BUILDING RETROFITS: ENERGY CONSERVATION AND EMPLOYEE RETENTION CONSIDERATIONS IN MEDIUM-SIZE COMMERCIAL BUILDINGS

A Thesis

by

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ABSTRACT

Commercial buildings are among the largest consumers of energy. In an attempt to control and reduce operating expenses, building owners and organizations leasing commercial space are pursuing energy efficiency measures to generate a higher return on investment. In this study, an extensive literature review is used to identify and discuss energy efficiency considerations for medium-size building owners and how savings from these measures may benefit organizations through employee satisfaction and retention.

For the purpose of this study, the specific topics related to commercial building energy efficiency that were investigated include (1) outcomes of building retrofits (2) corporate social responsibility and performance; (3) performance of energy efficient buildings; (4) employee commitment, satisfaction productivity and organizational profitability; (5) green companies and employee attraction; (6) the cost of turnover.

There is little literature specifically focused on the impact that energy efficient buildings have on medium-sized building owners and no literature that quantifies the financial benefits through a reduction in employee turnover or attrition. Facility managers of all building sizes will benefit from gaining (1) a broad understanding of the impact of energy efficiency measures on employees (2) the ability to articulate the impact of the building's role on employee productivity,

turnover and other HR related issues (3) the insight needed to contribute to strategic discussions within their organization about how facilities can benefit organizational profitability.

This research does not attempt to claim or determine a causal relationship between energy efficiency and employee turnover however it does discuss issues that that could affect employee attrition.. Further research to determine this causality would benefit the study of energy efficiency and its total impact on organizations.

DEDICATION

To my parents

Robert Candlish (in memory)

Annette Candlish

and

my children

Stephen Jr. and Ashor

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First and foremost, I thank God for guiding me through this experience, and allowing us to share this journey with my family.

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NOMENCLATURE

CSR	Corporate Social Responsibility
CBECS	Commercial Building Energy Consumption Survey
DOE	Department of Energy
EEM	Energy Efficiency Measure
EIA	Energy Information Administration
EPA	Environmental Protection Agency
GSA	U.S. General Services Administration
RICS	Royal Institution of Chartered Surveyors
USGBC	United States Green Building Council
WBCSD	World Business Council for Sustainable Development

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1. INTRODUCTION

According to the Department of Energy, last year, commercial and industrial buildings used roughly 50% of the energy in the U.S. economy at a cost of over $400 billion (DOE, 2013). In 2009, the National Academy of Sciences reported that commercial buildings in the U.S. could reduce energy use 32% by 2030 (NAS- NAE-NRC, 2009) and the Rocky Mountain Institute's (RMI), *Reinventing Fire*, indicates that those reductions can reach a minimum of 38% and a maximum of 69% by adopting energy efficiency solutions. These solutions can equate to a profit of $1.2 trillion for the building owners. Findings from RMI, the National Academy of Sciences and others reveal that there is a considerable opportunity for building owners to improve their profitability through an investment in energy efficiency.

There is much talk today about "green", "sustainability" and "environmentally friendly". The Environmental Protection Agency (EPA) defines "green building" as the "practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction" (EPA, 2012). Another commonly accepted description of "green" or "sustainable" buildings is a building that uses resources such as energy, water, materials and land much more efficiently than buildings built only to code. For the sake of this research, and to remove the environmental aspect from this review, we will replace "green" with "energy efficient". It seems that the environmental debate is adding complexity to the issue of improving building efficiency; by removing the environmental issue we will focus on the financial reasons why it is beneficial for building owners to pursue an energy efficient building retrofit.

According to the Royal Institution of Chartered Surveyors (RICS), 10% – 15% of businesses operating expenses relate to their facilities and 86% of business expenses are for salaries (Corps, 2006). There are several bodies of research indicating how businesses can improve the effectiveness of employees to improve overall productivity. Baird (2009) argued in his research that focusing on the well-being and productivity of employees was well worth the effort since employee compensation outweighs building design, operating and maintenance costs. Other studies focus on the benefits of improving the work environment in order to reduce operating costs. This study will list what these improvements look like and identify the value that these improvements bring to an organization. The outcome of this research will be a checklist of items that an organization should consider in order to improve the building's efficiency, by making facility improvements, building owners can then apply those cost savings to factors that will improve employee productivity. This checklist will include a focus on physical improvements to the built environment and will be tied to the quantitative benefits that the organization can anticipate reaping.

Research by the EPA has indicated that between the years of 2000 and 2030, an estimated 27% of existing buildings will be replaced and 50% of the total building stock will be constructed (EPA, 2009). Therefore, 73% of existing buildings will continue to see use, many for several decades (EPA, 2009;Durmus-Pedini et al., 2010). These buildings that are often inefficient are responsible for 73% of electricity consumption, 41% of energy use, 38% of carbon dioxide emissions, commercial buildings generate 61% of all building related waste and construction debris, consume 40% of raw materials and 13.6% of potable water consumption (USGBC, 2011). RICS produced a report with data from CB Richard Ellis (CBRE) indicating that energy accounts for 30% of commercial building operating costs (Corps, 2006). The world also faces the issue that existing non-green buildings outnumber new green construction starts by many times (McGraw-Hill Construction, 2009). Any efforts to build new "green" buildings can be negated by the presence of the existence of non-green buildings (Durmus-Pedini et al., 2010). In order to meet city density needs as a result of our growing populations, using existing building stock is key to meeting future space. For businesses that own these older facilities, the answer is not necessarily to abandon their building and build anew. An opportunity exists for building owners to reduce expenses and increase value by investing in building energy retrofits. Building retrofit benefits include reduced operating costs, increased building asset value, improved organizational profitability and employee productivity. (Romm & Browning, 1994; Turner Construction, 2005; GSA, 2008; Granade et al, 2009).

Challenges do exist that are impeding the ability for owners to improve the efficiency of their facilities; funding, the inability to articulate the outcomes of energy efficiency improvements, the inability to measure the impact of improvements and many more (Palmer et al., 2012; Sweetser, 2012). Measurement is vital to be able to effectively manage an efficiency program. A commonly used phrase by those charged with setting and achieving goals is, "you can't manage what you can't measure". Larger corporations do a fairly good job at setting up a means to measure their effectiveness, around 36% of large organizations (with revenues over $5 billion) said they conduct annual energy audits. Unfortunately, only 19% of companies with revenue under $500 million said the same (The Economist Intelligence Unit, 2011)

Despite the quantity of research available investigating the benefits of energy efficient buildings, there is little research that is centered around the benefits to medium-sized building owners, available research is centered around large commercial properties. Medium-sized business owners are often left to interpret on their own, how to adapt energy efficiency solutions for their own properties. This research will reveal the implications for medium-sized building owners. Energy efficiency solutions have been proven to reduce building operating expenses, by determining how to address these highly measureable improvements, building owners can then increase the extent of their improvements by applying energy savings to areas that can lead to increased profitability from a human perspective (increased employee satisfaction and productivity and decreased absenteeism and turnover). A survey of over 800 green building owners, developers, architects, engineers and consultants in Canada and the USA found that "green was good for asset value", the findings also concluded that these buildings were perceived as outperforming conventional commercial buildings from the perspective of occupant wellbeing, building value and return on investment (Davies, 2005).

The research provides medium-sized building owners with preliminary insight into the overall advantages of performing a building retrofit.

2. LITERATURE REVIEW

2.1 Outcomes of Building Retrofits

Buildings in the U.S. are being retrofit at a rate of 2.2% or 2 billion square feet a year, the average energy savings from these retrofits is approximately 11% (Olgyay & Seruto, 2010). If this pace continues, 50% of existing building inventory will be retrofit by 2030 (Olgyay & Seruto, 2010). ASHRAE President Gordon V.R. Holness has created a mission for ASHRAE professionals to "Sustain our future by rebuilding our past" (Olgyay & Seruto, 2010). The challenge is to have buildings undergo retrofits that will result in energy reductions of 50% or more.

The case to sell building retrofits should not be a difficult one according to research from the World Business Council for Sustainable Development (WBCSD). According to WBCSD's research into building retrofits, energy savings of 10% can be achieved with an investment of less than $1/square foot (WBCSD, 2009). Organizations looking to make a larger reduction in energy consumption can expect a 40% energy savings for an investment of $10 - $30/square foot (Pike Research, 2009). Additional research from the U.S. Green Building Council (USGBC) estimated that retrofitting an existing building can save the owner of a US commercial building $0.52 per square foot per year ($5.60 per square meter per year) in energy costs (Booz Allen Hamilton, 2009). There is considerable research into building efficiency and expected energy savings resulting from building retrofits: Rocky Mountain Institute estimates that building owners pursuing ENERGY STAR certification can expect energy cost savings between 25% - 50% of annual energy costs (Rocky Mountain Institute, 2012).

The benefits of energy efficient buildings and energy retrofits go beyond energy savings. Research from Romm and Browning (1994) state that focusing on an energy - efficient building design may be one of the least expensive ways for an organization to increase worker productivity and the quality of its' products (Romm & Browning, 1994), Eichhlotz et al. (2009) found that retrofitting an existing building would increase its capital value by 16%.

2.2 Organizational Corporate Social Responsibility and Performance

"Corporate Social Responsibility"(CSR) has become a strategic initiative known by many names; *corporate responsibility, citizenship, ethics, governance social enterprise, sustainability, triple-bottom line, etc.*(Harvard Kennedy School, 2008).

The executive director of Kenexa Research Institute (KRI) says that the benefits of participating in CSR activities include: providing a competitive advantage in recruiting; improvements in brand image; creating a sense of teamwork among employees; building an emotional tie between the employee and the organization; and employees that are more satisfied and stay at their jobs longer than those in organizations without a CSR.

Much of the inputs to an organization's corporate social responsibility policy are derived from how the organization operates, particularly its energy consumption, as a result it has become an increasingly popular issue among business leaders (Turban et al., 1996, Fombrun et al., 1990)

According to Ferdinand Fuke (2012), 96% or more of those activities fall in the realm of facilities (Fuke, 2012). Because of the statement that a corporate social responsibility policy sends to employees, investors and the larger community, it has become a critical element in strategic decision making (Delmas et al., 2008).

Investors consider a firm's level of corporate social responsibility when making investment decisions. Issues such as a firm's impact on the environment, the treatment of employees and the role the organization plays in the community play a role in attracting outside investment (Eichholtz et al., 2009).

Eichholtz et al., (2009) found that energy efficient buildings (receiving ENERGY STAR or LEED Certification) command higher rental rates and sales prices over non-energy efficient buildings. Their analysis also found that occupancy rates are higher and less volatile in the energy efficient buildings. Eichholtz et al's findings are consistent with those of a study in April 2008 by CoStar Group. Research into the economic benefits of LEED-certified buildings found that their occupancy rates are 3.8% higher, rent premiums are $11.24 more per square foot and LEED-certified buildings sell for $170 more per square foot (USGBC, 2008) than non-LEED buildings (USGBC, 2008; Deloitte, 2012).

Other benefits to organizations occupying energy efficient property is the perception that it leaves with stakeholders and customers. This measure to occupy energy efficient real estate can translate into a long-term commitment to corporate social responsibility and result in an increase in stakeholder and investor confidence and increased patronage from customers (Fisk et al., 1997).

Kahn's (2007) concept of environmental ideology lends to the idea that organizations that voluntarily move to improve their efficiency of their buildings can avoid the risk of future legislation mandating these changes at higher costs. Some building tenants believe that the non-financial benefits of pursuing a corporate social responsibility policy actually exceed the financial costs of such a policy (Kahn, 2007).

2.3 Performance of Energy Efficient Buildings

According to research conducted by the Rocky Mountain Institute and the U.S. Department of Energy, energy efficient retrofits for existing buildings and new buildings designed for energy efficient performance can have substantial economic returns (DOE, 2012; Romm & Browning, 1994; RMI, 2012). In each of the eight cases presented in the Romm and Browning study, improved efficiency in lighting, heating, and cooling increased worker productivity, decreased absenteeism, and sometimes improved quality of the work were demonstrated. While improving the environment of workers was not the original goal in most of the cases, it created a significant benefit for the organizations.

When life-cycle costs are analyzed, studies have suggested that an initial up-front investment of an extra 2% of construction cost (for new buildings) will yield over ten times that investment over the life-cycle of the building through energy and other operational cost savings (Wolff, 2006). Kats et al. (2003) shed more light into the costs of energy efficient buildings, LEED-certified offices and schools were estimated to cost 0.66 percent more than comparable non-LEED buildings, LEED Silver offices and schools were estimated at 2.11 percent more than comparable buildings, LEED Gold offices and schools cost approximately 1.82 percent more, and LEED Platinum buildings cost 6.5 percent more. Kats is not alone in his assessment that "green" or energy efficient buildings have up-front costs that are comparable to non-energy efficient buildings, Turner Construction (2005) found that LEED Certified buildings cost only 0.8 percent more, and Langdon (2007) found no significant price difference between LEED Certified building and comparable non-LEED buildings. (Other research quantifies the benefits of energy efficient buildings to amount to hundreds of thousands, possibly millions of dollars throughout the lifecycle of the building (Castro et al., 2008). Research done on the costs of and financial benefits of green building (new buildings) indicates that solely from energy savings, investing in green building provides a financial benefit (Katz et al., 2003).

The extent of the savings available to organizations that pursue energy conservation measures is in the billions of dollars in the U.S. alone. According to Granade et al. (2009), investing $125 billion in commercial buildings would reduce the amount of energy demanded by buildings by 29% and translate to a cost savings of $290 billion. To provide an international perspective, research also found that an investment of $90 billion in developing countries would result in energy cost savings of $600 billion (Granade et al.. 2009; McKinsey, 2010).

A study conducted by Ries and Bilec (2006) found that by investing in energy efficiency measures (EEMs), energy usage in a new manufacturing facility decreased by 30% on a square foot basis. The facility also required less water per square foot on an annual basis. More information about the results on this study will follow in this report.

2.4 Employee Commitment, Satisfaction, Productivity and Organizational Profitability

Research has demonstrated that energy efficient buildings enhance the productivity and health of occupants (Kats et al., 2003; Kozlowski, 2003; Lucuik, 2005). More specifically, the relationship between improved indoor environmental quality and increased occupant wellbeing and productivity is well-documented in literature (Kats et al., 2003; Fisk, 2000).

Rocky Mountain Institute found that only the efforts that contributed to visual acuity and thermal comfort appeared to lead to gains in employee productivity (Romm & Browning, 1994). This reinforces the importance of applying a holistic approach to building design and retrofits, an approach that seeks to improve energy efficiency and the quality of the workplace for employees, a focus on the end-user provides benefits cost savings and productivity improvements (Romm & Browning, 1994).

Studies by Lawrence Berkley National Laboratory and the Commission for Environmental Cooperation (CEC) (2008) found that U.S. businesses could save as much as $58 billion in lost sick time and an additional $200 billion in worker performance if improvements were made to the indoor air quality (Fisk, 2000).

The *General Services Administration (GSA*) has developed four overarching goals for the Federal Workplace in the new decade, two of which include improving environmental quality and engagement and well-being (GSA, 2002). According to the GSA's findings, these changes will include providing employees with greater access to daylight and views in addition to a healthy workplace. The GSA believes that these changes will contribute to engaged employees who are productive, demonstrate pride in their organization, and support for their organization's mission (GSA, 2002).

The research on how the work environment affects employees is plentiful (Romm & Browning, 1994; Heerwagen, 2001; Heerwagen & Heerwagen, 1986; Henneberger et al, 2005; Heschong, 2006; Hoskins, 2003; Menzies et al, 1997). Fish and Rosenfeld (1997) also found that energy efficient buildings have higher occupancy rates, lower operating costs and improved employee productivity or reduced labor costs (Fisk et al., 1997).

2.5 Green: Companies and Employee Attraction

Research from the GSA indicates that employees are contributing to one of the most recent trends seen in the federal workplace, "environmental awareness and energy price volatility have led to federal mandates for environmental quality and performance – as well as a pronounced end-user preference for work settings that are healthy and environmentally responsible" (GSA, 2002). That is to say, that individuals are attracted to companies that demonstrate a commitment to energy efficiency.

An organizations' commitment to energy efficiency is often communicated through a corporate social responsibility policy and through the organizations' performance. Research from Turban and Greening found that firms that scored high in corporate social performance have more positive reputations and are more attractive employers than firms with lower corporate social performance (Turban & Greening 1996).

Zhang and Gowan also found evidence that socially responsible companies are more attractive employers than less socially responsible (Zhang et al., 2011). These firms view corporate social responsibility as a competitive advantage, allowing them to attract a higher quality and quantity of job applicants (Turban & Greening, 1996; Fombrun et al., 1990; Davis, 1973).

The Bureau of Labor Statistics said in 2009 that there was a war for talent that was being driven by a labor shortage (US Department of Labor, 2009). As a result, organizations are increasingly focused on their attractiveness to potential applicants (Ehrhart et al., 2005).

2.6 The Cost of Turnover

Research indicates that office workers cost $130 per square foot – 72 times as much as the energy costs. That being said, an increase of just 1% in productivity can nearly offset a company's entire annual energy cost (Fisk, 2000; Romm & Browning, 1994).

According to research from RICS and Asset Strategies (2006), salaries of occupants account for as much as 86% of total business costs. Other researchers have estimated salaries to account for 22% to 70% of operating expenses (Society for Human Resource Management, 2008; Weatherly, 2003). Although quantifying the value of human capital and the overall percentage of salaries compared to operating expenses will vary according to industry, it is clear that improving the work environment for employees should be a concern for organizations. By improving employee productivity, lowering turnover rates or reducing absenteeism through an improved, healthy work environment, employers can expect to save between $17 – 48 billion in total health gains and $20 - 160 billion in worker performance (USGBC, 2009).

Upon further research into the actual costs of employee turnover, The Society for Human Resource Management (SHRM) states that direct replacement costs for an employee can range from 50 – 60% of an employee's annual salary. Total turnover costs range from 90 - 200% of those same salaries (Cascio, 2006). Taking a look at the cost of turnover from an overall percentage of organizational income, some have estimated that turnover related costs represent over 12% of pre-tax income for the average company, and can account for as much as 40% in companies that face high levels of turnover (in the 75^{th} percentile) (PricewaterhouseCoopers, 2006). The impact of turnover is not always measurable. Turnover also needs to be controlled in order to reduce the impact on workforce morale. Other benefits of reducing employee turnover include an increase in sales growth, firm profitability and market value (Griffeth & Hom, 2001).

The importance of considering the impact building retrofits is put into perspective through findings from Deloitte (2005) indicating that over 50% of organizations participating in their study believe that talent management issues impact overall organizational productivity and efficiency. Retaining good employees allows an organization to innovate, while turnover prevents an organization from meeting production requirements (Deloitte, 2005).

3. PROBLEM STATEMENT AND RESEARCH METHODS

3.1 Problem Statement

This study aims to examine the benefits of building retrofits for medium-sized business owners from the energy conservation and employee retention perspectives. The intent is to identify benefits and provide guidelines for building owners to consider when contemplating efforts to improve existing buildings. There is much literature focused on building energy efficiency, green building and retrofits; however, there is very little specifically aiming at investigating the benefits to medium-sized business owners, of pursuing a building retrofit solely from a cost perspective. Most studies to date include the benefits of reducing energy from a standpoint of meeting environmental targets. This study provides a focused summary of research and literature on the reduction of building energy costs and employee retention.

Three Texas buildings were selected in order to compare and contrast energy efficiency measures and performance, the building type of particular interest for this study was medium-sized commercial properties, between 10,000 and 50,000 square feet. The intent of this study was to demonstrate to building owners of this type that if energy efficiency measures are adopted, savings from the reduction in operating costs can lead to an increase in financial resources that can be applied to the physical work environment. These improvements to the physical work environment may lead to:

i. Increased worker satisfaction
ii. Increased employee productivity

iii. Improved employee attraction and retention

3.2 Sub Problems

The sub-problems will focus on two key areas: (1) Building and Corporate outcomes and (2) People outcomes. Among the building outcomes, subtopics include; outcomes of building retrofits, corporate and organizational citizenship, and the performance of energy efficient buildings. Subtopics covered under people outcomes include; employee commitment, satisfaction, productivity and organizational profitability; green companies and employee attraction and; the cost of turnover.

Following are the specific goals of this research:

a) To identify the outcomes of building retrofits.

   The study considers detailed analysis about commercial building retrofits to gain a better understanding about outcomes experienced by building owners.

b) To understand the impact that corporate and organizational social responsibility and performance have on the performance of organizations.

   The study focuses on the effects that corporate social responsibility has on current and potential employees of an organization. It also sheds light on the benefits to organizations' that are committed to corporate social responsibility.

c) To document the performance of energy efficient buildings.

This research explains how buildings that obtained energy efficiency retrofits perform. It identifies performance improvements that had a financial impact on organizations.

d) To understand how employee commitment, satisfaction and productivity affect organizational profitability.

   This analysis exposes the impact that buildings and work environments have on the satisfaction, commitment and productivity of employees and how these impact the organization's profitability. It also serves to expose some areas where building improvements may have an impact on employees.

e) To investigate whether being recognized as a "green" company has an impact on employee attraction.

   This study indicates whether there are any benefits to organizations that adopt "green" practices.

f) To understand the cost of employee turnover.

   This investigation explains the impact turnover has on organizations and whether a reduction of employee turnover benefits an organization.

3.3 Limitations

This research is limited to the extent of the search conducted of existing literature available at Texas A&M Libraries and on the World Wide Web. The scope extends to commercial office buildings and focuses primarily on the U.S. market.

3.4 Research Methods

To achieve the study objectives, an extensive literature survey pertinent to this study was performed to gather, review and interpret the data. In qualitative research, data are collected from numerous sources, reviewed and evaluated in order to form new concepts and theories (Holliday, 2007). An extensive literature review is suitable for gaining an understanding of the factors involved when considering a building retrofit, and based on that understanding, identifying the return to building owners for undertaking this investment.

The literature review will be paired with a review of four Texas buildings, in some instances, in order to provide insight into the application of energy efficiency measures in medium-sized buildings. Common data sources, to all sub-problems, are the databases used through the Texas A&M Libraries system. Specific databases used to obtain literature include: EBSCO, PsychNet, Sage, ERIC and ProQuest. The differences in data sources are listed in Tables 1 below.

Table 1. Research Data Sources

Benefits of Building Retrofits	
e-Journals & Trade Publications	The Journal of Facility Management, the Academy of Management Journal, Journal of Green Building, Science Journal, Annual Review of Energy and the Environment, Journal of Environmental Economics and Management, Lighting Design and Application, Academy of Management Executive, Artificial Intelligence Review, Indoor Built Environment, Journal of Corporate Real Estate, Science, Indoor Air, and Healthy Buildings, Journal of Real Estate Research, Journal of Property Investment and Finance, Administrative Science Quarterly, Journal of Sustainable Real Estate.
Reputable Organizations	Rocky Mountain Institute, Environmental Protection Agency (EPA), Energy Information Administration (EIA), Department of Energy (DOE), U.S. Green Building Council (USGBC), International Facility Management Association (IFMA), McGraw-Hill Construction, Deloitte, Johnson-Controls, McKinsey, Kenexa Research Institute (KRI), Royal Institution of Chartered Surveyors (RICS), and the World Business Council for Sustainable Development (WBCSD), Institute of Real Estate Management
Building examples	Four commercial buildings in Texas
Other published works	Books and work from authors in the fields of buildings and building retrofits
Organizational and Corporate Social Responsibility and Performance	
e-Journals & Trade Publications	The Journal of Business Ethics, the Academy of Management Journal, Strategic Management Journal, MIT Sloan Management Review, Journal of Business and Psychology, Journal of Green Building, Annual Review of Energy and the Environment, Journal of Environmental Economics and Management, Academy of Management Executive, Artificial Intelligence Review and the American Journal of Psychiatry.
Reputable Organizations	U.S. Green Building Council (USGBC), International Facility Management Association (IFMA), Monster, McGraw-Hill Construction, Deloitte, Johnson-Controls, McKinsey, Kenexa Research Institute and the World Business Council for Sustainable Development (WBCSD).
Building examples	None.
Other published works	Books and work from authors in the fields of corporate social responsibility.

Table 1. Continued	
Performance of Energy Efficient Buildings	
e-Journals & Trade Publications	The Journal of Facility Management, MIT Sloan Management Review, Journal of Green Building, Journal of Occupational and Environmental Medicine, Science Journal, Annual Review of Energy and the Environment, European Financial Management, Journal of Environmental Economics and Management, Lighting Design and Application, Academy of Management Executive, Artificial Intelligence Review, Indoor Built Environment, Journal of Corporate Real Estate, Science, Indoor Air, Healthy Buildings, Journal of Real Estate Research, Journal of Property Investment and Finance, Journal of Sustainable Real Estate.
Reputable Organizations	Rocky Mountain Institute, Environmental Protection Agency (EPA), Energy Information Administration (EIA), Department of Energy (DOE), U.S. Green Building Council (USGBC), International Facility Management Association (IFMA), McGraw-Hill Construction, Johnson-Controls, McKinsey, Kenexa Research Institute, Royal Institution of Chartered Surveyors (RICS), World Business Council for Sustainable Development (WBCSD), Institute of Real Estate Management
Building examples	Four commercial buildings in Texas
Other published works	Books and work from authors in the fields of building energy efficiency.
Employee Satisfaction, Productivity and Organizational Profitability	
e-Journals & Trade Publications	The Journal of Facility Management, the Journal of Business Ethics, the Academy of Management Journal, Strategic Management Journal, MIT Sloan Management Review, Journal of Business and Psychology, Journal of Green Building, Journal of Occupational and Environmental Medicine, Science Journal, Journal of Environmental Economics and Management, Academy of Management Executive, Artificial Intelligence Review, Indoor Built Environment, Journal of Corporate Real Estate, American Journal of Psychiatry, Indoor Air, and Healthy Buildings.
Reputable Organizations	Rocky Mountain Institute, U.S. Green Building Council (USGBC), Society for Human Resource Management (SHRM), International Facility Management Association (IFMA), Monster, McGraw-Hill Construction, Deloitte, Johnson-Controls, McKinsey, Kenexa Research Institute, and the World Business Council for Sustainable Development (WBCSD).
Building examples	Are not used as a data source for this topic.
Other published works	Books and work from authors in the fields of buildings and work environments and their impact on employees.

Table1. Continued	
Green Companies and Employee Attraction	
e-Journals & Trade Publications	The Journal of Business Ethics, the Academy of Management Journal, Strategic Management Journal, Journal of Business and Psychology, Journal of Green Building, Journal of Environmental Economics and Management, Academy of Management Executive, Artificial Intelligence Review, and the American Journal of Psychiatry, Journal of Sustainable Real Estate.
Reputable Organizations	Rocky Mountain Institute, U.S. Green Building Council (USGBC), Society for Human Resource Management (SHRM), International Facility Management Association (IFMA), Monster, McGraw-Hill Construction, Deloitte, McKinsey and Kenexa Research Institute.
Building examples	Are not used as a data source for this topic.
Other published works	Books and work from authors in the fields of human resource management, green or energy efficient buildings and psychology.
Cost of Turnover	
e-Journals & Trade Publications	The Academy of Management Journal, Strategic Management Journal, European Financial Management, and the Academy of Management Executive.
Reputable Organizations	Society for Human Resource Management (SHRM).
Building examples	Are not used as a data source for this topic.
Other published works	Books and work from authors in the fields of human resource management and psychology.

3.5 Texas Building Selection

The buildings selected are projects located in a similar geographic location: large metropolitan areas in the state of Texas. All buildings are used for commercial office purposes and range between 10,000 to 50,000 square feet in size, they include:

- The Rose Building (1986), Houston, TX - 33,500 square feet
- Trane San Antonio District Office (1980), San Antonio, TX - 32,000 square feet
- Lance Armstrong Foundation (1950), Austin, TX - 30,000 square feet
- SoFlo Office Studios (1940), San Antonio, TX – 16,600 square feet

These buildings, the energy efficiency solutions chosen and the outcomes expected or achieved will serve as the basis for this discussion, and provide insight into solutions that medium-sized building owners in Texas can consider.

4. DATA ANALYSIS AND FINDINGS

4.1 Outcomes of Building Retrofits

In 2010, U.S. buildings consumed 50% of the total energy used by the built environment (EIA, 2003; Yudelson, 2010; DOE, 2013). More than 80% of the energy that is consumed occurs when the building is being occupied and used (UNEP, 2009). Energy costs commercial and industrial building owners over $400 billion per year (DOE, 2013). The National Academy of Sciences and Rocky Mountain Institute indicate that an opportunity exists to reduce energy use between 32 – 69% by adopting energy efficiency solutions to the tune of $1.2 trillion in savings for building owners (RMI, 2012; NAS-NAE-NRC, 2009).

According to McGraw-Hill Construction (2009), there is 76.9 billion square feet of existing building stock. Most of these buildings, over 55%, are over 30 years old (EIA, 2003). Findings by McGraw-Hill Construction indicated that the buildings that are responsible for consuming the most energy and are considered to be the most inefficient are those that were built after 1970. Table 2. sheds light on the number of buildings in the U.S. by age. The most inefficient of these buildings make up 60% of existing buildings and are candidates for energy efficiency retrofits.

Table 2. Major Fuel Consumption (Btu) by End Use for Non-Mall Buildings

Year Constructed	Number of Buildings	Total Fuel Consumption (trillion Btu)
Before 1920	330	302
1920 to 1945	527	620
1946 to 1959	562	565
1960 to 1969	579,000	737
1970 to 1979	731,000	1,023
1980 to 1989	707,000	1,034
1990 to 1999	876,000	1,098
2000 to 2003	334,000	441
Total	**3,228,419**	**5,820**

(Adapted from Energy Information Administration, 2003 Commercial Buildings Energy Consumption Survey)

The building industry is undertaking measures to the energy that buildings consume and the resulting cost to operate buildings. As represented in Figure 1., McGraw-Hill Construction found that by 2009, 66% - 75% of building retrofits, reported by building owners, were focused on energy efficiency (McGraw-Hill Construction, 2009), compared to only 5 – 9% of building retrofits reported focused on green features. It is expected that by 2014, the share of energy- efficiency and green retrofits will continue to grow, reaching 85 – 95% and 20 – 30% respectively.

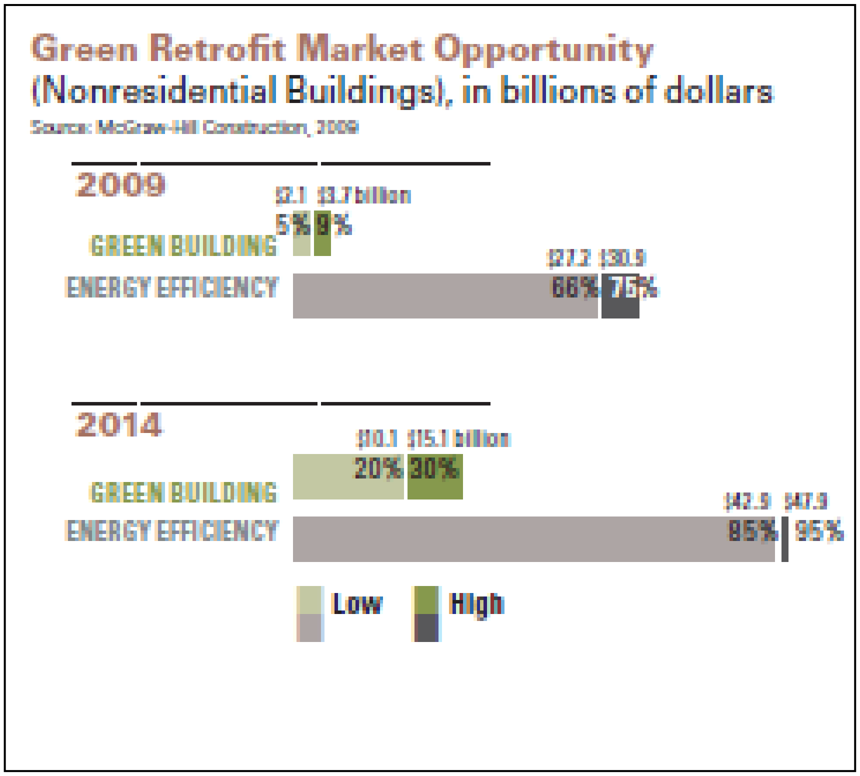


Figure 1. Green Retrofit Market Opportunity
Source: McGraw-Hill Construction 2009.

Not all energy efficiency retrofits are the same, achieving greater energy efficiency in existing buildings depends on many factors including; the building envelope, existing building systems, energy consumption, building operation and maintenance practices and more (Paterson & Gammill, 2010). The strategies that building owners employ to improve the efficiency of buildings range from simple (improving insulation and window glazing, using an opaque roofing material, replacement incandescent bulbs with compact fluorescents) to complex (installation of geothermal systems, incorporating passive ventilation and energy storage) . Adding to the case for energy efficiency retrofits is the fact that energy prices have increased significantly over the past several years, between 2000 and 2009 average commercial energy prices have increased almost 25 percent (Ciochetti & McGowan, 2009). With electricity prices expected to continue to rise (EIA, 2013), the affects of inefficient buildings will become more prevalent and may drive more interest in efficiency measures. According to CBECS's 2003 report, the energy expenditure for all office buildings was $1.40 per square foot in U.S. dollars, for all buildings under 50,000 square feet, that number was slightly less at $1.16 per square foot (CBECS 2003).

Buildings in the U.S. are being retrofit at a rate of 2.2% or 2 billion square feet a year with average energy savings of approximately 11% (Olgyay & Seruto, 2010). If this pace continues, we can expect 50% of existing building inventory to be retrofit by 2030 (Olgyay & Seruto, 2010). ASHRAE president Gordon V.R. Holness has created a mission for ASHRAE professionals to "Sustain our future by rebuilding our past" (Olgyay & Seruto, 2010). The challenge is to have buildings undergo retrofits that will result in energy savings of 50% or more, it's becoming the target for much of the building industry.

Building owners in Texas have experienced the benefits of energy efficiency improvements. Buildings studied (Table 3) were built between 1940 and 1986, the projects vary in size and budget and the measures pursued are unique to each building owner's interests, needs and ability. Costs per square foot vary from $9.70 for the lighting and minor system retrofit of the medical office building in Houston to $108.40

per square foot for the smallest project of 16,600 square feet in the oldest building, built in 1940.

Table 3. Building Examples

Project / Size	Building Type	Measures Undertaken	Cost
Rose Building, Houston, TX / 33,500 square feet Year built: 1986	Medical office facility	Lighting retrofit, HVAC upgrades, installation of a direct digital control system	$325,000 $9.70 per square foot
Trane San Antonio District Office / 32,000 square feet Year built: 1980s	Office building	High efficiency lighting and mechanical systems- 43% more efficient than ASHRAE standards, low emitting paints, carpets, wood and furniture, individual lighting controls, occupancy sensors, light meters to increase reliance on natural light. Parking lot of highly reflective concrete, use of recycled and rapidly renewable materials.	$1.9 million $59.30 per square foot
Lance Armstrong Foundation , Austin TX / 30,000 square feet Year built: 1950s	Office space, meeting rooms, dining facilities& gymnasium	Reuse of building materials, skylights, efficient electric lighting, mechanical system and controls	~ $2 million * $66.67 per square foot
SoFlo Office Studios, San Antonio, TX / 16,600 square feet Year built: 1940s	Office building	Use of salvaged materials, rainwater harvesting, a/c condensate collection, low-flow plumbing fixtures, window glazing with low-emission coating, low emitting paints, task lamps for occupant control, lighting timers and controls, ENERGY STAR appliances	$1.8 million $108.43 per square foot

Adapted from: U.S. Department of Energy, Better Building Challenge; USGBC Central Texas – Balcones Chapter, 2009 & 2010; McGraw-Hill Construction – Smart Market Reports, Case Study.

Medium-sized building owners need to identify, through measurement of their building performance, the areas consuming the most energy and having the largest impact on their business. These projects should be tackled as funding permits. Energy reductions are easily measured in savings on utility bills and can provide the earliest payback. The cases studied all experienced energy reductions in the range of 15 – 39.5%. Based on average national energy expenditures from CBECS (2003), these savings amount to annual savings ranging from $3,658 to $13,746 per year (Table 4.).

Table 4. Energy Efficiency Outcomes of Featured Buildings

Project / Size	**Measures**	**Annual Savings***
Rose Building, Houston, TX / 33,500 square feet Year built: 1986	Lighting retrofit, HVAC upgrades, installation of a direct digital control system	Expected Energy Savings: 23% Estimated savings: $8,938 / year
Trane San Antonio District Office / 32,000 square feet Year built: 1980s	High efficiency lighting and mechanical systems- 43% more efficient than ASHRAE standards, low emitting paints, carpets, wood and furniture, individual lighting controls, occupancy sensors, light meters to increase reliance on natural light. Parking lot of highly reflective concrete, use of recycled and rapidly renewable materials.	Actual Water: 32% Mechanical Systems: ~50% Lighting : 15% Estimated savings: n/a
Lance Armstrong Foundation , Austin TX / 30,000 square feet Year built: 1950s	Specialized ventilation system supplying 30% more fresh air than code, reuse of building materials, skylights, efficient electric lighting, mechanical system and controls, high-efficiency faucets, showers and low-flow and reduced flow toilets. Native low water use vegetation, efficient irrigation system. Green housekeeping, landscape maintenance and integrated pest management.	Actual Water: 67% Estimated savings: $13,746 / year
SoFlo Office Studios, San Antonio, TX / 16,600 square feet Year built: 1940s	Use of salvaged materials, rainwater harvesting, a/c condensate collection, low-flow plumbing fixtures, window glazing with low-emission coating, low emitting paints, task lamps for occupant control, lighting timers and controls, ENERGY STAR appliances	Actual $1.8 million (total) Estimated savings: $3,658 / year

* Annual estimated savings is derived based on the CBECS's value for the energy expenditure of all office buildings under 50,000 square feet ($1.16 per square foot).

The decision remains as to how to apply the energy savings, should it be applied to the bottom line as incremental profitability or applied to other projects. Further discussion will reveal areas where funds can be directed to decrease an organization's largest expense…employees.

Convincing commercial building owners to pursue building energy efficiency retrofits should be an easy task according to research from the World Business Council for Sustainable Development (WBCSD, 2009). According to WBCSD, energy savings of 10% can be achieved with an investment of less than $1 per square foot (WBCSD, 2009). Organizations looking to make a larger reduction in energy consumption can expect a 40% energy savings for an investment of $10 - $30 per square foot (Pike Research, 2009). The USGBC estimated that retrofitting an existing building can save the owner of a US commercial building $0.52 per square foot per year ($5.60 per square meter per year) in energy costs (Booz Allen Hamilton, 2009). There is considerable research into building efficiency and expected energy savings resulting from building retrofits: Rocky Mountain Institute estimates that building owners pursuing ENERGY STAR certification can expect energy cost savings between 25% - 50% of annual energy costs (Rocky Mountain Institute, 2012). Jones Lang LaSalle reports that of 115 commercial office buildings in its portfolio that received energy efficiency improvements in 2006, the average savings for 2007 and 2008 were $2.24 million and $3 million, respectively (Jones Lang LaSalle, 2009).

The benefits of energy efficient buildings and energy retrofits go beyond energy savings. Romm & Browning (1994) state that focusing on an energy efficient building design may be one of the least expensive ways for an organization to increase worker productivity and the quality of its' products (Romm & Browning, 1994), Eichhlotz et al. (2009) found that retrofitting an existing building would increase its capital value by 16%.

The commonly accepted financial benefits of investing in the energy efficiency retrofits include (Romm & Browning, 1994; Wolff, 2006; Turner Construction, 2005, 2012; Roper & Beard, 2006; GSA, 2008; EPA, 2012; DOE, 2013):

- Reduce operating costs
- Reduce life-cycle energy costs
- Increase asset value and profitability
- Improve employee productivity and satisfaction
- Optimize life-cycle economic performance
- Lower absenteeism
- Lower health related costs such as insurance premiums

The benefits that organizations can expect by pursuing these retrofits make energy efficiency improvements very attractive to building owners however; often organizations are unable to justify the cost to invest in energy efficiency, resulting in over 50% of energy savings alternatives being overlooked (Schneider & Rode, 2010).

Some of these organizations that forego green retrofits are simply unaware that green building options are available (Schneider & Rode, 2010). IFMA (2010) indicates that to be effective in retrofitting existing buildings, it is critical to understand end-use energy consumption. Tools in place to measure energy use include sub-meters, tracking utilities, data loggers, energy audits and more however, despite its importance just over 60% of organizations reported tracking energy data or their energy costs. Use of these tools and measures among medium-sized building owners is likely to be below 60% (WBSCD, 2009). This inability to accurately measure building performance leads many to determine that energy efficiency targets are unattainable, or a poor investment, and often leads to a decision not to pursue energy efficiency. It is believed that in the next three years, organizations that are not operating from green buildings will find themselves at a competitive disadvantage from higher operating costs, lower productivity, declining attraction and retention of skilled workers and a poor brand image (Deloitte, 2012; Wolff, 2006; Roper & Beard, 2006).

Organizations that are pursuing energy efficiency measures recognize the benefits of energy efficiency. A survey of over 700 executives in 2012 (Turner Construction, 2012) found that companies remain committed to efficient buildings because of their potential to reduce energy and on-going operation and maintenance costs. The reasons cited by executives to invest in energy efficiency measures are included in Figure 2 below:

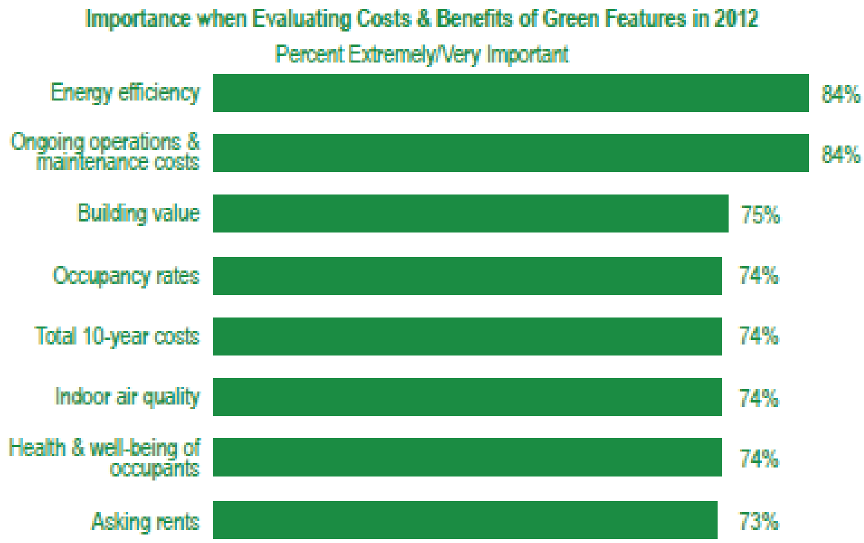


Figure 2. Importance when Evaluating Costs & Benefits of Green Features in 2012
Source: Turner Construction, 2012 Green Building Market Barometer

Environmental concerns were not ranked as Extremely or Very Important by executives in this survey, suggesting that economic decisions (operating cost reductions) are driving the interest in energy efficient building features.

Energy efficiency retrofits are saving building owners money. Nationwide, building owners pursuing whole building retrofits benefited from annual energy savings of 11 to 26% compared to comprehensive lighting retrofits with savings of 8 to 13% annually (Nadel & Geller, 1995; Nadel et al., 1994; Olgyay & Seruto, 2010).

A study of 678 Energy Service Companies (ESCOs) between 1982 and 2000 found that energy savings from projects incorporating energy efficient lighting and other efficiency improvements saved 23% of total facility electricity use. The energy efficient lighting projects saved 47% of total lighting costs (Osborn et al., 2002). The cost of these projects averaged $2.50 per square foot for institutional projects and $1.40 per square foot for private sector projects. Generally, the institutional projects were more comprehensive and included more energy efficiency measures than private sector projects (Osborn et al, 2002; Amann & Mendelsohn, 2005).

The needs of small and medium-sized building owners differ from large corporate real-estate executives as costs play a larger role in the decision making process. According to research by IFMA (2011), only 25% of small building owners plan to make energy efficiency improvements (Cramer-Krasselt, 2007), compared to the 84% of real-estate executives referenced earlier. The reason for the lower participation rate in energy efficient retrofits may be financial but Sweetser (2012) suggests that owners of existing commercial buildings of 100,000 square feet or less face the following challenges: (1) An inability to invest in current assessment and modeling tools; (2) challenges trying to integrate a number of complex components, subsystems, sensors and controls as one integrated building system; and (3) the increasing complexity of the building market. Sweetser explains, that in order for energy efficient initiatives to be successful for this market, leaders will need to maintain a reasonable amount of risk, rules need to be changed to support the efforts of small and medium-sized building owners, adequate training and education needs to be provided to decision makers and appropriate business models need to be developed for their success (Sweetser, 2012).

Small business owners have access to a guide published by the American Public Power Association and Association of Small Business Development Centers (2003) that identifies energy efficiency solutions for small business owners. The areas of focus include: lighting, office equipment, heating, ventilating, and air-conditioning (HVAC) equipment and maintenance, refrigeration and hot water.

Low-cost energy efficiency upgrades identified by the American Public Power Association and Association of Small Business Development Centers are described in Table 5.

Table 5. Low Cost Energy Efficiency Upgrades for Small Business Owners

Measure		Expected Energy Savings per item
Replace….	With…..	
Incandescent bulbs	Compact fluorescents	75%
Lower air-conditioning temperature	Use ceiling fans, increase temperature by 3 – 5 degrees	3%
Dirty air filters	New filters at least every 3 months	$5/month
Old incandescent exit signs	New LED exit signs	90% of operating cost
Replace old thermostats	Programmable / smart thermostats	Up to 30% on HVAC operating cost
Old light switches	Occupancy Sensors	Up to 75%
Old Office Equipment	ENERGY STAR Certified Equipment	Up to 58% of operating cost
Non-essential office equipment that runs for 24 hours	Turn off non-essential office equipment at night	Up to 75% of operating cost
Old refrigerator	ENERGY STAR rated refrigerator	Up to 30% of operating cost

Source: American Public Power Association and the Association of Small Business Development Centers (2003)

The application of these improvements is demonstrated in six small buildings located throughout the U.S. The organizations that pursued these energy efficiency improvements recorded savings ranging from 40 - 50% of their annual energy costs, as indicated in Table 6.

Table 6. Energy Efficiency Measures Applied in Small Buildings

Organization /Location	Measures	Square Feet	Annual Energy Savings
Kiddie U. / FL.	High-efficiency air-conditioning, programmable thermostats, compact fluorescent lamps, T-8, occupancy sensors, improved insulation	15,400	40%
Interiors by Casual Creations / FL.	2-lamp fixtures using energy efficient T-10, hi-lumen lamps	22,000	50% or $5,000/yr
Centerplex/ WA	Programmable thermostats, energy efficient lights, window improvements	26,500	50% or $23,000/yr
Inn at Wiccoppee / N.Y.	Reduced frozen food inventory, reduced freezers from 5 to 2.	n/a	$800/yr
Office building/ na	Repaired a leak and installed an insulated blanket wrap around the water heater.	2,000	$35/yr

Adapted from “Energy Efficiency Pays – A Guide for the Small Business Owner” (2003)

The small building owners, featured in the report by American Public Power Association and Association of Small Business Development Centers (2003), realized energy savings of up to 50% per year and were able to get a return on their investment in under two years. The payback period for these investments was consistent with research conducted by Cramer-Krasselt (2007)for Johnson Controls. Of the 1276 respondent surveyed, 64% of respondents’ maximum tolerable payback period was two to five years. Only 16% said that they would tolerate a payback of 6 years or more. A breakdown of the cost of these improvements and the payback period is included in Table 7 below.

Table 7. Small Buildings: Energy Efficiency Measures, Costs and Payback Period

Organization /Location	Building Type	Cost of Improvement	Payback Period
Kiddie U. / FL.	Daycare and learning facility.	$75,000+	n/a
Interiors by Casual Creations / FL.	Retail - Furniture showroom.	$6,500	1 year
Centerplex/ WA	Commercial office, 43 tenant firms and 100 occupants	$35,000	1.5 years
Inn at Wiccoppee / N.Y.	Restaurant	n/a	n/a
Office building/ n/a	Repaired a leak and installed an insulated blanket wrap around the water heater.	$40	1 year

Adapted from Energy Efficiency Pays – A Guide for the Small Business Owner (2003)

Despite an interest in undertaking sustainable retrofits, building owners and organizations, particularly small and medium-sized building and business face financial constraints and challenges from credit market failures that may lead to underinvestment in energy efficiency (DeCanio, 1993; Palmer et al., 2012; Golove & Eto, 1996). Even when investments in retrofits and new equipment pay off in future energy savings, the up-front expense is often substantial and may require financing (Palmer et al., 2012). The importance of accurately forecasting sustainable retrofit costs is of significant importance to ensure that inefficient building stock can receive efficiency upgrades.

Sixty-two percent of building owners expect to recoup the investment made into energy efficiency retrofits within 10 years (McGraw-Hill Construction, 2003). It is not uncommon for building owners to determine the viability of an investment in sustainable retrofits by using the Net Present Value (NPV) method (Menassa, 2011; Hill, 2001; Palmer et al., 2012; Kats et al., 2003). In order to address gaps in the method used to assess sustainable retrofit options, Menassa (2011) embarked on financial analysis to improve upon the current NPV method. Menassa's approach accounts for life-cycle costs and the perceived value of the retrofit and culminates in the NPV_m (modified NPV). This technique allows building owners to evaluate a variety of retrofit options for their buildings. Menassa's model allows a building owner to consider their investment decision under three main scenarios: Single-stage investment – option to defer; Multi-stage investment with option to abandon; Multi-stage investment with option to stage, additional options exist within these three main option types. Table 8 below adapted from Menassa 2010, provides an explanation of each option as well as its' application in sustainable retrofits.

Table 8. Financing Options Available Under the Modified NPV

Option	**Definitions** (Fichman et al., 2005)	**Application in Sustainable Retrofit Projects**
Option to stage	The project is divided into distinct stages. The costs/benefits of a completed stage are assessed to determine if subsequent stages can be pursued	The retrofitting can be divided into stages depending on the available budget. First stage might involve replacing light bulbs with more energy efficient ones, and use plug-load occupancy sensors to turn off lights when no one is using the space.
Option to abandon	Terminate a project any time prior to completion and deploy resources to other projects	An exhaustive feasibility study of the existing building condition might indicate that the associated incremental costs to make the building energy efficient are too high. In this case the owner might abandon the project.
Option to defer	A decision on whether to invest in a project can be postponed without imperiling the potential benefits	A decision to sustainably retrofit an existing building can be deferred until debt financing becomes available at attractive rates to the owner, or until the tenants can arrange to lease alternative space for the duration of the retrofitting project.
Option to grow	An initial baseline investment allows the project managers to pursue a variety of follow on opportunities	The owner of several existing buildings nationwide can decide to retrofit one building as a pilot project, and decide to expand retrofit work to the remaining of his/her existing building stock once perceived benefits from retrofitting the pilot project outweigh the costs incurred
Option to reduce	Reduce current scale of the project and save costs	Reduce the scope of the retrofitting endeavor when the costs of the retrofitting exceed the allocated budget. For example, replacing the existing HVAC system might exceed the allocated costs due to lack of information about the existing system and how it is distributed throughout the building. In this case, other scheduled energy efficient replacements or updates for the building will need to be postponed or forgone all together
Option to switch	An asset developed for one purse can be switched for redeployed to serve another purpose	An existing office building owner might decide to switch the tenant occupancy of certain floors from three to four tenants per floor to only one tenant per floor

Adapted from Menassa, C.C. (2011). Energy and Buildings 43. 3576-3583

Menassa's approach to determine the value of retrofit projects does not represent a significant deviation from existing financial analysis used today, parameters such as MARR and risk free interest year are used in this new model and are commonly used in the real-estate investment industry (Menassa, 2011). At a time when stakeholders are looking to better understand the implications of financial commitments, this new approach may reduce uncertainty and provide the clarity required to justify an investment in a building retrofit. In the case of a single-stage investment, stakeholders can decide whether postponing a project due to some level of uncertainty is beneficial. By doing so, the project will result in a higher NPV_m than the traditional NPV. Those considering a multi-stage investment, calculating the value of staging with an option to abandon gives building owners more flexibility than having the entire project be contingent on the completion of all stages. When uncertainty is high, the NPV_m provides a good alternative to traditional valuation methods.

4.1.1 Findings - Outcomes of Building Retrofits

The literature is abundant in making a case for energy efficiency retrofits. With the constant challenge placed on building owners of all sizes to decrease costs and increase building value, pursuing an energy efficient retrofit is an ideal approach to attaining both of these goals. Quantitative research provides evidence that building owners can expect to reduce operating costs, reduce life-cycle energy costs, increase asset value and profitability and optimize life-cycle performance. Often, the value to building owners, beyond energy cost savings provided by retrofits, make the difference between an owner deciding to go ahead with a project or not.

Buildings built between 1970 and 1999 are considered to be the least energy efficient. By 2030, 85 – 95% of building retrofits will focus on energy efficiency. Measures used to improve energy efficiency vary significantly, research and cases demonstrate that in spite of this, payback on energy efficient retrofits are possible in under two years.

Projects focused on energy efficient lighting and other efficiency improvements can attain overall energy reductions of 20% or more. An investment of $1 per square foot can achieve energy reductions of 10%. An investment of $10 - $30 per square foot can lead to energy savings of up to 40%. ENERGY STAR certification can led to energy savings between 25 – 50% and a retrofit can increase building value by 16%.

Energy efficient buildings have been found to lead to indirect benefits of increased organizational image and reputation, increased employee productivity and an improved ability to attract and retain skilled workers. A summary of the benefits to building owners of investing in an energy efficiency retrofit is found in Table 9.

Table 9. Value of Energy Efficiency Measures to Building Owners

Benefits to Building Owners	
Direct	**Indirect**
• Reduced operating and maintenance costs • Reduced life-cycle energy costs • Increased occupancy levels • Increased asset value and profitability • Decreased insurance rates and premiums • Improved life-cycle performance	• Goodwill/brand equity • Increased employee productivity and satisfaction • Increased ability to attract talent • Improved employee health and well-being • Improved ability to retain talent

Source: Romm & Browning, 1994; Wolff, 2006; Turner Construction, 2005, 2012; Roper & Beard, 2006; GSA, 2008; EPA, 2012; DOE, 2013

The benefits of building retrofits are relevant for medium-size building owners. Many medium-size building owners face financial challenges that reduce their ability to invest in energy efficient retrofits however, improvements in the tools to measure financial viability of retrofit projects, the anticipated growth in the retrofit market and the anticipated rising price of electricity, energy efficiency retrofits may become more accessible to medium-sized building owners.

4.2 Organizational Corporate Social Responsibility and Performance

"Corporate Social Responsibility"(CSR) has become a strategic initiative known by many names; *corporate responsibility, corporate citizenship, ethics, governance social enterprise, sustainability, triple-bottom line, etc.*(Harvard Kennedy School, 2008). In 1997 Podsakoff and MacKenzie studied the impact of Corporate Social Responsibility on organizational performance. They found that CSRs had a positive effect on performance by "lubricating the social machinery of the organization" (Podsakoff & MacKenzie, 1997). The researchers considered the social benefits of a CSR and the effect from employee engagement and interaction with their communities. Studies since then have considered the impact that buildings, particularly energy efficient or "green" buildings have on performance.

Corporate Social Responsibility is a powerful tool that allows organizations to humanize their organization and can serve as a differentiator in the marketplace. From an employee attraction perspective, "The best professionals in the world want to work in organizations in which they can thrive, and they want to work for companies that exhibit good corporate citizenship." (World Economic Forum, 2003). The executive director of Kenexa Research Institute (KRI), says that the benefits of participating in CSR activities include: providing a competitive advantage in recruiting; improvements in brand image; creating a sense of teamwork among employees; building an emotional tie between the employee and the organization; and employees that are more satisfied and stay at their jobs longer than those in organizations without a CSR.

A strong CSR gives organizations an advantage when recruiting talent (Economist Intelligence Unit, 2011; The Marlin Company, 2008; Turban & Greening, 1996; KRI, 2007; Zhang et al., 2011; Fombrun et al., 1990; Davis, 1973; Ehrhart et al., 2005; MonsterTRAK, 2007; Margolis & Walsh, 2003) and, showcases a companies' social and environmental good deeds, including philanthropic initiatives, reducing in energy use, pollution and more. The CSR communicates how the organization operates and interacts with the community that it operates in. Because of the statement that a corporate social responsibility policy sends to employees, investors and the larger community, it has become a critical element in strategic decision making in organizations of all sizes (Bhattacharya et al, 2008; Delmas et al., 2008).

Organizations occupying energy efficient buildings that communicate this fact via a CSR gain additional benefits that directly impact the bottom line. Research in 2009 and 2010 found that energy efficient buildings (receiving ENERGY STAR or LEED Certification) command higher rental rates and sales prices over non-energy efficient buildings (Eichholtz et al., 2009; Pivo & Fisher, 2010), their occupancy rates are higher and less volatile, they have higher resale values, decreased risk, liability and insurance rates and have longer operable lives (DOE, 2003). When these benefits are communicated openly through a CSR, they create a positive impression with stakeholders and customers. This measure to occupy energy efficient real estate can translate into a long-term commitment to corporate social responsibility and result in an increase in stakeholder and investor confidence and increased patronage from customers (Fisk et al., 1997).

There are several indirect benefits of investing in energy efficient buildings. A study of tenants in ENERGY STAR or LEED buildings found that these tenants chose to locate their operation in an energy efficient buildings to: 1) attract high-quality labor 2) offset negative reputation effects 3) gain from positive productivity effects on employees , and 4) to communicate their commitment to sustainability. Some building tenants believe that the non-financial benefits of pursuing a corporate social responsibility policy actually exceed the financial costs of such a policy (Eichholtz et al., 2009).

Table 10. provides a list of numerous benefits cited by researchers as a result of organizations occupying energy efficient buildings.

Table 10. Benefits of Leasing Energy Efficient Office Space

Benefits of CSR	Type of Organizational to benefit most
Improved corporate reputation	Large, most visible firms that are often under public scrutiny (Wal-Mart, Starbucks, McDonalds)
Communicate commitment to social causes and the environment	Any firm wishing to appeal to certain segments of customers.
Attract investors	Companies with highly developed environmental and social engagement can be more attractive to investors.
Gain customers	Firms operating in competitive markets heavily influenced by customers.
Attract and retain a better workforce	Where skilled employees are scarce and skills are inelastically supplied.
Alter a negative image	Those involved in risky technologies (nuclear or biotechnology) or operating in controversial product-markets (tobacco or weapons).
Decrease the risk of future litigation	Firms in environmentally sensitive industries

Adapted from Guenster et al., 2009; Porter & Van der Linde, 1995; Eichholtz et al.2009, Fombrun et al., 1990; Chen et al., 2008; Auger et al., 2003; Bassen et al., 2006; Fisk et al., 1997; Nelson & Rakau, 2010)

Companies that commit to a CSR have a competitive advantage over those that do not. This competitive advantage translates, indirectly to an economic benefit for organizations (Fisk et al., 1997; Eichholtz et al. 2009). Surveys of respondents in the

U.S. and the U.K. found that 83% of Americans and 86% of Brits would be more likely to support (via a more positive image or to purchase) from a company associated with a cause that they respected. (Ellen et al., 2000).

Researchers, and those involved in facility management, have been interested in understanding the role that buildings and facility managers play in CSR. According to Ferdinand Fuke (2012), 96% or more of activities referenced in an organization's CSR fall in the realm of facilities. Facility managers are providing strategic value to organizations by defining the role of buildings in meeting organizational needs. Facility managers efforts to pursue energy efficiency are often supported by senior executives; a global survey of 278 senior executives across a range of industries and organization sizes, see energy efficiency as part of their company's corporate social responsibility effort (Economist Intelligence Unit, 2011). Since 90%+ of the actions existing in corporate social responsibility statements fall within the realm of facility management and relate to the buildings that organizations operate, the impact of having a corporate social responsibility statement and its impact on the organization is worth further review.

There are many inputs to an organization's CSR, often they stem from how the buildings operate, however other corporate initiatives such as volunteerism, work-life balance programs and others are equal or greater value to stakeholders and customers. The diversity of programs communicated in an organization's CSR contribute to the complexity of measuring the impact that energy efficient buildings have on organizational profitability. Corporate social responsibility is continuing to evolve as organizations endeavor to maximize their effectiveness (Porter & Kramer, 2006).

4.2.1 Findings

Corporate social responsibility is a strategic corporate initiative that provides more benefits to an organization than simply volunteering to planting trees or turning-off lights in the evening.   Corporate social responsibility programs connect organizations to the communities that they operate in, they shed light on the good deeds and humanize an organization. Many outside organizations, stakeholders, customers and investors, rate companies based on the performance of their corporate social responsibility program. A corporate social responsibility program also provided benefits to internal stakeholders and employees. Organizations of all sizes can benefit by committing to a corporate social responsibility program. Internal and external benefits of a CSR program are included in Table 11.

Table 11. Benefits of Corporate Social Responsibility (CSR)

Benefits :	
External benefits (stakeholders, customers, investors)	**Internal benefits (employees, organization)**
– Improved corporate reputation – Alter a negative image – Attract investors – Attract a better workforce, particularly Generation Y – Communicate commitment to social causes and the environment	– Increase building value – Increase rental rates – Increase building occupancy – Gain customers – Retain employees – Decrease the risk of future litigation – Create a sense of teamwork among employees – Build an emotional tie between employees – Increase employee satisfaction

Source: Auger et al., 2003; Bassen et al., 2006; Chen et al., 2008; Eichholtz et al.2009, Fombrun et al., 1990; Fisk et al., 1997; Guenster et al., 2009; Porter & Van der Linde, 1995; Nelson & Rakau, 2010

Medium-size building owners who choose to pursue energy efficient improvements must begin to capture the programs and improvements that they have in place and develop a means to communicate them to the public. Developing an internal process that will solicit input from employees and from departments throughout the organization will provide a comprehensive source of inputs that are relevant to employees and to the community.

4.3 Performance of Energy Efficient Buildings

McKinsey & Company (2009) estimates that cost-effective energy efficiency improvements employed throughout the building sector in the United States has the potential to reduce annual electricity consumption by over 23 percent, resulting in a $100 billion reduction in electricity and natural gas bills for consumers and businesses.

According to Rocky Mountain Institute, energy efficient retrofits for existing buildings, and new buildings designed for energy efficient performance, can have substantial economic returns. In each of the cases presented, improved efficiency in lighting, heating, and cooling increased worker productivity, decreased absenteeism, and often led to improvements in the quality of work performed (RMI, 2012). According to the United Nations Environment Programme (2011), U.S. building owners benefited from productivity improvements of 6 – 9% from indoor air quality improvements, 3 – 18% from natural ventilation, 3.5 – 37% by installing local thermal controls and 3 – 40% from increasing daylighting (Wyon, 1996; Loftness et al, 2003).

When life- cycle costs are analyzed, studies have suggested that an initial up-front investment of an extra 2% of construction cost (for new buildings) will yield over ten times that investment over the life-cycle of the building through energy and other operational cost savings (Wolff, 2006). Research from Kats shed more light into the costs of energy efficient buildings, LEED-certified offices and schools were estimated to cost 0.66 percent more than comparable non-LEED buildings, LEED Silver offices and schools were estimated at 2.11 percent more than comparable buildings, LEED Gold offices and schools cost approximately 1.82 percent more and LEED Platinum buildings cost 6.5 percent more. Kats is not alone in his assessment that “green” or energy efficient buildings have up-front costs that are comparable to non-energy efficient buildings, Turner Construction (2005) found that LEED Certified buildings cost only 0.8 percent more and Langdon (2007) found no significant price difference between LEED Certified building and comparable non-LEED buildings. Research into additional economic benefits of LEED-certified buildings, found that their occupancy rates are 3.8% higher, rent premiums are $11.24 more per square foot and LEED-certified buildings sell for $170 more per square foot (USGBC, 2008) than non-LEED buildings (USGBC, 2008; Deloitte, 2012) . From an energy savings perspective alone, the costs of investing in new green buildings provide a financial benefit to building owners (Katz et al., 2003). Castro et al., quantifies the benefits of energy efficient buildings to amount to hundreds of thousands, possibly millions of dollars throughout the lifecycle of the building (Castro et al., 2008).

The extent of the savings available to organizations that pursue energy conservation measures is in the billions of dollars in the U.S. alone. According to Granade et al. (2009), investing $125 billion in commercial buildings would reduce the amount of energy demanded by buildings by 29% and translate to a cost savings of $290 billion. To provide an international perspective, research also found that an investment of $90 billion in developing countries would result in energy cost savings of $600 billion (Granade et al.. 2009; McKinsey, 2010).

A study conducted by Ries and Bilec (2006) found that energy usage in a new manufacturing facility decreased by 30% on a square foot basis. The facility also required less water per square foot on an annual basis. More information about the results on this study will follow in this report.

There are several voluntary programs and rating systems that support green building efforts, ENERGY STAR, LEED, Net-Zero Energy Buildings (NZEB), Green Globes, The Living Building Challenge, ASHRAE Standard 189 and others provide building owners with a variety of options and approached to attain a desired level of energy efficiency. Regardless of the path chosen to attain energy efficiency, it is widely accepted that the benefits of sustainable buildings are listed in Table 12:

Table 12. Benefits of Sustainable Buildings

Economic Benefits	**Social Benefits**
– Lower (or equal) first costs as conventional buildings	– Health, comfort and well-being of building occupants
– Decreased annual energy costs	– Building safety and security
– Reduced annual water costs	– Community and societal benefits
– Lower maintenance and repair costs	**Environmental Benefits**
– Better productivity and less absenteeism	– Lower air pollutant emissions
– Indirect economic benefits to the building owner (improved reputation, lower risk, ease of siting, etc.)	– Reduced solid-waste generation
– Economic benefits to society (decreased environmental damage costs, local economic growth, etc.)	– Decreased use of natural resources

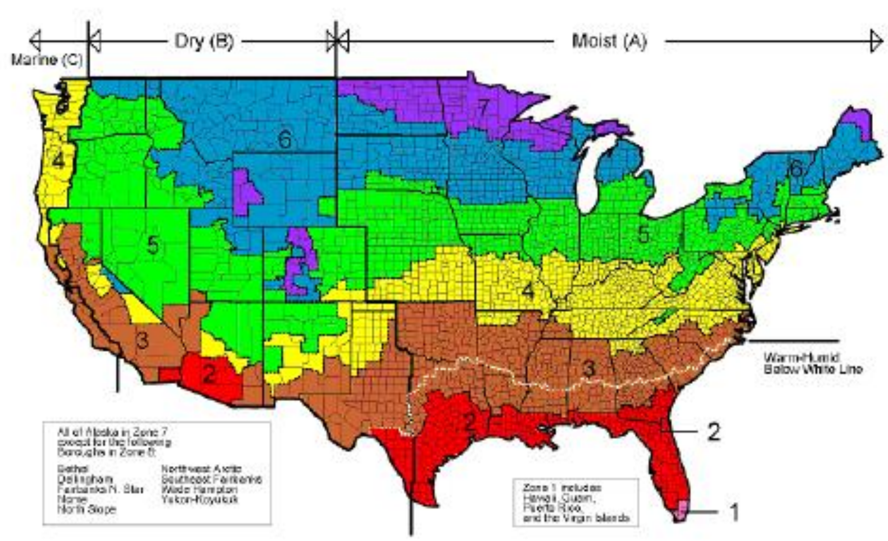
Adapted from: U.S. Department of Energy, Energy Efficiency and Renewable Energy. (2003). The Business Case for Sustainable Design in Federal Facilities.

Building owners are being challenged to reduce their energy dependence. The industry is adapting to meet these challenges, rating systems are raising the bar, legislatures are setting energy efficiency targets and building owners are analyzing their building stock to determine where improvements can be made to improve the efficiency and value of their buildings. Large commercial property owners have resources with expertise in energy efficiency, much of the technology and resources are designed for the large commercial building market (Palmer et al., 2012).

According to the Commercial Building Energy Consumption Survey (CBECS), 95% of buildings in the U.S. are less than 50,000 square feet in size (CBECS, 2003). These medium-sized business owners face challenges that are unique from large commercial real-estate owners. Often, they lack funding and resources (Palmer et al., 2012; RMI, 2012; IFMA, 2010; Sweetser, 2012). Additionally, medium-size buildings have energy systems that can be just as complex as larger buildings, making it equally difficult to quickly and cost-effectively identify and evaluate energy conservation measures (ECMs) (Sweetser, 2012).

In 2009, the Department of Energy and Pacific Northwest National Laboratory published a technical document to guide medium-sized business owners in their efforts to design new energy efficient medium –sized buildings. The guide, The Technical Support Document: 50% Energy Savings Design Technology Packages for Medium Office Buildings (TSD), leads building owners to develop solutions that can reduce energy requirements by 50 percent or more.

Based on a model building, 18 models are simulated by adjusting for the eight climate zone, heating degree days (HDDs), cooling degree days (CDDs), and moist, dry and marine climates. Figure 3. represents the cities where the model buildings are located.



The 16 cities representing the climate zones are:

- 1A: Miami, Florida (very hot, humid)
- 2A: Houston, Texas (hot, humid)
- 2B: Phoenix, Arizona (hot, dry)
- 3A: Atlanta, Georgia (warm, humid)
- 3B-CA: Los Angeles, California (warm, coastal)
- 3B-other: Las Vegas, Nevada (warm, dry)
- 3C: San Francisco, California (marine)
- 4A: Baltimore, Maryland (mixed, humid)
- 4B: Albuquerque, New Mexico (mixed, dry)
- 4C: Seattle, Washington (mixed, marine)
- 5A: Chicago, Illinois (cool, humid)
- 5B: Denver, Colorado (cool, dry)
- 6A: Minneapolis, Minnesota (cold, humid)
- 6B: Helena, Montana (cold, dry)
- 7: Duluth, Minnesota (very cold)
- 8: Fairbanks, Alaska (subarctic)

Figure 3. Buildings Simulated in Cities by Climate Zone

Source: U.S. DOE (2009). Technical Support Document: 50% Energy Savings Design Technology Packages for Medium Office Buildings.

The advanced Energy Efficiency Measures (EEM)s covered in the TSD include enhancements to the building envelope and insulation, windows, roofs, lighting, electricity loads and more. A listing of all components discussed in the TSD can be found in Table 13.

Table 13. Energy efficiency Measures in Medium-Sized Buildings

• Exterior wall and roof insulation	• Exterior lighting and controls
• Windows and glazing	• Office and other plug load equipment
• Overhangs for south windows	• Plug load equipment controls
• Cool roof	• Packaged rooftop or split system heat pumps
• Interior lighting	• Dedicated outdoor air system (DOAS)
• Occupancy sensors	• Improved ductwork design
• Perimeter daylighting controls	• Condensing gas water heaters

Adapted from U.S. DOE (2009). Technical Support Document: 50% Energy Savings Design Technology Packages for Medium Office Buildings.

The report concludes with recommendations for each climate zone and national-weighted average energy savings for two packages; a radiant heating and cooling system and; a heating, ventilating and air-conditioning (HVAC) system. The radiant heating system provides a higher national-weighted average energy savings than the HVAC system of 56.1% and 46.3% respectively (Table 14).

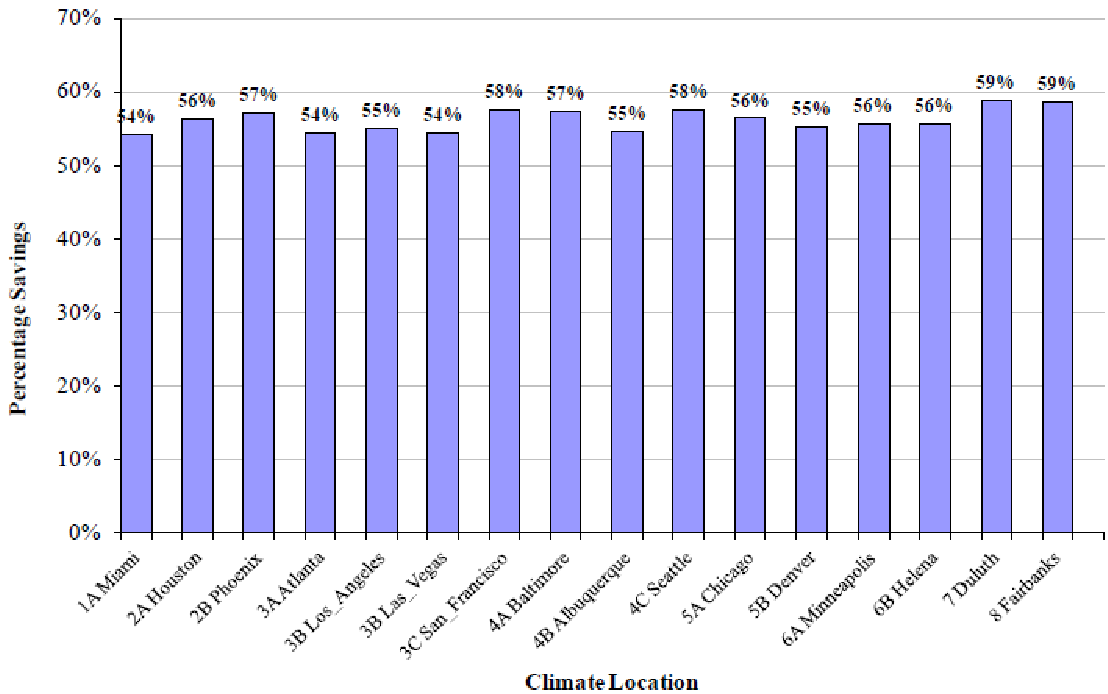
Table 14. Average Energy Efficiency Outcomes and Payback

Recommended System	Expected Efficiency	Expected Payback
Radiant systems	56.1%	7.6 years
VAV systems	46.3%	4.6 years

Adapted from U.S. DOE (2009). Technical Support Document: 50% Energy Savings Design Technology Packages for Medium Office Buildings.

Table 15 reproduced from the Department of Energy's Technical Support Document: 50% Energy Savings Design Technology Packages for Medium Office Buildings (2009), provides energy efficiency expectations for buildings in 16 different cities throughout the country. This prescriptive model was designed to facilitate the decision making for medium-size building owners who may lack the funding and access to tools used to perform energy audits.

Table 15. Energy Efficiency Expectations for Buildings in 16 Different Cities



Source: DOE (2009). Technical Support Document: 50% Energy Savings Design Technology Packages for Medium Office Buildings.

4.3.1 Findings

Energy efficient buildings are changing the way organizations' look at their building stock. Their improved working environments resonate with workers, and their economic profitability resonates with executives and stakeholders. The benefits of energy efficient buildings include reduced operating costs, productivity improvements and social benefits such as the improved health and well-being of building occupants.

Energy efficient buildings can be built for the same up-front cost as conventional buildings and reasonable payback periods, of five years or less, are attainable with these buildings. Energy efficient buildings can yield 10 times the incremental investment over the life-cycle of the building and provide numerous benefits to employees including productivity increase, increased satisfaction, improved health and well-being and more.

A summary of the benefits provided by energy efficient buildings can be found in Table 16.

Table 16. Energy Efficiency Building Benefits to Building Owners

Economic Benefits	**Social Benefits**
– Lower (or equal) first costs as conventional buildings	– Improved health, comfort and well-being of building occupants
– Decreased annual energy costs	– Building safety and security
– Increase occupancy rates and rent premiums	– Community and societal benefits
– Increase property value	– Improved sense of belonging
– Lower maintenance and repair costs	**Environmental Benefits**
– Improved productivity and less absenteeism	– Lower air pollutant emissions
– Indirect economic benefits to the building owner (improved reputation, lower risk, ease of siting, etc.)	– Reduced solid-waste generation
– Economic benefits to society (decreased environmental damage costs, local economic growth, etc.)	– Decreased use of natural resources
– Improved employee attraction and retention	
– Increased life-cycle performance of the building	

Resources, such as the Technical Support Document for medium office buildings, are available to guide building owners as they design new buildings and help alleviate some of the financial impediments to energy efficiency. The TSD serves as a road map for building owners throughout the U.S., and reduces the need to consult energy auditors and invest in costly building systems and additional consulting services.

4.4 Employee Satisfaction, Productivity and Organizational Profitability

The effects of indoor environmental quality (IEQ) on the health, well-being, satisfaction and productivity of employees has been studied extensively by occupational and public health researchers and practitioners. IEQ can have negative effects on physical health through poor air quality, extreme temperatures, excessive humidity and poor ventilation. The psychological health of workers can be negatively impacted as a result of inadequate lighting, acoustics and ergonomic design (Baughman & Arens, 1996; Henneberg et al, 2005; Hoskins, 2005; Institute of Medicine, 2001; May, 2006; Schleiff et al. 2003; Singh,J. 1996; Skov et al. 1996; Spengler & Sexton, 1983). Studies have shown that workers experiencing these physical or psychological health issues (asthma, respiratory allergies, depression, stress, etc..) have higher absenteeism, work less hours and as a result, are less productive (Burton et al.2001; Newsham et al. 2009; Wang et al. 2004; Wargocki et al. 2000). The claim that IEQ improves the health and productivity of employees has been made in many qualitative studies however, more quantitative studies are needed to confirm the relationship between them (Ries et al, 2006; Romm & Browning, 1994).

Ries et al. (2006) define productivity as "the output of any process, per unit of input, so it directly relates to the performance of the process elements, including the workers."

In a study conducted over a 5 year period, Ries, Bilec, Gokhan and Needy set out to develop a framework to evaluate the economic benefits of green buildings. Their analysis centered around a pre-cast concrete manufacturing facility located near Pittsburgh Pennsylvania. The old manufacturing facility was a conventional 17,000 square foot facility, the new facility was a new 37,000 square foot green facility.

To study the impact that the manufacturing facility had on employee productivity, a multi-disciplinary team was assembled from the University of Pittsburgh's Department of Industrial Engineering and Civil and Environmental Engineering to collect and analyze data focused in five specific areas:

- Gains in Worker Productivity
- Reductions in health and safety costs
- Improvements in indoor environmental quality
- Reduction in maintenance costs
- Energy and water savings

Quantitative data was collected through several employee surveys that were validated by management, this data would serve to determine whether a relationship between green building design and the five areas of interest existed. The analysis also consisted of a life-cycle cost analysis of the initial investments and building operational costs. Data is analyzed and compared; pre-and-post move for both traditional and green buildings.

The 45 employees surveyed included production workers and office workers ex. computer-aided design (CAD) operators and administrative staff. Productivity for office and production workers was measured through a self-reporting survey and by measuring man-hours per daily pounds of concrete, respectively.

Ries et al. found that office employees reported more significant factors for increased productivity than production workers (Figure 4). The team believes that this is an indication that office workers were impacted more by the new green building.

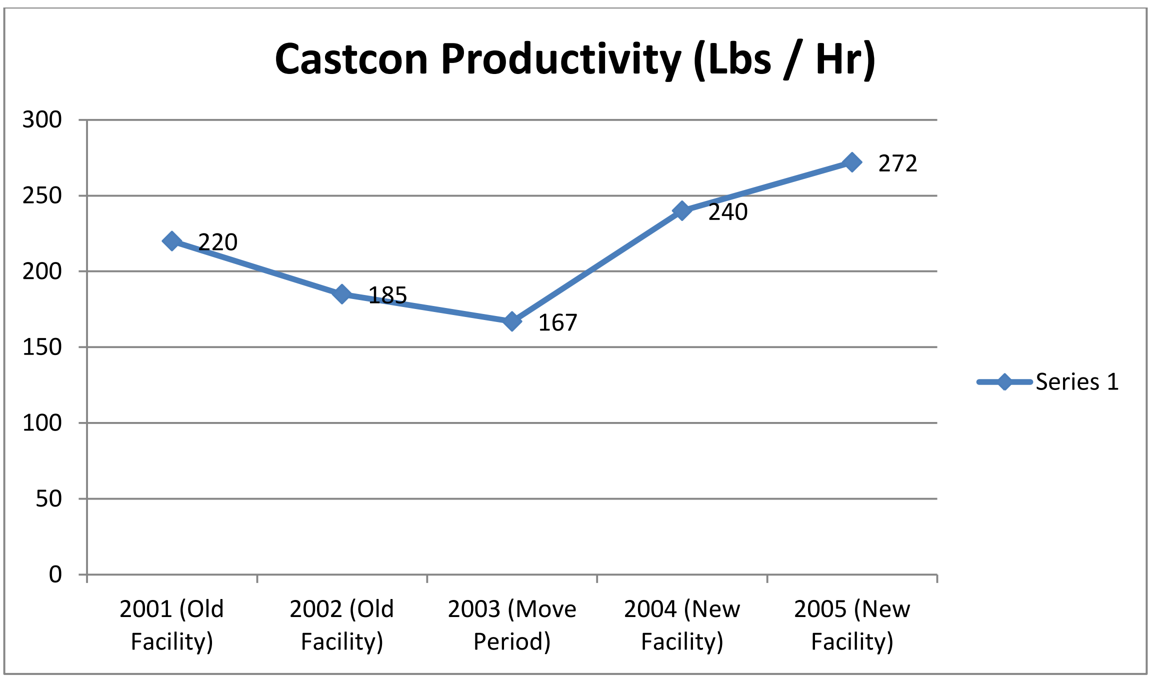


Figure 4. Impact of Green Measures on Productivity
Adapted from Ries et al. (2006). The Economic Benefits of Green Building: A Comprehensive Case Study.

Despite the relative ease of comparing productivity results of production workers, other factors impeded the ability to attribute productivity increases solely to the improved facilities. A new plant layout and a mandatory drug-free policy were also implemented in the new facility, productivity increases may be due to these influences.

Satisfaction questions were also included in employee surveys. The factors leading to increased satisfaction of office employees that proved to be statistically significant included; visual, acoustic and privacy of work area and the ability to adjust work areas to suit individual needs. Production workers worked indoors reported an increase in satisfaction with the location and amenities featured in the lunchroom, compared with the old facility. Combined satisfaction results, for all questions, do show an increase in satisfaction in the new facility except for the security of the building which was neutral for the new facility.

Health and safety and absenteeism data was compared between the old and new facility for the period between May 2002 and May 2004. Results for production workers demonstrated a statistically significant reduction in the percentage of workers' compensation-related absences. Reductions in the percentage of unexcused, no call and total absences were not statistically significant. An increase in sick-leave was also significantly significant. Combined, there was a statistically significant increase in total absences in the new facility (Figure 5.).

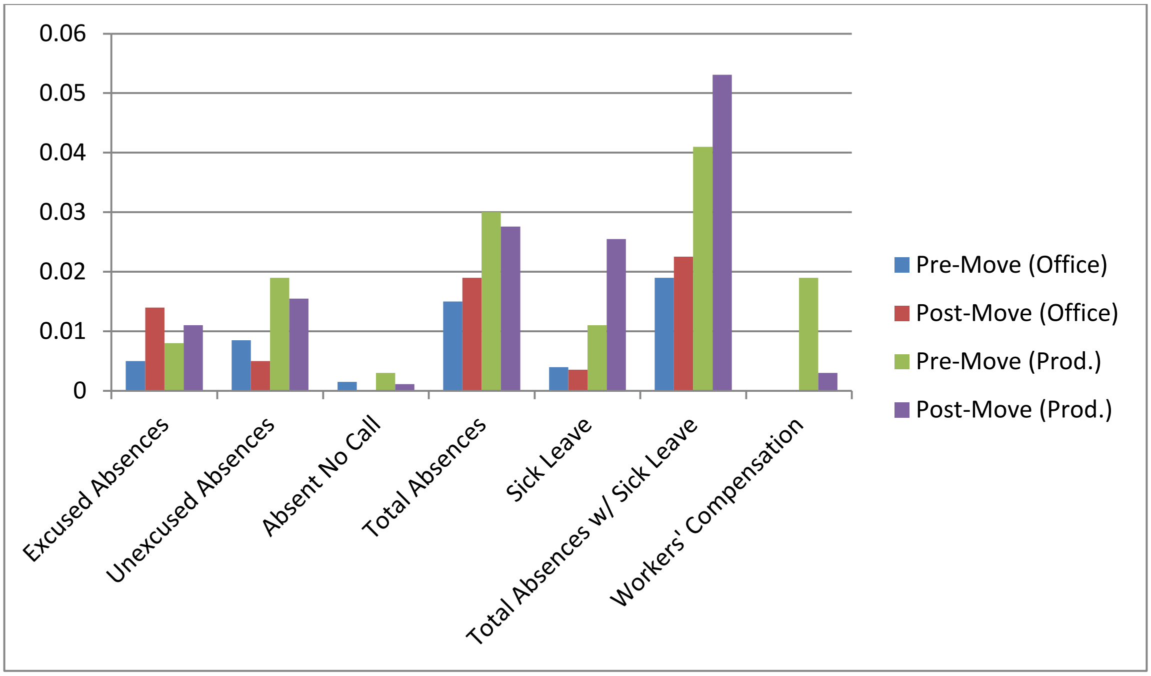


Figure 5. Comparison of Pre-Move vs. Post-Move Mean Values for Absenteeism and Sick Leave
Adapted from Ries et al. (2006). The Economic Benefits of Benefits of Green Buildings: A Comprehensive Case Study

Figure 6. represents absenteeism over a two year period due to worker's compensation. Markers indentifying the introduction of the mandatory drug-free policy, the implementation of an attendance incentive program and the move to the new facility have represented in this figure.

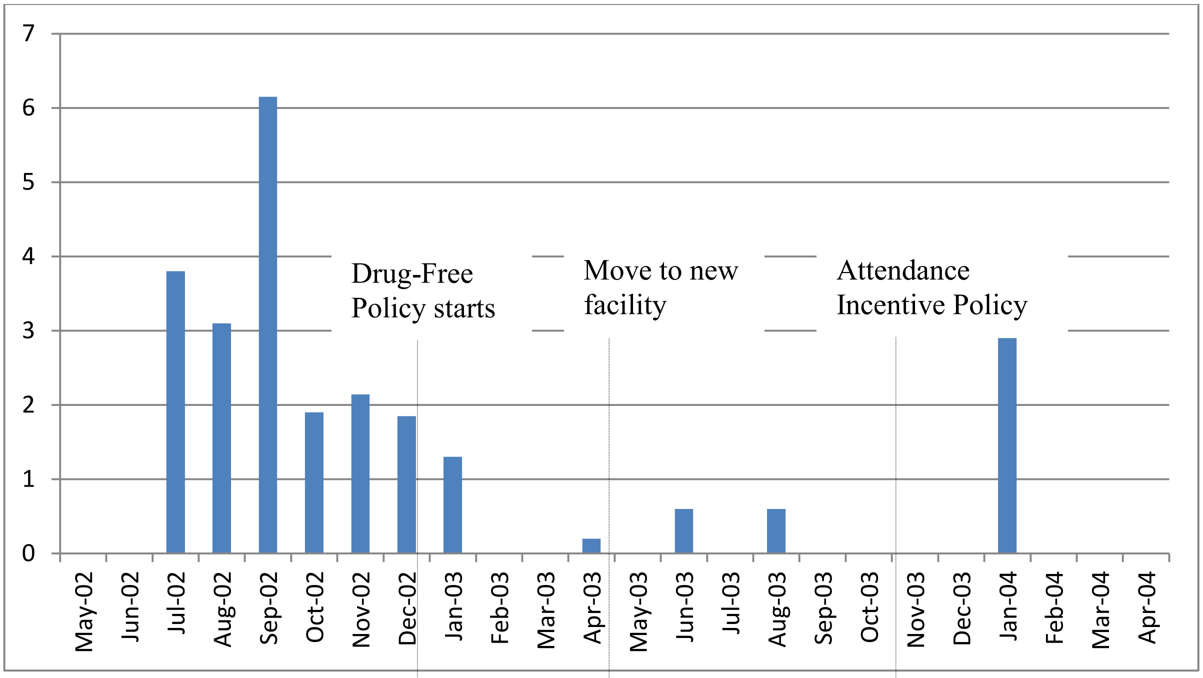


Figure 6. Workers' Compensation for Production Employees: Pre-Move vs. Post-Move
(Adapted from Ries et al. (2006). The Economic Benefits of Benefits of Green Buildings: A Comprehensive Case Study)

In this case, it was not possible to attribute a reduction in absenteeism to the features of the new facility. The introduction of a new drug-free policy and an attendance incentive policy made it impossible to single out the cause of the decrease in workers' compensation claims. A summary of the research measures and findings are found in Table 17.

Table 17. Summary of Findings

Measure	***Findings***
Productivity	Unable to quantify impact
Satisfaction	Combined increase in satisfaction
Health and Safety Including Absenteeism	Combined increase in absenteeism

(Adapted from Ries et al. (2006). The Economic Benefits of Benefits of Green Buildings: A Comprehensive Case Study)

Measuring productivity is often a difficult task, attempting to attribute productivity increases to the features and design of a building proves to be increasingly challenging. The greater challenge presents itself in the inability to control the research environment, other factors occurring in work environments can have an impact on absenteeism, productivity and other performance metrics (Ries et al, 2006).

As the average American spends 90% of their time indoors, significant research effort has been put into the analysis of a relationship between buildings and worker productivity. Some of this research has been referenced within this report, other institutions such as the EPA, the Green Building Alliance, the State of California and the City and County of San Francisco maintain databases on indoor air quality to study the relationship between specific building performance attributes and employee productivity and well-being.

It is a generally accepted fact that energy efficient buildings enhance the productivity and health of occupants (Kats et al., 2003; Kozlowski, 2003;Lucuik, 2005; Fang et al, 1998; Miller et al, 2009). More specifically, the relationship between improved indoor environmental quality and increased occupant well-being and productivity is well-documented in literature (Kats et al., 2003;Fisk, 2000;Heerwagen, J., 2010; Fang et al., 1998).

Heerwagen (2010) studied the human benefits of building design and found that there are basic needs or experiences that are linked to people's well-being, they include; a connection to nature and natural processes; an opportunity for regular exercise, sensory variability; behavioral choice and control; social interaction and; a need for privacy. Heerwagen then identified building features that address those needs and have a positive effect on building occupants. Daylighting, access to or views of nature, individual control of light and temperature controls and allowing for social interaction were some of the most prevalent building features that addressed the needs. A detailed list of features and attributes can be found in Table 18.

Table 18. Features and Attributes of Buildings Linked to Well Being Needs and Experiences

Experience / Need	**Environmental features and attributes**
Connection to nature and natural processes	Daylight; views of outdoor natural spaces; views of the sky and weather; water features; gardens; interior plantings; outdoor plazas or interior atria with daylight and vegetation; natural material and décor.
Opportunity for regular exercise	Open interior stairways; attractive outdoor walking paths; in-house exercise facilities; skip-floor elevators to encourage stair climbing.
Sensory chance and variability	Daylight; window views to the outdoors; materials selected with sensory experience in mind (touch, visual chance, color, pleasant sounds and odors); spatial variability; chance in lighting levels and use of highlights; moderate levels of visual complexity.
Behavioral choice and control	Personal control of ambient conditions (light, ventilation, temperature, noise); ability to modify and adapt environments to suit personal needs and preferences; multiple behavior settings to support different activities; technology to support mobility; ability to move easily between solitude and social engagement and spaces to support both.
Social support and sense of community	Multiplicity of meeting spaces, use of artifacts and symbols of culture and group identity; gathering "magnets" such as food; centrally located meeting and greeting spaces; signals of caring for the environment (maintenance, gardens, personalization, craftsmanship).
Privacy when desired	Enclosure; screening materials; ability to maintain desired distances from others; public spaces from anonymity.

Source: Heerwagen, J. (2010). Investing in People: The Social Benefits of Sustainable Design.

Numerous studies have indicated that the aforementioned features and attributes are associated with positive outcomes for building occupants, these outcomes include: reduced adaptive load (less effort required to adapt to an environment), reduced stress, improved emotional functioning, increased social support, reduced fatigue, and improved ability to focus attention on important activities (Heerwagen, 2000; Heerwagen et al., 2006; Ulrich, 1993; Kellert & Heerwagen, in press). For more detail on the specific benefits that are being attributed to these building features and attributes, please refer to Table 19 below.

Table 19. Building Features and Attributes & Benefits to Employees

Feature / Attribute	Benefit to Employees
Daylight & Sunlight	Improves mood (Boubekri et al., 1991; Leather et al, 1998). Also perceived as important for psychological well being, physical health and for aesthetic pleasantness (Heerwagen, & Heerwagen, 1986).
Connection to Nature	Reduced stress (Kaplan, 1992), can more quickly recover from stress, better moods, improves cognitive performance (Ulrich, 1993, Isen 1990), able to complete computerized tasks faster, lower blood pressure, more attentive (Lohr et al., 1996), perform better and faster on work tasks (Heschong, 2006)
Personal Control	Productivity increases (Kroner et al., 1992; Wyon & Wargocki, 2006; Menzies et al., 1997).
Sensory Change and Variability	Reduce boredom and passivity (Cooper, 1968; Schooler, 1984).
Stair Design & Exercise	More research is required to indicate a direct impact on obesity and improvements in physiological functioning.

Source: Heerwagen, J. (2010). Investing in People: The Social Benefits of Sustainable Design.

Kats et. al (2003) developed a report to aggregate the costs and benefits of green buildings, particularly in California. These researchers believe that the evidence supporting the fact that sustainable buildings have a large impact on productivity and health gains is well supported. Because of the complexity in determining a direct relationship between the design and operation of buildings and the comfort and productivity of employees different approaches have been taken to understand this relationship. Kats et. al (2003) relied on meta-studies that have screened hundreds of other studies and amalgamated their findings.

The issue of employee productivity, represented in Figure 7, is important to the State of California because of the portion of expenditures that it represents. In California, employee costs are ten times larger than the cost of property and 10.25 times larger than the cost of space per employee.

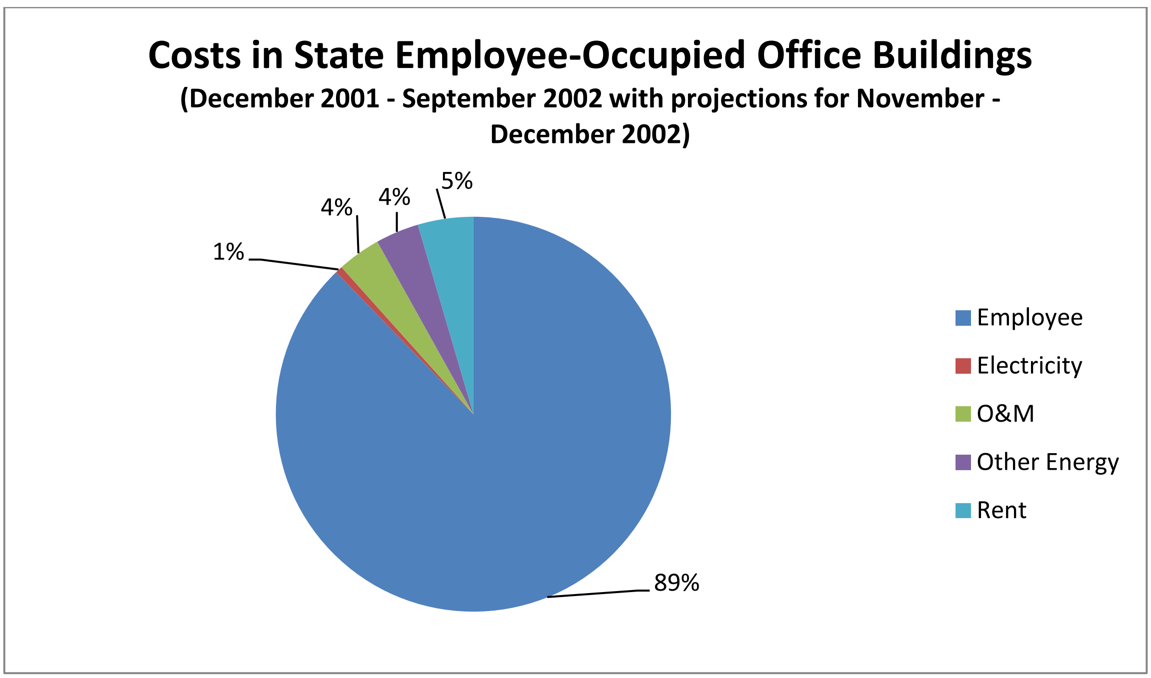


Figure 7. Costs in State Employee-Occupied Office Buildings
Adapted from Ries et al. (2006). The Economic Benefits of Benefits of Green Buildings: A Comprehensive Case Study.

Figure 7 represented costs for 27,428 state employees in 38 state-owned buildings. Average employee costs amounted to $65,141 versus the cost of space per employee of $6,477. For the State of California, a 1% increase in employee costs are equivalent to an increase in building costs of 10%, based on their findings, it is to their advantage to incorporate green design measures to increase productivity. An increase in employee productivity of 1% would, over time, have a financial impact that is almost equivalent to reducing building costs by 10%.

This report also found that increased productivity is closely linked to improved worker health. The researchers go further to equate these health benefits to reduced insurance premiums.

Kats et al's report referenced research from William Fisk et al.(2001) at the Lawrence Berkeley National Laboratory. Fisk et al.'s study divided the health benefits provided by sustainable buildings into four categories: Acute respiratory illness, allergies and asthma, sick building syndrome symptoms, and direct productivity gains. They analyzed the financial impact on organizations that result from these issues. A summary of their findings is found in Table 20.

Table 20. Potential Productivity Gains from Improvements in Indoor Environments

Source of Productivity Gain	Potential Annual Health Benefits	Potential U.S. Annual Savings or Productivity Gain (2002 dollars)
Reduced respiratory illness	16 to 37 million avoided cases of common cold or influenza	$7 – 16 billion
Reduced allergies and asthma	8% to 25% decrease in symptoms within 53 million allergy sufferers in 16 million asthmatics	$1 - $5 billion
Reduced sick building syndrome symptoms	20% to 50% reduction in SBS health symptoms experienced frequently at work by ~15 million workers	$10 - $35 billion
Sub-Total		**$18 - $56 billion**
Improved worker performance from changes in thermal environment and lighting	Not applicable	$25 - $180 billion
Total		**$43 - $235 billion**

Source: William Fisk (2000), "Health and Productivity Gains from Better Indoor Environments and their Relationships with Building Energy Efficiency"

In 1994, Joseph Romm from the U.S. Department of Energy and William D. Browning for the Rocky Mountain Institute conducted research that has been cited by numerous researches include Kats and Fisk that were referenced earlier. This was among the earlier research attempts to associate the condition of building and work environments with the productivity of employees. The research focused on eight buildings, seven located throughout the U.S. and one overseas in Amsterdam. Table 21 includes a summary of the facilities studied:

Table 21. List of Projects, Romm and Browning

Project / Organization	Project Type	Facility Location	Measures	Cost
Reno Post Office	Retrofit	Reno, NV	Lighting Retrofit, New Ceiling	$300,000
Boeing	Retrofit	Seattle, WA	Lighting Retrofit	n/a
Hyde Tools	Retrofit	MA	Lighting Retrofit	$98,000
Pennsylvania Power & Light	Retrofit	PA	Lighting Retrofit	$8,362
Lockheed Building 157	New Construction	Sunnyvale, CA	Daylighting, Energy Efficiency	n/a
West Bend Mutual Insurance	New Construction	West Bend, WI	Lighting, HVAC, Individual Controls	n/a
Wal-Mart	New Construction	Lawrence, KS	Daylighting, HVAC	n/a
ING Bank	New Construction	Amsterdam	Daylighting, HVAC, Overall Building	$700,000

Source: Romm, J.J. & Browning, W.D. (1994). Greening the building and the bottom line, Increasing Productivity through Energy efficient Design. Snowmass, CO:Rocky Mountain Institute.

For a cost of $300,000, the Reno Post Office resulted in energy savings of $22,400 per year. Productivity was measured by comparing work output and mail sorting error rates in the old and new environments. The estimated financial gains from increased productivity was $400,000 - $500,000 per year. The payback period, taking into account energy savings, reduced maintenance costs and productivity, was less than one year.

Like the post office Boeing was able to quickly gain a return on their investment, with a payback period of two years and annual energy savings of 90% and productivity increases of 53%.

Hyde Tools obtained funding from their local utility to reduce Hyde's investment to $50,000. Productivity increases resulted in an additional $25,000 per year and an increase in sales of $250,000. Hyde's payback period was under one year.

Pennsylvania Power and Light (PPL) renovated a relatively small space, 12,775 square feet in size and invested $8,362 for their retrofit. With productivity increases amounting to $42,240 per year and energy savings of $2,035 per year, PPL reached a payback period of 69 days.

Lockheed Building 157, a large 600,000 square foot facility invested $2,000,000 to increase the amount of daylight, encourage employee interaction and provide high-end workstations. Absenteeism reduced by 15% in the new facility and energy savings amounted to $500,000 per year. Lockheed believes that their investment in this new facility had a payback period of one year.

West Bend Mutual Insurance did not provide information about their initial investment or the payback period for this new building however, they stated that energy use was reduced by 40% and productivity increased by 16% after moving into their new facility.

Wal-Mart deviated from their standard plans to pursue innovative energy conservation approaches. The project called for an HVAC system that used ice storage, special light-monitoring skylights and improved indoor lighting while maximizing daylighting. The project faced system integration issues and the ice storage system was not able to generate enough ice because of the 24/7 operation, to be used as a viable cooling system. Financial data was not provided for this project however, sales in the daylit areas were significantly higher than sales in non-daylit areas.

ING Bank designed a new corporate headquarters at a cost of $700,000. ING recognized energy savings of $2.6 million per year and a 15% reduction in absenteeism giving them a payback period of 3 months.

The productivity and energy efficiency outcomes of the eight buildings studied are represented in Tables 22 and 23. Table 23 includes a detailed breakdown of project costs, gains and payback periods for each project.

Table 22. Energy Efficient Buildings and the Impact on Productivity

Project	Productivity Measure	Productivity Improvements
Reno Post Office	Comparisons of work output and mail sorting error rates in the old and new environments.	$400,000 to $500,000/year
Boeing	Ability to detect imperfections in the shop under the old and the new lighting systems.	ROI of 53%
Hyde Tools	The quality of work completed with fluorescent lighting versus the new lighting scheme.	$250,000 + $25,000/year
Pennsylvania Power & Light	Average productivity rates for drafters to complete a drawing were compared under the old and new lighting systems.	$42,240 /year
Lockheed Martin	A 15% reduction in absenteeism in the new facility.	15% reduction in absenteeism
West Bend Mutual Insurance	Tracking of the number of insurance files processed by each employee per week.	16% increase in overall productivity, 2.8% from ERWs worth $364,000.
Wal-Mart	Sales in the daylit area were significantly higher than sales in the non-daylit areas.	Sales increase in daylit areas
ING Bank	Reductions in absenteeism in the new facility.	15% reduction in absenteeism

Source: Romm, J. & Browning, D. (1994). Greening the Building and the Bottom Line.

Table 23. Financial Benefits of Energy Efficiency Measures

Project Outcomes				
	Costs	**Annual Energy Savings**	**Productivity Financial Gains**	**Payback Period**
Retrofits				
Reno Post Office	$300,000	$50,000/year	$400,000 to $500,000/year	Less than 1 year
Boeing	n/a	90% reduction	ROI of 53%	2 years
Hyde Tools	$50,000*	$48,000/year	$250,000 + $25,000/year	1 year
Pennsylvania Power & Light	$8,362	$2,035/year	$42,240 /year	69 days
New Construction				
Lockheed Martin	$2 million	$500,000/year	15% reduction in absenteeism	1 year
West Bend Mutual Insurance	n/a	40% reduction	16% increase in overall productivity, 2.8% from ERWs worth $364,000.	n/a
Wal-Mart	n/a	No recorded reduction	Sales increase in daylit areas	n/a
ING Bank	$700,000	$2.6 million/year		3 months

Source: Romm, J. & Browning, D. (1994). Greening the Building and the Bottom Line.

*Total cost of $98,000 of which $48,000 was covered by the local utility.

Romm and Browning found that the building attributes that lead to gains in productivity were those that improved visual acuity and thermal comfort.

The U.S. Department of Energy issued “The Business Case for Sustainable Design in Federal Facilities in October 2003. The report is the result of an initiative implemented by the U.S. Department of Energy’s Federal Energy Management Program (FEMP) and the U.S. Navy. These two groups assembled the Interagency Sustainability Working Group, a forum to share sustainable design experiences and information. Although the report was geared towards U.S. government facilities, the findings have relevance to the private-sector. The FEMP wanted to make a business case for sustainable design that was grounded in solid arguments and supported by defensible data.

From a human capital perspective, the study finds results consistent with those referenced earlier in this report. Among the economic benefits linked to sustainable design, include: better productivity and less absenteeism. The results of this report lend further credibility to the research conducted by the General Services Administration (GSA), the body responsible for managing federal facilities.

In a 2002 report, the GSA identified 4 overarching goals for the Federal Workplace in the new decade, two of which include improving environmental quality and engagement and well-being (GSA, 2002). According to the GSA's findings, these changes include providing employees with greater access to daylight and views in addition to a healthy workplace. The GSA believes that these changes will contribute to engaged employees who are productive, demonstrate pride in their organization, and support for their organization's mission (GSA, 2002).

As seen in research from the State of California, personnel costs are of significant concern to the Federal Government. Personnel costs in the U.S. government far exceed construction, energy or other annual costs.

Research contributing to this report was a study by Milton et al. (2000), the researchers studied workers at a large Massachusetts manufacturing firm. The study involved 3720 hourly workers and was established to determine the relationship between absenteeism and building factors such as ventilation, humidity, and indoor air quality.

The study showed that $24,444 per 100 employees could be saved annually with a one-time investment in improved ventilation of $8,050 per 100 employees. These results could be reasonably expected by undertaking a one-time investment in efficient ventilation systems of $8,000 per 100 employees. Another study by Fisk, W.J. in 2001, estimated that that value of increased productivity could reach $160 billion nationwide.

The Federal Energy Management Plan (F.E.M.P.) issued by the U.S. DOE in 2003 identifies additional benefits that represent indirect and long-term economic benefits to building owners:

- Improved employee retention and attraction (to be discussed further in this report)
- Lower cost of dealing with complaints
- Decreased risk, liability and insurance rates
- Greater building longevity
- Better resale value
- Ease of siting

A summary of the building features and attributes that impact employee productivity is represented in Table 24 below.

Table 24. Building Features & Attributes and Benefits to Employees

Sustainable Design Feature	Social Benefit to Employees
Indoor Air Quality	– Reduced adverse health impacts (especially respiratory disease/discomfort – Improved personal productivity
Good Visual Quality	– Satisfaction with work environment – Improved personal productivity
Noise Control	– Satisfaction with work environment – Improved personal productivity
Systems Control	– Thermal and visual comfort of occupants – Improved personal productivity
Commissioning and O&M	– Occupant satisfaction with building – Health/safety of building occupants
Sustainable Housekeeping and Maintenance	– Improved indoor environmental quality • Better health of occupants

Adapted from U.S. Department of Energy, Energy Efficiency and Renewable Energy. (2003). The Business Case for Sustainable Design in Federal Facilities.

There is a great deal of variability in the methods used to measure productivity. In some instances, such as data entry and simple information processing tasks, measuring productivity is relatively straightforward. For most white collar workers, those with tasks that are more knowledge based, it is more difficult. Work output from these workers is often intangible and difficult to measure; the impact these workers have on an organization is often measured in terms of impact on the organization and can be idea-based, conceptual or other. Because of the need for researchers to find a different means to measure output from these workers, there is a great deal of variability in this analysis.

4.4.1 Findings

According to the numerous studies and cases investigated, there is evidence that work environments have an impact on building occupants. Individual measures that have been linked to these benefits include: Daylighting, individual controls of temperature, ventilation, lighting and indoor air quality (Table 25).

Table 25. Features Associated with Productivity Increases

Feature / Attribute	Benefit to Employees
Daylight & Sunlight	– Improves mood, physical health and well-being – Increased productivity – Aesthetically pleasant
Indoor Air Quality	– Reduced adverse health impacts (especially respiratory disease/discomfort) – Increased productivity
Personal Control	– Increased productivity

Research into the impact that indoor environmental quality has on employee productivity has been proven however, the extent of the impact varies from project to project and as a result, it is not possible to predict outcomes for future projects.

Measuring the impact on employee productivity proves to be a challenge to researchers who often have little control over extraneous factors that affect employees. Particularly for large commercial properties or organizations that lease space, competing interests provide little incentive for building owners to invest in energy efficiency when they do not stand to reap the benefits. This means that often times, occupants of leased space have little control over the full work environment.

4.5 Green Companies and Employee Attraction

The potential benefit in terms of talent attraction and retention is another compelling reason to consider energy efficiency measures. Many experts in the human resources industry believe that companies, in all industries, will face a talent crunch as Baby Boomers continue to retire (US Department of Labor, 2009; Athey, 2004). To address this attrition, organizations need to appeal to younger generations, for whom the environment and social responsibility is an important factor in their choice of employer (MonsterTRAK, 2007).

In 2008, Marlin Company surveyed, 755 US workers ages 18 or older, working full or part time to understand how workers felt about working for their organizations. On the topic of working for green companies, Marlin found that 77.7% of workers in the U.S. said it was important to have an employer that was going green in a significant way (The Marlin Company, 2008). According to a MonsterTRAK poll on green employment, 92% of young professionals would be more inclined to work for an environmentally-friendly company and 80% said that they are interested in a job that has a positive impact on the environment.

The workplace plays a significant role in an organization's ability to attract employees. Johnson Control's, Generation Y and the Workplace 2010 report indicates that companies will need to provide environments where members of Generation Y can grow and evolve in order to attract their talent, the physical workspace is included in that environment. Workplace design may become a strategic weapon in the ability to attract and retain talent from this generation (Johnson Controls, 2010).

The importance of providing energy efficient, well designed workplaces is echoed by the GSA. Research from the GSA indicates that employees are contributing to one of the most recent trends seen in the federal workplace, “environmental awareness and energy price volatility have led to federal mandates for environmental quality and performance – as well as a pronounced end-user preference for work settings that are healthy and environmentally responsible” (GSA, 2002). That is to say that individuals are attracted to companies that demonstrate a commitment to energy efficiency.

An organizations’ commitment to energy efficiency is often communicated through a corporate social responsibility policy and through the organizations’ performance. Research indicates that firms that score high in corporate social performance have more positive reputations and are more attractive employers than firms with lower corporate social performance (Turban & Greening, 1996). These organizations with corporate social responsibility programs have employees that are more satisfied, happier, stay with their employer longer and are more content with senior management. Companies that are deemed to be environmentally responsible, will be better positioned to attract and retain their workforce (KRI, 2007).

Zhang and Gowan also found evidence that socially responsible companies are more attractive employers than less socially responsible (Zhang et al., 2011). These firms view corporate social responsibility as a competitive advantage, allowing them to attract a higher quality and quantity of job applicants (Turban & Greening, 1996; Fombrun et al., 1990;Davis, 1973). As a result, organizations are increasingly focused on their attractiveness to potential applicants (Ehrhart et al., 2005).

These surveys imply that green and responsible companies are attracting and retaining talented people. A commitment to CSR sets organizations part from the competition in terms of brand image, allowing them to gain an advantage when recruiting. Being green isn't only good for the Earth, it's good for the bottom-line.

A summary of how "green" impacts the ability to attract and retain talent is included in Table 26.

Table 26. How Green Buildings Benefits Organizations

"Green" Benefits to organizations
– Are viewed as a more attractive employer
– Attract and retain better talent
– Are more content with senior management
– A competitive advantage
– Employees are more satisfied
– More attractive to Generation Y
– Improved brand image
– Increased employee engagement

Adapted from Zhang et al., 2011; Turban & Greening, 1996; Fombrun et al., 1990; Davis, 1973; Ehrhart et al., 2005; JohnsonControls, 2010; GSA, 2002

The research supports that we are headed toward a future where green companies attract talented employees and talented employees are attracted to green companies.

4.5.1 Findings

The workplace plays a significant role in an organization's ability to attract employees. Employees that are satisfied with their work environment are often more productive, are happier and are better advocates for their organization. Organizations that operate from energy efficient buildings often communicate their environmental sensitivity to the public via their corporate social responsibility program. This communication signals to the public that the organization cares about the environment, the community they operate in and the workers that occupy their facilities, these benefits lead these organizations to improve their ability to attract talent.

4.6 The Cost of Turnover

The condition of workplaces has an impact on employee satisfaction, productivity and happiness. Whether the organization is committed to a CSR has also been demonstrated to have an impact on the organization's ability to attract and retain talent, and have an effect on employee satisfaction. Whether these factors can be linked to an employee's reason for leaving an organization, is an area of future research however, knowing that an organization's commitment to energy efficiency can play a role in workers deciding to leave an organization, we'll discuss the direct and indirect costs of turnover.

Turnover is defined as "the rate at which employees enter and leave a company in a given fiscal year (SHRM, 2011a), it can occur voluntarily (when an employee chooses to leave) or involuntarily (when the organization decides to make staffing changes). Employees voluntarily leave organizations for a number of reasons. For the purpose of this research, we consider that this turnover may stem from their dissatisfaction with building related issues (ex. Poor IEQ, an organization's lack of interest in energy efficiency or CSR, poor work environment, etc.). Involuntary turnover may result from an employee's poor performance that may have stemmed from a poor work environment. Employees often state their reason for leaving during their exit interviews but they have little incentive to provide honest or full descriptions for their decision to leave. Reasons commonly cited often include; a lack of satisfaction with their work, work environment or their employer (SHRM, 2011a; JohnsonControls, 2010). As it is difficult to understand the reasons why workers leave organizations, we will look further into the cost of turnover, regardless of the decision to separate from the organization.

The reasons for the focus on turnover by HR professionals and executives include: turnover's significant cost implications; its' overall affect on business performance; its' potential to become difficult to control (Allen, 2008). Turnover affects organizations in terms of direct and indirect costs. According to a 2008 SHRM study, the cost to replace and hire new staff may be as high as 60% of an employee's annual salary, accounting for additional training costs and the loss of productivity, the cost can increase to 90 – 200% of an employee's salary (Cascio, 2006; SHRM, 2008).

Research from the Center of American Progress (2012) studied 30 case studies taken from 11 of the most relevant research papers on the costs of employee turnover, their results found that it costs businesses about one-fifth of a worker's salary to replace that worker. A summary of their findings is included in Figure 8.

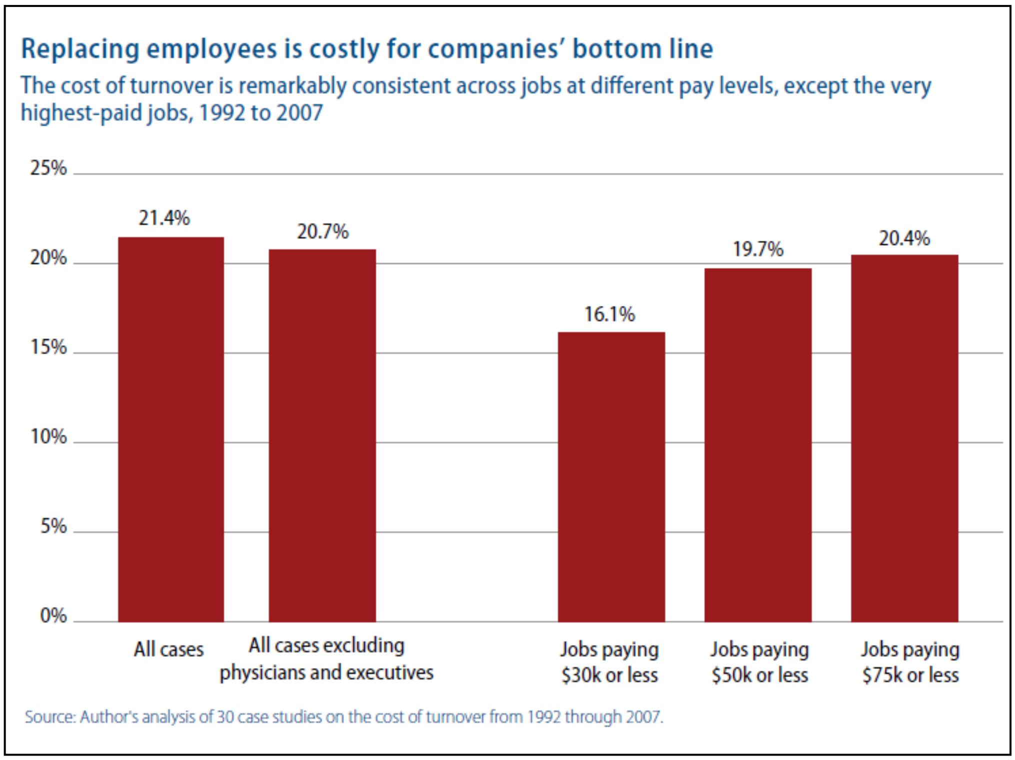


Figure 8. Cost of Turnover
Source: Boushey H. & Glynn, S.J. (2012). There Are Significant Business Costs to Replacing Employees. Center for American Progress.

Boushey & Glynn suggest that for all positions, except executives and physicians, the typical cost of turnover was 21 percent of an employee's annual salary. For workers earning less than $50,000 per year, representing three-quarters of all workers in the U.S., the typical cost of turnover was 20 percent of an employee's annual salary. The cost of turnover was also 20% for those earning $75,000 or less per year. Finally, for those earning less than $30,000 per year, more than half of working Americans, the typical cost of turnover was 16%. Jobs requiring high levels of education and specialized training have higher turnover costs (Tracey & Hinkin, 2008; Appelbaum & Milkman, 2006). Senior executives or executive levels, those that are highly paid, have much higher turnover costs as a percentage of salary, up to 213 percent.

Another method used to represent the cost of turnover is to determine the Revenue per FTE (Full Time Equivalent) (Table 27). The Revenue per FTE is a measure of productivity, it represents the amount of revenue generated per worker. The higher the Revenue per FTE, the greater the worker's productivity. It is a ratio linking the time and effort of workers productivity against the organization's revenue. Generally, the higher the revenue per FTE, the more effort an organization will make to hold on to their staff. Following is a table demonstrating Revenue per FTE for a variety of industries.

Table 27. Cost of Turnover Measured in Revenue per FTE

Industry	Average Annual Turnover	Revenue per FTE	Cost-Per-Hire
Services—accommodation, food and drinking places	35%	$183,173	$1,062
Arts, entertainment and recreation	27%	$188,817	$1,394
Retail/wholesale trade	22%	$523,529	$2,549
All industries	**15%**	**$339,785**	**$3,196**
High-tech	11%	$207,763	$3,357
Government/public—state/local	9%	$204,594	$2,293
Association—professional/trade	8%	$294,582	$5,582
Utilities	8%	$413,086	$3,936

Source: SHRM Human Capital Benchmarking Database (2011)

Source: SHRM 2011c.

The Revenue per FTE (RFTE) for high-tech of $207,763 is higher than that of the service industry ($183,173). The high-tech industry also reported lower average annual turnover rates than the service industry which is known for being a high-turnover industry. Accordingly, the cost-per-hire reflects the lower skill level typical in the service industry. This analysis provides additional insight into the cost of turnover, if you consider the cost-per-hire for each employee leaving an organization, it is easy to see how these costs can be considerable. Organizations need to pay attention to the satisfaction of employees to reduce the likelihood of incurring these costs (Boushey & Glynn, 2012; Allen 2008; Appelbaum & Milkman, 2006).

The cost of turnover depends on a number of factors, education level, job requirements and complexity, organization, skill set of employee and much more (Allen, 2008). Most importantly, the method used to arrive at these values can be considerably different. Despite the differences in the average costs of turnover, we will discuss the sources of direct and indirect turnover costs (Table 28).

Table 28. Direct and Indirect Costs of Turnover

Direct	**Indirect**
• **Separation costs**; exit interviews, severance pay, higher unemployment taxes • **Costs to temporarily cover an employee's duties** (overtime or temporary staffing). • **Replacement costs** (advertising, search and agency fees, screening applicants including testing, interviewing and selecting candidates, background verification, employment testing, hiring bonuses, application travel and relocation costs) • **Training costs** (orientation, classroom training, certifications, on-the-job training, uniforms, informational literature)	• Disruption may hinder the development of new products • Disrupts client relationships or a loss of client(s) • Delays customer deliverables • Decline in overall productivity • Decreased productivity due to learning curve (reduced quality, errors, waste) • Coping with a vacancy or giving additional work to other employees • Reduced morale • Lost institutional knowledge

Source: Boushey & Glynn, 2012; Hinkin & Tracey, 2000; Allen, 2008.

Additional challenges present themselves in attempting to recruit new employees with specific skillsets (SHRM, 2011b). SHRM indicates that on average, recruiting has become increasingly difficult since December 2009 (SHRM, 2011c).

Taking a different perspective on turnover costs, other researchers indicate that office workers cost $130 per square foot – 72 times as much as energy costs. That being said, an increase of just 1% in productivity can nearly offset a company's entire annual energy cost (Fisk, 2000;Romm & Browning, 1994). According to research from RICS and Asset Strategies (2006), salaries of occupants account for as much as 86% of total business costs. Other researchers have estimated salaries to account for 22% to 70% of operating expenses (SHRM, 2008;Weatherly, 2003). Taking a look at the cost of turnover from an overall percentage of organizational income, some have estimated that turnover related costs represent over 12% of pre-tax income for the average company, and can account for as much as 40% in companies that face high levels of turnover (in the 75th percentile) (PricewaterhouseCoopers, 2006).

Although quantifying the value of human capital and the overall percentage of salaries compared to operating expenses will vary according to industry, it is clear that improving the work environment for employees should be a concern for organizations. By improving employee productivity, lowering turnover rates or reducing absenteeism through an improved, healthy work environment, employers can expect to save between $17 – 48 billion in total health gains and $20 - 160 billion in worker performance (USGBC, 2009).

The impact of turnover is not always measurable. Turnover also needs to be controlled in order to reduce the impact on workforce morale. Other benefits of reducing employee turnover include an increase in sales growth, firm profitability and market value (Griffeth & Hom, 2001).

The importance of considering the impact building retrofits is put into perspective through findings from Deloitte indicating that over 50% of organizations participating in their study believe that talent management issues impact overall organizational productivity and efficiency. Retaining good employees allows an organization to innovate while turnover prevents an organization from meeting production requirements (Deloitte, 2005).

4.6.1 Findings

Replacing employees is a costly undertaking to organizations. Experts have estimated that the cost of turnover can range from 16 – 200% of an individuals' salary. Using the approach that provided the most conservative of these figures, Table 29 represents the costs that employers can use to estimate the impact of turnover on their organization.

Table 29. Costs of Turnover

Employee's Salary	*Cost of turnover*	*Actual Cost to Replace Employee*
Under $30,000	16.1%	$4,830
Under $50,000	19.7%	$9,850
Under $75,000	20.4%	$15,300
Executives (assume $180,000)	213%	$383, 400

Source: Boushey H. & Glynn, S.J. (2012).

Buildings have an impact on a worker's satisfaction and performance; many employees cite a lack of satisfaction with their work, work environment or their employer as the reason for resigning from a position (Griffeth & Hom, 2001). Understanding the cost of replacing employees is important for business owners, particularly if a facility is the source of dissatisfaction among employees.

Medium-size building owners face the same issues as owners of large commercial buildings. The size of building that an organization operates in does not appear to have any bearing on an employee's decision to leave an organization. As a result, medium-sized building owners, as others, must place significant focus on retaining employees in order to reduce turnover costs.

5. CONCLUSIONS

Buildings have a significant impact on the well-being of occupants, the study identified effects from; the quality of the indoor environment, the features of the building that result from energy efficiency and green building design and, the presence and commitment to an organizational corporate social responsibility program.

U.S. buildings are primarily comprised of older building stock. Over 60% of existing buildings are considered to be energy inefficient and ripe for energy efficiency retrofits (EIA, 2003). In order to effectively improve the operation of these buildings, building owners need to be able to quantify the viability of investing in these older buildings, drawing a connection to improved organizational profitability. Large corporate real estate organizations often have improved access to financial and consulting resources to help them navigate how to increase the value of their building portfolio and reduce operating costs. Small and medium –sized building owners, do not have the same level of access and are often kept out of the energy efficient retrofit market because of it (Sweetser, 2012) . This exclusion is to their own detriment, causing them to operate buildings that are most costly and less coveted by the marketplace (lower occupancy rates and lower rental prices).

The Department of Energy has developed a resource for medium-size building owners to increase their ability to build energy efficient buildings. Local organizations develop guides to support small and medium businesses in their ability to reduce operating costs of existing buildings and improve their value. Medium-size building and business owners working from these buildings stand to benefit from the same outcomes experienced by owners of larger buildings. Payback periods on energy efficiency measure can be achieved in under five years. Total energy savings of over 50% are attainable for building owners of all sizes.

The research has identified that there is a positive relationship between building design and feature and organizational profitability. Energy efficient buildings costs less to operate, they have upfront costs that are comparable to conventional buildings and as a result, provide direct financial benefits to organizations. Organizations realizing these financial benefits choose between realizing these savings as additional profit or, investing them further into additional building features that improve the comfort of building occupants. A summary of these benefits can be found in Table 30. Ranges for anticipated savings were derived based on the savings identified throughout this research. The study did not provide any metrics that would allow for quantifying the indirect benefits, those of a qualitative nature. Measuring these items, such as productivity, satisfaction, well-being, etc, is highly subjective and can vary from project to project.

While building features, whether they be specific to energy efficiency measures, or other design considerations have been proven to have an impact on organizational profitability, their relationship with employee retention is grey and hazy.

Much of the qualitative areas studied, those pertaining to effects on employees, lacked the controls needed to accurately draw inferences between tangible building features and effects such as satisfaction, productivity, attraction and turnover.

Table 31 includes some additional considerations for medium-size building owners. Much of the report's findings apply to this building market however, access to financing and the applicability of systems and tools to this market poses an additional challenge.

Table 30. Energy Efficiency - Summary of Benefits to Building Owners

Energy efficiency Measures	*Value*	*Estimated Cost Savings*	*Estimated Annual % Reduction*	*Estimated Increase in Value*
Direct Benefits				
ENERGY STAR certification or LEED Certification	Command higher rental rates (Eichhlotz et al., 2009)			2 – 4%
	Higher sale prices (Eichhlotz et al., 2009)			
	Reduce energy costs (Katz et al., 2003)		25 – 50%	
Energy efficiency measures	Increase capital value of building (Eichhlotz et al., 2009; DOE, 2003)			10 -20%
	Reduce operating costs (Romm & Browning, 1994; Wolff, 2006; Turner Construction, 2005, 2012; Roper & Beard, 2006; GSA, 2008; EPA, 2012; DOE, 2003, 2013; Katz et al., 2003; Granade et al, 2009;)		10 – 30%	
	Reduce life-cycle energy costs (Romm & Browning, 1994; Wolff, 2006; Turner Construction, 2005, 2012; Roper & Beard, 2006; GSA, 2008; EPA, 2012; DOE, 2013; Castro et al., 2008)	10x the cost of the initial investment		
	Increase asset value and profitability (Romm & Browning, 1994; Wolff, 2006; Turner Construction, 2005, 2012; Roper & Beard, 2006; GSA, 2008; EPA, 2012; DOE, 2013)			10 – 20%
	Optimize life-cycle economic performance (Romm & Browning, 1994; Wolff, 2006; Turner Construction, 2005, 2012; Roper & Beard, 2006; GSA, 2008; EPA, 2012; DOE, 2003, 2013; Castro et al., 2008)		n/a	
	Demand higher rents (Turner Construction, 2012; Peterson, K. & Gammill, R., 2010)		n/a	

Table 30. Continued

Energy Efficiency Measures	*Value*	*Estimated Cost Savings*	*Estimated Annual % Reduction*	*Estimated Increase in Value*
	Higher occupancy rates, less volatile (Peterson, K. & Gammill, R., 2010; Eichhlotz et al., 2009)		n/a	
	Avoid having to implement EEMs in the future at higher costs (Kahn, 2007).			
	Lower maintenance and repair costs (DOE, 2003,2013)		10 – 30%	
Indirect Benefits				
Energy efficiency measures (Daylighting, improved indoor air-quality, individual controls, noise control,	Increase in worker productivity (Romm & Browning, 1994; Wolff, 2006; Turner Construction, 2005, 2012; Roper & Beard, 2006; GSA, 2008; EPA, 2012; DOE, 2003,2013; Heschong, 2006; Kroner et al., 1992; Wyon & Wargocki, 2006; Menzies et al., 1997; State of California, 2000; Fang et al., 1998; Fisk, 2000, 2001)			
	Increased quality of products (Eichhlotz et al., 2009)			
	Increased employee satisfaction (Romm & Browning, 1994; Wolff, 2006; Turner Construction, 2005, 2012; Roper & Beard, 2006; GSA, 2008; EPA, 2012; DOE, 2013; Turban & Greening, 1996; KRI, 2007)			
	Lower absenteeism (Romm & Browning, 1994; Wolff, 2006; Turner Construction, 2005, 2012; Roper & Beard, 2006; GSA, 2008; EPA, 2012; DOE, 2003, 2013; Milton et al., 2000)			

Table 30. Continued

Energy Efficiency Measures	*Value*	*Estimated Cost Savings*	*Estimated Annual % Reduction*	*Estimated Increase in Value*
	Improved health, comfort and well-being of occupants (DOE, 2003; Katz et al., 2003; Kozlowski, 2003; Lucuik, 2005; Heerwagen, 2010; Fisk, 2000; Heerwagen & Heerwagen, 1986; Kaplan 1992, Ulrich, 1993; Isen 1990; Lohr et al., 1996; State of California; GSA, 2002) Lower health related costs (Wolff, 2006; Turner Construction, 2005, 2012; Roper & Beard, 2006; GSA, 2008; DOE, 2013) Demonstrates long-term commitment to corporate social-responsibility. Results in increased stakeholder and investor confidence. (Fisk et al., 1997) Increased patronage from customers (Fisk et al., 1997) Improved organizational reputation ((Ehrhart et al., 2005; KRI, 2007; Zhang et al., 2011) Improved employee retention and attraction (DOE, 2003; The Marlin Company, 2008; GSA, 2002) Improved ability to attraction Generation Y (MonsterTRAK, 2007) Lower cost of dealing with complaints (DOE, 2003) Ease of siting (DOE, 2003)			
Corporate Social Responsibility (to communicate energy efficiency)	Humanize organization Improved organizational reputation (Turban & Greening, 1996)			

Table 30. Continued

EnergyEfficiency Measures	*Value*	*Estimated Cost Savings*	*Estimated Annual % Reduction*	*Estimated Increase in Value*
	Improved employee retention and attraction (Economist Intelligence Unit, 2011; The Marlin Company, 2008; Turban & Greening, 1996; KRI, 2007; Zhang et al., 2011; Fombrun et al., 1990; Davis, 1973; Ehrhart et al., 2005) Provides a competitive advantage over organizations that do not. (Turban & Greening, 1996) Improved ability to attraction Generation Y (MonsterTRAK, 2007)			

Table 31. Considerations for Medium-Size Building Owners

Challenges of Medium-Sized Building Owners	***Recommendations***
Financing of energy efficiency improvements (Sweetser, 2012; Palmer et al., 2012)	Determine acceptable amount of risk in engaging in projects (Sweetser, 2012).
	Access to flexible, affordable financing alternatives. Options include: Internal – capital and operating budgets, maintenance funds, reserve accounts and External – capital leases, operating leases, loans, bonds, capital markets .(Palmer et al., 2012)
Inability to invest in current assessment and modeling tools (Sweetser, 2012)	More support needed for small and medium-sized building owners (Sweetser, 2012)
Challenges trying to integrate a number of complex components, subsystems, sensors and controls as one integrated building system (Sweetser, 2012)	Training and education of decision makers (Sweetser, 2012)
Complexity of the building market (Sweetser, 2012)	Develop business models for success (Sweetser, 2012)

5.1 Significance of Study

This study demonstrates that the work environment, the buildings that businesses occupy, have an impact on organizational success that is so large, it cannot go unnoticed.

The impact of energy efficiency measures discussed in this paper add value to owners of medium-sized buildings in the following ways:

- It allows building owners to gain a broad understanding of the benefits of investing in energy efficiency improvements and the financial impact of this investment
- Provides insight into direct and indirect benefits, those that have immediate financial benefits and those with longer-term qualitative benefits that have a larger impact on the bottom line; improvements to employee productivity, satisfaction and retention.
- It sheds light on the cost to business owners facing employee turnover and alludes to the fact that buildings can help to reduce its occurrence

This study's significant contribution is to connect things that have not typically been connected before; building efficiency and employee attrition.

5.2 Further Study

Building owners and business owners and the study of the impacts of energy efficient buildings on organizational profitability would benefit from further research identifying the relationship between building efficiency and employee retention.

Furthermore, the large body of research into employee satisfaction and productivity resulting from working in “green”, energy efficient buildings is qualitative and does not demonstrate causality between these two events.

This study leads to the development of a hypothesis that: energy efficiency buildings contribute to employee retention. The industry would benefit from a detailed study to determine if this is in-fact true.

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APPENDIX

Released: Dec 2006
Next CBECS will be conducted in 2007

Table B1. Summary Table: Total and Means of Floorspace, Number of Workers, and Hours of Operation for Non-Mall Buildings, 2003

	Number of Buildings (thousand)	Total Floorspace (million square feet)	Total Workers in All Buildings (thousand)	Mean Square Feet per Building (thousand)	Mean Square Feet per Worker	Mean Hours per Week
All Buildings*	4,645	64,783	72,807	13.9	890	61
Building Floorspace (Square Feet)						
1,001 to 5,000	2,552	6,789	9,936	2.7	683	57
5,001 to 10,000	889	6,585	7,512	7.4	877	61
10,001 to 25,000	738	11,535	10,787	15.6	1,069	67
25,001 to 50,000	241	8,668	8,881	35.9	976	72
50,001 to 100,000	129	9,057	8,432	70.4	1,074	80
100,001 to 200,000	65	9,064	11,632	138.8	779	89
200,001 to 500,000	25	7,176	6,883	289.0	1,043	100
Over 500,000	7	5,908	8,744	896.1	676	115
Principal Building Activity						
Education	386	9,874	12,489	25.6	791	50
Food Sales	226	1,255	1,430	5.6	877	107
Food Service	297	1,654	3,129	5.6	528	86
Health Care	129	3,163	6,317	24.6	501	59
Inpatient	8	1,905	3,716	241.4	513	168
Outpatient	121	1,258	2,600	10.4	484	52
Lodging	142	5,096	2,457	35.8	2,074	167
Retail (Other Than Mall)	443	4,317	3,463	9.7	1,246	59
Office	824	12,208	28,154	14.8	434	55
Public Assembly	277	3,939	2,395	14.2	1,645	50
Public Order and Safety	71	1,090	1,347	15.5	809	103
Religious Worship	370	3,754	1,706	10.1	2,200	32
Service	622	4,050	3,667	6.5	1,105	55
Warehouse and Storage	597	10,078	4,369	16.9	2,306	66
Other	79	1,738	1,819	21.9	956	63
Vacant	182	2,567	Q	14.1	Q	Q
Year Constructed						
Before 1920	330	3,769	3,045	11.4	1,238	48
1920 to 1945	527	6,871	6,122	13.0	1,122	51
1946 to 1959	562	7,045	6,646	12.5	1,060	52
1960 to 1969	579	8,101	8,708	14.0	930	63
1970 to 1979	731	10,772	12,597	14.7	855	65
1980 to 1989	707	10,332	15,032	14.6	687	62
1990 to 1999	876	12,360	16,181	14.1	764	71
2000 to 2003	334	5,533	4,476	16.6	1,236	68
Census Region and Division						
Northeast	726	12,905	14,908	17.8	866	67
New England	233	2,964	3,155	12.7	939	71
Middle Atlantic	493	9,941	11,752	20.1	846	65
Midwest	1,266	17,080	16,373	13.5	1,043	59
East North Central	696	11,595	11,489	16.7	1,009	61
West North Central	571	5,485	4,883	9.6	1,123	58
South	1,775	23,489	27,078	13.2	867	60
South Atlantic	874	12,258	16,757	14.0	732	60
East South Central	348	3,393	3,060	9.8	1,109	61
West South Central	553	7,837	7,261	14.2	1,079	60
West	878	11,310	14,448	12.9	783	62
Mountain	299	3,675	4,281	12.3	858	64
Pacific	580	7,635	10,168	13.2	751	61

Released: September, 2008

Table E1. Major Fuel Consumption (Btu) by End Use for Non-Mall Buildings, 2003

	Total Major Fuel Consumption (trillion Btu)										
	Total	Space Heating	Cooling	Ventilation	Water Heating	Lighting	Cooking	Refrigeration	Office Equipment	Computers	Other
All Buildings*	5,820	2,203	431	384	448	1,143	167	354	64	148	478
Building Floorspace (Square Feet)											
1,001 to 5,000	672	207	45	18	48	93	48	137	8	12	55
5,001 to 10,000	516	198	36	17	40	83	35	56	6	9	39
10,001 to 25,000	776	324	47	44	43	151	25	53	9	19	62
25,001 to 50,000	673	262	57	50	55	121	13	34	7	16	58
50,001 to 100,000	759	293	59	65	55	158	11	29	6	18	64
100,001 to 200,000	934	374	64	80	72	195	8	24	Q	31	73
200,001 to 500,000	725	280	55	54	67	162	14	9	8	19	58
Over 500,000	766	265	68	56	69	181	13	12	Q	23	70
Principal Building Activity											
Education	820	389	79	83	57	113	8	16	4	32	39
Food Sales	251	36	12	7	4	46	11	119	2	2	11
Food Service	427	71	29	24	67	42	105	70	2	2	16
Health Care	594	223	44	42	95	105	11	8	4	10	51
Inpatient	475	175	35	38	92	76	11	4	2	7	34
Outpatient	119	48	9	4	3	28	Q	4	2	3	17
Lodging	510	113	25	14	160	124	16	12	Q	6	36
Retail (Other Than Mall)	319	107	25	16	5	111	3	22	3	4	24
Office	1,134	400	109	63	24	281	4	35	32	74	110
Public Assembly	370	196	38	63	4	27	3	9	Q	Q	26
Public Order and Safety	126	54	10	10	15	18	1	3	1	2	12
Religious Worship	163	98	11	5	3	17	3	6	(*)	1	19
Service	312	145	16	24	4	63	Q	9	1	3	46
Warehouse and Storage	456	194	14	20	6	132	Q	36	2	5	48
Other	286	138	18	11	4	59	Q	10	Q	5	33
Vacant	54	37	2	1	(*)	4	Q	Q	Q	(*)	8
Year Constructed											
Before 1920	302	180	7	11	17	34	17	Q	2	4	15
1920 to 1945	620	315	25	30	42	89	20	26	3	8	62
1946 to 1959	565	277	31	34	44	87	13	26	4	11	38
1960 to 1969	737	336	45	50	64	113	12	40	6	18	52
1970 to 1979	1,023	356	79	74	90	220	26	58	12	27	80
1980 to 1989	1,034	315	95	66	86	236	26	66	15	37	92
1990 to 1999	1,098	317	104	88	70	246	36	85	17	35	100
2000 to 2003	441	106	45	32	35	116	18	38	4	9	38
Census Region and Division											
Northeast	1,271	634	48	67	84	206	34	58	12	30	98
New England	294	167	8	12	16	42	Q	19	2	6	16
Middle Atlantic	978	467	40	55	68	164	28	39	10	24	81
Midwest	1,690	830	62	103	101	287	35	89	15	35	133
East North Central	1,254	643	42	77	72	208	25	59	11	27	90
West North Central	436	187	20	25	29	79	10	29	4	9	43
South	1,948	473	251	153	166	449	70	154	18	55	159
South Atlantic	1,064	249	132	85	86	258	35	87	11	35	85
East South Central	309	107	23	22	29	63	7	24	2	5	26
West South Central	575	117	96	46	50	128	28	43	5	14	49
West	911	266	70	61	97	200	28	53	19	28	88
Mountain	381	149	26	23	36	78	5	18	Q	8	32
Pacific	530	117	44	38	61	122	24	35	Q	20	56

Released: Dec 2006
Next CBECS will be conducted in 2007

Table C13A. Total Electricity Consumption and Expenditures for All Buildings, 2003

	All Buildings Using Electricity			Electricity Consumption			Electricity Expenditures
				Primary	Site		
	Number of Buildings (thousand)	Floorspace (million square feet)	Floorspace per Building (thousand square feet)	Total (trillion Btu)	Total (trillion Btu)	Total (billion kWh)	Total (million dollars)
All Buildings	4,617	70,181	15.2	10,746	3,559	1,043	82,783
Building Floorspace (Square Feet)							
1,001 to 5,000	2,418	6,479	2.7	1,185	392	115	10,547
5,001 to 10,000	893	6,645	7.4	883	293	86	8,199
10,001 to 25,000	799	12,495	15.6	1,464	485	142	12,172
25,001 to 50,000	254	9,098	35.9	1,199	397	116	9,179
50,001 to 100,000	146	10,265	70.3	1,579	523	153	11,694
100,001 to 200,000	73	10,171	138.7	1,771	587	172	11,962
200,001 to 500,000	26	7,370	288.4	1,152	381	112	7,862
Over 500,000	8	7,660	937.6	1,513	501	147	11,167
Principal Building Activity							
Education	384	9,871	25.7	1,121	371	109	8,111
Food Sales	221	1,237	5.6	629	208	61	4,627
Food Service	297	1,654	5.6	654	217	63	5,176
Health Care	129	3,163	24.6	748	248	73	4,882
Inpatient	8	1,905	241.4	539	178	52	3,198
Outpatient	121	1,258	10.4	209	69	20	1,684
Lodging	142	5,096	35.8	709	235	69	5,288
Mercantile	657	11,192	17.0	2,214	733	215	18,883
Retail (Other Than Mall)	443	4,317	9.7	637	211	62	5,132
Enclosed and Strip Malls	213	6,875	32.2	1,578	523	153	13,751
Office	824	12,208	14.8	2,170	719	211	17,050
Public Assembly	274	3,935	14.4	506	167	49	3,943
Public Order and Safety	71	1,090	15.5	172	57	17	1,216
Religious Worship	370	3,754	10.1	188	62	18	1,628
Service	601	3,982	6.6	451	149	44	3,485
Warehouse and Storage	464	9,425	20.3	738	244	72	5,034
Other	76	1,729	22.7	401	133	39	3,049
Vacant	106	1,846	17.3	46	15	4	412
Year Constructed							
Before 1920	321	3,746	11.7	274	91	27	2,338
1920 to 1945	508	6,709	13.2	649	215	63	5,364
1946 to 1959	552	7,055	12.8	744	247	72	6,184
1960 to 1969	592	8,597	14.5	1,085	359	105	8,626
1970 to 1979	754	12,058	16.0	2,079	689	202	15,679
1980 to 1989	730	12,290	16.8	2,382	789	231	18,258
1990 to 1999	850	13,699	16.1	2,484	823	241	18,560
2000 to 2003	311	6,028	19.4	1,048	347	102	7,773
Census Region and Division							
Northeast	745	13,899	18.7	1,772	587	172	16,907
New England	247	3,430	13.9	426	141	41	4,157
Middle Atlantic	498	10,469	21.0	1,347	446	131	12,750
Midwest	1,228	17,725	14.4	2,414	799	234	15,677
East North Central	691	12,202	17.7	1,733	574	168	11,503
West North Central	537	5,523	10.3	681	225	66	4,174
South	1,752	26,017	14.8	4,654	1,542	452	31,849
South Atlantic	887	13,837	15.6	2,612	865	254	17,693
East South Central	325	3,546	10.9	591	196	57	3,881
West South Central	540	8,634	16.0	1,451	481	141	10,275
West	892	12,541	14.1	1,905	631	185	18,350
Mountain	303	4,165	13.7	700	232	68	5,205
Pacific	589	8,376	14.2	1,205	399	117	13,145