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DEVELOPING A BANK-WIDE ENERGY CONSERVATION PROGRAM

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This project report is submitted in partial fulfillment of the degree requirements of Worcester Polytechnic Institute. The views and opinions expressed herein are those of the authors and do not necessarily reflect the positions or opinions of FirstBank or Worcester Polytechnic Institute.

This report is the product of an education program, and is intended to serve as partial documentation for the evaluation of academic achievement. The report should not be construed as a working document by the reader.

ABSTRACT

This report presents the research, methods, analysis, and results of the creation of an energy conservation program for FirstBank of Puerto Rico. Opinions and ideas from different departments of the bank were incorporated into the final recommendations for a truly bank-wide energy conservation program. With the implementation of this program, FirstBank can save an estimated $103,000 to $301,000 annually, while furthering its image as Puerto Rico's "green" bank through energy conservation.

AUTHORSHIP PAGE

The contents of this report were written equally by the two members of the research team, Shawn Hallinan and Joseph Ho.

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With the implementation of this bank-wide energy conservation program, FirstBank of Puerto Rico can save an estimated $103,000 to $301,000 in energy expenses. In addition to the financial savings, the bank can also complement its image as an institution concerned with the preservation of the natural space of Puerto Rico.

Estimated Range of Savings through Energy Conservation		
	Low	**High**
Lighting	$ 25,000	$ 31,000
Air Conditioning	$ 78,000	$ 270,000
TOTAL SAVINGS	**$ 103,000**	**$ 301,000**

Background

Energy production using fossil fuels has negative effects on the environment. Carbon dioxide emissions into the atmosphere from energy production have led to global warming in recent decades, and the increasing need for energy due to the growth of the world economy has raised concerns regarding energy generation and how it affects the environment. In Puerto Rico, the economic growth in recent years has increased the demand for energy production on the island, which relies mainly on petroleum oil. In 1999, carbon emissions from burning petroleum oil in Puerto Rico equaled one third of the total carbon dioxide emissions in the United States, raising concern among environmentalists and others.

The increased worldwide concern for the environment has sparked "green" initiatives in many companies worldwide. Through energy conservation programs, waste management, and recycling plans, these companies are saving money and earning recognition for their efforts. One such company is FirstBank of Puerto Rico, a bank that promotes protecting and saving the island's natural environment. FirstBank has an opportunity to reduce its energy consumption in order to cut energy expenses, while at the same time promoting its environmentally friendly image.

This report presents the results of the research for and development of a bank-wide energy conservation program for FirstBank. Two students from Worcester Polytechnic Institute examined the energy usage at 19 branches of FirstBank that account for 80% of the total energy usage for all branches. The visits to the branches included gathering an inventory of lights, recording air conditioner temperatures, surveying employees about comfort, and obtaining information about branch operations from managers. We examined past electricity invoices of the branches to determine energy costs and usage. In addition, we interviewed key bank executives and personnel to understand the bank's perspectives on energy conservation.

Findings

We categorized branches by size (small, medium, large) and age (older, newer) to enable comparative analysis. Analysis of the data revealed patterns in energy usage and opportunities for energy conservation. We divided these results from our research into three major categories: case studies of energy conservation, lighting, and air conditioning:

Case Studies of Energy Conservation:

- Wells Fargo Bank plans to save $650,000 annually through the installation of fluorescent lights and motion sensors, and standardizing air conditioning temperatures to 76° from 68°
- Hilton Hotels Corporation saved $4 to $5 million annually through turning lights off in unoccupied rooms, installing energy efficient lighting, and cleaning dirty skylights

Lighting:

- An estimated 13% of the total energy usage by branch is from lighting; it accounts for 3% to 44% of the energy usage in the newer to older branches, respectively
- 65% of employees surveyed felt that lighting levels were adequate; 27% of employees felt that lighting levels were a little dark or too dark
- There was no standard of lighting among branches: wattage ratings of the fluorescent bulbs included 32W, 34W and 40W, and lighting fixtures contained 2 to 4 bulbs
- Lights in bathrooms, storage rooms, and break rooms were left on for most of the day, if not all day, in most of the visited branches

Air Conditioning:

- Air conditioning accounts for 45% of the bank's total energy usage, according to a previous energy study done on FirstBank by Global Energy Solutions in 2001; the bank spent approximately $650,000 on air conditioning in 2001
- 45% of employees surveyed felt that the branches were either much too cold or a little cold
- The average actual temperature in the branches was 70.9°; this is below the Energy Star Label for Buildings' acceptable cooling temperature range of 73° to 79°
- Every increase of 1° in temperature, up to 78°, will reduce air conditioning energy usage by 8%

Recommendations

Based upon our research and analysis of results, we make the following recommendations. We conclude that FirstBank can save a significant amount of money on energy expenses through the partial or full implementation of our bank-wide energy

conservation program. In addition, the bank can use our project as a way to complement its "friend to the environment" image.

Lighting:

- Incorporate a standard of lighting in branches: reflective fixtures using 32W fluorescent bulbs (Sylvania Octron 4100K F032/741)
- Install motion sensors in all bathrooms, storage rooms, and break rooms
- Set up a regular maintenance schedule (every 3 to 5 months) for light cleaning and replacement

Air Conditioning:

- Standardize all branch temperatures to 76°, or to a temperature within 73° to 78°
- Set up a regular maintenance and check up schedule for air conditioning units and building enclosures

Marketing, Public Relations, and Employee Incentives:

- Send press releases to local newspapers informing of energy conservation efforts within the bank
- Offer employee incentives, such as recognition awards or monetary awards taken directly from the savings, to promote energy conservation

Energy conservation is important in many aspects. It can save companies money and help the environment by reducing the amounts of energy consumed. The above recommendations are intended to reduce energy expenses at FirstBank by $103,000 to $301,000, to encourage employee participation in the bank's energy conservation efforts, and further the bank's image as Puerto Rico's "green" bank.

I. INTRODUCTION

The production of energy has direct effects on the environment. The growth in the global economy throughout the 20th century has increased energy demand and production, which has led to increased pollution of the environment. In particular, Puerto Rico's economic growth in recent decades has raised the awareness of energy production and how it affects the island's natural space. This global environmental concern has caused many businesses to go "green;" businesses are becoming more and more concerned with the environment. Companies have done numerous things to protect the environment, such as recycling, waste management, and the reduction of energy usage. In addition to preserving the environment, businesses can also save money by being "green," managing waste more efficiently and using less energy.

FirstBank of Puerto Rico is a bank that is recognized for its dedication to protecting and saving the natural space of Puerto Rico. It is one of the largest banking institutions in Puerto Rico, with nearly 50 branches spread across the 100-mile wide island. Although preserving the environment is a concern for the bank, it is a business; finances are a main concern for the bank. The bank realizes that by reducing its energy consumption, it will be able to save money annually on energy expenses, in addition to upholding and complementing its environmentally friendly image. The development of an energy conservation program would bring FirstBank financial savings, in addition to an improved relationship with the community and environment of Puerto Rico.

Other banks in the United States have already been successful in their energy conservation efforts. Wells Fargo Bank used many simple and basic energy conservation techniques, and is currently on its way to saving over half a million dollars annually on energy expenses. Banknorth Massachusetts, formerly known as FirstMass, updated their heating and cooling systems and has saved more than $35,000 annually. The success of the energy conservation initiatives of Wells Fargo Bank and Banknorth Massachusetts demonstrates that there exists potential for banks and other companies to save money by conserving energy using the numerous energy saving techniques and strategies available.

The main goal of this project was to research, develop, and recommend a Bank-Wide Energy Conservation Program for FirstBank of Puerto Rico that would save the bank money, encourage employee participation in energy conservation, and complement the community's perspective of FirstBank and its dedication to the preservation of the island's natural space. Often times, worker productivity is improved by increasing energy efficiency, because the quality of the work place is improved. Also, implementing energy conservation techniques will allow the bank to further market itself as a bank that is dedicated to preserving the environment.

Our research involved conducting small-scale energy audits at 19 branches of FirstBank and interviewing bank executives and personnel. Results from our visits and interviews were analyzed in the creation of our bank-wide energy conservation program. This project has the potential to significantly reduce energy costs for FirstBank, while maintaining or possibly improving the quality of the work environment for its employees. Associates of FirstBank and members of the Puerto Rican community may see the bank's energy conservation effort as a pioneering effort, possibly increasing community

awareness of the energy and environmental challenges facing Puerto Rico. While there exist many possible business-oriented benefits to this project, the future of the Puerto Rican natural environment may depend on initiatives such as FirstBank's Bank-Wide Energy Conservation Program.

II. BACKGROUND AND LITERATURE REVIEW

The rise in the global economy over the past decades has heightened the need for energy. Puerto Rico's economic development has resulted in a rising of demand for energy that is produced mainly by petroleum oil. This chapter investigates the current and future roles and costs of petroleum oil as a significant global source of energy, and its effects on the environment. The environmental impact of generating energy using petroleum has caused concerns in many countries and businesses around the world, and has led to energy conservation initiatives to save money and protect the environment. This chapter will also investigate the methods, results, and benefits of these energy conservation initiatives in an effort to provide a background for the development of an energy conservation program for FirstBank of Puerto Rico.

Petroleum Oil: A Source of Energy and an Threat to the Environment

Fossil fuels are "any naturally occurring fuel of an organic nature formed by decomposition of plants or animals" (American Heritage Dictionary). Petroleum, derived from the Latin words for "rock oil," is a fossil fuel obtained from drilling deep beneath the earth's surface. Petroleum oil has been the world's main source of energy, accounting for 40% of energy production from 1990 to 1999 (EIA of DoE, International Energy Outlook 2000). In the past, it has been the energy source of choice due to its supply and costs; oil was plentiful and cheap throughout most of the twentieth century (www.iclei.org). Petroleum was, and still is, widely used as a transportation fuel, as a source of electricity generation, and as a source of heat.

Energy production using fossil fuels, specifically petroleum, however, is very harmful to the environment (www.epa.gov). The combustion of petroleum in the energy production process releases large amounts of carbon dioxide (CO_2) into the earth's atmosphere. The amount of CO_2 deposited into the atmosphere has been identified as one of the main contributors to global warming (www.iclei.org).

During the 1990s, over 2,500 million metric tons of carbon from petroleum alone was emitted into the atmosphere (EIA of DoE, International Energy Outlook 2000). Figure I shows the rising rate of carbon dioxide emissions during the 1990's.

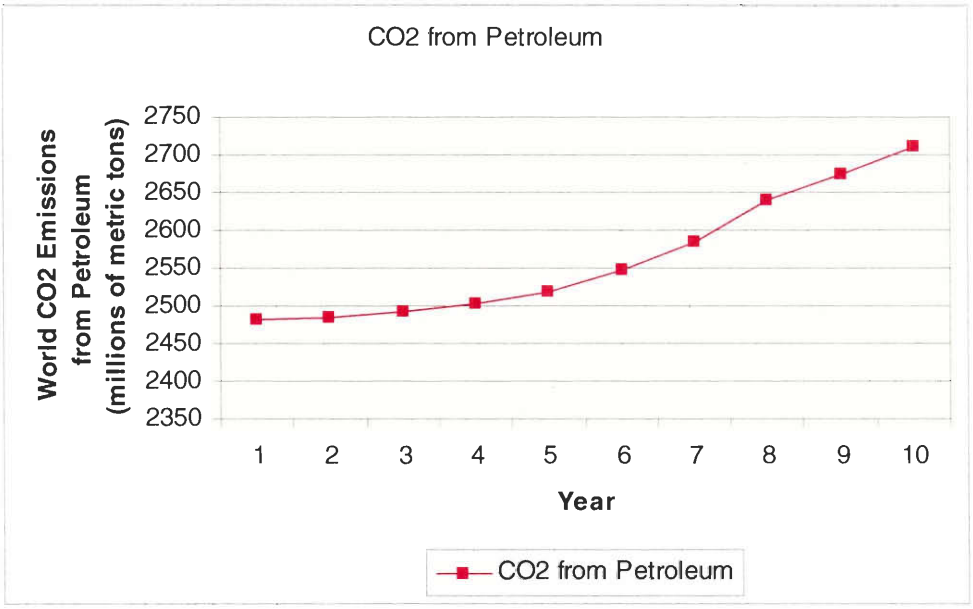


Figure I. World Carbon Dioxide Emissions from Petroleum

(Adapted from Table H2 – International Energy Outlook 2000, EIA of DoE)

This carbon emissions figure is expected to rise, as the demand for energy is projected to increase due to projected growth in the economy over the next twenty years. The expected growth of population, labor, and productivity has led to a positive outlook for the growth of the United States economy (EIA of DoE, Annual Energy Outlook 2002). The United States Department of Energy (DoE) projects that the United States' gross domestic product (GDP) will grow at an annual rate of 3.4%. This projected growth in the economy has resulted in the projected increase of energy consumption through the year 2020, calling for increased energy production. In turn, this increased energy production will deposit more amounts of CO_2 into the environment, adding to the pollution already present.

It is projected that the world's dependency on oil as an energy source will remain significant through the next twenty or so years (EIA of DoE, International Energy Outlook 2000). As shown in Figure II, the United States Department of Energy estimates that approximately 40% of the world's total energy consumption will be from petroleum oil until the year 2020, despite predictions that the use of alternative energy sources will increase, and so projected carbon dioxide emissions from the use of this oil are also high.

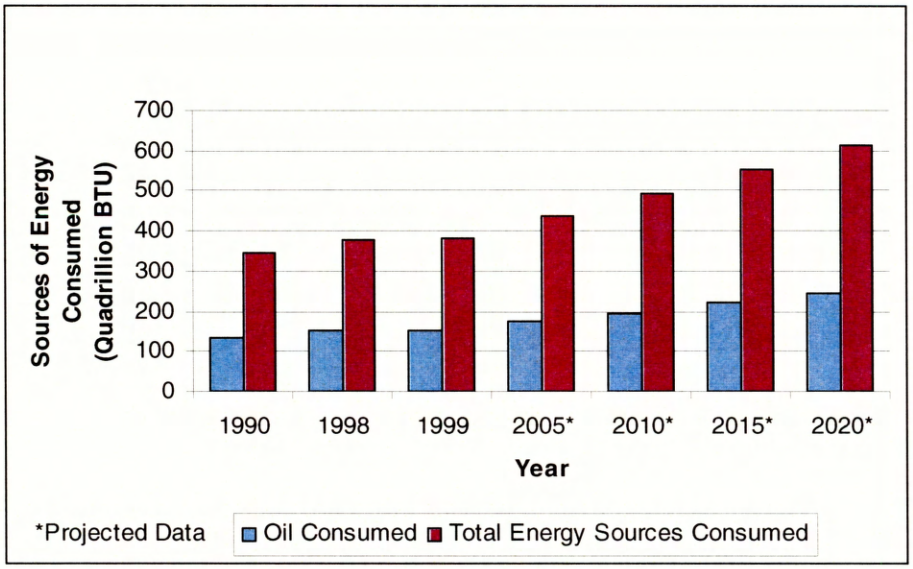


Figure II. Sources of Energy Consumed from 1990 to 2020 (in Quadrillions of BTU)

(Adapted from Table A2 "World Energy Consumption" – International Energy Outlook 2002, EIA of DoE)

The United States Department of Energy Annual Energy Outlook 2002 predicts that the carbon emissions from burning petroleum in the United States in 2020 will equal 43% of the nation's total of carbon emissions. This problem does not affect the United States alone; world carbon emissions are estimated to increase by 62% from 1999 to 2020 (EIA of DoE, International Energy Outlook 2002).

Puerto Rico: Growth of Economy

Puerto Rico's economy has undergone several important shifts since the beginning of the century. At the beginning of the century, the island relied on agriculture. However, after the depression of the 1930's, the United States government introduced Operation Bootstrap, which brought long-term tax exemptions, making manufacturing a significant force in the island's economy (Glaude, 1998). Now, the Puerto Rican economy appears to be shifting again as services become a major focus, and companies take advantage of their geographic position by serving as the middlemen between the advanced economy of the U.S. and the low-skill economies of South and Central America (Glaude, 1998). Ever since Operation Bootstrap was implemented, the island's per capita income has been the highest in Latin America (World Almanac and Book of Facts, 2001).

Puerto Rico's economy experienced positive growth during the 1990's. In those years, many corporations turned to Puerto Rico as their primary business location. There is great competition for Puerto Rico's high potential for economic growth (PRNewswire, 2000 February 14). As Figure III shows, during the fiscal years of 1993, 1996, and 1999, Puerto Rico's percent change in real gross national product (GNP) was higher than the real GNP growth rate of the entire United States. Figure III illustrates the positive growth

experienced by the island during the 1990's. Note the percentage growth from 1993 through 2000; the percentage growth was greater than 2.5% for those 7 years. This rate of economic development has raised the demand for energy.

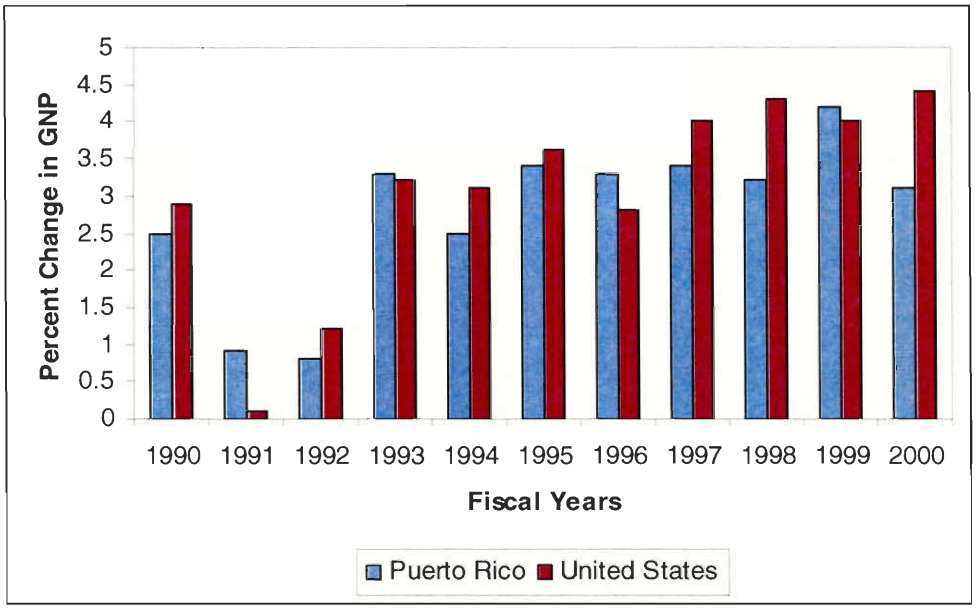


Figure III. Real GNP Growth, Puerto Rico and U.S.
(Adapted from "A Glance at Puerto Rico's Economy," p. 1)

Puerto Rico: Energy and Environment

Puerto Rico's main electric utility is the Puerto Rican Electric Power Authority (PREPA). PREPA provides the entire island with electricity produced by petroleum oil, the primary source of fuel for energy on the island. In the late 1990's, petroleum oil accounted for nearly 98% of the island's energy production, with the remaining 2% coming from hydroelectric sources (EIA of DoE – Puerto Rico; "The Price of Oil Affects Your Bill," 2000). The generation of energy using petroleum oil has produced great amounts of pollution in Puerto Rico. The burning of oil emits massive quantities of carbon dioxide into the atmosphere. In 1999, it was estimated that the carbon emissions from oil burning in Puerto Rico alone equaled one third of the carbon emissions of the whole United States (http://www.eia.doe.gov/emeu/cabs/prico.html).

Emissions from oil have caused great concern for the Puerto Rican environment (Edwards, 1998). The large amounts of pollution from burning oil have recently prompted the island to seek cleaner alternatives for energy (EIA of DoE – Puerto Rico). Liquefied natural gas (LNG) was recently introduced as an alternate source of energy in Puerto Rico. The EcoEléctrica power plant started commercial operation in March of 2000, producing electricity using LNG, a cheaper and cleaner type of fossil fuel, and reducing Puerto Rico's dependence on petroleum from 98% to 81%. Using LNG as a source of energy can also decrease the pollution caused by energy production on the

island (Davis, 2000). Another alternative energy source on the island is the planned AES power plant. This power plant, scheduled to start its operations in 2002, will assume 15% of Puerto Rico's electricity demand (www.aesc.com). This plant will produce its energy by burning coal, the third type of fossil fuel. Coal is a cleaner alternative to petroleum; it releases less carbon dioxide into the atmosphere at combustion time.

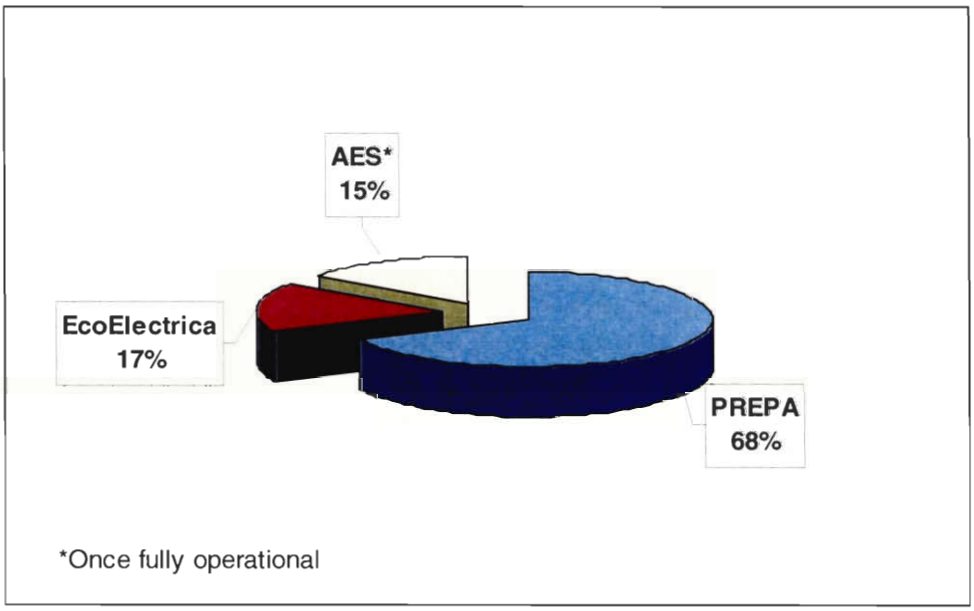


Figure IV. Percentage of Energy Generated by Utility

(Adapted from "A Glance at Puerto Rico's Economy," p. 23)

When the AES power plant is fully operational, the island's dependency on petroleum oil will be reduced even further. Figure IV illustrates the projected distribution of energy production when the AES plant is operational, with petroleum oil accounting for only 68% of the production and the remaining 32% being attributed to the AES and EcoEléctrica plants. This reduction in oil use promises to reduce the amounts of emissions of carbon dioxide into the Puerto Rican environment.

"Green" Businesses: Who, What, Why, and How?

The relationship between energy generation and the environment is a major concern for Puerto Rico and the rest of the world (Air/Water Pollution Report, 2001 July 16). Organizations such as the World Bank and the United States Environmental Protection Agency (EPA) have created and adopted guidelines that many businesses and organizations implement and follow to reduce their energy consumption while being environmentally friendly.

Accordingly, in recent years, many businesses around the world have attempted to convert to green businesses. A green business is one that focuses on a product design, energy efficiency, materials, and waste management that considers the environment

(Bogo, 2000). A growing number of businesses have embraced the idea that their company's financial success is directly correlated to how much they help the environment and society (Forsman, 2000). This is a new trend in the business world. The thought used to be that environmentalism obstructed capitalism; however, Clinton J. Andrews, Professor of Industrial Ecology at Rutgers University, has gone so far as to claim that not only do capitalism and environmentalism now go hand in hand, but capitalism is now good for the environment (Forsman, 2000).

The growth of green businesses has been motivated by a number of reasons. Using energy efficiently can save money and help preserve the environment. In addition, a company's stock valuation can be increased by an increased environmental awareness. In fact, Dow Jones has created the Sustainability Group Index, which ranks businesses for investment purposes centered on their performance in areas involving the environment and society (Forsman, 2000).

Many companies are motivated to become green; however, they may lack a plan to do so. One organization that helps companies prosper while being environmentally aware is the Business for Social Responsibility (BSR). BSR is a nonprofit organization that provides businesses with advice, information, and opportunities to achieve success while still respecting the environment. They maintain that businesses must regard their social responsibility as a vital part of their mission because more and more investors and consumers are requiring them to be responsible for their actions relating to the environment and society. This is illustrated by the following chart from their website; it is a good example of how consumers are looking for businesses to focus on more than just profits. BSR helps these businesses do that.

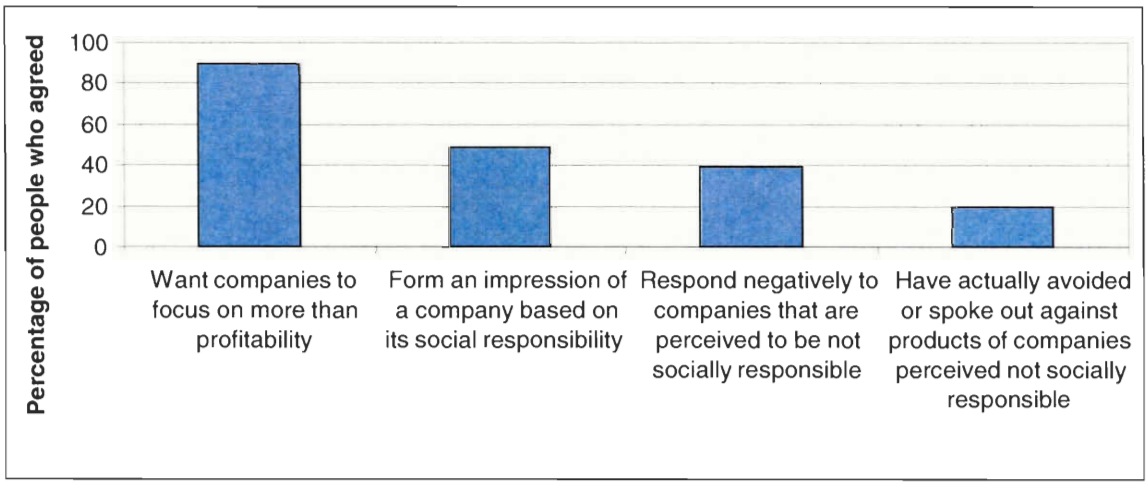


Figure V. Survey Results on A Company's Societal Awareness (Adapted from chart at www.bsr.org)

Companies that are able to transform themselves into green businesses receive many benefits for their work. One is in marketing. Many companies have used their environmental responsibility as a way to strengthen their image and reputation. According to *E* magazine, in the United States, consumers spend about $110 billion every

year on products they identify as "socially or environmentally progressive" (www.bsr.org). Also, a 1999 report by the Aspen Institute shows that companies that combine environmental factors into their business decisions are starting to see rewards from financial institutions and insurance companies (www.bsr.org). Another advantage of being environmentally friendly can be the improvement of worker productivity. Reducing energy consumption during peak hours of operation can give a company the ability to negotiate lower prices for their electricity (www.bsr.org). These bonuses that companies can take advantage of by being environmentally aware are only further motivation for them to become green businesses.

There exist many methods by which a business can promote and uphold their commitments to protecting and preserving the environment. Implementing these commitments can differ from company to company, depending on the company's size and culture setting (www.bsr.org), but there are basic ideas and principles that are common to environmentally friendly businesses. Companies can adopt and endorse environmental policies in which they express their environmental commitments in their mission statements. These policies could include a business' environmental goals and standards and explain its compliance with local environmental laws and regulations (www.bsr.org). They can also show their concern for the environment through their products and operations. With such policies in place, businesses can improve their own respective operations and practices, while improving relations with their customers and clients.

Other practices which businesses can adopt in order to promote the environment include recycling, employee and community involvement, and energy efficiency (www.bsr.org). Some companies have initiated "zero-waste" policies that promote the reuse of everything consumed by the company (www.bsr.org). Employee and community involvement can also play a big factor in a company's mission to be environmentally friendly. A company could educate their employees about their environmental policies in order to encourage the actual practice of the policies. Another possible way to promote employee involvement is to offer awards or incentives for their commitment to the company's environmental policies. Companies can also become involved in the community by becoming actively involved in environmental issues (www.bsr.org). This can improve a business' relations within the community and promote a better company image altogether.

Dell Computer Corporation, Forte Hotels, Ltd., The Gillette Company, and Target Corporation are just a few examples of companies that have implemented environmentally friendly strategies. Dell reduced its electricity usage for producing each computer from 11 kWh to 9 kWh per unit; its efforts resulted in an estimated 5,900-ton reduction in greenhouse emissions in 1998 (www.bsr.org). Forte Hotels, Ltd., based in the U.K., is one of the largest hotel operators in the world. It has been implementing energy efficiency measures since 1983 which has resulted in about a 28,000-ton gas emissions reduction every year (www.bsr.org). The Gillette Company set worldwide goals for both energy and water conservation in 1994. In Mexico City, it recently completed a large program of warehouse consolidation; analysis of this program revealed a 20% average savings in fuel consumption, translating into about a 1,250-ton reduction of CO_2 emissions from Gillette trucks (www.bsr.org). Target Corporation is a partner in both the EPA's Energy Star Buildings program and the EPA's Green Lights program. As

part of its energy conservation program, it has an environmental/energy management team that monitors all stores daily to ensure energy conservation (www.bsr.org). Using some of these techniques, FirstBank and other companies have the opportunity to take advantage of the many benefits that come along with being a green business.

FirstBank: Puerto Rico's "Green" Bank

One company that has an opportunity to project itself as a green business is FirstBank of Puerto Rico. It is one of the largest banks on the island, and it is recognized by its competitors as being concerned with environmental issues. FirstBank has already been involved with programs that help preserve the environment. It has worked in conjunction with the Conservation Trust of Puerto Rico, *El Fideicomiso de Conservación de Puerto Rico*, to create the "Isla Viva" program (www.firstbankpr.com). This program promotes the involvement of bank customers in the Conservation Trust of Puerto Rico and helps inform customers of the serious environmental issues that exist on the island. Every time a customer opens an account and makes transactions under the program, FirstBank makes a 5 cent donation to the Conservation Trust; the bank has already donated approximately $100,000. According to Josianne Rosselló, Senior Vice President of Marketing and Public Relations at the bank, this program has been extremely popular with the public.

FirstBank has also attempted to get its employees involved in its efforts to preserve the environment. Last year, it held a branch wide contest in which each branch was asked to do something beneficial to the environment. Each branch took pictures and wrote a synopsis of their environmentally friendly acts, and there was a competition among branches to see which had accomplished the most. More than half of the branches participated, so the contest was considered a success (Josianne Rosselló, personal correspondence, April 17, 2002). FirstBank's concern for the environment has opened the doors for them to become a "green" business.

Dell, Forte Hotels, Gillette and Target, as discussed in the previous section, are models that FirstBank can use to further its image as one concerned with the environment. FirstBank's mission is, "to be the primary banking institution in Puerto Rico, growing as the community and the economy of the island grows" (www.firstbankpr.com). With the growing environmental troubles on the island, FirstBank has the opportunity to further itself as Puerto Rico's "green" bank.

Energy Conservation Initiatives: What Companies Have Done to Save Money and Protect the Environment

There are many financial benefits to reducing energy consumption, in addition to promoting a clean environment. Businesses are institutions concerned with money and profit. Through energy conservation, businesses not only have the ability protect the environment, but also to reduce energy expenses. Many companies have researched, adopted, or improved their respective energy conservation methods. IBM Corporation, Johnson & Johnson, and Pitney-Bowes are just a few examples, in addition to those

stated in the previous sections, of major companies who have taken the challenge to conserve energy and cut back on energy-production pollution (PRNewswire, 2001 September 20). More and more companies are adopting energy conservation programs throughout the world in an effort to lower energy expenses and to promote a cleaner environment (Edwards, 1998).

Many businesses have attempted measures such as reducing lighting and shutting down office machines when possible (Trombley, 2001). Even measures that can be taken at home can also be implemented in the office. For example, Steve Greenburg, who received an award from the United States Department of Energy for fine-tuning the design of the mechanical systems for the National Energy Research Scientific Computing Center, has transformed his home into a virtual laboratory for energy efficiency measures (James, Mary, 2002). He replaced any light that is used often with either a CFL (compact fluorescent light) or a hard-wired fluorescent bulb. Such simple measures can greatly reduce one's daily energy consumption.

Wells Fargo & Co. Bank has begun implementing an energy conservation plan using widely available energy reduction strategies. Wells Fargo has already installed fluorescent lighting and electrical ballasts in its California banks (Gair, 2001). Future plans include maintaining cooling system temperatures at 76° instead of between 68° and 72°, and installing timed motion sensors to turn off lights in rooms that are not in use. From their first quarter energy prices, the bank plans to save $650,000 annually with an energy cost reduction of about 8.6% per branch (Gair, 2001).

Hilton Hotels Corporation also used energy conservation strategies in order to save money on energy. Some of Hilton's methods included turning off all lights in unoccupied rooms, installing energy efficient lighting in all rooms, cleaning dirty skylights to improve illumination levels of natural light, and scheduling meetings and cleanings to maximize the use of daylight (Gair, 2001). As a result of their work, they saved $4 to $5 million annually, and they won the Energy Star award for savings (Gair, 2001).

Another good example of saving money using energy conservation strategies involves students from Loyola Marymount University. The United States Department of Energy pays the cost of the Loyola Marymount program that trains a team of students to detect over-usage of energy in manufacturing plants. Each student receives class credit and $204 for each inspection (Pool, 2001). The students use many energy saving strategies such as installing skylights, using new bulbs, and putting reflectors on fluorescent ceiling lights to cut electricity use. They have already saved seven small businesses an estimated total of $2.2 million this year. These students have also recently inspected 10 other firms and expect that savings figure to double (Pool, 2001).

These cases are evidence that energy savings can have a substantial effect on a company's finances. Savings in energy costs can be significant by taking simple energy conservation measures.

Energy Conservation: How Companies Are Doing It

Energy conservation has become a main focus for many companies as a way to reduce spending and improve public relations. Most companies focus upon areas in their

facilities where most of the energy is used, such as the heating and ventilation systems, lighting, and the actual building enclosure itself. By improving and updating these areas, companies have saved significant amounts of money. This section will examine each of these areas in depth, giving specific cases in which each area has made a difference in a company's energy costs.

HVAC Systems

Heating, ventilation, and air-conditioning (HVAC) systems are important to any commercial or residential building. The HVAC system's main purpose is to control indoor air quality by regulating temperature and humidity throughout the building (Turner, 1997). HVAC systems are extremely important, because their job is to maintain the comfort level of every occupant of a particular building. However, occupant comfort is not the only reason to look at when considering HVAC system performance. HVAC systems consume an average of half of a commercial building's total energy (Fafard, 1997). Due to the amount of energy needed to operate these systems, analyzing and refining a HVAC system's efficiency and performance can potentially yield savings in energy costs for building management. The United States Department of Energy estimates that for every degree that an air conditioning system is raised, up to 78°, there is an 8% decrease in energy consumption (DoE Office of Codes and Standards). From this estimate, the possible energy cost savings from an HVAC system are significant.

Many types and variations of HVAC systems exist; the most common type of systems is an all-air system that focuses on airflow and temperature to provide a maximum comfort level through cooling (Turner, 1997). However, air is not the best medium for transferring heat. When heating a building to reach a comfort level, an all-water system is more efficient, because water and steam retain heat more easily than air (Turner, 1997). Combining the air and water systems yields a single system that provides both services; however the combined system is energy inefficient.

There are several different factors to consider when evaluating the performance of an HVAC system. Factors such as building size, environment, and usage should be carefully considered. Comfort level, air quality, airflow, and ventilation are also important things to examine. In order to achieve full efficiency of a system, regular maintenance should be performed on it. Automatic temperature controls and sensors will also help maximize the efficiency and performance of a system. Maximum effectiveness of a HVAC system can be obtained by balancing between all of these factors.

Many companies have looked to HVAC systems as a main source of cost reduction. The discount store chain Wal-Mart had introduced a totally new all-air HVAC system in one of its facilities, measuring 131,000 square feet in area. Combined with lighting improvements, the store claimed to be 50% more efficient, yielding an annual savings of approximately $75,000 (Chain Store Age Executive with Shopping Center, 1996). Filenes, a department store chain having 34 locations, chose a water-based HVAC system when building one of its stores in Massachusetts in 1996. The system saved the chain approximately $8600 annually, and is now an integral part in the prototype of any new Filenes building.

Upgrades and renovations to HVAC systems have also yielded great energy cost savings for businesses. The Greenwich Harbor Inn in Connecticut made changes to its HVAC system that are not only are expected to reduce costs but also free up space for more development. Banknorth Massachusetts, formerly known as the FirstMass, upgraded their heating and air-conditioning system. Since the upgrade, the bank has saved $36,000 annually in energy costs (Energy Conservation News, 2001 April).

Lighting

Lighting is another area in which significant savings can be attained. According to the United States Department of Energy, 30% to 60% of the energy consumed in commercial establishments is from lighting (www.energy.gov). Lighting retrofits can reduce energy expenses; also, they can improve the visual environment, which will increase worker productivity (Turner, 1997). Conversely, if the visual environment is impaired by the retrofits, then worker productivity will decrease, in which case loss of profits will overshadow energy savings. While energy savings are important, it is imperative that the quality of lighting does not decrease due to these savings.

Two things must be considered when analyzing lighting: quantity and quality. Quantity is related to three units: watts (W), lumens (l), and foot-candles (fc). A watt measures the amount of power (electricity) used over time. Lumens are the basic units of measurement for light, and quantify the amount of light emanating from a light source. Foot-candles measure the end result of watts being converted to lumens, and they express the "result" of a lighting system; they quantify the amounts of light that one sees (Turner, 1997). For bank environment, the Illuminating Engineering Society (IES) recommends 50 to 150 foot-candles as an appropriate light level (Turner, 1997). Of great importance is that many buildings are now over illuminated simply because of habit (Turner, 1997). Since energy costs are substantial, over-illumination can be an important factor in high energy costs.

The most common type of lighting technology is incandescent. However, it has the shortest life, and, according to Turner, lamp manufacturers only market them aggressively because they are easy to produce (1997). Nonetheless, there are other lighting technologies such as fluorescent and mercury vapor, whose comparable operating costs are both lower than incandescent, and yet they have longer life spans (Turner, 1997).

Lighting quality is more difficult to determine than lighting quantity, because it is a more subjective issue. It is, however, important because it can have an influence on worker attitude and performance (Turner, 1997). In fact, the Ducker Research Company Inc. performed a survey in which it interviewed facility managers from 104 companies in the United States. Results from that survey revealed a high demand for information about lighting and productivity (Lighting Study Illuminates Productivity, 2000). According to Turner, employees can work more efficiently if the lighting promotes a "work-like" atmosphere (1997). For example, drug and grocery stores use white lights to create a "cool and clean" feeling (1997).

When analyzing lighting quality, there are three things to consider: uniformity, glare, and color. Uniformity is used to determine how evenly light is spread. Uniform

lighting in large areas, however, can waste large amounts of energy (Turner, 1997). Glare is caused by bright objects in an occupant's field of view. Glare in certain work environments is a serious concern because it usually will cause discomfort, and decrease a worker's productivity. Glare can be measured by the Visual Comfort Probability (VCP), which indicates the percentage of people comfortable with the glare. A high-glare environment is generally characterized by either too much illumination and reflection, or the existence of very bright areas. The most common ways to reduce glare are by using indirect lighting or special lenses (Turner, 1997).

Color is also a very important consideration in lighting quality. The Color Rendering Index (CRI) and the Coordinated Color Temperature (CCT) are used to measure the quality of color. The CRI measures how colors appear under a given light source. It ranges from 0 to 100, with the higher number meaning colors are more easily distinguished. Usually, a CRI higher than 75 is a very good number (Turner, 1997). The CCT describes the color of the light source. It is measured in degrees Kelvin and it represents the color that an object would radiate at a certain temperature. The CCT has an influence on the atmosphere of a room. For example, hospitals and grocery stores generally use "cool" sources, while upscale restaurants seek a "warm" source to produce a candle-lit appearance. Office environments are often illuminated by cool white lamps (Turner, 1997). Although lighting quality is difficult to determine, its importance can not be overlooked.

The United States Department of Energy estimates that technologies developed during the last 10 years could reduce lighting costs by 30 to 60 percent (Trombley, 2001). There are two major lighting systems that stand out above the rest when it comes to lighting technologies: the Ergolight System (Bellet, 2001; BuildingGreen.com; Grahl, 2001) and the Fiberstars EFO lighting system (BusinessWire, Inc., 2001). The Ergolight system is an intelligent lighting system that uses computer based lighting controls, occupancy sensors, and daylight sensors. It uses software to dim or turn off the overhead fluorescent fixtures through a series of sensors that can detect if someone at a desk needs light (Bellet, 2001). The main feature of the system, however, is the MesoOptics technology, which has made it possible for the development of a new diffuser (the plastic material that fluorescent light passes through). This technology produces specific patterns of soft, uniform white light suitable for both indoor and outdoor applications. This is significant because, until this system, no practical method to control light on a smaller level has been available (Bellet, 2001). Ledalite Architectural Products Inc. located in Langley, Vancouver, produces the Ergolight system.

Numerous companies have tried the Ergolight system, and they are reportedly very impressed with its capabilities (Bellet, 2001; BuildingGreen.com; Grahl, 2001). Both the World Resources Institute (WRI) and Reynolds Metal of Richmond, Virginia have installed the Ergolight system in their companies. According to Nancy Fiefer, WRI's Director of Facilities and Office Services, Ledalite's customer service has been exceptional, and the system itself has worked well (Grahl, 2001). In addition, according to Damon Wood, the Director of Market Development for Ledalite, the success with WRI has helped the whole energy efficiency and green lighting movement (Grahl, 2001). Reynolds Metal spent $500,000 to retrofit their building with the Ergolight system. Peter Murphy, the Ledalite President, claims the lighting upgrade reduced electrical consumption by 87% in the building (Bellet, 2001). Also, many Canadian organizations

such as the Vancouver International Airport, Richmond City Hall, and the Vancouver Public Library have already installed the Ergolight system (Bellet, 2001).

The Fiberstars' EFO lighting system involves a new optical system using fiber optics which efficiently carries the visible spectrum of light. The fiber optic cables carry light instead of electricity and are free of both heat and ultraviolet radiation (BusinessWire, Inc, 2001). This new lighting system is produced by Fiberstars Inc., the world's leading supplier of fiber optic lighting. Two products are being shipped involving this technology: one for indoor use, and one for outdoor use. This system combines the advantages of both energy efficient lighting and high quality lighting (BusinessWire Inc., 2001). According to Fiberstars' CEO David Ruckert, Fiberstars' EFO is the first truly efficient fiber optics lighting system, and the system needs only about one-third to one-fourth the energy that incandescent systems in commercial settings use (BusinessWire Inc., 2001).

Although the above systems have been very effective in saving energy with lighting, there are simpler ways to save energy. One such way is through the use of occupancy sensors, also known as motion detectors. These devices turn lights on or off in response to the presence, or absence, of people in an area (Choose Green Report, 1997). These occupancy sensors are mainly used in bathrooms, small offices, and storage rooms, where lights are usually left on with no prolonged presence of people. Use of these sensors can reduce energy usage from lighting by 22% to 65% (Choose Green Report, 1997).

There are two main types of occupancy sensor technologies. Some sensors use infrared technology, which detects human body heat. Advantages to using infrared sensors are that they are resistant to false triggering and are inexpensive; however, these types of sensors cannot "see" through obstacles, such as walls or doors. The second technology mainly used in motion detectors is ultrasound. Ultrasonic sensors emit and reflect sound waves and detect changes in the reflected waves. These sensors can detect motion through obstacles, but are usually more expensive than their infrared counterparts. Through the installation of motion detectors, the energy usage of lights in unoccupied areas can be reduced greatly.

In 1991, as part of an energy-efficiency program, the State of Connecticut selected an 188,000 square foot office building to be made energy efficient. The building is about 2/3 open space and the lights are on for 14 to 16 hours a day, shut off only when the building is totally empty. These lights were wired with occupancy sensors; reported annual savings totaled $24,000 from the installations. The project cost $51,000, and the payback for the State's investment came in a little over 2 years (Choose Green Report, 1997).

Shading

The controlling of sunlight is another technique that can be used to save energy. This is especially true in a climate like Puerto Rico's where shading can be very important. There are various methods of internal and external shading. Some methods of external shading include installation of balconies, eaves, overhangs, and inset windows. Internal shading is not as effective as external shading. For one, internal shading takes

away from the window's intended purpose: to see through. It is, however, generally much cheaper than external shading at about $1 to $5 per square foot of window area.

Building Envelopes

A building's envelope is considered to be all the "components that enclose conditioned spaces and through which thermal energy is transferred to or from the outdoor environment" (Turner, 1997; Elder, 2000). These components include windows, insulation, floors and roofs. A building's envelope keeps heat out of a building while keeping cool air inside during the summer and vice versa during the winter. Leaks within a building's envelope could translate into large amounts of money wasted. It is estimated that the combination of windows and doors can account for up to 40% of a building's heat loss and gain (PRNewswire, 2001 March 12). With this, it is evident that windows and doors are easy ways to preserve building temperature and reduce costs.

One of the main components of a building's envelope is the window (PRNewswire, 2001 March 12). Quality windows that provide thermal insulation and keep drafts out play a significant role in a building's envelope. With the numbers of windows in any building, commercial or residential, the amount of heat kept in or out can add up quickly; this amount shows up in utility costs. These higher quality windows are not much more expensive than lesser quality windows, and the benefit from spending more should far outweigh the costs of replacing the windows.

There are many characteristics of windows that can make them more efficient parts of a building envelope. The number of panes of glass in the window contributes to the thermal resistance of a window (Elder, 2000). More panes of glass will result in a higher thermal seal. The gases in between panes will also help increase the thermal resistance of a window. Air, argon, carbon dioxide and krypton are examples of such gases used in between panes. Wooden or vinyl frames also offer thermal performance to the window (Elder, 2000).

Another main component of the building envelope is the door. Doors, like windows, also have the potential to allow drafts of hot or cold air into an enclosed area. There exist energy efficient doors where the core of the door is insulated and made of steel alloy or fiberglass (PRNewswire, 2001 March 12). This material prevents warping, and makes the application of weather-stripping around the door easier and more effective. Patio doors are typically made of glass, and the same energy saving principles used on windows can be used on patio doors to promote energy efficiency.

Learning and understanding the basic composition of a building can lead to a better comprehension of what makes an efficient building envelope (Elder, 2000). With knowledge, one can make a decision of whether to replace just the windows, both windows and doors, or neither, depending on the situation.

Employee and Customer Comfort: It Matters

In businesses such as banks, workers' and customers' comfort is vital to the prosperity of the company (Ebben, 2001). Energy cost savings are important to the business; however, if these savings have a negative effect on worker productivity and

customer satisfaction, then the loss in productivity and profits can overshadow the savings. In analyzing comfort levels, it is essential to look at specific factors such as lighting, heating, cooling, and air quality (Holness, 1990). These are the elements that affect energy costs the most and so it is important when attempting to reduce energy costs that the comfort implications in these areas are not overlooked.

Lighting is vital to employee comfort. According to Joy Ebben, appropriate lighting is critical in the design of work environments (2001). Neil Charness and Katinka Dijkstra conducted field studies in homes, offices, and public places to determine how legibility performance changes with luminance. Adding light helped most legibility tasks. In response to the feedback about low light levels, about 60% of building managers in public places said in a six-month follow up that they had improved lighting or were planning on doing so (Charness, Dijkstra, 1999). Workers' productivity is directly related to the lighting levels in the building. Different tasks require different amounts of luminance, as Table I shows (Ebben, 2001).

Variable	**Light Recommended**	
	More	**Less**
Task Detail	Fine	Coarse
Task Consequence	Critical	Not Critical
Task Complexity	Difficult	Easy
Task Familiarity	Unfamiliar or unique	Familiar or Routine
Time to Perform Task	Less	More
Object size	Small	Large
Age of Worker	Old	Young
Color Contrast	Poor	Excellent
Brightness Contrast	Poor	Excellent
Ambient Light	Low	High

Table I. Recommended Illumination Levels for Certain Variables of Tasks

These factors influence how much total luminance is recommended. According to Ebben, the effectiveness of workers in relation to lighting depends largely on the degree of control the user has, or the ability to select different lighting levels as needed (2001). For example, workers may want more light as the day progresses in order to counteract visual fatigue or workers may want less light when using a computer monitor (Ebben, 2001). Dimming the lights is a very effective way of dealing with this. Currently, there are available dimming systems for fluorescent lamps that can continuously adjust from 1 to 100 percent of available light without flicker (Ebben, 2001). Lighting can affect how we feel about our surroundings, how we relate to others, and how well we do at work (Meer, 1985). Jean Wineman, Professor of Architecture at Georgia Institute of Technology also notes that in the same room, lighting appropriate for a 25 year-old may not be appropriate for a 45 year-old (Meer, 1985).

Thermal levels must also be considered when analyzing employee comfort. According to the Professional Engineer's Guide to the Energy Star Label for Buildings, the acceptable thermal environment conditions during heating mode are 68° F to 74° F, and during cooling mode are 73° F to 79°F. If these levels are not met, then the

workplace environment may be uncomfortable, leading to a decrease in worker productivity.

Another important factor in the analysis of the employee comfort levels of a building is its indoor air quality (Holness, 1990). Factors such as ventilation and air circulation affect indoor air quality. Ventilation can help reduce the amounts of contaminants and bacteria found in the air, increasing the quality of the air in the area. However, the elimination of the source or sources of contaminants is crucial to maintaining a healthy level of air in a building (Holness, 1990). Bacterial growth can be hindered or fostered by the levels of humidity in an area. These bacteria could drastically deteriorate the quality of air inside an establishment, which could result in decreased worker productivity. Therefore, humidity plays a large role in the indoor air quality of a building.

Workplace environment is crucial to the productivity and well-being of a company's employees:

> "If you improve the space that employees work in, then they are likely to be happier, healthier, and more productive." – Owen Bailey, Research Associate, Rocky Mountain Institute (Bruening, 1996).

In energy conservation efforts, a business should take into consideration what effects certain changes will have on its employees. By reducing energy and increasing employee comfort, the business can reduce costs and gain improved productivity.

Customer comfort is also an important factor that businesses should consider when conserving energy. Jeff Haywood, an environmental psychologist, observed 140 blood donors in the recovery room of a Massachusetts clinic. Half of them were put in rooms with direct overhead lighting, and the other half were put in rooms lit only with table lamps. The ones with table lamps were much more interactive than those with the overhead lighting. Haywood believes that this was due to the more intimate table lighting (Meer, 1985). This would lead one to believe that lighting in the business environment should make customers feel comfortable.

The temperature inside business environments also affects customers. According to Steve Gamache, corporate maintenance manager of Musicland Group:

> A customer does not want to leave their 70[degrees] air-conditioned home and car to come shop in an 80[degrees] store. They want the same comfort maintained throughout the shopping experience. If it isn't, they will take their business elsewhere. If a customer feels a swell of warm air at the lease line, they will go right on to the next store. (*Comfort levels: Consistency is crucial*, 1995)

Therefore, it is critical that a business make sure that its heating and cooling systems are within the comfort levels; otherwise, customers may go to competitors where they can be comfortable.

III. METHODOLOGY

FirstBank of Puerto Rico wanted an energy conservation program that could be applied to most or all of its forty-six branches throughout the island. With the implementation of this program, the bank hopes to reduce spending by up to a quarter of a million dollars, in addition to complementing its image as Puerto Rico's "green" bank. This chapter describes the methods used in order to create this bank-wide energy conservation program. To create such a program, we examined and analyzed many different factors of the bank's energy usage and consumption. We observed bank operations and schedules, surveyed employees, conducted a small-scale energy audit, and consulted different departments of the bank. Through the collection and analysis of this data, the creation of a truly bank-wide energy conservation program was possible.

The Energy Audit

Energy audits, also known as an energy surveys or analyses, usually involve a detailed and comprehensive investigation of how a facility uses energy and pays for energy, and ultimately include recommendations for changes in practices and equipment that will save money (Turner, 1997). Due to the time constraints on our project, we decided to do an energy audit on a smaller scale at the branches of FirstBank. Given the amount of time available for the completion of this project, it was not feasible to visit all of the branches of FirstBank. We decided to visit those branches that accounted for most of the total combined energy usage of the FirstBank branches. After calculating the total energy usage (in dollars) for all of the 46 branches, we used Pareto Analysis, a technique used in industrial engineering to determine the percentages of use of resources, to determine a set branches that used 80% of the combined total energy consumption. The analysis consisted of arranging the branches in descending order of energy used (in dollars). Proceeding down the list, we added each branch's usage to the sum from the previous branches. This number was divided by the total combined energy usage of the branches to yield the percentage of total usage.

After determining the smallest set of branches that would account for 80% of the total combined energy usage for all the branches, we conducted the branch-by-branch scaled-down energy audits. Conducting an energy audit involves specifying various energy conservation opportunities (ECOs) that will be evaluated for their benefits and cost-effectiveness. The scaled-down energy audits conducted at the branches of FirstBank focused mainly on the ECOs involving lighting and air conditioning, because these are the areas where the most money can be saved in energy conservation efforts. The main goals of our scaled-down energy audit were to obtain information about the energy usage of the lighting and temperature information of the air conditioning. This information provided us with the necessary data to calculate the possible savings from the use of alternatives.

Lighting

When examining the lighting, we focused mainly on gathering an inventory of observable lights used inside and around the branches. During this inventory of lights, we also noted about the lights:

- Size and shape (long, short, U-shape)
- Type (fluorescent, incandescent)
- Make and model (Sylvania, Philips, GE, etc.)
- Wattage rating
- Cleanliness (clean, a little clean, a little dirty, dirty)

We also subjectively assessed the brightness levels in and around the branches, especially the teller areas, desk/office spaces, and customer/open areas. These brightness levels were classified as dark or bright, as compared to other perceived levels of lighting within the bank.

Air Conditioning

In the examination of the air conditioning, we looked particularly at the temperature controls. Most of the branches controlled their own temperatures with thermostats. Other branches' air conditioning temperatures were determined by the buildings in which they were situated (e.g., a mall). For the self-controlled branches, the temperatures on the thermostats were recorded, along with the actual temperature readings at the branches. We created a distribution of the actual temperatures and determined the range of temperatures that branch employees perceived, through our employee comfort survey, as cold. The differences in actual temperatures readings and temperature settings acted as flags for malfunctioning air conditioning systems or building enclosures; we believed that differences of 3° or more were signals of a possible malfunction.

Energy Costs

In order to develop a program that recommends ways FirstBank could save on energy costs, we had to first understand how and what the bank paid for energy. We examined the past year's (2001) energy bills for the branches that we visited to look for the monthly kWh usage. We decided to focus on kWh usage instead of dollar amount, because PREPA informed us that the price of electricity varies monthly, due to varying oil supply prices. We estimated the amount of energy used by lights using the inventory of lights completed at each branch. We also determined, through government energy usage estimates and a previous study on FirstBank by Global Energy Solutions, the percentage of energy use of air conditioning in the branches. We also obtained the average cost of electricity per kWh by dividing the monthly electricity charges by the kWh usage. This cost analysis allowed us to compare the energy usage of the current

lighting and air conditioning with our recommended changes and determine the possible savings from these changes.

The Human Factors

The main goal of the project was to save FirstBank money in energy costs. However, anticipated savings must be carefully balanced with worker productivity and customer satisfaction. To determine employee and customers attitudes, we decided to survey the employees in the branches we visited and to draw on the results of customer surveys and interviews conducted by the bank's Customer Relations/Service Quality Department.

When visiting each branch, we administered a brief employee comfort survey containing five questions, which could be completed in no more than 2 minutes. The questions were designed to obtain the distribution of employees' opinions about the amount of light, sunlight, and temperature inside the bank as well as which conditions affected their performance in the workplace. Employee opinions regarding the conditions that affected performance were assessed using a 5-point scale (1 corresponding to least effect and 5 corresponding to most effect) in question 5 of the survey, located in Appendix B. Questions 1, 2, and 4 from the survey were designed with a neutral answer in the middle and extremities to the left and right to allow for an intuitive graphical representation of the results.

To determine customers' attitudes about the lighting and temperature, we consulted the Customer Relations/Service Quality Department. The department conducts daily interviews with customers to determine their opinions on bank operations. The Vice President of Customer Relations Management, Maria Christina Oruña, allowed us to add 3 questions to the bank's daily interviews to assess customer opinions about the lighting and temperature inside the branches. These questions were taken directly from the employee comfort survey.

Interviews with Bank Executives and Personnel

Interviews with key bank figures were conducted to determine the bank's perspective on our energy conservation project. Interviews were conducted with the following FirstBank executives and personnel:

- Jorge Rendón, Vice President, Operational Support
- Maria Christina Oruña, Vice President, Customer Relations Management
- Josianne Rosselló, Senior Vice President, Marketing and Public Relations
- Aida García, Senior Vice President, Human Resources
- Carmelo Ayala, Security
- 19 Branch Managers

We consulted FirstBank's Vice President of Operational Support, Jorge Rendón, to inquire about lighting, temperature control, and energy costs of branches. The

interview with Mr. Rendón also consisted of questions regarding our observations inside the branches, particularly the makes and types of lights used and the locality of temperature control inside the branches. We also discussed current and planned energy conservation efforts that the bank has adopted.

The interview with Maria Christina Oruña consisted of questions concerning customers' opinions on the bank's environment, specifically temperature and lighting levels. We also inquired about customers' feelings on the FirstBank's friendliness to the environment. The department had no information concerning these specifics; as previously stated, Ms. Oruña allowed us to add questions about temperature, lighting, and environment to the department's daily customer interviews. The results from these interviews were provided to us for our analysis.

Josianne Rosselló and Aida García were asked questions regarding selling our energy conservation program, both internally within the bank and externally to the public. We needed to determine the feasibility and willingness of the bank to accommodate the marketing of our program. They offered their insights on marketing possibilities and employee participation incentives for our energy conservation program.

Carmelo Ayala of FirstBank's Security Department provided us with bank policies concerning which lights had to stay on all the time for security purposes. Information about a possible federal or bank temperature standard was also provided to us by Mr. Ayala.

Branch managers supplied us with information concerning daily bank operations, specifically peak hours inside the branch and hours of operation. The branch managers answered questions concerning the times when the lights and air conditioning are turned on and off.

Creating the Energy Conservation Program

The creation of the bank-wide energy conservation program incorporated all of the information gathered in our research, energy audits, cost analysis, surveys, and interviews. We compared the results of the lighting questions on the employee comfort survey from different types of branches (small, medium, large) to determine lighting patterns. Using these patterns, we researched appropriate alternatives that would lower the kWh usage that was determined in the cost analysis, and satisfy the lighting needs of each type of branch. We estimated cost savings using these alternatives. We identified specific areas where new equipment, particularly motion detectors, would be effective in reducing energy usage from lighting. We also evaluated the possible effectiveness, through our observations, of implementing a lighting maintenance schedule.

In order to analyze the air conditioning costs, we had to determine the costs of air conditioning within the bank using our research. To determine possible energy savings with air conditioning, we examined the graphs from the results of Question 2 from the survey about temperature to look for a temperature where most employees would be comfortable. We decided that the ideal temperature setting would be where the most responses would be in the neutral area. Using the range of temperatures that employees thought were cold, we estimated a range of increase in temperature using data from the Professional Engineer's Guide to the Energy Star Label for Buildings concerning

acceptable temperature levels. We also determined, through government estimates, the percentage use of air conditioning in the types of branches. Each degree raised in cooling temperature up to 78° F would result in an 8% savings in energy usage by the air conditioner (DoE). These energy savings were translated into estimated dollar savings.

In addition to the general analysis of the branch lighting and air conditioning, we examined the energy usage at specific branches that did not seem to follow general patterns of lighting and air conditioning of the other branches. We examined possible variables that would cause such an increased usage at these particular branches. These variables were then evaluated for their costs of operation, and recommendations were made to accommodate these specific branches.

Selling the Bank-Wide Energy Conservation Program

In order to make this a truly bank-wide energy conservation program, other areas of the bank had to be incorporated. We saw our project as a way for the Marketing Department to improve upon the bank's image as Puerto Rico's "green" bank. By marketing the project, the bank could appeal to its customers as a bank concerned with the future of Puerto Rico, and show that they are trying to preserve it. We brainstormed possible ways that FirstBank could market our plan based on previous marketing strategies and programs described to us by Josianne Rosselló of the Marketing and Public Relations Department.

Employees of FirstBank should also play a big role in energy conservation. Energy conservation cannot be achieved passively; the participation of employees in energy reduction will add greatly to the bank's overall energy conservation efforts. We believe that offering incentives is the best way to encourage employee participation in any company effort. The Human Resources Department could offer incentive programs for branches that conserve the most energy. We brainstormed different types of incentives that could be offered to employees and managers of branches; these incentive ideas were based on past successful incentive programs as described by the Senior Vice President of Human Resources, Aida García.

IV. RESULTS AND ANALYSIS

This chapter presents the results and analysis of the interviews and scaled-down energy audits conducted at the various branches of FirstBank. First, we describe the results from the analysis of costs and energy usage at all the branches. We then present our findings from our visits to the branches, specifically lighting, air conditioning, and the employee surveys. We finally analyze various opportunities for energy savings. The results and analysis contain both qualitative and quantitative data about the branches, lighting, air conditioning, and energy costs gathered through the methods described in the previous chapter. The analysis and data presented in this chapter was used in determining the final recommendations for FirstBank's bank-wide energy conservation program.

Bank-wide Energy Usage and Costs

The data gathered from our branch visits and analysis of costs of energy usage and costs reveal that lighting accounts for an estimated average of 13% of the energy usage inside the branches. We assume that air conditioning accounts for 45% of the energy usage inside the branches, as estimated by a previous energy usage study conducted on the bank by Global Energy Solutions in the summer of 2001. Figure VI, shown below, gives the breakdown of the energy usage inside the branches, which incorporates our own estimates and estimates from the study done by Global Energy Solutions.

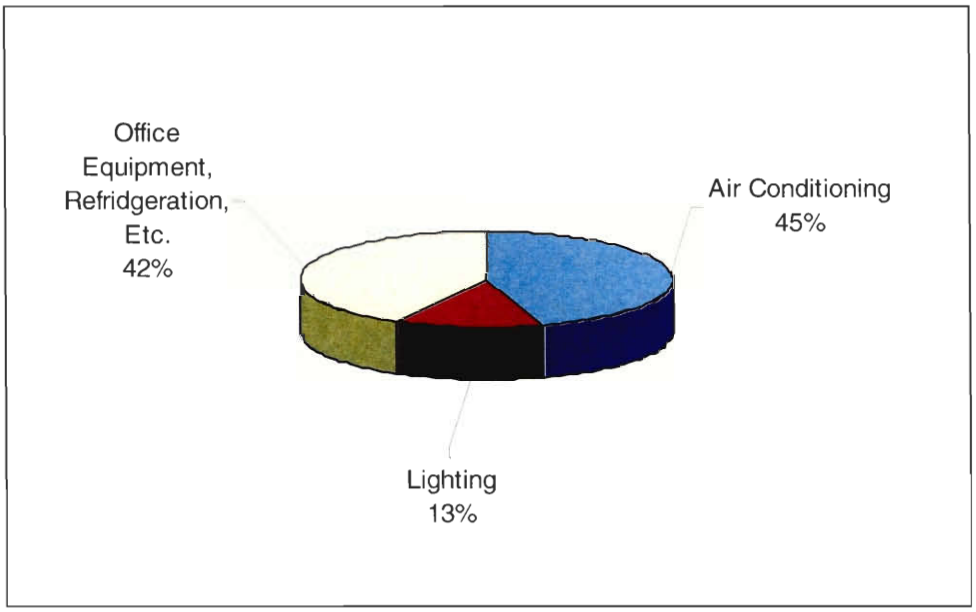


Figure VI. Breakdown of Estimated Energy Usage Inside Branches (Adapted From Global Energy Solutions)

We were able to estimate a cost per kWh using past energy invoices from 10 of the 19 branches we visited. Although the whole year's (2001) bills were not available, for most branches, 2 or 3 months worth of invoices were available, so we based our cost estimates and approximations on that limited information. We estimated that the average cost per kWh in Puerto Rico was $0.1568 using these bills. Separate energy costs were estimated for the 3 St. Thomas branches. Each branch in St. Thomas provided us with a single month's invoice; we based our estimated cost per kWh on these three invoices. We estimated an average cost per kWh of $0.1625 in St. Thomas.

Since we were provided with energy invoices from a few branches in Puerto Rico and a single invoice from each of the 3 St. Thomas branches, we were only able to estimate the energy usage in kWh for those branches. We estimated the average monthly usage in kWh for the following branches in Puerto Rico and St. Thomas:

Location	Average kWh/Month
Muñoz Rivera - Hato Rey	160160.0
Parque Escorial	17526.7
San Francisco - Caribe Beach	15675.0
Forest Hill	10450.0
Plaza Las Americas	12320.0
Barrio Obreros	10535.0
Isla Verde	11055.0
De Diego	8940.5
El Señorial	2316.7
Condado	8783.8
St. Thomas I	6989.0
St. Thomas II – Port of Sale	18760.0
St. Thomas III – GERS	660.0

Table II. Average Monthly kWh Usage at Branches

Table II shows the estimated average energy usage by branch, calculated using the methods described in the previous chapter. These average kWh usage values were used in our cost and savings analysis.

Breakdown of the Branches

Using Pareto Analysis, we determined the branches that used 80% of the total energy usage of all the branches. We visited, observed, and surveyed employees at the 19 branches listed in Table III.

Visited Branches	
Mayaguez Playa	St. Thomas II – Port of Sale
Muñoz Rivera – Hato Rey	Parque Escorial
Dorado	Kennedy Avenue
San Francisco	St. Thomas III – GERS Building
Ponce – Centro del Sur	Forest Hill
Plaza Las Americas	Barrio Obrero
Isla Verde	Bayamón Drive In
De Diego	El Senorial
Bayamón Rexville	St. Thomas I
Condado	

Table III. List of the 19 Visited Branches (in no order)

These branches were categorized by branch size and age for analysis of trends and patterns. In separating the branches by size, using the physical square footage of the branches for determining this seemed appropriate at first. Upon comparing the square footage values with our own observations of the branches, we determined that merely the square footage could not accurately define a branch as small, medium, or large; the reported square footage of each branch did not correspond with our observations. In the end, we decided to categorize the branches by size using our observations, because the reported areas of the branches did not account for the volume (cubic feet), which we concluded played a large factor in energy usage. The branches were categorized into small, medium and large as follows:

Small	**Medium**	**Large**
Bayamón – Rexville	Bayamón Drive-In	Mayaguéz Playa
Condado	Forest Hills	Muñoz Rivera
El Señorial	Dorado	San Francisco – Caribe
Barrio Obreros	Plaza Las Americas	St. Thomas II – Port of Sale
Ponce – Centro del Sur	Kennedy Avenue	De Diego
	Isla Verde	Parque Escorial
	St. Thomas III – GERS	
	St. Thomas I	

Table IV. Branches Categorized as Small, Medium, or Large

Through our subjective observations and information obtained from branch managers, we also categorized the branches by age. The older and newer branches are categorized in Table V.

Older	Newer
Bayamón – Rexville	Bayamón Drive-In
Forest Hills	Dorado
Condado	Plaza Las Americas
Mayaguéz Playa	Muñoz Rivera
El Señorial	San Francisco – Caribe
Kennedy Avenue	Ponce – Centro del Sur
Barrio Obreros	Isla Verde
St. Thomas III – GERS	St. Thomas II – Port of Sale
St. Thomas I	Parque Escorial
De Diego	

Table V. Branches Categorized by Building Age (Older, Newer)

Analysis of energy usage patterns and employee comfort opinions in the various branches were easier to compare using these categorizations of the 19 visited branches.

In order to determine why some branches consumed a lot of energy in comparison to others, we determined a number of factors that were unique to some branches. For example, some branches had old computer systems, so they kept the air conditioner on 24 hours a day in order to keep the servers cold. Other branches had parking lots that were lighted, while others had drive in tellers and many ATM machines with 24 hour per day air conditioning. Also, some of the new branches have metal detectors at the entrance for security purposes. Table VI shows special circumstances which could possibly contribute to high energy usage in each branch.

Total Energy Cost ($)	Location	Special Circumstances Contributing to High Energy Use
42,707	Mayaguez Playa	Large building, Upstairs unoccupied but lights always on, parking lot
41,816	St. Thomas II – Port of Sale	Large building, 7 A/C units, A/C on 24 hours a day, elevator
35,652	Muñoz Rivera	Large building, A/C on 24 hours a day, elevator, open Saturday
33,037	Parque Escorial	Large building, 2 A/C units, elevator, parking lot, 5 televisions, open Saturday, Sunday
29,782	Dorado	Metal detector security system at entrance, drive in ATM, parking lot, open Saturday
29,492	Ave. Kennedy	Metal detector security system at entrance, drive in ATM, parking lot, open Saturday
27,023	San Fransisco – Caribe Branch	Large building, elevator, open Saturday
24,665	St. Thomas III – Gers	Upstairs is unoccupied, but all

	Building	lights are turned on, A/C on 24 hours a day, open Saturday
24,198	Ponce – Centro del Sur	Metal detector security system at entrance, 2 drive in ATM's with 24 hour A/C, open Saturday
23,286	Forest Hill	Parking lot, drive in tellers with 24 hour A/C, open Saturday
22,042	Plaza las Americas	Large building, 4 ATM's with 24 hour A/C, open Saturday, Sunday
21,170	Barrio Obrero	2 A/C units, very busy branch, open Saturday
20,118	Isla Verde	Elevator, drive in ATM with 24 hour A/C, metal detector security system at entrance, 2 A/C units, open Saturday
18,922	Bayamon – Drive In	3 drive in tellers, 2 ATM's with 24 hour A/C, metal detector security system at entrance, open Saturday, Sunday
18,411	De Diego	Large building, lots of lights, drive in ATM with 24 hour A/C, open Saturday
16,857	El Senorial	Drive in ATM with 24 hour A/C, open Saturday
15,844	Bayamon – Rexville	2 ATM's with 24 hour A/C, open Saturday
15,783	St. Thomas I	2 A/C units, A/C on 24 hours a day
15,270	Condado	ATM with 24 hour A/C, open Saturday

Table VI. Special Circumstances Resulting in High Energy Usage in Branches

From the above table, we concluded that there were some branches that appear to use disproportionate amounts of energy due to factors not found in other branches on the list. These branches are:

- Mayaguéz Playa
- St. Thomas I
- St. Thomas II – Port of Sale
- St. Thomas III – GERS

Special recommendations were made for these particular branches to reduce energy consumption in order to accommodate the special circumstances at each respective branch.

Branch Visit Results

The results and observations from our visits to the branches dealing with lighting and air conditioning are presented in this section. Details from the branches, such as lighting fixture details, energy usage by lighting, and temperature readings and settings are discussed.

Lighting

The inventory of lights revealed that there is no standard for light bulbs used in the branches; there were different makes and models, sizes, and most importantly, wattage ratings, including 32W, 34W, and 40W. There was also an inconsistency in the quantity of light bulbs per fixture in each branch. Some of the fixtures contained anywhere from 2 to 4 fluorescent bulbs. We also noticed that the older branches were using non-reflective lighting fixtures.

As stated at the start of this chapter, an average of 13% of energy consumed by the branches is from lighting. This estimate was computed from a range of percentage usages; the minimum and maximum of this range was the Muñoz Rivera and El Señorial branches, respectively; Muñoz Rivera had the least energy usage from lighting, at 1.32%, while the El Señorial branch had the highest percentage use of energy from lighting, with 44%. Since we determined the percentages using kWh estimates, we could only determine these percentages for those branches for which we had energy invoices. Table VII presents the percentages of energy used for lighting at each of these branches.

Location	Percentage of Energy used by Lighting (%)
Barrio Obrero	11.19
Condado	6.87
Forest Hills	10.57
Muñoz Rivera	1.32
Isla Verde	2.39
San Francisco – Caribe	12.06
Parque Escorial	10.18
El Señorial	44.00
Plazas las Americas	5.02
De Diego	29.37
St. Thomas I	14.70
St. Thomas II – Port of Sale	11.91
St. Thomas III - GERS	INCONCLUSIVE

Table VII. Percentages of Energy used by Lighting

It was noted that most of the light bulbs in each branch were dirty; there was a lot of dust buildup on the bulbs. This dust buildup leads to decreased levels of light being emitted from the bulb, while still using the same amounts of energy. This is inefficient.

Another observation that we made during our branch visits was that the lights in the bathrooms, break rooms, and storage rooms were generally left on. These rooms are used periodically and there is no need for the lights in these rooms to be on all the time.

Air Conditioning

There were many observations that we made about the air conditioning when visiting each branch. We observed that many of the thermostat settings were very different from the actual temperature readings. We were able to obtain the actual temperature readings in 14 of the 19 branches that we visited. Of these 14 temperatures, only 6 were within 2° of the thermostat setting and only 7 were within 3°. In the Bayamón Rexville, Forest Hills, and Kennedy Avenue branches, there was more than a 7° difference between the thermostat setting and the actual temperature reading. The average temperature reading in the branches was 70.9°. The average thermostat setting in these buildings was 70.4°. The following table, Table VIII, lists the temperature settings and readings inside the branches we visited:

Branch	# of Systems	Thermostat Setting	Temperature Reading
Barrio Obrero	2	70	66
Bayamon - Drive In	1	70	70
Bayamon - Rexville	1	75	68
Condado	1	70	72
De Diego	1	N/A	N/A
Dorado	1	74	70
Forest Hill	1	62	72
St. Thomas III - GERS	1	75	74
Isla Verde	2	72, 71	70
Kennedy	1	60	67
Mayaguez Playa	1	N/A	N/A
Muñoz Rivera	1	N/A	N/A
Parque Escorial	2	70, 71	70, 68
Plaza las Americas	1	N/A	N/A
Ponce Centro del Sur	1	66	70
San Fransisco - Caribe	1	75	78
El Señorial	1	70	N/A
St. Thomas I	2	73, 72	72, 74
St. Thomas II - Port of Sale	7	74, 74, 76, 73, 75, 78, 70	75, 73, 73, 75, 75, 75, 70

Table VIII. List of Thermostat Settings and Temperature Readings in Visited Branches

The manager of the San Francisco branch complained that the thermostat did not work properly. Many branches could not control the temperature setting; they could only

turn the air conditioners on and off. This was true in the De Diego, Mayaguéz Playa, Muñoz Rivera, and Plaza las Americas branches.

One of our most important findings came in the Muñoz Rivera and all St. Thomas branches. In these branches, the air conditioning system was kept on 24 hours a day. A reason given for the constant operation of the air conditioning was that the computer servers needed to be kept cool at all times, therefore the air conditioning was kept on all the time.

Employee Comfort Survey Results

The results from the employee comfort surveys distributed in the visited branches revealed that 65% of FirstBank employees felt that the branches had adequate lighting, while 27% of employees thought that the branches were either much too dark or a little too dark. Figure VII illustrates the percentage breakdown of responses to the question pertaining to employee opinions about the lighting levels inside the branches.

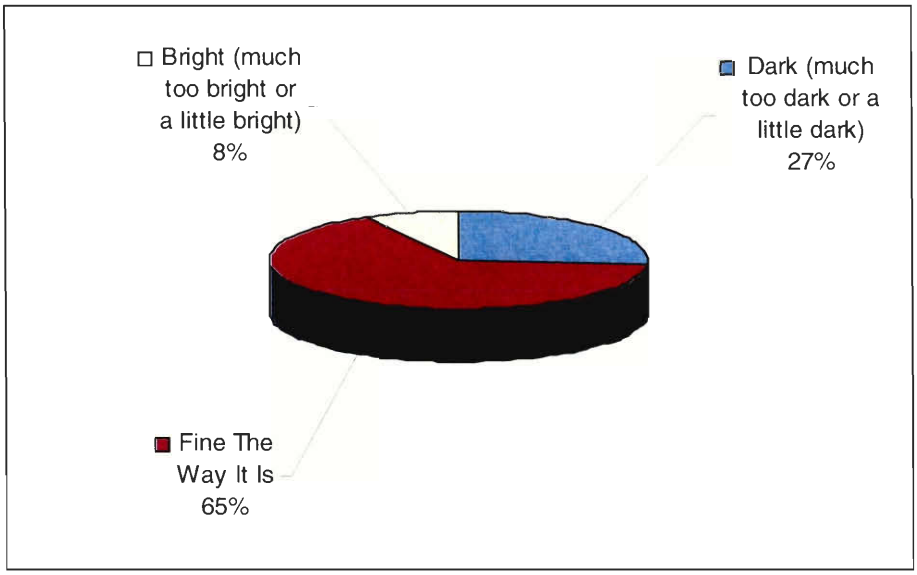


Figure VII. Employee Opinions About Lighting Levels

Analysis of employee comfort survey results according to sizes of branch reveals that approximately 70% of the employees surveyed in the smaller and medium branches, such as the Bayamón branches, felt that the lighting levels were fine the way they were. Similarly, in the larger branches, such as the St. Thomas Port of Sale and Mayaguéz Playa branches, the majority (57%) of employees felt that lighting levels were adequate. We also analyzed in terms of new and old branches. Again, the results were similar to those of all the branches. Approximately 67% of the employees in the old branches felt that the lighting levels were adequate, and 63% of employees in the newer branches believed that the branches had adequate lighting.

These results suggest that the lighting inside the branches was already at comfortable levels for most employees; the majority of employees felt that lighting levels

were adequate in each form of analysis. Nonetheless, by onsite observations, we noted that older branches were generally darker than the newer branches, specifically in the customer and open areas. The results from the employee comfort survey were based solely on the employees present during the administration of the surveys, a pool that included tellers, branch managers, and bank salespersons. These employees work in different areas of the branch; these areas were not recorded. Therefore, no single area of each branch may be identified from these survey results as dark or bright; only the general lighting in each branch can be indicated.

Also, from the employee comfort surveys, we saw that there was no significant difference in employees' opinions about the lighting levels in the branches that were using 32W bulbs and 40W bulbs. In fact, 75% of the employees in the branches using 32W bulbs stated that the lighting levels were adequate, as compared to the 65% of the overall employees who stated the same.

We analyzed the responses to the question in our survey that asked, "What do you feel about the temperature inside the bank?" We looked for trends among branches and it appeared that most branches felt that it was either too cold or fine the way it was. However, a small number of the employees surveyed felt that it was too warm. When we calculated the totals of responses for all the branches, this trend became more obvious. Figure VIII shows the results of the question throughout all the branches we visited.

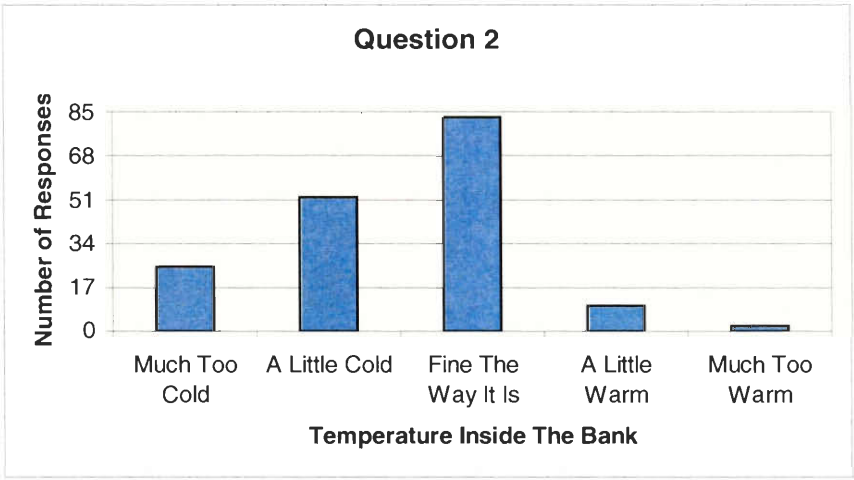


Figure VIII. Employee Opinions About Temperatures Inside Branches

Forty-five percent of the employees surveyed felt that it was either much too cold or a little cold, compared with only 7% who felt it was either much too warm or a little too warm.

Results from Interviews with Bank Executives and Personnel

As stated in the previous chapter, interviews were conducted with the following FirstBank executives and personnel:

- Jorge Rendón, Vice President, Operational Support
- Maria Christina Oruña, Vice President, Customer Relations Management
- Josianne Rosselló, Senior Vice President, Marketing and Public Relations
- Aida García, Senior Vice President, Human Resources
- Carmelo Ayala, Security
- 19 Branch Managers

Jorge Rendón revealed several important details about the lighting inside the branches. The bank is currently implementing energy conservation measures that were recommended as a result of an energy audit conducted by Global Energy Solutions of Idaho during the summer of 2001. The bank is also retrofitting lighting fixtures in some branches with energy efficient ballasts (T8). Mr. Rendón also informed us that the newer, more modern branches were already energy efficient with lighting; these branches were installed with latest lighting technologies at the time of construction or upgrade. The bank is also implementing initiatives for regular light cleaning and maintenance.

Maria Christina Oruña provided us with insight regarding the customer opinions of FirstBank. She told us the bank's image as the "green" bank of Puerto Rico is not recognized by many customers; rather, it is mostly recognized by the bank's competition. Ms. Oruña said that the bank was moving towards "owning" the environmental advertising aspects of Puerto Rico; other banks, such as Banco Popular already "own" music and sports advertisement in Puerto Rico. She also stated that customer comfort inside the branches is extremely important.

The interview with Josianne Rosselló revealed that environment is only part of a larger marketing program set forth by First Bank. The bank has not promoted its Isla Viva program aggressively, yet it has been very successful; the program has donated roughly $100,000 to the Conservation Trust of Puerto Rico to date. Ms. Rosselló stated that employees seem to be very concerned with the environment; over half the branches participated in a contest involving promotion of the environment – the winners were given a trip to a Conservation Trust property. With concern to marketing our project along the same lines as the Isla Viva program, she stated that no money would be invested, but that photographs and press releases in newspapers could be used to inform the public.

Aida García was interviewed to gain insight on the possibility of offering an employee incentive for energy conservation. She told us that offering employee incentives was possible. She gave us some examples of past incentives: money, recognition awards, cruises, time off, parking, and weekend getaways. Ms. García also stated that programs with money incentives get the most response from employees. She stated that if the bank were to offer money incentives to employees for energy conservation, it would be important to use part of the savings from the energy conservation to fund the incentives.

A brief interview with Carmelo Ayala revealed that the only lighting policy in place at FirstBank was that the lights near and around the vaults and ATMs had to be left on for the security purposes. He stated that it was common practice to leave lights around the teller areas on, because a good number of security cameras are located there. He also stated that there was no standard for temperature within the bank.

Interviews conducted with branch managers revealed branch-specific information, such as peak hours and hours when the lights and air conditioning is on. Most peak hours were stated to be between 11:00AM and 1:30PM. The lights and air conditioning at most branches were turned on about half an hour before opening and about 2 or 3 hours after closing, to accommodate for a cleaning service.

Customer Survey Results

The customer surveys conducted through the Customer Relations Management Department provided responses from 44 customers pertaining to the lighting and temperature levels inside the branches of FirstBank, and also about FirstBank's image as Puerto Rico's "green" bank. All of the customers questioned responded that the lighting inside the bank is good the way it is, and 91% indicated that the temperature is as well. Also, 81% percent of the surveyed customers said that FirstBank is an institution that is concerned with the environment.

Opportunities for Energy Savings

This section gives the cost-benefit analyses of implementing different energy conservation techniques. These techniques involve changing light bulbs, installing motion detectors, and changing the temperatures inside branches. Different options with investments and pay back periods are evaluated.

Lighting Savings

We believe that the use of 40W bulbs is not necessary; using 32W fluorescent light bulbs provides adequate amounts of lighting. The following 8 branches in Table X are known to use 40W bulbs in all or most of their lighting fixtures. This cost analysis assumes that the 8 branches switch from what they currently have in their lighting fixtures (number and type of bulb) to exactly two 32W bulbs per fixture. Fixtures in these branches that are already using 32W bulbs are accounted for.

Assuming a cost of $0.1568 per kWh in Puerto Rico and $0.1625/kWh in the United States Virgin Islands, the following values are cost estimates of lighting using values from our lighting inventory:

Location	Costs/Month (40W)	Costs/Month (32W)	Monthly Savings ($)	Annual Savings ($)
Bayamón Rexville	$205.00	$121.00	$84.00	$1,000.00
De Diego	$411.00	$311.00	$100.00	$1,200.00
El Señorial	$160.00	$123.00	$37.00	$450.00
Forest Hills	$173.00	$110.00	$63.00	$750.00
Mayaguez Playa	$294.00	$236.00	$58.00	$700.00
Muñoz Rivera	$180.00	$146.00	$34.00	$400.00
St. Thomas I	$196.00	$96.00	$100.00	$1,200.00
St. Thomas III GERS	$408.00	$218.00	$190.00	$2,300.00
	TOTAL SAVINGS		**$666.00**	**$8,000.00**

Table IX. Estimated Savings from Changing from 40W to 32W Fluorescent Bulbs

The combined energy costs from 2001 of the 19 branches visited accounted for 33% of the bank's total energy costs in 2001. Forty-two percent of these 19 branches currently use 40W bulbs. As Table IX shows, the bank can save an estimated $8,000 annually by converting to 32W bulbs in these branches. Assuming the unvisited branches have a similar percentage of branches that use 40W bulbs, and that they convert to using two 32W bulbs, the bank would save an estimated $23,000 annually.

The branch would need approximately 1040 bulbs to replace the 40W bulbs in the above 8 branches with Sylvania Octron 32W bulbs. Assuming an estimated cost of $74.00 for a pack of 25 Sylvania Octron 4100K F032/741 32W bulbs (www.houseneeds.com), the bank would need to invest approximately $3,000.00 for the purchase of the bulbs. The bank would need to invest an estimated $7,300.00 to replace the bulbs in all of the branches currently using 40W bulbs.

In addition to changing the light bulbs themselves, the fixtures in the branches converting to 32W bulbs would need to be retrofitted with reflectors to achieve similar levels of brightness to the 40W bulbs. If we assume that reflective retrofits cost $75.00 per fixture and that each of these branches has 35 fixtures, the bank would need to invest approximately $50,000.00 for the reflective retrofits.

If we assume that the installation/labor costs of these retrofits and changing the bulbs is $25.00 per hour, and that the installation would take 6 hours per branch, the branch would need to invest an estimated $3,000.00 for labor.

Equipment for 19 branches	Fixed Cost (one-time)
Sylvania Octron 32W bulbs	$7,300.00
Reflective retrofit for fixtures	$50,000.00
Installation/labor	$3,000.00
TOTAL COSTS	**$60,300.00**

Table X. Estimated Costs for Changing from 40W to 32W Fluorescent Bulbs

The total investment for this lighting change is an estimated $60,000.00, yielding a pay back period of a little less than 3 years.

The installation of occupancy sensors in bathrooms, break rooms, and storage rooms would also reduce energy costs from lighting. Lights were observed to be left on in unoccupied rooms in most of the branches, particularly in these rooms. We assume that all branches have:

- 2 bathrooms (men and women) containing 1 light fixture each
- 1 break room containing 2 light fixtures
- 1 storage room containing 1 light fixture

Assuming that the lights in the above rooms are on 10 hours per day and are using four 40W bulbs in its fixtures, the energy usage per branch for all these rooms is 192 kWh per month, which translates into electric utility costs of $19.00 per month. Sources from our background suggest that with the installation of motion detectors, the amount of time that the lights are on in these rooms are cut by at least 50%; assuming a 50% decrease, the lights are on 5 hours a day. The energy usage per branch for the operation of lights in these rooms is decreased to 96 kWh, or an estimated electric utility cost of $9.50 per month per branch. The following table, Table XI, presents the estimated cost savings of the installation of motion detectors in rooms with specific lighting configurations, assuming a cost of $0.1568 per kWh.

Lighting Configuration (# bulbs, W)	**Monthly Cost (10 hours/day)**	**Monthly Cost (5 hours/day)**	**Annual Savings per Branch**	**Annual Savings for 46 Branches**
4 bulbs, 40W	$30.00	$15.00	$180.00	**$8,300.00**
4 bulbs, 32W	$24.00	$12.00	$144.00	**$6,600.00**
2 bulbs, 40W	$15.00	$7.50	$90.00	**$4,100.00**
2 bulbs, 32W	$12.00	$6.00	$72.00	**$3,300.00**

Table XI. Estimated Savings of Motion Detector Installations in 46 Branches

The bank would need to purchase approximately 184 motion detector units to accommodate all the bathrooms, break rooms, and storage rooms in all 46 branches. Motion sensors that are sufficient for these rooms cost from $48.00 to $73.00.

One possible unit is the Sensor Switch WSDx infrared motion detector. Each unit costs $48.00 and is made for use in small areas of up to 800 square feet. With the installation of this particular unit, the bank would need to invest approximately $8,800.00. Other costs would most likely include installation. If we assume a rate of $25.00 per hour for installation at 92 hours (2 hours for each of the 46 branches), the bank would spend an estimated $2,300.00 for the installation of motion detectors in bathrooms, break rooms, and storage rooms at all branches.

Equipment for 46 branches	Fixed Costs (one-time)
184 Sensor Switch motion detector units	$8,800.00
Installation/labor	$2,300.00
TOTAL COSTS	**$11,100.00**

Table XII. Estimated Costs of Motion Detector Installations

The total investment for the purchase and installation of occupancy sensors in 46 branches would cost approximately $11,000.00. The pay back period for this investment would range from 1.5 years to 3.5 years, depending on the various lighting configurations inside the bathrooms, break rooms, and storage rooms.

Air Conditioning Savings

We determined that energy reduction was feasible through air conditioning methods. From our research, the Professional Engineer's Guide to the Energy Star Label for Buildings says that acceptable temperatures during cooling mode are 73° to 79°. We were able to collect temperature readings in 14 of the 19 branches that we visited. The average reading in these buildings was 70.9°, which is below the acceptable levels. Since the average temperature reading is well below acceptable levels, and 44% of employees were too cold, an increase in temperature is justified. Also, since the branches that we visited had such a large variety of temperatures, we believe that standardizing the temperature would increase employee comfort because it would ensure that most, if not all employees are at similar comfort levels. We graph employee comfort as a function of the temperature to try to determine what temperature to make standard. The graph is shown as Figure IX.

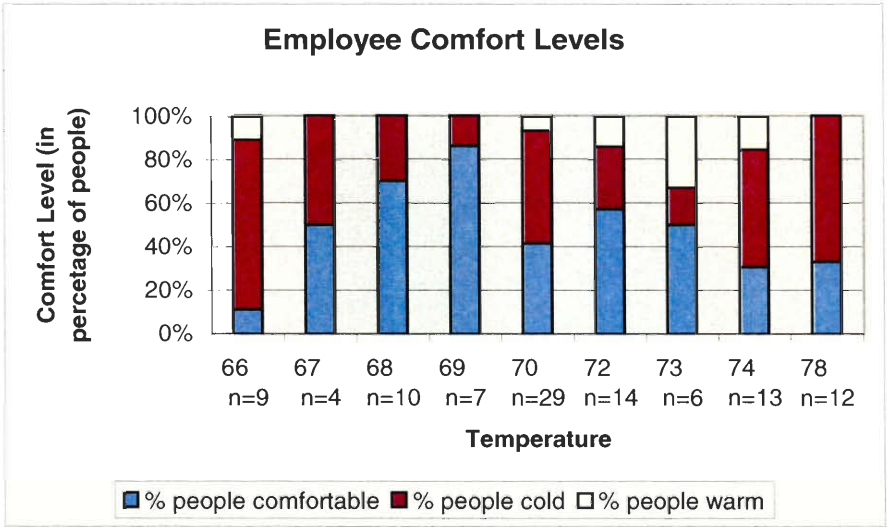


Figure IX. Employee Comfort Levels at Certain Temperatures

Although this graph is inconclusive as to what temperature is best, it does reveal some important information. For one, at 78° the majority of people were cold. Although this may just be an outlier, it is still striking. Also, in the 72° - 74° range of temperatures, the uncomfortable people are both warm and cold, whereas from 67° - 69° every person that was not comfortable was too cold. Because this data is inconclusive, we choose 76° as the standard temperature for each branch based on our research information and employee comfort. Since this temperature will make the branches warmer on average, the bank will save money in energy costs, while most likely maintaining, if not improving, current levels of employee comfort.

We looked at the bank's total energy costs from 2001 to estimate the savings from air conditioning. The bank's total energy expenses totaled $1,442,341. Assuming that air conditioning accounts for 45% of the banks total energy costs, then approximately $649,053 were a result of air conditioning costs for the bank in 2001. The United States Department of Energy estimates that for every degree raised in air conditioning temperature, up to 78°, air conditioning costs are reduced by 8%, and vice versa. Table XIII shows the estimated amount that each branch that we visited would either save or lose by standardizing the temperature to 76°.

Branch	Energy Cost	A/C Costs	Temperature Reading	Temperature Change	Estimated Amount Saved/Lost
Barrio Obrero	$21,170	$9,526.50	66°	+ 10	$5,400
Bayamon – Drive In	$18,922	$8,514.90	70°	+ 6	$3,400
Bayamon – Rexville	$15,844	$7,129.80	68°	+ 8	$3,500
Condado	$15,270	$6,871.50	72°	+ 4	$2,000
Dorado	$29,782	$13,401.90	70°	+ 6	$5,300
Forest Hill	$23,286	$10,478.70	72°	+ 4	$3,000
GERS Building	$24,665	$11,099.25	74°	+ 2	$1,700
Isla Verde	$20,118	$9,053.10	70°	+ 6	$3,600
Ave. Kennedy	$29,492	$13,271.40	67°	+ 9	$7,000
Parque Escorial	$33,037	$14,866.45	69°	+ 7	$6,600
Ponce – Centro del Sur	$24,198	$10,889.10	70°	+ 6	$4,300
San Fransisco – Caribe	$27,023	$12,160.35	78°	- 2	($2,000)
St. Thomas I	$15,783	$7102.35	73°	+ 3	$1,600
St. Thomas- Port of Sale	$41,816	$18,817.20	74°	+ 2	$2,900
Totals	**$340,406**	**$153,182.50**	--	--	**$48,300**

Table XIII. Cost Information about Temperature Increases

According to these calculations in Table XIII, if 76° became the standardized temperature in these branches, FirstBank would save about $48,000 annually. Of these branches, 4 are small, 7 are medium, and 3 are large. Also, 7 are old and 7 are new. Thus each type of branch is included in our estimate. Note, these figures do not take into account branches inside of a larger building, such as malls; these branches pay their energy costs as a percentage of the whole building's costs. These 14 branches accounted for 23.6% of the bank's total energy consumption in 2001. If we assume that the other branches follow the same distribution of temperatures as these branches do, then the bank

would save approximately $205,000 annually in energy costs by standardizing the temperature to 76°. As alternatives, we calculated the estimated savings for standard temperatures of 73° - 78°. Table XIV shows the estimated savings, by the same method of calculation, of each temperature.

Temperature	Total Estimated Savings
73°	*$78,000*
74°	*$128,000*
75°	*$165,000*
76°	***$205,000***
77°	*$239,000*
78°	*$270,000*

Table XIV. Estimated Savings From Temperature Increases

V. RECOMMENDATIONS

This chapter contains our recommendations for a bank-wide energy conservation program. Based on our analysis of FirstBank's energy use and potential cost-saving measures, we divide our recommendations into bank-wide energy conservation measures and measures for specific branches. We also offer recommendations for employee incentives and public relations.

The cost-saving estimates we present in Chapter IV strongly suggest that FirstBank can save money on energy expenses with the full or partial implementation of the suggestions made here.

Branch-Wide Recommendations

The recommendations presented here can be applied to most or all of the branches of FirstBank; they are not tailored to any specific branches. The recommendations are separated into lighting and air conditioning, each with supporting rationale, justification, and cost analysis.

Lighting Recommendations

We are recommending that each branch switch to using reflective fixtures with 2 fluorescent bulbs rated at 32W per lighting fixture.

Rationale: From our inventory of lighting, we saw that there was no standard in the wattage ratings of the lights; the ratings included 32W, 34W, and 40W. There was also no single standard of the number of light bulbs present in fixtures; the numbers ranged from 2 to 4 bulbs. Replacing the higher wattage bulbs of 34W or 40W should not affect employees' opinions about the lighting; from our employee comfort surveys, we saw that there was no significant difference in employees' opinions about lighting levels in branches that were using 40W bulbs and 32W bulbs. For example, 83% of the employees surveyed at the Isla Verde branch, which uses reflective lighting fixtures with two 32W bulbs, felt that lighting levels were fine. Therefore, we can conclude that the use of two 32W bulb fixtures can provide adequate lighting levels for the branches. The bulb that we recommend the branches use is the Sylvania Octron 4100K F032/741 32W. We suggest that the bank use this particular bulb, because a good number of the branches already have them installed, therefore upgrading or converting will be fairly easier.

FirstBank would save an estimated $23,000 annually through this standardization of lighting. Bulbs and reflectors to accommodate all of the branches in need of converting to 32W bulbs would cost an estimated $61,000 (including labor and installation). Thus, the pay back period for this investment would be a little under 3 years.

We recommend the use of motion detectors in all bathrooms, break rooms, and storage rooms.

Rationale: We noticed that most lights in the break rooms, storage rooms, and bathrooms were left on. Assuming these lights are left on all day, the energy usage and expenses from these lights alone add up. The use of occupancy sensors in these rooms will help reduce the amount of time that the lights are on while the rooms are unoccupied.

Assuming the lights in these particular rooms are left on for 10 hours a day, the bank can save an estimated $3,300 to $8,300 annually through the installation of motion detectors. The cost of purchasing and installing these motion detectors in all bathrooms, break rooms, and storage rooms at all branches would cost an estimated $11,100. This would yield a pay back period of 1.5 to 3.5 years for this investment, depending on the particular lighting configurations in these particular rooms.

We recommend that the bank continue to incorporate a regular maintenance and cleaning schedule for all major lighting fixtures inside branches (every 3 to 5 months).

Rationale: The employee comfort surveys revealed that 65% of branch employees felt that lighting levels were adequate, while 27% of the employees felt that the lighting levels were either too dark or a little dark. The low levels of lighting felt by some of the employees may be attributed to the dirtiness of the lights; from our observations, we saw that most of the light bulbs in most of the branches were dirty. Dirty bulbs output less levels of light and brightness while consuming the same amount of energy; this is inefficient. By cleaning lights periodically within a year, the bank can ensure maximum lighting levels and efficient use of energy throughout the whole year.

The bank is currently implementing initiatives for this plan, and the cleaning program should be fully implemented in the next budgetary cycle.

Air Conditioning Recommendations

We recommend standardizing the temperature inside each branch and office area to 76°.

Rationale: The employee comfort survey results revealed that 44.1% of employees were either a little too cold or much to cold compared with only 6.3% that felt it was either a little to warm or much to warm. Also, 76° is directly in the middle of the acceptable temperature levels during cooling mode of 73° to 79°, and the current average temperature reading of 70.9° is well below these levels. In addition, Wells Fargo Bank standardized their temperature to 76° and saved $650,000 annually by doing so. Because of these reasons, we believe that a standard temperature of 76° would result in the largest benefit for the bank. A standard temperature of 76° would save the bank an estimated $205,000 annually, or 14% of the energy costs from 2001. Standardizing the temperature to 76° could have a positive effect on worker comfort while saving the bank a substantial amount of money in energy costs.

We recommend maintenance of the air conditioning systems and branch building enclosures every 4 months.

Rationale: In order to standardize the temperature, the thermostat settings and readings must to correspond to one another. For this to occur, the systems will have to be working properly. In the branches that we visited, only half of the thermostat settings were within 3° of the actual temperature readings. If this were to remain the case, then standardizing the temperature would be futile, because in half of the branches there would be no means of ensuring that the temperature was similar to its setting.

From our research, we saw that checking the building enclosure would also be important. A building's envelope keeps heat out of a building while keeping cool air inside and leaks within a building's envelope can account for up to 40% of a building's heat loss or gain. The maintenance should include checking the building enclosure for air leaks in order to prevent heat from the outside environment from entering the branches.

If we assume that maintenance costs $25/hour and takes 4 hours per branch, the cost of maintenance every 4 months is approximately $14,000. Subtracting these costs from the $205,000 in savings would result in an estimated $190,000 that FirstBank would profit annually from standardizing the temperature to 76°.

Branch-Specific Recommendations

The recommendations made here are for specific branches whose energy usage was excessive due to factors found only at these branches. The factors consisted of many variables, such as unused, lighted office areas and 24 hour air conditioning. Energy expenses at these particular branches can be reduced significantly through the suggestions presented in this section.

St. Thomas Branches

We recommend designating a room for the computer servers and keeping a single air conditioner in that room on 24 hours a day.

Rationale: In all 3 St. Thomas branches, the air conditioners are left on 24 hours a day in order to keep the servers cool. Placing the servers in one room with its own respective air conditioning unit would enable these branches to turn the main air conditioner off when the buildings are unoccupied, and thus, save money on energy expenses.

St. Thomas III GERS Building and Mayaguéz Playa

We recommend keeping the upstairs lights off all day where the space is unoccupied.

Rationale: In both branches, the upstairs lights are left on all day but neither branch uses

the upstairs for anything more than storage. Shutting off the lights would reduce energy costs, and would not have any effect on worker productivity or customer satisfaction.

Employee Incentive Recommendations

We recommend that the bank offer incentives to branches or groups of employees to encourage employee participation energy conservation.

Rationale: Employee participation in the bank's energy conservation efforts is important to the success of this program. According to Josianne Rosselló, when the bank held a contest to see which branch could do the most to help the environment, participation was good and the incentive was only a trip to one of the Conservation Trust's properties. Thus offering incentives such as monetary awards taken directly from the savings of energy conservation or recognition awards would motivate employees to become actively involved in energy conservation within the bank. These incentives could spark competition among branches; the branches that save the most money over a period of time (3 to 6 months) will be rewarded with these incentives.

Marketing and Public Relations Recommendations

We recommend that the bank issue press releases to local newspapers about their energy conservation efforts and how conserving energy has positive effects on the environment.

Rationale: FirstBank has established itself as a bank concerned with the environment of Puerto Rico. Because of their past work with environmental issues, FirstBank has the opportunity to further establish itself as a bank that tries to preserve the environment. Josianne Rosselló suggested that the best direction to go in was public relations. If the project is implemented and there is great publicity for the program, FirstBank could gain recognition in the Puerto Rican community for their conservation efforts and how its efforts are helping the environment. This recommendation takes little investment from the bank, yet the bank can benefit greatly from the publicity.

Implementation Recommendations

We recommend that the implementation of our program begin with standardizing the temperature inside the branches.

Rationale: Standardizing the temperature to 76° will cost the bank very little, if any money, while providing the most savings of any of the recommendations of our project. After the savings begin to take place, the bank could use these savings to finance the costs of the other recommendations of our program. These savings can be used to pay for motion sensors, new light bulbs, and possibly some employee incentives. These are the

only recommendations of our program that have pay back periods, and this implantation plan will allow the program to pay for itself.

Summary of Costs and Savings

This section gives a summary of the savings and costs of our specific recommendations for lighting and air conditioning. The total savings after the payback periods are an estimated $230,000 annually, or 16% of FirstBank's total energy costs in 2001.

Lighting

Equipment/Changes	Costs	Pay Back Period	Annual Savings after Pay Back Period
32W Sylvania Octron fluorescent bulbs, reflective retrofits, and installation/labor	$61,000	3 Years	$23,000
Motion detectors and installation	$11,100	1.5 to 3.5 Years	$3,300 to $8,300

Table XV. Summary of Lighting Costs and Savings

Air Conditioning

Equipment/Changes	Costs	Pay Back Period	Annual Savings after Pay Back Period
Standardize to 76°	N/A	N/A	$205,000
A/C Maintenance every 4 months	$14,000 (annually)	N/A	N/A

Table XVI. Summary of Air Conditioning Costs and Savings

VI. APPENDIX A – BRANCH PROFILES

This appendix contains the profiles for the 19 branches of FirstBank that were visited in the creation of our bank-wide energy conservation program. These profiles contain our observations, as well as graphical representations of the results from the employee comfort surveys administered at each branch. The profiles are listed in alphabetical order by branch name.

Branch Profile

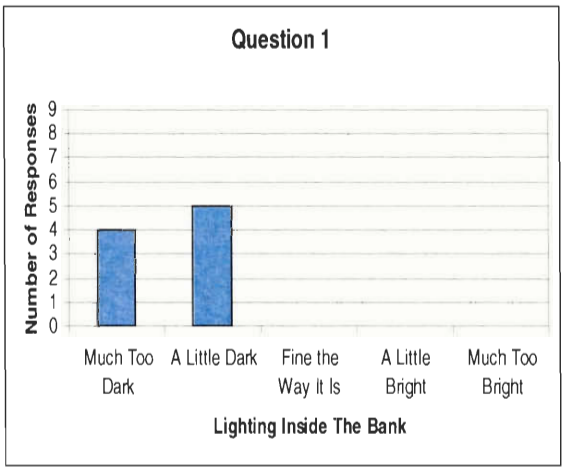
Location:	Barrio Obreros
Situated:	Stand-alone
Address:	Calle 13 #521, Santurce
Hours of Operation:	**Branch:** 8:30AM – 3:30PM Monday – Friday 9:00AM – 12:00PM Saturday **Walk Up Window:** 8:00AM – 8:30AM Monday – Friday
Branch Size:	Small/Medium
Energy Usage 2001 (in dollars):	$21,170
A/C Control:	Branch-controlled (2 A/C units)
A/C Temperature Setting:	70° F
Actual Temperature Reading	66° F

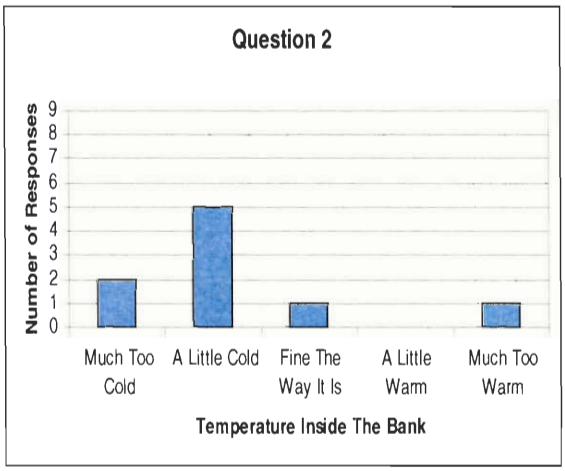
Observations/Comments:

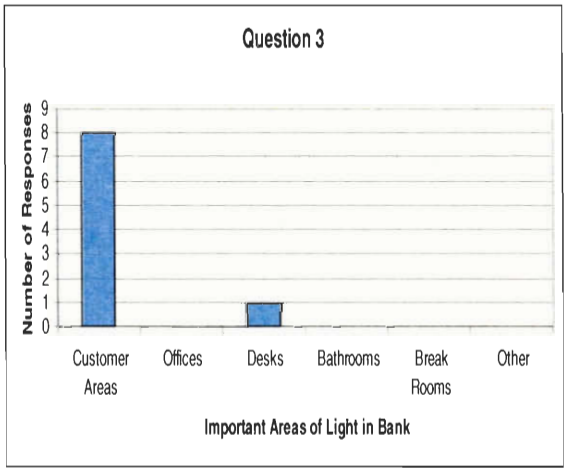
This branch is a really busy branch. The lights and A/Cs come on at 7:45AM and go off at 4:30PM. The bathroom lights are on all day and the teller lights are always on. The break room lights are also always on. There are not many windows in the building, with 6 really thin long windows and 2 regular size windows. The teller areas are bright, but the desk and customer areas are dark. The A/C control consists of three switches: FAN, COOL1, and COOL2. The branch only turns one on if there are little customers. There is no A/C in the back area (break room and bathrooms). The break room seemed really bright. Peak hours are from 10:00AM to about 1:00PM. There is an indoor ATM also.

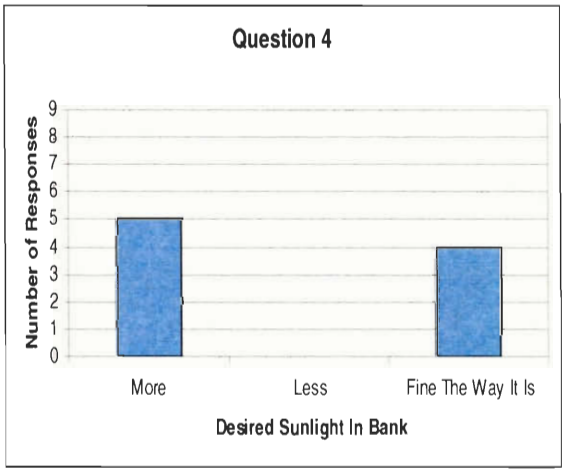
Light fixtures inside the bank: (1) 24 square fixtures with 4 fluorescent bulbs per square, (2) 9 square fixtures with 3 bulbs per square (3) 2 lamps in customer are with 4 40W Sylvania incandescent bulbs.

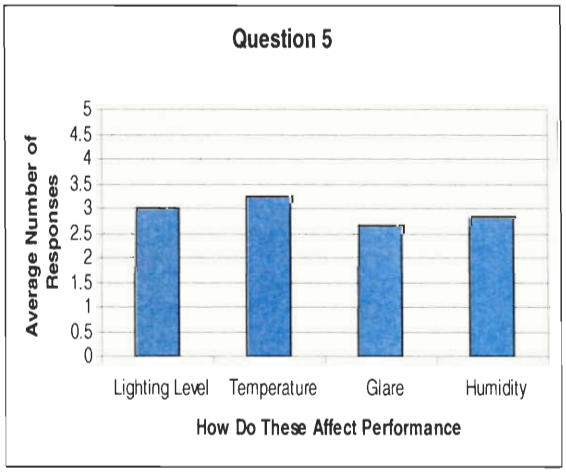
Barrio Obreros
Employee Survey Results:
(9 returned from 9)











Branch Profile

Location:	Bayamón Drive-In
Situated:	Stand-alone
Address:	KM 13.9, Barrio Hato Tejas Carretera Estatal #2
Hours of Operation:	**Branch:** 8:30AM – 4:00PM Monday – Friday 9:00AM – 12:00PM Saturday 11:00AM – 3:00PM Sunday **Drive In:** 8:30AM – 4:30PM Monday – Friday 9:00AM – 12:00PM Saturday 11:00AM – 3:00PM Sunday
Branch Size:	Medium
Energy Usage 2001 (in dollars):	$18,922
A/C Control:	Branch-controlled
A/C Temperature Setting:	70° F
Actual Temperature Reading:	70° F

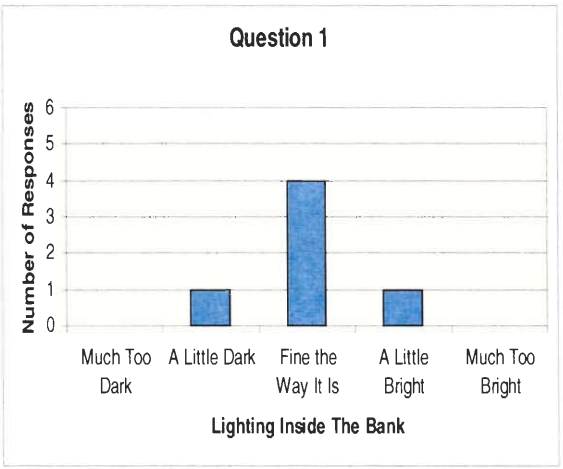
Observations/Comments:

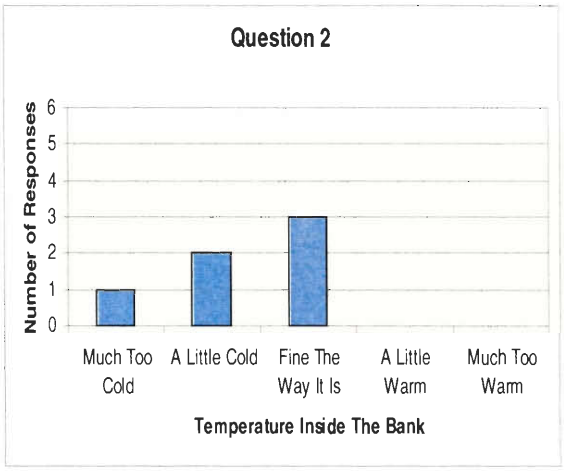
The branch was very modern. Everything comes on at 8:00AM and is turned off after the janitorial service leaves around 7:30PM. Computers are shut off as employees leave. The lights are controlled by 5 switches in the branch. It was observed that all areas of the branch were really bright, especially the customer areas. The branch manager stated that the lights by the bank's volt needed to be on at all times for security purposes (camera). The lights were dirty. There were a lot of windows inside the branch, letting in a lot of sunlight into the building. Blinds on all windows were open. However, the windows were not too warm. There was a little overhang outside. Break room and bathroom lights were on at time of observation. There was also a metal detector at the entrance where only one person is allowed to enter – this may help the escape of cool air to the outside. Air temperatures in the customer areas were comfortable; however it was a little cold by

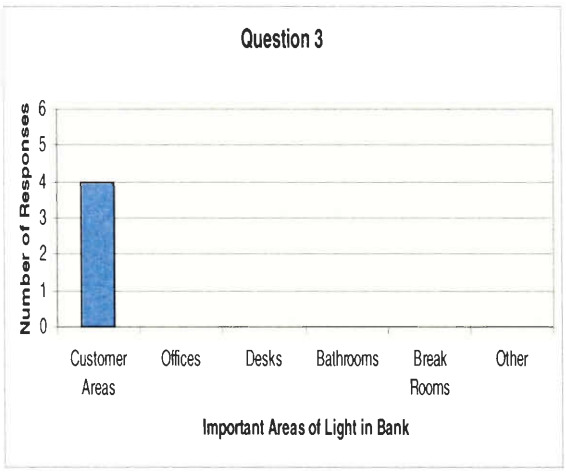
the office areas. Peak hours inside the branch were said to be from 11:30AM – 1:00PM. The branch has 3 drive-in tellers and 2 ATMs with their own A/C.

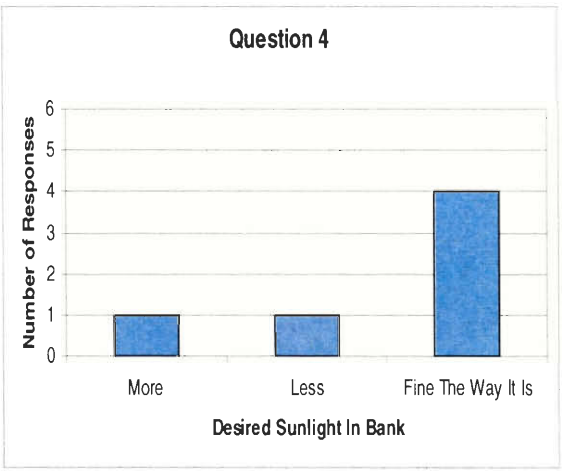
Light fixtures inside the bank: (1) 39 rectangular non-reflective fixtures with 4 long fluorescent Sylvania Octron 4100K 32W, (2) 4 square fixtures with 2 U-shaped bulbs each, (3) 20 circular lights with 2 fluorescent bulbs each.

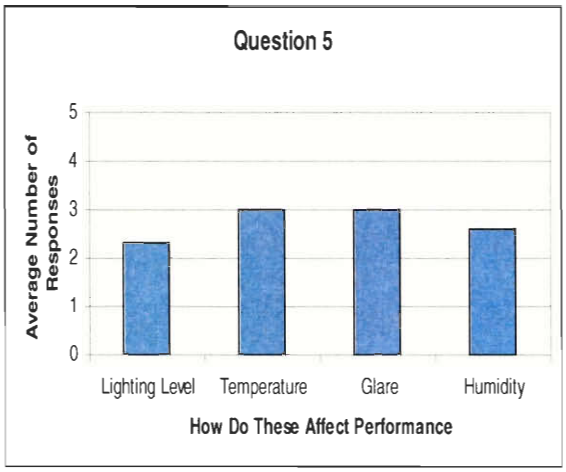
Bayamón Drive In
Employee Comfort Survey
(6 returned from 6)










Question 5
Average Number of Responses
5
4
3
2
1
0
Lighting Level
Temperature
Glare
Humidity
How Do These Affect Performance

Branch Profile

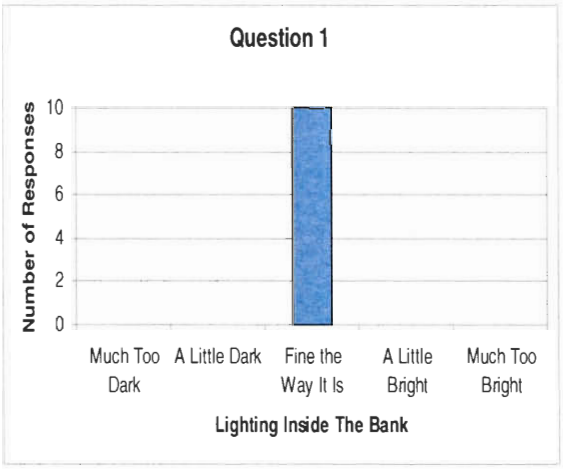
Location:	Bayamón Rexville
Situated:	Stand-alone (in plaza)
Address:	Rexville Plaza, Carretera #167, Bayamón
Hours of Operation:	**Branch:** 8:30AM – 3:30PM Monday – Friday 8:30AM – 12:00PM Saturday
Branch Size:	Small/Medium
Energy Usage 2001 (in dollars):	$15,844
A/C Control:	Branch-controlled
A/C Temperature Setting:	75° F
Actual Temperature Reading:	68° F

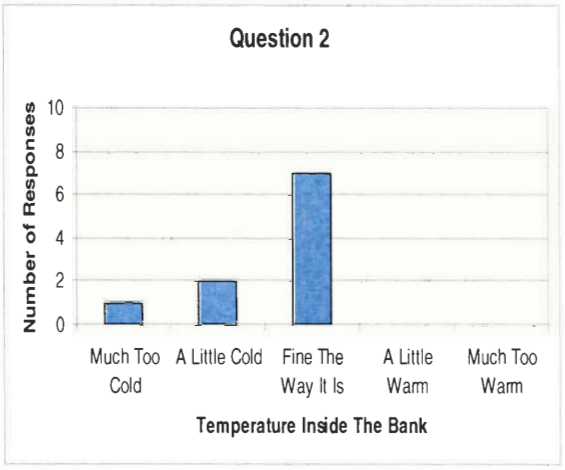
Observations/Comments:

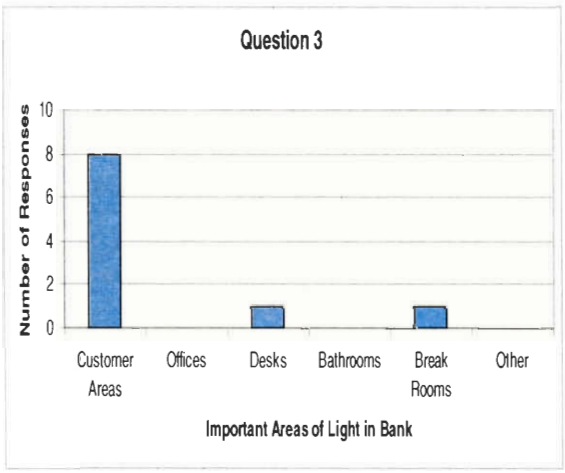
This is an older branch. There is not too much sunlight inside the branch. The customer areas and desk and office areas are bright. The teller areas seem dark though. The lighting fixtures are also arranged in weird patterns. The lights were dirty. There was a large overhang on the building. The lights are turned on at 7:30AM and are shut off at 5:30PM. The janitor comes in after that. Peak hours are around lunch time. There is only one light on in the branch at all times. There was only one light switch for the whole back area (break room, storage room, back hallway). Computers are shut off when employees leave. There are 2 ATMs that are on 24/7 with an A/C

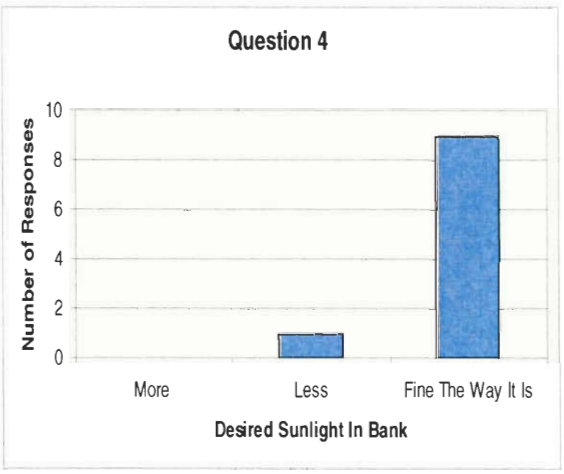
Light fixtures inside the bank: (1) 24 rectangular fixtures with 4 long fluorescent Philips F40DX 40W, (2) 27 square fixtures with 2 U-shaped Sylvania Octron 4100K 32W.

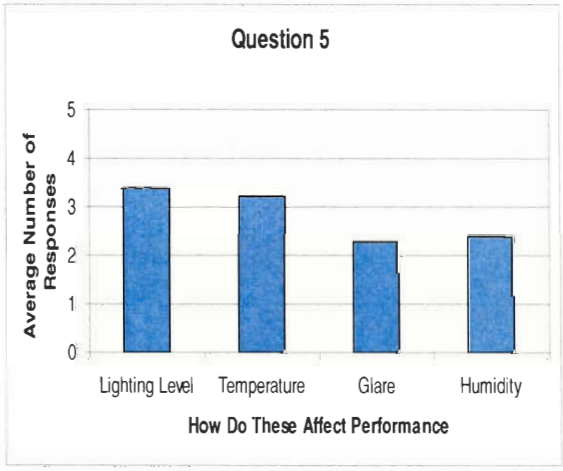
Bayamón Rexville
Employee Comfort Survey
(10 returned from 10)











Branch Profile

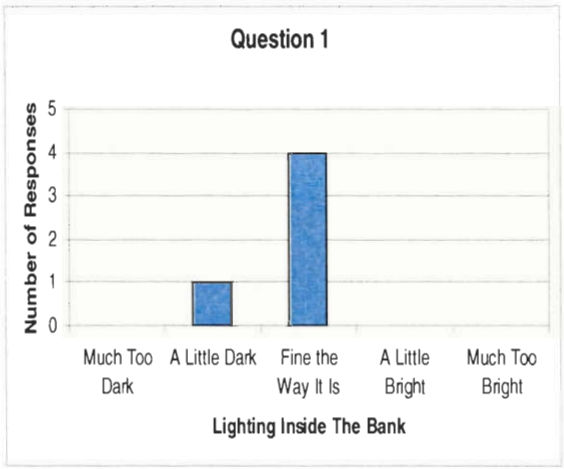
Location:	Condado
Situated:	Stand Alone
Address:	Ave. Ashford #1319, Condado
Hours of Operation:	**Branch:** 8:30AM – 4:00PM Monday – Friday 9:00AM – 12:00PM Saturday
Branch Size:	Small
Energy Usage 2001 (in dollars):	$15,270
A/C Control:	Branch-controlled
A/C Temperature Setting:	70° F
Actual Temperature Reading:	72° F

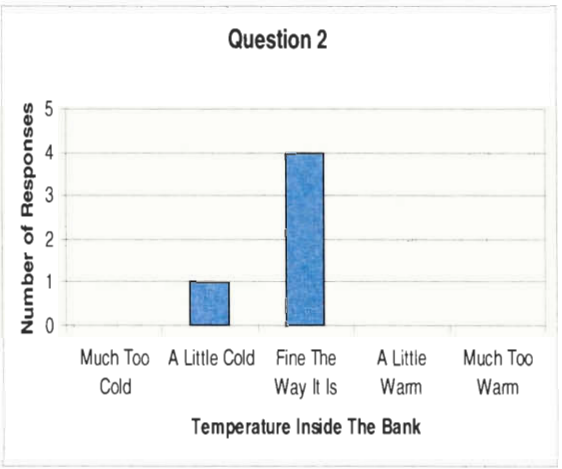
Observations/Comments:

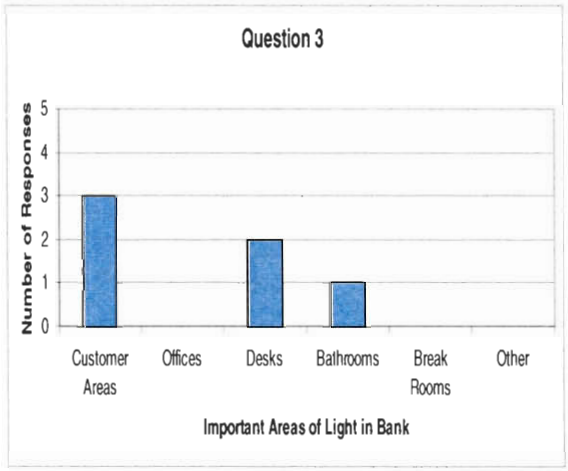
This branch is an old branch. The customer and teller areas are bright. The office areas seem a little dark. There is lots of sunlight in the bank. There are windows with blinds; some of the blinds were closed and some were open. The windows were by the desks; each desk had a window. The teller area lights stay on (2 fixtures). The lights and A/C come on at 8:00AM and go off at 4:30PM. The branch already has a few energy saving light bulbs installed. The peak hours are from 11AM to 1PM. There is a TV inside the branch.

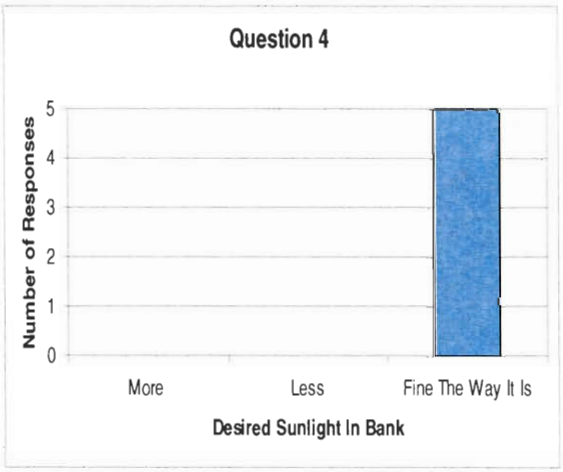
Light fixtures inside the bank: (1) 43 rectangular reflective fluorescent fixtures with 2 bulbs each Sylvania Super Saver Cool White 34W (2) 1 square fluorescent fixtures with 2 bulbs (same type of bulb) (3) 2 rectangular fixtures with 4 bulbs

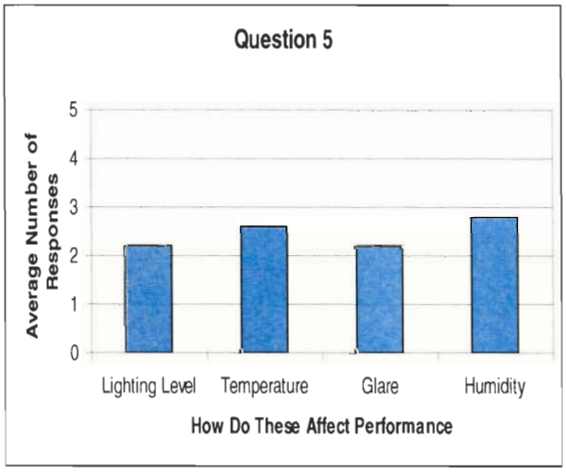
Condado
Employee Comfort Survey
(5 returned from 6)











Branch Profile

Location:	De Diego
Situated:	Stand Alone
Address:	Calle de Diego #254, Rio Piedras
Hours of Operation:	**Branch:** 8:30AM – 3:30PM Monday – Friday 9:00AM – 12:00PM Saturday **Drive In:** 8:30AM – 4:00PM Monday – Friday 9:00AM – 12:00PM Saturday
Branch Size:	Large
Energy Usage 2001 (in dollars):	$18,411
A/C Control:	Branch-controlled (on/off – no temp)
A/C Temperature Setting:	N/A
Actual Temperature Reading:	N/A

Observations/Comments:

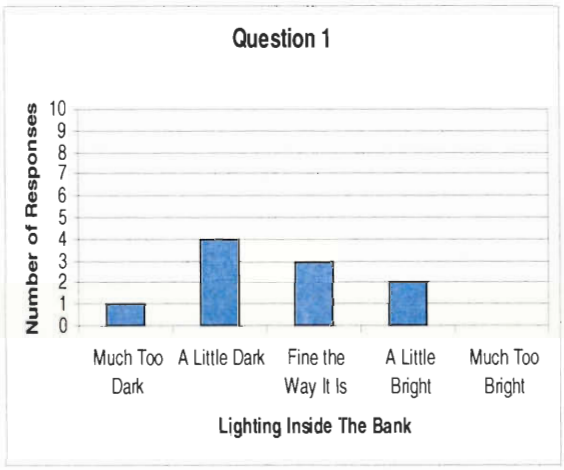
The branch is an older branch. There are no windows and there is no sunlight inside the bank. The desk areas are dark, but the customer areas are bright. The lights are pretty dirty. The branch cannot control the temperature of the air conditioner; they can only turn it on and off using a key. The branch seemed pretty cold. There is one set of light switches that turns all the lights on and off. The break, storage, and bath rooms have their own light switches. The teller lights are always on (16 fixtures). The lights come on at 7:45AM and go off at 5PM. The peak hours of operation are from 8AM until 2PM, with Mondays being the busiest.

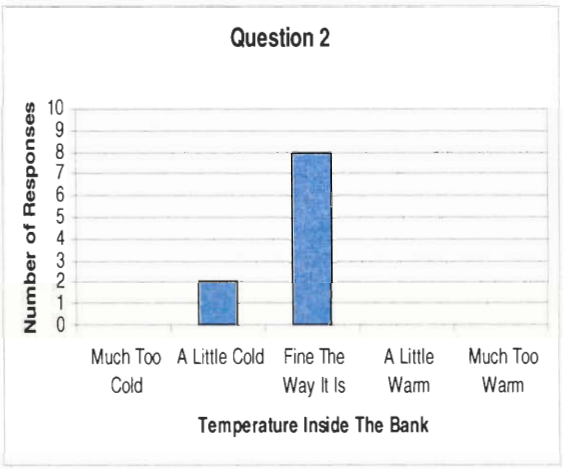
Light fixtures inside the bank: (1) 135 rectangular fluorescent fixtures with 2 bulbs each Sylvania Daylight Deluxe F40/DX 40W (2) 9 rectangular fixtures with 4 bulbs each (3) 6 square fluorescent fixtures with 2 bulbs in each.

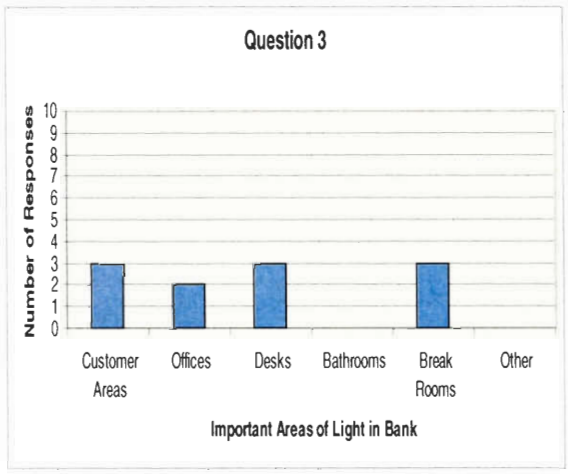
In the drive in there are 7 rectangular fixtures with 4 bulbs each. The A/C reading inside the drive in is at 76 degrees and the actual temperature was at 73 degrees. The server

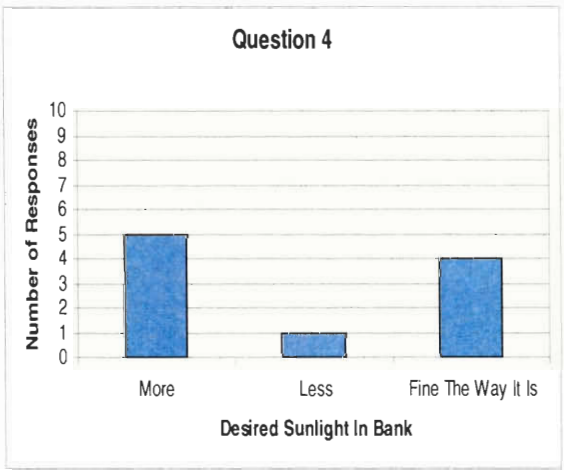
room had its own A/C unit, set to the coolest setting and on 24/7. There are also 12 lights outside by the drive in area.

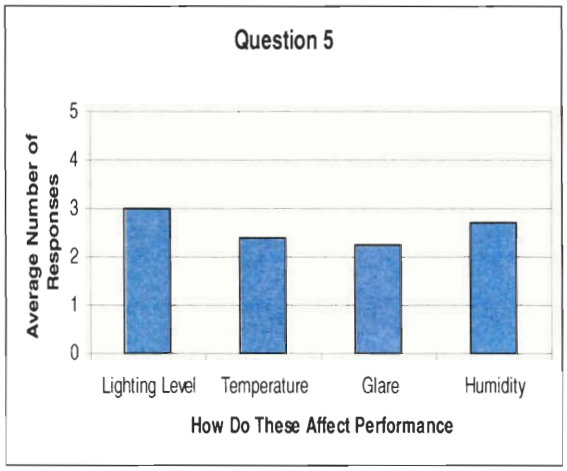
De Diego
Employee Comfort Survey Results:
(10 returned from 10)










Question 5
Average Number of Responses
5
4
3
2
1
0
Lighting Level
Temperature
Glare
Humidity
How Do These Affect Performance

Branch Profile

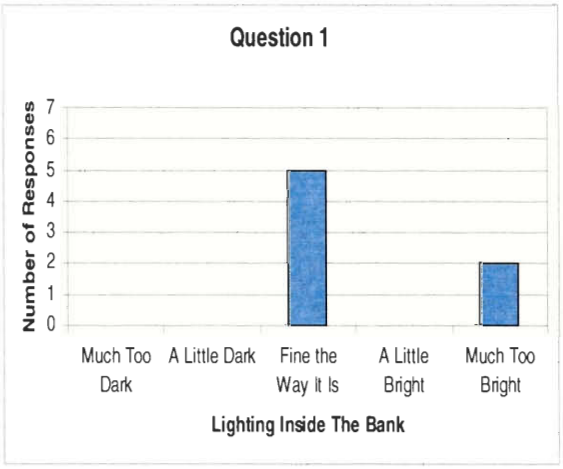
Location:	Dorado
Situated:	Stand Alone
Address:	Mahi Mahi Shopping Village Carretera Estatal 693 KM 7.5
Hours of Operation:	8:30AM – 4:00PM Monday – Friday 9:00AM – 12:00PM Saturday Drive In: 8:00AM – 4:30PM Monday – Friday 9:00AM – 12:00PM Saturday
Branch Size:	Medium
Energy Usage 2001 (in dollars):	$29,782
A/C System:	Branch-controlled
A/C Temperature Setting:	74° F
Actual Temperature Reading:	70° F

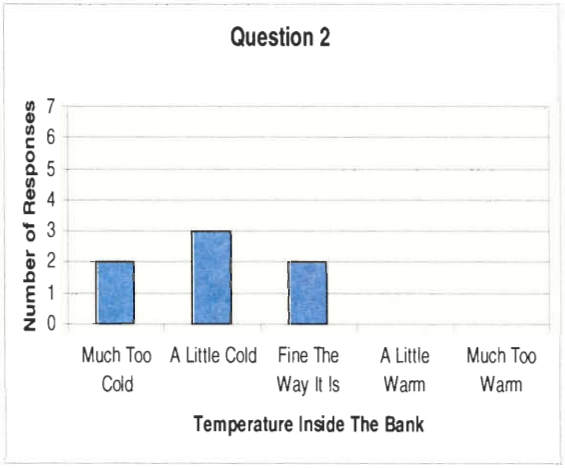
Observations/Comments:

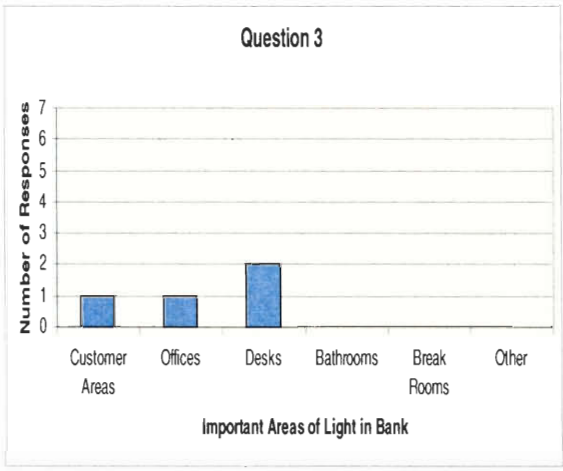
The branch has a security system that allows one person to enter at time. The branch has lots of windows and sunlight. The windows have shades and the office area shades are closed. The teller areas are bright and the desk areas are not too bright but are not too dark. The customer areas are dark. The lights are a little dirty. The lights come on at 8AM and go off at 5PM. All the lights in the main areas of the branch are controlled by 10 light switches. The branch also seems a little cold. The bathrooms are very hot and are controlled by a single switch. The break room lights are also controlled by a single switch. There is a small overhang outside. There are 2 TVs. The peak hours are during the midday hours.

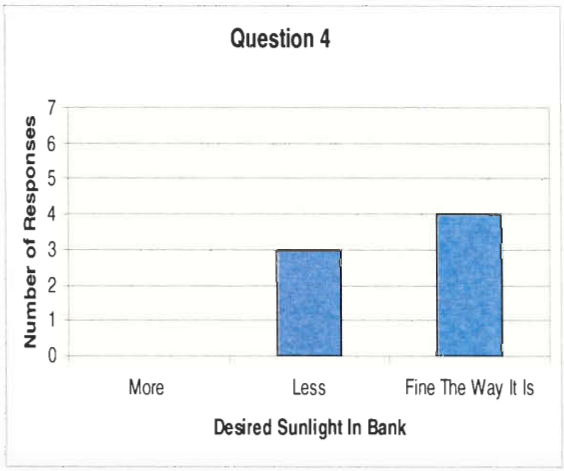
Lighting fixtures in the branch: (1) 15 circular lights (2) 4 accent lights (3) 9 other accent lights (4) 18 square fluorescent fixtures with 2 U-shaped Sylvania 4100K 32W (4) 12 rectangular fluorescent fixtures with 4 bulbs each.

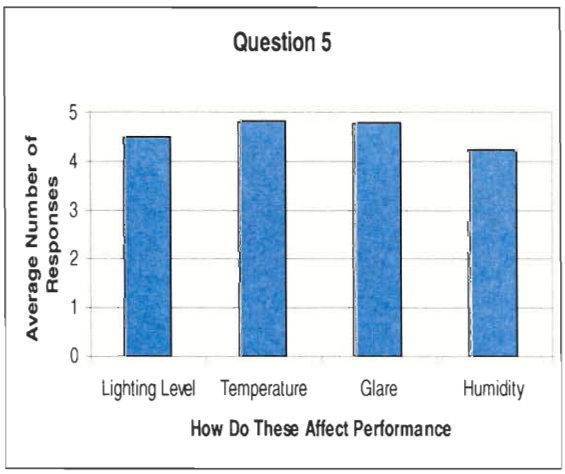
Dorado
Employee Comfort Survey
(7 returned from 7)











Branch Profile

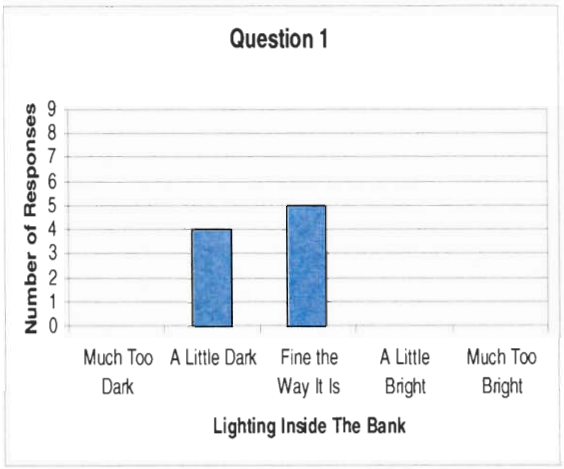
Location:	El Señorial
Situated:	Inside mall
Address:	El Señorial Shopping Center Ave. Winston Churchill, Rio Piedras
Hours of Operation:	**Branch:** 8:30AM – 4:00PM Monday – Friday 8:30AM – 12:00PM Saturday **Drive In:** 8:30AM – 4:00PM Monday – Friday 8:30AM – 12:00PM Saturday
Branch Size:	Small
Energy Usage 2001 (in dollars):	$16,857
A/C Control:	Branch-controlled
A/C Temperature Setting:	70°
Actual Temperature Reading:	N/A

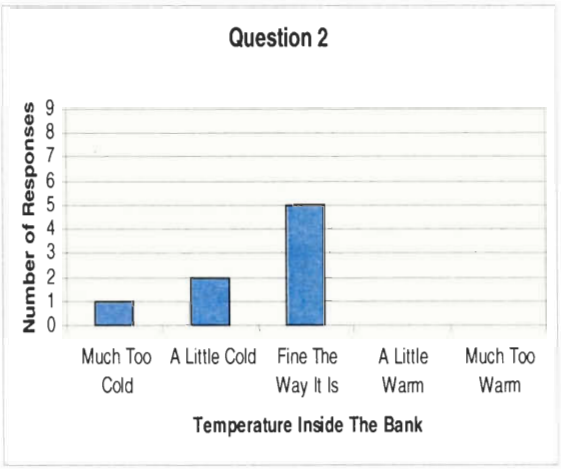
Observations/Comments:

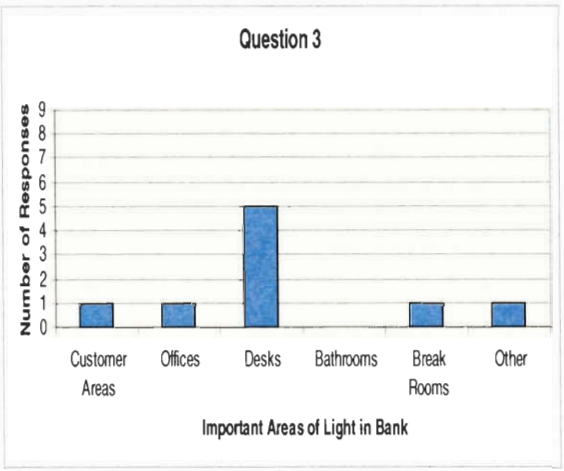
This is an old branch. The branch seemed dark overall. The desk and teller seemed the darkest of all observed areas. The lights in the branch are always on (teller and customer area). There were no windows inside the branch. The air conditioning is turned on at 8AM and goes off at around 4:30 to 5:00PM. The branch manager mention some law or rule that the A/C had to kept at 70 degrees, but Jorge Rendon said there was no such law. The peak hours in the branch are from 11:00AM until 2:00PM. There is also a drive-in teller and ATM. The lights in the break room and bath room were on during time of observation.

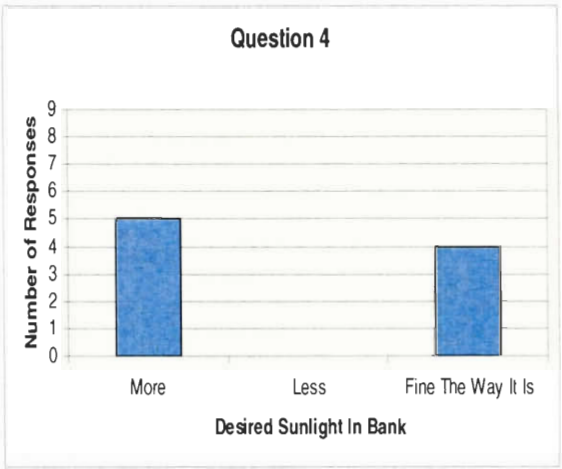
Light fixtures inside the bank: (1) 39 rectangular fluorescent fixtures with 2 bulbs each Philips F40DX 40W (2) 17 fixtures with 2 U-shaped bulbs each (3) 2 fixtures with 4 fluorescent bulbs each (3) 3 lights in the break room

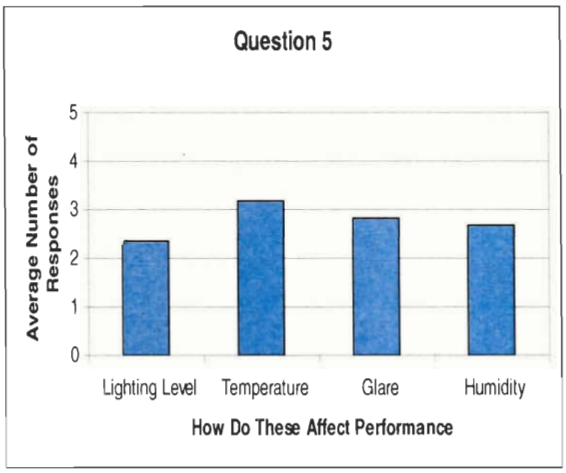
El Senorial
Employee Comfort Survey
(9 returned from 9)











Branch Profile

Location:	Forest Hills
Situated:	Stand-alone
Address:	Carretera Estatal, 167KM 1.3, Esq. La Paz Forest Hills, Bayamón
Hours of Operation:	**Branch:** 8:30AM – 4:00PM Monday – Friday 9:00AM – 12:00PM Saturday **Drive In:** 8:30AM – 4:30PM Monday – Friday 9:00AM – 12:00PM Saturday
Branch Size:	Medium
Energy Usage 2001 (in dollars):	$23,286
A/C Control:	Branch-controlled (automatic/manual temp)
A/C Temperature Setting:	62° F
Actual Temperature Reading:	72° F

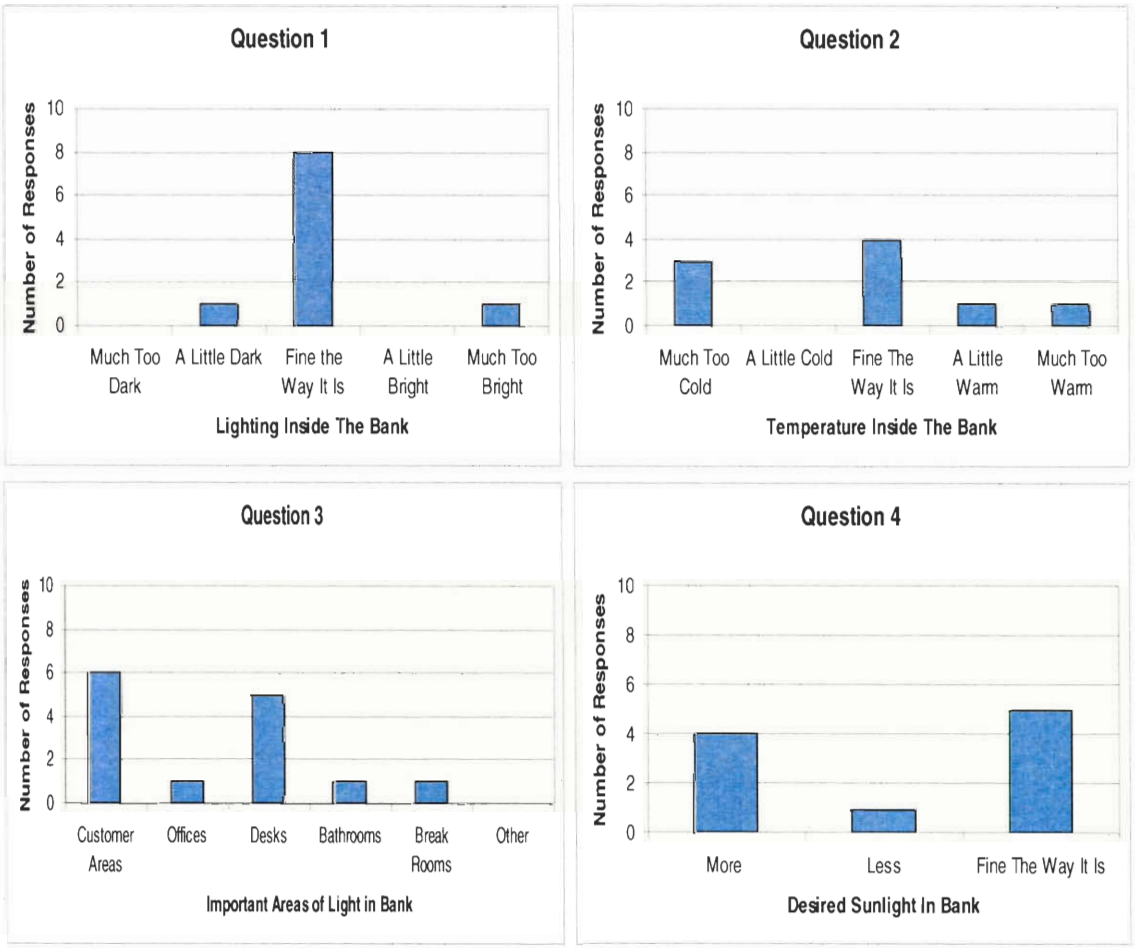
Observations/Comments:

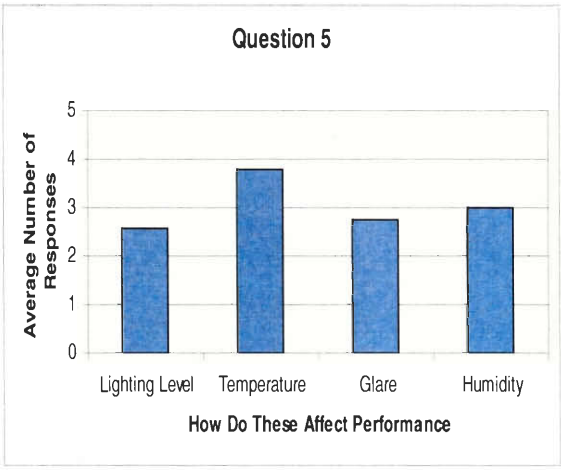
The branch is not too modern, but not too old looking. The branch turns everything on at around 7:50AM each morning. This includes the lights, air conditioning, and computers. Everything is turned off at around 5:00PM. There is a janitorial service that comes in and turns all the lights on for about an hour and half after closing hours. The teller areas are bright, while the customer and desk areas are dark. The lights in the branch were clean overall. Lights in the break room were on, with "extra" lights in the counter area in the kitchen. The 2 bathrooms are warmer than other areas of the bank. There are lots of windows with closed shades on them. Some of the windows had open shades by the drive-in teller areas. The drive-in teller area had an overhang outside. The estimated peak hours are at opening and from 11:30AM to 1:30PM.

There were 3 observed types of light fixtures inside the bank: (1) 21 rectangular reflective fixtures with 4 long fluorescent Sylvania Octron 4100K 32W, (2) 27 square fixtures with 2 U-shaped Sylvania Cool White 40W FB40CW-6, (3) 6 circular lights with 2 fluorescent bulbs each. There were also various lights on the outside of the branch, consisting of 2

large lights on tall poles to light the parking lot and13 lights in the drive-in overhang area. The branch also has one ATM, with its own air conditioner.

Forest Hills
Employee Comfort Survey
(10 returned from 10)




Question 5
Average Number of Responses
5
4
3
2
1
0
Lighting Level
Temperature
Glare
Humidity
How Do These Affect Performance

Branch Profile

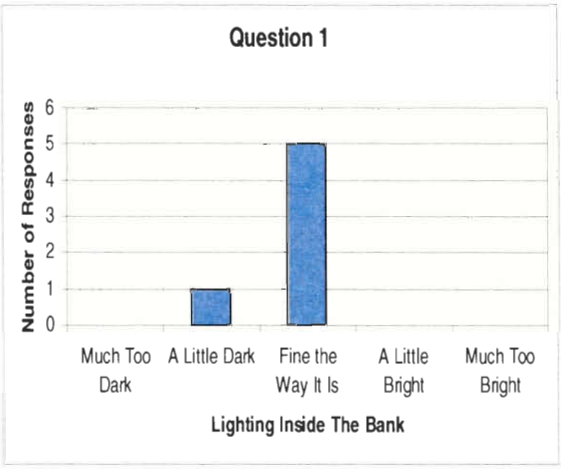
Location:	Isla Verde
Situated:	Stand-alone
Address:	Carretera Estatal, #37 Lote Num. 6 Ave. Isla Verde
Hours of Operation:	**Branch:** 8:30AM – 4:00PM Monday – Friday 9:00AM – 12:00PM Saturday **Drive In:** 8:30AM – 4:30PM Monday – Friday 9:00AM – 12:00PM Saturday
Branch Size:	Medium
Energy Usage 2001 (in dollars):	$20,118
A/C Control:	Branch-controlled (on/off with a key) 2 control units – platform/teller
A/C Temperature Setting:	72° F / 70° F
Actual Temperature Reading:	70° F

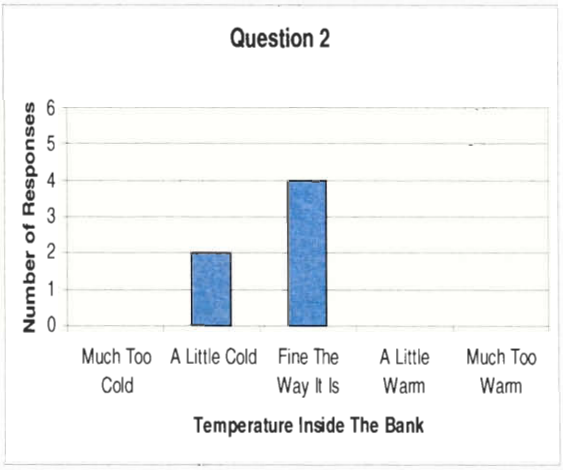
Observations/Comments:

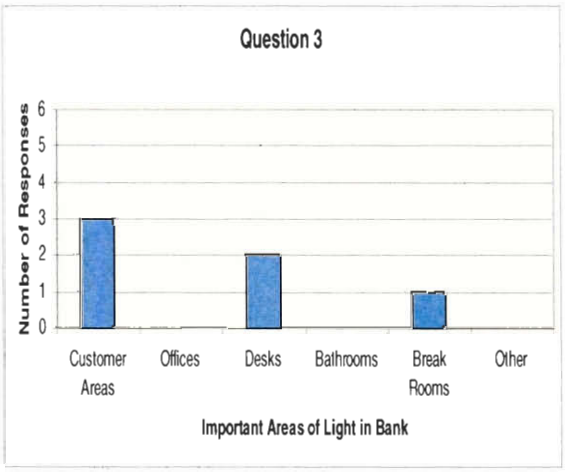
This is a new branch. The lights and A/C come on at 8AM and go off at 5PM. The lights were generally clean. The computers are turned off after employees leave. There is lots of sunlight inside the branch. Windows are mainly located in the desk areas. The blinds were open on these windows. The teller areas were bright, but the customer areas were dark. There were 12 light switches to control all of the lights on the platform. The break room and bathrooms had their own respective light switches. Peak hours were said to be from 11AM to 1PM. The branch is located on the second level; the first level consisted of drive up ATMs that are open 24/7. The branch has an elevator.

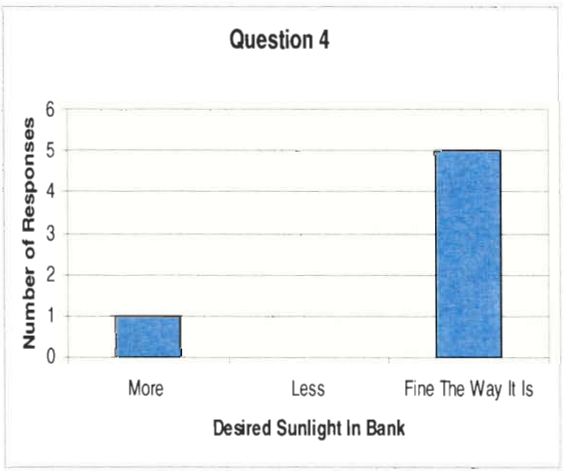
Light fixtures inside the bank: (1) 20 rectangular reflective fixtures with 2 long fluorescent Philips HiVision F32T8, (2) Green accent lights in the teller areas (3) 9 circular lights with 2 fluorescent bulbs each. There were also 3 large areas of lighting on the ceiling where fluorescent light was "reflected" off the ceiling.

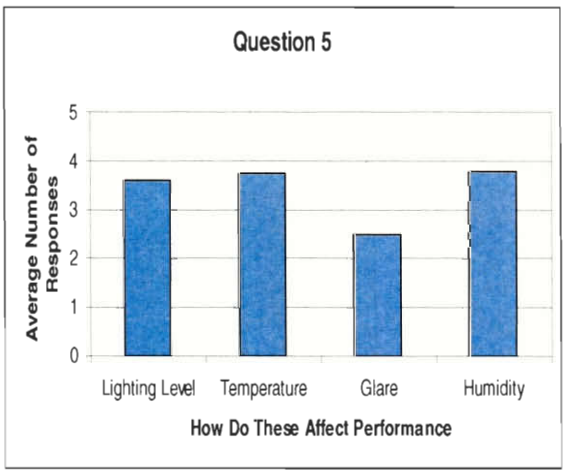
Isla Verde
Employee Comfort Survey
(6 returned out of 6)











Branch Profile

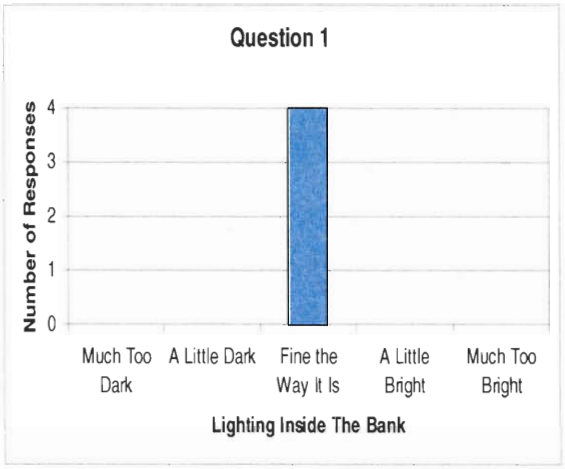
Location:	Ave. Kennedy
Situated:	Stand-alone
Address:	Ave. Kennedy Puerto Nuevo, San Juan
Hours of Operation:	**Branch:** 8:30AM – 4:00PM Monday – Friday 9:00AM – 12:00PM Saturday
Branch Size:	Medium
Energy Usage 2001 (in dollars):	$29,492
A/C Control:	Branch-controlled (on/off only – no temp)
A/C Temperature Setting:	60° F
Actual Temperature Reading:	67° F

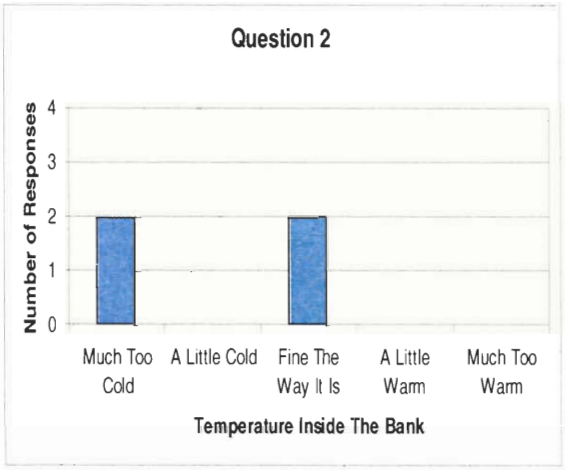
Observations/Comments:

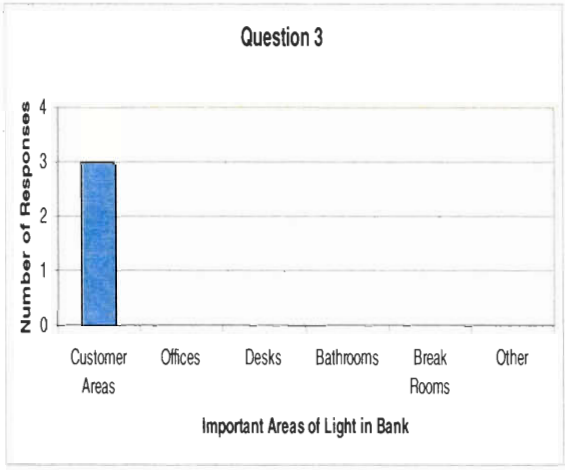
The lights and A/C come on at 7:30AM and go off at 4:30PM. All the lights are controlled by 4 switches. The branch has a metal detector – allowing only one person in at a time. There is a lot of sunlight on one end of the branch, and very little at the end. The teller lights are on all the time (branch manager says its bank policy). There are a lot of windows with blinds on them – some of the blinds were open and some were closed. The customer areas were a little dark while the teller and desk areas were bright. The lights were not dirty, but they were not really clean either. The break room lights were on during observation. The A/C control unit only has an on/off switch – there is no temperature control. The peak hours are from 11:30AM to 1:30PM.

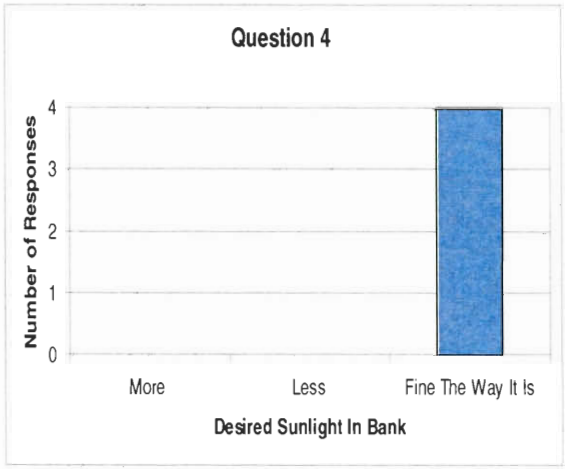
Light fixtures inside the bank: (1) 23 rectangular reflective fixtures with 4 long fluorescent bulbs, (2) 13 square fixtures with 2 U-shaped bulbs each (3) 17 circular lights with fluorescent/flood bulbs. There was also 1 ATM with 4 lights and green accent lights.

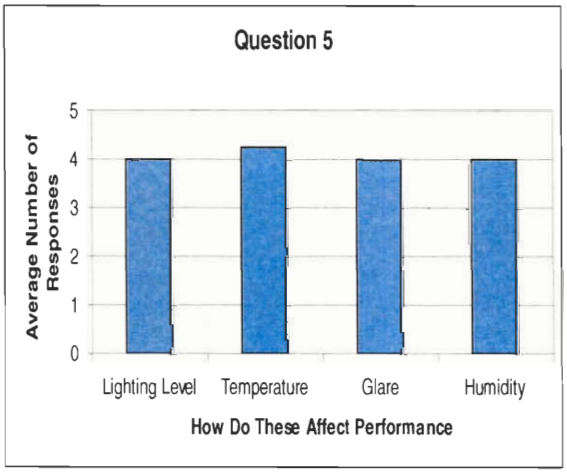
Kennedy
Employee Comfort Survey
(4 returned from 4)











Branch Profile

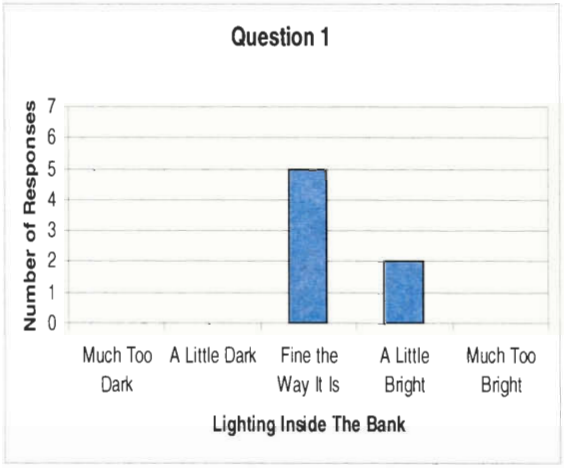
Location:	Mayaguez Playa
Situated:	Stand-alone
Address:	Ave. Gonzalez Clemente #52
Hours of Operation:	**Branch:** 8:30AM – 4:00PM Monday – Friday
Branch Size:	Large
Energy Usage 2001 (in dollars):	$42,707
A/C Control:	Branch-controlled (on/off – no temp)
A/C Temperature Setting:	N/A
Actual Temperature Reading:	N/A

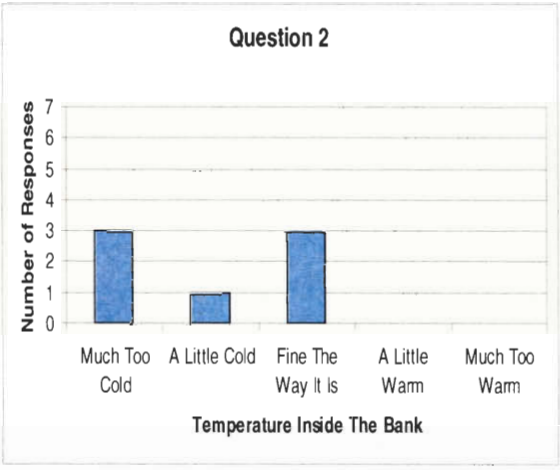
Observations/Comments:

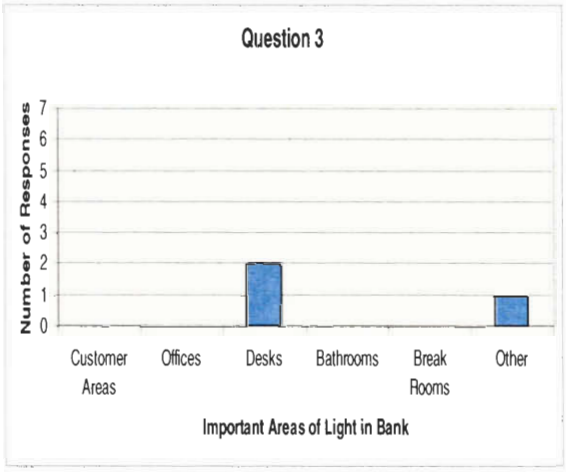
The branch is old. It was built as a Cold War shelter. There is a metal detector that allows one person to enter at a time. The lights and A/C come on at 7:30AM and go off at 5:50PM. The janitor service comes in from 7PM-8PM. There is one main circuit break for all the lights. It is bright everywhere in the branch. There is a second floor of open unused office space. The lights upstairs are on all day; the upstairs only used for training purposes. The upstairs has no A/C vents and is very warm, and there are a lot of tinted windows on the second floor. There is also a small section of the bank rented out to CitiBank. There is also an empty basement used to house the HVAC system. There is one A/C unit for the bank which they cannot control the temperature. The A/C unit uses 40 tons of loads of power. The peak hours are from 11AM to 2PM.

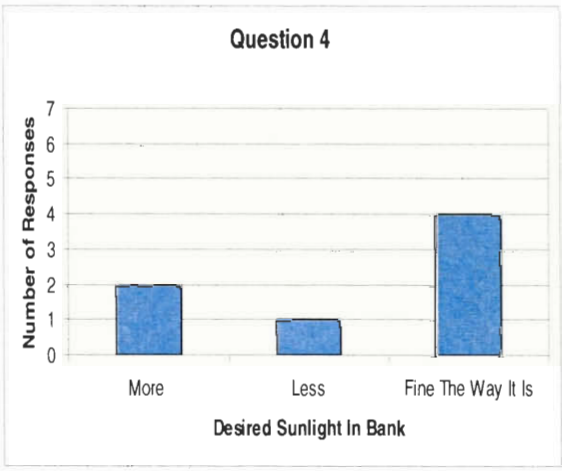
Light fixtures inside the bank: (1) 49 rectangular reflective fixtures (with covers on them) with 2 long fluorescent Sylvania Daylight Deluxe F40/DX Rapid Start 40W (FIRST FLOOR), (2) 46 rectangular fluorescent fixtures with 2 bulbs each (SECOND FLOOR) (controlled by 8 light switches left in the "on" position) (3) 12 lights outside turned on at night.

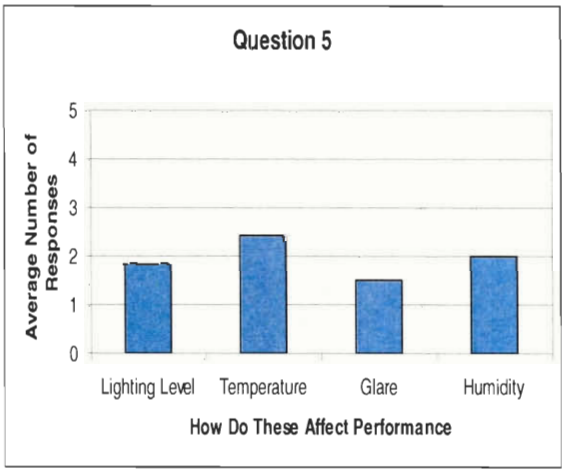
Mayaguéz Playa
Employee Comfort Survey
(7 returned from 8)











Branch Profile

Location:	Muñoz Rivera
Situated:	Stand Alone
Address:	Avenue Muñoz Rivera 876, Rio Piedras
Hours of Operation:	8:30AM – 4:00PM Monday – Friday 9:00AM – 12:00PM Saturday
Branch Size:	Large
Energy Usage 2001 (in dollars)	$35,652
A/C System:	N/A
A/C Temperature Setting:	N/A
Actual Temperature Reading:	N/A

Observations/Comments:

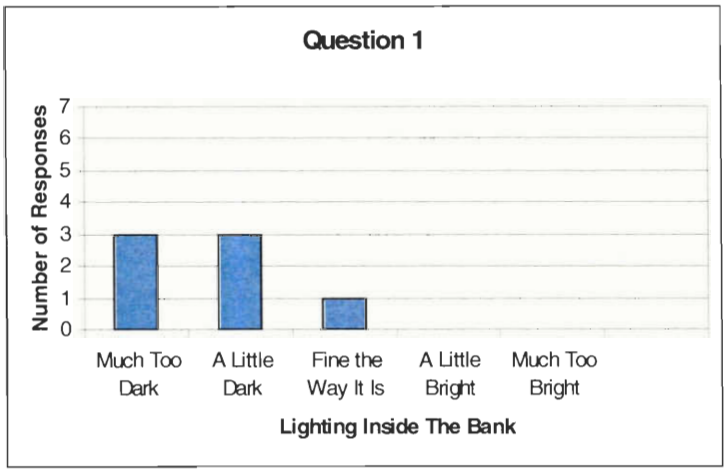
The branch has 3 floors, with the bottom floor being an actual branch, and the top 2 floors consisting of office space. Lights in the branch come on at around 7:30AM and go off at around 5:30PM. Computers inside the branch are always on during business hours. On the third floor office space, the light seemed really bright and it was really cold.

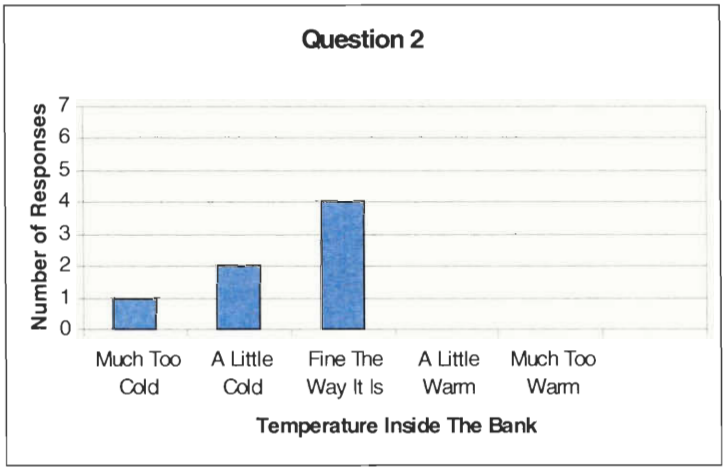
The branch is shaded by a small overhang on the outside. Large windows in the branch are covered with blinds, many of which were shut. The lights in this branch seemed cleaner than those of other observed branches. There were 71 square fluorescent light fixtures inside the branch, each have 2 U-shaped Philips 40W FB40DX/6 fluorescent bulbs. There were also 8 circular lights in the teller areas. The hallway leading to the branch and offices was really bright. It was lighted by 24 32W Sylvania Octron FD32/741 fluorescent light bulbs.

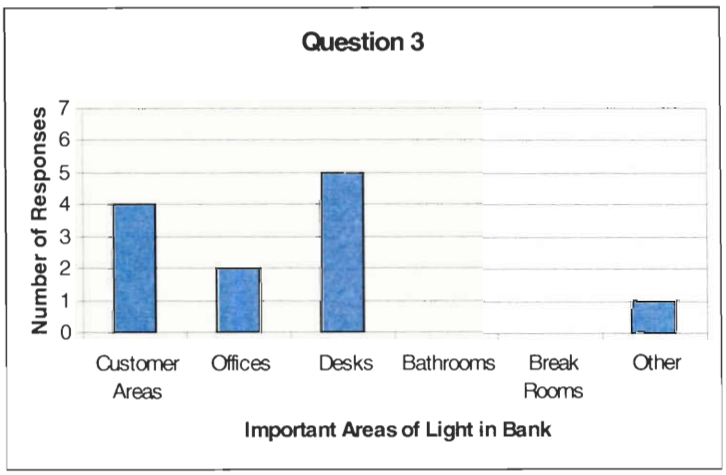
The office area on the third floor seemed really bright and extremely cold. We were not able to thoroughly examine the second and third floors due to the unavailability of key personnel.

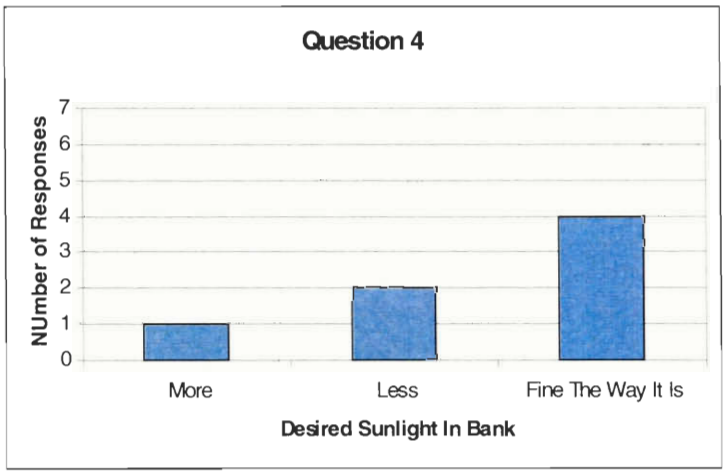
There were also 7 lights in the drive-in ATM area that were shut off

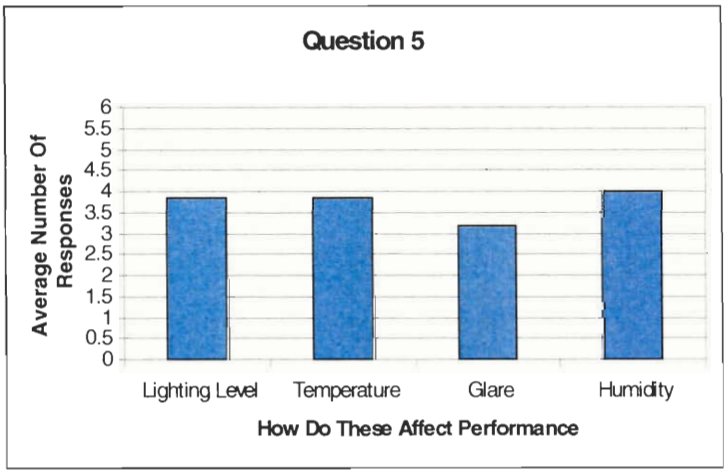
Employee Survey Results:
(7 returned from 11)











Branch Profile

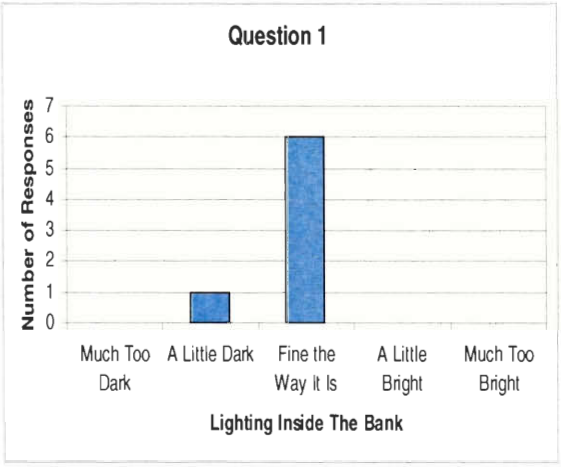
Location:	Parque Escorial
Situated:	Stand Alone
Address:	N/A
Hours of Operation:	**Branch:** 9:00AM – 6:00PM Monday – Friday 9:00AM – 2:00PM Saturday 11:00AM – 3:00PM Sunday
Branch Size:	Large
Energy Usage 2001 (in dollars):	$33,037
A/C Control:	Branch-controlled (2 units)
A/C Temperature Setting:	70°/71°
Actual Temperature Reading:	70°/68°

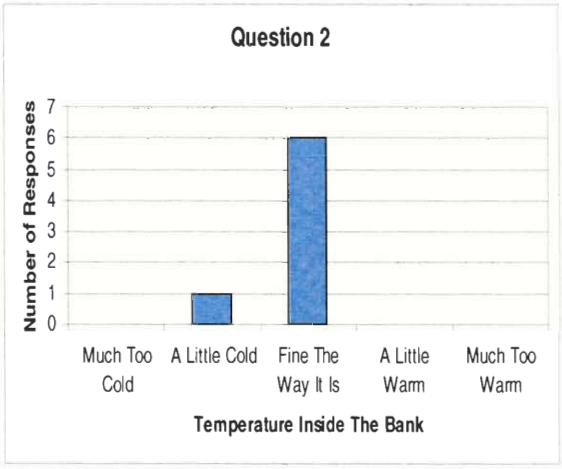
Observations/Comments:

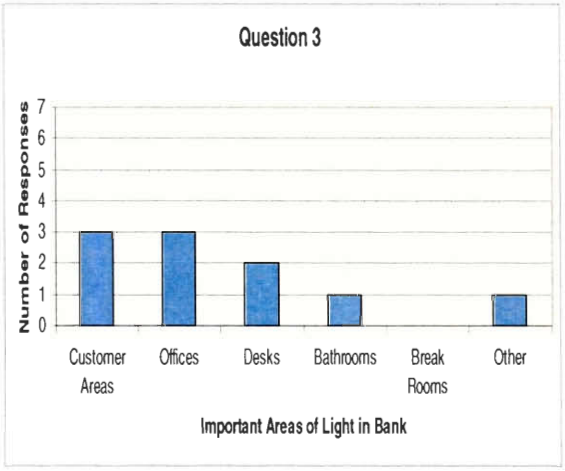
There is a metal detector in the entrance that allows one person in at a time. The branch has 2 air conditioning units: one for the back and one for the rest of the branch. The lights and A/C come on at 8:30AM. The A/C gets turned off at 6PM and the lights are turned off at 10PM after the janitorial service leaves. The branch is well lit. There are a lot of windows, but the shades on the windows are mostly closed. There is a small overhang outside. All office areas have windows. The lights are clean. There are 3 light switches for the office areas and 10 switches for the rest of the bank. The storage room had its lights on and it was very cold in there. The lights were also on in the bathrooms. There are 5 TVs. There is also an elevator. Peak hours are from 11AM – 1PM.

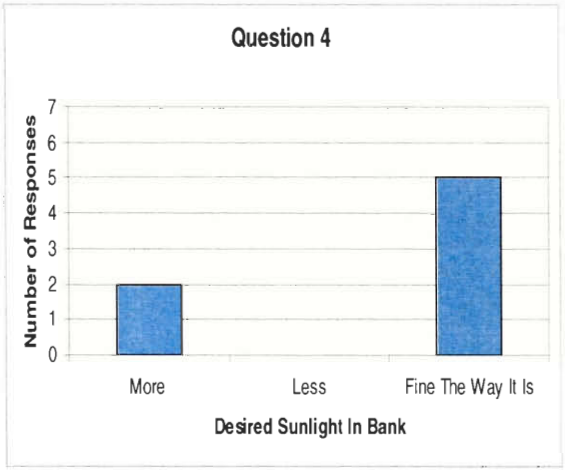
Light fixtures inside the bank: (1) 38 rectangular fluorescent fixtures with 4 bulbs each Sylvania Octron 4100K F032/741 32W (2) 7 square fluorescent fixtures with 2 U-shape bulbs in each (3) 15 halogen accent lights (4) 9 circular lights (5) 23 parking garage lights that come on at 6PM and shuts off at dawn.

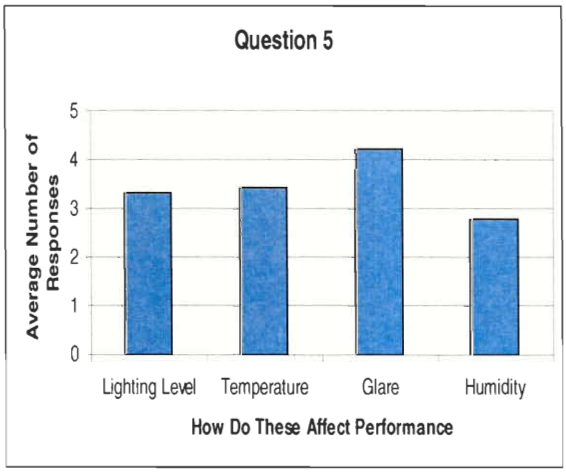
Parque Escorial
Employee Comfort Survey
(7 returned from 7)











Branch Profile

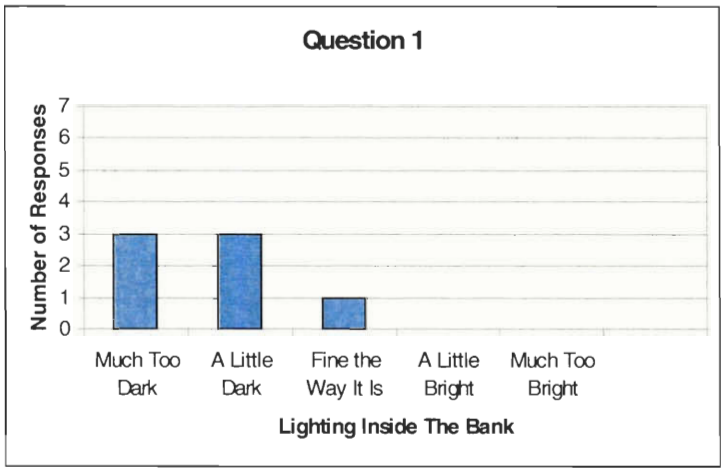
Location:	Plaza Las Americas Mall
Situated:	Inside mall
Address:	Center Avenue, FD Roosevelt, Hato Rey
Hours of Operation:	8:30AM – 7:00PM Monday – Friday 9:00AM – 7:00PM Saturday 11:00AM – 3:00PM Sunday
Branch Size:	Medium
Energy Usage 2001 (in dollars)	$22,042
A/C System:	Mall-controlled
A/C Temperature Setting:	N/A
Actual Temperature Reading:	N/A

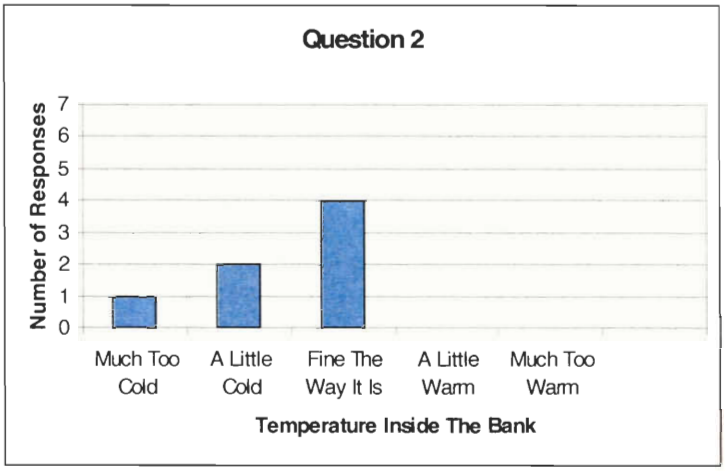
Observations/Comments:

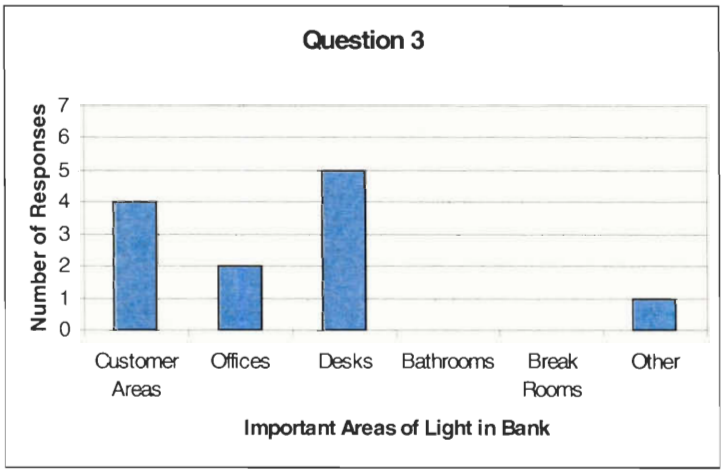
The branch turns everything (lights, office equipment, etc.) on at opening and shuts everything off at branch closing. Computers are turned on all day, except if the employee is absent. The only lights that are on all the time are some green outline lights in the teller area. Teller areas are a little dark, and employees complain that the lights do not work well. Lights inside the branch appear dusty and dirty. Lights in the back rooms, especially the upstairs break room/kitchen area and bank volts are always on (maybe use a motion sensor to control the lights). Some lights in the kitchen are unnecessary. The Operations Manager stated that the peak energy usage hours are from 10:30AM until 3:00PM. There are two employee shifts: 8:00AM to 5:00PM and 10:30AM to 7:00PM.

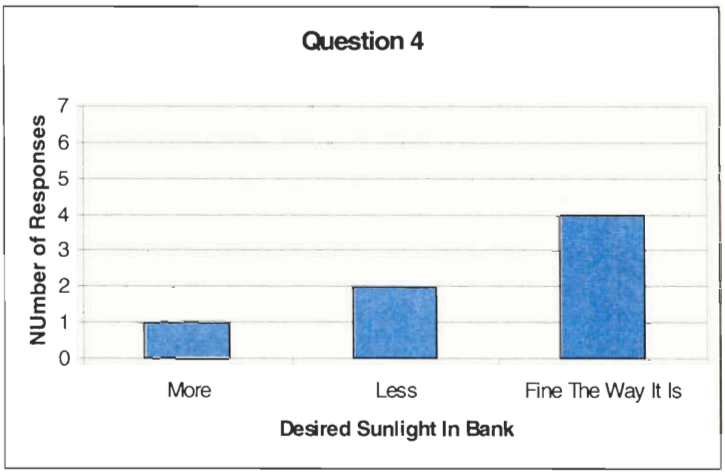
The branch recently installed shading film strips on their windows to reduce the glare from cars parked outside. The branch is shaded well by a large overhang outside. There are 5 types of light fixtures in the bank: (1) 5 large rectangular fluorescent fixtures that use 3 bulbs each, (2) 23 square fluorescent light fixtures that use U-shaped fluorescent lights (Sylvania Super Saver 34W FB40CW/RS/SS-6), (3) 8 circular lights at the entrance into the branch from the mall, (4) ? accent lights that provide light to advertisements in desk area cubicles, and (5) green accent lighting in the teller areas.

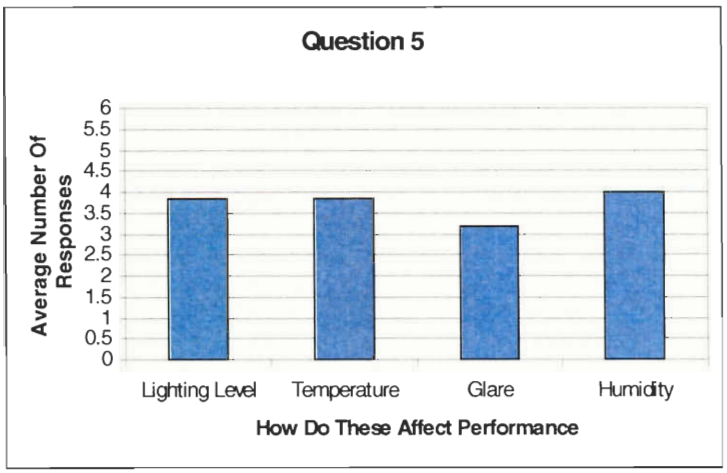
Employee Survey Results:
(7 returned from 11)










Question 5
Average Number Of Responses
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Lighting Level
Temperature
Glare
Humidity
How Do These Affect Performance

Branch Profile

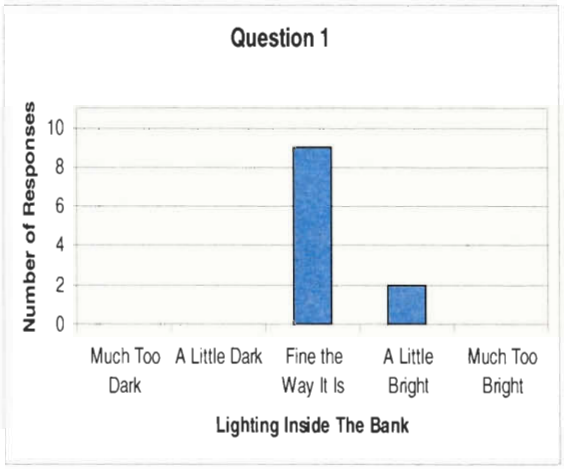
Location:	Ponce – Centro del Sur
Situated:	Stand-alone
Address:	Ave. Las America, Ponce
Hours of Operation:	**Branch:** 8:00AM – 4:00PM Monday – Friday 9:00AM – 12:00PM Saturday **Drive-In** 8:30AM-4:30PM Monday-Friday 9:00AM-2:00PM Saturday
Branch Size:	Small
Energy Usage 2001 (in dollars):	$24,198
A/C Control:	Branch-controlled (on/off – no temp)
A/C Temperature Setting:	66°
Actual Temperature Reading:	70°

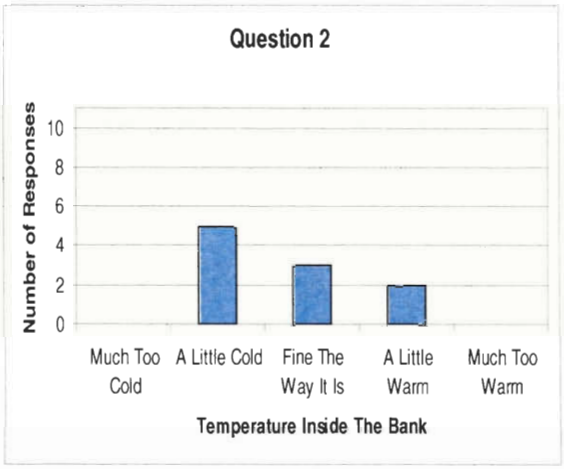
Observations/Comments:

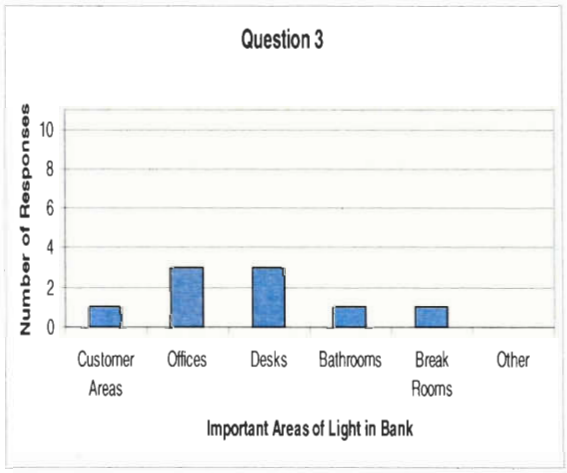
The branch is new. There is a metal detector that allows one person to enter at a time. The lights and A/C come on at 7:30AM and go off at 6:30PM. All the lights are shut off when they are turned off. There is a Television on all day. There are 2 ATM machines with Air Conditioners on 24 hours a day. There are also 2 drive in tellers. There is one bathroom with 1 square lighting fixture. The break room contains a small refrigerator and microwave. The branch felt a little cold. The peak hours in the branch are 11:00AM -2:00PM. There are 10 switches which control all the lights. There are a lot of windows and an overhang outside, which keeps some of the sunlight out, but there is still a lot of sunlight in the branch.

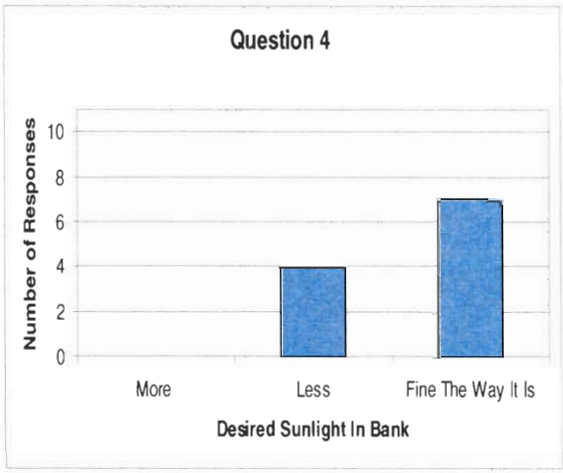
Light fixtures inside the bank: (1) 22 rectangular reflective fixtures (with covers on them) with 4 Sylvania Octron 32W 4100K in each. (2) 19 square reflective fixtures with 2 U-shaped bulbs in each. (the same type of bulbs). (3) 25 circular lights with one bulb in each. (4) 13 Halogen accent lights (Very small), of which 6 were shut off.

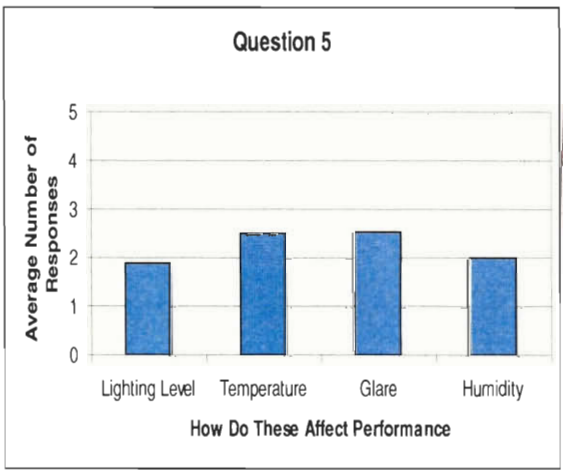
Ponce Centro del Sur
Employee Comfort Survey
(11 returned from 12)











Branch Profile

Location:	San Francisco
Situated:	Stand-alone
Address:	Ave. De Diego #200, Rio Piedras
Hours of Operation:	**Branch:** 8:30AM – 4:00PM Monday – Friday 9:00AM – 12:00PM Saturday **Drive In:** 8:30AM – 4:30PM Monday – Friday 9:00AM – 12:00PM Saturday
Branch Size:	Large
Energy Usage 2001 (in dollars):	$27,023
A/C Control:	Branch-controlled
A/C Temperature Setting:	75° F
Actual Temperature Reading:	78° F

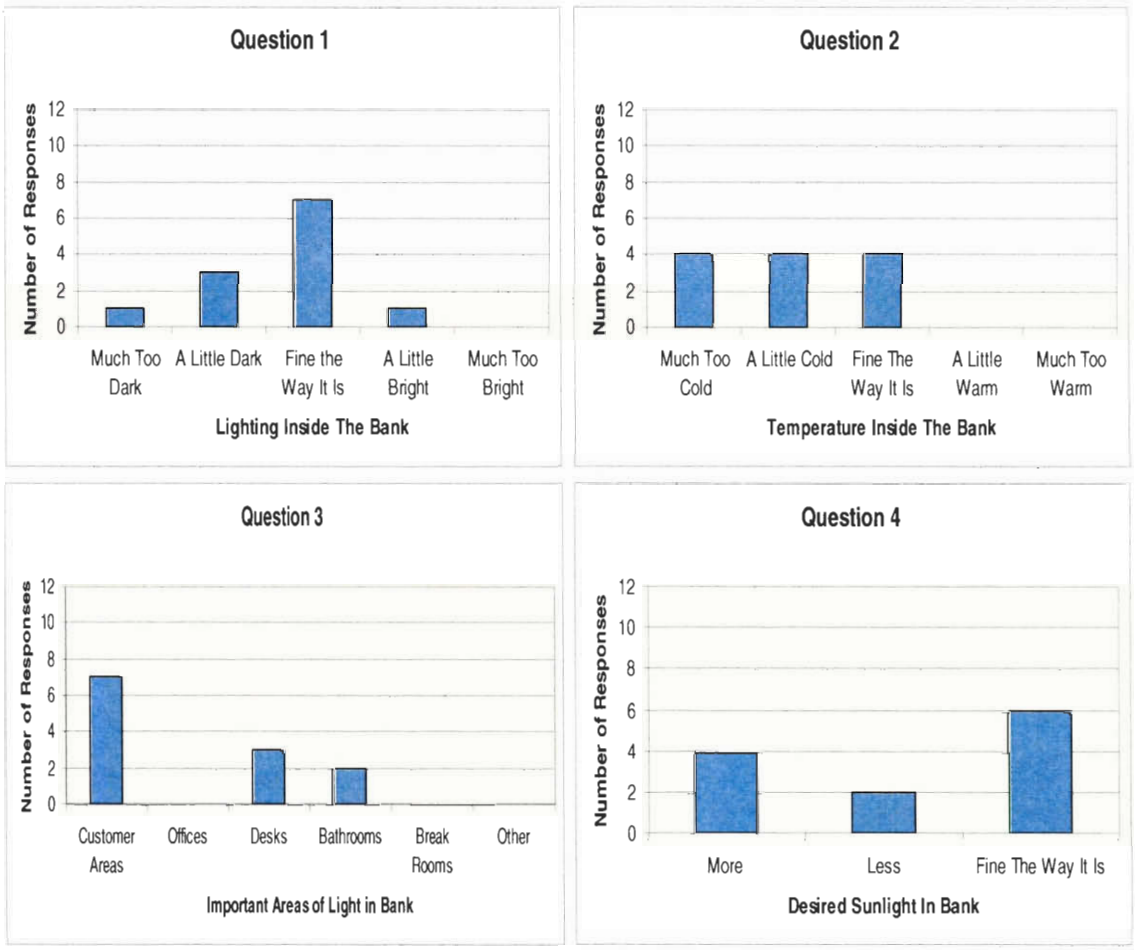
Observations/Comments:

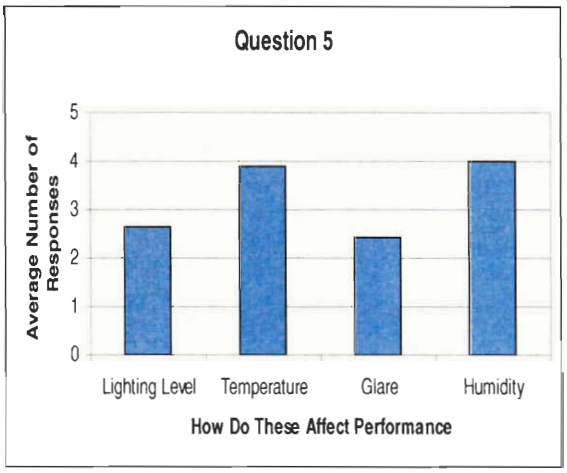
The lights and A/C come on at 7:30AM and go off at different times: 6:30, 7, or 8PM. Some lights were dirty and some were clean. Teller and parking lot lights stay on all day. The customer areas were dark while the teller and desk areas were well lit. There was no shading or overhangs. All the lights were controlled by 7 switches. There were large windows in the branch with closed blinds. There were 4 areas of fluorescent light "reflected" off the ceiling. The branch manager noted that the A/C was not working properly; the A/C used to be set between 70 and 80 degrees and now it must be set at 60 to achieve the same level of coolness. The branch manager's office was also much warmer than the rest of the branch. Also, half of the branch is a lot colder than the other half. Employees were also complaining about bad feelings every time there was a change in temperature. Lights were on in the bathroom. Peak hours for the branch were 10:30AM to 4:00PM.

Light fixtures inside the bank: (1) 45 rectangular reflective fixtures with 4 long fluorescent Philips HiVision F32T8/TL735/TL70, (2) 19 square fluorescent fixtures with 2 U-Shaped GE bulbs each (3) 26 circular lights in hallways and teller areas, (4) 36

parking garage lights. There were also 3 large areas of lighting on the ceiling where fluorescent light was "reflected" off the ceiling.

San Francisco
Employee Comfort Survey
(12 returned from 12)




Question 5
Average Number of Responses
5
4
3
2
1
0
Lighting Level
Temperature
Glare
Humidity
How Do These Affect Performance

Branch Profile

Location:	St. Thomas I
Situated:	Stand Alone
Address:	4 Kronprindsens Gade, Virgin Islands
Hours of Operation:	**Branch:** 8:30AM – 4:30PM Monday – Thursday 8:30AM – 5:00PM Friday **Walk-up-window:** 7:45AM – 8:30PM Monday – Thursday
Branch Size:	Medium
Energy Usage 2001 (in dollars):	$15,783
A/C Control:	Branch-controlled (2 units)
A/C Temperature Setting:	73°/72°
Actual Temperature Reading:	72°/74°

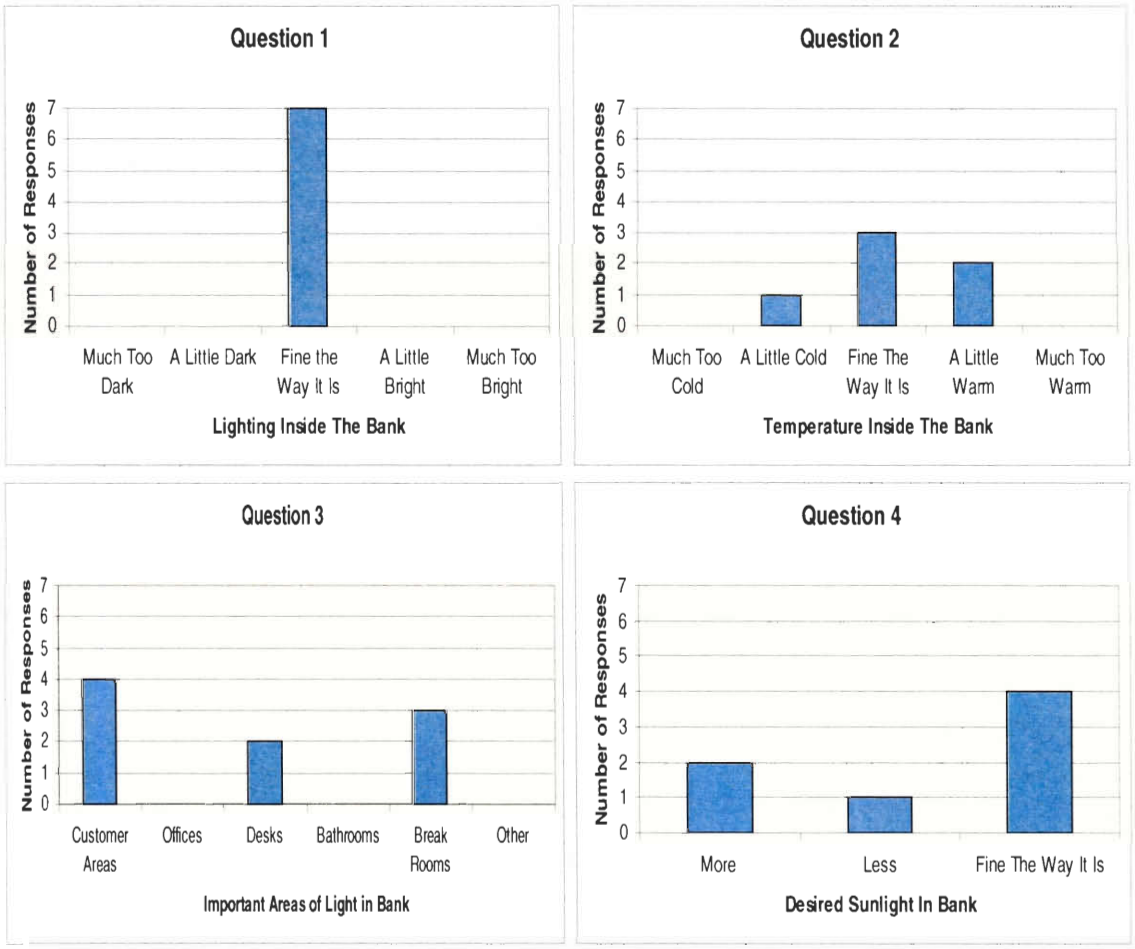
Observations/Comments:

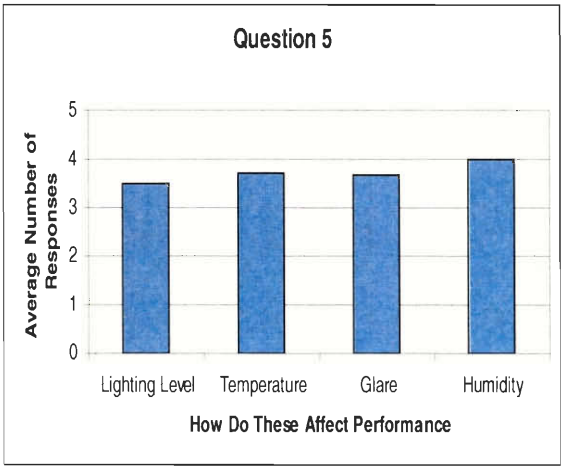
The branch has 2 air conditioning units. The units are on all the time and cuts off when the room reaches a certain temperature. The branch has two floors, and it was much cooler downstairs than upstairs. The branch is bright due to the amount sunlight inside. There are 4 large windows with blinds, but the blinds are open to let the sunlight in. The lights inside are bright and a little dirty. The building is not shaded; there are no overhangs. The combination of lighting and sunlight gives the branch a good feeling. Only one light stays on all the time. There are 4 light switches that control all the lights for the whole branch. Peak hours were said to be during the opening hours at 8:30AM and from 11:30AM to 1:30PM. The lights are on from 7:30AM until 7:00PM when the cleaning crew leaves.

Light fixtures inside the bank: (1) 20 rectangular fluorescent fixtures with 4 bulbs each GE F40DEX Daylight (2) 12 square fluorescent fixtures with 2 bulbs in each F40CW Cool White 40W.

It was also stated that there are a lot of power outages in the area and that the transformers were old. The branch has a backup generator. It was also observed that the computers used in the branch were extremely old without Energy Star compliance.

St. Thomas I
Employee Comfort Survey
(7 returned from 7)




Question 5
Average Number of Responses
5
4
3
2
1
0
Lighting Level
Temperature
Glare
Humidity
How Do These Affect Performance

Branch Profile

Location:	St. Thomas II Port of Sale
Situated:	Stand Alone
Address:	Port of Sales Mall 9100, Virgin Islands
Hours of Operation:	9:00AM – 3:00PM Monday – Friday
	Drive In: 8:00AM – 3:30PM Monday – Friday
Branch Size:	Large
Energy Usage 2001 (in dollars):	$41,816
A/C System:	Branch-controlled

A/C Temperature Setting/Actual:

1. Main Entrance/Lobby	74/75
2. Operations Collection	74/73
3. Lobby	76/73
4. Teller	73/75
5. Upstairs 1	75/75
6. Upstairs 2	78/75
7. Servers/ATM room	70/70

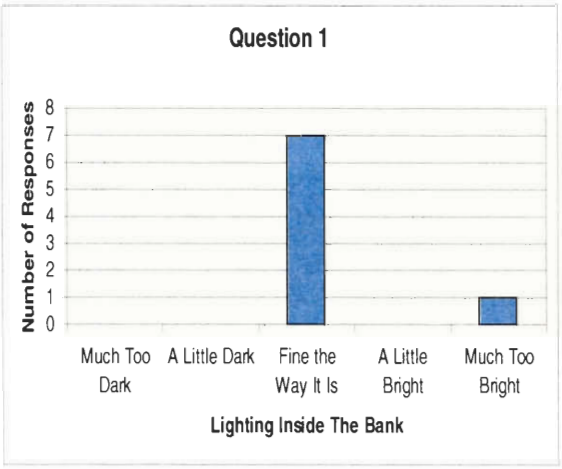
Observations/Comments:

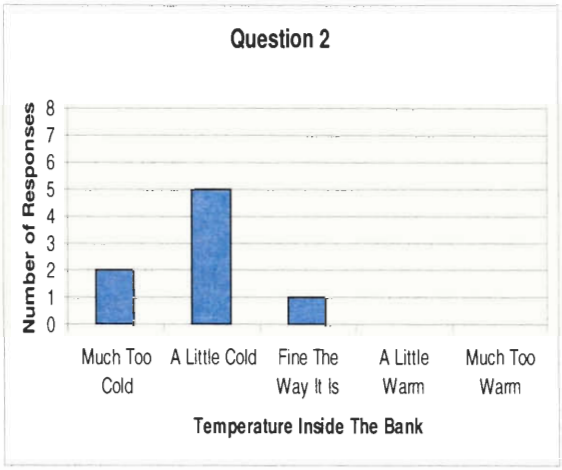
The branch is large and very modern. The branch's air conditioning is on all the time. It is controlled by 7 thermostats in the back. The branch is bright everywhere – the desks areas are bright and there are a lot of windows letting in a lot of sunlight. The lights come on at 7:30AM and go off at 10:00PM. Some of the lights stay on all the time. The lights were a little dirty. Some of the computers at the desks stay on all the time. Computers are new and are energy star compliant. The peak hours are from 11AM to 2PM. There are 2 ATMs and a small TV and VCR. There is also an elevator and signs with fluorescent back lighting to them. Bathroom and break room lights were on.

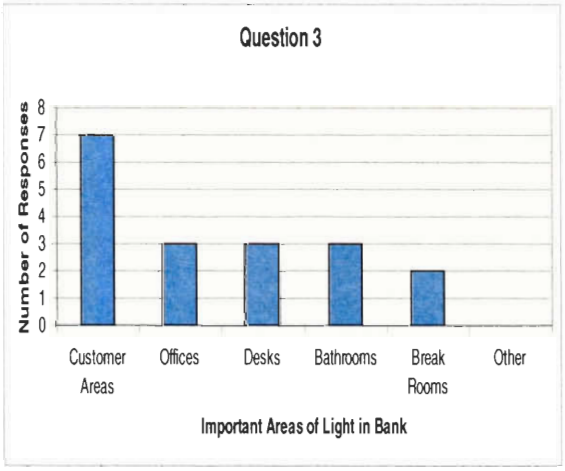
Lighting fixtures in the branch: (1) 112 square fluorescent fixtures with 2 U-shaped bulbs each Sylvania Octron 4100K FB032 32W (2) 6 lights by the teller (3) 10 hanging lights by the desks (2 for each desk) (4) 9 circular fluorescent lights with 2 bulbs each.

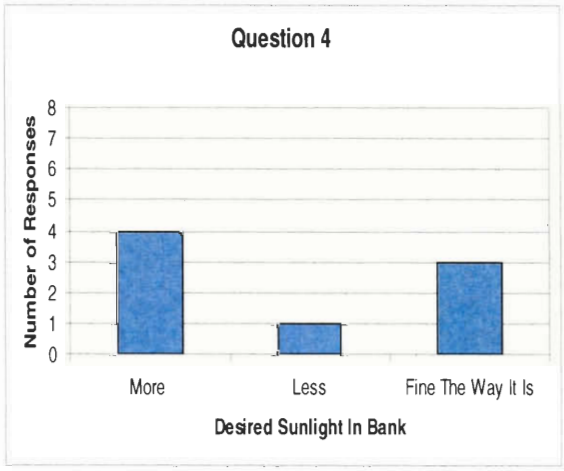
The drive in has 10 lights which are on all the time. The branch also has a generator.

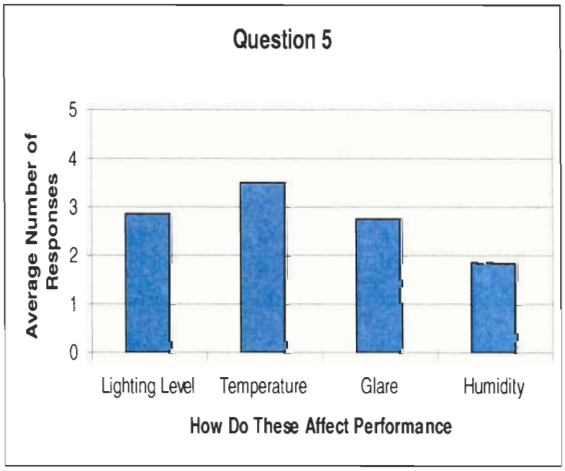
St. Thomas II Port of Sale
Employee Comfort Survey
(8 returned from 8)











Branch Profile

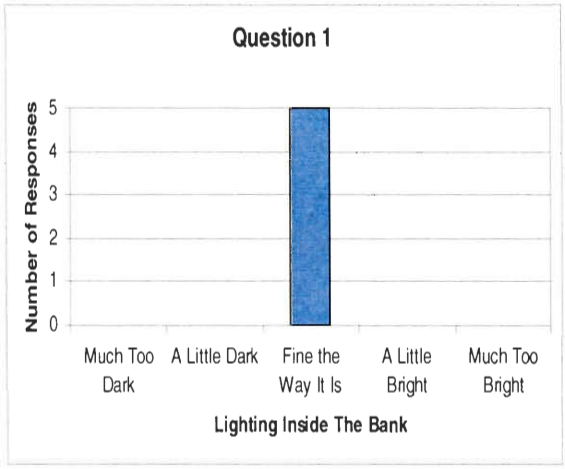
Location:	St. Thomas III-GERS Building
Situated:	Inside building
Address:	50 Kronprindsens Gade, Virgin Islands
Hours of Operation:	**Branch:** 8:00AM – 4:00PM Monday – Thursday 9:00AM – 4:30PM Friday
Branch Size:	Medium
Energy Usage 2001 (in dollars):	$24,665
A/C Control:	Branch-controlled (on/off – no temp)
A/C Temperature Setting:	75°
Actual Temperature Reading:	74°

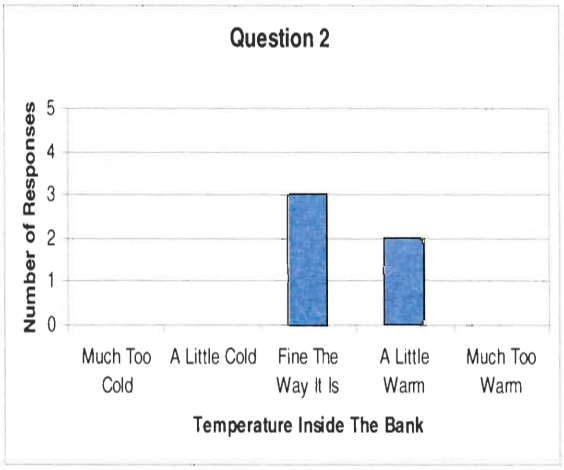
Observations/Comments:

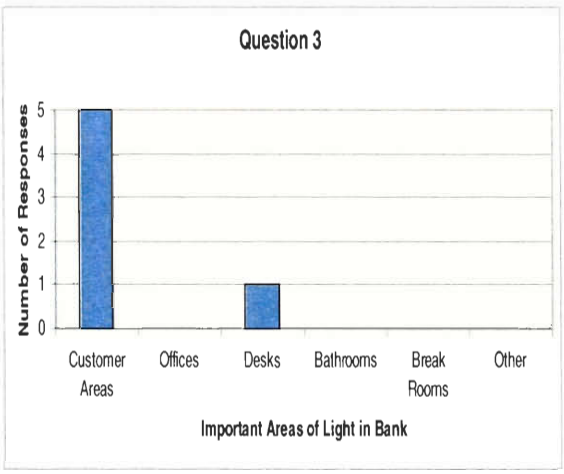
The branch is old. The air conditioner remains on 24 hours a day. The lights are turned on right before the branch opens, and shut off in between 6:30PM and 7:30PM when the janitor leaves. One third of the lights remain on when the rest are shut off for security purposes. There are no bathrooms; they use the ones in the building. There is an upstairs which is unoccupied at all times, however the lights are on all day, and they are all controlled by one switch. In the branch downstairs there are 3 switches for the lobby and 3 switches for the desk area. The windows are mostly by the desk area and the blinds are shut. It is dark in most of the areas of the branch (teller, desk, and customer areas). The computers are very old. It seemed a little warm in the branch. The break rooms have 3 fixtures with 2 bulbs in each, a refrigerator, and a microwave. The peak hours are from 11:00AM – 1:00PM everyday, and Monday mornings and Friday afternoons.

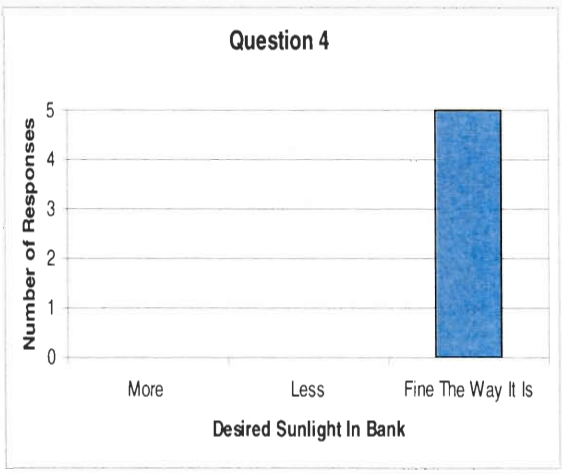
Light fixtures inside the bank: (1) 58 rectangular fluorescent fixtures with 3 Sylvania daylight deluxe F40/DX 40W Rapid Start bulbs in each. (2) 19 square fluorescent fixtures with 3 shorter bulbs in each.

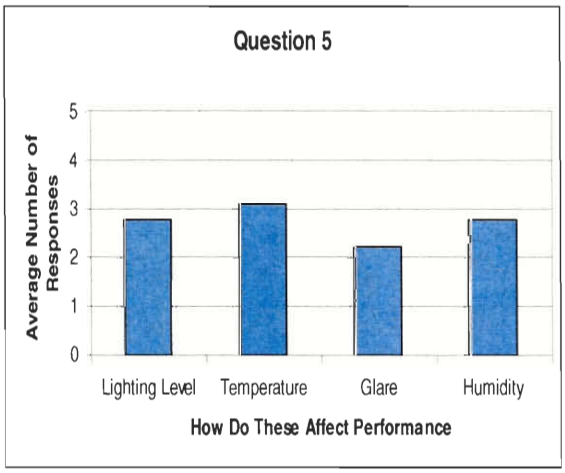
St. Thomas III GERS Building
Employee Comfort Survey
(5 returned from 5)











VII. APPENDIX B – EMPLOYEE COMFORT SURVEY

This appendix contains the employee comfort survey administered at the 19 branches that we visited during our research. The survey contains 6 questions inquiring about employees' opinions on lighting, temperature, and sunlight levels in the bank. There is also a question that allows for free response.

Employee Comfort Survey
Una Encuesta de la Comodidad de los Empleados

1. **What is your opinion about the lighting inside the bank?**
¿Cuál es su opinión de la luz (iluminación) en el banco?

___ Much too dark. *Demasiado obscura.*
___ A little dark. *Bastante obscura.*
___ It's OK the way it is. *Está bien como es.*
___ A little bright. *Bastante brillante.*
___Much too bright. *Demasiado brillante.*

2. **What is your opinion about the temperature in the bank?**
¿Cuál es su opinión de la temperatura en el banco?

___ Much too cold. *Demasiado frío.*
___ A little cold. *Bastante frío.*
___ It's OK the way it is. *Está bien como es.*
___ A little warm. *Bastante calor.*
___ Much too warm. *Demasiado calor.*

3. **Where do you think it is important to have a lot of light in the bank?**
¿A dónde cree Ud. hay mayor necesidad de luz (iluminación) en el banco?

___ Customer/Open Areas. *Las áreas de cliente o las áreas abiertas.*
___ Offices. *Las oficinas.*
___ Desks. *Los escritorios.*
___ Bathrooms. *Los baños.*
___ Break Rooms. *Las salas de descanso.*

4. **Would you prefer more or less sunlight in the bank?**
¿Prefiere Ud. más o menos luz del sol en el banco?

___ More. *Más.*
___ Less. *Menos.*
___ It's OK the way it is. *Está bien como es.*

5. **On a scale from 1 to 5 (5 being the most), how do the following conditions affect your performance?**
En una escala desde 1 hasta 5 (5 es lo más), ¿Como afectan su funcionamiento las condiciones siguientes?

	(Least. *Lo menos*)				(Most. *Lo más*)
Lighting level. *El nivel de luz (iluminación)*	1	2	3	4	5
Temperature. *La temperatura.*	1	2	3	4	5
Glare. *El fulgor.*	1	2	3	4	5
Humidity. *La humedad*	1	2	3	4	5

6. **Do you have any other questions or comments?**
¿Tiene Ud. preguntas o comentarios?

_____

_____

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