Establishing a Sustainable Vision for Healthcare

An Interactive Qualifying Project Report

submitted to the Faculty of

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the

Degree of Bachelor of Science

by

Sarah Albrecht

Benjamin Petrin

March 5, 2010

Advisor:

Professor Kent J. Rissmiller

Executive Summary

The idea that the healthcare industry could be a large source of environmental harm began to receive attention in the US during the 1960s and 1970s. This attention has steadily increased in the form of regulation and mandates on the healthcare industry since that time. At present, healthcare is one of the most regulated industries in the US, second only to nuclear power. Besides the fact that the healthcare industry is the source of many chemical pollutants such as mercury, it is also has one of the largest demands for energy per square foot.

A "greening movement" has begun and is spreading throughout the healthcare industry. This shift from current hospital operations to more environmentally friendly practices has been stimulated through the abovementioned mandates, societal and philosophical pressure, and most importantly economic reasons. The changes promoted by the green healthcare movement vary in scope and complexity from small projects such as recycling to large projects such as entirely new construction focused on minimizing the facility's carbon footprint.

A variety of green healthcare organizations have sprung up in the past decades to attempt to spread the ideas of the green healthcare movement to hospitals. These organizations seek to assist hospitals in becoming more environmentally friendly and attempt to give hospitals the tools they need to plan and implement such projects. Additionally, many programs are offered by utility companies servicing these hospitals that seek to reduce the energy demands of hospitals, thereby furthering the efficiency of that facility.

Despite the presence of such organizations and programs, many hospitals are still struggling to adopt such practices. The goal of this project, therefore, was to determine what factors stand in the way of hospitals becoming more sustainable. This would include any external policies and mandates affecting sustainability as well as prohibitive forces operating within the hospitals. The result is the formulation of recommendations for hospitals, green healthcare organizations, policymakers, and utility companies on what they can do to help the green healthcare movement progress.

We approached this problem by applying a multiphase methodological system. In the first phase, surveys and interviews were carried out after careful background research was performed. Surveys were sent to hospitals in the Massachusetts region for which we could obtain a contact. These surveys covered a variety of questions in order to gauge how active the

hospital might be in the green movement and what factors may be affecting their performance. We followed up with a supplemental survey for those hospitals that wished to participate further. In addition, some hospitals were interviewed in person or on the phone in order to obtain more focused responses to specific questions worth exploring in depth.

In addition to the hospital surveys, interviews were held with individuals from two major green healthcare organizations. Representatives from the American Society for Healthcare Engineering (ASHE) and Practice Greenhealth were contacted and interviewed for their thoughts on working with hospitals. Additionally, as our background research had indicated that many electric companies offered incentive and rebate programs, we decided to interview an account executive from National Grid which works closely with many of the hospitals we surveyed. For comparison, we also interview a senior program manager at the California-based company Intergy, a consulting firm that works on behalf of Southern California Edison to provide an assistance program specifically geared toward facilities in the healthcare industry. These interviews, as well as in-depth case study examination, allowed us to gain the perspective of all major players identified in the struggle to allow hospitals to go green.

In the second phase of our research, the survey results were analyzed using statistical software. In looking at the results of the survey, it was noted that the majority of hospitals rate their priority of reducing costs through energy efficiency measures as a six or higher on a scale of one to ten with the majority choosing ten. Most hospitals surveyed were also a member of some green health organization but less promising was the fact that these hospitals rated their activity in these organizations at 4.32 on average and the utility of the information they provided as only 5.27 on average on a scale of one to ten. Although responses from hospitals were mixed on the utility of using mandates as a tool to push hospitals to be green, the majority agreed that some sort of collaborative website where green ideas could be exchanged would be useful to augment the current communication methods available.

One of the important correlations observed in the survey data was the fact that the presence of a culture that encouraged sustainability in the hospital was a large predictor of other success measures in the green movement that we established. First, the presence of such a culture correlated with a hospital's awareness of different incentive programs offered by the

local utility companies. Additionally, the presence of an encouraging organizational culture correlated with the self-reported fact that the respondent felt his or her hospital was doing as much as possible with or without financial constraints with respect to sustainability projects.

The results of our analysis were combined with the various pieces of information gleaned from the interviews as well as the evidence gathered from our background research and case studies to produce overall conclusions and substantial recommendations. The first conclusion was of the importance of a hospital culture that encouraged sustainability. This fact was supported empirically in the survey we conducted and by the expert advice offered by both ASHE and Practice Greenhealth. Hospitals that had sustainability included in their mission statement and that considered environmental effects as they do economical impacts perform well in the green movement.

Somewhat related to culture was the importance of leadership to carry out sustainable projects. Leadership can mean having dedicated personnel in the hospital whose job it is to investigate specific matters such as sustainability or energy management as well as granting these people the necessary corporate ranking they need to effectively perform their duties. If these tasks are divided up among individuals that already have numerous responsibilities assigned, matters of sustainability will not take priority. Furthermore, if these individuals are too low in the corporate chain to enact change, great ideas will go unrealized and these resources unused.

Availability of knowledge on green ideas is necessary for hospitals to move forward with sustainable initiatives. These hospitals need to know what is being done, what is possible for their facilities, and how they can move ahead. Furthermore, competition between hospitals in the form of awards given to best practice hospitals or recognition in publicly available publications may stimulate other hospitals to take the next steps in green projects. Ambitious goals can be reached by small and large hospitals alike, as they both offer unique advantages to the problems of sustainability. Finally, with the rapid pace of new construction in healthcare, there is no better time to consider projects that will attempt to improve a facility's lifetime impact on the environment.

We developed numerous recommendations based on our research and conclusions that we feel will positively affect the green movement in healthcare. These recommendations apply to healthcare facilities, green healthcare organizations, policymakers, and utility companies. They are the result of careful analysis of all data gathered through background research, surveys and interviews with many stakeholders in the area of green health.

Measuring and tracking a hospital's performance in energy is an important step in improving sustainability and continually refining old practices. Hospitals must realize the importance of both auditing and benchmarking as a means of identifying points for improvement. Auditing may be performed by outside contractors if the hospital does not feel it possesses the resources necessary to carry out such a task. Additionally, several software solutions exist to help the hospital track its progress in energy consumption reduction.

As corporate culture was identified as a large factor in determining a hospital's chance of being successful with green initiatives, it is important that a facility puts forth the effort to positively influence the hospital's community of employees. Educating staff on current and future green initiatives at a facility may serve to generate interest in such projects. Such interest will stimulate a culture more accepting of sustainability changes, eventually leading to more efficiency measures being implemented. These factors influence each other in a cyclic nature. By educating its staff, a hospital stands to improve interest, culture, and its chance at completing these important and cost saving projects. Of course, such changes also take a large amount of leadership. Hospitals should not be afraid to put the resources towards a group of leaders meant to investigate the hospital's impact on the environment and the different ways the facility can adapt to decrease this impact.

Facility engineers need to be given the opportunity to increase their knowledge and education of what other facilities are doing to move towards the goal of sustainability. Participation in the various conferences put on by green healthcare organizations such as ASHE and Practice Greenhealth may help facility engineers get the important information they need to improve operations.

Green healthcare organizations can do their part in assisting facility engineers to find the information they need. We have identified several ways in which small and large hospitals

differ in their operations and it is important that these organizations provide targeted information to these groups. Information should be further subdivided by the hospital's knowledge or experience level of sustainability opportunities in healthcare. Hospitals new to the ideas of green health will need vastly different information than hospitals that are already well involved with the movement. Underwhelming high performing hospitals with simplistic information can be as much of a problem as overwhelming newcomers with too much information. Green healthcare organizations should organize their data so as to allow newcomers and more experienced facilities to easily find introductory material and advanced material respectively. These ideas can be usefully carried over to conferences as well. Interview data supported the conclusion that the lack of technical details at conferences was the largest reason to avoid attending these meetings.

We cautiously approach the topic of policy recommendations. Although it may be possible to stimulate hospitals to perform audits through the application of mandates, we understand hospitals are severely encumbered with mandates at present. Instead, we hope to inspire continued discussion on what can be done to improve the situation, perhaps by shifting the responsibility to utility companies. This will have the same effect without forcing the hospitals to remove resources from patient care in order to comply with new mandates.

Lastly, utility companies can do much to help hospitals in the movement while simultaneously reaching their goals of decreasing load. Utility companies must understand the unique view of the hospital being worked with, knowing that merely making a facility aware of certain opportunities is not always sufficient. Hospitals lacking the leadership resources in sustainability will need much help and convincing to take advantage of such incentives. Additionally, utility companies may consider rewarding hospitals that perform audits as such acts will undoubtedly highlight areas in need of improvement and promote more energy efficiency projects. Finally, we recommend that further incentives be developed that specifically target the unique needs and constraints on hospitals.

Energy efficiency and overall sustainability are popular topics at present. Current healthcare reform is focusing on making quality medical care affordable to all. However, healthcare facilities must balance the opportunities to reduce their operating costs while still

providing quality patient care. By implementing proven yet simple sustainability measures, hospitals are able to take the first step in becoming more efficient while never affecting the quality of the care they provide. The conclusions and recommendations summarized here and described in more detail within this report are meant to inspire interest and spark change within the healthcare industry as a whole to become responsible for their impact on the environment.

Abstract

Healthcare reform has centered on the ability to offer affordable yet quality medical care to all; however, few solutions have been offered to reduce hospital operating costs associated with high energy consumption to provide this quality care at a lower overall expense. Through interviews with green healthcare organizations, facility engineers, and utility company representatives, and a survey distributed to hospital facility engineers in Massachusetts, we determined that a majority of hospitals recognize energy efficiency as a way to reduce costs, but challenges do exist that appear to prohibit progress. Recommendations are made to healthcare facilities, green healthcare organizations, utility companies, and policymakers. This report will serve as a basis for further research focusing on the healthcare industry and energy efficiency and how hospitals may establish a sustainable vision on a more national level.

Authorship

Both authors of this report have contributed equally to ensure the success of the project; all aspects of the project from developing and working through the methodology to the writing of this report were joint efforts. Therefore we accept equal responsibility for the project and the content found within this report.

Acknowledgements

We would like to thank Professor Rissmiller for his advice and encouragement throughout the project.

We would like to acknowledge the following individuals for giving some of their time to interview with us.

Alex Araiza, Senior Program Manager of the Healthcare Energy Efficiency Program at Intergy, on behalf of Southern California Edison
Janet Brown, Director of Sustainable Operations at Practice Greenhealth
David Crowell, Director of Environmental Services at Saint Francis Medical Center
Diane Imrie, Director of Nutrition Services at Fletcher Allen Hospital
David Keelty, Director of Facilities Planning and Development at Fletcher Allen Hospital
Rick Malmstrom, Energy Manager at Dana-Farber Cancer Institute
Arthur Morin, Director of Facilities at Saints Memorial Medical Center
Paul Strniste, Associate Administrator of Facilities at Saint Vincent Hospital
Michael Thompson, Account Executive for National Grid
Dale Woodin, Executive Director of the American Society for Healthcare Engineering

Lastly, we would like to thank those individuals from various hospitals that participated in our survey. We are grateful to them for the success of our project.

Table of Contents

Table of Figures

Table of Tables

1. Introduction

The healthcare industry is currently under extreme scrutiny regarding skyrocketing operational and medical costs. Healthcare reform has been focusing on the ability to offer affordable and quality medical care available to all; however, solutions have not been offered to assist hospitals in reducing their own operational costs associated with twenty-four hours a day, seven days a week operation. Due to the recent energy crisis and thus rising energy costs, healthcare facilities are in need of opportunities to become more energy efficient so that capital can be used toward the hospital's main priority – patient care.

Hospitals have been slower than other corporations to implement green technologies to improve their operating margins. In 2007, only 2.1 percent of all new projects registered with the U.S. Green Building Council's LEED (Leadership in Energy and Environmental Design) program were in hospitals.[1] Some believe the reason for this sluggishness is heavy regulation of the healthcare industry high standards for infection control that hold a priority over generalized cost containment. Others feel that sustainable technologies require up-front expenses that a hospital cannot manage financially. Still others would argue that hospital leadership and organizational culture are instrumental in whether or not a facility will implement green technologies in an effort to reduce operating costs.

In a 2008 survey by Johnson Controls, healthcare companies noted that they spent a great deal more money on energy than companies in other industries and that although they are more likely to make capital investments to enhance energy efficiency, healthcare companies are less likely to believe that these improvements will cause major impacts.[2] In order to implement energy efficient projects, the expected results must be proven or offer an attractive return on investment. Also, according to this report, "the healthcare industry is less open than other industries to the use of renewable energy sources…"[3] Despite this industry-wide closed-mindedness and a lack of optimism, some hospitals are performing quite well in regard to energy efficiency and reduced operating costs.

---

[1] Healthcare Design and Construction, "Hospitals Slowly Warming to Green Design," http://www.djc.com/news/co/11188614.html (accessed 20 January 2010).

[2] Johnson Controls, *2008 Healthcare Energy Efficiency Indicator Report*, *http://johnsoncontrols.mediaroom.com/file.php/2123/2008+Healthcare+Energy+Efficiency+Indicator+Report.pdf (accessed 3 October 2009).*

[3] Ibid.

The goal of this IQP was to identify any prohibitive factors to becoming a sustainable healthcare facility, to investigate what hospitals can do to participate in the green healthcare movement, and to determine how policy and regulation may be affecting the healthcare industry's acceptance of energy efficient technologies. Surveys of Massachusetts hospitals and numerous interviews with individuals within green healthcare organizations, utilities companies, and hospitals themselves led to the development of recommendations for improvement to current policies, regulations, and incentive programs. Particular opportunities for improvement within hospitals are acknowledged, a set of recommendations to improve the communication of energy management techniques are identified, and best practices in energy efficiency within hospitals are documented. Our findings will be available to Massachusetts hospitals as well as the green healthcare organizations that participated in the project to help disperse the project results to as many facilities and individuals as possible. It is our hope, as well, that policymakers will also take our research and recommendations into consideration in order to perform further research at the national level and develop policy and incentives more relevant to the healthcare industry.

To achieve our goals, we gathered information and relevant data through surveys and interviews to gain insight into the energy efficiency issues from the standpoint of both hospital facility engineers and individuals who work at organizations devoted to encouraging and assisting hospitals in the transition to sustainability. We then analyzed the quantitative survey data and the qualitative interview information. From these analyses, we drew conclusions and developed the recommendations included in this report. Organizations that promote the green healthcare movement, particularly those who participated in this project, shall gain insight into their membership and how the information they present is being utilized. In addition, healthcare facilities will become aware of how rising energy costs affect operating costs and shall be empowered with much needed information to develop energy management strategies based on best practices.

The following chapters provide further information regarding the elements of the green healthcare movement relevant to our specific research and describe the methods used during our research in more detail. Case studies are cited and discussed to identify energy efficient

best practices within the healthcare industries. The next chapters then discuss the results of and conclusions drawn from the hospital surveys and numerous interviews. Overall conclusions and our recommendations are cited in the final chapters along with a brief discussion on topics and issues that came about during our project that we feel will warrant further research.

2. Background and Literature Review

History of the Environmental Revolution and Policy

During the 1960s and the 1970s, the United States federal government began to tackle the emerging social concern for the deterioration of the environment. Companies were in denial of the large negative ways in which they were impacting the environment.[4] Particularly in the 1970s, much legislation was passed to create a general awareness of the condition of the environment and the importance of meeting the standards being set to improve the quality of life for generations to come. Specifically, President Nixon signed the National Environmental Policy Act (NEPA) on January 1, 1970. NEPA changed the government's role in the environmental consciousness from conservator to protector and directed Nixon to establish specialized councils.[5] Thus, the Council on Environmental Quality was created that same year.[6] Some states passed their own environmental statutes; however, this appeared to be ineffective and soon provoked "environmental blackmail" from companies against states, threatening to lay off workers when states tried enforcing stricter pollution laws.[7] Unsurprisingly, environmental law and regulation "was for some time the fastest growing sector of the American Bar."[8]

After this explosion of interest and regulation on the part of the federal government in the 1970s, Nixon made a decision to establish the Environmental Protection Agency (EPA). The original mission of the EPA centered on establishing and enforcing standards consistent with environmental goals, researching the effects of pollution and methods to control it, offering grants and other means for others to control pollution, and to recommend to the President new policies for environmental protection.[9] Some of the most notable activities by the EPA include the Clean Air Acts, Superfund, Energy Star, the Clean Water Act, and the Pollution Prevention Act.[10]

---

[4] Stuart L. Hart, "Beyond Greening: Strategies for a Sustainable World," *Harvard Business Review* 75.n1 (Jan – Feb 1997), 66.
[5] Environmental Protection Agency, "The Guardian: Origins of the EPA," http://www.epa.gov/history/publications/print/origins.htm (accessed 15 January 2010).
[6] Philip Shabecoff, *Fierce Green Fire: The American Environmental Movement* (Washington: Island Press, 2003), 121-122.
[7] Ibid, 124-125.
[8] Ibid, 125.
[9] Environmental Protection Agency, "The Guardian: Origins of the EPA."
[10] Environmental Protection Agency, "Timeline," http://www.epa.gov/history/timeline/index.htm (accessed 15 January 2010).

Green Healthcare

Green healthcare is "the incorporation of environmentally friendly practices into healthcare delivery."[11] While the green movement within the healthcare industry can allow hospitals to protect the environment, exhibit leadership, educate communities, and save money, many healthcare professionals find the movement "most compelling because of its potential to protect and promote health."[12] Due to the recent popularity and awareness of this movement, it becomes beneficial to identify the elements that make up the movement. The following sections detail the various elements surrounding the issue of green healthcare more thoroughly.

Social Elements

The underlying social issues surrounding the topic of green healthcare could be summarized as the rate at which green healthcare information circulates throughout the healthcare industry and the reasons why a particular healthcare facility may not readily adapt to newer more environmentally friendly practices. The existence of several organizations committed to promoting the ideas of green healthcare to its members suggests at least some involvement of the healthcare industry is putting such theory into practice. Two key organizations are Practice Greenhealth and the American Society for Healthcare Engineering. While described briefly here, both organizations are discussed further in Chapter Six.

Practice Greenhealth is an organization committed to bringing together members of the healthcare industry committed to making environmentally smart decisions for their facilities. The organization consolidates a variety of information on topics from new construction to daily operations. Practice Greenhealth believes that implementing such changes will lead to creating sustainable infrastructures within the healthcare community. Additionally, the organization brings together a variety of tools, calculators, and educational information to help its members make the right decisions.

The American Society for Healthcare Engineering (ASHE) of the American Hospital Association is "dedicated to optimizing the healthcare physical environment" and works "to

[11] Howard Frumklin and Christine Coussens, *Green Healthcare Institutions: Health, Environment, and Economics, Workshop Summary* (Washington D.C.: National Academies Press, 2007), 1.
[12] Ibid.

engage stakeholders in the creation of the optimum healing healthcare environment."[13] ASHE strives to provide professional development assistance to healthcare engineers. Particularly due to the interest in green healthcare, much of the resources and tools provided by ASHE focus on educating these engineers on how to bring new ideas to hospital management and to make a difference within the facility.

Like most organizations, however, information and ideas alone may not always be sufficient to encourage the implementation of changes in either a for-profit or not-for-profit hospital. Justifications must be made to those in charge of making hospital-wide decisions including estimations on the impact the change will have on cost both now and in the future. Depending on the size of the hospital, obtaining approval for large expenditure green projects may pose a significant hassle. It is natural for both for-profit and not-for-profit hospitals to keep costs at a minimum, be it for higher profit or lower costs to the patient. It is possible that minimizing overall costs prevails over the more philanthropic goal of promoting human health by decreasing the environmental impact of such a large facility on the neighboring ecosystem. Lastly, the cultural mindset of a hospital may affect how important environmental issues are ranked in comparison to the everyday operations of such a large facility, perhaps without regard to cost.

Historical Elements

By 1998, great amounts of press and public attention made it obvious that the healthcare industry needed to more fully join the green movement that had been sweeping the country since the 1970s. The American Hospital Association (AHA) and the EPA signed an agreement called the Memorandum of Understanding (MOU) which led to the elimination of mercury waste and a reduction of the volume of waste in healthcare along with specific activities designed to educate and inform individuals within the healthcare industry on the importance of preventing pollution and minimizing the use of toxic materials.[14]

The Memorandum of Understanding set ten steps for the American Hospital Association Leadership Council to focus on over the next five years. Among the largest and most ambitious

[13] American Society for Healthcare Engineering. "Mission and Vision." American Hospital Association. http://www.ashe.org/ashe/about/mission/index.html (accessed 2 March 2010).
[14] Practice Greenhealth, "About Us," http://www.practicegreenhealth.org/about/ (accessed 18 January 2010).

was the virtual elimination of mercury in medical waste and overall waste reduction, both medical and otherwise, by 33% in 2005 and 50% in 2010. The MOU specified that seminars would be cosponsored by the parties involved to relay the important technical information for reaching these and other goals. Anonymous progress questionnaires would be used to gauge the progress towards these goals and the EPA would seek comments from the AHA on its policies and guidance to further the collaboration between the two organizations.[15]

Physical Elements

The problem of energy consumption has always been closely related to the current cost of energy. Hospitals are among the nation's most complex and energy intensive facilities. Using an average of 836 trillion British Thermal Units (BTUs) of energy annually, hospitals have more than 2.5 times the energy intensity of commercial office buildings of similar size. This high energy consumption equates to producing 30 pounds of CO_2 for every square foot of hospital space each year.[16] Although energy costs contribute to only about 1% of a hospital's overall cost,[17] due to the size of such facilities this accounts for $5 billion annually in energy costs alone.[18]

The problem of ever increasing rates of consumption is made worse with continually increasing energy costs. Overall US energy costs rose by 17% in 2007, which included a 57% increase in oil cost alone.[19] These costs affect both for-profit and not-for-profit hospitals alike, making it harder to maintain the same level of staffing and services while either generating a profit or staying open for service.

Most importantly, rising energy costs combined with the inflexibility of decreasing mission-critical costs make energy consumption one of the few costs a hospital stands to be

[15] Practice Greenhealth, "Memorandum of Understanding (MOU)," http://cms.h2e-online.org/about/mou (accessed 18 January 2010).
[16] "Department of Energy Announces the Launch of the Hospital Energy Alliance to Increase Energy Efficiency in the Healthcare Sector," U.S. Department of Energy press release, 29 April 2009, http://www.energy.gov/news2009/7363.htm (accessed 6 October 2009).
[17] Dan Bednarz, "Rising Energy Costs and the Future of Hospital Work," House of Delegates Meeting of the Pennsylvania Association of Staff Nurses & Allied Professionals, Harrisburg, PA, 28 April 2009, from The Oil Drum, http://www.theoildrum.com/node/3902 (accessed 1 October 2009).
[18] "Department of Energy Announces the Launch of the Hospital Energy Alliance to Increase Energy Efficiency in the Healthcare Sector," U.S. Department of Energy press release.
[19] Dan Bednarz, "Rising Energy Costs and the Future of Hospital Work".

able to reduce and manage.[20] By decreasing energy costs hospitals may be able to move savings to more productive outlets such as improving the level of patient care provided and pursuing costly medical and technological advancements.[21]

Policy Elements

A variety of existing policies serve to mandate certain operations of the healthcare industry, regardless of their impact on costs. These include the 1988 Medical Waste Tracking Act, the 1990 EPA Clean Air Act Amendments, and the 1976 Resource and Conservation Recovery Act. Although these regulations seek to reduce environmental impact, most have the side effect of increasing energy consumption by placing strict requirements on equipment. An example would be air circulation requirements that call for greater numbers of fans and filtration devices.

Additionally, there exist a variety of loan, rebate and incentive programs meant to encourage hospitals to implement certain energy conserving changes. Many of these exist at the state level and are often sponsored by local electric companies. As of 2006 ASHE lists 19 different state level programs, most of which have reserved millions in funds available for allocation. Many of these programs cover projects such as lighting retrofits, heating and air-conditioning modifications, insulation changes, and energy auditing.[22]

Literature Review

Healthcare and energy consumption are both very popular topics of discussion at present in the United States. The nation's focus has most recently been centered on healthcare as part of President Obama's attempt to reform the industry. Similarly, the nation is experiencing a booming interest in sustainability and energy efficiency within numerous industries. However, it does not appear to be the case that any group of researchers has taken a look at the reasons why hospitals may or may not be implementing certain sustainable

[20] "EnergySmart Hospitals," U.S. Department of Energy fact sheet, July 2008, http://apps1.eere.energy.gov/buildings/publications/pdfs/energysmarthospitals/esh_factsheet.pdf (accessed 10 September 2009).

[21] Todd Smith, *Energy Efficiency – for Environmental Responsibility, Comfort & Cost Savings* (TRANE: Trane Air Conditioning Solutions, 2006), http://www.trane.com/commercial/uploads/newsroom/energy_eff_tsmith_10-25-06.pdf (accessed 14 October 2009).

[22] Clark Reed, *Incentives for Energy Efficiency Projects* (Energy Start, May/June 2006), http://www.energystar.gov/index.cfm?c=healthcare.ashe_may_june_2006 (accessed 14 October 2009).

changes and what differences between hospitals may affect the extent to which they have gone green. This is surprising considering the fact that the healthcare industry is such a large consumer of energy. Perhaps hidden social or policy related barriers are preventing healthcare facilities from moving toward more sustainable operations. Furthermore, although there are several groups committed to the dispersal of knowledge and tools relating to green healthcare, their relatively young age means that little research has investigated their effectiveness in reaching the goals they strive to achieve.

It follows that much of the background research in healthcare and energy has gone into looking at what can be done to decrease energy consumption, carbon footprint, and a variety of other impacts that healthcare facilities have on the surrounding environment. Thus, the following studies and reports contain data that looks at what can be done other than specific reasons why certain facilities may not b e performing changes to decrease facility impact on the environment.

Studies and Reports

Background, Trends, Issues, and Opportunities in Healthcare[23]

Background, Trends, Issues, and Opportunities in Healthcare, a report issued in 1999, outlines many of the energy-centric issues in the healthcare industry. The report was compiled by the Electric Power Research Institute (EPRI) Healthcare Initiative by analyzing census data from a variety of government agencies. The report indicates that healthcare spending has increased over the last decade of data analyzed. In 1997, these expenditures reached as much as 13.5% of the Gross Domestic Product. Of these large expenditures, 34% were attributed to acute-care hospital facilities, one of the largest consumers of energy in the healthcare industry. Government involvement in healthcare with programs such as Medicare have contributed to even greater costs for hospitals, driving some to deny service to those unable to pay and others to close altogether.

The EPRI Healthcare Initiative stressed that hospitals are the most important component of the healthcare industry. Therefore, the goal of reducing costs in order to allow

[23] Electric Power Research Institute Final Report, *EPRI Report: Background, Trends, Issues, and Opportunities in Healthcare, September 1999*, Palo Alto, California: EPRI, 1999.

these facilities to continue operating should be of top concern to healthcare leaders. Increased managed care continues to decrease hospital profits and force hospitals to find new ways to keep rising costs under control. This pressure has led to many mergers and acquisitions of not-for-profit hospitals by larger for-profit facilities as well as an increase in the less costly area of outpatient services and sub-acute care.

One costly aspect of hospital operations falls under the area of plant engineering. Services provided by the plant engineer include heating, cooling, lighting, boilers, biomedical equipment as well as telecommunication systems. It is the facility engineer's concern to maintain energy consumption for the hospital's day-to-day operations, working under the direction of senior level management and further direction by the CEO or a Board of Directors that oversees expenditures. As with most organizations, an inverse relation may exist between the amount of decision making authority and technical expertise. This relation has the potential to create an imperfect decision making system, especially in the area of plant services where the nature of business is highly technical.

In addition to hierarchical and bureaucratic decision making issues, some hospital staff report being somewhat overwhelmed by the complexity of policies regulating the healthcare industry. "Many aspects of work in healthcare facilities are regulated by a host of federal, state, and local agencies, as well as private accreditation organizations."[24] A large number of policies, codes, and standards as well as external agencies such as the Occupational Safety and Health Administration (OSHA) and the EPA add a great deal of complication to an already difficult decision making process within the hospital.

Despite the complications surrounding the industry, reducing energy consumption remains a promising way for hospitals to minimize costs. Healthcare is the fourth largest consumer of energy, and the second highest in energy intensity measured in BTUs per square foot. Although many of the costs are similar to hospitality, dormitory, or food service industries, hospitals also carry a variety of properties unique to the healthcare industry including the aforementioned strict regulation. According to the report, some hospital equipment and processes benefit from updating. These include new waste processing techniques, lighting

[24] Electric Power Research Institute Final Report, 87.

changes (including bulbs, lenses, reflectors, and dimming equipment), chillers, dehumidifiers, thermal energy stores, as well as restructuring electrical systems to place sensitive equipment on dedicated panels. Past research has shown that hospitals are interested in value-added services from utility companies indicating close cooperation of hospitals and energy providers could provide for more efficient operation.

Green Healthcare Institutions: Health, Environment, and Economics, Workshop Summary[25]

Green Healthcare Institutions: Health, Environment, and Economics, Workshop Summary, a document published by the Institute of Medicine, summarizes the ninth workshop held by the Roundtable on Environmental Health Sciences, Research, and Medicine which took place in 2006. The report focuses on the impact healthcare facilities have on the environment and the humans in and around the facility. It is suggested that the unique relationship hospitals have with human health may even serve as a test-bed for green technologies, providing scientists with a way to learn more about how green technologies affect human health. The document introduces the topic of green healthcare by stating that healthcare should aim to be economical, prudent, long-term, and contextual.

In 2004 the healthcare industry was going through the largest building boom since the 1940s. This fact, combined with the idea that healthcare facilities are such large energy consumers, makes these facilities good candidates for implementing changes to reduce energy consumption. Research supports the idea that purposeful design choices can have a large impact on the health and well-being of staff and patients in hospitals as well as on the costs incurred from operations.

Connections between health and green building design have led to the government supported Leadership in Energy and Environmental Design (LEED) program which provides an incentive for green construction. Numerous LEED-registered healthcare institutions have made strides in reducing impact on the neighboring environment. These changes are often economically advantageous in addition to being environmentally sound. But, at the time of writing, the summary indicates only a small fraction, 2%, of the LEED certified buildings belong to the healthcare sector. A published guide known as the *Green Guide for Health Care* was

[25] Howard Frumklin and Christine Coussens, *Green Healthcare Institutions: Health, Environment, and Economics, Workshop Summary*, Washington D.C.: National Academics Press, 2007.

developed in 2004 to provide a best practices directory for sustainable design and operations for the healthcare industry.

Recognizing the need for economic benefits in order to justify green changes in healthcare, the summary additionally cites a recent California based study meant to evaluate the economics of green building construction. This study found that although initial costs are higher for green building construction ($3-$5 per square foot), these changes generated savings that totaled between $50 and $65 per square foot over the course of 20 years. Such economic benefits may ease the process of convincing hospitals to invest in green technology, despite and in fact because of increasing operational costs.

The summary noted that, in general, green healthcare is pursued because of the recently popularized triple bottom line: people, planet, and profit. This means that the organization acts in such a way as to optimize social (people), environmental (planet), and economic (profit) outcomes. Hospitals look to boost the social aspect of the bottom line due to their overall objective and dedication to quality patient care, the environmental aspect by implementing measures to improve energy efficiency and utilizing natural resources, and the economic aspect by showing appropriate financial performance. Many hospitals feel that approaching green healthcare on the basis of a triple bottom line actually increases customer loyalty and improves reputation.

Conclusion

This review has highlighted the concerns surrounding the healthcare industry's extreme operating costs as well as an interest in shifting toward sustainable operations to reduce these costs. According to the review, though, the current policies and regulations that are in place make the healthcare industry complex, so much so that the codes and standards set forth by OSHA and the EPA may actually be hindering the progress of hospitals in their attempts to become sustainable. In addition, hospitals have the benefit of being able to positively impact their triple bottom line. Not only could adopting green technologies improve the hospital's economic health by reducing operating costs, but it could also lead to national recognition, an improved reputation, and a reduced environmental footprint. Therefore, purposeful decisions on the part of the hospital to become sustainable can have a large impact in multiple ways.

3. Methodology

The foremost goal of this project was to determine what might improve the probability for success in implementing certain energy efficiency measures within a healthcare facility. In addition, we hoped to prompt improvement to current techniques being used to spur hospitals in realizing their effect on the environment and encourage the implementation of viable energy efficiency and other sustainable measures. In general, our major objectives included the following:

- To enhance the understanding of effective energy management
- To make evidence-based recommendations to healthcare facilities that are meant to improve their probability for success in implementing certain measures
- To offer suggestions for green healthcare organizations to improve communication strategies and member participation
- To provide advice to policymakers to better assist healthcare facilities in the endeavor to become green
- To aid utility companies in their attempts to reduce overall system load by helping large users such as hospitals perform energy saving projects that are financially beneficial

Before discussing the methods used to achieve these objectives, some major challenges were identified prior to the start of research and analysis and proved to be difficult through the course of the project. The first difficulty was obtaining the appropriate contact information for individuals that could complete our survey. The second, achieving a reasonable survey response rate, was somewhat beyond our control. We did encounter a great deal of difficulty with obtaining the cooperation of hospital facility engineers or other appropriate individuals in returning a completed survey. We did re-contact numerous hospitals to obtain contact information but, despite this effort, were still disappointed with the resulting response rate which was 29.43% of all hospitals originally contacted and 46.43% of hospitals to which we sent a sent a survey at least once. However, those individuals who did respond to our survey were very helpful and provided invaluable information that led to a successful project.

To meet the set objectives and overcome challenges most effectively, the project was completed in three main phases described in more detail below.[26] Phase one consisted of gathering general data both qualitative and quantitative in nature. During phase two, we analyzed the data gathered and organized in phase one and began drawing conclusions. A brochure was developed that summarized conclusions and recommendations that was shared with the participating healthcare facilities. Additionally, green healthcare organizations and policymakers were sent a hard copy of the report during the third and final phase for easy review.

Phase 1

The first phase consisted of gathering qualitative and quantitative data using two common research methods, surveying and interviewing. A list of the basic interview questions and a copy of the initial and supplemental surveys can be found in the appendices. In addition to these methods, we also analyzed two case studies to develop an understanding of the best practices in sustainability and other green challenges encountered in healthcare settings.

Surveying and Interviewing

Many organizations devoted to helping hospitals and other healthcare facilities achieve certain levels of green standards were found through quick Internet research. These organizations' websites offered insight into their missions and assisted in the initial identification of people who would serve as exceptional points of contact. We focused on two major organizations that are known throughout the nation as leaders in helping hospitals optimize their capabilities, American Society for Healthcare Engineering (ASHE) and Practice Greenhealth. Interviews with individuals at both of these organizations were conducted via telephone over the course of the beginning half of the project.

Through our background research and interviews with the representatives from ASHE and Practice Greenhealth, we learned of incentive programs run by utility companies, namely National Grid in the Massachusetts area. Therefore we identified a contact at National Grid to speak to the effectiveness of these incentive programs and how they might work for hospitals.

[26] Phases were used to better identify the methods of research used during this project. Phases were not necessarily completed in perfect sequence. Instead, the methods in the phases may have overlapped.

Also, because California is seen as a leader in energy efficiency and sustainability in many areas, we found much information regarding the programs available for healthcare facilities in that state. For comparison, we interviewed the senior program manager for three energy efficiency programs in California that are administered on behalf of Southern California Edison.

Hospital facilities managers and others who work in operations and other sustainability-specific capacities were the focus for the survey portion of the project. Research was centralized in the state of Massachusetts to ensure a reasonable sample size but also that project completion was reached in a timely manner. Using the American Hospital Directory[27] and the Commonwealth of Massachusetts' Board of Registration in Medicine[28] website, we compiled a list of hospitals within the state. Using these informational sites, a database of almost 100 facilities was compiled.

Using this compilation, we browsed each facility's website to obtain telephone numbers and email addresses in order to begin the process of determining the appropriate individual to receive our survey. Therefore, we sent out emails requesting appropriate contact information and called the facilities for which we could not find a relevant email address. Surveys were sent as we obtained the appropriate email addresses. Responses were gathered on a rolling basis through January.

The survey was performed electronically using a within-email survey sent to the email addresses gathered during the calling campaign. The within-email survey approach was chosen over other options due to the ease of completion and submission on behalf of the participants. Contacts were able to complete the survey within their email client upon receipt of the survey and submit their responses with a simple reply email. This approach also minimized problems with website blocking, internet browsing incompatibilities, or software inconsistencies. No deadline was specifically stated in an attempt to improve response rate; however, when responses were not received after a long period of time, we re-contacted the individuals and offered a reminder to encourage participation. A supplemental survey was sent out once we

[27] American Hospital Directory, *Free Hospital Information*, http://www.ahd.com/freesearch.php3 (accessed 10 January 2010).
[28] Commonwealth of Massachusetts, "List of Massachusetts Hospitals," *Board of Registration in Medicine*, http://www.massmedboard.org/links/hospital_list.shtm (accessed 15 September 2009).

identified new hypotheses we hoped to test as our research progressed. All survey responses were tracked by inputting data into a custom Microsoft Excel spreadsheet.

Interviews with facility engineers or other survey respondents also took place over the course of the surveying period. If survey responses for a particular facility warranted further investigation, we contacted the individual who completed the survey and requested a phone interview. When permitted, these interviews were recorded to use during analysis. These interviews provided supplementary insight into the green mission of the specific facilities beyond the information gathered using our survey tool.

Case Study Research

Case studies were used to determine the best energy management practices in a healthcare facility. These two cases focused on hospitals located in the same geographic location as Massachusetts which were chosen because of the valuable inferences that could be made due to the similarity in climate trends. One case lent itself to the investigation of new construction to achieve sustainability standards. This study discussed Fletcher Allen's renovation and construction project in Vermont. The project was designed by a Boston Architecture firm, Tsoi/Kobus and Associates. The other study discussed Hartford, Connecticut's Saint Francis Hospital's upgrades to existing systems to obtain certain levels of savings and sustainability.

Both studies were investigated beyond the information provided in the initial case studies that were publicly available online by contacting those involved in the projects in question. These interviews led to the identification of major motivators for implementing energy efficiency measures, reasons for success, and insight into what other facilities may be able to do to become just as successful from the point of view of these facilities.

Phase 2

Phase two work led to important insights surrounding the present energy situation within the healthcare industry and regarding the industry mindset surrounding energy efficiency. Statistical analysis using powerful software uncovered trends in data gathered from surveys. Using statistical analysis techniques such as t-tests, correlations, and frequency distributions, we examined qualitative data in many different ways. We also used quantitative

techniques to better analyze the interviews conducted over the course of the project. Toward the end of this phase, recommendations were developed based on the conclusions drawn from these in-depth analyses. These recommendations were meant for an audience consisting of healthcare facilities, green healthcare organizations, policymakers, and utility companies who develop incentive programs to attract these facilities to implement energy consumption reduction projects.

Data Analysis

The list of survey participants compiled in phase one consisted of 97 Massachusetts facilities. As we began contacting hospitals, some facilities were unable to provide us with the contact information we were requiring for various reasons but mainly because of internal policies on sharing email addresses. We were, however, able to get in contact with and obtain email addresses from 56 hospitals to which we sent surveys. From this sample, we were able to obtain a 46.43% response rate, receiving completed surveys from 26 hospitals. Once responses were received, data was analyzed using SPSS Statistics 17.0. Powerful statistical analysis software, SPSS provided us with a comprehensive tool set that aided in drawing conclusions. We were able to recode and compute new variables using our data imported into SPSS from Microsoft Excel and use analysis functions to identify correlations, produce distribution graphs, and perform t-tests to compare means between variables. Valuable inferences were made and effective graphs were created to illustrate our findings.

However, due to the number of interviews completed, a good deal of our research was qualitative. Therefore, we used content analysis to further understand the qualitative interview responses, particularly of the green healthcare organizations. To begin this analysis, the interviews with ASHE and Practice Greenhealth, both of which had been permitted to be recorded, were transcribed. After transcription was completed, we needed to identify the themes that were brought up in each interview. These themes included the topics of regulation, organizational challenges, culture, economics/cost-benefit, education, and organizational structure. Systematically, we identified portions of each interview that would fall into one of the identified themes and noted it. After this sorting of information, we were able to observe

the differences and similarities in opinion between the interviewees and draw conclusions on some different issues.

Development of Recommendations

As conclusions were drawn, we began noting points of further research along with issues on which we felt we could make concrete recommendations for healthcare facilities, green healthcare organizations, policymakers, and utility companies. Recommendations to hospitals centered on techniques to progress through the green healthcare movement. These included tracking energy usage within a hospital facility and acknowledging the importance of staff education and leadership on the success of energy efficiency programs. Also, the benefits of providing an encouraging environment where facility engineers are able to expand their knowledge on energy efficiency and sustainability measures and put their recommendations into practice were highlighted.

Specific recommendations to green healthcare organizations were developed through interviews with ASHE and Practice Greenhealth on their current techniques of assisting hospitals progress through the green movement as well as the opinions of survey respondents and the discussions with facility engineers who interact with these organizations via individual or facility memberships. These recommendations mainly surround the fact of providing information more relevant to the intended audience while also tailoring information to better suit the different types of hospitals within the membership base.

We then provided recommendations for policymakers while keeping in mind that the healthcare industry is already heavily regulated. Numerous interviews highlighted how beneficial regular audits may be and that they may lead to the implementation of best practices. Therefore, these recommendations were offered as suggestions to require audits to be performed regularly, either by requiring hospitals to do this or by placing this regulation on a utility company or third-party firm.

Lastly, we targeted recommendations toward utility companies. These recommendations were possible ways in which current incentive programs may be made more effective. They included ideas such as providing a more interactive service in which the account executives would work with hospitals through more of the greening process to encourage

project completion. In addition, the utility company may consider establishing a program specifically for those facilities in the healthcare industry. Our hope was that these recommendations would spur new ideas, actions, and policy that would more easily assist healthcare facilities in the endeavor to become green and more energy efficient.

Phase 3

The third and final phase of the study included the development of a brochure to submit to hospitals that participated in the survey as a technique to share the conclusions and recommendations of the full report. A cover letter was written to accompany this deliverable to re-introduce the facilities to the project, thank them for their participation, and instruct those who are interested in finding the full report online. All survey participants and interview subjects were given the option to receive a copy of the final report and a summary of our findings in PDF form. Hard copies were also printed and bound and sent to ASHE, Practice Greenhealth, and the Massachusetts Office of Energy and Environmental Services to encourage reviewing our conclusions and recommendations thoroughly.

4. Case Studies

Two case studies are cited below in an attempt to investigate the events and activities that may assist in identifying the motivations for pursing green healthcare, the key players within a hospital setting, and main reasons for success. These studies focus on two highly recognized hospitals for their implementation of sustainable initiatives and, as such, are major players in the green healthcare movement.

According to the 2009 State Energy Efficiency Scorecard, even the states where these organizations from the case studies are located are leaders in the movement, scoring in the top ten of all states.[29] The scorecard "examines six energy efficiency policy areas: (1) utility-sector and public benefits programs and policies; (2) transportation policies; (3) building energy codes; (4) combined heat and power; (5) state government initiatives; and (6) appliance efficiency standards."[30] States earn points in each of these categories – the higher the point total, the better the state in the sense of energy efficiency leadership. Connecticut, rated number three, is the home to Saint Francis Hospital and Medical Center. Fletcher Allen is located in Vermont, number six on the scorecard. For the sake of comparison, Massachusetts was rated number two on this energy efficiency scorecard.

Saint Francis Hospital and Medical Center

Saint Francis Hospital and Medical Center, located in Hartford, Connecticut, is a teaching hospital affiliated with the University of Connecticut – School of Medicine and Dentistry and falls within the same climate zone as Massachusetts according to the National Oceanic and Atmospheric Administration (NOAA).[31] These climate divisions group states into climatically homogeneous regions based on the number of cooling degree and heating degree days. See Figure 1.

[29] American Council for an Energy-Efficient Economy, "The 2009 State Energy Efficiency Scorecard: Abstract," http://www.aceee.org/pubs/e097.htm (accessed 18 January 2010).
[30] Ibid.
[31] American Society for Healthcare Engineering, "ASHE: E2C Map of Climate Zones," American Hospital Association, http://www.ashe.org/ashe/facilities/e2c/cs/index.html (accessed 4 November 2009).

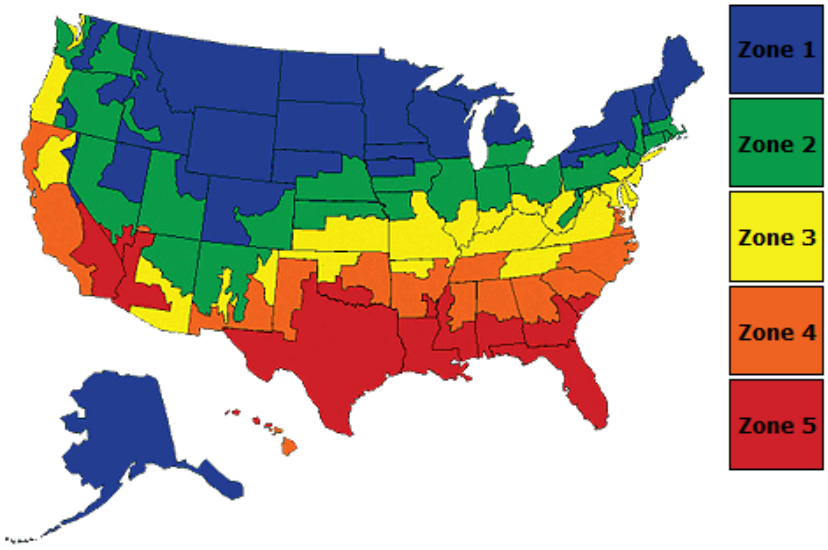

Figure 1. Climate Zones[32]

Saint Francis Hospital and Medical Center has been recognized with regard to the facility's green renovations in 2003, however a great deal of progress has been made since.[33] Founded in 1897, Saint Francis' facility is currently over 2 million square feet total and within its 17 buildings, it houses over 600 inpatient beds. Saint Francis's reputation and recognition make it a promising case study. Saint Francis was a member of Practice Greenhealth when it was originally Hospitals for a Healthy Environment (H2E). Senior management followed the templates and suggestions from H2E and created a greening committee in late 2005, early 2006. In Saint Francis's case, the CEO is a great pillar of support for green initiatives throughout the medical center. "All energy management issues are addressed and reviewed by [Saint Francis's] President, Executive Vice President, and Buildings and Grounds Committee."[34] This touches upon the greening committee which also consists of the Vice President of Support Services and Construction, the Director of Engineering, the Vice President of Operations, the Director of Food Services, the Senior Vice President for Planning, the Vice President of Mission Integration, the Director of Environmental Services, and representation from nursing.

David Crowell, Director of Environmental Services, spoke with us regarding this case study on the facility and the current status of the hospital in the green healthcare movement.

[32] American Society for Healthcare Engineering, "ASHE: E2C Map of Climate Zones."
[33] American Society for Healthcare Engineering, "ASHE: E2C SFHMC," *American Hospital Association*, http://www.ashe.org/ashe/facilities/e2c/cs/zone2/sfhmc.html (accessed 4 November 2009).
[34] American Society for Healthcare Engineering, "ASHE: E2C SFHMC."

He noted that a diverse set of skills and specialties on the greening committee is just one cause for success. This committee meets on a monthly basis and develops an annual picture of what can be done throughout the hospital. In fact, the first task completed by this group upon its formation was a detailed purchasing policy that takes environmental issues into consideration.

This purchasing policy was included in a Master Plan mentioned in the case study. During the development of this plan, the committee evaluated the different areas of the hospital and identified potential projects such as incorporating green roofs and other LEED components into new construction. The Master Plan still encourages those using it to make appropriate choices and has instilled a strong philosophy among the organization to take all facets of environmental issues into consideration when making decisions.

The devotion to sustainability, a constant consideration of environmental issues, and appropriate negotiation with suppliers has led to approximately 5 to 7% in realized electricity savings. Simple projects such as ensuring that computer monitors go to sleep when they should, implementing automatic lighting systems, and installing thermal-pane windows have all contributed to the noticeable savings. Interestingly, most of these projects were funded using incentive programs from local utility companies. Some other renovations that have been completed at Saint Francis in past years include:

- Upgrades to energy efficient systems in many of the hospital campus's buildings
- Lighting upgrades following stringent audits
- Replacement of ventilation fans in major buildings and major water systems with variable frequency drives
- Installation of efficient centrifugal/absorption chiller systems
- Replacement of steam traps and motors with impulse traps and high efficiency motors
- Installation of a 200kW fuel cell to supply critical energy to select areas of hospital[35]

[35] American Society for Healthcare Engineering, "ASHE: E2C SFHMC."

Numerous factors cited by both David Crowell and the original case study have led to Saint Francis's success and reputation. The first is that the hospital has Catholic roots; therefore, the mission of the hospital is devoted to the health of humans but also the environment and so has a connection to the green healthcare movement. In addition, Saint Francis makes it common practice to learn of other hospitals that are strong players within the green movement in healthcare. Specifically, members of Saint Francis visited Hackensack Medical Center and gained much inspiration to introduce new green initiatives. Finally, the opportunity to earn awards, particularly Practice Greenhealth's Partner for Change award and the hospital's Energy Star rating, are very important to the hospital. Not only are these honors and recognitions used to gauge the level of improvement that should be reached over the next year, but also to increase employee awareness of initiatives in place at Saint Francis. Through the communication of project status updates and sharing the successes of the hospital's energy initiatives, the Saint Francis community has become quite supportive.

In addition to these motivators, knowledge is power at Saint Francis. The hospital tracks energy consumption across the medical center's campus using Energy Star's interactive Portfolio Manager. This online tool is used to track and evaluate energy consumption across all buildings registered with the portfolio. It is helpful when the user wishes to identify under-performing buildings, verify the impact of efficiency improvements, and receive EPA recognition for best practice energy performance.[36] In addition, Saint Francis employees make use of an in-house energy management system to track utility usage by month and building. From these methods,

Key Points

- **Facility Characteristics**
  - Hartford, Connecticut
  - 2 million sq. ft.
- **Main Motivators**
  - Catholic roots, instilled into the organizational culture
  - Knowledge of other hospitals within green movement
  - Between hospital competition
  - Goals to obtain awards to increase employee awareness
- **Reasons for Success**
  - Management support
  - Greening committee
  - Consideration for environmental issues throughout decision making
  - Clear records of data is collected and assessed to track progress
  - Utility support

[36] Energy Star, "Portfolio Manager Overview," *U.S. Environmental Protection Agency*, http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager (accessed 4 November 2009).

Saint Francis is able to compare statistics from the data to verify their improvements and to set future goals. This assessment has become increasingly important as Saint Francis pursues prestigious recognition in healthcare sustainability.

Saint Francis has been recognized with the Partner for Change award for three years in a row and is currently pursuing the award for this year. "We are aggressively trying to see if we can upgrade this year to another level [of the award]."[37] David Crowell has found that being diligent in capturing data – looking at all of the projects that have been completed, ensuring that all possible data has been captured, and writing it up properly – has made the difference in being recognized and being passed over. In addition, the Energy Star rating offers Saint Francis the ability to benchmark and set goals to improve their operations. Saint Francis was honored three times with the Energy Star Mark for Superior Energy Efficiency for overall energy performance which rates, at the time of the original case study, in the top 25% of facilities across the country. For comparison, facilities that earn these Energy Star award use approximately 40% less energy than similar buildings.[38]

When asked why Saint Francis makes it a priority to strive for the Partner for Change award or to really base future projects on the Energy Star rating, Crowell explained that it makes a noticeable difference among hospital employees. "It's amazing; people don't realize just how much they are doing until you start tallying it up. And when you do, it kind of helps to get everybody more involved."[39]

Fletcher Allen Health Care

Fletcher Allen is an academic medical center located in Burlington, Vermont that works in alliance with the University of Vermont – College of Medicine.[40] Fletcher Allen houses over 560 licensed beds and handles well over 1,000,000 visits per year including inpatient and outpatient admissions and emergency department visits.[41] Fletcher Allen services a population

[37] David Crowell, Phone interview by authors, 19 January 2010.
[38] "Saint Francis Earns Energy Star Mark for Superior Energy Efficiency: Prestigious Designation Awarded to Hospital for Third Time," *Saint Francis In The News,* http://www.stfranciscare.org/body.aspx?id=14431 (accessed 4 November 2009).
[39] David Crowell, Phone interview.
[40] Healthy Building Network, *Green Healthcare Construction Case Studies*, September 2009 (Berkeley, CA: Healthy Building Network, 2005), 8, http://www.healthybuilding.net/healthcare/Green_Healthcare_Case_Studies.pdf (accessed 5 November 2009).
[41] Fletcher Allen Health Care. "Quick Facts." http://www.fletcherallen.org/about/welcome/quick_facts/quick_facts.html (accessed 20 January 2010).

of about one million people throughout portions of northern New York, Vermont, and New Hampshire. Fletcher Allen's success with an extensive renovation of the entire medical campus provides an excellent study of sustainable new construction within a hospital. Tsoi/Kobus & Associates, the Boston architecture firm chosen for the project, designed a 1.2 million square foot extension to the current Fletcher Allen facility. Tsoi/Kobus worked closely with hospital leadership to construct the 1.2 million square foot addition under a total project budget of approximately $380 million.

Dave Keelty, Fletcher Allen's Director of Facilities Planning and Development since 2000, was a major player in the campus redevelopment project, which is now referred to as the Renaissance Project. At the time when the Renaissance Project was conceived in the late 1990s, patient care was shifting from mainly inpatient to mostly outpatient due to the fact that new technology was allowing for more procedures to be completed on an outpatient basis. This shift, along with the fact that Fletcher Allen's "ambulatory space…was vastly outdated and very inefficient" are considered the main motivators for the completion of the Renaissance Project according to Keelty.[42]

Keelty was also involved in the selection of Tsoi/Kobus as the lead architect on this project. After issuing requests for information in 1998 to 30 nationally and/or regionally renowned architecture firms to obtain credentials and qualifications, the selection committee identified ten firms to whom to submit a request for proposal. After an in-depth analysis of the submitted proposals, Tsoi/Kobus was selected due to past experience, credentials, and an obvious understanding of the project's objective.

> They seemed to have the strengths and the imaginative creativity and got a real grasp of what we were trying to accomplish. They did a lot of work about gaining an understanding about the site – how it was integrated with its environment, how it integrated with the college of medicine, our neighbor, and came back with a very strong proposal, not an actual conceptual design of course, but in terms of an approach that they thought would be able to deliver a high quality outpatient facility, taking advantage of the site's environment and natural attributes…[43]

[42] Dave Keelty, Phone interview by authors, 8 January 2010.
[43] Dave Keelty, Phone interview.

Tsoi/Kobus has a strong portfolio of sustainable design projects.[44] Keelty noted that sustainable design was not included in the requirements on the request for proposal for the project on which Tsoi/Kobus and the other firms were bidding. In fact, in 1998 during the architect selection process and the initial design phase, sustainable design, particularly in healthcare, was a new idea. However, Tsoi/Kobus integrated sustainable elements into their proposed design of the hospital while also meeting the original objective of developing the ambulatory care space.

The architects drew upon local resources and recycled materials to increase functionality while, at the same time, reducing carbon emissions and energy consumption. Keelty specifically discussed the limestone exterior, quarried relatively closely in Ontario. The limestone would serve to be both durable and long-lasting. Green roofing over the parking garage was used to minimize the urban heat island effect and maximize available green space on the site. In addition to careful selection of materials, a solar façade was installed to take advantage of natural daylight.[45]

Figure 2. Fletcher Allen Medical Center - Tsoi/Kobus & Associates' Design[46]

The benefits of the Renaissance Project include a more adaptive facility that has the ability to support energy efficiency upgrades as well as a site that meets all codes and standards

[44] Tsoi/Kobus & Associates, "Portfolio: Healthcare," http://www.tka-architects.com/content.html (accessed 5 November 2009).
[45] Tsoi/Kobus & Associates, "Portfolio: Healthcare."
[46] Ibid.

set forth upon hospitals. "So the design that resulted was extremely sustainable in terms of its overall operating cost impact and environmental impacts."[47]

Despite not having a position dedicated to sustainability or energy management per se, Fletcher Allen's success, according to Keelty, can be traced back to the individuals in key positions –the Vice President of Hospital Services, the Director of Nutrition Services, the Director of Facilities Management and Environmental Services – who make it a priority to focus a piece of their job on sustainable efforts.

> I think it's more around the culture of the organization that's built up over the last, few years that is driving this and our CEO is providing the leadership and strategic goals and objectives to make Fletcher Allen Medical Center a national model for the delivery of high quality academic healthcare for a rural region… I think our success is because we are very fortunate to have the right mix of people and skill sets and mission driven values that kind of brings it about.[48]

Key Points

- **Facility Characteristics**
  - Burlington, Vermont
  - Larger than 1 million sq. ft.
  - Over 1,000,000 visits per year
- **Main Motivators**
  - Shift from many inpatient to a majority of outpatient services
  - Need to update ambulatory space
  - Sustainability motivation came from Tsoi/Kobus' experience
- **Reasons for Success**
  - Efforts are made by all employees, particularly CEO and other senior management
  - Culture and mission support sustainability efforts

Fletcher Allen has been recognized for its sustainability efforts by Practice Greenhealth in 2008 and 2009. According to Diane Imrie, Director of Nutrition Services, the reason for these recognitions revolves around the fact that sustainable issues are considered in every decision made at the hospital. "It's our culture, but it's also our reputation."[49] Fletcher Allen received Practice Greenhealth's National Environmental Award in 2008. Some steps taken by the hospital in order to obtain this recognition include composting, environmentally friendly cleaning products, and the immense

[47] Dave Keelty, Phone interview.
[48] Ibid.
[49] Diane Imrie, Phone interview by authors, 19 January 2010.

progress in sustainable facilities and energy reduction.[50] In 2009, Fletcher Allen was recognized by Practice Greenhealth once again. One of two medical centers in the nation to receive this honor, Fletcher Allen was selected to join Practice Greenhealth's Environmental Leadership Circle. This group consists of hospitals that have demonstrated their commitment to reducing the carbon footprint of their operations.

[50] "Fletcher Allen Receives National Environmental Award," Fletcher Allen press release, 23 June 2008, http://www.fletcherallen.org/about/news_room/press_releases/fletcher_allen_receives_national_environmental_award.html (accessed 4 November 2009).

5. Survey Analysis

The data collected from our surveys proved useful in testing a variety of hypotheses that surfaced during our background research as well as during the interviews carried out with various organizations, utility companies, and hospital facility engineers. The statistical software tool SPSS along with the data analysis features of Microsoft Excel were used to analyze the frequency distributions of the data collected, identify correlations between ordinal data, and perform t-tests to determine the effect of various binary response questions.

Variable Creation

It was decided that several new variables would have to be calculated in order to facilitate analyzing the data. Although our original survey investigated whether or not the individual being surveyed was a member of a green healthcare organization as well as asking if the facility was a member, it was decided that the union of these answers was more useful. We felt that if these organizations should be at all useful to the hospital, this utility would persist regardless of whether the individual or the hospital itself was a member. The size of hospitals, reported in square feet, varied widely over the sample surveyed. For this reason, the responses were divided over the median as either being small, which included the median because it was significantly lower than the mean size, or large. Lastly, we decided to group the answers for the survey respondents' perceived ease in finding green information. In this case the median was not used as a dividing point. The scale being used to indicate level of agreement or disagreement with the given statement implied that a number less than five would mean the respondent thought such information was easy to find while a number greater than five indicated this information was difficult to obtain. Following in this reasoning, a value of five would indicate no level of agreement or disagreement with the statement, so for the analysis below, values of 5 were ignored from the dataset.

Distributions

Before analyzing the data, it is necessary to become familiar with the distribution of answers to some important questions asked in order to better understand the sample being surveyed. In total, 26 facilities returned our survey. The majority of facilities surveyed were less than 5.5 million square feet with one large outlier. This is illustrated below in Figure 3.

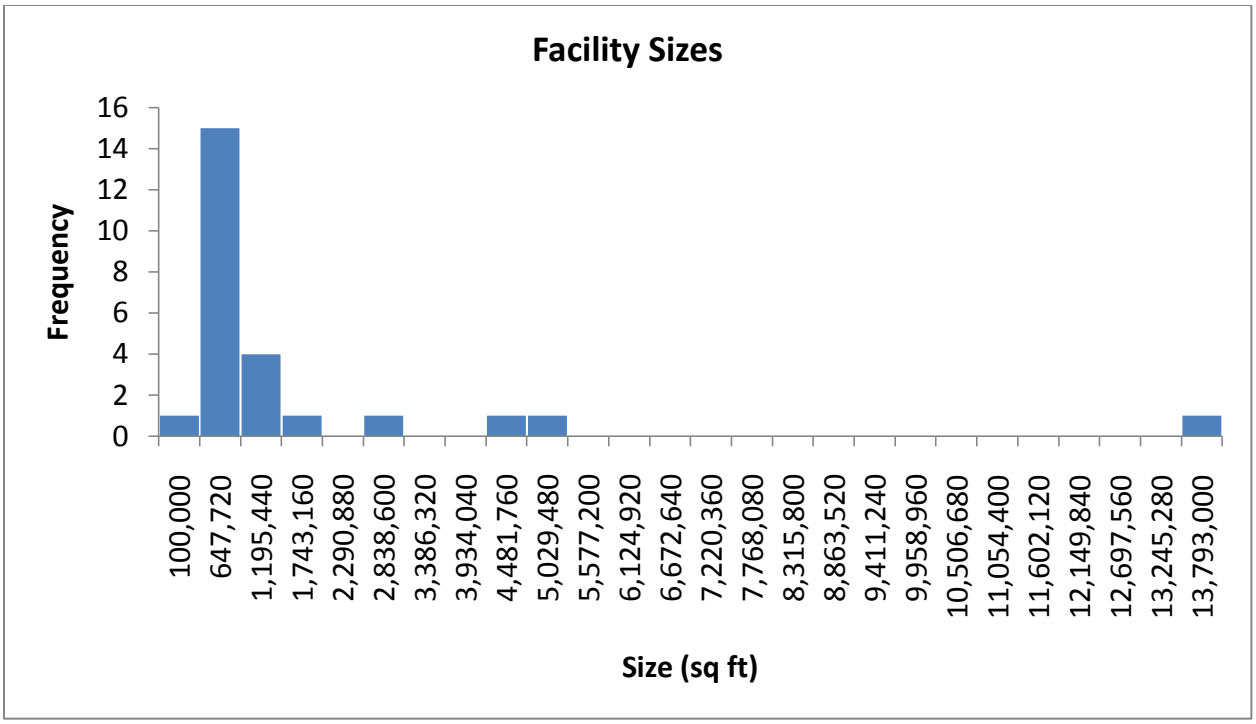

Figure 3. Histogram of Distribution of Facility Sizes of Those That Participated in Survey

As a median of 450,000 square feet was used to divide the population, it should be clear that this variable may not perfectly represent what it means to be a large or small hospital, but given the data available, we felt this was the most appropriate metric to use.

When the survey respondents were asked to rate their priority in reducing energy costs, only one hospital reported a priority of five, a middle rating. See Figure 4 below for the distribution. All other hospitals reported the priority of energy cost reduction as being higher than five, with the response of ten receiving the most responses and the average being 8.89. How much time these individuals devote on a day-to-day basis in trying to actually reduce energy was not determined, but we might surmise that respondents who gave a higher priority also spend more of their time seeking to reduce energy costs than respondents from other hospitals.

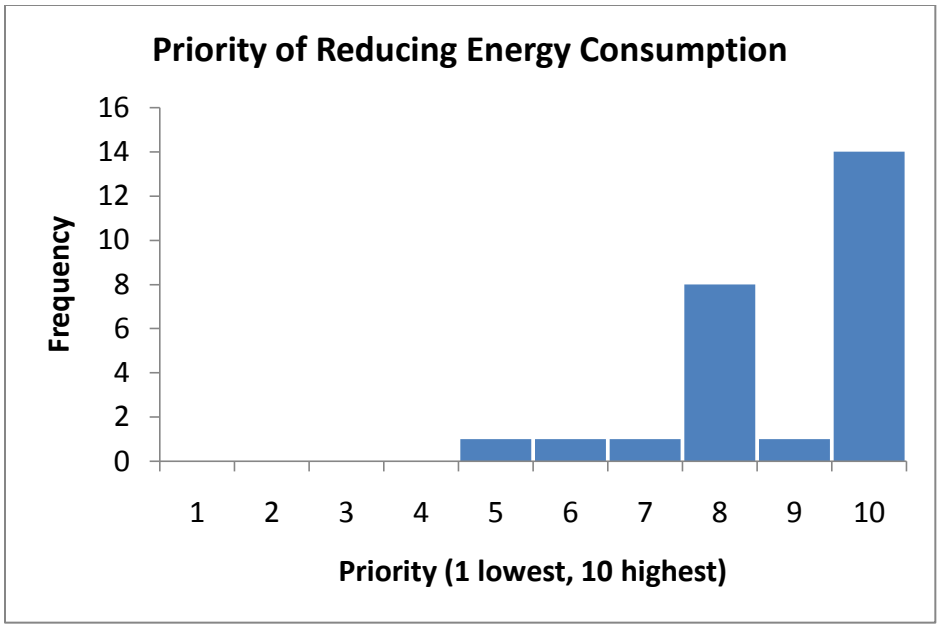

Figure 4. Histogram of Distribution of Priority in Reducing Energy Consumption within the Facility as Assessed by Survey Respondents

Our background research on high energy consumption in hospitals along with increasing energy costs supports that energy cost reduction is likely very important to the majority of hospitals.

The majority of hospitals surveyed were also a member of some green healthcare organization. When those who reported being members were asked how active they were in the organization, the average response was a 4.32 out of 10. These individuals also rated the information being provided by these organizations a 5.27 on a scale of 0 for not influential and 10 for very influential. The majority of hospitals also educated their staff on green initiatives. Unfortunately, because such a small number of respondents stated they did not educate their staff on these topics, it is possible that the small sample size prevented us from finding a statistical link between education and any success in other areas. See Figure 5.

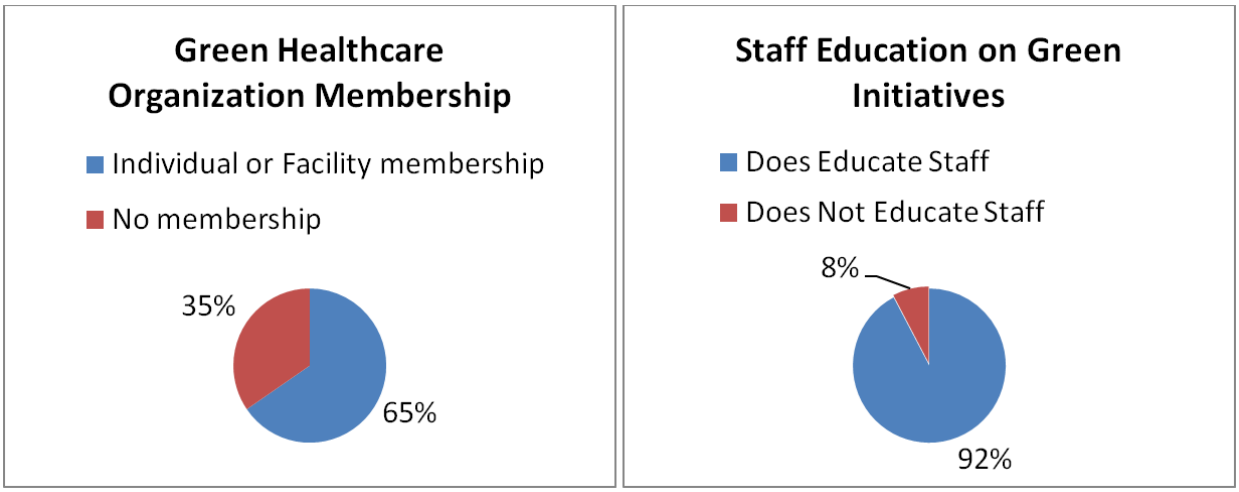

Figure 5. (LEFT) Membership in a Green Healthcare Organization, based on either individual or facility membership; (RIGHT) Hospitals that Educate Staff on Green Initiatives

In our survey we listed a variety of different types of the most common projects for which incentive programs are available. The list included lighting, HVAC, and variable speed drive project incentives. We asked if hospitals were aware of these programs and if they had taken advantage of them. We decided to combine these answers to produce a scale that represented the percentage of incentives of which each hospital was aware and had taken advantage. See Figure 6 below.

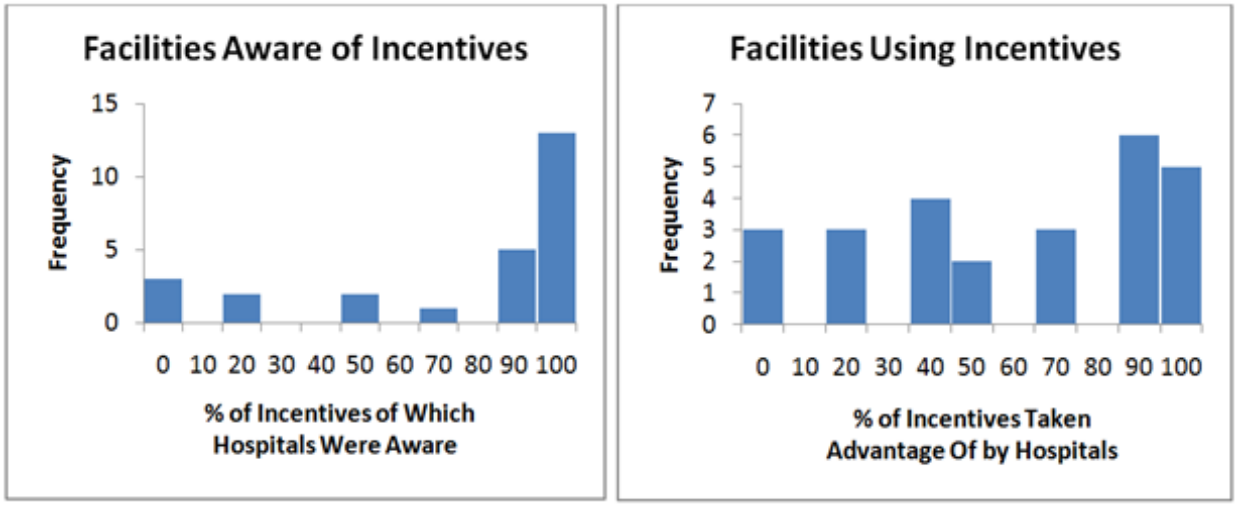

Figure 6. (LEFT) Awareness of Incentives as a Percent of the Number of Incentives Listed on Survey; (RIGHT) Number of Incentives Used as a Percent of the Number of Incentives Listed on Survey

As can be seen in the histograms, the answers ranged from being aware of none to being aware of all incentives and similarly having taken advantage of none to all incentives available.

Awareness of lighting incentive programs ranked highest (88%), followed by those for variable speed drives (81%), HVAC (77%), motors (73%), custom projects (69%), and lastly compressed air (54%). When it came to taking advantage of these incentives, 84% had done so for lighting, 65% for variable speed drives, 69% for HVAC, 65% for motors, 46% for custom projects, and 12% for compressed air. See Table 1 below.

	Aware of Programs	Taken Advantage of Programs
Lighting	88%	84%
HVAC	77%	69%
Variable Speed Drives	81%	65%
Motors	73%	65%
Compressed Air	54%	12%
Custom Projects	69%	46%

Table 1. Percentage of Respondents Aware of Incentive Programs and Who Have Taken Advantage of Incentive Programs

After our first survey, 11 respondents were willing to complete a supplemental survey. This survey consisted of more targeted questions, each with answers to be given on a scale of 1 to 10 to show level of agreement with the statement where 1 was complete disagreement and 10 was strong agreement. When asked if mandates or policies had been an effective tool in reducing energy use in the hospital, participants indicated slight agreement with a 6.30 on average. These respondents also slightly agreed that current mandates and policies were adequate for encouraging sustainability changes in hospitals (6.20 on average) and mostly undecided (5.09) if additional policies would be helpful in motivating hospitals to participate in the green movement. When asked about obtaining green information, the group was mostly undecided if current communication techniques for green ideas were adequate (5.73) but mostly agreed (7.46) that some sort of a collaborative website where hospitals could share sustainability ideas would be helpful. Despite this desire for such a website, the group's reported average for difficulty in finding information on green initiatives was a low 4.46 out of 10.

Correlations

Several potentially meaningful correlations were observed when analyzing the data at a 0.05 level of significance, with some also being significant at the 0.01 level. First, a survey respondent that rated themselves as being an active member of the green organization they belonged to also rated the information this organization gave as being more useful. Table 2 illustrates the correlation values for this analysis.

	How active	How influential
How active	1	**.887**[51]
How influential	**.887**	1

Table 2. Pearson Correlations between Being Active in a Green Organization and the Opinion on the Influence of the Information Distributed by that Organization

When the respondents were asked how much they agree that their hospital was doing everything they could to be green with or without financial constraints, these answers correlated positively with each other and the presence of a culture that encouraged sustainability practices in that hospital, as illustrated below in Table 3.

	Culture encourages green changes	Trying to be green	Trying to be green within financial constraints
Culture encourages green changes	1	**.693***	**.859****
Trying to be green	**.693***	1	**.636***
Trying to be green within financial constraints	**.859****	**.636***	1

Table 3. Pearson Correlations between Opinion on Efforts to be Green and an Organizational Culture that Encourages Green Changes

T-Tests

The various t-tests performed were analyzed at the 0.05 level of significance. It was found that a hospital's membership in a green organization served as a predictor of that hospitals awareness of incentive programs for the replacement of lighting and variable speed

[51] Correlation tables: ** flags significance at the 0.01 level (2-tailed); * flags significance at the 0.05 level (2-tailed).

drives, 0.010 and 0.017 respectively (see Table 4). Membership, however, did not appear to be statistically linked with whether or not any of these hospitals took advantage of these opportunities.

Grouping Variable: Membership in a Green Healthcare Organization	t	df	Sig. (2-tailed)
Aware lighting?	-2.801	24	**.010**
Aware HVAC?	-1.945	24	.064
Aware motors?	-1.470	24	.155
Aware custom projects?	-.921	24	.366
Aware compressed air?	-.592	24	.560
Aware variable speed drives?	-2.577	24	**.017**
Took incentive lighting?	-1.902	24	.069
Took incentive HVAC?	-1.082	24	.290
Took incentive motors?	-1.656	24	.111
Took incentive custom projects?	-.107	24	.916
Took incentive compressed air?	.762	24	.454
Took incentive variable speed drives?	-1.656	24	.111

Table 4. t-test for Equality of Means, Grouped by Membership in a Green Healthcare Organization

When we compared the size of the hospitals to the answers for any of the other questions asked on either survey, no statistically significant conclusions could be drawn. This fact in itself, however, may be just as important. It could be the case that size serves neither as a prohibitive nor conducive environment for green change insofar as what was investigated in our surveys. Perhaps any benefits offered by either size hospital are equally negated by drawbacks in that size facility.

Lastly, when the hospitals were grouped by the perceived ease in locating green information, this information aligned with the grouped size of the facility. Larger facilities reported it being easy to find green information.

Grouping Variable: Grouped Size, Large or Small	t	df	Sig. (2-tailed)
Level of difficulty finding green information	2.368	8	**.045**

Table 5. t-test for Equality of Means, Grouped by Size of Facility (Created Variable: Large or Small)

Perceived ease of finding information also matched positively with the respondent's belief that their facility possessed a culture or mission statement that encouraged green practices.

Grouping Variable: Grouped Difficulty of Finding Information, Hard or Easy	t	df	Sig. (2-tailed)
Culture encourages green opinion	2.867	8	**.021**

Table 6. t-test for Equality of Means, Grouped by Difficulty of Finding Information (Created Variable: Hard or Easy)

Conclusions

Caution must be exercised when analyzing the results of the survey and attempting to draw conclusions. First, the relatively small number of hospitals that participated leads to a relatively small sample size. Although our results are statistically significant, the small size means we must carefully dissect the possible meanings of each result. We must also consider both the possibility of confounding variables and the lack of proof for causation. Therefore, to strengthen our conclusions, it is therefore necessary to combine these results with the information we collected from other sources such as interviews and case studies performed. Such conclusions are the topic of chapter 8.

When considering the relationship between a hospital's or individual's activity level in a green healthcare organization and how useful the information is thought to be, it is tempting to say that hospitals will not participate actively in organizations that do not present meaningful and useful information in their email newsletters or conferences. It may instead be the case that the level of utility found in the distributed information is related to how much effort the hospital places in immersing itself in the information being made available. It might be the case, for instance, that plant service engineers with little time to devote to reading material that arrives in their email inbox do not find such information useful.

It is equally unsurprising that hospitals that report having an encouraging culture for green practices also report doing everything they can in the area of conservation efforts. This may be true for two separate reasons. First, with regards to upper management, having a culture supporting green practices may facilitate the approval of green projects and encourage their implementation. Less work may be necessary to market the project to those in charge of capital funds since the employee purposing the project is speaking a language with which upper management is very familiar and in alignment with— a language of conservation and environmental consciousness. Tangential to this are the projects that require the participation of the entire hospital. The success of a recycling program, for instance, will require that all employees of the hospital work towards a similar goal. Although poster campaigns and memos may help encourage people to recycle, the most successful programs will likely be the ones where people participate not because they have to but because they want to and it is incorporated into their specific jobs at the hospital.

Membership in a green healthcare organization also seemed to predict a hospital's awareness of certain incentive programs, particularly those for lighting and variable speed drive changes or upgrades. Membership did not appear to be related to taking advantage of such incentives. A possible explanation for this could be that green healthcare organizations are effectively spreading information about available incentives but perhaps not giving the information necessary to take the next step in performing these projects. Of course, causation is not a necessary explanation. Hospitals that are more active in green ideas may simply be more active in all areas, belonging to these organizations as well as being aware of the incentives. This survey and our current dataset are unable to discriminate between these possible cases.

The lack of a relationship between hospital size and any other metrics being gauged in our survey has several interpretations. One could simply state that our survey was not large or thorough enough to produce a reliably statistical connection. Although this may be the case, we may also entertain the idea that facility size offers certain advantages and disadvantages to conservation efforts in the hospital such as lack of overhead in small facilities and higher resources in larger facilities. This possibility takes on a new light when we combine this fact

with information gleaned from interviews performed. This matter is addressed more thoroughly in Chapter 8.

The connection between perceived ease in locating information and large facility size may show that higher resource facilities have positions that allow for an individual to focus on seeking out conservation information. Small hospitals, with few employees wearing many hats would not have the same time to seek out and sort through information. On the other hand, it could be that the sheer number of employees in a larger facility and its departments makes collecting information easier. These ideas relate to the connection between perceived ease in locating green information and a facility possessing an encouraging culture. Perhaps a hospital with an encouraging culture would create position dedicated to sustainability efforts and devote the extra resources towards seeking out conservation information.

6. Green Organization Findings

Hospitals are not alone in their endeavor to become sustainable facilities. Organizations such as the American Society for Healthcare Engineering (ASHE) and Practice Greenhealth, formerly Hospitals for a Healthy Environment, provide resources and tools for hospitals to use as they begin their transformation towards more energy efficient operations. Despite a disparity in their membership base, both ASHE and Practice Greenhealth are instrumental in assisting healthcare facilities take the first steps toward sustainability. Being such key groups, we interviewed individuals at both organizations to better understand their missions, their successes and challenges, and their views on some of issues that make the difference between implementing energy efficient technologies and disregarding these projects altogether.

Interview Summaries

Dale Woodin, Executive Director, ASHE[52]

ASHE, the engineering division of the American Hospital Association (AHA), is a large membership organization of approximately 10,000 members, primarily throughout the United States although the membership base does include some international members. Most members are hospital engineers, architects and design engineers who design healthcare facilities, and even contractors. In short, though, members are those individuals who "design, create, build, or operate the physical environment of hospitals and long-term care facilities."

Woodin cites professional growth and education of the profession as the large successes of ASHE. Apart from educating the hospital engineers and others who form the membership of ASHE, the organization strives to raise awareness of who these individuals are and what they do for the hospital. Hospital engineers professionally manage every engineering system within the hospital and still, there is "not a real good external comprehension on what it takes to do these things and what value of our profession is." In order to communicate with members and raise awareness, ASHE holds two conferences each year – one for operations and one for planning and construction. Each conference provides three days of intensive training with the hope that participants can go back to their facilities and put what they learned into action immediately.

[52] All quotations in this subsection are from the interview with Mr. Dale Woodin, Executive Director of ASHE, conducted on 12 December 2009.

“It’s tools, it’s resources, it’s research, it’s knowledge… things that help them in delivering their services to hospitals from day one.”

Dale Woodin also explains that next to nuclear power, the healthcare industry is the most regulated. ASHE makes a purposeful effort to make sure that these numerous regulations and standards are aligned with patient health. If they are not, ASHE works to prove the misalignment with the singular goal of patient care therefore seeking to remove the “unnecessary regulatory burden” the standards place on the industry. In particular regard to energy efficiency standards, Woodin understands that energy costs are inevitable in the healthcare industry due to issues such as temperature settings, humidity control, and appropriate ventilation for the prevention of infection. These everyday hospital concerns impact what energy efficiency projects can be implemented in a healthcare setting.

As Executive Director of ASHE, Dale observes the challenges that might prohibit hospitals from becoming more sustainable in their operations. Through ASHE's polls of their membership, it has been identified that most members are implementing energy efficient technologies during new construction. The challenges come into play when there are hospitals that date back to the 1950s, the 1940s, and some as early as the 1900s that were not designed with energy efficiency in mind. Lack of access to capital can be another challenge that hospitals face when attempting to implement efficient systems. Despite these challenges, Woodin asserts that hospitals should not be discouraged that cost savings will probably never reach the level of corporate buildings or universities of similar size because the demands on a hospital are extremely unique. One positive trend, notes Woodin, is better returns on investments for everything from lighting retrofits to exterior refinishing. Projects such as these were not very profitable to do in the past but because the returns are increasing, hospital leadership now sees the benefit to implementing these projects.

According to Woodin, “some of the best energy conforming hospitals we’ve seen are small hospitals.” Despite the amount of resources that large hospital systems may have, not every hospital within this system can be assumed to be exemplary. However, smaller hospitals experience financial crunches which can often discourage extra projects to improve

sustainability, and so Woodin feels that it may be easier to make sustainability a part of the facility mission and to make decisions with the fewer variables that apply to larger facilities.

Finally, Woodin discusses three main goals set for ASHE. The first is the desire to become an international company by increasing membership across the globe. Secondly, ASHE believes there is a shift in hospital leadership now from those with a financial background to those with a strong clinical background. ASHE hopes to provide the appropriate resources and assistance for individuals with a technical background to obtain positions as Chief Operating Officers and the Chief Executive Officers within the hospital. Finally, the organization plans to focus on repealing the "outdated code and standards" that hospitals are forced to comply with and to modify them to better align with the singular goal of patient care.

Janet Brown, Director of Sustainable Operations, Practice Greenhealth[53]

Janet Brown, Director of Sustainable Operations for Practice Greenhealth, works closely with healthcare facilities, forming a relationship with them to support them through their progress during the planning and implementation of sustainable initiatives. She explains the origins of the organization stretching back to when the EPA reported the damages of medical waste on the environment, particularly noting incinerator usage as a major source of mercury. This event, she mentions, set the wheels in motion for a variety of changes in the way the healthcare industry was viewed as a possible source of environmental harm.

A later signed agreement, the Memorandum of Understanding, between the EPA and the American Hospital Association requested that hospitals voluntarily attempt to both reduce the sheer quantity of waste generated by their operations as well as address the specific concerns of mercury due to incinerator use. The EPA would later provide funding for the starting of an organization that would be known as Hospitals for a Healthy Environment (H2E). This group, under the American Hospital Association, would help assist hospitals in making the changes the EPA felt important as part of the memorandum.

At that time, the Executive Director of H2E was Laura Brannen, a former employee of Dartmouth Hitchcock Medical Center. Brown, who was working at Beth Israel Medical Center, joined Brannen in her efforts and began working for the H2E program. As funding continued,

[53] All quotations in this subsection are from the interview with Ms. Janet Brown, Director of Sustainable Operations for Practice Greenhealth, conducted on 23 November 2009.

more people became involved and H2E grew. However, when funding began to dwindle, the program reorganized as the present day not-for-profit organization Practice Greenhealth, a sister organization to Health Care without Harm. Practice Greenhealth is now headquartered in Virginia.

Brown explains that Practice Greenhealth is a membership based organization that seeks to improve the environmental performance of the hospital or those businesses that work within the hospital. The general mission of Practice Greenhealth, according to Brown, is to "transform the healthcare sector to a healthier, safer, more mission-demonstrated sector." Brown refers to the irony of providing care while negatively impacting both general human health and the overall environment through inefficient or environmentally harmful operating practices. The 1000 hospital members and approximately 55 business members reported at the time of speaking with Brown show a commitment on the hospitals' behalf to improve their impact on the environment by becoming part of a community whose goal is to transform the healthcare sector to a more environmentally friendly one, much aligned with the general hospital goal of improving human health.

Various techniques are used to educate individuals and encourage participation in the green healthcare movement. Practice Greenhealth sponsors CleanMed, an annual conference at which the organization awards high-performing members with recognitions such as the Partner for Change award. In addition to promoting Practice Greenhealth's mission through CleanMed, communication is key in order to raise awareness. The organization uses a variety of methods to deliver information to its members. Communication, Janet notes, is the largest and most difficult part of spreading the word about Practice Greenhealth. The group seeks to augment its current use of phone, email, magazine publications, poster campaigns and other methods to reach even more people in the industry.

Practice Greenhealth has succeeded in raising awareness in many of the environmental issues in healthcare, citing an increase in mercury awareness as one of its largest successes in the past decade. Importantly, hospitals are now addressing this issue more seriously after many years of misunderstanding their direct role in environmental impact. Unfortunately, the changes that need to be made in hospitals take many years and much hard work. Although

many members are just beginning this transition, some of the long-time members are prime examples that with time and effort, the changes can make a great difference. However, the existence of an organization such as Practice Greenhealth and even hospital membership within it is not sufficient for a hospital to become green. Brown feels that an individual within the hospital committed to making sustainable changes is essential for success. Hospital leadership needs to be convinced that these changes are worthwhile and have an appropriate financial return in order for green projects and technologies to be pursued. Often this takes the internal pressure of someone working to meet these goals in the hospital. Having the support of leadership and an individual whose sole job is to plan for and implement energy efficiency projects proves to be a large predictor of a hospital's success in the matters of sustainability and energy efficiency.

Finally, in regard to regulation and policy as a potential motivator for energy efficiency within hospitals, Brown agrees with Woodin from ASHE in some respect. Brown feels that more regulation may not be the best solution. Other options may prove to be more effective such as more or better incentives. One reality that Brown discusses is that "hospitals are struggling financially." Even with mandates and regulations to become more sustainable, hospitals can have a hard time investing in green technologies when the initial costs are so high. A healthcare facility's main goal is patient health and it is not a simple thing to use money that could be budgeted for specific patient care initiatives and to implement instead a new green technology to reduce overall costs in some period of time.

Analysis

Common themes were identified between the interviews with Dale Woodin of ASHE and Janet Brown of Practice Greenhealth. One major theme is regulation as it relates directly to sustainability initiatives as well as energy conservation and, in addition, as it relates to the healthcare industry as a whole. Brown cites the EPA's report to Congress in 1997 as the first real acknowledgement of medical waste incinerators as a major source of mercury in the environment. This realization struck a chord within the industry and the EPA and the American Hospital Association signed a written agreement asking hospitals to address the volume of waste being produced. Woodin discusses the influence of the EPA in a different way. Woodin

notes that the singular goal of the hospital is patient care and that a responsibility of the hospitals is to promote health in the community which inevitably will create medical waste of all forms. From Woodin's perspective, the EPA establishes specific goals that, for example, may mandate that hospitals reduce energy consumption. However these mandates may be created without regard for the larger goal of the healthcare industry – patient care.

Interestingly, both Brown and Woodin agree that regulation may not be the solution to encourage hospitals to implement more sustainable initiatives. Woodin explains that the healthcare industry is the second most regulated industry in the country, nuclear power being the first. It is important that regulations and codes are aligned with patient care. However, hospitals are forced to comply with an "outdated" code of standards. In fact, being so outdated, some hospitals might not even be aware of certain regulations.

Challenges were discussed in both conversations. Challenges to the organizations themselves were touched upon in addition to challenges that hospitals face in implementing sustainable projects from the perspective of the organizations and their experiences. The challenges discussed from the organizational standpoint are slightly different. Woodin explains that the biggest challenge ASHE is facing is a general awareness of who hospital engineers are and what they do. On the other hand, Brown cites the small size of Practice Greenhealth as an issue at times. Practice Greenhealth is much younger than ASHE and has a small staff that is responsible for different areas of functionality. Because Practice Greenhealth is smaller, they are a much more virtual organization than ASHE may be. Despite these differences, both ASHE and Practice Greenhealth require the trust and cooperation of the hospitals and individuals that make up their memberships. In order for the tools and resources that either group can provide to be used, hospital leadership needs to understand that there is value to the hospital engineering profession and that by letting down their defenses, both organizations have the ability to help hospitals make an impact in their environmental performance.

While Woodin goes into more detail regarding challenges that hospitals face, Brown also touches on some that she notices. Brown highlights the irony between providing care while negatively impacting the environment and overall human health by noting that hospitals face the challenge of balancing patient care with their environmental responsibilities. Woodin

agrees and explains that hospital energy demands are so much higher than a similar corporate office building simply because of their responsibility to patient care. Similar to Brown's opinion, Woodin states that although hospitals will never achieve the same level of savings as other buildings of the same size, hospitals can get better and improve their footprints on the environment.

Woodin also describes the age and the size of a hospital facility as some additional challenges that he has observed while at ASHE. Newer facilities had the opportunity to have been designed with sustainability in mind, even in subtle ways. However, older facilities were designed with little to no thought given to energy efficiency or sustainability in general; therefore, bringing these facilities up to energy efficiency standards can take much time and capital. This challenge is exacerbated by the notion that Woodin brings up that "there is simply not enough money going into healthcare relative to what it costs to provide the care so, constantly, there is a crunch for money in every hospital." According to Woodin, even the process required to obtain federal grants is quite often too onerous to be worth what one gets at the end.

A facility's size can also affect how green projects are approached and also prove to be a challenge. It is here, though, that an interesting dichotomy arose during the discussions with Woodin and Brown. Woodin feels that some of the highest performing hospitals are smaller facilities. This can be explained by the small number of buildings on the medical campus to tend to and a smaller staff to motivate. Small grassroots projects could quickly spread throughout a facility and become part of that hospitals core mission. Decisions can be made more easily since, unlike a large hospital system, the decisions do not have implications in 50 or more locations, all with potentially very different needs.

This is in slight contrast to what Brown discusses. For her, success in her organization is being able to reach out and establish a contact within the hospital. Small facilities often have an equally small amount of people working in the engineering department. These employees, like the rest at the hospital may have to wear many hats and take on many different roles in order to keep the hospital operational. As a consequence, they may not have the amount of time necessary to devote to green projects. It is not a lack of interest so much as it is a lack of time.

Often the person who finds themselves responsible for such green projects is the same person who originally took an interest in them. Being a small hospital, these individuals may be charged with taking responsibility of their ideas only to find their day-to-day tasks consume all of their time. The job of conservation is a full time position, a job that large hospitals have the resources to define and employ a person to fill. It is in these large hospitals that Brown finds it easiest to connect with someone who can make the changes she is hoping more hospitals will make.

These differences in opinion are not so much disagreements as they are testament to the complexity of the topic. Large and small hospitals have both advantages and disadvantages to completing green projects. Ultimately it may be the case that even if smaller hospitals are operating more efficiently, their impact will never be as great as a large facility simply by virtue of differing footprint size.

Despite these challenges that ASHE and Practice Greenhealth must overcome and those that influence hospital participation in the green healthcare movement, Woodin cites organizational culture as a predictor for success in sustainable initiatives. Hospitals themselves make the decision to become sustainable or green. Therefore, if there is a related component to their mission, green projects may need to be justified less from a cost-savings standpoint but more so or at least equally from the notion that they would be fulfilling their mission by implementing the project. Neither Brown nor Woodin think that Massachusetts' hospitals would necessarily be considered a leader in green healthcare, although Woodin notes that some states do have a more cultural component to their decision making than others. However, the shift toward green healthcare operations is national and no one location is really ahead of another.

Both Woodin and Brown discuss the importance of costs versus benefits as a motivator for obtaining approval to implement green projects. Woodin mentions a current trend in which returns on investments are increasing; large retrofits that were once too expensive to carry out now have such high returns that almost any hospital can implement them. The potential for return also serves to aid in convincing senior management that a project is worthwhile. This comes at a time when, as Brown explains, hospitals are hurting. When finances are as tight as

they are currently, a hospital simply cannot justify expenditures unless they are proven to reduce the financial strain the hospital is facing.

When asked about educating and communicating with hospitals, Woodin explains the two conferences held by AHSE are meant to give three days of intense training on topics that should be valuable to participants. One conference offers training, tools, and resources for hospital operations while the other is more focused on planning, design and construction. Brown stresses how important communication is and that Practice Greenhealth is constantly seeking ways to reach people more effectively. Brown envisions a future in which hospital engineers are able to participate in an online environment where they will be able to share and connect more easily. Brown wishes to see the level of communication and sharing in the healthcare industry that Facebook brought to college students, thus suggesting that apart from conferences and phone calls, perhaps more communication techniques are needed to achieve ambitious outreach goals.

The structure of a healthcare facility, such as the positions that are within the structure and the type of leadership, can also impact the facilities attempting to become more sustainable. Woodin highlights a shift in hospital leadership while Brown cites the importance of an individual dedicated to the project along with the support of the facility as a whole. Woodin believes the leaders in hospitals are coming more frequently from a clinical background and less so from a financial background as they had been historically. Woodin hopes that hospital engineers and those other individuals with a technical background can move up within hospital leadership and obtain the title of Chief Operating Officer or Chief Executive Officer. A shift in leadership such as this suggests that hospitals might be able to place sustainability and energy efficiency as a higher priority to reduce operating costs.

On a similar note, Brown explains that one person cannot make the difference within a hospital alone. Despite the individual's position, once the person begins to move forward with specific initiatives, he or she will realize they cannot continue with his or her original job as well as the attempt to aid the hospital in becoming green. Energy efficiency and sustainability will lose and the initiative will be lost. This suggests that a position devoted specifically to these efforts and filled with an individual who has the drive and interest to do everything possible to

influence the leadership can drive the success of a hospital in the sense of sustainability. Therefore, Woodin and Brown both see the importance of making sustainability a priority and keeping it on the hospital's radar – be it by helping technical individuals reach higher positions within a hospital or by creating a position specifically meant to influence the rest of the facility into becoming more sustainable.

7. Utility Support Initiatives

One underlying notion was identified in the cited case studies, interviews with the green healthcare organizations, and throughout the interviews with and survey responses from hospital facility engineers. The support of a utility company was shown to be a major component to a hospital's decision to go green. Michael Thompson, a National Grid Account Executive, discusses National Grid's incentive programs as they affect hospitals in the Massachusetts area served by National Grid. For comparison, the Senior Program Manager of the Healthcare Energy Efficiency Program (HEEP), Alex Araiza, explains how the program run by the third-party company Intergy on behalf of Southern California Edison benefits California hospitals as well as the utility company. This chapter concludes with a comparison of the utility companies and their programs to promote efficiency as a way to address the differences between California, a state commonly perceived as a leader in energy efficiency and environmental, and Massachusetts, the state in which our research has been focused.

Healthcare Energy Efficiency Program, Intergy on behalf of Southern California Edison

Southern California Edison (SCE) is a large electric utility provider to the central, coastal, and southern regions of California which includes over 13 million people, 5000 large businesses, and 280,000 small businesses. SCE is also committed to environmental protection. The electric power supplied by SCE includes 16.7% more renewable energy than most other utility companies in the world.[54] SCE sponsors different energy efficiency programs, one of which is the Healthcare Energy Efficiency Program (HEEP). HEEP is administered by Intergy, an energy efficiency consulting firm recently acquired by Willdan Group. One of Intergy's services is developing energy efficiency programs on behalf of utility companies.

Alex Araiza is a Senior Program Manager at Intergy responsible for administering three energy efficiency programs: (1) SCE's Healthcare Energy Efficiency Program, (2) San Diego Gas & Electric's Healthcare Energy Efficiency Program, and the (3) Management Affiliated Program (MAP) for commercial offices. Pacific Gas & Electric's Healthcare Energy Efficiency Program is also underway in the northern California territory, and Araiza notes that he will hold an

[54] Southern California Edison, "Company Overview," *Southern California: About Us*, http://www.sce.com/AboutSCE/CompanyOverview/ (accessed 10 February 2010).

advisory position in this program. As a Senior Program Manager for these many programs, Araiza is responsible for the full execution of the program from strategic planning to marketing and implementation.

Araiza attributes the reason that California utility companies look to third-party consultants to develop and implement these programs to the California Public Utilities Commission (CPUC). The CPUC requires utility companies to set certain goals relating to reducing energy consumption. The energy efficiency programs are developed in an effort to assist utilities to meet these goals. Utility companies create and make public a Request for Proposal (RFP) for a specific program of interest to them or a recommendation for a specific program type. These RFPs are responded to by consultants that offer various solutions. Utilities will then choose one respondent to be the lead on developing and administering the program on behalf of the utility.

The SCE HEEP started in 2006 and was intended to be a two year program. However, the program was renewed to continue in 2009 and 2010. More recently, Intergy has been awarded the contract to continue the program through at least 2012. The HEEP is a "full one-stop shop for all energy efficiency needs to any hospital facility."[55] Every service offered as a part of this program is free to all healthcare facilities regardless of size. Therefore both small clinics and large medical campuses can participate in some fashion.

The program is broken down into two phases. Phase one includes a preliminary audit that lists every possible measure that could be improved upon at the hospital facility. According to a Mazetti Nash Lipsey Burch (M+NLB) case study of the program, the goal of the first audit is to summarize energy consumption data, aid in benchmarking the facility against others of similar size and overall function, and focus on feasible projects that might be implemented such as lighting, heating, cooling, pumping systems, and fans.[56] Representatives will then meet with the customer and determine their potential capital improvement budget and which energy efficiency measures should be implemented first. At this point, phase two commences. Energy efficiency measures identified as high priority during this meeting are

[55] Alex Araiza, Phone interview by authors, 3 January 2010.
[56] Mazzetti & Associates, "Case Studies," *M+NLB*, http://www.mazzetti.com/images/uploads/HEEP_MNLB_LR.pdf (accessed 5 November 2009).

further analyzed in a phase two report. This report is meant to aid in the decision making process within the healthcare facility. The report "includes estimating kWh savings, estimating kW savings, estimating project costs, return on investment, and payback, and defining the scope a bit better than in phase one."[57]

The HEEP at SCE has been very effective. According to Araiza, between 2006 and 2008, Edison realized 6 million kWh in savings. San Diego Gas & Electric's HEEP has also been successful with approximately 3 million kWh in savings between 2006 and 2008 and 5 million kWh in savings in 2009. To reach the energy consumption reduction goals set for 2010 and 2011 by the CPUC, the utility companies need to perform about 20 healthcare facility audits each year.

"I think it's really important to have a program like this, particularly for the healthcare industry," Araiza notes. Araiza explains that the healthcare industry is one of the biggest users of energy in general, and given that their business is operating 24 hours 7 days a week, their energy consumption is considered a cost of doing business. With agencies such as the Office of Statewide Health Planning and Development (OSHPD) of California that are "constantly regulating the work at hospitals which are important to satisfy in order to keep their business running, energy efficiency is at the bottom of the list."[58]

Intergy has been met with some challenges, but has also modified its programs to become more successful. The major challenge has been that once the technical service provided by Intergy stops, hospital facility engineers must continue the efforts alone; obtaining proposals, getting decision-makers involved, and moving forward with the project. Intergy has observed that hospitals, more often than not, will not continue through the process of becoming energy efficient once the HEEP services end. Therefore, HEEP has been modified. HEEP is a very interactive process, one in which technical experts guide the facilities through the audit and project selection process. Intergy is expanding their services to go even further into the process of aiding hospitals in becoming energy efficient by adding construction support management. This would shift the responsibility of identifying contractors and vendors, obtaining project proposals, determining the true scope of the project, reviewing proposals as

[57] Alex Araiza, Phone interview.
[58] Ibid.

they come in, and recommending a contractor or vendor onto Intergy's energy efficiency experts. This added service provides every resource necessary for the hospitals to engage with an appropriate contractor or vendor without overburdening existing facility engineering employees to take the time out of their current jobs to go through this process.

Araiza attributes the success of HEEP to the relationship between Intergy and SCE as well as the trust that is able to be established between the hospitals and Intergy. Being a third-party, Intergy is able to implement the program from a neutral standpoint. This neutrality and connection with the utility companies fosters credibility and so hospitals are more willing to engage in the program.

Utility Sponsored Incentive Programs, National Grid

National Grid is a utility provider supplying electricity to almost 3.5 million customers in New York, Massachusetts, Rhode Island, and parts of New Hampshire. As of 2008, National Grid's energy efficiency programs have helped customers reduce their energy consumption by over 29 billion kilowatt-hours.[59] National Grid works with numerous environmental organizations and state and federal agencies in an effort to maximize environmental protection. In particular, National Grid runs programs to help customers use electricity and natural gas in a more efficient manner. Other commitments include reducing pollution, protecting wildlife and wetlands, conserving natural resources, and promoting awareness of environmental issues.[60]

National Grid provides energy efficiency incentive programs for both residential and business customers. Michael Thompson, an Account Executive at National Grid, discusses his role as he works with large business clients. Thompson works closely with those accounts that have been assigned to him and specifically promotes energy efficiency programs that would be applicable for those key accounts. Key accounts are customers that have been identified as having a monthly peak demand of 750 kW or more. The account executives are seen as "one-stop shopping points" and work with the facilities engineers, the financial experts, or the

[59] "National Gird: An Overview," *National Grid*, Version 1, November 2008, http://www.nationalgridus.com/non_html/a2_us_facts.pdf (accessed 10 February 2010).
[60] "National Grid: Environmental Programs," *National Grid,* http://www.nationalgridus.com/commitment/d3-2_programs.asp (accessed 11 February 2010).

management of the customer to answer questions regarding general billing and service as well as energy efficiency opportunities.[61]

In order to communicate the available incentive programs, National Grid distributes a monthly newsletter to all commercial accounts that offers general information on energy efficiency opportunities. On a more personal level, Thompson and other account executives develop a relationship with the clients and meet as often as possible in order to discuss energy efficiency measures as they specifically relate to that account. Thompson himself works with many hospitals and has seen hospitals taking an interest in the incentive programs offered by National Grid. Their interest level, however, is "not as much as industrial customers."[62] Thompson attributes this to a hospital's management structure as well as the way hospital purchasing is done. He feels that it is quite difficult to convince the decision makers to establish requirements to save energy or to make energy efficiency a priority within their organization.

The incentive programs started in the late 1980s. National Grid was one of the first utility companies in the New England area to implement these programs for energy efficiency. Thompson notes that incentive programs such as these occurred first on the west coast, then in the Northeast, and finally in the upper Midwest. The reason for this is because these three regions typically have higher electricity costs. These costs have prompted customers and utility companies to think creatively for ways to reduce the overall cost of energy.

In the 1980s, National Grid was experiencing a great need to build more powerplants to sustain their customers. However, a powerplant is a huge capital expenditure and siting a powerplant in New England can be quite difficult due to the notion that "no one wants a powerplant in their backyard."[63] It made more sense to take the money that would have been used to build a powerplant and spend that money to reduce the loads of current customers so that additional powerplants would not be necessary. By reducing the load of customers, National Grid experiences a decrease in revenue. How, then, are these programs profitable for National Grid? National Grid is allowed to make a fixed return on the amount of money spent

[61] Michael Thompson, Phone interview by authors, 22 January 2010.
[62] Ibid.
[63] Ibid.

on energy efficiency, as decided and approved by the Department of Public Utilities (DPU) in Massachusetts to promote this incentive activity on the part of the utility company.

The incentive programs offered by National Grid have been quite beneficial to the large accounts that take advantage of them. "Customers oversubscribe to them every year. We typically run out of funds each year."[64] National Grid's projection for the energy efficiency budget in 2010 is twice as much as it was in 2008 and still, funds are being depleted annually. In general, incentive programs are available for new construction projects as well as existing facility retrofits or renovation projects. Thompson notes that the amount spent on incentives for new construction has been quite steady; however, the rest of the budget, as it grows year after year, has mainly been used toward incentives on existing facilities that are going through renovations or retrofits to become more efficient.

Utility Support Comparison

Both the Healthcare Energy Efficiency Program run by Intergy on behalf of Southern California Edison and National Grid's energy efficiency incentive programs appear to be quite successful according to both interviewees. However, there are some major differences in the implementation of each program along with some interesting similarities. In order to effectively analyze each program, we are highlighting particular points in Table 6 below.

[64] Michael Thompson, Phone interview.

	National Grid's Incentives	Southern California's HEEP
Target Clients	• All customers • Accounts with monthly demands of 750+ kW are assigned an account executive to make aware of specific opportunities	• All healthcare facilities regardless of size • Account executives help healthcare facilities engage in the program
Reason for Program	• To avoid the need for additional powerplants by reducing customer loads to lessen the load on the current system	• California Public Utilities Commission mandates utility companies to obtain certain energy consumption reduction goals
Success	• Customers reduced total energy consumption by over 29 billion kWh since the programs began over twenty years ago	• Realized over 6 million kWh in savings between 2006 and 2008, the first two years of the program
Reasons for Success	• Account executives are able to work with clients on a more personal level	• Relationship between Intergy and SCE helped to establish a trust between Intergy and the healthcare facilities
Major Challenge	• Convincing decision makers to make energy efficiency a priority is difficult due to their management structure and purchasing policies.	• Decision makers do not seem to continue with the initiative to become energy efficient once they receive the full report with recommendations.

Table 7. Comparison of National Grid's Incentive Programs and SCE Healthcare Energy Efficiency Program (HEEP)

Both programs have been quite successful despite their differences. HEEP is specific to healthcare facilities while National Grid offers incentive programs to all sectors, including residential customers. In addition, the disparity in the reasoning behind the two programs is quite interesting. The California Public Utilities Commission sets goals with which the utility companies with the state are expected and required to comply. "The CPUC serves the public interest by protecting consumers and ensuring the provision of safe, reliable utility service and infrastructure at reasonable rates, with a commitment to environmental enhancement and a healthy California economy."[65] While Massachusetts does have a Department of Public Utilities

[65] CA.gov, "California Public Utilities Commission," http://www.cpuc.ca.gov/puc/ (accessed 2 March 2010).

(DPU), it does not regulate the utility companies in the same way. The DPU, then, does not set standards or goals for the utility companies. Instead, as Thompson stated in our discussion, the DPU has recently mandated that the incentive programs be identical among the different utility companies in the state beginning in 2010.

It is interesting to note, however, that both have experienced similar challenges related to decision making within a healthcare setting. Thompson of National Grid discusses that the decision makers within a hospital are not easily convinced that energy efficiency should be of high priority. Araiza of Intergy expresses his experience with decision makers as one of high initial interest but with little to no follow-up. While hospitals are willing to engage in working to become more energy efficient with the Healthcare Energy Efficiency Program, once the audits are completed and the reports are distributed with specific recommendations, there is little progress made.

8. Conclusions

The information obtained through the case studies, interviews, and survey response analysis described in detail in prior chapters provided opportunities for interesting conclusions to be drawn. Within this chapter, concrete conclusions will be developed that integrate the individual conclusions drawn in each previous chapter. It is important to note that a larger sample size may provide new insights into these conclusions.

Organizational culture is a major predictor of success when attempting to implement sustainable or energy efficient measures within a hospital. This conclusion is corroborated by interviews with the green healthcare organizations, the majority of the interviews, and the survey results. Organizational culture itself, though, consists of many different elements. An organization with a culture that would entertain the idea of becoming more energy efficient should lead to success. In general, one would expect a facility with an encouraging culture to act upon sustainable measures, have superior support from hospital management, obtain interest and gain acknowledgement of the measures across the entire organization, and emanate a desire to incorporate sustainability and green practices into the mission statement along with everyday decisions.

Somewhat related to superior management support is the need for committed and ongoing leadership. We concluded that leadership in the matters of sustainability has a great effect on whether a hospital will implement certain measures to become more efficient. Many of the facility engineers interviewed noted that energy management was only a piece of their job responsibilities. Although not statistically significant as per our survey data analysis, we do feel that in-hospital leadership committed to making sustainability improvements is important for numerous reasons. The first is that an individual with a job specifically related to energy management or energy efficiency and is given a position high enough in the corporate structure will have leverage to make a major impact within a facility. Without other responsibilities that demand time and attention, this individual would also be able to learn more about best practices within the industry on energy management, research ways to implement energy efficiency projects without a financial loss to the facility, and be able to benchmark his or her facility against others to gauge progress.

Despite being a cliché, knowledge is power in the regard that it can make the difference between a successful implementation of energy efficient measures and falling far behind, as the healthcare sector has in the past. Both Practice Greenhealth and ASHE seem to highlight the importance of knowledge and provide as many resources and tools as possible to interested hospitals. Both also hold conferences as a means of supplying participants with important information, best practices, and current research. Survey respondents, however, were not overwhelmingly supportive of the idea that current communication techniques to share green ideas were adequate. As discussed in the Chapter 5, it received a rating of 5.73, where 5 is a neutral response of no agreement or disagreement. However, it was agreed upon by the participants, with a rating of 7.46, that the creation of a collaborative website would be helpful in sharing sustainability ideas. Therefore, we conclude that the idea put forth by Janet Brown of Practice Greenhealth for a new collaborative web platform centered on green healthcare may be well accepted by the healthcare community of facility engineers.

Knowledge is also useful when facility engineers are preparing and presenting sustainability project ideas to management for approval and when expenses require justification to prove the initiative to be appealing. By working closely with utility companies, hospital facility engineers or decision makers are also able to learn of specific programs and incentives as they relate to their facilities. This knowledge is imperative to making an informed decision that is the best not only financially for the hospital but also environmentally for the community.

In addition, inter-hospital competition was noted throughout some interviews. We concluded that competition between hospitals is, in fact, a technique of information sharing. Competition between hospitals encourages research into best practices and green movements in other healthcare facilities and truly sets the scene for inspiration to improve, an increase in awareness throughout the facility at all levels, and a desire to be recognized as one of the best in the industry. In particular, Practice Greenhealth sets goals that are used when selecting facilities that will be honored with their well-known awards and recognitions. ASHE surveys member facilities and publishes the results in the publicly available *Health Facilities Management* magazine.

This competition between hospitals can also be encouraged through benchmarking and we have concluded that tracking energy consumption and benchmarking is imperative for success. Performing audits, while not statistically significantly related to other responses on the survey, does seem to be popular amongst the survey population and the individuals with which we interviewed. Through interviews we learned of different techniques used to monitor consumption which included the use of online tools such as Energy Star's Portfolio Manager as well as use of database systems that have been purchased or developed in house. Alex Araiza of Intergy and Senior Program Manager of the Healthcare Energy Efficiency Program on behalf of Southern California Edison specifically noted the criticality of gauging performance against similar facilities.

Through background research and statements made by interviewees, we also concluded that new construction is the best opportunity to implement energy efficient measures. In 2004, the healthcare industry was experiencing a building boom.[66] Many hospitals are finding that additional space is necessary to provide quality care and the Fletcher Allen case study is a prime example of incorporating sustainable features into a much needed hospital addition. Since the construction project at Fletcher Allen and discussed in this report was completed, it has been considered a model for sustainability and recognized by Practice Greenhealth. Not only was the construction an opportunity to implement features that would be energy saving, but it also served as a catalyst to implement other efficiency measures throughout the facility. Woodin of ASHE cited new construction as a prime time to implement sustainability initiatives. However, over the course of the project, we did become aware of numerous older hospitals for which renovations and retrofits make more sense. There is evidence of a shift from taking incentives for new construction to taking incentives for retrofitting projects, particularly in Massachusetts. Despite this, we do still believe that new construction is a prime opportunity for hospitals to implement energy saving features. Therefore, if hospitals are planning a construction project, the opportunity to implement energy efficiency measures is great and should not be bypassed without deep consideration and discussion.

[66] Howard Frumklin and Christine Coussens, *Green Healthcare Institutions.*

Although it may be surprising, another conclusion drawn from our research is that the size of a hospital facility does not specifically affect the success of that facility or system in becoming more sustainable and green. There is no clear benefit to a hospital of larger size versus one that is smaller. Additionally, both interviewees and survey respondents cited advantages and disadvantages of their hospitals' size. Large hospitals or hospital systems may have more resources than smaller hospitals, while smaller hospitals may find it easier to make a change with just a handful of interested individuals. Larger facilities may also have the capital to spend on larger initiatives than smaller hospitals; however, smaller projects may actually make noticeable impacts in smaller facilities.

Conclusion Summary

- Organizational culture is a major factor for success
- Strong leadership is important to sustain green measures
- Knowledge is power
- Between hospital competition serves as a motivator for change
- New construction is a prime opportunity to consider implementing energy efficiency measures
- Hospital size does not put a facility at an advantage or disadvantage in achieving success

9. Recommendations

Based on these conclusions we have numerous recommendations for various parties including hospitals and their facility engineers, green healthcare organizations, policymakers and utility companies. Here the items are categorized within these groups, although it is important to note that some recommendations may be relevant across different categories.

Healthcare Facilities

First and foremost, we recommend that hospitals perform audits to track their energy consumption and to identify potential areas for improvement. Audits can be performed by the hospital's own facility engineers or other qualified individuals. Additionally, an outside consultant may be brought in to conduct the audit. Many consultants may provide an initial audit free of charge. Audits are a simple yet valuable technique that can be used to set any healthcare facility on the track for green improvements.

In addition to auditing, benchmarking is the next step that hospitals can take to identify areas for improvement as well as find inspiration to continue with implementing energy efficiency measures. Benchmarking can be done using online tools or simply by keeping up to date with the current best practices in the industry and performing comparisons between those best practice facilities and one's own hospital. Benchmarking may also prompt the inter-hospital competition discussed in the conclusions in Chapter 8 and thus inspire facilities to strive to considered a best practice facility.

As a facility begins adopting green practices, it is important to educate the staff on any and all sustainable initiatives currently in place as well as in the process of being implemented. Staff education will increase the knowledge of sustainability throughout the facility but also infuse a common interest in those individuals working at the facility. This increase in interest should also encourage an organizational culture more accepting of sustainability and energy efficient initiatives. The hope is that this cycle, as shown below in Figure 7, would continue and become even more influential in a hospital's progress and sustainability success.

Figure 7. Cycle to Illustrate Benefits of Staff Education

We also recommend developing a leadership within the facility to become the facility experts on sustainability. This leadership's only responsibility would be to focus on the facility's engagement with green issues and recommend new objectives and goals. In a facility of any size, it is important to have a handful of individuals that can be main contacts on sustainability and green efforts to any outside party, particularly the green healthcare organizations. There is a better chance that an individual whose sole responsibility is sustainability or energy management will invest more time in identifying ways to reduce facility energy consumption while also determining how money can be saved by implementing these solutions.

Lastly, we highly recommend that hospital management encourage facility engineers or other similarly qualified individuals to attend relevant conferences, such as those held by ASHE or Practice Greenhealth. It is important that facility engineers or their counterparts increase their knowledge base on the green movement in the healthcare industry. Obtaining both technical and practical information while also researching into general sustainability trends across the industry will help facility engineers make informed decisions regarding energy management and general facility sustainability.

Green Healthcare Organizations

Our recommendations to green healthcare organizations focus specifically on the distribution of information. First, we recommend that information be specifically targeted to hospitals that are differently staffed. This would require acknowledging the advantages and disadvantages associated with larger hospitals or hospital systems and smaller facilities. Information should be distributed to each group using these characterizations as differentiating factors. Although hospital size was not determined to be a factor in this report, we do acknowledge extreme differences that differently staffed hospitals face. Therefore, providing information relevant to hospitals with these defining characteristics might prove to be especially valuable to healthcare facilities.

Information should also be targeted to a hospital based on the facility's experience with regard to energy efficiency. Hospitals that are just beginning to consider sustainability as an option or to implement green measures require very different information than experienced facilities. These facilities would be those that have already performed the more common measures of energy efficiency and prefer more technical information on more impactful projects or energy saving techniques. The matrix below in Figure 8 illustrates the different groups to which information should be differentiated.

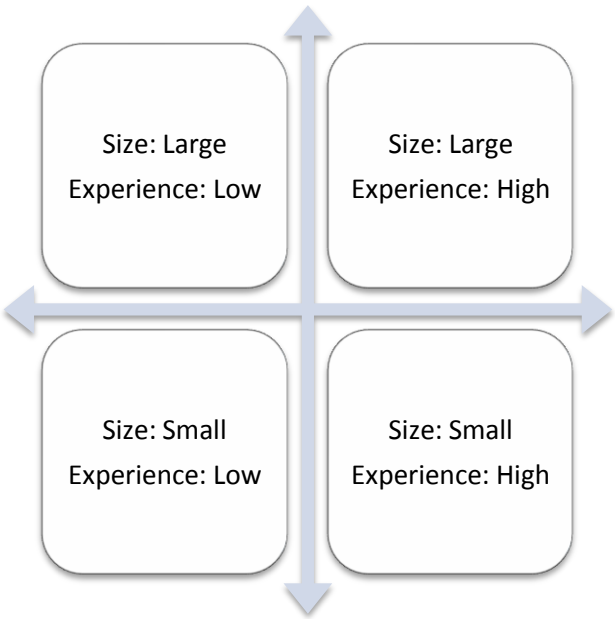

Figure 8. Four Groups to Receive Targeted Information

Lastly, we recommend ensuring that distributed information includes specific metrics on hospitals that are considered to be implementing best practices. Also, sharing detailed information on those hospitals that have been recognized or awarded for their implementation of energy efficiency measures might assist facilities in benchmarking or initiate positive inter-hospital competition. The availability of this type of information through public channels will inspire hospitals to pursue the projects and may also encourage membership in the organization from facilities new to the green healthcare movement.

Policymakers

These recommendations for policymakers are meant to promote discussion and consideration of different issues that come up in this report. First, we recommend considering requiring audits to occur within healthcare facilities. However, it is very important to remember that the healthcare industry is already quite regulated and to require a hospital to perform audits may cause for an unnecessary and improper shift in priorities. We do not want hospitals to push patient care aside to comply with a new regulation that requires an annual audit. Therefore, we recommend that consideration be given to requiring utility companies to perform audits for their key accounts which include many hospitals. We feel that if the regulation is placed onto the utility company and it becomes the account executive's responsibility to ensure that an audit is performed at the hospital, this may encourage a hospital to pursue green improvements as per audit findings.

We also recommend considering setting specific goals for utility companies to reduce their load over a set range of years or to set a goal for the number of audits that should be completed for the utilities' clients to encourage consumers to reduce energy consumption on their own. This appears to work well in California through the Healthcare Energy Efficiency Program by Intergy on behalf of Southern California Edison. We understand that the structure of the utilities or the current regulations placed on local utility companies may not be conducive to setting such goals, but consideration on how to improve the incentive to reduce energy consumption from a policy standpoint should be an important discussion.

Utility Companies

We highly recommend that utility companies work interactively with hospitals to engage interest in the incentive and assistance programs available to become more energy efficient. Although account executives are assigned to the large accounts, working as closely as possible with the hospital will certainly help facilities become more involved in the green movement. In addition to this, we recommend that the key account executives assist hospitals through more of the greening process than just making the facilities aware of relevant incentives. Through our research, outside help to improve current energy practices proves to be quite valuable. This is particularly true for facilities that may be new to energy efficiency or sustainability initiatives or may not yet have an established leadership to focus on these issues.

We also want to recommend incentives for performing audits as a supplement to current programs. As already discussed, audits are beneficial to a healthcare facility. With an incentive to perform an audit, facilities may be more likely to complete one. Also, we recommend considering the possibility of establishing an incentive or assistance program specifically for the healthcare industry similar to the program in California identified in this report. Hospitals may be more willing to make use of incentives if the program was designed specifically to benefit the healthcare industry. It can be assumed that this assistance would be more relevant to the healthcare industry instead of just general projects that may relate to the majority of industries that are pursuing energy efficiency opportunities.

10. Further Research Opportunities

As evidenced in other chapters, many questions still arise concerning the topic of inquiry on which this report is based. Therefore we feel it is necessary to provide a list, while not exhaustive, of the main issues that warrant further research and inquiry. The main reason for more investigation is due to the small survey sample on which the conclusions and recommendations in this report are based.

Investigate for a relationship between the education of staff and a facility's success in implementing sustainable measures

Although not statistically significant or correlated using the data obtained in our survey, we do believe there is an important connection between staff education and success, even if it is purely psychological. Thus, we recommend further research into this relationship to develop a more concrete conclusion.

Examine why membership is correlated with being aware of incentives but not necessarily with taking advantage of incentives

We found a statistical significance between the responses of membership and being aware of incentives, but not with taking advantage of incentives. This raises some questions that warrant further research. Is there evidence that green health organizations are providing more information to members on available incentives rather than recommending hospitals take advantage of these incentives? Is this correlation pure chance?

Explore the lack of statistical significance regarding facility size as a prohibitive or as a promotional factor in success more thoroughly

Through interviews and survey responses, we concluded that facility size had little to no affect on determining a hospital's success in implementing energy efficiency measures. However, due to the small sample size of the survey, we highly recommend investigating the implications of facility size on sustainability successes.

Bibliography

American Council for an Energy-Efficient Economy. "The 2009 State Energy Efficiency Scorecard: Abstract." http://www.aceee.org/pubs/e097.htm.

American Hospital Directory. *Free Hospital Information*. http://www.ahd.com/freesearch.php3.

American Society for Healthcare Engineering. "ASHE: E2C Map of Climate Zones." American Hospital Association. http://www.ashe.org/ashe/facilities/e2c/cs/index.html.

American Society for Healthcare Engineering. "ASHE: E2C SFHMC." American Hospital Association. http://www.ashe.org/ashe/facilities/e2c/cs/zone2/sfhmc.html.

American Society for Healthcare Engineering. "Mission and Vision." American Hospital Association. http://www.ashe.org/ashe/about/mission/index.html.

Araiza, Alex. Phone interview by authors. 3 January 2010.

Bednarz, Dan. "Rising Energy Costs and the Future of Hospital Work." House of Delegates Meeting of the Pennsylvania Association of Staff Nurses & Allied Professionals. Harrisburg, PA. 28 April 2009. From The Oil Drum, http://www.theoildrum.com/node/3902.

Berg, Bruce. *Qualitative Research Methods for the Social Sciences*. 7th ed. Boston, MA: Allyn & Bacon, 2009.

Brown, Janet. Phone interview by authors. 23 November 2009.

CA.gov. "California Public Utilities Commission." http://www.cpuc.ca.gov/puc/.

Commonwealth of Massachusetts. "List of Massachusetts Hospitals." *Board of Registration in Medicine*. http://www.massmedboard.org/links/hospital_list.shtm.

Crowell, David. Phone interview by authors. 19 January 2010.

"Department of Energy Announces the Launch of the Hospital Energy Alliance to Increase Energy Efficiency in the Healthcare Sector." U.S. Department of Energy press release, 29 April 2009. http://www.energy.gov/news2009/7363.htm.

Electric Power Research Institute Final Report. *EPRI Report: Background, Trends, Issues, and Opportunities in Healthcare.* September 1999. (Palo Alto, California: EPRI, 1999).

Energy Star, "Portfolio Manager Overview," U.S. Environmental Protection Agency, http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager.

"EnergySmart Hospitals." U.S. Department of Energy fact sheet, July 2008. http://apps1.eere.energy.gov/buildings/publications/pdfs/energysmarthospitals/esh_factsheet.pdf.

Environmental Protection Agency. “The Guardian: Origins of the EPA.” http://www.epa.gov/history/publications/print/origins.htm.

Environmental Protection Agency. “Timeline.” http://www.epa.gov/history/timeline/index.htm.

Fletcher Allen Health Care. “Quick Facts.” http://www.fletcherallen.org/about/welcome/quick_facts/quick_facts.html.

“Fletcher Allen Receives National Environmental Award.” Fletcher Allen press release, 23 June 2008. http://www.fletcherallen.org/about/news_room/press_releases/fletcher_allen_receives_national_environmental_award.html.

Frumklin, Howard, and Christine Coussens. *Green Healthcare Institutions: Health, Environment, and Economics, Workshop Summary*. Washington D.C.: National Academics Press, 2007.

Hart, Stuart L. “Beyond Greening: Strategies for a Sustainable World.” *Harvard Business Review* 75.n1 (Jan – Feb 1997): 66 – 77.

Healthcare Design and Construction. “Hospitals Slowly Warming to Green Design.” http://www.djc.com/news/co/11188614.html.

Healthy Building Network. *Green Healthcare Construction Case Studies*. September 2009 (Berkeley, CA: Healthy Building Network, 2005), 8. http://www.healthybuilding.net/healthcare/Green_Healthcare_Case_Studies.pdf.

Imrie, Diane. Phone interview by authors. 19 January 2010.

Johnson Controls. *2008 Healthcare Energy Efficiency Indicator Report*. http://johnsoncontrols.mediaroom.com/file.php/2123/2008+Healthcare+Energy+Efficiency+Indicator+Report.pdf.

Keelty, Dave. Phone interview by authors. 8 January 2010.

Malmstrom, Rick. Phone interview by authors. 19 January 2010.

Mass.gov. “Energy and Environmental Affairs.” http://www.mass.gov/?pageID=eoeeahomepage&L=1&sid=Eoeea&L0=Home.

Mazzetti & Associates. “Case Studies.” M+NLB. http://www.mazzetti.com/images/uploads/HEEP_MNLB_LR.pdf.

Morin, Arthur. Phone interview by authors. 28 January 2010.

“National Gird: An Overview.” National Grid. Version 1. November 2008. http://www.nationalgridus.com/non_html/a2_us_facts.pdf.

“National Grid: Environmental Programs.” National Grid. http://www.nationalgridus.com/commitment/d3-2_programs.asp.

Practice Greenhealth. “About Us.” http://www.practicegreenhealth.org/about/.

Practice Greenhealth. “Memorandum of Understanding (MOU).” http://cms.h2e-online.org/about/mou.

Reed, Clark. *Incentives for Energy Efficiency Projects*. Energy Star, May/June 2006. http://www.energystar.gov/index.cfm?c=healthcare.ashe_may_june_2006.

“Saint Francis Earns Energy Star Mark for Superior Energy Efficiency: Prestigious Designation Awarded to Hospital for Third Time.” *Saint Francis In The News.* http://www.stfranciscare.org/body.aspx?id=14431.

Shabecoff, Philip. *Fierce Green Fire: The American Environmental Movement.* Washington: Island Press, 2003.

Smith, Todd. *Energy Efficiency – for Environmental Responsibility, Comfort & Cost Savings*. TRANE: Trane Air Conditioning Solutions, 2006. http://www.trane.com/commercial/uploads/newsroom/energy_eff_tsmith_10-25-06.pdf.

Southern California Edison. “Company Overview.” *Southern California: About Us*. http://www.sce.com/AboutSCE/CompanyOverview/.

Strniste, Paul. Phone interview by authors. 8 December 2009.

Thompson, Michael. Phone interview by authors. 22 January 2010.

Tsoi/Kobus & Associates. “Portfolio: Healthcare.” http://www.tka-architects.com/content.html.

Woodin, Dale. Phone interview by authors. 2 December 2009.

Appendix A: Typical Interview Questions

Interviews with Hospital Facility Engineers:

What does your job description entail? What are your day-to-day activities?
What are some of the current/upcoming projects that relate to energy conservation and cost reduction?
- Are you taking advantage of any federal/state/local utility company incentives?
- Is public policy adequate to help you achieve the goals of your energy efficiency projects?
- What could policy makers do to help accelerate these changes?

Have changes been considered but rejected? What was the reason for rejection?
Have there been any policies or practices that hold you back from making certain changes or improvements?
Are you aware of the organizations dedicated to green healthcare, or the green healthcare movement in general?
- If no, would you be interested in more information? Do you have time to learn more?
- If yes, are you a member of an organization? Which one?
  - If no, why are you not a member?
    - What would encourage you to become involved in a group such as this?
    - Are there any incentives to you to reduce utility cost at your facility?
  - If yes, are you an active member? (attend meetings/conferences, read mailings)
    - What is your role in the organization?
    - What benefits have you received from being a member?

If you had to prioritize your financial concerns, where would energy consumption costs rank?
- If low, why is it such a low priority?
  - Do you think the mindset of the facility might change if new information is presented such as an increasing cost trend in your expenses due to rising energy costs?
- If high, looking at your expenditures, how important are your utility/operating expenses?
  - Who is in charge of approving projects and/or expenses that might fall within the scope of an energy enhancement project?
  - Have you noticed any trends in operating costs/utility costs over past years?

Where has your focus been in regard to cost reduction?
Do you see energy efficiency as a viable avenue for cost reduction? Why/why not?
- If no, has your focus on something else (from a previous question) been successful?
  - Are you still looking for more opportunities for cost reduction?
- If yes, are you taking any steps toward energy efficiency as a cost reduction measure?
  - What are they?

Interviews with Representatives from Green Healthcare Organizations:

How is your group organized?
Where does your funding come from? How do you use your funding?

What are some of your successes? What are your strengths?
What are some of your organization's weaknesses?
    What is standing in the way of overcoming these weaknesses/barriers?
How do you see hospitals using the information you communicate to healthcare facilities?
    Are they ignoring the information? Implementing the recommendations?
Can you share any membership data with us? (such as whether members are mostly small or large hospitals, not-for-profit or for-profit, etc)
What does the average member do?
    What is the average level of participation?
        What do you find to be the most effective method of communication (if any)?
        How do you know?
    Have you been doing anything to encourage a higher level of participation?
What are some future goals for your organization?

Appendix B: Survey

Dear sir or madam,

This email is intended for the plant services or facilities engineering manager (or the equivalent position) at this facility. If you are not the intended recipient of this message, we kindly request that you forward this to the appropriate individual or department.

We are emailing you on behalf of an undergraduate student research project of which we are a part at Worcester Polytechnic Institute in Worcester, Massachusetts. We are seeking responses for a short survey involving facilities engineering at hospitals in the state. We are particularly interested in learning more about energy consumption and the steps being taken to move to more sustainable operations within the healthcare industry.

Participation is voluntary but your responses would be greatly appreciated and are very useful to our research. All precautions will be taken to ensure that no information gathered will be used to identify the hospitals involved or those individuals completing the survey.

Participation is easy; simply reply to this email with your answers clearly displayed at the end of each question. The survey should only take between 10 and 15 minutes to complete.

If you have any questions or concerns, please feel free to contact my partner or myself using the information below. By completing this survey, you give our research group permission to use your confidential responses as part of our report. For your participation, we will provide you with a completed copy of our report upon completion in late February or early March 2010.

Thank you in advance for you cooperation and participation.

Best regards,

Sarah Albrecht
WPI Class of 2011
Industrial Engineering
Entrepreneurship Minor

Benjamin Petrin
WPI Class of 2011
Computer Science

The survey begins below. Your participation is greatly appreciated.
Instructions: Type your answers at the end of the question on the same line. (Y=YES|N=NO)

1. Has your hospital been the subject of a recent merger or acquisition (in the past ten years)? (Y / N)

2. What is the approximate size of the hospital, in square feet, including all buildings (care facilities and others)?

3. Do you educate your staff on the conservation efforts that you are engaged in? (Y / N)

4. Are YOU (as an individual) a member of any “green” healthcare organizations such as Practice Greenhealth, Health Care Without Harm, or the American Society for Healthcare Engineering (ASHE)? (Y / N)
a. If so, on a scale of 1 to 10, 10 being the most active, how active are you in the organization you belong to?
b. If so, on a scale of 1 to 10, 10 being the most influential, how influential has the information provided by the organization been on your operations?

5. Is your facility a member of any “green” healthcare organizations such as Practice Greenhealth or Health Care Without Harm? (Y / N)

6. On a scale of 1 to 10, 10 being the highest priority, how would you rate your interest in reducing energy costs?

7. Are you aware of any incentive / rebate programs for which hospitals may be eligible for (hospital specific or general) that assist in upgrading or replacing
a. Lighting & Controls (Y / N)
b. HVAC Systems (Y / N)
c. Motors (Y / N)
d. Custom Projects (Y / N)
e. Compressed Air (Y / N)
f. Variable Speed Drives (Y / N)

8. Have you taken advantage of any incentive / rebate programs meant to assist in upgrading or replacing
a. Lighting & Controls (Y / N)
b. HVAC Systems (Y / N)
c. Motors (Y / N)
d. Custom Projects (Y / N)
e. Compressed Air (Y / N)
f. Variable Speed Drives (Y / N)

9. Have you recently (in the past 5 years) upgraded or replaced any of the following
a. Lighting & Controls (Y / N)
b. HVAC Systems (Y / N)
c. Motors (Y / N)
d. Custom Projects (Y / N)
e. Compressed Air (Y / N)
f. Variable Speed Drives (Y / N)

10. Are energy audits performed regularly? (Y / N)
a. If so, at what intervals?

Optional: Please provide your name and/or official job title:

Would you be willing to participate in a short follow-up survey if we find we have additional questions? (Y / N)

Would you be willing to participate in a phone interview if necessary? (Y / N)

If so, please provide your contact information and phone number below.

Thank you for your time!

Appendix C: Supplemental Survey

We would first like to thank you for your responses for the survey sent to you regarding steps being taken within your hospital to move toward sustainable operations. This information has certainly proved valuable.

However, we are nearing the final stages of our research and we have compiled a supplemental survey that we hope you can find the time to complete. Again, participation is voluntary but responses are greatly appreciated. All precautions will be taken to ensure that no information gathered will be used to identify the hospitals involved or those individuals completing the survey.

The same technique will be used to respond to this survey as the original. Simply reply to this email with your answers clearly displayed at the end of each question. The survey is below and should not take any more than 5 or 10 minutes to complete.

As a reminder, your responses are assisting us to complete an undergraduate research project at Worcester Polytechnic Institute. You will still be provided with a completed copy of our final report in late February or early March. If you have any questions or concerns, please feel free to contact my partner or myself using the information below.

Thank you in advance for you cooperation and participation.

Best regards,

Sarah Albrecht
WPI Class of 2011
Industrial Engineering
Entrepreneurship Minor

Benjamin Petrin
WPI Class of 2011
Computer Science

The supplemental survey begins here. Each question requires a response on a scale of 1 to 10: 1 – Disagree Completely to 10 – Agree Completely.

We strongly encourage additional comments. Please include any comments you may have following each individual question or at the end of the survey.

1. Do you agree? Mandates and policies have been/are an effective tool in reducing energy use in a hospital?

2. Do you agree? Current policies and mandates are adequate in encouraging/motivating sustainable changes within hospitals.

3. Do you agree? Additional policies or mandates should be put in place to motivate hospitals to participate in the green movement.

4. Do you agree? Current communication techniques of green/sustainable ideas are adequate.

5. Do you agree? I think a website that would allow hospitals to collaborate more easily regarding sustainable initiatives would assist in communication and awareness of sustainability in healthcare.

6. Do you agree? It has been difficult to find the specific information I want regarding sustainability in healthcare.

7. Do you agree? My hospital is doing everything it can in regards to sustainability and energy consumption reduction.

8. Do you agree? My hospital is doing everything it can in regards to sustainability and energy consumption reduction within its financial constraints.

9. Do you agree: My hospital's corporate/organizational culture or mission statement encourages sustainability initiatives.

10. Do you agree? My hospital's size has been prohibitive of moving forward with sustainability practices.

Additional comments:

Thank you again for your responses.