certainty of Resource Availability

Resources such as energy and water are vital to footwear production, and increasing the certainty of resource availability is important to assure that no delays occur in production. However, significant increases in population are straining the availability of resources in China, particularly energy and water. For example, the Chinese recently predicted that there will be "a power shortage of 10 to 15 percent in the key manufacturing areas estimating that about $108 billion of new generation capacity

will be needed in the coming five years to close the gap" (World Bank 2008). Another estimate by CBCSD claims that 40 percent of China's energy usage is attributed to buildings and if growth is unchecked, energy needs for buildings will double by 2020 (CBCSD 2004). By reducing their reliance on outside energy sources through improved efficiency and on-site production, facilities can ensure a constant supply of power and avoid production delays.

Scarcity of fresh water and its linkage to climate change and growing population is gaining attention in the business sector. A recent World Resources Institute article highlights the vulnerability of businesses when water becomes limited, as well as the investor and market ramifications of these limitations (Klop 2008). The issue of scarce resources, especially in China, is sparking attention to companies that depend on them for continued business. Water availability and treatment of wastewater are concerns that can be minimized by implementing onsite recycling and treatment systems and rainwater capture, which are all examples of green manufacturing initiatives.

5.2.3. Preventing Negative Public Perception of Deckers

The final and most easily quantified risk mitigation element is to reduce the probability of an environmental event that sparks negative public perception of Deckers. This type of event could be caused by a catastrophe—such as a fuel spill or the sale of contaminated products—or by current poor practices catching the public's attention. For many Deckers' customers, particularly the environmentally-conscious Simple and Teva shoppers, the simple fact that Deckers' shoes are made in China could be considered a poor practice. Any of these types of negative public relations (PR) events can lead to a tarnished company image and lost sales.

Background Research

To illustrate the hypothesis that negative PR events can hurt sales, we conducted research into similar negative PR events that affected other companies. The most relevant event is Nike's PR disaster in the late 1990s related to the use of sweatshop labor. Consumers are now at least as concerned about environmental practices as they are about labor practices. In a 2008 global survey, the Nielsen Company found that 51 percent of those surveyed consider it very important for companies to improve their environmental practices, while 42 percent consider it very important for companies to improve other CSR programs that improve society (Nielsen 2008). This public concern over corporate environmental practices, in conjunction with the outfall seen from Nike seen in the 1990's, shows the vulnerability of companies without extensive, sound environmental practices and guidelines. In order to further explore this relationship, let us continue looking at the case of Nike.

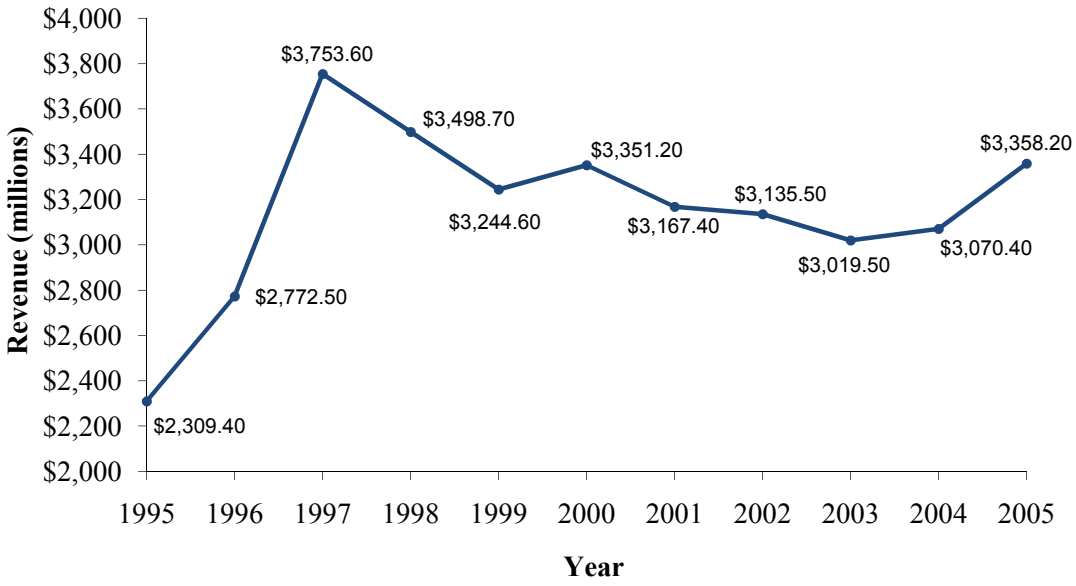
The following timeline outlines the series of events that affected Nike:

- October 1996: CBS airs an episode of *48 Hours* which reveals unfair working conditions in a Vietnamese factory making Nike products
- February 1997: Nike's stock price is $36.75
- April 1998: Michael Moore's documentary *The Big One* premiers and focuses significantly on Nike's practices in Asia
- May 1998: Nike CEO Phil Knight announces six point plan, which includes independent monitoring of labor practices, raised minimum age requirements, and sets targets for improving working conditions
- September 1998: Nike's stock drops to $17.19
- February 2004: Nike's stock returns to $36 for the first time since 1997

In 1998, public concern about labor practices in Asian factories that make Nike footwear and clothing reached a peak. In response to the high levels of negative PR in the press, Nike created a Labor Relations Department, contracted Ernst and Young to monitor the factories, hired former UN ambassador Andrew Young to review their implementation of their own Code of Conduct, and joined Business for Social Responsibility (Global Exchange 1997). It is unclear what the actual cost of these activities was to Nike, but it appears they were quite concerned about the tarnishing of their brand and willing to allocate whatever resources were necessary to fix it.

Figure 2 shows Nike's revenue from North American footwear sales from 1995 to 2005 (SEC 2008). When considering the events above, the years of 1997 to 2000 are of most relevance. During this time, revenue decreased by 10.7 percent. Quarterly data from 1996 to 2000 yielded a significant drop in revenue from November of 1997 ($788 million) to November of 1998 ($666 million) (SEC 2008). This amounts to a 15.5 percent drop in one year. It should be noted that while Nike's revenues were dropping from 1997 to 2000, the American Apparel and Footwear Association indicated the overall footwear industry was growing (AAFA 2007b).

Figure 2: Nike's North American Footwear Annual Revenue (SEC 2008)



While Nike's experience was related to social and not environmental concerns, it still emphasizes the importance of taking steps to mitigate the risk of a negative PR event. Negative PR events related to environmental degradation are also more likely today than they were in the 1990s due to increasing public concern and media coverage about the environment (Nielson 2008). Additionally, many consumers understand that there is a direct connection between environmental and social concerns, as a company's environmental impacts affect the people that live and work in the area.

Financial Analysis

As seen with Nike, a negative PR event can cause significant losses in revenue and profit. The following quantitative reasoning outlines the potential losses averted through the initiative to green the manufacturing facilities in China. To calculate the avoided losses, we considered how the following two factors would vary with and without the initiative in place:

1. Percent loss in profit caused by a negative PR event
2. Probability of a negative PR event

Profit Loss: If a negative PR event were to happen, we assume a loss of profit of 10 percent is possible. This number was specified by Deckers' management and consultants and confirmed by the market research discussed above. When looking at Nike, it saw a loss in revenue of over 15 percent in one year, indicating that our assumption of 10 percent is a conservative estimate. We assume that the same loss in profit would be seen whether or not the initiative is implemented, although it is likely

that with the initiative in place, Deckers will be better equipped to dampen the effects of a negative PR event.

Probability: Without the initiative in place, we assume that the probability of a negative PR event happening is between 10 and 40 percent. This range was specified by Deckers' management and consultants and is based on the lack of a dedicated sustainability department at Deckers. Further, the current success and visibility of the Ugg brand invites attention from consumers as well as watchdog organizations. It was concluded by Deckers management and consultants that the initiative, which includes a dedicated sustainability department at Deckers, could reduce the likelihood of an event to five percent.

Avoided Losses: To calculate how these assumptions translate into avoided losses, we used an annual profit of $270 million for the first year. This is based on a profit margin of 45 percent and revenue of $600 million, which is a conservative estimate of Deckers' 2008 revenue. In subsequent years, we assume the profit will increase by 10 percent per year.

By multiplying the annual profit by the profit loss and probability percentages, as shown in Equation 1, we can determine the losses that would be seen in a given year for each scenario. Then, by comparing the losses that would be seen with and without the initiative in place, we can calculate the avoided losses in a given year due to the implementation of the initiative, as shown in Equation 2.

Equation 1: Annual Profit x Profit Loss x Probability = Losses

Equation 2: Losses Without Initiative – Losses With Initiative = Avoided Losses

ROI: As discussed in Section 5.1, the costs to Deckers to implement the initiative are $440,000 in the first year, increasing by 5 percent per year in subsequent years. By comparing these costs to the avoided losses, we can calculate a rate of return on an investment in the initiative. As shown in Equations 3 and 4, the ROI can be expressed as both a dollar return on every dollar spent and as a percent difference between the avoided losses and the costs.

Equation 3: $\frac{\text{Avoided Losses}}{\text{Costs}}$ = Return on Every $1 Spent

Equation 4:	$\frac{\text{Avoided Losses} - \text{Costs}}{\text{Costs}}$	x 100 =	ROI Expressed as a Percent Difference

When considering the ROI, we looked at how the investment would pay back after five years. With the initiative, we estimate that after the initial implementation, the probability of a negative PR event will decrease by 0.5 percent each year for five years. This is based on the assumption that the effort will improve over time and will gain greater visibility in the consumer market. However, because it will take some time for the initiative to have an effect on risk, we assume that avoided losses will not be seen until the second year. Deckers will still incur costs during the first year.

As discussed above, we also assume that costs will increase by five percent and profit will increase by 10 percent, which is a very conservative estimate judging by Deckers' recent growth.

Table 2 outlines the costs and profits over the five-year analysis period and Table 3 outlines the losses and avoided losses over the five-year analysis period. Two sets of numbers for losses and avoided losses are presented, representing the range of profit loss expected to be seen due to a negative PR event.

Table 2: Costs and Profits Over the Five-Year Period

Year	Costs	Profit
1	$440,000	$270,000,000
2	$462,000	$297,000,000
3	$485,100	$326,700,000
4	$509,355	$359,370,000
5	$534,823	$395,307,000

Table 3: Losses and Avoided Losses Over the Five-Year Analysis Period

Year	Losses			Avoided Losses	
	No Initiative		Initiative	10% Probability	40% Probability
	10% Probability	40% Probability			
1	$2,700,000	$10,800,000	$0	$0	$0
2	$2,970,000	$11,880,000	$1,336,500	$1,633,500	$10,543,500
3	$3,267,000	$13,068,000	$1,306,800	$1,960,200	$11,761,200
4	$3,593,700	$14,374,800	$1,257,795	$2,335,905	$13,117,005
5	$3,953,070	$15,812,280	$1,185,921	$2,767,149	$14,626,359

To determine the ROI of the initiative over five years, we used a standard discount rate of five percent to determine the present value of the avoided losses and costs and find their total over five years. We then calculated the overall ROI using these discounted total avoided losses and costs, which are shown in Table 4.

Table 4: Discounted Avoided Losses and Costs Over Five-Year Period

Year	Costs	Avoided Losses	
		10% Probability	40% Probability
1	$440,000	$0	$0
2	$438,900	$1,551,825	$10,016,325
3	$437,803	$1,769,081	$10,614,483
4	$436,708	$2,002,747	$11,246,192
5	$435,616	$2,253,860	$11,913,261
Total Present Value	**$2,189,027**	**$7,577,512**	**$43,790,261**

Based on the present values of the costs and avoided losses, we calculated the ROI in two forms, using Equations 3 and 4. By dividing the avoided losses by the costs, we can see that every dollar spent on the initiative will return $3.46 to $20.00. When looking at the percent difference between the costs and the avoided losses, we can see that the initiative will result in a 246 to 1,900 percent return on the investment.

5.3. Consumer Response

The second opportunity for improved business for Deckers through this initiative is related to consumer response. By improving the environmental performance of the Chinese manufacturing facilities, Deckers can then leverage these changes through marketing into improved knowledge of the Deckers' brand names, increased loyalty to Deckers from existing customers, and increased incidence of recommendations of Deckers to others. This leveraging possibility can be quantified for Deckers specifically through a consumer survey and can be assessed qualitatively based on overall consumer trends in the footwear and apparel industries.

5.3.1. Consumer Survey

While a survey could not be administered due to time and logistical constraints, a useful survey tool was drafted and is presented in Appendix 1. This survey uses the following two statements:

1. Approximately 99 percent of footwear consumed in the U.S. is manufactured in another country. Deckers Outdoor Corporation employs independent companies to assemble their high quality footwear in China.

2. Approximately 99 percent of footwear consumed in the U.S. is manufactured in another country. Deckers Outdoor Corporation employs independent companies to assemble their high quality footwear in China. Currently, Deckers is working to enact more stringent environmental standards for the manufacturing facilities where Deckers' shoes are assembled.

Respondents will be randomly chosen to receive one of the two statements and then asked a series of three questions about whether they are more or less likely to buy Deckers' brands, recommend Deckers' brands, and pay more for Deckers' brands, based on the statement. By administering this tool to Deckers customers, it would be possible to gauge whether customers will be more likely to buy, recommend, or pay more for Deckers' products due to stronger environmental standards at manufacturing facilities in China.

While it was not possible during the course of this project to perform this specific survey, a recent study conducted by Trudel and Cotte for the Wall Street Journal and MIT Sloan Management Review used a similar method for determining whether "being ethical pay[s]?" (2008). Test subjects were shown coffee and t-shirts and told (1) nothing, (2) that they were either made "using high ethical standards," or (3) that they were made using low standards. These ethical standards accounted for aspects such as "diversity in hiring…consumer safety…environmental practices…[and] human rights." In this experiment, consumers were only asked whether they would be willing to pay more or less for the products based on the information they were told. For the coffee, the results, which were statistically significant, showed that consumers were willing to pay more for the coffee produced with ethical standards and that consumer were willing to pay less for the coffee produced with poor ethical standards. In fact, "negative information had almost twice the impact of positive information on the participants' willingness to pay." For the t-shirt, consumers were willing to pay a similar amount more for the organic cotton t-shirts, no matter how much organic cotton they contained. This indicated that while companies could demand a price premium for "ethically produced" products, "once companies hit a certain ethical threshold," consumers will pay more but will not continue to increase their willingness to pay as the product becomes more and more ethically produced. The final part of the experiment showed that consumers with "high expectations" of the corporation who were told that the product was made under high ethical standards were willing to pay even more than those with "low expectations." The results of this survey suggest that companies may be able to demand a price premium for their green products, particularly from those individuals who expect companies to behave ethically. These consumers, sometimes labeled as LOHAS or Lifestyles of Health and Sustainability, are particularly relevant to Deckers' Simple brand, which has attracted environmentally conscious consumers by offering shoes made from sustainable and non-animal-based materials. (Trudel and Cotte 2008).

5.3.2. Overall Consumer Trend

A significant amount of qualitative information can be learned from existing research. Whether consumers are interested in making purchases from "green" companies, how consumers determine which companies are green, and what green marketing strategies consumers are most receptive to are important questions to answer to determine if Deckers' efforts will result in increased sales and/or promote its image as an environmental leader in the footwear industry.

Green marketing, a term defined by the American Marketing Association as "the efforts by organizations to produce, promote, package, and reclaim products in a manner that is sensitive or responsive to ecological concerns," has become increasingly prevalent in the marketing landscape as environmental concerns, particularly related to climate change, have grown (AMA 2008). This is confirmed by the series of Federal Trade Commission (FTC) workshops held in 2008 on green marketing, which were focused on the revision of their Guides for the Use of Environmental Marketing Claims, otherwise known as the "Green Guides" (FTC 2007). While these guides are only interpretation of law and therefore do not have the same force as law, they were originally issued in the 1990s "to help marketers avoid making unfair or deceptive environmental claims" (FTC 2008a). On July 15, 2008, the third of these workshops focused on green claims in the building and textiles industries and how consumers perceive these claims (FTC 2008a, Environmental Leader 2008). While footwear was not specifically covered in this workshop, they did discuss the marketing of green textiles, including organic cotton, and green building materials, such as carpeting, paint, and lighting (FTC 2008a, b). The workshop also focused on third-party certification programs for green claims, such as LEED (FTC 2008a). While the updated Green Guides will not be published until later in 2009, the workshops indicate an overall trend in consumer industries – including the apparel and building industries – towards making environmentally-friendly claims about products and services (Environmental Leader 2008). As Deckers moves forward with this initiative, attention should be paid to the updated Green Guides to ensure that any marketing claims made by Deckers follow these guidelines.

However, just because Deckers implements a program to green manufacturing facilities in China does not mean that it should market its efforts extensively. As discussed in Section 5.2, considerable benefits from risk reduction can be seen through implementing this type of program. Whether extra financial benefits are available to Deckers through positive consumer response is less clear. Research into whether green marketing is effective at improving sales has shown mixed results, and with the current state of the economy, many consumers are not able to spend more for environmentally-friendly products.

A recent consumer survey conducted by Cone, a brand strategy and communications agency, has shown that 42 percent of Americans "consider the environmental impact of either making purchases or supporting companies in" the footwear and apparel industry (Cone 2008). Additionally, a Boston Consulting Group survey of adults in nine countries (including the United States, Germany, China, Japan, Italy, Spain, the United Kingdom, France, and Canada) showed that 36 percent of respondents "sometimes" or "systematically buy green" in the textiles and clothing product category (Manget et al. 2009). An additional 14 percent used to purchase green products in this category but no longer did at the time of the survey, presumable at least partially due to the current economic downturn (Manget et al. 2009). While the category of textiles and clothing fell below several other categories of consumer products (including fresh meats and vegetables and paper and packaged products), this does affirm that many consumers will care about Deckers' environmental efforts.

Moreover, another survey conducted by EcoAlign, which is a marketing agency focused solely on energy and the environment, showed that consumers prioritize energy efficient operations and buildings and renewable energy investment when considering which corporations are environmental leaders (Cogar 2008). This highlights that Deckers' desire to focus on greener manufacturing facilities is relevant in the current consumer landscape (Cogar 2008).

However, some research has indicated that while consumers are demanding environmentally-friendly products, they are often not willing to pay higher prices for these products, particularly with the current state of the global economy (Makower 2008). A recent survey by the marketing company Yankelovich showed that compared with 2007, "fewer consumers [were] willing to pay more for green products despite growing consumer interest in the environment, green behaviors and green lifestyles" (Automatic Merchandiser Magazine 2008). But according to a recent report by the Boston Consulting Group, while "green is not a license to charge more…many consumers will pay a little more for green products offering the right benefits" (Manget et al. 2009). When looking at footwear specifically, about 26 percent of "green-product buyers" said they would pay "at least 10 percent more for green [footwear] products" (Manget et al. 2009).

Further exacerbating the uncertainty of whether consumers will pay more for greener products is the increasing level of consumer skepticism and alertness to greenwashing that has arisen due to the large number of green marketing campaigns (Makower 2008). In fact, 90 percent of Americans believe that companies must prove their product is good for the environment, not just say it is (Cone 2008, Cogar 2008). Along these lines, "Americans say they want additional information about environmental impacts on product labels" (GfK Roper and Yale 2008). While these

factors may go hand-in-hand (i.e., consumers are not willing to pay more for products that they have no way of knowing are truly greener), they present significant challenges for companies desiring to make genuine, substantial changes and somehow employ these changes to improve their profit margin, whether it be through increased prices or increased brand loyalty. This indicates that Deckers must seriously consider its goals in promoting greener manufacturing facilities in China as well as when and how to market its environmental agenda to its consumers.

6.Industry Analysis

We performed an industry analysis to view the context in which our proposed initiative would perform. Specifically, we considered how Deckers' current and future manufacturing sustainability efforts compare to the efforts of its competitors. Due to Deckers' variety of shoe brands, we chose several different types of shoe companies as competitors—Keen Footwear, Merrell Shoes, Nike, Timberland, and Rockport. We evaluated these competitors for the extent to which they have a corporate social responsibility (CSR) message visible to consumers. Further, if they have a CSR message, we considered how close it comes to addressing the environmental performance of its suppliers.

6.1. Competitor Efforts

Keen Footwear
Keen's CSR message consists of their HybridLife campaign, which is committed to environmental and social causes. From their website: "…Through our leadership and commitment to social and environmental causes, we hope to encourage and empower others to do the same."

Keen's efforts are mostly realized through supporting other organizations. For example, Keen has worked with the "1 KG More" program, a Chinese non-profit that works to distribute school supplies to Sichuan Province. "In addition to donating 12,000 pairs of shoes to the cause, KEEN is working with 1 KG More to rally industry support to provide books and scholarships for children in the 2008 earthquake-devastated city of Mianzhu."

Since 2004, Keen has distributed $1.5 million to 1 KG More, Winter Wildlands Alliance, Medicines Global, Youth Outdoors Legacy Fund, Leave No Trace, Big City Mountaineers, American Whitewater, Outdoor Industry Foundation, Friends of Forest Park, The Conservation Alliance, Conservation Alliance Japan, Association for Conservation, Surfrider Foundation Japan, Bruce Trail, and Earth Day Tokyo 2007.

Keen does not appear to be making efforts towards improving the environmental performance of its suppliers. (Keen 2009)

Merrell Shoes
Merrell Shoes does not appear to have any outward CSR message. Their website shows nothing concerning any efforts to reduce its impact on the environment. Instead, their focus is on showing how their product is a connection to the outdoors:

> Merrell believes in continuously expanding the outdoor journey of discovery and freedom. Being outside brings us adventure and exhilaration, as well as self-knowledge and fulfillment. It blurs the boundaries between people and cultures, uniting those who enjoy exploring and seeking out new experiences.
>
> Merrell believes in encouraging and equipping everyone to get outside. It doesn't need to be complicated-outside is where you find it. Whether encompassing the wonder of the natural world or the heart of an urban landscape, it's the journey that spurs us on, serving as the inspiration for everything we do. (Merrell 2009)

Nike

Although it is difficult to find on its website, Nike has an extensive and transparent CSR program in place. Under "Workers/Factories" is extensive literature on efforts Nike is making to improve conditions at factories that produce Nike products. This includes making their own code of conduct, audit tools, a list of factories used, and a list of factories that produce collegiate products available for download. Nike's environmental audit is compliance based.

According to the document "Nike China 2008 Corporate Responsibility Supplement," Nike is currently working to set targets for reductions in CO_2 emissions from factories located in China. This includes a pilot monitoring program started in 2007 to create a baseline of data. Nike's plan is to share this information with the World Federation of Sporting Goods Industries, a trade organization that includes the top 150 sporting goods companies. (Nike 2009)

Rockport

Rockport has no CSR or environmental message visible on its website (Rockport 2009).

Timberland

Timberland has an extensive and transparent CSR message, which can be viewed in detail from its website. There are four pillars of their CSR strategy: Energy, Products, Workplaces, and Service. Additionally, there are links to CSR reports on specific performance indicators quarterly through Justmeans, a third party website that specializes in communicating the social and environmental efforts of companies (Justmeans 2009).

Under Workplaces, there are metrics in place to rate footwear factories based on labor practices. This is used in their goal of limiting Timberland's use of "high risk" factories. From 2007 to 2008, their use of high risk factories has been reduced from 34 percent to 8 percent.

Additionally, Timberland has developed Average Environmental Assessment Scores for factories producing its products. This metric includes compliance, waste, water, water based adhesives, chemicals, and energy. For a facility's environmental footprint, scores are given for monitoring and reporting. Highest scores are given for making improvements in their environmental footprint. (Timberland 2009)

6.2. Conclusions

There are varying levels of effort within the U.S. footwear industry to improve conditions at supplier factories. Some companies have no outward CSR message whatsoever (i.e., Merrell Shoes and Rockport), while others partner with and donate to non-profit organizations that resonate with their customers. Keen, for example, has donated $1.5 million to 18 conservation and charitable organizations since 2004 (Keen 2009). It does not, however, address any aspects related to the sustainability of its supply chain.

The CSR efforts of Timberland and Nike have extended to the working conditions and environmental footprints of supplier factories, including those located in China. Nike has made its efforts transparent through making its code of conduct, audit tools, a list of factories used, and a list of factories that produce collegiate products available for download. Although this audit is compliance based, in a recent document (Nike 2008), Nike states that it is currently working to set targets for reductions in CO_2 emissions of factories located in China. Timberland has gone so far as to develop a metric that includes ratings for compliance, waste, water, water-based adhesives, chemicals, and energy.

Deckers' message is currently similar to that of Timberland and Nike. It shows an awareness of social and environmental issues associated with working with factories located in China. Further, Deckers' CSR message shows a willingness to work only with suppliers who meet their criteria for environmental and social performance, based on audits, reviews, and improvements. However, where Deckers lags behind Timberland and Nike is the transparency of their efforts. Timberland and Nike take this process a step further by provide links to reports, audit metrics, and the names of companies who produce their products.

7.Competitive Advantage

This section considers how an initiative to improve the environmental performance of manufacturing facilities will add value to Deckers' position within the footwear industry. To determine this, we examined how difficult it is to employ the initiative, how relevant the initiative is to the current market, and whether or not Deckers is capable of executing the initiative.

7.1. Control of Supply Chain

Deckers holds an advantage through its ability to control its supply chain. Within China, there are five companies from which Deckers currently contracts to produce its products. Also, there are additional footwear manufacturers not used by Deckers but that could be sourced if needed. If manufacturers do not cooperate with efforts to improve their environmental performance, they run the risk of Deckers choosing another manufacturer.

7.2. Barriers to Entry

There are high barriers to entry in successfully improving environmental performance of manufacturing facilities based in China. First, capital must be available to develop a team dedicated to working with the manufacturers. Deckers has this capital available given its strong yearly returns and growth. Second, there must be a strong relationship in place between the seller and the manufacturer. Deckers has several employees based in China dedicated to communications between the manufacturing facilities and Deckers. Additionally, as mentioned earlier, Deckers already has Ethical Supply Chain Guidelines in place which it has already begun to implement with manufacturers. Finally, the seller needs a strong reputation for responsibility among customers, regulators, employees, non-government organizations, and the general public. To date, Deckers has not had any major public relations or regulatory problems. Also, their eco-friendly Simple Shoe line gives them credibility in the realm of corporate responsibility.

7.3. Lack of Substitutes

Currently, not many footwear companies have taken on the task of reducing the environmental impact of their manufacturers (see Section 6: Industry Analysis). This would give Deckers an advantage with customers who are looking to buy from companies with environmentally sustainable supply chains.

7.4. Timing

As mentioned in Section 6, Timberland and Nike have made considerable progress towards the goal of reducing the environmental impact of their suppliers. The longer Deckers waits to move on this initiative, the more it runs the risk of becoming laggards in the industry because other companies will likely take similar action.

8.Critical Risks

8.1. Facilities Do Not Comply

The success of an initiative by Deckers to improve the environmental performance of manufacturing facilities hinges on cooperation, since Deckers does not own the factories that make its products. Therefore, there must be incentives in place to make this a successful venture. The first incentive for the manufacturers is cost savings. Many of the changes that improve a facility's environmental impact are efficiency improvements which save money through reduced energy or water use. Although these usually require some investment, the payback can often be realized soon enough to make it a sound investment. Secondly, through cooperation, there is greater certainty for working with Deckers. Due to its sales volume, Deckers is a valuable client that factories do not want to lose. Therefore, if Deckers is committed to environmentally sustainable manufacturing, it has leverage with its manufacturers. Additionally, the potential for cooperation in this venture is furthered by the relationship Deckers already has with its manufacturing companies. For example, in order to sell shoes to universities, they worked with several facilities to make them compliant with standards set by the Fair Labor Association (FLA). Also, Deckers' Ethical Supply Chain Group has already begun work with facilities to ensure compliance with Deckers' Ethical Supply Chain Guidelines.

8.2. Economic Downturn

As the economy worsens and customers have less money to spend, traditional economic theory says they care less about the environment and more about life's necessities – food, shelter, and health. This could mean footwear customers may not care about the environmental performance of the manufacturing facilities in which their shoes are made, and only case about the price and performance of the shoe. However, according to the 2009 Cone Consumer Environmental Survey, consumers are still buying green. Thirty four percent of those surveyed said they are more likely to buy environmentally responsible products today (even consider the current state of the economy). Also, 35 percent of Americans claim to have a higher interest in the environment today than they did one year ago. Furthermore, 35 percent have increased expectations for companies to sell environmentally responsible products and services during the economic downturn (Cone 2009). There is also a threat that, as the economy sinks, companies will be likely to spend less money on environmental sustainability. This could put initiatives such as the one put forward in this business plan at risk of losing funding. According to a recent analysis conducted by A.T. Kearney (2009), postponing environmental sustainability initiatives could be a mistake. This analysis found that companies with strong corporate sustainability efforts are performing better than average during the current economic downturn.

9.Logistics

9.1. Operations

To implement this initiative, Deckers will first need to hire a Corporate Social Responsibility Director and staff to carry out audits, maintain close communications with manufacturing facilities, and recommend improvements. With the staff in place, audits can initially be carried with the facilities that are likely to have "low hanging fruit" and will therefore gain higher cost savings from environmental improvements. Once other factories see the positive results of the process, buy-in and cooperation should increase. While audits are carried out, manufacturers will be given copies of the Green Facility Recommendations Handbook. Ideally, as the process matures, facilities will become more proactive, needing less micromanagement from Deckers staff and management. This will allow Deckers to focus on the training of factory designated environmental officers who will take the lead in auditing and reporting of factory practices and operations.

9.2. Timeline

Activity	Jun-09	Dec-09	Jun-10	Dec-10	Jun-11	Dec-11	Jun-12	Dec-12	Jun-13	Dec-13
Hire Director										
Hire Staff										
Initial Audits										
Distribute Handbook										
Audit All Facilities										
Training of Environmental Officers										

9.3. Team

Danielle Côté-Schiff

Danielle completed her undergraduate degree at the University of Puget Sound in Tacoma, Washington with a double major in Mathematics and Natural Science with a physics emphasis, and a Philosophy minor. She also graduated from the Honors

Program in the classics. Upon graduation she took at job at ECHO, Inc, now an Intuit Company, where she was a Senior Business Analyst for the Risk Management department. Two years later she began her masters at Bren where she has two specializations in Corporate Environmental Management and Pollution Prevention and Remediation. Danielle has worked on various extra internships such as organizing the Sustainable Footwear Forum, an industry education and discussion group co-hosted by Deckers Outdoor and the Bren School, and working on a spreadsheet tool to assist remediation efforts to quantify the environmental impacts of cleaning up toxic spill sites based on CO2 emissions, energy and water use, cost, and waste parameters. Danielle is most interested in renewable energy generation and energy efficiency measures to mitigate climate change effects and minimize pollution and waste. Danielle was also just married in August 2008.

Clancy Donnelly

After earning his Bachelor of Science degree from James Madison University with a geology major and an environmental engineering concentration, Clancy worked for five years as a production manager in the quarrying industry. In this position, his experience included managing environmental reclamation projects, coordinating with state and federal regulators, personnel management, and facilitating community outreach. Following several years working for the Geosciences Department at Trinity University in San Antonio, Texas, Clancy decided to go to the Bren School to pursue a degree which would build upon his background in science and business management. With his education and experience, Clancy hopes to assist corporations further their sustainability efforts. During the summer of 2008, he worked with Toyota Motor Sales' Environmental Coordination Office to gain valuable expertise in corporate sustainability including green house gas inventory analysis, environmental initiative proposals, and shaping quantifiable environmental targets.

Lauren Flinn

Lauren earned her Bachelor of Arts degree from Williams College in 2003 with a biology major and environmental studies concentration. While at Williams, Lauren studied abroad at James Cook University in Australia and at the School for Field Studies in Mexico. She also spent a month with the Bioko Biodiversity Protection Program conducting a primate census in Equatorial Guinea. Through these experiences, Lauren realized her desire to work in the environmental field, and after graduation she took a job interning for the non-profit Oceana in Washington, D.C. Shortly thereafter, she took a job with ICF International where she worked for three years. While at ICF, Lauren worked on a number of national and international environmental issues, focusing on stratospheric ozone depletion and climate change. During her time at ICF, Lauren decided to pursue an advanced degree in the environmental field and selected the MESM program at Bren. While at Bren, Lauren has realized an interest in the fields of public participation and environmental conflict

resolution. Through a public outreach internship with the Community Environmental Council and a public affairs internship with Katz & Associates, Lauren has strengthened her experience in these fields.

Brian Fulmer
Born in Jacksonville, Florida, Brian graduated from Colby College in 2007 with a degree in Science, Technology and Society, and a minor in Environmental Studies. While his undergraduate work focused largely on the history of modern biology, his love of the natural world and his passion for spreading this love far and wide led him to pursue a Master's degree at the Donald Bren School of Environmental Science and Management, University of California, Santa Barbara. While his interests are broad, Brian chose to specialize in Water Resource Management, though he has maintained a diverse curriculum, with sub-concentrations in conservation planning and corporate environmental management. Brian is planning to graduate upon completion of the winter quarter in March 2009, and hopes to pursue a career in land trust management or river restoration. In his free time Brian is an avid rock climber, telemark skier, cyclist, surfer and when the proper facilities are available he can often be found blacksmithing and woodworking.

10. Initiative Toolbox

Sections 5 – 9 outline the business plan for an initiative to green the manufacturing facilities in China where Deckers' products are assembled, as described in Section 4. In addition to proving the business case for this initiative, we also created products to help facilitate Deckers' implementation of this initiative. These products, known as the Initiative Toolbox, include a Facility Audit and a Green Facility Recommendations Handbook. These tools will allow Deckers to determine a baseline of the facilities' current environmental performance and to perform a gap analysis to determine what benefits can be achieved by greening the facilities.

10.1. Facility Audit

Prior to making recommendations on how to green the manufacturing facilities, Deckers must understand the current level of environmental performance at these facilities. Therefore, we created an Excel-based Facility Audit to gather information from the facilities about their current policies, energy and water use, equipment and fixture types, waste management practices, and other relevant practices.

10.1.1. Methodology

In order to understand what building characteristics should be considered in developing the audit, we examined the following green building certification programs:

- Leadership in Environmental Engineering and Design (LEED)
- Building Research Establishment Environmental Assessment Method (BREEAM)
- Hong Kong Building Environmental Assessment Method (HK-BEAM)
- Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB)
- Green Building Assessment (GBA)
- Building Environmental Performance Analysis Club (BEPAC)
- Green Star Building Council of Australia

Table 5 summarizes the focus areas of several of these certification programs, which were compared in a study by Crawley and Aho (1999).

Table 5: Descriptions of Certification Programs (Crawley and Aho 1999)

Program	Construction Type/Location	Focus Areas
BREEAM	New and existing construction in England as well as Hong Kong, Australia, and Canada	1. Global Impact 2. Local Impact 3. Indoor Issues
BEPAC	New and existing construction in Canada	1. Ozone Protection 2. Environmental Impacts of Energy Use 3. Indoor Environmental Quality 4. Resource Conservation 5. Site and Transportation
LEED	New and existing construction in the United States, though some international projects exist	1. Building Commissioning 2. Energy Efficiency 3. Indoor Air Quality 4. Ozone Depletion/CFCs 5. Smoking Ban 6. Comfort 7. Water
GBA	International standard developed by 13 countries based on the results of the 1998 Green Building Challenge	1. Resource Consumption 2. Environmental Loadings 3. Quality of Indoor Environment 4. Longevity 5. Process 6. Contextual Factors

Crawley and Aho conclude—based on an assessment of methodologies, scope, and applications of the building certifications—that GBA is the strongest of the tools studied. The program was developed to be applicable to multiple building types, including manufacturing facilities. Further, GBA was developed specifically for international situations where there may be varying availability of information.

The GBA framework was summarized in an Excel-based tool, the *GBTool*, a robust tool for ranking buildings' environmental performance. While this tool met several of our needs for an audit, we determined that it was too complex to scale down for a project of our scope and timeline. Further, we did not believe that it was straight-forward enough to be understood by non-native English speakers.

Therefore, we decided to consider the LEED certification requirements as a basis for our environmental baseline audit. In the U.S., the third party certification program LEED, developed by the U.S. Green Building Council (USGBC), is considered by many to be the definitive measure of building sustainability. These standards can be applied to new or existing buildings of all types and focus on sustainable site development, water savings, energy efficiency, material selection and indoor environmental quality. The program focuses largely on building design,

maintenance, and systems. The LEED Rating System has been, and continues to be developed in an open and transparent process by LEED committees. It is an established, widely-used sustainability certification in the U.S., and in recent years it has seen a drastic increase in popularity around the globe.

LEED currently certifies existing buildings (LEED EB), helping to optimize operational efficiency while lowering environmental impacts. According to the USGBC website,

> LEED for Existing Buildings…addresses building exterior and site maintenance programs, efficient and optimized use of energy and water, the purchase of environmentally preferred products and food, waste stream management and ongoing indoor environmental quality. In addition, LEED for Existing Buildings…provides sustainability guidelines for whole-building cleaning and maintenance, recycling programs and systems upgrades to improve building energy performance, water consumption, indoor environmental quality and materials use. (USGBC 2008)

While LEED does certify existing buildings, it does not have a specific measure for manufacturing facilities. However, further research showed that LEED has certified several manufacturing buildings through their Existing Building program. Therefore, we decided that we would use this standard as a basis for selecting the information to ask for in our audit. Not only is the LEED EB program relevant, as all of Deckers' manufacturing partners are using facilities that are already in place, but LEED is also the most visible of the green building certifications within the American consumer market. This is a benefit if Deckers ever decides to have their manufacturing partners certify a facility.

10.1.2. Excel-Based Tool

To create the audit, we used the recommendations of the LEED EB program to determine what is important in greening and properly maintaining an existing building. This information enabled us to determine what characteristics of the manufacturing facilities we needed to document to develop an understanding of their current environmental performance.

The audit we created is an Excel-based tool for existing single-building or entire facility use. The areas of focus in the audit were based of LEED EB certification requirements. Policies and Plans, Water, Energy, Indoor Air Quality, Materials and Resources and Building Site are all considered under the audit. Each section has as many as ten subsections containing specific questions about the facility, equipment, operating procedures, and maintenance. The final audit template can be found in Appendix 2.

10.2. Green Facility Recommendations Handbook

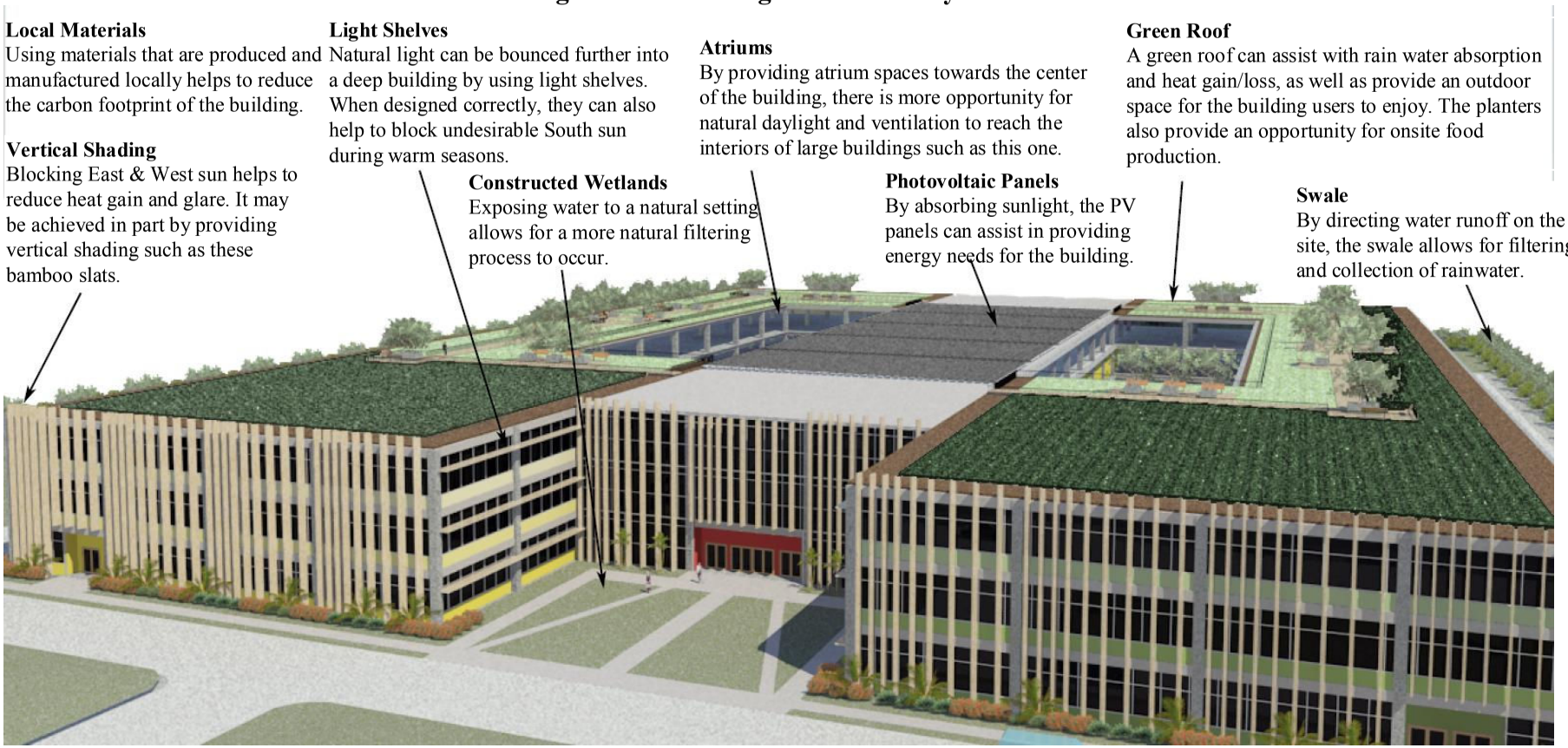
Using the knowledge of green buildings we gathered from creating the audit, we created a Green Facility Recommendations Handbook, which is designed to be a beginner's guide to green building. The completed handbook can be found in Appendix 3. The handbook includes all areas covered in the audit, though with different names: Employee Health and Productivity, Energy, Water, Materials and Resources, and Sustainable Sites. The handbook makes specific recommendations for each of these sections, giving examples regarding what can be done to improve the environmental performance of a facility.

In developing the specific recommendations in the Handbook, we considered the current state of the green building market. We looked into the technologies and best management practices (BMPs) that are being used to address the environmental issues that arise from manufacturing buildings and included many of these technologies and BMPs in the handbook. We also included example calculations to show building managers how to calculate the amount of energy/water/money saved by implementing several of the recommendations. With the completed audit, building managers can insert their baseline numbers into these calculations and obtain results specific to their facility. These sorts of comparisons and calculations will give managers access to information that they are currently largely ignorant of, not by their own fault, but by the way in which their jobs have historically been conducted. Generally, building managers base purchasing decisions on the lowest up-front cost of goods, not the long-term cost savings which can be achieved through higher up-front cost.

10.3. New Facility Renderings

In addition to the recommendations for existing facilities that are included in the Handbook, we commissioned two architecture students at California Polytechnic State University to create architectural renderings of an ideal green manufacturing facility. Figure 4 presents an overview of the ideal facility. Further views of the building as well as descriptions of the specific technologies are presented in the Green Facility Recommendations Handbook in Appendix 3.

Figure 3: Rendering of New Facility



11. Case Study

In order to test the Facility Audit and Green Facility Recommendations Handbook, we conducted a case study on a specific manufacturing facility—a Stella International Holdings Limited facility in Hebei, China (shown in Figure 5).

Figure 4: Map of Hebei Province in China

Stella International is a Vietnamese company whose operations are largely based in the Guangdong Province of China. The company manufactures shoes for casual footwear companies (such as Clarks, Deckers, ECCO, Rockport, Timberland and Wolverine), fashion footwear labels (such as Cole Haan, Kenneth Cole, Guess and Nine West), and the high-fashion brands (such as DKNY, Enzo Angiolini, Marc by Marc Jacobs, and Via Spiga) (Stella 2008). In short, Stella manufactures footwear for some of the highest profile footwear companies in the world. As of December 31, 2007 Stella had manufactured 47.7 million pairs of footwear valued at US$937.2 million (Stella 2008).

The manufacturing facility in Hebei, China is a multi-building campus that manufactures only Deckers footwear, a rarity in the footwear industry. This is largely due to the strong connections between Deckers and Stella, which is often referred to as a strategic partner by Deckers' management. Given the strength of this relationship, we determined that it would be an ideal case study for our audit and handbook.

11.4. Audit Results

Our first step in the case-study process was to send the audit to Jessica Min, a Deckers employee in charge of manufacturing facility audits in China. Jessica passed on our audit to the appropriate persons at the Hebei facility and within a few weeks, we received our completed audit. While the audit was not completed in its entirety,

we were able to gain a strong understanding of the practices at the facility through the information in the audit and follow up questions. The results of the audit received from the facility, as well as the responses to the follow up questions, are presented in Appendix 4.

11.5. Suggestions

Based on the results of the audit, we proposed several green retrofitting and management suggestions based on our Green Facility Recommendations Handbook. These suggestions, which are list below and elaborated on in Appendix 5, are separated into two categories. The priority suggestions are the first tier of recommended actions, and the secondary suggestions are meant for further consideration.

Priority Suggestions
The following suggestions were rated as priority action because of low cost, high feasibility, or relative environmental gain.

- Insulate the hot water pipes
- Paint the roofs white
- Improve lighting efficiency through the use of occupancy sensors, dimmers, and/or timers
- Conduct a water audit
- Harvest and reuse rainwater
- Conduct a waste stream audit and implement a solid waste management policy
- Conduct noise and air quality testing
- Implement an environmentally-focused training program
- Have the building commissioned

Secondary Suggestions
The secondary suggestions listed below are ideas that should be considered but may be cost prohibitive or infeasible, which we could not determine based on our limited information.

- Install solar tubes
- Install wind turbines or solar panels for on-site electricity generation
- Purchase environmentally-friendly vehicles
- Grow an organic garden
- Landscape for natural cooling

11.6. Conclusion

As discussed in Section 2, Deckers' Ethical Supply Chain Guidelines include the following environmental expectations:

> We require a continuous effort to improve environmental performance along a defined path towards clean production. We expect our business partners to: 1) adopt environmental management systems that address key business impacts and advance sustainable environmental practices; 2) disclose environmental impacts and activities through regular reporting; 3) reduce or eliminate toxic and hazardous substances from operations and products, in accordance with the Deckers Restricted Substances Policy; 4) increase efficiency and thereby minimize pollution and waste; 5) reduce the use of natural resources including raw materials, energy and water; and 6) take responsibility for proper waste management. (Deckers 2008b)

While Deckers has created these Guidelines, they have not taken significant steps to support their manufacturing partners as they strive to meet these goals. As demonstrated through our case study, our Facility Audit and Green Facility Recommendations Handbook can be used by Deckers to help the manufacturing companies improve their environmental performance over time. This continuous improvement will have positive repercussions for both Deckers and the manufacturing facilities. As shown in Section 5, Deckers can see benefits from greener manufacturing facilities through reduced risk and positive consumer response. The manufacturing companies can also see positive benefits from cost savings (as highlighted in the handbook) as well as reduced risk and positive consumer response. Most of Deckers' manufacturing partners work with many footwear companies. By making improvements to meet Deckers' desire for improved environmental performance, the manufacturing companies can also appeal to other footwear companies interested in improved environmental performance, reduced risk, and/or positive consumer response.

12. References

AAFA. (2007a). "ShoeStats." American Apparel and Footwear Association. July 2007. Available online at http://www.apparelandfootwear.org/Statistics.asp.

AAFA. (2007b). "Trends: An Annual Compilation of Statistical Information of the U.S. Apparel and Footwear Industries." American Apparel and Footwear Association.

AAFA. (2006). "ShoeStats." American Apparel and Footwear Association. July 2006. Available online at http://www.apparelandfootwear.org/Statistics.asp.

Albers, Kyle, Peter Canepa, and Jennifer Miller. (2008). "Analyzing the Environmental Impacts of Simple Shoes: A Life Cycle Assessment of the Supply Chain and Evaluation of End-of-Life Management Options." Bren School of Environmental Science and Management. University of California, Santa Barbara. March 21, 2008

AMA. (2008). "Dictionary." American Marketing Association. Available online at http://www.marketingpower.com/_layouts/Dictionary.aspx?dLetter=G.

A.T. Kearney. (2009). "'Green' Winners: The performance of sustainability-focused companies during the financial crisis." A.T. Kearney. Available online at http://www.atkearney.com/shared_res/pdf/Green_Winners.pdf.

Automatic Merchandiser Magazine. (2008). "Yankelovich Survey: Consumers Less Willing To Pay Extra For Green Products." September 18, 2008. Available online at http://www.amonline.com/online/printer.jsp?id=22643.

Ball, Jeffrey. (2008). "Six Products, Six Carbon Footprints." *The Wall Street Journal*. October 6, 2008.

CBCSD. (2004). "China Pushes for More Energy-efficient Buildings." China Business Council for Sustainable Development. Available online at http://english.cbcsd.org.cn/themes/buildingenergy/4968.shtml.

China Daily. (2006). Shoe firmoss damns EU's tariff decision. October 13, 2006. Available online at http://www.chinadaily.com.cn/chinagate/doc/2006-10/13/content_707564.htm.

Cogar, D. (2008). "Branding Green But Seeing Red: Consumer Perceptions of Green Brands." EcoAlign. Survey Report. Issue 3. March 2008. Available online at http://www.ecoalign.com/assets/EcoPinionSurveyReport03final.pdf.

Cone. (2008). "Green Gap Survey." Cone LLC and The Boston College Center for Corporate Citizenship. Available online at http://www.coneinc.com/content1136.

Crawley, D. and I. Aho. (1999). "Building Environmental Assessment methods: applications and development trends." *Building Research and Information*. 27(4-5): 300-308.

Day, D. 2(008). "Social Responsibility: The Nike Story." *Branding Strategy Insider* (Blog). Accessed on October 20, 2008 at: http://www.brandingstrategyinsider.com/2008/07/social-responsi.html.

Deckers. (2008a). "Mission Statement." Deckers Outdoor Corporation. Available online at http://www.deckers.com/about/mission.aspx.

Deckers. (2008b). "Corporate Social Responsibility: Deckers Ethical Supply Chain Guidelines." Deckers Outdoor Corporation. Available online at http://www.deckers.com/about/CorporateSocialResponsibility.aspx.

Derby, M. (2008). "Driving Deckers." Footwear News. March 31, 2008. Available online at http://www.footwearnews.com/site/article.php?id=963.

Environmental Leader. (2008). "FTC Examines Green Building, New Green Guides 'Definitely' In 2009." July 16, 2008. Available online at http://www.environmentalleader.com/2008/07/16/ftc-examines-green-building-new-green-guides-definitely-in-2009/.

Ernst & Young. (2008). "Strategic Business Risk: Consumer Products 2008." Ernst & Young in Collaboration with Oxford Analytica. Available online at http://www.ey.com/Global/assets.nsf/International/Industry_CP_Strategic_Business_Risk_2008/$file/StrategicBusinessRisk_CP_March08.pdf.

Fegley, Mark. (2009). Personal communications with Mark Fegley, Senior Vice President of Supply Chain, Deckers Outdoor Corporation.

Frenkel, Stephen J. (2001). "Globalization, Athletic Footwear Commodity Chains and Employment Relations in China." Organization Studies. 22(4): 531–562.

FTC. (2008a). "Guides for the Use of Environmental Marketing Claims; Green Building and Textiles; Public Workshop." Federal Trade Commission. 16 CFR Part 260. Available online at http://www.ftc.gov/os/2008/06/P084203ggfrn.pdf.

FTC. (2008b). "Eco In The Market - Green Building And Textiles." Transcript. Federal Trade Commission. Tuesday, July 15, 2008. Available online at Http://Www.Ftc.Gov/Bcp/Workshops/Buildingandtextiles/Transcript.Pdf.

FTC. (2007). "FTC Reviews Environmental Marketing Guides, Announces Public Meetings." Federal Trade Commission. November 26, 2007. Available online at http://www.ftc.gov/opa/2007/11/enviro.shtm

Global Exchange. (1997). "Nike: Just Don't Do It." *Third World Traveler*. Accessed on October 20, 2008 at: http://www.thirdworldtraveler.com/Boycotts/Nike_DontDoIt_GX.html.

GfK Roper and Yale. (2008). "The GfK Roper Yale Survey on Environmental Issues. Summer, 2008: Consumer Attitudes toward Environmentally-Friendly Products and Eco-labeling." GfK Roper Public Affairs & Media and Yale School of Forestry & Environmental Studies. July 2008. Available online at http://environment.yale.edu/documents/downloads/a-g/GfK-Roper-Yale-Survey.pdf.

JP Morgan. (2008). "Watching water: A guide to evaluating corporate risks in a thirsty world." Global Equity Research. March 31, 2008. Available online at http://www.wri.org/publication/watching-water.

Justmeans. (2009). "Timberland." Available online at http://www.justmeans.com/index.php?action=viewcompanyprofile&id=122.

Keen. (2009). "Hybrid Life." Available online at: http://www.keenfootwear.com/hybrid_life_intro.aspx.

Klassen, Robert D, Whybark, D. Clay. (1999). "The Impact of Environmental Technologies on Manufacturing Performance." *Academy of Management Journal*. 42(6): 599-615.

Klop, Piet. (2008). "Increasing Water Scarcity Increases Business Vulnerability, and Investor Questions." World Resources Institute. Available online at http://www.wri.org/stories/2008/05/increasing-water-scarcity-increases-business-vulnerability-and-investor-questions.

Lowder, Stella. (1999). "Globalisation of the Footwear Industry: A Simple Case of Labour?" Tijdschrift voor Economische en Sociale Geografie (Journal of Economic & Social Geography). 90(1): 47-61.

Makower, J., and the editors of GreenBiz.com. (2008). "State of Green Business." Greener World Media. Available online at http://stateofgreenbusiness.com/files/StateOfGreenBusiness2008.pdf.

Manget, J., C. Roche, and F. Münnich. (2009). "Capturing the Green Advantage for Consumer Companies." The Boston Consulting Group. January 2009.

Merrell. (2009). “Philosophy.” Available online at http://www.merrell.com/US/About/Philosophy.aspx.

Nielsen. (2008). “The Environment – #1 Corporate Priority According to the World’s Consumers.” Available online at http://pt.nielsen.com/documents/CSR_Global_BN.

Nike. (2009). “Nike Responsibility.” Available online at http://www.nikebiz.com/responsibility/.

Nike. (2008). “Innovate for a Better World: Nike China 2008 Corporate Responsibility Reporting Supplement.” Available online at http://www.nikeresponsibility.com/pdfs/Nike_China_CR_Report_Supplement.pdf.

Portney, Paul R. (2005). “Corporate Social Responsibility: An Economic and Public Policy Perspective.” *Environmental Protection and the Social Responsibility of Firms: Perspectives from Law, Economics, and Business.* Eds. Bruce L. Hay, Robert N. Stavins, & Richard H.K. Vietor. Resources for the Future: Washington D.C. p.107-131.

Reinhardt, Forest L. (2005). Environmental Protection and the Social Responsibility of Firms: Perspectives from the Business Literature. *Environmental Protection and the Social Responsibility of Firms: Perspectives from Law, Economics, and Business*. Eds. Bruce L. Hay, Robert N. Stavins, & Richard H.K. Vietor. Resources for the Future: Washington D.C.

Rusinko, Cathy A. (2007). “Green Manufacturing: An Evaluation of Environmentally Sustainable Manufacturing Practices and Their Impacts on Competitive Outcomes.” *IEEE Transactions on Engineering Management*. 54(3).

RNCOS. (2008). “Skills & Low-cost Benefits Underpinning China Footwear Industry.” July 2008. Available online at http://www.prminds.com/pressrelease.php?id=6138.

Rockport. (2009). “About Rockport.” Available online at http://www.rockport.com/.

SEC. (2008). U.S. Securities and Exchange Commission. “Nike Form 10-K.” Available online at http://www.sec.gov/cgi-bin/browse-idea?action=getcompany&CIK=0000320187&owner=exclude&count=40.

Timberland. (2009). “CSR Strategy.” Available online at http://www.timberland.com/corp/index.jsp?page=csr_strategy.

Stella. (2008). “Casual Footwear.” Stella International Holdings Limited. Available online at http://www.stella.com.hk/products/causal.

Trudel, R. AND J. Cotte. (2008). "Does Being Ethical Pay?" Wall Street Journal. May 12, 2008. Corporate Reputation. Available online at http://online.wsj.com/article_email/SB121018735490274425-lMyQjAxMDI4MTEwMjExODI3Wj.html.

U.S. Bureau of the Census. (1980). "Money Income of Families and Persons in the United States: 1978." Current Population Reports. Series P-60, No. 123. U.S. Government Printing Office, Washington, D.C.

U.S. EPA. (2009). "Ground-level Ozone." United States Environmental Protection Agency. Available online at http://www.epa.gov/air/ozonepollution/.

U.S. EPA. (2007). "Effects of Acid Rain." United States Environmental Protection Agency. Available online at http://www.epa.gov/acidrain/effects/.

USGBC. (2008a). "LEED for Existing Buildings: Operations & Maintenance." U.S. Green Building Council. April 2008. Available online at https://www.usgbc.org/ShowFile.aspx?DocumentID=3617.

WRI and A.T. Kearney. (2008). "Rattling Supply Chains: The Effect of Environmental Trends on Input Costs for the Fast-Moving Consumer Goods Industry." World Resources Institute and A.T. Kearney. Available online at http://www.wri.org/publication/rattling-supply-chains.

World Bank. (2008). "China and Energy: Ensuring Energy Supply Reliability to Meet Demand Growth." The World Bank. Available online at http://go.worldbank.org/B1F4M5YQ70.

Appendix 1: Survey

Introductory Language

Thank you for your interest in our survey. The results of the survey will help Deckers as they move towards a more environmentally-friendly future.

This survey contains four simple questions and should only take about 5 minutes of your time to complete. No sensitive questions will be asked and responding to our survey should not present any risks to you. This survey is entirely voluntary and your consent to participate can be withdrawn at any time.

The survey is hosted on a secure site that is operated by Deckers Outdoor Corporation and uses SSL encryption. When taking this survey, your IP address will not be recorded and no personally identifiable information will be requested. Therefore, taking this survey is entirely anonymous. If you have any questions about this survey, please contact [Name] at [Phone Number] or [Email] during normal business hours. If you wish to complete the survey after reading this information, please click here.

Survey

Deckers Outdoor Corporation owns the Simple Shoes, Teva Footwear, Ugg Australia, Deckers Flip Flops and Tsubo brands. Which brand's website were you viewing today before you decided to take our survey?

- ☐ Simple Shoes
- ☐ Teva Footwear
- ☐ Ugg Australia
- ☐ Deckers Flip Flops
- ☐ Tsubo
- ☐ Deckers Outdoor Corporation

[Respondents will be randomly selected to receive one of the following two statements.]

1. Approximately 99 percent of footwear consumed in the U.S. is manufactured in another country. Deckers Outdoor Corporation employs independent companies to assemble their high quality footwear in China.
2. Approximately 99 percent of footwear consumed in the U.S. is manufactured in another country. Deckers Outdoor Corporation employs independent companies to assemble their high quality footwear in China. Currently, Deckers is working to enact more stringent environmental standards for the manufacturing facilities where Deckers' shoes are assembled.

[All respondents will receive the following three questions and response options.]

1. Are you more or less likely to buy Deckers' brands based on this statement?
    - ☐ Much More Likely
    - ☐ More Likely
    - ☐ No Change
    - ☐ Less Likely
    - ☐ Much Less Likely

2. Are you more or less likely to recommend Deckers' brands based on this statement?
    - ☐ Much More Likely
    - ☐ More Likely
    - ☐ No Change
    - ☐ Less Likely
    - ☐ Much Less Likely

3. Would you be willing to pay slightly more for Deckers' brands based on this statement?
    - ☐ Definitely Yes
    - ☐ Probably Yes
    - ☐ Unsure
    - ☐ Probably No
    - ☐ Definitely No

Follow Up Language

Thank you for taking our survey!

The information we receive from this survey will help us determine if customers care whether their footwear is made in environmentally-friendly manufacturing facilities in China and if this will change their opinions of Deckers Outdoor Corporation. This information will be used to help make a business case for environmental actions at Deckers and to recommend the best marketing techniques for any actions that are taken.

Appendix 2:
Facility Audit Spreadsheet

Introduction

Thank you in advance for taking the time to answer our questions. This spreadsheet is organized by tabs (see below), each containing a set of questions.

To answer the questions on this page, please select one campus and one manufacturing building within this campus. This building should be one used to assemble Deckers' brands.

Campus

Please provide the name of the campus.	
How many buildings are on the campus?	

	Building 1	Building 2	Building 3	Building 4	Building 5	Building 6
What is the square footage of each building?						
Please describe the use of each building?						

If the campus contains more than six buildings, please add additional columns to answer the questions.

Manufacturing Building

Please provide a name or number for this facility.	
What brands are made in this manufacturing facility?	
How many hours per day is the facility in use?	
One average, how many people are working in the facility at any one time, while the facility is in use.	

	Quantity	Description of Use
How many floors are there in this facility?		
How many rooms are in the facility?		

	Floor 1	Floor 2	Floor 3
What is the square footage of each floor?			

If the building contains more than three floors, please add additional columns to answer the question.

For the remainder of the questions on the next four tabs, please answer for this manufacturing building alone.

Policies and Plans

The question on this page addresses any policies or plans in place to govern the operations and maintenance of the building.

1. For the following list of **policies/plans**, please indicate whether you have any in place by selecting yes or no. If you do have a policy or plan in place, please provide a general description and include any available documentation about the policy/plan as a separate email attachment.

	In Place?	General Description	Documentation Attached?	Comments
Operating plan for building				
Indoor air quality policy				
Pest management plan/Pesticide use plan				
Sustainable purchasing policy (covering food, durable goods, office supplies, etc.)				
Policy on the use of sustainable/eco-friendly cleaners, paints, sealants, chemicals, etc.				
Cleaning policy				
Site waste management policy				
Erosion control/storm water plan				
Other				
Other				

Energy

The questions on this page address the energy use of the selected manufacturing building Please answer these questions as accurately as possible.

1. Describe the HVAC system in use for the building. Please include information on the equipment types, refrigerants, and hours in use per day, if applicable.	Type	Make	Model	Refrigerant	Hours in Use per Day	Comments
Air Conditioner						
Heating						
Refrigeration						

2. For all lighting fixtures in the facility, please include the type, make, model, quantity, and hours in use per day. If more than five types are in use, please insert additional rows.	Type	Make	Model	Quantity	Hours in Use per Day	Comments
Lighting Fixture Type 1						
Lighting Fixture Type 2						
Lighting Fixture Type 3						
Lighting Fixture Type 4						
Lighting Fixture Type 5						

3. For any other powered equipment used in the facility, please indicate the type of equipment, the quantity, the hours in use per day, and the approximate energy use per hour for a single piece of equipment. Please add additional rows if there are more than five equipment types.	Equipment Type	Quantity	Hours in Use per Day	Approximate Energy Use	Comments
Equipment Type 1					
Equipment Type 2					
Equipment Type 3					
Equipment Type 4					
Equipment Type 5					

4. What type, make, and model of fire-suppression system is used in the building and what is the fire suppressant contained in this system?	Type	Make	Model	Fire Suppressant	Comments
Fire-Suppression System					

5. Does the facility have a power backup system? If so, what type of system is it and what type of fuel powers the system? On average, how many times per month is this system used, and how long does the system run per use?	In Place?	Type	Fuel	Use per Month	Run Time per Use	Comments
Power Backup System						

6. Does the building have a computer-based automation system in place that monitors and controls key building systems? If so, which systems are monitored/controlled by the automated system?	In Place?	Systems Monitored/ Controlled	Comments
Computer-based Automation System			

7. Does the building use any energy-saving techniques or technologies to reduce the building's energy use? If so, please describe the technique/technology and provide the approximate energy savings achieved by its use.	In Place?	Description	Energy Savings	Comments
Energy-saving techniques				
Energy-efficient equipment				
Renewable energy systems (on-site or off-site)				

8. In addition to the specific questions above, please provide the following information in a separate email attachment if available.	Documentation Attached?	Comments
Results of an energy audit of the building		
Monthly energy use data for the building for the previous year		
Breakdown, by equipment type, of energy use for the building		

Water

The questions on this page address the water use of the selected manufacturing building. Please answer these questions as accurately as possible.

1. For all water fixtures/fittings, please provide the maximum flow rate and/or make and model, along with the number of units installed in the building.	Maximum Flow Rate (Liter per Minute)	Make	Model	Quantity	Comments
Water closets/flush toilets					
Urinals					
Showerheads					
Faucets					
Faucet-replacement aerators					
Metering faucets					

2. Does the building have any water-saving systems, fixtures, or technologies in place for the building or grounds? If so, please describe the system/fixture/technology and provide the approximate water savings achieved by its use.	In Place?	Description	Energy Savings	Comments
Systems				
Fixtures/fittings				
Technologies				
Water recycling and reuse				

3. Are any water metering systems currently in place for the building, specific equipment, and/or the grounds?	In Place?	Comments
Building		
Grounds		
Specific Equipment		

4. What is your estimate for average potable water use and water discharge per day for a typical footwear manufacturing building similar to this building.	Liters per Day	Comments
Typical Potable Water Use		
Typical Water Discharge		

5. For all landscaping surrounding the building, please describe the irrigation technologies used and provide information on the amount of water used to irrigate these areas per week.	Description	Liters per Week	Comments
Landscape Irrigation Technology 1			
Landscape Irrigation Technology 2			

6. Does the building have a cooling tower? If so, is a metering system in place to measure the amount of water used by the tower.	Cooling Tower?	Metering System?	Comments
Cooling Tower			

7. Are there any quality controls or filtering on the water discharged from the building? If so, please describe these systems.	In Place?	Description	Comments
Water Discharge Control			

8. In addition to the specific questions above, please provide the following information in a separate email attachment if available.	Documentation Attached?	Comments
Water-use data for the past year, broken down by day, week, or month		
Water-discharge data for the past year, broken down by day, week, or month		

Indoor Air Quality, Materials and Resources, and Building Site

The questions on this page address issues related to indoor air quality, materials and resources, and the building site. Please answer these questions as accurately as possible.

1. Please describe the ventilation system used in the building. Does the building have filtration media installed at all outside air intakes and inside air recirculation returns?	Description	Filtration Installed?	Comments
Ventilation			

2. Do you have any measures in place to reduce the heat-island effects of your property? (For example, providing shade for impervious surfaces on the property to block mid-day sun or using high reflectance paints/coatings on building exteriors and roofs)	In Place	Description	Comments
Reduction in Heat-Island Effects			

3. Does the building utilize any natural light sources? If so, please indicate the type of sources (windows, sky lights, etc.).	In Place	Description	Comments
Natural Lighting			

4. Do you use any sustainable cleaning products such as paper products, trash bags, and degreasers? For concentrated chemical cleaning products, do you use them with appropriate dilution systems?	Yes or No	Comments
Sustainable Cleaning Products		
Dilute Concentrated Chemical Products		

5. Do you have any entryway systems (grilles, grates, mats) in place to reduce the amount of particles entering the building at public entryways?	Yes or No	Comments
Entryway Systems		

6. What types of chemicals are used for pest management in the building?	Chemical 1	Chemical 2	Chemical 3	Chemical 4	Comments
Pest Management Chemicals					

7. Please approximate the amount of waste produced from building operations (per month or year). Approximately how much of that waste is reused or recycled?	Amount	Percentage Reused or Recycled	Comments
Solid Waste			

8. Do you have landscaping at your facility? If so, please provide the size of the landscaped area and describe the type of pesticides and fertilizers used. Additionally, please indicate the approximate percentage of native plants used in then landscaped area.	Area	Pesticides	Fertilizers	Native Plant Percentage	Comments
Landscaping					

9. Please indicate the percentage of employees that work in the building who bike, walk, take public transposition, drive a car, or drive a moped/motorcycle to work.	Walk	Bike	Public Transportation	Drive	Motorbike	Comments
Transportation						

Appendix 3: Green Facility Recommendations Handbook

Green Facility Recommendations Handbook

deckers
OUTDOOR CORPORATION

Green Facility Recommendations Handbook

This handbook is part of the following report:

Green Footwear Manufacturing in China for Deckers Outdoor Corporation:
An Internal Business Plan to Reduce the Environmental Impact of Manufacturing Facilities

This report was prepared by students at the Bren School of Environmental Science and Management in partial satisfaction of the requirements for the degree of Master of Environmental Science and Management.

March 2009

Report Prepared By:
Danielle Côté-Schiff, Clancy Donnelly, Lauren Flinn, and Brian Fulmer

Faculty Advisor:
Gary Libecap

Table of Contents

Introduction

This handbook is designed to be used by employees and contractors of Deckers Outdoor Corporation to learn more about green buildings. According to the U.S. EPA:

> Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as sustainable or high performance building.[i]

As a step in implementing Deckers Ethical Supply Chain Guidelines related to environmental sustainability, Deckers is starting a program to promote the greening of its own buildings as well as those of its footwear manufacturing partners. Deckers' Ethical Supply Chain Guidelines related to the environment are as follows:

> We require a continuous effort to improve environmental performance along a defined path towards clean production. We expect our business partners to: 1) adopt environmental management systems that address key business impacts and advance sustainable environmental practices; 2) disclose environmental impacts and activities through regular reporting; 3) reduce or eliminate toxic and hazardous substances from operations and products, in accordance with the Deckers Restricted Substances Policy; 4) increase efficiency and thereby minimize pollution and waste; 5) reduce the use of natural resources including raw materials, energy and water; and 6) take responsibility for proper waste management.

By implementing recommendations in this handbook, you can take steps to improve your environmental management systems, keep track of your environmental impacts, reduce your use of toxic and hazardous substances, increase your water- and energy- use efficiency, and reduce and properly dispose of your pollution and waste.

Acronyms

When reading this handbook and as you learn more about green buildings, you may encounter some of the following acronyms:

CFL	Compact Fluorescent Light bulb
EPA	United States Environmental Protection Agency
GHG	Greenhouse Gas
HVAC	Heating, Ventilation, and Air Conditioning
IAQ	Indoor Air Quality
LED	Light Emitting Diode
LEED	Leadership in Energy and Environmental Design
LPF	Liters per Flush
LPM	Liters per Minute
ODS	Ozone Depleting Substance
MERV	Minimum Efficiency Reporting Value
USGBC	United States Green Building Council
VOC	Volatile Organic Compound

Note: All prices and costs presented in this handbook are in US Dollars.

Energy

Introduction

Energy use is often a major cost for buildings and can result in significant environmental effects depending on the source of energy. This section presents several steps you can take to reduce the energy use of your facility. The easiest step to increasing energy efficiency is to promote **conservation behavior and policies** among employees. Simple retrofits to **lighting systems** can also greatly reduce energy use. This can be achieved by switching out lightbulbs for more efficiency models, installing automatic dimmers, motion sensors, and/or timers to promote more efficient use of existing lighting, and installing solar tubes for natural light to reduce the need for artificial lighting. Improvements in **equipment energy efficiency** can also save energy at your facility.

In addition to improving lighting and equipment efficiency, energy efficiency can be improved through adjustments to **heating, cooling, and ventilation systems**. These adjustments can include painting the roof white, installing a green or living roof, and/or installing a solar chimney to reduce cooling costs, installing a geothermal heating and cooling system, and taking action to reduce the thermal transfer of the facility. Energy can be saved by using modern **water heating** technologies such as geothermal, solar thermal, or tankless water heaters and by insulating water heaters and pipes. In addition to improving energy efficiency, the environmental impacts of energy use can be reduced by sourcing **renewable energy** that is either produced on- or off-site.

These recommendations are described in more detail on the following pages.

Conservation Behavior and Policies

An important and often underrated part of energy conservation is human behavior. Employee education about conservation behavior can reduce energy waste on every level of use. In additional to overall employee training, designating a specific individual or group of individuals to be in charge of making sure that all lights and equipment are turned off at the end of each day can help reduce waste. Throughout the day, this team can monitor light and equipment use to make sure nothing is on that is not being used. Another simple measure is to adjust temperature control on the HVAC system to reduce over heating or over cooling. For example, setting the thermostat a few degrees cooler in the winter and a few degrees warmer in the summer can save a significant amount of electricity. Education can also improve workers' interaction with their work environment.

Training

A training program for employees and managers to educate about and encourage conservation behavior is an important step in reducing a facility's environmental footprint. This program should explain why conservation behavior is important, focusing on environmental issues relevant to the area of the facility. Additional details on training programs can be found in the Employee Health and Productivity section.

Lighting Systems

Lightbulbs

The three main types of light bulb are incandescent, compact fluorescent (CFL), and light emitting diode (LED), which range in cost and use lifetime. CFLs and LEDs are more energy efficient than incandescent bulbs, and switching to these bulb types can ultimately save you money.

Below is a table that explains the different cost variables in choosing a light bulb, specifically for a 65-watt equivalent flood lamp bulb in use for 60,000 hours. As the table shows, the initial cost per bulb ranges from $2.91 for an incandescent to $52.00 for an LED, and the lifetime differs from 2,000 to 50,000 hours. Based only on up-front costs, the incandescent would be the first choice. After taking into account the life expectancy of the bulb, the amount of electricity it uses, and an assumed $0.16 per kWh for 60,000 hours of use, the CFL and LED become the clear winners. Lifecycle calculations such as these are important in making purchasing decisions. A slightly higher upfront cost can result in a much greater savings in the long run.

Comparison of Costs for Lightbulb Types

Parameter	Incandescent	CFL	LED
Cost	$2.91	$5.97	$52.00
Power (watts)	65	14	11
Lifetime (hours)	2,000	8,000	50,000
Quantity (for 60,000 hours)	30	7.5	1.2
Total Purchase Cost	$87.43	$44.78	$62.40
Total Electricity Used (kWh)	3,900	840	660
Total Use Cost	$624.00	$134.40	$105.60
Overall Cost for 60,000 hours	**$711.43**	**$179.18**	**$168.00**

Example Motion Sensor[ii]

Example Motion Sensor[iii]

Example Timer[iv]

Automatic Dimmers, Motion Sensors, and Timers

Once more efficient lighting has been installed, there are various technologies to aid in reducing the number of hours the bulbs are operating unnecessarily.

An **automatic dimmer** is a devise that is best used in conjunction with natural lighting. As the amount of natural light increases, the bulb will automatically dim itself in the same proportion that the natural light is already providing. When the natural light begins to fade, the bulb will increase its output to compensate. Automatic dimmers reduce lightbulb use when adequate light is available from windows and skylights. One report claims a 10 to 30% reduction of energy consumption with daylighting controls such as these.[v]

Motion sensors, or occupancy sensors, are another good way to reduce unneeded lighting in a room automatically. A motion sensor is connected to a light such that when someone walks into the room the light comes on automatically. After a specified period of time where the sensor does not sense motion, the light will automatically turn off. This eliminates wasted electricity from someone forgetting to turn off the lights when leaving a room. Occupancy sensors have been estimated to reduce energy use for lighting by 30 to 80%. [vi]

If an area needs to be lit for specific hours during the day or night, a **timer** may be used. Like the functionality of a motion sensor, the timer will automatically turn on and off the lights and eliminate the risk of lights being left on past operating hours.

Solar Tubes

Solar tubes are a cost-effective method for indoor lighting that do not use electricity. Solar tubes are reflective tubes that extend from a hole in the roof down to the ceiling of the room to be lit. Solar tubes can extend many stories if desired. The roof opening is covered with a dome that captures more light than a regular skylight. The light travels down a mirrored tube to a lens in the ceiling that scatters the light more efficiently. Purchase costs are around $200 to $300 per tube depending on length, and solar tubes are easily self-installed.

Diagram of a Solar Tube[vii]

Additional Lighting Efficiency Measures:

- Use task lighting.
- Utilize natural sunlight with windows and skylights.
- Do not *over* light an area. When natural light is sufficient, turn off additional lights when dimmers are not available.

Equipment

The electrical equipment used within the building can contribute to a building's energy load. There are some simple steps to consider when purchasing and operating equipment, such as:

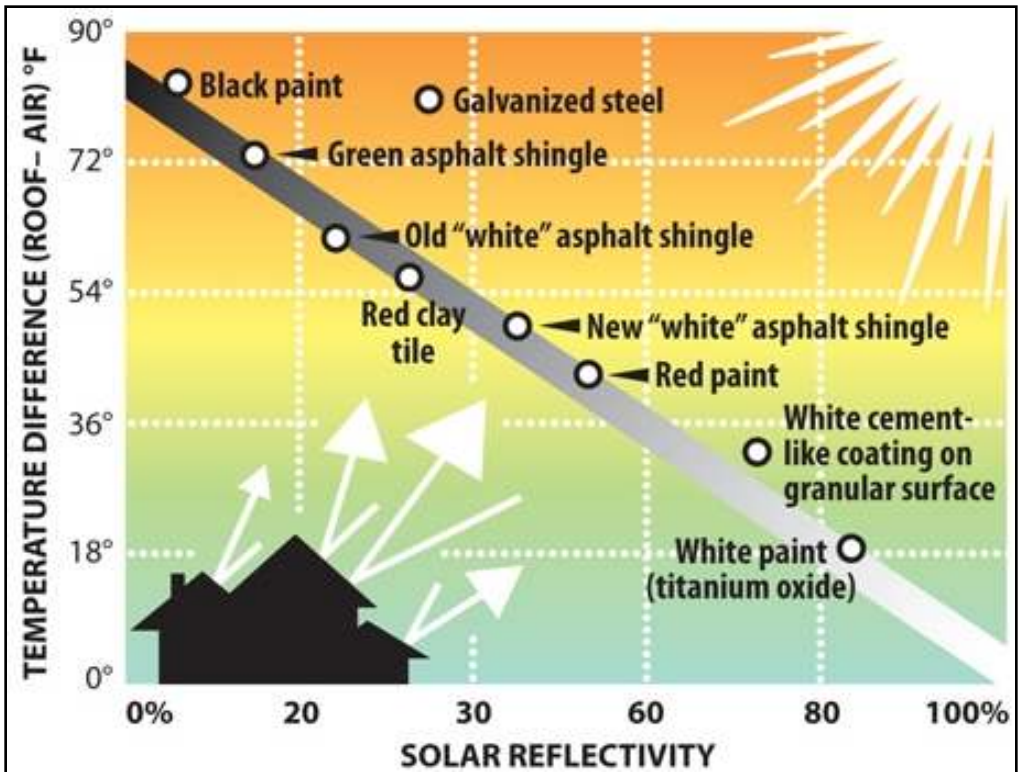
- Always set equipment to energy efficient settings. This applies to office equipment (such as computers, printers, and copy machines) as well as manufacturing equipment (such as cutters, sewers, and electric motors).
- Purchase energy efficient equipment that has been rated by a certification program such as the U.S. EPA's Energy Star program.
- Turn off all equipment when not in use.
- Remove "vampire" plugs (such as chargers) when not in use. These plugs still consume energy even when not in active use.
- If a process is producing waste heat, attempt to utilize the heat from that system for some other beneficial use.

Heating, Cooling, and Ventilation

Painting a Roof White[viii]

White Roofs

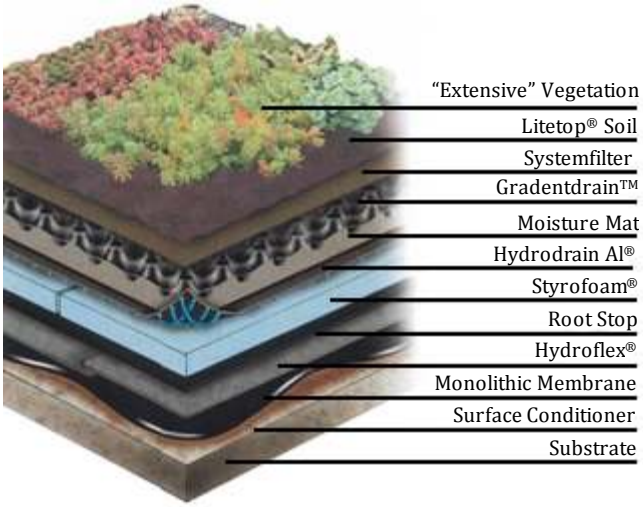
Painting the roof of your facility white can reduce energy costs by 20%.[ix] Because of the natural reflectivity of white surfaces, the building roof will stay cooler and therefore reduce cooling costs. One article claims that a one thousand square foot rooftop painted white can have the same one-time impact on global warming as removing 10 tons of carbon dioxide from the atmosphere.



Temperature Differences of Various Roof Materials[x]

Green Roofs or Living Roofs

A green roof is a roof covered with a vegetated layer. They can range in complexity, soil depth, and plant types. More elaborate roofs with trees and deeper soils may strain the structural soundness of a building. Therefore it is important to plan a green roof and verify the load capacity of the building. A Pennsylvania State University study concluded that a standard dark roof can peak at 30°C (54°F) hotter than a green roof.[xi] A cooler roof translates into lower air temperatures inside the building, therefore reducing cooling costs. Green roofs can save electricity, provide rainwater catchment functions, and offer an area for employees to relax or plant a garden. See the Renderings Section for further examples of green roofs.



Layers of a Green Roof[xii]

Example of a Green Roof[xiii]

Solar Chimney Ventilation

Natural ventilation should always be utilized by opening windows and skylights where possible. Another option is to construct a Solar Chimney. Also called a thermal chimney, these devices improve ventilation by natural convection of air using passive solar energy. As can be seen in the figure, the chimney is a vertical shaft with openings at the top that draw hot air from the building. This decreases cooling costs because no electricity is used in this process.

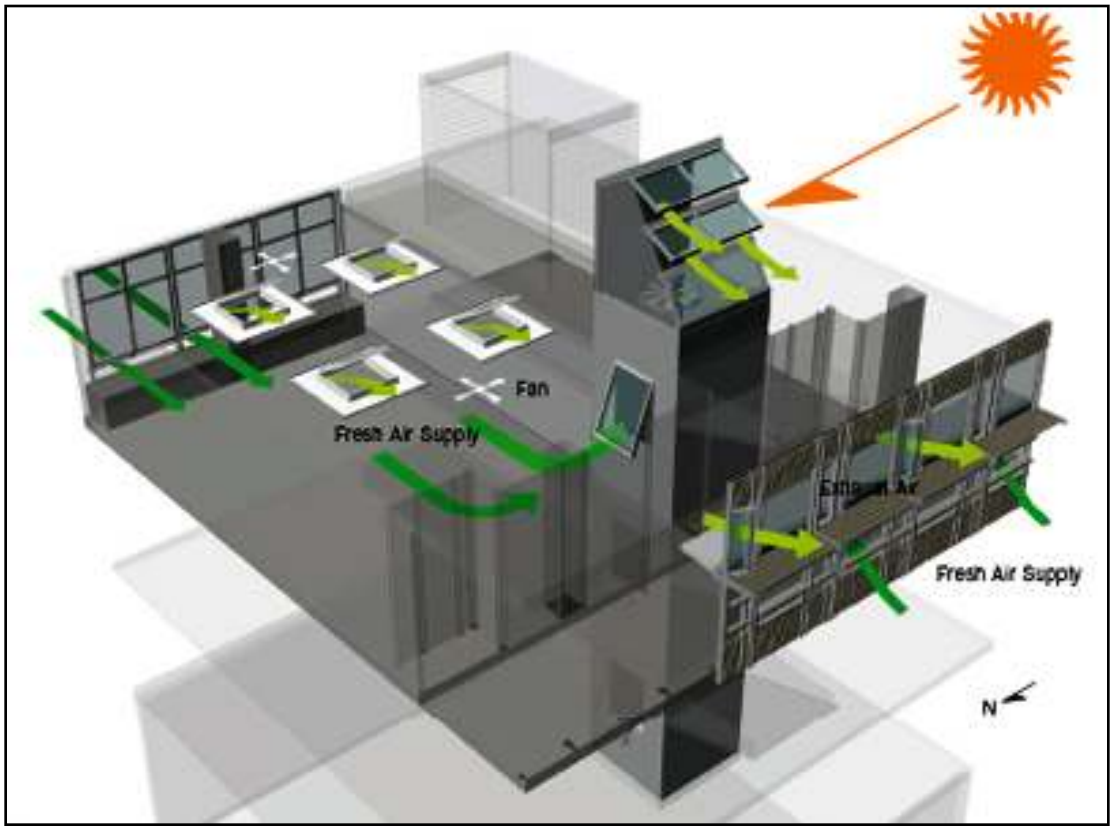


Diagram of a Solar Chimney

Geothermal Heating and Cooling

Geothermal heating and cooling systems are an energy efficient method to provide two benefits with one system. Pipes are placed deep into the earth's crust where average soil temperatures range from 50 to 70°F. A heat pump is used to circulate a heat transfer liquid through the pipes, and the natural heat from the ground is transferred into the building via the circulating liquid. During summer months, the same system can be run in reverse, and the liquid can extract heat out of the building and transfer it to the ground, thereby cooling the building. Installation of underground loops and a heat pump will cost roughly $2,500 per ton of capacity.[xiv]

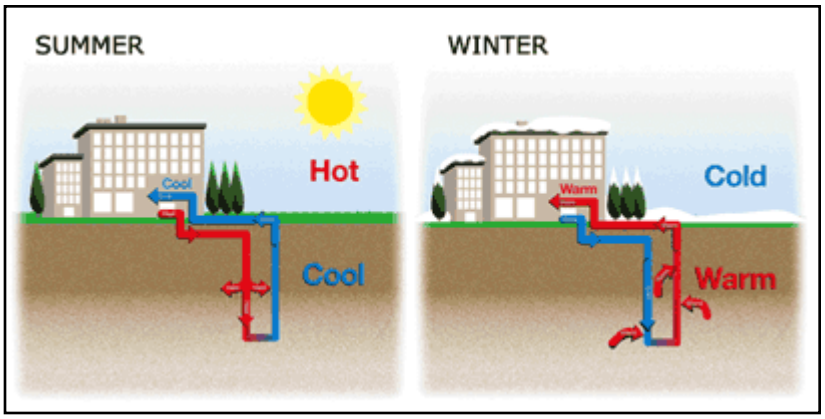


Diagram of a Geothermal Heating and Cooling System[xv]

Heat Island Effects

The grounds surrounding a building can contribute to a heat island effect that increases the temperature of the overall site. The following measures can reduce heat island effects and reduce cooling costs:

- Plant shade trees that cover the building
- Build shade structures
- Utilize open-grid pavement
- Properly clean and maintain structures

Thermal Transfer Reduction

Paper Insulation

Storm Window[xvi]

Heating and cooling efficiencies of a facility can be greatly reduced by leaks in walls, doors, and windows. A few simple measures can be taken to reduce these losses.[xvii]

- Improve building insulation: If the facility is lacking insulation or has low-quality or degraded insulation in the walls or ceiling, install or replace the insulation. There are many varieties of insulation that are less environmentally harmful than traditional fiberglass insulation. These include recycled blue jeans, recycled paper, and soy-based spray foam insulation.
- Seal windows and doors to reduce leakage: Many leaks that occur around windows and doors can easily be fixed with weather stripping. Savings can be up to 10% of heating energy costs.
- Use double paned windows or storm windows: During new construction or retrofitting, purchase double paned or storm windows, which will greatly reduce the transfer of heat.
- Use window shades: To reduce cooling costs, close indoor window shades or coverings when direct sunlight is coming through the windows. Exterior window shelves and vertical shading can also reduce heat gain due to direct sunlight. See the Renderings Section for examples of exterior window shades.

Additional Heating and Cooling Efficiency Tips:

- Purchase more efficient HVAC systems.
- Maintain heating and cooling systems to reduce waste and leakage.
- Use ceiling fans or individual station fans instead of air conditioning.
- Reference energy efficiency programs such as Energy Star.

Water Heating

Geothermal Water Heater

Heat pumps utilizing geothermal energy from the ground (see the Heating, Cooling, and Ventilation section on Geothermal Heating and Cooling for further information) can also be an efficient method to heat water. The energy savings come from the principle that heat pumps do not create heat but rather move heat from one reservoir to another. These systems can be two to three times more efficient than traditional water heaters.[xviii]

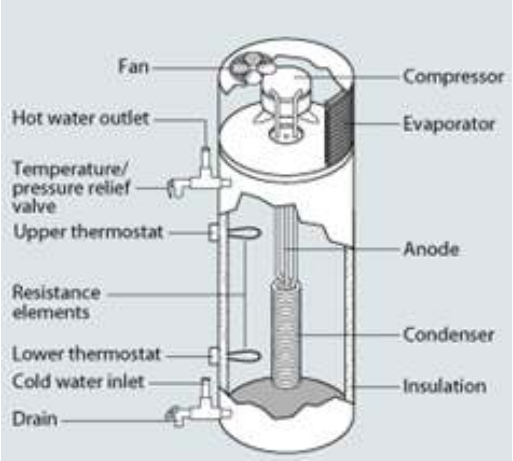


Diagram of a Heat Pump Water Heater[xix]

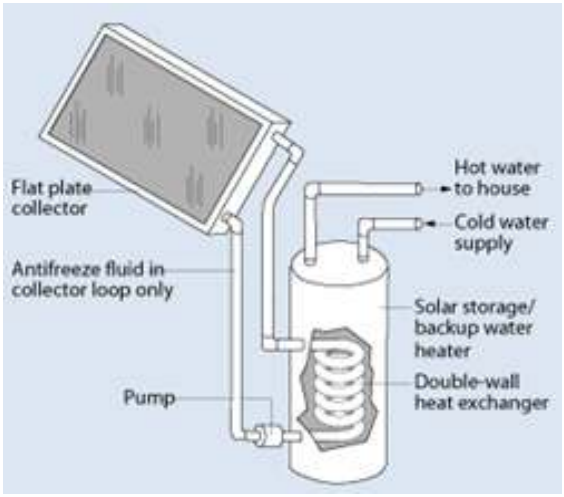


Diagram of an Active, Closed-Loop Solar Water Heater

Solar Thermal Water Heater

In addition to creating electricity, the sun can also naturally warm water sufficient to provide hot water needs. A solar thermal water heating system consists of a solar collector, typically located on a roof, which contains a liquid to be heated by the sun. This liquid travels into a well-insulated water tank that holds the hot water and dispenses it to the building. It is also common to not use a separate heating fluid, but instead heat the water directly. After installation costs, there is very little or no energy used depending on whether or not the system requires a pump.[xx]

Tankless Water Heater

Tankless Water Heater[xxi]

Tankless water heaters (also known as instant water heaters) employ the idea that water should be warmed only when it is needed. Traditional water heaters heat water and then store it in a tank that must also be kept constantly heated. This wastes money in the form of heat loss from the tank. The tankless water heater will super heat water on demand when it is needed. It is important to purchase the right size heater for the intended use because the capacity of the heater is limited by its flow rate. Therefore, as demand for hot water increases, the temperature of the hot water will decrease. Gas powered tankless water heaters are typically more efficient and can produce a higher flow rate than electric systems.

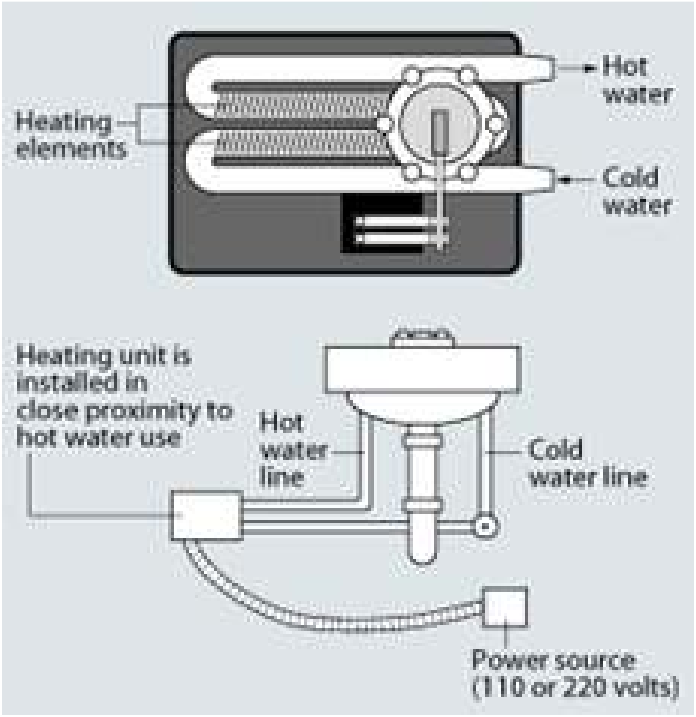


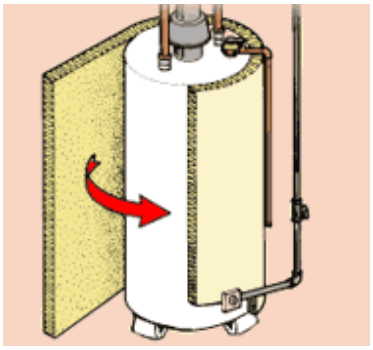
Diagram of an Electric Demand Water Heater[xxii]

Water Pipe and Heater Insulation

One method to reduce heat lost during water transport and therefore increase the resulting water temperature is to insulate exposed hot water pipes. Water temperatures can be 2 to 4°F warmer than uninsulated pipes. [xxiii] Insulation sleeves are most often made from polyethylene or neoprene. The areas of piping used to directly heat the building should not be insulated, but the pipes leading to or from those areas could benefit from insulation. This insulation can allow a lower heat setting on the water heater, and hot water will come to the faucet more quickly. This can also results in decreased water use. The cost to insulate pipes can be as little as $0.30 per foot.

Water has a very high heat capacity, so keeping the temperature high over a long period of time takes a significant amount of energy. Insulating hot water tanks with an insulation blanket can reduce standby heat losses by 25 to 45%.[xxiv]

Insulated Water Pipes[xxv]



Water Heater Insulation[xxvi]

Additional Water Heating Energy Saving Tips:

- Reduce the temperature of the water heater to 120-130°F or 49-54.5°C.
- Clean and remove sediment at the bottom of water heater tanks to increase efficiency.

Renewable Energy Generation

Electricity shortages and increasing electricity costs are an ongoing concern that can be solved by installing on-site renewable electricity generation systems. If the upfront costs of installing a total wind or solar system are too expensive, a smaller system can offset some electricity usage. In order to determine how much wind and solar power could be retrieved from the facility site, an on-site examination must be performed. If renewable installation is determined to be cost prohibitive, contact your local utility provider and ask to purchase electricity generated by renewable sources. If this is not possible, carbon offsets can be purchased from third party organizations to make up for the greenhouse gas emissions that result from the facility's energy use.

Wind Turbines

Wind turbines are a very simple technology to create renewable electricity. Once purchased, the "fuel" to run the turbine is wind and is completely free. It is important to consult specialists before installing a wind turbine to make sure the area is suited for a turbine and to specify direction and placement on or near a building. The size of the turbine directly corresponds to its power output rating in watts. The larger the turbine, the more power it can generate with proper wind conditions. Additionally, due to economies of scale, larger turbines cost less per watt than smaller units.

Compact Wind Turbine[xxvii]

Rooftop Wind Turbine[xxviii]

Photovoltaic Solar Panels

The greatest energy source available to humans is the sun, and it is clean and renewable. Solar radiation can be captured for beneficial use in many ways, including generation of renewable electricity. One form is the very portable photovoltaic solar panel, which can easily be installed on a rooftop or parking structure. Photovoltaic panels create electricity when solar radiation interacts with the material, often silica, and strips away electrons, creating electricity. Some systems are still very expensive, but competition is driving down prices each year. National governments are also starting to provide financial incentives to companies to install solar systems.

Photovoltaic Solar Panels[xxix]

Biofuels

When using liquid petroleum based fuels for transportation or back-up generators, consider using biofuels instead. These fuels are derived from plant-based material and may have a smaller overall greenhouse gas impact. It is essential that any biofuels (such as ethanol and biodiesel) be sustainably manufactured and that the agricultural practices used when growing the fuel source are not harmful.

Water Consumption and Reuse

Introduction

A facility's water withdrawal, use, and discharge can play a large role in its overall environmental impact. Withdrawal of groundwater can lead to aquifer overdraft, which can permanently harm long-term water supply and cause ecological harm. Water discharged from facilities can carry toxins and sediments that may harm people as well as plants and animals. Further, water costs money. Even if your facility is currently able to cheaply extract groundwater for everyday use, long-term water shortages are predicted for many parts of the world. In a world of decreasing water supply, regulatory requirements will become stricter and fees will become higher, even for personal wells. Further, the cost of buying water from a municipal water management district will also increase as supply diminishes. Putting measures in place to ensure that water use is minimized in terms of consumption and maximized in terms of efficiency will lead to greatly decreased resource consumption as well as greatly decreased long-term risk.

All calculations in this section use the fluid measurement units of liters and meters. The following formulas can be used to convert units of measure:

$$\frac{Liters\ (L)}{3.785} = Gallons\ (G)$$

$$Square\ Meters\ (m^2)\ \times\ 10.76 = Square\ Feet\ (ft^2)$$

Indoor Plumbing Fixture Efficiency

Many buildings in the United States and abroad are utilizing outdated plumbing fixtures that have very high water consumption rates. The table below shows the water consumption averages for fixtures from different time periods.

As you can see, even relatively modern fixtures may fall well below the efficiency standards set by those specifically manufactured to be high efficiency or ultra-high efficiency. Replacing these fixtures with those of higher efficiency can produce significant water savings, though the exact extent of the savings will depend on the fixture being replaced as well as the frequency of use. For example, consider the following two hypothetical situations:

Toilet
Replacing a pre-1980 toilet with an ultra-high efficiency toilet will save approximately 1,700 liters of water per 100 flushes.

Faucet
Switching from a pre-1980 faucet to an ultra-high efficiency faucet will save between 946 and 2082 liters of water per 100 minutes, depending on the age and efficiency of the faucet replaced.

Water Efficiency of Plumbing Fixtures in Different Time Periods

Time Period	Toilet	Urinal	Showerheads	Faucets
Unit of Measure	LPF	LPF	LPM	LPM
Pre-1980	20.8	NA	15.1	11.4 - 18.9
1980-1994	13.2	NA	10.4	10.4
Post 1994	6.1	1	9.5	9.5
High-Efficiency	4.8	NA	8.5	1.8 - 5.7
Ultra High-Efficiency	3.8	0.1	4.5	1.9
Dual Flush (Avg.)	4.5	NA	NA	NA

Sustainable Landscaping

Landscaped areas *generally* require a substantial amount of water to maintain, and for many facilities, this can make up a significant proportion of overall water consumption. Altering vegetation types and changing irrigation practices for landscaping can play a significant role in lowering the water consumption of a facility. The specific cost savings associated with this decrease in water consumption will depend upon the vegetation and irrigation types replaced.

Landscaping can also be used to enhance the natural cooling effects of vegetation on buildings. This can be accomplished by planting trees and shrubs with dense foliage downwind of or above air inlets. In summer months, the trees act as natural evaporative coolers, reducing energy costs. Water requirements of vegetation should be considered as some plants can be very water intensive.

Zero-scaping

Zero-scaping is the use of native plants or succulents in lieu of water intensive non-native varieties of vegetation in landscaping. Many landscaped areas utilize exotic plants for their aesthetic value rather than considering the amount of water they consume. Using plants native to your region should allow your landscaping to go without watering or with very little watering, as they are adapted to the local climate and should be able to survive on the area's natural rainfall. Zero-scaping can also involve minimal vegetation use and focus on utilizing rocks, gravels, sands, and other natural materials in the landscaping to further lessen water and fertilizer requirements.

Invasive Species

In many areas of the world, invasive species are becoming a large problem, as they are often able to out-compete local fauna, leading to uncontrolled spreading. Many of these invasive plants come from landscaping at private homes, commercial lots, and even industrial facilities. Ensuring that your landscaping is free from non-native plant species can help combat the spread of these ecologically-harmful plants.

Utilizing rock for ground-cover in conjunction with succulents minimizes irrigation requirements.

Irrigation

Drip Irrigation Head

Soil Moisture Sensor[xxx]

For those areas which are not zero-scaped and require watering, switching from traditional sprinklers or hand-watering to drip irrigation systems can increase water efficiency by 30 to 50%.[xxxi] Drip irrigation systems can be as simple as piping which is perforated or has nozzles located at the base of each individual plant. This allows water to be applied directly to the plants roots, greatly decreasing the amount of water which is evaporated before it can be used by the plant or infiltrate into the soil.[xxxii] Drip irrigation systems can even be used for lawns, with the pipes being buried every few feet. The cost for most facilities should be relatively low for the benefit achieved. Oregon State University estimates the costs at $500 to $1,200 per acre, only $100 to $300 more than comparable sprinkler systems.[xxxiii]

To Further Your Efficiency:
Use soil moisture sensors in conjunction with soil moisture meters.

These devices measure soil moisture content so that you only water when your plants truly need it. These systems cost from $25 to $80 per monitoring head, depending on the type of system you install. Specific information regarding different types of sensors, their pros/cons, and their costs can be found at: http://attra.ncat.org/attra-pub/soil_moisture.html

Stormwater Management

Stormwater discharge can be a problem at many industrial and manufacturing facilities. This is because many of these sites are composed largely of impermeable surfaces, which water cannot penetrate. This prevents water from being absorbed by the soil and draining naturally. As a result, stormwater moves over land and into the municipal sewers, which, in most places in the world, can quickly become overwhelmed during a large rain event. In many cases, large rain events have the potential to cause sewers to spill untreated wastewater into otherwise uncontaminated environments. Limiting your facility's discharge can help ease this load on municipal systems. One way to limit your facility's impact from stormwater discharge is through constructing a bioswale on the premises, as described in the next section. Reducing the amount of impermeable surfaces on your property can also result in decreased stormwater runoff. This can be achieved in various ways, including through the use of porous pavement, infiltration basins/trenches, or sand filters.

Porous Pavement[xxxiv]

Infiltration Basin[xxxv]

Sand Filter[xxxvi]

Infiltration Trench[xxxvii]

Bioswale Construction and Benefit

A bioswale is a landscape element designed to filter sediments and pollutants from stormwater runoff before entering a municipal sewer system. They allow this water to infiltrate into the soil and return to the groundwater system. This helps filter contaminants from the water as well as ease stormwater loads on municipal sewer systems. The diagram below shows how a swale is constructed. In general, it is constructed next to an impervious surface where stormwater will run during a rain event. Flow through gravel and vegetation clarifies the water, particularly while it moves through the root-zone of the vegetation. Bioswales are built for a certain capacity, and if this is exceeded, there is an outflow pipe which will discharge excess water into the municipal storm sewer or overflow pond. See the Renderings section for a visual depiction of an overflow pond.

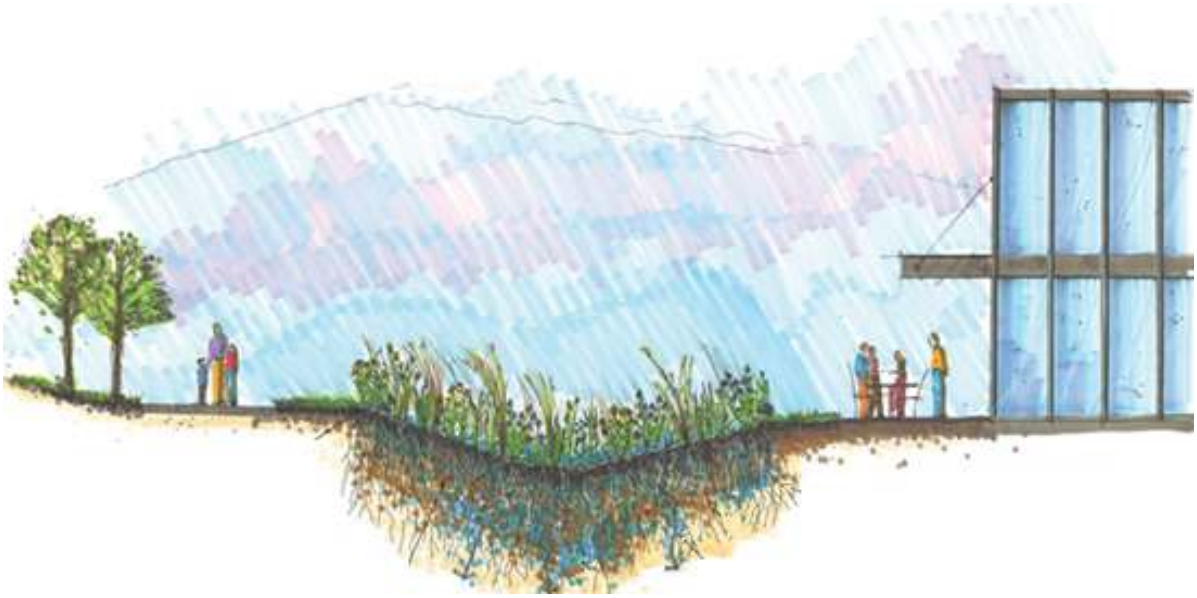


Diagram of a Bioswale

Rainwater Harvesting

Rainwater harvesting is a highly effective and simple means of lowering water withdrawals from private wells or municipal water systems. The simplest means of harvesting rainwater is to install gutter systems on the eaves of facility roofs. This allows you to capture any rain that falls onto the facility roof and divert it through a filtering system into a cistern for storage and later reuse. This water cannot be used for potable uses unless it is tested and treated first. Rather, harvested water is typically used for irrigation and maintenance purposes.

The cost of cisterns varies depending upon materials used, as well as size, and are outlined in the table below. Cisterns are the largest cost associated with rainwater harvesting, though the gutters, piping, and filters all have additional capital costs. However, they are negligible in comparison to the cost of the cistern.

The amount of water which can be harvested depends directly on the amount of roof-space available for collection, as well as the amount of rainfall in your particular location. Once you have determined this, the calculation is fairly straightforward and is outlined in the box to the right.

If there is 2.54 cm (1 in.) of rainfall over 1 m^3 of roof-space, we can expect a volume of 26.5 liters of water to fall within this area.

Given this, we can calculate the rain volume that falls over the entire roof using the following formula and assuming a 1,000 m^3 roof:

$$1{,}000m^3 \times 26.5\ {}^{L}/_{m^3} = 26{,}500L$$

For a 1,000 m^3 roof and a rain event totaling 2.54 cm of rainfall, we can expect that 26,500 L of water will fall over the given area. However, water harvesting systems are not perfectly efficient and there will be losses from leaks, overflow, and evaporation. Thus, you should assume a 10 – 25% loss for any system. What is left over for physical use will be referred to as usable yield. So, for 1 m^2 of roof space you can expect 19.9 to 23.9 liters of usable yield. For a 1,000 m^2 roof you can expect 19,900 to 23,900 L of usable yield.

Cistern Costs by Size and Material

Material	Cost, Small System	Cost, Large System
Galvanized Steel	$225 for 757 liters	$950 for 7,570 liters
Polyethylene	$160 for 625 liters	$1100 for 6,813 liters
Fiberglass	$660 for 1,325 liters	$10,000 for 37,850 liters
Ferro-cement	Price variable upon location	Price variable upon location
Fiberglass/Steel Composite	$300 for 1,136 liters	$10,000 for 18,925 liters
Aluminum	Cost prohibitive for water use	Cost prohibitive for water use

Wastewater Testing

For manufacturing facilities, any wastewater discharged from the facility can potentially contain substances that are hazardous to both people and ecosystems. Further, depending on local laws, this discharge may be illegal and result in significant financial penalty. For these reasons, we recommend that if your facility is discharging any water used within an industrial or manufacturing context that you regularly test your discharged water using a third-party testing service. This will decrease the risk of discharging potentially harmful substances into the public water system.

Wastewater Testing Resources:
www.biologylab.com
www.palintestusa.com

Wastewater Reclamation and Reuse

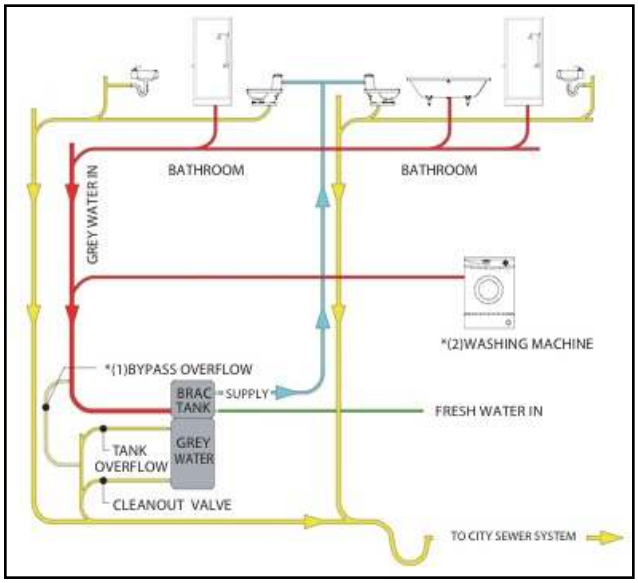
Some water used by a facility can be collected, reclaimed, and reused, assuming it is not contaminated with human waste or potentially hazardous chemicals. Wastewater which is not able to be reclaimed, known as "black water," generally comes from toilets, though most water used in industrial processes also falls under this category. A typical system for wastewater reuse, known as a greywater system, is discussed in the next section.

General Information
www.greywater.net

Greywater Systems

Greywater recycling systems divert water from facility showers, sinks, dishwashers, or laundry facilities for reuse in flushing toilets and landscaping irrigation. Water collected from a greywater recycling system is NOT potable and should not be used for direct human contact or consumption. Greywater systems can vary dramatically in design and cost.

We recommend contacting a consultant or company who specializes in grey-water systems to discuss the feasibility of installing a system. Utilizing a consulting company is important for several reasons. First, the regulatory environment regarding greywater systems is highly heterogeneous and it may in fact be illegal in your area to install one. Further, systems must be specially designed depending on how your facility is constructed, the source of grey-water and its intended use to ensure that human health and safety is protected at all times. However, greywater systems can contribute to substantial water resource savings, a benefit in areas which are experiencing increasing water prices resulting from water shortages.



Example of a Greywater System[xxxviii]

Materials and Resources

Make sure to consider all of the following **types of products** when creating a sustainable purchasing and solid waste management policy:

- ✓ regularly-purchased consumables
  - paper
  - batteries
  - cleaning supplies
  - trash bags
  - lightbulbs
- ✓ durable goods
  - furniture
  - equipment
  - carpet
- ✓ materials for renovations
  - paints
  - adhesives
  - sealants

Sustainable Purchasing Policy

Develop and implement a sustainable purchasing policy. The following characteristics should be maximized to the extent possible in purchased products:

- recycled content (post-consumer and post-industrial)
- biodegradability
- use of renewable materials
- use of local materials
- energy efficiency
- water efficiency
- certification by relevant organizations (e.g., Forest Stewardship Council, Energy Star, Green Seal, Carpet and Rug Institute)

The following substances, which purchased products can contain, should be avoided to the maximum extent possible:

- mercury, lead, and other hazardous substances
- volatile organic compounds (VOCs)
- use of ozone depleting substances (ODS) and high-global-warming-potential (GWP) gases

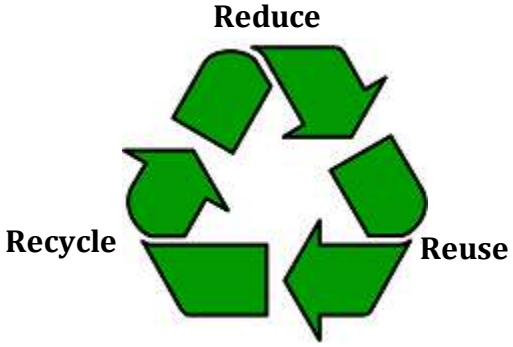
Waste Stream Audit and Solid Waste Management Policy

Conduct an audit of all waste generated at the facility. Consider how waste is currently being managed and develop a solid waste management policy to divert waste from landfills and/or incinerators. This policy should prioritize waste minimization, followed by reuse and composting, followed by recycling. If any waste is already being reused or recycled, determine how much is actually being reused or recycled. Include in the solid waste management policy a plan to improve this percentage.

Any products containing toxic materials, such as mercury-containing CFLs, should be disposed of properly. For more information on proper disposal of CFLs, see the following websites:
http://www.tcpi.com/corp/TCP_JUCCCE_Recycling_Program.aspx
http://www.epa.gov/epawaste/hazard/wastetypes/universal/lamps/index.htm

For food waste, implement a composting program. In conjunction with an onsite garden, composting has several economic advantages. It lowers waste removal costs by reducing solid waste. Also, it is a low cost fertilizer, eliminating the cost of purchasing fertilizer. Lastly, it can reduce the need for pesticides and water.

Compost



Sustainable Food Policy

Develop and implement a sustainable food policy. Organic, fair trade, and local food sources should be prioritized when making food purchasing decisions. If possible, grow food onsite in an organic garden. This accomplishes several goals. First, it reduces the environmental footprint of the food, as it does not have to be transported. Second, the quality of the food is improved due to freshness and elimination of harmful pesticides. And third, residents of the campus are able to participate by choosing which foods to grow and possibly tending the garden themselves.

- **Local food** is grown in the local area surrounding the location where it is consumed.
- **Organic food** is grown, stored, processed, packaged, and/or shipped using a set of standards, which vary by country and certification body. Typical characteristics of organic food include minimal or no use of synthetic additives (such as fertilizers, pesticides, and antibiotics), genetically modified organisms, irradiation, or sewage sludge.
- **Fair trade food** is produced to certain social and environmental standards, which vary by the certification body.

International Organizations

- Organic Trade Association
- Organic Crop Improvement Association
- ECOCERT
- International Federation of Organic Agriculture Movements

Country-Specific Certifications

- EU-Eco-regulation
- US Department of Agriculture National Organic Program
- China Green Food Development Center
- Japanese Agricultural Standard

Sustainable Sites

Site Management Plan

Develop and implement an environmentally-minded management plan for building exteriors (e.g., walls, roof), hardscaping (e.g., sidewalks, paved areas), and landscaping on the site. This plan should focus on minimizing energy, water, and chemical use, as well as the generation of wastewater, air pollution, solid waste, soil erosion, and chemical runoff.

Minimization of environmental effects can be achieved in a variety of ways, including:

- using energy-efficient and water-efficient equipment
- using environmentally-friendly paints, sealants, and cleaning supplies
- using an automated dispenser for concentrated chemicals, which allows proper dilution, cleaner operation and reduced costs
- using non-chemical methods of pest management
- if using chemical methods of pest management, minimizing the use of pest management chemicals, using least-toxic chemical pesticides, and using only in targeted locations for targeted species
- controlling dust and particulates during maintenance activities
- minimizing erosion and restoring eroded areas
- reusing landscape waste
- minimizing or eliminating chemical fertilizer use; landscaping with native or adapted plants and removing invasive species
- protecting or restoring open spaces

This plan should cover equipment, supplies, and maintenance activities, such as the following:

- ✓ equipment and supplies
  - pressure washers
  - cleaning supplies
  - paints and sealants
  - pesticides and fertilizers
- ✓ maintenance activities
  - cleaning of building exteriors
  - hardscape cleaning
  - construction
  - painting and sealing
  - pesticide and fertilizer application

Transportation

Encourage and incentivize the use of carpooling and alternative transportation (e.g., mass transit, bicycling, walking) for employee commuting and other transportation needs. If vehicles are owned and used by the company, consider purchasing/renting low emission, fuel efficient and/or alternative fuel vehicles.

Environmentally-Friendly Vehicles

- ✓ Hybrid Vehicles
- ✓ Flex-Fuel Vehicles
- ✓ Alternative Fuel Vehicles
  - Ethanol
  - Biodiesel
  - Natural gas
  - Propane
  - Hydrogen
- ✓ Electric Vehicles
- ✓ Fuel Cell Vehicles

National Environmental Balancing Bureau: http://www.nebb.org

Building Commissioning Association: http://www.bcxa.org

PECI Commissioning Resource Center: http://www.peci.org/cx_resources.html

Hong Kong Building Commissioning Center: http://www.hkbcxc.org

Building Services Commissioning Association: http://www.bsca.or.jp/english/english_top.html

Commissioning

If the building was not commissioned when built, implement an existing building commissioning (EBCx) process for the building to ensure that all building systems are functioning optimally. According to the Building Commissioning Association, EBCx (also known as retro-commissioning, re-commissioning, and ongoing commissioning) is "a systematic process for investigating, analyzing, and optimizing the performance of building systems by improving their operation and maintenance to ensure their continued performance over time. This process helps make the building systems perform interactively to meet the owner's current facility requirements".[xxxix] More information on commissioning can be found at the website of the organizations listed in the text box to the left.

Employee Health and Productivity

Air Quality and Noise

- Minimize fume exposure to employees when using toxic/harmful chemicals, cleaners, degreasers, pesticides, etc.
- Make sure filtration media is installed at all outside air intakes and inside air recirculation returns and that it has a minimum efficiency rating (MERV) of at least 13.
- Prohibit smoking inside buildings and designate smoking areas outside that are at least 25 feet away from building entrances and windows.
- Complete indoor air quality and indoor noise level testing. Contact one of the consultants recommended through the American Industrial Hygiene Association (AIHA) website (http://www.aiha.org) to complete testing.
- Place houseplants throughout work areas.

Plants, Lighting, and Productivity

Studies have shown that worker productivity can be measurably improved by both the presence of plants and natural light. One study has shown that increased natural daylight could increase worker productivity by as much a 13%.[xl] Indoor plants, a relatively low cost investment, have also been shown to not only increase productivity, but to reduce the occurrence of a variety of complaints including fatigue, headaches, and sore throats by 25%.[xli]

Daylighting

Maximize natural daylight illumination for occupied areas. For example, LEED recommends maintaining a minimum natural daylight illumination of 25 foot-candles (269 lux) for 50% of all regularly occupied areas. This can be measured with a standard light meter.

For building occupants, maximize direct lines of sight to the outdoor environment. For example, LEED recommends at least 50% of regularly occupied areas have a direct line of sight.

Measuring Daylighting

Daylighting is measured with the use of a light meter – a hand held device that can be used to measure the amount of light in an area normally occupied by workers. There are many types of light meters available, but for measuring daylight in the workplace, a simple model, such as the one shown to the right, will work well.

Training

Develop a training program for employees and managers to educate about and encourage conservation behavior. This program should explain why conservation behavior is important, focusing on environmental issues relevant to the area of the facility.

The program should including the following activities:

- Ensuring the building management systems are used as effectively as possible to obtain the highest possible energy and water efficiency.
- Using only as much heating and cooling as is needed to reduce water and electricity usage.
- Using only as much lighting as is needed.
- Turning off all lighting and electronics when not in use and at the end of each day. Designating one person to ensure that everything is turned off.
- Using only as much water as is needed.
- Recycling.

Resources

The following organizations provide excellent resources for **green buildings**:

- ✓ U.S. Green Building Council (www.usgbc.org)
- ✓ Building Research Establishment Environmental Assessment Method (www.breeam.org)
- ✓ The Hong Kong Building Environmental Assessment Method Society (www.hk-beam.org.hk)
- ✓ Green Star Building Council of Australia (www.gbca.org.au)
- ✓ China Business Council for Sustainable Development (english.cbcsd.org.cn/themes/buildingenergy)
- ✓ Alliance for Sustainable Built Environments (www.greenerfacilities.org)
- ✓ Global FM (www.globalfm.org)
- ✓ International Facilities Management Association (www.ifma.org)
- ✓ U.S. EPA Green Building website (www.epa.gov/greenbuilding)

The following organizations and programs offer additional **energy**-related information:

- ✓ U.S. EPA Energy Star Program (http://www.energystar.gov/)
- ✓ U.S. EPA eeBuildings Program (www.epa.gov/eeBuildings)
- ✓ U.S. Department of Energy, Energy Efficiency and Renewable Energy (www.eere.energy.gov)
- ✓ Alliance to Save Energy (ase.org)

The following companies specialize in **water efficiency and reuse**:

- ✓ Brac Systems BC
- ✓ Free Water UK Ltd.
- ✓ Nubian Water Systems
- ✓ Aqua Pro Solutions
- ✓ Espiritus Water Systems Ltd.

Renderings

The following diagrams demonstrate the characteristics of an ideal green footwear manufacturing campus. The renderings highlight the manufacturing facility, which utilizes the following green building technologies:

- Vertical shading
- Light shelves
- Green roof
- Solar panels
- Local materials
- Natural light and ventilation

Two versions of the building are shown, each using a different type of natural light and ventilation technology. One building uses large atria while the other uses multiple solar chimneys.

In addition to the manufacturing facility, the renderings highlight several green aspects of the campus, including the following:

- Constructed wetlands
- Bioswale

The first diagram explains these technologies in further detail.

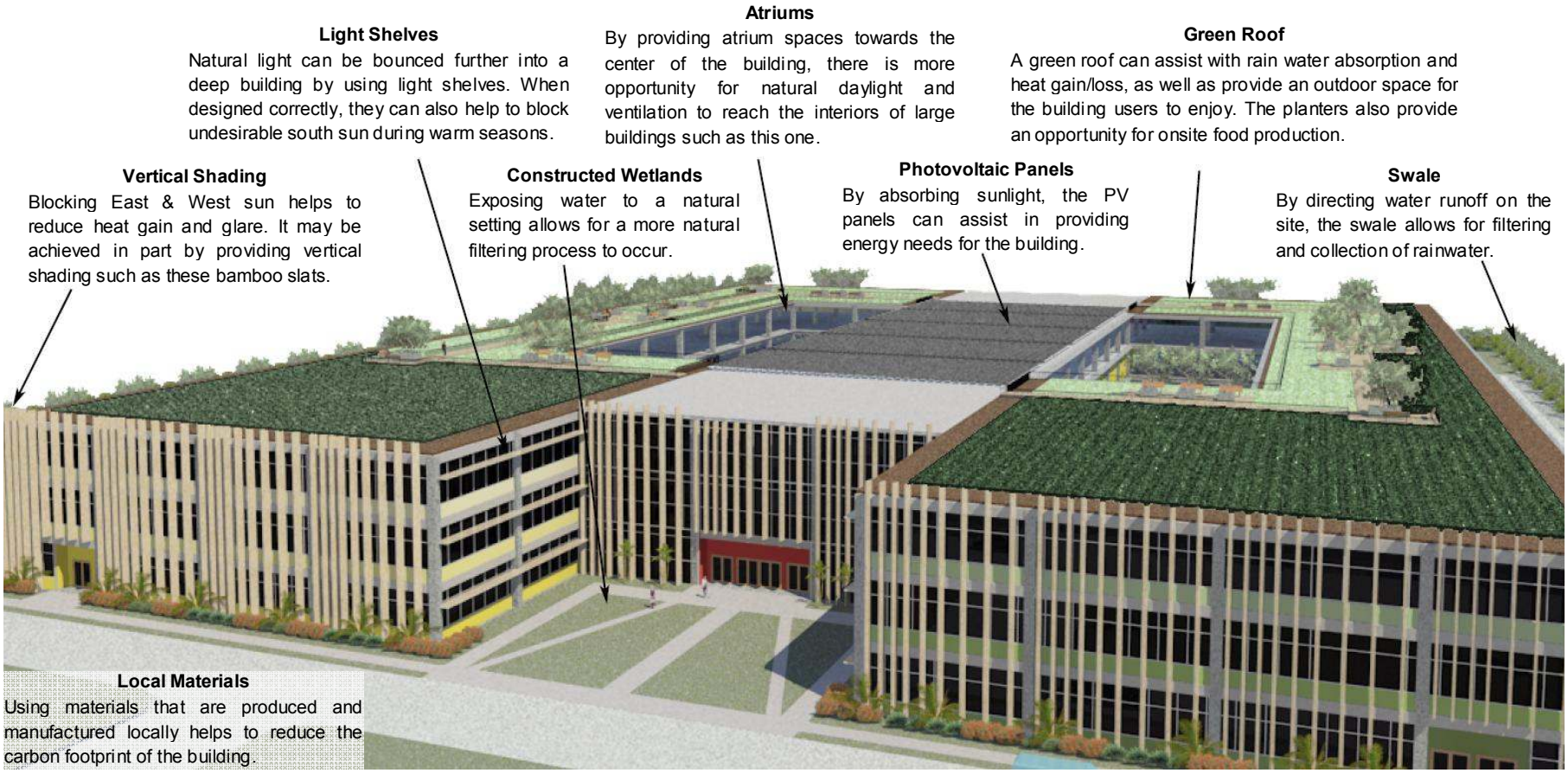
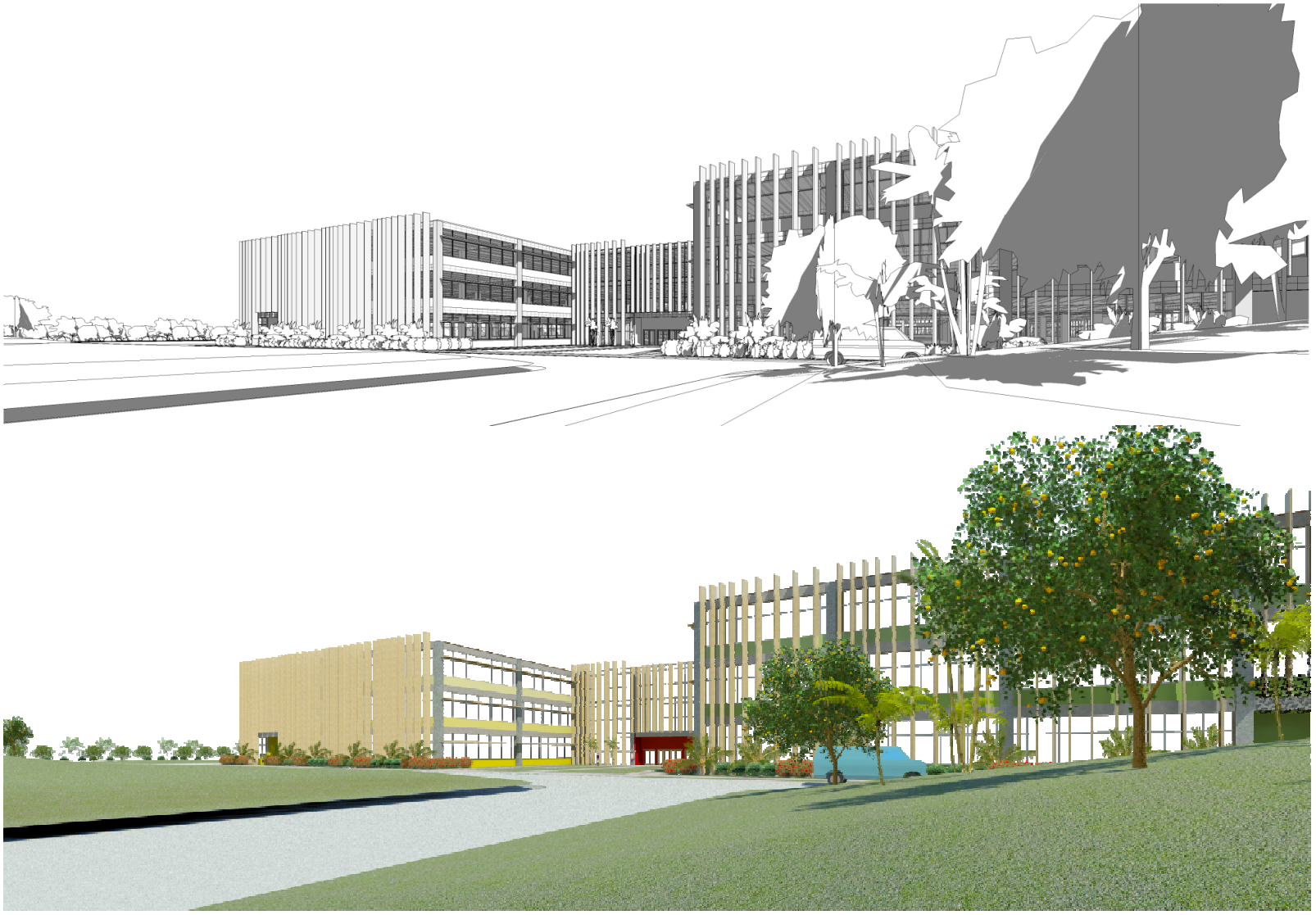
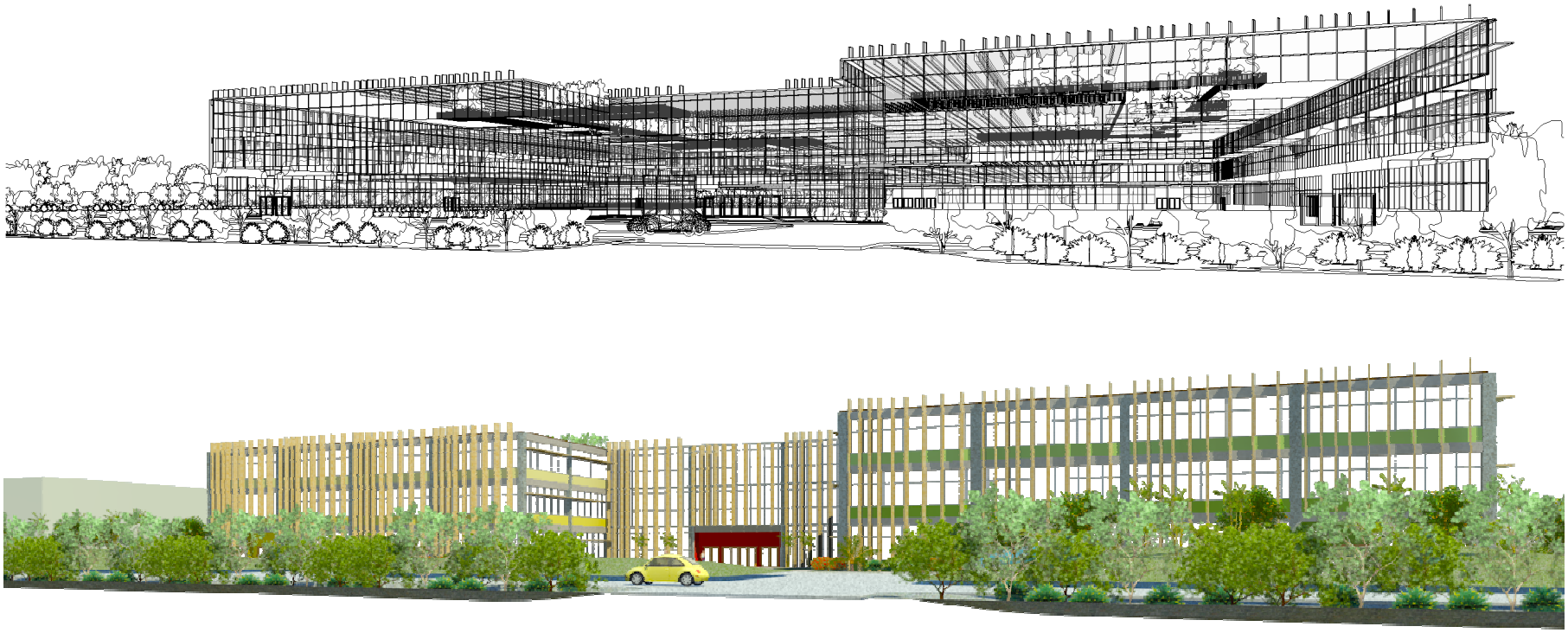


Diagram of a Green Footwear Manufacturing Facility

Front View of the Facility, Highlighting the Vertical Shading and Light Shelves

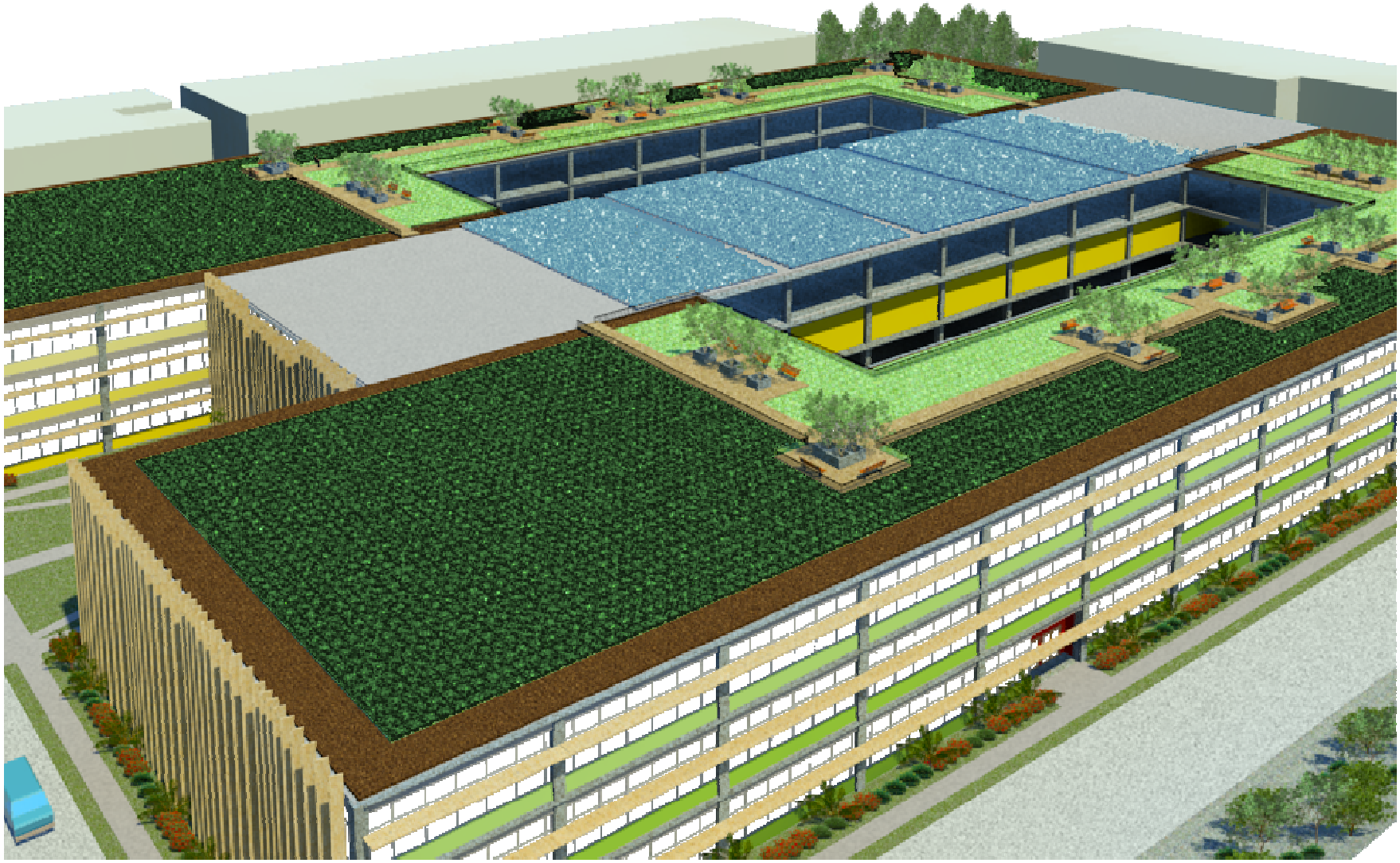


Front Views of the Facility



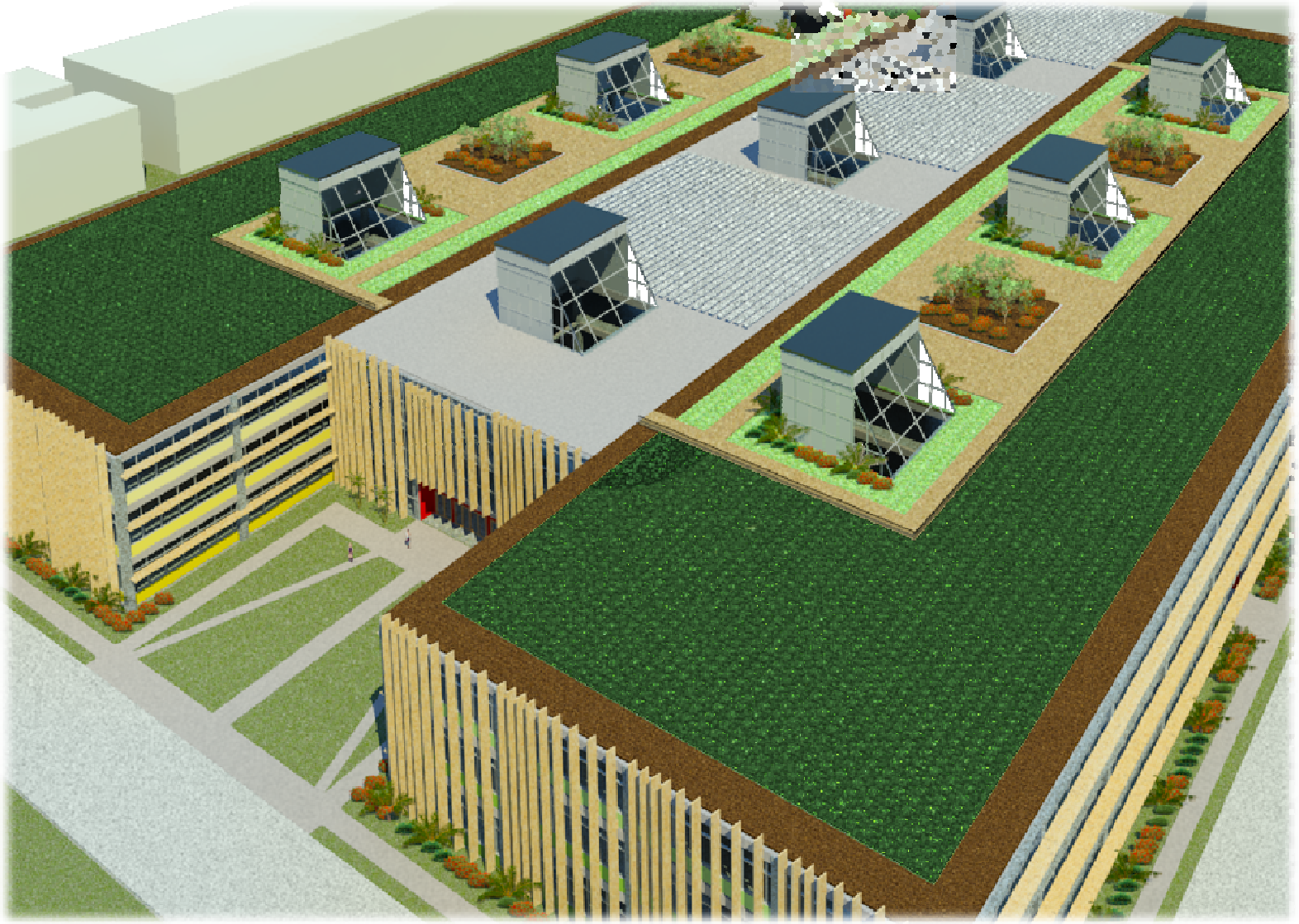
Front Views of the Facility

Close-Up Front View of the Facility, Highlighting the Constructed Wetlands

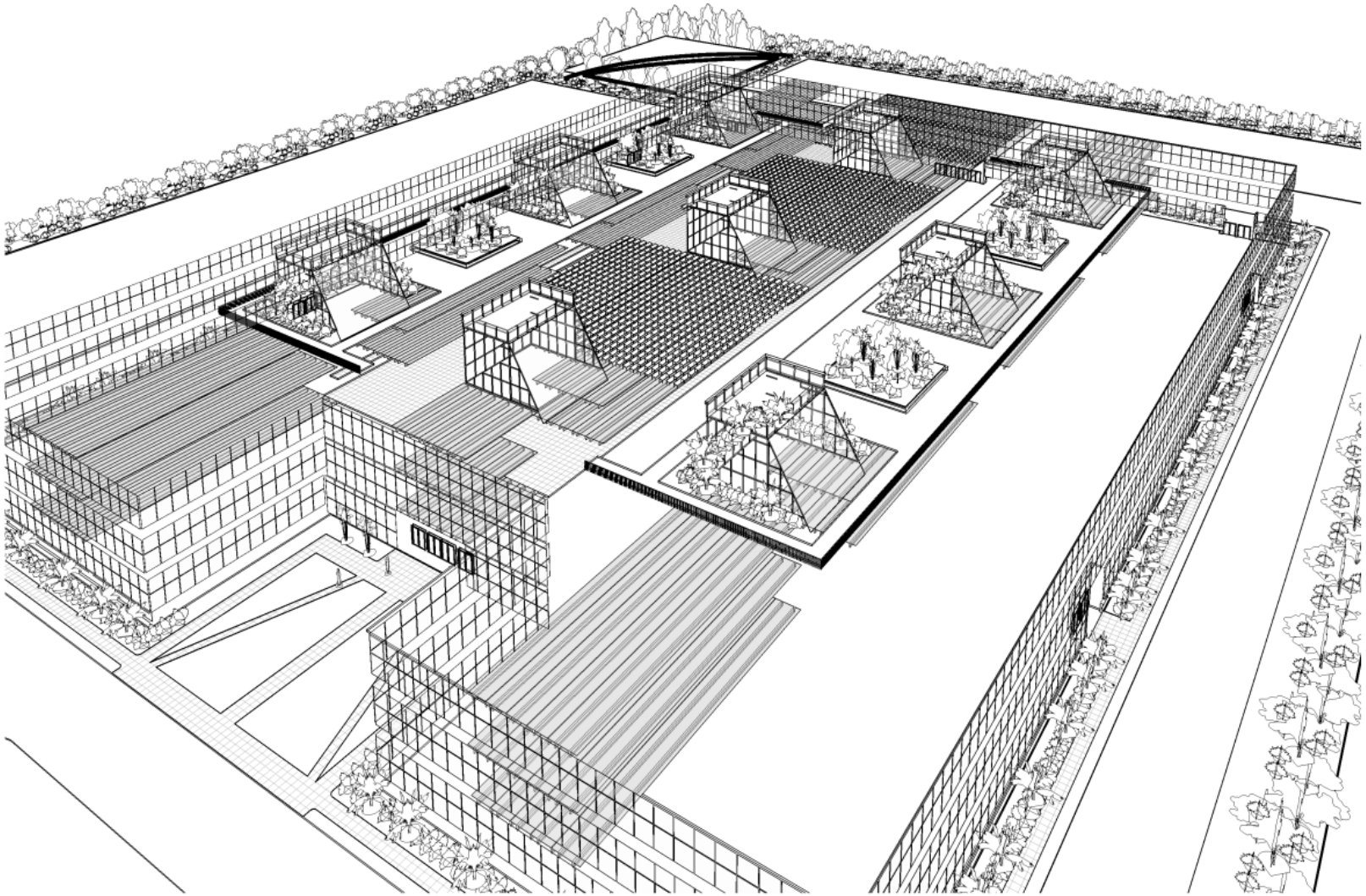


Overhead View of the Facility, Highlighting the Green Roof, Atria, and Solar Panels

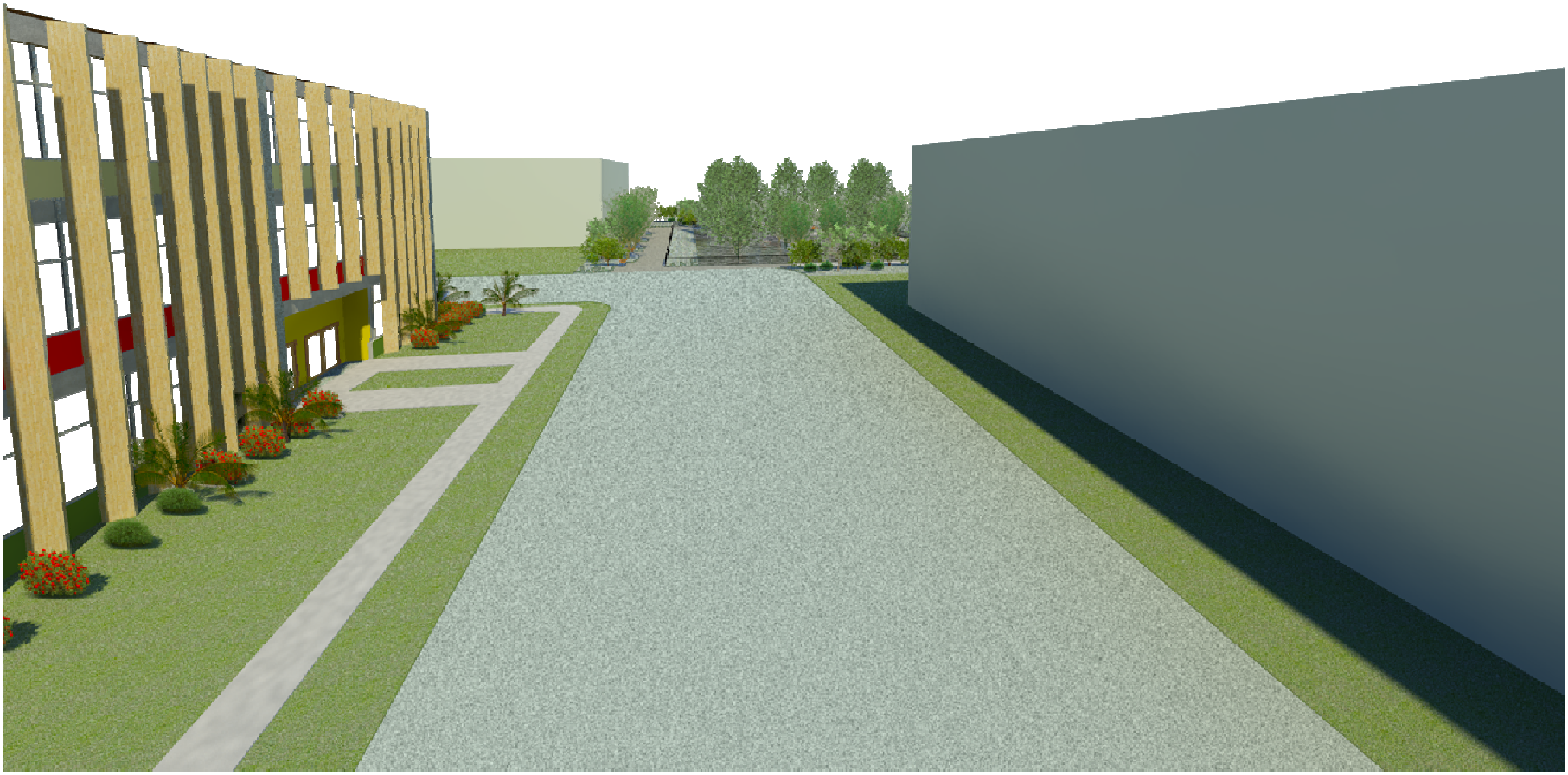
View of the Green Roof Being Used by Employees



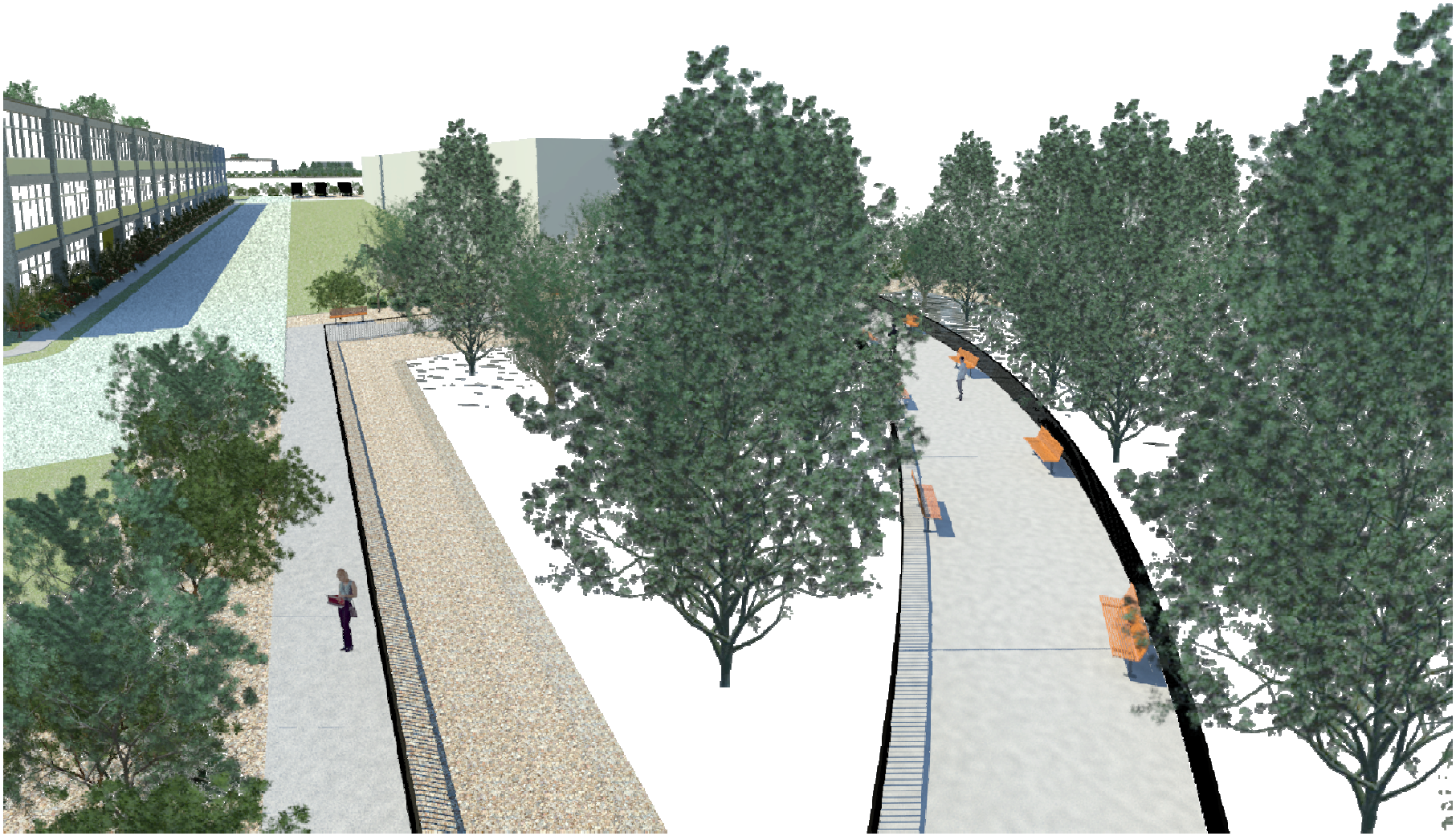
Overhead View of the Facility with Solar Chimneys



Overhead View of the Facility with Solar Chimneys



View of the Campus Grounds, Looking Toward the Bioswale



View of the Campus Grounds, Bioswale Overflow Collection Area

Real World Examples

The following section highlights several companies that have implemented green building retrofits and policies, as well as built new facilities in the last few years. These examples highlight the environmental improvements that can be seen and the potential cost savings that can be realized by greening a manufacturing facility. In addition to these green facilities, the following companies have also retrofitted existing buildings to be greener or recently opened green stores, facilities, and offices:

- REI
- Office Depot
- Target
- Best Buy
- JC Penny
- Walmart
- Staples
- Macy's
- Kohls
- Safeway
- Kettle Foods
- Contessa

MAS Holdings

In 2008, MAS Holdings—India's biggest apparel company—opened a green clothing manufacturing facility in Sri Lanka. This facility was constructed to manufacture lingerie exclusively for Marks and Spencer and was initiated as part of "Marks and Spencer's five year plan to make their operations more environmentally friendly." The facility cost 25% more to build than a traditional factory of similar size, but MAS expects this initial investment to pay off within five years. The facility uses 40% less electricity than a similarly-sized plant, and the remaining electricity needs are sourced from an on-site solar power systems and an off-site hydropower plant. Electricity needs are reduced through the use of green roofs and highly reflective roofing materials, which allows to facility to forgo air condition. The facility also utilizes natural light and focused task lighting using LED lightbulbs.[xlii, xliii]

Bentley Prince Street Facility

In November of 2007, Bentley Prince Street's California carpet mill became the first carpet manufacturing facility in the U.S. to receive a LEED certified silver rating. Company President Anthony Minite said, "Not only is it in line with our mission to eliminate any negative impact our company may have on the environment by 2020, it's also a way we can influence others to take action. We believe we have a responsibility to demonstrate that the perceptions of what types of facilities can – and should – be LEED certified need to be expanded to the manufacturing sector. We hope our LEED-EB certification will encourage other manufacturers to follow our lead and attempt to do the same".[xliv] Some of the 280,000 square foot facility's features include: the construction of a solar power array to help power the manufacturing process, a sustainable purchasing policy, 95% of waste is diverted from landfills, and reduced water usage through improved practices. The result has been a 50% reduction in energy use and a 57% reduction in water use.[xlv]

Dansko Headquarters

Recently, Dansko showed its commitment to being environmentally responsible through the construction of their 80,000 square foot corporate headquarters.[xlvi] LEED certified gold, the office building/retail space complex has many sustainable features. These include rain irrigated gardens, permeable paving, green roofs, rainwater harvesting, recycled construction materials, Forest Stewardship Council certified wood products, displacement heating and cooling, automated lighting controls, and a Living Wall for bio-filtration of indoor air. Additionally, Dansko purchases 100% of the building's electricity from wind power sources.[xlvii] "The result is a site and building design that reduces environmental impacts, uses less energy, enhances marketability, and increases user sense of well-being".[xlviii]

ISA Tan Tec

ISA Tan Tec is a leather tanning company primarily operating in China and Vietnam that has taken many actions to mitigate its environmental impact with regard to building operations. ISA has achieved a 30% reduction in electricity usage, a 35% reduction in carbon dioxide emissions, and a 50% reduction in water consumption at their Guangzhou, China, location. These reductions were gained primarily through energy efficiency, alternative energy sources, water recycling, heat recycling, and internal process improvements. Solar water heaters are used to generate 30,000 liters of hot water per day, thereby reducing energy needs. The buildings also use energy-efficient lighting. The leather drying is accomplished using low-temperature drying equipment that then recycles the warmed water. Finishing processes have been altered to use fewer chemicals and

reduce the need for energy in drying. A bioswale has also been constructed to help filter wastewater. It appears that most of these improvements have been realized by strong support of executive management, daily data recording and analysis, employee training, and extensive process review for ongoing improvements.[xlix]

These efficiency measures are providing lessons for the new plant that will be constructed in Ho Chi Mihn City, Vietnam. The facility is expected to be completed in the third quarter of 2009 and is named "Project 2030." Because leather tanning is very water intensive, ISA has focused on a green water treatment process that utilizes plants for water purification and uses no electricity or chemicals. The purified water will be delivered to the live bamboo fencing surrounding the property. ISA expects to avoid over 2,000 tons of carbon dioxide emissions from this water treatment system. Other process improvements aim to reduce the amount of fresh water needed by using a closed-cycle-reuse process that will save 60,000 liters of fresh water per day.[l]

[i] U.S. EPA. (2009) "Basic Information: Definition of Green Building." Available online at http://www.epa.gov/greenbuilding/pubs/about.htm.
[ii] Available online at http://yaleappliance.blogspot.com/2007_08_01_archive.html.
[iii] Available online at http://yaleappliance.blogspot.com/2007_08_01_archive.html.
[iv] Available online at http://nuclearmoose.com/greenlighting.php.
[v] Dilouie. Craig. (n.d.) "Industrial Lighting: Beyond 50% Energy Savings." Rexelusa.com. Available online at http://www.rexelusa.com/pdf/v9n1_PowerOutlet_IndLighting.pdf.
[vi] Dilouie. Craig. (n.d.) "Industrial Lighting: Beyond 50% Energy Savings." Rexelusa.com. Available online at http://www.rexelusa.com/pdf/v9n1_PowerOutlet_IndLighting.pdf.
[vii] Solatube International, Inc. (2008) "Brighten Up® Series." Available online at http://www.solatube.com/homeowner/brightenup.php.
[viii] Available online at http://www.swepdri.com.au/swepco/swepco-white-roofshield.php.
[ix] Mann, Christine. (2008) "Reflective White Roofs Cut Energy Costs 20%." Suite101.com. Available online at http://saving-energy.suite101.com/article.cfm/energyefficient_white_roofs_save_money.
[x] Clayton, Mark. (2008) "How white roofs shine bright green." *The Christian Science Monitor*. Available online at http://features.csmonitor.com/innovation/2008/10/03/how-white-roofs-shine-bright-green/
[xi] NASA. (2009) "White Versus Green: Earth Observatory." Available online at http://earthobservatory.nasa.gov/Features/GreenRoof/greenroof3.php.
[xii] Available online at http://www.livemusicss.com/GREEN_ROOF.jpg.
[xiii] NASA. (2009) "White Versus Green: Earth Observatory." Available online at http://earthobservatory.nasa.gov/Features/GreenRoof/greenroof3.php.
[xiv] Alternative Heating. (2009) "How Do Geothermal Heating Systems Work?" Alternative-Heating.com. Available online at http://www.alternative-heating.com/geothermal-heating-systems.html.
[xv] Alternative Heating. (2009) "How Do Geothermal Heating Systems Work?" Alternative-Heating.com. Available online at http://www.alternative-heating.com/geothermal-heating-systems.html.
[xvi] Available online at http://www.capitolwindowanddoor.com/services-door-window.html.
[xvii] Sun Journal. (2009) "Low-cost ways to reduce heating bills Savings: from 2 to 25 percent, or $20 to $500." Available online at http://www.sunjournal.com/story/304180-3/BreakingItDown/Lowcost_ways_to_reduce_heating_bills_Savings_from_2_to_25_percent_or_20_to_500/.
[xviii] U.S. Department of Energy. (2008) "Heat Pump Water Heaters." Energy Efficiency and Renewable Energy. Available online at http://apps1.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12840.
[xix] U.S. Department of Energy. (2008) "Heat Pump Water Heaters." Energy Efficiency and Renewable Energy. Available online at http://apps1.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12840.
[xx] U.S. Department of Energy. (2008) "Solar Water Heaters." Energy Efficiency and Renewable Energy. Available online at http://apps1.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12850.
[xxi] Available online at http://www.amazon.com/gp/product/images/B001AHO8AK/sr=8-4/qid=1237264998/ref=dp_image_0?ie=UTF8&n=228013&s=hi&qid=1237264998&sr=8-4.
[xxii] Tankless Water Heater Buying Guide. (n.d.) Available online at http://www.tanklesswaterheaterguide.com/.
[xxiii] Aubuchon Hardware. (2009) "8 Simple Steps To Saving Energy." Available online at http://electrical.hardwarestore.com/learning/8-simple-steps-to-saving-energy.aspx.
[xxiv] U.S. Department of Energy. (2008) "Insulate Your Water Heater Tank for Energy Savings." Energy Efficiency and Renewable Energy. Available online at http://apps1.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=13070.
[xxv] Aubuchon Hardware. (2009) "8 Simple Steps To Saving Energy." Available online at http://electrical.hardwarestore.com/learning/8-simple-steps-to-saving-energy.aspx.
[xxvi] Available online at http://www.daviddarling.info/encyclopedia/W/AE_water_heater_tank_insulation.html.
[xxvii] Vestas. (2007) "kW – the turbine that goes anywhere." Available online at http://www.vestas.com/en/wind-power-solutions/wind-turbines/kw.aspx.
[xxviii] Available online at http://blog.energymattersweb.com/energy_insights/2009/01/22/.
[xxix] SolarEnergySouthAfrica. (2008) "Solar Panels." SolarEnergySouthAfrica - Renewable Energy Solutions. Available online at http://www.solarenergysouthafrica.com/products/solar%20panels/index_solar_panels.html.
[xxx] Available online at http://www.berryhilldrip.com/images/meter_and_sensor.JPG.
[xxxi] Bilderback, T. E., and Powell, M. A. (1996) "Efficient Irrigation." North Carolina. Cooperative Extension Service, Publication Number: AG-508-6.

[xxxii] Ghebreiyessus, Yemane. (1999) "Supplementary Irrigation for the Small Farmer." *Agricultural Marketing Outreach Workshop Training Manual.* Available online at http://marketingoutreach.usda.gov/info/99Manual/suppirr.html.
[xxxiii] Shock, C. C. "An Introduction to Drip Irrigation." OSU Malheur Experiment Station. August 2006. Oregon State University. Available online at http://www.cropinfo.net/drip.htm.
[xxxiv] Available online at http://www.concretedecor.net/All_Access/506/CD506-New_Technology.cfm.
[xxxv] Available online at http://www.washco-md.net/public_works/engineering/swmstruct.htm.
[xxxvi] Available online at http://www.washco-md.net/public_works/engineering/swmstruct.htm.
[xxxvii] Available online at http://www.washco-md.net/public_works/engineering/swmstruct.htm.
[xxxviii] Laumer, John. (2007). "'Radical' Water Saving Measures May Become the Norm in Atlanta." *Treehuger*. October 11, 2007. Available online at http://www.treehugger.com/files/2007/10/radical_green_w.php.
[xxxix] Building Commissioning Association. (2009). "Commissioning for Existing Buildings." Available online at http://www.bcxa.org/.
[xl] Heschong Mahone Group. (2003*). "*Windows and offices: a study of office workers performance and the indoor environment." Prepared for California Energy Commission. Fair Oaks, CA.
[xli] Fjeld, T. (2002) "The effects of plants and artificial daylight on the well-being and health of office workers, school children and health-care personnel." Proceedings of International Plants for People Symposium, Floriade, Amsterdam.
[xlii] Weerasinghe, Harshani. (2008) "Green Apparel: Inside Sri Lanka M&S supplier's 'green' factory." *Lanka Business Online*. May 2008. Available online at http://www.lbo.lk/print.php?nid=1217278044.
[xliii] Economist. (2008) "Get your green plants here." May 29, 2008. *The Economist.* Available online at http://www.economist.com/business/PrinterFriendly.cfm?story_id=11455047.
[xliv] Bentley Prince Street. (2007) "Bentley Prince Street's California Manufacturing Facility Receives LEED-EB Silver Certification." Available online at http://www.bentleyprincestreet.com/MeetBentleyPrinceStreet/documentation/BPS_LEED_EB_Certification.pdf.
[xlv] Bentley Prince Street. (2009) "Our LEED-EB Silver Certification." Available online at http://www.bentleyprincestreet.com/MeetBentleyPrinceStreet/LEEDEB.aspx.
[xlvi] Dansko. (2009) "Our Footprint." Available online at http://www.dansko.com/default.aspx#innersole,1.
[xlvii] Delaware Valley Green Building Council. (2008) "Green Building Tour of the Dansko Corporate Headquarters and Retail Complex." Available online at http://www.dvgbc.org/events/08events/091208/091208.pdf.
[xlviii] Gilmore and Associates. (2008) "Dansko Business Facility." Available online at http://www.gilmore-assoc.com/pdf/Dansko.pdf.
[xlix] ISA. (2006) "Actions." ISA Tan Tec, Lite Leather. Available online at http://www.liteleather.com/online/upload/index.php?act=viewDoc&docId=8.
[l] ISA. (2006) "Project 2030." ISA Tan Tec, Lite Leather. Available online at http://www.liteleather.com/online/upload/index.php?act=viewDoc&docId=9.

Appendix 4: Audit Results

The following presents the audit results received from the case-study facility.

Introduction

Figure 4.1: Layout of Campus

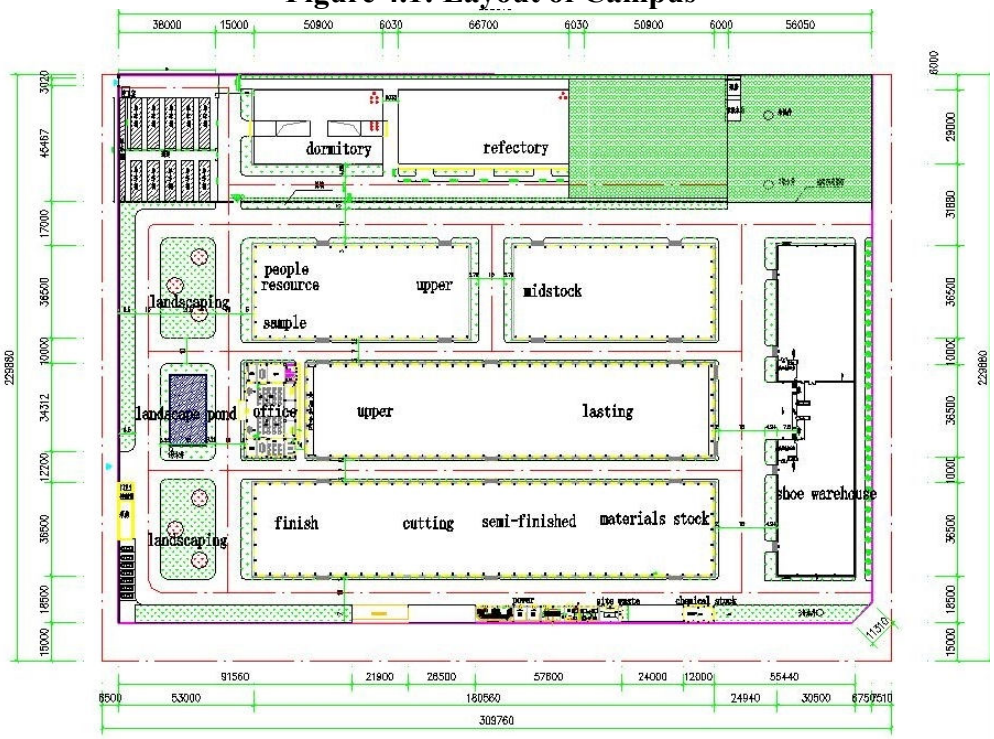


Table 4.1: Square Footage, Number of Floors, and Description of Each Building

Building	Square Footage (m^2)	Floors	Description
1	6,590.44	1	workshop (cutting, semi-finished, materials stock)
2	5,842.19	1	workshop (upper, lasting)
3	6,590.44	1	workshop (sample, resouse, midstock, etc.)
4	2,135.25	3	office block
5	7,579.70	2	shoe warehouse
6	7,469.50	5	dormitory
7	5,924.16	3	dining room (2 floors) and pastimes (1 floor)
Total	**42,131.68**	**16**	

Table 4.2: Hours per Day Facility is in Use, By Season and Day

Season	Mondays to Fridays	Saturdays
March to November	10.5	7.5
December to February	9.5	4.5

Average People Working in Facility at One Time: 2,300

Building Materials: brick wall with encaustic tile

Table 4.3: General Description of Plans and Policies in Place at BDF

Plan Type	General Description
Operating plan for building	Have been added some environmental consciousness into it
Indoor air quality policy	We have installed the exhauster on each window within each workshop.
Pest management plan/Pesticide use plan	Well keep and use pesticide each month (within a valid period), the workers who used the pesticide wear special protective tools, (gauze mask, gloves,& MSDS stand)
Sustainable purchasing policy (covering food, durable goods, office supplies, etc.)	We purchase these things on a fixed time and chose the cheap but good quality goods.
Policy on the use of sustainable/eco-friendly cleaners, paints, sealants, chemicals, etc.	Build a single chemical warehouse to split pest in the safe distance, and make out some planning for standard operate
Cleaning policy	To wax the floor in a fixed time and clean every day. For the machines, we clean and maintain on time.
Site waste management policy	Classify the site waste at any time ,and have the specialized cleaner to deal with it regularly ,
Erosion control/storm water plan	Around the factory we plant trees and lay greensward.
Maintenance/operations personnel training policy	Factory has a training system, arranging some training such as computer, operation, purchase process etc.

Energy

Electricity Costs: urban electricity cost 0.78 RMB per kilowatt hour in 2008

Table 4.4: Description of HVAC Equipment Use

	Hours in Use per Day	Description	Comments
Air Conditioner	7 hours	evaporative cooling units	From 10:00 to 17:00 in Summer
Heating	24 hours	warm pipes	From Nov 15 to Mar 15 in each year

Table 4.5: Lighting Fixture Types and Description

Type	Quantity	Hours in Use per Day (On Average)	Wattage
daylight lamp	470 pieces	10 hours	20w
daylight lamp	755 pieces	10 hours	40w
electricity-saving lamp	63 pieces	10 hours	

Note: The light bulbs used in the dormitory rooms are model T5 fluorescent (28 w).

Table 4.6: Powered Equipment Type and Description

Equipment Type	Quantity	Hours in Use per Day	Comments
freeze machine (evaporative cooling air conditioner)	85	10 hours	from June to September
printer	3	10 hours	everyday
cupboard with sterilizer	4	2 hours	everyday

Table 4.7: Fire-Suppression System Description

Type	Fire Suppressant
4 kg, 24 kg, water column	dry powder fire extinguisher, carbon dioxide, water column

Table 4.8: Power Backup System Description

Type	Fuel	Use per Month	Run Time per Use
diesel-electric set	diesel fuel	one day per month	10.5 hours for special dept.

Systems Monitored/Controlled by Computer-Based Automation Systems: used for each corridor, exit, and material in factory

Energy-Savings Techniques and Technologies:
Solar Power Energy: used to heat water for workers to wash themselves

Table 4.9: Monthly Energy Use Data

Power	30,2631.57 kilowatts per month
Diesel Fuel	1,000 liters per month

Water

General Description of Water Supply and Use: The factory has constructed one well, which can provide constantly 50°C of warm water. The water runs through the pipes and provides heats to the buildings. The water then runs back to the warm tank around the well, exiting through others pipes to be reused to wash leather in the leather department. Part of the water is reused to flush toilets within the facility.

Water Costs: 1 RMB per ton since we've drilled wells ourselves.

Table 4.10: Description of Water Fixtures and Fittings

Type	Dormitory	Refectory	Workshop	Maximum Flow Rate
Toilet	119	6	44	2.1 liters/flush
Water Saving Switch (automatic faucet)	119	6		
Tap	415	171	18	7.5 liters/minute in dormitory 12-13 liters/minute in factory
Drinking Fountain (3 taps for each)	2		4	
Shower	119			4.5 liters/minute

Table 4.11: Description of Water-Saving Systems, Fixtures, and Technologies

Type	In Place?	Description
Systems	No	
Fixtures/Fittings	Yes	water save switch
Technologies	No	
Water Recycling and Reuse	Yes	see description above

Table 4.12: Typical Water Use and Discharge for Facility

Type	Amount	Comments
Typical Potable Water Use	2,400 liters per day	drinking water machine with more faucets
Typical Water Discharge	500,000 liters per day	flowed into municipal sewage pipeline by the blowdown channel; empties into XinJi wastewater treatment station
Total Water Use	10,000 tons/month	

Note: use water gauge with flowing 50 m^3/hour and 60 m^3/hour to control water discharge.

Table 4.13: Description of Landscape Irrigation Technology

Description	Liters per Week
use the water pipe	100,000

Additional Information:
Water gauge systems in place for building, grounds, and specific equipment.
The facility does not have a cooling tower.

Other

Table 4.14: Description of Roof Materials

Location	Description
Office	plaster plate; flat
Campus	encaustic tile; angled

Table 4.15: Description of Solid Waste Amounts and Management

Amount	Comments
210,000 kg/year	burned or landfilled; no materials are recycled or reused

Table 4.16: Description of Landscaping

Area	Pesticides	Fertilizers	Native Plant Percentage
15,981.91m^2	No	No	100%

Facility Vehicles: one bus, two trucks; owned by facility

Table 4.17: Employee Transportation Breakdown

Type	Percentage
Walk	5%
Motorbike	40%
Public Transportation	15%
Drive	0%
Comments	40% live in dormitory

Ventilation System: extractor fan with filtration

Measures to Reduce Heat-Island Effects: use encaustic tile for refraction lights

Sources of Natural Light: windows, day lighting board insert into each ceiling

Pest Management Chemicals: pesticides and mice poisoning

Additional Information:
Do not use any sustainable cleaning products.
Entryway systems are in place to reduce the amount of particles entering the building at public entryways.
The building has never been commissioned.
Indoor air quality testing is not regularly performed by a third party.

Appendix 5:
Case-Study Suggestions

Suggestions for Stella Internationals' Footwear Manufacturing Facility in Hebei, China

The green retrofitting and management suggestions provided below are separated into two categories and are based off of the Green Facility Recommendations (GFR) Handbook. The Priority Suggestions are the first tier of recommended actions, and the Secondary Suggestions are meant for further consideration.

Priority Suggestions

The following suggestions were rated as priority actions because of low cost, high feasibility, or relative environmental gain:

- Insulate the hot water pipes
- Paint the roofs white
- Improve lighting efficiency through the use of occupancy sensors, dimmers, and/or timers
- Conduct a water audit
- Harvest and reuse rainwater
- Conduct a waste stream audit and implement a solid waste management policy
- Conduct noise and air quality testing
- Implement an environmentally-focused training program
- Have the building commissioned

Insulate Hot Water Pipes

The Hebei factory already utilizes geothermal water heating for both building heating and hot water needs. The water is naturally heated to 50°C (122°F) and does not require any further heating. One method to reduce heat lost in transportation and therefore increase the resultant water temperature is to insulate exposed hot water pipes. Water temperatures can be 2 – 4°F warmer than uninsulated pipes. Insulation sleeves are most often made from polyethylene or neoprene. The areas of piping used to directly heat the building should not be insulated, but the pipes leading to or from those areas could benefit from insulation. The cost can be as little as US$0.30 per foot.

Paint Roofs White

The roofs on the manufacturing facility, dorms, and other buildings can all benefit from a white coating. The reflectivity of white surfaces can reduce the surface temperature and decrease the need for cooling the building. Energy costs for cooling can be reduced up to 20% with white roofs.

Lighting Efficiency

The Hebei facilities use energy efficient compact fluorescent bulbs, so a huge energy savings has already been realized. Further energy savings can be achieved by using lighting technologies such as timers, dimmers, and occupancy sensors. Please see the GFR Handbook for further information on each of the lighting efficiency technologies. For rooms that are seldom used, such as bathrooms or storage rooms, occupancy sensors are recommended to minimize the likelihood that lights will be left on when the room is not in use. Energy savings of 30 – 80% are possible. Automatic dimmers are best used in conjunction with natural lighting. As the amount of natural light increases or decreases, the dimmers will automatically dim or increase the amount of lighting the bulb produces to keep the overall amount of light in the room constant. This helps to prevent over lighting of an area, which wastes electricity, and can save 10 – 30% of the energy consumed for lighting. Finally, if rooms need lighting at specific hours of the day, timers can be used to reduce the risk of lights being left on past operation hours. Occupancy sensors (120 volt) cost about US$30, dimmer kits (230vac) cost around US$45, and timers can cost US$15 – $20.

Water Audit

The audit and follow up questions sent to the Hebei facility specify that 309,000 liters of water are used per day at the facility, though the discharges to sewer are listed at 500,050 liters of water per day. Unless the audit results have been misunderstood, this implies that there is a large input of water (nearly 200,000 liters per day) that is unaccounted for. This, in conjunction with the lack of sub-metering of water at the facility, makes it hard to put forward specific recommendations. As a first step to reducing water use, we suggest that the facility place sub-meters throughout the campus to monitor water consumption for the areas outlined in the water-specific audit below.

Total Water Used/Withdrawn (liters)
Total Water Discharged (liters)
Total Water Used in Bathrooms (liters)
Total Water Used in Irrigation (liters)
Total Water Used in Factory (liters)
Other Water use (liters)

We recommend finding these numbers and using the GFR Handbook to determine what changes can be made to improve water-use efficiency.

It is worth noting several areas at which the facility is clearly excelling with regard to water efficiency. The plumbing fixtures used in the buildings exceed even the ultra-high efficiency standards within the United States. The faucets used in the facility are the only exceptions. While the factory faucets may need to have high flow for manufacturing

purposes, the bathroom faucets can gain of 75% in water-use efficiency if ultra-high efficiency 1.2 l pm faucets are installed. We recommend this change be made as it has the potential to lead to significant resource savings.

Rainwater Harvesting

We recommend the installation of a rainwater collection system and cistern to be used for irrigation. Rainwater harvesting is the practice of collecting rainwater from roofs by using eave-mounted gutters and piping systems to siphon water into a cistern or collection tank. This water can then be stored until needed for use. Cistern water is not potable and should only be used for irrigation, flushing toilets, and washing down equipment.

Based on the information in the audit we have determined that the roof area available for rainwater catchment is approximately 32,100 m^3. The average precipitation for the Hebei Province is highly variable but is generally between 12 and 24 inches per year. If we assume that only half the roof space is used for rain catchment, and the efficiency of the catchment is 75%, then installing a rainwater catchment and cistern system can yield from 3.6 – 7.3 million liters of water per year. Given that the facility audit states that 100,000 liters of water are used per week (5,200,000 liters per year) to irrigate, the facility can offset all or most of their irrigation water use with rainwater, which would otherwise exit the property as runoff. While this provides little direct financial benefit in the short-term, having a readily available water source increases future resource security. This is especially important given China's growth trends and concerns over groundwater overdraft. Having a readily available supply of essentially free water will avoid this problem if it is encountered in the future. A cistern able to hold 3,000 gallons of water should cost about US$1000 to build in-house. Constructed cisterns will cost about US$950 for a 7,570 liter galvanized steel tank, or US$10,000 for a 37,850 liter fiberglass tank.

Waste Stream Audit and Solid Waste Management Policy

According to the audit, all waste at the facility is currently landfilled or incinerated. To determine how waste can be reduced, reused, composted, and/or recycled, conduct an audit of all waste generated at the facility, cataloging the types and amounts of waste produced weekly and determining what types of waste can be reused, composted, and recycled. Based on this audit, develop a solid waste management policy to encourage waste reduction and ensure that reusable, compostable, and recyclable wastes are disposed of properly. This plan should also ensure that any products containing toxic materials, such as mercury-containing compact fluorescent lightbulbs (CFLs), are disposed of properly. The Joint US-China Cooperation on Clean Energy (JUCCCE) recently launched a CFL recycling program in China, which is one option for disposing of CFLs properly. For more information on the program, see: http://www.tcpi.com/corp/TCP_JUCCCE_Recycling_Program.aspx.

For food waste that is produced at the refectory, implement a composting program. In conjunction with an onsite garden, composting has several economic advantages. It lowers waste removal costs by reducing solid waste. Also, it is a low cost fertilizer, eliminating the cost of purchasing fertilizer. Lastly, it reduces the need for pesticides and water.

Noise and Air Quality Testing

Have a third party conduct onsite air quality and noise pollution assessments. Contact one of the following consultants recommended through the American Industrial Hygiene Association (AIHA) website (http://www.aiha.org/Content/AccessInfo/consult/consultantsearch.htm) to complete testing:

- ESIS Global Risk Control Services (Shanghai) - www.esis.com/rcs
- Golder Associates (Shanghai and Yau Ma Tei) - www.golder.com
- Hygiene Technologies International, Inc. (Beijing) - www.hygienetech.com
- International Safety Systems, Inc. (Shanghai) - www.issehs.com

Through our communications with Hygiene Technologies International, Inc., the following steps were suggested:

1. Complete a qualitative survey using a sound level meter, velometer (measures air movement), photo ionization detector (PID – measures VOCs), and an indoor air quality (IAQ) meter. Approximate cost is US$1000 plus transportation expenses.
2. Based on results of this testing, a more quantitative survey could be completed which includes both chemical and noise exposure testing. Approximate cost is US$1500 - US$2000 per day

Training

Develop a training program for employees and managers to educate about and encourage conservation behavior. This program should explain why conservation behavior is important, focusing on environmental issues relevant to the area and to China, such as drought and air pollution.

The program should including the following activities:

- Ensuring that building management systems are used as effectively as possible to obtain the highest possible energy and water efficiency.
- Using only as much heating and cooling as is needed, which will reduce water and electricity usage.

- Using only as much lighting as is needed.
- Turning off all lighting and electronics when not in use and at the end of each day. Designating one person to ensure that everything is turned off.
- Using only as much water as is needed.
- Waste reuse, composting, and recycling.

Commissioning

Implement an existing building commissioning (EBCx) process for the buildings to ensure that all building systems are functioning optimally. Please see the GFR Handbook for further information on building commissioning. In China, Facilities Analysis & Control Ltd (http://www.fac-ltd.com/china/index_en.htm) performs building commissioning.

Secondary Suggestions

The secondary suggestions listed below are ideas that should be considered but may be cost prohibitive or infeasible, which we could not determine based on our limited information.

- Install solar tubes
- Install wind turbines or solar panels for on-site electricity generation
- Purchase environmentally-friendly vehicles
- Grow an organic garden
- Landscape for natural cooling

Solar Tubes

Solar tubes are a cost effective method for indoor lighting without using electricity. Solar tubes are not rated as a priority simply because we lack sufficient building information to determine the feasibility of installation. Installation costs are around US$200 – 300 per tube depending on length. If desired, solar tubes can stretch multiple stories. Please see the GFR Handbook for more information.

Wind Turbines and Solar Panels for On-Site Electricity Generation

Electricity shortages are an ongoing concern that can be solved by installing on-site wind turbines or solar panels. The Hebei region gets an average of 2,500 – 3,100 hours of sunshine per year and has a frost-free period that lasts between 120 and 200 days. Therefore a modest solar system could enhance or offset electricity usage during the day. A very large wind power farm is being built in Hebei, which supports the possibility of productive wind conditions in the area. In order to determine how much wind and solar power could be retrieved from the facility campus, an on-site examination must be performed. Solar panel costs are still high, ranging from US$3 – 4 per kWh installed, but

costs are dropping, and government subsidies may be available. According to some retailers, a 10kW turbine costs around US$23,900 with very minimal maintenance costs after installation.

Environmentally-Friendly Vehicles

When company-owned vehicles need replacing, purchase low emission and fuel efficient vehicles or ideally, alternative fuel vehicles. For more information on these types of vehicles, please see the GFR Handbook.

Organic Garden

Construct an on-site organic garden for growing food. This accomplishes several goals. First, it reduces the environmental footprint of the food, as it does not have to be transported. Second, the quality of the food is improved due to freshness and elimination of harmful pesticides. Finally, residents of the campus are able to participate by choosing which foods to grow and possibly tending the garden themselves.

Landscaping for Natural Cooling

Create landscaping that enhances the natural cooling effects of vegetation on buildings. This can be accomplished by planting trees and shrubs with dense foliage downwind of or above air inlets. In summer months, the trees act as natural evaporative coolers, reducing energy costs. Water requirements of vegetation should be considered as some plants can be very water intensive.